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## The Meteoritical Bulletin, No. 109

J. Gattacceca, Francis Mccubbin, Jeffrey Grossman, Audrey Bouvier, Emma Bullock, Hasnaa Chennaoui Aoudjehane, Vinciane Debaille, Massimo D'orazio, Mutsumi Komatsu, Bingkui Miao, et al.

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3 **1 The Meteoritical Bulletin, No. 109**

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43 **21 Abstract**

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45 22 Meteoritical Bulletin 109 contains the 2790 meteorites approved by the Nomenclature

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47 23 Committee of the Meteoritical Society in 2020. It includes 17 falls (Al Farciya, Auckland,

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49 24 Cavezzo, Flensburg, Gatuto, Kolang, Mahadeva, Matarka, Narashino, Novo Mesto, Oslo,

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51 25 Saint-Ouen-en-Champagne, Santa Filomena, Tarda, Tiros, Wad Lahteyba, Zhob), with

52  
53 26 2336 ordinary chondrites, 131 carbonaceous chondrites (including 8 ungrouped ones), 123

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3 27 HED achondrites, 41 martian meteorites, 35 lunar meteorites, 23 iron meteorites, 21  
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5 28 ureilites, 17 primitive achondrites, 13 ungrouped achondrites, 12 mesosiderites, 12  
6  
7 29 Rumuruti chondrites, 9 enstatite chondrites, 8 pallasites, 4 unclassified meteorites  
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9 30 (identified at the surface of Mars), 3 enstatite achondrites, 1 angrite, and 1 ungrouped  
10  
11 31 chondrite. One thousand five hundred and forty-one are from Antarctica, 763 from Africa,  
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13 32 297 from South America, 127 from Asia, 31 from North America, 11 from Europe, 10 from  
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15 33 Oceania, 9 from Mars, and 1 from an unknown location.  
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### 23 35 **1. Trends and specificities**

24 36 Meteoritical Bulletin 109 (MB109) contains the 2790 meteorites reported to and  
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26 37 accepted by the Nomenclature Committee of the Meteoritical Society in 2020. This is the  
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28 38 highest number since Meteoritical Bulletin has been phased with calendar years starting  
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30 39 with Meteoritical Bulletin 105 in 2016 (Figure 1). This high number is driven by the large  
31  
32 40 numbers of Antarctic meteorites. The fraction of meteorites classified as Northwest Africa  
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34 41 (NWA) meteorites is the lowest since 2016 with 22%. The 2790 meteorites in MB109 total  
35  
36 42 4.38 tons of material, including 7 meteorites over 100 kg, and 20 meteorites over 50 kg.  
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39

40 43 In details, 1541 meteorites are from Antarctica, 763 from Africa, 297 from South  
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42 44 America (99% from Chile), 127 from Asia, 31 from North America, 11 from Europe, 10  
43  
44 45 from Oceania, and 1 from an unknown location. As for the last few years, Chile, with 293  
45  
46 46 meteorites (13% of the total) is now the main meteorite source outside of north Africa and  
47  
48 47 Antarctica.  
49

50  
51 48 It is noteworthy that the 1250 non-Antarctic meteorites were classified by a relatively  
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53 49 small number of scientists. Four scientists (Tony Irving at the University of Washington,  
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3 50 Jérôme Gattacceca at CEREGE in Aix-en-Provence, Ansgar Greshake at the Museum für  
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5 51 Naturkunde in Berlin, and Cyril A. Lorentz at the Verdnasky Institute in Moscow)  
6  
7  
8 52 classified 55% of these 1250 meteorites. Ninety percent of these meteorites were classified  
9  
10 53 by only 10 scientists.

11  
12 54 The meteorites classified in MB109 include 17 falls. Nine of these falls actually  
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14 55 occurred in 2020, the others are from 2019 (4 falls) and before, including a 1799 French  
15  
16 56 fall (Saint-Ouen-en-Champagne). It is noteworthy that the number of falls has increased  
17  
18 57 significantly over the last 20 years (Figure 2). Since 2016, there were three years with more  
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20 58 than 10 falls reported, whereas this occurred only 5 times before 2000 (1933 with 17 falls;  
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22 59 1950, 1949, and 1868, all with 12 falls; and 1938 with 11 falls). This increase may be  
23  
24 60 driven, at least in part, by the increasing number of meteorites that are found using camera  
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26 61 networks such as the Desert Fireball Network in Australia (Bland et al., 2012), or  
27  
28 62 international networks such as FRIPON (Colas et al., 2020) and the Global Fireball  
29  
30 63 Observatory (Devillepoix et al., 2020). In 2020, 4 meteorites were found with the  
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32 64 contribution of such networks: Cavezzo (Italy), Madura Cave (Australia), Santa Filomena  
33  
34 65 (Brazil), and to a lesser extent Tiros (Brazil).

35  
36 66 The meteorites listed in MB109 comprise 1640 ordinary chondrites, 131 carbonaceous  
37  
38 67 chondrites (including 41 CM, 41 CO, 34 CV, 30 CK among which 9 CK3, 6 CR, and 8  
39  
40 68 ungrouped carbonaceous chondrites), 123 HED achondrites, 41 martian meteorites, 35  
41  
42 69 lunar meteorites, 23 iron meteorites, 21 ureilites, 17 primitive achondrites, 12 Rumuruti  
43  
44 70 chondrites, 12 mesosiderites, 9 enstatite chondrites, 8 pallasites, 3 enstatite achondrites, 1  
45  
46 71 angrite, as well as four unclassified stony iron meteorites identified at the surface of Mars  
47  
48 72 by the Mars Exploration Rover, Opportunity.

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3 73 The Nomenclature Committee now distinguishes CVred and CVox as different  
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5 74 chondrite groups following Gattacceca et al. (2020). Compared to previous years, the  
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8 75 number of ungrouped chondrites (8) and ungrouped achondrites (12) has increased  
9  
10 76 significantly. These ungrouped chondrites include very primitive chondrites that are on the  
11  
12 77 border between type 2 and type 3 (Chwichiya 002 and NWA 12957, which may in fact be  
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14 78 paired), and hydrated chondrites whose oxygen isotopic composition is distinct from CM2  
15  
16 79 (e.g., NWA 13167, NWA 13249).

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18  
19 80 The number of martian meteorites classified each year has been increasing for the last  
20  
21 81 12 years and has reached a record high of 41 meteorites in 2020 (Figure 3), for a total of  
22  
23 82 33 kg of material. All these martian meteorites are from northwest Africa and most of them  
24  
25 83 are shergottites. Noteworthy exceptions are NWA 13368 (1.1 kg nakhlite) and NWA 13179  
26  
27 84 (175 g olivine websterite). The number of lunar meteorites has been steady and high over  
28  
29 85 the last few years (Figure 3), but this year has been exceptional in terms of mass with 167  
30  
31 86 kg of material, including three meteorites over 10 kg (NWA 13101 with 68.8 kg,  
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33 87 Tisserlitine 001 with 57.4 kg, and NWA 13582 with 11.3 kg).

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37 88 The following references were used to support the classification of meteorites in  
38  
39 89 MB109: Bonal et al., 2020; DeHart et al., 1992; Evans et al., 1982; Fritz et al., 2017;  
40  
41 90 Gattacceca et al., 2020; Grossmann and Brearley, 2005; Huss et al., 2006; Schröder et al.,  
42  
43 91 2008; Schröder et al., 2010; Stöffler et al., 2018; Zurfluh et al., 2016.

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## 48 49 93 **2. Notable meteorites**

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51 94 Three carbonaceous chondrite falls are reported, including two ungrouped ones:  
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53 95 Flensburg (C1-ung), described in Bischoff et al. (2021), Tarda (C2-ung), described in  
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3 96 Chennaoui Aoudjehane et al. (2021) and Marrocchi et al. (2021), and Kolang (CM1/2),  
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5 97 briefly described in Schrader et al. (2021). Other notable falls are Santa Filomena (80 kg  
6  
7 98 H5-6), and Tiros (cumulate eucrite). Meteorite finds that are notable for their mass, rarity,  
8  
9  
10 99 and/or scientific interest include Erg Chech 002 (32 kg ungrouped achondrite, described in  
11  
12 100 details in Barrat et al., 2021), NWA 13133 (90 kg EL6), Oiuru 001 (450 kg IVB iron),  
13  
14 101 Orlov Dol (151 kg IID iron), NWA 13583 (78 kg eucrite), NWA 11333 (56 kg ureilite),  
15  
16 102 Balambala (the 7<sup>th</sup> IIF iron), and NWA 13368 (nakhlite).  
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18  
19 103

### 104 **3. Alphabetical text entries for non-Antarctic meteorites**

105 See online version of this article.  
106

### 107 **4. New Dense Collection Areas (DCA)**

108 In 2019, 21 new DCA were created in Algeria (Hassi el Biod, Hassi el Madani, Rafsa,  
109 Tibertatine), Chile (Toconao), China (Pakepake, Tazhong, Kuiyibage, Liuyuan), Iran (Iran,  
110 as a generic name for meteorites from this country but without precise coordinates), Lybia  
111 (Gadamis, Ghadduwah, Oiuru), Mali (Tisserlitine), Mauritania (El Hassan Ould Hamed),  
112 Morocco (Akka, Tata, Tazzarine), Niger (Gouchi), United States (Black Butte Nevada,  
113 Crescent Valley). A full list of all approved DCAs, with maps, can be found at  
114 <https://www.lpi.usra.edu/meteor/DenseAreas.php>.  
115

### 116 **5. Listing of institutes and collections**

117 Five new type specimen repositories were approved in 2020: Auckland War Memorial  
118 Museum (New Zealand); Université des Sciences et de la Technologie H. Boumediene,

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3 119 Algiers (Algeria); Bayerisches Geoinstitut, University of Bayreuth (Germany); Georg-  
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5 120 August-Universität Göttingen (Germany); Natural History Museum University of Oslo  
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7  
8 121 (Norway).

9  
10 122 An up-to-date index of collections and approved repositories (next to a green check  
11  
12 123 mark) cited in the Meteorite Bulletin can be found here:

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14  
15 124 <https://www.lpi.usra.edu/meteor/MetBullAddresses.php?grp=country>  
16  
17 125

### 18 19 126 **Supporting information**

20  
21 127 Supplementary information can be found in the online version of this article: Table S1  
22  
23 128 of data including Antarctic meteorites; a complete copy of the text entries for non-Antarctic  
24  
25 129 meteorites.

26  
27  
28 130 Information about the approved meteorites can be obtained from the Meteoritical  
29  
30 131 Bulletin Database (MBD) available online at <https://www.lpi.usra.edu/meteor/>.

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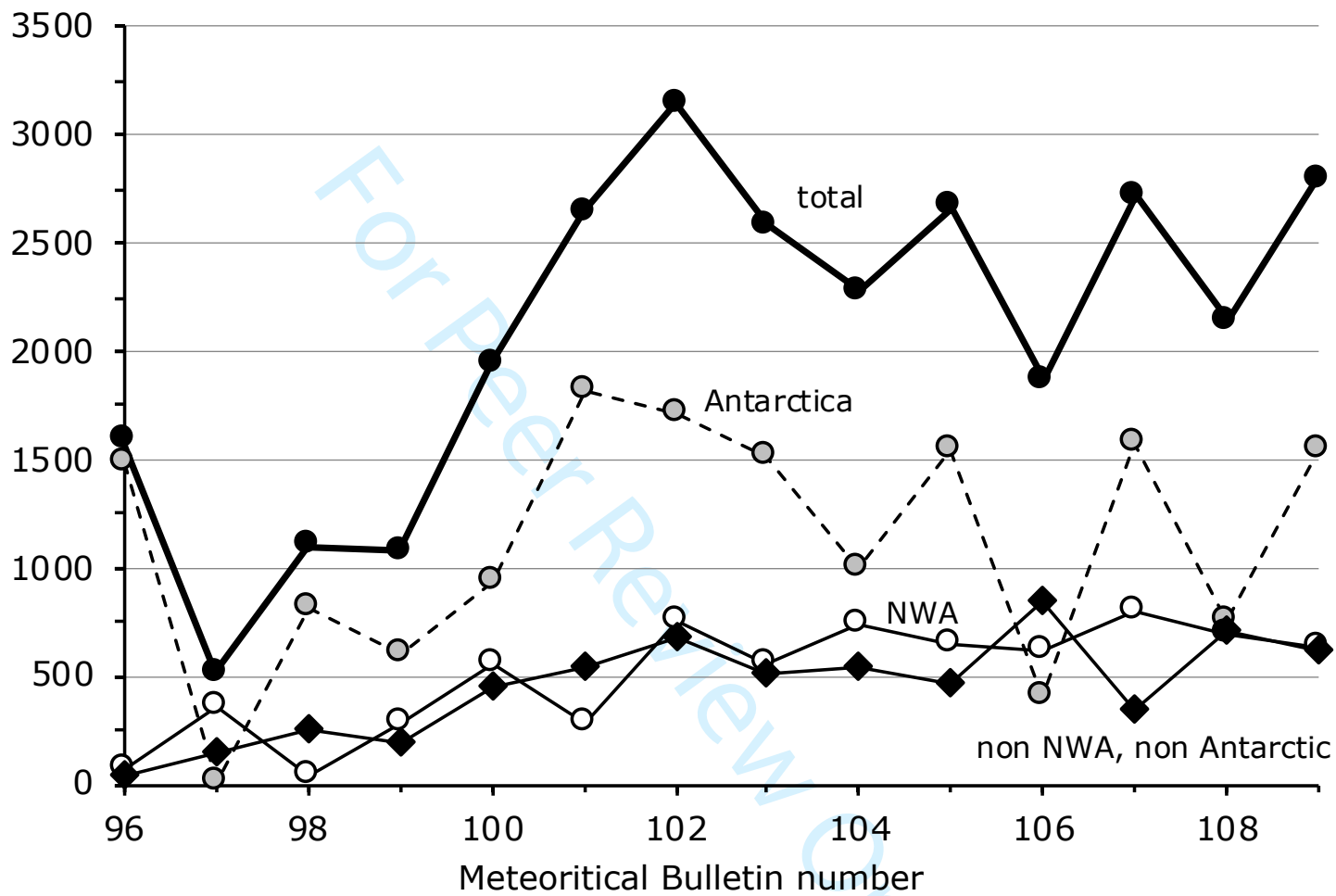


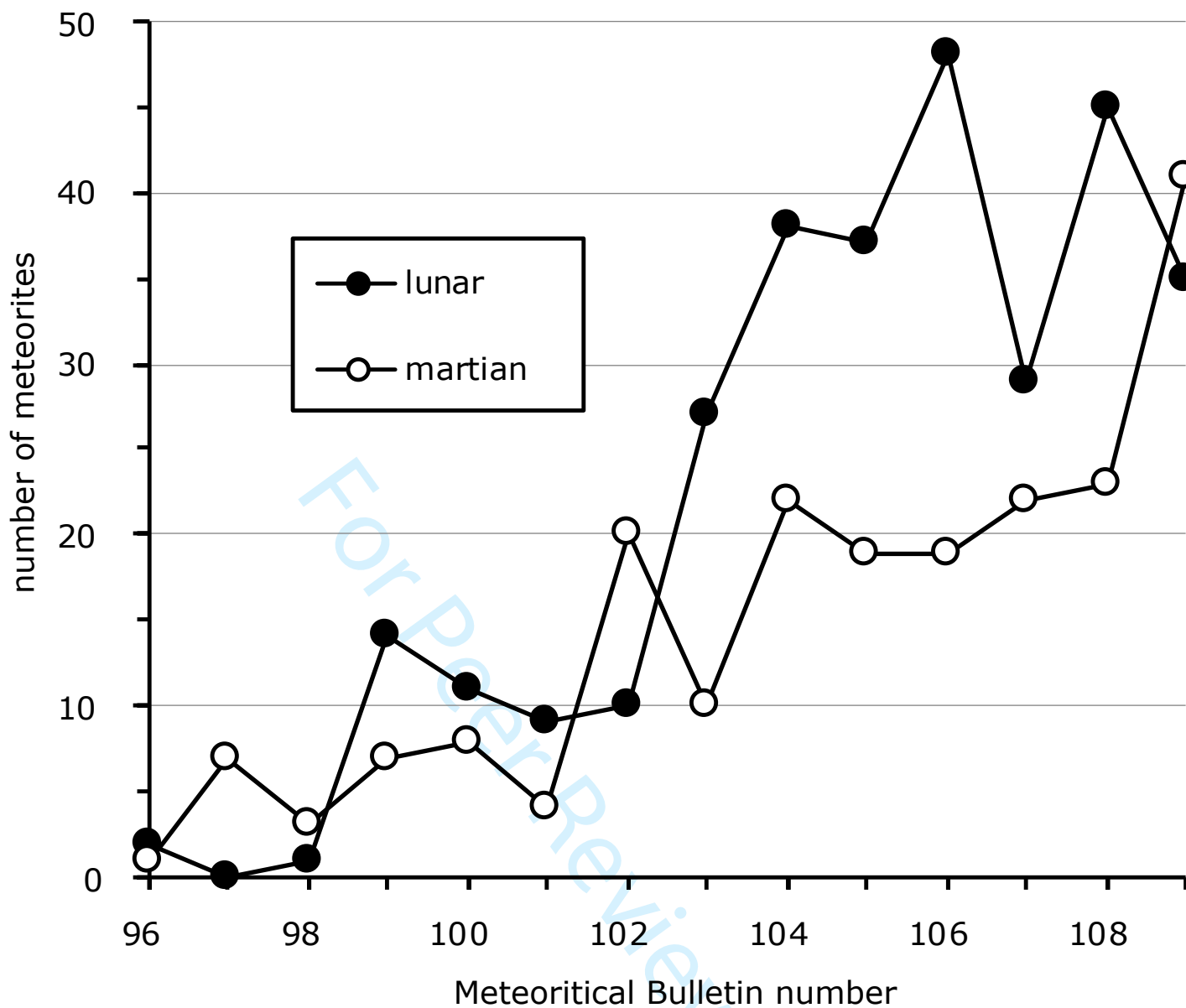
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21 **Figure captions**

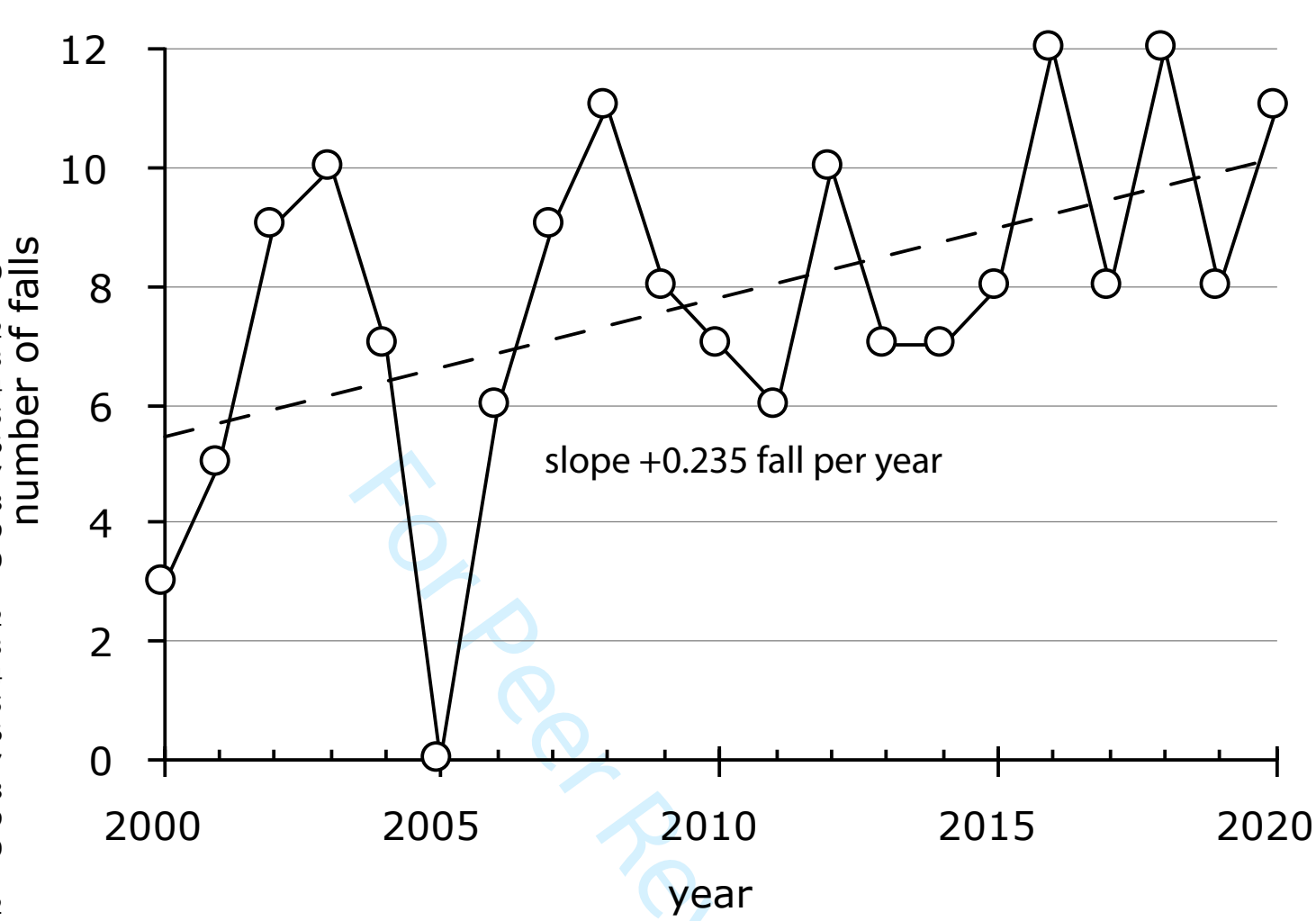
- 22  
23  
24 212 Figure 1: Number of meteorites from Antarctica, northwest Africa, and other areas reported  
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26 213 in the last 14 Meteoritical Bulletins.  
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28 214 Figure 2: Number of falls per year since 2000.  
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31 215 Figure 3: Number of lunar and martian meteorites reported in the last 14 Meteoritical  
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33 216 Bulletins.  
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## The Meteoritical Bulletin, No. 108

### Supporting online material

#### 1. Alphabetical text entries for non-Antarctic meteorites

**Acfer 402** 27°30'42.7"N, 3°56'54.7"E

Tamanghasset, Algeria

Find: 2019 Nov

Classification: Carbonaceous chondrite (CV3)

**Petrography:** Chondrite with large chondrules (mm-sized), AOAs, and CAIs set in an abundant fine-grained Fe-rich matrix. Main silicates include olivine, low-Ca, and Ca-pyroxene. Opaque areas are basically made of terrestrial alteration products.

**Geochemistry:** Most olivine in chondrules and AOAs is Fo-rich. The average composition of these olivines is  $Fa_{4.2\pm 4.8}$  (range:  $Fa_{0-22}$ ; N=24). Low-Ca pyroxene is  $Fs_{2.0\pm 1.0}$  (range  $Fs_{1-5}$ ; n=10).

**Classification:** Carbonaceous chondrite (CV3)

**Akka 001** 29°04'48"N, 8°51'26"W

South, Morocco

Find: 2020

Classification: Primitive achondrite (Acapulcoite)

**History:** Found by a meteorite hunter close to the village of Icht, Tata region, in Morocco.

**Physical characteristics:** A single, fully crusted stone.

**Petrography:** (J. Gattacceca, *CEREGE*) Crystalline rock with triple junctions. Grain size ~250  $\mu$ m. The main mineral is olivine. Other silicates are plagioclase and less abundant Ca-pyroxene. Opaque minerals are metal and troilite.

**Geochemistry:** Olivine  $Fa_{10.6\pm 0.2}$ ,  $FeO/MnO = 26.0$  (n=3). Ca-pyroxene  $Fs_{4.7}Wo_{44.3}$ , 1.45 wt%  $Cr_2O_3$ ,  $FeO/MnO = 18.7$  (n=2). Plagioclase  $An_{17.1}Ab_{79.3}Or_{3.6}$  (n=2).

**Classification:** Primitive achondrite (acapulcoite).

**Specimens:** Type specimen at *CEREGE*. Main mass with J. Bassemon.

**Al Farciya** 27°01'27.59"N, 9°44'39.59"W

Morocco/Western Sahara

Confirmed fall: 2019 Aug 20

Classification: Ordinary chondrite (L6)

**History:** (H. Chennaoui Aoudjehane, *FSAC*: A. Bouragaa "Moroccan Association of Meteorites", F.Z. Jadid *FSAC*) A fireball was seen by many nomads in Al Farciya area on the night of 19-20 August 2019 at 01:15 am (GMT+1). Eyewitnesses from Al Farciya region Ajanid Youssef and Benabbou Ahmed reported a fireball with red color crossing the clouds followed by two sonic booms. Another eyewitness, Salah Tehlaoui, described a red fireball from the Houza district. The reported direction by Azizi El Hassani and Moha Ould Aicha from Zag was north to south. In the morning of the same day, many hunters went to the area where the fall was expected, namely Al Farciya, and first pieces were found in the evening. Collected pieces show a strewnfield of around  $8 \times 1$  km north to south in a good agreement with the testimonies. The area is mostly known by the name Al Farciya, however, some hunters used the name of Khdim Chham for this fall.

**Physical characteristics:** (H. Chennaoui Aoudjehane) Some pieces recovered, mostly complete and covered by fusion crust. The internal part of the meteorite shows brecciation with dark and clear grey zones. We notice some millimetric sulfide grains, metal is thin, some chondrules are detected. Shock veins and a kind of layering are visible in the rock. Some complete pieces show primary and secondary fusion crust black and mat. Magnetic susceptibility (H. Chennaoui Aoudjehane) measured by SM30 is  $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.94$ .

**Petrography:** (C. Agee, *UNM*) Microprobe examination of a polished mount shows scattered, faint, texturally equilibrated chondrules set in a recrystallized groundmass. Plagioclase grains are ubiquitous with sizes up to 100 microns in diameter. FeNi-metal and troilite observed throughout. Apatite and chromite are ubiquitous minor phases.

**Geochemistry:** (C. Agee, *UNM*) Olivine  $\text{Fa}_{25.3\pm 0.4}$ ,  $\text{Fe/Mn}=49\pm 2$ ,  $n=10$ ; low-Ca pyroxene  $\text{Fs}_{21.3\pm 0.1}\text{Wo}_{1.6\pm 0.2}$ ,  $n=6$ .

**Classification:** Ordinary chondrite (L6), S3, W0

**Specimens:** 20.3 g provided by the "Moroccan Association of Meteorites", 12 g provided by Hamza El Harbi (including microprobe mount at *UNM* 0.8 g) and 9 g provided by Ali Ben Amro on deposit at *FSAC*. Vincent Jacques holds 142 g (so far the main mass) and 98 g; 118.8 g, 97.6 g, 50.6 g, 35.8 g, 8.1 g, 4.1 g and 1.6 g on a private collection Casablanca.

### Antarctica 001

Antarctica

Find: 1992-1993

Classification: Ordinary chondrite (L/LL4)

**History:** Two fragments weighing 1904 g and 399 g were collected by a Canadian pilot supporting ANSMET searching during the 1992-93 season, from an unspecified location within Antarctica.

**Physical characteristics:** Both masses have little fusion crust and show well-defined chondrules. Iron staining is prevalent. The two masses fit together.

**Petrography:** (C. Herd, *UAb*) Optical and microprobe examination of a polished thin section of each fragment shows well-defined chondrules in a fine-grained, clastic matrix. Chondrule glass was sought but not found, although equilibration is locally variable based on microprobe results. Sharp optical extinction with  $< 2^\circ$  angular variation in olivine. Minor iron staining is present locally. Weathering grade according to [Zurfluh et al. \(2016\)](#); shock stage according to [Fritz et al. \(2017\)](#).

**Geochemistry:** (C. Herd, *UAb*) Data obtained by EMP examination of two carbon-coated thin sections consisting of 7 chips of the rock: Olivine  $\text{Fa}_{26.4\pm 1.4}$  ( $n=157$ ); Low-Ca Pyroxene  $\text{Fs}_{19.1\pm 4.0}\text{Wo}_{1.2\pm 1.1}$  ( $n=85$ ).

**Classification:** Ordinary chondrite, L/LL4

**Specimens:** Entire specimens, including two thin sections are at *UAb*. Difference between recovered weight and type specimen is due to cutting losses.

**Auckland** 36°53.352'S, 174°48.362'E

Auckland, New Zealand

Confirmed fall: 2004 Jun 12

Classification: Ordinary chondrite (L5)

**History:** The meteorite came through the roof of the Archer family home in Ellerslie, New Zealand, on June 12, 2004, at 9:30 am local time, and landed on the couch in the lounge.

**Physical characteristics:** Oriented fully crusted stone.

**Petrography:** Equilibrated ordinary chondrite with average plagioclase size below 50  $\mu\text{m}$ .

**Classification:** Ordinary chondrite (L5).

**Aydar 004** 27.880°N, 10.418°W

South, Morocco

Find: 2019

Classification: HED achondrite (Eucrite, brecciated)

**History:** Found in 2019 in Reg Labyad, southern Morocco, by a nomad. Purchased in Zagora, Morocco, in August 2019 from a dealer by Juan Avilés Poblador on behalf of the Earth Sciences Department at the University of Alicante, Spain.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Complex breccia containing a variety of lithic eucrite clasts (with fine-intersertal, diabasic, porphyritic and vitrophyric textures) together with ~5 vol.% dark melt-matrix breccia clasts set in a finer grained matrix of related crystal debris. The melt-matrix breccia clasts contain angular grains of pyroxene and plagioclase in a quench-textured matrix. Pyroxene in all of the components is similarly pale brown in thin section. Minerals are compositionally-zoned low-Ca pyroxene (some exhibiting extremely fine exsolution features), calcic plagioclase, ferroan orthopyroxene, augite, ferroan pigeonite, subcalcic augite, silica polymorph, ilmenite intergrown with chromite, troilite, chlorapatite and minor kamacite. No diagenitic orthopyroxene was observed.

**Geochemistry:** Pigeonite cores ( $\text{Fs}_{29.8-34.9}\text{Wo}_{6.1-7.2}$ ,  $\text{FeO/MnO} = 27-29$ ,  $N = 3$ ), ferroan low-Ca pyroxene rims ( $\text{Fs}_{55.6-59.3}\text{Wo}_{3.8-4.3}$ ,  $\text{FeO/MnO} = 32$ ,  $N = 3$ ), orthopyroxene ( $\text{Fs}_{63.2-63.8}\text{Wo}_{2.3-2.4}$ ,  $\text{FeO/MnO} = 32-33$ ,  $N = 2$ ), augite ( $\text{Fs}_{28.0}\text{Wo}_{42.8}$ ,  $\text{FeO/MnO} = 34$ ), ferroan pigeonite ( $\text{Fs}_{54.3}\text{Wo}_{13.6}$ ,  $\text{FeO/MnO} = 33$ ), subcalcic augite ( $\text{Fs}_{44.5}\text{Wo}_{25.5}$ ,  $\text{FeO/MnO} = 31$ ), plagioclase ( $\text{An}_{87.6-92.2}\text{Or}_{0.5-0.3}$ ,  $N = 3$ ).

**Classification:** Eucrite (breccia).

**Specimens:** 22.9 g including one polished thin section at *UWB*; remainder in the collection of *UAlic*.

**Baja California** 28°N, 113°W

Baja California, Mexico

Find: before July 2017

Classification: Iron meteorite (IIIAB)

**History:** (D. Hill, *UAz*) One meteorite specimen was found by Mr. Aguilar (date unknown) near a ranch 70 km east of Guerrero Negro, Baja California, Mexico, on a rocky mountain (probably near Rancho). Friends of the finder brought an endcut of the meteorite to the U. of Arizona for examination. It was eventually sold to a group of meteorite dealers in 2019.

**Physical characteristics:** Total mass of a single specimen is approximately 10 kg. Dimensions are  $30.5 \times 16 \times 5$  cm and tapers on one end. It is irregularly shaped and flat on one side. The meteorite's unusual shape is defined by a 10 cm cavity where an inclusion melted and ablated away during atmospheric passage. The specimen exhibits an oxidized brown to black-brown, weathered fusion crust with pits up to 7 mm in diameter over the entire surface. There are some whitish and bluish paint spots on the exterior. The meteorite has deep regmaglypts and large rounded regions ranging from a few cm across to 11 cm diameter and 4 cm deep where inclusions probably melted and softened during entry through the atmosphere.

**Petrography:** (D. Hill, *UAz*) Widmansatten pattern exhibits kamacite with average bandwidth of  $1.48 \pm 0.48$  mm; largest bands are 3 mm wide. Kamacite bands are stubby in length; up to 10 mm. Taenite is zoned with plessite interiors, most commonly comb plessite. Schreibersite



tends to occur near pinched ends of taenite and as ribbons adjacent to taenite. Sulfides are present as 2 mm grains and complex, fine grained, spider-like regions containing kamacite, pentlandite, and schreibersite with nickel-bearing troilite as 10  $\mu\text{m}$  raisin-like inclusions.

**Geochemistry:** Mineral compositions and geochemistry: (D. Hill, *UAz*): EMP data, kamacite: Fe = 92.47, Ni = 6.63; taenite: Fe = 63.77 Ni = 35.33 (all in %). Average composition: (N. Chabot, JHUAPL and R. Ash, UMD), LA-ICP-MS data (four laser tracks), Co = 4980 $\pm$ 180, Cu = 180 $\pm$ 30, Ga = 16.6 $\pm$ 0.4, Ge = 37 $\pm$ 1, As = 6.4 $\pm$ 0.9, Ir = 0.238 $\pm$ 0.028, Au = 0.72 $\pm$ 0.03 (all in ppm). Distance, physical characteristics, and composition preclude pairing with [Loreto](#) (IIIAB), Mexico.

**Classification:** Iron, IIIAB. Coarse octahedrite.

**Specimens:** Type specimen: 311 g *UAz*

**Balambala** 0°3.555'N, 39°6.45'E

North-Eastern, Kenya

Find: 2018 Jan

Classification: Iron meteorite (IIF)

**History:** Dhagax Bir is the name attributed to the meteorite by the region's goat herders; the name means metal stone in the local spoken Somali dialect. According to the local residents the meteorite was in this location for as long as anyone could remember, including a woman 60 years of age who regularly herded goats past this stone since she was 10 years old. In January 2018, a nomad identified the stone as an iron meteorite, and then brought it to a local broker in the nearest city of Garissa. The broker began circulating photos and it was subsequently purchased by Mahamed Nur Ogle and John Higgins.

**Physical characteristics:** The single, approximately shield-shaped mass is about 33  $\times$  41 cm in width and 10-15 cm thick. It is covered in large (~5 cm-wide) regmaglypts; a few cm-sized spherical holes are also present on one side. Some rust is present on the top surface, but otherwise, there is little evidence of oxidation.

**Petrography:** (C. Herd and L. Tunney, *UAb*) Optical investigation of a 4.5  $\times$  6 cm polished and etched end slice reveals cm-scale rounded troilite inclusions, and lath-like (~1  $\times$  8 mm) schreibersite inclusions, both swathed in kamacite. The bulk of the meteorite consists of kamacite spindles in a matrix of taenite. The spindles occur evenly throughout, except for adjacent to inclusions, where ~500  $\mu\text{m}$ -wide spindle-poor regions are surrounded by ~200  $\mu\text{m}$ -wide spindle-rich rings that broadly parallel the outlines of the inclusions. SEM investigation reveals that larger kamacite spindles or groupings of spindles are often cored by 50-100  $\mu\text{m}$  subequant schreibersite crystals. The average kamacite bandwidth is 53 $\pm$ 17  $\mu\text{m}$  (n=36). Taenite is zoned to higher Ni adjacent to kamacite spindles. No alteration was observed.

**Geochemistry:** (C. Herd, L. Tunney, and G. Chen, *UAb*) ICP-MS data, using sample of [North Chile](#) (Filomena) as standard: Ni = 13.0, Co = 0.67 (both wt%); Ir = 5.2, Ge = 223, Ga = 8.1, As = 20.6, W = 0.76, Re = 0.45, Pt = 14.9, Cu = 208, Au = 2.6 (all  $\mu\text{g/g}$ ).

**Classification:** Iron, IIF, based on the high Ge/Ga ratio, high Co content, and fit with regression parameters established by Kracher et al. (1980).

**Specimens:** Type specimen of 261 g at *UAb*. Main mass with Mahamed Nur Ogle and J. Higgins.

**Balyer Bluff** 27°27'50.81"S, 117°50'37.82"E

Western Australia, Australia

Find: 2012 Dec 26

Classification: Ordinary chondrite (LL6)

**History:** Two interlocking, freshly crusted fragments (351.79 and 1728.36 g) were found lying on the surface in 2012 and 2013, respectively, by M. Jefferson (Alex Bevan, *WAM*).

**Physical characteristics:** Physical Characteristics: The wedge-shaped, reassembled mass measures  $16.5 \times 12 \times 7$  cm. Total weight 2080.15 g (Alex Bevan, *WAM*).

**Petrography:** (L. Daly, L. V. Forman, *CUWA*). Specimen has poorly defined chondrules that have been heavily recrystallized. The sample is domainal with an annealed red stained matrix and clean relict chondrules. The relict chondrules are grouped together and include types C, POP, and BO. Chondrule mesostases are coarsely crystalline. Sizes range from 1.52-5.13 mm with a mean of 2.7 mm (n=8). Mineralogy consists of olivine, pyroxene, chromite, feldspar, as well as some metal and sulfide. Olivine and pyroxene have undulose extinction, and planar fractures, some grains exhibit a weak mosaicism. Feldspars are  $>50 \mu\text{m}$  and partially converted to maskelynite. The metal and sulfide present in the sample are blebby, representative of melt pockets, and have been approximately 10% replaced with iron oxide.

**Geochemistry:** Mineral Compositions and Geochemistry: (L. Daly, L. V Forman, *CUWA*) EDS, Olivine:  $\text{Fa}_{27\pm 0.9}$  (n=11). Low-Ca pyroxene:  $\text{Fs}_{22.4\pm 0.9}\text{Wo}_{1.7\pm 0.2}$  (n=6). Feldspar  $\text{Ab}_{86.7}$ .

**Classification:** Ordinary Chondrite LL6, S4, W2

**Specimens:** The *WAM* holds the main mass now 1725.34 g and one thin section.

**Baqiangzi** 43°54'09.2"N, 93°12'13.2"E

Xinjiang, China

Find: 2012

Classification: Enstatite chondrite (EL7)

**History:** (Ziyao Wang) One piece was discovered by the geologist Jianming Wang (Hami/Xinjiang) during field work near Barkol in 2012. After confirmation of its meteoritic nature, Jianming Wang discovered further fragments in 2019.

**Physical characteristics:** (Ziyao Wang) Three dark-yellowish, irregular stones of 899, 176 and 125 g.

**Petrography:** (R. Bartoschewitz) Breccia of dark olive-green silicate clasts with fine metal particles in a lighter host, often separated by a spongy network of metal veins. Strongly recrystallized meteorite (av. grain size  $\sim 100 \mu\text{m}$ ), with few chondrules relict up to 0.8 mm. Main minerals are olivine, pyroxene, metal, and sulfides. Feldspar grains are up to  $150 \mu\text{m}$ .

**Geochemistry:** (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) olivine  $\text{Fa}_{0.2\pm 0.1}$  (n=19); low-Ca pyroxene  $\text{Fs}_{0.3\pm 0.1}\text{Wo}_{1.4\pm 0.3}$  (n=6); diopside  $\text{En}_{53}\text{Fs}_1\text{Wo}_{46}$  (n=2); feldspar  $\text{An}_{17\pm 5}\text{Or}_2$  (n=3). Kamacite Ni=6.9, Co=0.7, Si<0.1 (n=6); troilite Cr=0.7, Ti=0.2 (n=4); alabandite Fe=6 (n=1) (all wt-%). Magnetic susceptibility (R. Bartoschewitz, *Bart*)  $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 5.45$

**Classification:** Enstatite chondrite (EL7, W1), based on texture and plagioclase size

**Specimens:** 20.4 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 17 g with *Bart*.

**Bayin Gobi 003 (BG 003)**  $\sim 41^\circ 19' \text{N}$ ,  $\sim 105^\circ 20' \text{E}$

Nei Mongol, China

Find: Oct 2015

Classification: Ordinary chondrite (L~6)

**History:** (Ziyao Wang) Discovered by Xueming Tang in the desert near Bayin Gobi in Oct. 2015. He sold it to Songshan Wang and was purchased by Ziyao Wang in June 2020.

**Physical characteristics:** (Ziyao Wang) brown stone of 3920 g without fusion crust

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3 **Petrography:** (R. Bartoschewitz) brown stained recrystallized matrix with indistinct  
4 chondrules (0.4-1.5 mm, mean 0.8 mm), and tiny sulfide specks and mainly oxidized metal  
5 **Geochemistry:** Magnetic susceptibility (R. Bartoschewitz, *Bart*)  $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.37$   
6 **Classification:** Ordinary chondrite (L~6, W4)  
7 **Specimens:** 21.3 g on deposit at *Kiel*, Weichao Li and Ziyao Wang hold the main mass, and  
8 207 g with *Bart*.  
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12 **Black Butte 001** (BB 001) 41°24.061'N, 118°13.198'W  
13 Nevada, United States  
14 Find: 2015 Aug 8  
15 Classification: Ordinary chondrite (H3-4)

16  
17 **History:** While searching for meteorites on a small drylake, Robert *Verish* recovered this  
18 stone on a west-facing stranding-surface.

19 **Physical characteristics:** This 27.5 g stone is an oriented individual with the aft-end having a  
20 subtle overlapping. Originally, this stone had a discoidal shape, but a fragment is missing, and  
21 now it is shield-shaped with a smooth, brownish-black fusion-crust exterior. Cut surface  
22 shows a mottled, light-brown interior.

23 **Petrography:** (D. Sheikh, *FSU*) Sample contains well-defined chondrules (Av. 550  $\mu\text{m}$ )  
24 along with metal and troilite. Both unequilibrated and equilibrated clasts present.

25 **Geochemistry:** Olivine in type 3 clasts ( $\text{Fa}_{15.2-26.3}$ , n=10), Olivine in type 4 clasts ( $\text{Fa}_{18.6\pm 0.6}$ ,  
26 n=12), Low-Ca Pyroxene in type 4 clasts ( $\text{Fs}_{17.0\pm 0.7}\text{Wo}_{1.3\pm 0.2}$ , n=10).

27 **Classification:** Ordinary Chondrite (H3-4). The sample contains both unequilibrated (type 3)  
28 and equilibrated (type 4) clasts.

29 **Specimens:** 5.5 grams at *UCLA*; main mass with *Verish*.  
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34 **Black Butte 002** (BB 002) 41°24.207'N, 118°13.478'W  
35 Nevada, United States  
36 Find: 2015 Aug 9  
37 Classification: Ordinary chondrite (H3-4)

38  
39 **History:** While searching for meteorites, Robert *Verish* recovered this stone along the apron  
40 of a hummock which formed a west-facing stranding-surface.

41 **Physical characteristics:** This 9.9 g well-rounded, orangish-brown whole-stone has a rough,  
42 fusion-crust exterior, and a cut surface reveals visible chondrules, metal-grains and troilite  
43 in a light-brown groundmass.

44 **Petrography:** (D. Sheikh, *FSU*) Sample contains well-defined chondrules (Av. 600  $\mu\text{m}$ )  
45 along with metal and troilite. Both unequilibrated and equilibrated clasts present.

46 **Geochemistry:** Olivine in type 3 clasts ( $\text{Fa}_{17.4-26.1}$ , n=10), Low-Ca Pyroxene in type 3 clasts  
47 ( $\text{Fs}_{15.4-25.6}\text{Wo}_{1.0-1.8}$ , n=8), Olivine in type 4 clasts ( $\text{Fa}_{19.1\pm 0.9}$ , n=12), Low-Ca Pyroxene in type 4  
48 clasts ( $\text{Fs}_{16.8\pm 0.8}\text{Wo}_{1.4\pm 0.3}$ , n=10).

49 **Classification:** Ordinary Chondrite (H3-4). The sample contains both unequilibrated (type 3)  
50 and equilibrated (type 4) clasts.

51 **Specimens:** 2.2 grams at *UCLA*; main mass with *Verish*.  
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56 **Black Butte 003** (BB 003) 41°23.3'N, 118°7.8'W  
57 Nevada, United States  
58 Find: 2018 Sep 27  
59 Classification: Ordinary chondrite (H4)  
60

**History:** This fragment was recovered by Robert *Verish* while he was searching for meteorites at the north end of a playa.

**Physical characteristics:** This angular 4.4 g dark brownish-black fragment has a very weathered exterior. A cut surface shows visible chondrules and metal-grains in a brown matrix.

**Petrography:** (D. Sheikh, *FSU*) Sample contains well-defined chondrules (Av. 500  $\mu\text{m}$ ) along with metal and troilite. Chromite, merrillite, and secondary Fe-oxides present as well.

**Geochemistry:** Olivine ( $\text{Fa}_{18.6\pm 0.5}$ ,  $n=42$ ), Low-Ca Pyroxene ( $\text{Fs}_{16.3\pm 0.4}\text{Wo}_{1.0\pm 0.1}$ ,  $n=14$ ), High-Ca Pyroxene ( $\text{Fs}_{6.5}\text{Wo}_{41.1}$ ,  $n=1$ ), Calcic Plagioclase ( $\text{An}_{11.0}$ ,  $n=1$ ).

**Classification:** Ordinary Chondrite (H4)

**Specimens:** 1.1 grams at *UCLA*; main mass with *Verish*.

**Blaubeuren** 48°24'06.4"N, 9°46'01.3"E

Baden-Wurttemberg, Germany

Find: 1989

Classification: Ordinary chondrite (H4-5)

**History:** (D. *Heinlein*): In the garden of his property in Blaubeuren-Weiler, Mr. Hansjörg Bayer was laying an empty pipe for power cabling in 1989. When excavating the cable duct, he found a stone of over 30 kg at 50-70 cm depth, which had an unusually high density and was attracted to a magnet. The finder noticed the object as something special, hence he kept the stone in his garden from 1989 to 2015. In this period it was placed at different locations, always outdoors, exposed to weathering. Since 2015 the stone was kept dry in the basement of his house. In 2020 it was examined and recognized as a stony meteorite.

**Physical characteristics:** (D. *Heinlein*, A. Bischoff, *IfP*): The rock has a mass of 30.26 kg and is heavily weathered at the outside, since it was lying in the garden for several decades. Bulk density is  $3.34\pm 0.01$  g/cm<sup>3</sup>. Fusion crust is absent due to weathering. After the examination of the meteorite another fragment of 410 grams was found in the garden, which obviously was broken off from the main piece.

**Petrography:** (A. Bischoff, *IfP*): The meteorite is heavily weathered (W3). The remaining metal grains have thick rims of terrestrial alteration products (Fe-oxides and Fe-hydroxides). The rock is a breccia containing fragments of petrologic type 4 and type 5. The breccia is very weakly shocked (S2).

**Geochemistry:** (K. Klemm, A. Bischoff, *IfP*): The mean composition of olivine is  $\text{Fa}_{18.4\pm 0.3}$  with a compositional range of  $\text{Fa}_{18.0-19.2}$  ( $n = 19$ ). The low-Ca pyroxenes have a mean composition of  $\text{Fs}_{16.2\pm 0.4}$  ( $n = 18$ ) with a range of  $\text{Fs}_{15.7-17.4}$ .

**Classification:** (K. Klemm, A. Bischoff, *IfP*): H4-5; the rock is a brecciated H-group ordinary chondrite containing fragments of petrologic type 4 and type 5.

**Specimens:** Type specimen: 20.2 g, *IfP*; the main mass with finder

**Calama 058** 22°21.521'S, 068°35.335'W

Antofagasta, Chile

Find: 2016-Oct-17

Classification: Carbonaceous chondrite (CR2)

**Physical characteristics:** Sawn surface shows many large, well-defined chondrules mostly of 0.5-1 mm but also few up to 3 mm in a fine-grained dark matrix containing abundant phyllosilicates. Abundant metal blebs and metal decorating chondrule rims. Stone moderately weathered.

**Petrography:** Thin section shows packed rounded to irregularly shaped chondrules separated by opaque matrix. Sulfide and metal abundant in matrix. Some metal weathered to iron oxides. Wide variety of chondrule types present.

**Geochemistry:** Olivine in the range  $Fa_{0.5-70.5}$  (mean  $Fa_{14.8\pm 12.6}$ ,  $N=28$ ).  $Cr_2O_3$  in ferroan olivine  $0.6\pm 0.2$  wt.% ( $N=12$ ). Low-Ca pyroxene in the range  $Fs_{3.0-25.7}$  (mean  $Fs_{16.2\pm 10.6}$ ,  $Wo_{1.1\pm 0.6}$ ,  $N=19$ ).

**Calama 062** 22°25.615'S, 068°39.164'W

Antofagasta, Chile

Find: 2017-Aug-27

Classification: Iron meteorite (IIAB)

**Physical characteristics:** A single mass partly sand-blasted. Sawn surface shows unweathered metallic interior.

**Petrography:** Optical investigation of a ~3 by 2 cm polished and etched section reveals a coarse texture of kamacite up to 1 cm, with 120° junctions. Inclusions of troilite and schreibersite up to 0.5 mm are abundant.

**Geochemistry:** ICP-OES data: Ni=57.6, Co=4.6, P=2.9 (all mg/g); ICP-MS data: Cu=128, Cr=80, S=114, Ge=147, Ga=49, Ir=6.8, Au=0.6 (all µg/g)

**Calama 075** 22°29.05'S, 68°48.17'W

Antofagasta, Chile

Find: 18 Oct 2019

Classification: Ordinary chondrite (H3)

**Petrography:** (Lorenz C.A., *Vernad*) The meteorite comprises chondrules and chondrule fragments with minor interstitial fine-grained, and in places, devitrified melt matrix, metal-troilite and troilite-silicate aggregates, opaque and silicate melt veinlets and melt pockets. Chondrules are well lined. Olivine has undulatory and mosaic optical extinction, planar fractures and planar deformation features. Feldspatic glass is mostly isotropic, in places partially anisotropic.

**Geochemistry:** Mineral composition and geochemistry: Olivine  $Fa_{19.6\pm 1.87}$ , PMD  $Fa_{9.5}$  ( $N=18$ ); Pyroxene  $Fs_{15.9\pm 0.98}$   $Wo_{1.21\pm 0.31}$  ( $N=17$ ); rare large chondrules are Mg-rich: Ol  $Fa_{5.02\pm 2.52}$ , PMD  $Fa_{50}$  ( $N=19$ ); Px  $Fs_{3.64\pm 2.5}$   $Wo_{1.16\pm 1.35}$  ( $N=4$ ).

**Calama 076** 22°29.320'S, 68° 53.347'W

Antofagasta, Chile

Find: 2019 Mar 30

Classification: HED achondrite (Diogenite)

**History:** Found on March 30, 2019, by Jimmy Pizarro and Alfonso Viera

**Physical characteristics:** One stone with some patch of fusion crust.

**Petrography:** (J. Gattacceca, *CEREGE*) Pyroxenite with grain size 1.5 mm. Mineralogy: ultradominant pyroxene, and minor metal, silica, chromite, troilite.

**Geochemistry:** Pyroxene  $Fs_{22.5\pm 0.7}$   $Wo_{1.6\pm 0.3}$ ,  $FeO/MnO=32.2\pm 3.0$  ( $n=7$ )

**Classification:** Achondrite (diogenite)

**Specimens:** Type specimen at *CEREGE*, main mass with *Kuntz*

**Calama 077** 22°26.569'S, 68°37.983'W



1  
2  
3 Antofagasta, Chile

4 Find: 2017 Oct 19

5 Classification: Ordinary chondrite (H4)

6 **History:** Meteorite (175.26 g) was found 19 October 2017 by the *UrFU* meteorite expedition-  
7 2017 in Chile (Pastukhovich A. Yu., Larionov M. Yu., Kruglikov N.A., Kolunin R.N.) near  
8 Chiu-Chiu.  
9

10 **Physical characteristics:** Total mass is 175.26 g. The meteorite has roughly rounded shape.  
11 Exterior of the stone is desert polished. The surface and interior of the meteorite is light to  
12 dark brown in color due to Fe-hydroxides. No fusion crust was observed.

13 **Petrography:** Classification (D. Dugushkina, *RAS-UB*). The meteorite consists mostly of a  
14 fine-grained inequigranular recrystallized matrix and chondrules (15%). Chondrite consists of  
15 olivine 55%, orthopyroxene 25%, clinopyroxene 7-10%, plagioclase 5%, chromite 1-2%,  
16 troilite 2-3%, kamacite and taenite 2-4%. Also chondrite contains accessory apatite.

17 Porphyritic olivine (PO) and porphyritic olivine-pyroxene (POP) chondrules predominates.  
18 Chondrules have clear boundaries. Petrographic type is 4. Chromite-plagioclase assemblages  
19 are found in chondrite recrystallized matrix. The assemblages range in size from 50-300  $\mu\text{m}$   
20 and consist of 0.2-30- $\mu\text{m}$ -size rounded, euhedral, subhedral and anhedral chromite grains  
21 surrounded by plagioclase or glass of plagioclase composition. There are grid of thin metal-  
22 troilite shock veins in fractures in olivine, pyroxene and plagioclase. Plagioclase is not  
23 melted. Shock stage is S2. Minor oxide rims around metal and troilite, minor oxide veins.  
24 Weathering grade is W1.

25 **Geochemistry:** EDX analyses by K. Dugushkina, *RAS-UB*. The chondrite paragenesis  
26 includes olivine  $\text{Fa}_{20\pm 0.5}$  (N=23), orthopyroxene  $\text{En}_{82\pm 0.5}\text{Fs}_{17\pm 0.4}\text{Wo}_{1\pm 0.2}$  (N=14), clinopyroxene  
27  $\text{En}_{48\pm 0.5}\text{Fs}_{14\pm 1.4}\text{Wo}_{44\pm 0.9}$  (N=10), plagioclase  $\text{An}_{26\pm 3.6}$  (N=9), chromite, troilite, kamacite (Ni  
28 5.0-8.9 wt%), taenite (Ni 13.8-31.9 wt%), apatite. The average composition of chromite  
29 (N=12):  $\text{Cr}_2\text{O}_3$  55.3 $\pm$ 0.5%,  $\text{TiO}_2$  2.1 $\pm$ 0.4%,  $\text{Al}_2\text{O}_3$  6.5 $\pm$ 0.3%, FeO 31.1 $\pm$ 1.0%, MgO  
30 3.7 $\pm$ 0.7%,  $\text{SiO}_2$  0.5 $\pm$ 0.05%, MnO 0.8 $\pm$ 0.1%.

31 **Classification:** (K. Dugushkina, *RAS-UB*) H4, ordinary chondrite.

32 **Specimens:** 168.56 g 2 samples and 3.7 g cut-off and thin section *UrFU*  
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39 **Calama 078** 22°22.855'S, 68°35.996'W

40 Antofagasta, Chile

41 Find: 2018 Oct 14

42 Classification: Ordinary chondrite (LL5)

43 **History:** One fragment of meteorite (1686.00 g) was found 14 October 2017 by  
44 the *UrFU* meteorite expedition-2017 in Chile (Pastukhovich A.Yu., Larionov M.Yu.,  
45 Kruglikov N.A., Kolunin R.N.) near Chiu-Chiu.

46 **Physical characteristics:** Total mass is 1686.00 g. The meteorite has roughly rounded shape.  
47 Exterior of the stone is desert polished. The surface and interior of the meteorite is light to  
48 dark brown in color due to Fe-hydroxides. No fusion crust was observed.

49 **Petrography:** Classification (K. Dugushkina, *RAS-UB*). The meteorite consists mostly of a  
50 fine-grained inequigranular recrystallized matrix and chondrules (25%). Chondrite consists of  
51 olivine 60%, orthopyroxene 20%, clinopyroxene 5-7%, plagioclase 5-7%, chromite 1-2%,  
52 troilite 2-3%, Fe-Ni-metal <2%. Also chondrite contains accessory apatite and ilmenite.

53 Predominant porphyritic olivine (PO) and porphyritic olivine-pyroxene (POP) chondrules.  
54 Chondrules have vague boundaries. Petrographic type is 5. Chromite-plagioclase assemblages  
55 are found in chondrite recrystallized matrix. The assemblages range in size from 10-1000  $\mu\text{m}$   
56 and consist of 0.2-30- $\mu\text{m}$ -size rounded, euhedral, subhedral and anhedral chromite grains  
57 surrounded by plagioclase or glass of plagioclase composition. There are grid of thin metal-  
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troilite shock veins in fractures in olivine, pyroxene and plagioclase. Plagioclase is not melted. Shock stage is S2. Moderate oxidation of metal, about 20-60% being affected, alteration of mafic silicates is beginning. Metal and troilite is almost completely oxidized in the grid of thin shock veins. Weathering grade is W2-3.

**Geochemistry:** EDX analyses by K. Dugushkina, *RAS-UB*. The chondrite paragenesis includes olivine  $\text{Fa}_{27\pm 0.5}$  (N=17), orthopyroxene  $\text{En}_{77\pm 0.3}\text{Fs}_{22\pm 0.4}\text{Wo}_{1\pm 0.2}$  (N=11), clinopyroxene  $\text{En}_{45\pm 0.8}\text{Fs}_{20\pm 2.8}\text{Wo}_{43\pm 1.2}$  (N=3), plagioclase  $\text{An}_{21\pm 2.6}$  (N=10), chromite, apatite, troilite, kamacite, taenite, ilmenite. The average composition of chromite (N=6):  $\text{Cr}_2\text{O}_3$  52.8±1.7%,  $\text{TiO}_2$  2.9±0.6%,  $\text{Al}_2\text{O}_3$  6.5±1.2%,  $\text{FeO}$  33.5±1.4%,  $\text{MgO}$  3.0±0.9%,  $\text{SiO}_2$  0.7±0.2.

**Classification:** (Kseniya Dugushkina, *RAS-UB*) LL5, ordinary chondrite.

**Specimens:** 1676.4 g 2 samples and 9.6 g cut-off and thin section *UrFU*

**Calama 079** 22°24.362 S, 68°34.391 W

Antofagasta, Chile

Find: 2017 Oct 14

Classification: Ordinary chondrite (H4)

**History:** One fragment weighing 44.34 g was found 14 October 2017 by the *UrFU* meteorite expedition-2017 in Chile (Pastukhovich A.Yu., Larionov M.Yu., Kruglikov N.A., Kolunin R.N.) near Chiu-Chiu.

**Physical characteristics:** The meteorite has roughly rounded shape. Exterior of the stone is desert polished. The surface and interior of the meteorite is light to dark brown in color due to Fe-hydroxides. No fusion crust was observed.

**Petrography:** Classification (K. Dugushkina and S. Berzin, *RAS-UB*). The meteorite consists mainly of a fine-grained inequigranular recrystallized matrix; chondrules make up 25-30% of the volume. Predominantly porphyritic olivine (PO) and porphyritic olivine-pyroxene (POP) chondrules. Chondrules mostly have even boundaries. The meteorite consists mainly of olivine 55%, low-Ca pyroxene 20%, Ca pyroxene 10%, plagioclase 10%, troilite 2-3%, Fe-Ni-metal 2-3%. Also chondrite contains accessory apatite, chromite and ilmenite. Heavy oxidation of metal and troilite, 60-95% being replaced (W3). Shock stage is S3.

**Geochemistry:** EDX analyses by K. Dugushkina, *RAS-UB*. Olivine  $\text{Fa}_{20.3\pm 0.6}$  (N=16), orthopyroxene  $\text{Fs}_{17.8\pm 0.8}\text{Wo}_{1.2\pm 0.2}$  (N=14), clinopyroxene  $\text{En}_{43\pm 1.5}\text{Fs}_{20\pm 2.8}\text{Wo}_{46\pm 0.5}$ , plagioclase  $\text{An}_{37\pm 0.14}$  (N=9), chromite, apatite, troilite and FeNi-metal.

**Classification:** H4, ordinary chondrite.

**Specimens:** 29.54 g sample and 14.8 g cut-off and thin section, *UrFU*

**Calama 080** 22°27.941'S, 68°38.858'W

Antofagasta, Chile

Find: 2017 Oct 24

Classification: Ordinary chondrite (H4)

**History:** Two fragments of meteorite (138.25 and 10.27 g) were found 24 October 2017 by the *UrFU* meteorite expedition-2017 in Chile (Pastukhovich A.Yu., Larionov M.Yu., Kruglikov N.A., Kolunin R.N.) near Chiu-Chiu.

**Physical characteristics:** Total mass is 148.52 g. The meteorite has roughly rounded shape. Exterior of the stone is desert polished. The surface and interior of the meteorite is light to dark-brown in color due to Fe-hydroxides. No fusion crust was observed.

**Petrography:** Classification (K. Dugushkina and S. Berzin, *RAS-UB*). The meteorite consists mostly of a fine-grained, inequigranular recrystallized matrix and chondrules (15%).

Chondrite consists of olivine 60%, orthopyroxene 15%, clinopyroxene 7-10%, plagioclase 5-



7%, chromite 1-2%, troilite 4-6%, Fe-Ni-metal 3-5%, with accessory apatite. Predominately porphyritic olivine (PO) and porphyritic olivine-pyroxene (POP) chondrules. Chondrules have vague boundaries. Minor oxide rims around metal and troilite, minor oxide veins (weathering grade - W1). Meteorite is very weakly shocked. There are no opaque melt veins or melt pockets. Shock stage is 1-2. A xenolith with a size of  $1.5 \times 2.5$  mm and an angular shape was found, consisting mostly of orthopyroxene  $\text{En}_{81\pm0.5}\text{Fs}_{18\pm0.4}\text{Wo}_{1\pm0.3}$  (N=12) with rounded inclusions of olivine (Fa  $_{20\pm0.3}$ %) and a small amount of mesostasis. The mesostasis is 5-7 vol% and composed of plagioclase and clinopyroxene.

**Geochemistry:** Clinopyroxene  $\text{En}_{51\pm1.4}\text{Fs}_{15\pm0.1}\text{Wo}_{41\pm1.5}$  (N=7), plagioclase  $\text{An}_{16\pm0.04}$  (N=12), chromite, apatite, troilite, kamacite (Ni 5.8-6.5 wt%). The composition of chromite:  $\text{Cr}_2\text{O}_3$  58.4%,  $\text{TiO}_2$  2.7%,  $\text{Al}_2\text{O}_3$  6.04%, FeO 27.7%, MgO 4.7%,  $\text{SiO}_2$  0.5%. The average composition of orthopyroxene from xenolith (N=12):  $\text{SiO}_2$   $56.4\pm0.2\%$ , MgO  $30.6\pm0.3\%$ , FeO  $11.9\pm0.2\%$ , MnO  $0.5\pm0.1\%$ , CaO  $0.6\pm0.1\%$ ,  $\text{Cr}_2\text{O}_3$  ?0.1%.

**Classification:** (K. Dugushkina, *RAS-UB*) H4, ordinary chondrite.

**Specimens:** 129. 32 g in 2 samples, plus 19.2 g cut-off and thin section, *UrFU*

**Calama 082** 22°8.50'S, 68°37.37'W

Antofagasta, Chile

Find: 19 Oct 2019

Classification: HED achondrite (Diogenite, polymict)

**History:** The numerous fragments of meteorite were collected over 50 m<sup>2</sup> by Mr. Ilya Chaplygin, who was searching for meteorites in the Atacama Desert.

**Physical characteristics:** Physical properties: The meteorite has more than 100 fragments. The largest pieces are 843, 476 and 350 g. The stone of 843 g of mass has isometric shape; half of the stone surface is covered with dark-gray fusion crust. Smaller fragments have not fusion crust and are dark gray in color. The brecciated texture is visible. Total mass of collected fragments is 2850 g.

**Petrography:** (Lorenz C. A., *Vernad*) the meteorite has brecciated texture. The poorly sorted breccia comprises of fragments of pyroxenites, melt matrix breccias, minor fragments of pyroxene-feldspar rocks, recrystallized breccias and sulfide-silicate breccias settled in the fine-grained clastic matrix. Main phase is pyroxene; feldspar is minor, olivine, chromite, silica, troilite and metal are rare. The melt matrix breccia fragments are up to 2 cm of size. The rock is crossed by rare shock melt veins.

**Geochemistry:** Mineral compositions and geochemistry: (N. N. Kononkova, EMPA, *Vernad*; T. Kryachko, SEM, Technograd, Moscow): Low-Ca pyroxene is  $\text{En}_{63.5}\text{-En}_{79}\text{Wo}_{1.4-4.5}$  (Fe/Mn=21.5-35.3); Olivine  $\text{Fo}_{62.3-66.3}$ ; Pyroxene in eucritic fragments  $\text{En}_{37-62}\text{Wo}_{2.4-4.4}$  with lamellae of  $\text{En}_{41.5-50.5}\text{Wo}_{41.5-44.6}$ . Feldspar  $\text{An}_{87.4}\text{Ab}_{11.6}\text{-An}_{91.9}\text{Ab}_{8.1}$

**Classification:** polymict diogenite

**Specimens:** The type specimen of 564.3 g and four thin sections are on deposit at *Vernad*. Mr. Chaplygin holds the main mass.

**Calama 085** 22°26.854'S, 68°36.489'W

Antofagasta, Chile

Find: 2017 Oct 19

Classification: Ordinary chondrite (H(L)3)

**History:** One fragment of meteorite (1486 g) was found 24 October 2017 by the *UrFU* meteorite expedition-2017 in Chile (Pastukhovich A.Yu., Larionov M.Yu., Kruglikov N.A., Kolunin R.N.) near village Chiu-Chiu.

**Physical characteristics:** Total mass is 1486 g. The meteorite has roughly rounded shape. Exterior of the stone is desert polished. The surface and interior of the meteorite is light to dark brown in color due to Fe-hydroxides. No fusion crust was observed.

**Petrography:** (K. Dugushkina, *RAS-UB*) The meteorite has a dark-brown color. The sections show numerous distinct chondrules (average apparent diameter  $\sim 400\text{-}500\ \mu\text{m}$ , up to 2 mm) in a fine-grained matrix of silicates, metal, and troilite. The meteorite is dominated by porphyritic olivine chondrules (PO) and olivine-pyroxene chondrules (POP). Also present are porphyritic pyroxene (PP), radiating pyroxene (RP), and barred olivine (BO) chondrules. Also chondrite contains accessory apatite and chromite. Heavy oxidation of metal and troilite, 60-95% being replaced (W3). Shock stage is S2/3.

**Geochemistry:** EDX analyses by K. Dugushkina, *RAS-UB*. The rock is unequilibrated with a large range in olivine composition ( $\text{Fa}_{3.7\text{-}28.8}$ ,  $N=38$ ). The mean olivine composition is  $\text{Fa}_{20.3\pm 7.8}$  and it has a percent mean deviation (PMD for FeO in olivine) of 31%. The chondrite paragenesis, in addition to olivine, includes orthopyroxene  $\text{En}_{78.6\pm 2.9}\text{Fs}_{20.1\pm 2.7}\text{Wo}_{1.3\pm 0.5}$  ( $N=15$ ), clinopyroxene  $\text{En}_{47.1\pm 0.7}\text{Fs}_{8.6\pm 0.8}\text{Wo}_{44\pm 0.7}$  ( $N=5$ ), chromite, apatite, troilite, taenite (Ni 14.3-45.8%) and kamacite (Ni  $\sim 6.8\%$ ). The average composition of chromite ( $N=6$ ):  $\text{Cr}_2\text{O}_3$   $55.3\pm 0.8$  wt%, FeO  $30.8\pm 0.6$  wt%, MgO  $3.4\pm 0.4$  wt%,  $\text{Al}_2\text{O}_3$   $5.7\pm 0.4$  wt%,  $\text{TiO}_2$   $3.1\pm 0.4$  wt%, MnO  $0.55\pm 0.1$  wt%,  $\text{SiO}_2$   $0.8\pm 0.1$  wt%, CaO  $0.3\pm 0.5$  wt%, NiO  $0.2\pm 0.1$  wt%.

**Classification:** Ordinary chondrite, H(L)3, estimated subtype 3.5. Chondrule size closer to the H range, but silicate compositions may indicate L group.

**Specimens:** 1474.00 g sample and 12.00 g cut-off and thin section *UrFU*

**Calama 087**  $22^\circ 28.25'S$ ,  $68^\circ 51'W$

Antofagasta, Chile

Find: 2018 Oct 27

Classification: Carbonaceous chondrite (CO3)

**Petrography:** (J. Gattacceca, *CEREGE*) Chondrite with well-delineated chondrules (average apparent diameter  $250\pm 90\ \mu\text{m}$ ,  $n=31$ ) and small CAIs set in an abundant, fine grained, iron-rich matrix. Opaque are metal and troilite.

**Geochemistry:** Olivine  $\text{Fa}_{23.5\pm 17.0}$ , range  $\text{Fa}_{1.2\text{-}55.8}$ , Fa PMD 65% ( $n=21$ ),  $\text{Cr}_2\text{O}_3$  in ferroan olivine  $0.21\pm 0.26$  wt% ( $n=19$ ). Low-Ca pyroxene  $\text{Fs}_{4.8\pm 3.0}\text{Wo}_{1.5\pm 1.0}$  ( $n=8$ ).

**Classification:** Carbonaceous chondrite (CO3).

**Calama 114**  $22^\circ 24.88'S$ ,  $68^\circ 37.61'W$

Antofagasta, Chile

Find: 9 Apr 2018

Classification: Ordinary chondrite (L6, melt breccia)

**Petrography:** The meteorite is a melt-rock matrix breccia, composed of the mm-sized fragments of recrystallized chondritic texture joined together by poorly transparent devitrified melt ( $\sim 15$  vol.%).

**Caleta el Cobre 037** (CeC 037)  $24^\circ 14' 1''S$ ,  $70^\circ 18' 59''W$

Antofagasta, Chile

Find: 2018

Classification: Ordinary chondrite (L6, melt breccia)

**Petrography:** (J. Gattacceca, *CEREGE*) Melt-rock supported breccia. Clasts are cm-sized, and are type 6.

**Caleta el Cobre 041** (CeC 041) 24°17.678'W, 70°19.746'W

Antofagasta, Chile

Find: 2018 Dec

Classification: Ordinary chondrite (L3)

**Petrography:** (J. Gattacceca, *CEREGE*) Chondrite with packed chondrules. Opaque are metal and troilite. Shock veins.

**Geochemistry:** Olivine  $Fa_{24.5\pm 5.3}$ ,  $Fa$  PMD = 16% (n=5). Low-Ca pyroxene  $Fs_{17.0\pm 2.3}Wo_{0.9\pm 0.6}$  (n=4).

**Classification:** Ordinary chondrite (L3). Possibly paired with [Los Vientos 171](#).

**Caleta el Cobre 050** (CeC 050) 24°15'S, 70°31'W

Antofagasta, Chile

Find: 2020 Apr 27

Classification: Ungrouped achondrite

**Physical characteristics:** Single brownish stone. Cut surface reveals a coarse crystalline interior with green (low-Ca pyroxene) and white (plagioclase) crystals. Some pyroxene are stained with rust. Ductile deformation is visible at cm scale.

**Petrography:** (J. Gattacceca, *CEREGE*) Fractured but unbrecciated igneous rock with triple junctions. Grain size 300  $\mu$ m. Main minerals are plagioclase and low-Ca pyroxene in similar abundances. Opaque minerals are kamacite and troilite, found as small grains or along grain rims. A few pyroxene grains are exsolved and contain  $\sim 10$   $\mu$ m kamacite grains associated with the exsolutions.

**Geochemistry:** Plagioclase  $An_{57.0\pm 3.8}Ab_{42.6\pm 3.8}Or_{0.3\pm 0.1}$  (n=4). Pyroxenes: low-Ca pyroxene  $Fs_{5.8\pm 0.2}Wo_{2.3\pm 0.1}$  (n=4), augite  $Fs_{2.4\pm 0.0}Wo_{45.9\pm 0.2}$  (n=2),  $FeO/MnO = 4.59\pm 0.75$  (n=6). Oxygen isotopic composition (J. Gattacceca, C. Sonzogni, *CEREGE*) from analysis of one 1.5 mg aliquot of a powdered 353 mg bulk sample is  $\delta^{17}O = 3.48\text{‰}$ ,  $\delta^{18}O = 8.28\text{‰}$ ,  $\Delta^{17}O = -0.83\text{‰}$  (slope 0.52, analytical uncertainties 0.08‰, 0.12‰, 0.01‰ respectively).

**Classification:** Achondrite-ungrouped. The ungrouped designation is based on the oxygen isotopic composition, mineralogy and mineral chemistry.

**Specimens:** Type specimen at *CEREGE*. Main mass at *MMC*.

**Camel Donga 054** 30°19'S, 126°37'E

Western Australia, Australia

Find: 2007 Apr 24

Classification: Ordinary chondrite (H6)

**History:** Found on the surface by K. Hicks on open plain within the strewnfield of the Camel Donga eucrite (A. Bevan, *WAM*)

**Physical characteristics:** Physical Characteristics: A crusted, broken, weathered fragment weighing 49.28 g, measuring 5x3x3.5 cm (A. Bevan, *WAM*).

**Petrography:** (L. Daly, L. V. Forman, Curtin). Specimen has poorly defined chondrules within a heavily stained red/opaque matrix. The chondrules include types RP, PO, POP, and BO, and chondrule mesostases are crystalline. Sizes range from 0.45-1.8 mm with a mean of 1.1 mm (n=18). Mineralogy consists of olivine, pyroxene, chromite, feldspar, and FeO. Olivine and pyroxene have undulose extinction, and planar fractures. Feldspars are mostly

<50  $\mu\text{m}$  but some larger grains were observed. Any metal and sulfide previously present in the sample have been completely replaced with iron oxide > 95 %.

**Geochemistry:** Mineral Compositions and Geochemistry: EDS, Olivine:  $\text{Fa}_{20.1\pm 0.6}$  (n=12).

Low Ca pyroxene:  $\text{Fs}_{17.6\pm 1.2}\text{Wo}_{2.3\pm 1.1}$  (n=6) rare diopside is present  $\text{Fs}_{6.8}\text{Wo}_{46.4}$ . Feldspar

$\text{Ab}_{86.5\pm 1.3}$  with some rare Ca rich varieties  $\text{Ab}_{60-47.9}$ .

**Classification:** Ordinary Chondrite, H6, S3, W4

**Specimens:** The *WAM* holds the main mass now 47.28 g and one thin section.

**Carson Lake** 38°36.432'N, 103°0.087'W

Colorado, United States

Find: 1941

Classification: Ordinary chondrite (H6)

**History:** Frank Jacobs discovered the 18.37 kg sample in 1941 in a farm field 7.2 miles N of Galatea, Kiowa Co., Colorado (CO Sect. 4 T17SR50W). In 2019, Jake Jacobs and his wife brought the sample to the Colorado School of Mines Museum of Earth Science for identification. Daniel Wray, a museum volunteer, recognized the sample as a meteorite.

**Physical characteristics:** The sample has an irregular, tabular shape with abundant broad shallow regmaglypts. The exterior of the sample is covered in an orange-colored weathered fusion crust. The interior is dark-brown in color and shows sulfides and a few shiny grains of un-weathered FeNi metal.

**Petrography:** Description and Classification (A. Love, *App*) Sample shows recrystallized chondritic texture composed of indistinct chondrules with an average apparent diameter of 623  $\mu\text{m}$  (n=29). Secondary plagioclase has an average grain size of 60  $\mu\text{m}$  (n=38). Chondrule mesostasis has been completely recrystallized. A region of the sample, bounded by opaque shock veins, is composed of 25-200  $\mu\text{m}$  brecciated grains of olivine, pyroxene and plagioclase. Additional minerals are: troilite, phosphates and chromite.

**Geochemistry:** (A. Love, *App*) Olivine ( $\text{Fa}_{17.9\pm 0.2}$ ,  $\text{Fe/Mn}=35.7\pm 0.8$  n=12); low Ca pyroxene ( $\text{Fs}_{15.7\pm 0.1}\text{Wo}_{1.3\pm 0.1}$ , n=12).

**Classification:** Ordinary Chondrite (H6, C-S3, W3). Based on mineral textures, compositions and grain size of secondary plagioclase, this sample is an H6.

**Specimens:** Jake Jacobs holds the main mass. A 38.90 g fragment and a polished thin section are on deposit at *App*.

**Catalina 344** 24°56'27.5"S, 69°44'18.8"W

Antofagasta, Chile

Find: 2016 Nov 03

Classification: Ordinary chondrite (H4)

**Petrography:** (J. Gattacceca, *CEREGE*) Chondrite with packed well-delineated chondrules with average apparent diameter 465±244 (n=215). Opaque minerals are metal and troilite.

**Geochemistry:** Olivine  $\text{Fa}_{18.9\pm 1.0}$ , range  $\text{Fa}_{15.6}$ - $\text{Fa}_{20.1}$ ,  $\text{Fa PMD}$  3.3% (n=15). Low-Ca pyroxene  $\text{Fs}_{12.8\pm 3.8}\text{Wo}_{1.3\pm 1.3}$ , range  $\text{Fs}_{4.7}$ - $\text{Fs}_{16.6}$  (n=13).

**Classification:** Ordinary chondrite (H4). This meteorite is classified as H from the apparent chondrule size and 37 vol% of opaques converted to oxyhydroxides.

**Specimens:** Type specimen at *CEREGE*. Main mass at *MMC*.

**Cavezzo** 44°49'44"N, 10°58'20"E

Emilia-Romagna, Italy

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3 Confirmed fall: 1 Jan 2020

4 Classification: L5-an

5 **History:** (INAF) On January 1, 2020, at 18:26:54 UT, a bolide was observed by many people  
6 in northern and central Italy. At the same time at least 8 all-sky cameras of the Italian  
7 PRISMA Fireball Network, which is part of the international FRIPON network, recorded a  
8 track, inclined at about 68° with respect to the Earth's surface, that started at an altitude of 76  
9 km and ended at an altitude of 21.7 km. A pre-atmospheric speed of the meteoroid of about  
10 12 km/s and an initial mass of several kg was estimated. During the fall, two main  
11 fragmentation events were registered at altitudes of 50 and 30 km, while the dark flight started  
12 at 21.7 km altitude. According to the PRISMA calculations the estimated strewn field of the  
13 fragments in the area between Rovereto sul Secchia, Disvetro and Cavezzo, near Modena. On  
14 January 4, at around 15.30 UT, Mr. Davide Gaddi, who had been informed through the  
15 newspapers of the notice published by PRISMA-INAF about the possible fall, was walking  
16 with his dog over the embankment of the Secchia river floodwater detention basin and was  
17 attracted by a little piece of a dark stone, that he picked up (sample #1). Later he looked  
18 around and was able to find the main mass a few meters away (sample #2).

19 **Physical characteristics:** Two main samples weighing 52.2 and 3.6 g were recovered. Both  
20 are almost entirely covered by a black, shiny fusion crust. The big one has on one side an  
21 oriented and rounded shape while the other side displays a fragmented surface which shows  
22 an internal structure characterized by a fine-grained chondritic texture consisting of pale green  
23 and white crystals with scattered tiny shiny particles. At the boundary between the original  
24 and the fragmented surfaces signs of an impact with a hard, white rock, presumably a  
25 limestone, can be seen on the crust, suggesting a possible fragmentation on the ground. The  
26 small one has an almost spherical shape, is partially fragmented, too, and, on a cut surface,  
27 shows a marked chondritic structure with no traces of shiny particles.

28 **Petrography:** (V. Moggi Cecchi, G. Pratesi, *UniFi*); Two thin sections were analyzed,  
29 sampling fragments from both the main mass and the small fragment. The thin section of the  
30 main mass (sample #2) displays a typical chondritic texture, with chondrules of various types  
31 (PO, POP, PP) ranging from 200 to 800 µm set in medium grained matrix consisting of  
32 orthopyroxene, olivine, plagioclase and minor clinopyroxene. Opaque phases are represented  
33 by scattered Fe,Ni alloys and sulphides both in chondrules and in the matrix. Merrillite and  
34 chromite are also present as rare small (max 50 µm) spots. The thin section of the small  
35 sample (#1) displays an anomalous chondritic texture, with chondrules ranging from 800 to  
36 2000 µm in a coarse grained matrix; a chondrules/matrix ratio of 1 has been estimated; some  
37 chondrules belong to the BO type and display elongated olivine bars separated by a fine-  
38 grained matrix consisting of clinopyroxene and minor plagioclase and orthopyroxene; most of  
39 the chondrules consist of large (200-600 µm) olivine crystals, often fractured, with a  
40 continuous rim of olivine and separated by an interstitial matrix mostly consisting of  
41 clinopyroxene and plagioclase, with minor orthopyroxene; both types show diffuse tiny  
42 chromite veins and droplets cross-cutting crystals; the interchondrules matrix consists mostly  
43 of large olivine crystals with irregular rounded shapes separated by fine grained aggregates of  
44 clinopyroxene, olivine and plagioclase, with minor orthopyroxene; plagioclase is also found  
45 as rare large (200-400 µm) crystals in the matrix; minor apatite crystals ranging from 300 to  
46 1000 µm are visible; metal is rare and can be found in tiny small droplet inside chromite veins  
47 1-4 µm in size or as very rare larger (20-100 µm) blebs; chromite is diffuse, mainly as small  
48 droplets (20-40 µm) and veins (1-2 µm wide and up to 300 µm long) or, more rarely, as larger  
49 blebs up to 100 µm; ilmenite is present as rare scattered blebs 20-40 µm in size; troilite is  
50 absent. A modal analysis of sample #1 based on X-ray maps performed on 11 areas  
51 1700x1200 µm wide provided the following results (all in vol%): ol = 67; pl = 14.8; cpx =  
52 9.1; opx = 5.6; apa = 3.1; chr = 0.2; Fe,Ni = 0.05;

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**Geochemistry:** EMP (V. Moggi Cecchi, G. Pratesi, *UniFi*); Sample #2 (main mass): Olivine in both chondrules and matrix ( $\text{Fa}_{24.6\pm 0.2}\text{Fo}_{75.4\pm 0.2}$ ;  $\text{Fe/Mn} = 28.6$ ,  $n=25$ ); Orthopyroxene in chondrules and matrix ( $\text{Fs}_{20.5\pm 0.3}\text{En}_{78.0\pm 0.2}\text{Wo}_{1.5\pm 0.1}$ ,  $\text{Fe/Mn} = 48.1$ ,  $n=18$ ); High-Ca pyroxene both in chondrules and matrix ( $\text{Fs}_{7.3\pm 0.1}\text{En}_{47.8\pm 0.3}\text{Wo}_{43.7\pm 0.3}$ ); Plagioclase both in crystals and matrix ( $\text{An}_{10.2}\text{Ab}_{83.9}\text{Or}_{5.8}$ ,  $\text{FeO} = 0.44$  Wt.%); a bulk chemical analysis on major and minor elements performed by SEM-EDS on 15 areas  $1700\times 1200$   $\mu\text{m}$  wide provided the following results (elements, all in mg/g): Si = 195.5, Ti = 0.8, Al = 18.9, Cr = 6.3, Fe = 153.0, Mn = 3.2, Mg = 145.1, Ca = 13.5, Na = 10.2, K = 1.4, P = 2.4, S = 17.7; A modal analysis of sample #1 based on Xray maps performed on 15 areas  $1700\times 1200$   $\mu\text{m}$  wide provided the following results (all in vol%): ol = 35; opx = 34; pl = 16; cpx = 9; troilite = 3.6; Fe,Ni = 1.7; chr = 0.7; Sample #1: Olivine in both chondrules and matrix ( $\text{Fa}_{23.8\pm 0.2}\text{Fo}_{76.2\pm 0.2}$ ;  $\text{Fe/Mn} = 45.5$ ,  $n=37$ ); Orthopyroxene in chondrules and matrix ( $\text{Fs}_{19.8\pm 0.1}\text{En}_{78.7\pm 0.1}\text{Wo}_{1.4\pm 0.1}$ ,  $\text{Fe/Mn} = 26.6$ ,  $n=8$ ); High-Ca pyroxene both in chondrules and matrix ( $\text{Fs}_{7.0\pm 0.2}\text{En}_{47.8\pm 0.1}\text{Wo}_{45.2\pm 0.3}$ ,  $\text{Fe/Mn} = 60.6$ ,  $n=6$ ;  $\text{Al}_2\text{O}_3 = 0.52$ ,  $\text{TiO}_2 = 0.57$ ,  $\text{Cr}_2\text{O}_3 = 0.80$ ,  $\text{Na}_2\text{O} = 0.56$ , all in Wt.%); Plagioclase both in large crystals and in fine grained matrix ( $\text{An}_{11.4}\text{Ab}_{83.1}\text{Or}_{5.5}$ ,  $\text{FeO} = 0.37$  Wt.%); Metal: four clusters at  $\text{Fe}83.4\text{Co}1.3\text{Ni}15.3$ ;  $\text{Fe}94.0\text{Co}1.8\text{Ni}4.2$ ;  $\text{Fe}70.6\text{Co}1.6\text{Ni}27.8$   $\text{Fe}52.0\text{Co}1.0\text{Ni}47.0$  (all in Wt.%); a bulk chemical analysis on major and minor elements performed by SEM-EDS on 15 areas  $1700\times 1200$   $\mu\text{m}$  wide of sample #1 provided the following results (elements, all in mg/g): Si = 200.5, Ti = 0.6, Al = 21.8, Cr = 4.1, Fe = 135.9, Mn = 2.4, Mg = 161.6, Ca = 28.0, Na = 10.3, K = 0.9, P = 7.2, S = 0.0; Oxygen isotopes (sample #1): (I.Franchi, R.Greenwood, *OU*)  $\delta^{17}\text{O} = 3.25$  ‰,  $\delta^{18}\text{O} = 4.74$  ‰,  $\Delta^{17}\text{O} = 0.79$  ‰

**Classification:** Ordinary chondrite (anomalous) L5, S2, W0;

**Specimens:** Both samples, totally weighing 55.3 g (#2, 52.2 g and #1, 3.1 g), two thin sections and two thick sections are on deposit at *MSN-FI*, inventory # I-3613 and I-3557). Sample #1 is property of INAF (Istituto Nazionale di Astrofisica).

**Chug Chug 019** 22°29.46'S, 69°07.57'W

Antofagasta, Chile

Find: 27 Oct 2018

Classification: Ordinary chondrite (H4, anomalous)

**History:** one piece of meteorite (field number 4-57) was found in the the desert by Mr. T. V. Kryachko.

**Physical characteristics:** a sample of meteorite has a brown fusion crust.

**Petrography:** M. A. Ivanova (*Vernad*) Meteorite consists of well-defined chondrules,  $0.34\pm 0.21$  cm in size, embedded in matrix enriched in Fe-oxides. POP and PP chondrules are abundant, BO and PR are rare; minerals are olivine, pyroxene, Fe,Ni-metal and iron oxides, sulfide, quartz, phosphate, carbonate and chromite. Glass of plagioclase composition occurs in chondrules. Shock stage is S1, weathering grade is W3.

**Geochemistry:** Mineral compositions and geochemistry: M. A. Ivanova. Olivine  $\text{Fa}_{10.2\pm 0.28}$  (N=39), orthopyroxene  $\text{Fs}_{11.6\pm 4.44}$ ;  $\text{Wo}_{0.64\pm 0.47}$ ,  $\text{Fe/Mn} = 21.2\pm 8.7$  (N=32), clinopyroxene is represented by pigeonite :  $\text{Fs}_{29-32}\text{Wo}_{8-12}$  and augite  $\text{Fs}_{3-4}\text{Wo}_{37-43}$ ; plagioclase glass in chondrule has a variable composition:  $\text{Ab}_{44-88}\text{Or}_{0.7-13}$ ; Fe,Ni-metal contains 4.0-15.7 wt% Ni,  $0.48\pm 0.04$  wt% Co; sulfide is represented by troilite. Oxygen isotopic composition (*OU*):  $\delta^{17}\text{O} = 3.100$ ,  $\delta^{18}\text{O} = 4.589$ ,  $\Delta^{17}\text{O} = 0.714$ ;  $\delta^{17}\text{O} = 3.083$ ,  $\delta^{18}\text{O} = 4.605$ ,  $\Delta^{17}\text{O} = 0.688$  (all ‰).

**Classification:** based on chondrules size ( $0.34 \pm 0.21$  cm), very reduced silicates compared to H chondrite ( $\text{Fa}_{10}$ ), Co content (0.48 wt.%) in low-Ni Fe,Ni-metal and oxygen isotopic composition, this meteorite is an anomalous H chondrite. Based on homogeneous olivine composition but very clear boundaries of chondrules and variable low-Ca pyroxene composition, petrological type should be 4.

**Specimens:** individual sample of meteorite (1.54 g) and 1 polished section are deposited in *Vernad.*

**Chug Chug 022** 22°29.37'S, 69°8.20'W

Antofagasta, Chile

Find: 21 Oct 2019

Classification: Ordinary chondrite (L(H)3)

**Petrography:** The meteorite is composed of well-delineated chondrules with average apparent diameter  $410 \pm 230 \mu\text{m}$  (N=110), chondrule fragments and opaque grains embedded in minor fine-grained matrix. Olivine has undulatory extinction and planar fractures; feldspatic glass is partly anisotropic; opaque phases are metal (6 vol%), minor troilite and rare chromite.

**Geochemistry:** Mineral composition and geochemistry: Olivine is  $\text{Fa}_{22.7 \pm 8.28}$ , PMD  $\text{Fa}_{37.7}$  (N=36) including less ferroan main mass  $\text{Fa}_{18.8 \pm 4.3}$ , PMD  $\text{Fa}_{23}$  (N=28) and untypical Fe-rich objects containing  $\text{Fa}_{36.3 \pm 4.7}$  (N=8); Pyroxene is  $\text{Fs}_{14.5 \pm 7.61}$   $\text{Wo}_{1.17 \pm 0.79}$  (N=23)

**Classification:** Ordinary chondrite (L(H)3), estimated subtype 3.7. Metal content favors L classification, but the average chondrule size is closer to the H range. Hence the L(H) designation.

**Chug Chug 044** 22°29.969'S, 69°10.181'W

Antofagasta, Chile

Find: 2018 Mar 18

Classification: Ordinary chondrite (L4)

**History:** The meteorite (one piece) was found on March 31, 2018, by Ilya Chaplygin during a meteorite searching expedition organized by Timur Kryachko.

**Physical characteristics:** Total mass of the piece is about 1270 g. 90% of the meteorite is covered by black, rough fusion crust with cracks. Some parts are weathered or broken revealing uneven surface dominated by rounded chondrules. Bottom side is colored by light-reddish desert material. The interior of the meteorite is light-brown with clearly visible abundant chondrules and metal particles.

**Petrography:** (Pavel Yu. Plechov, *FMMR*). Petrographic observation of a polished section show that the meteorite consist of chondrules sizes vary from 300 to 750  $\mu\text{m}$  (with predominant size 500-750  $\mu\text{m}$ ) in recrystallized matrix. Olivine, low-Ca pyroxene and metall blebs are the main minerals in matrix. Olivine is equilibrated (with PMD of FeO 1.14%) but low-Ca pyroxene is not equilibrated. Nonsilicates is present and consist of both merrillite and Cl-apatite. These features indicate a petrological type of 4 for the meteorite. Metall and sulfides are fresh but have rare weathering products (goethite) that occur as veins and in situ alteration of FeNi-metals and troilite (weathering grade W1). Olivine has no undulatory extinction, and opaque shock veins and melt pockets are absent, indicating a shock stage of S1.

**Geochemistry:** Mineral composition and Geochemistry: EDS analyses (Pavel Yu. Plechov, *FMMR*, Sergey Ev. Borisovskiy, *IGEM*). The primary chondrite paragenesis includes olivine  $\text{Fa}_{25.2 \pm 1.4}$  (N=25), Low-Ca pyroxene  $\text{Fs}_{12.6 \pm 5.5}$   $\text{Wo}_{1.01 \pm 0.91}$  (N=22), chromite  $\text{Crt}_{36.8 \pm 51.9}$   $\text{Spl}_{36.9 \pm 34.7}$  (N=2).

**Classification:** Ordinary chondrite. L4 , S1, W1.

**Specimens:** Type specimen: 62 g and thin section at *FMMR*.



**Chug Chug 059** 22°29.96'S, 69°2.04'W

Antofagasta, Chile

Find: 30 Mar 2018

Classification: Ordinary chondrite (L5)

**Petrography:** the meteorite is impact melt breccia. It is composed of mm- to cm-sized chondritic fragments (~80 vol%) joined together by interstitial melt matrix. The matrix has a cryptocrystalline texture. Olivine in the fragments has undulatory extinction and weak mosaicism corresponding to S4 shock stage.

**Chug Chug 080** 22°29.88'S, 69°2.38'W

Antofagasta, Chile

Find: 17 Oct 2018

Classification: Ordinary chondrite (L5)

**Petrography:** The rock is composed of the fragments of type 5 chondrite up to 1 cm in size joined together by shock melt veins and pockets of fine-grained melt-matrix breccia.

**Chwichiya 002** 27°06'45.02"N, 11°10'25.2"W

Sagua el Hamra, Western Sahara

Find: 2018 Jun 10

Classification: Carbonaceous chondrite (C3.00, ungrouped)

**History:** Found close to Houza village by Elho Sbiti on June 10, 2018. Bought from Mohamed Elguirad in Guelmim in June and October 2018. More samples bought from Mohamed Elguirah, Habib-Naji Naji and Youssef Ait El Caid in January 2019. Some material bought by Nourddine Azelmat.

**Physical characteristics:** Fragments and crusted stones, including a 158 g full stone. Cut surface reveals a dark porous interior with chondrules.

**Petrography:** (J. Gattacceca, *CEREGE*) Chondrite with well-defined chondrules (average apparent diameter  $480 \pm 300$   $\mu\text{m}$ ,  $n=29$ ) set in an abundant fine-grained iron-rich matrix (74 vol%, by point counting,  $n=371$ ). Opaques are troilite, magnetite, rare metal (as inclusion in silicates and in the matrix). XRD over a  $\sim 1$  cm<sup>2</sup> area on a polished section (D.

Borschnek, *CEREGE*) does not reveal the presence of hydrous phases (serpentine, tochilinite) typically observed in type 2 chondrites using the same experimental setup. In contrast to type 2 chondrites, IR transmission spectroscopy (L. Bonal, *IPAG*) on matrix grains only reveal a faint water and Si-O-band (attributable to phyllosilicates), reflecting a very low extent of aqueous alteration. Based on the structural order of the polyaromatic matter assessed by Raman spectroscopy (L. Bonal, *IPAG*), this meteorite appears to be less heated than the least heated type 3 ordinary chondrite, [Semarkona](#).

**Geochemistry:** Olivine  $\text{Fa}_{37.6 \pm 16.7}$ , range  $\text{Fa}_{1.2-46.5}$  ( $n=16$ ),  $\text{Cr}_2\text{O}_3$  in ferroan olivine  $0.39 \pm 0.12$  wt% ( $n=11$ ). Low-Ca pyroxene  $\text{Fs}_{3.1 \pm 3.0} \text{Wo}_{0.8 \pm 0.3}$  ( $n=4$ ). Defocused (10  $\mu\text{m}$ ) microprobe totals in the matrix  $90.9 \pm 1.2\%$  ( $n=11$ ). Oxygen isotopic composition (J. Gattacceca, C. Sonzogni, *CEREGE*) from analysis of one acid-washed 1.5 mg aliquot of a powdered 38 mg bulk sample is  $\delta^{17}\text{O}=0.42\%$ ,  $\delta^{18}\text{O}=8.23\%$ ,  $\Delta^{17}\text{O}=-3.88\%$  (linearized, slope 0.5247, analytical uncertainties 0.08%, 0.12%, 0.03% respectively).

**Classification:** Carbonaceous chondrite (C3.00-ungrouped). This meteorite is distinct from CM2 chondrites for its larger chondrule size and only incipient aqueous alteration. Type 3.00 is based on the non-detection of phyllosilicates by XRD and microprobe total in the matrix higher than usually measured in type 2 chondrites (see e.g., Ebert et al. 2019,

MAPS [doi:10.1111/maps.13212](https://doi.org/10.1111/maps.13212)), and Raman spectroscopy. Possibly paired with [NWA 12957](#) and [NWA 11750](#) despite having distinct oxygen isotopic composition.

**Specimens:** Type specimen at *CEREGE*. Main mass with Jean Redelsperger and Nourddine Azelmat.

**Chwichiya 005** 27°14.39' N, 011° 40.12'W

Saguia el Hamra, Western Sahara

Find: 2019

Classification: Carbonaceous chondrite (CO3)

**History:** A single 249 g stone was found by Iken Mohamed in the Saguia el Hamra region of Western Sahara in 2019. John Higgins purchased the stone from Mohamed Elguirah in 2020.

**Physical characteristics:** Sample is dark brown in color, has a triangular profile with a rounded convex face and a flat bottom. The convex face is weathered and shows an irregular pattern of fractures. The cut face shows abundant small chondrules in a dark brown matrix.

**Petrography:** Description and classification (A. Love, *App*): Sample shows chondritic texture composed of chondrules with an average apparent diameter 208  $\mu\text{m}$  (n=60), fragments mineral grains and abundant refractory inclusions, abundant sulfide and weathered metal set within a fine-grained, opaque matrix. Additional minerals are: plagioclase, Si-polymorph, troilite and oxidized FeNi metal.

**Geochemistry:** (A. Love, *App*) Olivine,  $\text{Fa}_{22.5\pm 16.0}(\text{Fa}_{0.9-52.0})$ , n=18.  $\text{Cr}_2\text{O}_3$  Wt% in type II chondrules -  $0.4\pm 0.2$ , n=15); low-Ca pyroxene,  $\text{Fs}_{4.7\pm 3.8}\text{Wo}_{1.2\pm 1.0}(\text{Fs}_{0.7-8.2}\text{Wo}_{0.3-1.6})$ , n=11); pigeonite,  $\text{Fs}_{3.5-5.8}\text{Wo}_{7.4-5.3}$ , n=2.

**Classification:** Carbonaceous chondrite (CO3, C-S2, W3) Based on texture, chondrule diameter and magnetic susceptibility this sample is an CO chondrite.

**Specimens:** John Higgins holds the main mass. An end cut, several smaller slices and fragments that comprise the 23.55 g type specimen and a polished thin section and mount are on deposit at *App*.

**Chwichiya 006** 27° 7'40.65"N, 11°12'33.33"W

Saguia el Hamra, Western Sahara

Purchased: 2020 Mar

Classification: Ureilite

**History:** The meteorite was found by a Moroccan meteorite hunter on his way to hunt for Chwichiya specimens, acquired by a seller in Zagora and subsequently sold to Fabien *Kuntz*.

**Physical characteristics:** Dark brownish rock without fusion crust.

**Petrography:** The meteorite shows a cumulate texture composed of up to 2 mm sized olivine and pigeonite grains. Both, olivine and pyroxene display characteristic reduced rims and the meteorite contains rare flaky graphite. Some cracks are filled with secondary clacite.

**Geochemistry:** reduced rims in olivine:  $\text{Fa}_{3.6-13.0}$ ; olivine contains  $0.90\pm 0.06$  wt%  $\text{Cr}_2\text{O}_3$  and  $0.43\pm 0.02$  wt% CaO; reduced rims in pyroxene:  $\text{Fs}_{7.0-10.5}\text{Wo}_{6.6-11.4}$ ; pigeonite contains  $1.34\pm 0.05$  wt%  $\text{Cr}_2\text{O}_3$  and  $0.60\pm 0.03$  wt%  $\text{Al}_2\text{O}_3$

**Cleghorn Lakes** 34°15.396'N, 115°47.188'W

California, USA

Find: 2018 May 13

Classification: Ordinary chondrite (LL3)

**History:** On May 13, 2018, while searching for meteorites, Robert *Verish* found in a saddle (formed by the pediment of two mountain ridges) a tight cluster of many fragments of a stony meteorite.

**Physical characteristics:** Over 150 angular fragments were recovered (total over 1100 g) with many that could be physically paired, but not enough to reconstruct the original mass. Many fragments are missing, estimated to be 30%. A return trip to the find site resulted in only an additional 20 g.

**Petrography:** (D. Sheikh, *FSU*) Abundant chondrules ( $900\pm 50\ \mu\text{m}$ ) set in a fine-grained matrix containing accessory chromite, Fe oxides, and stained Fe-Ni metal.

**Geochemistry:** Olivine ( $\text{Fa}_{0.7-44.3}$ ,  $n=53$ ), Low-Ca Pyroxene ( $\text{Fs}_{1.2-29.9}\text{Wo}_{0.2-3.9}$ ,  $n=83$ ).

**Classification:** Ordinary Chondrite (LL3) due to chondrule size and magnetic susceptibility.

**Specimens:** 40 grams at *UCLA*; main mass with *Verish*.

**Crescent Valley 001 (CV 001)**       $40^{\circ}25.924'\text{N}$ ,  $116^{\circ}30.754'\text{W}$

Nevada, United States

Find: 2013 Oct 16

Classification: Ordinary chondrite (H4)

**History:** These two fragments (which were less than a meter apart) were recovered by Robert *Verish* while he was searching for meteorites at the south end of a small drylake.

**Physical characteristics:** These 1.6 and 0.87 g fragments are physically paired. There are still some small fragments missing. The orange-brown exterior has lost its fusion-crust due to weathering. A cut surface shows a brown interior with visible chondrules and metal-grains.

**Petrography:** (D. Sheikh, *FSU*) Sample contains well-defined chondrules (Av.  $500\ \mu\text{m}$ ) along with metal and troilite. Secondary Fe-oxides present as well.

**Geochemistry:** Olivine ( $\text{Fa}_{18.8\pm 0.6}$ ,  $n=14$ ), Low-Ca Pyroxene ( $\text{Fs}_{16.4\pm 0.7}\text{Wo}_{1.1\pm 0.1}$ ,  $n=12$ ).

**Classification:** Ordinary Chondrite (H4)

**Specimens:** 0.87 grams at *UCLA*; main mass with *Verish*.

**Crescent Valley 002 (CV 002)**       $40^{\circ}25.754'\text{N}$ ,  $116^{\circ}30.729'\text{W}$

Nevada, United States

Find: 2013 Oct 22

Classification: Ordinary chondrite (H4)

**History:** This nearly whole individual was recovered 315 m SSE of Crescent Valley 001 by Robert *Verish* while he was searching for meteorites at the south end of a small drylake.

**Physical characteristics:** This 6.4 g orangish-brown, rectangular, nearly whole stone has a rough exterior, which has had its fusion crust weathered-away. A cut surface reveals visible chondrules, metal-grains and many fractures filled-in with weathering-products.

**Petrography:** (D. Sheikh, *FSU*) Sample contains well-defined chondrules (Av.  $500\ \mu\text{m}$ ).

Sample is heavily weathered and contains numerous interconnected Fe-oxide veins; metal and troilite absent.

**Geochemistry:** Olivine ( $\text{Fa}_{18.6\pm 0.5}$ ,  $n=12$ ), Low-Ca Pyroxene ( $\text{Fs}_{16.9\pm 0.8}\text{Wo}_{1.1\pm 0.2}$ ,  $n=13$ ).

**Classification:** Ordinary Chondrite (H4)

**Specimens:** 1.7 grams at *UCLA*; main mass with *Verish*.

**Dhofar 2102 (Dho 2102)**       $19^{\circ}8.860'\text{N}$ ,  $54^{\circ}39.316'\text{E}$

Zufar, Oman

Find: 2010

Classification: Ordinary chondrite (L6)

**History:** The meteorite was found 2010 during a field trip in the Oman desert.

**Physical characteristics:** Three dark brownish individuals lacking any fusion crust.

**Petrography:** The plagioclase grain size is about 80  $\mu\text{m}$ .

**Dhofar 2104** (Dho 2104) 19°7.755'N, 54°36.036'E

Zufar, Oman

Find: 2009

Classification: Ordinary chondrite (H4)

**History:** The meteorite was found 2009 during a field trip in the Oman desert.

**Physical characteristics:** Dark brownish fragment with some fusion crust.

**Petrography:** The meteorite displays a chondritic texture with small, partly flattened chondrules (mean diameter about 0.3 mm) in a fine-grained dark matrix that contains sulfides and abundant FeNi metal. Olivine is equilibrated; low-Ca-pyroxene is unequilibrated.

**Dhofar 2106** (Dho 2106) 18°21.638'N, 54°10.470'E

Zufar, Oman

Find: 2010

Classification: Carbonaceous chondrite (CM2)

**History:** The meteorite was found 2010 during a field trip in the Oman desert.

**Physical characteristics:** Small black individual without fusion crust.

**Petrography:** Carbonaceous chondrite composed of small (apparent mean diameter about 250  $\mu\text{m}$ ) chondrules, chondrule pseudomorphs, mineral fragments, and rare CAIs many of which surrounded by fine-grained dust rims set into abundant fine-grained matrix. Several chondrule pseudomorphs contain fibrous phyllosilicates. Matrix is Fe-rich with abundant Fe-sulfides and rare Ca-carbonates.

**Eboliang 004** 38°12'08"N, 92°50'32"E

Qinghai, China

Find: 2016

Classification: Ordinary chondrite (L5)

**History:** (Ziyao Wang) Discovered by Peng Zhenhong about 13 km SW of the Eboliang 001 in July 2013.

**Physical characteristics:** (Ziyao Wang) dark brown fragment of 30.2 g

**Petrography:** (R. Bartoschewitz, *Bart*) strong recrystallized matrix with indistinct chondrules. Cracks are filled mainly with iron hydroxides.

**Geochemistry:** (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine

Fa<sub>24.2±0.5</sub> (n=32); pyroxene Fs<sub>20.9±1.3</sub>Wo<sub>1.7±0.2</sub> (n=9); chromite CRAL86, FFM87; pyrrhotite.

Ni=4 wt%; pentlandite. Magnetic susceptibility (R. Bartoschewitz, *Bart*)  $\log \chi$  ( $\times 10^{-9} \text{ m}^3/\text{kg}$ ) = 4.62.

**Classification:** Ordinary chondrite (L5, S4, W4)

**Specimens:** 6.9 g on deposit at *Kiel*, *Bart* holds the main mass.

**Eboliang 005** 38°26'15.05"N, 92°29'59.14"E

Qinghai, China

Find: 2018 Dec 12

Classification: Ordinary chondrite (H4)

**Petrography:** The rock is mainly composed of olivine, low-Ca pyroxene, secondary plagioclase, Fe-Ni metal and troilite. The chondrules with rims are well defined. The size of the plagioclase is mainly from 2 to 10  $\mu\text{m}$ . Besides, The Fe-Ni metal and troilite have been nearly totally weathered.

**Geochemistry:** Olivine  $\text{Fa}_{18.9-19.0}$ , N=5; Low-Ca pyroxene  $\text{Fs}_{16.6-17.5}\text{Wo}_{1.03-1.45}$ , N=5 (EPMA)

**El Hassan Ould Hamed 001** (EHOH 001) 25.229°N, 08.624°W

Tiris Zemmour, Mauritania

Find: 2019 Dec

Classification: HED achondrite (Eucrite, unbrecciated)

**History:** Found in December 2019 at a site NE of Imourene, Mauritania, and purchased a few weeks later by Mohamed Brahim Sueilem and Naji Ben Faraji from a dealer in Tindouf, Algeria.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Fresh protogranular gabbroic assemblage (grainsize up to 3.4 mm) of predominantly exsolved pigeonite and calcic plagioclase, together with accessory silica polymorph, Ti-Al-chromite, ilmenite, baddeleyite, zircon and troilite. Host low-Ca pyroxene in pyroxene grains exhibits distinctive polysynthetic twinning. Chromite and ilmenite grains occur mainly as inclusions within pyroxenes.

**Geochemistry:** Low-Ca pyroxene host ( $\text{Fs}_{57.2-59.0}\text{Wo}_{5.3-4.1}$ ,  $\text{FeO/MnO} = 29-33$ , N = 4), augite exsolution lamellae ( $\text{Fs}_{26.6-27.1}\text{Wo}_{42.5-43.4}$ ,  $\text{FeO/MnO} = 29-31$ , N = 4), plagioclase ( $\text{An}_{89.2-90.7}\text{Or}_{0.4-0.3}$ , N = 3). Oxygen isotopes (K. Ziegler, *UNM*): analyses of acid-washed subsamples by laser fluorination gave, respectively,  $\delta^{17}\text{O}$  1.652, 1.812, 1.789;  $\delta^{18}\text{O}$  3.676, 3.963, 3.944;  $\Delta^{17}\text{O}$  -0.289, -0.280, -0.293 per mil.

**Classification:** Eucrite (unbrecciated, gabbroic, protogranular).

**Specimens:** 20.3 g including one polished thin section at *UWB*; remainder with Mr. N. Ben Faraji.

**El Médano 444** (EM 444) 24°44.75'S, 70°21.49' W

Antofagasta, Chile

Find: 14 Nov. 2017

Classification: Enstatite chondrite (EL6)

**Petrography** (E. Jacquet, B. Doisneau, *MNHNP*): The meteorite shows a granular texture of enstatite (58 vol%), plagioclase (11 vol%), silica (2 vol%), with no olivine, with irregularly shaped (few 100  $\mu\text{m}$ ) grains of Fe-Ni metal (24 vol%) associated with subordinate (<1 vol%) schreibersite, troilite, daubreelite (as exsolution lamellae in the former) and rare alabandite. Some trails of micron-sized metal and sulfide occur within silicates. Locally, metal may form symplectic intergrowths with plagioclase (10s of  $\mu\text{m}$ ). Graphite grains (4 vol%), sometimes euhedral, often in sheaves showing pressure lamellae such as Fig. 4 of Ramdohr (1963), up to 1 mm occur mostly associated with the metal. Only one relict radial pyroxene chondrule was recognized in the section studied.

**Geochemistry:** Enstatite  $\text{Fs}_{0.39\pm 0.15}\text{Wo}_{1.53\pm 0.07}$  (N=16); plagioclase  $\text{An}_{16.1\pm 0.3}\text{Ab}_{80.1\pm 0.4}\text{Or}_{3.7\pm 0.4}$  (N=9); silica  $1.3\pm 0.5$  wt%  $\text{Al}_2\text{O}_3$ ,  $0.6\pm 0.3$  wt% FeO (N=9); Fe, Ni metal  $5.8\pm 0.4$  wt% Ni,  $1.1\pm 0.05$  wt% Si (N=32); troilite  $0.45\pm 0.05$  wt% Ti,  $0.87\pm 0.11$  wt% Cr (N=9).

**Classification:** Enstatite chondrite (EL6). Chondritic nature is indicated by the abundance of metal and tentative evidence of relict chondrules. The reduced mineralogy, and in particular



the presence of alabandite and the Si content of kamacite, indicates affiliation to EL, with the abundance of metal on the high end of the range. A petrographic type 6 despite the paucity of chondrules seems consistent with enstatite chondrite usage.

**Specimens:** 135 g with *MNHNP* (type specimen), 32 g at *CEREGE*.

**El Médano 463** (EM 463) 24°51'S, 70°32'W

Antofagasta, Chile

Find: 2016 Nov 04

Classification: Carbonaceous chondrite (CO3)

**Physical characteristics:** Single brown stone.

**Petrography:** (J. Gattacceca, *CEREGE*) Chondrite with well-defined chondrules (average apparent diameter ~200 µm) and small CAIs set in abundant fine-grained iron-rich matrix. Opaque minerals are mostly kamacite.

**Geochemistry:** Olivine  $Fa_{19.2\pm 14.5}$  (n=5). Low-Ca pyroxene  $Fs_{1.6\pm 0.7}$  (n=2).

**Classification:** Carbonaceous chondrite (CO3). Likely paired with [El Médano 216](#).

**El Médano 464** (EM 464) 24°51'S, 70°32'W

Antofagasta, Chile

Find: 2019 Jan 09

Classification: Carbonaceous chondrite (CO3)

**Physical characteristics:** Single brown stone.

**Petrography:** (J. Gattacceca, *CEREGE*) Chondrite with well-defined chondrules (average apparent diameter ~200 µm) and CAIs (to 500 µm) set in abundant fine-grained iron-rich matrix. Opaque minerals are mostly kamacite.

**Geochemistry:** Olivine  $Fa_{22.7\pm 12.9}$ , range  $Fa_{0.3-39.7}$ ,  $Fa$  PMD = 46% (n=8),  $Cr_2O_3$  in ferroan olivine  $0.09\pm 0.03$  wt% (n=7). Low-Ca pyroxene  $Fs_{1.6\pm 0.7}$  (n=2).

**Classification:** Carbonaceous chondrite (CO3). Likely paired with [El Médano 216](#).

**El Médano 465** (EM 465) 24°51'S, 70°32'W

Antofagasta, Chile

Find: 2019 Jan 10

Classification: Carbonaceous chondrite (CO3)

**Physical characteristics:** Single brown stone.

**Petrography:** (J. Gattacceca, *CEREGE*) Chondrite with well-defined chondrules (average apparent diameter  $200\pm 80$  µm, n=26) and CAIs (to 600 µm) set in abundant (31 vol%) fine-grained iron-rich matrix. Opaque minerals are mostly kamacite.

**Geochemistry:** Olivine  $Fa_{27.1\pm 16.5}$ , range  $Fa_{4.8-53.1}$ ,  $Fa$  PMD = 54%,  $Cr_2O_3$   $0.08\pm 0.04$  (n=25). Low-Ca pyroxene  $Fs_{1.5\pm 0.1}Wo_{1.5\pm 0.8}$  (n=7). Ca-pyroxene  $Fs_{33.1}Wo_{51.0}$  (n=1).

**Classification:** Carbonaceous chondrite (CO3). Likely paired with [El Médano 216](#).

**Erenhot** ~43°40'N, ~112° 0'E

Nei Mongol, China

Find: 2018

Classification: Ordinary chondrite (H~6)

**History:** (Ziyao Wang) Guijun Miao discovered this meteorite among many terrestrial rocks and archaeological objects on a sales table of a stone merchant in Erenhot in Aug. 2018. The

1  
2  
3 merchant did not remember where he found that stone exactly, but he collected it in the  
4 steppe, southeast of Erenhot.

5 **Physical characteristics:** (Ziyao Wang) brown stone of 117.9 g without fusion crust

6 **Petrography:** (R. Bartoschewitz, *Bart*) dark gray, recrystallized, porous matrix with indistinct  
7 chondrules, little metal and sulfide.

8 **Geochemistry:** Magnetic susceptibility (R. Bartoschewitz, *Bart*)  $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.90$

9 **Classification:** Ordinary chondrite (H-6, W3)

10 **Specimens:** 21.1 g on deposit at *Kiel*, Ziyao Wang and Guijun Miao holds the main mass, and  
11 17 g with *Bart*.  
12  
13  
14

15  
16 **Erenhot 002** 43°26'44"N, 111°57'9"E

17 Nei Mongol, China

18 Find: 2019 Apr 12

19 Classification: Ordinary chondrite (L5)

20 **Petrography:** The rock is mainly composed of olivine, low-Ca pyroxene, secondary  
21 plagioclase, Fe-Ni metal, and troilite. Chondrules with poorly defined rims are present.  
22 Chondrules are mainly PP, PO, POP, and BO. The size of the plagioclase is mainly from 2 to  
23 50  $\mu\text{m}$ .  
24

25 **Geochemistry:** Olivine  $\text{Fa}_{24.4-25.7}$ , N=5; Low-Ca pyroxene  $\text{Fs}_{20.7-22.5}\text{Wo}_{1.13-1.81}$ , N=5 (EPMA)  
26  
27

28  
29 **Erg Chech 002 (EC 002)** 26.032°N, 1.611°W

30 Adrar, Algeria

31 Find: 2020 May

32 Classification: Ungrouped achondrite

33 **History:** Numerous stones containing distinctive large greenish crystals were found in May  
34 2020 near Bir Ben Takoul, southern Algeria, within the Erg Chech sand sea. Three of these  
35 stones (weighing 1839, 467, and 207 g) were obtained by Rachid Chaoui, and two of them  
36 were subsequently purchased by Mark Lyon and one by Jason Utas. Additional stones (110,  
37 178, 355, 360, 408, 480, 550, 587, 750, 805, 855, 1071, 1175, 1417, 1857, 2647, 3485, 3910,  
38 4130, and 4140 g) were purchased in June and July 2020 from different Moroccan dealers by  
39 Ben Hoefnagels, Eric Twelker, Luc Labenne, Darryl Pitt, Vincent Jacques, Ziyao Wang,  
40 Marcin Cimała, Adam Aaronson, Michael Farmer and Aziz Habibi.  
41

42 **Physical characteristics:** The stones under classification (combined weight 31.783 kg) lack  
43 fusion crust, and have an overall relatively coarse grained, tan and beige appearance with  
44 sporadic larger green, yellow-green and less commonly yellow-brown crystals (up to 9 cm by  
45 4 cm in some specimens). Some minor reddish-brown staining is evident in the groundmass  
46 regions. This classification is based on direct analysis of samples from the 1839 g stone  
47 augmented by examination of photographs and descriptions of other stones found with them.  
48

49 **Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Unbrecciated igneous texture.  
50 Sporadic pyroxene megacrysts (ranging in size from 1.7 to 11.5 mm in the studied thin  
51 section), exhibiting angular or ellipsoidal and embayed shapes, and comprising orthopyroxene  
52 (of varying composition), pigeonite and augite occur within a dominant, medium to relatively  
53 coarse grained groundmass. The cores of each of the analyzed megacrysts are fairly  
54 homogeneous in composition, but all are mantled by zones of different composition and  
55 distinct, fine grained rim overgrowths against the groundmass parallel to grain outlines  
56 (irrespective of geometry). Some low-Ca pyroxene cores contain thin lamellae and some  
57 larger inclusions (up to 300  $\mu\text{m}$ ) of Ti-poor chromite. The groundmass representing the major  
58 portion of the specimens (mean grain size  $\sim 1.5 \text{ mm}$ ) is composed predominantly of exsolved  
59  
60

pigeonite (commonly as radiating clusters of prismatic grains) and lath-like sodic plagioclase (zoned from irregular oligoclase cores to albitic rims with oriented dagger-like K-feldspar exsolution blades) together with accessory Ti-chromite, ilmenite (some as rims on chromite), troilite, silica polymorph (with a curved "fish-scale" fracture pattern suggestive of cristobalite), merrillite, and rare Ni-poor metal (in composite grain clusters with ilmenite, Ti-chromite and troilite). Secondary weathering products include minor goethite after primary troilite and metal, and sporadic very thin veinlets of calcite.

**Geochemistry:** Orthopyroxene megacryst #1 (core  $\text{Fs}_{17.7}\text{Wo}_{3.3}$ ; mantle  $\text{Fs}_{23.4-31.1}\text{Wo}_{3.4-3.8}$ ; rim  $\text{Fs}_{37.6-42.5}\text{Wo}_{2.9-3.3}$ ;  $\text{FeO/MnO} = 21-26$ ,  $\text{Cr}_2\text{O}_3 = 0.3-0.5$  wt.%;  $N = 6$ ), orthopyroxene megacryst #2 (core  $\text{Fs}_{14.4\pm 0.0}\text{Wo}_{2.2-2.3}$ ; mantle  $\text{Fs}_{19.2-28.7}\text{Wo}_{2.0-2.1}$ ; rim  $\text{Fs}_{33.1-36.8}\text{Wo}_{2.8-3.5}$ ;  $\text{FeO/MnO} = 17-26$ ;  $\text{Cr}_2\text{O}_3 = 0.3-1.0$  wt.%;  $N = 7$ ), orthopyroxene megacryst #3 (core  $\text{Fs}_{22.8}\text{Wo}_{1.2}$ ; mantle  $\text{Fs}_{30.8}\text{Wo}_{2.2}$ ; rim  $\text{Fs}_{43.5}\text{Wo}_{2.5}$ ;  $\text{FeO/MnO} = 16-23$ ;  $\text{Cr}_2\text{O}_3 = 0.2-0.4$  wt.%;  $N = 3$ ), pigeonite megacryst (core  $\text{Fs}_{21.3}\text{Wo}_{7.0}$ ; mantle  $\text{Fs}_{23.4}\text{Wo}_{11.8}$ ; rim  $\text{Fs}_{40.7}\text{Wo}_{5.0}$ ;  $\text{FeO/MnO} = 17-20$ ;  $\text{Cr}_2\text{O}_3 = 0.3-0.8$  wt.%;  $N = 3$ ), augite megacryst (core  $\text{Fs}_{14.7-19.4}\text{Wo}_{38.5-30.2}$ ; rim  $\text{Fs}_{24.7}\text{Wo}_{38.1}$ ;  $\text{FeO/MnO} = 15-18$ ;  $\text{Cr}_2\text{O}_3 = 1.1$  wt.%;  $N = 4$ ), groundmass exsolved pigeonite (low-Ca pyroxene host  $\text{Fs}_{42.3-52.2}\text{Wo}_{2.9-4.6}$ ,  $\text{FeO/MnO} = 21-23$ ,  $N = 6$ ; augite exsolution lamellae  $\text{Fs}_{18.1-25.9}\text{Wo}_{40.8-38.1}$ ,  $\text{FeO/MnO} = 18-22$ ,  $N = 5$ ), groundmass plagioclase (oligoclase cores and intergrown with pyroxene megacrysts  $\text{Ab}_{68.8-79.0}\text{An}_{26.7-17.9}\text{Or}_{4.4-2.6}$ ,  $N = 6$ ; albitic rims on laths  $\text{Ab}_{84.4-86.7}\text{An}_{11.4-7.1}\text{Or}_{4.2-7.0}$ ,  $N = 5$ ), K-feldspar exsolution blade in albite ( $\text{Or}_{84.1}\text{Ab}_{11.3}\text{An}_{4.6}$ ), Fe metal ( $\text{Ni} = 0.13-0.18$  wt.%,  $N = 2$ ). Oxygen isotopes (K. Ziegler, *UNM*): analyses of acid-washed subsamples of groundmass and an orthopyroxene megacryst by laser fluorination gave, respectively: groundmass  $\delta^{17}\text{O}$  1.548, 1.788, 1.831, 1.773;  $\delta^{18}\text{O}$  3.201, 3.657, 3.728, 3.593;  $\Delta^{17}\text{O}$  -0.142, -0.143, -0.137, -0.123 (linearized, all per mil, TFL slope = 0.528); megacryst  $\delta^{17}\text{O}$  1.780, 1.639, 1.682;  $\delta^{18}\text{O}$  3.594, 3.329, 3.379;  $\Delta^{17}\text{O}$  -0.117, -0.119, -0.103 (linearized, all per mil, TFL slope = 0.528). Magnetic susceptibility  $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 3.06$ .

**Classification:** Achondrite (ungrouped, gabbroic with pyroxene megacrysts, sodic). Although the exsolved pigeonite in this meteorite is reminiscent of pyroxene in typical eucrites (with the notable exception of systematically much lower  $\text{FeO/MnO}$  ratios), the highly sodic and mildly potassic plagioclase is very different from the much more calcic plagioclase in eucrites (typically bytownite to anorthite, and only rarely as sodic as calcic labradorite  $\text{Ab}_{33}\text{An}_{67}$ ). The cores of orthopyroxene megacrysts differ from typical diagenetic orthopyroxene in usually being more magnesian, more Cr-rich and having lower  $\text{FeO/MnO}$  ratios. Oxygen isotopes ( $\Delta^{17}\text{O}$  values) plot between the field for the majority of eucrites and the trend for angrites, in the vicinity of values for anomalous eucrites [Bunburra Rockhole](#), [Emmaville](#), [Asuka 881394](#) and [EET 92023](#). However, Erg Chech 002 is mineralogically quite different from those four meteorites in many respects, most notably the prevalence of highly sodic plagioclase and lower  $\text{FeO/MnO}$  ratios in pyroxenes.

**Specimens:** 50.1 g including one polished thin section and one polished mount at *UWB*; main mass of the 1839 g stone and the 207 g stone with Mr. M. Lyon; 467 g stone with Mr. J. Utas; 110 g stone with Mr. E. Twelker; 4140 g stone, 355 g stone and main mass of 408 g stone with Mr. B. Hoefnagels; 480 g stone with Mr. L. Labenne; 587 g, 855 g, 1071 g and 1417 g stones with *DPitt*; 550 g stone with Mr. M. Cimala; 4130 g stone with Mr. V. Jacques; 805 g stone with Mr. Ziyao Wang; 1857 g stone with Mr. S. Jurvetson; 2647 g stone with Mr. T. Boudreaux; 1175 g and 3485 g stones with Farmer; 178 g and 360 g stones with *Aaronson*; 3910 g stone at MMGM; 750 g with Mr. A. Habibi; 892 g with Matthew Stream.

**Errachidia 003**      32°02.250'N, 4°03.733'W  
Centre-South, Morocco



Purchased: 2020 Mar

Classification: Primitive achondrite (Winonaite)

**Petrography:** (J. Gattacceca, *CEREGE*) Highly recrystallized crystalline rock with triple junctions. Main mineral are olivine (~250  $\mu\text{m}$ ), low-Ca pyroxene (~250  $\mu\text{m}$ ), plagioclase (~200  $\mu\text{m}$ ), and less abundant Ca-pyroxene (~100  $\mu\text{m}$ ). Other minerals: troilite, kamacite, rare chromite.

**Geochemistry:** Olivine  $\text{Fa}_{1.2\pm 0.2}$ ,  $\text{FeO/MnO} = 6.2$  (n=3). Pyroxenes: orthopyroxene  $\text{Fs}_{4.7}\text{Wo}_{2.2}$  (n=2), Ca-pyroxene  $\text{Fs}_{1.9}\text{Wo}_{45.1}$  (n=1),  $\text{FeO/MnO} = 4.0$  (n=3). Plagioclase  $\text{An}_{10.1}\text{Ab}_{85.6}\text{Or}_{4.3}$  (n=2).

**Classification:** Primitive achondrite (winonaite)

**Flensburg** 54°45.6873' N, 9°22.7353' E

Schleswig-Holstein, Germany

Confirmed fall: 2019 Sept 12

Classification: Carbonaceous chondrite (C1, ungrouped)

**History:** (D. Heinlein): The bolide was observed on September 12, 2019, at 12:49:48 (UT) by hundreds of eye-witnesses from the Netherlands, Germany, Belgium, Denmark, and the UK. The daylight fireball was registered by an all-sky meteor camera from Herford, Germany, and there are several casual videos recordings (dash and security cams) from the Netherlands and Germany. One day later, on the 13 September, a small meteorite fragment resulting from this event was found by accident by Mr. Erik Due-Hansen on the lawn of his front yard in Flensburg.

**Physical characteristics:** (D. Heinlein): A meteorite with a total mass of 24.5 g (roughly 3.7  $\times$  3.5 cm in size) was recovered one day after the fireball event. The rock has a very fresh black fusion crust showing contraction cracks and a thin layer of brownish secondary fusion crust on several patches where the primary crust has been broken off. The meteorite has a bulk density of 1.984 g/cm<sup>3</sup>.

**Petrography:** (M. Patzek and A. Bischoff, *IffP*): Rounded to ellipsoidal relict chondrules (0.05 to ~1 mm in apparent diameter) and clusters of sulfide and magnetite grains are set in a dark, fine-grained matrix. The most abundant phases are different phyllosilicates and S-bearing phase(s) (probably tochilinite). The relict chondrules are free of any anhydrous silicates (such as olivine and pyroxene), contain abundant phyllosilicates and carbonates, and are often surrounded by sulfide laths. Troilite, pyrrhotite, and pentlandite were identified as sulfides. Carbonates occur as calcites, Mn-bearing dolomites, and a Na-rich phase. The mean apparent size of altered chondrules is ~150  $\mu\text{m}$ .

**Geochemistry:** (M. Patzek and A. Bischoff, *IffP*): No olivine and pyroxene could be identified and analyzed. Defocused beam microprobe analyses (n = 135) revealed a bulk composition (in wt%) of: O: 32.0; Na: 0.29; Mg: 10.7; Al: 1.04; Si: 11.7; K: 0.04; P: 0.12; S: 2.04; Ca: 1.15; Fe: 16.0; Co: 0.03; Ti: 0.05; Cr: 0.25; Mn: 0.15; Ni: 0.85; Total: 76.3. O-isotopes (A. Pack; *UGött*): The oxygen isotope compositions of three analyzed fragments of Flensburg are:  $\delta^{17}\text{O} = 0.0806; -0.73023; -0.57844$  ‰ and  $\delta^{18}\text{O} = 5.3032; 3.0272; 3.2993$  ‰,  $\Delta^{17}\text{O} = -2.677; -2.304; -2.294$  ‰ (relative to a reference line with a slope of 0.5305). The data are within the <sup>16</sup>O-rich part of the field for CM chondrites.

**Classification:** Carbonaceous chondrite (C1-ung, W0). This meteorite is distinct from CM chondrites for the following reasons: chondrule apparent size (150  $\mu\text{m}$ ) is significantly different from that in CM chondrites (~270  $\mu\text{m}$ ), an heavily-altered CM would have a  $\delta^{18}\text{O}$ -rich composition compared to CM2 chondrites, Zn abundance (150 ppm) is too low for a CM (200 ppm without significant variations).

**Specimens:** Type specimen and PTS at *IffP*; the main mass is also at *IffP*.

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6 **Foum Agoutir** 27° 51.052'N, 12° 9.670'W

7 South, Morocco

8 Find: 2017 Apr 03

9 Classification: Ordinary chondrite (L4)

10 **History:** A single stone was found in April 2017 by Hassan Oubaha about 27 km SSE of  
11 Akhfennir, near Oued Khaoui Naam, Morocco

12 **Petrography:** (J. Gattacceca, *CEREGE*) Chondrite with well-defined packed chondrules.  
13 Olivine are zoned compositionally. Opaques are metal and troilite.

14 **Specimens:** Type specimen at *CEREGE*. Main mass with *Kuntz*.  
15  
16  
17

18 **Gadamis 001** 30.203°N, 9.535°E

19 Ghadamis, Libya

20 Purchased: 2019 May

21 Classification: Martian meteorite (Shergottite)

22 **History:** Found by Bedouins about 8.5 km north of Gadamis, Libya, in April 2019, and  
23 purchased shortly thereafter by Aziz Habibi.

24 **Physical characteristics:** The specimen was found as three larger pieces which fit together to  
25 make an almost complete stone plus some additional fragments (total weight 7000 g). The  
26 very fresh larger specimens exhibit primary and secondary, black to reddish-brown fusion  
27 crusts.  
28

29 **Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Very fresh specimen with diabasic  
30 texture. Composed predominantly of zoned, prismatic clinopyroxene and lath-like  
31 maskelynite (some as thin, curved grains in sheaf-like bundles) together with accessory  
32 merrillite, apatite, silica polymorph, titanomagnetite, ilmenite and pyrrhotite. Some pockets of  
33 deep brown quenched, glassy shock-melt are present.

34 **Geochemistry:** Subcalcic augite cores ( $\text{Fs}_{23.4-23.7}\text{Wo}_{32.3-30.4}$ ,  $\text{FeO/MnO} = 27-28$ ,  $N = 2$ ), augite  
35 ( $\text{Fs}_{19.5}\text{Wo}_{39.8}$ ,  $\text{FeO/MnO} = 31$ ), ferropigeonite rims ( $\text{Fs}_{67.0-77.9}\text{Wo}_{20.9-16.2}$ ,  $\text{FeO/MnO} = 39-43$ ,  $N$   
36  $= 3$ ), maskelynite ( $\text{An}_{54.2}\text{Or}_{0.8}$ ).  
37

38 **Classification:** Shergottite (diabasic).  
39

40 **Specimens:** 20.1 g including one polished thin section at *UWB*; remainder with A. Habibi.  
41  
42

43 **Gandom Beryan 012** 31°52.223'N, 57°08.846'E

44 Kerman, Iran

45 Find: 3 Jan 2017

46 Classification: Ordinary chondrite (H5)

47 **History:** The meteorite was found 3 January 2017 by the *UrFU* meteorite expedition-2017 in  
48 Iran (Pastukhovich A. Yu., Larionov M. Yu., Kruglikov N. A., Zamyatin D. A.) in the northern  
49 sandy part of the Lut desert.  
50

51 **Physical characteristics:** A dark-brown fragment with angular shape. The surface and  
52 interior of the meteorite is light to dark brown in color due to abundant Fe-hydroxides. Some  
53 parts have glassy-like surface due to desert weathering. No fusion crust was observed.

54 **Petrography:** Classification (K. Dugushkina, *RAS-UB*). Chondrite with recrystallized texture.  
55 Predominantly porphyritic olivine (PO) and porphyritic olivine-pyroxene (POP) chondrules.  
56 Weathering grade is W3, heavy oxidation of metal and troilite. There is a network of thin  
57 metal-troilite shock veins in fractures in olivine, pyroxene and plagioclase. Plagioclase is not  
58 melted. Shock stage is S3/4.  
59  
60

**Geochemistry:** EDX analyses by K. Dugushkina, *RAS-UB*. The chondrite paragenesis includes olivine  $Fa_{16.9\pm 1.9}$  (N=33), orthopyroxene  $En_{84.7\pm 0.8}Fs_{14.2\pm 0.7}Wo_{1.1\pm 0.2}$  (N=17), clinopyroxene  $En_{44.7\pm 1.1}Fs_{6.7\pm 0.7}Wo_{44.7\pm 1.1}$  (N=4), plagioclase  $An_{23.3\pm 1.5}$  (N=8), chromite, apatite, troilite, taenite and kamacite. The average composition of chromite (N=5):  $Cr_2O_3$  57.4±0.3 wt%, FeO 27.3±0.3 wt%, MgO 4.6±0.3 wt%,  $Al_2O_3$  7.4±0.6 wt%,  $TiO_2$  1.7±0.3 wt%,  $SiO_2$  0.7±0.3 wt%, NiO 0.1±0.04 wt%.

**Classification:** (K. Dugushkina, *RAS-UB*) H5, ordinary chondrite.

**Specimens:** 293 g sample and 4.19 g cut-off and thin section *UrFU*

**Gandom Beryan 013** 31°54.296'N, 57°02.350'E

Kerman, Iran

Find: 3 Jan 2017

Classification: Ordinary chondrite (H4)

**History:** Four fragments (65.68, 7.06, 3.14, and 2.87 g) were found found 3 January 2017 by the *UrFU* meteorite expedition-2017 in Iran (Pastukhovich A.Yu., Larionov M.Yu., Kruglikov N.A., Zamyatin D.A.) in the northern sandy part of the Lut desert.

**Physical characteristics:** All fragments have angular to roughly rounded shape. The surface and interior of the meteorite is light to dark brown in color due to abundant Fe-hydroxides. Some parts have glassy-like surface due to desert weathering. No fusion crust was observed.

**Petrography:** Classification (K. Dugushkina, *RAS-UB*). Chondrite with fine-grained, recrystallized matrix. Predominantly porphyritic olivine (PO) and porphyritic olivine-pyroxene (POP) chondrules. Chondrules have clear boundaries. Heavy oxidation of metal and troilite, 60-95% being replaced (W3). There is a network of thin metal-troilite shock veins in fractures in olivine, pyroxene and plagioclase. Shock stage is S3.

**Geochemistry:** EDX analyses by K. Dugushkina, *RAS-UB*. The chondrite paragenesis includes olivine  $Fa_{17.8\pm 1.0}$  (N=34), orthopyroxene  $En_{83.9\pm 0.9}Fs_{15.0\pm 0.8}Wo_{1.1\pm 0.3}$  (N=14), clinopyroxene  $En_{45.6\pm 0.5}Fs_{5.4\pm 0.8}Wo_{49.0\pm 0.9}$ , plagioclase, chromite (average composition (N=5):  $Cr_2O_3$  55.0±1.9 wt%, FeO 31.7±2.1 wt%, MgO 2.7±0.2 wt%,  $Al_2O_3$  6.8±0.4 wt%,  $TiO_2$  1.6±0.2 wt%,  $SiO_2$  0.6±0.1 wt%, NiO 0.3±0.2 wt%), troilite, FeNi-metal, apatite and merrillite ( $SiO_2$  1,38 wt%, FeO 2,74 wt%, MgO 3,92 wt%, CaO 45,38 wt%,  $Na_2O$  2,69 wt%,  $P_2O_5$  42,92 wt%).

**Classification:** (K. Dugushkina, *RAS-UB*) H4, ordinary chondrite.

**Specimens:** 71.69 g (4 samples) and 6.30 g cut-off and thin section, *UrFU*

**Ganq 004** 37°35'29.80"N, 92°17'38.48"E

Qinghai, China

Find: 22. June 2014

Classification: Ordinary chondrite (L~5)

**History:** (Ziyao Wang) Five dark-brown rocks were discovered by Liu Bingham (Haixi/Qinghai) within 400 m during field work in the desert about 150 km SE of Huangtouzhen, Haixi Mongolian and Tibetan Autonomous Prefecture, Qinghai province on June 15 and 22, 2014.

**Physical characteristics:** Five dark brown rock fragments of 1953, 765, 579, 489, and 117 g

**Petrography:** (R. Bartoschewitz, *Bart*) gray recrystallized matrix with well-defined chondrules (0.4 - 4 mm, av. 0.8 mm) and irregular metal and sulfide inclusions up to 3 mm (lager often intergrown).

**Geochemistry:** Magnetic susceptibility (R. Bartoschewitz, *Bart*)  $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.99-5.09$

1  
2  
3 **Classification:** Ordinary chondrite (L~5, W1)

4 **Specimens:** 21.1 g on deposit at *Kiel*, Liu Binghan (Haixi/Qinghai) holds the main mass, and  
5 181 g with *Bart*.  
6  
7

8  
9 **Ganq 005** 37°35'32.88"N, 92°17'53.90"E

10 Qinghai, China

11 Find: 22. June 2014

12 Classification: Ordinary chondrite (L~5)

13 **History:** (Ziyao Wang) Discovered by Liu Binghan (Haixi/Qinghai) during field work in the  
14 desert about 150 km SE of Huangtouzhen, Haixi Mongolian and Tibetan Autonomous  
15 Prefecture, Qinghai province on June 15, 2014.

16 **Physical characteristics:** Dark brown fragment of 1184 g

17 **Petrography:** (R. Bartoschewitz, *Bart*) gray recrystallized matrix with well-defined  
18 chondrules (0.4 - 2 mm, av. 0.8 mm) and irregular metal and sulfide inclusions up to 3 mm  
19 (often intergrown).  
20

21 **Geochemistry:** Magnetic susceptibility (R. Bartoschewitz, *Bart*)  $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.95$

22 **Classification:** Ordinary chondrite (L~5, W1)

23 **Specimens:** 21.0 g on deposit at *Kiel*, Liu Binghan (Haixi/Qinghai) holds the main mass, and  
24 15 g with *Bart*.  
25  
26  
27

28 **Ganq 006** ~37°35'30"N, ~92°17'30"E

29 Qinghai, China

30 Find: June 2014

31 Classification: Ordinary chondrite (L~5)

32 **History:** (Ziyao Wang) Discovered by Liu Binghan (Haixi/Qinghai) during field work in the  
33 desert about 150 km SE of Huangtouzhen, Haixi Mongolian and Tibetan Autonomous  
34 Prefecture, Qinghai province on June 22, 2014.

35 **Physical characteristics:** Dark brown fragment of 125.8 g

36 **Petrography:** (R. Bartoschewitz, *Bart*) gray recrystallized matrix with well-defined  
37 chondrules (0.4 - 3 mm, av. 0.8 mm) and irregular metal and sulfide inclusions up to 3 mm  
38 (often intergrown).  
39

40 **Geochemistry:** Magnetic susceptibility (R. Bartoschewitz, *Bart*)  $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.88$

41 **Classification:** Ordinary chondrite (L~5, W1)

42 **Specimens:** 20.4 g on deposit at *Kiel*, main mass of 96.3 g with *Bart*.  
43  
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47 **Ganq 007** ~37°35'30"N, ~92°17'40"E

48 Qinghai, China

49 Find: June 2014

50 Classification: Ordinary chondrite (L~6)

51 **History:** (Ziyao Wang) Discovered by Liu Binghan (Haixi/Qinghai) during field work in the  
52 desert about 150 km SE of Huangtouzhen, Haixi Mongolian and Tibetan Autonomous  
53 Prefecture, Qinghai province in June 2014.

54 **Physical characteristics:** Dark brown fragment of 150 g

55 **Petrography:** (R. Bartoschewitz, *Bart*) gray recrystallized matrix with well-defined  
56 chondrules (0.4 - 3 mm, av. 0.8 mm) and irregular metal and sulfide inclusions up to 3 mm  
57 (often intergrown).  
58

59 **Geochemistry:** Magnetic susceptibility (R. Bartoschewitz, *Bart*)  $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.75$   
60

**Classification:** Ordinary chondrite (L~6, W1)

**Specimens:** 20.4 g on deposit at *Kiel*, Liu Binghan (Haixi/Qinghai) holds the main mass, and 4 g with *Bart*.

**Gatuto** 0° 34' 12"S, 37° 17' 24"E

Central, Kenya

Confirmed fall: 2020

Classification: Ordinary chondrite (L6)

**History:** (per J. Higgins and M. Farmer) At about 8:27 pm on the evening of April 24, 2020, several witnesses near the village of Gatuto, Kenya, saw a bright trail in the sky, and about 5 minutes later heard three detonations followed by another longer sound ending with a bang. One of the witnesses to these phenomena, Mr. Josphat Gakere, was outside his house near Gatuto road when he and his family saw the fireball and heard detonations. Moments later he witnessed the impact of an object 15 m away, and discovered a 1 m deep hole in his maize garden. The following morning, an intact 6140 g fusion-crust stone was excavated from the hole. Mrs. Mary Wamburu was preparing supper in her house near the village of Kombuini (between Kagio and Kutus) when she heard a noise on the corrugated metal roof. She looked into the next room and saw a hole in the roof and shattered rock on the concrete floor. Further investigations led by Mr. Mahamed Nur Ogle resulted in the recovery of a 2290 g stone, excavated next to a tree with bark shredded at a high angle to the ground on the farm adjacent to Mr. Gakere's farm, as well as a 1 kg stone next to the Kerugoya-Kaguma road near the nearby village of Kimicha, an additional 494.4 g of fragments from other farms, and 117.7 g of fragments which had impacted and made white marks on the Kagio-Kutus road near Kimicha. Another >8 kg stone was excavated from its impact hole behind a man's home located 2.2 km NNW of Gatuto; although people struck the stone with a hammer and removed some fragments, a ~7.4 kg intact piece remained. Soon after the fall event John Higgins in collaboration with Mahamad Nur Ogle acquired a total of 10.122 kg of material, and independently Michael Farmer obtained a total of 9.3 kg of material.

**Physical characteristics:** The total weight of recovered material is estimated to be ~25 kg. The most complete stones are largely coated by black fusion crust. Their interiors and the broken fragments are light gray in color with a crystalline ("sugary") appearance and visible fresh metal grains. Some stones exhibit rare very thin, black shock veinlets.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Very sparse chondrules and partial chondrules occur within a recrystallized, locally poikiloblastic matrix containing unaltered kamacite, taenite, chromite, troilite and chlorapatite. A single 5 mm fine-grained type 7 clast exhibiting complete recrystallization and triple grain junction texture is present in the studied thin section.

**Geochemistry:** Olivine ( $\text{Fa}_{24.8\pm 0.1}$ , range  $\text{Fa}_{24.7-25.0}$ ,  $N = 5$ ), low-Ca pyroxene ( $\text{Fs}_{21.0\pm 0.2}\text{Wo}_{1.6\pm 0.1}$ , range  $\text{Fs}_{20.7-21.2}\text{Wo}_{1.4-1.8}$ ,  $N = 5$ ), augite ( $\text{Fs}_{8.2\pm 0.2}\text{Wo}_{44.5\pm 0.3}$ , range  $\text{Fs}_{8.1-8.4}\text{Wo}_{44.3-44.9}$ ,  $N = 3$ ), plagioclase ( $\text{Ab}_{84.0\pm 0.7}\text{An}_{10.2\pm 0.4}\text{Or}_{5.7\pm 0.4}$ , range  $\text{Ab}_{83.3-84.6}\text{An}_{10.5-9.8}\text{Or}_{6.2-5.4}$ ,  $N = 3$ ), chromite ( $\text{Cr}_{1.56}\text{Fe}_{0.91}\text{Al}_{0.24}\text{Mg}_{0.12}\text{Ti}_{0.08}$ ). Magnetic susceptibility  $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.71$ .

**Classification:** Ordinary chondrite (L6).

**Specimens:** 27.5 g including one polished thin section and one polished mount at *UWB*; 62 g at *ASU*; 10.1 kg including 6140 g main mass with Mr. J. Higgins; 9.3 kg with Farmer.

**Ghadduwah 001** 26.803056, 13.535278

Awbari, Libya



Find: 2020 Jan 7

Classification: Lunar meteorite (anorth)

**History:** This stone was found by vacationers on January 7, 2020, near Lake Gaberoun, Libya.

**Physical characteristics:** Single stone covered in pale-green, glassy fusion crust; oriented shape with a broad rollover lip. One side of the stone is broken and the interior is exposed, however this is not recent fracture as the surface is slightly weathered and smoothed. A freshly fractured surface shows a sugary, shiny texture of white to light gray grains.

**Petrography:** (C. Agee, *UNM*) Microprobe and SEM reveals an anorthitic plagioclase host without visible grain boundaries making up ~92% of this meteorite. Poikilolitically enclosed in the plagioclase are olivine and pyroxene grains, most in the size range 100-300  $\mu\text{m}$ , making up a total of ~7% of this meteorite. Olivine grains are very homogeneous, some with resorbed rims. Pyroxene grains have exsolution lamellae with coarser bands of low-Ca pyroxene and finer bands of augite. Accessory chromite was observed throughout. Fusion crust is ~75  $\mu\text{m}$  thick.

**Geochemistry:** (C. Agee, *UNM*) Plagioclase  $\text{An}_{98.1\pm 0.8}\text{Ab}_{1.8\pm 0.3}\text{Or}_{0.0\pm 0.0}$ ,  $n=4$ ; pyroxene  $\text{Fs}_{30.5\pm 6.2}\text{Wo}_{12.7\pm 11.4}$ ,  $\text{Fe}/\text{Mn}=52\pm 8$ ,  $n=9$ ; olivine  $\text{Fa}_{40.9\pm 0.3}$ ,  $\text{Fe}/\text{Mn}=88\pm 3$ ,  $n=6$ ; fusion crust  $\text{SiO}_2=43.1\pm 0.2$ ,  $\text{Al}_2\text{O}_3=31.0\pm 0.1$ ,  $\text{FeO}=3.7\pm 0.2$ ,  $\text{MgO}=3.3\pm 0.1$ ,  $\text{MnO}=0.05\pm 0.03$ ,  $\text{CaO}=17.0\pm 0.1$ ,  $\text{Na}_2\text{O}=0.19\pm 0.02$  all wt%,  $n=5$ . Oxygen isotopes (K. Ziegler, *UNM*): 3 acid-washed fragments analyzed by laser fluorination gave  $\delta^{18}\text{O}=5.810, 6.152, 5.852$ ;  $\delta^{17}\text{O}=3.038, 3.198, 3.042$ ;  $\Delta^{17}\text{O}=-0.029, -0.050, -0.047$  (linearized, all per mil, TFL slope=0.528).

**Classification:** Lunar ferroan anorthosite, unbrecciated. Olivine, pyroxene and plagioclase compositional values plot within the FAN suite field (after Warren, 1993).

**Specimens:** 20.6 g on deposit at *UNM*, Abdelhadi Aithiba holds the main mass.

**Golden Gate Mountain** 32°08.999'N, 111°06.817'W

Arizona, USA

Find: 2011 May 1

Classification: Ordinary chondrite (H4)

**History:** Ingrid "Twink" Monrad found the meteorite on May 1, 2011, while she was meteorite hunting in the area where the [Cat Mountain](#) meteorite was found. The stone was found on top of the sand in a little dry streambed and was attracted to a magnet.

**Physical characteristics:** The 16.7 g complete stone is approximately 1.5  $\times$  2.5  $\times$  1.25 cm. It exhibits patchy, remnant fusion crust along with desert varnish in some places. The exposed meteorite displays a caramel color that is in contrast to the black and brown-stained interior cut face. Deep fractures penetrate the entire rock, some containing thin deposits of caliche. Numerous well-delineated chondrules are visible in the hand specimen.

**Petrography:** (K. Domanik and D. Hill, *UAz*) Microprobe examination of a polished mount shows numerous distinct, round to irregularly shaped chondrules that range from 50 to 1300  $\mu\text{m}$  in size. Most chondrules are less than 100  $\mu\text{m}$  in diameter. POP, PO, and PP chondrules predominate with a few RP and BO also present. 10 to 50  $\mu\text{m}$  plagioclase patches occur almost exclusively within chondrules and typically contain abundant, small, quench crystals of clinopyroxene. The matrix consists of smaller chondrule fragments. Numerous veins and grains of highly oxidized (weathered) metal and troilite form complex networks. Minor amounts of chromite, merrillite, and chlorapatite are also present.

**Geochemistry:** Mineral compositions and geochemistry: (K. Domanik, *UAz*) EMPA: Olivine  $\text{Fa}_{18.1\pm 0.2}$ ,  $\text{Fe}/\text{Mn}=36.1\pm 2.1$ , ( $N=57$ ); low-Ca pyroxene  $\text{Fs}_{16.0\pm 0.2}\text{Wo}_{1.1\pm 0.4}$ ,  $\text{Fe}/\text{Mn}=22.4\pm 3.1$ , ( $N=31$ ); plagioclase  $\text{An}_{10.9\pm 4.7}\text{Ab}_{83.8\pm 3.5}\text{Or}_{5.3\pm 1.4}$ , ( $N=6$ ); kamacite  $\text{Fe}=92.9\pm 0.4$ ,  $\text{Ni}=6.5\pm 0.1$ ,  $\text{Co}=0.66\pm 0.04$  (all in wt%), ( $N=6$ ).



**Classification:** H4 (severe weathering)

**Specimens:** 13 g main mass, Ingrid "Twink" Monrad; 3.7 g *UAz*

**Gömüce** 36°23'18.3"N , 29°44'08.6"E

Antalya, Turkey

Find: 2018 Nov 20

Classification: Ordinary chondrite (L6)

**History:** The meteorite was found by Mr. Mehmet Güngör near the village of Gömüce, Turkey, when he was working in the field on 20 November 2018. In 2019, a friend of him, Mr. Erdal Karakehya, suspected that it might be a meteorite, and provided the type specimen. The main mass remains with Mr. Mehmet Güngör.

**Petrography:** Recrystallized chondrite containing indistinct chondrules in a coarsely crystalline matrix. Chondrule margins are difficult to discern. Highly weathered sample with abundant oxidation.

**Gonggar** 29°20'25.91"N, 91°4'57.12"E

Xizang, China

Find: 2017 Jul 12

Classification: Ordinary chondrite (L5)

**History:** Found on the bank of the Yaluzangbu River, Gonggar country, Xizang province. The meteorite was found by meteorite collector Deshi Wu and his friends.

**Petrography:** The rock is mainly composed of olivine, low-Ca pyroxene, secondary plagioclase, Fe-Ni metal, and troilite. Chondrules with poorly defined rims are present. The type of chondrules are mainly BO, PO, and PP. The size of the plagioclase is mainly from 2 to 50  $\mu\text{m}$ .

**Geochemistry:** Olivine  $\text{Fa}_{24.5-25.7}$ , N=5; Low-Ca pyroxene  $\text{Fs}_{20.4-23.5}\text{Wo}_{1.50-1.94}$ , N=5 (EPMA)

**Gouchi 001** 13°49'15.4"N, 9°00'10.8"E

Zinder, Niger

Find: June 2019

Classification: Rumuruti chondrite (R4)

**Petrography:** The rock has abundant olivine, but also contains some low-Ca pyroxene grains as well as Ca-pyroxene. The chondrite is heavily weathered (W4) and its chondrules are well defined making up about 50 vol.%. Chondrule types include BO, PP, PO, POP, C, and RP.

**Geochemistry:** The olivine is equilibrated ( $\text{Fa}_{39.4\pm 0.4}$ ; N=18); and the low-Ca pyroxene has  $\text{Fs}_{26.3\pm 4.8}\text{Wo}_{1.2\pm 0.9}$ ; N=9).

**Gourara 003** 29°48.79'N, 2°56.66'E

Ghardaia, Algeria

Find: 2020

Classification: HED achondrite (Eucrite, monomict)

**History:** A single fusion-crusted broken stone weighing 3273 g was found by nomads in the desert outside the town of Hassi Gara, Algeria, in early 2020. Broken fragments were subsequently purchased from a Moroccan dealer in April and May 2020 by Oz Backman, Topher Spinnato, and Jason Bliss.

**Physical characteristics:** Fragments of the single broken stone display an extremely fresh, black glossy fusion crust. Certain fragments display radial flowlines, rollover lip, and regmaglypts. A slice of the interior reveals a brecciated sample with an assortment of light and dark clasts set in a finer-grained matrix.

**Petrography:** (D. Sheikh, *FSU*) Specimen is a monomict breccia consisting of eucrite lithic clasts exhibiting primarily diabasic textures (grain size 800  $\mu\text{m}$ , up to 3 mm) set in a fine-grained clastic matrix of similar lithology with approximately 50% pyroxene, 45% plagioclase, 4% opaques, and 1% shock-melt veins. Mineral phases include pigeonite (most displaying exsolution lamellae of varying width; some inverted to orthopyroxene), augite (some exsolved from pigeonite), orthopyroxene, calcic plagioclase (display both polysynthetic and carlsbad twinning under cross-polarized light), ilmenite, chromite (some Ti-rich), and  $\text{SiO}_2$ -rich glass.

**Geochemistry:** Orthopyroxene ( $\text{Fs}_{51.5\pm 1.9}\text{Wo}_{4.9\pm 0.7}$ , range  $\text{Fs}_{48.5-55.0}\text{Wo}_{3.6-5.7}$ ,  $\text{FeO/MnO} = 31\pm 4$ ,  $n=15$ ), Pigeonite ( $\text{Fs}_{50.7\pm 1.3}\text{Wo}_{7.4\pm 1.2}$ , range  $\text{Fs}_{47.9-53.3}\text{Wo}_{6.1-10.8}$ ,  $\text{FeO/MnO} = 32\pm 4$ ,  $n=26$ ), Augite ( $\text{Fs}_{27.7\pm 3.4}\text{Wo}_{37.7\pm 4.6}$ , range  $\text{Fs}_{21.3-33.9}\text{Wo}_{27.1-42.3}$ ,  $\text{FeO/MnO} = 28\pm 4$ ,  $n=8$ ), Calcic Plagioclase ( $\text{An}_{91.6\pm 1.2}$ , range  $\text{An}_{88.7-94.2}$ ,  $n=42$ ).

**Classification:** HED Achondrite (Eucrite, monomict breccia).

**Specimens:** 20.21 g at *UNM*; 430 g with Oz Backman; 2714 g with Topher Spinnato; 129 g with Jason Bliss.

**Gusev Crater 001**      14.60107°S, 175.526855°E

Mars

Find: 2 Jun 2006

Classification: Iron meteorite

**History:** The Mars Exploration Rover Spirit observed the rock informally named Allan Hills (henceforth Gusev Crater 001) on sol 858, while the rover was parked on the flank of Low Ridge, within the Columbia Hills inside Gusev crater ([Schröder et al. 2008](#)).

**Physical characteristics:** 28 cm in its longest dimension.

**Classification:** Gusev Crater 001 has a pitted, light-colored, spectrally gray surface in [Pancam images](#) and thermal infrared characteristics in Mini-TES spectra similar to those of [Meridiani Planum 001](#), an iron meteorite. Because Gusev Crater 001 and [002](#) are located less than a meter apart, they may be paired.

**Gusev Crater 002**      14.60107°S, 175.526855°E

Mars

Find: 2 Jun 2006

Classification: Iron meteorite

**History:** The Mars Exploration Rover Spirit observed the rock informally named Zhong Shan (henceforth Gusev Crater 002) on sol 858, while the rover was parked on the flank of Low Ridge, within the Columbia Hills inside Gusev Crater ([Schröder et al. 2008](#)).

**Physical characteristics:** Dimensions: 25-30 cm.

**Classification:** Gusev Crater 002 has a pitted, spectrally gray surface in [Pancam images](#) and thermal infrared characteristics in Mini-TES spectra similar to those of [Meridiani Planum 001](#), an iron meteorite. Because [Gusev Crater 001](#) and 002 are located less than a meter apart, they may be paired.

**Halloran Spring**      35°25.63'N, 115°55.62'W

California, United States

Find: March 2019

Classification: Iron meteorite (IIIAB)

**History:** Found by the owner on their property near Halloran Spring, California, while he was prospecting with a metal detector in March 2019.

**Physical characteristics:** The meteorite measures approximately  $33 \times 30 \times 15$  cm, is irregularly shaped and has an orange-red exterior surface. Mass was readily broken after discovery into numerous silvery-black, ~kg-sized fragments with red-brown exteriors.

**Petrography:** (C. Herd, *UAb*) Optical investigation of several specimens including a  $\sim 3 \times 5$  cm polished surface reveals a highly weathered iron meteorite, with veins following and cross-cutting kamacite lamellae boundaries. In some specimens, metal has been completely replaced by magnetite. Measurement of kamacite lamellae, while difficult due to the alteration, suggests a medium to coarse octahedrite (BW  $1.5 \pm 0.2$  mm;  $n=9$ ). Several mm-scale lath-shaped inclusions (replaced by oxide) with swathing kamacite are present.

**Geochemistry:** ICP-MS data, using sample of [North Chile](#) (Filomena) as standard (C. Herd and G. Chen, *UAb*): Ni = 5.6, Co = 0.3 (both wt%); Ir = 1.4, Ga = 72, , Ge = 94, As = 11, W = 0.8, Re = 0.15, Pt = 4.8, Cu = 125, Au = 1.1 (all  $\mu\text{g}$ ).

**Classification:** (C. Herd, *UAb*): The highly altered nature of the meteorite is a challenge for classification. Ni, Co, Ga, Ge, and possibly As values have likely been modified by alteration. Other values are consistent with trends observed in IIIAB meteorites. If the meteorite is a IIIAB, then known Au-Ni relationships in IIIAB meteorites indicates that the original Ni content was  $\sim 8.5$  wt%.

**Specimens:** Type specimen consisting of 468 g and 249 g representative masses, and 288 g of numerous small fragments, at *UAb*. Main mass with Peter Goldy.

**Hardpan Flat** 41°7.0'N, 118°19.0'W

Nevada, United States

Find: 2015 Aug 06

Classification: Ureilite

**History:** While searching for meteorites on the evening of 2015 August 06, Robert *Verish* hastily gathered a bagful of pebbles from the surface of a dry lake just before nightfall. It was not until 2019 August that he scrutinized the contents of that bag, and recognized one of the small pebbles as being a meteorite.

**Physical characteristics:** This 2.6 g, black fusion-crust, oriented pebble has a well-preserved exterior. A cut surface reveals a gray, coarse-crystalline matrix.

**Petrography:** The silicates are about 90% olivine, 10% pigeonite. In typical ureilite fashion an additional minor component is dark interstitial matter, presumably carbon; and olivine rims are sprinkled with tiny Fe-metals formed by reduction. The silicates are uniformly close to  $1.0 \times 0.5$  mm; with maximum dimension found (in one small thin section) about 1.8 mm. The silicate grains show a clear preferred alignment of their long axes (lamination).

**Geochemistry:** Olivine core composition clusters very tightly at  $\text{Fa}_{16.48 \pm 0.14}$  (9 analyses), but reduced rim compositions (7 analyses) are as FeO-depleted as  $\text{Fa}_{3.3}$ . Pigeonite clusters very tightly at  $\text{Fs}_{14.2}\text{Wo}_{8.8}$  (8 analyses).

**Classification:** Ureilite

**Specimens:** 1.1 grams at *UCLA*; main mass with *Verish*.

**Hassi el Biod 001 (HeB 001)** 28°46'16.10"N, 05°30'10.00"E

Ouargla, Algeria

Purchased: 2020 Jan 2

Classification: HED achondrite (Diogenite, anomalous)

**History:** The meteorite was found by a nomad named Abo Zaid on January 2, 2020, in the great Sahara south of the village of Wargla, Algeria, and subsequently purchased by the main mass holder, Said Yousfi.

**Physical characteristics:** Light-brownish rock with very minor fusion crust.

**Petrography:** Unbrecciated ultramafic rock displaying a cumulate texture of up to 0.6 mm sized low-Ca pyroxene poikilitically enclosing rounded to subrounded olivine grains 20 to 400  $\mu\text{m}$  in size. Most regions are pyroxene-dominated while few contain abundant clustered olivine grains. Pyroxene is compositionally zoned, i.e., exhibits Mg-rich cores and Fe-rich rims. Olivine grains are compositionally homogeneous but of four distinct compositions varying in Fe/Mg ratios. Many olivine grains show outer rims of symplectic intergrowth of chromite and silica. Plagioclase is a minor component typically occurring interstitial to pyroxene and olivine and is of highly variable composition. Opaques include Ti-poor zoned chromite, troilite blebs, and kamacite often intergrown with FeS.

**Geochemistry:** low-Ca pyroxene:  $\text{Fs}_{23.7\pm 2.3}\text{Wo}_{2.8\pm 1.2}$  ( $\text{Fs}_{17.7-28.8}\text{Wo}_{1.8-4.8}$ ,  $\text{FeO/MnO}=22-32$ ,  $n=39$ ); predominant olivine:  $\text{Fa}_{28.9\pm 0.2}$  ( $\text{Fa}_{28.6-29.1}$ ,  $\text{FeO/MnO}=41\pm 2$ ,  $n=22$ ); Fe-rich olivine:  $\text{Fa}_{31.0\pm 0.1}$  ( $\text{Fa}_{30.8-31.2}$ ,  $\text{FeO/MnO}=40\pm 2$ ,  $n=5$ ); intermediate olivine:  $\text{Fa}_{25.6\pm 0.1}$  ( $\text{Fa}_{25.4-25.8}$ ,  $\text{FeO/MnO}=43\pm 2$ ,  $n=5$ ); Fe-poorer olivine:  $\text{Fa}_{24.1\pm 0.2}$  ( $\text{Fa}_{23.9-24.3}$ ,  $\text{FeO/MnO}=42\pm 4$ ,  $n=5$ ); plagioclase:  $\text{An}_{84.5\pm 4.1}\text{Ab}_{14.9\pm 3.9}\text{Or}_{0.5\pm 0.2}$  ( $\text{An}_{76.2-91.3}\text{Ab}_{8.4-22.5}\text{Or}_{0.3-1.4}$ ,  $n=19$ ); chromite:  $\text{Cr}_2\text{O}_3$  45.22-52.41,  $\text{TiO}_2$  0.84-1.24,  $\text{Al}_2\text{O}_3$  14.31-20.17,  $\text{MgO}$  5.82-6.91 (all in wt%); Oxygen isotopes (K. Ziegler, *UNM*): 3 acid-washed fragments analyzed by laser fluorination gave:  $\delta^{18}\text{O}=3.816, 3.852, 3.830$ ;  $\delta^{17}\text{O}=1.734, 1.753, 1.748$ ;  $\Delta^{17}\text{O}=-0.280, -0.280, -0.274$  (all per mil)

**Classification:** Achondrite (diogenite-anomalous, harzburgitic). The anomalous designation comes from the texture (pronounced cumulate texture of orthopyroxene poikilitically enclosing rounded olivine), and the oxygen isotopic composition that is apart from typical diogenites.

**Hassi el Madani 001** (HeM 001) 28.772° N, 01.539° W

Adrar, Algeria

Find, possible fall: 2019 Aug 01

Classification: Ordinary chondrite (LL4)

**History:** On August 1, 2019, observers in the vicinity of Adrar, Algeria, witnessed a bright fireball event. After searching in the desert for several days, crusted and broken stones were found by an anonymous hunter on August 7 in the region north of Adrar and close to a named well (Hassi el Madani). Subsequently in early October 2019, Naji Ben Faraji purchased the stones from the finder in Tindouf, Algeria.

**Physical characteristics:** Many of the broken stones (total weight 6115 g) are partially coated in fresh black fusion crust and the light gray interiors contain visible, slightly stained but mostly very fresh metal.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Very fresh specimen composed of fairly closely packed, relatively large, equilibrated PO, BO and RP chondrules set in a finer grained, partly recrystallized matrix containing taenite, stained kamacite, troilite, chromite, merrillite and chlorapatite. PO chondrules consist of euhedral olivine and pyroxene grains within a groundmass of glassy microcrystalline material containing albitic plagioclase. Calcic plagioclase was observed in one BO chondrule. A metal-rich nugget (0.4 mm across) in the studied thin section is composed of taenite, stained kamacite and troilite.

**Geochemistry:** Olivine ( $\text{Fa}_{27.0\pm 0.2}$ , range  $\text{Fa}_{26.8-27.2}$ ,  $N = 9$ ), low-Ca pyroxene ( $\text{Fs}_{21.5\pm 0.8}\text{Wo}_{2.2\pm 1.6}$ , range  $\text{Fs}_{20.2-22.2}\text{Wo}_{0.4-4.4}$ ,  $N = 5$ ), pigeonite ( $\text{Fs}_{19.0}\text{Wo}_{9.2}$ ;  $\text{Fs}_{17.1}\text{Wo}_{17.4}$ ;  $N = 2$ ), augite ( $\text{Fs}_{7.6}\text{Wo}_{45.9}$ ), plagioclase in BO chondrule ( $\text{An}_{80.4}\text{Ab}_{19.4}\text{Or}_{0.3}$ ). Magnetic susceptibility  $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.58$ . Oxygen isotopes (K. Ziegler, *UNM*): analyses of acid-washed subsamples by laser fluorination gave, respectively,  $\delta^{17}\text{O}$  4.299, 4.234, 4.335, 4.104;  $\delta^{18}\text{O}$  5.799, 5.197, 5.841, 5.425;  $\Delta^{17}\text{O}$  1.237, 1.490, 1.251, 1.240 per mil (all data linearized).

**Classification:** Ordinary chondrite (LL4).

**Specimens:** 24.1 g including one polished thin section at *UWB*; remainder with Mr. N. Ben Faraji.

**Hongliu Daquan** 40°57'25.79"N, 98°32'49.35"E

Nei Mongol, China

Find: 2019 May 11

Classification: Ordinary chondrite (H~6)

**History:** (Ziyao Wang) Discovered by Ba Gena near Ma Zong mountain, Ejn Qi (Inner Mongolia) on 2019 May 11

**Physical characteristics:** (Ziyao Wang) seven light-brown stones with a total weight of 2.9 kg were discovered within 10 m distance.

**Petrography:** (R. Bartoschewitz, *Bart*) light-brown matrix with indistinct chondrules (0.3-1.5 mm, av. 0.6 mm), cracks with iron oxides/-hydroxides

**Geochemistry:** Magnetic susceptibility (R. Bartoschewitz, *Bart*)  $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.84$

**Classification:** Ordinary chondrite (H~6, W3)

**Specimens:** 22.3 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 142 g with *Bart*.

**Hongshijing 002** 40°16'13.63"N, 92° 0'54.63"E

Xinjiang, China

Find: 2017

Classification: Ordinary chondrite (LL4)

**History:** (Ziyao Wang) Discovered by Wentao Yang (Urumqi) in the desert near Hongshijing (Xinjiang Province) in 2017

**Physical characteristics:** (Ziyao Wang) Oval brown-yellow stone of 710 g. On the surface, many chondrules are visible

**Petrography:** (R. Bartoschewitz, *Bart*) recrystallized brown stained matrix with well developed chondrules of various types (0.4-3 mm, av. 0.9 mm).

**Geochemistry:** (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine  $\text{Fa}_{26.5\pm 0.2}$  ( $n=20$ ); pyroxene  $\text{Fs}_{19.3\pm 3.9}\text{Wo}_{0.8\pm 0.8}$  ( $n=20$ ); chromite CRAL87, FFM91. Kamacite  $\text{Ni}=4.2$ ,  $\text{Co}=1.4$  ( $n=1$ ); taenite  $\text{Ni}=21-40$ ,  $\text{Co}=1.0-1.3$  ( $n=2$ ); troilite; smythite  $\text{Ni}=5.4$ ,  $\text{Co}=0.4$  (all wt%). Magnetic susceptibility (R. Bartoschewitz, *Bart*)  $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.65$

**Classification:** Ordinary chondrite (LL4, S2, W4)

**Specimens:** 23.0 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 74 g with *Bart*.

**Huangtuya 002** 42°38'45"N, 91°15'20"E

Xinjiang, China

Find: 2016 Sep 23

Classification: Iron meteorite (IIIAB)



**History:** The meteorite was found in September 2016 by Dr. Gaojie in the Gobi desert of Shanshan County, Xinjiang Province. A local meteorite hunter Han Yongfeng identified it as an iron meteorite.

**Physical characteristics:** The total mass of the meteorite is 5345 g. It is a cone-shaped mass with fusion crust and regmaglypts.

**Petrography:** Bands of kamacite and taenite can be found in the sample, with the bandwidth of 1.5-2 mm, in a coarse Widmanstaetten pattern. Some inclusions of troilite can be found in the sample, including an elliptical one with a long axis of 15 mm.

**Geochemistry:** (By using ELAN DRC-e Q-ICP-MS) Fe=90.3, Ni=7.90, Co=0.13 (in wt%). Ga=17.19, Ge=30.87, As=3.39, W=1.23, Ir=4.80, Au=0.65 (in ppm)

**Classification:** Iron Meteorite (Og), IIIAB

**Hughes 059** 30°8'S, 129°8'E

South Australia, Australia

Find: 1975

Classification: Ordinary chondrite (H5)

**History:** Weathered fragments of 181 g, and two interlocking fragments totaling 11.4 g were found on open plain.

**Physical characteristics:** The irregular and partly interlocking fragments are deeply weathered.

**Petrography:** (A.W.R. Bevan *WAM*) Recognizable chondrules, radiating pyroxene, porphyritic olivine and barred olivine, in crystalline matrix. Most metal and troilite grains altered to oxyhydroxides of iron. Heavy oxide staining and veining. Olivine shows undulose extinction and planar fracturing.

**Geochemistry:** Mineral compositions and geochemistry: (A. W. R. Bevan, *WAM*). Mineral compositions as determined by EMP: olivine Fa<sub>18.6</sub>; orthopyroxene Fs<sub>15.6</sub>.

**Classification:** (H5); S3, W4.

**Specimens:** Sectioned fragments 32.9 g, *WAM*. Main mass in the *SAM*

**Hughes 060** 30°7'46.03"S, 129°8'47.84"E

South Australia, Australia

Find: 1982

Classification: Ordinary chondrite (H5)

**History:** A single stone weighing 39.3 g was found on open plain

**Physical characteristics:** A completely crusted individual with flight markings.

**Petrography:** (A. W. R. Bevan, *WAM*) Discernable chondrules in a moderately crystalline matrix. Chondrules include barred olivine, porphyritic olivine, and pyroxene-olivine types, all with microcrystalline mesostases. Some chondrules contain relict polysynthetically twinned clinopyroxene. Olivine shows slight undulose extinction. Heavily weathered with extensive oxide veining.

**Geochemistry:** Mineral compositions and geochemistry: (A. W. R. Bevan *WAM*). Mineral compositions as determined by EMP: olivine Fa<sub>19.5</sub>; orthopyroxene Fs<sub>17.5</sub>. Petrographically and mineralogically distinct from Hughes 059.

**Classification:** (H5); S2, W4.

**Specimens:** Main mass and thin section at *WAM*

**Hughes 061** 30°34'S, 129°0.7'E



1  
2  
3 South Australia, Australia

4 Find: 1986

5 Classification: Ordinary chondrite (H5)

6 **History:** A single stone was found on open plain.

7 **Physical characteristics:** Physical characteristics: A large crusted, but deeply weathered  
8 stone missing only a few fragments.

9 **Petrography:** (A. W. R. Bevan *WAM*) The stone comprises recognizable chondrules in a  
10 moderately crystalline matrix. Chondrule types include BO, RP, and PO. Olivine shows slight  
11 undulose extinction. Metal and troilite particles are heavily weathered to oxyhydroxides of  
12 iron, and there is extensive oxide veining. Petrographically distinct from Hughes 060.

13 **Geochemistry:** Mineral compositions and geochemistry: (A. W. R. Bevan, *WAM*). Mineral  
14 compositions as determined by EMP: olivine  $Fa_{18.9}$ ; orthopyroxene  $Fs_{17.0}Wo_{1.24}$ .

15 **Classification:** (H5); S2, W3.

16 **Specimens:** Main mass and thin section at *WAM*

17  
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19  
20  
21 **Huntsman (b)** 41°13.498'N, 103°1.595'W

22 Nebraska, United States

23 Find: 1977

24 Classification: Ordinary chondrite (H3)

25 **History:** 10.215 kg found in 1977 on the Spiker family farm near Huntsman, Nebraska.

26 Sample was initially screened and passed on for classification by New England Meteoritical  
27 Services (NEMS).

28 **Physical characteristics:** Physical Characteristics: Single stone, weathered dark-brown  
29 exterior with sparse minor patches of weathered fusion crust. Saw cut reveals dark interior  
30 with scattered chondrules, numerous bright grains of iron-nickel metal and sulfide, and a  
31 small darker inclusion lacking metal or sulfide grains.

32 **Petrography:** (K. Domanik and F. Stephan, *UAz*) Microprobe examination of a polished  
33 mount shows numerous recognizable chondrules averaging ~500  $\mu\text{m}$  in diameter set in a  
34 fragmental matrix. Silicate compositions of both chondrules and matrix are highly variable.  
35 Secondary plagioclase is minor to absent. Kamacite grains, 200-400  $\mu\text{m}$  in size constitute ~10  
36 vol% of the meteorite and are associated with lesser amounts of troilite and Ni-rich taenite.  
37 The sample examined contains several small, recrystallized shock veins as well as a  $9 \times 3$  mm  
38 melt area containing zoned euhedral to subhedral olivine crystals set in a matrix of isotropic  
39 glass. Minor merrillite and silica were also observed.

40 **Geochemistry:** Mineral compositions and geochemistry: (K. Domanik and F. Stephan, *UAz*)

41 Olivine  $Fa_{16.9 \pm 5.6}$ , range  $Fa_{0.6-33.0}$ , PMD-FeO 20.8%, Fe/Mn =  $39.3 \pm 7.7$ , n=112; low-Ca

42 pyroxene  $Fs_{11.3 \pm 6.4}Wo_{0.9 \pm 0.6}$ , range  $Fs_{1.6-30.6}$ , PMD-FeO 44.7, Fe/Mn =  $20.3 \pm 7.1$ , n=48.

43 Kamacite Fe =  $92.9 \pm 0.9$ , Ni =  $6.1 \pm 0.9$ , Co =  $0.5 \pm 0.1$  (wt%), n=24.

44 **Classification:** Ordinary Chondrite (H3), consistent with type 3.6 based on PMD-FeO of  
45 olivine and low-Ca pyroxene, sigma Fa vs. average Fa content of olivine, and low Co  
46 heterogeneity in kamacite. Found 5.2 km NW of [Huntsman](#) [which now gets the synonym  
47 Huntsman (a)] and maybe potentially paired with it given the proximity. Although Huntsman  
48 (a) is classified as H4, data for Fa and Fs variability are currently lacking for this specimen.

49 **Specimens:** 48.1 g, two probe mounts and a thin section on deposit at *UAz*, Jerry Spiker holds  
50 the main mass.

51  
52  
53 **Iran 001**

54 Semnan, Iran

1  
2  
3 Find: 2019

4 Classification: Ordinary chondrite (L6)

5 **History:** Meteorite with the generic name Iran were purchased in Iran, and were found at  
6 undisclosed locations in the country.  
7  
8  
9

10 **Iran 005**

11 Kerman, Iran

12 Find: 2019

13 Classification: Ordinary chondrite (L6)

14 **Petrography:** (J. Gattacceca) Contains a clast of L6-impact melt breccia (L6 clasts set in a  
15 melt rock matrix).  
16  
17  
18

19 **Istifane 006** 31°34.91'N, 5°32.32'W

20 South, Morocco

21 Find: 2017 Feb 12

22 Classification: Ordinary chondrite (L6)

23 **History:** The meteorite was found in Morocco on February 12, 2017, by Aadel Bouzada, who  
24 contacted John Shea via Facebook. John Shea purchased the sample on March 17, 2017, and  
25 sent a piece to the *Cascadia* for classification.  
26

27 **Physical characteristics:** Individual covered entirely by dark fusion crust, with patches of  
28 rust. Complex dark veins surrounding small clasts of the host meteorite crosscut the cut face  
29 of the sample.  
30

31 **Petrography:** (M. Hutson, A. Ruzicka, W. Fish, *Cascadia*): In thin section, most of the  
32 meteorite is very well integrated, with a few barely discernible chondrules. Feldspathic  
33 material consists of maskelynite areas up to 150  $\mu\text{m}$  across. The host is crosscut by an  
34 elaborate network of shock veins containing abundant dendritic metal-sulfide intergrowths  
35 forming droplets, small veins, and irregular patches. Purple ringwoodite grains are visible in  
36 thin section in transmitted light, and were observed to be intergrown with equant subhedral  
37 grains of majorite-garnet in a portion of the shock vein examined with BSE imaging and EDS  
38 mapping.  
39

40 **Geochemistry:** Mineral compositions and geochemistry: Olivine and pyroxene grains are  
41 equilibrated:  $\text{Fa}_{25.1\pm 0.2}$ ,  $N=15$ ;  $\text{Fs}_{21.0\pm 0.2}\text{Wo}_{1.6\pm 0.2}$ ,  $N=12$ .

42 **Classification:** Ordinary chondrite (L6) based on chemistry and texture.

43 **Specimens:** *Cascadia* holds 24.1 g in one piece, in addition to two polished thin sections and  
44 a mounted butt. The main mass is held by John Shea.  
45  
46  
47

48 **Jdiriya 003** 27°36'59.42"N, 10°26'48.85"W

49 Saguia el Hamra, Western Sahara

50 Find: 2019 Dec 18

51 Classification: HED achondrite (Eucrite)

52 **History:** Found by Zaid Oualguirah on 2019 Dec 18.

53 **Physical characteristics:** A single crusted stone. Cut surface reveals a light homogeneous  
54 interior with  $\sim 500$   $\mu\text{m}$  plagioclase and pyroxene grains.  
55

56 **Petrography:** (J. Gattacceca, *CEREGE*) Igneous rock with subophitic texture. Main minerals  
57 are pyroxene (with both fine- and large-scale exsolutions) and plagioclase, with typical grain  
58 size 400  $\mu\text{m}$ . Other minerals: chromite, ilmenite, metal, troilite, silica.  
59  
60

**Geochemistry:** Low-Ca pyroxene  $\text{Fs}_{58.0\pm 2.8}\text{Wo}_{6.0\pm 3.3}$  (n=6), Ca-pyroxene exsolutions  $\text{Fs}_{26.2}\text{Wo}_{44.5}$  (n=2),  $\text{FeO/MnO } 31.2\pm 1.9$  (n=8). Plagioclase  $\text{An}_{88.4\pm 0.6}\text{Ab}_{11.3\pm 0.6}\text{Or}_{0.3\pm 0.1}$  (n=6).  
**Specimens:** Type specimen at *CEREGE*. Main mass with Jean Redelsperger.

**Jiddat al Harasis 1107** (JaH 1107)       $19^{\circ}40.668'\text{N}, 55^{\circ}44.913'\text{E}$

Al Wusta, Oman

Find: 2010

Classification: Ordinary chondrite (H6)

**History:** The meteorite was found 2010 during a field trip in the Oman desert.

**Physical characteristics:** Dark brownish individual lacking any fusion crust.

**Petrography:** The plagioclase grain size is about 70  $\mu\text{m}$ .

**Jiddat al Harasis 1108** (JaH 1108)       $19^{\circ}37.511'\text{N}, 55^{\circ}47.111'\text{E}$

Al Wusta, Oman

Find: 2010

Classification: Ordinary chondrite (LL6, melt breccia)

**History:** The meteorite was found 2010 during a field trip in the Oman desert.

**Physical characteristics:** Dark-brownish individual with some fusion crust.

**Petrography:** The meteorite is a melt breccia composed of completely recrystallized LL6 regions (plagioclase grain size about 80  $\mu\text{m}$ ) and abundant up to 2 cm wide recrystallized shock melt veins and pockets with characteristic FeNi metal and sulfide spherules.

**Jiddat al Harasis 1110** (JaH 1110)       $19^{\circ}47'48,18''\text{N}, 55^{\circ}53'30,34''\text{E}$

Al Wusta, Oman

Find: 2012

Classification: Ordinary chondrite (L5)

**History:** The meteorite was found 2012 during a field trip in the Oman desert and purchased by Jens Bäumer from the anonymous finder.

**Physical characteristics:** Dark brownish fragment with some fusion crust.

**Petrography:** The plagioclase grain size is about 20  $\mu\text{m}$ .

**Kerman 205**       $30^{\circ}46.41'\text{N}, 57^{\circ}47.71'\text{E}$

Kerman, Iran

Find: 13 Mar 2017

Classification: Ordinary chondrite (H5)

**History:** Collected during the 2017 joint Italian-Iranian recovery campaign

**Physical characteristics:** A single piece weighing 52.2 g.

**Petrography:** (G. Giuli, *UniCam*; V. Moggi Cecchi, G. Pratesi *UniFi*); The thin section displays a chondritic texture, with rare chondrules of various types set in abundant silicate matrix. Kamacite and troilite are diffuse and partially weathered to iron oxides. Several metal veins, altered to iron oxides, are visible;

**Geochemistry:** EMP (V. Moggi Cecchi, G. Pratesi - *UniFi*; G. Giuli - *UniCam*); Olivine in chondrules and matrix; ( $\text{Fa}_{19.0}\text{Fo}_{81.0}$ , N=9); Orthopyroxene in chondrules and matrix ( $\text{Fs}_{16.2}\text{En}_{82.4}\text{Wo}_{1.4}$ , N=5);

**Classification:** Ordinary chondrite (H5); S1; W3; Possibly paired with Kerman 206 to 213, Kerman 215, Kerman 217 to 225, Kerman 228 & 229, Kerman 232 & 233, Kerman 236 & 237, Kerman 240 to 248.

**Specimens:** A total of 21.07 g specimen is on deposit at *MSN-FI*; 6 g at *SBU*. Main mass (23.7 g) at *OAM*.

**Kerman 206** 30°46.41'N, 57°47.71'E

Kerman, Iran

Find: 13 Mar 2017

Classification: Ordinary chondrite (H5)

**History:** Collected during the 2017 joint Italian-Iranian recovery campaign

**Physical characteristics:** A single piece weighing 10.2 g.

**Petrography:** (G. Giuli, *UniCam*; V. Moggi Cecchi, G. Pratesi *UniFi*); The thin section displays a chondritic texture, with rare chondrules of various types set in abundant silicate matrix. Kamacite and troilite are diffuse and partially weathered to iron oxides. Several metal veins, altered to iron oxides, are visible;

**Geochemistry:** EMP (V. Moggi Cecchi, G. Pratesi - *UniFi*; G. Giuli - *UniCam*); Olivine in chondrules and matrix; ( $\text{Fa}_{20.6}\text{Fo}_{79.4}$ , N=7); Orthopyroxene in chondrules and matrix ( $\text{Fs}_{18.0}\text{En}_{80.8}\text{Wo}_{1.2}$ , N=6);

**Classification:** Ordinary chondrite (H5); S2; W2; Possibly paired with Kerman 205 to 213, Kerman 215, Kerman 217 to 225, Kerman 228 & 229, Kerman 232 & 233, Kerman 236 & 237, Kerman 240 to 248.

**Specimens:** A total of 9.27 g specimen (main mass) is on deposit at *MSN-FI*; 0.86 g at *SBU*.

**Kerman 207** 30°46.41'N, 57°47.71'E

Kerman, Iran

Find: 13 Mar 2017

Classification: Ordinary chondrite (H5)

**History:** Collected during the 2017 joint Italian-Iranian recovery campaign

**Physical characteristics:** 5 pieces totally weighing 6.8 g.

**Petrography:** (G. Giuli, *UniCam*; V. Moggi Cecchi, G. Pratesi *UniFi*); The thin section displays a chondritic texture, with rare chondrules of various types set in abundant silicate matrix. Kamacite and troilite are diffuse and partially weathered to iron oxides. Several metal veins, altered to iron oxides, are visible;

**Geochemistry:** EMP (V. Moggi Cecchi, G. Pratesi - *UniFi*; G. Giuli - *UniCam*); Olivine in chondrules and matrix; ( $\text{Fa}_{19.3}\text{Fo}_{80.7}$ , N=7); Orthopyroxene in chondrules and matrix ( $\text{Fs}_{17.3}\text{En}_{81.3}\text{Wo}_{1.4}$ , N=9);

**Classification:** Ordinary chondrite (H5); S1; W3; Possibly paired with Kerman 205 to 213, Kerman 215, Kerman 217 to 225, Kerman 228 & 229, Kerman 232 & 233, Kerman 236 & 237, Kerman 240 to 248.

**Specimens:** A total of 2.1 g specimen is on deposit at *MSN-FI*; 3 pcs (tot. 1.92 g) at *SBU*. Main mass (2.8 g) at University of Camerino, Italy.

**Kerman 208** 30°46.41'N, 57°47.71'E

Kerman, Iran

Find: 13 Mar 2017

Classification: Ordinary chondrite (H5)

**History:** Collected during the 2017 joint Italian-Iranian recovery campaign

**Physical characteristics:** A single piece weighing 14.8 g.

**Petrography:** (G. Giuli, *UniCam*; V. Moggi Cecchi, G. Pratesi *UniFi*); The thin section displays a chondritic texture, with rare chondrules of various types set in abundant silicate matrix. Kamacite and troilite are diffuse and partially weathered to iron oxides. Several metal veins, altered to iron oxides, are visible;

**Geochemistry:** EMP (V. Moggi Cecchi, G. Pratesi - *UniFi*; G. Giuli - *UniCam*); Olivine in chondrules and matrix; ( $\text{Fa}_{20.8}\text{Fo}_{79.2}$ , N=18); Orthopyroxene in chondrules and matrix ( $\text{Fs}_{18.3}\text{En}_{80.2}\text{Wo}_{1.5}$ , N=9);

**Classification:** Ordinary chondrite (H5); S1; W2; Possibly paired with Kerman 205 to 213, Kerman 215, Kerman 217 to 225, Kerman 228 & 229, Kerman 232 & 233, Kerman 236 & 237, Kerman 240 to 248.

**Specimens:** A total of 13.16 g specimen (main mass) is on deposit at *MSN-FI*; 1.50 g at *SBU*.

**Kerman 209** 30°46.41'N, 57°47.71'E

Kerman, Iran

Find: 13 Mar 2017

Classification: Ordinary chondrite (H5)

**History:** Collected during the 2017 joint Italian-Iranian recovery campaign

**Physical characteristics:** A single piece weighing 35.6 g.

**Petrography:** (G. Giuli, *UniCam*; V. Moggi Cecchi, G. Pratesi *UniFi*); The thin section displays a chondritic texture, with rare chondrules of various types set in abundant silicate matrix. Kamacite and troilite are diffuse and partially weathered to iron oxides. Several metal veins, altered to iron oxides, are visible;

**Geochemistry:** EMP (V. Moggi Cecchi, G. Pratesi - *UniFi*; G. Giuli - *UniCam*); Olivine in chondrules and matrix; ( $\text{Fa}_{20.8}\text{Fo}_{79.2}$ , N=8); Orthopyroxene in chondrules and matrix ( $\text{Fs}_{18.5}\text{En}_{80.0}\text{Wo}_{1.5}$ , N=6);

**Classification:** Ordinary chondrite (H5); S2; W4; Possibly paired with Kerman 205 to 213, Kerman 215, Kerman 217 to 225, Kerman 228 & 229, Kerman 232 & 233, Kerman 236 & 237, Kerman 240 to 248.

**Specimens:** A total of 30.9 g specimen (main mass) is on deposit at *MSN-FI*; 2 pcs (tot. 4.26 g) at *SBU*.

**Kerman 210** 30°46.41'N, 57°47.71'E

Kerman, Iran

Find: 13 Mar 2017

Classification: Ordinary chondrite (H5)

**History:** Collected during the 2017 joint Italian-Iranian recovery campaign

**Physical characteristics:** A single piece weighing 23.0 g.

**Petrography:** (G. Giuli, *UniCam*; V. Moggi Cecchi, G. Pratesi *UniFi*); The thin section displays a chondritic texture, with rare chondrules of various types set in abundant silicate matrix. Kamacite and troilite are diffuse and partially weathered to iron oxides. Several metal veins, altered to iron oxides, are visible;

**Geochemistry:** EMP (V. Moggi Cecchi, G. Pratesi - *UniFi*; G. Giuli - *UniCam*); Olivine in chondrules and matrix; ( $\text{Fa}_{20.8}\text{Fo}_{79.2}$ , N=7); Orthopyroxene in chondrules and matrix ( $\text{Fs}_{17.9}\text{En}_{80.4}\text{Wo}_{1.7}$ , N=7);



**Classification:** Ordinary chondrite (H5); S1; W3; Possibly paired with Kerman 205 to 213, Kerman 215, Kerman 217 to 225, Kerman 228 & 229, Kerman 232 & 233, Kerman 236 & 237, Kerman 240 to 248.

**Specimens:** A total of 20.1 g specimen (main mass) is on deposit at *MSN-FI*; 2 pcs (tot. 2.37 g) at *SBU*.

**Kerman 211** 30°46.41'N, 57°47.71'E

Kerman, Iran

Find: 13 Mar 2017

Classification: Ordinary chondrite (H5)

**History:** Collected during the 2017 joint Italian-Iranian recovery campaign

**Physical characteristics:** A single piece weighing 20.6 g.

**Petrography:** (G. Giuli, *UniCam*; V. Moggi Cecchi, G. Pratesi *UniFi*); The thin section displays a chondritic texture, with rare chondrules of various types set in abundant silicate matrix. Kamacite and troilite are diffuse and partially weathered to iron oxides. Several metal veins, altered to iron oxides, are visible;

**Geochemistry:** EMP (V. Moggi Cecchi, G. Pratesi - *UniFi*; G. Giuli - *UniCam*); Olivine in chondrules and matrix; ( $\text{Fa}_{20.8}\text{Fo}_{79.2}$ , N=9); Orthopyroxene in chondrules and matrix ( $\text{Fs}_{16.3}\text{En}_{82.4}\text{Wo}_{1.3}$ , N=10);

**Classification:** Ordinary chondrite (H5); S1; W3; Possibly paired with Kerman 205 to 213, Kerman 215, Kerman 217 to 225, Kerman 228 & 229, Kerman 232 & 233, Kerman 236 & 237, Kerman 240 to 248.

**Specimens:** A total of 18.5 g specimen (main mass) is on deposit at *MSN-FI*; 1.80 g at *SBU*.

**Kerman 212** 30°46.41'N, 57°47.71'E

Kerman, Iran

Find: 13 Mar 2017

Classification: Ordinary chondrite (H5)

**History:** Collected during the 2017 joint Italian-Iranian recovery campaign

**Physical characteristics:** 15 pieces totally weighing 51.9 g.

**Petrography:** (G. Giuli, *UniCam*; V. Moggi Cecchi, G. Pratesi *UniFi*); The thin section displays a chondritic texture, with rare chondrules of various types set in abundant silicate matrix. Kamacite and troilite are diffuse and partially weathered to iron oxides. Several metal veins, altered to iron oxides, are visible;

**Geochemistry:** EMP (V. Moggi Cecchi, G. Pratesi - *UniFi*; G. Giuli - *UniCam*); Olivine in chondrules and matrix; ( $\text{Fa}_{20.7}\text{Fo}_{79.3}$ , N=9); Orthopyroxene in chondrules and matrix ( $\text{Fs}_{18.4}\text{En}_{80.3}\text{Wo}_{1.3}$ , N=10);

**Classification:** Ordinary chondrite (H5); S1; W3; Possibly paired with Kerman 205 to 213, Kerman 215, Kerman 217 to 225, Kerman 228 & 229, Kerman 232 & 233, Kerman 236 & 237, Kerman 240 to 248.

**Specimens:** A total of 42.71 g specimen (main mass) is on deposit at *MSN-FI*; 7 pcs (tot. 9.16 g) at *SBU*.

**Kerman 213** 30°46.41'N, 57°47.71'E

Kerman, Iran

Find: 13 Mar 2017

Classification: Ordinary chondrite (H5)



**History:** Collected during the 2017 joint Italian-Iranian recovery campaign

**Physical characteristics:** 8 pieces totally weighing 9.9 g.

**Petrography:** (G. Giuli, *UniCam*; V. Moggi Cecchi, G. Pratesi *UniFi*); The thin section displays a chondritic texture, with rare chondrules of various types set in abundant silicate matrix. Kamacite and troilite are diffuse and partially weathered to iron oxides. Several metal veins, altered to iron oxides, are visible;

**Geochemistry:** EMP (V. Moggi Cecchi, G. Pratesi - *UniFi*; G. Giuli - *UniCam*); Olivine in chondrules and matrix; ( $\text{Fa}_{20.8}\text{Fo}_{79.2}$ , N=7); Orthopyroxene in chondrules and matrix ( $\text{Fs}_{17.3}\text{En}_{81.2}\text{Wo}_{1.3}$ , N=7);

**Classification:** Ordinary chondrite (H5); S2; W3; Possibly paired with Kerman 205 to 213, Kerman 215, Kerman 217 to 225, Kerman 228 & 229, Kerman 232 & 233, Kerman 236 & 237, Kerman 240 to 248.

**Specimens:** A total of 6.91 g specimen (main mass) is on deposit at *MSN-FI*; 3 pcs (tot. 2.88 g) at *SBU*.

**Kerman 214** 30°46.41'N, 57°47.71'E

Kerman, Iran

Find: 13 Mar 2017

Classification: Ordinary chondrite (H4)

**History:** Collected during the 2017 joint Italian-Iranian recovery campaign

**Physical characteristics:** A single piece weighing 19.9 g.

**Petrography:** (G. Giuli, *UniCam*; V. Moggi Cecchi, G. Pratesi *UniFi*); The thin section displays a marked chondritic texture, with scattered evident chondrules of various types set in silicate matrix. Kamacite and troilite are diffuse and partially weathered to iron oxides;

**Geochemistry:** EMP (V. Moggi Cecchi, G. Pratesi - *UniFi*; G. Giuli - *UniCam*); Olivine in chondrules and matrix; ( $\text{Fa}_{20.1}\text{Fo}_{79.9}$ , N=14); Orthopyroxene in chondrules and matrix ( $\text{Fs}_{16.8}\text{En}_{81.9}\text{Wo}_{1.3}$ , N=6);

**Classification:** Ordinary chondrite (H4); S3; W3

**Specimens:** A total of 6.71 g specimen is on deposit at *MSN-FI*; 2.16 g at *SBU*. Main mass (10.6 g) at University of Camerino, Italy.

**Kerman 215** 30°46.41'N, 57°47.71'E

Kerman, Iran

Find: 13 Mar 2017

Classification: Ordinary chondrite (H5)

**History:** Collected during the 2017 joint Italian-Iranian recovery campaign

**Physical characteristics:** A single piece weighing 28.8 g.

**Petrography:** (G. Giuli, *UniCam*; V. Moggi Cecchi, G. Pratesi *UniFi*); The thin section displays a chondritic texture, with rare chondrules of various types set in abundant silicate matrix. Kamacite and troilite are diffuse and partially weathered to iron oxides. Several metal veins, altered to iron oxides, are visible;

**Geochemistry:** EMP (V. Moggi Cecchi, G. Pratesi - *UniFi*; G. Giuli - *UniCam*); Olivine in chondrules and matrix; ( $\text{Fa}_{20.5}\text{Fo}_{79.5}$ , N=8); Orthopyroxene in chondrules and matrix ( $\text{Fs}_{17.4}\text{En}_{81.5}\text{Wo}_{1.1}$ , N=7);

**Classification:** Ordinary chondrite (H5); S1; W3; Possibly paired with Kerman 205 to 213, Kerman 217 to 225, Kerman 228 & 229, Kerman 232 & 233, Kerman 236 & 237, Kerman 240 to 248.

**Specimens:** A total of 12.15 g specimen is on deposit at *MSN-FI*; 3.24 g at *SBU*. Main mass (12.4 g) at University of Camerino, Italy.

**Kerman 216** 30°46.41'N, 57°47.71'E

Kerman, Iran

Find: 13 Mar 2017

Classification: Ordinary chondrite (H4)

**History:** Collected during the 2017 joint Italian-Iranian recovery campaign

**Physical characteristics:** A single piece weighing 16.7 g.

**Petrography:** (G. Giuli, *UniCam*; V. Moggi Cecchi, G. Pratesi *UniFi*); The thin section displays a marked chondritic texture, with scattered evident chondrules of various types set in silicate matrix. Kamacite and troilite are diffuse and partially weathered to iron oxides;

**Geochemistry:** EMP (V. Moggi Cecchi, G. Pratesi - *UniFi*; G. Giuli - *UniCam*); Olivine in chondrules and matrix; (Fa<sub>19.3</sub>Fe<sub>80.7</sub>, N=5); Orthopyroxene in chondrules and matrix (Fs<sub>16.8</sub>En<sub>81.7</sub>Wo<sub>1.5</sub>, N=5);

**Classification:** Ordinary chondrite (H4); S2; W3

**Specimens:** A total of 6.70 g specimen is on deposit at *MSN-FI*; 2.19 g at *SBU*. Main mass (7.1 g) at *OAM*.

**Kerman 217** 30°46.41'N, 57°47.71'E

Kerman, Iran

Find: 13 Mar 2017

Classification: Ordinary chondrite (H5)

**History:** Collected during the 2017 joint Italian-Iranian recovery campaign

**Physical characteristics:** 5 pieces totally weighing 14.5.

**Petrography:** (G. Giuli, *UniCam*; V. Moggi Cecchi, G. Pratesi *UniFi*); The thin section displays a chondritic texture, with rare chondrules of various types set in abundant silicate matrix. Kamacite and troilite are diffuse and partially weathered to iron oxides. Several metal veins, altered to iron oxides, are visible;

**Geochemistry:** EMP (V. Moggi Cecchi, G. Pratesi - *UniFi*; G. Giuli - *UniCam*); Olivine in chondrules and matrix; (Fa<sub>20.5</sub>Fe<sub>79.5</sub>, N=7); Orthopyroxene in chondrules and matrix (Fs<sub>19.0</sub>En<sub>79.6</sub>Wo<sub>1.4</sub>, N=6);

**Classification:** Ordinary chondrite (H5); S2; W3; Possibly paired with Kerman 205 to 213, Kerman 215, Kerman 218 to 225, Kerman 228 & 229, Kerman 232 & 233, Kerman 236 & 237, Kerman 240 to 248.

**Specimens:** A total of 9.74 g specimen (main mass) is on deposit at *MSN-FI*; 3 pcs (tot. 4.82 g) at *SBU*.

**Kerman 218** 30°44.15'N, 57°48.83'E

Kerman, Iran

Find: 14 Mar 2017

Classification: Ordinary chondrite (H5)

**History:** Collected during the 2017 joint Italian-Iranian recovery campaign

**Physical characteristics:** A single piece weighing 10.6 g.

**Petrography:** (G. Giuli, *UniCam*; V. Moggi Cecchi, G. Pratesi *UniFi*); The thin section displays a chondritic texture, with rare chondrules of various types set in abundant silicate

matrix. Kamacite and troilite are diffuse and partially weathered to iron oxides. Several metal veins, altered to iron oxides, are visible;

**Geochemistry:** EMP (V. Moggi Cecchi, G. Pratesi - *UniFi*; G. Giuli - *UniCam*); Olivine in chondrules and matrix; ( $\text{Fa}_{19.8}\text{Fo}_{80.2}$ , N=5); Orthopyroxene in chondrules and matrix ( $\text{Fs}_{17.9}\text{En}_{81.1}\text{Wo}_{1.0}$ , N=6);

**Classification:** Ordinary chondrite (H5); S2; W3; Possibly paired with Kerman 205 to 213, Kerman 215, Kerman 217 to 225, Kerman 228 & 229, Kerman 232 & 233, Kerman 236 & 237, Kerman 240 to 248.

**Specimens:** A total of 3.73 g specimen is on deposit at *MSN-FI*; 1.59 g at *SBU*. Main mass (4.7 g) at *OAM*.

**Kerman 219** 30°44.15'N, 57°48.83'E

Kerman, Iran

Find: 14 Mar 2017

Classification: Ordinary chondrite (H5)

**History:** Collected during the 2017 joint Italian-Iranian recovery campaign

**Physical characteristics:** 2 pieces totally weighing 5.5 g.

**Petrography:** (G. Giuli, *UniCam*; V. Moggi Cecchi, G. Pratesi *UniFi*); The thin section displays a chondritic texture, with rare chondrules of various types set in abundant silicate matrix. Kamacite and troilite are diffuse and partially weathered to iron oxides. Several metal veins, altered to iron oxides, are visible;

**Geochemistry:** EMP (V. Moggi Cecchi, G. Pratesi - *UniFi*; G. Giuli - *UniCam*); Olivine in chondrules and matrix; ( $\text{Fa}_{20.8}\text{Fo}_{79.2}$ , N=9); Orthopyroxene in chondrules and matrix ( $\text{Fs}_{18.5}\text{En}_{80.4}\text{Wo}_{1.1}$ , N=5);

**Classification:** Ordinary chondrite (H5); S2; W3; Possibly paired with Kerman 205 to 213, Kerman 215, Kerman 217 to 225, Kerman 228 & 229, Kerman 232 & 233, Kerman 236 & 237, Kerman 240 to 248.

**Specimens:** A total of 2.12 g specimen is on deposit at *MSN-FI*; Di Martino holds the main mass (3.4 g).

**Kerman 220** 30°43.35'N, 57°49.30'E

Kerman, Iran

Find: 14 Mar 2017

Classification: Ordinary chondrite (H5)

**History:** Collected during the 2017 joint Italian-Iranian recovery campaign

**Physical characteristics:** A single piece weighing 1.6 g.

**Petrography:** (G. Giuli, *UniCam*; V. Moggi Cecchi, G. Pratesi *UniFi*); The thin section displays a chondritic texture, with rare chondrules of various types set in abundant silicate matrix. Kamacite and troilite are diffuse and partially weathered to iron oxides. Several metal veins, altered to iron oxides, are visible;

**Geochemistry:** EMP (V. Moggi Cecchi, G. Pratesi - *UniFi*; G. Giuli - *UniCam*); Olivine in chondrules and matrix; ( $\text{Fa}_{20.5}\text{Fo}_{79.5}$ , N=7); Orthopyroxene in chondrules and matrix ( $\text{Fs}_{17.5}\text{En}_{81.1}\text{Wo}_{1.4}$ , N=5);

**Classification:** Ordinary chondrite (H5); S2; W3; Possibly paired with Kerman 205 to 213, Kerman 215, Kerman 217 to 225, Kerman 228 & 229, Kerman 232 & 233, Kerman 236 & 237, Kerman 240 to 248.

**Specimens:** A total of 0.53 g specimen (main mass) is on deposit at *MSN-FI*; 0.32 g at *SBU*. Di Martino holds the main mass (0.54 g).

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6 **Kerman 221** 30°45.12'N, 57°48.59'E

7 Kerman, Iran

8 Find: 14 Mar 2017

9 Classification: Ordinary chondrite (H5)

10 **History:** Collected during the 2017 joint Italian-Iranian recovery campaign

11 **Physical characteristics:** A single piece weighing 13.2 g.

12 **Petrography:** (G. Giuli, *UniCam*; V. Moggi Cecchi, G. Pratesi *UniFi*); The thin section  
13 displays a chondritic texture, with rare chondrules of various types set in abundant silicate  
14 matrix. Kamacite and troilite are diffuse and partially weathered to iron oxides. Several metal  
15 veins, altered to iron oxides, are visible;

16 **Geochemistry:** EMP (V. Moggi Cecchi, G. Pratesi - *UniFi*; G. Giuli - *UniCam*); Olivine in  
17 chondrules and matrix; (Fa<sub>19.9</sub>Fo<sub>80.1</sub>, N=6); Orthopyroxene in chondrules and matrix  
18 (Fs<sub>17.7</sub>En<sub>81.2</sub>Wo<sub>1.1</sub>, N=5);

19 **Classification:** Ordinary chondrite (H5); S2; W3; Possibly paired with Kerman 205 to 213,  
20 Kerman 215, Kerman 217 to 225, Kerman 228 & 229, Kerman 232 & 233, Kerman 236 &  
21 237, Kerman 240 to 248.

22 **Specimens:** A total of 10.16 g specimen (main mass) is on deposit at *MSN-FI*; 2.82 g at *SBU*.  
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27 **Kerman 222** 30°45.12'N, 57°48.59'E

28 Kerman, Iran

29 Find: 14 Mar 2017

30 Classification: Ordinary chondrite (H5)

31 **History:** Collected during the 2017 joint Italian-Iranian recovery campaign

32 **Physical characteristics:** 45 piece totally weighing 106.3.

33 **Petrography:** (G. Giuli, *UniCam*; V. Moggi Cecchi, G. Pratesi *UniFi*); The thin section  
34 displays a chondritic texture, with rare chondrules of various types set in abundant silicate  
35 matrix. Kamacite and troilite are diffuse and partially weathered to iron oxides. Several metal  
36 veins, altered to iron oxides, are visible;

37 **Geochemistry:** EMP (V. Moggi Cecchi, G. Pratesi - *UniFi*; G. Giuli - *UniCam*); Olivine in  
38 chondrules and matrix; (Fa<sub>20.6</sub>Fo<sub>79.4</sub>, N=11); Orthopyroxene in chondrules and matrix  
39 (Fs<sub>18.0</sub>En<sub>80.2</sub>Wo<sub>1.8</sub>, N=13);

40 **Classification:** Ordinary chondrite (H5); S2; W3; Possibly paired with Kerman 205 to 213,  
41 Kerman 215, Kerman 217 to 225, Kerman 228 & 229, Kerman 232 & 233, Kerman 236 &  
42 237, Kerman 240 to 248.

43 **Specimens:** A total of 89.6 g specimen (main mass) is on deposit at *MSN-FI*; 15 pcs (tot  
44 23.23 g) at *SBU*.  
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50 **Kerman 223** 30°46.41'N, 57°47.71'E

51 Kerman, Iran

52 Find: 14 Mar 2017

53 Classification: Ordinary chondrite (H5)

54 **History:** Collected during the 2017 joint Italian-Iranian recovery campaign

55 **Physical characteristics:** A single piece weighing 4.0 g.

56 **Petrography:** (G. Giuli, *UniCam*; V. Moggi Cecchi, G. Pratesi *UniFi*); The thin section  
57 displays a chondritic texture, with rare chondrules of various types set in abundant silicate  
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matrix. Kamacite and troilite are diffuse and partially weathered to iron oxides. Several metal veins, altered to iron oxides, are visible;

**Geochemistry:** EMP (V. Moggi Cecchi, G. Pratesi - *UniFi*; G. Giuli - *UniCam*); Olivine in chondrules and matrix; ( $\text{Fa}_{20.2}\text{Fo}_{79.8}$ , N=6); Orthopyroxene in chondrules and matrix ( $\text{Fs}_{17.7}\text{En}_{80.3}\text{Wo}_{2.0}$ , N=5);

**Classification:** Ordinary chondrite (H5); S2; W3; Possibly paired with Kerman 205 to 213, Kerman 215, Kerman 217 to 225, Kerman 228 & 229, Kerman 232 & 233, Kerman 236 & 237, Kerman 240 to 248.

**Specimens:** A total of 3.65 g specimen (main mass) is on deposit at *MSN-FI*; 0.25 g at *SBU*.

**Kerman 224** 30°46.41'N, 57°47.71'E

Kerman, Iran

Find: 14 Mar 2017

Classification: Ordinary chondrite (H5)

**History:** Collected during the 2017 joint Italian-Iranian recovery campaign

**Physical characteristics:** A single piece weighing 2.5 g.

**Petrography:** (G. Giuli, *UniCam*; V. Moggi Cecchi, G. Pratesi *UniFi*); The thin section displays a chondritic texture, with rare chondrules of various types set in abundant silicate matrix. Kamacite and troilite are diffuse and partially weathered to iron oxides. Several metal veins, altered to iron oxides, are visible;

**Geochemistry:** EMP (V. Moggi Cecchi, G. Pratesi - *UniFi*; G. Giuli - *UniCam*); Olivine in chondrules and matrix; ( $\text{Fa}_{19.8}\text{Fo}_{80.2}$ , N=5); Orthopyroxene in chondrules and matrix ( $\text{Fs}_{17.7}\text{En}_{80.2}\text{Wo}_{2.1}$ , N=8);

**Classification:** Ordinary chondrite (H5); S2; W3; Possibly paired with Kerman 205 to 213, Kerman 215, Kerman 217 to 225, Kerman 228 & 229, Kerman 232 & 233, Kerman 236 & 237, Kerman 240 to 248.

**Specimens:** A total of 2.1 g specimen (main mass) is on deposit at *MSN-FI*; 0.40 g at *SBU*.

**Kerman 225** 30°44.62'N, 57°48.49'E

Kerman, Iran

Find: 14 Mar 2017

Classification: Ordinary chondrite (H5)

**History:** Collected during the 2017 joint Italian-Iranian recovery campaign

**Physical characteristics:** A single piece weighing 9.9 g.

**Petrography:** (G. Giuli, *UniCam*; V. Moggi Cecchi, G. Pratesi *UniFi*); The thin section displays a chondritic texture, with rare chondrules of various types set in abundant silicate matrix. Kamacite and troilite are diffuse and partially weathered to iron oxides. Several metal veins, altered to iron oxides, are visible;

**Geochemistry:** EMP (V. Moggi Cecchi, G. Pratesi - *UniFi*; G. Giuli - *UniCam*); Olivine in chondrules and matrix; ( $\text{Fa}_{20.8}\text{Fo}_{79.2}$ , N=7); Orthopyroxene in chondrules and matrix ( $\text{Fs}_{17.8}\text{En}_{80.8}\text{Wo}_{1.4}$ , N=6);

**Classification:** Ordinary chondrite (H5); S2; W3; Possibly paired with Kerman 205 to 213, Kerman 215, Kerman 217 to 224, Kerman 228 & 229, Kerman 232 & 233, Kerman 236 & 237, Kerman 240 to 248.

**Specimens:** A total of 3.88 g specimen is on deposit at *MSN-FI*; 1.11 g at *SBU*. Main mass (4.2 g) at University of Camerino, Italy.



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3 **Kerman 226** 30°39.92'N, 57°50.37'E

4 Kerman, Iran

5 Find: 14 Mar 2017

6 Classification: Ordinary chondrite (H5)

7 **History:** Collected during the 2017 joint Italian-Iranian recovery campaign

8 **Physical characteristics:** A single piece weighing 229.0 g covered with fusion crust.

9 **Petrography:** (G. Giuli, *UniCam*; V. Moggi Cecchi, G. Pratesi *UniFi*); The thin section  
10 displays a chondritic texture, with rare chondrules of various types set in abundant silicate  
11 matrix. Kamacite and troilite are diffuse and partially weathered to iron oxides;

12 **Geochemistry:** EMP (V. Moggi Cecchi, G. Pratesi - *UniFi*; G. Giuli - *UniCam*); Olivine in  
13 chondrules and matrix; (Fa<sub>18.4</sub>Fe<sub>81.6</sub>, N=7); Orthopyroxene in chondrules and matrix  
14 (Fs<sub>16.0</sub>En<sub>82.6</sub>Wo<sub>1.4</sub>, N=6);

15 **Classification:** Ordinary chondrite (H5); S1; W2

16 **Specimens:** A total of 180.1 g specimen (main mass) is on deposit at *MSN-FI*; 46.69 g  
17 at *SBU*.

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22 **Kerman 227** 30°42.42'N, 57°49.40'E

23 Kerman, Iran

24 Find: 14 Mar 2017

25 Classification: Ordinary chondrite (H3)

26 **History:** Collected during the 2017 joint Italian-Iranian recovery campaign

27 **Physical characteristics:** A single piece weighing 954.9 g covered with fusion crust

28 **Petrography:** (G. Giuli, *UniCam*; V. Moggi Cecchi, G. Pratesi *UniFi*); The thin section  
29 displays a marked chondritic texture, with abundant well delineated chondrules of various  
30 types set in silicate matrix. Kamacite and troilite are diffuse and partially weathered to iron  
31 oxides;

32 **Geochemistry:** EMP (V. Moggi Cecchi, G. Pratesi; G. Giuli, *UniCam*); Olivine in chondrules  
33 (Fa<sub>12.5±5.7</sub>Fe<sub>87.5±5.7</sub>, N=11); Olivine in matrix; (Fa<sub>17.3±3.9</sub>Fe<sub>82.7±3.9</sub>, N=13); Orthopyroxene in  
34 chondrules (Fs<sub>8.8±4.4</sub>En<sub>90.3±4.4</sub>Wo<sub>0.9±0.1</sub>, N=10); Orthopyroxene in matrix  
35 (Fs<sub>14.4±4.2</sub>En<sub>84.8±4.2</sub>Wo<sub>0.8±0.1</sub>, N=12);

36 **Classification:** Ordinary chondrite (H3); estimated subtype 3.8; S1; W3

37 **Specimens:** A total of 754.31 g specimen (main mass) is on deposit at *MSN-FI*; 166.0 g  
38 at *SBU*.

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43 **Kerman 228** 30°40.67'N, 57°50.57'E

44 Kerman, Iran

45 Find: 15 Mar 2017

46 Classification: Ordinary chondrite (H5)

47 **History:** Collected during the 2017 joint Italian-Iranian recovery campaign

48 **Physical characteristics:** A single piece weighing 134.7 g covered with fusion crust.

49 **Petrography:** (G. Giuli, *UniCam*; V. Moggi Cecchi, G. Pratesi *UniFi*); The thin section  
50 displays a chondritic texture, with rare chondrules of various types set in abundant silicate  
51 matrix. Kamacite and troilite are diffuse and partially weathered to iron oxides. Several metal  
52 veins, altered to iron oxides, are visible;

53 **Geochemistry:** EMP (V. Moggi Cecchi, G. Pratesi - *UniFi*; G. Giuli - *UniCam*); Olivine in  
54 chondrules and matrix; (Fa<sub>20.3</sub>Fe<sub>79.7</sub>, N=10); Orthopyroxene in chondrules and matrix  
55 (Fs<sub>17.5</sub>En<sub>81.6</sub>Wo<sub>0.9</sub>, N=7);

**Classification:** Ordinary chondrite (H5); S1; W3; Possibly paired with Kerman 205 to 213, Kerman 215, Kerman 217 to 225, Kerman 229, Kerman 232 & 233, Kerman 236 & 237, Kerman 240 to 248.

**Specimens:** A total of 125.9 g specimen (main mass) is on deposit at *MSN-FI*; 7.67 g at *SBU*.

**Kerman 229** 30°35.45'N, 57°52.87'E

Kerman, Iran

Find: 15 Mar 2017

Classification: Ordinary chondrite (H5)

**History:** Collected during the 2017 joint Italian-Iranian recovery campaign

**Physical characteristics:** 2 pieces totally weighing 4.3 g.

**Petrography:** (G. Giuli, *UniCam*; V. Moggi Cecchi, G. Pratesi *UniFi*); The thin section displays a chondritic texture, with rare chondrules of various types set in abundant silicate matrix. Kamacite and troilite are diffuse and partially weathered to iron oxides. Several metal veins, altered to iron oxides, are visible;

**Geochemistry:** EMP (V. Moggi Cecchi, G. Pratesi - *UniFi*; G. Giuli - *UniCam*); Olivine in chondrules and matrix; (Fa<sub>20.2</sub>Fe<sub>79.8</sub>, N=6); Orthopyroxene in chondrules and matrix (Fs<sub>17.4</sub>En<sub>81.6</sub>Wo<sub>1.0</sub>, N=6);

**Classification:** Ordinary chondrite (H5); S1; W3; Possibly paired with Kerman 205 to 213, Kerman 215, Kerman 217 to 225, Kerman 228, Kerman 232 & 233, Kerman 236 & 237, Kerman 240 to 248.

**Specimens:** A total of 3.44 g specimen (main mass) is on deposit at *MSN-FI*; 0.86 g at *SBU*.

**Kerman 230** 30°40.67'N, 57°50.57'E

Kerman, Iran

Find: 15 Mar 2017

Classification: Ordinary chondrite (L5)

**History:** Collected during the 2017 joint Italian-Iranian recovery campaign

**Physical characteristics:** 3 pieces totally weighing 230.5 g with fusion crust.

**Petrography:** (G. Giuli, *UniCam*; V. Moggi Cecchi, G. Pratesi *UniFi*); The thin section displays a chondritic texture, with rare chondrules of various types set in abundant silicate matrix. Scattered kamacite and troilite grains, partially weathered to iron oxides are visible;

**Geochemistry:** EMP (V. Moggi Cecchi, G. Pratesi - *UniFi*; G. Giuli - *UniCam*); Olivine in chondrules and matrix; (Fa<sub>25.0</sub>Fe<sub>75.0</sub>, N=5); Orthopyroxene in chondrules and matrix (Fs<sub>21.7</sub>En<sub>76.7</sub>Wo<sub>1.6</sub>, N=6);

**Classification:** Ordinary chondrite (L5); S1; W2

**Specimens:** A total of 69.8 g specimen is on deposit at *MSN-FI*; 10.0 g at *SBU*. Main mass (143.9 g) at University of Camerino, Italy.

**Kerman 231** 30°39.85'N, 57°50.93'E

Kerman, Iran

Find: 15 Mar 2017

Classification: Ordinary chondrite (H3)

**History:** Collected during the 2017 joint Italian-Iranian recovery campaign

**Physical characteristics:** A single piece weighing 404.6 g covered with fusion crust.

**Petrography:** (G. Giuli, *UniCam*; V. Moggi Cecchi, G. Pratesi *UniFi*); The thin section displays a marked chondritic texture, with abundant well delineated chondrules of various

types set in silicate matrix. Kamacite and troilite are diffuse and partially weathered to iron oxides;

**Geochemistry:** EMP (V. Moggi Cecchi, G. Pratesi; G. Giuli, *UniCam*); Olivine in chondrules ( $\text{Fa}_{15.4\pm 7.3}\text{Fo}_{84.6\pm 7.3}$ , N=12); Olivine in matrix; ( $\text{Fa}_{23.8\pm 4.7}\text{Fo}_{76.2\pm 4.7}$ , N=8); Orthopyroxene in chondrules ( $\text{Fs}_{13.0\pm 4.9}\text{En}_{86.2\pm 4.9}\text{Wo}_{0.8\pm 0.1}$ , N=11); Orthopyroxene in matrix ( $\text{Fs}_{17.8\pm 0.7}\text{En}_{81.3\pm 0.7}\text{Wo}_{0.9\pm 0.1}$ , N=6);

**Classification:** Ordinary chondrite (H3); estimated subtype 3.8; S2; W3

**Specimens:** A total of 336.2 g specimen (main mass) is on deposit at *MSN-FI*; 64.94 g at *SBU*.

**Kerman 232** 30°39.85'N, 57°50.93'E

Kerman, Iran

Find: 15 Mar 2017

Classification: Ordinary chondrite (H5)

**History:** Collected during the 2017 joint Italian-Iranian recovery campaign

**Physical characteristics:** A single piece weighing 3.5 g.

**Petrography:** (G. Giuli, *UniCam*; V. Moggi Cecchi, G. Pratesi *UniFi*); The thin section displays a chondritic texture, with rare chondrules of various types set in abundant silicate matrix. Kamacite and troilite are diffuse and partially weathered to iron oxides. Several metal veins, altered to iron oxides, are visible;

**Geochemistry:** EMP (V. Moggi Cecchi, G. Pratesi - *UniFi*; G. Giuli - *UniCam*); Olivine in chondrules and matrix; ( $\text{Fa}_{19.4}\text{Fo}_{80.6}$ , N=6); Orthopyroxene in chondrules and matrix ( $\text{Fs}_{17.1}\text{En}_{81.4}\text{Wo}_{1.5}$ , N=7);

**Classification:** Ordinary chondrite (H5); S2; W3; Possibly paired with Kerman 205 to 213, Kerman 215, Kerman 217 to 225, Kerman 228 & 229, Kerman 233, Kerman 236 & 237, Kerman 240 to 248.

**Specimens:** A total of 3.46 g specimen (main mass) is on deposit at *MSN-FI*;

**Kerman 233** 30°46.23'N, 57°48.20'E

Kerman, Iran

Find: 15 Mar 2017

Classification: Ordinary chondrite (H5)

**History:** Collected during the 2017 joint Italian-Iranian recovery campaign

**Physical characteristics:** A single piece weighing 88.6 g.

**Petrography:** (G. Giuli, *UniCam*; V. Moggi Cecchi, G. Pratesi *UniFi*); The thin section displays a chondritic texture, with rare chondrules of various types set in abundant silicate matrix. Kamacite and troilite are diffuse and partially weathered to iron oxides. Several metal veins, altered to iron oxides, are visible;

**Geochemistry:** EMP (V. Moggi Cecchi, G. Pratesi - *UniFi*; G. Giuli - *UniCam*); Olivine in chondrules and matrix; ( $\text{Fa}_{19.3}\text{Fo}_{80.7}$ , N=6); Orthopyroxene in chondrules and matrix ( $\text{Fs}_{17.0}\text{En}_{81.6}\text{Wo}_{1.4}$ , N=5);

**Classification:** Ordinary chondrite (H5); S2; W3; Possibly paired with Kerman 205 to 213, Kerman 215, Kerman 217 to 225, Kerman 228 & 229, Kerman 232, Kerman 236 & 237, Kerman 240 to 248.

**Specimens:** A total of 35.63 g specimen is on deposit at *MSN-FI*; 7.73 g at *SBU*. Main mass (46.3 g) at University of Camerino, Italy.

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3 **Kerman 234** 30°46.23'N, 57°48.20'E

4 Kerman, Iran

5 Find: 15 Mar 2017

6 Classification: Ordinary chondrite (H6)

7 **History:** Collected during the 2017 joint Italian-Iranian recovery campaign

8 **Physical characteristics:** A single piece weighing 207.2 g covered with fusion crust.

9 **Petrography:** (G. Giuli, *UniCam*; V. Moggi Cecchi, G. Pratesi *UniFi*); The thin section  
10 displays a faint chondritic texture, with very rare relic chondrules in a fine-grained silicate  
11 matrix. Kamacite and troilite are diffuse and partially weathered to iron oxides;

12 **Geochemistry:** EMP (V. Moggi Cecchi, G. Pratesi - *UniFi*; G. Giuli - *UniCam*); Olivine in  
13 chondrules and matrix; (Fa<sub>19.7</sub>Fe<sub>80.3</sub>, N=9); Orthopyroxene in chondrules and matrix  
14 (Fs<sub>17.1</sub>En<sub>81.5</sub>Wo<sub>1.4</sub>, N=8);

15 **Classification:** Ordinary chondrite (H6); S2; W3

16 **Specimens:** A total of 74.5 g specimen is on deposit at *MSN-FI*; 33.67 g at *SBU*. Main mass  
17 (91.3 g) at University of Camerino, Italy.  
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23 **Kerman 235** 30°46.23'N, 57°48.20'E

24 Kerman, Iran

25 Find: 15 Mar 2017

26 Classification: Ordinary chondrite (H4)

27 **History:** Collected during the 2017 joint Italian-Iranian recovery campaign

28 **Physical characteristics:** A single piece weighing 125.4 g covered with fusion crust.

29 **Petrography:** (G. Giuli, *UniCam*; V. Moggi Cecchi, G. Pratesi *UniFi*); The thin section  
30 displays a marked chondritic texture, with scattered evident chondrules of various types set in  
31 silicate matrix. Kamacite and troilite are diffuse and partially weathered to iron oxides;

32 **Geochemistry:** EMP (V. Moggi Cecchi, G. Pratesi - *UniFi*; G. Giuli - *UniCam*); Olivine in  
33 chondrules and matrix; (Fa<sub>19.2</sub>Fe<sub>80.8</sub>, N=7); Orthopyroxene in chondrules and matrix  
34 (Fs<sub>16.7</sub>En<sub>81.9</sub>Wo<sub>1.4</sub>, N=5);

35 **Classification:** Ordinary chondrite (H4); S2; W3

36 **Specimens:** A total of 45.7 g specimen is on deposit at *MSN-FI*; 27.3 g at *SBU*. Di Martino  
37 holds the main mass (46.4 g).  
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42 **Kerman 236** 30°46.23'N, 57°48.20'E

43 Kerman, Iran

44 Find: 15 Mar 2017

45 Classification: Ordinary chondrite (H5)

46 **History:** Collected during the 2017 joint Italian-Iranian recovery campaign

47 **Physical characteristics:** 4 pieces totally weighing 70.7 g with fusion crust.

48 **Petrography:** (G. Giuli, *UniCam*; V. Moggi Cecchi, G. Pratesi *UniFi*); The thin section  
49 displays a chondritic texture, with rare chondrules of various types set in abundant silicate  
50 matrix. Kamacite and troilite are diffuse and partially weathered to iron oxides. Several metal  
51 veins, altered to iron oxides, are visible;

52 **Geochemistry:** EMP (V. Moggi Cecchi, G. Pratesi - *UniFi*; G. Giuli - *UniCam*); Olivine in  
53 chondrules and matrix; (Fa<sub>19.1</sub>Fe<sub>80.9</sub>, N=6); Orthopyroxene in chondrules and matrix  
54 (Fs<sub>17.9</sub>En<sub>80.9</sub>Wo<sub>1.2</sub>, N=6);

55 **Classification:** Ordinary chondrite (H5); S2; W3; Possibly paired with Kerman 205 to 213,  
56 Kerman 215, Kerman 217 to 225, Kerman 228 & 229, Kerman 232 & 233, Kerman 237,  
57 Kerman 240 to 248.  
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3 **Specimens:** A total of 54.67 g specimen (main mass) is on deposit at *MSN-FI*; 15.99 g  
4 at *SBU*.  
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8 **Kerman 237** 30°46.23'N, 57°48.20'E

9 Kerman, Iran

10 Find: 15 Mar 2017

11 Classification: Ordinary chondrite (H5)

12 **History:** Collected during the 2017 joint Italian-Iranian recovery campaign

13 **Physical characteristics:** 3 pieces totally weighing 16.6 g.

14 **Petrography:** (G. Giuli, *UniCam*; V. Moggi Cecchi, G. Pratesi *UniFi*); The thin section  
15 displays a chondritic texture, with rare chondrules of various types set in abundant silicate  
16 matrix. Kamacite and troilite are diffuse and partially weathered to iron oxides. Several metal  
17 veins, altered to iron oxides, are visible;

18 **Geochemistry:** EMP (V. Moggi Cecchi, G. Pratesi - *UniFi*; G. Giuli - *UniCam*); Olivine in  
19 chondrules and matrix; (Fa<sub>19.7</sub>Fe<sub>80.3</sub>, N=7); Orthopyroxene in chondrules and matrix  
20 (Fs<sub>16.8</sub>En<sub>81.9</sub>Wo<sub>1.3</sub>, N=6);

21 **Classification:** Ordinary chondrite (H5); S2; W3; Possibly paired with Kerman 205 to 213,  
22 Kerman 215, Kerman 217 to 225, Kerman 228 & 229, Kerman 232 & 233, Kerman 236,  
23 Kerman 240 to 248.

24 **Specimens:** A total of 12.17 g specimen (main mass) is on deposit at *MSN-FI*; 4.40 g at *SBU*.  
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30 **Kerman 238** 30°47.28'N, 57°47.88'E

31 Kerman, Iran

32 Find: 15 Mar 2017

33 Classification: Ordinary chondrite (L5)

34 **History:** Collected during the 2017 joint Italian-Iranian recovery campaign

35 **Physical characteristics:** A single piece weighing 76.9 g covered with fusion crust.

36 **Petrography:** (G. Giuli, *UniCam*; V. Moggi Cecchi, G. Pratesi *UniFi*); The thin section  
37 displays a chondritic texture, with rare chondrules of various types set in abundant silicate  
38 matrix. Scattered kamacite and troilite grains, partially weathered to iron oxides are visible;

39 **Geochemistry:** EMP (V. Moggi Cecchi, G. Pratesi - *UniFi*; G. Giuli - *UniCam*); Olivine in  
40 chondrules and matrix; (Fa<sub>25.7</sub>Fe<sub>74.3</sub>, N=10); Orthopyroxene in chondrules and matrix  
41 (Fs<sub>21.3</sub>En<sub>77.2</sub>Wo<sub>1.5</sub>, N=10);

42 **Classification:** Ordinary chondrite (L5); S1; W3

43 **Specimens:** A total of 76.9 g specimen (main mass) is on deposit at *MSN-FI*;  
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48 **Kerman 239** 30°35.52'N, 57°51.80'E

49 Kerman, Iran

50 Find: 16 Mar 2017

51 Classification: Ordinary chondrite (H5)

52 **History:** Collected during the 2017 joint Italian-Iranian recovery campaign

53 **Physical characteristics:** A single piece weighing 8.6 g.

54 **Petrography:** (G. Giuli, *UniCam*; V. Moggi Cecchi, G. Pratesi *UniFi*); The thin section  
55 displays a chondritic texture, with rare chondrules of various types set in abundant silicate  
56 matrix. Kamacite and troilite are diffuse and partially weathered to iron oxides;  
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**Geochemistry:** EMP (V. Moggi Cecchi, G. Pratesi - *UniFi*; G. Giuli - *UniCam*); Olivine in chondrules and matrix; (Fa<sub>20.0</sub>Fe<sub>80.0</sub>, N=12); Orthopyroxene in chondrules and matrix (Fs<sub>17.4</sub>En<sub>81.1</sub>Wo<sub>1.5</sub>, N=10);

**Classification:** Ordinary chondrite (H5); S1; W3

**Specimens:** A total of 3.13 g specimen is on deposit at *MSN-FI*; 1.50 g at *SBU*. Main mass (3.4 g) at University of Camerino, Italy.

**Kerman 240** 30°46.42'N, 57°49.15'E

Kerman, Iran

Find: 16 Mar 2017

Classification: Ordinary chondrite (H5)

**History:** Collected during the 2017 joint Italian-Iranian recovery campaign

**Physical characteristics:** 5 pieces totally weighing 14.6 g.

**Petrography:** (G. Giuli, *UniCam*; V. Moggi Cecchi, G. Pratesi *UniFi*); The thin section displays a chondritic texture, with rare chondrules of various types set in abundant silicate matrix. Kamacite and troilite are diffuse and partially weathered to iron oxides. Several metal veins, altered to iron oxides, are visible;

**Geochemistry:** EMP (V. Moggi Cecchi, G. Pratesi - *UniFi*; G. Giuli - *UniCam*); Olivine in chondrules and matrix; (Fa<sub>20.7</sub>Fe<sub>79.3</sub>, N=6); Orthopyroxene in chondrules and matrix (Fs<sub>19.0</sub>En<sub>80.0</sub>Wo<sub>1.0</sub>, N=7);

**Classification:** Ordinary chondrite (H5); S2; W3; Possibly paired with Kerman 205 to 213, Kerman 215, Kerman 217 to 225, Kerman 228 & 229, Kerman 232 & 233, Kerman 236 & 237, Kerman 241 to 248.

**Specimens:** A total of 12.08 g specimen (main mass) is on deposit at *MSN-FI*; 4 pcs (tot 2.51 g) at *SBU*.

**Kerman 241** 30°39.98'N, 57°58.15'E

Kerman, Iran

Find: 18 Mar 2017

Classification: Ordinary chondrite (H5)

**History:** Collected during the 2017 joint Italian-Iranian recovery campaign

**Physical characteristics:** A single piece weighing 255.0 g covered with fusion crust.

**Petrography:** (G. Giuli, *UniCam*; V. Moggi Cecchi, G. Pratesi *UniFi*); The thin section displays a chondritic texture, with rare chondrules of various types set in abundant silicate matrix. Kamacite and troilite are diffuse and partially weathered to iron oxides. Several metal veins, altered to iron oxides, are visible;

**Geochemistry:** EMP (V. Moggi Cecchi, G. Pratesi - *UniFi*; G. Giuli - *UniCam*); Olivine in chondrules and matrix; (Fa<sub>19.5</sub>Fe<sub>80.5</sub>, N=5); Orthopyroxene in chondrules and matrix (Fs<sub>17.9</sub>En<sub>81.0</sub>Wo<sub>1.1</sub>, N=6);

**Classification:** Ordinary chondrite (H5); S2; W3; Possibly paired with Kerman 205 to 213, Kerman 215, Kerman 217 to 225, Kerman 228 & 229, Kerman 232 & 233, Kerman 236 & 237, Kerman 240 to 248.

**Specimens:** A total of 198.3 g specimen (main mass) is on deposit at *MSN-FI*; 3 pcs (tot 51.40 g) at *SBU*.

**Kerman 242** 30°46.00'N, 57°47.52'E

Kerman, Iran

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3 Find: 19 Mar 2017

4 Classification: Ordinary chondrite (H5)

5 **History:** Collected during the 2017 joint Italian-Iranian recovery campaign

6 **Physical characteristics:** A single piece weighing 31.2 g covered with fusion crust.

7 **Petrography:** (G. Giuli, *UniCam*; V. Moggi Cecchi, G. Pratesi *UniFi*); The thin section  
8 displays a chondritic texture, with rare chondrules of various types set in abundant silicate  
9 matrix. Kamacite and troilite are diffuse and partially weathered to iron oxides. Several metal  
10 veins, altered to iron oxides, are visible;

11 **Geochemistry:** EMP (V. Moggi Cecchi, G. Pratesi - *UniFi*; G. Giuli - *UniCam*); Olivine in  
12 chondrules and matrix; (Fa<sub>20.8</sub>Fe<sub>79.2</sub>, N=8); Orthopyroxene in chondrules and matrix  
13 (Fs<sub>18.0</sub>En<sub>80.5</sub>Wo<sub>1.5</sub>, N=9);

14 **Classification:** Ordinary chondrite (H5); S2; W3; Possibly paired with Kerman 205 to 213,  
15 Kerman 215, Kerman 217 to 225, Kerman 228 & 229, Kerman 232 & 233, Kerman 236 &  
16 237, Kerman 240 to 248.

17 **Specimens:** A total of 9.98 g specimen is on deposit at *MSN-FI*; 3.57 g at *SBU*. Main mass  
18 (16.9 g) at *OAM*.  
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24 **Kerman 243** 30°45.83'N, 57°47.52'E

25 Kerman, Iran

26 Find: 19 Mar 2017

27 Classification: Ordinary chondrite (H5)

28 **History:** Collected during the 2017 joint Italian-Iranian recovery campaign

29 **Physical characteristics:** A single piece weighing 68.9 g covered with fusion crust.

30 **Petrography:** (G. Giuli, *UniCam*; V. Moggi Cecchi, G. Pratesi *UniFi*); The thin section  
31 displays a chondritic texture, with rare chondrules of various types set in abundant silicate  
32 matrix. Kamacite and troilite are diffuse and partially weathered to iron oxides. Several metal  
33 veins, altered to iron oxides, are visible;

34 **Geochemistry:** EMP (V. Moggi Cecchi, G. Pratesi - *UniFi*; G. Giuli - *UniCam*); Olivine in  
35 chondrules and matrix; (Fa<sub>20.0</sub>Fe<sub>80.0</sub>, N=9); Orthopyroxene in chondrules and matrix  
36 (Fs<sub>17.4</sub>En<sub>81.3</sub>Wo<sub>1.3</sub>, N=6);

37 **Classification:** Ordinary chondrite (H5); S2; W3; Possibly paired with Kerman 205 to 213,  
38 Kerman 215, Kerman 217 to 225, Kerman 228 & 229, Kerman 232 & 233, Kerman 236 &  
39 237, Kerman 240 to 248.

40 **Specimens:** A total of 56.7 g specimen (main mass) is on deposit at *MSN-FI*; 10.7 g at *SBU*.  
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46 **Kerman 244** 30°45.73'N, 57°47.60'E

47 Kerman, Iran

48 Find: 19 Mar 2017

49 Classification: Ordinary chondrite (H5)

50 **History:** Collected during the 2017 joint Italian-Iranian recovery campaign

51 **Physical characteristics:** A single piece weighing 13.2 g.

52 **Petrography:** (G. Giuli, *UniCam*; V. Moggi Cecchi, G. Pratesi *UniFi*); The thin section  
53 displays a chondritic texture, with rare chondrules of various types set in abundant silicate  
54 matrix. Kamacite and troilite are diffuse and partially weathered to iron oxides. Several metal  
55 veins, altered to iron oxides, are visible;

56 **Geochemistry:** EMP (V. Moggi Cecchi, G. Pratesi - *UniFi*; G. Giuli - *UniCam*); Olivine in  
57 chondrules and matrix; (Fa<sub>20.8</sub>Fe<sub>79.2</sub>, N=6); Orthopyroxene in chondrules and matrix  
58 (Fs<sub>18.7</sub>En<sub>80.0</sub>Wo<sub>1.3</sub>, N=5);  
59  
60

**Classification:** Ordinary chondrite (H5); S2; W3; Possibly paired with Kerman 205 to 213, Kerman 215, Kerman 217 to 225, Kerman 228 & 229, Kerman 232 & 233, Kerman 236 & 237, Kerman 240 to 248.

**Specimens:** A total of 12.3 g specimen (main mass) is on deposit at *MSN-FI*; 0.90 g at *SBU*.

**Kerman 245** 30°45.70'N, 57°47.62'E

Kerman, Iran

Find: 19 Mar 2017

Classification: Ordinary chondrite (L5)

**History:** Collected during the 2017 joint Italian-Iranian recovery campaign

**Physical characteristics:** A single piece weighing 9.1 g.

**Petrography:** (G. Giuli, *UniCam*; V. Moggi Cecchi, G. Pratesi *UniFi*); The thin section displays a chondritic texture, with rare chondrules of various types set in abundant silicate matrix. Scattered kamacite and troilite grains, partially weathered to iron oxides are visible;

**Geochemistry:** EMP (V. Moggi Cecchi, G. Pratesi - *UniFi*; G. Giuli - *UniCam*); Olivine in chondrules and matrix; (Fa<sub>23.6</sub>Fe<sub>76.4</sub>, N=7); Orthopyroxene in chondrules and matrix (Fs<sub>21.3</sub>En<sub>77.2</sub>Wo<sub>1.5</sub>, N=6);

**Classification:** Ordinary chondrite (L5); S2; W3;

**Specimens:** A total of 8.17 g specimen (main mass) is on deposit at *MSN-FI*; 0.63 g at *SBU*.

**Kerman 246** 30°45.55'N, 57°47.74'E

Kerman, Iran

Find: 19 Mar 2017

Classification: Ordinary chondrite (H5)

**History:** Collected during the 2017 joint Italian-Iranian recovery campaign

**Physical characteristics:** 14 pieces totally weighing 90.7g with fusion crust.

**Petrography:** (G. Giuli, *UniCam*; V. Moggi Cecchi, G. Pratesi *UniFi*); The thin section displays a chondritic texture, with rare chondrules of various types set in abundant silicate matrix. Kamacite and troilite are diffuse and partially weathered to iron oxides. Several metal veins, altered to iron oxides, are visible;

**Geochemistry:** EMP (V. Moggi Cecchi, G. Pratesi - *UniFi*; G. Giuli - *UniCam*); Olivine in chondrules and matrix; (Fa<sub>19.2</sub>Fe<sub>80.8</sub>, N=9); Orthopyroxene in chondrules and matrix (Fs<sub>16.7</sub>En<sub>82.1</sub>Wo<sub>1.2</sub>, N=7);

**Classification:** Ordinary chondrite (H5); S2; W3; Possibly paired with Kerman 205 to 213, Kerman 215, Kerman 217 to 225, Kerman 228 & 229, Kerman 232 & 233, Kerman 236 & 237, Kerman 240 to 248.

**Specimens:** A total of 72.24 g specimen (main mass) is on deposit at *MSN-FI*; 7 pcs (tot 18.48 g) at *SBU*.

**Kerman 247** 30°45.36'N, 57°47.71'E

Kerman, Iran

Find: 19 Mar 2017

Classification: Ordinary chondrite (H5)

**History:** Collected during the 2017 joint Italian-Iranian recovery campaign

**Physical characteristics:** 2 pieces totally weighing 54.0 g with fusion crust.

**Petrography:** (G. Giuli, *UniCam*; V. Moggi Cecchi, G. Pratesi *UniFi*); The thin section displays a chondritic texture, with rare chondrules of various types set in abundant silicate

matrix. Kamacite and troilite are diffuse and partially weathered to iron oxides. Several metal veins, altered to iron oxides, are visible;

**Geochemistry:** EMP (V. Moggi Cecchi, G. Pratesi - *UniFi*; G. Giuli - *UniCam*); Olivine in chondrules and matrix; ( $\text{Fa}_{20.2}\text{Fo}_{79.8}$ , N=6); Orthopyroxene in chondrules and matrix ( $\text{Fs}_{17.8}\text{En}_{80.6}\text{Wo}_{1.6}$ , N=6);

**Classification:** Ordinary chondrite (H5); S2; W3; Possibly paired with Kerman 205 to 213, Kerman 215, Kerman 217 to 225, Kerman 228 & 229, Kerman 232 & 233, Kerman 236 & 237, Kerman 240 to 248.

**Specimens:** A total of 16.6 g specimen is on deposit at *MSN-FI*; 1.55 g at *SBU*. Main mass (33.4 g) at University of Camerino, Italy.

**Kerman 248** 30°45.36'N, 57°47.71'E

Kerman, Iran

Find: 19 Mar 2017

Classification: Ordinary chondrite (H5)

**History:** Collected during the 2017 joint Italian-Iranian recovery campaign

**Physical characteristics:** 3 pieces totally weighing 4.7 g.

**Petrography:** (G. Giuli, *UniCam*; V. Moggi Cecchi, G. Pratesi *UniFi*); The thin section displays a chondritic texture, with rare chondrules of various types set in abundant silicate matrix. Kamacite and troilite are diffuse and partially weathered to iron oxides. Several metal veins, altered to iron oxides, are visible;

**Geochemistry:** EMP (V. Moggi Cecchi, G. Pratesi - *UniFi*; G. Giuli - *UniCam*); Olivine in chondrules and matrix; ( $\text{Fa}_{20.8}\text{Fo}_{78.0}$ , N=5); Orthopyroxene in chondrules and matrix ( $\text{Fs}_{18.9}\text{En}_{79.9}\text{Wo}_{1.2}$ , N=5);

**Classification:** Ordinary chondrite (H5); S2; W3; Possibly paired with Kerman 205 to 213, Kerman 215, Kerman 217 to 225, Kerman 228 & 229, Kerman 232 & 233, Kerman 236 & 237, Kerman 240 to 247.

**Specimens:** A total of 1.25 g specimen is on deposit at *MSN-FI*; 0.94 g at *SBU*. Main mass (2.5 g) at University of Camerino, Italy.

**Kerman 249** 30°32.73'N, 57°45.93'E

Kerman, Iran

Find: 17 Mar 2017

Classification: Ordinary chondrite (L5)

**History:** Collected during the 2017 joint Italian-Iranian recovery campaign

**Physical characteristics:** A single piece weighing 17.0 g.

**Petrography:** (G. Giuli, *UniCam*; V. Moggi Cecchi, G. Pratesi *UniFi*); The thin section displays a chondritic texture, with rare chondrules of various types set in abundant silicate matrix. Scattered kamacite and troilite grains, partially weathered to iron oxides are visible;

**Geochemistry:** EMP (V. Moggi Cecchi, G. Pratesi - *UniFi*; G. Giuli - *UniCam*); Olivine in chondrules and matrix; ( $\text{Fa}_{26.0}\text{Fo}_{74.0}$ , N=6); Orthopyroxene in chondrules and matrix ( $\text{Fs}_{22.6}\text{En}_{76.1}\text{Wo}_{1.3}$ , N=6);

**Classification:** Ordinary chondrite (L5); S2; W3

**Specimens:** A total of 10.5 g specimen (main mass) is on deposit at *MSN-FI*; 6.30 g at *SBU*.

**Kerman 253** 30°45.353'N, 57°48.126'E

Kerman, Iran

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3 Find: 2017 Jan 9

4 Classification: Ordinary chondrite (H5)

5 **History:** Meteorite (one sample, 29.4 g) was found 9 January 2017 by the *UrFU* meteorite  
6 expedition-2017 in Iran (Pastukhovich A.Yu., Larionov M.Yu., Kruglikov N.A., Zamyatin  
7 D.A.) in the northwest part of the Kalout region of the Lut desert. This meteorite was  
8 observed on the hard surface (probably, the place of fall).

9 **Physical characteristics:** Total mass is 29.4 g. Meteorite has angular to roughly rounded  
10 shape. The surface and interior of the meteorite is light to dark brown in color due to abundant  
11 Fe-hydroxides. Some parts have glassy-like surface due to desert weathering. Fusion crust  
12 was locally observed (60-150  $\mu\text{m}$ ). Some small cracks are totally filled with Fe-hydroxides.

13 **Petrography:** Classification (Victor V. Sharygin, *SIGM* and *UrFU*). Petrographic observation  
14 of a polished section shows chondrules in a recrystallized matrix. Chondrules are readily  
15 delineated and their sizes mostly vary from 200 to 700  $\mu\text{m}$ . They have BO, POP and RP  
16 texture and some of them consist of Ol+Opx+Cpx+Pl $\pm$ Crt or Ol+Opx+Pl $\pm$ Crt. Large  
17 chondrules (1.5-5 mm) also occur. Olivine, low-Ca pyroxene and plagioclase are the main  
18 minerals in matrix. Plagioclase grains are less than 50  $\mu\text{m}$ . This indicates a petrologic type of  
19 5 for the meteorite. Undulatory extinction and irregular fractures in olivine, as well as the  
20 absence of opaque shock veins and melt pockets, indicate a shock stage of S2. Relics of fresh  
21 FeNi metals (kamacite, taenite, tetrataenite, up to 450  $\mu\text{m}$ ) and troilite (up to 200  $\mu\text{m}$ ) are rare  
22 due to intensive alteration. Weathering products (goethite, "hydrogoethite", akaganeite,  
23 droninoite and other Fe-hydroxides, rarely siderite and anhydrite) occur as veins and in situ  
24 alteration of FeNi-metals and troilite and fill all microfractures in minerals from matrix and  
25 chondrules. The replacement of olivine by serpentine is occasionally fixed in outer zones of  
26 grains (weathering grade – W3). Clinopyroxene, chromite, chlorapatite and merrillite (up to  
27 200  $\mu\text{m}$ ) occur locally in the matrix. Pyrrhotite and hydrated sulfide FeS $\cdot$ nH<sub>2</sub>O (alteration of  
28 troilite?) form grains up to 100  $\mu\text{m}$ . Fusion crust (60-150  $\mu\text{m}$  in thickness) is fine-grained and  
29 contains skeletal crystals of olivine (10-50  $\mu\text{m}$ ), mafic glass and metal-sulfide blebs  
30 (martensite or taenite and troilite, 1-20  $\mu\text{m}$ ).

31 **Geochemistry:** EDS-WDS analyses (Victor V. Sharygin, *SIGM* and *UrFU*). The primary  
32 chondrite paragenesis includes olivine Fa<sub>19.51 $\pm$ 0.13</sub> (N=24), low-Ca-pyroxene  
33 Fs<sub>17.37 $\pm$ 0.38</sub>Wo<sub>1.29 $\pm$ 0.15</sub> (N=26), plagioclase Ab<sub>83.0</sub>An<sub>11.5</sub>Or<sub>5.5</sub> (N=7), Cr-bearing clinopyroxene  
34 En<sub>47.0</sub>Fs<sub>6.7</sub>Wo<sub>46.3</sub> (Cr<sub>2</sub>O<sub>3</sub> – 0.8 wt.%, N=1), chromite Cr<sub>80.4</sub>Spl<sub>14.3</sub> (N=8), chlorapatite,  
35 merrillite, FeNi-metals and troilite. Chlorapatite contains F (0.9 wt.%) and Cl (4.4 wt.%,  
36 N=1). Merrillite is poor in FeO (0.4-0.7 wt.%, N=7). Composition of metals (in wt.%):  
37 kamacite (N=16) – Fe 92.51 $\pm$ 1.21, Ni – 6.80 $\pm$ 1.10, Co – 0.57 $\pm$ 0.08; taenite (N=3) – Fe 68.73,  
38 Ni 31.03, Co 0.27; tetrataenite (N=6) – Fe 49.92 $\pm$ 3.95; Ni 49.89 $\pm$ 3.96, Co 0.22 $\pm$ 0.02. Troilite  
39 is close to ideal FeS. Composition of pyrrhotite (in wt.%, N=8): Fe 59.54 $\pm$ 1.44, Ni 1.44 $\pm$ 1.08;  
40 S 39.04 $\pm$ 0.53. Fe-rich serpentine-group mineral contains NiO (up to 1.1 wt.%). Goethite and  
41 "hydrogoethite" contain 3.9-16.1 wt.% NiO, up to 0.6 wt.% CoO. Droninoite bears NiO  
42 (47.4), FeO (19.4) and Cl (8.6 wt.%).

43 **Classification:** (Victor V. Sharygin, *SIGM* and *UrFU*). Ordinary chondrite. H5, S2, W2-3.

44 **Specimens:** 14.7 g (cut-off) – *UrFU*; 7.2 g (cut-off) and thin section – *SIGM*.

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47 **Kerman 254** 30°45.299'N, 57°48.005'E

48 Kerman, Iran

49 Find: 2017 Jan 9

50 Classification: Ordinary chondrite (H5)

51 **History:** Meteorite (11 samples, 534.28 g) was found 9 January 2017 by the *UrFU* meteorite  
52 expedition-2017 in Iran (Pastukhovich A.Yu., Larionov M.Yu., Kruglikov N.A., Zamyatin  
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D.A.) in the northwest part of the Kalout region of the Lut desert. All fragments of the meteorite were observed on the hard surface (probably, the place of fall).

**Physical characteristics:** Total mass is 534.28 g. All fragments have angular to roughly rounded shape. The surface and interior of the meteorite is light to dark brown in color due to abundant Fe-hydroxides. Some parts have glassy-like surface due to desert weathering. Some small cracks are totally filled with Fe-hydroxides and sulfates.

**Petrography:** Classification (Victor V. Sharygin, *SIGM* and *UrFU*). Petrographic observation of a polished section shows chondrules in a recrystallized matrix. Chondrules are readily delineated and their sizes mostly vary from 600 to 1000  $\mu\text{m}$ . They have BO, POP and GOP texture and some of them consist of Ol+Opx+Cpx+Pl $\pm$ Crt or Ol+Opx+Pl $\pm$ Crt. Olivine, low-Ca-pyroxene and plagioclase are main minerals in middle-grained matrix. Plagioclase grains are less than 50  $\mu\text{m}$ . This indicates a petrologic type of 5 for the meteorite. Undulatory extinction and irregular fractures in olivine, as well as the absence of opaque shock veins and melt pockets, indicate a shock stage of S2. Fresh FeNi metals and troilite are very rare due to intensive alteration. Relics of taenite grains (up to 50  $\mu\text{m}$ ) were observed only. Weathering products (goethite, "hydrogoethite", akaganeite, droninoite and other Fe-hydroxides, rarely siderite and anhydrite) are very abundant and occur as veins and in situ alteration of FeNi-metals and troilite and fill all microfractures in minerals from matrix and chondrules (weathering grade – W3-4). Clinopyroxene, chromite, chlorapatite and merrillite (up to 150  $\mu\text{m}$ ) occur locally in the matrix; K-feldspar is found in the BO chondrules. Pyrrhotite and hydrated sulfide FeS $\cdot$ nH<sub>2</sub>O (alteration after troilite?) form grains up to 20-50  $\mu\text{m}$ . Association of anhydrite and natrojarosite is occasionally present in alteration products.

**Geochemistry:** EDS-WDS analyses (Victor V. Sharygin, *SIGM* and *UrFU*). The primary chondrite paragenesis includes olivine 19.32 $\pm$ 0.19 (N=33), low-Ca pyroxene Fs<sub>17.29 $\pm$ 0.28</sub>Wo<sub>1.45 $\pm$ 0.21</sub> (N=28), plagioclase Ab<sub>81.2</sub>An<sub>12.3</sub>Or<sub>6.5</sub> (N=15), K-feldspar Ab<sub>8.6</sub>An<sub>4.7</sub>Or<sub>86.7</sub> (N=1), Cr-bearing clinopyroxene En<sub>46.2</sub>Fs<sub>7.2</sub>Wo<sub>46.6</sub> (Cr<sub>2</sub>O<sub>3</sub> – 0.9 wt.%, N=4), chromite Cr<sub>80.5</sub>Sp<sub>14.3</sub> (N=12), chlorapatite, merrillite, FeNi-metals and troilite. Chlorapatite contains F (0.8 wt.%) and Cl (5.2 wt.%, N=4). Merrillite is poor in FeO (0.4-0.8 wt.%, N=6). Composition of taenite (in wt.%, N=4): Fe 74.51, Ni 25.26, Co 0.25. Pyrrhotite bears up to 7.6 wt.% Ni. Fe-rich serpentine-group mineral contains NiO (up to 1.1 wt.%). Goethite and "hydrogoethite" contain 2.5-13.4 wt.% NiO, up to 0.8 wt.% CoO.

**Classification:** (Victor V. Sharygin, *SIGM* and *UrFU*). Ordinary chondrite. H5, S2, W3-4.

**Specimens:** 521.54 g (10 samples) – *UrFU*; 12.74 g (1 sample) and thin section – *SIGM*.

**Kerman 255**      30°45.477'N, 57°48.085'E

Kerman, Iran

Find: 2017 Jan 9

Classification: Ordinary chondrite (H5)

**History:** Meteorite (3 samples, 35.3 g) was found 9 January 2017 by the *UrFU* meteorite expedition-2017 in Iran (Pastukhovich A.Yu., Larionov M.Yu., Kruglikov N.A., Zamyatin D.A.) in the northwest part of the Kalout region of the Lut desert. All fragments of the meteorite were observed on the hard surface (probably, the place of fall).

**Physical characteristics:** Total mass is 35.3 g. All fragments have angular to roughly rounded shape. The surface and interior of the meteorite is light to dark brown in color due to abundant Fe-hydroxides. Some parts have glassy-like surface due to desert weathering. Some small cracks are totally filled with Fe-hydroxides and sulfates.

**Petrography:** Classification (Victor V. Sharygin, *SIGM* and *UrFU*). Petrographic observation of a polished section shows chondrules in a recrystallized matrix. Chondrules are readily delineated and their sizes mostly vary from 600 to 1000  $\mu\text{m}$ . They have PO, POP and RP

texture and some of them consist of Ol+Opx+Cpx+Pl±Crt or Ol+Opx+Pl±Crt. Olivine, low-Ca-pyroxene and plagioclase are main minerals in middle-grained matrix. Plagioclase grains are less than 50  $\mu\text{m}$ . This indicates a petrologic type of 5 for the meteorite. Undulatory extinction and irregular fractures in olivine, as well as the absence of opaque shock veins and melt pockets, indicate a shock stage of S2. Grains of FeNi metals (kamacite, taenite, tetrataenite, up to 300  $\mu\text{m}$ ) and troilite (up to 250  $\mu\text{m}$ ) are partially altered. Weathering products (goethite, "hydrogoethite", akaganeite and other Fe-hydroxides, rarely anhydrite and magnetite) occur as veins and in situ alteration of FeNi-metals and troilite and fill all microfractures in minerals from matrix and chondrules (weathering grade – W2).

Clinopyroxene, chromite, chlorapatite and merrillite (up to 300  $\mu\text{m}$ ) occur locally in the matrix. Pyrrhotite and hydrated sulfide  $\text{FeS}\cdot\text{nH}_2\text{O}$  (alteration after troilite?) form grains up to 100-200  $\mu\text{m}$ .

**Geochemistry:** EDS-WDS analyses (Victor V. Sharygin, *SIGM* and *UrFU*). The primary chondrite paragenesis includes olivine  $\text{Fa}_{19.68\pm 0.20}$  (N=42), low-Ca-pyroxene  $\text{Fs}_{17.03\pm 0.23}\text{Wo}_{1.42\pm 0.22}$  (N=31), plagioclase  $\text{Ab}_{82.8}\text{An}_{11.1}\text{Or}_{6.1}$  (N=11), Cr-bearing clinopyroxene  $\text{En}_{46.6}\text{Fs}_{7.7}\text{Wo}_{45.7}$  ( $\text{Cr}_2\text{O}_3$  – 0.8 wt.%, N=5), chromite  $\text{Crt}_{80.9}\text{Spl}_{13.9}$  (N=7), chlorapatite, merrillite, FeNi-metals and troilite. Chlorapatite contains F (0.8-1.1 wt.%) and Cl (4.5-4.9 wt.%, N=2). Merrillite is poor in FeO (0.5-1.8 wt.%, N=12). Composition of metals (in wt.%): kamacite (N=11) – Fe 93.69 $\pm$ 1.88, Ni – 5.76 $\pm$ 1.86, Co – 0.56 $\pm$ 0.07; taenite (N=14) – Fe 72.97 $\pm$ 4.06, Ni 26.68 $\pm$ 4.11, Co 0.32 $\pm$ 0.05; tetrataenite (N=10) – Fe 48.34 $\pm$ 1.78; Ni 51.39 $\pm$ 1.88, Co 0.20 $\pm$ 0.08. Troilite is close to ideal FeS. Pyrrhotite bears up to 2.2 wt.% Ni. Goethite and "hydrogoethite" contain up to 6.6 wt.% NiO and up to 0.7 wt.% CoO.

**Classification:** (Victor V. Sharygin, *SIGM* and *UrFU*). Ordinary chondrite. H5, S2, W2.

**Specimens:** 24.7 g (2 samples) – *UrFU*; 10.6 g (1 sample) and thin section – *SIGM*.

**Kolang** 1°53'18.8"N, 98°39'39.6"E

Sumatera Utara, Indonesia

Fall: 1 Aug 2020

Classification: Carbonaceous chondrite (CM1/2)

**History:** (M. Farmer, Arizona) Around 4 pm local time (9 am UTC) on 1 August 2020, residents in northwest Sumatra (Central Tapanuli Regency) heard loud booming sounds that shook their houses. A single stone weighing ~2100 g went through the roof of a house in Kolang at 1°53'18.8"N 98°39'39.6"E (Satahi Nauli, Kolang, Central Tapanuli Regency, North Sumatra, Indonesia) and embedded itself into the soil beside the house. Another stone impacted in a rice paddy about 2.2 km south of the main mass. Two more stones were found ~7.8 km to the SE (around 1°49'50.22"N 98°41'51.22"E). Michael Farmer initially acquired 266 g, which includes fragments from the main mass and the rice paddy stone. This material was used for the classification.

**Physical characteristics:** To date, four stones have been recovered 2100 g (main mass), ~250 g (rice paddy), ~100 g (in two pieces), and ~100 g (complete stone). The masses of the two 100 g stones were estimated from their photographs. The main mass is blocky with a flat face and well-developed regmaglypts. About 250 g was broken off the main mass revealing a highly brecciated interior. Fragments crushed with water emit a delicate, earthy smell, though not as persistent or complex as that from Aguas Zarcas or Murchison.

**Petrography:** (L. Garvie, *ASU*) The interior of the stones are dark gray to black and sparsely decorated with light-colored speckles, and host common breccia fragments that protrude from the fracture surfaces. One fragment shows a large (3 mm) CAI with a pinkish hue. Three breccia types are visible: hard with conchoidal fracture and lacking or poor in chondrules; chondrule rich; and, greenish gray. Powder XRD shows considerable mineralogical diversity

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3 between different areas of matrix and clasts. Representative pieces from the bulk matrix are  
4 dominated by serpentine, with medium- to low-intensity reflections for regularly  
5 interstratified tochilinite/cronstedtite, tochilinite, calcite, pyrrhotite, and pentlandite. Some  
6 areas contain two distinct serpentines with basal spacings of 7.297 and 7.213 Å. BSE images  
7 from an  $\sim 1.5 \times 2$  cm fragment from the visually average lithology shows intense brecciation  
8 at all magnification scales, but is best described by two end-member petrographies. A)  
9 Intensely comminuted consisting of breccia fragments, sparse silicate fragments, and rare  
10 recognizable chondrules in a fine-grained matrix that is locally PCP rich. The chondrules and  
11 silicate fragments show a range of alteration to hydrous phases and many lack anhydrous  
12 silicates. B) Chondrule-rich breccia clast with a matrix dominated by PCP-rich objects.  
13 Chondrule mean diameter=125  $\mu\text{m}$  (n=41, range 34 to 291  $\mu\text{m}$ ), not including a large  $1.5 \times 1$   
14 mm BO chondrule. Particularly noticeable in hand specimen are sparsely distributed greenish-  
15 gray breccia clasts (to 2 cm). Powder XRD shows the clast to be dominated by two  
16 serpentines, pyrrhotite, pentlandite, and calcite, and a medium-intensity basal reflection from  
17 well-crystallized smectite. Polished mount of this clast shows abundant chondrule  
18 pseudomorphs and coarse-grained sulfides.

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21 **Geochemistry:** Oxygen isotopes (K. Ziegler, *UNM*) (linearized, all per mil, TFL  
22 slope=0.528): Eight fragments were analyzed by laser fluorination of which seven lie within  
23 the CM field. Two pieces were run from each fragment. Sample weights for each  
24 measurement were between 2.0 and 5.6 mg. All data in ‰. These include: Average lithology  
25 fragment 1 ( $\delta^{18}\text{O}$  7.669,  $\delta^{17}\text{O}$  1.332,  $\Delta^{17}\text{O}$  -2.717 and  $\delta^{18}\text{O}$  8.591,  $\delta^{17}\text{O}$  1.493, D18O -3.043);  
26 Average lithology fragment 2 ( $\delta^{18}\text{O}$  9.141,  $\delta^{17}\text{O}$  2.171,  $\Delta^{17}\text{O}$  -2.656 and  $\delta^{18}\text{O}$  8.477,  $\delta^{17}\text{O}$   
27 1.992,  $\Delta^{17}\text{O}$  -2.484); Chondrule-rich lithology ( $\delta^{18}\text{O}$  7.310,  $\delta^{17}\text{O}$  1.480,  $\Delta^{17}\text{O}$  -2.380 and  $\delta^{18}\text{O}$   
28 9.245,  $\delta^{17}\text{O}$  2.224,  $\Delta^{17}\text{O}$  -2.658); Chondrule-poor clast 1 ( $\delta^{18}\text{O}$  11.378,  $\delta^{17}\text{O}$  2.708,  $\Delta^{17}\text{O}$  -  
29 3.299 and  $\delta^{18}\text{O}$  11.137,  $\delta^{17}\text{O}$  2.580,  $\Delta^{17}\text{O}$  -3.301); Chondrule-poor clast 2 ( $\delta^{18}\text{O}$  8.774,  $\delta^{17}\text{O}$   
30 2.116,  $\Delta^{17}\text{O}$  -2.517 and  $\delta^{18}\text{O}$  9.765,  $\delta^{17}\text{O}$  2.414,  $\Delta^{17}\text{O}$  -2.742), Chondrule-poor clast 3 ( $\delta^{18}\text{O}$   
31 13.133,  $\delta^{17}\text{O}$  3.984,  $\Delta^{17}\text{O}$  -2.950 and  $\delta^{18}\text{O}$  12.346,  $\delta^{17}\text{O}$  3.310,  $\Delta^{17}\text{O}$  -3.209). Greenish-grey  
32 breccia clast ( $\delta^{18}\text{O}$  6.377,  $\delta^{17}\text{O}$  0.642,  $\Delta^{17}\text{O}$  -2.725 and  $\delta^{18}\text{O}$  6.790,  $\delta^{17}\text{O}$  0.848,  $\Delta^{17}\text{O}$  -2.737).  
33 The data for the metal-rich and chondrule-rich clast falls outside the CM field ( $\delta^{18}\text{O}$  -0.161,  
34  $\delta^{17}\text{O}$  -6.189,  $\Delta^{17}\text{O}$  -6.104 and  $\delta^{18}\text{O}$  1.595,  $\delta^{17}\text{O}$  -4.374,  $\Delta^{17}\text{O}$  -5.216). Microprobe (L.  
35 Garvie, *ASU*): Olivine shows a wide compositional range from  $\text{Fa}_{0.5}$  to  $\text{Fa}_{41.5}$  (n=13), with  
36 CaO up to 0.5 wt%,  $\text{Cr}_2\text{O}_3$  up to 0.6 wt%, NiO up to 0.1 wt%, and  $\text{Al}_2\text{O}_3$  up to 0.5 wt%.  
37 **Classification:** CM1/2. All the oxygen isotopes, except the metal- and chondrule-rich clast,  
38 fall within the CM field. The dominant lithology contains areas with chondrules completely  
39 replaced by hydrous silicates and intimately associated and mixed with chondrules and olivine  
40 fragments partially replaced by hydrous phases (CM1/2), to areas more typical of CM2  
41 meteorites. The bulk mineralogy is largely consistent with CM1 to 2 meteorites.  
42 **Specimens:** Total known weight of approximately 2550 g. The distribution of the masses are  
43 as follows Michael Farmer (296 g); *ASU* 28.7 g off the main mass; remaining main mass of  
44 1843 g was purchased by Robert Wesel, Mark Lyon and Jared Collins and now owned by Jay  
45 Piatek. The whereabouts of the two smaller stones is unknown.  
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52 **Kuiyibage** 38°5.02'N, 77°9.51'E

53 Xinjiang, China

54 Find: 2018

55 Classification: Ordinary chondrite (H5)

56 **History:** Purchased by Corey Kuo on 17 June 2018 from a local in Xinjiang named Mr. Hu,  
57 who had previously found the stone in the Gobi desert nearby to a town called Kuiyibage.

58 **Physical characteristics:** Single stone with dark-brown fusion crust.  
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**Petrography:** (D. Sheikh, *FSU*) Sample is an equilibrated chondrite containing blurred chondrules (0.2-1.2 mm, n=12), secondary recrystallized albitic feldspar (Av.  $25\pm 5$   $\mu\text{m}$ ), troilite, kamacite, taenite, Fe-oxides, chlorapatite, and chromite.

**Geochemistry:** Olivine ( $\text{Fa}_{17.9\pm 0.2}$ , range  $\text{Fa}_{17.6-18.3}$ , n=24), Low-Ca Pyroxene ( $\text{Fs}_{16.0\pm 0.3}\text{Wo}_{1.3\pm 0.2}$ , range  $\text{Fs}_{15.6-16.5}\text{Wo}_{0.8-1.7}$ , n=18).

**Classification:** Ordinary Chondrite (H5)

**Specimens:** 45 grams at *UCLA*; main mass with Corey Kuo.

**Kumtag 041** 41°31'2.12"N, 93°36'35.08"E

Xinjiang, China

Find: 21. Aug 2012

Classification: Ordinary chondrite (L~5)

**History:** (Ziyao Wang) Discovered by the geologist Wang Jianming (Hami/Xinjiang) during field work in the Kumtag Desert on 21. Aug 2012.

**Physical characteristics:** (Ziyao Wang) Dark-black stone of 53 g, partly covered with fusion crust

**Petrography:** (R. Bartoschewitz, *Bart*) gray-black matrix with many vugs (av. 0.2 mm), poorly defined chondrules (0.2-2.0 mm) and irregular rounded metal and sulfide inclusions. Silicate cracks are filled with metal/sulfide.

**Geochemistry:** Magnetic susceptibility (R. Bartoschewitz, *Bart*)  $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 5.00$

**Classification:** Ordinary chondrite (L5, S4, W3)

**Specimens:** 11.0 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 13 g with *Bart*.

**Kumtag 055** 41°35'51.44"N, 93°47'42.43"E

Xinjiang, China

Find: 2013

Classification: Ordinary chondrite (L6)

**History:** (Ziyao Wang) Discovered by the geologist Jianming Wang (Hami/Xinjiang) during field work in the Kumtag Desert in 2013

**Physical characteristics:** (Ziyao Wang) Black, irregular stone without fusion crust of 235.3 g

**Petrography:** (R. Bartoschewitz, *Bart*) fractured shock-darkened matrix with chondrules and mineral fragments.

**Geochemistry:** (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine  $\text{Fa}_{23.9\pm 0.7}$  (n=20); poor Ca pyroxene  $\text{Fs}_{20.3\pm 0.6}$  (n=9),  $\text{Wo}_{2.0\pm 0.4}$ : high Ca pyroxene  $\text{En}_{75}\text{Fs}_{18}\text{Wo}_7$ . Magnetic susceptibility (R. Bartoschewitz, *Bart*)  $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.71$ .

**Classification:** Ordinary chondrite (L6 shock darkened, S4, W2)

**Specimens:** 22.3 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 30 g with *Bart*.

**Kumtag 056** 41°42'3.15"N, 93°43'26.98"E

Xinjiang, China

Find: 2019 Mar

Classification: Ordinary chondrite (L5)

**History:** (Ziyao Wang) Discovered by Wentao Yang (Urumqi) in the desert near Kumtag (Xinjiang Province) in Mar 2019

**Physical characteristics:** (Ziyao Wang) Three black stones with a total weight of 1020 g were discovered within 1.5 m distance.



**Petrography:** (R. Bartoschewitz, *Bart*) well-defined chondrules (0.3-1.0 mm, av. 0.6 mm) of various types and chondrule fragments are set in recrystallized matrix. Metal and sulfide penetration into cracks blackened the meteorite.

**Geochemistry:** (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine  $\text{Fa}_{23.5\pm 0.5}$  (n=20); pyroxene  $\text{Fs}_{19.1\pm 0.3}\text{Wo}_{1.8\pm 1.1}$  (n=5); chromite  $\text{CRAL}=86, \text{m FFM}=75$ . Magnetic susceptibility (R. Bartoschewitz, *Bart*)  $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.68$

**Classification:** Ordinary chondrite (L5, W2)

**Specimens:** 22.6 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 101 g with *Bart*.

**Kumtag 059** 41°37'8.50"N, 93°41'23.56"E

Xinjiang, China

Find: 2012

Classification: Ordinary chondrite (L5)

**History:** (Ziyao Wang) Discovered by the geologist Jianming Wang (Hami/Xinjiang) during field work in the Kumtag Desert in 2012.

**Physical characteristics:** (Ziyao Wang) Black stone of 11.3 kg without fusion crust

**Petrography:** (R. Bartoschewitz, *Bart*) fractured recrystallized matrix with poorly developed chondrules of various types (0.4-1.5 mm, av. 0.7 mm). Fractures filled with iron hydroxides.

**Geochemistry:** (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine  $\text{Fa}_{23.0\pm 0.4}$  (n=21); pyroxene  $\text{Fs}_{19.5}\text{Wo}_{1.5}$  (n=1); diopsid  $\text{En}_{52}\text{Fs}_8\text{Wo}_{40}$  (n=1). Magnetic susceptibility (R. Bartoschewitz, *Bart*)  $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.85$

**Classification:** Ordinary chondrite (H5, S1, W4)

**Specimens:** 21.3 g at *Kiel* on deposit, Ziyao Wang holds the main mass and 138 g with *Bart*.

**Kumtag 061** 41°16'9.20"N, 93°14'14.10"E

Xinjiang, China

Find: 27 Oct. 2019

Classification: Primitive achondrite (Brachinite)

**History:** The meteorite was discovered by Wang Zijian and Chen Pengli in Kumtag desert during their meteorite hunting campaign on 27 Oct 2019.

**Physical characteristics:** One stone partly covered with fusion crust. The mass of the meteorite is 2540 g.

**Petrography:** Dunitic rock with subequigranular texture. The dominant mineral of the meteorite is olivine (grain size 0.25-1.2 mm). Both pyroxene and plagioclase with grain size varies from several microns to about 0.7 mm. Troilite is dispersed in other grains and gaps among minerals. Anhedral chromite grains with sizes between 0.1 to 0.7 mm.

**Geochemistry:** Olivine  $\text{Fa}_{34.8-36.2}$ ,  $\text{FeO/MnO}=65.3-98.7$ , N=12; low-Ca pyroxene  $\text{Fs}_{27.7-29.5}\text{Wo}_{2.1-5.1}$ ,  $\text{FeO/MnO}=66.0-69.9$ , N=8; Plagioclase  $\text{An}_{29.2-35.4}$  (EPMA).

**Kumtag 062** 41°31'56.14"N, 93°19'49.80"E

Xinjiang, China

Find: 2019 Dec 8

Classification: Ordinary chondrite (L6)

**Petrography:** The rock is mainly composed of olivine, low-Ca pyroxene, secondary plagioclase, Fe-Ni metal, and troilite. Most of the chondrules have been altered totally. The size of the plagioclase is mainly larger than 10  $\mu\text{m}$ . The Fe-Ni metal and troilite have been nearly totally weathered.



**Geochemistry:** Olivine  $Fa_{24.6-25.3}$ , N=5; Low-Ca pyroxene  $Fs_{20.5-20.9}Wo_{1.90-2.29}$ , N=4 (EPMA)

**Kumtag 063** 41°17'42.75"N, 93°19'20.36"E

Xinjiang, China

Find: 2019 Oct 27

Classification: Ordinary chondrite (H4)

**Petrography:** The rock is mainly composed of olivine, low-Ca pyroxene, secondary plagioclase, Fe-Ni metal, and troilite. Chondrules with well-preserved rims are present. The size of the plagioclase is mainly from 2 to 10  $\mu$ m. The Fe-Ni metal and troilite have been nearly totally weathered.

**Geochemistry:** Olivine  $Fa_{17.0-17.7}$ , N=5; Low-Ca pyroxene  $Fs_{14.4-15.1}Wo_{0.18-0.26}$ , N=5 (EPMA)

**Kumtag 064** 41°25'57"N, 93°29'37"E

Xinjiang, China

Find: 2020 Mar 27

Classification: Ordinary chondrite (L6)

**Petrography:** The rock is mainly composed of olivine, low-Ca pyroxene, secondary plagioclase, Fe-Ni metal and troilite. Most of the chondrules in this rock are altered totally. The size of most plagioclases is larger than 50 $\mu$ m. 60%-90% of the Fe-Ni metal and troilite have been weathered.

**Geochemistry:** Olivine  $Fa_{24.8-25.5}$ , N=5; Low-Ca pyroxene  $Fs_{20.8-21.3}Wo_{1.1-1.5}$ , N=5 (EPMA)

**Kuźnica** 51°02'10.64"N, 19°05'33.31"E

Czestochowa, Poland

Find: 2008

Classification: Ordinary chondrite (H5)

**History:** An anonymous citizen of the Czestochowa city in Poland found the rock during summer, 2008. The village where the meteorite was found is Kuźnica, close to the Kocinka river. The specimen was found in an aeolian sand, where exotic rocks connected with glaciers activity are not known. The suspected meteorite was kept by the owner until autumn 2018. The owner then contacted the owners of the [wiki.meteoritica.pl](http://wiki.meteoritica.pl) web-page. After the meeting, Jan Woreczko and Wadi bought the meteorite, which is now the part of their collection.

**Physical characteristics:** The fusion crust is black to brownish and typical for a chondrite. Regmaglypts are visible.

**Petrography:** Chondrules apparent diameter 150  $\mu$ m to 1 mm The most common type of chondrules are barred olivine, porphyritic chondrules, and radial pyroxene chondrules. Modal abundances: pyroxene and olivine 71.9 vol%, plagioclase 11.2 vol%, metallic phases 7.0 vol%, troilite 4.2 vol%, Cr-spinel 1.1 vol%, terrestrial weathering products 4.4 vol%. Chlorapatite and merrillite are also present.

**Geochemistry:** Plagioclase  $Ab_{82.06-78.79}Or_{6.69-4.15}An_{17.61-12.3}$ ; Augite  $Fs_{9.6}Wo_{44.7}$ ; Troilite: Ni up to 0.01; Kamacite: Ni 6.90-5.83Co0.56-0.43; Taenite: Ni39.4-33.1Co0.09-0.06; Tetrataenite: Ni50.46-49.68, Co up to 0.05.

**Classification:** Ordinary chondrite (H5)

**Specimens:** The main mass is 2037 g, in the Jan Woreczko and Wadi private collection. 5.8 g are with K. Skadanek. 21 g and two thin sections are stored by *USil* (catalog no: WNoZ/Mt/105)

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5 **Lake Gwynne** 30°31'57"S, 121°36'27"E

6 Western Australia, Australia

7 Find: 2003

8 Classification: Ordinary chondrite (H5)

9 **History:** A single stone was found on the surface.

10 **Physical characteristics:** Physical characteristics: A completely crusted stone.

11 **Petrography:** (A. W. R. Bevan, *WAM*). Indistinct chondrules are set in a moderately  
12 crystalline matrix. Chondrule mesostases are devitrified to microcrystalline. Heavily shocked  
13 with abundant black veins with mobilized troilite and metal. Olivine shows variable undulose  
14 extinction to strong mosaicism and planar fracturing closer to shock veins.

15 **Geochemistry:** Mineral compositions and geochemistry: (P. Downes *WAM*). Mineral  
16 compositions as determined by EMP: olivine  $Fa_{19}$ ; orthopyroxene  $Fs_{16.9}Wo_{1.06}$ ; chromite #Cr  
17 85.8; kamacite (average  $n=8$ ) Ni 6.28%, Co 0.52%. Petrographically and mineralogically  
18 similar to [Mount Marion](#) found 63.8 km away.

19 **Classification:** (H5); S4: W1.

20 **Specimens:** Type specimens 23.68 g and thin section *WAM*. Main mass in possession of  
21 finder.

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27 **Lenghu 007** 38°24'52.48"N, 93°47'56.08"E

28 Qinghai, China

29 Find: 2019 Sept 11

30 Classification: Ordinary chondrite (L~6)

31 **History:** (Ziyao Wang) Discovered by Yonglu Ma near Lenghu Town (Qinghai) on 2019  
32 Sept 11

33 **Physical characteristics:** (Ziyao Wang) Gray-brown stone of 605 g without fusion crust

34 **Petrography:** (R. Bartoschewitz, *Bart*) gray-brown matrix with indistinct chondrules up to 1  
35 mm, cracks with evaporation minerals

36 **Geochemistry:** Magnetic susceptibility (R. Bartoschewitz, *Bart*)  $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.87$

37 **Classification:** Ordinary chondrite (L~6, W4)

38 **Specimens:** 22.1 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 57 g with *Bart*.

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43 **Limón Verde 008** 22°30.07'S, 68°51.74'W

44 Antofagasta, Chile

45 Find: 20 Oct 2019

46 Classification: Carbonaceous chondrite (CK5)

47 **History:** The meteorite was found by Mr. M. Nepomiluev during a visual search for  
48 meteorites in the Atacama desert.

49 **Physical characteristics:** Single stone with pebble-like shape has fractured black fusion  
50 crust. Total mass of the stone is 3 g.

51 **Petrography:** (C. A. Lorenz, *Vernad*). The meteorite is composed of recrystallized granular  
52 matrix joining the chondrules, chondrule fragments and large mineral grains. The contacts of  
53 chondrules and matrix are poorly delineated. The meteorite contains olivine, pyroxene,  
54 plagioclase, magnetite, spinel, ilmenite, pentlandite and pyrrhotite. Olivine has weak  
55 undulatory optical extinction, irregular and minor planar fractures; magnetite contains fine  
56 exsolution lamellae and inclusions of spinel and ilmenite.

**Geochemistry:** Mineral composition and geochemistry: (T. Kryachko, Technograd, Moscow) Olivine  $\text{Fa}_{30.9\pm 0.26}$  (N=17), Ni in olivine is  $0.36\pm 0.08$  wt%; clinopyroxene  $\text{En}_{8.16-23.6}\text{Wo}_{6.02-45.6}$ ; rare low-Ca pyroxene  $\text{En}_{25.3}\text{Wo}_{0.77}$ ; magnetite (wt%): Cr  $6.38\pm 1.35$ ; Ti  $0.40\pm 0.18$ ; Al  $2.5\pm 0.27$  (N=12).

**Classification:** CK chondrite of type 5 (CK5), shock stage is S2, weathering index is wi-1.

**Specimens:** Type specimen of 1.23 g and thin polished section are on deposit in *Vernad.* Mr. M. Nepomiluev holds the main mass of the meteorite.

**Liuyuan 001** 41°59'28.11"N, 95° 6'59.35"E

Xinjiang, China

Find: 1 May 2019

Classification: Ordinary chondrite (L~5)

**History:** (Ziyao Wang) Discovered by the geologist Jianming Wang (Hami/Xinjiang) during field work about 160 km SE of Hami on May 1, 2019

**Physical characteristics:** (Ziyao Wang) broken 51 g individual with fresh thick (~1 mm) fusion crust

**Petrography:** (R. Bartoschewitz, *Bart*) yellowish brown stained recrystallized matrix with poorly developed chondrules (0.3-2 mm, av. 0.8 mm), metal and sulfide.

**Geochemistry:** Magnetic susceptibility (R. Bartoschewitz, *Bart*)  $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.68$

**Classification:** Ordinary chondrite (L~5, W1)

**Specimens:** 10.26 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 6 g with *Bart*.

**Los Vientos 355** (LoV 355) 24°39'04.5''S, 069°55'34.2''W

Antofagasta, Chile

Find: 2017 Feb 20

Classification: Ordinary chondrite (H6)

**History:** Found on granodiorite pediment surface by a six-person team.

**Petrography:** (J. Gattacceca, *CEREGE*) Highly recrystallized chondrite. Euhedral plagioclase with typical size 100  $\mu\text{m}$ . No relict chondrule was observed in the studied section. Opaque are metal and troilite.

**Los Vientos 360** (LoV 360) 24°36.28'S, 69°51.37'W

Antofagasta, Chile

Find: 2018 Jan 25

Classification: Ordinary chondrite (LL4-6)

**History:** Marc Jost found two large pieces and several smaller fragments within 1 m<sup>2</sup> area while hunting for meteorites on the desert pavement in the Atacama Desert. The total known weight of the samples collected is 277.5 g.

**Physical characteristics:** Fragments have rounded, irregularly shaped exteriors showing dark brown contraction-cracked fusion crust. Some fragments contain an orange coating of caliche. The cut face of the type specimen shows the sample has a light-colored, brecciated texture composed of a few chondrules, fragments and angular clasts.

**Petrography:** Description and classification (A. Love, *App*) Sample is a breccia composed of mm-sized, angular-sub-rounded clasts set within a host of poorly equilibrated chondrules and related mineral debris. Clasts show a range of petrologic types from 4-6 in addition to a vitrophyric impact melt clast. Chondrules within the type 4 clast contain clinoenstatite and

some show sulfide rims. Secondary plagioclase in recrystallized clasts has an average grain size of 77  $\mu\text{m}$ ,  $n=14$ .

**Geochemistry:** (A.Love-*App*): Olivine ( $\text{Fa}_{27.7\pm 0.8}$ ,  $\text{Fe/Mn}=54.0\pm 0.8$   $n=8$ ); low Ca pyroxene  $\text{Fs}_{16.1\pm 7.4}\text{Wo}_{0.9\pm 0.6}$  ( $\text{Fs}_{7.2-24.8}\text{Wo}_{0.5-1.5}$ ,  $n=8$ ).

**Classification:** Ordinary chondrite (LL4-6, C-S3 W1). LL chondrite based on olivine and pyroxene compositions, chondrule diameter and magnetic susceptibility. Clasts of type 4 based on poorly equilibrated compositions of pyroxenes and type 6 based on recrystallized textures and size of secondary plagioclase.

**Specimens:** Marc Jost (*SJS*) holds the main masses. Several fragments and an end cut weighing 25.57 g and a polished thin section are on deposit at *App*.

**Los Vientos 363** (LoV 363)      24°38.659'S, 69°52.231'W

Antofogasta, Chile

Find: 4 Nov 2019

Classification: Ordinary chondrite (L5)

**History:** One fragment of meteorite (14 g) was found 4 November 2019 by the KFU meteorite expedition-2019 in Chile (Nurgaliev D., Kuzina D., Kuzin D., Pastukhovich A.).

**Physical characteristics:** Total mass is 14.0 g. The meteorite has roughly rounded shape. Exterior of the stone is desert polished. The surface and interior of the meteorite is light to dark brown in color due to Fe-hydroxides. No fusion crust was observed.

**Petrography:** (Kseniya Dugushkina, *RAS-UB*) The meteorite has a dark-brown color. The meteorite consists mainly of a fine-grained, inequigranular, recrystallized matrix; chondrules make up 20% of the volume. Predominant porphyritic olivine (PO) and porphyritic olivine-pyroxene (POP) chondrules. Chondrules have vague boundaries. Chromite-plagioclase assemblages are found in recrystallized matrix. The assemblages range in size from 10-450  $\mu\text{m}$  and consist of 0.2-30- $\mu\text{m}$  rounded and euhedral chromite grains surrounded by plagioclase. Heavy oxidation of metal and troilite, 60-95% being replaced (W3). Shock stage is S1.

**Geochemistry:** EDX analyses by Kseniya Dugushkina, *RAS-UB*. The chondrite paragenesis includes olivine  $\text{Fa}_{25.2\pm 0.8}$  ( $N=27$ ), orthopyroxene  $\text{En}_{77.8\pm 0.3}\text{Fs}_{20.6\pm 0.3}\text{Wo}_{1.6\pm 0.3}$  ( $N=22$ ), clinopyroxene  $\text{En}_{47.4\pm 1.2}\text{Fs}_{8.8\pm 1.1}\text{Wo}_{43.8\pm 1.4}$  ( $N=9$ ), plagioclase  $\text{An}_{26.8\pm 1.9}$  ( $N=16$ ), chromite, apatite, troilite, taenite (Ni 27.9-35.9%) and kamacite (Ni 6.3-6.4%). The average composition of chromite ( $N=5$ ):  $\text{Cr}_2\text{O}_3$  56.6 $\pm$ 0.9 wt%, FeO 30.1 $\pm$ 1.1 wt%, MgO 2.7 $\pm$ 0.4 wt%,  $\text{Al}_2\text{O}_3$  6.7 $\pm$ 0.4 wt%,  $\text{TiO}_2$  2.5 $\pm$ 0.5 wt%, MnO 0.7 $\pm$ 0.1 wt%,  $\text{SiO}_2$  0.5 $\pm$ 0.2 wt%.

**Classification:** Ordinary chondrite, L5.

**Specimens:** 12.39g 1 sample and 1.61 g cut-off and thin section *UrFU*

**Los Vientos 364** (LoV 364)      24°40.108'S, 69°53.504'W

Antofagasta, Chile

Find: 2019 Feb 1

Classification: HED achondrite (Eucrite)

**History:** Marc Jost found the 180 g sample on February 1, 2019, while he was hunting for meteorites on the desert pavement in Los Vientos dense collection area of the Atacama Desert in Chile.

**Physical characteristics:** Sample is a broken stone ~50% covered by a wind ablated brownish fusion crust. The fusion crust, where present, is still shiny and shows some relict flow lines and a faint roll-over lip from flight orientation. The cut face shows the interior is a

breccia dominated by granular material with a couple of fine-grained clasts and a larger clast with a recrystallized texture.

**Petrography:** Description and classification (A. Love, *App*) Sample is a recrystallized breccia composed of coarse-grained (~1000µm), subophitic gabbro and finer-grained (~500 µm) basaltic clasts set within a recrystallized matrix of related mineral debris. Pyroxenes are exsolved and share 120° grain boundaries with adjacent grains. Additional minerals are: plagioclase, a SiO<sub>2</sub> polymorph, ilmenite and chromite.

**Geochemistry:** (A. Love, *App*) Pigeonite (Fs<sub>58.7±0.2</sub>Wo<sub>6.2±0.6</sub>, Fe/Mn=30.7±0.3, Mg#37.3±0.2, n=8); high Ca pyroxene (Fs<sub>29.7±0.4</sub>Wo<sub>41.7±0.4</sub>, Fe/Mn=31.6±0.7, n=8); plagioclase (An<sub>91.3±0.3</sub>Or<sub>0.3±0.0</sub>, n=6).

**Classification:** HED Achondrite (recrystallized basaltic and gabbroic eucrite breccia). Based on mineral compositions, Fe/Mn ratios and Mg#'s, this sample is composed of equilibrated basaltic eucrite clasts. Textures and grainsizes indicate this is a recrystallized breccia. Low weathering, low shock.

**Specimens:** Marc Jost (*SJS*) holds the main mass. A fusion-crust endcut and partial slice weighing 20.88g and a polished thin section are on deposit at *App*.

**Los Vientos 368** (LoV 368)      24°36.427'S, 69°51.355'W

Antofagasta, Chile

Find: 2018 Jan 5

Classification: Ordinary chondrite (LL4-6)

**History:** Marc Jost found the sample on January 5, 2018, during a meteorite hunt in the Los Vientos dense collection area of the Atacama Desert in Chile.

**Physical characteristics:** The sample is a complete stone ~50% covered by a dull black, contraction-cracked, flow-lined fusion crust. The surface of the sample has experienced significant wind damage while in residence on the desert pavement. The cut face shows the interior has a brecciated texture composed of chondrules, fresh metal grains and angular clasts.

**Petrography:** Description and classification (A. Love, *App*) Sample is a breccia composed of chondrules, fragments and sparse recrystallized lithic clasts set within a clastic host.

Chondrules average diameter of 754 µm (n=20). Secondary plagioclase has an average length of 50 µm (n=53). Clinoenstatite is present. Type 4 lithic clasts show distinct chondrules and twinned clinoenstatite in a recrystallized matrix. Type 6 clasts are thoroughly recrystallized and lack chondrules. Additional minerals are: phosphates, ilmenite, chromite, high Ca pyroxene, troilite.

**Geochemistry:** (A. Love-*App*) Olivine (Fa<sub>28.0±0.5</sub>, Fe/Mn=52.5±2.1 n=10); low Ca pyroxene (Fs<sub>18.1±5.0</sub>Wo<sub>0.9±0.8</sub> (Fs<sub>7.6-24.7</sub>Wo<sub>0.2-2.3</sub>), Fe/Mn32.8, n=11).

**Classification:** Ordinary Chondrite (LL4-6, C-S3, W2). Based on chondrule size, magnetic susceptibility and compositions of olivine and pyroxene, sample is an LL chondrite.

Equilibrated olivine and unequilibrated pyroxenes in host and one clast indicate type 4.

Recrystallized texture and grainsize of secondary plagioclase in lithic clasts indicate type 6. May be paired with LV360 (found 450 m away).

**Specimens:** Marc Jost (*SJS*) holds the main mass. 2 sliced fragments weighing a total of 23.54 g and a polished mount and thin section are on deposit at *App*.

**Los Vientos 369** (LoV 369)      24°39'22.1''S, 069°53'09.1''W

Antofagasta, Chile

Find: 21 Feb 2017



Classification: Ordinary chondrite (L6)

**History:** Found on grano-diorite pediment surface while meteorite prospecting with six-person team.

**Los Vientos 370** (LoV 370)      24°36'48.8"S, 69°51'51.1"W

Antofagasta, Chile

Find: 2019 Nov 12

Classification: Ordinary chondrite (H5)

**Petrography:** (J. Gattacceca, *CEREGE*) High porosity (18% by point counting, N=240) under the form of interchondrule pores with typical size 100-200  $\mu\text{m}$ , similar to what is observed in, e.g., Baszkowka [Krzyszowska and Almeida, MAPS 54:54-71].

**Los Vientos 376** (LoV 376)      24°36'41.0"S, 69°51'57.7"W

Antofagasta, Chile

Find: 2019 Nov 12

Classification: Ordinary chondrite (L6)

**Petrography:** (J. Gattacceca, *CEREGE*) Shock-darkened ordinary chondrite with pervasive Fe,Ni metal and troilite veinlets and fizzed grains. Eutectic assemblages of metal and troilite are present.

**Classification:** Ordinary chondrite (L6), shock-darkened.

**Los Vientos 379** (LoV 379)      24.703192°S, 69.865290°W

Antofagasta, Chile

Find: 2006 Sep 28

Classification: Ordinary chondrite (H4)

**Petrography:** (J. Gattacceca, *CEREGE*) Chondrite with packed chondrules with average apparent diameter  $340 \pm 200 \mu\text{m}$  (n=50). Opaque are metal and sulfides. Some fine-grained silicate clasts are present with typical grain size 50  $\mu\text{m}$ .

**Specimens:** Type specimen at *CEREGE*. Main mass with Eric Christensen.

**Los Vientos 383** (LoV 383)      24°41'S, 69°46'W

Antofagasta, Chile

Find: 2019 Nov 11

Classification: HED achondrite (Howardite)

**Physical characteristics:** Single light-gray stone with fusion crust. Cut surface show fine-grained light-gray interior.

**Petrography:** (J. Gattacceca, *CEREGE*) Brecciated igneous rock with grain size  $\sim 400 \mu\text{m}$ . Main minerals are pyroxene (exsolved) and plagioclase (not maskelynite). This rock contains both eucrite material with subophitic texture, and diogenite material (more than 10 vol%). Accessory minerals: sulfide, chromite, ilmenite, kamacite, silica polymorph.

**Geochemistry:** Diogenitic low-Ca pyroxene  $\text{Fs}_{25.1 \pm 0.8} \text{Wo}_{3.0 \pm 0.5}$  (n=4). Eucritic low-Ca pyroxene  $\text{Fs}_{35.7} \text{Wo}_{5.5}$  (n=2),  $\text{Fs}_{59.2 \pm 1.2} \text{Wo}_{5.3 \pm 1.5}$  (n=3). Ca-pyroxene  $\text{Fs}_{31.1} \text{Wo}_{39.0}$  (n=1). Pyroxene overall  $\text{FeO/MnO}$   $31.4 \pm 2.1$  (n=10). Plagioclase  $\text{An}_{91.0} \text{Ab}_{8.8} \text{Or}_{0.3}$  (n=2). Olivine  $\text{Fa}_{58.4}$ ,  $\text{FeO/MnO} = 45.3$  (n=2).

**Classification:** Achondrite (howardite). Likely paired with Los Vientos 383 that was found within 100 m.

**Los Vientos 384** (LoV 384) 24°41'S, 69°46'W

Antofagasta, Chile

Find: 2019 Nov 12

Classification: HED achondrite (Howardite)

**Physical characteristics:** Single light-gray stone with fusion crust. Cut surface show fine-grained light-gray interior.**Petrography:** (J. Gattacceca, *CEREGE*) Brecciated igneous rock with grain size ~400  $\mu\text{m}$ . Main minerals are pyroxene (exsolved) and plagioclase (not maskelynite). This rock contains both eucrite material with subophitic texture, and diogenite material (more than 10 vol%). Accessory minerals: sulfide, chromite, ilmenite, kamacite, silica polymorph.**Geochemistry:** Diogenitic low-Ca pyroxene  $\text{Fs}_{25.9}\text{Wo}_{3.1}$  (n=2). Eucritic low-Ca pyroxene  $\text{Fs}_{34.8}\text{Wo}_{3.1}$  (n=1),  $\text{Fs}_{57.1\pm 1.1}\text{Wo}_{7.9\pm 2.0}$  (n=3). Ca-pyroxene  $\text{Fs}_{30.1}\text{Wo}_{39.4}$  (n=2). Pyroxene overall  $\text{FeO/MnO}$   $29.8\pm 1.1$  (n=8). Plagioclase  $\text{An}_{90.5}\text{Ab}_{9.3}\text{Or}_{0.1}$  (n=2). Chromite  $\text{Cr}\# = 0.82$ **Classification:** Achondrite (howardite). Likely paired with [Los Vientos 383](#) that was found within 100 m.**Los Vientos 385** (LoV 385) 24°41'S, 69°46'W

Antofagasta, Chile

Find: 2020 Apr 04

Classification: Ureilite

**Physical characteristics:** Dark brown stone.**Petrography:** (J. Gattacceca, *CEREGE*) Blocky assemblage of olivine with reduced rims. Grain size ~1.5 mm. Carbon material is present at grain rims. Metal is present along grain rims and as small aligned or isolated  $\mu\text{m}$ -size blebs within olivine. Troilite is present.**Geochemistry:** Olivine  $\text{Fa}_{18.5\pm 0.2}$ ,  $\text{FeO/MnO} = 43.6\pm 2.9$ ,  $\text{CaO}$   $0.33\pm 0.02$  wt%,  $\text{Cr}_2\text{O}_3$   $0.69\pm 0.03$  wt% (n=3). Olivine rim  $\text{Fa}_{11.2}$  (n=1).**Los Vientos 386** (LoV 386) 24°41'S, 69°46'W

Antofagasta, Chile

Find: 2020 Apr 16

Classification: HED achondrite (Eucrite)

**Physical characteristics:** Crusted stone. Cut surface shows coarse, gray interior.**Petrography:** (J. Gattacceca, *CEREGE*) Brecciated igneous rock displaying a variety of textures (subophitic, granulitic, etc.). The main lithology has subophitic texture with typical grain size 400  $\mu\text{m}$ . Main minerals are low-Ca pyroxene (exsolved) and plagioclase. Other minerals: silica polymorph (to 250  $\mu\text{m}$ ), ilmenite, chromite, rare metal, troilite.**Geochemistry:** Pyroxene: low-Ca pyroxene  $\text{Fs}_{60.0\pm 2.3}\text{Wo}_{3.6\pm 1.8}$ , (n=5), augite exsolution  $\text{Fs}_{28.0}\text{Wo}_{42.7}$  (n=2),  $\text{FeO/MnO} = 29.8\pm 2.6$  (n=7). Plagioclase  $\text{An}_{88.3}\text{Ab}_{11.2}\text{Or}_{0.6}$  (n=3).**Los Vientos 387** (LoV 387) 24°42'21.9''S, 069°54'06.8''W

Antofagasta, Chile

Find: 2017 Feb 19

Classification: Ordinary chondrite (H4)

**History:** Found on gravel surface by a six-person team.

**Petrography:** (J. Gattacceca, *CEREGE*) Chondrite with well-delineated chondrules with average apparent diameter  $430 \pm 210 \mu\text{m}$  ( $n=32$ ). Opaque minerals are metal and troilite.

**Loulan Yizhi 028**      $\sim 40^{\circ}26'N$ ,  $\sim 89^{\circ}54'E$

Xinjiang, China

Find: 2019

Classification: Ordinary chondrite (L6)

**History:** (Ziyao Wang) Purchased by Ziyao Wang from Jianming Wang in Hami/Xinjiang in 2019. This meteorite was discovered in the Loulanyizhi dense collection area in 2019.

**Physical characteristics:** (Ziyao Wang) Black-brown stone of 59 g with fusion crust

**Petrography:** (R. Bartoschewitz, *Bart*) chondrule margins (PP, PO, BO) are difficult to discern in the strongly recrystallized matrix; metal and sulfide mainly show irregular inclusions.

**Geochemistry:** (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine

$\text{Fa}_{24.6 \pm 0.5}$  ( $n=19$ ); pyroxene  $\text{Fs}_{20.4 \pm 0.3}$  ( $n=12$ ),  $\text{Wo}_{1.5 \pm 0.3}$ ; feldspar  $\text{An}_{11}\text{Or}_6$ ; chromite CRAL86, FFM88; troilite. Magnetic susceptibility (R. Bartoschewitz, *Bart*)  $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.58$ .

**Classification:** Ordinary chondrite (L6, S3, W3)

**Specimens:** 12.4 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 14 g with *Bart*.

**Loulan Yizhi 034**      $\sim 40^{\circ}09'N$ ,  $\sim 89^{\circ}39'E$

Xinjiang, China

Find: 28 Mar 2019

Classification: Ureilite

**History:** (Ziyao Wang) Purchased by Ziyao Wang from Aikeranmu Jiapaer (Shanshan County, Xinjiang) in Shanshan/Xinjiang in Jul 2019. This meteorite was discovered by Aikeranmu Jiapaer on 28 Mar 2019

**Physical characteristics:** (Ziyao Wang) Two brown individuals of 6.2 kg and 850 g without fusion crust

**Petrography:** (R. Bartoschewitz, *Bart*) silicate grains up to 3 mm in length with triple junctions, surrounded by graphite.

**Geochemistry:** (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine

$\text{Fa}_{21.6 \pm 0.7}$  ( $n=22$ ); pigeonite  $\text{En}_{73}\text{Fs}_{18}\text{Wo}_9$  ( $n=11$ ). Ni-poor kamacite  $\text{Ni}=0.7$ ,  $\text{Co}=0.3$  ( $n=3$ ). Magnetic susceptibility (R. Bartoschewitz, *Bart*)  $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.45$

**Classification:** Ureilite

**Specimens:** 20.2 g at *Kiel*, Ziyao Wang, Yifeng Duan and Shuming Wang hold the main mass and 166 g with *Bart*.

**Loulan Yizhi 035**      $\sim 40^{\circ}37'N$ ,  $\sim 89^{\circ}52'E$

Xinjiang, China

Find: 2018

Classification: Ordinary chondrite (H5)

**History:** (Ziyao Wang) Purchased by Ziyao Wang from Wentao Yang in Urumqi/Xinjiang in 2019. This meteorite was discovered in the Loulanyizhi dense collection area in 2018.

**Physical characteristics:** (Ziyao Wang) Gray-black stone of 4.7 kg, without fusion crust

**Petrography:** (R. Bartoschewitz, *Bart*) well developed chondrules (0.2-1 mm, av. 0.5 mm) of various types, chondrule and many mineral fragments set in a brown stained matrix.

**Geochemistry:** (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine  $Fa_{18.3\pm 0.3}$  (n=42); pyroxene  $Fs_{16.1\pm 0.3}Wo_{1.1\pm 0.2}$  (n=20); chromite CRAL=70-84, FFM=80-89. Kamacite Ni=6.8, Co=0.6 (n=2); pyrrhotite Ni=1.4-5.2 (n=11 (all wt%). Magnetic susceptibility (R. Bartoschewitz, *Bart*)  $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.98$

**Classification:** Ordinary chondrite (L5, S3, W4)

**Specimens:** 20.2 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 117 g with *Bart*.

**Loulan Yizhi 040** ~40°09'N, ~89°39'E

Xinjiang, China

Find: 2019

Classification: Ordinary chondrite (LL~6)

**History:** (Ziyao Wang) Purchased by Ziyao Wang from Aikeranmu Jiapaer in Turpan/Xinjiang in 2019, who discovered it in 2019.

**Physical characteristics:** (Ziyao Wang) Brown individual of 515 g without fusion crust

**Petrography:** (R. Bartoschewitz, *Bart*) light to dark gray-brown recrystallized matrix with indistinct chondrules, metal and sulfide.

**Geochemistry:** Magnetic susceptibility (R. Bartoschewitz, *Bart*)  $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 3.23$

**Classification:** Ordinary chondrite (LL~6, W2)

**Specimens:** 6 g on deposit at *Kiel*, Jiachang Yu and Ziyao Wang holds the main mass, and 46 g with *Bart*.

**Loulan Yizhi 041** ~40°30'N, ~89°40'E

Xinjiang, China

Find: 2019

Classification: Ordinary chondrite (L~4)

**History:** (Ziyao Wang) Ai Li Kayiti discovered this stone close to Loulan Yizhi in 2019 while he was searching for archaeological objects, and sold it on the Shanshan market to Ziyao Wang and donated it to R. Bartoschewitz.

**Physical characteristics:** Brown stone of 63.1 g.

**Petrography:** (R. Bartoschewitz, *Bart*) brown recrystallized matrix with distinct chondrules (0.5-1 mm, av. 0.8 mm), vugs filled with evaporation minerals

**Geochemistry:** Magnetic susceptibility (R. Bartoschewitz, *Bart*)  $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.55$

**Classification:** Ordinary chondrite (L~4, W4)

**Specimens:** 12.65 g on deposit at *Kiel*, main mass with *Bart*.

**Loulan Yizhi 044** ~40°30'N, ~89°40'E

Xinjiang, China

Find: 2019

Classification: Ordinary chondrite (H~4)

**History:** (Ziyao Wang) Ai Li Kayiti discovered this stone close to Loulan Yizhi in 2019 while he was searching for archaeological objects, and sold it on the Shanshan market to Ziyao Wang and donated it to R. Bartoschewitz.

**Physical characteristics:** Brown stone of 11.2 g

**Petrography:** (R. Bartoschewitz, *Bart*) dark gray-brown matrix with distinct chondrules (0.1-0.8 mm, av. 0.4 mm), metal and sulfide

**Geochemistry:** Magnetic susceptibility (R. Bartoschewitz, *Bart*)  $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 5.02$

**Classification:** Ordinary chondrite (H~4, W2)

**Specimens:** 2.7 g on deposit at *Kiel*, main mass with *Bart*.

**Loulan Yizhi 046** 40°24'16.59"N, 89°54'51.01"E

Xinjiang, China

Find: 2019 Jun 28

Classification: Ordinary chondrite (L5, melt breccia)

**Petrography:** The rock is a breccia and mainly composed of olivine, low-Ca pyroxene, secondary plagioclase, Fe-Ni metal, and troilite. Chondrules are present in the clasts, with poorly defined rims. The clasts are surrounded by lighter-colored quenched melt and igneous-textured microporphyrific melt domains. The size of plagioclase in clasts is mainly from 2 to 50  $\mu\text{m}$ . The pyroxene phenocrysts in the melt domains show heterogeneous compositional zoning. Most of the metal are surrounded by coatings of troilite. Troilite is single crystal or polycrystalline.

**Geochemistry:** Olivine  $\text{Fa}_{24.3-26.0}$ , N=6; Low-Ca pyroxene  $\text{Fs}_{20.4-20.5}\text{Wo}_{1.47-1.91}$ , N=5 (EPMA)

**Loulan Yizhi 047** 40°0'39.93"N, 89°5'57.71"E

Xinjiang, China

Find: 2019 Aug 20

Classification: Ordinary chondrite (L6)

**Geochemistry:** Olivine  $\text{Fa}_{24.7-25.2}$ , N=5; Low-Ca pyroxene  $\text{Fs}_{20.6-21.0}\text{Wo}_{1.48-1.85}$ , N=5 (EPMA)

**Mahadeva** 26°28'56.28''N, 86°35'53.17''E

Bihar, India

Confirmed fall: 2019 Jul 22

Classification: Ordinary chondrite (H5)

**History:** A single stone weighing ~15 kg fell at 14:30 IST, July 22, 2019, in a water-laden paddy field near Mahadeva village, ~6 km east of the Laukahi Police station, Madhubani district, Bihar state, India. Farmers witnessed a fireball-like object and heard a loud sound, with emanations of smoke from the site after the fall. The meteorite was recovered by the farmers from a 1.5 m deep impact pit.

**Physical characteristics:** The fusion crust is relatively smooth, dull brown, with regmaglypts (simple to compound). Flow lines are absent. A few broken surfaces of the sample expose the interior, with abundant grains of metal/sulfide set in a grayish white silicate matrix.

**Petrography:** EPMA and SEM were used to examine a polished thick section. Most chondrules are in the 250-600  $\mu\text{m}$  size range, and are barred, porphyritic, and cryptocrystalline varieties. Modal abundances are 40% olivine, 35% low-Ca pyroxene, 7% feldspar (makelynite/ plagioclase glass), 4% high-Ca pyroxene, 8% metal, 4% troilite, 2% accessories like chromite and merrillite. The matrix is coarsely crystalline, and chondrule-matrix integration is common. Feldspars (<70  $\mu\text{m}$ ) are common in matrix, some occurring as an interstitial phase within chondrules.

**Geochemistry:** The olivine composition of chondrule and matrix are almost indistinguishable ( $\text{Fa}_{17-21}$ , mean  $\text{Fa}_{19.3}$ , and  $\text{Fa}_{19-23}$ , mean  $\text{Fa}_{20.4}$ , respectively). The feldspar in matrix is fairly uniform in composition of  $\text{Ab}_{80.3\pm 1.9}\text{An}_{17.1\pm 2.4}\text{Or}_{2.6\pm 0.8}$ . Low-Ca pyroxene and high-Ca pyroxene composition ranges are  $\text{Fs}_{17.6-19.3}\text{Wo}_{1.6-3.2}$  and  $\text{Fs}_{6.8}\text{Wo}_{46.6}$ , respectively. Bulk chemical composition  $\text{SiO}_2$  (33.9%),  $\text{FeO}$  (35.7%),  $\text{Al}_2\text{O}_3$  (2.35%),  $\text{CaO}$  (1.76%),  $\text{MgO}$  (22.4%),  $\text{Na}_2\text{O}$  (0.97%) and  $\text{K}_2\text{O}$  (0.10%).

**Classification:** H5



**Specimens:** 100 g at *PRL*. Main Mass at Bihar Museum, Patna.

**Matarka** 33°15'N, 02°45'W

Eastern, Morocco

Confirmed fall: 2018 Jan 5

Classification: Ordinary chondrite (L6)

**History:** In the evening of January 5, 2018, between 21:00 and 22:00 local time, a bright fireball was witnessed by people in the communities Tendrara, Anoual and Bouarfa in northeastern Morocco. The event was described as of several seconds duration, and with a green color. At least one fragmentation was described by one observer. No sound phenomena were reported. Eyewitness accounts were collected in May and June 2018 by Abdelaziz Mouadine from two eyewitnesses, Ali Atewi (Matarka) and Keser Haron (Talsint). On February 5, one month after the event, a single meteorite was found near Matarka, and subsequently offered to Moroccan meteorite dealers. Eventually it was purchased by Aid Mohamed, and on April 27, 2018, it was sold to M. Jost in Fom Zgouid, near Zagora, Morocco.

**Physical characteristics:** Single stone with dimensions  $7.5 \times 6.5 \times 6.5$  cm and a mass of 538 g. Angular shape with smoothly rounded edges, indicating significant ablation and extended atmospheric flight as individual. The mass displays a fresh appearance and, apart from a small ( $1 \times 3$  cm) area, is completely covered in fresh fusion crust. One area is rough and shows melting lips along the edge, probably the result of a fragmentation at high altitude. The matrix shows a bright ash-colored appearance. Neither the exterior nor the interior shows oxidation of metal.

**Petrography:** (B. Hofmann, *NMBE*, J. Pape, *UBE/NMBE*): Strongly recrystallized, chondrules only present as relicts. Mineral grains (except Fe metal) show strong irregular fracturing. Mean size of plagioclase grains is 80–150  $\mu\text{m}$ . Very minor rust staining around metal grains. Rare small (to 10  $\mu\text{m}$ ) native Cu at troilite-iron boundaries. Troilite shows lamellar twinning and contains inclusions of pentlandite to 20  $\mu\text{m}$ . Below fusion crust cracks filled with remobilized troilite.

**Geochemistry:** Electron microprobe analysis (J. Pape, *UBE/NMBE*): olivine  $\text{Fa}_{24.3 \pm 0.3}$  (range  $\text{Fa}_{23.8-24.7}$ ;  $n=17$ ), pyroxene  $\text{Fs}_{20.5 \pm 0.2} \text{Wo}_{1.5 \pm 0.2}$  (range  $\text{Fs}_{20.1-20.5} \text{Wo}_{1.1-1.7}$ ;  $n=17$ ), plagioclase  $\text{An}_{10.4 \pm 0.3} \text{Or}_{5.9 \pm 1.1}$  (range  $\text{An}_{9.9-10.9} \text{Or}_{3.9-7.9}$ ;  $n=13$ ). Cosmogenic radionuclides: (Å. Rosén, Germanium Material and Meteorite Screening Experiment): Gamma-spectroscopy performed in November 2018 showed the presence of the following short-lived radionuclides (dpm/kg as of 5 January 2018):  $^{46}\text{Sc}$   $5.0 \pm 1.5/-1.3$ ,  $^{54}\text{Mn}$   $44.5 \pm 4.7/-3.3$ ,  $^{57}\text{Co}$   $4.7 \pm 0.8/-0.3$ ,  $^{22}\text{Na}$   $71.8 \pm 6.0/-5.2$ ,  $^{26}\text{Al}$   $34.4 \pm 1.7/-3.9$  and  $^{60}\text{Co}$   $0.36 \pm 0.07/-0.09$ . The  $^{22}\text{Na}/^{26}\text{Al}$  activity ratio of 2.16(+0.09, -0.08) and activities of  $^{54}\text{Mn}$  and  $^{46}\text{Sc}$  are in the range of recent falls. The activity ratio of  $^{54}\text{Mn}/^{46}\text{Sc}$  is 8.9. Activity ratios of fresh OC falls are 8.1–17.2 (mean  $11.1 \pm 2.8$ , median 10.0, based on 27 analyses in [Evans et al. \(1982\)](#)). Assuming the lowest reported initial ratio of 8.1 at the time of fall, the actual fall date would have been just ~16 days before January 5, 2018. The fall must thus very likely have occurred after December 20, 2017, even with this unlikely assumption. Low  $^{26}\text{Al}$  and  $^{60}\text{Co}$  indicate a small pre-atmospheric size.

**Classification:** Ordinary chondrite (L6), shock stage S3, no weathering (W0).

**Specimens:** 22.2 g and one polished thin sections at *NMBE*. Main mass with Beat Booz.

**Mederdra** 16.8539806, -15.9293383

Trarza, Mauritania

Find: 2019 July 17

Classification: Rumuruti chondrite (R4-5)

**History:** The meteorite was found during a search for meteorites.

**Physical characteristics:** Complete piece. It has primary fusion crust over 70% of the surface, secondary crust over 20%. The fusion crust is brown dark, thick, well preserved, and has contraction cracks. The rock measures  $12 \times 9.5 \times 7.5$  cm. It weighs 1552 g.

**Petrography:** Breccia containing chondrules and chondrule fragments embedded in a fine-grained yellow-brown matrix. Opaque phases are chromite and FeNi-sulfides. Metallic FeNi has not been found. Low-Ca pyroxene has not been found.

**Geochemistry:** Olivine,  $\text{Fa}_{39.2 \pm 0.8}$  ( $\text{Fa}_{38.1-42.2}$ ;  $n=20$ )  $\text{Fe/Mn}=82 \pm 1.5$ ; pyroxene,

$\text{Fs}_{11.5 \pm 0.9} \text{Wo}_{45.0 \pm 1.1}$  ( $\text{Fs}_{10.2-12.7} \text{Wo}_{43.7-46.6}$ ;  $n=15$ ); Plagioclase:  $\text{An}_{9.7-11.1}$  ( $n=4$ ).

**Classification:** R4-5, S2, W3

**Specimens:** 20 g type specimen in *UPC*; 20 g J. Llorca. The remaining mass in *MCM*.

**Meridiani Planum 002** 1.951°S, 5.512°W

Mars

Find: 27 May 2004

Classification: Stony iron

**History:** The Mars Exploration Rover Opportunity observed a pebble on sol 121 at the rim of Endurance crater, informally named Barberton.

**Physical characteristics:** The pebble is angular, with flat facets intersecting at sharp angles, and has an indistinct surface texture without visible layering or crystals at the Microscopic Imager scale (Weitz et al., 2010). Longest dimension is 3 cm.

**Geochemistry:** In Pancam, Meridiani Planum 002 exhibits some spectral variation but not enough to adequately determine mineralogy (Weitz et al., 2010). The iron-bearing mineralogy determined with the rover's Mössbauer spectrometer is dominated by ferrous iron in olivine and pyroxene with smaller amounts of metallic iron in the form of kamacite; minor ferric iron is likely a result of alteration on Mars (Schröder et al., 2010; Schröder et al., 2008). The chemical composition determined by the Alpha Particle X-ray Spectrometer (APXS) is rich in Mg and Ni and poor in Al and Ca compared to other material on the plains of Meridiani Planum and excavated by craters in the area. Meridiani Planum 002 has similar Mg/Si, Ca/Si and Al/Si ratios to HED meteorites, but is enriched in S/Si, Fe/Si and Ni and depleted in O (Schröder et al., 2010; Schröder et al., 2008).

**Classification:** The HED-like silicate composition with additional metal and sulfide composition links Meridiani Planum 002 with the HED or potentially the mesosiderite group. Meridiani Planum 002 is likely paired with [Meridiani Planum 003](#), [004](#), and [005](#).

**Meridiani Planum 003** 2.049°S, 5.504°W

Mars

Find: 21 Dec 2006

Classification: Stony-iron

**History:** A field of cobbles was discovered by the Mars Exploration Rover Opportunity on the Cabo Anonimo promontory at the rim of Victoria Crater. A cobble informally named Santa Catarina (henceforth Meridiani Planum 003) was selected for detailed investigation between sols 1034 and 1055.

**Physical characteristics:** Meridiani Planum 003 is a brecciated rock with several subangular clasts clearly visible in images obtained with the rover's Microscopic Imager. Semi-circular cavities and subplanar protrusions with highly irregular edges result in an angular appearance. The rock is ~14 cm in its longest dimension and ~11 cm across.

**Geochemistry:** The clasts in the rock are spectrally distinct from the rock matrix, with the clasts having a distinct pyroxene absorption in Pancam (Weitz et al., 2010). The iron-bearing mineralogy determined with the rover's Mössbauer spectrometer is dominated by ferrous iron in olivine and pyroxene, with smaller amounts in troilite; minor amounts of ferric iron is likely a result of alteration on Mars (Fleischer et al., 2010b; Schröder et al., 2010). The chemical composition determined with the rover's Alpha Particle X-ray Spectrometer (APXS) is rich in Ni, Mg, and Cr and poor in Al, K, and Ti, compared with other material on the plains of Meridiani Planum and excavated by craters in the area.

**Classification:** Meridiani Planum 003 has Mg/Si, Ca/Si and Al/Si ratios similar to HED meteorites, but enriched in S/Si, Fe/Si and Ni and depleted in O. Meridiani Planum 003 may thus belong to the HED or mesosiderite group, having HED-like silicate composition with additional metal and sulfide. Several other rocks in the cobble field associated with Meridiani Planum 003 have similar characteristics as shown with Pancam (the rocks informally named Ibirama, Florianopolis, and Lajes; (Schröder et al., 2008) and MiniTES spectra (the rocks informally named Jaocaba, Mafra, and Paloma; (Ashley et al., 2009). The cobble field may represent an accumulation of paired meteorite fragments or a strewn field suggested to be part of the impactor that created Victoria Crater (Schröder et al., 2010; Squyres et al., 2009).

**Meridiani Planum 004**      2.076°S, 5.512°W

Mars

Find: 18 Nov 2008

Classification: Stony-iron

**History:** A small rock informally named Santorini (henceforth Meridiani Planum 004) was discovered ~800 m south of Victoria crater, along the Mars Exploration Rover Opportunity's traverse from Victoria crater to Endeavour crater.

**Physical characteristics:** The angular, cobble-sized rock was investigated between sols 1713 and 1749. The cobble has a massive lithology, with angles and facets at both the cm-scale and in MI images (Weitz et al., 2010). Portions of its surface appear lustrous in MI images.

Numerous pits with angular edges are also visible, typically 300-400 um in diameter.

Dimensions: approx. 8 × 6 cm.

**Geochemistry:** The iron-bearing mineralogy determined with the rover's Mössbauer spectrometer is dominated by ferrous iron in olivine and pyroxene, with smaller amounts in troilite; minor ferric iron is likely a result of alteration on Mars (Fleischer et al., 2010b; Schröder et al., 2010). The chemical composition of Meridiani Planum 004 is rich in Ni, Mg, and Cr and poor in Al, K, and Ti compared to other material on the plains of Meridiani Planum and excavated by craters in the area.

**Classification:** Meridiani Planum 004 has similar Mg/Si, Ca/Si and Al/Si ratios to HED meteorites, but is enriched in S/Si, Fe/Si and Ni and depleted in O (Fleischer et al., 2010b; Schröder et al., 2010). The HED-like silicate composition with additional metal and sulfide composition links Meridiani Planum 004 with the HED or potentially the mesosiderite group. Meridiani Planum 004 is likely paired with [Meridiani Planum 002](#), [003](#), and [005](#).

**Meridiani Planum 005**      2.106°S, 5.520°W

Mars

Find: 12 May 2009

Classification: Stony-iron

**History:** The Mars Exploration Opportunity discovered a cobble on the plains of Meridiani Planum ~3 km south of Victoria crater. The cobble, informally named Kasos (henceforth Meridiani Planum 005), was investigated between sols 1884 and 1890.

**Physical characteristics:** In MI images, the rock has a glassy, lustrous appearance with few visible grains or clasts, and Pancam color variations are subtle, apparently caused by variations in dust abundance on the surface of the cobble (Weitz et al., 2010). Dimensions: 7 × 6 cm.

**Geochemistry:** The iron-bearing mineralogy determined with the rover's Mössbauer spectrometer is dominated by ferrous iron in olivine and pyroxene, with smaller amounts in troilite. Small amounts of metallic iron in the form of kamacite are also present; ferric iron is likely a result of alteration on Mars (Fleischer et al., 2010b; Schröder et al., 2010). The chemical composition is rich in Ni, Mg, and Cr and poor in Al, K, and Ti compared to other material on the plains of Meridiani Planum and excavated by craters in the area.

**Classification:** Kasos is similar in Mg/Si, Ca/Si and Al/Si ratios to howardites and diogenites, but enriched in S/Si, Fe/Si and Ni and depleted in O (Fleischer et al., 2010b; Schröder et al., 2010). The HED-like silicate composition with additional metal and sulfide composition links Meridiani Planum 005 with the HED or potentially the mesosiderite group. Meridiani Planum 005 is likely paired with [Meridiani Planum 002](#), [003](#), and [004](#).

**Meridiani Planum 006**      2.120°S, 5.521°W

Mars

Find: 31 Jul 2009

Classification: Iron meteorite (IAB complex)

**History:** Meridiani Planum 006 (informally named Block Island) is an angular boulder discovered as the Mars Exploration Rover Opportunity traversed to Endeavour crater.

**Physical characteristics:** Although much of the surface is dust-covered, Pancam images show Meridiani Planum 006 has a metallic surface texture, with numerous hollows and caverns, giving it a pitted appearance. Microscopic Imager (MI) images of smooth areas show slightly raised (resistant) linear features indicative of a Widmanstätten pattern exposed through aeolian scouring (Weitz et al., 2010). Pancam color images reveal spectral heterogeneities across the surface probably representing weathering rinds (Ashley et al., 2011; Weitz et al., 2010); similar ferric oxide coatings are seen in spectra of [Meridiani Planum 001](#) (Heat Shield Rock) (Schröder et al., 2008). Dimensions: 60 × 40 × 25 cm.

**Geochemistry:** Mössbauer analyses showed the dominance of metallic iron-nickel phases, with resolvable kamacite and taenite; ferric oxides, cohenite, and schreibersite were also detected by Mossbauer in the coating areas (Fleischer et al. 2010a).

**Classification:** Iron, Ni, Ge, and Ga abundances measured using the Alpha Particle X-Ray Spectrometer (APXS) are consistent with an origin in the IAB Complex, followed by post-fall water-related oxidation and acidic corrosion (Ashley et al., 2011).

**Meridiani Planum 007**      2.121°S, 5.532°W

Mars

Find: 1 Oct 2009

Classification: Iron meteorite (IAB complex)

**History:** The Mars Exploration Rover Opportunity encountered a pitted boulder on sol 2022 along the rover's traverse to Endeavour crater.

**Physical characteristics:** The rock appears to be extensively weathered, some parts appearing deeply pitted with large spires whereas smooth areas on the surface show an eroded

Widmanstätten pattern (Ashley et al., 2011). Dimensions:  $50 \times 24 \times 20$  cm. It would have an approximate mass of ~245 kg if it were a hemisphere, but it is more likely closer to half this mass (Chappelow and Golombek, 2010).

**Geochemistry:** Mössbauer analyses showed the dominance of metallic iron-nickel phases, with resolvable kamacite and taenite (Fleischer et al. 2010a).

**Classification:** Iron, Ni, Ge, and Ga abundances measured using the Alpha Particle X-Ray Spectrometer (APXS) are consistent with an iron meteorite in the IAB Complex (Fleischer et al. 2010a; Ashley et al. 2011). Pancam color imaging and APXS composition shows the presence of a dark surficial coating similar in hue, composition, and occurrence to that found on [Meridiani Planum 001](#) (Heat Shield Rock) (Johnson et al., 2009; Fleischer et al., 2010a).

### **Meridiani Planum 008**     2.120°S, 5.533°W

Mars

Find: 14 Oct 2009

Classification: Iron meteorite

**History:** The Mars Exploration Rover Opportunity encountered a pitted boulder on sol 2034 along the rover's traverse to Endeavor crater.

**Physical characteristics:** The rock exhibits severe erosion: portions of Mackinac Island are smooth with rounded hollows, but the rock has an excavated interior, with a metal lacework all that remains in some regions.

**Classification:** Pancam 13-filter images show that Mackinac Island has similar VIS-NIR spectral patterns and morphologies as Block Island and Shelter island, found nearby, suggesting it is an iron meteorite (Ashley et al. 2011). The rover compositional instruments were not used on this rock so the grouping cannot be further defined.

### **Montes Claros de Goiás**     15°45'46.53"S, 51°31'1.75"W

Goiás, Brazil

Find: 2018 Sept

Classification: Ordinary chondrite (H5)

**History:** (Andre L R Moutinho, Carlo Bottelli) In September 2018, Dione Pantaleão, a manager of the Corrego Mestre farm located ~30 km northwest of Montes Claros de Goiás city, Goiás State, noticed a large stone in an area without any other rocks. In May 2019, the large and unusually heavy specimen was shown to the farm's owner, Eduardo F. de Melo, who then contacted the meteorite collector Carlo Bottelli to seek assistance in identifying the possible meteorite. In July 2019, Bottelli and Eduardo took the meteorite to an astronomy meeting (5º Encontro Paulista de Astronomia - Sertãozinho, São Paulo), where its authenticity was confirmed by Andre L R Moutinho and Maria Elizabeth Zucolotto.

**Physical characteristics:** Single stone with a mass of 14.915 kg measuring approximately  $31.5 \times 21 \times 16$  cm and showing few regmaglypts. Bulk density 3.589 g/cm<sup>3</sup>

**Petrography** (M. E. Zucolotto, MN/UFRJ): Two thin sections were analyzed. Chondrules are not well defined. Chondrules, with apparent diameter ranging from 0.5 to 1.5 mm (mean 0.7 mm) set in medium grained matrix consisting of orthopyroxene, olivine, plagioclase and minor clinopyroxene. The major pyroxene crystals in the whole section are orthopyroxenes. Olivine show undulatory extinction, planar fractures and mosaicism. The meteorite shows thin melt veins, some of them with small melt pockets and presence of melted metal and troilite flakes. Opaque phases are represented by Fe,Ni alloys (alpha and gamma) and sulphides both in chondrules and in the matrix. Neumann lines can be seen on many large kamacite crystals and around 20 to 30% of the metal has already been oxidized. This



generates an orange to brown staining on the silicate phase also many fractures filled with oxide. The presence of feldspathic, chromite and phosphate grains up to 100  $\mu\text{m}$  in size.

**Geochemistry:** Electron microprobe analysis yielded (A. Tosi, IGEO/UFRJ): olivine  $\text{Fa}_{18.6\pm 0.6}$  (18), low-Ca pyroxene  $\text{Fs}_{16.7\pm 0.6}\text{En}_{82.2\pm 0.7}\text{Wo}_{1.1\pm 0.5}$  (17), high-Ca pyroxene  $\text{Fs}_{12.9\pm 2.8}\text{En}_{65.1\pm 0.7}\text{Wo}_{22.0\pm 8.1}$  (5); plagioclase  $\text{Ab}_{80.4\pm 2.1}\text{An}_{12.2\pm 1.2}\text{Or}_{7.5\pm 1.2}$  (10), Co in kamacite  $0.46\pm 0.02$  (30).

**Classification:** H5, weathering (W2) and moderately shocked (S4) ordinary chondrite.

**Specimens:** Main mass with finder; two polished thin sections and 25 g at *MNRJ*; *AMoutinho*: (2 pcs) 110 g; Carlo Bottelli: (4 pcs) 104 g; Rodrigo Guerra (1 pc) 4.8 g

**Mount Marion** 31°5'53"S, 121°28'42"E

Western Australia, Australia

Find: 2010 Sept

Classification: Ordinary chondrite (H5)

**History:** A single stone of 38.3 g was found at a depth of 12" in an alluvial wash by a person with a metal detector.

**Physical characteristics:** Physical characteristics: A completely crusted stone.

**Petrography:** (A. W. R. Bevan, *WAM*) Discernable chondrules are set in a moderately crystalline matrix. Chondrule mesostases are devitrified to microcrystalline. Olivine shows undulose extinction to mosaicism and abundant planar fractures. The fabric of the meteorite is pervaded by black shock veins with melted troilite and metal droplets.

**Geochemistry:** Mineral compositions and geochemistry: (P. Downes, *WAM*) Mineral compositions as determined by EMP: olivine  $\text{Fa}_{19.1}$ ; orthopyroxene  $\text{Fs}_{16.8}\text{Wo}_{1.12}$ ; chromite #Cr 86.0; kamacite (average  $n=7$ ) Ni 6.85%, Co 0.46%. Petrographically and mineralogically similar to [Lake Gwynne](#) found 63.8 km away.

**Classification:** (H5); S4: W1.

**Specimens:** Type specimen 12.65 g, cut slices 11.45 and 10.86 g, and thin section at *WAM*.

**Mundrabilla 022** 30°46'17.99"S, 127°44'32.16"E

Western Australia, Australia

Find: 2013

Classification: Ordinary chondrite (H5)

**History:** A completely crusted stone weighing 66.53 g was found on open plain by G. Kelahar (Alex Bevan, *WAM*).

**Physical characteristics:** Physical Characteristics: Elongated, completely crusted stone weighing 66.53 g measuring  $5.5 \times 3.5 \times 2.5$  cm (A. Bevan, *WAM*)

**Petrography:** (L. Daly, L. V. Forman, Curtin). Specimen has readily defined chondrules within a heavily stained dark red matrix. The chondrules include types RP, PO, POP, C and BO, and chondrule mesostases are devitrified. Sizes range from 0.46-2.1 mm with a mean of 1.1 mm ( $n=13$ ). Mineralogy consists of olivine, pyroxene, chromite, feldspar, as well as some metal and sulphide and Ca-rich phosphate. Olivine and pyroxene have undulose extinction and planar fractures. Some grains exhibit a weak mosaicism. Feldspars are  $<50$   $\mu\text{m}$ . The metal and sulfide present in the sample have been approximately 20-30% replaced with iron oxide. The sample also contains shock veins with some melt pockets.

**Geochemistry:** Mineral Compositions and Geochemistry: (L. Daly, L. V Forman, Curtin)

EDS, Olivine:  $\text{Fa}_{20.2\pm 2.1}$  ( $n=12$ ) with some rare fayalitic grains  $\text{Fa}_{79.6}$ . Low Ca pyroxene:

$\text{Fs}_{17.8\pm 0.9}\text{Wo}_{1.3\pm 0.3}$  ( $n=8$ ) there are also rare augite  $\text{Fs}_{16.1}\text{Wo}_{20.8}$ . Feldspar  $\text{Ab}_{85.1\pm 2.1}$ .

**Classification:** Ordinary Chondrite H5, S4, W2

**Specimens:** The *WAM* holds the main mass now 64.32 g and one thin section.

**Narashino** 35°41'26"N, 140°01'51"E

Kanto, Japan

Confirmed fall: 2020 Jul 2

Classification: Ordinary chondrite (H5)

**History:** At 2:32 am JST on July 2, 2020, a bright fireball was observed over the Kanto region, Japan (see IAU CBET No. 4810 for trajectory and orbital information). At the same time, a detonating sound was heard at an apartment in Narashino city, *Chiba* prefecture, Japan and in the morning at that day, a 63 g fragment was found in the corridor at the second floor of the apartment (35°41'26"N, 140°01'51"E). On July 4, another 70 g fragment was found in the garden of the apartment (35°42'01"N, 140°02'34"E). Both fragments fit together, thus they were originally one mass (No. 1) and were fragmented on impact. The meteorite was reported to the local museum and then brought to *NMNS* on July 5, where cosmogenic  $^{52}\text{Mn}$ ,  $^{48}\text{V}$ ,  $^{54}\text{Mn}$ ,  $^{22}\text{Na}$  and  $^{26}\text{Al}$  gamma rays were detected by the pure Ge detector. Several small fragments, 22 g in total were found on a terrace at the fifth floor of the apartment on July 18, thus the total weight of the mass No. 1 is more than 156 g. On July 22, another mass (No. 2) was found in Funabashi city, *Chiba* about 1 km northeast of the No. 1 site. A roofing tile of an apartment was broken and 2 large fragments, 95 g and 73 g, and 8 small fragments of the meteorite, 184 g in total were found on the ground with roofing tile fragments. Later, 3 small fragments, 10 g in total, were reported, thus the total weight of the mass No. 2 is more than 194 g.

**Physical characteristics:** Two large fragments of mass No. 1 make a rounded cube shape, half covered by the fusion crust. The first fragment is fresh but second one is slightly rusted due to the rainy weather where it was in the garden for 2 days. Two large fragments of mass No. 2 make a heart-shaped, relatively flat mass half covered by fusion crust. The surface without fusion crust of No. 2 is heavily rusted due to the weather outside for 20 days. The cut surface has no apparent rust, however.

**Petrography:** Polished thick and thin sections were made from the 70 g fragment of No. 1 and the 73 g fragment of No. 2 at *NIPR*. Olivine compositions of No. 1 and No. 2 are  $\text{Fa}_{17.0-18.1}$  (mean= $\text{Fa}_{17.7}$ ,  $N=27$ ) and  $\text{Fa}_{16.9-18.0}$  (mean  $\text{Fa}_{17.6}$ ,  $N=25$ ), and low-Ca pyroxene compositions are  $\text{Fs}_{15.4-16.5}$  (mean= $\text{Fs}_{15.8}$ ,  $N=13$ ) and  $\text{Fs}_{15.5-16.2}$  (mean= $\text{Fs}_{15.8}$ ,  $N=19$ ), respectively. No presence of plagioclase  $>50\mu\text{m}$  indicates that the petrologic type is 5.

**Geochemistry:** Using small fragments from the 63 g No. 1 fragment and the 73 g No. 2 fragment, rare gas analyses were made at *KyuuU*. The K-Ar gas retention age is about 4.5 Ga (assuming the K content of 780 ppm).

**Classification:** H5

**Specimens:** *NMNS*: 63g for Type specimen; *NIPR*: 2 polished thick and thin sections

**North Edwards** 35.055° N, 117.811° W

California, United States

Find: 1976

Classification: Ordinary chondrite (L6)

**History:** The meteorite was found by Mike Brady in 1976 close (within about 50 m east) to Claymine Road, about 4 km NNE of the community of North Edwards, Kern County, California. The discovery location is no longer known to better than a distance of  $\pm 200$  m; the location is within an unnamed cluster of small volcanic domes.

**Physical characteristics:** The mass as received at *UCLA* was 2438 g. Two medium-size pieces had previously been removed thus the original mass was about 3 kg.

**Petrography:** The meteorite is highly recrystallized; plagioclase grains are 40-100  $\mu\text{m}$  in size. Ca-pyroxene has a composition of  $\text{Fs}_{7.9\pm 0.7}\text{Wo}_{44.7\pm 0.8}$  ( $n=4$ ).

### Northeast Africa 009 (formerly Northwest Africa 13243) (NEA 009)

Libya

Purchased: 2020 Jan

Classification: Martian meteorite (Shergottite)

**History:** A group of 20 similar-appearing stones found together in Libya was purchased by Mbark Arjdal in January 2020 from a Libyan dealer.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Relatively fine grained (mean grain size 0.5 mm) aphyric assemblage of predominantly zoned clinopyroxene and maskelynite with accessory merrillite, ilmenite, ulvöspinel, pyrrhotite, alkali feldspar and rare silica polymorph. Sparse pockets of vesicular shock glass are present; in thin section these appear pale brown with a swirly texture and contain opaque inclusions.

**Geochemistry:** Subcalcic augite ( $\text{Fs}_{20.6-25.7}\text{Wo}_{35.9-27.9}$ ,  $\text{FeO/MnO} = 28-30$ ,  $N = 4$ ), pigeonite ( $\text{Fs}_{35.9-27.9}\text{Wo}_{12.8-17.3}$ ,  $\text{FeO/MnO} = 35-38$ ,  $N = 6$ ), maskelynite ( $\text{An}_{56.8-60.6}\text{Or}_{1.7-1.1}$ ,  $N = 4$ ).

**Classification:** Shergottite (aphyric).

**Specimens:** 22.7 g including one polished thin section at *UWB*; remainder with Mr. M. Arjdal.

### Northeast Africa 010 (NEA 010)

Libya

Purchased: 2019 Jan

Classification: Rumuruti chondrite (R3-5)

**History:** Purchased by Mbark Arjdal in November 2019 from a Libyan dealer.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Relatively small separated, well-formed, relatively unequilibrated chondrules (apparent diameter  $650\pm 330\ \mu\text{m}$ ,  $N = 24$ ), plus some equilibrated type 4 and 5 clasts and olivine mineral fragments, are set in a finer grained matrix (orange in thin section) containing Ti-Al chromite and stained pentlandite. Metal is apparently absent.

**Geochemistry:** Olivine in chondrules ( $\text{Fa}_{32.1\pm 11.5}$ , range  $\text{Fa}_{10.1-39.6}$ ,  $N = 10$ ), low-Ca pyroxene ( $\text{Fs}_{18.8\pm 9.9}\text{Wo}_{1.2\pm 0.5}$ , range  $\text{Fs}_{8.0-29.9}\text{Wo}_{0.5-1.7}$ ,  $N = 5$ ), subcalcic augite ( $\text{Fs}_{7.4}\text{Wo}_{31.3}$ ), augite ( $\text{Fs}_{10.6}\text{Wo}_{45.6}$ ), olivine in Type 4 clast ( $\text{Fa}_{39.4\pm 0.4}$ , range  $\text{Fa}_{39.1-39.7}$ ,  $N = 2$ ).

**Classification:** R chondrite (Type 3-5 breccia).

**Specimens:** 43.4 g including one polished thin section at *UWB*; remainder with Mr. M. Arjdal.

### Northeast Africa 011 (NEA 011)

Libya

Purchased: 2020 Jan

Classification: Martian meteorite (Shergottite)

**History:** Purchased by Mbark Arjdal in January 2020 from a Libyan dealer.

**Physical characteristics:** Two nearly identical regmaglypted stones (total weight 161.2 g) completely coated by black fusion crust. The fresh interiors are overall gray in color, and

exhibit elongate, light-gray pyroxene grains, glassy maskelynite and sparse black, glassy shock pockets.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) This aphyric specimen is notable for the large differences in grain size among the constituent minerals. The major components are zoned clinopyroxene (as elongate prismatic grains up to 1.8 mm long) interspersed with thin lath-like maskelynite grains (up to 0.5 mm long), together with much finer grained accessory merrillite, ilmenite, titanomagnetite, pyrrhotite and interstitial K-rich alkali feldspar.

**Geochemistry:** Pigeonite ( $\text{Fs}_{28.4-31.8}\text{Wo}_{10.4-12.1}$ ,  $\text{FeO/MnO} = 28$ ,  $N = 2$ ), subcalcic augite ( $\text{Fs}_{21.7-25.5}\text{Wo}_{35.3-28.7}$ ,  $\text{FeO/MnO} = 27-30$ ,  $N = 2$ ), ferroan pigeonite rims ( $\text{Fs}_{53.5-69.1}\text{Wo}_{22.3-14.3}$ ,  $\text{FeO/MnO} = 37-42$ ,  $N = 4$ ), maskelynite ( $\text{An}_{44.0-47.0}\text{Or}_{1.9-3.2}$ ,  $N = 3$ ), alkali feldspar ( $\text{Or}_{68.5}\text{Ab}_{26.4}\text{An}_{5.2}$ ).

**Classification:** Shergottite (aphyric).

**Specimens:** 21.1 g including one polished thin section at *UWB*; remainder with Mr. M. Arjdal.

### Northeast Africa 012 (NEA 012)

Libya

Purchased: 2019 Aug

Classification: Ordinary chondrite (L3)

**History:** Purchased by Mbark Arjdal in August 2019 from a Libyan dealer.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Closely-packed, well-formed chondrules (apparent diameter  $800 \pm 660 \mu\text{m}$ ,  $N = 23$ ) are set in a sparse matrix containing altered kamacite, taenite, chromite, troilite and chlorapatite.

**Geochemistry:** Olivine ( $\text{Fa}_{19.6 \pm 11.4}$ , range  $\text{Fa}_{4.0-29.4}$ ,  $N = 4$ ;  $\text{Cr}_2\text{O}_3$  in ferroan examples 0.03-0.10 wt.%, mean  $0.05 \pm 0.02$  wt.%,  $N = 10$ ), low-Ca pyroxene ( $\text{Fs}_{12.5 \pm 6.6}\text{Wo}_{1.1 \pm 1.2}$ , range  $\text{Fs}_{3.8-21.7}\text{Wo}_{0.2-3.1}$ ,  $N = 5$ ), pigeonite ( $\text{Fs}_{16.7 \pm 1.7}\text{Wo}_{6.1 \pm 0.8}$ , range  $\text{Fs}_{15.5-17.9}\text{Wo}_{5.5-6.7}$ ,  $N = 2$ ), augite ( $\text{Fs}_{1.8}\text{Wo}_{49.2}$ ;  $\text{Fs}_{5.5}\text{Wo}_{39.3}$ ;  $\text{Fs}_{12.1}\text{Wo}_{34.9}$ ,  $N = 3$ ). Magnetic susceptibility  $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.63$ .

**Classification:** Ordinary chondrite (L3).

**Specimens:** 21.7 g including one polished thin section at *UWB*; remainder with Mr. M. Arjdal.

### Northeast Africa 013 (NEA 013)

Northeast Africa

Purchased: 2020 May

Classification: Diogenite-melt rock

**History:** Purportedly found in Libya, purchased by Rachid Chaoui in May 2020 from a Libyan dealer, and acquired in July 2020 by Terry *Boudreaux*.

**Physical characteristics:** A single pale greenish stone (3250 g) partially coated by patchy black fusion crust. The fresh interior appears uniform and very fine grained with sparse small vesicles and tiny grains of shiny metal.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Very fresh igneous-textured specimen with sporadic small spherical vesicles (up to 0.8 mm in diameter). Composed predominantly of plumose arrays of thin laths of zoned pyroxene (up to 1.9 mm long) intergrown with calcic plagioclase. Subhedral grains of unzoned olivine (containing sparse melt inclusions) and chromite are associated with pyroxene, which exhibits compositional zoning from orthopyroxene cores to pigeonite rims. Accessory phases are silica polymorph, FeNi metal (kamacite, taenite) and troilite.

**Geochemistry:** Orthopyroxene cores ( $\text{Fs}_{17.6-18.5}\text{Wo}_{0.9-1.1}$ ,  $\text{FeO/MnO} = 27-31$ ,  $N = 3$ ), pigeonite rims ( $\text{Fs}_{36.7-38.5}\text{Wo}_{8.4-11.1}$ ,  $\text{FeO/MnO} = 31-32$ ,  $N = 3$ ), olivine ( $\text{Fa}_{33.9-39.3}$ ,  $\text{FeO/MnO} = 47-50$ ,  $N = 4$ ), plagioclase ( $\text{An}_{87.6-94.2}\text{Or}_{0.7-0.2}$ ,  $N = 4$ ).

**Classification:** Diogenite (melt rock, olivine-plagioclase-bearing, vesicular).

**Specimens:** 30.8 g including one polished endcut and one polished thin section at *UWB*; main mass with Mr. T. *Boudreaux*.

#### Northeast Africa 014 (NEA 014)

Libya

Purchased: 2020 Aug

Classification: Lunar meteorite (feldspathic breccia)

**History:** Purchased by Aziz Habibi in August 2020 from a Libyan dealer.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Breccia composed of mineral clasts of anorthite, relatively abundant exsolved pigeonite and subordinate olivine set in a very fine grained matrix (sparsely vesicular) containing ilmenite, aluminous chromite, troilite and taenite. Pyroxene grains consist of augite lamellae within orthopyroxene or pigeonite hosts.

**Geochemistry:** Orthopyroxene host ( $\text{Fs}_{28.4-31.0}\text{Wo}_{3.1-3.3}$ ,  $\text{FeO/MnO} = 54-61$ ,  $N = 3$ ), pigeonite host ( $\text{Fs}_{36.7}\text{Wo}_{9.3}$ ,  $\text{FeO/MnO} = 65$ ), pigeonite lamella ( $\text{Fs}_{27.2}\text{Wo}_{21.5}$ ,  $\text{FeO/MnO} = 67$ ), augite lamellae ( $\text{Fs}_{13.1-19.1}\text{Wo}_{40.1-40.9}$ ,  $\text{FeO/MnO} = 50$ ,  $N = 2$ ), olivine ( $\text{Fa}_{21.0-23.5}$ ,  $\text{FeO/MnO} = 81-103$ ,  $N = 3$ ), anorthite ( $\text{An}_{95.6-97.1}\text{Or}_{0.1}$ ,  $N = 3$ ).

**Classification:** Lunar (feldspathic breccia, olivine-poor).

**Specimens:** 20.5 g including one polished mount at *UWB*; remainder with Mr. A. Habibi.

#### Northeast Africa 015 (NEA 015)

Libya

Purchased: 2020 Dec

Classification: Martian meteorite (Shergottite)

**History:** Purportedly found in Libya, purchased by Mohammed *Hmani* in November 2020 from a Mauritanian dealer, and subsequently acquired by Edwin Thompson.

**Physical characteristics:** An elongate stone (610 g) with flat sides and rounded edges, partially covered by small patches of black fusion crust. Exterior surfaces exhibit dark brown grains set in a fine grained, pale brown groundmass. The fresh interior exhibits larger brown grains within a pale greenish-gray groundmass containing obvious glassy maskelynite.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Fresh porphyritic igneous rock containing phenocrysts of olivine (up to 2.2 mm) in a groundmass of zoned subcalcic augite and maskelynite plus accessory chromite (with variable Ti content), merrillite, chlorapatite, pyrrhotite and pentlandite. Secondary calcite, gypsum and halite are present in microfractures, some of which cut the fusion crust.

**Geochemistry:** Olivine ( $\text{Fa}_{30.9-38.7}$ ,  $\text{FeO/MnO} = 50-55$ ,  $N = 6$ ), subcalcic augite ( $\text{Fs}_{7.4-12.4}\text{Wo}_{24.6-30.7}$ ,  $\text{FeO/MnO} = 29-32$ ,  $N = 6$ ), maskelynite ( $\text{An}_{62.2-63.1}\text{Or}_{0.5}$ ,  $N = 2$ ).

**Classification:** Shergottite (olivine-phyric).

**Specimens:** 24.1 g including one polished thin section and one polished thick section at *UWB*; remainder with Paul Stahura, Sammamish, WA.

#### Northwest Africa 1281 (NWA 1281)

(Northwest Africa)

Purchased: 2002



Classification: HED achondrite (Diogenite, polymict)

**History:** Purchased by Adam and Greg *Hupe* in 2002 from a dealer in Zagora, Morocco.

**Petrography:** (A. Irving, *UWS* and J. Boesenberg, *BrownU*) Very fresh breccia composed predominantly of angular mineral clasts of diogenitic orthopyroxene (of several different compositions with widely different Mg/Fe ratios), olivine, calcic plagioclase, chromite, silica polymorph, pigeonite and subcalcic augite, plus sparse lithic clasts of quench-textured eucrite, set in a fine grained matrix containing ilmenite and Ni-poor metal. Eucritic clasts consist of acicular skeletal grains of pigeonite and very fine grained, indeterminate opaque mesostasis.

**Geochemistry:** Diogenitic orthopyroxene ( $\text{Fs}_{15.2-18.4}\text{Wo}_{1.2-1.4}$ ,  $N = 6$ ;  $\text{Fs}_{22.1-23.4}\text{Wo}_{2.4-3.0}$ ,  $N = 2$ ;  $\text{Fs}_{28.0}\text{Wo}_{3.4}$ ;  $\text{FeO/MnO} = 27-31$ ), pigeonite ( $\text{Fs}_{48.9}\text{Wo}_{7.7}$ ;  $\text{Fs}_{56.2}\text{Wo}_{9.5}$ ;  $\text{FeO/MnO} = 27-29$ ), subcalcic augite ( $\text{Fs}_{44.4-47.3}\text{Wo}_{25.5-29.8}$ ,  $N = 2$ ;  $\text{Fs}_{61.8}\text{Wo}_{25.9}$ ;  $\text{FeO/MnO} = 29-34$ ), olivine ( $\text{Fa}_{32.8-40.4}$ ,  $\text{FeO/MnO} = 54-64$ ,  $N = 4$ ), plagioclase ( $\text{An}_{80.8-94.1}\text{Or}_{0.4-0.1}$ ,  $N = 6$ ).

**Classification:** Diogenite (polymict breccia).

**Specimens:** 22.8 g at *UCLA*; 0.95 g including one polished thin section at *PSF*; remainder with A. and G. *Hupe*.

#### Northwest Africa 1286 (NWA 1286)

(Northwest Africa)

Purchased: 2002

Classification: Ordinary chondrite (L4)

**History:** Purchased by Adam and Greg *Hupe* in 2002 from a dealer in Zagora, Morocco.

**Petrography:** (A. Irving, *UWS* and J. Boesenberg, *BrownU*) Well-formed chondrules are set in a relatively coarse grained matrix containing altered metal, troilite, chromite and apatite.

**Geochemistry:** Olivine ( $\text{Fa}_{24.5\pm 0.1}$ , range  $\text{Fa}_{24.3-24.7}$ ,  $N = 6$ ), low-Ca pyroxene ( $\text{Fs}_{21.0\pm 0.2}\text{Wo}_{1.2\pm 0.1}$ , range  $\text{Fs}_{20.6-21.2}\text{Wo}_{1.1-1.2}$ ,  $N = 5$ ).

**Classification:** Ordinary chondrite (L4).

**Specimens:** 21 g at *UCLA*; 1.7 g including one polished thin section at *PSF*; remainder with A. & G. *Hupe*.

#### Northwest Africa 1458 (NWA 1458)

(Northwest Africa)

Purchased: 2002

Classification: Ordinary chondrite (H4)

**History:** Purchased by Adam and Greg *Hupe* in 2002 from a dealer in Zagora, Morocco.

**Petrography:** (A. Irving, *UWS* and J. Boesenberg, *Brown U*) Well-formed, relatively small chondrules are set in a relatively coarse grained matrix containing altered metal, troilite, chromite and apatite.

**Geochemistry:** Olivine ( $\text{Fa}_{19.6\pm 0.8}$ , range  $\text{Fa}_{19.3-21.1}$ ,  $N = 5$ ), low-Ca pyroxene ( $\text{Fs}_{17.3\pm 0.9}\text{Wo}_{1.5\pm 0.1}$ , range  $\text{Fs}_{16.3-17.3}\text{Wo}_{1.2-1.6}$ ,  $N = 5$ ).

**Classification:** Ordinary chondrite (H4).

**Specimens:** 20 g at *UCLA*; 1.7 g including one polished thin section at *PSF*; remainder with A. & G. *Hupe*.

#### Northwest Africa 2628 (NWA 2628)

(Northwest Africa)

Purchased: 2004

Classification: Carbonaceous chondrite (CK3)

**History:** Purchased by Mike Farmer in 2004 from a dealer in Erfoud, Morocco.

**Petrography:** (A. Irving and S. Kuehner, *UWS*; T. Bunch and J. Wittke, *NAU*; P. Carpenter, *WUSL*) Separated well-formed, granular unequilibrated chondrules (apparent diameter  $980 \pm 280 \mu\text{m}$ ,  $N = 20$ ) containing more magnesian cores are set in a fresh matrix containing Cr-magnetite.

**Geochemistry:** Olivine ( $\text{Fa}_{20.3 \pm 13.3}$ , range  $\text{Fa}_{0.3-33.2}$ ,  $N = 11$ ), orthopyroxene ( $\text{Fs}_{13.8 \pm 11.4} \text{Wo}_{1.0 \pm 0.1}$ , range  $\text{Fs}_{0.9-22.5} \text{Wo}_{1.0-0.9}$ ,  $N = 3$ ), subcalcic augite ( $\text{Fs}_{1.0} \text{Wo}_{33.9}$ ), diopside ( $\text{Fs}_{1.0} \text{Wo}_{49.8}$ ), augite ( $\text{Fs}_{13.9} \text{Wo}_{41.5}$ ), magnetite (0.6-2.9 wt.%  $\text{Cr}_2\text{O}_3$ ,  $N = 3$ ), plagioclase ( $\text{An}_{21.7} \text{Or}_{3.1}$ ).

**Classification:** Carbonaceous chondrite (CK3).

**Specimens:** 26.2 g including one polished thin section at *PSF*; remainder with Mr. M. Farmer.

#### Northwest Africa 2682 (NWA 2682)

(Northwest Africa)

Purchased: 2004

Classification: Ordinary chondrite (L3-6)

**History:** Purchased by Nelson Oakes in 2004 from a dealer in Erfoud, Morocco.

**Petrography:** (A. Irving and S. Kuehner, *UWS*; T. Bunch and J. Wittke, *NAU*; P. Carpenter, *WUSL*) Closely-packed, well-formed chondrules (apparent diameter  $820 \pm 300 \mu\text{m}$ ,  $N = 20$ ) plus some angular clasts (Type 6, equilibrated with rare remnant chondrules) are set in a finer grained matrix containing stained metal.

**Geochemistry:** Olivine ( $\text{Fa}_{27.9 \pm 9.3}$ , range  $\text{Fa}_{8.7-36.9}$ ,  $N = 8$ ;  $\text{Cr}_2\text{O}_3$  in ferroan examples 0.05-0.69 wt.%, mean  $0.21 \pm 0.25$  wt.%,  $N = 7$ ), orthopyroxene ( $\text{Fs}_{10.1 \pm 10.3} \text{Wo}_{0.7 \pm 0.5}$ , range  $\text{Fs}_{3.4-21.9} \text{Wo}_{0.4-1.2}$ ,  $N = 3$ ), clinopyroxene ( $\text{Fs}_{10.7} \text{Wo}_{37.5}$ ;  $\text{Fs}_{7.9} \text{Wo}_{46.3}$ ;  $N = 2$ ), olivine in Type 6 lithic clast ( $\text{Fa}_{26.1 \pm 0.1}$ , range  $\text{Fa}_{26.0-26.2}$ ,  $N = 2$ ).

**Classification:** Ordinary chondrite (L3-6). Affinity to L chondrites is established from olivine composition in equilibrated lithic clasts.

**Specimens:** 47.4 g including one polished thin section at *PSF*; remainder with Mr. N. Oakes.

#### Northwest Africa 2696 (NWA 2696)

Northwest Africa

Purchased: 2004

Classification: HED achondrite (Eucrite, brecciated)

**History:** Purchased by Greg Hupé in 2004 from several Moroccan dealers.

**Petrography:** (A. Irving, *UWS* and J. Boesenberg, Brown U) Breccia containing some fine-to medium-grained eucrite clasts plus abundant related angular crystalline debris. Minerals are exsolved pigeonite, calcic plagioclase, unexsolved pigeonite, subcalcic augite, ilmenite, silica, chromite, altered Ni-free metal and troilite. No olivine or diagenitic orthopyroxene was found in the studied thin section.

**Geochemistry:** Low-Ca pyroxene host ( $\text{Fs}_{55.9-57.8} \text{Wo}_{2.6-4.6}$ ,  $\text{FeO/MnO} = 27-29$ ,  $N = 7$ ), augite exsolution lamellae ( $\text{Fs}_{26.5-29.2} \text{Wo}_{38.2-41.2}$ ,  $\text{FeO/MnO} = 26-28$ ,  $N = 2$ ), pigeonite ( $\text{Fs}_{44.6-48.8} \text{Wo}_{19.5-14.7}$ ;  $\text{Fs}_{54.0} \text{Wo}_{7.6}$ ;  $\text{FeO/MnO} = 25-29$ ,  $N = 6$ ), subcalcic augite ( $\text{Fs}_{39.7-42.0} \text{Wo}_{27.0-24.0}$ ,  $\text{FeO/MnO} = 25-29$ ,  $N = 2$ ), plagioclase ( $\text{An}_{76.8-93.1} \text{Or}_{1.9-0.5}$ ,  $N = 5$ ).

**Classification:** Eucrite (breccia).

**Specimens:** 28 g including one polished thin section at *PSF*; remainder with Mr. G. Hupé.

**Northwest Africa 3144** (NWA 3144)

Northwest Africa

Purchased: 2004 Aug

Classification: Carbonaceous chondrite (CV3)

**History:** Purchased by Greg Hupé in August 2004 from a dealer in Rissani, Morocco.**Physical characteristics:** Very fresh subspherical stone (1053 g) with complete black fusion crust. Relatively large chondrules and white to pale pink CAI are present in a very fine grained dark matrix.**Petrography:** (A. Irving and S. Kuehner, *UWS*; J. Boesenberg, Brown U) Well-formed chondrules (mostly granular but also some BO, apparent diameter  $880 \pm 330 \mu\text{m}$ ,  $N = 25$ ), relatively abundant amoeboid to irregularly-shaped, very fine grained CAI and sparse olivine-rich aggregates are set in a fine grained matrix (~20 vol.%, sepia brown in thin section). Olivine-rich chondrules and olivine-rich aggregates consist mainly of forsterite with minor enstatite, taenite, Cr-bearing magnetite (commonly associated with metal), troilite, pentlandite and rare copper metal (containing Mo and Sn). One barred olivine chondrule is surrounded by an olivine aggregate rim with embedded chondrule fragments. Several large CAI appear to be fluffy type A with cores composed of Mg-Al spinel (with variable Fe contents), grossular garnet, perovskite, fassaitic clinopyroxene, anorthite, sodalite (some Ca-bearing), and minor anorthoclase, ilmenite and Ni-Zn metal. Wark-Lovering rims on CAI consist of gehlenite, anorthite, spinel, olivine (~Fa<sub>60</sub>), andradite garnet, hedenbergite, diopside, kirchsteinite(?) and awaruite (with measurable Pt and Rh).**Geochemistry:** (J. Boesenberg, Brown U) Olivine (Fa<sub>22.9±19.3</sub>, range Fa<sub>0.5-45.7</sub>,  $N = 8$ ), enstatite (Fs<sub>2.3±2.0</sub>Wo<sub>2.6±1.4</sub>, range Fs<sub>1.1-4.6</sub>Wo<sub>1.0-3.4</sub>,  $N = 3$ ), subcalcic augite (Fs<sub>4.5</sub>Wo<sub>30.7</sub>), plagioclase (An<sub>87.8-93.8</sub>Or<sub>0.0</sub>,  $N = 4$ ).**Classification:** Carbonaceous chondrite (CV3).**Specimens:** 20 g at *AMNH*; 1.6 g at *PSF* converted to a polished thin section; one polished thin section at *UWB*; remainder with Mr. G. Hupé.**Northwest Africa 4295** (NWA 4295)

Morocco

Purchased: 2006 Mar

Classification: Enstatite chondrite (EL melt rock)

**History:** Purchased by Adam Hupé in March 2006 from a dealer in Erfoud, Morocco. A small specimen was sold to *PSF* in 2007.**Physical characteristics:** Five similar stones (total weight 312 g) consisting of aggregates of small whitish grains crosscut by distinctive thin compression fractures filled with terrestrial limonite.**Petrography:** (A. Irving, *UWS* & J. Boesenberg, *BrownU*) All five stones were examined petrographically. They are fine grained aggregates of predominantly enstatite (mostly as prismatic grains) with accessory sodic plagioclase, iron hydroxides (after primary metal), troilite, daubreelite and schreibersite. No fresh metal was found in the studied thin sections. Rare but clearly defined, spherical RP chondrules are present, and there are subparallel veinlets of secondary iron hydroxides and some calcite.**Geochemistry:** Enstatite (Fs<sub>0.5±0.2</sub>Wo<sub>1.4±0.0</sub> (range Fs<sub>0.3-0.8</sub>Wo<sub>1.4</sub>,  $N = 6$ ), plagioclase (Ab<sub>80.5-81.8</sub>An<sub>15.6-14.2</sub>Or<sub>4.0-3.4</sub>,  $N = 5$ ).**Classification:** EL3-melt rock. Paired with [Al Haggounia 001](#) and related material.**Specimens:** 20.5 g including one polished thin section at *UWB*; 9.04 g at *PSF*; remainder with *AHupé*.

**Northwest Africa 4454** (NWA 4454)

(Northwest Africa)

Purchased: 2006 Feb

Classification: Ordinary chondrite (H6)

**History:** Purchased by Nelson *Oakes* in February 2006 from a dealer in Erfoud, Morocco.**Petrography:** (A. Irving, *UWS* and J. Boesenberg, *BrownU*) The specimen is almost entirely recrystallized with rare chondrule remnants. One very large, well-formed BO chondrule (apparent diameter 3.5 mm) is present in the studied thin section. Accessory phases are stained metal, chlorapatite, chromite and troilite.**Geochemistry:** Olivine ( $Fa_{19.4\pm 0.1}$ , range  $Fa_{19.2-19.5}$ ,  $N = 7$ ), low-Ca pyroxene ( $Fs_{16.9\pm 0.2}Wo_{1.3\pm 0.2}$ , range  $Fs_{16.7-17.4}Wo_{0.9-1.5}$ ,  $N = 8$ ).**Classification:** Ordinary chondrite (H6).**Specimens:** 22 g including one polished thin section at *PSF*; remainder with Mr. N. *Oakes*.**Northwest Africa 4837** (NWA 4837)

(Northwest Africa)

Purchased: 2006

Classification: Carbonaceous chondrite (CV3)

**History:** Purchased by Marcin Cimała in 2006 from a dealer in Erfoud, Morocco.**Petrography:** (A. Irving, *UWS* and J. Boesenberg, *BrownU*; T. Bunch and J. Wittke, *NAU*) Well-formed chondrules (apparent diameter  $980\pm 340$   $\mu\text{m}$ ,  $N = 23$ ) and CAI (both very fine grained and relatively coarse grained) are set in a fine grained matrix (~50 vol.%, deep red-brown in thin section).**Geochemistry:** Olivine ( $Fa_{15.3\pm 17.3}$ , range  $Fa_{2.3-45.7}$ ,  $N = 9$ ), low-Ca pyroxene ( $Fs_{1.0\pm 0.2}Wo_{1.0\pm 0.1}$ , range  $Fs_{0.7-1.1}Wo_{0.8-1.1}$ ,  $N = 3$ ), subcalcic augite ( $Fs_{0.9}Wo_{28.4}$ ), diopside ( $Fs_{1.1}Wo_{37.8}$ ).**Classification:** Carbonaceous chondrite (CV3).**Specimens:** 20.2 g including one polished thin section at *PSF*; remainder with Mr. M. Cimała.**Northwest Africa 4839** (NWA 4839)

(Northwest Africa)

Purchased: 2006

Classification: Carbonaceous chondrite (CV3)

**History:** Purchased by Marcin Cimała in 2006 from a dealer in Erfoud, Morocco.**Petrography:** (A. Irving, *UWS* and J. Boesenberg, *BrownU*; T. Bunch and J. Wittke, *NAU*) Well-formed chondrules (apparent diameter  $980\pm 450$   $\mu\text{m}$ ,  $N = 24$ ) and very fine grained CAI are set in a fine grained opaque matrix (~35 vol.%, black in thin section).**Geochemistry:** Olivine ( $Fa_{18.7\pm 17.3}$ , range  $Fa_{0.5-45.7}$ ,  $N = 9$ ), low-Ca pyroxene ( $Fs_{1.5\pm 0.5}Wo_{0.7\pm 0.2}$ , range  $Fs_{1.1-2.1}Wo_{0.5-0.9}$ ,  $N = 3$ ), diopside ( $Fs_{1.0\pm 0.1}Wo_{44.7\pm 2.0}$ , range  $Fs_{0.9-1.1}Wo_{43.2-46.1}$ ,  $N = 2$ ).**Classification:** Carbonaceous chondrite (CV3).**Specimens:** 6.0 g including one polished thin section at *PSF*; remainder with Mr. M. Cimała.**Northwest Africa 5147** (NWA 5147)

(Northwest Africa)

Purchased: 2007

Classification: HED achondrite (Howardite)

**History:** Purchased by Terry Boswell in 2007 from a Moroccan dealer.

**Petrography:** (A. Irving, *UWS* and J. Boesenberg, *BrownU*; T. Bunch and J. Wittke, *NAU*) Breccia composed of sparse lithic diogenite and eucrite clasts plus related angular mineral fragments in a finer grained matrix. The proportion of diogenitic material is 30-40 vol.%. Minerals include diogenitic orthopyroxene, exsolved pigeonite, unexsolved pigeonite, calcic plagioclase, ferropigeonite, silica polymorph, fayalite, chromite, troilite, ilmenite and Ni-free metal. Lithic eucrite clasts have intersertal, diabasic and microgabbroic textures.

**Geochemistry:** Diogenitic orthopyroxene ( $\text{Fs}_{23.6-32.1}\text{Wo}_{1.9-3.6}$ ,  $\text{FeO/MnO} = 25-31$ ,  $N = 5$ ), pigeonite ( $\text{Fs}_{39.3-50.5}\text{Wo}_{11.3-21.8}$ ,  $\text{FeO/MnO} = 23-31$ ,  $N = 6$ ), orthopyroxene host ( $\text{Fs}_{54.8-60.1}\text{Wo}_{1.5-4.1}$ ,  $\text{FeO/MnO} = 29-31$ ,  $N = 8$ ), clinopyroxene exsolution lamellae ( $\text{Fs}_{24.6-24.9}\text{Wo}_{42.0-43.8}$ ,  $\text{FeO/MnO} = 29-30$ ,  $N = 2$ ), ferroan orthopyroxene ( $\text{Fs}_{37.5}\text{Wo}_{2.1}$ ,  $\text{FeO/MnO} = 30$ ), ferropigeonite ( $\text{Fs}_{76.3}\text{Wo}_{17.5}$ ,  $\text{FeO/MnO} = 33$ ), fayalite ( $\text{Fa}_{75.8}$ ,  $\text{FeO/MnO} = 39$ ), plagioclase ( $\text{An}_{87.7-94.4}\text{Or}_{0.4-0.1}$ ,  $N = 8$ ).

**Classification:** Howardite.

**Specimens:** 20.9 g including one polished thin section at *PSF*; remainder with Mr. T. Boswell.

#### Northwest Africa 5150 (NWA 5150)

(Northwest Africa)

Purchased: 2007

Classification: Ordinary chondrite (H7)

**History:** Purchased by Terry Boswell in 2007 from a Moroccan dealer.

**Petrography:** (A. Irving, *UWS* and J. Boesenberg, *BrownU*; T. Bunch and J. Wittke, *NAU*) The specimen has a triple grain junction texture and is completely devoid of chondrules. Accessory phases include abundant altered kamacite, troilite and rare chromite. Thin cross-cutting veinlets of secondary goethite are present.

**Geochemistry:** Olivine ( $\text{Fa}_{18.7\pm 0.4}$ , range  $\text{Fa}_{18.4-19.1}$ ,  $N = 9$ ), low-Ca pyroxene ( $\text{Fs}_{16.4\pm 0.2}\text{Wo}_{3.7\pm 0.4}$ , range  $\text{Fs}_{16.2-16.7}\text{Wo}_{3.2-4.0}$ ,  $N = 4$ ).

**Classification:** Ordinary chondrite (H7).

**Specimens:** 26.3 g including one polished thin section at *PSF*; remainder with Mr. T. Boswell.

#### Northwest Africa 5335 (NWA 5335)

(Northwest Africa)

Purchased: 2008

Classification: Mesosiderite

**History:** The meteorite was purchased from a meteorite dealer in Besancon, France.

**Physical characteristics:** Many brownish fragments without fusion crust.

**Petrography:** The meteorite is composed of about 60% silicates and 40% FeNi metal. The metallic lithology consists of kamacite and taenite, the silicate fraction is dominated by up to 1 mm sized and compositionally zoned low-Ca pyroxene, less abundant olivine, and calcic plagioclase. Minor phases include silica, chromite, troilite, and merrillite.

**Geochemistry:** olivine:  $\text{Fa}_{30.3\pm 0.2}$  ( $\text{Fa}_{29.8-30.8}$ ,  $n=12$ ,  $\text{FeO/MnO}=27\pm 3$ ); low-Ca pyroxene:  $\text{Fs}_{29.6\pm 5.2}\text{Wo}_{4.6\pm 2.4}$  ( $\text{Fs}_{22.3-44.9}\text{Wo}_{1.5-10.2}$ ,  $n=13$ ,  $\text{FeO/MnO}=27\pm 4$ ); calcic plagioclase:  $\text{An}_{93.1\pm 1.3}$  ( $\text{An}_{91.6-96.0}$ ,  $n=14$ )



**Northwest Africa 5471 (NWA 5471)**

(Northwest Africa)

Purchased: 2008

Classification: Primitive achondrite (Brachinite)

**History:** The meteorite was purchased from a local meteorite dealer in Erfoud, Morocco.**Physical characteristics:** Twenty-one brownish fragments without fusion crust.**Petrography:** The meteorite shows an equilibrated texture (120° triple junctions) and is predominantly composed of olivine (>90 vol.%) and Ca-pyroxene. Grains sizes of the silicates vary between 200 and 1000 µm. Accessories include FeS and FeNi metal. Feldspar and low-Ca pyroxene were not detected in the section studied. Metal is often replaced by alteration products decorating the grain boundaries and cracks are filled with terrestrial clacite.**Geochemistry:** olivine:  $\text{Fa}_{28.3\pm 0.1}$  ( $\text{Fa}_{28.0-28.5}$ ,  $\text{FeO/MnO}=57\pm 2$ ,  $n=14$ ); Ca-pyroxene:  $\text{Fs}_{9.5\pm 0.3}\text{Wo}_{43.6\pm 0.3}$  ( $\text{Fs}_{8.9-9.8}\text{Wo}_{43.4-44.3}$ ,  $n=16$ )**Northwest Africa 5596 (NWA 5596)**

(Northwest Africa)

Purchased: 2007

Classification: Carbonaceous chondrite (CO3)

**History:** The meteorite was purchased from a meteorite dealer in Morocco.**Physical characteristics:** Brownish rock without fusion crust.**Petrography:** The meteorite shows a dark brownish interior and is predominantly composed of abundant chondrules (mean diameter about 180 µm), CAIs, and mineral fragments set into a fine-grained matrix. Chondrules are highly unequilibrated and sometimes surrounded by fine-grained dust rims. Sulfides and FeNi metal are present in matrix and chondrules.**Northwest Africa 5597 (NWA 5597)**

(Northwest Africa)

Purchased: 2007

Classification: HED achondrite (Diogenite)

**History:** The meteorite was purchased in Outat el Hadj, Morocco.**Physical characteristics:** Two greyish-greenish fragments largely covered by shiny fusion crust.**Petrography:** The meteorite is a monomict breccia predominantly composed of blocky up to 3 mm sized orthopyroxene grains and fine-grained cataclastic regions. Minor phases include olivine, plagioclase, chromite, and FeS. No metallic iron has been detected.**Geochemistry:** low-Ca pyroxene:  $\text{Fs}_{25.4\pm 0.2}\text{Wo}_{2.7\pm 0.5}$  ( $\text{Fs}_{24.8-25.6}\text{Wo}_{1.8-3.2}$ ,  $n=11$ ,  $\text{FeO/MnO}=24-26$ ); olivine:  $\text{Fa}_{30.0\pm 0.2}$  ( $\text{Fa}_{29.8-30.2}$ ,  $n=7$ ,  $\text{FeO/MnO}=41-50$ ); calcic plagioclase:  $\text{An}_{87.1\pm 0.7}$  ( $\text{An}_{86.3-87.4}$ ,  $n=10$ )**Northwest Africa 5888 (NWA 5888)**

(Northwest Africa)

Purchased: 2008

Classification: Pallasite

**History:** The meteorite was purchased from a meteorite dealer on a mineral fair in St. Marie aux Mines, France.**Physical characteristics:** Small brownish fragment without fusion crust.

**Petrography:** The meteorite is composed of about 6 mm sized subrounded olivine grains surrounded and also crosscut by abundant brownish iron oxides or hydroxides. Only minor amounts of pristine FeNi-metal and troilite are present.

**Geochemistry:** Olivine:  $\text{FeO/MnO}=36\pm 3$ ,  $n=11$

#### Northwest Africa 5889 (NWA 5889)

(Northwest Africa)

Purchased: 2008

Classification: Primitive achondrite (Winonaite)

**History:** The meteorite was purchased from a meteorite dealer in Besancon, France.

**Physical characteristics:** Three small brownish fragments without fusion crust.

**Petrography:** The meteorite displays an equilibrated texture with abundant  $120^\circ$  triple junctions. Low-Ca pyroxene is the most abundant phase with forsteritic olivine, augite, and feldspar grains being subordinate. Grain sizes are typically 100 to 200  $\mu\text{m}$ . Minor phases include kamacite, schreibersite, and troilite. Contains veinlets of metal or Fe-oxide throughout. No chondrules were observed.

**Geochemistry:** olivine:  $\text{Fa}_{4.6\pm 0.1}$  ( $\text{Fa}_{4.4-4.8}$ ,  $\text{FeO/MnO}=27\pm 3$ ,  $n=12$ ); low-Ca pyroxene:

$\text{Fs}_{6.8\pm 0.2}\text{Wo}_{1.8\pm 0.1}$  ( $\text{Fs}_{6.3-7.1}\text{Wo}_{1.6-2.0}$ ,  $\text{FeO/MnO}=29\pm 6$ ,  $n=12$ ); Ca-pyroxene:

$\text{Fs}_{2.6\pm 0.2}\text{Wo}_{45.6\pm 0.3}$  ( $\text{Fs}_{2.4-2.9}\text{Wo}_{45.2-46.2}$ ,  $n=7$ ); feldspar:  $\text{An}_{12.4\pm 1.2}\text{Ab}_{84.9\pm 1.0}\text{Or}_{2.7\pm 0.3}$ ,  $n=9$

#### Northwest Africa 5890 (NWA 5890)

(Northwest Africa)

Purchased: 2009

Classification: Primitive achondrite (Winonaite)

**History:** The meteorite was purchased from a local meteorite dealer in Erfoud, Morocco.

**Physical characteristics:** Thirty-six up to 1 cm sized brownish fragments without fusion crust.

**Petrography:** Sawn surfaces of the fragments show that the meteorite is composed of larger metal-dominated and less abundant silicate-rich regions. Silicate regions display a recrystallized texture dominantly composed of typically 100 to 200  $\mu\text{m}$  sized enstatite, forsteritic olivine, augite, and feldspar grains, with enstatite being the most abundant mineral phase.  $120^\circ$  degree triple junctions are abundant. Metal is kamacite and taenite and has been partly altered to reddish-brownish iron oxides and hydroxides; contains some troilite. Chondrules were not observed.

**Geochemistry:** olivine:  $\text{Fa}_{4.0\pm 0.1}$  ( $\text{Fa}_{3.8-4.0}$ ,  $\text{FeO/MnO}=23\pm 2$ ,  $n=4$ ); low-Ca pyroxene:

$\text{Fs}_{6.0\pm 0.2}\text{Wo}_{1.7\pm 0.1}$  ( $\text{Fs}_{5.7-6.2}\text{Wo}_{1.6-1.7}$ ,  $\text{FeO/MnO}=27\pm 4$ ,  $n=4$ ); Ca-pyroxene:

$\text{Fs}_{2.2\pm 0.2}\text{Wo}_{46.4\pm 0.3}$  ( $\text{Fs}_{1.9-2.4}\text{Wo}_{46.1-46.7}$ ,  $n=5$ ); feldspar:  $\text{An}_{10.5\pm 1.0}\text{Ab}_{87.4\pm 0.9}\text{Or}_{2.2\pm 0.2}$ ,  $n=3$

**Classification:** Winonaite (metal rich)

#### Northwest Africa 5891 (NWA 5891)

(Northwest Africa)

Purchased: 2005

Classification: Pallasite

**History:** The meteorite was purchased from a local meteorite dealer in Midelt, Morocco.

**Physical characteristics:** Brownish fragment without fusion crust.

**Petrography:** The meteorite is composed of up to 1 cm sized subrounded and partly fragmented olivine grains surrounded by a matrix of brownish iron oxides which are also

present along the olivine grain boundaries and cracks. Contains some Cr-bearing troilite; no pristine FeNi-metal was detected.

**Geochemistry:** olivine:  $Fa_{7.5\pm 0.1}$  ( $Fa_{4.4-4.8}$ ,  $FeO/MnO=37\pm 3$ ,  $n=11$ )

#### Northwest Africa 6027 (NWA 6027)

(Northwest Africa)

Purchased: 2009

Classification: Carbonaceous chondrite (CK3)

**History:** The meteorite was purchased from a local meteorite dealer in Erfoud, Morocco.

**Physical characteristics:** Dark grayish to greenish rock partly covered with fusion crust.

**Petrography:** The meteorite displays a dark greenish interior and is composed of well separated and sharply defined chondrules (apparent mean diameter about 600  $\mu\text{m}$ ) set into abundant matrix dominated by Fe-rich olivine, intermediate plagioclase, and Cr-rich magnetite. Minor phases include Ca-pyroxene and FeNi-sulfide; no metal was detected.

**Geochemistry:** Fe-rich matrix olivine:  $Fa_{31.1\pm 0.3}$ ,  $FeO/MnO=107\pm 9$ ,  $n=11$ ; unequilibrated olivine:  $Fa_{21.1\pm 7.9}$  ( $Fa_{9.9-30.4}$ ,  $n=18$ ); low-Ca pyroxene:  $Fs_{7.9\pm 6.6}Wo_{1.4\pm 0.5}$  ( $Fs_{1.0-20.5}Wo_{0.9-2.8}$ ,  $n=14$ ); Ca-pyroxene:  $Fs_{1.2\pm 0.1}Wo_{42.3\pm 0.6}$ ,  $n=5$

#### Northwest Africa 6431 (NWA 6431)

(Northwest Africa)

Purchased: 2009 Feb

Classification: Ordinary chondrite (LL(L)3)

**History:** Purchased by Blaine *Reed* in February 2009 from a Moroccan dealer at the Tucson Gem and Mineral Show.

**Petrography:** (A. Irving and S. Kuehner, *UWS*; P. Carpenter, *WUSL*) Closely packed, well-formed chondrules (apparent diameter  $910\pm 550$   $\mu\text{m}$ ,  $N = 23$ ) are set in a sparse matrix (opaque in thin section) containing chromite, stained kamacite and troilite.

**Geochemistry:** Olivine ( $Fa_{20.4\pm 15.6}$ , range  $Fa_{0.9-44.8}$ ,  $N = 6$ ;  $Cr_2O_3$  in ferroan olivine = 0.02-0.52 wt.%, mean  $0.12\pm 0.14$  wt.%,  $N = 11$ ), orthopyroxene ( $Fs_{14.9\pm 8.6}Wo_{1.4\pm 0.6}$ , range  $Fs_{1.8-21.6}Wo_{0.6-2.0}$ ,  $N = 5$ ), subcalcic augite ( $Fs_{26.4}Wo_{30.5}$ ), augite ( $Fs_{19.9\pm 2.5}Wo_{39.3\pm 0.4}$ ,  $N = 2$ ). Magnetic susceptibility  $\log \chi$  ( $\times 10^{-9}$   $\text{m}^3/\text{kg}$ ) = 4.47.

**Classification:** Ordinary chondrite (LL(L)3).

**Specimens:** 22.7 g plus one polished thin section at *PSF*; main mass with Mr. B. *Reed*.

#### Northwest Africa 6445 (NWA 6445)

(Northwest Africa)

Purchased: 2010

Classification: Carbonaceous chondrite (CO3)

**History:** Purchased by Fabien *Kuntz* in 2010 from a dealer in Erfoud, Morocco.

**Petrography:** (A. Irving and S. Kuehner, *UWS*; P. Carpenter, *WUSL*; T. Bunch and J. Wittke, *NAU*) Granular chondrules (apparent diameter  $390\pm 280$   $\mu\text{m}$ ,  $N = 23$ ), sparse, rimmed, amoeboid inclusions and angular mineral fragments are set in a finer grained matrix ( $\sim 20$  vol.%, orange in thin section). The amoeboid inclusions are composed of very fine grained hercynite, Al-Ti-diopside, calcite and ilmenite, and are rimmed by a chlorite-like phase.

**Geochemistry:** Olivine ( $Fa_{15.4\pm 20.3}$ , range  $Fa_{0.2-40.3}$ ,  $N = 5$ ;  $Cr_2O_3$  in ferroan examples 0.02-0.06 wt.%, mean  $0.04\pm 0.02$  wt.%,  $N = 7$ ), low-Ca pyroxene ( $Fs_{6.8\pm 5.1}Wo_{2.8\pm 1.9}$ , range  $Fs_{1.2-}$

$_{14.6}\text{Wo}_{0.9-5.5}$ ,  $N = 7$ ), clinopyroxene ( $\text{Fs}_{3.5\pm 2.2}\text{Wo}_{44.9\pm 3.6}$ , range  $\text{Fs}_{1.0-5.4}\text{Wo}_{41.3-48.4}$ ,  $N = 3$ ), plagioclase ( $\text{An}_{74.7}\text{Or}_{0.8}$ ).

**Classification:** Carbonaceous chondrite (CO3). The mean size of chondrules in this specimen is somewhat larger than in most CO chondrites. Typical CAI appear to be absent; the phyllosilicate-rimmed amoeboid inclusions are very unusual and are mineralogically unlike typical CAI.

**Specimens:** 21.0 g plus one polished thin section at *PSF*; main mass with *Kuntz*.

#### Northwest Africa 7051 (NWA 7051)

Morocco

Purchased: 2011

Classification: HED achondrite (Eucrite)

**History:** Purchased from A. *Aaronson* in 2011 at the Tucson Gem and Mineral Show, who provided origin of sample as being from Morocco. Catalogued in the Royal Ontario Museum collection as LM55991

**Physical characteristics:** The meteorite has a weathered, fractured fusion crust on two surfaces, with cracks and an exposed interior faces covered with caliche. Interior of the sample largely light-grey in colour with larger black clasts visible. No shock veins observed.

**Petrography:** Monomict breccia composed of clasts with a gabbroic texture. In most areas of the thin section the clasts are tightly abutting however there is clear offset between them. The few areas where the clasts are separated are filled with a finely comminuted matrix. Mineral grains show mosaicism.

**Geochemistry:** Mineral composition and geochemistry: Plagioclase composition:

$\text{An}_{89.31\pm 1.72}\text{Or}_{0.42\pm 0.12}$  ( $n=20$ ). Low Ca-pyroxene composition:  $\text{Fs}_{60.07\pm 1.71}\text{Wo}_{3.13\pm 2.24}$  and

$\text{FeO/MnO} = 31.81\pm 0.84$  ( $n=19$ ). High Ca-pyroxene composition:  $\text{Fs}_{27.30\pm 1.44}\text{Wo}_{42.08\pm 0.25}$  and  $\text{FeO/MnO} = 30.36\pm 1.47$  ( $n=4$ ).

**Classification:** (K. Tait, *ROM*). Texture and composition suggest the sample is a monomict breccia.

#### Northwest Africa 7145 (NWA 7145)

(Northwest Africa)

Purchased: 2011

Classification: Carbonaceous chondrite (CK4)

**History:** Purchased in Temara, Morocco by Adam *Aaronson* in 2011.

**Petrography:** (A. Irving and S. Kuehner, *UWS*; T. Bunch and J. Wittke, *NAU*; P. Carpenter, *WUSL*) Separated well-formed, granular, equilibrated chondrules containing Cr-magnetite are set in a finer grained groundmass (pale orange in thin section) containing stained Cr-magnetite.

**Geochemistry:** Olivine ( $\text{Fa}_{31.4\pm 0.2}$ , range  $\text{Fa}_{31.2-31.6}$ ,  $N = 7$ ), orthopyroxene ( $\text{Fs}_{26.0\pm 0.1}\text{Wo}_{1.0\pm 0.1}$ , range  $\text{Fs}_{26.0-26.2}\text{Wo}_{0.8-1.1}$ ,  $N = 4$ ), clinopyroxene ( $\text{Fs}_{6.8}\text{Wo}_{49.3}$ ;  $\text{Fs}_{13.3}\text{Wo}_{38.4}$ ;  $N = 2$ ), magnetite (4.0-4.4 wt.%  $\text{Cr}_2\text{O}_3$ ,  $N = 3$ ), plagioclase ( $\text{An}_{47.8}\text{Or}_{1.8}$ ).

**Classification:** Carbonaceous chondrite (CK4).

**Specimens:** 15.4 g including one polished thin section at *PSF*; remainder with Mr. A. *Aaronson*.

#### Northwest Africa 7167 (NWA 7167)

(Northwest Africa)

Purchased: 2011

Classification: Carbonaceous chondrite (CK4)

**History:** Purchased by Marcin Cimała in 2011 from a dealer in Erfoud, Morocco.

**Petrography:** (A. Irving and S. Kuehner, *UWS*; P. Carpenter, *WUSL*) Separated well-formed, equilibrated chondrules containing Cr-magnetite occur in a finer grained matrix (pale orange in thin section) containing intermediate plagioclase, stained Cr-magnetite, ferropseudobrookite and chlorapatite.

**Geochemistry:** Olivine ( $\text{Fa}_{33.4\pm 0.3}$ , range  $\text{Fa}_{32.9-33.7}$ ,  $N = 7$ ), orthopyroxene ( $\text{Fs}_{27.3\pm 0.3}\text{Wo}_{1.4\pm 0.1}$ , range  $\text{Fs}_{27.1-27.6}\text{Wo}_{1.5-1.4}$ ,  $N = 3$ ), clinopyroxene ( $\text{Fs}_{8.6}\text{Wo}_{47.4}$ ;  $\text{Fs}_{10.1}\text{Wo}_{46.4}$ ;  $N = 2$ ), magnetite (5.1-5.3 wt.%  $\text{Cr}_2\text{O}_3$ ,  $N = 3$ ), plagioclase ( $\text{An}_{28.3}\text{Or}_{5.3}$ ;  $\text{An}_{43.2}\text{Or}_{2.8}$ ;  $\text{An}_{58.1}\text{Or}_{1.5}$ ;  $N = 3$ ).

**Classification:** Carbonaceous chondrite (CK4).

**Specimens:** 21.4 g including one polished thin section at *PSF*; main mass with Mr. M. Cimała.

### Northwest Africa 7357 (NWA 7357)

Morocco

Purchased: 2019

Classification: HED achondrite (Eucrite, cumulate)

**Physical characteristics:** The stone's surface is half covered by fusion crust, which manifests streaming of melt. In places the surface shows significant tan-orange weathering and caliche staining. On interior broken surfaces, light mineral clasts fluoresce orange under 365 nm UV light.

**Petrography:** This highly shocked breccia consists dominantly of pyroxene and plagioclase (now partly maskelynite). Vaguely discernible vestiges of an original texture, and macroscopic observations, suggest grains were typically much coarser than 1 mm, but most of the material has been either granulated to much finer than 1 mm or shock-melted. A distinctive aspect of the texture is that a component of inferred likely shock-melt origin is dominantly neither glassy nor in the form of veins: Many large areas, constituting about 30% of the rock, show a crystalline but incongruously fine-grained (<20  $\mu\text{m}$ ) and subophitic texture, of suspected in situ, or near-in situ, impact-melt origin. This mode of origin is inferred from the sharp textural disparity with, and yet close geochemical similarity to, the surrounding coarser groundmass (which is of distinctively magnesian-cumulate composition; see below). Accessory phases include Cr-spinel, Fe-metal, troilite, and a glassy shock-melt vein. Within a few relatively ungranulated pyroxene grains, exsolved augite lamellae are seen to be typically about 4-7  $\mu\text{m}$  wide. Classification as a cumulate eucrite is based on geochemistry (see below), not the severely impact-modified texture.

**Geochemistry:** Low-Ca pyroxene (32 analyses) clusters near  $\text{Fs}_{34.4}\text{Wo}_{2.5}$ . High-Ca pyroxene blebs and lamellae (4 analyses) cluster near  $\text{Fs}_{14.8}\text{Wo}_{43.6}$ . As a subset, pyroxenes in the fine-grained/subophitic enclaves (18 analyses) are not compositionally distinctive, apart from showing mostly intermediate Ca (Wo, 3.2-17.4 mol%), as their low-Ca and high-Ca components are not resolved by EPMA. Pyroxene FeO/MnO (wt; 36 analyses) averages 28.3. Plagioclase (8 analyses) is  $\text{An}_{92.2-93.7}$ , average  $\text{An}_{92.6\pm 0.5}$ ; which includes a subset of 3 analyses, averaging  $\text{An}_{93.1}$ , from the fine-grained/subophitic domains. The fine-grained/subophitic domains are thus geochemically fully as cumulate-like as the less shocked, coarser balance of the rock. Classification as a cumulate eucrite is based on geochemistry (consistently magnesian mafic silicates, Na-poor plagioclase, far more Cr-spinel than ilmenite), not texture. Analyses (6) of a long glassy shock-melt vein average  $19.3\pm 1.3$  wt%  $\text{Al}_2\text{O}_3$  with FeO/MgO (wt) = 1.05.

**Classification:** Eucrite, cumulate, brecciated.



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3 **Specimens:** 24 g at *UCLA*; main mass (5 kg) with *Gessler*.  
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7 **Northwest Africa 7359** (NWA 7359)

8 Morocco

9 Purchased: 2019

10 Classification: HED achondrite (Diogenite)

11 **Physical characteristics:** The stone's surface is 98% covered by a thin fusion crust. Some  
12 tan-orange weathering and caliche staining is visible on broken surfaces. Cut surface is  
13 orange/tan with scattered areas of dark green.

14 **Petrography:** The rock is a monomict and almost completely monominerallic breccia.  
15 Surviving pyroxene grain fragments (equant, with optical continuity) are up to 9 mm across.  
16 A trace of opaque oxide, probably Cr-spinel, is also present.

17 **Geochemistry:** Low-Ca pyroxene compositions (6 analyses) cluster very tightly near  
18  $\text{Fs}_{24.9}\text{Wo}_{3.5}$ , with 1.3 wt%  $\text{Al}_2\text{O}_3$ , 0.70 wt%  $\text{Cr}_2\text{O}_3$ , and  $\text{FeO/MnO}$  (wt) = 30.8.

19 **Classification:** Diogenite

20 **Specimens:** 22 g at *UCLA*; main mass (5 kg) with *Gessler*.  
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25 **Northwest Africa 7363** (NWA 7363)

26 Morocco

27 Purchased: 2019

28 Classification: HED achondrite (Eucrite, polymict)

29 **Physical characteristics:** The material is friable. Largest intact individuals are 315, 140, 71  
30 and 36 g, some showing black fusion crust, and/or scattered orange-tan weathering and  
31 caliche staining. Numerous clasts up to 2 cm consist of conspicuously coarse, black-and-white  
32 shaded grains, in contrast with the stone's finer grained, gray matrix.

33 **Petrography:** The rock is a polymict breccia with a finely granulated groundmass. Lithic  
34 clast textures range from aphanitic (but sprinkled with relict coarse grains) to gabbroic. A 1.5-  
35 cm clast, conspicuously leucocratic compared to the groundmass, is a eucrite uncommonly  
36 rich in fayalite. The fayalite is largely in the form of veins within coarse first-generation  
37 pyroxenes; the veins are nearly monomineralic but include traces of plagioclase and Cr-  
38 spinel, and are consistently surrounded by reaction zones of low-Mg/Fe pyroxene (cf. NWA  
39 5073).  
40  
41

42 **Geochemistry:** Low-Ca pyroxene (34 analyses) ranges from  $\text{Fs}_{30.7}\text{Wo}_{5.4}$  to  $\text{Fs}_{59.8}\text{Wo}_{6.6}$ . High-  
43 Ca pyroxene (4 analyses) clusters near  $\text{Fs}_{27}\text{Wo}_{42}$ . Pyroxene  $\text{FeO/MnO}$  (wt; 40 analyses)  
44 averages 31.2. Olivine (6 analyses, all from the aforementioned veins in the large eucrite  
45 clast) is  $\text{Fa}_{62.7-66.3}$ , average  $\text{Fa}_{65.0\pm 1.1}$ . Plagioclase in the veins is anomalously Na-poor,  
46  $\text{An}_{96.8-98.7}$  (11 analyses). Elsewhere, plagioclase (31 analyses) is  $\text{An}_{75.6-98.8}$ , average  $\text{An}_{92.5\pm 3.7}$ .

47 **Classification:** Although the texture indicates a polymict breccia, no diogenite component  
48 was found (so it is not a howardite). The meteorite is a polymict eucrite.  
49

50 **Specimens:** 35 g at *UCLA*; main mass (5 kg) with *Gessler*.  
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54 **Northwest Africa 7540** (NWA 7540)

55 (Northwest Africa)

56 Purchased: 2011 Oct 26

57 Classification: Ordinary chondrite (LL3)

58 **History:** Purchased from a Moroccan mineral dealer at the mineral show in Hamburg,  
59 Germany  
60

**Petrography:** (K. Metzler, *IfP*) Shock-darkened ordinary chondrite of very low petrologic type, consisting of closely packed chondrules (up to 2.9 mm), chondrule fragments, troilite, and very low amounts of Fe-Ni metal. Small amounts of fine-grained interchondrule matrix. The mean apparent chondrule size is 570  $\mu\text{m}$  (n=45). The mean value of  $\text{Cr}_2\text{O}_3$  (wt.%) in ferroan olivine and the 1-sigma standard deviation is  $0.23 \pm 0.08$  (n=13), similar to [Y-791558](#).

**Geochemistry:** Mineral compositions and geochemistry: The mean olivine composition is  $\text{Fa}_{15.9 \pm 8.5}$  ( $\text{Fa}_{2.3-31.5}$ ; n=21); the mean low-Ca pyroxene composition is  $\text{Fs}_{7.9 \pm 6.7}$   $\text{Wo}_{0.8 \pm 0.7}$  ( $\text{Fs}_{1.9-17.8}$   $\text{Wo}_{0.1-2.2}$ ; n=7).

**Classification:** LL chondrite, based on mean chondrule size and very low metal content. Estimated petrologic subtype 3.15 based on the mean value and standard deviation of  $\text{Cr}_2\text{O}_3$  in ferroan olivine ([Grossman and Brearley, 2005](#)).

#### Northwest Africa 8580 (NWA 8580)

(Northwest Africa)

Purchased: 2014 Jun 25

Classification: Ordinary chondrite (L3.15)

**History:** Purchased from a Moroccan mineral dealer at the mineral show in Sainte-Marie-aux-Mines, France

**Petrography:** (K. Metzler, *IfP*) Ordinary chondrite of low petrologic type consisting of closely packed chondrules with very low amounts of interchondrule matrix. The mean apparent chondrule size is 490  $\mu\text{m}$  (140-1970  $\mu\text{m}$ ; n=223). Accessory phases are Fe, Ni metal and troilite, mostly residing outside of chondrules.

**Geochemistry:** Mineral compositions and geochemistry: The mean olivine composition is  $\text{Fa}_{17.8 \pm 12.7}$  (0.5-47.9; n=36); the mean low-Ca pyroxene composition is  $\text{Fs}_{7.7 \pm 6.9}$   $\text{Wo}_{0.9 \pm 1.1}$  ( $\text{Fs}_{0.7-27.5}$   $\text{Wo}_{0.1-5.2}$ ; n=28). The ferroan olivine mean value of  $\text{Cr}_2\text{O}_3$  and 1-sigma standard deviation is  $0.19 \pm 0.13$  (n=44), similar to [Y-791324](#) (LL3.15; [Grossman and Brearley, 2005](#)).

**Classification:** L chondrite, based on the mean chondrule size. Petrologic type 3.15 based on 1-sigma standard deviation of Fa and Fs, and on the ferroan olivine mean value of  $\text{Cr}_2\text{O}_3$  and 1-sigma standard deviation.

#### Northwest Africa 10189 (NWA 10189)

Morocco

Find: 2014

Classification: Carbonaceous chondrite (CR2)

**History:** Aziz Habibi purchased the stone from a meteorite hunter traveling from southern Morocco. The stone was purchased from Aziz Habibi by *UCLA*.

**Physical characteristics:** The meteorite consisted of a flattened, irregular stone. It exhibits ~50% weathered fusion crust; the rest of the surface is desert-varnished and very irregular.

**Petrography:** (J. Utas, *UCLA*) Spherical metal blebs are abundant in both matrix and chondrules, measuring up to 1.5 mm across. Chondrules average ~1.1 mm in diameter, and are set in a fine-grained, Fe and FeS-rich matrix. Chondrules are predominantly type IA, PO, and many exhibit igneous rims. The thin-section examined exhibits two coherent ~5 mm. Fine-grained carbonaceous clasts with abundant disseminated FeS. No CAIs were observed. Large metal blebs exhibit thin oxide rims, and fine-grained metal in the matrix is heterogeneously oxidized. Some chondrules appear unweathered, while others retain no unoxidized metal. Limonite and some carbonate veins are present.

**Northwest Africa 10898** (NWA 10898)

(Northwest Africa)

Purchased: 2015

Classification: Ordinary chondrite (LL3.10)

**History:** Purchased in 2015 by Brahim Tahiri in Morocco and sent to his partner Sean Tutorow for analysis.**Physical characteristics:** Weathered fusion-crust exterior. Saw cuts reveal well defined, densely packed chondrules, up to 7 mm in diameter, most in the size range 0.5 to 2 mm.**Petrography:** (C. Agee, *UNM*) Microprobe examination of a polished mount shows numerous porphyritic chondrules, most with glass or mesostasis. Abundant fine-grained, opaque matrix.**Geochemistry:** (C. Agee and M. Spilde, *UNM*) Olivine  $Fa_{18.4\pm 11}$ ,  $Fe/Mn=60\pm 24$ ,  $Cr_2O_3=0.27\pm 0.16$  (wt%),  $n=18$ ; low-Ca pyroxene  $Fs_{11.0\pm 9.1}Wo_{1.7\pm 1.0}$ ,  $Fe/Mn=13\pm 9$ ,  $n=11$ . Analyses of 43 ferroan olivine gives an average  $Cr_2O_3$  content of  $0.284\pm 0.206$  wt%.**Classification:** Ordinary chondrite (LL3.10) subtype 3.10 based on mean values of Fa and Fs and 1-sigma standard deviation, and on the ferroan olivine mean value of  $Cr_2O_3$  and 1-sigma standard deviation, similar to [NWA 3127](#) (LL3.10) ([Grossman and Brearley, 2005](#)), also similar to [NWA 7029](#) (LL3.10).**Specimens:** 23.95 g including a probe mount on deposit at *UNM*, Sean Tutorow holds the main mass.**Northwest Africa 11333** (NWA 11333)

(Northwest Africa)

Purchased: 2017 Mar

Classification: Ureilite

**History:** Purchased in Foum Zguid, Morocco by Mohamed Aid in March 2017.**Physical characteristics:** Large (56 kg) specimen lacking fusion crust.**Petrography:** (A. Irving and S. Kuehner, *UWS*) Protogranular assemblage of olivine (~65 vol.%, with reduced metal-bearing rims) and twinned pigeonite (~35 vol.%). No carbon phases were detected.**Geochemistry:** Olivine (cores  $Fa_{14.4-14.5}$ ; rim  $Fa_{9.1}$ ;  $N = 3$ ), pigeonite ( $Fs_{12.2-12.3}Wo_{8.1-8.0}$ ,  $N = 2$ ). Mafic silicate compositions are unusually magnesian in comparison to the majority of ureilite specimens.**Classification:** Ureilite.**Specimens:** 25.2 g including one polished thin section at *UWB*; remainder with M. Aid.**Northwest Africa 11333** (NWA 11333)

(Northwest Africa)

Purchased: 2017 Mar

Classification: Ureilite

**History:** Purchased in Foum Zguid, Morocco, by Mohamed Aid in March 2017.**Physical characteristics:** Large (56 kg) specimen lacking fusion crust.**Petrography:** (A. Irving and S. Kuehner, *UWS*) Protogranular assemblage of olivine (~65 vol.%, with reduced metal-bearing rims) and twinned pigeonite (~35 vol.%). No carbon phases were detected.

**Geochemistry:** Olivine (cores  $\text{Fa}_{14.4-14.5}$ ; rim  $\text{Fa}_{9.1}$ ;  $N = 3$ ), pigeonite ( $\text{Fs}_{12.2-12.3}\text{Wo}_{8.1-8.0}$ ,  $N = 2$ ). Mafic silicate compositions are unusually magnesian in comparison to the majority of ureilite specimens.

**Classification:** Ureilite.

**Specimens:** 25.2 g including one polished thin section at *UWB*; remainder with M. Aid.

#### Northwest Africa 11867 (NWA 11867)

(Northwest Africa)

Purchased: 2005

Classification: Ordinary chondrite (L3-7)

**History:** Purchased by an anonymous collector from a dealer at the Munich Show in 2005, subsequently acquired by the Hollis Collection and then donated to *PSF*.

**Petrography:** (A. Irving and S. Kuehner, *UWS*; P. Carpenter, *WUSL*) Breccia containing multiple components in a sparse matrix containing stained metal. Isolated well-formed, unequilibrated chondrules (apparent diameter  $800 \pm 340 \mu\text{m}$ ,  $N = 21$ ) are present, together with equilibrated Type 4 clasts, Type 5 clasts and rare Type 7 clasts (with poikiloblastic textures devoid of remnant chondrules).

**Geochemistry:** Olivine ( $\text{Fa}_{22.6 \pm 9.1}$ , range  $\text{Fa}_{6.9-33.1}$ ,  $N = 7$ ;  $\text{Cr}_2\text{O}_3$  in all ferroan examples  $< 0.03$  wt.%), orthopyroxene ( $\text{Fs}_{5.1 \pm 3.8}\text{Wo}_{0.4 \pm 0.2}$ , range  $\text{Fs}_{0.8-8.0}\text{Wo}_{0.5-0.6}$ ,  $N = 3$ ), clinopyroxene ( $\text{Fs}_{2.0}\text{Wo}_{41.9}$ ;  $\text{Fs}_{7.4}\text{Wo}_{44.4}$ ;  $N = 2$ ), olivine in Type 5 lithic clast ( $\text{Fa}_{24.9 \pm 0.1}$ , range  $\text{Fa}_{24.8-25.1}$ ,  $N = 2$ ). Magnetic susceptibility  $\log \chi (\times 10^{-9} \text{m}^3/\text{kg}) = 4.73$ .

**Classification:** Ordinary chondrite (L3-7 breccia). Affinity to L chondrites is established from olivine composition in equilibrated lithic clasts and bulk magnetic susceptibility.

**Specimens:** The entire specimen including one polished thin section is at *PSF*.

#### Northwest Africa 11983 (NWA 11983)

(Northwest Africa)

Purchased: 2005

Classification: Ordinary chondrite (L3-6)

**History:** Purchased by an anonymous collector from a dealer at the Munich Show in 2005, subsequently acquired by the Hollis Collection and then donated to *PSF*.

**Petrography:** (A. Irving and S. Kuehner, *UWS*; P. Carpenter, *WUSL*) Breccia composed of multiple components in a sparse matrix containing stained metal, chlorapatite and merrillite. Isolated well-formed, unequilibrated chondrules (apparent diameter  $860 \pm 520 \mu\text{m}$ ,  $N = 22$ ) are present, together with some much more recrystallized Type 5 and Type 6 clasts, set in a sparse matrix containing chlorapatite and merrillite.

**Geochemistry:** Olivine ( $\text{Fa}_{24.2 \pm 7.5}$ , range  $\text{Fa}_{9.3-34.6}$ ,  $N = 7$ ;  $\text{Cr}_2\text{O}_3$  in ferroan examples 0.02-0.07 wt.%, mean  $0.04 \pm 0.02$  wt.%,  $N = 6$ ), orthopyroxene ( $\text{Fs}_{11.7 \pm 13.0}\text{Wo}_{1.0 \pm 1.0}$ , range  $\text{Fs}_{2.5-20.9}\text{Wo}_{0.3-1.7}$ ,  $N = 2$ ), clinopyroxene ( $\text{Fs}_{7.2}\text{Wo}_{45.9}$ ;  $\text{Fs}_{8.1}\text{Wo}_{44.5}$ ;  $N = 2$ ), olivine in Type 6 lithic clast ( $\text{Fa}_{25.0 \pm 0.1}$ , range  $\text{Fa}_{24.9-25.0}$ ,  $N = 2$ ). Magnetic susceptibility  $\log \chi (\times 10^{-9} \text{m}^3/\text{kg}) = 4.73$ .

**Classification:** Ordinary chondrite (L3-6 breccia). Affinity to L chondrites is established from olivine composition in equilibrated lithic clasts and bulk magnetic susceptibility.

**Specimens:** The entire specimen including one polished thin section is at *PSF*.

#### Northwest Africa 11988 (NWA 11988)

(Northwest Africa)

Purchased: 2005

Classification: Ordinary chondrite (L3-6)

**History:** Purchased by an anonymous collector from a dealer at the Munich Show in 2005, subsequently acquired by the Hollis Collection and then donated to *PSF*.

**Petrography:** (A. Irving and S. Kuehner, *UWS*; P. Carpenter, *WUSL*) Breccia composed of some discrete, well-formed chondrules (apparent diameter  $660 \pm 220 \mu\text{m}$ ,  $N = 20$ ), together with some more recrystallized Type 5 clasts, in a matrix containing altered metal, chlorapatite and merrillite.

**Geochemistry:** Olivine ( $\text{Fa}_{27.8 \pm 3.9}$ , range  $\text{Fa}_{23.1-34.2}$ ,  $N = 7$ ;  $\text{Cr}_2\text{O}_3$  in ferroan examples 0.06-0.14 wt.%, mean  $0.08 \pm 0.03$  wt.%,  $N = 7$ ), orthopyroxene ( $\text{Fs}_{20.6 \pm 0.3} \text{Wo}_{1.6 \pm 1.0}$ , range  $\text{Fs}_{20.4-20.8} \text{Wo}_{0.9-2.3}$ ,  $N = 3$ ), clinopyroxene ( $\text{Fs}_{8.4} \text{Wo}_{44.7}$ ;  $\text{Fs}_{10.2} \text{Wo}_{43.6}$ ;  $N = 2$ ), olivine in Type 5 lithic clast ( $\text{Fa}_{24.9 \pm 0.2}$ , range  $\text{Fa}_{24.7-25.1}$ ,  $N = 2$ ). Magnetic susceptibility  $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.65$ .

**Classification:** Ordinary chondrite (L3-5 breccia). Affinity to L chondrites is established from olivine composition in equilibrated lithic clasts and bulk magnetic susceptibility.

**Specimens:** The entire specimen including one polished thin section is at *PSF*.

#### Northwest Africa 11989 (NWA 11989)

(Northwest Africa)

Purchased: 2005

Classification: Ordinary chondrite (L3-6)

**History:** Purchased by an anonymous collector from a dealer at the Munich Show in 2005, subsequently acquired by the Hollis Collection and then donated to *PSF*.

**Petrography:** (A. Irving and S. Kuehner, *UWS*; P. Carpenter, *WUSL*) Breccia composed of sparse discrete, well-formed chondrules (apparent diameter 0.8-1.2 mm,  $N = 5$ ), together with some more recrystallized Type 5 and Type 6 clasts, in a matrix containing altered metal, chlorapatite and merrillite.

**Geochemistry:** Olivine ( $\text{Fa}_{28.9 \pm 5.0}$ , range  $\text{Fa}_{24.9-35.2}$ ,  $N = 7$ ;  $\text{Cr}_2\text{O}_3$  in all  $< 0.04$  wt.%), orthopyroxene ( $\text{Fs}_{21.4 \pm 0.8} \text{Wo}_{1.9 \pm 0.1}$ , range  $\text{Fs}_{20.8-21.9} \text{Wo}_{1.9-1.8}$ ,  $N = 2$ ), clinopyroxene ( $\text{Fs}_{6.7} \text{Wo}_{46.6}$ ;  $\text{Fs}_{16.7} \text{Wo}_{40.4}$ ;  $N = 2$ ), olivine in Type 6 lithic clast ( $\text{Fa}_{24.5 \pm 0.1}$ , range  $\text{Fa}_{24.3-24.6}$ ,  $N = 2$ ). Magnetic susceptibility  $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.53$ .

**Classification:** Ordinary chondrite (L3-6 breccia). Affinity to L chondrites is established from olivine composition in equilibrated lithic clasts and bulk magnetic susceptibility.

**Specimens:** The entire specimen including one polished thin section is at *PSF*.

#### Northwest Africa 12266 (NWA 12266)

(Northwest Africa)

Purchased: 2018 Jun

Classification: Ordinary chondrite (L3)

**History:** Purchased by Ben Hoefnagels in June 2018 from a Moroccan dealer.

**Petrography:** (A. Irving and S. Kuehner, *UWS*) Closely-packed, well-formed chondrules (apparent diameter  $510 \pm 290 \mu\text{m}$ ,  $N = 22$ ) are set in a sparse, brown-stained matrix containing very little fresh metal (kamacite with taenite).

**Geochemistry:** Olivine ( $\text{Fa}_{19.1 \pm 14.2}$ , range  $\text{Fa}_{0.9-37.2}$ ,  $N = 5$ ;  $\text{Cr}_2\text{O}_3$  in ferroan examples 0.02-0.08 wt.%, mean  $0.05 \pm 0.02$  wt.%,  $N = 6$ ), orthopyroxene ( $\text{Fs}_{8.3 \pm 9.0} \text{Wo}_{0.7 \pm 0.8}$ , range  $\text{Fs}_{0.6-21.0} \text{Wo}_{0.2-1.9}$ ,  $N = 4$ ), pigeonite ( $\text{Fs}_{5.8} \text{Wo}_{12.1}$ ), augite ( $\text{Fs}_{16.5} \text{Wo}_{35.9}$ ), diopside ( $\text{Fs}_{1.6} \text{Wo}_{43.6}$ ). Oxygen isotopes (K. Ziegler, *UNM*): analyses of acid-washed subsamples by laser fluorination gave, respectively,  $\delta^{17}\text{O}$  3.283, 3.116, 3.446;  $\delta^{18}\text{O}$  4.842, 4.425, 5.206;  $\Delta^{17}\text{O}$  0.726, 0.780, 0.697 per mil. Magnetic susceptibility  $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.57$ .

**Classification:** Ordinary chondrite (L3).



**Specimens:** 35.7 g including one polished thin section at *UWB*; remainder with Mr. B. Hoefnagels.

#### Northwest Africa 12302 (NWA 12302)

Morocco

Purchased: 2017

Classification: Carbonaceous chondrite (CV3)

**History:** (Ziyao Wang) Purchased by Ziyao Wang from Adnane Sami during the China (Hunan) Mineral & Gem Show in Chenzhou City in May 2017.

**Physical characteristics:** (Ziyao Wang) Dark gray-yellow flat stone of 50 g without fusion crust

**Petrography:** (R. Bartoschewitz, *Bart*) well defined chondrules (0.3-1.8 mm, av. 1 mm) of various types (PO, POP, RP, BO, GO), chondrule fragments, and AOAs are set in dark brown opaque matrix (~15%).

**Geochemistry:** (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine  $Fa_{18.4}$  ( $Fa_{0.2-36.5}$ ;  $Fe/Mn=54$ ;  $Fe/Mg=0.25$ ;  $n=15$ ); pyroxene  $Fs_{9.4\pm 6.7}Wo_{0.6\pm 0.5}$  ( $Fe/Mn=20$ ;  $Fe/Mg=0.1$ ;  $n=11$ ); Ca pyroxene  $En_{32}Fs_5Wo_{63}$  ( $n=1$ );  $An_{74}Or_1$  ( $n=1$ ). Kamacite  $Ni=6.8$ ,  $Co=1.7$  ( $n=1$ ); taenite  $Ni=36.9$ ,  $Co=0.5$  ( $n=2$ ) (all wt%). Magnetic susceptibility (R. Bartoschewitz, *Bart*)  $\log \chi (\times 10^{-9} m^3/kg) = 3.43$

**Classification:** carbonaceous chondrite (CV3, S2)

**Specimens:** 10.2 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 5.5 g with *Bart*.

#### Northwest Africa 12313 (NWA 12313)

Morocco

Purchased: 2018

Classification: Ordinary chondrite (H4)

**History:** (Ziyao Wang) Purchased by Ziyao Wang from Simo Mezgouri in Agadir Oct. 2018.

**Physical characteristics:** (Ziyao Wang) Reddish brown 439 g stone with very flat bottom, no fusion crust.

**Petrography:** (R. Bartoschewitz, *Bart*) very well defined chondrules (0.3-1.8 mm, av. 0.7 mm) of various types (PP, BO, POP) and chondrule fragments are set in dark matrix (about 15 vol% matrix). Chondrules mainly surrounded by metal-rich rims.

**Geochemistry:** (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine  $Fa_{16.0\pm 1.2}$  ( $n=13$ ); pyroxene  $Fs_{14.8\pm 2.8}Wo_{0.8\pm 0.7}$  ( $n=13$ ); silicates:  $Fe/Mn=25$   $Fe/Mg=0.22$ . Chromite CRAL90, FFM79 ( $n=2$ ); spinel CRAL21, FFM39 ( $n=2$ ). Kamacite in chondrules  $Ni=1.7$ ,  $Co=0.4$  ( $n=4$ ). Magnetic susceptibility (R. Bartoschewitz, *Bart*)  $\log \chi (\times 10^{-9} m^3/kg) = 4.99$

**Classification:** Ordinary chondrite (H4, S2, W4).

**Specimens:** 14.8 g at *Kiel* and 5.9 g at Münster, Ziyao Wang holds the main mass, and 28 g with *Bart*. Polished thin sections *Bart* and *IfP*

#### Northwest Africa 12386 (NWA 12386)

(Northwest Africa)

Purchased: 2018 Mar

Classification: Ordinary chondrite (L5)

**History:** A meteorite, broken into two pieces, was purchased at Ouarzazate, Morocco, in May 2018. The smaller one, 289.1 g, has a broken surface, with the remaining surface covered with

fusion crust. The cut surface of the smaller meteorite indicates the sample has an achondritic texture. The larger stone, 1192.5 g, is composed of two parts: the chondritic main body and an igneous clast. The larger stone also has a broken surface, with other surfaces covered by fusion crust.

**Physical characteristics:** The meteorite is composed of two lithologies: an ordinary chondrite and an igneous clast.

**Petrography:** The igneous clast is composed mainly of olivine (70 vol%), feldspar (15 vol%), high-Ca pyroxene, and minor minerals (including phosphate, troilite and Fe-Ni metal). Almost no low-Ca pyroxene was found. The abundance of Fe-Ni metal is about 1 vol%. Olivine occurs as phenocrysts, with a particle size of 200-300  $\mu\text{m}$ . The feldspar occurs as interstitial grains filled with skeletal crystals of high-Ca pyroxene.

**Geochemistry:** For the L5 ordinary lithology: Olivine  $\text{Fa}_{23.1\pm 2.7}$  (N=23), CaO  $0.04\pm 0.03$  wt% MnO  $0.42\pm 0.05$  wt%; low-Ca pyroxene  $\text{Fs}_{21.7\pm 2.7}\text{Wo}_{2.1\pm 0.2}$  (N=6). For the igneous clast: Olivine  $\text{Fa}_{22.1\pm 3.3}$  (N=34), CaO  $0.07\pm 0.06$  wt% MnO  $0.41\pm 0.05$  wt%. Oxygen isotopes (Huiming Bao, LSU): Analyses of three acid-washed whole rock of the clast lithology by  $\text{CO}_2$  laser fluorination:  $\delta^{18}\text{O} = 4.803, 4.825, 4.795$ ;  $\delta^{17}\text{O} = 3.568, 3.552, 3.543$ ;  $\Delta^{17}\text{O} = 1.020, 0.992, 0.999$  (all permil).

#### Northwest Africa 12445 (NWA 12445)

(Northwest Africa)

Purchased: 2018 Aug

Classification: HED achondrite (Eucrite, anomalous)

**History:** A total of 21 similar stones (total 797 g) were recovered ~70 m apart at a location in Algeria, and were purchased by Mbark Arjidal in August 2018 from an Algerian dealer.

**Petrography:** (A. Irving and S. Kuehner, *UWS*) Breccia composed of some lithic eucrite clasts plus a lot of related, angular crystalline debris in a finer grained matrix. Lithic clasts have microgabbroic to subophitic textures. Minerals are exsolved pigeonite (pale orange in thin section), anorthite (exhibiting undulose extinction), silica polymorph, fayalite, ilmenite, troilite and minor Ni-free metal.

**Geochemistry:** Low-Ca pyroxene host ( $\text{Fs}_{67.7\pm 1.6}\text{Wo}_{3.1\pm 1.3}$ , range  $\text{Fs}_{66.0-70.6}\text{Wo}_{1.7-5.3}$ , FeO/MnO = 29-31, N = 6;  $\text{Fs}_{59.7}\text{Wo}_{2.4}$ , FeO/MnO = 28), high-Ca pyroxene exsolution lamellae ( $\text{Fs}_{32.1\pm 2.0}\text{Wo}_{42.8\pm 0.7}$ , range 29.2-34.4  $\text{Wo}_{42.0-43.7}$ , FeO/MnO = 30-33, N = 6;  $\text{Fs}_{24.7-25.9}\text{Wo}_{44.5-42.9}$ , FeO/MnO = 29-30, N = 2), fayalitic olivine ( $\text{Fa}_{73.8\pm 6.5}$ , range  $\text{Fa}_{69.3-78.4}$ , FeO/MnO = 46, N = 2), anorthite ( $\text{An}_{91.9-93.3}\text{Or}_{0.6-0.3}$ , N = 2).

**Classification:** Eucrite (breccia, anomalous). The predominance of highly ferroan low-Ca and high-Ca pyroxenes in this specimen is an anomalous feature; these now-exsolved highly ferroan pigeonites are reminiscent of similar pyroxenes in anomalous ferroan eucrite [NWA 11729](#).

**Specimens:** 38.2 g including one polished thin section at *UWB*; remainder with Mr. M. Arjidal.

#### Northwest Africa 12458 (NWA 12458)

(Northwest Africa)

Purchased: 2005

Classification: Ordinary chondrite (L3-6)

**History:** Purchased by an anonymous collector from a dealer at the Munich Show in 2005, subsequently acquired by the Hollis Collection and then donated to *PSF*.

**Petrography:** (A. Irving and S. Kuehner, *UWS*; P. Carpenter, *WUSL*) Breccia composed of well-formed chondrules (apparent diameter  $810 \pm 410 \mu\text{m}$ ,  $N = 20$ ) plus some angular Type 5 and Type 6 clasts in a finer grained matrix containing stained metal, merrillite and chlorapatite.

**Geochemistry:** Olivine ( $\text{Fa}_{19.7 \pm 8.0}$ , range  $\text{Fa}_{6.3-27.1}$ ,  $N = 7$ ;  $\text{Cr}_2\text{O}_3$  in ferroan examples 0.02-0.08 wt.%, mean  $0.04 \pm 0.03$  wt.%,  $N = 3$ ), orthopyroxene ( $\text{Fs}_{12.9 \pm 8.7}\text{Wo}_{0.9 \pm 1.1}$ , range 3.4-20.5  $\text{Wo}_{0.3-2.1}$ ,  $N = 3$ ), clinopyroxene ( $\text{Fs}_{4.1-9.4}\text{Wo}_{36.7-43.2}$ ,  $N = 2$ ), olivine in Type 6 lithic clast ( $\text{Fa}_{25.0 \pm 0.0}$ ,  $N = 2$ ). Magnetic susceptibility  $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.67$ .

**Classification:** Ordinary chondrite (L3-6 breccia). Affinity to L chondrites is established from olivine composition in equilibrated lithic clasts and bulk magnetic susceptibility.

**Specimens:** The entire specimen including one polished thin section is at *PSF*.

### Northwest Africa 12493 (NWA 12493)

(Northwest Africa)

Purchased: 2018

Classification: Ordinary chondrite (H3-5)

**History:** Purchased at Hamburg Mineral Show Dec. 2018.

**Physical characteristics:** 701.5 g black-brown stone fragment, partly covered by black fusion crust with one 1 cm metal inclusion. Cut face shows gray host with lighter and darker gray xenoliths.

**Petrography:** (R. Bartoschewitz, *Bart*) dark lithology: well defined chondrules (0.1-1.5 mm, av.  $\sim 0.4$  mm) of various types and irregular metallic inclusions up to 10 mm (some with eutectic metal/troilite intergrowth) in a black opaque matrix. Light lithology: strongly recrystallized matrix with indistinct chondrules and metal.

**Geochemistry:** Dark H3: olivine  $\text{Fa}_{18.6 \pm 3.3}$  (range 13.1-30.7;  $n=34$ ); low Ca pyroxene  $\text{Fs}_{16.3 \pm 2.5}\text{Wo}_{1.1 \pm 0.6}$  ( $n=33$ ); Ca pyroxene  $\text{En}_{69}\text{Fs}_{17}\text{Wo}_{14}$  ( $n=2$ ); chromite  $\text{CRAL}=91$ ,  $\text{FFM}=87$  ( $n=2$ ); kamacite  $\text{Ni}=6.7-7.9$  wt%,  $\text{Co}=0.6$  wt% ( $n=5$ ). Light H5: olivine  $\text{Fa}_{18.5 \pm 0.8}$  ( $n=10$ ), low Ca pyroxene  $\text{Fs}_{16.4 \pm 0.3}\text{Wo}_{1.5 \pm 0.4}$  ( $n=4$ ); Ca pyroxene  $\text{En}_{79}\text{Fs}_{16}\text{Wo}_5$  ( $n=1$ ); chromite  $\text{CRAL}=83$ ,  $\text{FFM}=85$  ( $n=2$ ); kamacite  $\text{Ni}=3.6-5.7$  wt%,  $\text{Co}=0.6-0.7$  wt% ( $n=3$ ). Magnetic susceptibility  $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 5.55$ ,  $\rho_s = 3.69 \text{ g/cm}^3$

**Classification:** Ordinary chondrite (H3-5, S2, W0)

**Specimens:** 26.1 g on deposit at *Kiel*, *Bart* holds the main mass.

### Northwest Africa 12497 (NWA 12497)

(Northwest Africa)

Purchased: 2018

Classification: Ordinary chondrite (H4)

**History:** Purchased at Hamburg Mineral Show Dec. 2018.

**Physical characteristics:** 99.8 g black stone with metallic specks on the surface

**Petrography:** (R. Bartoschewitz, *Bart*) fractured matrix with indistinct chondrule relicts. Metal and sulfide penetration into cracks blacken the meteorite.

**Geochemistry:** (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine  $\text{Fa}_{18.5 \pm 0.6}$  (range  $\text{Fa}_{17.9-20.1}$ ;  $n=16$ ); pyroxene  $\text{Fs}_{15.8 \pm 0.2}\text{Wo}_{1.7 \pm 0.2}$  ( $n=5$ ); feldspar  $\text{An}_{14}\text{Or}_6$  ( $n=1$ ); merrillite. Kamacite  $\text{Ni}=7.7-8.5$  wt%,  $\text{Co}=0.6$  wt%. Magnetic susceptibility (R. Bartoschewitz, *Bart*)  $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 5.44$

**Classification:** Ordinary chondrite (H4, S4, W0)

**Specimens:** 23.9 g on deposit at *Kiel*, *Bart* holds the main mass.

**Northwest Africa 12505** (NWA 12505)

Mauritania

Purchased: 2017

Classification: Rumuruti chondrite (R3)

**History:** (Ziyao Wang) Purchased by Ziyao Wang from Aziz Habibi in Erfoud, Morocco 2017.**Physical characteristics:** (Ziyao Wang) Dark brown stone of 81 g with visible chondrules its smooth, wind-eroded surface.**Petrography:** (R. Bartoschewitz, *Bart*) Well-developed chondrules (0.1-1 mm, av. 0.3 mm) and rare CAIs set in a dark-gray matrix (~40 vol%).**Geochemistry:** (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) OlivineFa<sub>37.5±10.6</sub> (Fa<sub>8.2-49.2</sub>; n=47); pyroxene Fs<sub>14.2±10.6</sub>Wo<sub>0.1.8±4.0</sub> (n=14); Ca pyroxene En<sub>40-61</sub>Fs<sub>17-27</sub>Wo<sub>12-44</sub> (n=2); Cr-spinel CRAL=73-86, FFM=92-95, 1.8-4.2 wt% TiO<sub>2</sub> (n=3). Pentlandite: Ni=29, Co=1 (n=3); pyrrhotite Ni?0.3, Co=0.1 (n=2); smythite Ni=28, Co=1.5 (n=1) (all wt-%). Magnetic susceptibility (R. Bartoschewitz, *Bart*) log  $\chi$  ( $\times 10^{-9}$  m<sup>3</sup>/kg) = 3.52**Classification:** R3**Specimens:** 16.3 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 14 g with *Bart*.**Northwest Africa 12512** (NWA 12512)

(Northwest Africa)

Purchased: 2005

Classification: Ordinary chondrite (L3-6)

**History:** Purchased by an anonymous collector from a dealer at the Munich Show in 2005, subsequently acquired by the Hollis Collection and then donated to *PSF*.**Petrography:** (A. Irving and S. Kuehner, *UWS*; P. Carpenter, *WUSL*) Well-formed chondrules (apparent diameter 820±420  $\mu$ m, N = 22) together with angular Type 6 clasts (largely recrystallized with rare chondrule remnants) are set in a finer matrix containing stained metal, merrillite and chlorapatite.**Geochemistry:** Olivine (Fa<sub>25.4±7.3</sub>, range Fa<sub>13.1-38.0</sub>, N = 7; Cr<sub>2</sub>O<sub>3</sub> in ferroan examples 0.04-0.18 wt.%, mean 0.08±0.06 wt.%, N = 6), orthopyroxene (Fs<sub>10.1±9.9</sub>Wo<sub>1.0±0.6</sub>, rangeFs<sub>2.5-21.2</sub>Wo<sub>0.6-1.6</sub>, N = 3), subcalcic augite (Fs<sub>12.5</sub>Wo<sub>28.4</sub>), augite (Fs<sub>7.9</sub>Wo<sub>44.7</sub>), olivine in Type 6 lithic clast (Fa<sub>23.9±0.1</sub>, range Fa<sub>23.7-24.0</sub>, N = 2). Magnetic susceptibility log  $\chi$  ( $\times 10^{-9}$  m<sup>3</sup>/kg) = 4.70.**Classification:** Ordinary chondrite (L3-6 breccia). Affinity to L chondrites is established from olivine composition in equilibrated lithic clasts and bulk magnetic susceptibility.**Specimens:** The entire specimen including one polished thin section is at *PSF*.**Northwest Africa 12518** (NWA 12518)

(Northwest Africa)

Purchased: 2018 Aug

Classification: Ordinary chondrite (LL3)

**History:** Purchased by John Higgins in August 2018 from a dealer in Zagora, Morocco.**Petrography:** (A. Irving and S. Kuehner, *UWS*) Well-formed chondrules (apparent diameter 850±370  $\mu$ m, N = 23) are set in a finer matrix containing altered metal.

**Geochemistry:** Olivine ( $\text{Fa}_{7.8-39.1}$ ,  $\text{Cr}_2\text{O}_3$  in ferroan examples 0.03-0.32 wt.%, mean  $0.14 \pm 0.10$  wt.%,  $N = 8$ ), orthopyroxene ( $\text{Fs}_{1.8-20.7}\text{Wo}_{0.3-3.9}$ ,  $N = 3$ ), subcalcic augite ( $\text{Fs}_{10.3-24.3}\text{Wo}_{34.2-29.7}$ ,  $N = 2$ ). Magnetic susceptibility  $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 3.95$ .

**Classification:** Ordinary chondrite (LL3)

**Specimens:** 55 g including one polished thin section at *UWB*; remainder with Mr. J. Higgins.

#### Northwest Africa 12520 (NWA 12520)

(Northwest Africa)

Purchased: 2018 Nov

Classification: Ordinary chondrite (LL6, melt breccia)

**History:** Purchased by Aziz Habibi in November 2018 from a Mauritanian dealer.

**Petrography:** (A. Irving and S. Kuehner, *UWS*) Relatively fresh, shock-modified breccia consisting of clasts of petrographic type 6 and shock stage S1 (largely recrystallized with rare chondrule remnants and stained metal) in a very fine grained to glassy matrix (black to cinnamon-brown in thin section).

**Geochemistry:** Olivine ( $\text{Fa}_{30.8-31.2}$ ,  $N = 3$ ), orthopyroxene ( $\text{Fs}_{25.1-25.5}\text{Wo}_{2.2-1.6}$ ,  $N = 3$ ), clinopyroxene ( $\text{Fs}_{10.5-10.6}\text{Wo}_{42.9-42.7}$ ,  $N = 2$ ). Magnetic susceptibility  $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 3.95$ .

**Classification:** Ordinary chondrite (LL6 melt breccia).

**Specimens:** 83.5 g including one polished thin section at *UWB*; remainder with Mr. A. Habibi.

#### Northwest Africa 12523 (NWA 12523)

(Northwest Africa)

Purchased: 2017

Classification: Carbonaceous chondrite (CVred3)

**History:** The meteorite was found in the Sahara and purchased in Agadir

**Petrography:** Chondrite with mm-sized chondrules and CAIs set in abundant fine-grained matrix. Opaques are metal and sulfides. Chondrules show flattening and preferential orientation.

**Geochemistry:** Olivine  $\text{Fa}_{13.5 \pm 8.3}$ , PMD 54%, range 0.9-27.0 ( $N=7$ ). Orthopyroxene  $\text{Fs}_{1.7}\text{Wo}_{1.3}$  ( $N=1$ )

**Classification:** Carbonaceous chondrite (CV3). Reduced sub-group.

**Specimens:** Type specimen at *CEREGE*. Main mass with *Labenne*.

#### Northwest Africa 12524 (NWA 12524)

(Northwest Africa)

Purchased: 2018 Apr

Classification: Carbonaceous chondrite (CK5)

**History:** The meteorite was found in the Sahara and purchased in Agadir

**Physical characteristics:** Crusted stone. Cut surface reveals dark-gray interior.

**Petrography:** Chondrite with recrystallized texture. Matrix is abundant. Opaques are mostly Cr-bearing magnetite and sulfides. Ca-phosphate is present. Rare metal. No CAI was observed over the 2 cm<sup>2</sup> studied section.

**Geochemistry:** Olivine  $\text{Fa}_{32.0 \pm 0.2}$ , NiO  $0.52 \pm 0.08$  wt% ( $n=4$ ). Plagioclase  $\text{An}_{60.8}\text{Ab}_{38.3}\text{Or}_{0.9}$  ( $n=1$ ). Magnetite  $\text{Cr}_2\text{O}_3$  3.98 wt%.

**Classification:** Carbonaceous chondrite (CK5).



**Specimens:** 22 g and a polished section at *CEREGE*. Main mass with *Labenne*.

**Northwest Africa 12688** (NWA 12688)

(Northwest Africa)

Purchased: 20 Apr 2017

Classification: Ureilite

**History:** The meteorite was purchased from Mr. Aziz Habibi in Agadir (Morocco) in April 20, 2017.

**Physical characteristics:** Single stone of 140 g total weight has angular shape and dark brownish surface. Fusion crust is not preserved.

**Petrography:** (Lorenz C. A., *Vernad*) The rock has coarse grained (0.5-1 cm) metamorphic texture with triple junctions of mineral grains and composes of clino and orthopyroxene and olivine. Clinopyroxene contains rare large inclusions of olivine, orthopyroxene and glass. Accessory metal Fe and sulfide form thin linear veinlets along the silicate grains borders and are mostly replaced by Fe-hydroxides. Rare rounded inclusions of intergrown metal Fe, troilite and shreibersite occur within the silicate grains. Olivine has undulatory optical extinction, irregular and planar fractures. Some olivine grains are rich in fine-grained vermicular aggregates of troilite associated with the veinlets. Graphite was not found.

**Geochemistry:** Mineral compositions and geochemistry: (N. N. Kononkova, EMP, *Vernad*) Pyroxene:  $\text{Fs}_{10.6\pm 0.2}\text{Wo}_{4.7\pm 0.3}$  (in wt%:  $\text{Al}_2\text{O}_3 = 1.23\pm 0.19$ ;  $\text{Cr}_2\text{O}_3 = 1.09\pm 0.07$ ;  $\text{Fe/Mn} = 12.0\pm 1.6$ ;  $\text{N} = 18$ ); Ca-pyroxene  $\text{Fs}_{6.4\pm 0.3}\text{Wo}_{38.5\pm 2.1}$  (in wt%:  $\text{Al}_2\text{O}_3 = 2.59\pm 1.66$ ;  $\text{Cr}_2\text{O}_3 = 1.29\pm 0.17$ ;  $\text{TiO}_2 = 0.4 \pm 0.2$ ;  $\text{Fe/Mn} = 12.0\pm 1.6$ ;  $\text{N} = 7$ ); Glass, in wt%:  $\text{SiO}_2 = 60.0$ ;  $\text{Al}_2\text{O}_3 = 23.5$ ;  $\text{Na}_2\text{O} = 4.81$ ;  $\text{CaO} = 8.78$ ;  $\text{FeO} = 2.41$ ;  $\text{MgO} = 2.13$ ; metal Fe (in wt%):  $\text{Ni} = 1.7$ ;  $\text{P} = 1.2$ ;  $\text{Si} < 0.04$ ;  $\text{Ni/Co} = 7.7$ ; troilite  $\text{Cr} = 2.0$  wt%. Mineral norms from bulk analysis (T. G. Kuzmina, XRF, *Vernad*), in wt% Ol 54.2; Hyp 23.3; Di 18.9; Fsp 3.4; Oxygen isotopes (I. A. Franchi, *OU*, laser fluorination):  $\delta^{17}\text{O} = 3.13$   $\delta^{18}\text{O} = 7.78$   $\Delta^{17}\text{O} = -0.916$ ;  $\delta^{17}\text{O} = 3.095$   $\delta^{18}\text{O} = 7.791$   $\Delta^{17}\text{O} = -0.956$ .

**Classification:** Based on a texture, mineral chemistry and oxygen isotopic composition the meteorite is classified as ureilite.

**Specimens:** Cutted piece and three sub-samples of 27.7 g in total, and thin polished section are on deposit in *Vernad*.

**Northwest Africa 12727** (NWA 12727)

Morocco

Purchased: 2018

Classification: Ordinary chondrite (LL3)

**History:** Collected by nomads in Western Sahara and purchased by Giorgio Tomelleri at the Erfoud market in 2018 from a Moroccan dealer.

**Physical characteristics:** A single piece weighing 4560 g with a black fusion crust. The cut surface appears weakly weathered and displays scattered CAIs.

**Petrography:** (V. Moggi Cecchi, G. Pratesi, S. Caporali, *UniFi*); The thin section displays a chondritic texture, with PO and POP chondrules ranging from 800 to 1200  $\mu\text{m}$  in a fine grained matrix. PO chondrules display zoned olivine crystals. POP chondrules display olivine grains and elongated pyroxene grains. Olivine is markedly inhomogeneous and Mg-rich in chondrules, while Fe-rich in the matrix. Orthopyroxene in chondrules is inhomogeneous, with a core-rim variability. Plagioclase is Na and K-rich. Opaque phases are consisting of iron oxides, Fe-Ni alloys and troilite as individual grains scattered in the matrix or rimming chondrules.

**Geochemistry:** EMP (V. Moggi Cecchi, G. Pratesi, S. Caporali, *UniFi*); Olivine in chondrules ( $\text{Fa}_{14.5\pm 9.5}\text{Fo}_{85.5\pm 9.5}$ ;  $\text{Fe/Mn} = 63.0$ ,  $n=33$ ); Olivine in matrix ( $\text{Fa}_{34.3\pm 1.4}\text{Fo}_{65.6\pm 1.7}$ ;  $\text{Fe/Mn} = 62.9$ ,  $n=10$ ); Orthopyroxene in chondrules ( $\text{Fs}_{11.1\pm 7.0}\text{En}_{88.2\pm 6.8}\text{Wo}_{0.7\pm 0.1}$ ,  $\text{Fe/Mn} = 25.2$ ,  $n=15$ ); Orthopyroxene in matrix ( $\text{Fs}_{25.4\pm 1.5}\text{En}_{72.7\pm 1.3}\text{Wo}_{1.9\pm 0.1}$ ,  $\text{Fe/Mn} = 34.3$ ,  $n=6$ ); plagioclase ( $\text{An}_{40.1}\text{Or}_{46.7}$ ); Oxygen isotopes (I. Franchi, R. Greenwood, *OU*):  $\delta^{17}\text{O} = 3.99$ ,  $\delta^{18}\text{O} = 5.79$ ,  $\Delta^{17}\text{O} = 0.973$ , all permil.

**Classification:** Ordinary Chondrite (LL3); S2; W2. Estimated subtype LL3.3.

**Specimens:** A total of 21.7 g specimen is on deposit at *MSN-FI*, Inv.#3456-I). Tomelleri holds the main mass.

### Northwest Africa 12735 (NWA 12735)

(Northwest Africa)

Purchased: 2018

Classification: LL6-anom

**History:** Bought in Morocco in 2018

**Physical characteristics:** Brown stone. Cut face reveals dark gray interior.

**Petrography:** (J. Gattacceca, *CEREGE*) Recrystallized chondrite with olivine dominant over pyroxene. Plagioclase average size above 50  $\mu\text{m}$ . Opaque are sulfides (including pentlandite) and magnetite. No metal was observed

**Geochemistry:** Olivine  $\text{Fa}_{33.6\pm 0.2}$ ,  $\text{NiO} 0.10\pm 0.04$  wt% ( $n=4$ ). Orthopyroxene  $\text{Fs}_{27.1\pm 0.1}\text{Wo}_{1.9\pm 0.2}$  ( $n=3$ ). Plagioclase  $\text{An}_{10.0}\text{Ab}_{84.8}\text{Or}_{5.3}$  ( $n=2$ ). Oxygen isotopic composition (J. Gattacceca, C. Sonzogni, *CEREGE*) from analysis of one acid-washed 1.5 mg aliquot of a powdered 270 mg bulk sample is  $\delta^{17}\text{O}=4.01\text{‰}$ ,  $\delta^{18}\text{O}=5.14\text{‰}$ ,  $\Delta^{17}\text{O}=1.31\text{‰}$  (linearized, slope 0.5247, analytical uncertainties 0.08‰, 0.12‰, 0.03‰ respectively).

**Classification:** Ordinary chondrite (LL6-anomalous). The anomalous designation is based on the Fa content of olivine, magnetic susceptibility, and the opaque mineralogy. The Fa content of olivine is higher than for typical LL chondrite: only 3 out of about 1800 LL chondrites have a higher Fa content ([NWA 10462](#), [NWA 11776](#), and [NWA 12334](#), all classified as LL6-anomalous). Magnetic susceptibility is also lower than in other moderately weathered LL chondrites. The opaque mineralogy, featuring magnetite and pentlandite, is also unusual for a LL chondrite.

**Specimens:** Type specimen at *CEREGE*. Main mass with *Labenne*.

### Northwest Africa 12736 (NWA 12736)

(Northwest Africa)

Purchased: 2015

Classification: Achondrite-ung

**Petrography:** (J. Gattacceca, *CEREGE*) Blocky aggregate of olivine and pyroxene with grain size 600  $\mu\text{m}$ . Metal and troilite are present as veinlets, along silicate rims and as small aligned crystals within silicates. No graphite was observed; and no silicate zoning was observed.

**Geochemistry:** Olivine  $\text{Fa}_{12.2\pm 0.6}$ ,  $\text{FeO/MnO} 23.4\pm 4.5$ ,  $\text{CaO} 0.26\pm 0.04$  wt%,  $\text{Cr}_2\text{O}_3 0.50\pm 0.04$  wt% ( $n=6$ ). Pyroxene: low-Ca pyroxene  $\text{Fs}_{10.9\pm 0.2}\text{Wo}_{4.7\pm 0.1}$  ( $n=5$ ), high-Ca pyroxene  $\text{Fs}_{6.6\pm 0.1}\text{Wo}_{37.8\pm 0.3}$  ( $n=5$ ),  $\text{FeO/MnO} 12.8\pm 2.7$  ( $n=10$ ). Oxygen isotopic composition (J. Gattacceca, C. Sonzogni, *CEREGE*) from analysis of one acid-washed 1.5 mg aliquot of a powdered 118 mg bulk sample is  $\delta^{17}\text{O}=0.05\text{‰}$ ,  $\delta^{18}\text{O}=1.65\text{‰}$ ,  $\Delta^{17}\text{O}=-0.81\text{‰}$  (linearized, slope 0.5247, analytical uncertainties 0.08‰, 0.12‰, 0.03‰ respectively).

**Classification:** Achondrite-ungrouped. The mineralogy is reminiscent of ureilites but significant differences are the absence of carbon material (graphite, diamond) and the absence of reduced rim in silicates. Oxygen isotopic composition is also distinct from that of ureilites.

**Northwest Africa 12780** (NWA 12780)

Morocco

Purchased: 2019

Classification: Ordinary chondrite (LL7)

**History:** (Ziyao Wang) Purchased by Ziyao Wang from Said Yousfi in Errachidia, Morocco, in Oct. 2019.

**Physical characteristics:** (Ziyao Wang) brown stone 8.5 g, without fusion crust

**Petrography:** (R. Bartoschewitz, *Bart*) highly recrystallized granular texture with grain sizes up to 0.6 mm (av. 0.1 mm), no relict chondrules, and abundant feldspar >100  $\mu\text{m}$ .

**Geochemistry:** (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine  $\text{Fa}_{31.1\pm 0.4}$  (n=16); pyroxene  $\text{Fs}_{25.8\pm 1.2}\text{Wo}_{3.5\pm 0.9}$  (n=3); Ca pyroxene  $\text{En}_{45-48}\text{Fs}_{10-13}\text{Wo}_{39-43}$  (n=3); feldspar  $\text{An}_{4-14}\text{Or}_3$  (n=3); chromite CRAL87, FFM92 (n=3). Tetrataenite Co=2.2 wt% (n=3); troilite. Magnetic susceptibility (R. Bartoschewitz, *Bart*)  $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 3.31$ .

**Classification:** Ordinary chondrite (LL7), based on texture, Wo content of pyroxenes, plagioclase size, and absence of chondrules

**Specimens:** 1.73 g at *Kiel* on deposit, Ziyao Wang holds the main mass and 1 g with *Bart*.

**Northwest Africa 12781** (NWA 12781)

Morocco

Purchased: 2019

Classification: Carbonaceous chondrite (CV3)

**History:** (Ziyao Wang) Purchased by Ziyao Wang from Craig Zlimen in the US, 2019. Zlimen had bought it from a Moroccan dealer.

**Physical characteristics:** (Ziyao Wang) dark-yellow flat stone 34 g, without fusion crust

**Petrography:** (R. Bartoschewitz, *Bart*) well-defined chondrules (~70 vol%, 0.4-3 mm, av. 0.7 mm) of various types and AOAs set in a opaque brown matrix.

**Geochemistry:** (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine  $\text{Fa}_{14.2}$  (1.1-22.6; n=27); pyroxene  $\text{Fs}_{6.7}\text{Wo}_{0.9}$  ( $\text{Fs}_{2.2-18.6}\text{Wo}_{0.2-3.5}$ , n=11); Cr-spinel. Kamacite Ni=4.2, Co=1.4 (n=1); taenite Ni=21-40, Co=0.3-1.0 (n=2) (all wt%); troilite; pyrrhotite. Magnetic susceptibility (R. Bartoschewitz, *Bart*)  $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 3.83$

**Classification:** Carbonaceous chondrite (CV3)

**Specimens:** 6.9 g at *Kiel* on deposit, Ziyao Wang holds the main mass and 6 g with *Bart*.

**Northwest Africa 12782** (NWA 12782)

Morocco

Purchased: 2018

Classification: Carbonaceous chondrite (CV3)

**History:** (Ziyao Wang) Purchased by Ziyao Wang from Fayssal Mezgouri in Agadir, Morocco, Nov 2018.

**Physical characteristics:** (Ziyao Wang) dark brown stone 92.5 g, without fusion crust. Many chondrules are visible on the surface

**Petrography:** (R. Bartoschewitz, *Bart*) well defined chondrules (~60 vol%, 0.4-2 mm, av. 0.6 mm) of various types (PO, PP, RP) and CAIs/AOAs set in a brown opaque matrix. Metal occurs as small droplets inside the chondrules.

**Geochemistry:** (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine  $Fa_{10.2}$  (0.8-16.2; n=16); pyroxene  $Fs_{12.1}Wo_{1.4}$  ( $Fs_{1.5-25.7}Wo_{0.3-4.4}$ , n=15); chromite CRAL=86-96, FFM=89-93 (n=3). Kamacite Ni=3.5-4.5, Co=0.7-1.8 (n=3); taenite Ni=20-40, Co=0.5-1.0 (n=6) (all wt%); troilite. Magnetic susceptibility (R. Bartoschewitz, *Bart*)  $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 3.40$

**Classification:** Carbonaceous chondrite (CV3)

**Specimens:** 20.0 g at *Kiel* on deposit, Ziyao Wang holds the main mass and 9 g with *Bart*.

#### Northwest Africa 12786 (NWA 12786)

Morocco

Purchased: 2018

Classification: Ordinary chondrite (L4, melt breccia)

**History:** (Ziyao Wang) Purchased by Ziyao Wang from Fayssal Mezgouri in Agadir, Morocco, Nov 2018.

**Physical characteristics:** (Ziyao Wang) one 422 g gray, flat stone

**Petrography:** (R. Bartoschewitz, *Bart*) meteorite show two lithologies: a) recrystallized matrix with chondrules of 0.2-1.5 mm (POP, PP, RP), metal and sulfide grains; and b) recrystallized fine grained (~50  $\mu\text{m}$ ) melt.

**Geochemistry:** (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine  $Fa_{24.2\pm 0.9}$  (n=13); pyroxene  $Fs_{20.2\pm 6.2}Wo_{1.5\pm 0.2}$  (n=7); chromite CRAL87, FFM88; Cl-apatite and merrillite. Kamacite Ni=3.6-6.4, Co=0.8-1.0 (n=3); taenite Ni=30-33, Co=0.3 (n=4) (all wt%); troilite. Magnetic susceptibility (R. Bartoschewitz, *Bart*)  $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.57$ .

**Classification:** Ordinary chondrite (L4-melt breccia, W2)

**Specimens:** 21.9 g at *Kiel* on deposit, Ziyao Wang holds the main mass and 53 g with *Bart*.

#### Northwest Africa 12787 (NWA 12787)

Morocco

Purchased: 2019

Classification: Ordinary chondrite (H3)

**History:** (Ziyao Wang) Purchased by Wei Jiang from Sbai Mohamed at the mineral show in *Beijing* in Nov. 2018

**Physical characteristics:** (Ziyao Wang) 196 g brown stone with spherical appearance. Weathering is very significant, the appearance is broken, without fusion crust

**Petrography:** (R. Bartoschewitz, *Bart*) well-defined chondrules (0.1-1.5 mm, av. 0.5 mm) of various types (PO, PP, RP) and mineral fragments in a brown stained matrix, metal and sulfides are nearly complete oxidized.

**Geochemistry:** (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine  $Fa_{16.3\pm 4.9}$  (n=25); pyroxene  $Fs_{18.8\pm 5.0}Wo_{0.9\pm 0.8}$  (n=13); chromite CRAL91, FFM98. Kamacite Ni=4.6-6.1, Co=0.8 (n=3); taenite Ni=18.5, Co=0.5 (n=1) (all wt%). Magnetic susceptibility (R. Bartoschewitz, *Bart*)  $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 5.06$

**Classification:** Ordinary chondrite (H3, S2, W5)

**Specimens:** 22.3 g at *Kiel* on deposit, Wei Jiang holds the main mass, Ziyao Wang 18 g, and 65 g with *Bart*.

#### Northwest Africa 12793 (NWA 12793)

(Northwest Africa)

Purchased: 2019

Classification: Ordinary chondrite (L6)

**History:** (Ziyao Wang) Purchased by Ziyao Wang from Fayssal Mezgouri at the mineral show in Chenzhou in May 2019

**Physical characteristics:** Flat brown stone of 50 g with recognizable tiny metallic spots on its surface

**Petrography:** (R. Bartoschewitz, *Bart*) Light-brown stained fractured recrystallized matrix with indistinct chondrules. Fractures are filled with hydroxides of the nearly complete oxidized metal and sulfide; beginning alteration of mafic silicates.

**Geochemistry:** (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine  $\text{Fa}_{23.4\pm 0.4}$  (n=15); pyroxene  $\text{Fs}_{19.5\pm 0.3}\text{Wo}_{1.1\pm 0.2}$  (n=6); mellillite. Magnetic susceptibility (R. Bartoschewitz, *Bart*)  $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 3.54$

**Classification:** Ordinary chondrite (L6,W5)

**Specimens:** 12.3 g at *Kiel* on deposit, main mass with *Bart*.

#### Northwest Africa 12794 (NWA 12794)

Sahara

Purchased: 2004

Classification: Ordinary chondrite (L5, melt breccia)

**History:** A single stone weighing 7 g was bought from a dealer from Morocco

**Petrography:** The rock mainly consists of fine-grained material embedding a large clast of L5 chondrite. The fine-grained portion has a melt texture with olivine and pyroxene embedded in a feldspathic matrix. The melt portion also contains metal-sulfide assemblages as typical for other melt rocks.

**Geochemistry:** Random analyses of the rock revealed mean olivine and pyroxene composition of  $\text{Fa}_{24.0\pm 1.9}$  (n=15) and  $\text{Fs}_{18.4\pm 1.7}$  (n=18), respectively.

**Classification:** Ordinary chondrite (L5-melt breccia)

**Specimens:** *IJP*: 2.1 g and 1 thin section

#### Northwest Africa 12868 (NWA 12868)

Morocco

Purchased: 2013

Classification: Ureilite

**History:** Purchased by D. Gregory in Tuscon, Arizona, from Said Haddany in 2013. S. Haddany accredits the source of the material to Morocco. Type specimen is catalogued at *ROM* as M58158.

**Physical characteristics:** The sample is covered by a weakly weathered, dark fusion crust.

**Petrography:** The sample exhibits medium to coarse-grained cumulate texture, with major olivine approximately 60%, low-Ca pyroxene 34%, and carbon 4%. Olivine grains exhibit planar fracturing, undulatory extinction, and minor reduction rims. Low-Ca pyroxene exhibits twinning and undulatory extinction. Raman analysis confirms graphite is the carbon phase.

**Geochemistry:** Mineral compositions and geochemistry: Olivine cores:  $\text{Fa}_{13.8\pm 2.5}$  (n=12), 0.01±0.00 wt% CaO, 0.02±0.00 wt% Cr<sub>2</sub>O<sub>3</sub>, and 0.01±0.00 wt% MnO. Pyroxene cores:  $\text{Fs}_{12.6\pm 0.2}\text{Wo}_{9.9\pm 0.1}$  (n=10), 0.19±0.00 wt% CaO, 0.03±0.00 wt% Cr<sub>2</sub>O<sub>3</sub>, and 0.01±0.00 wt% MnO.

**Classification:** Achondrite (ureilite). Low shock, moderate weathering.

**Specimens:** The 23.84 g sample and one thin section are held at the *ROM*.



**Northwest Africa 12894** (NWA 12894)

Morocco

Purchased: 2019

Classification: Ordinary chondrite (L3)

**History:** (Ziyao Wang) Purchased by Haichuan Tang from a Moroccan dealer at the mineral show in Chenzhou in May, 2019**Physical characteristics:** (Ziyao Wang) Dark yellow stone of 202 g without fusion crust, weathering is very serious**Petrography:** (R. Bartoschewitz, *Bart*) well defined, fractured chondrules (0.3-2 mm, av. 0.7 mm) set in a brown-stained matrix; cracks and vugs are filled with Fe-hydroxides.**Geochemistry:** (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine  $Fa_{23.6\pm 2.3}$  (n=16); pyroxene  $Fs_{13.5\pm 8.6}Wo_{0.7\pm 0.5}$  (n=9). Taenite; troilite (Ni=0.2-0.8 wt%).Magnetic susceptibility (R. Bartoschewitz, *Bart*)  $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.43$ **Classification:** Ordinary chondrite (L3, S2, W4)**Specimens:** 32.1 g at *Kiel* on deposit, Haichuan Tang and Ziyao Wang hold the main mass and 75 g with *Bart*.**Northwest Africa 12899** (NWA 12899)

Northwest Africa

Purchased: 2017

Classification: HED achondrite (Eucrite)

**History:** A single stone weighing 77 g was found by an anonymous finder in Western Sahara and purchased in October 2017 at the Munich Fair for the collections of the Museo di Storia Naturale - SMA, University of Florence, Italy.**Physical characteristics:** The main mass is partially covered by a black, shiny fusion crust with several cracks.**Petrography:** (V. Moggi Cecchi, G. Pratesi, S. Caporali, *UniFi*): The thin section analyzed displays a basaltic texture. Orthopyroxene crystals, ranging in width from 80 to 160  $\mu\text{m}$  are common, with minor clinopyroxene and anorthitic plagioclase. Low-Ca pyroxene crystals with fine (2-5  $\mu\text{m}$ ) pigeonite exsolution lamellae are diffuse. Minor phases are FeNi metal and troilite, with rare ilmenite and chromite grains.**Geochemistry:** EMP (V. Moggi Cecchi, G. Pratesi, S. Caporali *UniFi*); Host: low-Ca pyroxene ( $Fs_{62.1\pm 0.3}En_{35.1\pm 0.7}Wo_{2.8\pm 0.3}$ ; n=7; Fe/Mn = 34.0 $\pm$ 0.2); Diopside exsolution lamellae in orthopyroxene ( $Fs_{27.5\pm 0.2}En_{28.7\pm 0.3}Wo_{44.0\pm 0.2}$ ; n=8; Fe/Mn = 30.0 $\pm$ 0.3); Calcic plagioclase  $An_{86.8\pm 0.5}Or_{0.6\pm 0.5}$ , n=9;**Classification:** Eucrite with medium degree of shock and medium degree of weathering.**Specimens:** The main mass, weighing 55 g, the type specimen, weighing 24 g, and one thin section are on deposit at *MSN-FI* (Inventory N G-75062).**Northwest Africa 12907** (NWA 12907)

(Northwest Africa)

Purchased: 2019

Classification: Primitive achondrite

**History:** Two single, identically appearing complete stones of 134 and 590 g were purchased from Moroccan dealers in April 2019.

**Physical characteristics:** Single stone, sand blasted brownish exterior lacking fusion crust. Broken surface reveals poly-phase aggregate of yellow and gray crystals. Many small vugs or vesicles are visible. Very dark patches appear to be shock melt.

**Petrography:** (C. Agee, *UNM*; X. Gu, *CSU-China*) Microprobe examination of a polished mount shows an ultramafic rock with approximately 60% olivine, 30% pyroxene, and 10% alkali-rich glass. Pyroxenes often mantle olivine phenocrysts and are zoned with low calcium pyroxene cores and subcalcic augite rims. Some olivines are euhedral with grain size ~500  $\mu\text{m}$ . Glass of approximately trachytic composition is evenly distributed throughout, primarily in pockets ~100  $\mu\text{m}$ . Troilite is ubiquitous as small (~20  $\mu\text{m}$ ) spherical blebs observed mostly in glass, although one large bleb ~1 mm was observed. Trace amounts of kamacite are present.

**Geochemistry:** (C. Agee, *UNM*; X. Gu, *CSU-China*) Olivine  $\text{Fa}_{20.0\pm 2.6}$ ,  $\text{Fe/Mn}=48\pm 4$ ,  $n=12$ ; low-Ca pyroxene  $\text{Fs}_{21.6\pm 0.5}\text{Wo}_{3.0\pm 0.2}$ ,  $\text{Fe/Mn}=29\pm 1$ ,  $n=4$ ; subcalcic augite  $\text{Fs}_{22.6\pm 0.2}\text{Wo}_{24.1\pm 1.7}$ ,  $\text{Fe/Mn}=25\pm 1$ ,  $n=2$ ; glass  $\text{SiO}_2=64.8\pm 0.7$ ,  $\text{TiO}_2=0.63\pm 0.7$ ,  $\text{Al}_2\text{O}_3=17.4\pm 0.5$ ,  $\text{Cr}_2\text{O}_3=0.01\pm 0.01$ ,  $\text{MgO}=0.7\pm 0.4$ ,  $\text{MnO}=0.04\pm 0.03$ ,  $\text{FeO}=2.9\pm 1.2$ ,  $\text{CaO}=2.9\pm 0.5$ ,  $\text{Na}_2\text{O}=8.8\pm 0.3$ ,  $\text{K}_2\text{O}=1.1\pm 0.5$  (wt%),  $n=6$ . Oxygen isotopes (K. Ziegler, *UNM*): 3 acid-washed fragments analyzed by laser fluorination gave  $\delta^{18}\text{O}=4.950, 4.899, 5.195$ ;  $\delta^{17}\text{O}=3.672, 3.652, 3.848$ ;  $\Delta^{17}\text{O}=1.058, 1.066, 1.105$  (linearized, all per mil, TFL slope=0.528).

**Classification:** Primitive achondrite. Oxygen isotope values overlap with the L-LL chondrite field. Possibly related to [NWA 11042](#), but not likely paired as it possesses no maskelynite, but does have glassy melt pockets and similar olivine and pyroxene compositions.

**Specimens:** 20.4 g including a probe mount on deposit at *UNM*, Zuokai Ke holds the main mass.

#### Northwest Africa 12940 (NWA 12940)

Morocco

Purchased: 2012

Classification: HED achondrite (Eucrite)

**History:** Purchased from A. *Aaronson* in 2012 at the Tucson Gem and Mineral Show, who provided origin of sample as being from Morocco. Catalogued in the Royal Ontario Museum as sample LM58201

**Physical characteristics:** The meteorite has a well-preserved, black fusion crust with little signs of weathering. Cracks in the fusion crust are not filled with caliche. Interior of the sample fresh light grey, intact, uniform with no obvious signs of shock or weathering.

**Petrography:** Monomict breccia of basaltic clasts. Most pyroxene grains show mosaicism.

**Geochemistry:** Mineral composition and geochemistry: Plagioclase  $\text{An}_{90.21\pm 1.24}$  ( $n=23$ ).

Pyroxene composition:  $\text{Fs}_{40.68\pm 13.81}\text{Wo}_{1.35\pm 0.42}$  and  $\text{Mg}\#54.06$  ( $n=29$ ).

**Classification:** (K. Tait, *ROM*). Texture and composition suggest the sample is a monomict breccia.

#### Northwest Africa 12941 (NWA 12941)

Morocco

Purchased: 2012

Classification: HED achondrite (Eucrite)

**History:** Purchased from A. *Aaronson* in 2012 at the Tucson Gem and Mineral Show, who provided origin of sample as being from Morocco. Catalogued at the Royal Ontario Museum collection as sample LM58149

**Physical characteristics:** The meteorite has a weathered, fractured fusion crust on two surfaces, with cracks and an exposed interior faces covered with caliche. Interior of the sample largely light-grey in colour with larger black clasts visible. No shock veins observed.

**Petrography:** Breccia composed of clasts set in a matrix dominated by large crystal fragments. The majority of the clasts are composed of previously brecciated material. They contain crystal fragments and small gabbroic textured clasts set in a finely comminuted matrix. Mineral grains in both matrix and clasts show undulatory extinction.

**Geochemistry:** Mineral composition and geochemistry: Plagioclase composition:  $An_{90.01 \pm 2.34}$  (n=27) Low Ca-pyroxene composition:  $Fs_{43.66 \pm 14.83} Wo_{4.90 \pm 3.19}$  and  $FeO/MnO = 30.06 \pm 1.98$  (n=24).

**Classification:** (K. Tait, *ROM*) Texture and compositions suggest the sample is a polymict eucrite breccia. Lack of clear Opx-dominated composition excludes the possibility of this meteorite being a howardite.

#### Northwest Africa 12942 (NWA 12942)

Morocco

Purchased: 2014

Classification: HED achondrite (Eucrite)

**History:** Purchased from A. *Aaronson* in 2014 at the Tucson Gem and Mineral Show, who provided origin of sample as being from Morocco. Catalogued in the Royal Ontario Museum collection as LM58152

**Physical characteristics:** The meteorite has a well-preserved, dark fusion crust, with very minor weathering. Interior of the meteorite intact, uniform and pale gray, with visible thin, black veins and very fine-grained texture.

**Petrography:** Breccia composed almost entirely of crystal fragments set in a finely comminuted matrix. Crystal fragments range from 60 by 70  $\mu m$  to 1200 by 600  $\mu m$ . One gabbroic textured clast, measuring 0.5 by 0.4 cm, is present. Shock state is high as evidenced by strong mosaicism and fracturing of mineral grains.

**Geochemistry:** Mineral composition and geochemistry: Plagioclase composition:  $An_{88.38 \pm 3.21} Or_{0.09 \pm 0.03}$  (n=11). Low Ca-pyroxene composition:  $Fs_{42.98 \pm 14.37} Wo_{6.39 \pm 4.74}$  and  $FeO/MnO = 30.92 \pm 1.10$  (n =20). High Ca-pyroxene composition:  $Fs_{31.81 \pm 1.48} Wo_{28.47 \pm 9.97}$ . and  $FeO/MnO = 30.97 \pm 0.71$  (n=3).

**Classification:** (K. Tait, *ROM*) Texture and compositions suggest the sample is a polymict eucrite breccia.

#### Northwest Africa 12943 (NWA 12943)

Morocco

Purchased: 2011

Classification: HED achondrite (Eucrite)

**History:** Purchased from A. *Aaronson* in 2011 at the Tucson Gem and Mineral Show, who provided origin of sample as being from Morocco. Catalogued in the Royal Ontario Museum as sample LM55992

**Physical characteristics:** Visible fusion crust showing low to moderate weathering, evident by a light beige coloring. Cracks in the fusion crust filled in with caliche. Interior of the sample is intact, uniform and pale grey with a fine-grained texture.

**Petrography:** Breccia composed of gabbroic clasts set in a comminuted matrix of coarsely grained crystal fragments. Crystal fragments range from 80-900  $\mu m$ . The largest clast is 1.2

by 1.0 cm. Variable shock state. Some grains, mostly in clasts, go into extinction while others show mosaicism.

**Geochemistry:** Mineral composition and geochemistry: Plagioclase composition:  $An_{91.52\pm 0.83}Or_{0.05\pm 0.01}$  (n=23). Low Ca-pyroxene composition:  $Fs_{41.03\pm 0.20}Wo_{3.40\pm 1.29}$  and  $FeO/MnO = 28.89\pm 0.58$  (n =17). High Ca-pyroxene composition:  $Fs_{34.05\pm 1.10}Wo_{38.21\pm 6.41}$  and  $FeO/MnO = 29.45\pm 0.84$  (n=7).

**Classification:** (K. Tait, *ROM*) Texture and compositions suggest the sample is a polymict eucrite breccia.

#### Northwest Africa 12944 (NWA 12944)

Morocco

Purchased: 2006

Classification: HED achondrite (Eucrite)

**History:** Purchased from A. Habibi in 2006 at the Tucson Gem and Mineral Show, who provided origin of sample as being from Morocco. Catalogued at the Royal Ontario Museum collection as sample LM59807

**Physical characteristics:** Visible fusion crust exhibiting low to moderate weathering, evident by a light beige coloring. Cracks in the fusion crust filled in with caliche. Interior of the sample is intact, uniform and pale grey with a fine-grained texture.

**Petrography:** The thin section of this small specimen, largest dimensions are 1.5 by 1.0 cm, is dominated by 4 clasts with a gabbroic texture. The pyroxenes are mostly lath-shaped although a few more equant grains are present. Plagioclase is difficult to observe and appears to have been maskelynized. The clasts are separated by a very fine grained to glassy comminuted matrix with some isolated crystal fragments. The entire specimen, clasts and matrix, are shock darkened and the pyroxene lathes show radial extinction.

**Geochemistry:** Mineral composition and geochemistry: Plagioclase composition:  $An_{82.2\pm 5.06}Or_{0.24\pm 0.15}$  (n=19). Low Ca-pyroxene composition:  $Fs_{33.68\pm 0.64}Wo_{8.39\pm 2.85}$  and  $FeO/MnO = 32.72\pm 0.57$  (n =7). High Ca-pyroxene composition:  $Fs_{30.43\pm 1.15}Wo_{30.60\pm 7.63}$  and  $FeO/MnO = 32.71\pm 1.08$  (n=16).

**Classification:** (K. Tait, *ROM*) Texture and compositions suggest the sample is a polymict eucrite breccia.

#### Northwest Africa 12957 (NWA 12957)

(Northwest Africa)

Purchased: 2018

Classification: Carbonaceous chondrite (C3.00, ungrouped)

**History:** Purchased in Morocco in 2018.

**Physical characteristics:** Black irregular fragments. Cut face reveals a dark interior with small light chondrules.

**Petrography:** (J. Gattacceca, *CEREGE*) Chondrules with average apparent diameter  $300\pm 200$   $\mu\text{m}$  (n=25) set in a abundant iron-rich fine-grained matrix. Most chondrules have fine-grained rims. Opaques are metal, sulfides and magnetite. No phyllosilicates were observed. Raman spectra of the fine-grained matrix reveal the presence of polyaromatic carbonaceous matter characterized by a structural order comparable to type 2 chondrites, thus reflecting a peak metamorphic temperature lower than in the least metamorphosed type 3 chondrites (e.g., Semarkona).

**Geochemistry:** Olivine  $Fa_{24.3\pm 20.8}$ , range  $Fa_{1.0}$ - $Fa_{58.7}$ ,  $Fa$  PMD 79% (n=21),  $Cr_2O_3$  in ferroan olivine  $0.32\pm 0.10$  (n=16). Low-Ca pyroxene  $Fs_{8.8\pm 12.7}Wo_{1.5\pm 0.8}$  (n=10). Matrix microprobe

over an area of  $30 \times 30 \mu\text{m}^2$ : total 84.4%, FeO 36.1 wt% (n=2). Oxygen isotopic composition (J. Gattacceca, C. Sonzogni, *CEREGE*) from analysis of one acid-washed 1.5 mg aliquot of a powdered 148 mg bulk sample is  $\delta^{17}\text{O}=-3.82\text{‰}$ ,  $\delta^{18}\text{O}=1.45\text{‰}$ ,  $\Delta^{17}\text{O}=-4.59\text{‰}$  (linearized, slope 0.5247, analytical uncertainties 0.08‰, 0.12‰, 0.03‰ respectively)

**Classification:** Carbonaceous chondrite (C3.00-ungrouped). The type 3 derives from the unequilibrated nature, the absence of phyllosilicates and abundance of metal. The subtype 3.00 derives from Raman spectroscopy. The ungrouped designation derives from petrography. Possibly paired with [Chwichiya 002](#) despite having distinct oxygen isotopic composition.

**Specimens:** Type specimen at *CEREGE*. Main mass with Isabelle Pothier.

### Northwest Africa 12969 (NWA 12969)

(Northwest Africa)

Purchased: 2019 May

Classification: Ungrouped achondrite

**History:** Purchased by Habib Naji in May 2019 from a dealer in Nouakchott, Mauritania.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Composed predominantly of subequal proportions of forsterite (as coarse grained, polygranular aggregates up to 4 mm across) and enstatite (also as polygranular aggregates, in part exhibiting polysynthetic twinning). Some enstatite is recrystallized into much finer subgrains, and all is lightly stained by secondary iron hydroxides. Accessory phases include altered Si-bearing kamacite and schreibersite, but no sulfides were observed despite a careful search. Minor secondary barite and calcite are also present.

**Geochemistry:** Forsterite ( $\text{Fa}_{1.0\pm 0.0}$ , N = 3), enstatite ( $\text{Fs}_{0.4-0.7}\text{Wo}_{0.9-1.1}$ , N = 3), diopside ( $\text{Fs}_{0.3}\text{Wo}_{38.0}$ ), kamacite (Ni 4.8 wt.%, Si 1.7 wt.%). Oxygen isotopes (K. Ziegler, *UNM*): analyses of acid-washed subsamples by laser fluorination gave, respectively,  $\delta^{17}\text{O} = 1.501, 1.727, 1.354$ ;  $\delta^{18}\text{O} = 6.280, 6.762, 6.064$ ;  $\Delta^{17}\text{O} = -1.815, -1.844, -1.847$  per mil.

**Classification:** Ungrouped achondrite (enstatite-forsterite-rich). This specimen is very unusual in being so olivine-rich, so iron-poor and magnesium-rich, and in evidently containing no sulfides, as well as having an extreme sub-TFL oxygen isotopic composition.

**Specimens:** 22.5 g including one polished thin section at *UWB*; remainder with Mr. H. Naji.

### Northwest Africa 12984 (NWA 12984)

Mauritania

Find: 2017

Classification: Iron meteorite (ungrouped)

**History:** Purchased online in 2017 by George Penneff from a seller in Mauritania.

**Physical characteristics:** Single stone with dark-brown fusion crust.

**Petrography:** (D. Sheikh, *FSU*) Coarse-grained octahedrite having a well-developed Widmanstätten pattern with 1.9-2.8 mm kamacite bands, taenite, and plessite. Troilite nodules present as well.

**Geochemistry:** (INAA, ActLabs) Ni=70.2 mg/g (DL=0.01 mg/g), Co=4.54 mg/g (DL=0.01 mg/g), Cr=353  $\mu\text{g/g}$  (DL=1  $\mu\text{g/g}$ ), Cu=95  $\mu\text{g/g}$  (DL=1  $\mu\text{g/g}$ ), Ga=37  $\mu\text{g/g}$  (DL=1  $\mu\text{g/g}$ ), Ge=100  $\mu\text{g/g}$  (DL=10  $\mu\text{g/g}$ ), As=11.2  $\mu\text{g/g}$  (DL=0.5  $\mu\text{g/g}$ ), Re=0.23  $\mu\text{g/g}$  (DL=0.01  $\mu\text{g/g}$ ), Ir=2.46  $\mu\text{g/g}$  (DL=0.001  $\mu\text{g/g}$ ), Au=1.08  $\mu\text{g/g}$  (DL=0.01  $\mu\text{g/g}$ ). Precision at detection limit to be  $\pm 100\%$ , at ten times detection limit  $\pm 10-20\%$  and at 100 times detection limit  $\pm 5\%$ .

**Classification:** Iron, Ungrouped. Although Ni (70.2 mg/g) and Co (4.54 mg/g) as similar to IAB-MG, Au (1.08 ppm) is lower than that of IAB irons, and so this sample is ungrouped.

**Specimens:** 28.4 g at *UCLA*; main mass with Penneff.



**Northwest Africa 13002 (NWA 13002)**

Algeria

Purchased: 2019

Classification: HED achondrite (Eucrite, brecciated)

**History:** Purchased in November 2019 by Matthew Stream from Mostafa Hnini.**Physical characteristics:** Single stone with weathered fusion crust.**Petrography:** (D. Sheikh, *FSU*) Sample is a breccia composed of basaltic clasts and isolated mineral fragments present in a fine-grained matrix. Minerals present include orthopyroxene, pigeonite, augite, calcic plagioclase, troilite, SiO<sub>2</sub> rich glass, chromite, and ilmenite.**Geochemistry:** Low-Ca Pyroxene (Fs<sub>53.7±2.8</sub>Wo<sub>5.4±0.4</sub>, range Fs<sub>49.5-59.5</sub>Wo<sub>4.7-5.9</sub>, FeO/MnO= 30±3, n=15); pigeonite (Fs<sub>51.4±3.2</sub>Wo<sub>8.7±2.9</sub>, range Fs<sub>44.1-58.0</sub>Wo<sub>6.0-17.7</sub>, FeO/MnO= 31±3, n=50); high-Ca pyroxene (Fs<sub>29.7±3.7</sub>Wo<sub>36.8±4.3</sub>, range Fs<sub>25.3-37.1</sub>Wo<sub>30.9-43.4</sub>, FeO/MnO= 30±4, n=15); calcic plagioclase (An<sub>88.8±3.0</sub>, range An<sub>80.4-92.9</sub>, n=20).

Classification: HED achondrite (Eucrite, brecciated)

**Specimens:** 26 grams at *UCLA*; main mass with Matthew Stream.**Northwest Africa 13019 (NWA 13019)**

(Northwest Africa)

Purchased: 2016

Classification: Carbonaceous chondrite (CK6)

**History:** The meteorite was purchased from a meteorite dealer in Erfoud, Morocco.**Physical characteristics:** Brownish rock without fusion crust.**Petrography:** The meteorite predominantly consists of fine-grained recrystallized matrix mainly composed of ferroan olivine. Chondrules are sparse and only weakly defined. Minor phases include intermediate plagioclase (grain size about 80 μm), low-Ca pyroxene, Ca-pyroxene, and troilite. Cr-rich magnetite is abundant; metal is virtually absent.**Geochemistry:** olivine: Fa<sub>30.0±0.1</sub>, FeO/MnO= 120±13, n=11; low-Ca pyroxene: Fs<sub>25.4±0.4</sub>Wo<sub>0.7±0.1</sub>, FeO/MnO= 72±8, n=14, Ca-pyroxene: Fs<sub>13.1±0.6</sub>Wo<sub>44.6±1.9</sub>, n=11; Cr<sub>2</sub>O<sub>3</sub> in magnetite is about 3.0 wt%.**Northwest Africa 13021 (NWA 13021)**

(Northwest Africa)

Purchased: 2014

Classification: Pallasite

**History:** The meteorite was purchased from a meteorite dealer in Morocco.**Physical characteristics:** Eighteen dark brownish fragments some of which partly covered with fusion crust.**Petrography:** The meteorite is composed of about 6 mm sized subrounded olivine grains surrounded by a matrix of brownish iron oxides or hydroxides. Only few small pristine FeNi-metal grains have been found in the fragment studied.**Geochemistry:** Olivine: FeO/MnO=42±3, n=14; taenite: 24.9 wt% Ni, n=3**Northwest Africa 13025 (NWA 13025)**

(Northwest Africa)

Purchased: 2016

Classification: Pallasite

**History:** The meteorite was purchased from a meteorite dealer in Zagora, Morocco.

**Physical characteristics:** Thirty two dark brownish fragments without fusion crust.

**Petrography:** The meteorite is composed of up to 1 cm sized subrounded olivine grains surrounded by a matrix of partly layered brownish iron oxides or hydroxides. Alteration products are also present along the olivine grain boundaries. Contains some Cr-bearing troilite but no pristine FeNi-metal was detected.

**Geochemistry:** Olivine: FeO/MnO=42±4, n=13

#### Northwest Africa 13026 (NWA 13026)

(Northwest Africa)

Purchased: 2019

Classification: Ureilite

**History:** The meteorite was purchased from a meteorite dealer in Erfoud, Morocco.

**Physical characteristics:** Dark brownish rock without fusion crust.

**Petrography:** The meteorite shows a cumulate texture composed of up to 1 mm sized olivine and pigeonite grains. Olivine displays characteristic reduced rims and the meteorite contains flaky graphite.

**Geochemistry:** reduced rims in olivine: Fa<sub>4.1-7.6</sub>; olivine contains 0.48±0.04wt% Cr<sub>2</sub>O<sub>3</sub> and 0.50±0.02 wt% CaO

#### Northwest Africa 13027 (NWA 13027)

(Northwest Africa)

Purchased: 2019

Classification: HED achondrite (Eucrite)

**History:** The meteorite was purchased from a meteorite dealer in Erfoud, Morocco.

**Physical characteristics:** Dark greyish rock with some fusion crust.

**Petrography:** Coarse-grained monomict basaltic breccia predominantly composed of exsolved pyroxene and calcic plagioclase with average grains sizes of about 300 μm (up to 700 μm). Minor phases include ilmenite, chromite, and barite; no metallic iron has been detected. The meteorite contains shock melt veins.

**Geochemistry:** low-Ca pyroxene: Fs<sub>58.7±1.3</sub>Wo<sub>4.2±1.8</sub> (Fs<sub>56.3-61.0</sub>Wo<sub>2.2-8.0</sub>, FeO/MnO=29-32, n=14); Ca-pyroxene: Fs<sub>27.0±1.9</sub>Wo<sub>42.4±2.0</sub> (Fs<sub>25.1-32.0</sub>Wo<sub>37.0-44.4</sub>, FeO/MnO=27-32, n=16); calcic plagioclase: An<sub>92.0±1.0</sub> (An<sub>90.3-93.0</sub>, n=15)

#### Northwest Africa 13028 (NWA 13028)

(Northwest Africa)

Purchased: 2019

Classification: Carbonaceous chondrite (CV3)

**History:** The meteorite was purchased from a meteorite dealer in Morocco.

**Physical characteristics:** Dark greyish rock without fusion crust.

**Petrography:** Carbonaceous chondrite composed of chondrules (mean diameter about 1 mm; up to 3 mm sized), CAIs (up to 2 mm sized), and olivine amoeboids all set into a fine-grained brownish matrix. Contains both, type I and type II chondrules.

#### Northwest Africa 13029 (NWA 13029)

(Northwest Africa)

Purchased: 2019

Classification: Carbonaceous chondrite (CO3)

**History:** The meteorite was purchased from a meteorite dealer in Morocco.

**Physical characteristics:** Dark brownish rock without fusion crust.

**Petrography:** Carbonaceous chondrite exhibiting a chondritic texture of abundant small and well defined chondrules, CAIs, and mineral fragments set into a fine-grained almost black matrix. Chondrules are dominantly porphyritic type I and typically 0.1-0.2 mm in diameter. Contains sulfides and FeNi metal in matrix and chondrules.

### Northwest Africa 13030 (NWA 13030)

(Northwest Africa)

Purchased: 2019

Classification: Carbonaceous chondrite (CV3)

**History:** The meteorite was purchased from a meteorite dealer in Morocco.

**Physical characteristics:** Many dark brownish fragments without fusion crust.

**Petrography:** The meteorite displays a brownish to slightly greenish interior and is composed of well defined chondrules (mean diameter about 0.9 mm; up to 3.5 mm sized), CAIs (up to 3.5 mm sized), and olivine amoeboids all set into a fine-grained matrix. Type I and Type II chondrules are present.

### Northwest Africa 13031 (NWA 13031)

(Northwest Africa)

Purchased: 2018 Mar

Classification: Martian meteorite (Shergottite)

**History:** A group of four stones were found together at an unspecified location and purchased in Agadir, Morocco, by Aziz Habibi in March 2019.

**Physical characteristics:** The four stones (total weight 211 g) all have a distinctive light-green color. Fresh interiors exhibit sparse larger, lighter-colored macrocrysts in a predominant darker, finer-grained groundmass.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Composed predominantly of a relatively fine grained assemblage (mean grainsize 0.3 mm) of polysynthetically-twinned, prismatic clinopyroxene and maskelynite with accessory Ti-free chromite, Ti-chromite, ilmenite, ulvöspinel, pyrrhotite, merrillite and silica polymorph. Very sparse macrocrysts (up to 2 mm) of orthopyroxene and pigeonite (with included olivine) are present, as well as rare very thin secondary calcite veinlets.

**Geochemistry:** Orthopyroxene macrocryst core ( $\text{Fs}_{20.5}\text{Wo}_{3.2}$ ,  $\text{FeO/MnO} = 30$ ), pigeonite cores ( $\text{Fs}_{24.7-28.6}\text{Wo}_{8.5-10.4}$ ,  $\text{FeO/MnO} = 29-31$ ,  $N = 2$ ), high-Ca pyroxene rims ( $\text{Fs}_{47.3-58.7}\text{Wo}_{14.1-19.3}$ ,  $\text{FeO/MnO} = 36-39$ ,  $N = 3$ ), olivine in pigeonite macrocryst ( $\text{Fa}_{34.5-35.8}$ ,  $\text{FeO/MnO} = 50-56$ ,  $N = 4$ ), maskelynite ( $\text{An}_{58.9-59.5}\text{Or}_{0.5-0.3}$ ,  $N = 2$ ).

**Classification:** Shergottite (aphyric, pigeonite-rich with sparse macrocrysts).

**Specimens:** 20.1 g including one polished thin section at *UWB*; remainder with A. Habibi.

### Northwest Africa 13032 (NWA 13032)

Algeria

Find: 2019 Jun

Classification: HED achondrite (Diogenite, polymict)

**History:** Found by prospectors in the vicinity of Adrar, Algeria, in June 2019.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Breccia composed of diogenite clasts and related crystalline debris. The predominant mineral phase is orthopyroxene (exhibiting undulose extinction and a wide range of compositions); accessory minerals are clinopyroxene, calcic plagioclase, stained troilite and Ti-V-bearing chromite.

**Geochemistry:** Orthopyroxene ( $\text{Fs}_{18.3}\text{Wo}_{2.0}$ ;  $\text{Fs}_{24.3-25.1}\text{Wo}_{1.5-2.5}$ ;  $\text{Fs}_{30.2}\text{Wo}_{1.7}$ ;  $\text{FeO/MnO} = 29-31$ ;  $N = 6$ ), clinopyroxene ( $\text{Fs}_{8.0}\text{Wo}_{46.2}$ ,  $\text{FeO/MnO} = 20$ ), plagioclase ( $\text{An}_{87.6}\text{Or}_{0.1}$ ).

**Classification:** Diogenite (polymict breccia). The polymict designation reflects the very wide range in orthopyroxene compositions derived from at least three distinct diogenite lithologies.

**Specimens:** 26 g including one polished thin section and one polished mount at *UWB*; remainder with anonymous finders.

### Northwest Africa 13034 (NWA 13034)

(Northwest Africa)

Find: 2018 Aug

Classification: HED achondrite (Eucrite, brecciated)

**History:** Found by prospectors in the border region between Mauritania and Algeria in August 2018.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Breccia composed of fairly closely-packed eucrite clasts (of varied texture and grainsize) in a sparse matrix of related crystalline debris. Clast textures range from fine-intersertal to diabasic to gabbroic, but all have similar mineralogy, being composed predominantly of exsolved pigeonite (pale orange in thin section) and calcic plagioclase (exhibiting undulose extinction or polycrystalline) with accessory silica polymorph, ilmenite, aluminous Ti-chromite and minor secondary calcite.

**Geochemistry:** Orthopyroxene host ( $\text{Fs}_{60.7-63.6}$ ,  $\text{FeO/MnO} = 31-33$ ,  $N = 5$ ), clinopyroxene exsolution lamellae ( $\text{Fs}_{25.8-28.6}\text{Wo}_{43.2-44.0}$ ,  $\text{FeO/MnO} = 31-34$ ,  $N = 6$ ), plagioclase ( $\text{An}_{86.8-88.0}\text{Or}_{0.3-0.5}$ ,  $N = 3$ ).

**Classification:** Eucrite (breccia, moderately shocked).

**Specimens:** 27 g including one polished thin section at *UWB*; remainder with anonymous finders.

### Northwest Africa 13035 (NWA 13035)

Algeria

Find: 2019 May

Classification: Carbonaceous chondrite (CK4)

**History:** Found by prospectors in the vicinity of Adrar, Algeria, in May 2019.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Relatively closely-packed well-formed, equilibrated chondrules (mostly granular but also PO and BO) are set in a sparse finer grained matrix (~15 vol.%). Both chondrules and matrix contain Cr-magnetite, some of which has minor light orange staining.

**Geochemistry:** Olivine ( $\text{Fa}_{31.8\pm 0.2}$  (range  $\text{Fa}_{31.6-31.9}$ ,  $N = 7$ ), orthopyroxene ( $\text{Fs}_{26.2\pm 0.2}\text{Wo}_{0.8\pm 0.1}$  (range  $26.0-26.4\text{Wo}_{0.7-0.9}$ ,  $N = 5$ ), augite ( $\text{Fs}_{13.8}\text{Wo}_{39.9}$ ;  $\text{Fs}_{8.2-9.7}\text{Wo}_{46.7-47.1}$ ;  $N = 3$ ), plagioclase ( $\text{An}_{35.0}\text{Or}_{3.8}$ ), magnetite ( $\text{Cr}_2\text{O}_3$  4.1-4.2 wt.%,  $N = 2$ ).

**Classification:** Carbonaceous chondrite (CK4).

**Specimens:** 21 g including one polished thin section at *UWB*; remainder with anonymous finders.

**Northwest Africa 13036** (NWA 13036)

Morocco

Purchased: 2020 Sep

Classification: Lunar (feldsp. melt breccia)

**History:** A group of stones found together about 30 km north of Tichia, southern Morocco at 24.502°N, 13.767°W (within the Talhat Lihoudi dense collection area) was initially offered by the finders for purchase jointly by Adam Aaronson and Ahmad Bouragaa in December 2019. Although a sample was provided for analysis, the owners and potential buyers of the stones could not reach an agreement. Subsequently in September 2020 Rachid Chaoui and Jaouad Chaoui purchased the entire batch of stones from the finders, and provided the additional type material and GPS coordinates of the find site.

**Physical characteristics:** The stones (total weight 1815 g) lack fusion crust but have a dark external weathering patina. Interiors are light gray and very fine grained with visible tiny rounded vesicles.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Very fine grained specimen dominated by microvesicular, melt-textured crystalline material surrounding sparse small feldspathic lithic clasts. Minerals are anorthite, olivine, orthopyroxene, subcalcic augite, chromite, troilite and secondary barite.

**Geochemistry:** Olivine ( $\text{Fa}_{26.9-36.8}$ ,  $\text{FeO/MnO} = 73-93$ ,  $N = 10$ ), low-Ca pyroxene ( $\text{Fs}_{17.4-18.4}\text{Wo}_{3.4-5.1}$ ,  $\text{FeO/MnO} = 50-58$ ,  $N = 2$ ), subcalcic augite ( $\text{Fs}_{23.0}\text{Wo}_{20.3}$ ,  $\text{FeO/MnO} = 42$ ), anorthite ( $\text{An}_{95.9-97.5}\text{Or}_{0.1}$ ,  $N = 4$ ).

**Classification:** Lunar (feldspathic melt breccia). Although these stones were found in the same general region as lunar meteorite stone Talhat Lihoudi, they are distinct from it in both texture and mineral compositions.

**Specimens:** 21.6 g including a polished endcut at UWB; remainder with R. Chaoui and J. Chaoui.

**Northwest Africa 13038** (NWA 13038)

(Northwest Africa)

Purchased: 2019 Nov

Classification: Martian meteorite (Shergottite)

**History:** Purchased by Mbark Arjdal from a dealer in Zouerat, Mauritania in November 2019.

**Physical characteristics:** A single stone (587 g) partly covered with black fusion crust and with several broken surfaces revealing the fresh light gray interior.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Relatively fine grained (mean grain size 0.4 mm) and composed predominantly of polysynthetically-twinned, zoned clinopyroxene and maskelynite with accessory ilmenite, ulvöspinel (both Cr-bearing and Cr-free), chromite (with Ti-rich lamellae and rims), pyrrhotite, merrillite, chlorapatite and silica polymorph. One large orthopyroxene grain (2.5 mm across) with a pigeonite rim was found in the studied thin section. Sparse patches of pale glassy, vesicular impact melt and a thin darker veinlet of similar material were observed, as well as minor secondary calcite (as thin veinlets and vesicle linings).

**Geochemistry:** Pigeonite ( $\text{Fs}_{26.1-28.3}\text{Wo}_{6.7-11.9}$ ,  $\text{FeO/MnO} = 29-30$ ,  $N = 3$ ), subcalcic augite ( $\text{Fs}_{20.4-21.4}\text{Wo}_{34.1-31.5}$ ,  $\text{FeO/MnO} = 26-28$ ,  $N = 2$ ), ferropigeonite rims ( $\text{Fs}_{48.7-57.3}\text{Wo}_{13.1-18.1}$ ,  $\text{FeO/MnO} = 37-38$ ,  $N = 4$ ), large orthopyroxene grain ( $\text{Fs}_{20.0}\text{Wo}_{2.8}$ ,  $\text{FeO/MnO} = 29$ ), pigeonite rim on large orthopyroxene grain ( $\text{Fs}_{31.5-39.2}\text{Wo}_{12.6-19.2}$ ,  $\text{FeO/MnO} = 30-37$ ,  $N = 2$ ), maskelynite ( $\text{An}_{57.8-61.4}\text{Or}_{1.7-1.3}$ ,  $N = 2$ ).

**Classification:** Shergottite (aphyric, intersertal).



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3 **Specimens:** 25.3 g including one polished thin section at *UWB*; remainder with Mr. M.  
4 Arjdal.  
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8 **Northwest Africa 13040** (NWA 13040)

9 (Northwest Africa)

10 Purchased: 2019

11 Classification: Ordinary chondrite (LL~3)

12 **History:** (Ziyao Wang) Purchased by Wei Jiang from a Moroccan dealer (Rachid Adnane) at  
13 the mineral show in Chenzhou in May 2019

14 **Physical characteristics:** (Ziyao Wang) More than 30 individuals and fragments between 1 kg  
15 and 20 g. The total discovered mass exceeds 15 kg.

16 **Petrography:** (R. Bartoschewitz, *Bart*) light brown cut face with close-fit texture of  
17 interlocking deformed and undeformed chondrules (0.3-3 mm), chondrule:interchondrule  
18 matrix about 9:1. Weathered surface with Ni-bearing evaporates.

19 **Geochemistry:** Magnetic susceptibility (R. Bartoschewitz, *Bart*)  $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.06$

20 **Classification:** Ordinary chondrite (LL~3, W4)

21 **Specimens:** 21.4 g on deposit at *Kiel*, Wei Jiang holds the main mass, and 275 g with *Bart*.  
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26 **Northwest Africa 13042** (NWA 13042)

27 Morocco

28 Purchased: 2019

29 Classification: Ordinary chondrite (LL~4)

30 **History:** (Ziyao Wang) Purchased by Ziyao Wang from a Moroccan dealer at the mineral  
31 show in Chenzhou in May 2019

32 **Physical characteristics:** (Ziyao Wang) Three brown fragments of totally 372 g without  
33 fusion crust

34 **Petrography:** (R. Bartoschewitz, *Bart*) gray to brown stained matrix with well developed  
35 chondrules (0.3-2 mm, av. 1 mm), metal and sulfide

36 **Geochemistry:** Magnetic susceptibility (R. Bartoschewitz, *Bart*)  $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.45$

37 **Classification:** Ordinary chondrite (LL~4, W2)

38 **Specimens:** 22.9 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 66 g with *Bart*.  
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44 **Northwest Africa 13049** (NWA 13049)

45 (Northwest Africa)

46 Purchased: 2019

47 Classification: Ordinary chondrite (L~6)

48 **History:** (Ziyao Wang) Purchased by Ziyao Wang from a Moroccan dealer at the China  
49 Mineral & Gem Show in *Beijing* City in Nov. 2019

50 **Physical characteristics:** (R. Bartoschewitz) 54 g black-gray edged stone, the cut face dark  
51 gray

52 **Petrography:** (R. Bartoschewitz) strong recrystallized matrix with indistinct chondrules (0.5-  
53 1.5 mm) and irregular metal and sulfide patches up to 2 mm

54 **Geochemistry:** Magnetic susceptibility (R. Bartoschewitz, *Bart*)  $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.98$

55 **Classification:** Ordinary chondrite (L~6, W1)

56 **Specimens:** 10.8 g on deposit at *Kiel*, Wang Ziyao holds the main mass, and 7 g with *Bart*.  
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**Northwest Africa 13051** (NWA 13051)

(Northwest Africa)

Purchased: 2019

Classification: Ordinary chondrite (L~6)

**History:** (Ziyao Wang) Purchased by Ziyao Wang from a Moroccan dealer at the China Mineral & Gem Show in *Beijing* City in Nov. 2019**Physical characteristics:** 150 g light gray brown broken individual with some fusion crust**Petrography:** (R. Bartoschewitz, *Bart*) light gray, partly brown stained recrystallized matrix with chondrules (0.3-2 mm, av. 0.8 mm), metal and sulfide inclusions.**Geochemistry:** Magnetic susceptibility (R. Bartoschewitz, *Bart*)  $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.81$ **Classification:** Ordinary chondrite (L~6, W2)**Specimens:** 20.5 g at *Kiel* on deposit, main mass with *Bart*.**Northwest Africa 13052** (NWA 13052)

(Northwest Africa)

Purchased: 2019

Classification: Ordinary chondrite (H~4)

**History:** (Ziyao Wang) Purchased by Ziyao Wang from a Moroccan dealer at the China Mineral & Gem Show in *Beijing* City in Nov. 2019**Physical characteristics:** 6.0 g dark gray fragment with surface-recognizable chondrules and metal specks**Petrography:** (R. Bartoschewitz, *Bart*) dark gray, porous matrix with chondrules (0.2-0.8 mm, av. 0.4 mm) and metal inclusions.**Geochemistry:** Magnetic susceptibility (R. Bartoschewitz, *Bart*)  $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 5.17$ **Classification:** Ordinary chondrite (H~4, W1)**Specimens:** 1.5 g at *Kiel* on deposit, main mass with *Bart*.**Northwest Africa 13054** (NWA 13054)

(Northwest Africa)

Purchased: 2019

Classification: Carbonaceous chondrite (CV3)

**History:** The meteorite was purchased from a meteorite dealer in Morocco.**Physical characteristics:** Dark brownish rock without fusion crust.**Petrography:** Carbonaceous chondrite composed of up well-defined chondrules (mean diameter about 900  $\mu\text{m}$ ), CAIs (up to 5 mm), and olivine amoeboids all set into a fine-grained almost black matrix. Type II chondrules are absent. Some chondrules show reddish staining due to terrestrial weathering.**Northwest Africa 13055** (NWA 13055)

(Northwest Africa)

Purchased: 2019

Classification: Ordinary chondrite (LL3)

**History:** The meteorite was purchased from a meteorite dealer in Morocco.**Physical characteristics:** Brownish rock lacking any fusion crust.**Petrography:** The meteorite shows a chondritic texture with mostly flattened and partly packed chondrules (mean diameter about 0.9 mm) in a fine-grained, strongly altered matrix that contains only few pristine FeNi metal grains.

**Northwest Africa 13058** (NWA 13058)

(Northwest Africa)

Purchased: 2019

Classification: Carbonaceous chondrite (CO3)

**History:** The meteorite was purchased from a meteorite dealer in Morocco.**Physical characteristics:** Dark brownish rock with some fusion crust.**Petrography:** Carbonaceous chondrite composed of abundant, well-defined small chondrules (mean diameter about 180  $\mu\text{m}$ ), CAIs, and olivine amoeboids all set into a fine-grained dark brownish matrix. Type II chondrules are rare. Some chondrules show reddish staining due to terrestrial weathering. Opaque are metal and sulfide.**Northwest Africa 13059** (NWA 13059)

(Northwest Africa)

Purchased: 2019

Classification: Carbonaceous chondrite (CO3)

**History:** The meteorite was purchased from a meteorite dealer in Morocco.**Physical characteristics:** Dark brownish rock without fusion crust.**Petrography:** The meteorite shows a dark brownish interior and is composed of abundant small chondrules, CAIs, and mineral fragments set into a fine-grained matrix that contains sulfides and FeNi metal. Chondrules have a mean diameter of about 0.2 mm; several regions show brownish staining due to terrestrial weathering.**Northwest Africa 13060** (NWA 13060)

(Northwest Africa)

Purchased: 2019

Classification: Rumuruti chondrite (R3)

**History:** The meteorite was purchased from a meteorite dealer in Morocco.**Physical characteristics:** Brownish rock with some fusion crust.**Petrography:** The meteorite displays a light brownish to orange interior and is composed of sparse up to 1 mm sized angular type 3 clasts and matrix. Olivine and low-Ca pyroxene are compositionally unequilibrated in clasts and matrix; Fe-rich olivine is the most dominant mineral phase in the matrix. Chondrules have an average diameter of about 400  $\mu\text{m}$ . More minor phases include low-Ca pyroxene, rare Ca-pyroxene, sodic plagioclase, sulfides, and Ti-bearing chromite; no metal has been detected.**Geochemistry:** Olivine:  $\text{Fa}_{24.9\pm 16.7}$  ( $\text{Fa}_{2.6-47.7}$ ,  $n=27$ ); low-Ca pyroxene: $\text{Fs}_{16.7\pm 10.6}\text{Wo}_{0.7\pm 0.6}$  ( $\text{Fs}_{4.4-34.8}\text{Wo}_{0.2-2.5}$ ,  $n=23$ )**Northwest Africa 13061** (NWA 13061)

(Northwest Africa)

Purchased: 2019

Classification: Ureilite

**History:** The meteorite was purchased from a meteorite dealer in Morocco.**Physical characteristics:** Dark brownish rock with some fusion crust.

**Petrography:** The meteorite shows a cumulate texture composed of up to 1.5 mm sized olivine and pigeonite grains. Olivine displays characteristic reduced rims and the meteorite contains flaky graphite.

**Geochemistry:** reduced rims in olivine:  $Fa_{1.4-3.7}$ ; olivine contains  $0.62 \pm 0.03 \text{ wt\% Cr}_2\text{O}_3$  and  $0.30 \pm 0.01 \text{ wt\% CaO}$

### Northwest Africa 13063 (NWA 13063)

(Northwest Africa)

Purchased: 2019

Classification: Carbonaceous chondrite (CO3)

**History:** The meteorite was purchased from a meteorite dealer in Morocco.

**Physical characteristics:** Many dark-brownish fragments without fusion crust.

**Petrography:** The meteorite exhibits a chondritic texture of abundant, well defined, small chondrules, CAIs, and mineral fragments set into a fine-grained matrix. Chondrules are dominantly porphyritic type I and typically 0.1-0.2 mm in diameter. Contains sulfides and FeNi metal in matrix and chondrules. Some regions show orange staining due to terrestrial alteration.

### Northwest Africa 13064 (NWA 13064)

(Northwest Africa)

Purchased: 2019

Classification: HED achondrite (Eucrite)

**History:** The meteorite was purchased from a meteorite dealer in Morocco.

**Physical characteristics:** Many greyish fragments without fusion crust.

**Petrography:** The meteorite is a fragmental breccia composed of larger exsolved pyroxene (up to 400  $\mu\text{m}$ ) and calcic plagioclase (up to 500  $\mu\text{m}$ ) grains set into a more fine-grained clastic matrix. Minor phases include silica, chromite, FeS, and ilmenite. No metallic iron has been detected. The meteorite contains shock melt veins.

**Geochemistry:** low-Ca pyroxene:  $Fs_{57.4 \pm 0.5}Wo_{2.7 \pm 0.2}$  ( $Fs_{57.0-58.8}Wo_{2.2-3.1}$ ,  $FeO/MnO=26-28$ ,  $n=12$ ); Ca-pyroxene:  $Fs_{25.2 \pm 0.7}Wo_{43.3 \pm 0.7}$  ( $Fs_{24.4-27.3}Wo_{41.1-44.0}$ ,  $FeO/MnO=24-28$ ,  $n=15$ ); calcic plagioclase:  $An_{90.9 \pm 0.4}$  ( $An_{90.2-91.6}$ ,  $n=14$ )

### Northwest Africa 13065 (NWA 13065)

(Northwest Africa)

Purchased: 2019

Classification: HED achondrite (Eucrite)

**History:** The meteorite was purchased from a meteorite dealer in Morocco.

**Physical characteristics:** Small brownish rock without fusion crust.

**Petrography:** The meteorite is an unbrecciated fine-grained basalt predominantly composed of exsolved pyroxene and often laths-shaped calcic plagioclase with average grain sizes of about 300  $\mu\text{m}$ . Pyroxene appears brownish in plane polarized light. Minor phases include silica, chromite, troilite, zircon, and metallic iron.

**Geochemistry:** low-Ca pyroxene:  $Fs_{57.7 \pm 0.7}Wo_{2.7 \pm 0.7}$  ( $Fs_{56.5-58.7}Wo_{1.8-4.5}$ ,  $FeO/MnO=31-34$ ,  $n=11$ ); Ca-pyroxene:  $Fs_{25.6 \pm 0.8}Wo_{43.0 \pm 0.7}$  ( $Fs_{24.6-26.9}Wo_{41.9-43.9}$ ,  $FeO/MnO=28-34$ ,  $n=12$ ); calcic plagioclase:  $An_{85.7 \pm 0.8}$  ( $An_{84.7-87.8}$ ,  $n=11$ )

**Northwest Africa 13066** (NWA 13066)

(Northwest Africa)

Purchased: 2019

Classification: Carbonaceous chondrite (CO3)

**History:** The meteorite was purchased from a meteorite dealer in Morocco.**Physical characteristics:** Dark brownish rock without fusion crust.**Petrography:** The meteorite shows a dark brownish interior and is composed of abundant small chondrules, CAIs (up to 500  $\mu\text{m}$ ), and mineral fragments some of which surrounded by fine-grained dust rims set into a fine-grained black matrix. Chondrules have a mean diameter of about 0.2 mm; few regions show brownish staining due to terrestrial weathering. Opaque minerals are sulfide and Fe,Ni metal.**Northwest Africa 13067** (NWA 13067)

(Northwest Africa)

Purchased: 2019

Classification: HED achondrite (Eucrite)

**History:** The meteorite was purchased from a meteorite dealer in Morocco.**Physical characteristics:** Greyish rock with some fusion crust.**Petrography:** The meteorite is a fragmental breccia composed of up to 3 mm sized basaltic and sparse up to 2 mm sized black impact melt clasts set into a clastic matrix. Mineral phases are predominantly up to 300  $\mu\text{m}$  sized pyroxene and up to 700  $\mu\text{m}$  sized calcic plagioclase grains. Pyroxene is compositionally zoned indicating a low degree of thermal metamorphism. Minor phases include silica, chromite, and troilite. No metallic iron has been detected.**Geochemistry:** low-Ca pyroxene:  $\text{Fs}_{37.5\pm 7.9}\text{Wo}_{7.6\pm 1.2}$  ( $\text{Fs}_{31.7-53.1}\text{Wo}_{6.4-9.6}$ ,  $\text{FeO/MnO}=24-29$ ,  $n=15$ ); Ca-pyroxene:  $\text{Fs}_{48.4\pm 4.0}\text{Wo}_{23.4\pm 0.6}$  ( $\text{Fs}_{45.5-58.0}\text{Wo}_{22.9-25.2}$ ,  $\text{FeO/MnO}=25-31$ ,  $n=13$ ); calcic plagioclase:  $\text{An}_{87.7\pm 5.8}$  ( $\text{An}_{82.0-94.6}$ ,  $n=13$ )**Northwest Africa 13068** (NWA 13068)

(Northwest Africa)

Purchased: 2019

Classification: Carbonaceous chondrite (CO3)

**History:** The meteorite was purchased from a meteorite dealer in Morocco.**Physical characteristics:** Dark brownish rock without fusion crust.**Petrography:** Carbonaceous chondrite composed of abundant small chondrules, CAIs, and their fragments set in a fine-grained, almost black matrix. Chondrules are dominantly porphyritic type I and about 180  $\mu\text{m}$  in mean diameter. Sulfides and FeNi metal are present in matrix and chondrules.**Northwest Africa 13069** (NWA 13069)

(Northwest Africa)

Purchased: 2016

Classification: Ordinary chondrite (LL4)

**History:** The meteorite was purchased from a meteorite dealer in Zagora, Morocco.**Physical characteristics:** Grayish rock partly covered with fusion crust.**Petrography:** The meteorite displays a grayish interior and shows a chondritic texture composed of mostly rounded chondrules (mean diameter about 800  $\mu\text{m}$ ) that are only loosely



packed. The matrix appears brecciated and contains sulfides and rare FeNi metal. Olivine is compositionally equilibrated while low-Ca pyroxene shows zoning.

### Northwest Africa 13070 (NWA 13070)

(Northwest Africa)

Purchased: 2015

Classification: Ordinary chondrite (L3)

**History:** The meteorite was purchased from a meteorite dealer in Morocco.

**Physical characteristics:** Two grayish fragments without fusion crust.

**Petrography:** The meteorite shows a chondritic texture with well packed and partly flattened chondrules (apparent mean diameter about 0.7 mm). The fine-grained matrix contains sulfides and FeNi metal.

### Northwest Africa 13071 (NWA 13071)

(Northwest Africa)

Purchased: 2015

Classification: Carbonaceous chondrite (CO3)

**History:** The meteorite was purchased from a meteorite dealer in Morocco.

**Physical characteristics:** Dark brownish rock without fusion crust.

**Petrography:** The meteorite shows a dark brownish interior and is composed of abundant small chondrules, CAIs, and mineral fragments set into a fine-grained matrix. Chondrules are dominantly porphyritic type I and have an apparent mean diameter of about 0.2 mm. Some chondrules are surrounded by accretionary dust rims. Sulfides and FeNi metal are present in matrix and chondrules.

### Northwest Africa 13072 (NWA 13072)

(Northwest Africa)

Purchased: 2018

Classification: HED achondrite (Eucrite)

**History:** The meteorite was purchased from a meteorite dealer in Zagora, Morocco.

**Physical characteristics:** Grayish rock partly covered with fusion crust.

**Petrography:** The meteorite is a fragmental breccia composed of basaltic clasts and abundant black impact melt clasts set into a fine-grained clastic matrix. Basaltic clasts and matrix are dominantly composed of exsolved pyroxene and plagioclase grains up to 2 mm in size. Minor phases include chromite, FeS, and silica. No metallic iron has been detected.

**Geochemistry:** large low-Ca pyroxene grains:  $\text{Fs}_{40.5\pm 0.3}\text{Wo}_{2.7\pm 0.1}$  ( $\text{Fs}_{40.2-40.9}\text{Wo}_{2.6-2.8}$ ,  $\text{FeO/MnO}=23-26$ ,  $n=11$ ); low-Ca pyroxene host to augite exsolution lamellae:  $\text{Fs}_{54.3\pm 0.6}\text{Wo}_{2.8\pm 1.0}$  ( $\text{Fs}_{53.2-55.2}\text{Wo}_{1.7-4.7}$ ,  $\text{FeO/MnO}=29-31$ ,  $n=11$ ); Ca-pyroxene exsolution lamellae:  $\text{Fs}_{28.4\pm 1.1}\text{Wo}_{37.7\pm 1.4}$  ( $\text{Fs}_{26.4-31.1}\text{Wo}_{34.1-39.9}$ ,  $\text{FeO/MnO}=24-31$ ,  $n=12$ ); calcic plagioclase:  $\text{An}_{93.9\pm 0.4}$  ( $\text{An}_{93.1-94.5}$ ,  $n=12$ )

### Northwest Africa 13073 (NWA 13073)

(Northwest Africa)

Purchased: 2015

Classification: Ordinary chondrite (L3)

**History:** The meteorite was purchased online from a Moroccan meteorite dealer.

**Physical characteristics:** Dark greyish rock without fusion crust.

**Petrography:** The meteorite displays a chondritic texture with partly flattened separated chondrules (mean diameter about 0.6 mm) in a fine-grained dark matrix that contains sulfides and FeNi metal.

#### Northwest Africa 13074 (NWA 13074)

(Northwest Africa)

Purchased: 2016

Classification: Carbonaceous chondrite (CK6)

**History:** The meteorite was purchased from a meteorite dealer in Zagora, Morocco.

**Physical characteristics:** Brownish to dark greenish rock partly covered with fusion crust.

**Petrography:** The meteorite displays a dark greenish interior and is largely composed of fine-grained recrystallized matrix dominated by Fe-rich olivine. Chondrules are only rarely encountered. Minor phases include intermediate plagioclase, low-Ca pyroxene, Ca-pyroxene and FeS. Cr-rich magnetite is abundant; metal was not detected.

**Geochemistry:** olivine:  $Fa_{28.9\pm 0.2}$ ,  $FeO/MnO = 92\pm 8$ ,  $n=14$ ; low-Ca pyroxene:

$Fs_{24.7\pm 0.3}Wo_{1.2\pm 0.7}$ ,  $FeO/MnO = 62\pm 5$ ,  $n=13$ , Ca-pyroxene:  $Fs_{8.7\pm 0.6}Wo_{46.4\pm 0.7}$ ,  $n=5$ ;  $Cr_2O_3$  in magnetite is about 2.7 wt%.

#### Northwest Africa 13077 (NWA 13077)

Morocco

Purchased: 2016

Classification: Rumuruti chondrite (R3-5)

**History:** Purchased by Said Yufsi in 2016 from a moroccan dealer in Dakhla city. Later acquired by Roberto Vargas.

**Physical characteristics:** Single stone with dark-brown fusion crust.

**Petrography:** (D. Sheikh, *FSU*) This sample is a breccia composed of well-formed chondrules (Av. diameter  $\sim 500$   $\mu m$ ) and an assortment of equilibrated angular clasts (up to 4 mm) set in a fine-grained matrix. Minerals present include olivine, orthopyroxene, augite, sodic plagioclase, pentlandite, troilite, and Ti-rich chromite.

**Geochemistry:** Olivine in equilibrated clasts ( $Fa_{38.7\pm 0.7}$ ,  $n=70$ ), olivine in unequilibrated chondrules ( $Fa_{23.3\pm 16.8}$ , range  $Fa_{3.7-44.5}$ ,  $n=20$ ) orthopyroxene in equilibrated clasts ( $Fs_{29.6\pm 0.3}Wo_{1.5\pm 0.4}$ ,  $n=10$ ) orthopyroxene in unequilibrated chondrules ( $Fa_{21.3\pm 12.7}Wo_{1.2\pm 0.6}$ , range  $Fs_{1.4-29.9}Wo_{0.1-1.9}$ ,  $n=10$ ), augite ( $Fs_{11.8\pm 1.5}Wo_{44.1\pm 1.1}$ ,  $n=30$ ), sodic plagioclase ( $An_{11.6\pm 4.7}$ , range  $An_{6.6-22.3}$ ,  $n=20$ ).

**Classification:** Rumuruti chondrite (R3-5). This sample is classified as an R3-5 due to the fact that it contains both type 3 unequilibrated chondrules and type 5 equilibrated clasts with recrystallized plagioclase grain size at  $\sim 20$   $\mu m$ .

**Specimens:** 14.2 grams at *UCLA*; main mass with Roberto Vargas.

#### Northwest Africa 13087 (NWA 13087)

(Northwest Africa)

Purchased: March 2018

Classification: HED achondrite (Eucrite, polymict)

**History:** The main mass was purchased in March 2018 in Arfoud, Morocco, from the Bouhayek brothers by Société Astronomique de France (SAF) member Pascal Maugein, who was given the type specimen in November 2018.

**Physical characteristics:** Main mass fully covered by black, regmaglypted fusion crust  
**Petrography:** (E. Jacquet, B. Doisneau, *MNHNP*). Breccia with ophitic/subophitic and more blocky textured pyroxene/plagioclase clasts, along with mineral clasts of same. Pyroxene is frequently zoned in the former, and otherwise often presents augite lamellae, sometimes folded. The clasts may also contain silica and ilmenite-troilite-silica-pyroxene symplectites. Opaque clasts, whether with cryptocrystalline (plagioclase-pyroxene, <10  $\mu\text{m}$ ) or glassy (eucritic major element composition) groundmasses, are likely impact melts (with olivine a common minor mineral). Ferroan hedenbergite-fayalite-silica (or K-feldspar) clasts such as those described by Barrat et al. (2012) in howardites occur. One curious 0.6 mm anorthite clast with round <60  $\mu\text{m}$  nodules of equant <10  $\mu\text{m}$  euhedral pyroxene, silica, plagioclase crystals.

**Geochemistry:** Mineral compositions and geochemistry: Pyroxene Fe/Mn=34 $\pm$ 4. Plagioclase is An<sub>85.2 $\pm$ 6.6</sub>Ab<sub>13.4 $\pm$ 6.0</sub>Or<sub>1 $\pm$ 0.9</sub> (An<sub>72.2-97.5</sub>Ab<sub>1.1-19.2</sub>Or<sub>0.1-2.5</sub>, N=19). One coarse chromite (Al<sub>2</sub>O<sub>3</sub> = 17-21 wt%, Cr<sub>2</sub>O<sub>3</sub> = 43-46 wt%; N=3). Olivine Fa<sub>79.6 $\pm$ 20.4</sub> (Fa<sub>51.9-90.0</sub>, N=4).

**Classification:** Eucrite (polymict). Clasts correspond to eucrite mineralogy but are variable in texture, mineral chemistry and metamorphism, hence the polymict nature of the breccia. Pyroxene Fe/Mn is consistent with HED.

**Specimens:** 320 g (main mass, plus one thin section, with P. Maugein); 30 g (type specimen, plus one thin section)

### Northwest Africa 13088 (NWA 13088)

Morocco

Purchased: 2017

Classification: Ordinary chondrite (L3.1)

**History:** Purchased in Morocco by Brahim Tahiri in late 2017 and brought to Sean Tutorow in late December 2017. Tutorow donated 94.40 g to *Cascadia* for classification.

**Physical characteristics:** *Cascadia* received two thin slices completely covered in a coating which darkens the sample and causes it to appear wet. Overall, the slices are dark orange-brown in color and show abundant chondrules. Some areas have chondrules set in an orange-brown background, while in other areas the background is dark brown to black. Boundaries between the two are generally indistinct, although there is one example of a sharp contact between a large (4  $\times$  3 cm, truncated along the edge of the slice), angular, orange-brown colored clast and the rest of the slice, indicating that this sample is brecciated.

**Petrography:** (M. Hutson and A. Ruzicka, *Cascadia*): The section is crossed by numerous weathering veins composed of calcite and iron-rich hydroxides. One edge of the section is less weathered and shows abundant discolored and partially-replaced troilite, much of it as rims around chondrules. Chondrules are distinct, and have an apparent mean diameter of 756 $\pm$ 366 microns (N= 113). Two subtly different lithologies with indistinct boundaries are visible in thin section in optical and BSE imaging. One lithology (lithology A) has a somewhat higher proportion of forsteritic olivine grains than the other (lithology B); the overall lithology A clast appears slightly darker in BSE imaging. Chondrule mesostases in lithology A contain fewer crystallites than those of lithology B.

**Geochemistry:** Mineral compositions and geochemistry: Olivine and pyroxene grains are highly unequilibrated: Fa<sub>17.7 $\pm$ 10.7</sub>N=161; Fs<sub>11.5 $\pm$ 10.1</sub>Wo<sub>1.0 $\pm$ 1.1</sub>, N=82. There is no significant difference in Fa or Fs contents between the two lithologies. However, Cr<sub>2</sub>O<sub>3</sub> in olivine suggests a slightly different petrographic subtype: Cr<sub>2</sub>O<sub>3</sub> in olivine (lithology A) = 0.42 $\pm$ 0.19 wt%, consistent with a subtype of 3.10, N=72; Cr<sub>2</sub>O<sub>3</sub> in olivine (lithology B) = 0.19 $\pm$ 0.21 wt%, consistent with a subtype of 3.15, N=84.

**Classification:** Ordinary chondrite (L3.1) based on olivine fayalite content, overall  $\text{Cr}_2\text{O}_3$  in olivine, and mean chondrule diameter.

**Specimens:** *Cascadia* holds 90.3 g in six pieces, in addition to a polished thin section and a mounted butt. The main mass is held by Sean Tutorow, Arizona.

#### Northwest Africa 13089 (NWA 13089)

Morocco

Purchased: 2019 Mar 27

Classification: Ordinary chondrite (LL5)

**History:** Purchased in Morocco by a friend of Mr. Jason Phillips, who sent a half of the stone to Mr. James *Tobin*, who sent pieces to the *Cascadia* for classification.

**Physical characteristics:** *Cascadia* received two slices; an abraded, bumpy exterior is visible along the slices' edges. Cut faces show readily distinguished, mainly dark-colored chondrules and flecks of metal and sulfide set in an orange-brown background.

**Petrography:** (M. Hutson and A. Ruzicka, *Cascadia*): Chondrules are readily distinguished, and many are surrounded by partial rims of mainly sulfide. Albitic feldspar grains up to 20 microns across are present. In addition to single grains, chromite-plagioclase-rich mesostases were observed in several chondrules.

**Geochemistry:** Mineral compositions and geochemistry: Olivine and pyroxene grains are equilibrated:  $\text{Fa}_{29.0\pm 0.2}$ ,  $N=36$ ;  $\text{Fs}_{23.7\pm 0.3}$   $\text{Wo}_{1.4\pm 0.4}$ ,  $N=26$ . Limited data were collected on feldspars in two areas:  $\text{Ab}_{85.2\pm 3.0}$   $\text{An}_{10.3\pm 1.7}$   $\text{Or}_{4.5\pm 1.8}$ ,  $N=5$ .

**Classification:** Ordinary chondrite (LL5) based on olivine fayalite and pyroxene ferrosilite contents, and feldspar grain size.

**Specimens:** *Cascadia* holds 24.3 g in two pieces, in addition to a polished thin section and a mounted butt. The main mass was divided in half: Jason Phillips holds 219.1 g; James *Tobin* holds 218.6 g.

#### Northwest Africa 13090 (NWA 13090)

Morocco

Purchased: 2019 Mar 27

Classification: Ordinary chondrite (LL3)

**History:** Purchased in Morocco by a friend of Mr. Jason Phillips, who sent a half of the stone to Mr. James *Tobin*, who sent pieces to the *Cascadia* for classification.

**Physical characteristics:** *Cascadia* received an end cut and a small corner piece; exterior surfaces of both are abraded, dark gray, and bumpy, with lighter-colored chondrules visible. The cut face shows well-defined, oblate, and aligned chondrules set against a medium-gray background. Sulfide and metal are visible, mainly rimming chondrules. Two perpendicular faces are visible on the corner piece; chondrules are oblate and aligned on only one face.

**Petrography:** (M. Hutson and A. Ruzicka, *Cascadia*): Chondrules are distinct, and have an apparent mean diameter of  $0.99\pm 0.46$  mm ( $N=36$ ). Many chondrules are surrounded by rims of mainly sulfide. Fe-Ni metal comprises 2.1% of the thin section. Native copper is present. Visible in thin section are brown glass, low-Calcium clinopyroxene, and zoned olivine grains, as well as "bleached" rims on some chondrules. BSE imaging shows many examples of forsteritic olivine cut by linear bands of Fe-rich olivine that appear to represent pre-terrestrial alteration along fractures.

**Geochemistry:** Mineral compositions and geochemistry: Olivine and pyroxene grains are unequilibrated:  $\text{Fa}_{25.3\pm 9.0}$ ,  $N=157$ ;  $\text{Fs}_{12.8\pm 9.5}$   $\text{Wo}_{0.9\pm 0.8}$ ,  $N=33$ .

**Classification:** Ordinary chondrite (LL3) based on olivine fayalite content, metal abundance, and mean chondrule diameter.

**Specimens:** *Cascadia* holds 33.0 g in two pieces, in addition to a polished thin section and a mounted butt. The main mass was divided in half: Jason Phillips holds 571.2 g; James *Tobin* holds 540.8 g.

#### Northwest Africa 13091 (NWA 13091)

Morocco

Purchased: 2014 Feb

Classification: Ordinary chondrite (L6)

**History:** Purchased from a Moroccan dealer in 2013

**Physical characteristics:** Single stone, Rusty exterior with small patches of fusion crust covering <5%. Saw cut reveals vague outlines of chondrules, some shock melt veins, small flakes of metal and troilite

**Petrography:** (T. Swindle, *UAz*) Microprobe examination of a polished mount shows some largely re-crystallized chondrules up to 2 mm in size, in a recrystallized matrix. Plagioclase grains in matrix up to 70  $\mu\text{m}$  in size. Incipient oxidation of troilite, approximately 50% of kamacite weathered. Sample cut by many small iron-oxide weathering veins, and occasional melt veins a few tens of  $\mu\text{m}$  in width. Minor chromite present. Some areas with abundant metal blebs.

**Geochemistry:** Mineral composition and geochemistry (T. Swindle, *UAz*): Olivine  $\text{Fa}_{25.3\pm 0.7}$ ,  $\text{Fe}/\text{Mn} = 46.8\pm 3.3$ ,  $n=8$ ; low-Ca pyroxene  $\text{Fs}_{21.1\pm 0.2}\text{Wo}_{1.6\pm 0.2}$ ,  $\text{Fe}/\text{Mn}=27.6\pm 0.7$ ,  $n=8$

**Classification:** Ordinary Chondrite (L6), Weathering grade W2, weakly shocked (S3)

**Specimens:** 43.7 g and epoxy mount deposit at *UAz*. Fredric Stephan holds the main mass.

#### Northwest Africa 13092 (NWA 13092)

Morocco

Purchased: 2014 Feb

Classification: Ordinary chondrite (H6)

**History:** Purchased from a Moroccan dealer in 2014

**Physical characteristics:** Physical Characteristics: Covered with black fusion crust. Saw cut reveals abundant metal and sulfides.

**Petrography:** (AS Djakaria and IJ Ong, *UAz*) Microprobe examination of a polished mount shows chondrules of 500-1500  $\mu\text{m}$ . Plagioclase grains 100-200  $\mu\text{m}$  observed. Large, moderately oxidized, kamacite and taenite grains are common and are connected by a widespread set of complex, convoluted, small metal veins incorporating numerous small silicate inclusions. Troilite, chromite, merrillite, and chlorapatite are also present.

**Geochemistry:** Mineral compositions and geochemistry: (AS Djakaria and IJ Ong, *UAz*) Olivine  $\text{Fa}_{18.9\pm 0.2}$ ,  $\text{Fe}/\text{Mn}=36.9\pm 1.7$ ,  $n=10$ ; low-Ca pyroxene  $\text{Fs}_{16.8\pm 0.4}\text{Wo}_{1.7\pm 0.1}$ ,  $\text{Fe}/\text{Mn}=22.9\pm 1.5$ ,  $n=10$ ; Kamacite  $\text{Fe}=91.51\pm 0.82$ ,  $\text{Ni}=6.93\pm 0.21$ ,  $\text{Co}=0.51\pm 0.03$ ,  $n=3$ .

**Classification:** Ordinary Chondrite (H6), Weathering grade W2.

**Specimens:** 22.4 g and epoxy mount deposit at *UAz*. Fredric Stephan holds the main mass.

#### Northwest Africa 13093 (NWA 13093)

Morocco

Purchased: 2014 Feb

Classification: Ordinary chondrite (L6)



**History:** Purchased from a Moroccan dealer in 2014.

**Physical characteristics:** Physical Characteristics: Almost completely covered by black fusion crust. Interior shows moderate amount of metallic and sulfide flakes. Dark parallel bands run along the length of the interior.

**Petrography:** (S. Chapin and K. Kingsbury, *UAz*) Microprobe examination of a polished mount shows a few, barely distinguishable, partly recrystallized chondrules, some up to 500-900  $\mu\text{m}$  in size. Plagioclase grains are large (70-200  $\mu\text{m}$ ). Minor oxidization seen along rims of kamacite and troilite. A few small shock veins several mm long are observed. Troilite, merrillite, and chromite are also present.

**Geochemistry:** Mineral compositions and geochemistry: (S. Chapin and K. Kingsbury, *UAz*) Olivine  $\text{Fa}_{25.4\pm 1.2}$ ,  $n=10$ ; low-Ca pyroxene  $\text{Fs}_{20.8\pm 0.3}\text{Wo}_{1.6\pm 0.3}$ ,  $n=10$ ; Kamacite  $\text{Fe}=91.93\pm 0.94$ ,  $\text{Ni}=6.23\pm 0.23$ ,  $\text{Co}=0.96\pm 0.11$  wt%,  $n=3$ .

**Classification:** Ordinary Chondrite (L6), weathering grade W2.

**Specimens:** 31 g and an epoxy probe mount on deposit at *UAz*. Fredric Stephan holds the main mass.

### Northwest Africa 13094 (NWA 13094)

Morocco

Purchased: 2014 Feb

Classification: Ordinary chondrite (H5)

**History:** Purchased from a Moroccan dealer in 2014

**Physical characteristics:** Complete fusion crust surrounds the meteorite exterior while a saw cut reveals some chondrules. Scattered flakes of troilite and metal were observed.

**Petrography:** Microprobe examination of an epoxy probe mount reveals many distinguishable chondrules ranging between 100-500  $\mu\text{m}$  in size. Limited amount of plagioclase grains are present within the matrix, mostly between 10-50  $\mu\text{m}$  in size. There is moderate oxidation of kamacite and troilite with about 30% oxidation of metal in total. Sample is cut by several iron-oxide weathering veins. Small disseminated metal in some areas suggests the meteorite to be very weakly shocked. The presence of small amounts of merrillite was observed.

**Geochemistry:** Olivine  $\text{Fa}_{18.7\pm 0.2}$ ,  $\text{Fe}/\text{Mn}=35.3\pm 2.1$ ,  $n=10$ ; low-Ca pyroxene  $\text{Fs}_{16.5\pm 0.2}\text{Wo}_{0.99\pm 0.11}$ ,  $\text{Fe}/\text{Mn}=21.3\pm 1.5$ ,  $n=11$ ; Kamacite  $\text{Fe}=92.0\pm 1.0$ ,  $\text{Ni}=6.7\pm 0.1$ ,  $\text{Co}=0.52\pm 0.02$  wt%,  $n=3$ .

**Classification:** Ordinary Chondrite (H5), Weathering grade W3.

**Specimens:** 41.6 g and an epoxy probe mount on deposit at *UAz*. Fredric Stephan holds the main mass.

### Northwest Africa 13095 (NWA 13095)

Morocco

Purchased: 2014 Feb

Classification: Ordinary chondrite (L6)

**History:** Purchased from a Moroccan dealer in 2015

**Physical characteristics:** 328g single piece that has a brownish red fusion crust. The fusion crust is broken suggesting weathering of the piece. A saw cut reveals a moderate amount of bright speckled metal and sulfides. There is a large dark area lacking metals and sulfides.

**Petrography:** (T. Burd and E. Ratliff, *UAz*) There are plagioclase grains to 110 microns. Extensive recrystallization has taken place with indistinct chondrules present. Chromite,

1  
2  
3 taenite, and apatite present. Troilite and kamacite also observed in a partially oxidized state.  
4 Sample cut by many iron-oxide weathering veins.

5 **Geochemistry:** Mineral compositions and geochemistry: Olivine  $\text{Fa}_{25.2\pm 1.0}$ ,  $\text{Fe/Mn}=48.7\pm 3.9$ ,  
6  $n=10$ ; low-Ca pyroxene  $\text{Fs}_{21.1\pm 0.6}\text{Wo}_{1.6\pm 0.3}$ ,  $\text{Fe/Mn}=29.1\pm 2.2$ ,  $n=10$ ; Kamacite  $\text{Fe}=92.9\pm 0.4$ ,  
7  $\text{Ni}=6.4\pm 0.3$ ,  $\text{Co}=0.65\pm 0.04$  wt%,  $n=3$

8 **Classification:** Ordinary Chondrite (L6), Weathering Grade W3.

9 **Specimens:** 27.4 g and an epoxy probe mount on deposit at *UAz*. Fredric Stephan holds the  
10 main mass.  
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#### 14 Northwest Africa 13096 (NWA 13096)

15 Morocco

16 Purchased: 2014 Feb

17 Classification: Ordinary chondrite (H6)

18 **History:** Purchased from a Moroccan dealer in 2014

19 **Physical characteristics:** Nearly complete fusion crust, cut by deep cracks. Saw cut reveals a  
20 grayish-green interior with a number of small chondrules visible and relatively few bright  
21 metal and sulfide grains.  
22

23 **Petrography:** Numerous moderately distinct to poorly delineated chondrules are observed,  
24 approximately 200-800  $\mu\text{m}$  in size. Plagioclase grains are 50-200  $\mu\text{m}$ . Large kamacite and  
25 taenite grains are abundant and highly oxidized. Cut by numerous terrestrial Fe-oxide veins.  
26 Minor chromite is also observed.

27 **Geochemistry:** Olivine  $\text{Fa}_{19.1\pm 0.3}$ ,  $\text{Fe/Mn}=36.4\pm 2.4$   $n=10$ ; low-Ca Pyroxene  
28  $\text{Fs}_{16.7\pm 0.2}\text{Wo}_{1.74\pm 0.06}$ ,  $\text{Fe/Mn}=22.1\pm 0.9$   $n=10$ ; Taenite  $\text{Fe}=92.0\pm 0.3$ ,  $\text{Ni}=6.4\pm 0.3$ ,  
29  $\text{Co}=0.51\pm 0.04$  wt%,  $n=3$ .

30 **Classification:** Ordinary chondrite (H6), weathering W3

31 **Specimens:** 31.6 g and an epoxy probe mount on deposit at *UAz*. Fredric Stephan holds the  
32 main mass.  
33  
34  
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#### 36 Northwest Africa 13097 (NWA 13097)

37 Morocco

38 Purchased: 2014 Feb

39 Classification: Ordinary chondrite (L6)

40 **History:** Purchased from a Moroccan dealer in 2014

41 **Physical characteristics:** Single rough stone, completely covered with fusion crust. Saw cut  
42 reveals sparse amount of metal and sulfide flakes

43 **Petrography:** Microprobe examination of a polished mount shows a few indistinct  
44 chondrules present, set in a highly recrystallized matrix. Plagioclase grains range up to 200  
45  $\mu\text{m}$  in size. Kamacite, taenite, and troilite are not abundant, and are highly oxidized. Sample is  
46 cut by several terrestrial iron-oxide veins. Minor chromite is also present.

47 **Geochemistry:** Olivine  $\text{Fa}_{24.9\pm 0.3}$ ,  $\text{Fe/Mn}=46.8\pm 2.6$   $n=10$ ; low-Ca pyroxene  $\text{Fs}_{20.9\pm 0.5}\text{Wo}=$   
48  $1.6\pm 0.3$ ,  $\text{Fe/Mn}=27.7\pm 1.3$   $n=10$ ; Taenite  $\text{Fe}=70.4\pm 1.8$ ,  $\text{Ni}=28.2\pm 1.7$ ,  $\text{Co}=0.27\pm 0.09$  wt%,  
49  $n=10$ .

50 **Classification:** Ordinary Chondrite (L6), weathering grade (W3)

51 **Specimens:** 20.8 g and an epoxy probe mount on deposit at *UAz*. Fredric Stephan holds the  
52 main mass.  
53  
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55

#### 56 Northwest Africa 13098 (NWA 13098)

Morocco

Purchased: 2014 Feb

Classification: Ordinary chondrite (H5)

**History:** Purchased from a Moroccan dealer in 2014

**Physical characteristics:** Physical Characteristics: Single rough stone, has a black fusion crust. Saw cut reveals a red and brown interior with abundant specks of metals and sulfides.

**Petrography:** (K. Van Atta, T. Elliott, M. Trinh) Microprobe examination of a polished mount shows a few portions recrystallized, high amounts of metal and sulfides. Numerous plagioclase grains, 20-70  $\mu\text{m}$ , in the matrix. Large, oxidized, kamacite and taenite grains are common and are connected by a widespread set of complex, convoluted, small metal veins incorporating numerous small silicate inclusions. A few larger pools of plagioclase composition are also observed, which contain densely concentrated small crystals of chromite and metal. Kamacite is highly oxidized and troilite is also partly altered. Large chromite and merrillite, and some chlorapatite, also present.

**Geochemistry:** Mineral compositions and geochemistry: (K. Van Atta, T. Elliott, M. Trinh) Olivine  $\text{Fa}_{19.1\pm 0.3}$ ,  $\text{Fe/Mn}=36.1 \pm 1.6$ ,  $n=10$ ; low-Ca pyroxene  $\text{Fs}_{16.9\pm 0.3}\text{Wo}_{1.8\pm 0.05}$ ,  $\text{Fe/Mn}=22.6 \pm 1.3$ ,  $n=10$ ; Kamacite  $\text{Fe}=91.86\pm 0.13$ ,  $\text{Ni}=6.75\pm 0.20$ ,  $\text{Co}=0.49\pm 0.05$  wt%,  $n=10$ .

**Classification:** Ordinary Chondrite (H5), weathering grade (W3)

**Specimens:** 32.6 g and an epoxy probe mount on deposit at *UAz*. Fredric Stephan holds the main mass.

#### Northwest Africa 13099 (NWA 13099)

Morocco

Purchased: 2014 Feb

Classification: Ordinary chondrite (H5)

**History:** Purchased from a Moroccan dealer in 2014.

**Physical characteristics:** Physical Characteristics: Fusion crust covers most of the specimen, with some weathered patches. Saw cut reveals weathered interior with abundant reflective patches of metal and sulfide.

**Petrography** (D. Cantillo, M. James, S. Morin, *UAz*): Microprobe examination shows chondrules 500-1000  $\mu\text{m}$  in size. The boundaries of these chondrules are relatively well-defined, with some partial re-crystallization. The areas of the matrix that were metal were surrounded by rust, composing about 50% of the sample. Plagioclase grains  $<70$   $\mu\text{m}$  in size. Large troilite, chromite, and merrillite grains are also present.

**Geochemistry:** Mineral composition and geochemistry (D. Cantillo, M. James, S. Morin, *UAz*): Olivine  $\text{Fa}_{18.1\pm 0.2}$ ,  $\text{Fe/Mn}$   $33.49\pm 2.06$ ,  $n=10$ . Low-Ca Pyroxene  $\text{Fs}_{15.4\pm 0.6}\text{Wo}_{0.5\pm 0.3}$ ,  $\text{Fe/Mn}$   $22.15\pm 1.95$ ,  $n=10$ . Kamacite  $\text{Fe}$   $92.30\pm 0.28\%$ ,  $\text{Ni}$   $6.36\pm 0.30\%$ ,  $\text{Co}$   $0.463\pm 0.04\%$ ,  $n=3$ .

**Classification:** Ordinary Chondrite (H5), weathering grade W2

**Specimens:** 32.1 g and epoxy mount deposit at *UAz*. Fredric Stephan holds the main mass.

#### Northwest Africa 13100 (NWA 13100)

(Northwest Africa)

Purchased: 2019

Classification: Ordinary chondrite (LL6)

**History:** Purchased in 2019 by Luc Labenne from a dealer in Erfoud, Morocco.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Breccia composed of fairly closely packed angular clasts, which are extensively recrystallized but contain rare relict chondrules and some altered metal.

**Geochemistry:** Olivine ( $\text{Fa}_{30.3\pm 0.5}$  (range  $\text{Fa}_{29.9-31.2}$ ,  $N = 5$ ), low-Ca pyroxene ( $\text{Fs}_{26.6\pm 0.3}\text{Wo}_{2.3\pm 0.4}$  (range  $\text{Fs}_{25.4-26.0}\text{Wo}_{1.9-2.9}$ ,  $N = 5$ ), high-Ca pyroxene ( $\text{Fs}_{11.4\pm 1.0}\text{Wo}_{42.2\pm 1.4}$  (range  $\text{Fs}_{10.3-11.5}\text{Wo}_{43.6-40.9}$ ,  $N = 3$ ).

**Classification:** Ordinary chondrite (LL6 breccia).

**Specimens:** 22.3 g including one polished thin section at *UWB*; remainder with Mr. L. Labenne.

### Northwest Africa 13101 (NWA 13101)

(Northwest Africa)

Find: 2017 Jan

Classification: Lunar meteorite (feldspathic breccia)

**History:** A batch of specimens (total weight 68.796 kg), including two large intact stones (28.498 and 24.292 kg) was recovered in January 2017 in Western Sahara or the Western Sahara/Algeria border region, and purchased by *DPitt* in February 2017 from a Mauritanian dealer.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Breccia composed of angular mineral clasts of anorthite, olivine, orthopyroxene, pigeonite, subcalcic augite, chromite and ilmenite set in a sparsely vesicular, partly vitreous matrix containing minor troilite, kamacite and taenite.

**Geochemistry:** Olivine ( $\text{Fa}_{18.5-20.9}$ ,  $\text{FeO/MnO} = 88-97$ ,  $N = 4$ ), orthopyroxene ( $\text{Fs}_{16.3-17.1}\text{Wo}_{2.4-4.0}$ ,  $\text{FeO/MnO} = 47-54$ ,  $N = 2$ ), pigeonite ( $\text{Fs}_{18.3}\text{Wo}_{5.6}$ ;  $\text{Fs}_{37.3-47.1}\text{Wo}_{4.4-9.0}$ ;  $\text{FeO/MnO} = 53-62$ ;  $N = 3$ ), subcalcic augite ( $\text{Fs}_{49.2}\text{Wo}_{25.4}$ ,  $\text{FeO/MnO} = 63$ ), plagioclase ( $\text{An}_{96.2-96.6}\text{Or}_{0.1}$ ,  $N = 2$ ).

**Classification:** Lunar (feldspathic breccia).

**Specimens:** 24.9 g including one polished endcut at *UWB*; remainder with *DPitt*.

### Northwest Africa 13102 (NWA 13102)

(Northwest Africa)

Purchased: 2019 Aug

Classification: Mesosiderite

**History:** Purchased from a dealer in Zagora, Morocco in August 2019 by Juan Avilés Poblador on behalf of *UAlie*.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Recrystallized breccia composed of a variety of mineral clasts, some of which are rimmed by apparent reaction assemblages. Predominant component minerals are orthopyroxene (of several distinct compositions, with rare augite inclusions), olivine (of several distinct compositions) and anorthite, together with accessory kamacite (with taenite rims), silica (as acicular grains associated with anorthite), merrillite, chromite and troilite. Some orthopyroxene grains are rimmed by more ferroan orthopyroxene and some olivine grains are rimmed by orthopyroxene.

**Geochemistry:** Orthopyroxene cores ( $\text{Fs}_{17.6}\text{Wo}_{0.9}$ ;  $\text{Fs}_{25.2}\text{Wo}_{2.4}$ ;  $\text{Fs}_{33.7}\text{Wo}_{2.3}$ ;  $\text{FeO/MnO} = 27-29$ ,  $N = 3$ ), orthopyroxene rims ( $\text{Fs}_{31.8-37.5}\text{Wo}_{2.6-3.5}$ ,  $\text{FeO/MnO} = 25-26$ ,  $N = 3$ ), pigeonite rim on large orthopyroxene grain ( $\text{Fs}_{33.4}\text{Wo}_{9.4}$ ,  $\text{FeO/MnO} = 26$ ), olivine ( $\text{Fa}_{16.6-16.8}$ ;  $\text{Fa}_{34.4}$ ;  $\text{FeO/MnO} = 40-45$ ,  $N = 3$ ), orthopyroxene rim on magnesian olivine ( $\text{Fs}_{21.9}\text{Wo}_{1.9}$ ,  $\text{FeO/MnO} = 25$ ), augite inclusion in orthopyroxene ( $\text{Fs}_{16.9}\text{Wo}_{42.0}$ ,  $\text{FeO/MnO} = 21$ ), anorthite ( $\text{An}_{90.4-95.8}\text{Or}_{0.3-0.1}$ ,  $N = 3$ ).

**Classification:** Mesosiderite.

**Specimens:** 21.2 g including one polished endcut at *UWB*; remainder in the collection *UAlic*.

**Northwest Africa 13103** (NWA 13103)

(Northwest Africa)

Purchased: 2018 Mar

Classification: Ordinary chondrite (L6, melt breccia)

**History:** Purchased in Agadir, Morocco by Aziz Habibi in March 2018.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Sparse Type 6 clasts containing rare chondrule remnants occur within a dominant very fine grained lithology composed of melt-textured material containing clusters of rounded opaque minerals. The specimen is crosscut by subparallel veinlets of iron hydroxides from terrestrial weathering of primary metal.

**Geochemistry:** Type 6 clast: Olivine ( $\text{Fa}_{24.7}$ ), low-Ca pyroxene ( $\text{Fs}_{20.6}\text{Wo}_{1.4}$ ). Melt matrix: Olivine ( $\text{Fa}_{24.3\pm 0.2}$  (range  $\text{Fa}_{24.1-24.5}$ ,  $N = 3$ ), low-Ca pyroxene ( $\text{Fs}_{20.6\pm 0.2}\text{Wo}_{1.4\pm 0.3}$  (range  $\text{Fs}_{20.3-20.8}\text{Wo}_{1.1-1.7}$ ,  $N = 4$ ).

**Classification:** Ordinary chondrite (L6-melt breccia).

**Specimens:** 221 g including one polished thin section at *UWB*; remainder with Mr. A. Habibi.

**Northwest Africa 13104** (NWA 13104)

(Northwest Africa)

Purchased: 2019 Apr

Classification: HED achondrite (Eucrite, monomict)

**History:** Purchased in Rissani, Morocco by Adam Aaronson in April 2019.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Monomict breccia composed of closely-packed very fine grained granulitic eucrite clasts in a sparse matrix. Minerals are exsolved pigeonite, calcic plagioclase, silica polymorph, Ti-Al-bearing chromite, troilite, ilmenite and rare zircon.

**Geochemistry:** Orthopyroxene host ( $\text{Fs}_{60.7-62.0}\text{Wo}_{3.4-1.9}$ ,  $\text{FeO/MnO} = 31-32$ ,  $N = 5$ ), clinopyroxene exsolution lamellae ( $\text{Fs}_{26.4-27.4}\text{Wo}_{44.2-43.3}$ ,  $\text{FeO/MnO} = 31-34$ ,  $N = 5$ ), plagioclase ( $\text{An}_{88.0-90.0}\text{Or}_{0.4}$ ,  $N = 4$ ).

**Classification:** Eucrite (monomict breccia, fine grained, recrystallized).

**Specimens:** 20.2 g including one polished thin section at *UWB*; remainder with Aaronson.

**Northwest Africa 13105** (NWA 13105)

(Northwest Africa)

Purchased: 2018 Mar

Classification: Ordinary chondrite (L7)

**History:** Purchased in Agadir, Morocco, by Aziz Habibi in March 2018.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Some portions of this specimen exhibit an equigranular, triple grain junction texture whereas other portions have poikiloblastic texture (consisting of olivine chadacrysts within orthopyroxene oikocrysts). No chondrules were observed.

**Geochemistry:** Olivine ( $\text{Fa}_{22.9\pm 0.2}$  (range  $\text{Fa}_{22.7-23.1}$ ,  $N = 4$ ), low-Ca pyroxene ( $\text{Fs}_{19.5\pm 0.1}\text{Wo}_{3.7\pm 0.7}$  (range  $\text{Fs}_{19.4-19.6}\text{Wo}_{2.6-4.3}$ ,  $N = 4$ ), high-Ca pyroxene ( $\text{Fs}_{9.1\pm 0.9}\text{Wo}_{42.0\pm 2.2}$  (range  $\text{Fs}_{8.4-9.7}\text{Wo}_{43.5-40.4}$ ,  $N = 2$ ).

**Classification:** Ordinary chondrite (L7).

**Specimens:** 28.2 g including one polished thin section at *UWB*; remainder with Mr. A. Habibi.



**Northwest Africa 13106** (NWA 13106)

(Northwest Africa)

Purchased: 2019 May

Classification: Martian meteorite (Shergottite)

**History:** Purchased in Agadir, Morocco, by Aziz Habibi in May 2019.**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Intersertal texture with a prominent lattice preferred orientation of maskelynite laths and prismatic clinopyroxene (strongly compositionally zoned). Accessory phases include merrillite, silica polymorph, pyrrhotite, ilmenite (with hematite exsolution lamellae), titanomagnetite (with ulvöspinel exsolution lamellae), baddeleyite, fayalite (in melt inclusions) and anorthoclase (in mesostasis).**Geochemistry:** Pigeonite cores ( $\text{Fs}_{33.0-33.4}\text{Wo}_{15.0-14.2}$ ,  $\text{FeO/MnO} = 28-29$ ,  $N = 2$ ), subcalcic augite cores ( $\text{Fs}_{24.7-29.1}\text{Wo}_{24.1-30.0}$ ,  $\text{FeO/MnO} = 27-29$ ,  $N = 3$ ), ferropigeonite rims ( $\text{Fs}_{70.2-78.3}\text{Wo}_{13.4-19.9}$ ,  $\text{FeO/MnO} = 39-40$ ,  $N = 4$ ), subcalcic ferroan augite rim ( $\text{Fs}_{58.7}\text{Wo}_{25.3}$ ,  $\text{FeO/MnO} = 38$ ), maskelynite ( $\text{An}_{55.2-56.1}\text{Or}_{1.1-1.7}$ ,  $N = 3$ ), ferropigeonite in mesostasis ( $\text{Fs}_{84.3}\text{Wo}_{10.4}$ ,  $\text{FeO/MnO} = 41$ ), anorthoclase in mesostasis ( $\text{Ab}_{41.4}\text{An}_{35.3}\text{Or}_{23.3}$ ).**Classification:** Shergottite (intersertal).**Specimens:** 20.5g including one polished thin section at *UWB*; remainder with Mr. A. Habibi.**Northwest Africa 13107** (NWA 13107)

(Northwest Africa)

Purchased: 2018 Mar

Classification: Ordinary chondrite (LL7)

**History:** Purchased in Rissani, Morocco, by Adam Aaronson in March 2018.**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Triple grain junction texture with no chondrules. Major minerals are olivine, orthopyroxene, rare high-Ca pyroxene and sodic plagioclase, together with accessory altered kamacite, chromite and chlorapatite.**Geochemistry:** Olivine ( $\text{Fa}_{27.7\pm 0.4}$  (range  $\text{Fa}_{27.1-28.1}$ ,  $N = 5$ ), low-Ca pyroxene ( $\text{Fs}_{22.8\pm 0.1}\text{Wo}_{2.1\pm 0.0}$  (range  $\text{Fs}_{22.7-22.9}\text{Wo}_{2.1-2.2}$ ,  $N = 5$ ), high-Ca pyroxene ( $\text{Fs}_{9.4\pm 0.0}\text{Wo}_{44.2\pm 0.0}$  (range  $\text{Fs}_{9.3-9.4}\text{Wo}_{44.2}$ ,  $N = 2$ ), plagioclase ( $\text{An}_{38.6\pm 0.0}\text{Or}_{0.5\pm 0.0}$  (range  $\text{An}_{38.5-38.6}\text{Or}_{0.5-0.6}$ ,  $N = 3$ ).**Classification:** Ordinary chondrite (LL7).**Specimens:** 20.6 g including one polished thin section at *UWB*; remainder with Aaronson.**Northwest Africa 13108** (NWA 13108)

(Northwest Africa)

Purchased: 2019 Mar

Classification: Enstatite chondrite (EL6)

**History:** Purchased in Zagora, Morocco, by Jaouad Achouri in March 2019.**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Mostly recrystallized aggregate of enstatite, sodic plagioclase and partially altered opaque phases (brown in thin section). Rare recrystallized RP chondrules were observed. Careful analysis of accessory phases identified daubreeelite (partially altered to jarosite), altered troilite, Cu-bearing violarite, Ni-free Fe silicide (possibly naquite) and rare oldhamite. Most of the relatively sparse primary metal has been completely replaced by iron hydroxides, but a few grains of taenite and Si-poor kamacite were observed.

**Geochemistry:** Enstatite ( $\text{Fs}_{0.1\pm 0.0}\text{Wo}_{1.4\pm 0.0}$ ,  $N = 2$ ), plagioclase ( $\text{Ab}_{78.6\pm 0.5}\text{An}_{16.8\pm 0.1}\text{Or}_{4.6\pm 0.3}$ ,  $N = 2$ ), kamacite ( $\text{Si} = 1.3\pm 0.7$  wt.%,  $\text{Ni} = 4.2\pm 1.6$  wt.%,  $N = 4$ ).

**Classification:** Enstatite chondrite (EL6).

**Specimens:** 23.6 g including one polished thin section at *UWB*; remainder with Mr. J. Achouri.

#### Northwest Africa 13109 (NWA 13109)

(Northwest Africa)

Purchased: 2005

Classification: Ordinary chondrite (L4)

**History:** Purchased by an anonymous collector from a dealer at the Munich Show in 2005, subsequently acquired by the Hollis Collection and then donated to *PSF*.

**Petrography:** (A. Irving, *UWS* & J. Boesenberg, *BrownU*) Well-formed chondrules occur in a recrystallized matrix containing altered metal. Opaque veinlets of secondary goethite are also present in this fairly weathered specimen.

**Geochemistry:** Olivine ( $\text{Fa}_{25.1\pm 1.3}$  (range  $\text{Fa}_{24.2-27.5}$ ,  $N = 7$ ), low-Ca pyroxene ( $\text{Fs}_{20.9\pm 0.4}\text{Wo}_{2.3\pm 0.4}$  (range  $\text{Fs}_{20.6-21.4}\text{Wo}_{1.8-1.4}$ ,  $N = 4$ ).

**Classification:** Ordinary chondrite (L4).

**Specimens:** The entire specimen including one polished thin section is at *PSF*.

#### Northwest Africa 13110 (NWA 13110)

(Northwest Africa)

Purchased: 2019 Aug

Classification: HED achondrite (Diogenite, polymict)

**History:** Purchased from a dealer in Zagora, Morocco, in August 2019 by Juan Avilés Poblador on behalf of *UAlic*.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Breccia composed predominantly of angular mineral grains derived from several different diogenite lithologies together with ~2 vol.% of lithic eucrite clasts (exhibiting fine-intersertal, granulitic, vitrophyric and microgabbroic textures). Minerals are diogenitic orthopyroxene (of several distinct compositions), calcic plagioclase, olivine (one grain with an orthopyroxene rim), exsolved pigeonite, ferroan orthopyroxenes, silica polymorph, kamacite, Ni-free Fe metal, aluminous low-Ti chromite, ilmenite and troilite.

**Geochemistry:** Diogenitic orthopyroxenes ( $\text{Fs}_{18.4}\text{Wo}_{0.8}$ ;  $\text{Fs}_{22.9}\text{Wo}_{2.1}$ ;  $\text{Fs}_{24.4-24.6}\text{Fs}_{1.6-2.6}$ ;  $\text{FeO/MnO} = 27-31$ ;  $N = 4$ ), olivine ( $\text{Fa}_{51.7-56.2}$ ,  $\text{FeO/MnO} = 47-51$ ,  $N = 3$ ), orthopyroxene rim on olivine ( $\text{Fs}_{41.5}\text{Wo}_{1.8}$ ,  $\text{FeO/MnO} = 32$ ), ferroan orthopyroxenes ( $\text{Fs}_{59.3}\text{Wo}_{4.1}$ ;  $\text{Fs}_{47.5}\text{Wo}_{2.1}$ ;  $\text{FeO/MnO} = 25-31$ ;  $N = 2$ ), ferroan pigeonite host ( $\text{Fs}_{50.1}\text{Wo}_{6.5}$ ,  $\text{FeO/MnO} = 30$ ), augite exsolution lamellae ( $\text{Fs}_{18.9}\text{Wo}_{43.2}$ ;  $\text{Fs}_{26.4-28.2}\text{Wo}_{37.9-41.4}$ ;  $\text{FeO/MnO} = 24-31$ ;  $N = 3$ ), plagioclase ( $\text{An}_{83.8-90.9}\text{Or}_{0.7-0.3}$ ,  $N = 3$ ).

**Classification:** Diogenite (polymict breccia).

**Specimens:** 9.8 g including one polished thin section at *UWB*; remainder in the collection of *UAlic*.

#### Northwest Africa 13111 (NWA 13111)

(Northwest Africa)

Purchased: 2005

Classification: Ordinary chondrite (H4/5)

**History:** Purchased by an anonymous collector from a dealer at the Munich Show in 2005, subsequently acquired by the Hollis Collection and then donated to *PSF*.

**Petrography:** (A. Irving, *UWS* & J. Boesenberg, *BrownU*) Some well-formed chondrules occur in a recrystallized matrix containing altered metal.

**Geochemistry:** Olivine ( $\text{Fa}_{18.8\pm 0.3}$  (range  $\text{Fa}_{18.4-19.1}$ ,  $N = 5$ ), low-Ca pyroxene ( $\text{Fs}_{16.7\pm 0.2}\text{Wo}_{1.4\pm 0.1}$  (range  $\text{Fs}_{16.5-16.8}\text{Wo}_{1.1,3-1.5}$ ,  $N = 4$ ), high-Ca pyroxene ( $\text{Fs}_{5.9}\text{Wo}_{45.1}$ ).

**Classification:** Ordinary chondrite (H4/5).

**Specimens:** The entire specimen including one polished thin section is at *PSF*.

#### Northwest Africa 13112 (NWA 13112)

(Northwest Africa)

Purchased: 2019 Jun

Classification: Lunar meteorite (feldspathic breccia)

**History:** Purchased by Luc *Labenne* in June 2019 from a Moroccan dealer at the Ensisheim Show, and subsequently acquired by Theatrum Mundi.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Breccia composed of angular mineral grains of anorthite, orthopyroxene, pigeonite and augite plus some glass beads set in a finer grained matrix containing ilmenite, Ti chromite, troilite, pentlandite, kamacite and taenite.

**Geochemistry:** Olivine ( $\text{Fa}_{37.8-49.1}$ ,  $\text{FeO/MnO} = 81-98$ ,  $N = 5$ ), orthopyroxene ( $\text{Fs}_{33.8-37.2}\text{Wo}_{2.5-1.8}$ ,  $\text{FeO/MnO} = 52-61$ ,  $N = 3$ ), pigeonite ( $\text{Fs}_{41.5}\text{Wo}_{6.1}$ ,  $\text{FeO/MnO} = 63$ ), augite ( $\text{Fs}_{25.0}\text{Wo}_{35.4}$ ;  $\text{Fs}_{18.4}\text{Wo}_{40.8}$ ;  $\text{Fs}_{12.5-16.3}\text{Wo}_{45.7-42.7}$ ;  $\text{FeO/MnO} = 43-54$ ;  $N = 5$ ), anorthite ( $\text{An}_{94.7-96.6}\text{Or}_{0.1}$ ,  $N = 3$ ).

**Classification:** Lunar (feldspathic breccia).

**Specimens:** 20.5 g including one polished piece at *UWB*; main mass with Theatrum Mundi (Via Cesalpino 20, 52100 Arezzo, Italy).

#### Northwest Africa 13113 (NWA 13113)

Mali

Purchased: 2019 Aug

Classification: Ordinary chondrite (L4)

**History:** Purchased by Mbark Arjdal in August 2019 from a dealer in Timbuktu, Mali.

**Petrography:** (A. Irving, *UWS* & J. Boesenberg, *BrownU*) Well-formed chondrules (some with devitrified glass) occur in a recrystallized matrix containing stained metal, troilite, ilmenite, chromite and chlorapatite.

**Geochemistry:** Olivine ( $\text{Fa}_{23.4\pm 0.3}$  (range  $\text{Fa}_{22.8-23.7}$ ,  $N = 6$ ), low-Ca pyroxene ( $\text{Fs}_{19.8\pm 0.4}\text{Wo}_{1.7\pm 1.2}$  (range  $\text{Fs}_{19.5-20.3}\text{Wo}_{1.0-3.8}$ ,  $N = 5$ ).

**Classification:** Ordinary chondrite (L4).

**Specimens:** 64.5 g including one polished thin section at *UWB*; main mass with Mr. M. Arjdal.

#### Northwest Africa 13114 (NWA 13114)

Algeria

Purchased: 2019 Apr

Classification: Carbonaceous chondrite (CV3)

**History:** Purchased by Mbark Arjdal in April 2019 from an Algerian dealer.

**Petrography:** (A. Irving, *UWS*, and J. Boesenberg, *BrownU*) Well-formed granular, PO and BO chondrules (apparent diameter  $1040\pm 480$   $\mu\text{m}$ ,  $N = 24$ ; some glass-bearing) together with

amoeboid, very fine grained CAI occur in a highly oxidized matrix (~30 vol.%, red-brown in thin section). Cr-bearing magnetite is present in chondrules. Accessory phases in the matrix include pentlandite, troilite and chromite; metal is absent.

**Geochemistry:** Olivine ( $\text{Fa}_{22.9\pm 16.6}$  (range  $\text{Fa}_{1.1-43.2}$ ,  $N = 12$ ), low-Ca pyroxene ( $\text{Fs}_{0.5\pm 0.1}\text{Wo}_{0.7\pm 0.1}$  (range  $\text{Fs}_{0.40-0.5}\text{Wo}_{0.6-0.8}$ ,  $N = 5$ ), high-Ca pyroxene ( $\text{Fs}_{0.3\pm 0.1}\text{Wo}_{19.5\pm 2.0}$  (range  $\text{Fs}_{0.2-0.5}\text{Wo}_{16.6-21.1}$ ,  $N = 5$ ), magnetite in chondrules ( $\text{Cr}_2\text{O}_3 = 1.3-2.3$  wt.%,  $\text{NiO} = 0.06$  wt.%,  $N = 3$ ).

**Classification:** Carbonaceous chondrite (CV3, oxidized subclass).

**Specimens:** 66 g including one polished thin section at *UWB*; main mass with Mr. M. Arjdal.

### Northwest Africa 13115 (NWA 13115)

(Northwest Africa)

Purchased: 2019 Nov

Classification: Martian meteorite (Shergottite)

**History:** The stone was acquired in 2019 in Temara, Morocco, by Adam Aaronson and in November 2019 sold to ArtAncient, London.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Diabasic texture with some lattice preferred orientation of elongate prismatic zoned clinopyroxene and lath-like maskelynite grains. Accessory phases include ilmenite, ulvöspinel, merrillite, baddeleyite, pyrrhotite (some with secondary Fe hydroxide staining), silica polymorph and rare fayalite (as inclusions in ulvöspinel and as rim on ilmenite).

**Geochemistry:** Pigeonite cores ( $\text{Fa}_{32.0-34.4}\text{Wo}_{11.3-12.0}$ ,  $\text{FeO/MnO} = 31-35$ ,  $N = 4$ ), subcalcic augite cores ( $\text{Fs}_{24.6-24.8}\text{Wo}_{32.3-31.3}$ ;  $\text{FeO/MnO} = 28-30$ ,  $N = 2$ ), ferroan pigeonite rims ( $\text{Fs}_{45.8-64.2}\text{Wo}_{12.5-19.3}$ ,  $\text{FeO/MnO} = 33-37$ ,  $N = 6$ ), fayalite ( $\text{Fa}_{87.5-88.8}$ ,  $\text{FeO/MnO} = 52-55$ ,  $N = 2$ ), maskelynite ( $\text{An}_{52.0-56.5}\text{Or}_{1.3-0.9}$ ,  $N = 3$ ), maskelynite in mesostasis ( $\text{An}_{49.0}\text{Or}_{4.2}$ ).

**Classification:** Shergottite (diabasic).

**Specimens:** 21.0 g including one polished thin section at *UWB*; main mass with ArtAncient (Chelsea Creek, London, UK).

### Northwest Africa 13116 (NWA 13116)

Mali

Purchased: 2019 Aug

Classification: Ordinary chondrite (H6)

**History:** Purchased by Mbark Arjdal in August 2019 from a dealer in Timbuktu, Mali.

**Petrography:** (A. Irving, *UWS* & J. Boesenberg, *BrownU*) Mostly recrystallized with rare chondrule remnants, stained metal, sodic plagioclase, troilite, chromite and chlorapatite. The specimen is crosscut by some thin veinlets of secondary goethite and calcite.

**Geochemistry:** Olivine ( $\text{Fa}_{19.7\pm 0.2}$  (range  $\text{Fa}_{19.2-19.9}$ ,  $N = 6$ ), low-Ca pyroxene ( $\text{Fs}_{17.3\pm 0.3}\text{Wo}_{1.4\pm 0.2}$  (range  $\text{Fs}_{16.9-17.5}\text{Wo}_{1.2-1.6}$ ,  $N = 5$ ), subcalcic augite ( $\text{Fs}_{13.7}\text{Wo}_{20.3}$ ), augite ( $\text{Fs}_{6.2}\text{Wo}_{45.0}$ ).

**Classification:** Ordinary chondrite (H6).

**Specimens:** 199 g including one polished thin section at *UWB*; main mass with Mr. M. Arjdal.

### Northwest Africa 13117 (NWA 13117)

(Northwest Africa)

Purchased: 2019 Aug

Classification: HED achondrite (Euclite, monomict)

**History:** Purchased from a dealer in Zagora, Morocco, in August 2019 by Juan Avilés Poblador on behalf of the Earth Sciences Department at the University of Alicante, Spain.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Monomict breccia composed of subophitic euclite clasts within a matrix of related crystalline debris. Minerals are exsolved pigeonite, calcic plagioclase, silica polymorph, ilmenite, troilite, chromite and Ni-free metal.

**Geochemistry:** Orthopyroxene host ( $\text{Fs}_{59.9-61.9}\text{Wo}_{1.7-3.8}$ ,  $\text{FeO/MnO} = 32-33$ ,  $N = 4$ ), clinopyroxene exsolution lamellae ( $\text{Fs}_{26.0-29.2}\text{Wo}_{41.7-44.4}$ ,  $\text{FeO/MnO} = 30-32$ ,  $N = 4$ ), plagioclase ( $\text{An}_{81.4-88.9}\text{Or}_{1.0-0.4}$ ,  $N = 4$ ).

**Classification:** Euclite (monomict breccia).

**Specimens:** 20.4 g including one polished thin section at *UWB*; remainder in the collection of *UAlic*.

### Northwest Africa 13118 (NWA 13118)

(Northwest Africa)

Purchased: 2005

Classification: Ordinary chondrite (L6)

**History:** Purchased by an anonymous collector from a dealer at the Munich Show in 2005, subsequently acquired by the Hollis Collection and then donated to *PSF*.

**Petrography:** (A. Irving, *UWS*, and J. Boesenberg, *BrownU*) Breccia composed of closely-packed, angular clasts that are largely recrystallized with rare remnant chondrules and stained metal.

**Geochemistry:** Olivine ( $\text{Fa}_{25.1\pm 0.4}$  (range  $\text{Fa}_{24.7-25.8}$ ,  $N = 6$ ), low-Ca pyroxene ( $\text{Fs}_{21.5\pm 0.9}\text{Wo}_{2.1\pm 0.1}$  (range  $\text{Fs}_{20.8-22.9}\text{Wo}_{2.0-2.2}$ ,  $N = 5$ ).

**Classification:** Ordinary chondrite (L6 breccia).

**Specimens:** The entire specimen including one polished thin section is at *PSF*.

### Northwest Africa 13119 (NWA 13119)

Mauritania

Purchased: 2019

Classification: Lunar meteorite (feldspathic breccia)

**History:** Purchased from a Mauritanian meteorite dealer by Edwin *Thompson* and Phillip Todd in August of 2019.

**Physical characteristics:** Three pieces that fit together. No fusion crust. Saw cuts reveal a fragmental breccia with numerous angular shaped, cm-sized, white feldspathic clasts set in a predominantly light gray groundmass. There are also a few scattered brown-green lithic clasts present.

**Petrography:** (C. Agee, *UNM*) SEM images show fragmental breccia of differing grain-size scales. The groundmass is extremely fine-grained with cataclastic domains, and a variety of micro-basaltic lithologies and single-phase fragments of olivine, pyroxene, and plagioclase. Ubiquitous shock melt veins and vesicles are present throughout.

**Geochemistry:** (C. Agee, *UNM*) Olivine  $\text{Fa}_{25.6\pm 10.7}$ , range  $\text{Fa}_{8.1-41.2}$ ,  $\text{Fe/Mn}=114\pm 26$ ,  $n=7$ ; pigeonite  $\text{Fs}_{24.4\pm 8.9}\text{Wo}_{10.1\pm 2.0}$ ,  $\text{Fe/Mn}=48\pm 2$ ,  $n=2$ ; augite  $\text{Fs}_{16.8\pm 1.0}\text{Wo}_{31.7\pm 10.1}$ ,  $\text{Fe/Mn}=58\pm 8$ ,  $n=3$ ; plagioclase  $\text{An}_{95.4\pm 0.8}$ ,  $n=4$ ; shock melt (proxy for bulk composition)  $\text{SiO}_2=45.0$ ,  $\text{TiO}_2=0.37$ ,  $\text{Al}_2\text{O}_3=29.7$ ,  $\text{MgO}=6.2$ ,  $\text{FeO}=2.3$ ,  $\text{MnO}=0.07$ ,  $\text{CaO}=15.7$ ,  $\text{Na}_2\text{O}=0.45$  (wt%).

**Classification:** Lunar, feldspathic breccia

**Specimens:** 28.7 g on deposit at *UNM*, Phillip Todd holds the main mass.



**Northwest Africa 13120** (NWA 13120)

Southern Provinces, Morocco

Find: 2015

Classification: Lunar meteorite (feldspathic breccia)

**History:** The meteorite was purchased in Tucson by Zhouping Guo.**Physical characteristics:** A single bulk specimen lacks fusion crust. The sample specimen has obvious breccia characteristics and presents two different color regions: the dark color region with a polished external appearance; the light color region with a large amount of fine-grained terrestrial mineral fragment on the surface.**Petrography:** Petrology (Z.Xia, B.Miao, *GUT*): The polished section was cut from the light color region of the specimen. The observation of petrology of this meteorite is based on this polished section. The meteorite shows typical breccia structure and large-area melt. All the lithological clast are melt-rock, except a basalt clast ( $80 \times 160 \mu\text{m}$ ). The matrix is dominated by glass with lot of vesicles, as well as few very-fine particles ( $<10 \mu\text{m}$ ). The chemical composition of the glass is similar with that of anorthite. The main mineral is plagioclase, with a small amount of olivine, pyroxene, ilmenite, and troilite. Pyroxenes show chemical zoning in basalt clast. The abundance of the vesicles reaches 4 vol%.**Geochemistry** (Z.Xia, B.Miao, *GUT*): Plagioclase:  $\text{An}_{92.1-96.4}\text{Or}_{0.03-0.71}$  (n=48); Olivine:  $\text{Fa}_{27-35}$ , Fe/Mn=78-101 in melt-rock clast. Pyroxene in basalt:  $\text{Fs}_{15.11-69.72}\text{Wo}_{22.36-46.14}$ , Fe/Mn=37-73; Glass:  $\text{SiO}_2$  42.9 wt%,  $\text{Al}_2\text{O}_3$  35.93 wt%, CaO 19.9 wt%, FeO 0.47 wt%,  $\text{Na}_2\text{O}$  0.49 wt%, MgO 0.18 wt%,  $\text{K}_2\text{O}$  0.01 wt%.**Classification:** Lunar (feldspathic breccia)**Specimens:** Two polished sections and about 20 g sample are stored in the Institution of Meteorites and Planetary Materials Research of *GUT*, the main mass is exhibited in the Geological Museum of Guilin.**Northwest Africa 13126** (NWA 13126)

Morocco

Purchased: 2012

Classification: Ordinary chondrite (L4)

**History:** Purchased from Said Hadnany who acquired it from Morocco. Sample is catalogued at the *ROM* as LM58144**Petrography:** Chondrules are well defined, matrix has begun coarsening but ultimately remains cryptocrystalline. Minor undulose extinction indicates a very weak shock. Moderately weathered, approximately 20-30% of metal and sulfides have been oxidized.**Northwest Africa 13127** (NWA 13127)

Morocco

Purchased: 2012

Classification: Ordinary chondrite (LL6)

**History:** Purchased from Said Hadnany who acquired it from Morocco. Sample is catalogued at *ROM* as LM58143.**Petrography:** Chondrules are very poorly defined. Extensive recrystallization of matrix and coarse grain sizes indicate high levels of thermal metamorphism. Irregular, and planar of fractures of olivine indicate a weakly shocked sample, undulose extinction is evident in

1  
2  
3 certain grains. This sample has been moderately weathered with about 20-30% of  
4 metal/sulfides being replaced. Large conglomerates of sulfides and metal occur together.  
5  
6  
7

#### 8 **Northwest Africa 13129** (NWA 13129)

9 Morocco

10 Purchased: Feb 2015

11 Classification: Ordinary chondrite (L5)

12 **History:** Purchased from Adam *Aaronson* who purchased it from Morocco. Catalogued  
13 at *ROM* as M58186

14 **Petrography:** Sample has a highly recrystallized coarse grained matrix bearing chondrules  
15 which are readily delineated. Unulatory extinction is visible in olivine grains, however no  
16 shock veins are present. Minor oxide rims are visible around metal and sulfides.  
17  
18  
19

#### 20 **Northwest Africa 13130** (NWA 13130)

21 (Northwest Africa)

22 Purchased: 2019

23 Classification: Carbonaceous chondrite (CV3)

24 **History:** The meteorite was purchased from a meteorite dealer in Morocco.

25 **Physical characteristics:** Dark brownish rock with some fusion crust.

26 **Petrography:** Carbonaceous chondrite composed of chondrules (mean diameter about 1 mm;  
27 up to 2 mm sized), CAIs (up to 3 mm sized), and olivine amoeboids all set into a fine-grained  
28 brownish to almost black matrix. Type II chondrules are absent. Some chondrules show  
29 reddish staining due to terrestrial alteration.  
30  
31  
32  
33

#### 34 **Northwest Africa 13131** (NWA 13131)

35 (Northwest Africa)

36 Purchased: 2019

37 Classification: Ordinary chondrite (H5)

38 **History:** Purchased by Wei Jiang in 2019 from Morocco.

39 **Physical characteristics:** Most specimens are covered by dark fusion crust. The partial fusion  
40 crust surface is cemented by brownish red material. The masses of specimens are in a range  
41 50 to 200 g. The total mass is ~20 kg.

42 **Petrography:** (J. Ji, S. Hu and Y. Lin, *IGGCAS*) The meteorite is mainly composed of  
43 olivine, pyroxene, plagioclase, Fe-Ni metal and troilite, with minor chromite and phosphates.  
44 Several relict chondrules in nonimpact region are identified, ranging up to ~2 mm in diameter.  
45 Some shock induced melt pockets and veinlets are found across the section.

46 **Geochemistry:** Mineral compositions and geochemistry: (J. Ji, S. Hu and Y. Lin, *IGGCAS*)  
47 The olivine and pyroxene are homogeneous in chemical compositions. Olivine:

48  $Fa_{18.4\pm 0.4}$  (n=43), orthopyroxene:  $Fs_{16.1\pm 0.4}Wo_{1.4\pm 0.3}$  (n=25)

49 **Classification:** (J. Ji, S. Hu and Y. Lin, *IGGCAS*) H5

50 **Specimens:** The main mass is held by Wei Jiang.  
51  
52  
53  
54  
55

#### 56 **Northwest Africa 13132** (NWA 13132)

57 Niger

58 Purchased: 2017

59 Classification: Ordinary chondrite (L5/6)  
60

**History:** Purchased by Wei Jiang in 2017 from Morocco.

**Physical characteristics:** Most fragments are covered by black fusion crust. The masses of fragments are in a range 50 to 500 g. The total mass is ~180 kg.

**Petrography:** (J. Ji, S. Hu and Y. Lin, *IGGCAS*) The meteorite is mainly consisting of olivine, pyroxene, plagioclase, Fe-Ni metal, and troilite, with minor chromite and phosphates. Several relict chondrules in nonimpact region, ranging up to ~2.5 mm in diameter. Few shock melt veins are observed.

**Geochemistry:** Mineral compositions and geochemistry: (J. Ji, S. Hu and Y. Lin, *IGGCAS*) The olivine and pyroxene are homogeneous in chemical compositions. Olivine:

$\text{Fa}_{25.4\pm 0.4}$  (n=27), Orthopyroxene:  $\text{Fs}_{21.5\pm 0.5}\text{Wo}_{1.5\pm 0.2}$  (n=17), Clinopyroxene:  $\text{Fs}_{10.6}\text{Wo}_{35.4}$  (n=1)

**Classification:** (J. Ji, S. Hu and Y. Lin, *IGGCAS*) L5/6

**Specimens:** The main mass is held by Wei Jiang.

### Northwest Africa 13133 (NWA 13133)

(Northwest Africa)

Find: unknown

Classification: Enstatite chondrite (EL6)

**History:** Purchased by Wei Jiang in 2018 from Morocco.

**Physical characteristics:** Many fragments are severely weathered. The masses of the individual fragments are in a range of 20 to 300 g. The total mass is ~90 kg.

**Petrography:** (J. Ji, S. Hu and Y. Lin, *IGGCAS*) One relict chondrule was found, ~3 mm in diameter. The meteorite is mainly composed of enstatite, with minor albite, daubreelite, silica, troilite, and kamacite. Most metal grains are oxidized. Some kamacite grains less than 10 mm are found in enstatite.

**Geochemistry:** Mineral compositions and geochemistry: (J. Ji, S. Hu and Y. Lin, *IGGCAS*) Enstatite  $\text{Fs}_{0.5\pm 0.2}\text{En}_{98.1\pm 0.3}\text{Wo}_{1.4\pm 0.1}$  (n=23), Plagioclase  $\text{An}_{15.3\pm 0.6}\text{Ab}_{80.7\pm 0.7}$  (n=5), kamacite contains ~1 wt% silicon

**Classification:** (J. Ji, S. Hu and Y. Lin, *IGGCAS*) Enstatite chondrite (EL6)

**Specimens:** The main mass is held by Wei Jiang.

### Northwest Africa 13134 (NWA 13134)

(Northwest Africa)

Find: 2012

Classification: Martian meteorite (Shergottite)

**History:** purchased in 2013 by M. Morgan in Morocco

**Physical characteristics:** Physical: several pieces, some with fresh fusion crust

**Petrography:** (Y. Liu, JPL) Medium-grained (up to ~3 mm in length) sub-ophitic assemblage of maskelynite and pyroxenes, with accessory ulvöspinel, ilmenite, merrillite, and apatite. Ulvöspinel contains Si-rich glass. K-rich mesostasis is abundant.

**Geochemistry:** Minerology: Pigeonite ( $\text{Fs}_{41\pm 10}\text{Wo}_{13\pm 2}$ ,  $\text{FeO/MnO}=32\pm 3$ , n=17), Augite ( $\text{Fs}_{26\pm 8}\text{Wo}_{33\pm 2}$ ,  $\text{FeO/MnO}=30\pm 3$ , n = 4), maskelynite ( $\text{An}_{49\pm 3}\text{Or}_{2\pm 1}$ , n =10). Oxygen isotopes (E. Young, *UCLA*): 2 acid-washed fragments analyzed by laser fluorination gave  $\delta^{18}\text{O}=4.503, 4.636$ ;  $\delta^{17}\text{O}=2.699, 2.770$ ;  $\Delta^{17}\text{O}=0.318, 0.318$ .

**Classification:** Martian (basaltic shergottite)

**Specimens:** 3 g at *UCLA*. The remainder is held by M. Morgan at Mile High Meteorites.

### Northwest Africa 13135 (NWA 13135)

Morocco

Purchased: 2018 Apr

Classification: Ureilite

**History:** One piece with a weight of 58.3 g was purchased by Sergey Vasiliev from a Moroccan meteorite dealer in Zagora in 2018.

**Physical characteristics:** Dark-brown individual with well preserved fusion crust. The interior of the meteorite is grayish, with granular texture.

**Petrography:** (P. Yu. Plechov, *FMMR*). Petrographic observation of a polished section shows that the meteorite is composed of coarse-grained olivine (up to 2 mm) and fine pigeonite (size up to 400  $\mu\text{m}$ ). Olivine grains are  $\text{Fo}_{80.5}$  and elevated CaO ( $0.38\pm 0.05$  wt.%,  $n=13$ ) and  $\text{Cr}_2\text{O}_3$  ( $0.78\pm 0.06$  wt.%,  $n=13$ ) abundances. No high-Ca pyroxene or orthopyroxene were observed. Pigeonite has 5.5-6.0 wt.% CaO. Saw-tooth, carbon-rich veins cross the meteorite. Veins or vein fragments with thicknesses of about 50  $\mu\text{m}$  are composed by graphite (without diamond). Thinner veins of about 20  $\mu\text{m}$  thickness contain kamacite with schreibersite rims and troilite-daubreelite intergrowths. Narrower veins, up to 10  $\mu\text{m}$  in thickness, are mostly filled with iron hydroxides. Olivines have reduced rims with very tiny ( $\ll 1$   $\mu\text{m}$ ) drops of iron (without Ni) and more magnesium than the cores (up to  $\text{Fo}_{87.8}$ ). These features are typical for olivine-pigeonite, main group ureilites (monomict ureilites). Irregularly shaped cracks and the absence of other features of impact indicate the sample has a very weak shock stage.

Kamacite is partially replaced by iron hydroxides, whereas sulfides and silicates are fresh.

**Geochemistry:** Mineral composition and Geochemistry: EDS-WDS analyses (P. Yu. Plechov, *FMMR*). Ureilite consists of olivine  $\text{Fa}_{19.5\pm 0.13}$ , CaO  $0.38\pm 0.05$  wt.% and  $\text{Cr}_2\text{O}_3$   $0.78\pm 0.06$  wt.% ( $N=13$ ), pigeonite  $\text{Fs}_{16.10\pm 0.27}\text{Wo}_{11.58\pm 0.26}$  ( $N=13$ ), kamacite (in wt.%): Fe-94.22, Ni-4.57, troilite, daubreelite (in wt.%): Fe-52.54, S-32.66, Cr-7.96, schreibersite or nickelphosphide, graphite, iron and hydroxides.

**Classification:** (P. Yu. Plechov, *FMMR*). Ureilite.

**Specimens:** Sergey Vasiliev holds main mass 44.7 g. 13.6 g *FMMR*.

### Northwest Africa 13136 (NWA 13136)

Algeria

Find: 2017

Classification: Ordinary chondrite (L3)

**History:** Purchased in 2018 by Matthew Stream from Didi Baidari in Algeria.

**Physical characteristics:** Single stone with dark-brown fusion crust.

**Petrography:** (D. Sheikh, *FSU*) Abundant chondrules ( $750\pm 100$   $\mu\text{m}$ ) and some clasts set in a fine-grained matrix containing accessory troilite, Fe oxides, and Fe-Ni metal.

**Geochemistry:** Olivine ( $\text{Fa}_{12.0-43.5}$ ,  $n=30$ ), Low-Ca Pyroxene ( $\text{Fs}_{1.3-34.0}\text{Wo}_{0.2-2.1}$ ,  $n=60$ ).

**Classification:** Ordinary Chondrite (L3) due to chondrule size and magnetic susceptibility.

**Specimens:** 21.78 grams at *UCLA*; main mass with Matthew Stream.

### Northwest Africa 13137 (NWA 13137)

(Northwest Africa)

Purchased: 2019

Classification: Ordinary chondrite (H5, melt breccia)

**History:** Purchased in 2019 by Geologist Juan Aviles Poblador from a nomadic dealer in Morocco.

**Physical characteristics:** Two stones with dark-brown fusion crust.

**Petrography:** (D. Sheikh, *FSU*) Chondrules absent. Sample is a breccia composed of angular clasts (up to 3 cm) set in a melt rock matrix containing FeNi metal, troilite, and chromite. Recrystallized plagioclase (~10  $\mu\text{m}$ ) present.

**Geochemistry:** Olivine ( $\text{Fa}_{18.0\pm 0.6}$ ,  $n=40$ ), Low-Ca Pyroxene ( $\text{Fs}_{16.4\pm 0.6}\text{Wo}_{1.1\pm 0.2}$ ,  $n=40$ ).

**Classification:** Ordinary Chondrite (H5, melt breccia).

**Specimens:** 58.72 g at *UCLA*; main mass with Juan Aviles Poblador.

#### Northwest Africa 13138 (NWA 13138)

(Northwest Africa)

Purchased: 2019

Classification: Lunar meteorite (feldspathic breccia)

**Physical characteristics:** Grey irregular fragments. Cut face show a dark-gray interior with mm-sized white angular clasts.

**Petrography:** (J. Gattacceca, *CEREGE*) Sparse mineral clasts (anorthite, olivine, pyroxene, to 300  $\mu\text{m}$ ) in a feldspathic melt rock matrix. Melt rock has numerous vesicles with typical sizes 30  $\mu\text{m}$ . Chromite, troilite and rare metal are present.

**Geochemistry:** Anorthite  $\text{An}_{97.1}\text{Ab}_{3.0}\text{Or}_{0.0}$  ( $n=2$ ). Augite  $\text{Fs}_{21.1\pm 14.8}\text{Wo}_{36.5\pm 8.7}$ ,  $\text{FeO/MnO}=53$  ( $n=3$ ). Olivine  $\text{Fa}_{26.9\pm 4.2}$ ,  $\text{FeO/MnO}=110$  ( $n=2$ ).

**Classification:** Lunar (feldspathic melt breccia).

**Specimens:** Type specimen at *CEREGE*. Main mass with Jérémy Bassemon.

#### Northwest Africa 13141 (NWA 13141)

Morocco

Find: 2018

Classification: Mesosiderite

**Petrography:** (J. Gattacceca, *CEREGE*) The meteorite is composed approximately of 50% Fe,Ni large metal grains and 50% of pyroxene (mostly Ca-pyroxene) and plagioclase. Other minerals: chromite, silica polymorph, troilite.

**Geochemistry:** Pyroxenes: low-Ca pyroxene  $\text{Fs}_{32.5}\text{Wo}_{3.8}$  ( $n=1$ ), Ca-pyroxene  $\text{Fs}_{16.3}\text{Wo}_{38.7}$  ( $n=2$ ),  $\text{FeO/MnO}=22.9$  ( $n=3$ ). Plagioclase  $\text{An}_{93.2}\text{Ab}_{6.7}\text{Or}_{0.1}$  ( $n=3$ ). Chromite  $\text{Cr}\#=0.80$ .

**Specimens:** Type specimen at *CEREGE*. Main mass with George Penneff

#### Northwest Africa 13143 (NWA 13143)

Morocco

Find: 2018

Classification: HED achondrite (Howardite)

**Physical characteristics:** Crusted stone. Cut surface reveals a light-gray interior with subrounded whitish clasts with size up to 1 cm, and more angular chondritic black clasts up to 1 cm.

**Petrography:** (J. Gattacceca, *CEREGE*) Mineral clasts (to 500  $\mu\text{m}$ ) set in a clastic matrix. Main minerals are plagioclase and pyroxene (some exsolved). Pyroxene of diogenitic and eucritic composition are found approximately in equal proportions. Other minerals: ilmenite, chromite (to 200  $\mu\text{m}$ ), silica polymorph (to 200  $\mu\text{m}$ ), troilite, metal. Contains a 5 mm  $\times$  5 mm chondritic clast with small chondrules set in an abundant, fine-grained, iron-rich, phyllosilicate-rich matrix containing sulfide and magnetite.



**Geochemistry:** Diogenitic low-Ca pyroxene  $\text{Fs}_{29.4\pm 2.13}\text{Wo}_{2.7\pm 1.0}$  (n=4). Euclitic low-Ca pyroxene  $\text{Fs}_{54.6\pm 7.0}\text{Wo}_{2.0\pm 0.3}$  (n=3). Ca-pyroxene  $\text{Fs}_{30.2\pm 5.8}\text{Wo}_{28.0\pm 9.4}$  (n=3). Overall pyroxene  $\text{FeO/MnO}=31.5\pm 2.4$ . Two Mg-rich pyroxene were analyzed with  $\text{Fs}_{13.8}\text{Wo}_{1.0}$  and  $\text{Fs}_{14.2}\text{Wo}_{1.0}$ ,  $\text{FeO/MnO}=25.8$ . Plagioclase  $\text{An}_{92.3\pm 1.3}\text{Ab}_{7.4\pm 1.3}\text{Or}_{0.3\pm 0.1}$  (n=5). Chondritic clast: Olivine  $\text{Fa}_{21.7\pm 12.2}$  (range  $\text{Fa}_{2.1-32.2}$ ),  $\text{Cr}_2\text{O}_3$   $0.45\pm 0.03$  wt% (n=4), low-Ca pyroxene  $\text{Fs}_{1.6\pm 0.4}\text{Wo}_{1.1\pm 0.2}$  (n=3). Analyses of a  $50\ \mu\text{m} \times 50\ \mu\text{m}$  matrix area in the chondritic clast gives an analytical total of 80.3 wt%, and FeO 28.6 wt%.

**Classification:** Achondrite (howardite). Contains a cm-sized CM2-like clast.

**Specimens:** Type specimen at *CEREGE*. Main mass with George Penneff

#### Northwest Africa 13145 (NWA 13145)

(Northwest Africa)

Purchased: 2019 May

Classification: Ordinary chondrite (LL3)

**Petrography:** (J. Gattacceca, *CEREGE*) Chondrite with packed chondrules with average apparent diameter  $1090\pm 600\ \mu\text{m}$  (n=33). Opaque are metal and sulfides.

**Geochemistry:** Olivine  $\text{Fa}_{24.8\pm 9.6}$ , Fa PMD=30% (n=5). Low-Ca pyroxene  $\text{Fs}_{13.2\pm 8.4}\text{Wo}_{1.6\pm 1.1}$  (n=4).

**Classification:** LL3. LL group based on chondrule size.

**Specimens:** Type specimen at *CEREGE*, main mass with *Kuntz*

#### Northwest Africa 13146 (NWA 13146)

(Northwest Africa)

Purchased: 2019 Sep

Classification: HED achondrite (Eucrite)

**Physical characteristics:** Single stone, about 60% covered by fusion crust with flowlines.

**Petrography:** (J. Gattacceca, *CEREGE*) Fragmental breccia with lithic clasts (ophitic texture) set in a clastic matrix. Main minerals are Ca-pyroxene and plagioclase. Other minerals include ilmenite, troilite, metal.

**Geochemistry:** Ca-pyroxene  $\text{Fs}_{57.8\pm 3.4}\text{Wo}_{14.3\pm 4.5}$ ,  $\text{FeO/MnO}=32.0\pm 1.5$  (n=5). Plagioclase  $\text{An}_{88.4}\text{Ab}_{11.1}\text{Or}_{0.5}$  (n=2).

**Specimens:** Type specimen at *CEREGE*, main mass with *Kuntz*

#### Northwest Africa 13147 (NWA 13147)

(Northwest Africa)

Purchased: 2019 Sep

Classification: Ordinary chondrite (L4)

**Physical characteristics:** Single stone, no fusion crust

**Petrography:** (J. Gattacceca, *CEREGE*) Chondrite with well-delineated packed chondrules (average apparent diameter  $640\pm 280\ \mu\text{m}$ , n=19). Opaques are Fe,Ni metal and troilite.

**Geochemistry:** Olivine  $\text{Fa}_{24.6\pm 1.1}$ , Fa PMD 3.2% (n=17). Low-Ca pyroxene  $\text{Fs}_{17.6\pm 4.4}\text{Wo}_{1.6\pm 1.2}$ , range  $\text{Fs}_{12.4-24.3}$  (n=5)

**Classification:** Ordinary chondrite (L4).

**Specimens:** Type specimen at *CEREGE*, main mass with *Kuntz*

#### Northwest Africa 13148 (NWA 13148)

(Northwest Africa)

Purchased: 2019 Sep

Classification: HED achondrite (Eucrite)

**Physical characteristics:** One fusion crusted stone

**Petrography:** (J. Gattacceca, *CEREGE*) Igneous rock with ophitic texture. Minerals include dominant pyroxene and plagioclase (fractured, grain size about 1 mm), chromite, troilite, silica polymorph, Fe,Ni metal.

**Geochemistry:** Low Ca-pyroxene  $Fs_{61.0\pm 1.8}Wo_{3.7\pm 1.8}$ ,  $FeO/MnO=32.2\pm 1.2$  (n=6). Plagioclase  $An_{89.3}Ab_{10.2}Or_{0.5}$  (n=2).

**Specimens:** Type specimen at *CEREGE*, main mass with *Kuntz*

#### Northwest Africa 13149 (NWA 13149)

(Northwest Africa)

Purchased: 2019 Sep

Classification: HED achondrite (Eucrite)

**Physical characteristics:** Several fragments, some with fusion crust, some without.

**Petrography:** (J. Gattacceca, *CEREGE*) Igneous rock with ophitic texture. Minerals include dominant exsolved pyroxene and plagioclase (grain size about 700  $\mu$ m), chromite, troilite, silica polymorph, Fe,Ni metal.

**Geochemistry:** Pyroxenes: low Ca-pyroxene  $Fs_{62.2\pm 0.8}Wo_{3.3\pm 1.0}$  (n=3), Ca-pyroxene  $Fs_{30.8}Wo_{39.8}$  (n=2),  $FeO/MnO=34.7\pm 2.1$  (n=5). Plagioclase  $An_{88.1.3}Ab_{11.6}Or_{0.3}$  (n=1).

**Specimens:** Type specimen at *CEREGE*, main mass with *Kuntz*

#### Northwest Africa 13150 (NWA 13150)

(Northwest Africa)

Purchased: 2019 Sep

Classification: Carbonaceous chondrite (CM2)

**Physical characteristics:** Several black fragments from few milligrams to 0.18 g

**Petrography:** (J. Gattacceca, *CEREGE*) Small chondrules (average apparent diameter  $300\pm 150$   $\mu$ m, n=19) and minerals fragments set in an abundant fine-grained, Fe-rich, phyllosilicate-rich matrix. Many chondrules have fine-grained dust rim. Opaque minerals are mostly magnetite and sulfides, with rare metal as small grains enclosed within silicates.

**Geochemistry:** Olivine  $Fa_{8.2\pm 10.2}$  (n=13),  $Cr_2O_3$  in ferroan olivine  $0.37\pm 0.07$  wt% (n=5). Low-Ca pyroxene  $Fs_{1.9}Wo_{1.0}$  (n=2). Microprobe analytical total over a  $50 \times 50$   $\mu$ m<sup>2</sup> matrix area is 75.6 wt%.

**Specimens:** Type specimen at *CEREGE*, main mass with *Kuntz*

#### Northwest Africa 13151 (NWA 13151)

(Northwest Africa)

Purchased: 2019 Sep

Classification: Ordinary chondrite (LL7)

**Physical characteristics:** Single stone. Approximately 75% covered by thick fusion crust

**Petrography:** (J. Gattacceca, *CEREGE*) Strongly recrystallized chondrite. Opaque minerals are metal and troilite. No visible chondrule in the studied section. Plagioclase to 200  $\mu$ m.

**Geochemistry:** Olivine  $Fa_{30.6}$  (n=1). Orthopyroxene  $Fs_{25.7}Wo_{2.5}$  (n=2)

**Specimens:** Type specimen at *CEREGE*, main mass with *Kuntz*

**Northwest Africa 13152** (NWA 13152)

(Northwest Africa)

Purchased: 2019 Sep

Classification: Ordinary chondrite (LL3)

**Physical characteristics:** Single stone lacking fusion crust**Petrography:** (J. Gattacceca, *CEREGE*) Chondrite with well-delineated packed chondrules (average apparent diameter  $1050 \pm 280 \mu\text{m}$ ,  $n=18$ ). Opaques are Fe,Ni metal and troilite.**Geochemistry:** Olivine  $\text{Fa}_{19.0 \pm 8.2}$ , Fa PMD 40%,  $\text{Cr}_2\text{O}_3$   $0.08 \pm 0.04 \text{ wt}\%$  ( $n=10$ ). Low-Ca pyroxene  $\text{Fs}_{14.5 \pm 7.7} \text{Wo}_{0.6 \pm 0.4}$  ( $n=7$ ).**Classification:** Ordinary chondrite (LL3). LL group based on magnetic susceptibility and chondrule size.**Specimens:** Type specimen at *CEREGE*, main mass with *Kuntz***Northwest Africa 13153** (NWA 13153)

Morocco

Purchased: 2014 May

Classification: Ordinary chondrite (LL7)

**History:** Bought from a Moroccan dealer.**Petrography:** (J. Gattacceca, *CEREGE*) Highly recrystallized chondrite with almost granoblastic texture. Opaques are rare metal and troilite. Ca-phosphate to  $200 \mu\text{m}$ , chromite to  $50 \mu\text{m}$ .**Geochemistry:** Olivine  $\text{Fa}_{30.6}$  ( $n=2$ ). Orthopyroxene  $\text{Fs}_{24.7 \pm 0.2} \text{Wo}_{2.5 \pm 0.1}$  ( $n=4$ ), Ca-pyroxene  $\text{Fs}_{10.8 \pm 0.2} \text{Wo}_{43.5 \pm 0.1}$  ( $n=3$ ). Plagioclase  $\text{An}_{10.8} \text{Ab}_{85.5} \text{Or}_{3.8}$ .**Classification:** LL7**Specimens:** Type specimen at *CEREGE*, main mass with Lucian Cojocar**Northwest Africa 13155** (NWA 13155)

(Northwest Africa)

Purchased: 2019 Sept

Classification: Ureilite

**Petrography:** (J. Gattacceca, *CEREGE*) Blocky aggregate of mm-sized olivine grains. Fe,Ni metal present at grain junctions, and as trails of  $\mu\text{m}$ -sized blebs in silicates. Abundant carbon material at grain junction as pockets up to  $500 \mu\text{m} \times 100 \mu\text{m}$ .**Geochemistry:** Olivine  $\text{Fa}_{21.5 \pm 0.1}$ ,  $\text{CaO}=0.40 \text{ wt}\%$ ;  $\text{Cr}_2\text{O}_3=0.70 \text{ wt}\%$  ( $n=3$ ). Olivine rims  $\text{Fa}_{13.3-16.4}$ .**Classification:** Ureilite**Specimens:** Type specimen at *CEREGE*, main mass with *Labenne***Northwest Africa 13156** (NWA 13156)

(Northwest Africa)

Purchased: 2019 Sept

Classification: Carbonaceous chondrite (CK6)

**Petrography:** (J. Gattacceca, *CEREGE*) Recrystallized chondrite with abundant Cr-magnetite, accessory sulfides. Plagioclase average size is  $>50 \mu\text{m}$ .

**Geochemistry:** Olivine  $\text{Fa}_{32.9\pm 1.0}$ ,  $\text{NiO}=0.68$  wt% (n=3). Low-Ca pyroxene  $\text{Fs}_{25.9}\text{Wo}_{2.9}$  (n=2). Plagioclase  $\text{An}_{30.7}\text{Ab}_{66.6}\text{Or}_{2.7}$ . Magnetite has 3.9 wt%  $\text{Cr}_2\text{O}_3$ .

**Classification:** Carbonaceous chondrite (CK6)

**Specimens:** Type specimen at *CEREGE*, main mass with *Labenne*

#### Northwest Africa 13158 (NWA 13158)

(Northwest Africa)

Purchased: 2019

Classification: Ordinary chondrite (H3)

**History:** The meteorite was purchased from a meteorite dealer in Zagora, Morocco.

**Physical characteristics:** Dark brownish rock without fusion crust.

**Petrography:** The meteorite shows a chondritic texture with well separated rounded chondrules (apparent mean diameter about 0.4 mm). FeNi metal and sulfides and are almost completely altered to Fe-hydroxides.

#### Northwest Africa 13159 (NWA 13159)

(Northwest Africa)

Purchased: 2019

Classification: Ordinary chondrite (L6, melt breccia)

**History:** The meteorite was purchased from a Moroccan dealer at the mineral show in Munich, Germany.

**Physical characteristics:** Many small dark brownish individuals lacking any fusion crust.

**Petrography:** The meteorite dominantly consists of partly recrystallized melt rock regions with characteristic FeNi metal and sulfide spherules. Few unmelted regions are of L6 type with plagioclase grains about 80  $\mu\text{m}$  in size; no metal or sulfide veins are observed.

#### Northwest Africa 13160 (NWA 13160)

(Northwest Africa)

Purchased: 2019

Classification: HED achondrite (Eucrite)

**History:** The meteorite was purchased from a Moroccan dealer at the mineral show in Munich, Germany.

**Physical characteristics:** Greyish rock with some fusion crust.

**Petrography:** The meteorite is a fine-grained fragmental breccia composed of basaltic clasts and black melt rock clasts up to 2 mm in size set into a clastic matrix. Basaltic clasts and matrix are dominantly composed of exsolved pyroxene and plagioclase grains up to 900  $\mu\text{m}$  in size. Some pyroxenes show compositional zoning indicating a low degree of thermal metamorphism. Minor phases include silica, FeS, chromite, ilmenite, and metallic iron.

**Geochemistry:** low-Ca pyroxene:  $\text{Fs}_{41.0\pm 9.1}\text{Wo}_{5.8\pm 1.2}$  ( $\text{Fs}_{28.8-53.7}\text{Wo}_{3.5-8.1}$ ,  $\text{FeO/MnO}=24-30$ , n=17); Ca-pyroxene:  $\text{Fs}_{34.4\pm 9.4}\text{Wo}_{36.7\pm 6.2}$  ( $\text{Fs}_{24.5-48.4}\text{Wo}_{26.4-43.5}$ ,  $\text{FeO/MnO}=25-29$ , n=22); calcic plagioclase:  $\text{An}_{91.6\pm 0.4}$  ( $\text{An}_{90.7-92.0}$ , n=12)

#### Northwest Africa 13161 (NWA 13161)

(Northwest Africa)

Purchased: 2019

Classification: Ordinary chondrite (L3)

**History:** The meteorite was purchased from a Moroccan dealer at the mineral show in Munich, Germany.

**Physical characteristics:** Dark-grayish rock without fusion crust.

**Petrography:** The meteorite displays a grayish interior and shows a chondritic texture composed of slightly flattened chondrules (mean diameter about 700  $\mu\text{m}$ ) that are only loosely packed. The matrix contains sulfides and FeNi metal.

#### Northwest Africa 13162 (NWA 13162)

(Northwest Africa)

Purchased: 2019

Classification: Rumuruti chondrite (R3-6)

**History:** The meteorite was purchased from a local meteorite dealer in Nouakchott, Mauritania.

**Physical characteristics:** Dark brownish rock partly covered with fusion crust.

**Petrography:** The meteorite displays a light brownish to orange interior and is composed of up to 1.5 cm sized angular type 6 clasts and type 3 matrix. Olivine and low-Ca pyroxene are compositionally unequilibrated in the matrix. Fe-rich olivine is the most dominant mineral phase in the clasts. Chondrules have an average diameter of about 400  $\mu\text{m}$ . More minor phases include low-Ca pyroxene, Ca-pyroxene, sodic plagioclase, sulfides, and Ti-bearing chromite; no metal has been detected.

**Geochemistry:** type 3 lithology: olivine:  $\text{Fa}_{23.5\pm 15.5}$  ( $\text{Fa}_{1.9-48.1}$ ,  $n=16$ ); low-Ca pyroxene:  $\text{Fs}_{11.8\pm 6.0}\text{Wo}_{1.3\pm 1.2}$  ( $\text{Fs}_{2.6-19.6}\text{Wo}_{0.4-3.5}$ ,  $n=11$ ); type 6 lithology: olivine:  $\text{Fa}_{36.6\pm 0.2}$  ( $\text{FeO/MnO}=71\pm 5$ ,  $n=11$ ); Ca-pyroxene:  $\text{Fs}_{10.7\pm 0.5}\text{Wo}_{43.6\pm 0.3}$ ,  $n=11$

#### Northwest Africa 13163 (NWA 13163)

(Northwest Africa)

Purchased: 2019

Classification: HED achondrite (Diogenite)

**History:** The meteorite was purchased from a local meteorite dealer in Nouadhibou, Mauritania.

**Physical characteristics:** Greyish to slightly greenish rock with some patches of fusion crust.

**Petrography:** The meteorite displays a light-greenish interior and is a monomict breccia predominantly composed of blocky up to 3 mm sized orthopyroxene grains and more fine-grained cataclastic regions. Minor phases include plagioclase, silica, chromite, FeS, and metallic iron; no olivine has been found in the section studied.

**Geochemistry:** low-Ca pyroxene:  $\text{Fs}_{24.9\pm 0.2}\text{Wo}_{2.9\pm 0.1}$  ( $\text{Fs}_{24.6-25.2}\text{Wo}_{2.8-3.2}$ ,  $n=11$ ,  $\text{FeO/MnO}=26-30$ ); calcic plagioclase:  $\text{An}_{92.9\pm 0.8}$  ( $\text{An}_{91.6-93.8}$ ,  $n=11$ )

#### Northwest Africa 13164 (NWA 13164)

(Northwest Africa)

Purchased: 2019

Classification: HED achondrite (Eucrite)

**History:** The meteorite was purchased from a meteorite dealer in Erfoud, Morocco.

**Physical characteristics:** Grayish rock partly covered with fusion crust.

**Petrography:** The meteorite is a coarse-grained monomict breccia composed of exsolved pyroxene and plagioclase grains up to 4 mm in size. Minor phases include silica, ilmenite, and FeS. No metallic iron has been detected.



**Geochemistry:** low-Ca pyroxene:  $\text{Fs}_{57.6\pm 1.1}\text{Wo}_{2.5\pm 0.6}$  ( $\text{Fs}_{55.6-59.5}\text{Wo}_{1.9-3.9}$ ,  $\text{FeO/MnO}=24-29$ ,  $n=12$ ); Ca-pyroxene:  $\text{Fs}_{24.9\pm 0.5}\text{Wo}_{44.2\pm 0.8}$  ( $\text{Fs}_{24.2-26.5}\text{Wo}_{42.0-45.2}$ ,  $\text{FeO/MnO}=25-29$ ,  $n=16$ ); calcic plagioclase:  $\text{An}_{88.9\pm 1.6}$  ( $\text{An}_{86.5-90.5}$ ,  $n=13$ )

### Northwest Africa 13166 (NWA 13166)

(Northwest Africa)

Purchased: 2019

Classification: HED achondrite (Eucrite, melt breccia)

**History:** The meteorite was purchased from a meteorite dealer in Morocco.

**Physical characteristics:** Dark-grayish rock with some fusion crust.

**Petrography:** The meteorite is a eucrite-melt breccia composed of up to 1.5 cm sized basaltic clasts set into black melt rock matrix. Basaltic clasts consist of exsolved pyroxenes and often lath shaped calcic plagioclase up to 1.5 mm in size. The fine-grained melt rock is mostly recrystallized and mineral grains in contact with the melt are partly resorbed; some regions show flow textures. Minor phases include silica, chromite, ilmenite, FeS, and barite. No metallic iron has been detected.

**Geochemistry:** low-Ca pyroxene:  $\text{Fs}_{59.2\pm 0.5}\text{Wo}_{2.2\pm 0.1}$  ( $\text{Fs}_{58.4-59.8}\text{Wo}_{2.0-2.4}$ ,  $\text{FeO/MnO}=25-28$ ,  $n=14$ ); Ca-pyroxene:  $\text{Fs}_{25.7\pm 0.9}\text{Wo}_{43.8\pm 0.8}$  ( $\text{Fs}_{24.4-27.7}\text{Wo}_{41.9-43.8}$ ,  $\text{FeO/MnO}=25-34$ ,  $n=13$ ); calcic plagioclase:  $\text{An}_{90.3\pm 1.1}$  ( $\text{An}_{88.9-92.1}$ ,  $n=13$ )

### Northwest Africa 13167 (NWA 13167)

(Northwest Africa)

Purchased: 2019

Classification: Carbonaceous chondrite (C2, ungrouped)

**History:** The meteorite was purchased from a meteorite dealer in Morocco.

**Physical characteristics:** Five black individuals partly covered with fusion crust.

**Petrography:** The meteorite a brecciated matrix-dominated carbonaceous chondrite with chondrules (mean diameter about 300  $\mu\text{m}$ ), mineral fragments, and few CAIs. Most of the components are surrounded by fine-grained dust rims. The matrix is highly porous and composed of Ca-carbonates, phyllosilicates with fibrous and flaky appearance, and Fe-sulfides. Some FeNi metal grains are present mostly as inclusions in forsteritic olivine.

**Geochemistry:** Mean values of defocused matrix analyses (beam diameter 10  $\mu\text{m}$ ; all wt%;  $N=25$ ):  $\text{SiO}_2$ : 24.1,  $\text{TiO}_2$ : 0.03,  $\text{Na}_2\text{O}$ : 0.46,  $\text{Cr}_2\text{O}_3$ : 0.29,  $\text{MgO}$ : 13.9,  $\text{MnO}$ : 0.16,  $\text{FeO}$ : 31.2,  $\text{Al}_2\text{O}_3$ : 2.50,  $\text{NiO}$ : 2.10,  $\text{P}_2\text{O}_5$ : 0.34, S: 4.6, Total: 79.69; Oxygen isotopes (K. Ziegler, *UNM*): 6 acid-washed fragments analyzed by laser fluorination gave:  $\delta^{18}\text{O}=-6.769, -2.952, -1.991, 1.322, -2.345, -3.978$ ;  $\delta^{17}\text{O}=-10.566, -7.481, -6.795, -4.079, -6.747, -8.036$ ;  $\Delta^{17}\text{O}=-6.992, -5.922, -5.744, -4.777, -5.509, -5.936$  (all per mil)

**Classification:** C2 due to petrography and presence of phyllosilicates and carbonates. Ungrouped according to oxygen isotopic composition which is incompatible with CM.

### Northwest Africa 13170 (NWA 13170)

(Northwest Africa)

Purchased: May 2015

Classification: Ungrouped achondrite

**History:** Bought in Erfoud, Morocco, in May 2015.

**Physical characteristics:** A dark-brown stone. Cut surface reveals a homogeneous dark interior.

**Petrography:** (J. Gattacceca, *CEREGE*) Equilibrated equigranular texture with triple junctions. Main mineral are olivine and pyroxene (grain size 200  $\mu\text{m}$ ), plagioclase (grain size 100  $\mu\text{m}$ , 17 vol%), FeS (8 vol%, well preserved, grain size 100  $\mu\text{m}$ ). Accessory metal (mostly replaced by weathering products), chromite. No chondrule visible in the 1 cm<sup>2</sup> section.

**Geochemistry:** Olivine  $\text{Fa}_{30.8\pm 0.3}$ , CaO  $0.08\pm 0.01$  wt%, FeO/MnO =  $81.4\pm 8.9$  (N=7). Ca-pyroxene  $\text{Fs}_{10.4\pm 0.8}\text{Wo}_{44.3\pm 1.4}$  (N=5). No low-Ca pyroxene was found in the section. Plagioclase  $\text{An}_{30.4\pm 0.8}\text{Ab}_{66.7\pm 0.8}\text{Or}_{2.9\pm 0.1}$  (N=4). Chromite  $\text{Cr}/(\text{Cr}+\text{Al}) = 0.76$  (N=1). Oxygen isotopic composition (J. Gattacceca, C. Sonzogni, *CEREGE*) from analysis of one acid-washed 1.5 mg aliquot of a powdered 185 mg bulk sample is  $\delta^{17}\text{O} = -2.28\text{‰}$ ,  $\delta^{18}\text{O} = 0.97\text{‰}$ ,  $\Delta^{17}\text{O} = -2.79\text{‰}$  (linearized, slope 0.5247, analytical uncertainties 0.08‰, 0.12‰, 0.03‰ respectively). Magnetic susceptibility  $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 3.68$ .

**Classification:** Achondrite-ungrouped. The oxygen isotopic composition is far removed from other achondrite groups. The mineralogy and mineral composition are similar to NWA 10503, but oxygen isotopic composition is different.

**Specimens:** 15 g and a polished section at *CEREGE*. Main mass with Luc Labenne.

### Northwest Africa 13171 (NWA 13171)

Morocco

Purchased: 2017 Jun 18

Classification: Ordinary chondrite (L3)

**History:** The meteorite was purchased by Bing'an Miao at the China Mineral and Gem Show (CMGS), Chenzhou, China, in 2018.

**Physical characteristics:** The sample, without fusion crust, has a dark-gray interior with a light-brown surface. The chondrules are clearly visible on the surface, with sizes generally from 1 mm to 3 mm, a few up to 5 mm. It is relative fresh, without visible iron rust on the surface.

**Petrography:** Under microscopy, the chondrules are well-defined, and they generally range from 0.1 to 3 mm, with an average of 0.74 mm, a few up to 5 mm. The chondrule types include POP, PO, PP, RP, and BO et al. Mesostasis glass is present in porphyritic chondrules. The matrix between the chondrules (12.5 vol%) is opaque and black, without any obvious recrystallization. The Fe-Ni metal, about 3.5 vol%, is dispersed in matrix as fine particles, partially surrounding chondrules. The mineral assemblage is olivine, orthopyroxene, clinopyroxene, kamacite, taenite and troilite.

**Geochemistry:** Mineral chemistry and geochemistry: Olivine is  $\text{Fa}_{21.9\pm 6.2}$ , n=13, low-Ca pyroxene is  $\text{Fs}_{19.3\pm 7.8}\text{Wo}_{3\pm 0.5}$ , n=15. Kamacite is Fe  $95.4\pm 0.8$ , Ni  $4.9\pm 0.9$ , Co  $0.72\pm 0.1$ , N=11; Taenite is Fe  $52.2\pm 4.3$ , Ni  $47.2\pm 3.8$ , Co  $0.2\pm 0.1$ , N=10; Troilite is Fe  $63\pm 0.7$ , Ni  $0.06\pm 0.01$ , Co  $0.11\pm 0.01$ , N=22.

**Classification:** ordinary chondrite (L3)

**Specimens:** About 100 g sample and 1 polished thin section are deposited in the Institution of Meteorites and Planetary Materials Research of *GUT*. The main mass is held by Bing-an Miao.

### Northwest Africa 13172 (NWA 13172)

Bechar, Algeria

Find: 2018

Classification: Ordinary chondrite (L5)

**History:** The 86.81 g fragment was found near Bechar, Algeria, by a truck driver in 2018. Dave Lehman and partner acquired the sample from this individual.

**Physical characteristics:** Sample is irregular-ovoid in shape and has a dark brown, wind-ablated exterior. The interior of the stone shows chondrules and fragments set within a recrystallized matrix.

**Petrography:** Classification and Description (A. Love, *App*): Sample shows recrystallized chondritic texture, composed of closely packed chondrules with an avg. apparent diameter 784  $\mu\text{m}$  (n=24). Secondary plagioclase has an average size of 43  $\mu\text{m}$  (n=7). Additional minerals are: troilite, apatite, chromite, weathered FeNi.

**Geochemistry:** (A. Love, *App*): Olivine ( $\text{Fa}_{25.6\pm 0.2}$ ,  $\text{Fe/Mn}=43.3\pm 1.1$ , n=3), low-Ca pyroxene ( $\text{Fs}_{21.4\pm 0.2}\text{Wo}_{1.4\pm 0.7}$ , n=3).

**Classification:** Ordinary chondrite (L5, C-S3, W3). L5 based on mineral compositions and size of secondary plagioclase.

**Specimens:** Dave Lehman and a partner hold the main mass. Two slices totaling 17.5 g and a polished mount are on deposit at *App*.

### Northwest Africa 13173 (NWA 13173)

(Northwest Africa)

Find: 2017

Classification: Ordinary chondrite (H5)

**History:** The 47.44 g fragment was found by a border security agent on near the border between Morocco and Western Sahara in 2017. Dave Lehman and a partner acquired the stone from the finder.

**Physical characteristics:** Sample is irregular-ovoid in shape and has a dark brown, wind-ablated exterior. The interior of the stone shows chondrules and fragments set within a recrystallized matrix.

**Petrography:** Classification and Description (A. Love, *App*): Sample shows recrystallized chondritic texture composed of closely packed chondrules with an avg. apparent diameter 377  $\mu\text{m}$  (n=9). Secondary plagioclase has an average size of 39  $\mu\text{m}$  (n=9). Additional minerals are: albitic plagioclase, troilite, apatite, taenite and kamacite, chromite.

**Geochemistry:** (A. Love, *App*): Olivine ( $\text{Fa}_{19.1\pm 0.4}$ ,  $\text{Fe/Mn}=35.5\pm 0.8$ , n=3), low-Ca pyroxene ( $\text{Fs}_{16.7\pm 0.4}\text{Wo}_{2.5\pm 1.9}$ , n=3)

**Classification:** Ordinary chondrite (H5, C-S3, W2) Based on mineral compositions, chondrule diameters and size of secondary plagioclase, this sample is H5.

**Specimens:** Dave Lehman and his partner hold the main mass. A polished thin section and endcut weighing 4.1g are on deposit at *App*.

### Northwest Africa 13174 (NWA 13174)

Mauritania

Find: 2016

Classification: Ordinary chondrite (LL5)

**History:** The 82.47 g fragment was found by a Bedouin guide in Mauritania in 2016. Dave Lehman and his partner acquired the sample in 2019.

**Physical characteristics:** Sample is ovoid in shape and has a dark brown, wind-ablated fusion crust covering approximately 60% of stone. The lower portion of the stone is covered in a thin layer of orange-colored caliche. The interior of the stone shows abundant chondrules and fragments set within a finer-grained yellowish matrix.

**Petrography:** Classification and Description (A. Love, *App*): Sample is a breccia composed of chondrules, fragments and fine-grained clasts set within a recrystallized matrix of olivine, pyroxene and secondary plagioclase crystals with an avg. length of 26  $\mu\text{m}$  (n=9). Chondrules

1  
2  
3 have an avg. apparent diameter 1019  $\mu\text{m}$  (n=8). Additional minerals are chromite, apatite,  
4 troilite, FeNi, secondary calcite.

5 **Geochemistry:** (A. Love, *App*): Olivine ( $\text{Fa}_{29.1\pm 0.0}$ ,  $\text{Fe/Mn}=53.4\pm 0.1$ , n=3), low-Ca pyroxene  
6 ( $\text{Fs}_{23.9\pm 0.2}\text{Wo}_{1.5\pm 0.1}$ , n=3).

7 **Classification:** Ordinary chondrite (LL5, CS-3, W1) Textures, mineral compositions and size  
8 of secondary plagioclase grains indicate this sample is an LL5.

9 **Specimens:** Dave Lehman and his partner hold the main mass. Two slices totaling 16.6 g and  
10 a polished thin section are on deposit at *App*.  
11  
12  
13

#### 14 Northwest Africa 13175 (NWA 13175)

15 Algeria

16 Find: 2018

17 Classification: Ordinary chondrite (H5)

18 **History:** The 280.66g sample was found by a meteorite prospector near Tindouf, Algeria, in  
19 October, 2018. Dave Lehman and his partner acquired the sample from the finder.

20 **Physical characteristics:** Sample is irregular in shape and has a dark brown, wind-ablated  
21 exterior. The interior of the stone shows chondrules and fragments set within a recrystallized  
22 matrix.  
23

24 **Petrography:** Classification and Description (A. Love, *App*): Sample shows recrystallized  
25 chondritic texture composed of closely packed chondrules with an avg. apparent diameter 407  
26  $\mu\text{m}$  (n=15). Secondary albitic plagioclase has an average size of 37  $\mu\text{m}$  (n=9). Additional  
27 minerals are: troilite, apatite, chromite, weathered FeNi.

28 **Geochemistry:** (A. Love, *App*): Olivine ( $\text{Fa}_{19.1\pm 0.1}$ ,  $\text{Fe/Mn}=34.6\pm 0.5$ , n=3), low-Ca pyroxene  
29 ( $\text{Fs}_{17.0\pm 0.1}\text{Wo}_{1.2\pm 0.1}$ , n=3).

30 **Classification:** Ordinary chondrite (H5, C-S3, W3) Based on mineral compositions,  
31 chondrule diameter and size of secondary plagioclase, this sample is an H5.

32 **Specimens:** Dave Lehman and his partner hold the main mass. Two slices totaling 20 g and a  
33 polished mount are on deposit at *App*.  
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#### 39 Northwest Africa 13176 (NWA 13176)

40 Algeria

41 Find: 2019

42 Classification: HED achondrite (Diogenite)

43 **History:** Three samples weighing (91.79, 56.39, 74.3 7g) were found in the desert near  
44 Tindouf, Algeria, in March 2019. Dave Lehman and a partner acquired the samples from the  
45 collector.  
46

47 **Physical characteristics:** Samples are irregularly shaped and are partially covered with a  
48 black, wind-ablated fusion crust. One sample shows flight orientation with weak flow lines  
49 and frothy fusion crust covering the crusted portions of the sample. The uncrusted portions  
50 with fractured surfaces are light greenish colored.

51 **Petrography:** Description and classification (A. Love, *App*) Sample is a cataclastic breccia  
52 composed of dominant lath-shaped orthopyroxene up to ~9 mm and augite. Additional  
53 minerals are (~3 vol%) twinned plagioclase (with an average length of 529 $\mu\text{m}$ ), chromite,  
54 troilite, a silica polymorph and rare K-feldspar ( $\text{Or}_{98}\text{An}_{1.8}$ ).

55 **Geochemistry:** (A. Love, *App*): Low Ca pyroxene ( $\text{Fs}_{24.1\pm 0.2}\text{Wo}_{2.0\pm 0.5}$ ,  $\text{Fe/Mn}=27.6\pm 0.3$ ,  
56  $\text{Mg}\#75.4\pm 0.2$ , n=10); high Ca pyroxene ( $\text{Fs}_{7.8\pm 0.3}\text{Wo}_{45.8\pm 0.4}$ ,  $\text{Fe/Mn}=21.7\pm 1.8$ , n=5);  
57 plagioclase ( $\text{An}_{83.8\pm 2.1}\text{Or}_{0.2\pm 0.1}$ , n=3).  
58  
59  
60

**Classification:** HED achondrite (Diogenite). Textures, mineralogy and Fe/Mn ratios of pyroxenes suggest this sample is a diogenite breccia. Weathering grade is low.

**Specimens:** Dave Lehman and a partner hold the main masses. An endcut and 2 slices weighing 20.97 g and a polished thin section are on deposit at *App*.

#### Northwest Africa 13177 (NWA 13177)

Morocco

Find: 2019

Classification: Ordinary chondrite (L3-6)

**History:** Fabien *Kuntz* purchased 28 stones (ranging 4.8-338 g) in Guelmin, Morocco, in 2019.

**Physical characteristics:** Sample has an irregular ovoid shape and is dark brown in color. Chondrules and brecciated texture are visible on the surface.

**Petrography:** Description and classification: (A. Love, *App*): Sample is a breccia composed of light-colored, mm-sized chondritic clasts set within dark-colored, host of unequilibrated and equilibrated chondrules and fragments. Type 4, type 6 and carbonaceous (CM-like) lithologies are present. Chondrules within host are poorly equilibrated and have an average apparent diameter of 523 μm (n=56). Additional minerals are albitic plagioclase, chromite, phosphate, FeNi metal and troilite.

**Geochemistry:** (A. Love, *App*) Host: Olivine (Fa<sub>22.67±3.4</sub>, (Fa<sub>15.64-27.19</sub>), Fe/Mn=46.8±3.5 n=11); low Ca pyroxene (Fs<sub>14.8±7.0</sub>Wo<sub>1.4±2.0</sub> (Fs<sub>6.9-22.9</sub>Wo<sub>0.1-4.9</sub>), n=5); Equilibrated clasts: Olivine (Fa<sub>24.7±0.7</sub>, Fe/Mn=47.8±4.4, n=7); low Ca pyroxene (Type 4 Fs<sub>18.1±7.2</sub>Wo<sub>2.7±4.4</sub>, n=5; Type 6 Fs<sub>21.4±0.6</sub>Wo<sub>1.7±0.2</sub>, n=5) Xenolithic clast: Olivine (Fa<sub>2.8±2.2</sub>, Fe/Mn=16.2±16.4, n=3); low Ca-pyroxene (Fs<sub>2.7</sub>Wo<sub>2.0</sub>, n=1).

**Classification:** Ordinary chondrite (L3-6 xenolithic breccia, C-S3, W1). Based on the textures, mineral compositions, magnetic susceptibility and chondrule diameters, this is an L3-6 chondrite breccia. The xenolith has textures and compositions similar to CM2 carbonaceous chondrites.

**Specimens:** The main masses are held by Fabien *Kuntz*. An endcut and slice weighing 28.75 g and a polished thin section are on deposit at *App*.

#### Northwest Africa 13178 (NWA 13178)

Mali

Purchased: 2019 Aug

Classification: Carbonaceous chondrite (CO3)

**History:** Purchased by Mbark Arjdal in August 2019 from a dealer in Nouakchott, Mauritania.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Fairly closely packed, small well-formed chondrules (apparent diameter 220±130 μm, N = 23), very fine-grained CAI and mineral fragments are set in a fine-grained matrix (~15 vol.%, orange-brown in thin section).

**Geochemistry:** Olivine (Fa<sub>30.5±16.1</sub>, range Fa<sub>1.2-56.8</sub>, N = 14; Cr<sub>2</sub>O<sub>3</sub> in ferroan examples 0.03-0.61 wt.%, mean 0.13±0.16 wt.%, N = 11), low-Ca pyroxene (Fs<sub>2.0±1.8</sub>Wo<sub>2.5±1.5</sub>, range Fs<sub>0.8-5.0</sub>Wo<sub>0.9-4.1</sub>, N = 5), pigeonite (Fs<sub>10.7</sub>Wo<sub>4.5</sub>), diopside (Fs<sub>1.1</sub>Wo<sub>43.8</sub>).

**Classification:** Carbonaceous chondrite (CO3).

**Specimens:** 27.6 g including one polished thin section at *UWB*; remainder with Mr. M. Arjdal.



**Northwest Africa 13179** (NWA 13179)

Algeria

Purchased: 2019 Aug

Classification: Martian meteorite

**History:** Purchased by Ben Hoefnagels in July 2019 from a dealer in Zagora, Morocco.**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Medium grained (mean grainsize ~0.7 mm) assemblage of predominantly pyroxenes with subordinate subhedral, compositionally-zoned olivine (~15 vol.%) and minor (~5 vol.%) interstitial maskelynite (as bundles of thin laths). Accessory phases include chromite, Ti-chromite, pyrrhotite, pentlandite, ilmenite, silica polymorph and merrillite. Pyroxene grains have prominent orthopyroxene cores mantled by pigeonite and subcalcic augite.**Geochemistry:** Olivine (cores  $\text{Fa}_{17.7-21.6}$ , rims  $\text{Fa}_{25.5-30.3}$ ,  $\text{FeO/MnO} = 44-50$ ,  $N = 4$ ), orthopyroxene cores ( $\text{Fs}_{14.7-14.9}\text{Wo}_{1.2-1.4}$ ,  $\text{FeO/MnO} = 28-30$ ,  $N = 3$ ), pigeonite rims ( $\text{Fs}_{20.5-44.2}\text{Wo}_{4.0-12.6}$ ,  $\text{FeO/MnO} = 29-36$ ,  $N = 4$ ), subcalcic augite ( $\text{Fs}_{34.9}\text{Wo}_{28.4}$ ,  $\text{FeO/MnO} = 35$ ), maskelynite ( $\text{An}_{65.9-69.6}\text{Or}_{0.3-0.2}$ ,  $N = 2$ ). O isotopes measured by K. Ziegler at UNM on two acid-washed aliquots of sample:  $\delta^{17}\text{O}$  2.799, 2.801;  $\delta^{18}\text{O}$  4.719, 4.690;  $\Delta^{17}\text{O}$  0.308, 0.325 per mil.**Classification:** Martian (ultramafic, olivine microwebsterite). This specimen is ultramafic based on the paucity of plagioclase (maskelynite), a microproxenite based on its mean grainsize, and an olivine websterite based on the proportions of olivine, orthopyroxene and clinopyroxene.**Specimens:** 20.4 g including one polished thin section at *UWB*; remainder with Mr. B. Hoefnagels.**Northwest Africa 13180** (NWA 13180)

Algeria

Purchased: 2019 Jun

Classification: Ordinary chondrite (L4)

**History:** Purchased by Mbark Arjdal in June 2019 from an Algerian dealer.**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Well-formed chondrules are set in a recrystallized matrix containing altered kamacite, taenite, chromite and troilite.**Geochemistry:** Olivine ( $\text{Fa}_{24.7\pm 0.1}$ , range  $\text{Fa}_{24.6-24.9}$ ,  $N = 7$ ), low-Ca pyroxene ( $\text{Fs}_{20.8\pm 0.2}\text{Wo}_{1.6\pm 0.2}$ , range  $\text{Fs}_{20.6-21.0}\text{Wo}_{1.4-1.9}$ ,  $N = 5$ ), augite ( $\text{Fs}_{8.2\pm 1.2}\text{Wo}_{44.7\pm 1.0}$ , range  $\text{Fs}_{7.1-9.5}\text{Wo}_{45.8-44.1}$ ,  $N = 3$ ).**Classification:** Ordinary chondrite (L4).**Specimens:** 47.8 g including two polished thin sections at *UWB*; remainder with Mr. M. Arjdal.**Northwest Africa 13181** (NWA 13181)

(Northwest Africa)

Purchased: 2019 Jun

Classification: HED achondrite (Eucrite, brecciated)

**History:** Purchased by Laurent Combaud in June 2019 from a dealer in Tagounite, Morocco on behalf of a jewelry store in Nice, France.**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Breccia composed of equigranular clasts in a finer grained matrix. The clasts are composed predominantly of exsolved pigeonite and calcic plagioclase together with accessory silica polymorph, Ti chromite, ilmenite,

troilite, zircon and merrillite. Although the majority of the plagioclase is very calcic (bytownite), more sodic and potassic plagioclase is present in one region of the studied stone.

**Geochemistry:** Low-Ca pyroxene host (Fs<sub>52.9-57.1</sub>Wo<sub>2.4-3.8</sub>, FeO/MnO = 34-38, N = 6), high-Ca pyroxene exsolution lamellae (Fs<sub>26.9-29.3</sub>Wo<sub>38.6-42.1</sub>, FeO/MnO = 32-37, N = 4), subcalcic augite grain (Fs<sub>34.3</sub>Wo<sub>32.6</sub>, FeO/MnO = 34), augite in matrix (Fs<sub>20.0</sub>Wo<sub>45.8</sub>, FeO/MnO = 32), pigeonite in matrix (Fs<sub>54.8</sub>Wo<sub>7.7</sub>, FeO/MnO = 33), calcic plagioclase (An<sub>78.4-86.0</sub>Or<sub>1.5-0.7</sub>, N = 3), more sodic and potassic plagioclase (An<sub>73.6</sub>Or<sub>9.4</sub>).

**Classification:** Euclite (breccia).

**Specimens:** 6.2 g including a polished mount at *UWB*; remainder with Akwadra Bijoux et Météorites, Nice, France.

#### Northwest Africa 13182 (NWA 13182)

Mali

Purchased: 2019 Aug

Classification: Ordinary chondrite (LL3)

**History:** Purchased by Mbark Arjdal in August 2019 from a dealer in Timbuktu, Mali.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Well-formed, closely-packed chondrules (apparent diameter  $930 \pm 510 \mu\text{m}$ , N = 23) are set in a medium-grained matrix containing stained kamacite, taenite, low-Ti chromite, troilite and pentlandite.

**Geochemistry:** Olivine (Fa<sub>23.6±13.7</sub>, range Fa<sub>0.7-45.6</sub>, N = 9; Cr<sub>2</sub>O<sub>3</sub> in ferroan examples 0.01-0.52 wt.%, mean 0.11 wt.%, sd 0.17 wt.%, N = 13), low-Ca pyroxene (Fs<sub>15.8±7.1</sub>Wo<sub>0.8±1.1</sub>, range Fs<sub>5.4-23.9</sub>Wo<sub>0.1-3.0</sub>, N = 6), pigeonite (Fs<sub>27.0</sub>Wo<sub>21.9</sub>), subcalcic augite (Fs<sub>1.7</sub>Wo<sub>32.4</sub>), diopside (Fs<sub>0.9</sub>Wo<sub>44.8</sub>). Magnetic susceptibility  $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.11$ .

**Classification:** Ordinary chondrite (LL3).

**Specimens:** 16.7 g including one polished thin section at *UWB*; remainder with Mr. M. Arjdal.

#### Northwest Africa 13183 (NWA 13183)

(Northwest Africa)

Purchased: 2005

Classification: Ordinary chondrite (H5)

**History:** Purchased by an anonymous collector from a dealer at the Munich Show in 2005, subsequently acquired by the Hollis Collection and then donated to *PSF*.

**Petrography:** (A. Irving, *UWS* and J. Boesenberg, *BrownU*) Sparse chondrules are set in a recrystallized matrix containing stained metal.

**Geochemistry:** Olivine (Fa<sub>18.1±0.2</sub>, range Fa<sub>18.0-18.4</sub>, N = 6), low-Ca pyroxene (Fs<sub>16.4±0.4</sub>Wo<sub>1.1±0.4</sub>, range Fs<sub>16.0-16.9</sub>Wo<sub>0.9-1.8</sub>, N = 5).

**Classification:** Ordinary chondrite (H5).

**Specimens:** The entire specimen including one polished thin section is at *PSF*.

#### Northwest Africa 13184 (NWA 13184)

(Northwest Africa)

Purchased: 2005

Classification: Ordinary chondrite (L4/5)

**History:** Purchased by an anonymous collector from a dealer at the Munich Show in 2005, subsequently acquired by the Hollis Collection and then donated to *PSF*.

**Petrography:** (A. Irving, *UWS* and J. Boesenberg, *BrownU*) Some well-formed chondrules are set in a recrystallized matrix containing stained metal.

**Geochemistry:** Olivine ( $\text{Fa}_{24.4\pm 0.5}$ , range  $\text{Fa}_{23.7-24.9}$ ,  $N = 5$ ), low-Ca pyroxene ( $\text{Fs}_{19.8\pm 2.2}\text{Wo}_{1.7\pm 0.3}$ , range  $\text{Fs}_{16.0-21.0}\text{Wo}_{1.3-2.1}$ ,  $N = 5$ ).

**Classification:** Ordinary chondrite (L4/5).

**Specimens:** The entire specimen including one polished thin section is at *PSF*.

#### Northwest Africa 13185 (NWA 13185)

(Northwest Africa)

Purchased: 2019 Mar

Classification: Lunar meteorite (feldspathic breccia)

**History:** Purchased in Agadir, Morocco by Aziz Habibi in March 2019.

**Physical characteristics:** The dark brown stones exhibit diffuse small clasts in a very fine grained matrix.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Breccia composed of small mineral clasts plus sparse lithic clasts (including microgabbro and some quench-textured glassy beads) set in a fine grained, partly glassy and microvesicular matrix. Minerals include anorthite, olivine, orthopyroxene, pigeonite, ferropigeonite and augite together with accessory Ti chromite, ilmenite, zircon, kamacite and secondary barite.

**Geochemistry:** Olivine ( $\text{Fa}_{28.2-45.8}$ ,  $\text{FeO/MnO} = 97-125$ ,  $N = 5$ ), orthopyroxene ( $\text{Fs}_{41.0-43.0}\text{Wo}_{2.4-2.9}$ ,  $\text{FeO/MnO} = 57-66$ ,  $N = 2$ ), pigeonite ( $\text{Fs}_{46.5}\text{Wo}_{5.4}$ ;  $\text{Fs}_{27.6}\text{Wo}_{8.5}$ ;  $\text{Fs}_{28.0-28.7}\text{Wo}_{11.0-10.4}$ ;  $\text{Fs}_{44.2}\text{Wo}_{16.9}$ ;  $\text{FeO/MnO} = 53-61$ ,  $N = 5$ ), ferropigeonite ( $\text{Fs}_{60.7}\text{Wo}_{18.7}$ ,  $\text{FeO/MnO} = 74$ ), augite ( $\text{Fs}_{22.3}\text{Wo}_{40.1}$ ,  $\text{FeO/MnO} = 50$ ;  $\text{Fs}_{46.9}\text{Wo}_{38.9}$ ,  $\text{FeO/MnO} = 68$ ;  $N = 2$ ), anorthite ( $\text{An}_{95.8-97.1}\text{Or}_{0.3-0.1}$ ,  $N = 3$ ).

**Classification:** Lunar (feldspathic breccia).

**Specimens:** 20.3 g including one polished piece at *UWB*; 100 g with Mr. M. Stream; remainder with A. Habibi.

#### Northwest Africa 13186 (NWA 13186)

(Northwest Africa)

Purchased: 2005

Classification: Ordinary chondrite (L4)

**History:** Purchased by an anonymous collector from a dealer at the Munich Show in 2005, subsequently acquired by the Hollis Collection and then donated to *PSF*.

**Petrography:** (A. Irving, *UWS* and J. Boesenberg, *BrownU*) Well-formed chondrules are set in a recrystallized matrix containing altered metal.

**Geochemistry:** Olivine ( $\text{Fa}_{25.0\pm 0.3}$ , range  $\text{Fa}_{24.7-25.3}$ ,  $N = 5$ ), low-Ca pyroxene ( $\text{Fs}_{20.6\pm 0.2}\text{Wo}_{1.7\pm 0.1}$ , range  $\text{Fs}_{20.5-20.9}\text{Wo}_{1.6-1.8}$ ,  $N = 5$ ).

**Classification:** Ordinary chondrite (L4).

**Specimens:** The entire specimen including one polished thin section is at *PSF*.

#### Northwest Africa 13187 (NWA 13187)

(Northwest Africa)

Purchased: 2019 Sep

Classification: Martian meteorite (Shergottite)

**History:** Purchased by Mark Lyon in September 2019 from a Moroccan dealer. Some of this material was subsequently sold to Mike Fleeman and Roberto Vargas.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Diabasic texture. Composed predominantly of zoned clinopyroxene and maskelynite with accessory ulvöspinel (some Cr-bearing), ilmenite, silica polymorph, merrillite, pyrrhotite and minor secondary calcite.

**Geochemistry:** Subcalcic augite cores ( $\text{Fs}_{20.3-23.3}\text{Wo}_{36.2-32.0}$ ,  $\text{FeO/MnO} = 28-29$ ,  $N = 4$ ), ferroan pigeonite rims ( $\text{Fs}_{52.4-59.2}\text{Wo}_{14.2-19.7}$ ,  $\text{FeO/MnO} = 36-39$ ,  $N = 4$ ), maskelynite ( $\text{An}_{50.5-57.2}\text{Or}_{1.9-0.7}$ ,  $N = 3$ ).

**Classification:** Shergottite (diabasic).

**Specimens:** 20.1 g including one polished thin section at *UWB*; remainder held by Mr. M. Lyon, Mr. M. Fleeman (550 g) and Mr. R. Vargas (50 g).

### Northwest Africa 13188 (NWA 13188)

(Northwest Africa)

Purchased: 2018 Jun

Classification: Ungrouped achondrite

**Physical characteristics:** Partially crusted stone

**Petrography:** (J. Gattacceca, *CEREGE*) Igneous rock with overall subophitic texture. Main minerals are pyroxene (300  $\mu\text{m}$ ) and plagioclase (to 400  $\mu\text{m}$ ). Abundant vesicles 250  $\mu\text{m}$  in diameter. FeTi oxides (~0.5 vol%) as blebs adjacent to vesicles, or acicular and dendritic within the fine-grained intergrowths of plagioclase and pyroxene that are found around plagioclase crystals. No metal was found. Modal abundances from point counting (vol%): plagioclase 49%, pyroxene 26%, vesicles 8%, fine-grained intergrowth of plagioclase and pyroxene 18%.

**Geochemistry:** Low-Ca pyroxene  $\text{Fs}_{25.4\pm 6.6}\text{Wo}_{8.3\pm 0.7}$ ,  $\text{FeO/MnO}=42.2\pm 4.3$  ( $n=5$ ). Ca pyroxene  $\text{Fs}_{18.4\pm 4.2}\text{Wo}_{38.1\pm 0.8}$ ,  $\text{FeO/MnO}=60.3\pm 11.7$  ( $n=3$ ). Plagioclase  $\text{An}_{70.1\pm 4.7}\text{Ab}_{29.0\pm 4.4}\text{Or}_{0.9\pm 0.3}$  ( $n=5$ ). The bulk sample has a basaltic composition with 52.3%wt  $\text{SiO}_2$ ; 8.0%wt  $\text{MgO}$ ; 10.1 %wt  $\text{FeO}$ ; 10.5%wt  $\text{CaO}$ ; 14.1 %wt  $\text{Al}_2\text{O}_3$  (ICP-OES, V. Debaille, *ULB*), and is enriched in incompatible trace elements:  $(\text{La}/\text{Sm})N=2$ ,  $(\text{La}/\text{Lu})N=3.5$  (ICP-MS, V. Debaille, *ULB*). Oxygen isotopic composition (J. Gattacceca, C. Sonzogni, *CEREGE*) from two analyses of acid-washed 1.5 mg aliquots of a powdered 128 mg bulk sample is  $\delta^{17}\text{O}=3.885, 4.410$ ,  $\delta^{18}\text{O}=7.552, 8.516$ ,  $\Delta^{17}\text{O}=-0.042, -0.018\text{‰}$  (slope 0.52, analytical uncertainties 0.08‰, 0.12‰, 0.03‰ respectively).

**Classification:** Achondrite-ung. The oxygen isotopic composition and mineral chemistry (basaltic composition enriched in incompatible elements) set this rock apart from other achondrites.

**Specimens:** Type specimen at *CEREGE*. Main mass with A. Jambon.

### Northwest Africa 13189 (NWA 13189)

Morocco

Purchased: 2017 Mar

Classification: Mesosiderite

**Physical characteristics:** Brown irregular fragments.

**Petrography:** (J. Gattacceca, *CEREGE*) This rock is composed of approximately 70 vol% silicates and 30 vol% metal (and associated terrestrial weathering products). The silicate fraction is composed mostly of pyroxene and plagioclase, with minor silica polymorph. Metal is found mostly as grains with smooth shapes and typical size 1 mm. Most metal is replaced by terrestrial weathering products. Metal and troilite are also found as  $\mu\text{m}$  size grains within silicates. Abundant veins filled with weathering products.

**Geochemistry:** Pyroxene  $\text{Fs}_{36.8\pm 1.7}\text{Wo}_{7.1\pm 3.0}$ ,  $\text{FeO/MnO}=27.2\pm 1.8$  (n=3). Plagioclase  $\text{An}_{91.2\pm 1.5}\text{Ab}_{8.7\pm 1.5}\text{Or}_{0.1\pm 0.1}$  (n=4). Chromite Cr# 0.78.

**Classification:** Mesosiderite

**Specimens:** Type specimen at *CEREGE*, main mass with Lucian Cojocar

#### Northwest Africa 13190 (NWA 13190)

Algeria

Find: 2019

Classification: Martian meteorite (Shergottite)

**History:** Purchased in 2019 by Miguel Angel Contreras Gomez from a meteorite dealer in Algeria.

**Physical characteristics:** This sample has a weathered fusion crust exterior, however the interior remains fresh.

**Petrography:** (D. Sheikh, *FSU*) Sample is a diabase having a predominantly subophitic texture composed of complexly zoned, tabular and prismatic (sometimes twinned) chadacrysts of subcalcic augite and pigeonite (Av.  $330\pm 50$   $\mu\text{m}$ , up to 1mm, 60 vol%) contained within larger oikocrysts of maskelynite (Av.  $800\pm 100$   $\mu\text{m}$ , up to 2 mm, 40 vol%). Accessory phases include titanomagnetite (some Cr rich), ilmenite, silica, Si-Al-K-Na rich glass, merrillite, and pyrrhotite.

**Geochemistry:** Subcalcic augite ( $\text{Fs}_{32.3\pm 6.6}\text{Wo}_{30.7\pm 2.3}$ , range  $\text{Fs}_{21.7-47.7}\text{Wo}_{25.4-35.2}$ ,  $\text{FeO/MnO}=34\pm 6$ , n=37) pigeonite ( $\text{Fs}_{52.7\pm 8.5}\text{Wo}_{14.4\pm 2.3}$ , range  $\text{Fs}_{30.6-72.3}\text{Wo}_{10.0-19.3}$ ,  $\text{FeO/MnO}=36\pm 4$ , n=54) maskelynite ( $\text{An}_{48.9\pm 5.1}\text{Or}_{1.9\pm 1.0}$ , range  $\text{An}_{41.4-55.7}\text{Or}_{0.3-3.8}$ , n=43).

**Classification:** Martian (shergottite, diabasic) Silicate chemistry, the presence of maskelynite, FeO/MnO ratios of pyroxenes, and magnetic susceptibility provide support for classification as shergottite. Average grain sizes of pyroxenes and maskelynite larger than that of basaltic shergottites, but smaller than gabbroic shergottites, hence diabasic.

**Specimens:** 10.02 grams at *UCLA*; main mass with Miguel Angel Contreras Gomez.

#### Northwest Africa 13191 (NWA 13191)

Southern Provinces, Morocco

Find: 2015

Classification: Lunar meteorite (feldspathic breccia)

**History:** The meteorite was purchased by Guilin Geological Museum from Bing-an Miao, the owner of Huizhou Caiyuan Meteorite Technology Co., Ltd, Guandong, China.

**Physical characteristics:** It is a single specimen without fusion crust and has a typical breccia structure that consists of dark gray matrix and white clasts with size of a few mm, up to 5 mm. There are some fractures inside the sample.

**Petrography:** Petrology (H. Chen, Z. Xia, B. Miao, *GUT*): The meteorite is a feldspathic breccia composed of lithic clasts, mineral clasts, and vitric clast, set in a fine-grained, vesicular and partly vitreous matrix. The lithic clasts consist of anorthosite, gabbro, peridotitic anorthosite, gabbro anorthosite, and troctolite. Mineral clasts are mainly anorthite, orthopyroxene, clinopyroxene, pyroxene with exsolution lamella, olivine, and ilmenite.

**Geochemistry** (Z. Xia, *GUT*): Plagioclase (maskelynite):  $\text{An}_{91.2-99.9}\text{Or}_{0-2.73}$  (n=29); Olivine:  $\text{Fo}_{51.8-68.9}$ ,  $\text{Fe/Mn}=85.7-97.6$  (n=8); Pyroxene:  $\text{Fs}_{14.6-66.0}\text{En}_{10.8-78.8}\text{Wo}_{3.0-43.0}$ ,  $\text{Fe/Mn}=42.2-78.7$  (n=26); silica:  $\text{SiO}_2$ : 97.3-97.9,  $\text{TiO}_2$ : 0.30-0.38,  $\text{Al}_2\text{O}_3$ : 1.13-1.41,  $\text{CaO}$ : 0.43-0.52;  $\text{Na}_2\text{O}$ : 0.32-0.39 (n=3).

**Classification:** Lunar (feldspathic breccia)



**Specimens:** A polished thin section and about 20 g sample are stored in the Institution of Meteorites and Planetary Materials Research of *GUT*, the main mass is exhibited in the Guilin Geological Museum.

**Northwest Africa 13192** (NWA 13192)

Kem Kem, Morocco

Find: August 1999

Classification: Ordinary chondrite (L5)

**History:** Iffat Jabeen is the owner of this meteorite, who bought it from Michael I. *Casper*, Meteorites, Inc. in March 2000.

**Physical characteristics:** A 59 g fragment. It has a smooth, thin, dark-brown fusion crust present on two faces and other four uneven faces are also slightly fused. There are no contraction cracks present on this chondrite. The sample is attracted by a magnet.

**Petrography** (S. Nasir, *SQU*): Porphyritic olivine pyroxene (POP) and radial pyroxene (RP) chondrules are readily defined. Heavy oxidization is observed throughout the thin section.

**Geochemistry:** (N. K. Kim, C. Park and J. I. Lee, *KOPRI*) Duplicate oxygen isotope analysis of untreated bulk materials (grains) by laser-assisted fluorination provided, respectively,  $\delta^{17}\text{O}$  3.861, 3.905;  $\delta^{18}\text{O}$  5.178, 5.279;  $\Delta^{17}\text{O}$  1.127, 1.118 per mil.

**Classification:** Classification: Ordinary chondrite (L5), W3.

**Northwest Africa 13193** (NWA 13193)

(Northwest Africa)

Find: 1998

Classification: Ordinary chondrite (L5)

**History:** Iffat Jabeen is the owner of this meteorite who bought it from Michael I. *Casper*, Meteorites, Inc. in March 2000

**Physical characteristics:** A 9 g polished slice. It has a smooth, thin, dark-brown fusion crust present on the edges of the slice. The polished surfaces show several bright spots of metal that make the sample strongly magnetic.

**Petrography** (S. Nasir, *SQU*): Porphyritic olivine pyroxene (POP), radial pyroxene (RP) and barred olivine (BO) chondrules are readily defined. Moderate oxidization of metal is observed.

**Geochemistry:** (N. K. Kim, C. Park and J. I. Lee, *KOPRI*) Duplicate oxygen isotope analysis of untreated bulk materials (grains) by laser-assisted fluorination provided, respectively,  $\delta^{17}\text{O}$  3.625, 3.659;  $\delta^{18}\text{O}$  4.787, 4.778;  $\Delta^{17}\text{O}$  1.098, 1.136 per mil.

**Classification:** Ordinary chondrite (L5), W2.

**Northwest Africa 13194** (NWA 13194)

(Northwest Africa)

Find: 1999

Classification: Ordinary chondrite (L6)

**History:** Iffat Jabeen is the owner of this meteorite who bought it from Michael I. *Casper*, Meteorites, Inc. in March 2000

**Physical characteristics:** A 52.2 g piece. It has a damaged fusion crust that varies in thickness at different places on the surface. The sample is magnetic.

**Petrography** (S. Nasir, *SQU*): Porphyritic olivine (PO) and few barred olivine (BO) chondrules are poorly defined. Heavy oxidization is observed throughout the thin section causing an overall orange hue.

**Geochemistry**: (N. K. Kim, C. Park and J. I. Lee, *KOPRI*) Duplicate oxygen isotope analysis of untreated bulk materials (grains) by laser-assisted fluorination provided, respectively,  $\delta^{17}\text{O}$  3.619, 3.717;  $\delta^{18}\text{O}$  4.871, 5.089;  $\Delta^{17}\text{O}$  1.047, 1.030 per mil.

**Classification**: Ordinary chondrite (L6), W2.

#### **Northwest Africa 13195** (NWA 13195)

(Northwest Africa)

Find: 1999

Classification: Ordinary chondrite (L6)

**History**: Iffat Jabeen is the owner of this meteorite who bought it from Michael I. *Casper*, Meteorites, Inc. in March 2000

**Physical characteristics**: A 45.3 g piece. It has mostly damaged/lost fusion crust. The sample is magnetic.

**Petrography** (S. Nasir, *SQU*): Porphyritic olivine pyroxene (POP), Porphyritic olivine (PO) and porphyritic pyroxene (PP) chondrules are poorly defined. Oxidization is prevalent throughout the thin section causing an overall orange hue.

**Geochemistry**: (N. K. Kim, C. Park and J. I. Lee, *KOPRI*) Duplicate oxygen isotope analysis of untreated bulk materials (grains) by laser-assisted fluorination provided, respectively,  $\delta^{17}\text{O}$  3.603, 3.621;  $\delta^{18}\text{O}$  4.819, 4.872;  $\Delta^{17}\text{O}$  1.058, 1.049 per mil.

**Classification**: Ordinary chondrite (L6), W2.

#### **Northwest Africa 13196** (NWA 13196)

(Northwest Africa)

Find: 1999

Classification: Ordinary chondrite (L6)

**History**: Iffat Jabeen is the owner of this meteorite who bought it from Michael I. *Casper*, Meteorites, Inc. in March 2000

**Physical characteristics**: A 57.3 g piece. It has a altered fusion crust on one side and remaglypts on the other. Generally, the fusion crust is thin and dark to light brown in color. The sample is magnetic.

**Petrography** (S. Nasir, *SQU*): Porphyritic olivine pyroxene (POP) and barred olivine (BO) chondrules are poorly defined. Oxidization is prevalent throughout the thin section causing an overall orange hue.

**Geochemistry**: N. K. Kim, C. Park and J. I. Lee, *KOPRI*) Duplicate oxygen isotope analysis of untreated bulk materials (grains) by laser-assisted fluorination provided, respectively,  $\delta^{17}\text{O}$  3.740, 3.916;  $\delta^{18}\text{O}$  5.059, 5.338;  $\Delta^{17}\text{O}$  1.069, 1.098 per mil.

**Classification**: Ordinary chondrite (L6), W2.

#### **Northwest Africa 13197** (NWA 13197)

(Northwest Africa)

Purchased: 2019 Mar

Classification: Ordinary chondrite (H5)

**History**: Purchased from a dealer in Morocco in March 2019.

**Physical characteristics:** Physical Characteristics: the 4 stone pieces of the repository specimen are rounded with rugged surfaces and lack of fusion crust. The stones have a dark reddish color with light grey chondrules clasts, showing a dark colored matrix and oxidized metal.

**Petrography:** (N. Ma, UBT) Individual chondrules vary from 0.1 to 2 mm but most chondrules are 0.3-0.7 mm in diameter. Various groups of chondrules (75 area%) are present with PO, GOP and C types as the most abundant. The shape of chondrules remains for most of them sharp against the matrix. Matrix is recrystallized to few-micrometer sized crystals with dispersed oxidized metallic veins under reflected light and in BSE images. Metal (~5%) is only oxidized around the rims, but oxidized veins from terrestrial weathering are found penetrating into the matrix and chondrules.

**Geochemistry:** Mineral compositions and geochemistry: Olivine ( $\text{Fa}_{18.0\pm 0.2}$ ;  $\text{Fe/Mn}_{35\pm 4}$ ;  $n=31$ ), Orthopyroxene ( $\text{Fs}_{15\pm 1}\text{Wo}_{4\pm 1}$ ,  $n=3$ ).

**Classification:** Ordinary Chondrite (H5, W2, S2).

**Specimens:** 64.3 g including a thin section on deposit at *UBayr*, S. Tutorow holds the main mass.

### Northwest Africa 13198 (NWA 13198)

(Northwest Africa)

Purchased: 2019 Mar

Classification: Ordinary chondrite (LL6)

**History:** Purchased from a dealer in Morocco in March 2019.

**Physical characteristics:** Single stone with a dark brown fusion crust. Shock veins are visible in a dark main mass, with no distinction between chondrules and matrix.

**Petrography:** Minerals present include olivine and pyroxene, present in equal amounts, and minor plagioclase. Olivine and pyroxene grains show planar and irregular fractures. Olivine grains show some weak mosaicism. Accessory phases include metal/opaque (modal abundance: about 2.0%). Mineral grains have a maximum size of about 0.4 mm. Porphyritic (olivine, olivine-pyroxene, pyroxene) and non-porphyritic (granular olivine-pyroxene) chondrules have been recrystallized and do not show any boundaries with the surrounding matrix. Average chondrule diameter found is  $0.8\pm 0.4$  mm ( $N=15$ ). Thin ( $<0.2$  mm) veins are present filled with carbonates.

**Geochemistry:** Mineral compositions and geochemistry: Pyroxene:

$\text{Fs}_{23.6\pm 4.5}\text{En}_{70.7\pm 8.1}\text{Wo}_{5.7\pm 12.6}$ ,  $\text{Fe/Mn}=33.0\pm 4.0$ ,  $N=11$ ; Olivine:  $\text{Fa}_{31.4\pm 1.2}\text{Fo}_{68.6\pm 1.2}$ ,

$\text{Fe/Mn}=60.9\pm 7.0$ ,  $N=15$ ; Plagioclase:  $\text{An}_{10.6\pm 0.01}\text{Ab}_{84.1\pm 0.5}\text{Or}_{5.3\pm 0.5}$ ,  $N=3$ .

**Classification:** Ordinary chondrite (LL6, S4, W2)

**Specimens:** 21.9 g at *Ubayr* including a thin section. Main mass owned by S. Tutorow.

### Northwest Africa 13199 (NWA 13199)

(Northwest Africa)

Purchased: 2019 Mar

Classification: Ordinary chondrite (H4)

**History:** Purchased from a dealer in Morocco in March 2019.

**Physical characteristics:** The meteorite has a brown to reddish colour with dark fractures and a thin fusion crust ( $< 1$  mm). In hand specimen only very few chondrules are visible by eye.

**Petrography:** (Alena Krupp, *Ubayr*) Chondrule sizes vary between 0.2 mm up to 1 mm, with the smaller ones more abundant. The following types of chondrules were observed: PO, POP,

1  
2  
3 PP, GOP, RP, BO and C, dominating types are GOP and POP, BO and C are rare. Only some  
4 have clear boundaries (e.g. BO), but most are less sharp, and some are indistinct in the matrix  
5 under polarized light. Irregular as well as planar fractures are clearly visible in olivines and  
6 pyroxenes. Metal and sulfides are present.

7  
8 **Geochemistry:** Mineral compositions: Olivine  $\text{Fa}_{18.2\pm 0.4}$  (N=14). Mean  $\text{Cr}_2\text{O}_3 = 0.0007$ , sigma  
9  $\text{Cr}_2\text{O}_3 = 0.0011$ .  $\text{FeO/MnO} = 38\pm 3$ . Low Ca pyroxenes  $\text{Fs}_{15.9\pm 0.4}\text{Wo}_{1.2\pm 0.4}$  (N=15). High-Ca  
10 pyroxenes  $\text{Fs}_{6.3\pm 0.7}\text{Wo}_{43.9\pm 2.2}$  (N=6).

11 **Classification:** Ordinary chondrite (H4), S3, W1.

12 **Specimens:** 49.8g at *UBayr* including a thin section and polished mount. S. Tutorow holds  
13 the main mass.  
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15  
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### 17 Northwest Africa 13200 (NWA 13200)

18 (Northwest Africa)

19 Purchased: 2019 Mar

20 Classification: Ordinary chondrite (L3)

21 **History:** Purchased from a dealer in Morocco in March 2019.

22 **Physical characteristics:** The fusion crust has a dark color.

23 **Petrography:** (D. Souza, *UBayr*). Chondrules have an apparent diameter of around 500  $\mu\text{m}$   
24 (N = 30) making up ~80% in vol. of the meteorite. Chondrules are principally porphyritic  
25 pyroxene (PP), olivine (PO) and granular olivine-pyroxene (GOP). Radial pyroxene and are  
26 also present in smaller amounts. The matrix is composed mainly of olivine which presents  
27 undulatory extinction and pyroxenes. Metal and troilite have oxidized rims. Metal content in  
28 thin section is ~8% in volume.

29 **Geochemistry:** Mineral compositions and Geochemistry: Olivine ( $\text{Fa}_{25.1\pm 3.2}$ ;  $\text{Cr}_2\text{O}_3$  in ferroan  
30 examples  $0.1\pm 0.07$  wt.%;  $\text{Fe/Mn} = 54\pm 9$ ; N=13). Orthopyroxene ( $\text{Fs}_{17.8\pm 3.6}$ ;  $\text{Fe/Mn} = 28\pm 11$ ;  
31 N = 12).

32 **Classification:** Ordinary chondrite (L3, S2, W2).

33 **Specimens:** 27.7g at *UBayr* including a thin section. S. Tutorow holds the main mass.  
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### 39 Northwest Africa 13201 (NWA 13201)

40 (Northwest Africa)

41 Purchased: 2019 Oct

42 Classification: Ordinary chondrite (L4/5)

43 **History:** Purchased by Darryl Pitt in October 2019 from a dealer in Erfoud, Morocco.

44 **Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Some well-formed chondrules are  
45 set in a relatively coarse-grained, recrystallized matrix containing altered kamacite, taenite,  
46 troilite, merrillite and chlorapatite.

47 **Geochemistry:** Olivine ( $\text{Fa}_{24.7\pm 0.2}$ , range  $\text{Fa}_{24.4-25.0}$ , N = 5), low-Ca pyroxene  
48 ( $\text{Fs}_{20.7\pm 0.2}\text{Wo}_{1.6\pm 0.3}$ , range  $\text{Fs}_{20.5-20.9}\text{Wo}_{1.1-2.0}$ , N = 5), augite ( $\text{Fs}_{7.8\pm 0.9}\text{Wo}_{44.8\pm 1.0}$ , range  $\text{Fs}_{6.8-}$   
49  $8.4\text{Wo}_{46.0-44.2}$ , N = 3), plagioclase ( $\text{Ab}_{83.2}\text{An}_{11.5}\text{Or}_{5.2}$ ).

50 **Classification:** Ordinary chondrite (L4/5).

51 **Specimens:** 35.5 g including one polished thin section at *UWB*; remainder with *DPitt*.  
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### 56 Northwest Africa 13202 (NWA 13202)

57 (Northwest Africa)

58 Purchased: 2020 Jan

59 Classification: Ungrouped chondrite  
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**History:** A very dense, metal-rich specimen, found as two naturally-broken pieces which fit together, was purchased in January 2020 by Mark Lyon from a dealer in Zagora, Morocco.

**Physical characteristics:** The broken surfaces on both pieces are coated by rusty terrestrial weathering products. Polished interior surfaces exhibit dominant fresh metal (with minimal staining) and subordinate interspersed silicate-rich regions.

**Petrography:** (A. Irving, *UWS* and J. Boesenberg, *BrownU*) The specimen consists of two distinct interspersed components with overall proportions of ~75% metal and ~25% silicate-rich material. Metal-rich regions (up to 0.5 mm) are composed of 95% kamacite with 5% taenite, and contain fine grained metal plates ranging from 100 to 500  $\mu\text{m}$  in diameter. Silicate-rich regions (up to 0.5 mm) contain a variety of chondrules (with apparent diameters ranging from ~100 to 1500  $\mu\text{m}$ ). Most chondrules are glass-bearing (PP, PO, POP and barred pyroxene types) but some are cryptocrystalline. Accessory phases in silicate-rich regions include kamacite, taenite, chromite, troilite, merrillite and chlorapatite.

**Geochemistry:** Olivine ( $\text{Fa}_{24.6\pm 3.9}$ , range  $\text{Fa}_{15.5-28.0}$ ,  $N = 16$ ), low-Ca pyroxene ( $\text{Fs}_{15.8\pm 1.4}\text{Wo}_{1.5\pm 0.9}$ , range  $\text{Fs}_{14.6-19.6}\text{Wo}_{0.6-3.5}$ ,  $N = 11$ ), pigeonite ( $\text{Fs}_{14.8-15.1}\text{Wo}_{8.3-9.1}$ ,  $N = 2$ ), kamacite ( $\text{Ni} = 4.8-7.0$  wt.%,  $N = 7$ ), taenite ( $\text{Ni} = 16.5-21.3$  wt.%,  $N = 3$ ).

**Classification:** Chondrite (ungrouped, metal-rich). Paired with [NWA 12273](#) and [NWA 12379](#).

**Specimens:** 20.0 g including one polished slice at *UWB*; remainder with Mr. M. Lyon.

#### Northwest Africa 13203 (NWA 13203)

(Northwest Africa)

Purchased: 2020 Jan

Classification: Ordinary chondrite (L4)

**History:** Purchased by Darryl Pitt in January 2020 from a Moroccan dealer living in Spain.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Well-formed chondrules are set in a relatively coarse-grained, recrystallized matrix containing altered kamacite, taenite, troilite, Ti-chromite, merrillite and chlorapatite.

**Geochemistry:** Olivine ( $\text{Fa}_{24.6\pm 0.2}$ , range  $\text{Fa}_{24.4-24.8}$ ,  $N = 5$ ), low-Ca pyroxene ( $\text{Fs}_{20.6\pm 0.2}\text{Wo}_{1.7\pm 0.3}$ , range  $\text{Fs}_{20.3-20.9}\text{Wo}_{1.5-1.8}$ ,  $N = 5$ ), augite ( $\text{Fs}_{7.5\pm 0.6}\text{Wo}_{45.2\pm 1.0}$ , range  $\text{Fs}_{6.9-8.0}\text{Wo}_{46.3-44.5}$ ,  $N = 3$ ), plagioclase ( $\text{Ab}_{83.6}\text{An}_{10.3}\text{Or}_{6.1}$ ).

**Classification:** Ordinary chondrite (L4).

**Specimens:** 26.4 g including one polished thin section at *UWB*; remainder with *DPitt*.

#### Northwest Africa 13204 (NWA 13204)

(Northwest Africa)

Purchased: 2019 Oct

Classification: Martian meteorite (Shergottite)

**History:** Purportedly found in Morocco and purchased by Luc *Labenne* in October 2019 from a dealer in Agadir, Morocco.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Diabasic texture (mean grain size 0.8 mm). Composed predominantly of zoned clinopyroxene and maskelynite with accessory alkali feldspar, silica polymorph, merrillite (Na-Mg-Fe bearing), pyrrhotite, ilmenite, Cr-ulvöspinel and rare baddeleyite. There are melt pockets consisting of vesicular, heterogeneous glassy material (sepia brown to pale yellow in thin section with streaky and swirly textures).

**Geochemistry:** Pigeonite cores ( $\text{Fa}_{33.3-37.5}\text{Wo}_{9.3-12.2}$ ,  $\text{FeO/MnO} = 29-34$ ,  $N = 4$ ), subcalcic augite cores ( $\text{Fs}_{24.8-25.4}\text{Wo}_{33.1-33.4}$ ,  $\text{FeO/MnO} = 29-30$ ,  $N = 2$ ), ferroan pigeonite rims ( $\text{Fs}_{44.6-}$



$59.0\text{Wo}_{12.8-16.6}$ ,  $\text{FeO/MnO} = 34-37$ ,  $N = 5$ ), maskelynite ( $\text{An}_{50.3-52.2}\text{Or}_{1.4-2.0}$ ,  $N = 3$ ), alkali feldspar in mesostasis ( $\text{Or}_{57.3}\text{Ab}_{32.9}\text{An}_{9.8}$ ).

**Classification:** Shergottite (diabasic).

**Specimens:** 15.4 g including one polished thin section at *UWB*; remainder with *L. Labenne*.

#### Northwest Africa 13205 (NWA 13205)

(Northwest Africa)

Purchased: 2019 May

Classification: Ordinary chondrite (H4/5)

**History:** Purchased by Darryl Pitt in May 2019 from a dealer in Agadir, Morocco.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Some well-formed, relatively small chondrules are set in a relatively coarse-grained, recrystallized matrix containing altered kamacite, taenite, troilite, Ti-poor chromite, merrillite and chlorapatite.

**Geochemistry:** Olivine ( $\text{Fa}_{17.5\pm 0.4}$ , range  $\text{Fa}_{17.0-17.9}$ ,  $N = 5$ ), low-Ca pyroxene ( $\text{Fs}_{15.5\pm 0.3}\text{Wo}_{1.1\pm 0.1}$ , range  $\text{Fs}_{15.2-16.1}\text{Wo}_{1.0-1.2}$ ,  $N = 5$ ), augite ( $\text{Fs}_{5.7\pm 0.5}\text{Wo}_{45.3\pm 1.2}$ , range  $\text{Fs}_{5.3-6.2}\text{Wo}_{46.0-43.9}$ ,  $N = 3$ ), plagioclase ( $\text{Ab}_{81.2}\text{An}_{14.7}\text{Or}_{4.1}$ ).

**Classification:** Ordinary chondrite (H4/5).

**Specimens:** 27.4 g including one polished thin section at *UWB*; remainder with *DPitt*.

#### Northwest Africa 13206 (NWA 13206)

(Northwest Africa)

Purchased: 2019 Dec

Classification: HED achondrite (Howardite)

**History:** Purchased by Terry *Boudreaux* in December 2019 from a dealer in Zagora, Morocco.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Breccia composed of sparse lithic eucrite clasts (with microgabbroic, subophitic and granulitic textures), related mineral debris and abundant diogenitic orthopyroxene clasts (overall ~65 vol.%, exhibiting undulose extinction) within a finer grained matrix. Other minerals are exsolved pigeonite, calcic plagioclase, olivine, unexsolved pigeonite, silica polymorph, fayalite, chromite, ilmenite, troilite and Ni-poor metal.

**Geochemistry:** Diogenitic orthopyroxene ( $\text{Fs}_{23.6-26.5}\text{Wo}_{1.8-2.7}$ ,  $\text{FeO/MnO} = 27-30$ ,  $N = 3$ ), olivine ( $\text{Fa}_{24.0}$ ,  $\text{FeO/MnO} = 43$ ), low-Ca pyroxene host ( $\text{Fs}_{58.4-62.0}\text{Wo}_{6.8-4.9}$ ,  $\text{FeO/MnO} = 30-34$ ,  $N = 3$ ), clinopyroxene exsolution lamellae ( $\text{Fs}_{30.5-31.4}\text{Wo}_{39.5-40.6}$ ,  $\text{FeO/MnO} = 32-34$ ,  $N = 2$ ), pigeonite ( $\text{Fs}_{31.6-34.2}\text{Wo}_{4.8-7.5}$ ,  $\text{FeO/MnO} = 28-29$ ,  $N = 3$ ), fayalite ( $\text{Fa}_{75.8}$ ,  $\text{FeO/MnO} = 47$ ), plagioclase ( $\text{An}_{89.8-93.7}\text{Or}_{0.4-0.2}$ ,  $N = 4$ ).

**Classification:** Howardite.

**Specimens:** 20.4 g including one polished thin section at *UWB*; remainder with Mr. *T. Boudreaux*.

#### Northwest Africa 13207 (NWA 13207)

(Northwest Africa)

Purchased: 2019

Classification: Ordinary chondrite (H5-6)

**History:** The meteorite was purchased from a Moroccan dealer at the mineral show in Hamburg, Germany.

**Physical characteristics:** Brownish rock without fusion crust.

**Petrography:** The meteorite a chondritic breccia composed of up to 2 cm sized H5-type fragments (plagioclase grain size is about 30  $\mu\text{m}$ ) set into H6-type matrix (plagioclase grain size is about 60  $\mu\text{m}$ ).

**Northwest Africa 13208 (NWA 13208)**

(Northwest Africa)

Purchased: 2019

Classification: Ureilite

**History:** The meteorite was purchased from a Moroccan dealer at the mineral show in Munich, Germany.

**Physical characteristics:** Three dark brownish rocks without fusion crust.

**Petrography:** The meteorite shows a characteristic cumulate texture of typically 1.5 and up to 2 mm sized olivine and pigeonite grains. Olivine and pigeonite are enriched in  $\text{Cr}_2\text{O}_3$  and display both typical reduced rims. The meteorite contains graphite.

**Geochemistry:** reduced rims in olivine:  $\text{Fa}_{1.7-2.0}$ ; olivine contains  $0.52\pm 0.02$  wt%  $\text{Cr}_2\text{O}_3$  and  $0.36\pm 0.01$  wt%  $\text{CaO}$ ; reduced rims in pyroxene:  $\text{Fs}_{10.9-15.0}\text{Wo}_{4.4-10.1}$ ; pigeonite contains  $0.87\pm 0.02$  wt%  $\text{Cr}_2\text{O}_3$  and  $0.68\pm 0.02$  wt%  $\text{Al}_2\text{O}_3$

**Northwest Africa 13210 (NWA 13210)**

(Northwest Africa)

Purchased: 2019

Classification: Enstatite chondrite (EL melt rock)

**History:** The meteorite was purchased from a Moroccan dealer at the mineral show in Munich, Germany.

**Physical characteristics:** Ten grayish to light brownish individuals without fusion crust.

**Petrography:** Strongly recrystallized enstatite chondrite predominantly composed of 100-150  $\mu\text{m}$  sized enstatite and less abundant plagioclase grains. Opaque phases are troilite, daubr elite, and metallic iron. Contains some silica, abundant vesicles, and brownish alteration products. No relict chondrules were observed.

**Geochemistry:** feldspar:  $\text{An}_{16.3\pm 0.4}\text{Ab}_{83.7\pm 0.4}$  ( $\text{An}_{15.5-16.9}\text{Ab}_{83.1-84.5}$ ,  $n=10$ )

**Classification:** Enstatite-melt rock (EL melt rock). Likely paired with [Al Haggounia 001](#) and [NWA 12962](#).

**Northwest Africa 13211 (NWA 13211)**

(Northwest Africa)

Purchased: 2019

Classification: HED achondrite (Eucrite)

**History:** The meteorite was purchased from a Moroccan dealer at the mineral show in Hamburg, Germany.

**Physical characteristics:** Twelve dark-grayish fragments, some of which partly covered with fusion crust.

**Petrography:** The meteorite is a medium-grained monomict breccia composed of exsolved pyroxene and plagioclase grains up to 0.8 mm in size. Minor phases include silica, ilmenite, chromite,  $\text{FeS}$ , and metallic iron. Contains several shock melt veins and pockets.

**Geochemistry:** low-Ca pyroxene:  $\text{Fs}_{58.5\pm 0.4}\text{Wo}_{2.5\pm 0.5}$  ( $\text{Fs}_{57.6-59.1}\text{Wo}_{1.9-3.6}$ ,  $\text{FeO/MnO}=27-28$ ,  $n=13$ ); Ca-pyroxene:  $\text{Fs}_{25.8\pm 0.7}\text{Wo}_{43.0\pm 0.8}$  ( $\text{Fs}_{24.7-27.3}\text{Wo}_{41.8-44.1}$ ,  $\text{FeO/MnO}=25-32$ ,  $n=13$ ); calcic plagioclase:  $\text{An}_{90.2\pm 0.5}$  ( $\text{An}_{89.5-90.9}$ ,  $n=14$ )

**Northwest Africa 13212** (NWA 13212)

(Northwest Africa)

Purchased: 2019

Classification: Carbonaceous chondrite (CK6)

**History:** The meteorite was purchased from a Moroccan dealer at the mineral show in Hamburg, Germany.**Physical characteristics:** Dark grayish to greenish individual with some fusion crust.**Petrography:** The meteorite displays a greyish to dark greenish interior and is predominantly composed of recrystallized Fe-rich olivine dominated matrix with some scattered well defined chondrules. Cr-rich magnetite is abundant. More minor phases include intermediate plagioclase, low-Ca pyroxene, Ca-pyroxene, and troilite; metal was not found.**Geochemistry:** olivine:  $\text{Fa}_{28.5\pm 0.2}$  ( $\text{FeO}/\text{MnO}=94\pm 11$ ,  $n=12$ ); low-Ca pyroxene: $\text{Fs}_{25.3\pm 0.2}\text{Wo}_{0.7\pm 0.1}$ ,  $n=6$ ; Ca-pyroxene:  $\text{Fs}_{9.4\pm 0.5}\text{Wo}_{44.5\pm 0.9}$ ,  $n=15$ **Northwest Africa 13213** (NWA 13213)

(Northwest Africa)

Purchased: 2019

Classification: Ordinary chondrite (L3)

**History:** The meteorite was purchased from a meteorite dealer in Morocco.**Physical characteristics:** Dark-grayish rock with some fusion crust.**Petrography:** The meteorite shows a chondritic texture with well-packed and partly flattened chondrules (apparent mean diameter about 0.7 mm). The fine-grained matrix contains sulfides and FeNi metal.**Northwest Africa 13214** (NWA 13214)

(Northwest Africa)

Purchased: 2019

Classification: Ungrouped achondrite

**History:** The meteorite was purchased from a meteorite dealer in Laayoune, Morocco.**Physical characteristics:** Small brownish fragment without fusion crust.**Petrography:** The meteorite shows a cumulate texture of up to 1 mm sized high-Ca pyroxene, calcic plagioclase, and less abundant forsteritic olivine often poikilitically enclosed by plagioclase. Pyroxene appears slightly greenish due to its high Cr-content and typically shows reaction textures with adjacent plagioclase. Plagioclase displays a mottled texture but has not been converted into maskelynite. Minor phases include Cr-bearing iron sulfide, taenite and kamacite. Some brownish alteration products are present in the thin section studied.**Geochemistry:** olivine:  $\text{Fa}_{3.3\pm 0.1}$  ( $\text{Fa}_{3.2-3.4}$ ,  $\text{FeO}/\text{MnO}=29\pm 3$ ,  $n=10$ ), contains  $0.26\pm 0.02$  wt%  $\text{Cr}_2\text{O}_3$  and  $0.35\pm 0.03$  wt% CaO; Ca-pyroxene:  $\text{Fs}_{1.3\pm 0.1}\text{Wo}_{45.1\pm 0.2}$  ( $\text{Fs}_{1.2-1.4}\text{Wo}_{44.7-45.5}$ ,  $\text{FeO}/\text{MnO}=16\pm 11$ ,  $n=13$ ), contains  $0.68\pm 0.03$  wt%  $\text{Cr}_2\text{O}_3$  and  $2.68\pm 0.11$  wt%  $\text{Al}_2\text{O}_3$ ; calcic plagioclase:  $\text{An}_{89.1\pm 0.9}\text{Ab}_{10.9\pm 0.9}$  ( $\text{An}_{87.2-90.2}\text{Ab}_{9.8-12.8}$ ,  $n=15$ )**Classification:** Achondrite (ungrouped). Likely paired with [NWA 7325](#).**Northwest Africa 13215** (NWA 13215)

(Northwest Africa)

Purchased: 2019

Classification: Martian meteorite (Shergottite)

**History:** The meteorite was purchased from a meteorite dealer in Laayoune, Morocco.

**Physical characteristics:** Dark-grayish rock largely covered with fusion crust.

**Petrography:** The meteorite displays a fresh grayish interior with a coarse-grained basaltic texture predominantly composed of up to 3 mm sized pyroxene and plagioclase grains.

Pyroxene is intensely fractured pigeonite and augite showing patchy compositional zoning.

Minor phases are merrillite, ilmenite, pyrrhotite, and some Si-rich mesostasis. The meteorite is highly shocked, i.e., plagioclase is completely transformed into maskelynite and black shock melt pockets and shock veins are abundant.

**Geochemistry:** pigeonite:  $\text{Fs}_{54.7\pm 16.3}\text{Wo}_{16.8\pm 1.1}$  ( $\text{Fs}_{31.2-69.3}\text{Wo}_{15.2-18.2}$ ,  $n=6$ ,  $\text{FeO/MnO}=26-35$ ); augite:  $\text{Fs}_{45.4\pm 13.7}\text{Wo}_{25.4\pm 4.2}$  ( $\text{Fs}_{27.3-68.9}\text{Wo}_{20.3-34.1}$ ,  $n=12$ ,  $\text{FeO/MnO}=26-36$ ); maskelynite:  $\text{An}_{56.0\pm 1.9}\text{Ab}_{43.9\pm 1.9}\text{Or}_{0.1\pm 0.0}$ ,  $n=17$

### Northwest Africa 13216 (NWA 13216)

Northwest Africa

Purchased: 2019

Classification: Lunar meteorite (feldspathic breccia)

**History:** Purchased from Morocco October 2019.

**Physical characteristics:** Eighteen identical appearing pieces. No fusion crust, desert weathered exteriors.

**Petrography:** (C. Agee, *UNM*) EPMA images show fragmental breccia of differing grain-size scales. The groundmass is extremely fine-grained with multiple lithologies and single-phase fragments of olivine, pyroxene, and plagioclase. Chromite, spinel, silica, and shock melt were observed.

**Geochemistry:** (C. Agee, *UNM*) Olivine  $\text{Fa}_{31.5\pm 8.8}$ ,  $\text{Fe/Mn}=95\pm 12$ ,  $n=12$ ; pigeonite  $\text{Fs}_{36.0\pm 13.7}\text{Wo}_{11.9\pm 9.6}$ ,  $\text{Fe/Mn}=63\pm 13$ ,  $n=12$ ; plagioclase  $\text{An}_{96.2\pm 1.2}$ ,  $n=6$ ; shock melt (proxy for bulk composition)  $\text{SiO}_2=43.6$ ,  $\text{TiO}_2=0.38$ ,  $\text{Al}_2\text{O}_3=28.5$ ,  $\text{MgO}=6.4$ ,  $\text{FeO}=4.6$ ,  $\text{MnO}=0.07$ ,  $\text{CaO}=15.6$ ,  $\text{Na}_2\text{O}=0.09$  (wt%).

**Classification:** Lunar, feldspathic breccia

**Specimens:** 20.4 g on deposit at *UNM*, Larry Atkins holds the main mass.

### Northwest Africa 13217 (NWA 13217)

Northwest Africa

Purchased: 2019

Classification: Martian meteorite (Shergottite)

**History:** Purchased from Morocco May 2019.

**Physical characteristics:** Five identical appearing pieces. No fusion crust, desert weathered exteriors. Saw cuts reveal fine-grained pyroxene grains and shiny maskelynite. Numerous black shock melt pockets present.

**Petrography:** (C. Agee, *UNM*) EPMA images show ~60% igneous-zoned pyroxene and 35% maskelynite. Ubiquitous Ti-magnetite, ilmenite, sulfide, and shock melt observed.

**Geochemistry:** (C. Agee, *UNM*) Pigeonite  $\text{Fs}_{57.7\pm 2.8}\text{Wo}_{15.1\pm 3.2}$ ,  $\text{Fe/Mn}=37\pm 1$ ,  $n=6$ ; augite  $\text{Fs}_{27.8\pm 9.8}\text{Wo}_{33.0\pm 2.5}$ ,  $\text{Fe/Mn}=30\pm 3$ ,  $n=6$ ; plagioclase  $\text{An}_{49.3\pm 3.5}$ ,  $\text{Ab}_{49.3\pm 3.1}$ ,  $\text{Or}_{1.5\pm 0.5}$ ,  $n=6$ ; shock melt (proxy for bulk composition)  $\text{SiO}_2=48.4$ ,  $\text{TiO}_2=1.3$ ,  $\text{Al}_2\text{O}_3=7.2$ ,  $\text{MgO}=7.0$ ,  $\text{FeO}=21.0$ ,  $\text{MnO}=0.55$ ,  $\text{CaO}=9.9$ ,  $\text{Na}_2\text{O}=1.4$ ,  $\text{K}_2\text{O}=0.17$  (wt%),  $n=4$ .

**Classification:** Martian basaltic shergottite.

**Specimens:** 11 g on deposit at *UNM*, Larry Atkins holds the main mass.

**Northwest Africa 13218** (NWA 13218)

Northwest Africa

Purchased: 2014

Classification: Ordinary chondrite (LL3.2)

**History:** Purchased from Morocco November 2014.**Physical characteristics:** Seven matching stones, dark brown weathered exterior, no fusion crust, sawn surface reveals densely packed chondrules of variable size.**Petrography:** (C. Agee, *UNM*) Microprobe examination of a polished mount shows numerous unequilibrated chondrules, many are porphyritic, apparent mean diameter  $625 \pm 330$   $\mu\text{m}$   $n=24$ . Abundant opaque matrix, most chondrules with glass or mesostasis. Aluminous augite, Fe,Ni-metal, and sulfide present.**Geochemistry:** (C. Agee, *UNM*) Chondrule olivine  $\text{Fa}_{17.2 \pm 9.2}$ ,  $\text{Fe/Mn} = 52 \pm 19$ ,  $\text{Cr}_2\text{O}_3 = 0.13 \pm 0.13$  wt%, range  $\text{Cr}_2\text{O}_3 = 0.02$ - $0.70$  wt%,  $\text{CaO} = 0.08 \pm 0.07$  wt%,  $n=31$ ; low-Ca pyroxene  $\text{Fs}_{9.7 \pm 8.7}\text{Wo}_{0.6 \pm 0.4}$ ,  $\text{Fe/Mn} = 20 \pm 19$ ,  $n=6$ .**Classification:** Ordinary chondrite (LL3.2), transitional between type 3.2 and 3.15 based on ferroan olivine mean  $\text{Cr}_2\text{O}_3$  content and sigma from [Grossman and Brearley \(2005\)](#).**Specimens:** 20.6 g on deposit at *UNM*, Larry Atkins holds the main mass.**Northwest Africa 13219** (NWA 13219)

Niger

Purchased: 2019 August

Classification: HED achondrite (Eucrite, cumulate)

**History:** Purchased over the Internet from anonymous finder; said to be from Niger; shipped from Mauritania.**Physical characteristics:** A nearly-whole, oriented individual stone covered 90% in a dark-brown and spotted fusion-crust which has flow-lines and over-lipping. The fusion crust has a distinctive, locally translucent appearance, with "spots" where the fusion crust is clear (dependent upon the minerals in the underlying stone).**Petrography:** This highly shocked breccia consists dominantly of pyroxene and plagioclase (now partly maskelynite). Vaguely discernible vestiges of the original texture suggest grains up to 3.5 mm (plagioclase) but conceivably even coarser; most of the material has been granulated to  $\ll 1$  mm. Accessory phases include Cr-spinel, Fe-metal, troilite, and a glassy shock-melt vein. Within a few relatively ungranulated pyroxene grains, exsolved augite lamellae are seen to be about 5-8  $\mu\text{m}$  wide. Classification as a cumulate eucrite is based on geochemistry (see below), not the severely impact-modified texture.**Geochemistry:** Low-Ca pyroxene (10 analyses) clusters near  $\text{Fs}_{36.4}\text{Wo}_{4.3}$ . High-Ca pyroxene blebs and lamellae (3 analyses) cluster near  $\text{Fs}_{18.6}\text{Wo}_{37.9}$ . Pyroxene  $\text{FeO/MnO}$  (wt; 14 analyses) averages 28.2. Plagioclase (8 analyses) is  $\text{An}_{92.3-95.3}$ , average  $\text{An}_{93.9 \pm 1.0}$ . Classification as a cumulate eucrite is based on geochemistry (magnesian mafic silicates, Na-poor plagioclase, little if any ilmenite), not texture. Analyses (2) of a glassy shock-melt vein average 18.0 wt%  $\text{Al}_2\text{O}_3$  with  $\text{FeO/MgO}$  (wt) = 1.09.**Classification:** Eucrite, cumulate, brecciated.**Specimens:** 24 grams at *UCLA*; main mass with *Verish*.**Northwest Africa 13220** (NWA 13220)

(Northwest Africa)



Purchased: 2019 Oct

Classification: Ordinary chondrite (H3)

**History:** Purchased by Grant Harkness in October 2019 from a dealer in Zagora, Morocco.

**Petrography:** (A. Irving, *UWS* and J. Boesenberg, *BrownU*) Relatively small, unequilibrated glass-bearing chondrules (apparent diameter  $370 \pm 200 \mu\text{m}$ ,  $N = 20$ ) are set in a finer grained matrix containing abundant fresh metal, troilite, chromite, Cl-free apatite and chlorapatite.

**Geochemistry:** Olivine ( $\text{Fa}_{18.7 \pm 3.5}$ , range  $\text{Fa}_{14.0-27.6}$ ,  $N = 9$ ;  $\text{Cr}_2\text{O}_3$  in ferroan examples  $< 0.06$  wt.%,  $N = 5$ ), low-Ca pyroxene ( $\text{Fs}_{15.9 \pm 0.4}\text{Wo}_{0.9 \pm 0.7}$ , range  $\text{Fs}_{15.5-16.4}\text{Wo}_{0.3-1.8}$ ,  $N = 4$ ;  $\text{Fs}_{5.1}\text{Wo}_{0.4}$ ).

**Classification:** Ordinary chondrite (H3). Likely paired with "HC8" and "HC11".

**Specimens:** 44.5 g including one polished thin section at *PSF*; remainder in the Harkness Collection.

### Northwest Africa 13221 (NWA 13221)

Mali

Purchased: 2019 Sep

Classification: Ordinary chondrite (L4)

**History:** Purchased by Mbark Arjdal in September 2019 from an Algerian dealer.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Well-formed chondrules are set in a recrystallized matrix containing merrillite, chlorapatite, taenite, chromite, troilite, stained kamacite and pentlandite.

**Geochemistry:** Olivine ( $\text{Fa}_{24.9 \pm 0.1}$ , range  $\text{Fa}_{24.8-25.1}$ ,  $N = 6$ ), low-Ca pyroxene ( $\text{Fs}_{20.3 \pm 0.3}\text{Wo}_{2.2 \pm 0.7}$ , range  $\text{Fs}_{19.8-20.5}\text{Wo}_{1.7-3.7}$ ,  $N = 6$ ), augite ( $\text{Fs}_{8.8 \pm 0.9}\text{Wo}_{43.5 \pm 1.5}$ , range  $\text{Fs}_{7.8-9.6}\text{Wo}_{45.1-42.2}$ ,  $N = 3$ ).

**Classification:** Ordinary chondrite (L4).

**Specimens:** 66.9 g including one polished thin section at *UWB*; remainder with Mr. M. Arjdal.

### Northwest Africa 13222 (NWA 13222)

(Northwest Africa)

Purchased: 2019 Oct

Classification: Ordinary chondrite (H3)

**History:** Purchased by Grant Harkness in October 2019 from a dealer in Zagora, Morocco.

**Petrography:** (A. Irving, *UWS* and J. Boesenberg, *BrownU*) Relatively small, unequilibrated glass-bearing chondrules (apparent diameter  $530 \pm 270 \mu\text{m}$ ,  $N = 22$ ) are set in a finer-grained matrix containing abundant fresh metal, troilite, chromite and Cl-free apatite.

**Geochemistry:** Olivine ( $\text{Fa}_{21.4 \pm 6.2}$ , range  $\text{Fa}_{17.3-37.3}$ ,  $N = 8$ ;  $\text{Cr}_2\text{O}_3$  in ferroan examples  $< 0.09$  wt.%,  $N = 5$ ), low-Ca pyroxene ( $\text{Fs}_{15.4 \pm 2.9}\text{Wo}_{1.0 \pm 0.3}$ , range  $\text{Fs}_{10.3-17.5}\text{Wo}_{0.5-1.3}$ ,  $N = 5$ ), augite ( $\text{Fs}_{5.1}\text{Wo}_{45.9}$ ).

**Classification:** Ordinary chondrite (H3). [NWA 13220](#), NWA 13222, [NWA 13226](#), and [NWA 13228](#), which were obtained from the same source at the same time, are probably paired.

**Specimens:** 27.4 g including one polished thin section at *PSF*; remainder in the Harkness Collection.

### Northwest Africa 13223 (NWA 13223)

(Northwest Africa)

Purchased: 2019 Nov

Classification: HED achondrite (Eucrite, monomict)

**History:** Purchased by Aziz Habibi in November 2019 from a Malian dealer.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Monomict breccia composed of large diabasic eucrite clasts (mean grain size 0.5 mm) with sparse regions of polygranular matrix and cross-cutting granulated zones. Major minerals are zoned pyroxenes (consisting of low-Ca pyroxene cores and rims of pigeonite with patchy, dark pyroxferroite) and lath-like calcic plagioclase (converted completely to maskelynite), together with accessory silica polymorph, ilmenite, troilite, Ni-free metal, and baddeleyite. Minor thin veinlets of secondary calcite and small grains of barite are present.

**Geochemistry:** Low-Ca pyroxene cores ( $\text{Fs}_{35.7-47.1}\text{Wo}_{7.5-11.8}$ ,  $\text{FeO/MnO} = 27-28$ ,  $N = 4$ ), pigeonite rims ( $\text{Fs}_{44.0-66.6}\text{Wo}_{18.6-21.7}$ ,  $\text{FeO/MnO} = 28-36$ ,  $N = 4$ ), subcalcic augite ( $\text{Fs}_{46.6-56.7}\text{Wo}_{29.6-25.6}$ ,  $\text{FeO/MnO} = 32-36$ ,  $N = 2$ ), pyroxferroite ( $\text{Fs}_{77.6}\text{Wo}_{15.7}$ ,  $\text{FeO/MnO} = 19$ ), fayalite ( $\text{Fa}_{92.6-96.2}$ ,  $\text{FeO/MnO} = 43-46$ ,  $N = 2$ ), maskelynite ( $\text{An}_{87.6-89.0}\text{Or}_{0.4-0.5}$ ,  $N = 3$ ).

**Classification:** Eucrite (monomict breccia, diabasic, highly shocked, maskelynite-bearing).

**Specimens:** 20.0 g including one polished thin section at *UWB*; remainder with Mr. A. Habibi.

### Northwest Africa 13224 (NWA 13224)

(Northwest Africa)

Purchased: 2019 Oct

Classification: Ordinary chondrite (LL6)

**History:** Purchased by Grant Harkness in October 2019 from a dealer in Zagora, Morocco.

**Petrography:** (A. Irving, *UWS* and J. Boesenberg, *BrownU*) Breccia composed of angular clasts in a finer grained matrix. The clasts are mostly recrystallized but contain some remnant chondrules and partial chondrules along with accessory sodic plagioclase, troilite, chromite and minor stained metal.

**Geochemistry:** Olivine ( $\text{Fa}_{29.5\pm 0.5}$ , range  $\text{Fa}_{29.1-30.2}$ ,  $N = 5$ ), low-Ca pyroxene ( $\text{Fs}_{24.2\pm 0.4}\text{Wo}_{1.8\pm 0.0}$ , range  $\text{Fs}_{23.6-24.6}\text{Wo}_{1.8-1.9}$ ,  $N = 5$ ).

**Classification:** Ordinary chondrite (LL6 breccia).

**Specimens:** 56.6 g including one polished thin section at *PSF*; remainder in the Harkness Collection.

### Northwest Africa 13225 (NWA 13225)

(Northwest Africa)

Purchased: 2015

Classification: Lunar meteorite (feldspathic breccia)

**History:** Purchased by Mohammed *Hmani* in 2015 from a dealer in Erfoud, Morocco.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Breccia composed of mineral clasts of calcic plagioclase (including anorthite), orthopyroxene, pigeonite, subcalcic augite and rare olivine (< 2 vol.%) set in a finer grained matrix containing the same minerals plus kamacite, ilmenite and troilite. Rare olivine-free diabasic lithic clasts and glass fragments are present.

**Geochemistry:** Anorthite ( $\text{An}_{95.4-97.8}\text{Or}_{0.1}$ ,  $N = 3$ ), plagioclase ( $\text{An}_{87.0}\text{Or}_{0.1}$ ), orthopyroxene ( $\text{Fs}_{17.6-23.3}\text{Wo}_{2.9-3.1}$ ,  $\text{FeO/MnO} = 47-55$ ,  $N = 2$ ), pigeonite ( $\text{Fs}_{25.3}\text{Wo}_{8.9}$ ,  $\text{FeO/MnO} = 47$ ), subcalcic augite ( $\text{Fs}_{12.1-27.0}\text{Wo}_{34.2-34.4}$ ,  $\text{FeO/MnO} = 40-57$ ,  $N = 2$ ), olivine ( $\text{Fa}_{37.1}$ ;  $\text{Fa}_{58.2}$ ;  $\text{FeO/MnO} = 94-99$ ;  $N = 2$ ).

**Classification:** Lunar (feldspathic breccia).

**Specimens:** 20.4 g including one polished mount at *UWB*; remainder with Mr. M. *Hmani*.

**Northwest Africa 13226** (NWA 13226)

(Northwest Africa)

Purchased: 2019 Oct

Classification: Ordinary chondrite (H3-4)

**History:** Purchased by Grant Harkness in October 2019 from a dealer in Zagora, Morocco.**Petrography:** (A. Irving, *UWS* and J. Boesenberg, *BrownU*) Part of this specimen consists of relatively small, unequilibrated glass-bearing chondrules (apparent diameter  $380 \pm 230 \mu\text{m}$ ,  $N = 23$ ) set in a finer grained matrix containing abundant fresh metal, troilite, chromite, Cl-free apatite and chlorapatite. Also present in the studied thin section are several large (up to 2.5 cm across), angular H4 chondrite clasts. These lithic clasts are more recrystallized and more equilibrated than the majority of the specimen, and contain well-formed chondrules set in a relatively coarse grained matrix containing abundant relatively fresh metal.**Geochemistry:** Olivine ( $\text{Fa}_{17.9 \pm 8.4}$ , range  $\text{Fa}_{2.9-31.3}$ ,  $N = 6$ ;  $\text{Cr}_2\text{O}_3$  in ferroan examples  $< 0.08$  wt.%,  $N = 5$ ), low-Ca pyroxene ( $\text{Fs}_{15.0 \pm 2.3}\text{Wo}_{0.5 \pm 0.2}$ , range  $\text{Fs}_{13.4-16.6}\text{Wo}_{0.3-0.6}$ ,  $N = 2$ ). H4 clast: olivine ( $\text{Fa}_{17.8 \pm 0.1}$ , range  $\text{Fa}_{17.6-17.9}$ ,  $N = 6$ ), low-Ca pyroxene ( $\text{Fs}_{17.5 \pm 2.9}\text{Wo}_{1.2 \pm 0.1}$ , range  $\text{Fs}_{16.0-21.9}\text{Wo}_{1.0-1.3}$ ,  $N = 4$ ), augite ( $\text{Fs}_{5.2}\text{Wo}_{45.9}$ ).**Classification:** Ordinary chondrite (H3-4 breccia). [NWA 13220](#), [NWA 13222](#), NWA 13226, and [NWA 13228](#), which were obtained from the same source at the same time, are probably paired.**Specimens:** 28.0 g including one polished thin section at *PSF*; remainder in the Harkness Collection.**Northwest Africa 13227** (NWA 13227)

(Northwest Africa)

Purchased: 2019 Nov

Classification: Martian meteorite (Shergottite)

**History:** Purchased by Mark Lyon in November 2019 from a Moroccan dealer.**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Coarse grained (gabbroic) assemblage of zoned clinopyroxene (up to 3.5 mm), olivine (some as inclusions in clinopyroxene) and curvilinear, lath-like maskelynite (~15 vol.%), together with accessory Mg-ilmenite, Cr-ulvöspinel, pyrrhotite, baddeleyite, merrillite and chlorapatite. Minor veinlets of secondary calcite are present.**Geochemistry:** Olivine ( $\text{Fa}_{35.5-51.6}$ ,  $\text{FeO/MnO} = 50-55$ ,  $N = 11$ ), pigeonite cores ( $\text{Fs}_{25.6-28.2}\text{Wo}_{5.2-9.3}$ ,  $\text{FeO/MnO} = 28-33$ ,  $N = 6$ ), subcalcic augite rims ( $\text{Fs}_{21.5-21.6}\text{Wo}_{31.3-31.8}$ ;  $\text{Fs}_{28.0}\text{Wo}_{26.9}$ ;  $\text{FeO/MnO} = 27-30$ ,  $N = 3$ ), pigeonite rims ( $\text{Fs}_{34.6-36.6}\text{Wo}_{12.3-15.7}$ ,  $\text{FeO/MnO} = 30-33$ ,  $N = 3$ ), maskelynite ( $\text{An}_{51.7-57.1}\text{Or}_{1.8-2.8}$ ,  $N = 4$ ).**Classification:** Shergottite (olivine gabbroic).**Specimens:** 21.6 g including one polished thin section at *UWB*; remainder with Mr. M. Lyon.**Northwest Africa 13228** (NWA 13228)

(Northwest Africa)

Purchased: 2019 Oct

Classification: Ordinary chondrite (H3)

**History:** Purchased by Grant Harkness in October 2019 from a dealer in Zagora, Morocco.**Petrography:** (A. Irving, *UWS* and J. Boesenberg, *BrownU*) Relatively small, unequilibrated glass-bearing chondrules (apparent diameter  $430 \pm 290 \mu\text{m}$ ,  $N = 22$ ) are set in a finer grained matrix containing abundant fresh metal, troilite, chromite, Cl-free apatite and chlorapatite.

**Geochemistry:** Olivine ( $\text{Fa}_{19.4\pm 3.2}$ , range  $\text{Fa}_{17.3-34.7}$ ,  $N = 9$ ;  $\text{Cr}_2\text{O}_3$  in ferroan examples  $<0.08$  wt.%,  $N = 6$ ), low-Ca pyroxene ( $\text{Fs}_{15.5\pm 0.3}\text{Wo}_{0.8\pm 0.5}$ , range  $\text{Fs}_{15.2-15.8}\text{Wo}_{0.3-1.6}$ ,  $N = 6$ ).

**Classification:** Ordinary chondrite (H3). Likely paired with "HC7" and "HC8".

**Specimens:** 21.5 g including one polished thin section at *PSF*; remainder in the Harkness Collection.

#### Northwest Africa 13229 (NWA 13229)

(Northwest Africa)

Purchased: 2019

Classification: Martian meteorite (Shergottite)

**History:** The meteorite was purchased from a meteorite dealer in Laayoune, Morocco.

**Physical characteristics:** Grayish to light brownish fragment without fusion crust.

**Petrography:** Medium-grained basalt composed of up to 1 mm sized calcic pyroxenes that show complex irregular patchy compositional zoning and equally sized maskelynite grains. Minor phases include ilmenite, merrillite, FeS, and some Si-rich mesostasis. Pyroxene displays very fine exsolution lamellae. The meteorite is highly shocked and contains abundant shock melt pockets up to 1 mm in diameter. Cracks are often filled with terrestrial carbonates.

**Geochemistry:** pigeonite:  $\text{Fs}_{56.4\pm 7.0}\text{Wo}_{15.8\pm 1.2}$  ( $\text{Fs}_{47.2-65.0}\text{Wo}_{14.4-17.7}$ ,  $n=8$ ,  $\text{FeO/MnO}=30-33$ ); augite:  $\text{Fs}_{27.4\pm 8.4}\text{Wo}_{34.7\pm 2.5}$  ( $\text{Fs}_{18.2-38.2}\text{Wo}_{29.1-38.6}$ ,  $n=12$ ,  $\text{FeO/MnO}=22-33$ ); maskelynite:  $\text{An}_{58.1\pm 1.0}\text{Ab}_{41.9\pm 1.0}$ ,  $n=14$

**Classification:** Martian (shergottite)

#### Northwest Africa 13230 (NWA 13230)

(Northwest Africa)

Purchased: 2019

Classification: Ureilite

**History:** The meteorite was purchased from a meteorite dealer in Erfoud, Morocco.

**Physical characteristics:** Brownish rock without fusion crust.

**Petrography:** The meteorite shows a cumulate texture of about 1 mm sized equigranular sized olivine grains displaying typical reduced rims. Pyroxene appears to be recrystallized from a melt and shows patchy compositional zoning. Some melt regions contain abundant vesicles. Olivine and pyroxene are enriched in  $\text{Cr}_2\text{O}_3$  and the meteorite contains graphite; calcite filled cracks attest to intense terrestrial weathering.

**Geochemistry:** olivine:  $\text{Fa}_{18.6\pm 0.1}$  ( $\text{Fa}_{18.4-18.7}$ ,  $n=11$ ), contains  $0.52\pm 0.07$  wt%  $\text{Cr}_2\text{O}_3$  and  $0.37\pm 0.02$  wt% CaO; reduced rims in olivine:  $\text{Fa}_{4.2-8.6}$ ; pyroxene:  $\text{Fs}_{11.6\pm 2.7}\text{Wo}_{11.0\pm 6.7}$  ( $\text{Fs}_{6.9-16.0}\text{Wo}_{4.1-24.8}$ ,  $n=14$ ), contains  $0.91\pm 0.09$  wt%  $\text{Cr}_2\text{O}_3$  and  $0.44\pm 0.25$  wt%  $\text{Al}_2\text{O}_3$

**Classification:** Ureilite melt rock. The melt rock designation is from the recrystallized texture of pyroxene, with patchy compositional zoning, and the abundant vesicles (similar to [NWA 10870](#)).

#### Northwest Africa 13231 (NWA 13231)

(Northwest Africa)

Purchased: 2019

Classification: Ordinary chondrite (H4)

**History:** The meteorite was purchased from a meteorite dealer in Errachidia, Morocco.

**Physical characteristics:** Brownish rock with some fusion crust.

**Petrography:** The meteorite shows a chondritic texture with well separated and mostly rounded chondrules (apparent mean diameter about 0.4 mm). The fine-grained matrix contains abundant sulfides and partly altered FeNi metal.

#### Northwest Africa 13233 (NWA 13233)

(Northwest Africa)

Purchased: 2019

Classification: HED achondrite (Eucrite, melt breccia)

**History:** The meteorite was reportedly found near Dakhla city and purchased by the main mass holder from a meteorite dealer in Morocco.

**Physical characteristics:** Dark grayish rock without fusion crust.

**Petrography:** The meteorite is a melt breccia predominantly composed of large up to 600 mm sized pyroxene grains set into a feldspar-dominated matrix. Pyroxenes are completely recrystallized and display mottled compositional zoning. Feldspar often show fibrous textures indicative for crystallization from a melt. No lithic clasts have been encountered. Minor phases include silica, chromite, and ilmenite. No metallic iron has been found.

**Geochemistry:** pyroxene:  $\text{Fs}_{52.8\pm 3.7}\text{Wo}_{10.0\pm 3.9}$  ( $\text{Fs}_{47.1-57.0}\text{Wo}_{4.9-18.5}$ ,  $n=14$ ,  $\text{FeO/MnO}=26-31$ ); calcic plagioclase:  $\text{An}_{90.7\pm 1.1}$  ( $\text{An}_{89.5-92.9}$ ,  $n=11$ )

#### Northwest Africa 13234 (NWA 13234)

(Northwest Africa)

Purchased: 2019

Classification: Ordinary chondrite (LL7)

**History:** The meteorite was purchased from a meteorite dealer in Mauritania.

**Physical characteristics:** Five dark-brownish rocks without fusion crust. Exhibits dark grayish cut face.

**Petrography:** The meteorite displays a recrystallized texture of abundant olivine and less abundant low-Ca pyroxene and feldspar. Feldspar grain size is about 60  $\mu\text{m}$ ; some poorly defined relict chondrules are present. Opaque phases are minor magnetite and abundant sulfides, the latter often finely dispersed in the silicates. No metal is present in the thin section studied.

**Geochemistry:** Feldspar:  $\text{An}_{8.9}\text{Ab}_{84.3}\text{Or}_{6.8}$  ( $n=3$ )

**Classification:** LL7. The opaque mineralogy is unusual, as is the low magnetic susceptibility.

#### Northwest Africa 13235 (NWA 13235)

(Northwest Africa)

Purchased: 2019

Classification: HED achondrite (Howardite)

**History:** The meteorite was found by Muhhamad Imam in Mali and subsequently purchased by Marcin Cimała.

**Physical characteristics:** Light to dark grayish rock with some larger cavities and few patches of fusion crust.

**Petrography:** The meteorite is an achondritic melt breccia consisting of large black-white speckled to completely black melt regions showing pronounced flow structures and whitish less intensely or entirely unmelted clasts. Melt regions are composed of exsolved pyroxene, recrystallized pyroxene displaying mottled compositional zoning, and calcic plagioclase fragments set into a recrystallized matrix of pyroxene and often fibrous feldspar. Vesicles are



abundant in the matrix and the mineral fragments frequently show resorption features at their contact to the melt. Unmelted regions show an overall eucritic mineral assemblage with exsolved pyroxene and plagioclase fragments set into a clastic matrix. Minor phases are silica, chromite, FeS, and rare metallic iron. The meteorite contains large up to 4 mm sized diagenetic low-Ca pyroxenes some of which have olivine, augite, and/or feldspar inclusions. Due to the heterogeneity of the material it is not possible to determine the percentage of diagenetic material precisely, i.e., more or less than 10 vol.%. The unmelted precursor was, thus, either a polymict eucrite or a howardite.

**Geochemistry:** diagenetic pyroxene:  $\text{Fs}_{34.3\pm 0.2}\text{Wo}_{2.0\pm 0.4}$  ( $\text{Fs}_{33.9-34.7}\text{Wo}_{1.7-3.2}$ ,  $n=12$ ,  $\text{FeO/MnO}=27-30$ ); olivine:  $\text{Fs}_{49.0\pm 0.5}$  ( $\text{Fs}_{48.4-49.7}$ ,  $n=11$ ,  $\text{FeO/MnO}=46\pm 1$ ); eucritic low-Ca pyroxene:  $\text{Fs}_{59.8\pm 0.3}\text{Wo}_{1.8\pm 0.1}$  ( $\text{Fs}_{59.2-60.2}\text{Wo}_{1.7-1.9}$ ,  $n=11$ ,  $\text{FeO/MnO}=28-32$ ); eucritic Ca-pyroxene:  $\text{Fs}_{24.5\pm 1.7}\text{Wo}_{44.0\pm 0.4}$  ( $\text{Fs}_{21.5-25.9}\text{Wo}_{43.1-44.7}$ ,  $n=14$ ,  $\text{FeO/MnO}=26-32$ ); calcic plagioclase:  $\text{An}_{92.7\pm 0.6}$  ( $\text{An}_{91.6-93.6}$ ,  $n=12$ )

**Classification:** Howardite-melt breccia due to presence of eucritic and diagenetic material embedded in a melt rock matrix.

### Northwest Africa 13236 (NWA 13236)

(Northwest Africa)

Purchased: 2020

Classification: Ordinary chondrite (LL6, melt breccia)

**History:** The meteorite was purchased from a meteorite dealer in Algeria.

**Physical characteristics:** Dark brownish to black rock with some fusion crust.

**Petrography:** The meteorite is a melt breccia composed of large black completely molten and recrystallized regions and some few unmelted chondritic clasts. Chondritic clasts are of LL6 type (plagioclase grain size about 70  $\mu\text{m}$ ) and contain rare poorly defined relict chondrules. Melt regions contain characteristic FeNi metal and sulfide spherules and frequently carry mineral fragments of the host rock.

### Northwest Africa 13237 (NWA 13237)

(Northwest Africa)

Purchased: 2014

Classification: Martian meteorite (Shergottite)

**History:** Purchased by John Humphries at the Sainte-Marie-aux-Mines Mineral Show in France, July 2014.

**Physical characteristics:** Black fusion crust exterior. Saw cuts reveal a light-gray color, with medium-grained pyroxene grains, many of which are lath shaped. Scattered shiny maskelynite patches and dark oxide grains are visible. A few thin, dark, shock melt veins are present.

**Petrography:** (C. Agee, *UNM*) EPMA images show ~70% igneous-zoned pyroxene and ~20% maskelynite. Ubiquitous Ti-magnetite, ilmenite, Fe-sulfide, silica and apatite observed.

**Geochemistry:** (C. Agee, *UNM*) Pigeonite  $\text{Fs}_{51.6\pm 6.6}\text{Wo}_{14.0\pm 2.0}$ ,  $\text{Fe/Mn}=36\pm 1$ ,  $n=13$ ; augite  $\text{Fs}_{38.1\pm 4.2}\text{Wo}_{32.7\pm 3.9}$ ,  $\text{Fe/Mn}=37\pm 1$ ,  $n=2$ ; maskelynite  $\text{An}_{39.9\pm 1.0}$ ,  $\text{Ab}_{57.4\pm 1.3}$ ,  $\text{Or}_{2.7\pm 0.6}$ ,  $n=2$ .

**Classification:** Martian basaltic shergottite

**Specimens:** 7.36 g on deposit at *UNM*, John Humphries holds the main mass.

### Northwest Africa 13238 (NWA 13238)

(Northwest Africa)

Purchased: 2019 Jun

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3 Classification: Ordinary chondrite (LL4)

4 **History:** Purchased in June 2019 by two anonymous collectors from a Moroccan dealer at the  
5 Ensisheim Show.

6 **Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Well-formed, relatively large  
7 equilibrated chondrules are set in a recrystallized matrix containing sodic plagioclase,  
8 relatively abundant sulfides (troilite and pentlandite), Ti-chromite, ilmenite and minor  
9 kamacite (as altered holly-leaf-shaped grains) and taenite. One unusual chromite-rich  
10 chondrule is composed predominantly of chromite with subordinate ilmenite, intermediate  
11 plagioclase (labradorite) and pentlandite.

12 **Geochemistry:** Olivine ( $\text{Fa}_{32.6\pm 0.1}$ , range  $\text{Fa}_{32.4-32.8}$ ,  $N = 6$ ), low-Ca pyroxene  
13 ( $\text{Fs}_{25.9\pm 0.3}\text{Wo}_{1.6\pm 0.2}$ , range  $\text{Fs}_{25.5-26.2}\text{Wo}_{1.2-1.7}$ ,  $N = 6$ ), plagioclase in chondrule ( $\text{An}_{85.9}\text{Or}_{0.2}$ ),  
14 chromite in chondrule ( $\text{Mg} = 0.403$ ,  $\text{Cr} = 0.221$ ). Magnetic susceptibility  $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg})$   
15 = 3.38. Oxygen isotopes (K. Ziegler, *UNM*): analyses of acid-washed subsamples by laser  
16 fluorination gave, respectively,  $\delta^{17}\text{O}$  4.740, 4.523;  $\delta^{18}\text{O}$  6.518, 6.151;  $\Delta^{17}\text{O}$  1.298, 1.275 per  
17 mil.

18 **Classification:** Ordinary chondrite (LL4). This LL chondrite has some anomalous features,  
19 including the presence of calcic plagioclase in chondrules, almost complete absence of metal,  
20 unusually high abundance of sulfides, elevated  $\delta^{18}\text{O}$  relative to literature values for 43 LL  
21 chondrite specimens.

22 **Specimens:** 20.4 g including one polished thin section at *UWB*; remainder with anonymous  
23 owners.

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30 **Northwest Africa 13239** (NWA 13239)

31 (Northwest Africa)

32 Purchased: 2019 Aug

33 Classification: Ureilite

34 **History:** Purchased by Mbark Arjdal in August 2019 from a dealer in Timbuktu, Mali.

35 **Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Aggregate (mean grain size 1.2 mm)  
36 of olivine with thick opaque, reduced magnesian rims (~75 vol.%), pigeonite (~25 vol.%) and  
37 accessory bladed grains of graphite.

38 **Geochemistry:** Olivine (cores  $\text{Fa}_{21.3-21.7}$ ,  $N = 3$ ; rims  $\text{Fa}_{3.0-3.2}$ ,  $N = 2$ ), pigeonite ( $\text{Fs}_{10.5-}$   
39  $18.1\text{Wo}_{6.5-14.0}$ ,  $N = 4$ ).

40 **Classification:** Ureilite.

41 **Specimens:** 25.0 g including one polished thin section at *UWB*; remainder with Mr. M.  
42 Arjdal.

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47 **Northwest Africa 13240** (NWA 13240)

48 (Northwest Africa)

49 Purchased: 2019 Dec

50 Classification: Carbonaceous chondrite (CV3)

51 **History:** Purchased in Laayoune, Morocco, by Rachid and Jaouad Chaoui in December 2019.

52 **Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Well-formed chondrules (apparent  
53 diameter  $1000\pm 530 \mu\text{m}$ ,  $N = 22$ ) and irregularly shaped CAI (mostly very fine grained but  
54 some coarser grained) are set in a fine grained matrix (~40 vol.%, deep sepia brown in thin  
55 section).

56 **Geochemistry:** Olivine ( $\text{Fa}_{14.6\pm 15.7}$ , range  $\text{Fa}_{0.7-47.8}$ ,  $N = 7$ ), low-Ca pyroxene ( $\text{Fs}_{0.9\pm 0.8}\text{Wo}_{2.2\pm 1.5}$ ,  
57 range  $\text{Fs}_{0.3-1.4}\text{Wo}_{1.1-3.2}$ ,  $N = 2$ ), augite ( $\text{Fs}_{1.0\pm 0.4}\text{Wo}_{38.5\pm 1.0}$ , range  $\text{Fs}_{0.7-1.2}\text{Wo}_{37.8-39.2}$ ,  $N = 2$ ),  
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plagioclase ( $\text{An}_{82.3}\text{Or}_{0.1}$ ), ferroan olivine in matrix (cores  $\text{Fa}_{56.5-66.7}$ ,  $N = 2$ ; rims  $\text{Fa}_{76.6-93.3}$ ,  $N = 2$ ).

**Classification:** Carbonaceous chondrite (CV3).

**Specimens:** 30.2 g including one polished thin section at *UWB*; remainder with Mr. R. Chaoui and Mr. J. Chaoui.

#### Northwest Africa 13241 (NWA 13241)

(Northwest Africa)

Purchased: 2019 Nov

Classification: Primitive achondrite (Lodranite)

**History:** Purchased by Darryl Pitt in November 2019 from a dealer in Smara, Morocco.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Protogranular aggregate (mean grain size 0.9 mm) composed of olivine, orthopyroxene and clinopyroxene together with accessory kamacite (partially altered to iron hydroxides), troilite and schreibersite. Silicates are stained by terrestrial iron hydroxides. Minor secondary Ca sulfate is present as well as some cross-cutting veinlets of goethite.

**Geochemistry:** Olivine ( $6.4-6.5$ ,  $\text{FeO/MnO} = 13-15$ ,  $N = 5$ ), orthopyroxene ( $\text{Fs}_{2.3-4.1}\text{Wo}_{1.3-2.4}$ ,  $\text{FeO/MnO} = 3-5$ ,  $N = 5$ ), clinopyroxene ( $\text{Fs}_{1.9-2.6}\text{Wo}_{46.4-43.5}$ ,  $\text{FeO/MnO} = 5$ ,  $N = 3$ ).

**Classification:** Lodranite.

**Specimens:** 20.2 g including one polished thin section at *UWB*; remainder with *DPitt*.

#### Northwest Africa 13242 (NWA 13242)

(Northwest Africa)

Purchased: 2019 Jun

Classification: Ordinary chondrite (L4)

**History:** Purchased by Mbark Arjdal in June 2019 from a Libyan dealer.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Fairly closely-packed, well-formed chondrules (apparent diameter  $800 \pm 320 \mu\text{m}$ ,  $N = 22$ ) are set in a sparse matrix containing altered kamacite, pentlandite and ilmenite. A single CAI-like object (0.4 mm across) was observed; it is partially rimmed by kamacite and is composed predominantly of compositionally zoned Cr-pleonaste spinel with minor merrillite, Fe-Ni-bearing phosphate and rare baddeleyite.

**Geochemistry:** Olivine ( $\text{Fa}_{23.1 \pm 0.9}$ , range  $\text{Fa}_{22.4-24.6}$ ,  $N = 5$ ), low-Ca pyroxene ( $\text{Fs}_{22.6 \pm 4.6}\text{Wo}_{2.2 \pm 2.1}$ , range  $\text{Fs}_{18.6-29.6}\text{Wo}_{0.7-2.1}$ ,  $N = 5$ ), pigeonite ( $\text{Fs}_{21.4 \pm 3.0}\text{Wo}_{5.1 \pm 0.1}$ , range  $\text{Fs}_{19.3-23.5}\text{Wo}_{5.0-5.2}$ ,  $N = 2$ ;  $\text{Fs}_{18.9}\text{Wo}_{14.0}$ ), subcalcic augite ( $\text{Fs}_{11.8 \pm 2.3}\text{Wo}_{33.8 \pm 4.3}$ , range  $\text{Fs}_{8.7-14.1}\text{Wo}_{30.5-39.9}$ ,  $N = 4$ ).

**Classification:** Ordinary chondrite (L4).

**Specimens:** 51 g including one polished thin section at *UWB*; remainder with Mr. M. Arjdal.

#### Northwest Africa 13244 (NWA 13244)

(Northwest Africa)

Purchased: 2016 Mar

Classification: Carbonaceous chondrite (CV3)

**History:** Purchased in Khatari, Morocco by Aziz Habibi in March 2016.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Well-formed PO and BO chondrules (apparent diameter  $1070 \pm 610 \mu\text{m}$ ,  $N = 24$ ) plus irregularly shaped, very fine-grained CAI and

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3 mineral grains (mostly olivine) are set in a fine grained matrix (~30 vol.%, light gray-brown  
4 in thin section) containing sparse chlorapatite and stained grains of metal.

5 **Geochemistry:** Olivine ( $\text{Fa}_{27.2\pm 16.6}$ , range  $\text{Fa}_{0.3-47.5}$ ,  $N = 18$ ), low-Ca pyroxene  
6 ( $\text{Fs}_{3.3\pm 3.7}\text{Wo}_{2.2\pm 2.1}$ , range  $\text{Fs}_{0.9-7.6}\text{Wo}_{1.0-4.6}$ ,  $N = 3$ ), augite ( $\text{Fs}_{1.0\pm 0.6}\text{Wo}_{42.8\pm 5.4}$ , range  $\text{Fs}_{0.7-}$   
7  $1.5\text{Wo}_{46.6-39.0}$ ,  $N = 2$ ).

8 **Classification:** Carbonaceous chondrite (CV3).

9 **Specimens:** 20.5 g including one polished thin section at *UWB*; remainder with Mr. A.  
10 Habibi.  
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#### 14 Northwest Africa 13245 (NWA 13245)

15 (Northwest Africa)

16 Purchased: 2019 Mar

17 Classification: HED achondrite (Eucrite, melt breccia)

18 **History:** Purchased in Agadir, Morocco by Aziz Habibi

19 **Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Breccia composed of lithic clasts  
20 (gabbroic to microgabbroic with poikilitic to equigranular textures) and related crystalline  
21 debris set within a finer grained, vesicular melt-textured matrix. Minerals in clasts are  
22 exsolved pigeonite, calcic plagioclase, silica polymorph, ilmenite, chromite (with variable Al  
23 and Ti contents) and troilite. The matrix contains strongly zoned pyroxenes (with ferroan rims  
24 of almost pyroxferroite composition) and acicular to plumose plagioclase.

25 **Geochemistry:** Gabbroic clasts: Low-Ca pyroxene host ( $\text{Fs}_{60.9-62.6}\text{Wo}_{2.4-4.6}$ ,  $\text{FeO/MnO} = 29-$   
26  $33$ ,  $N = 5$ ), augite exsolution lamellae ( $\text{Fs}_{27.6-28.3}\text{Wo}_{43.1-44.1}$ ,  $\text{FeO/MnO} = 30-32$ ,  $N = 5$ ),  
27 plagioclase ( $\text{An}_{88.2-89.7}\text{Or}_{0.2-0.5}$ ,  $N = 4$ ). Matrix pyroxene: augite core ( $\text{Fs}_{26.4}\text{Wo}_{44.2}$ ,  $\text{Fe/MnO} =$   
28  $29$ ), low-Ca pyroxene ( $\text{Fs}_{60.1}\text{Wo}_{2.5}$ ,  $\text{FeO/MnO} = 31$ ), ferroan pigeonite rim ( $\text{Fs}_{81.4}\text{Wo}_{15.5}$ ,  
29  $\text{FeO/MnO} = 38$ ).

30 **Classification:** Eucrite (melt-matrix breccia).

31 **Specimens:** 23.3 g in the form of a polished endcut at *UWB*; remainder with Mr. A. Habibi.  
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#### 38 Northwest Africa 13246 (NWA 13246)

39 (Northwest Africa)

40 Purchased: 2019 Nov

41 Classification: Carbonaceous chondrite (CK3)

42 **History:** Purchased by Fabien *Kuntz* in November 2019 from a dealer in Zagora, Morocco.

43 **Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Separated, well-formed chondrules  
44 (apparent diameter  $650\pm 290$   $\mu\text{m}$ ,  $N = 23$ ) and CAIs are set in a fine-grained matrix (~80  
45 vol.%) containing abundant Cr-magnetite (stained orange by secondary alteration).

46 **Geochemistry:** Olivine ( $\text{Fa}_{26.6\pm 11.0}$ , range  $\text{Fa}_{4.8-36.5}$ ,  $N = 12$ ), low-Ca pyroxene  
47 ( $\text{Fs}_{19.5\pm 8.4}\text{Wo}_{1.2\pm 0.5}$ , range  $\text{Fs}_{1.8-25.1}\text{Wo}_{0.9-2.2}$ ,  $N = 7$ ), augite ( $\text{Fs}_{16.3\pm 2.2}\text{Wo}_{48.4\pm 1.6}$ , range  $\text{Fs}_{14.7-}$   
48  $18.8\text{Wo}_{46.7-49.9}$ ,  $N = 3$ ), magnetite ( $\text{Cr}_2\text{O}_3 = 3.4$  wt.%).

49 **Classification:** Carbonaceous chondrite (CK3).

50 **Specimens:** 20.9 g including one polished thin section at *UWB*; remainder with *Kuntz*.  
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#### 55 Northwest Africa 13247 (NWA 13247)

56 (Northwest Africa)

57 Purchased: 2019 Nov

58 Classification: Primitive achondrite (Winonaite)

59 **History:** Purchased by Darryl Pitt in November 2019 from a dealer in Smara, Morocco.  
60

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Protogranular aggregate (mean grain size 0.9 mm) composed predominantly of forsteritic olivine and polysynthetically twinned enstatitic orthopyroxene together with accessory kamacite, Cr-Mn-bearing troilite, schreibersite and graphite.

**Geochemistry:** Olivine ( $Fa_{0.4-2.0}$ ,  $FeO/MnO = 2-8$ ,  $N = 9$ ), orthopyroxene ( $Fs_{3.3-5.0}Wo_{0.7-1.9}$ ,  $FeO/MnO = 1-3$ ,  $N = 7$ ).

**Classification:** Winonaite.

**Specimens:** 22.4 g including one polished thin section at *UWB*; remainder with *DPitt*.

#### Northwest Africa 13248 (NWA 13248)

Niger

Purchased: 2018 Mar

Classification: Ordinary chondrite (H5, melt breccia)

**History:** Found with many other similar stones in the vicinity of Akokan, Niger, and purchased by Aziz Habibi in March 2018 from a dealer in Niger.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) The specimen consists of H5 lithic clasts within a much finer grained matrix (composed of fine, lath-like silicate grains and spherical opaques). Lithic clasts are composed of sparse, relatively small equilibrated chondrules in recrystallized matrices containing relatively abundant metal. Minerals are equilibrated olivine, low-Ca pyroxene, sodic plagioclase, kamacite, taenite, low-Ti chromite and troilite. Clasts have shock stage S2.

**Geochemistry:** Olivine ( $Fa_{18.5\pm 0.1}$  (range  $Fa_{18.4-18.6}$ ,  $N = 4$ ), low-Ca pyroxene ( $Fs_{16.1\pm 0.4}Wo_{1.9\pm 0.2}$  (range  $Fs_{15.5-16.4}Wo_{2.1-1.6}$ ,  $N = 4$ ).

**Classification:** Ordinary chondrite (H5-melt breccia). Paired with [Tassédet 004](#), [NWA 12923](#), [NWA 12924](#) and other material from the same strewnfield.

**Specimens:** 38.7 g including one polished thin section at *UWB*; remainder with Mr. A. Habibi.

#### Northwest Africa 13249 (NWA 13249)

Libya

Purchased: March 2019

Classification: Carbonaceous chondrite (C2, ungrouped)

**History:** Reportedly found 400 km south of Gadamis in the Libya-Algeria border region. Purchased at the market in Gadamis in 2019.

**Physical characteristics:** Thirty matching stones, fresh fusion crust covers the exterior. Contraction cracks on the surface filled with desert soil are present. Saw cuts reveal numerous small chondrules set in a very dark colored abundant matrix. Friable. Scattered CAIs observed throughout.

**Petrography:** (C. Agee, *UNM*) Microprobe examination shows scattered chondrules, many of which are irregular in shape. There are approximately equal numbers of type I and type II chondrules. Apparent mean chondrule diameter  $230\pm 230$   $\mu m$ ,  $n=33$ . Fine-grained matrix makes up about 70% of this meteorite. Cronstedtite was detected in the matrix. Aluminous diopside and Cr-rich spinel present. Fusion crust is approximately 200  $\mu m$  thick.

**Geochemistry:** (C. Agee, *UNM*) All chondrule olivine  $Fa_{24.4\pm 21.6}$ ,  $Fe/Mn=63\pm 44$ ,  $Cr_2O_3=0.33\pm 0.15$  wt%,  $n=20$ ; ferroan chondrule olivine  $Fa_{40.1\pm 11.5}$ ,  $Fe/Mn=97\pm 12$ ,  $Cr_2O_3=0.32\pm 0.11$  wt%,  $n=12$ ; low-Ca pyroxene  $Fs_{12.0\pm 13.7}Wo_{1.6\pm 1.0}$ ,  $n=5$ . Oxygen isotopes (K. Ziegler, *UNM*): 3 acid-washed fragments analyzed by laser fluorination gave  $\delta^{18}O = -4.759$ , -



6.292, -1.716;  $\delta^{17}\text{O} = -8.654, -10.479, -5.673$ ;  $\Delta^{17}\text{O} = -6.141, -7.157, -4.767$  (linearized, all per mil, TFL slope=0.528).

**Classification:** Carbonaceous chondrite C2 ungrouped. Type 2 based on the presence of cronstedtite in the matrix. Ungrouped based on the oxygen isotopes plotting near the CO3 field with small chondrules, but the meteorite is petrologic type 2 with abundant matrix. This is not a CM2 or CO3, possibly similar to [NWA 5958](#).

**Specimens:** 20.1 g on deposit at UNM, DPitt holds the main mass.

### Northwest Africa 13250 (NWA 13250)

Mauritania

Purchased: 2019 Dec

Classification: Martian meteorite (Shergottite)

**History:** Purchased from a Mauritanian meteorite (and desert truffle) hunter.

**Physical characteristics:** Single stone; saw cut reveals an ultramafic cumulate rock with ophitic to poikilitic textures with mm-size pale yellow and dark gray grains.

**Petrography:** (C. Agee, UNM) Microprobe examination shows approximately 50% olivine, 40% pyroxene, and 5-10% maskelynite. Two distinct pyroxene trends are present 1) Mg-rich low calcium pyroxene trending to slightly more Fe-rich pigeonite, 2) Mg-rich augite trending to diopsidic. Three distinct Cr-Fe spinel phases were detected throughout the sample, one with high  $\text{TiO}_2$  (~14 wt%), one with intermediate  $\text{TiO}_2$  (~7.5 wt%), and one with very low  $\text{TiO}_2$  concentrations. Ilmenite and Fe-sulfide are minor ubiquitous phases.

**Geochemistry:** (C. Agee, UNM) Olivine  $\text{Fa}_{34.3\pm 2.4}$ ,  $\text{Fe/Mn}=50\pm 3$ ,  $n=7$ ; low Ca-pyroxene  $\text{Fs}_{24.6\pm 2.8}\text{Wo}_{7.3\pm 2.1}$ ,  $\text{Fe/Mn}=30\pm 1$ ,  $n=11$ ; augite  $\text{Fs}_{15.8\pm 1.1}\text{Wo}_{38.5\pm 5.6}$ ,  $\text{Fe/Mn}=25\pm 1$ ,  $n=5$ .

**Classification:** Martian peridotitic shergottite. Macroscopic textural appearance similar to [NWA 1950](#) and [ALHA77005](#).

**Specimens:** 22.7 g on deposit at UNM, DPitt holds the main mass.

### Northwest Africa 13251 (NWA 13251)

Western Sahara

Purchased: 2008

Classification: Ordinary chondrite (L, melt rock)

**History:** Purchased in 2008 from a Moroccan meteorite and mineral dealer in Erfoud for *JTESM*, then sold to an anonymous owner. Meteorite is reportedly from Western Sahara.

**Physical characteristics:** The exterior has a dark brown to black appearance with lighter-colored red-tan areas. Interior slices reveal mm-scale blebs of metal and sulfide in a very fine-grained, dark-gray matrix.

**Petrography:** (C. Herd, UAb) Optical and microprobe examination of a polished thin section shows Fe-Ni metal and sulfide blebs as well as irregular to subrounded olivine or olivine+low-Ca pyroxene intergrowths up to 600  $\mu\text{m}$  across containing  $\mu\text{m}$ -scale inclusions of troilite. These reside in a groundmass consisting of 10-50  $\mu\text{m}$  scale crystallites of olivine and low-Ca pyroxene with interstitial glass of plagioclase composition. Shock effects include weak mosaicism and planar fractures in olivine.

**Geochemistry:** (C. Herd, UAb) Data obtained by EMP examination of carbon-coated thin section: Olivine  $\text{Fa}_{24.4\pm 0.9}$  ( $n=63$ ); Low-Ca Pyroxene  $\text{Fs}_{19.2\pm 1.3}\text{Wo}_{2.7\pm 1.0}$  ( $n=42$ ). No difference in composition between olivine and low-Ca pyroxene in intergrowths and olivine and low-Ca pyroxene in the groundmass was observed.

**Classification:** L, melt rock

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3 **Specimens:** Type specimen of 20.8 g, including one thin section, is at *UAb*. Main mass with  
4 an anonymous owner.  
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8 **Northwest Africa 13251** (NWA 13251)

9 Western Sahara

10 Purchased: 2008

11 Classification: Ordinary chondrite (L, melt rock)

12 **History:** Purchased in 2008 from a Moroccan meteorite and mineral dealer in Erfoud  
13 for *JTESM*, then sold to an anonymous owner. Meteorite is reportedly from Western Sahara.

14 **Physical characteristics:** The exterior has a dark brown to black appearance with lighter-  
15 colored red-tan areas. Interior slices reveal mm-scale blebs of metal and sulfide in a very fine-  
16 grained, dark-gray matrix.

17 **Petrography:** (C. Herd, *UAb*) Optical and microprobe examination of a polished thin section  
18 shows Fe-Ni metal and sulfide blebs as well as irregular to subrounded olivine or  
19 olivine+low-Ca pyroxene intergrowths up to 600  $\mu\text{m}$  across containing  $\mu\text{m}$ -scale inclusions of  
20 troilite. These reside in a groundmass consisting of 10-50  $\mu\text{m}$  scale crystallites of olivine and  
21 low-Ca pyroxene with interstitial glass of plagioclase composition. Shock effects include  
22 weak mosaicism and planar fractures in olivine.

23 **Geochemistry:** (C. Herd, *UAb*) Data obtained by EMP examination of carbon-coated thin  
24 section: Olivine  $\text{Fa}_{24.4\pm 0.9}$  (n=63); Low-Ca Pyroxene  $\text{Fs}_{19.2\pm 1.3}\text{Wo}_{2.7\pm 1.0}$  (n=42). No difference in  
25 composition between olivine and low-Ca pyroxene in intergrowths and olivine and low-Ca  
26 pyroxene in the groundmass was observed.

27 **Classification:** L, melt rock

28 **Specimens:** Type specimen of 20.8 g, including one thin section, is at *UAb*. Main mass with  
29 an anonymous owner.  
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35 **Northwest Africa 13252** (NWA 13252)

36 Morocco

37 Purchased: 2019

38 Classification: Ordinary chondrite (L6, melt breccia)

39 **History:** Sergey Vasiliev purchased the 99.3 g sample while at the Munich mineral show in  
40 2019.

41 **Physical characteristics:** Sample has a rounded irregular shape, and is dark brown on the  
42 exterior with a dark-brown weathered fusion crust. The cut face of the interior is dark brown  
43 and shows a brecciated texture composed of clasts surrounded by dark veins.

44 **Petrography:** Description and classification (A. Love, *App*) Sample has a brecciated texture  
45 composed of cm-sized, sub-rounded clasts and mineral fragments surrounded by  
46 interconnected shock melt veins. Clasts shows recrystallized chondritic texture composed of  
47 indistinct chondrules (with an average apparent diameter of 829  $\mu\text{m}$ , n=11) set within a  
48 recrystallized matrix. Secondary plagioclase has an average grain size of 63  $\mu\text{m}$  (n=51).  
49 Additional minerals are troilite, phosphates and chromite.

50 **Geochemistry:** (A. Love, *App*) Olivine ( $\text{Fa}_{24.8\pm 1.4}$ ,  $\text{Fe}/\text{Mn}=57.0\pm 24.4$ , n=8), low-Ca pyroxene  
51 ( $\text{Fs}_{21.4\pm 0.4}\text{Wo}_{1.6\pm 0.2}$ , n=8).

52 **Classification:** Ordinary chondrite (L6 shock melt breccia C-S5/6 W4). Based on textures,  
53 olivine compositions and grainsize of secondary plagioclase, this sample is an L6. Presence  
54 shock melt veining, pervasive maskelynite, mosaic extinction and staining of olivine this  
55 sample has been shocked to C-S5/6 (Stoffler et al. 2018).  
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**Specimens:** Sergey Vasiliev holds the main mass. A 20 g type specimen and a polished thin section and mount are on deposit at *App*.

### Northwest Africa 13253 (NWA 13253)

Morocco

Purchased: 2019

Classification: Ordinary chondrite (H5)

**History:** Marc Jost (*SJS*) purchased the sample from Mohamed *Hmani* at the St. Marie aux Mines show in June 2019.

**Physical characteristics:** The 210.6 g stone is dark-brown in color, irregular in shape and lacks fusion crust. Small chondrules are visible on the surface. The cut face is pock marked and shows abundant chondrules surrounded by gray veinlets and troilite grains.

**Petrography:** Description and classification (A. Love, *App*) Sample has a recrystallized chondritic texture composed of distinct, densely packed chondrules and fragments surrounded by abundant weathered FeNi metal and FeS. Chondrules have an average apparent diameter of 504  $\mu\text{m}$  (n=44) and show recrystallized mesostasis. Additional minerals are chromite, apatite, troilite, pentlandite and secondary plagioclase.

**Geochemistry:** (A. Love, *App*) Olivine ( $\text{Fa}_{17.5\pm 0.1}$ ,  $\text{Fe/Mn}=35.2\pm 0.8$ , n=8), low-Ca pyroxene ( $\text{Fs}_{16.2\pm 0.1}\text{Wo}_{1.1\pm 0.1}$ , n=8).

**Classification:** Ordinary chondrite (H5, C-S2, W3). Based on mineral compositions and textures this is an H5.

**Specimens:** Marc Jost (*SJS*) holds the main mass. An endcut weighing 20.59 g and a polished thin section and epoxy mount are on deposit at *App*.

### Northwest Africa 13254 (NWA 13254)

Morocco

Purchased: 2019

Classification: Ordinary chondrite (LL3)

**History:** Marc Jost (*SJS*) purchased the sample from a Moroccan dealer at the Ensisheim show in June 2019.

**Physical characteristics:** Sample is rounded to irregular in shape and has a dark-brown, wind ablated surface. The cut face shows the sample is composed of numerous, closely packed, dark and light colored chondrules surrounded by sulfide rims.

**Petrography:** Description and classification (A. Love, *App*) Sample displays chondritic texture composed of closely packed, well defined, chemically zoned chondrules (with an average apparent diameter of 775  $\mu\text{m}$ , n=80), surrounded by fine-grained, opaque rims. Chondrules with devitrified mesostasis are more abundant than those with clear isotropic glass.

**Geochemistry:** (A. Love, *App*) Olivine,  $\text{Fa}_{16.2\pm 11.6}$  ( $\text{Fa}_{0.3-38.6}$ ),  $\text{Fe/Mn}=45.9\pm 21.4$ , n=25.  $\text{Cr}_2\text{O}_3$  in type II chondrules has an average of 0.1 wt% with a standard deviation of 0.0, n=23); low-Ca pyroxene,  $\text{Fs}_{12.6\pm 8.1}\text{Wo}_{1.0\pm 0.7}$  ( $\text{Fs}_{1.7-3.0}\text{Wo}_{0.3-2.7}$ ), n=12.

**Classification:** Ordinary chondrite (LL3, C-S2, W1) Based on chondrule size and magnetic susceptibility this sample is an LL chondrite. Estimated subtype for this sample is 3.5 based on unequilibrated compositions, presence of isotropic glass mesostasis (3.4-3.5), lack of yellow CL in chondrule mesostasis (>3.4) and presence of red luminescence in chondrule olivine (>3.1, <3.6).

**Specimens:** Marc Jost (*SJS*) holds the main mass. A 24.6 g endcut and a polished thin section are on deposit at *App*.

**Northwest Africa 13255** (NWA 13255)

Morocco

Find: 2019

Classification: HED achondrite (Diogenite)

**History:** Purchased in August 2019 by Juan Aviles Poblador from a meteorite dealer in Morocco. Later acquired by Daniel Sheikh.**Physical characteristics:** Single stone with weathered fusion crust.**Petrography:** (D. Sheikh, *FSU*) This sample is a breccia composed almost entirely of angular and tabular grains of orthopyroxene (Av. 1 mm, up to 3 mm) set in a fine-grained matrix composed of smaller orthopyroxene grains. Accessory phases include Al-bearing chromite, plagioclase, augite, sulfides, and Fe-oxides.**Geochemistry:** Orthopyroxene ( $\text{Fs}_{28.2\pm 0.4}\text{Wo}_{4.0\pm 0.3}$ , range  $\text{Fs}_{27.5-29.0}\text{Wo}_{3.0-4.5}$ ,  $\text{FeO/MnO}=28\pm 3$ ,  $n=30$ ), Augite ( $\text{Fs}_{14.0\pm 1.3}\text{Wo}_{41.9\pm 0.5}$ , range  $\text{Fs}_{13.1-14.9}\text{Wo}_{41.6-42.3}$ ,  $\text{FeO/MnO}=25\pm 3$ ,  $n=2$ ), Plagioclase ( $\text{An}_{92.2\pm 0.3}\text{Or}_{0.2\pm 0.1}$ , range  $\text{An}_{91.9-92.5}\text{Or}_{0.1-0.4}$ ,  $n=4$ ).**Classification:** Diogenite (monomict breccia)**Specimens:** 65.2 grams at *UCLA*; main mass with *UCLA*.**Northwest Africa 13256** (NWA 13256)

Western Sahara

Find: 2019

Classification: Lunar meteorite (feldspathic breccia)

**History:** Purchased in 2019 by Matthew Stream from a meteorite dealer in Western Sahara.**Physical characteristics:** Minor fusion crust exterior; interior contains a few visible weathering veins.**Petrography:** (D. Sheikh, *FSU*) This sample is a feldspathic fragmental breccia containing sub-angular clasts and isolated mineral grains (up to 4 mm) set in a fine-grained matrix. Anorthitic plagioclase is the dominant phase, with minor phases including pigeonite, augite, low-ca pyroxene, maskelynite, olivine, and ilmenite.**Geochemistry:** Olivine ( $\text{Fa}_{36.3,2\pm 0.2}$ , range  $\text{Fa}_{36.2-36.5}$ ,  $\text{FeO/MnO}=90\pm 3$ ,  $n=2$ ), Low-Ca Pyroxene ( $\text{Fs}_{20.3\pm 3.7}\text{Wo}_{3.0\pm 1.8}$ , range  $\text{Fs}_{16.3-25.3}\text{Wo}_{0.4-4.4}$ ,  $\text{FeO/MnO}=49\pm 7$ ,  $n=4$ ), Pigeonite ( $\text{Fs}_{33.2\pm 5.6}\text{Wo}_{11.5\pm 3.2}$ , range  $\text{Fs}_{24.9-38.6}\text{Wo}_{7.5-16.7}$ ,  $\text{FeO/MnO}=48\pm 7$ ,  $n=7$ ), Augite ( $\text{Fs}_{37.3\pm 11.7}\text{Wo}_{36.6\pm 1.6}$ , range  $\text{Fs}_{20.2-45.0}\text{Wo}_{34.3-37.8}$ ,  $\text{FeO/MnO}=48\pm 3$ ,  $n=7$ ), Plagioclase ( $\text{An}_{95.3\pm 1.4}\text{Or}_{0.2\pm 0.1}$ , range  $\text{An}_{92.1-97.5}\text{Or}_{0.1-0.6}$ ,  $n=77$ ).**Classification:** Lunar (feldspathic fragmental breccia).**Specimens:** 20.3 grams at *UCLA*; main mass with Matthew Stream.**Northwest Africa 13257** (NWA 13257)

(Northwest Africa)

Purchased: 2018

Classification: Martian meteorite (Shergottite)

**History:** Purchased in 2018 by Daoud Wabich from a meteorite dealer in Algeria.**Physical characteristics:** Multiple stones with weathered fusion crust.**Petrography:** (D. Sheikh, *FSU*) Sample is a diabase having a predominantly subophitic texture composed of zoned, tabular and prismatic (sometimes twinned) chadacrysts of subcalcic augite and pigeonite (Av.  $600\pm 50$   $\mu\text{m}$ , up to 1 mm, 58 vol%) contained within larger oikocrysts of maskelynite (Av.  $800\pm 50\mu\text{m}$ , up to 2mm, 42 vol%). Accessory phases

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2  
3 include titanomagnetite (some Cr rich), silica, Si-Al-K-Na rich glass, merrillite, chlorapatite,  
4 and pyrrhotite. Sample contains minor carbonate weathering veins.

5 **Geochemistry:** Subcalcic augite ( $\text{Fs}_{34.2\pm 8.7}\text{Wo}_{30.9\pm 2.1}$ , range  $\text{Fs}_{20.4-46.2}\text{Wo}_{26.5-35.7}$ ,  
6  $\text{FeO/MnO}=34\pm 5$ ,  $n=30$ ) pigeonite ( $\text{Fs}_{51.3\pm 5.7}\text{Wo}_{15.0\pm 3.1}$ , range  $\text{Fs}_{39.4-61.9}\text{Wo}_{10.7-22.8}$ ,  
7  $\text{FeO/MnO}=35\pm 4$ ,  $n=30$ ) maskelynite ( $\text{An}_{47.4\pm 6.9}\text{Or}_{2.4\pm 1.2}$ , range  $\text{An}_{34.7-58.7}\text{Or}_{0.5-4.8}$ ,  $n=26$ ).

8 **Classification:** Martian (shergottite, diabasic) Silicate chemistry, the presence of maskelynite,  
9 FeO/MnO ratios of pyroxenes, and magnetic susceptibility provide support for classification  
10 as shergottite. Average grain sizes of pyroxenes and maskelynite larger than that of basaltic  
11 shergottites, but smaller than gabbroic shergottites, hence diabasic.

12 **Specimens:** 21.3 grams at *UCLA*; main mass with Daoud Wabich.  
13  
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### 17 Northwest Africa 13258 (NWA 13258)

18 Morocco

19 Find: 2019

20 Classification: Carbonaceous chondrite (CV3)

21 **History:** Purchased in November 2019 by Juan Aviles Poblador from Said Yousfii in  
22 Morocco.

23 **Physical characteristics:** Multiple stones with dark-brown fusion crust.

24 **Petrography:** (D. Sheikh, *FSU*) Sample contains abundant chondrules (Av. 1mm, up to  
25 4mm), CAIs (Av. 2 mm, up to 4 mm), and isolated mineral fragments set in a fine-grained  
26 opaque matrix. Accessory phases include magnetite (some containing Cr), sodalite, and  
27 pentlandite.  
28

29 **Geochemistry:** Olivine ( $\text{Fa}_{19.1\pm 22.5}$ , range  $\text{Fa}_{1.3-75.7}$ ,  $n=37$ ), Low-Ca Pyroxene  
30 ( $\text{Fs}_{1.8\pm 0.7}\text{Wo}_{2.4\pm 1.5}$ , range  $\text{Fs}_{0.7-3.1}\text{Wo}_{0.8-4.5}$ ,  $n=20$ ).

31 **Classification:** Carbonaceous chondrite (CV3-Ox). Strong Mg-Fe zonation in chondrule  
32 olivine (the majority of chondrule olivines being Mg rich), the lack of FeNi metal, and the  
33 presence of magnetite, pentlandite, some isolated fayalite grains, and sodalite throughout the  
34 matrix point to the oxidized subgroup.  
35

36 **Specimens:** 20.07 grams at *UCLA*; main mass with Juan Aviles Poblador.  
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### 40 Northwest Africa 13259 (NWA 13259)

41 (Northwest Africa)

42 Purchased: 26.10.2018

43 Classification: Lunar meteorite (feldspathic breccia)

44 **History:** The sample was purchased October 26, 2018 in Munich as a single piece of 24.4 g.

45 **Physical characteristics:** The piece has a dark appearance with white clasts and no fusion  
46 crust. Saw cuts reveal a breccia with numerous angular shaped, mm-sized, white feldspathic  
47 clasts set in a predominantly dark gray to black groundmass. Some brownish clasts are also  
48 visible. The clasts are smaller than most other lunar breccias, which typically contain cm-  
49 sized fragments.  
50

51 **Petrography:** (A. Bischoff and K. Klemm, *IfP*). SEM images show that it is a breccia of  
52 different clasts embedded in a fine-grained matrix. The groundmass is partly a melt matrix  
53 with abundant pores (vesicles). The lithic clasts primarily consist of highland clasts  
54 dominated by anorthositic lithologies, but also fragments with abundant mafic mineral  
55 (olivine, pyroxenes) are frequently observed. Typical melt clasts and melt spherules are also  
56 present. The plagioclase has been partially transformed into maskelynite. Mineral fragments  
57 of olivine, pyroxene, plagioclase (and maskelynite), ilmenite and an  $\text{SiO}_2$  phase were found.  
58  
59  
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Ubiquitous melt veins and vesicles are present throughout the groundmass. Locally, the rock can be defined as a melt breccia.

**Geochemistry:** (A. Bischoff and K. Klemm, *IfP*) Mineral compositions: Olivine  $Fa_{38.4\pm 6.6}$ , range  $Fa_{29-56}$ ,  $Fe/Mn=113$ ,  $n=15$ ; low-Ca pyroxene  $Fs_{40.7\pm 19.6}Wo_{16.9\pm 7.4}$   $Fe/Mn=73$ ,  $n=11$ ; Ca-pyroxene  $Fs_{38.0\pm 15.6}Wo_{38.3\pm 3.0}$ ,  $Fe/Mn=74$ ,  $n=13$ ; plagioclase:  $An_{95.8\pm 0.8}$ ,  $n=4$ , one grain with  $An_{59}$  was also found.

**Classification:** Lunar, less feldspathic, regolith to melt breccia

**Specimens:** Type specimen: 4.9 g *IfP*

### Northwest Africa 13260 (NWA 13260)

(Northwest Africa)

Purchased: 2019

Classification: Ordinary chondrite (H6)

**History:** Purchased from a Moroccan meteorite dealer (and hotelier) in Agadir.

**Physical characteristics:** Single stone, multiple faces are covered with highly articulated regmaglypts further embellished with a desert varnish gloss. Saw cut reveals faint chondrules set in a light-brown groundmass. Abundant metal grains are present throughout.

**Petrography:** (C. Agee, *UNM*) Microprobe examination shows texturally equilibrated, recrystallized chondrules. Plagioclase grain size up to 150  $\mu m$  in diameter.

**Geochemistry:** (C. Agee, *UNM*) Olivine  $Fa_{17.6\pm 0.4}$ ,  $Fe/Mn=39\pm 3$ ,  $n=12$ ; low-Ca pyroxene  $Fs_{15.8}Wo_{1.5}$ ,  $n=1$ .

**Classification:** Ordinary chondrite (H6)

**Specimens:** 24.5 g on deposit at *UNM*, Darryl Pitt holds the main mass.

### Northwest Africa 13261 (NWA 13261)

Northwest Africa

Purchased: 2019

Classification: Carbonaceous chondrite (CK5)

**History:** Purchased from a Moroccan meteorite dealer and hotelier in Agadir.

**Physical characteristics:** The single dense mass has a finely reticulated ash-hued outer surface sheathed in a desert varnish. Chondrules and CAIs protrude from the surface. The cut face reveals a greige matrix with numerous chondrules along with CAIs more than a centimeter in diameter and somewhat larger dark inclusions.

**Petrography:** (C. Agee, *UNM*) Microprobe examination shows texturally equilibrated, recrystallized chondrules and matrix, fine-grained Cr-magnetite is present throughout and abundant. No metal was observed.

**Geochemistry:** (C. Agee, *UNM*) Olivine  $Fa_{32.3\pm 1.0}$ ,  $Fe/Mn=123\pm 17$ ,  $NiO=0.39\pm 0.04$  (wt%),  $n=12$ ; high-Ca pyroxene  $Fs_{8.2\pm 1.1}Wo_{49.5\pm 0.8}$ ,  $Fe/Mn=77\pm 2$ ,  $n=2$ .

**Classification:** Carbonaceous chondrite (CK5)

**Specimens:** 21.9 g on deposit at *UNM*, *DPitt* holds the main mass.

### Northwest Africa 13262 (NWA 13262)

(Northwest Africa)

Purchased: 2016

Classification: Ordinary chondrite (L3)

**Petrography:** (I. Kerraouch; A. Bischoff, *IfP*) Chondrules, chondrule fragments, and alteration products (mainly of metal and sulfides) are embedded in a fine-grained brownish

matrix, which has an abundance of about 10-15 vol%. The majority of chondrules are porphyritic in texture and the mean apparent chondrule size is about 500  $\mu\text{m}$ . The sample is heavily weathered (W3/4).

**Geochemistry:** (K. Klemm; A. Bischoff, *IfP*) Mineral compositions and geochemistry:

Random measurements of olivine grains revealed  $\text{Fa}_{16.3\pm 10.4}$  ( $\text{Fa}_{1.1-33.0}$ );  $n=21$ . Random measurements of low-Ca pyroxene grains revealed  $\text{Fs}_{7.9\pm 7.4}\text{Wo}_{0.5\pm 0.4}$  ( $\text{Fs}_{1.1-25.4}\text{Wo}_{0.1-1.7}$ );  $n=17$ .

**Classification:** L3 chondrite based on the chondrule size, chondrule-matrix ratio, texture, and unequilibrated mineral chemistry.

**Specimens:** 23.7 g, *IfP*; 6 g, M. Zolensky, *JSC*

### Northwest Africa 13263 (NWA 13263)

(Northwest Africa)

Purchased: 2019

Classification: HED achondrite (Howardite)

**History:** The meteorite was purchased from a meteorite dealer in Layoune, Western Sahara.

**Physical characteristics:** Brownish rock partly covered with fusion crust.

**Petrography:** The meteorite is a polymict breccia with fine- and coarse-grained basaltic clasts, black impact melt clasts, and up to 4 mm sized diagenetic low-Ca pyroxene set into a clastic matrix predominantly composed of exsolved pyroxene, compositionally zoned low-Ca pyroxene, and calcic plagioclase of variable grain sizes. Contains about 15-20% diagenetic components. Minor phases include silica, chromite, FeS, and ilmenite. No metallic iron has been detected. One chondrule-like object composed of barred olivine and pyroxene crystals has been found. The meteorite is highly shocked, i.e., plagioclase is partly transformed to maskelynite and shock melt veins and pockets are present.

**Geochemistry:** diagenetic pyroxene:  $\text{Fs}_{22.7\pm 0.2}\text{Wo}_{2.0\pm 0.1}$  ( $\text{Fs}_{22.3-22.9}\text{Wo}_{1.9-2.0}$ ,  $\text{FeO/MnO}=25-30$ ,  $n=11$ ); zoned low-Ca pyroxene:  $\text{Fs}_{27.7\pm 3.4}\text{Wo}_{2.7\pm 1.0}$  ( $\text{Fs}_{24.2-32.5}\text{Wo}_{2.2-5.7}$ ,  $\text{FeO/MnO}=25-29$ ,  $n=10$ ); low-Ca pyroxene host to augite exsolution lamellae:  $\text{Fs}_{64.0\pm 1.2}\text{Wo}_{7.0\pm 1.0}$  ( $\text{Fs}_{61.9-65.3}\text{Wo}_{5.9-8.6}$ ,  $\text{FeO/MnO}=25-27$ ,  $n=10$ ); Ca-pyroxene exsolution lamellae:  $\text{Fs}_{36.0\pm 1.4}\text{Wo}_{39.1\pm 1.3}$  ( $\text{Fs}_{35.1-40.2}\text{Wo}_{35.5-40.2}$ ,  $\text{FeO/MnO}=25-29$ ,  $n=11$ ); calcic plagioclase:  $\text{An}_{86.4\pm 4.3}$  ( $\text{An}_{81.5-92.3}$ ,  $n=12$ )

### Northwest Africa 13265 (NWA 13265)

(Northwest Africa)

Purchased: 2019

Classification: Carbonaceous chondrite (CV3)

**History:** The meteorite was purchased from a meteorite dealer in Layoune, Western Sahara.

**Physical characteristics:** Many several cm sized individuals some of which completely covered by fusion crust.

**Petrography:** Carbonaceous chondrite composed of chondrules (mean diameter about 1 mm; up to 2 mm sized), CAIs (up to 3 mm sized), and olivine amoeboids all set into a fine-grained dark brownish to almost black matrix. Several chondrules show brownish staining due to terrestrial alteration.

### Northwest Africa 13266 (NWA 13266)

(Northwest Africa)

Purchased: 2018

Classification: Enstatite achondrite

**History:** The meteorite was purchased from a local meteorite dealer in Niger.

**Physical characteristics:** Dark brownish rock without fusion crust.

**Petrography:** The meteorite is an enstatite achondrite predominantly composed of 50-1000  $\mu\text{m}$  sized enstatite and less abundant sodic feldspar grains. Some regions appear to be recrystallized exhibiting triple junctions. Albitic and Si-rich glass is present throughout the meteorite. Opaque phases include nodules composed of niningerite and Cr-rich troilite, Si-rich kamacite, and rare Zn-bearing daubréelite. Metal grains are often spherical. No relict chondrules have been observed.

**Geochemistry:** enstatite:  $\text{Fs}_{0.3\pm 0.2}\text{Wo}_{0.3\pm 1.3}$  ( $\text{Fs}_{0.1-0.6}\text{Wo}_{0.2-0.3}$ ,  $n=12$ ); feldspar:  $\text{An}_{19.2\pm 1.9}\text{Ab}_{79.1\pm 1.9}\text{Or}_{1.7\pm 0.2}$  ( $\text{An}_{81.5-92.3}\text{Ab}_{75.9-83.2}\text{Or}_{1.4-2.0}$ ,  $n=18$ ); kamacite:  $\text{Ni}=7.04\pm 0.18$ ,  $\text{Si}=2.99\pm 0.01$ ,  $\text{Co}=0.24\pm 0.01$ ,  $\text{P}=0.58\pm 0.39$  (wt%),  $n=3$

**Classification:** Enstatite achondrite.

### Northwest Africa 13267 (NWA 13267)

(Northwest Africa)

Purchased: 2020

Classification: Ordinary chondrite (L6, melt breccia)

**History:** The meteorite was purchased from a local meteorite dealer in Algeria.

**Physical characteristics:** Brownish rock without fusion crust.

**Petrography:** The meteorite is a melt breccia and largely consists of partly recrystallized melt regions with characteristic FeNi metal and sulfide spherules. Unmelted chondritic regions are of type L6 (plagioclase grain size about 70  $\mu\text{m}$ ) and contain few relict chondrules; no metal or sulfide veins are observed.

### Northwest Africa 13268 (NWA 13268)

Algeria

Find: 2013

Classification: Ordinary chondrite (H4/5)

**History:** The meteorite has been found by nomads in Algeria in 2013. Later a Hungarian IMCA member, Zsolt Kereszty purchased this specimen from a Moroccan dealer. In the end Hungarian scientific journalist and meteorite collector Nandor Rezsabek bought it for his private meteorite collection in 21 June 2017.

**Physical characteristics:** A single angular dark brown stone (333.2 g) with weathered fusion crust on its two sides. Elongated regmaglypts with faint remnants of flowlines on one of the crusted sides are observable. Where the brownish black fusion crust is absent several shiny metal grains are visible and chondrules bulge out from the matrix. Cut surface reveals porous inner material. Broken surfaces show significant amount of brown alteration products.

**Petrography:** (D. Rezes, *CSFK*) The stone has chondritic texture with mostly well-defined chondrules. However, some chondrules show transition to less delineated state. Chondrules are relatively small, although some of them reach 2 mm in diameter. Igneous glass in chondrules is not observable. The texture is porous with pores up to 0.5 mm in diameter. FeNi metal and troilite show heavy oxidation without the alteration of mafic silicates. Olivine shows irregular fractures, the optical extinction is weakly undulatory. Shock veins are absent. Cl-apatite as accessory mineral is identified.

**Geochemistry:** (D. Rezes and M. Szabo, *CSFK*) Mineral chemistry: Olivine  $\text{Fa}_{16.81\pm 0.45}$ ,  $\text{Fe/Mn}=23.6\pm 3.3$ ,  $N=21$ ; Low-Ca pyroxene  $\text{Fs}_{14.90\pm 0.61}\text{Wo}_{1.34\pm 0.20}$ ,  $\text{Fe/Mn}=13.6\pm 1.7$ ,  $N=21$ ; Feldspar  $\text{Ab}_{80.51\pm 1.43}$ ,  $N=11$

**Classification:** Ordinary chondrite (H4/5), shock stage S2, weathering W3.

**Specimens:** 20 g on deposit at *CSFK*, N. Rezsabek holds the main mass including one polished thin section.

### Northwest Africa 13269 (NWA 13269)

Mauritania

Purchased: 2019

Classification: HED achondrite (Eucrite, unbrecciated)

**History:** Purchased in December 2019 by Didi Baidari from a Mauritanian meteorite dealer.

**Physical characteristics:** Two matching stones. Fusion crust typical of eucrites, black and shiny with swirls. Broken surface showing scattered phenocrysts of pyroxene up to 4mm in size all embedded in a grey matrix. The stone is unbrecciated.

**Petrography:** (T. Shissh, *FSAC*) Fusion crust is 30-100  $\mu\text{m}$  thick and penetrates the interior up to 1.5mm in some areas. Porphyritic texture with pyroxene phenocrysts up to 2-4 mm embedded in a matrix dominated by equilibrated pyroxene showing exsolution lamella with remnant-Ca zoning in rims plus variolitic and blocky plagioclase. Minor phases are silica, chromite, ilmenite and troilite. Pyroxene phenocrysts show rare tiny ( $\sim 1\mu\text{m}$ ) chromite and high-Ca exsolution lamella with often plagioclase veinlets associated with chromite. Clouding is frequently observed in pyroxene and plagioclase located in the matrix. Pyroxenes have minute inclusions of plagioclase, troilite and chromite. Plagioclase clouding is mostly dominated by pyroxene inclusions. Mesostasis is present commonly located between plagioclase laths.

**Geochemistry:** (T. Shissh, *FSAC* and C. Agee, *UNM*) Pyroxene phenocrysts

$\text{Fs}_{51\pm 1.6}\text{Wo}_{2.4\pm 0.7}$ ,  $\text{Fe/Mn}=31\pm 1$ ,  $\text{Mg}\#=47\pm 1.7$  ( $n=15$ ); high-Ca pyroxene in matrix:

$\text{Fs}_{25\pm 7.5}\text{Wo}_{38\pm 9.3}$ ,  $\text{Fe/Mn}=28\pm 1.5$ ,  $\text{Mg}\#=58\pm 5$  ( $n=8$ ); low-Ca pyroxene in matrix:

$\text{Fs}_{48\pm 5.2}\text{Wo}_{11.5\pm 6}$ ,  $\text{Fe/Mn}=30\pm 0.8$ ,  $\text{Mg}\#=45\pm 2$  ( $n=3$ ); plagioclase in matrix

$\text{An}_{82\pm 3.2}\text{Ab}_{15\pm 2.8}\text{Or}_{2\pm 2.5}$  ( $n=15$ ); plagioclase veinlets in pyroxene phenocrysts

$\text{An}_{97\pm 0.2}\text{Ab}_{2.7\pm 0.18}\text{Or}_{0.07\pm 0.07}$  ( $n=3$ ). Chromite associated with plagioclase veinlets  $\text{Chr}67.8\pm 1.7$

$\text{Uvp}7\pm 1.5$ ,  $\text{Spl}23\pm 2.7$  ( $n=3$ ).

**Classification:** Unbrecciated eucrite

**Specimens:** 58.4 g including a probe mount on deposit at *UNM*, Didi Baidari and Habib Naji hold the main mass.

### Northwest Africa 13270 (NWA 13270)

Algeria

Find: 2019 Feb 7

Classification: Ordinary chondrite (LL3.5)

**History:** Found by nomads in Algeria on 7 Feb 2019, purchased by Stephen Amara from Mustapha Hnini in Tindouf on 10 Oct 2019.

**Physical characteristics:** Single stone with dark-brown fusion crust.

**Petrography:** (D. Sheikh, *FSU*; A. Love, *App*) Sample is a chondrite composed of well-defined chondrules (Av.  $815\pm 50\ \mu\text{m}$ , range 250-1802  $\mu\text{m}$ ,  $n=37$ ) and a few dark, fine-grained inclusions ( $<5\text{mm}$ ) set in an opaque matrix. Devitrified mesostasis is present in most chondrules while isotropic glassy mesostasis is relatively rare. Many chondrules are armored with sulfides and contain rounded globules of FeNi metal. (A. Love, *App*) Optical CL: Sample exhibits bright and distinct CL. Sample is dominated by chondrules with olivine displaying dull red luminescence (A5) and blue to blue-purple mesostasis (B2, B3), however the sample does contain 5% A2 chondrules. Chondrules with bright red luminescence lack the

1  
2  
3 prominent CL zoning seen in lower petrologic types. Chondrule rims and matrix show dim,  
4 dark red and blue CL (>type 3.4, <type 4).

5 **Geochemistry:** (D. Sheikh, *FSU*) Olivine ( $\text{Fa}_{18.2\pm 11.1}$ , range  $\text{Fa}_{1.6-45.0}$ ,  $\text{CaO wt\%} = 0.11\pm 0.07$ ,  
6  $n=42$ ),  $\text{Cr}_2\text{O}_3$  in ferroan olivine ( $0.06\pm 0.04$  wt%, range 0.01-0.26,  $n=32$ ), Low-Ca Pyroxene  
7 ( $\text{Fs}_{9.6\pm 6.2}$   $\text{Wo}_{0.5\pm 0.4}$ , range  $\text{Fs}_{1.0-23.4}$   $\text{Wo}_{0.2-1.5}$ ,  $n=21$ ).

8 **Classification:** Ordinary Chondrite (LL3.5) LL group is due to average chondrule diameter  
9 and magnetic susceptibility. Subtype 3.5 is due to numerous reasons: 1) While devitrified  
10 mesostasis may be more dominant in the chondrules, there is still primary isotropic glassy  
11 mesostasis contained within some chondrules as evident by the 5% of A2 chondrules ([Dehart  
12 et al. 1992](#)). 2) The  $\text{Cr}_2\text{O}_3$  values and standard deviations for ferroan chondrule olivines plot  
13 in the 3.2 field for UOCs. 2) The measured fayalite and CaO values for chondrule olivines  
14 indicate a petrologic type <3.8 (Huss et al. 2006). Overall, the presence of primary glassy  
15 mesostasis and ferroan olivine containing low subtype  $\text{Cr}_2\text{O}_3$  values in a small percentage of  
16 chondrules (5%) indicates that the peak metamorphic temperature or duration during thermal  
17 metamorphism of the sample was not enough to fully devitrify the primary glassy chondrule  
18 mesostasis throughout all of the chondrules, one of the observed features for subtype  
19 3.6 ([Dehart et al. 1992](#)). Therefore, this sample is estimated to have a subtype of 3.5.  
20  
21

22 **Specimens:** 7.65 grams at *UCLA*; main mass with Stephen Amara.  
23  
24  
25

#### 26 Northwest Africa 13271 (NWA 13271)

27 Northwest Africa

28 Purchased: 2019 Aug

29 Classification: Ordinary chondrite (LL3.15)

30  
31 **History:** Purchased in August 2019 by Fabien *Kuntz* from a meteorite dealer in Zagora.

32 **Physical characteristics:** Single stone with dark-brown fusion crust.

33 **Petrography:** (D. Sheikh, *FSU*) Sample is a chondrite composed of well-defined chondrules  
34 (Av.  $800\pm 50$   $\mu\text{m}$ ) and a few dark, fine-grained inclusions (<4mm) set in a completely opaque  
35 matrix. Most chondrules preserve their primary isotropic glassy mesostasis, although some  
36 contain devitrified mesostasis.

37  
38 **Geochemistry:** Olivine ( $\text{Fa}_{17.1\pm 8.3}$ , range  $\text{Fa}_{0.4-30.0}$ ,  $\text{CaO wt\%} = 0.17\pm 0.12$ ,  $n=44$ ),  $\text{Cr}_2\text{O}_3$  in  
39 ferroan olivine ( $0.21\pm 0.11$  wt%, range 0.06-0.39,  $n=30$ ), Low-Ca Pyroxene  
40 ( $\text{Fs}_{11.5\pm 6.1}$   $\text{Wo}_{0.8\pm 0.6}$ , range  $\text{Fs}_{2.5-21.0}$   $\text{Wo}_{0.1-2.0}$ ,  $n=17$ ).

41 **Classification:** Ordinary Chondrite (LL3.15) LL group is due to average chondrule diameter  
42 and magnetic susceptibility. Subtype 3.15 is based on 1) mean  $\text{Cr}_2\text{O}_3$  value and standard  
43 deviation from ferroan olivines ([Grossman and Brearley, 2005](#)), similar to Y58, 2) The  
44 presence of a completely opaque matrix and primary isotropic glassy mesostasis in most  
45 chondrules, 3) The large observed range in Fa, Fs, and in CaO content of olivines ([Huss et al.,  
46 2006](#)).

47  
48 **Specimens:** 4.25 grams at *UCLA*; main mass with Fabien *Kuntz*.  
49  
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#### 51 Northwest Africa 13272 (NWA 13272)

52 (Northwest Africa)

53 Purchased: 2019 Dec

54 Classification: Ungrouped achondrite

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56 **History:** Found in Mauritania and purchased by Rachid and Jaouad Chaoui in December  
57 2019 from a dealer in Zouerat, Mauritania.  
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**Physical characteristics:** The specimen lacks fusion crust and is coated by a shiny brown desert patina. Polished interior surfaces reveal the presence of rare tiny specks of partially altered metal.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) The specimen has a fine grained, poikilitic igneous texture. Composed predominantly of polysynthetically-twinned, compositionally-zoned pyroxene oikocrysts (with domains of orthopyroxene, pigeonite and subcalcic augite) enclosing chadacrysts of olivine, together with interstitial devitrified silicic glass (pale pink in thin section) plus accessory troilite (some Cr-bearing), Ti-poor chromite and very rare kamacite (some altered to Fe hydroxides). Olivine is preferentially stained pale orange in thin section, and there are some cross-cutting dilation veins filled with comminuted olivine and orthopyroxene. Minor secondary calcite and anhydrite are present.

**Geochemistry:** Olivine ( $\text{Fa}_{24.0-29.5}$ ,  $N = 8$ ), orthopyroxene ( $\text{Fs}_{17.9-19.0}\text{Wo}_{2.0-3.8}$ ,  $N = 5$ ), pigeonite ( $\text{Fs}_{18.9-19.0}\text{Wo}_{7.2-9.0}$ ,  $N = 2$ ), subcalcic augite ( $\text{Fs}_{12.2-12.6}\text{Wo}_{33.7-37.1}$ ,  $N = 4$ ). Oxygen isotopes (K. Ziegler, *UNM*): analyses of acid-washed bulk subsamples by laser fluorination gave, respectively,  $\delta^{17}\text{O}$  4.120, 4.159, 4.045;  $\delta^{18}\text{O}$  5.908, 6.096, 5.717;  $\Delta^{17}\text{O}$  1.001, 0.940, 1.026 per mil.

**Classification:** Achondrite (ungrouped, igneous, with oxygen isotopic affinity to L chondrites).

**Specimens:** 22.1 g including one polished thin section at *UWB*; remainder held by Mr. R. Chaoui and Mr. J. Chaoui.

#### Northwest Africa 13273 (NWA 13273)

(Northwest Africa)

Purchased: 2019 Oct

Classification: Ordinary chondrite (L6)

**History:** Purchased by Grant Harkness in October 2019 from a dealer in Zagora, Morocco, and later sold to Patrick Brown.

**Petrography:** (A. Irving, *UWS* and J. Boesenberg, *BrownU*) Extensively recrystallized specimen with rare remnant partial chondrules and altered metal grains.

**Geochemistry:** Olivine ( $\text{Fa}_{24.8\pm 0.3}$ , range  $\text{Fa}_{24.5-25.3}$ ,  $N = 5$ ), low-Ca pyroxene ( $\text{Fs}_{20.8\pm 0.2}\text{Wo}_{1.3\pm 0.3}$ , range  $\text{Fs}_{20.6-21.1}\text{Wo}_{1.0-1.7}$ ,  $N = 5$ ), augite ( $\text{Fs}_{7.8\pm 0.8}\text{Wo}_{44.5\pm 0.8}$ , range  $\text{Fs}_{6.9-8.3}\text{Wo}_{43.5-45.1}$ ,  $N = 3$ ).

**Classification:** Ordinary chondrite (L6).

**Specimens:** 53.95 g including one polished thin section at *PSF*; main mass plus one polished thin section with Mr. P. Brown.

#### Northwest Africa 13274 (NWA 13274)

(Northwest Africa)

Purchased: 2019

Classification: Ungrouped achondrite

**History:** Purchased by Mark Lyon in December 2019 and January 2020 from two separate Moroccan dealers.

**Physical characteristics:** A total of eight similar-appearing brown stones (combined weight 255.5 g).

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Analysis of two different stones shows this material to be composed predominantly of larger grains (mean size  $\sim 0.6$  mm) of finely-exsolved low-Ca and high-Ca pyroxenes plus polygranular calcic plagioclase, together

with accessory silica polymorph, ferroan olivine, merrillite, chromite, ilmenite, Cr ulvöspinel, troilite and pentlandite (stained).

**Geochemistry:** Low-Ca pyroxene ( $\text{Fs}_{62.2-63.6}\text{Wo}_{6.3-6.8}$ ,  $\text{FeO/MnO} = 60-65$ ,  $N = 6$ ), high-Ca pyroxene ( $\text{Fs}_{34.8-35.9}\text{Wo}_{38.1-39.1}$ ,  $\text{FeO/MnO} = 60-69$ ,  $N = 5$ ), olivine ( $\text{Fa}_{72.1-82.0}$ ,  $\text{FeO/MnO} = 90-100$ ,  $N = 4$ ), plagioclase ( $\text{An}_{84.8-88.2}\text{Or}_{0.3}$ ,  $N = 3$ ).

**Classification:** Achondrite (ungrouped). Paired with [NWA 011](#), [NWA 2400](#), [NWA 2976](#), [NWA 4587](#), [NWA 4901](#) and [NWA 8545](#).

**Specimens:** 20.7 g including one polished thin section at *UWB*; remainder with Mr. M. Lyon.

### Northwest Africa 13275 (NWA 13275)

(Northwest Africa)

Purchased: 2019 Oct

Classification: Ordinary chondrite (L6)

**History:** Purchased by Grant Harkness in October 2019 from a dealer in Zagora, Morocco, and later sold to Patrick Brown.

**Petrography:** (A. Irving, *UWS* and J. Boesenberg, *BrownU*) Extensively recrystallized specimen with rare remnant partial chondrules and stained metal grains.

**Geochemistry:** Olivine ( $\text{Fa}_{24.9\pm 0.6}$ , range  $\text{Fa}_{24.0-25.6}$ ,  $N = 7$ ), low-Ca pyroxene ( $\text{Fs}_{20.7\pm 0.2}\text{Wo}_{1.5\pm 0.2}$ , range  $\text{Fs}_{20.4-21.0}\text{Wo}_{1.1-1.8}$ ,  $N = 5$ ), augite ( $\text{Fs}_{8.6\pm 0.9}\text{Wo}_{43.8\pm 0.9}$ , range  $\text{Fs}_{7.7-9.5}\text{Wo}_{43.0-44.8}$ ,  $N = 3$ ).

**Classification:** Ordinary chondrite (L6).

**Specimens:** 53.95 g including one polished thin section at *PSF*; main mass plus one polished thin section with Mr. P. Brown.

### Northwest Africa 13276 (NWA 13276)

(Northwest Africa)

Purchased: 2019 Dec

Classification: Martian meteorite (Shergottite)

**History:** Four separate but identical-appearing stones were purchased in December 2019 independently by Aziz Habibi (2200 g, 772 g) and Rachid Chaoui (390g, 290 g) from dealers in Mali and Mauritania. Subsequently the 2200 g and 772 g stones were acquired by Darryl Pitt, and the 290 g stone was acquired by Dr. David Gregory.

**Physical characteristics:** The specimens lack fusion crust. Fresh interiors are relatively coarse grained and exhibit deep brown olivine grains accompanied by pale green pyroxene and sparkling interstitial maskelynite.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Poikilitic texture (mean grain size 0.7 mm). Composed predominantly of compositionally-zoned pyroxene oikocrysts (with domains of pigeonite and subcalcic augite) enclosing chadacrysts of shock-darkened olivine (with limited compositional zoning), accompanied by lath-like maskelynite and accessory Ti-poor chromite, Ti-chromite, ilmenite, merrillite, pyrrhotite, pentlandite and baddeleyite. Melt inclusions are present within olivine grains. Small shock melt pockets are present and minor secondary barite was observed.

**Geochemistry:** Olivine ( $\text{Fa}_{33.1-37.1}$ ,  $\text{FeO/MnO} = 46-53$ ,  $N = 14$ ), zoned olivine (core  $\text{Fa}_{40.4}$ , rim  $\text{Fa}_{35.2}$ ,  $\text{FeO/MnO} = 51-53$ ), pigeonite cores ( $\text{Fs}_{21.5-22.8}\text{Wo}_{3.4-7.6}$ ,  $\text{FeO/MnO} = 27-32$ ,  $N = 7$ ), subcalcic augite cores ( $\text{Fs}_{15.5-18.5}\text{Wo}_{27.6-33.1}$ ,  $\text{FeO/MnO} = 25-27$ ,  $N = 4$ ), pigeonite rims ( $\text{Fs}_{23.0-30.0}\text{Wo}_{8.6-14.0}$ ,  $\text{FeO/MnO} = 27-30$ ,  $N = 7$ ), subcalcic augite rims ( $\text{Fs}_{15.6-16.4}\text{Wo}_{32.5-36.7}$ ,  $\text{FeO/MnO} = 23-26$ ,  $N = 3$ ), maskelynite ( $\text{An}_{57.5-59.5}\text{Or}_{1.6-0.9}$ ,  $N = 6$ ).

**Classification:** Shergottite (poikilitic).

**Specimens:** 21.5 g including one polished thin section at *UWB*; remainder with Mr. A. Habibi, Mr. R. Chaoui and Dr. D. Gregory.

### Northwest Africa 13277 (NWA 13277)

(Northwest Africa)

Purchased: 2019

Classification: Ordinary chondrite (L, melt rock)

**History:** Purchased by Mark Lyon in December 2019 and January 2020 from a single Moroccan dealer.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) The specimen has an igneous texture and is moderately vesicular. Composed predominantly of compositionally-zoned olivine and polysynthetically-twinned low-Ca pyroxene with subordinate higher-Ca pyroxenes, sodic plagioclase, troilite, minor chromite and interstitial quenched glassy mesostasis. Much of the olivine is poikilitically enclosed in pyroxene. Metal is almost completely absent except for one occurrence of kamacite in a large troilite grain. Minor secondary barite was observed.

**Geochemistry:** Olivine ( $\text{Fa}_{25.4\pm 3.0}$ , range  $\text{Fa}_{22.1-30.3}$ ,  $N = 9$ ), low-Ca pyroxene ( $\text{Fs}_{22.2\pm 0.2}\text{Wo}_{3.2\pm 0.4}$ , range  $\text{Fs}_{22.02-9-3.6-22.4}\text{Wo}$ ,  $N = 3$ ), subcalcic augite ( $\text{Fs}_{17.4-23.0}\text{Wo}_{30.3-33.3}$ ;  $\text{Fs}_{39.7}\text{Wo}_{36.2}$ ;  $N = 3$ ), augite ( $\text{Fs}_{34.3}\text{Wo}_{44.9}$ ), fayalite in matrix ( $\text{Fa}_{87.5}$ ), plagioclase ( $\text{Ab}_{77.3-84.3}\text{An}_{15.3-6.0}\text{Or}_{7.4-9.8}$ ,  $N = 2$ ).

**Classification:** Ordinary chondrite (L-melt rock, vesicular, metal-poor). This material has some similarities to [NWA 11253](#), although the metal content is much lower.

**Specimens:** 20.1 g including one polished thin section at *UWB*; remainder with Mr. M. Lyon.

### Northwest Africa 13278 (NWA 13278)

(Northwest Africa)

Purchased: 2019 Nov

Classification: Enstatite achondrite (Aubrite)

**History:** Purchased by Zaid Sbitti in November 2019 from a dealer in Ouargla, Algeria.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Breccia composed of large clasts of enstatite (with diopside exsolution lamellae) and subordinate forsterite set within a finer grained matrix composed of enstatite, sodic plagioclase, Cr-troilite, niningerite and Si-bearing kamacite.

**Geochemistry:** Enstatite ( $\text{Fs}_{0.0-0.1}\text{Wo}_{0.9-1.1}$ ,  $N = 2$ ), diopside ( $\text{Fs}_{0.0-0.1}\text{Wo}_{44.4-45.8}$ ,  $N = 2$ ), forsterite ( $\text{Fa}_{0.0\pm 0.0}$ ,  $N = 2$ ), plagioclase ( $\text{Ab}_{86.1}\text{An}_{0.5}\text{Or}_{13.4}$ ), kamacite ( $\text{Ni} = 3.0$  wt.%,  $\text{Si} = 3.1$  wt.%), troilite ( $\text{Cr} = 2.8$  wt.%).

**Classification:** Aubrite.

**Specimens:** 24.7 g in the form of a polished endcut at *UWB*; remainder held by Mr. L. Ouabicha and Mr. Z. Sbitti.

### Northwest Africa 13279 (NWA 13279)

(Northwest Africa)

Purchased: 2019 Apr

Classification: Carbonaceous chondrite (CV3)

**History:** Purchased by Mark Lyon in April 2019 from a Moroccan dealer.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Well-formed PO and BO chondrules (apparent diameter  $890 \pm 400 \mu\text{m}$ ,  $N = 24$ ) and irregularly-shaped, very fine grained CAI are set in fine grained matrix ( $\sim 20 \text{ vol.}\%$ , deep reddish sepia brown in thin section).

**Geochemistry:** Olivine in chondrules ( $\text{Fa}_{11.8 \pm 14.2}$ , range  $\text{Fa}_{0.4-38.2}$ ,  $N = 7$ ), low-Ca pyroxene ( $\text{Fs}_{7.7 \pm 6.0} \text{Wo}_{2.2 \pm 1.3}$ , range  $\text{Fs}_{0.8-12.2} \text{Wo}_{1.0-3.6}$ ,  $N = 3$ ), olivine in matrix ( $\text{Fa}_{49.8-53.6}$ ,  $N = 2$ ), diopside ( $\text{Fs}_{0.5} \text{Wo}_{43.8}$ ;  $\text{Fs}_{0.5} \text{Wo}_{49.0}$ ;  $N = 2$ ), plagioclase ( $\text{An}_{81.6-88.0} \text{Or}_{0.0}$ ,  $N = 2$ ).

**Classification:** Carbonaceous chondrite (CV3).

**Specimens:** 20.9 g including one polished thin section at *UWB*; 1418 g main mass with Mr. C. Shipbaugh; remainder with Mr. M. Lyon.

#### Northwest Africa 13280 (NWA 13280)

(Northwest Africa)

Purchased: 2019 Jun

Classification: HED achondrite (Eucrite, polymict)

**History:** Purchased by Mbark Arjdal in June 2019 from an Algerian dealer.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Complex breccia composed of crystalline debris from several different types of eucrite together with minor ( $< 10 \text{ vol.}\%$ ) diagenetic orthopyroxene. Major minerals are exsolved and unexsolved low-Ca, predominantly pigeonitic pyroxenes (some more magnesian, others more ferroan) and calcic plagioclase with accessory augite, silica polymorph, ilmenite, Ti chromite and troilite.

**Geochemistry:** Diagenetic orthopyroxene ( $\text{Fs}_{24.3} \text{Wo}_{2.7}$ ;  $\text{Fs}_{27.8} \text{Wo}_{4.1}$ ;  $\text{FeO/MnO} = 25-29$ ,  $N = 2$ ), more magnesian low-Ca pyroxene ( $\text{Fs}_{34.7-39.4} \text{Wo}_{4.5-8.4}$ ,  $\text{FeO/MnO} = 27-33$ ,  $N = 3$ ), more ferroan low-Ca pyroxene ( $\text{Fs}_{47.9-55.4} \text{Wo}_{16.4-4.6}$ ,  $\text{FeO/MnO} = 29-33$ ,  $N = 4$ ), augite ( $\text{Fs}_{18.4} \text{Wo}_{44.3}$ ,  $\text{FeO/MnO} = 25$ ), fayalite ( $\text{Fa}_{75.3}$ ,  $\text{FeO/MnO} = 44$ ), plagioclase ( $\text{An}_{89.4-92.0} \text{Or}_{0.5-0.3}$ ,  $N = 3$ ).

**Classification:** Eucrite (polymict breccia).

**Specimens:** 27.2 g including one polished thin section at *UWB*; remainder with Mr. M. Arjdal.

#### Northwest Africa 13281 (NWA 13281)

Niger

Find: 2019

Classification: Ordinary chondrite (L5)

**History:** Found by nomads in Niger in 2019. Later purchased by Jesper Gronne from a Moroccan dealer in October 2019.

**Physical characteristics:** Sample contains a dark-brown fusion crust.

**Petrography:** (D. Sheikh, *FSU*) Sample is an equilibrated ordinary chondrite with blurred chondrule boundaries (Av.  $750 \pm 50 \mu\text{m}$ ,  $n=7$ ) and contains olivine, orthopyroxene, kamacite, taenite, troilite, chromite, merrillite, chlorapatite, iron oxides, and secondary recrystallized plagioclase ( $20 \pm 10 \mu\text{m}$ ).

**Geochemistry:** Olivine ( $\text{Fa}_{22.8 \pm 0.3}$ , range  $\text{Fa}_{22.2-23.2}$ ,  $n=30$ ), Orthopyroxene ( $\text{Fs}_{19.5 \pm 0.3} \text{Wo}_{1.3 \pm 0.2}$ , range  $\text{Fs}_{19.1-20.1} \text{Wo}_{1.0-1.6}$ ,  $n=30$ ).

**Classification:** Ordinary Chondrite (L5) based on Fa and Fs homogeneity, secondary recrystallized plagioclase grain size, and magnetic susceptibility.

**Specimens:** 55.73 grams at *UCLA*; main mass with Jesper Gronne.

#### Northwest Africa 13282 (NWA 13282)

Western Sahara

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3 Find: 2018

4 Classification: Ordinary chondrite (L3)

5 **History:** Found in Western Sahara in late 2018. Purchased on January 11, 2019, by John  
6 Higgins from a meteorite dealer in Morocco.

7 **Physical characteristics:** Single stone with dark-brown fusion crust.

8 **Petrography:** (D. Sheikh, *FSU*) Sample is a chondrite composed of well-defined chondrules  
9 (Av.  $750 \pm 50 \mu\text{m}$ ) set in a dark, fine-grained matrix containing silicates, Fe-Ni metal, troilite,  
10 and chromite. Most chondrules contain devitrified mesostasis.

11 **Geochemistry:** Olivine ( $\text{Fa}_{22.1 \pm 5.7}$ , range  $\text{Fa}_{3.1-28.7}$ ,  $n=26$ ), Low-Ca Pyroxene  
12 ( $\text{Fs}_{14.0 \pm 5.8} \text{Wo}_{0.8 \pm 0.5}$ , range  $\text{Fs}_{2.2-20.4} \text{Wo}_{0.2-2.2}$ ,  $n=16$ ).

13 **Classification:** Ordinary Chondrite (L3) due to chondrule size, Fa,Fs heterogeneity, and  
14 magnetic susceptibility.

15 **Specimens:** 22.25 grams at *UCLA*; main mass with John Higgins.  
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20 **Northwest Africa 13283** (NWA 13283)

21 (Northwest Africa)

22 Purchased: 2019

23 Classification: Lunar meteorite

24 **History:** In July 2019, Marc Jost purchased 8 fragments totaling 200.6 g from Aziz Mouadine  
25 in Rissani, Morocco.

26 **Physical characteristics:** Samples are angular in shape and are coated with a yellowish  
27 orange layer of caliche that covers the exterior. The samples have a dark-colored exterior with  
28 white-grey, angular clasts. The interior shows light colored brecciated clasts in a dark-  
29 colored, micro-vesicular matrix.

30 **Petrography:** Sample is a clast-supported breccia composed of: mm-cm-sized, angular  
31 micro-gabbroic and rare basaltic lithic fragments; mineral clasts of olivine, exsolved  
32 pigeonite, orthopyroxene and anorthite; impact melt breccias; quenched glassy fragments; and  
33 schlieren-textured, micro-vesicular glassy breccias (agglutinates) set within a fine-grained  
34 matrix. Additional minerals include: ilmenite, chromite, FeNi fragments and troilite.

35 **Geochemistry:** (A. Love, *App*) Olivine ( $\text{Fa}_{9.5-53.6}$ ,  $\text{Fe/Mn}=72.4-89.2$ ,  $n=12$ ), low-Ca pyroxene  
36 ( $\text{Fs}_{26.4-54.2} \text{Wo}_{2.0-4.7}$ ,  $\text{Fe/Mn}=53.0-60.3$   $n=8$ ), pigeonite ( $\text{Fs}_{30.5-39.7} \text{Wo}_{7.6-18.0}$ ), high-Ca pyroxene  
37 exsolution lamellae ( $\text{Fs}_{12.9-27.9} \text{Wo}_{36.9-41.4}$ ,  $n=9$ ), plagioclase ( $\text{An}_{96.4-98.3} \text{Or}_{0.0}$ ,  $n=10$ ).

38 **Classification:** Lunar (anorthosite regolith breccia). Fe/Mn ratios in and pyroxene and  
39 anorthite compositions suggest this is a lunar sample. Textures and mineralogy suggest  
40 sample is an anorthositic regolith breccia.

41 **Specimens:** Marc Jost (*SJS*) holds the main masses. A polished thin section and mount and  
42 fragment weighing 20.1 g are on deposit at *App*.  
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49 **Northwest Africa 13286** (NWA 13286)

50 (Northwest Africa)

51 Purchased: 2019

52 Classification: HED achondrite (Howardite)

53 **History:** A 1050 g sample was found in Morocco. Thierry Simard purchased the sample at a  
54 market in Agadir, Morocco in October 2019.

55 **Physical characteristics:** Sample is light-brown in color and has an irregular shape.  
56 Approximately 30% of the sample is covered by a dark-brown, wind-ablated fusion crust. The  
57 cut face shows the interior is a breccia composed of a heterogeneous mixture of lithic clasts  
58 and fragmental mineral debris.  
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**Petrography:** Description and classification (A. Love, *App*): Sample is a polymict breccia composed of 0.5-2 cm rounded-angular, unequilibrated (pyroxenes show zonation) and equilibrated lithic and mineral clasts. Sample contains a heterogeneous mixture of dominant (77 vol %) equilibrated basaltic and cumulate lithologies, subordinate (23 vol%) heterogeneous diogenites, impact melt clasts and symplectites. Eucritic clasts and mineral fragments contain exsolved pyroxenes and some contain fayalitic veins. Additional minerals are olivine, ilmenite, chromite, Si-polymorphs, troilite, apatite, ferroan pigeonite.

**Geochemistry:** (A. Love, *App*): Diogenite clasts: low Ca pyroxene ( $\text{Fs}_{27.7\pm 4.4}\text{Wo}_{2.5\pm 0.9}(\text{Fs}_{22.3-32.8}\text{Wo}_{1.2-3.8})$ , Mg# 71.6 $\pm$ 4.6, Fe/Mn=30.0 $\pm$ 2.1, n=6); eucrites: low Ca pyroxene ( $\text{Fs}_{49.8\pm 10.9}\text{Wo}_{3.6\pm 2.0}(\text{Fs}_{38.9-62.8}\text{Wo}_{1.6-7.0})$ , Fe/Mn=30.1 $\pm$ 1.9, n=7); high Ca pyroxene exsolution lamellae ( $\text{Fs}_{36.8\pm 10.1}\text{Wo}_{33.7\pm 9.5}(\text{Fs}_{27.9-49.8}\text{Wo}_{22.1-42.8})$ , Fe/Mn=30.3 $\pm$ 2.8, n=6); plagioclase ( $\text{An}_{91.2\pm 2.4}\text{Or}_{0.6\pm 0.2}$ ), n=6.

**Classification:** HED achondrite (Howardite). Textures, mineral compositions and modal estimates of clastic debris (Fe/Mn ratios) indicate this sample is a howardite.

**Specimens:** Thierry Simard holds the main mass. A polished thin section and a 20.3 g type specimen are on deposit at *App*.

### Northwest Africa 13287 (NWA 13287)

(Northwest Africa)

Purchased: 2017

Classification: HED achondrite (Eucrite)

**History:** Marc Jost (*SJS*) purchased the 705.4 g sample from Aziz Mouadine August 17, 2017, in Brügg, Switzerland.

**Physical characteristics:** The sample has a tabular shape and is ~45% covered by a dark-colored glossy fusion crust. The leading edge is decorated with radial flow lines. The cut face of the sample is light grey in color, unbrecciated, shows flakes of metal and has an interlocking crystalline texture.

**Petrography:** Description and Classification (A. Love, *App*) Sample has a fine-grained (avg. grain size 0.5 mm) granoblastic texture with anhedral crystals of: exsolved pyroxene (49 vol%); twinned plagioclase (43 vol%); Si polymorph (6 vol%); ilmenite (1 vol%) and Fe metal (1 vol%). Accessory minerals are: chromite and troilite and rare phosphates.

**Geochemistry:** (A. Love, *App*): Low-Ca pyroxene ( $\text{Fs}_{60.3\pm 0.4}\text{Wo}_{2.7\pm 0.5}$ , Fe/Mn=27.2 $\pm$ 0.3, Mg#38.8 $\pm$ 0.6, n=6); high-Ca pyroxene ( $\text{Fs}_{27.7\pm 0.3}\text{Wo}_{42.4\pm 0.2}$ , Fe/Mn=27.2 $\pm$ 0.5, n=6); plagioclase ( $\text{An}_{92.8\pm 0.2}\text{Or}_{0.2\pm 0.0}$ , n=5).

**Classification:** HED Achondrite (Eucrite). Based on recrystallized texture, equilibrated compositions, Fe/Mn and Mg# of orthopyroxenes, this sample is an unbrecciated, equilibrated basaltic eucrite M-S2 (Stoffler et al., 2018), low weathering.

**Specimens:** Marc Jost (*SJS*) holds the main mass. A 26.2 g type specimen and a polished thin section are on deposit at *App*.

### Northwest Africa 13288 (NWA 13288)

(Northwest Africa)

Purchased: 2019

Classification: HED achondrite (Eucrite)

**History:** Marc Jost (*SJS*) purchased the 633 g sample in June 2019 from Aziz Mouadine at the St. Marie aux Mines show, France.

**Physical characteristics:** Approximately 40% of this irregular-shaped stone is coated by a dark-brown, weathered fusion crust. The cut face shows the sample is a breccia composed of light- to dark-gray, cm-sized igneous-textured clasts.

**Petrography:** Description and classification (A. Love, *App*) Sample is a breccia composed of irregularly shaped, up to 3 cm, porphyritic (32 vol%) to basaltic (13 vol%) textured eucrite clasts, diogenite clasts (5 vol%) and vitrophyric shock-melted clasts (10 vol%) surrounded by a comminuted matrix of similar materials. Porphyritic eucrites display quenched textures composed of subequal amounts of up to 1 mm to 1 cm long, prismatic, hollow weakly-zoned, low-Ca pyroxene ("soda straw" texture) phenocrysts set within variolitic textured groundmass of 0.5 mm euhedral plagioclase laths. Basaltic clasts display intersertal texture composed of similar pyroxene morphologies and larger (1 mm avg. long dimension) skeletal - lath-shaped plagioclase that occur in a radial arrangement around pyroxenes. Diogenite occurs as unbrecciated, mosaiced crystalline fragments and a brecciated olivine and plagioclase-bearing lithology. Accessory minerals are a silica polymorph, ilmenite, chromite, troilite and phosphates.

**Geochemistry:** (A. Love, *App*): Diogenite: low Ca-pyroxene ( $\text{Fs}_{34.2\pm 4.1}\text{Wo}_{3.4\pm 0.6}$ ,  $\text{Mg}\#64.5\pm 4.4$ ,  $\text{Fe}/\text{Mn}=31.3\pm 0.8$ ,  $n=6$ ); olivine ( $\text{Fa}_{43.0}$ ,  $\text{Fe}/\text{Mn}=45.9$ ,  $n=1$ ). Basaltic clast: pigeonite ( $\text{Fs}_{40.1\pm 3.1}\text{Wo}_{16.3\pm 5.0}$ ,  $\text{Mg}\#52.5\pm 1.7$ ,  $\text{Fe}/\text{Mn}=28.1\pm 0.1$ ,  $n=3$ ); plagioclase ( $\text{An}_{93.4\pm 1.4}\text{Or}_{0.1\pm 0.1}$ ,  $n=2$ ). Quenched clasts: pigeonite ( $\text{Fs}_{43.8\pm 2.4}\text{Wo}_{8.2\pm 2.2}$ ,  $\text{Mg}\#52.2\pm 3.0$ ,  $\text{Fe}/\text{Mn}=27.8\pm 0.8$ ,  $n=6$ ); augite ( $\text{Fs}_{24.1}\text{Wo}_{40.2}$ ,  $\text{Fe}/\text{Mn}=25.7$ ,  $n=1$ ); plagioclase ( $\text{An}_{81.4\pm 2.8}\text{Or}_{1.2\pm 0.4}$ ,  $n=8$ ).

**Classification:** HED achondrite (polymict eucrite breccia). Based on textures and Fe/Mn ratios within pyroxenes, this sample is an HED breccia. Clast lithologies suggest this is a polymict eucrite breccia, low weathering level, MS-2 (Stöffler et al., 2018).

**Specimens:** Marc Jost (*SJS*) holds the main mass. A single slice weighing 21.88 g and a polished thin section and mount are on deposit at *App*.

### Northwest Africa 13289 (NWA 13289)

(Northwest Africa)

Purchased: 2019

Classification: Martian meteorite (Shergottite)

**History:** Marc Jost (*SJS*) purchased the 387.4g sample from Aziz Mouadine in Rissani, Morocco, in July, 2019.

**Physical characteristics:** Sample is irregular in shape and has a dark-brown, wind ablated surface. One portion of the stone contains a coating of orange caliche. The cut face shows an igneous texture composed of light greenish-gray colored interlocking crystals.

**Petrography:** Description and Classification (A. Love, *App*) Sample has an diabasic texture composed of 62 vol% chaotically-zoned, prismatic pyroxenes (568  $\mu\text{m}$  avg. length), 34 vol% lath-shaped maskelynite (781  $\mu\text{m}$  in length), Fe-Ti oxides with ilmenite lamellae, 2 vol% merrillite, mesostasis, pyrrhotite. Some pyroxenes show  $\sim 1\mu\text{m}$  exsolution lamellae. Maskelynite is zoned with K-bearing rims ( $\text{An}_{45}\text{Or}_4$ ) and more calcic cores ( $\text{An}_{49}\text{Or}_2$ ).

**Geochemistry:** (A. Love, *App*) Pyroxenes show two compositional trends: pigeonite ( $\text{Fs}_{35.7-59.1}\text{Wo}_{9.9-20.8}$ , average  $\text{Fs}_{48.2\pm 7.9}\text{Wo}_{15.2\pm 3.6}$ ,  $\text{Fe}/\text{Mn}=35.2\pm 2.6$ ,  $n=21$ ) and augite ( $\text{Fs}_{20.0-46.7}\text{Wo}_{36.5-28.5}$ , average  $\text{Fs}_{48.2\pm 6.8}\text{Wo}_{32.3\pm 2.0}$ ,  $\text{Fe}/\text{Mn}=30.3\pm 3.0$ ,  $n=26$ ). Ferropigeonite ( $\text{Fs}_{67.7\pm 2.9}\text{Wo}_{17.1\pm 0.1}$ ,  $\text{Fe}/\text{Mn}=36.8\pm 1.8$ ,  $n=2$ ). Maskelynite ( $\text{An}_{47.5\pm 5.2}\text{Or}_{2.7\pm 1.7}$ ,  $n=18$ ).

**Classification:** Martian (basaltic shergottite). Based on chaotic patchy zonation, distinctive compositions and Fe/Mn ratios of pyroxenes and compositions of maskelynite, this sample is a martian meteorite. Mineralogy and textures suggest this is a basaltic shergottite, M-S4 (Stöffler et al., 2018) low weathering grade.

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3 **Specimens:** Marc Jost (*SJS*) holds the main mass. A polished thin section, an endcut, a slice  
4 and few fragments weighing 21.87 g are on deposit at *App*.  
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#### 8 **Northwest Africa 13290** (NWA 13290)

9 Algeria

10 Find: 2019 Apr

11 Classification: Ordinary chondrite (H6)

12 **History:** Purchased in June 2019 by Juan Aviles Poblador from a meteorite dealer in Algeria.

13 **Physical characteristics:** Sample has a slightly weathered fusion crust.

14 **Petrography:** (D. Sheikh, *FSU*) Sample is an equilibrated chondrite containing blurred  
15 chondrules (0.2-1.1mm, n=5), secondary recrystallized albitic feldspar (Av.  $62\pm 5$   $\mu\text{m}$ ),  
16 troilite, kamacite, Fe oxides, chlorapatite, and chromite.

17 **Geochemistry:** Olivine ( $\text{Fa}_{18.8\pm 0.3}$ , range  $\text{Fa}_{18.3-19.2}$ , n=23), Low-Ca Pyroxene  
18 ( $\text{Fs}_{16.3\pm 0.2}\text{Wo}_{1.2\pm 0.2}$ , range  $\text{Fs}_{16.2-16.5}\text{Wo}_{0.8-1.4}$ , n=8).

19 **Classification:** Ordinary Chondrite (H6)

20 **Specimens:** 20.62 grams at *UCLA*; main mass with Juan Aviles Poblador.  
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#### 25 **Northwest Africa 13291** (NWA 13291)

26 (Northwest Africa)

27 Purchased: April 2019

28 Classification: Ordinary chondrite (H5)

29 **History:** Purchased by Juan Aviles Poblador in April 2019 from a meteorite dealer in  
30 Mauritania.

31 **Physical characteristics:** Single stone with dark-brown fusion crust.

32 **Petrography:** (D. Sheikh, *FSU*) Sample is an equilibrated chondrite containing blurred  
33 chondrules (0.2-1.1mm, n=6), secondary recrystallized albitic feldspar (Av.  $15\pm 5$   $\mu\text{m}$ ),  
34 troilite, kamacite, Fe-oxides, and chromite.

35 **Geochemistry:** Olivine ( $\text{Fa}_{18.0\pm 0.3}$ , range  $\text{Fa}_{17.5-18.5}$ , n=27), Low-Ca Pyroxene  
36 ( $\text{Fs}_{15.9\pm 0.2}\text{Wo}_{1.1\pm 0.2}$ , range  $\text{Fs}_{15.6-16.1}\text{Wo}_{0.9-1.3}$ , n=5).

37 **Classification:** Ordinary Chondrite (H5)

38 **Specimens:** 38.3 g at *UCLA*; main mass with Juan Aviles Poblador.  
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#### 44 **Northwest Africa 13292** (NWA 13292)

45 Algeria

46 Find: 2019

47 Classification: Ordinary chondrite (H3)

48 **History:** Acquired by Juan Aviles Poblador in 2019 from Brahim Tahiri in Morocco.

49 **Physical characteristics:** Two stones with dark-brown fusion crust.

50 **Petrography:** (D. Sheikh, *FSU*) Sample is a chondrite containing abundant chondrules (Av.  
51  $450\pm 50$   $\mu\text{m}$ ), troilite, kamacite, Fe-oxides, and chromite in an opaque matrix.

52 **Geochemistry:** Olivine ( $\text{Fa}_{17.2\pm 3.6}$ , range  $\text{Fa}_{2.8-21.1}$ , n=30), Low-Ca Pyroxene  
53 ( $\text{Fs}_{13.9\pm 3.9}\text{Wo}_{1.1\pm 0.5}$ , range  $\text{Fs}_{4.5-18.6}\text{Wo}_{0.3-2.5}$ , n=33).

54 **Classification:** Ordinary Chondrite (H3)

55 **Specimens:** 22.41 g at *UCLA*; main mass with Juan Aviles Poblador.  
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#### 60 **Northwest Africa 13293** (NWA 13293)

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Algeria

Find: 2019

Classification: Ordinary chondrite (LL3)

**History:** Purchased by Stephen Amara from Mustapha Hnini on 11/5/2019.

**Physical characteristics:** Single stone with dark-brown fusion crust.

**Petrography:** (D. Sheikh, *FSU*) Sample is a chondrite containing abundant chondrules (Av.  $750 \pm 50$   $\mu\text{m}$ ), troilite, Fe-oxides, and chromite in an opaque matrix.

**Geochemistry:** Olivine ( $\text{Fa}_{18.3 \pm 10.8}$ , range  $\text{Fa}_{0.8-39.2}$ ,  $n=50$ ), Low-Ca Pyroxene ( $\text{Fs}_{18.5 \pm 6.5} \text{Wo}_{1.2 \pm 0.7}$ , range  $\text{Fs}_{3.5-28.7} \text{Wo}_{0.2-2.6}$ ,  $n=15$ ).

**Classification:** Ordinary Chondrite (LL3)

**Specimens:** 20.98 g at *UCLA*; main mass with Stephen Amara.

#### Northwest Africa 13294 (NWA 13294)

(Northwest Africa)

Purchased: 2018

Classification: HED achondrite (Eucrite)

**History:** Purchased by Shawn Kashay in 2018 from Mustapha Hnini in Algeria.

**Physical characteristics:** Single stone with minor fusion crust.

**Petrography:** (D. Sheikh, *FSU*) Sample is a fine-grained eucrite containing low-calcium pyroxene, pigeonite, augite, calcic plagioclase, silica glass, Si-Al-Ca rich glass, and ilmenite. Minor secondary calcite weathering veins present.

**Geochemistry:** Low-Ca pyroxene ( $\text{Fs}_{60.7 \pm 1.9} \text{Wo}_{2.6 \pm 0.8}$ , range  $\text{Fs}_{58.1-64.6} \text{Wo}_{1.3-4.1}$ ,  $\text{FeO/MnO}=30 \pm 2$ ,  $n=16$ ); pigeonite ( $\text{Fs}_{53.2 \pm 3.1} \text{Wo}_{12.1 \pm 3.0}$ , range  $\text{Fs}_{48.1-56.7} \text{Wo}_{7.6-17.2}$ ,  $\text{FeO/MnO}=31 \pm 4$ ,  $n=9$ ); augite ( $\text{Fs}_{28.7 \pm 4.6} \text{Wo}_{38.7 \pm 3.7}$ , range  $\text{Fs}_{23.3-34.9} \text{Wo}_{31.4-42.2}$ ,  $\text{FeO/MnO}=30 \pm 3$ ,  $n=8$ ); calcic plagioclase ( $\text{An}_{89.8 \pm 2.4}$ , range  $\text{An}_{85.8-96.7}$ ,  $n=26$ ).

**Classification:** HED achondrite (Eucrite)

**Specimens:** 5.35 grams at *UCLA*; main mass with Shawn Kashay.

#### Northwest Africa 13295 (NWA 13295)

Algeria

Find: 2019

Classification: Carbonaceous chondrite (CV3)

**History:** Purchased by Stephen Amara from Mustapha Hnini in Algeria on 26 Dec 2019.

**Physical characteristics:** Single stone with dark-brown fusion crust.

**Petrography:** (D. Sheikh, *FSU*) Sample is a chondrite containing abundant chondrules (Av.  $1.2 \pm 0.1$  mm), CAIs (Av.  $1.4 \pm 0.1$  mm), and Fe-oxides in an opaque matrix.

**Geochemistry:** Olivine ( $\text{Fa}_{30.0 \pm 21.2}$ , range  $\text{Fa}_{5.7-63.4}$ ,  $n=44$ ), Low-Ca Pyroxene ( $\text{Fs}_{4.2 \pm 1.5} \text{Wo}_{2.4 \pm 0.9}$ , range  $\text{Fs}_{2.0-6.4} \text{Wo}_{1.6-3.5}$ ,  $n=8$ ).

**Classification:** Carbonaceous Chondrite (CV3, CVOxA subgroup). Lack of Fe-Ni metal points to the oxidized subgroup. Magnetic susceptibility points to CVOxA subgroup ([Bonal et al., 2020](#)).

**Specimens:** 27.27 grams at *UCLA*; main mass with Stephen Amara.

#### Northwest Africa 13296 (NWA 13296)

Algeria

Find: 2019

Classification: HED achondrite (Eucrite, brecciated)

**History:** Purchased by Matthew Stream in 2019 from a meteorite dealer in Algeria.

**Physical characteristics:** Single stone with minor fusion crust.

**Petrography:** (D. Sheikh, *FSU*) Sample is a brecciated eucrite containing low-calcium pyroxene, pigeonite, augite, calcic plagioclase, ilmenite, SiO<sub>2</sub> glass, troilite, fayalite, zircon, chromite (some with Ti), and baddeleyite.

**Geochemistry:** Low-Ca pyroxene (Fs<sub>60.5±1.1</sub>Wo<sub>2.1±0.5</sub>, range Fs<sub>57.2-62.7</sub>Wo<sub>1.5-4.2</sub>, FeO/MnO=32±3, n=60); pigeonite (Fs<sub>54.6±3.5</sub>Wo<sub>10.8±4.1</sub>, range Fs<sub>46.4-58.1</sub>Wo<sub>6.5-18.3</sub>, FeO/MnO=33±3, n=10); augite (Fs<sub>26.7±2.3</sub>Wo<sub>42.5±2.8</sub>, range Fs<sub>25.2-32.5</sub>Wo<sub>35.8-45.4</sub>, FeO/MnO=32±3, n=12); calcic plagioclase (An<sub>85.1±3.0</sub>, range An<sub>79.1-92.7</sub>, n=50), Ilmenite (Fe/(Fe+Mg)=97.8±0.3, n=4); fayalite (Fa<sub>80.1</sub>, n=1).

**Classification:** HED achondrite (Eucrite, brecciated)

**Specimens:** 22.51 grams at *UCLA*; main mass with Matthew Stream.

### Northwest Africa 13297 (NWA 13297)

Algeria

Purchased: 2020

Classification: Ordinary chondrite (LL3)

**History:** A sample comprised of many weathered pieces weighing 1973 g were found by meteorite prospectors in Algeria and sold to Mohamed Elguirah in Laayoune, Morocco. John Higgins and Carlos Muñecas Muñoz purchased the samples in 2020.

**Physical characteristics:** Most samples are tabular in shape. One sample has an irregular ovoid shape with a dark brown weathered exterior. The cut face of the irregular sample shows a fresh, unweathered interior composed of abundant chondrules surrounded by fine-grained sulfide rims. FeNi grains occur within the interiors of chondrules. The unweathered interior is surrounded by a well-developed weathering rind with concentric cracks that surround unweathered interior. Material in the weathering rind is identical to tabular samples.

**Petrography:** Description and classification (A. Love, *App*) Sample has a chondritic texture composed of distinct, close-packed chondrules with an average apparent diameter of 763 μm (n=77) set within an opaque fine-grained, clastic matrix. Chondrules are surrounded by fine-grained rims of sulfide and have mesostasis commonly composed of isotropic glass and devitrified glass (dominant). Additional minerals are troilite, apatite and secondary calcite.

**Geochemistry:** (A. Love, *App*) Olivine (Fa<sub>16.7±10.2</sub>(Fa<sub>0.6-30.1</sub>), Fe/Mn=36.6±11.8, n=12. Cr<sub>2</sub>O<sub>3</sub> in type II chondrules has an average of 0.22±0.10, n=10); low Ca-pyroxene (Fs<sub>12.9±10.1</sub>Wo<sub>0.9±0.6</sub>(Fs<sub>1.7-34.5</sub>Wo<sub>0.2-2.5</sub>), n=10).

**Classification:** Ordinary chondrite (LL3, C-S3, W1-3) Based on chondrule size and magnetic susceptibility this sample is an LL chondrite. Estimated subtype for this sample is between 3.15 and 3.2 based on unequilibrated compositions, presence of isotropic glass mesostasis (<3.3), yellow CL in chondrule mesostasis (3.1-3.2) and presence of red luminescence in chondrule olivine <3.5) and low CL of matrix (>3.1).

**Specimens:** John Higgins holds 1213 g including the 250 g main mass and Carlos Muñoz holds and additional 760 g of tabular fragments. Many spalled tabular fragments and an endcut weighing a total of 130 g are and a polished thin section are on deposit at *App*.

### Northwest Africa 13298 (NWA 13298)

Morocco

Purchased: 2020

Classification: Ordinary chondrite (LL3)



**History:** Fabien *Kuntz* purchased the 730 g sample in Errachidia, Morocco, from a meteorite prospector in 2020.

**Physical characteristics:** Sample is brownish-yellow in color, has a rounded, irregular shape and displays a heavily sand-blasted interior which shows chondrules up to cm in size.

Abundant chondrules and clasts are visible on the cut face showing the interior of the sample.

**Petrography:** Description and classification (A. Love, *App*) Sample is a breccia composed of unequilibrated type 3 clasts in a host type 3 material. Host is composed of distinct, close-packed 805 $\mu$ m (avg. dia.) chondrules in opaque matrix. Chondrules with isotropic glass are present, but devitrified mesostasis is dominant. Clasts contain unequilibrated chondrules set in a transparent and brecciated matrix.

**Geochemistry:** (A. Love, *App*) Host: Olivine (Fa<sub>16.8±11.9</sub> (Fa<sub>0.7-38.7</sub>), Fe/Mn=50.3±22.2, n=11.

Mean Cr<sub>2</sub>O<sub>3</sub> in type II 0.08 Wt% and sigma of 0.05, n=9); low Ca-pyroxene

(Fs<sub>16.2±13.6</sub>Wo<sub>1.0±0.6</sub> (Fs<sub>2.1-28.9</sub>Wo<sub>0.3-2.0</sub>), n=10). Clast A: olivine (Fa<sub>14.5±5.2</sub>, n=4); low Ca

pyroxene (Fs<sub>15.2</sub>Wo<sub>1.3</sub>, n=1). Clast B: Olivine (Fa<sub>10.8±4.9</sub>, n=2); low Ca pyroxene

(Fs<sub>17.9±0.7</sub>Wo<sub>0.5±/-0.1</sub>, n=2).

**Classification:** Ordinary chondrite (LL3, C-S3, W2) Based on texture, chondrule size and magnetic susceptibility this sample is an LL chondrite breccia. Estimated subtype for this sample is 3.5 based on unequilibrated compositions, presence of isotropic glass mesostasis (3.4-3.5), lack of yellow CL in chondrule mesostasis (>3.4) and presence of red luminescence in chondrule olivine >3.5). Clasts A & B are type 3 (>3.5) based on unequilibrated olivine compositions and CL signatures.

**Specimens:** Fabien *Kuntz* holds the main mass. A thick slice and several smaller slices and fragments comprise the 36.43g type specimen. A polished thin section and mount are on deposit at *App*.

### Northwest Africa 13299 (NWA 13299)

Algeria

Purchased: 2020

Classification: Enstatite chondrite (EH3)

**History:** Fabien *Kuntz* purchased the 298.8 g sample from a nomad in Tindouf, Algeria, in 2020.

**Physical characteristics:** Sample has a brown weathered exterior, is irregular in shape, and has a distinctive odor of sulfur during cutting, grinding and polishing operations. The interior of the sample is metal-rich. Abundant small light-gray chondrules are visible on the cut face.

**Petrography:** Description and classification (A. Love, *App*): Sample shows a chondritic texture composed of ovoid chondrules and fragments with an average apparent diameter 299  $\mu$ m (n=66) set within a fine-grained clastic matrix composed of opaques and silicates. Sample contains poikilitic chondrules with olivine chadacrysts and porphyritic chondrules contain clear isotropic mesostasis. Additional minerals are: daubr elite, niningerite, schreibersite, djerfisherite, rudashevskyite, troilite ( 2wt% Cr), perryite, Si polymorph, albitic plagioclase. Si-bearing kamacite has an average of 2.41 wt% Si.

**Geochemistry:** (A. Love, *App*) Low-Ca pyroxene, Fs<sub>4.1±4.3</sub>Wo<sub>0.6±0.5</sub> (Fs<sub>0.6-16.9</sub>Wo<sub>0.2-2.4</sub>, n=18); olivine, Fa<sub>0.6±0.2</sub>, Cr<sub>2</sub>O<sub>3</sub>=0.3±0.1 (Fa<sub>0.4-0.9</sub>, n=7).

**Classification:** Enstatite chondrite (EH3, C-S3, W2). Textures, mineralogy, mineral chemistry, cathodoluminescence, chondrule diameters and magnetic susceptibility indicate this sample is an unequilibrated EH chondrite.

**Specimens:** Fabien *Kuntz* holds the main mass. A 31.27 g slice and polished thin section are on deposit at *App*.

**Northwest Africa 13300 (NWA 13300)**

Ouargla, Algeria

Purchased: 2019

Classification: Ordinary chondrite (L5)

**History:** The 20.5 g fragment was found by a Bedouin named Bobakar in Ouargla, Algeria, in February of 2018. Dave Lehman and his partner acquired the sample in 2019.

**Physical characteristics:** Sample is ovoid in shape and has a dark-brown, wind-ablated surface. The interior of the stone is crystalline and shows sparse weakly discernible chondrules and fragments.

**Petrography:** Classification and Description (A. Love, *App*): Sample has a recrystallized chondritic texture composed of indistinct chondrules and secondary plagioclase with an avg. crystal length of  $39\mu\text{m}$  ( $n=18$ ). Chondrules have an avg. apparent diameter  $1028\mu\text{m}$  ( $n=12$ ). Additional minerals are chromite, apatite, secondary calcite.

**Geochemistry:** (A. Love, *App*) Olivine ( $\text{Fa}_{25.2\pm 1.3}$ ,  $\text{Fe/Mn}=46.4\pm 2.4$ ,  $n=3$ ), low-Ca pyroxene ( $\text{Fs}_{21.6\pm 0.3}\text{Wo}_{1.4\pm 0.1}$ ,  $n=3$ ).

**Classification:** Ordinary chondrite (L5 C-S2 W3) Based on compositions of ferromagnesian minerals, sample is an L chondrite. Based on grain size of secondary plagioclase this is an L5.

**Specimens:** Dave Lehman and his partner hold the main mass. A 4.37 g slice and polished mount are on deposit at *App*.

**Northwest Africa 13302 (NWA 13302)**

Morocco

Purchased: 2020

Classification: Mesosiderite- A3

**History:** The 402.8 g sample was found in Morocco. Fabien *Kuntz* purchased the sample in Zagora, Morocco, in February 2020.

**Physical characteristics:** Sample is irregular in shape and has a reddish-brown exterior with visible flakes of metal protruding through the surface. The cut face shows a metal-rich interior with angular clasts of pyroxene.

**Petrography:** Sample is a breccia composed of: 0.5-10 mm clasts of normally zoned, anhedral orthopyroxene ( $\text{Fs}_{18-32}\text{Wo}_{0.9-2.4}$ ) and 8 vol% unzoned, anhedral olivine ( $\text{Fa}_{34.72-37.49}$ ) set within a matrix of:  $523\mu\text{m}$  (avg. grain size) poikiloblastic, exsolved Opx ( $\text{Fs}_{34.5\pm 1.4}\text{Wo}_{2.4\pm 0.23}$ ) (all pyx 47 vol%);  $257\mu\text{m}$  anhedral plagioclase (22 vol%), and 18 vol% cm-sized rounded nuggets and irregularly shaped intergrowths of FeNi metal. Matrix pyroxenes show lamellar to blebby exsolution. Olivine shows reaction coronas. Orthopyroxene makes up 63% of silicates and plagioclase makes up 31% of silicates.

Additional minerals are: kamacite, taenite, lath-shaped Si polymorph (5 vol%), apatite, troilite, FeNi metal, chromite, trace ilmenite.

**Geochemistry:** (A. Love, *App*) Olivine,  $\text{Fa}_{36.1\pm 1.4}$  ( $\text{Fa}_{34.7-37.5}$ ),  $\text{Fe/Mn}=36.8-36.8$ ,  $n=2$ ); low-Ca pyroxene,  $\text{Fs}_{30.6\pm 4.5}\text{Wo}_{2.0\pm 0.5}$  ( $\text{Fs}_{23.0-35.6}\text{Wo}_{1.4-2.7}$ ,  $\text{Fe/Mn}=25.3\pm 2.6$ ,  $n=8$ ); high-Ca pyroxene ( $\text{Fs}_{17.2}\text{Wo}_{38.8}$ ,  $n=1$ ); plagioclase ( $\text{An}_{93.0\pm 1.0}\text{Or}_{0.1\pm 0.0}$ ,  $n=8$ ).

**Classification:** Mesosiderite (class A3) Sample is type A based on modal abundance of plagioclase and orthopyroxene. Sample is type 3 based on poikiloblastic texture with interlocking grain boundaries and inverted, exsolved pyroxenes.

**Specimens:** Fabien *Kuntz* holds the main mass. An endcut and part slice weighing 33.9 0g and a polished mount are on deposit at *App*.

**Northwest Africa 13303 (NWA 13303)**

(Northwest Africa)

Purchased: 2019

Classification: Ureilite

**History:** Dustin Dickens was given a single stone for analysis in village of Ait Youb by a dealer named Zaid from southern Morocco.

**Physical characteristics:** Exterior with desert weathering; saw cut surface reveals a mosaic of brown and green grains.

**Petrography:** (C. Agee, *UNM*) This meteorite consists primarily of olivine and pigeonite grains, many greater than 1 mm in size. Very fine-grained metal occupies silicate grain boundaries. Some elongate domains are plucked by grinding and polishing and are likely to be void casts of a once present carbon phase. Olivine is Cr-bearing. No plagioclase observed.

**Geochemistry:** (C. Agee, *UNM*) Olivine  $Fa_{21.1\pm 0.1}$ ,  $Fe/Mn=46\pm 2$ ,  $Cr_2O_3=0.60\pm 0.02$  (wt%),  $n=6$ ; pigeonite  $Fs_{17.7\pm 0.4}Wo_{3.8\pm 0.0}$ ,  $Fe/Mn=29\pm 2$ ,  $n=6$ .

**Classification:** Ureilite

**Specimens:** 9 g including a probe mount on deposit at *UNM*, Dustin Dickens holds the main mass.

**Northwest Africa 13304 (NWA 13304)**

Northwest Africa

Purchased: 2019

Classification: Enstatite achondrite (Aubrite)

**History:** Two fragments of ~23 g purchased by Dustin Dickens October of 2019 in Morocco from Mohamed Amouri. Dustin later received an additional ~24 0g stone from Hammi in February of 2020 at the Tucson gem and mineral show.

**Physical characteristics:** Exterior has dark colored fusion crust patches. Saw cuts and broken surfaces reveal a breccia of fragmented white pyroxene grains, some up to several mm in size, set in a fine-grained matrix. Scattered brown-orange colored, oxidized metal grains are visible throughout.

**Petrography:** (C. Agee, *UNM*) This meteorite consists primarily of larger fragmental enstatite and diopside grains nested in a fine-grained, cataclastic matrix of enstatite and diopside. Kamacite, troilite, alabandite, and daubreelite were detected. Olivine and plagioclase were not detected.

**Geochemistry:** (C. Agee, *UNM*) Enstatite  $Fa_{0.1\pm 0.1}Wo_{1.3\pm 0.3}$ ,  $n=5$ ; diopside  $Fs_{0.0\pm 0.0}Wo_{42.1\pm 4.7}$ ,  $n=2$ . Oxygen isotopes (K. Ziegler, *UNM*): 3 acid-washed fragments analyzed by laser fluorination gave  $\delta^{18}O=5.511, 5.608, 5.742$ ;  $\delta^{17}O=2.868, 2.924, 3.004$ ;  $\Delta^{17}O=-0.042, -0.037, -0.028$  (linearized, all per mil, TFL slope=0.528).

**Classification:** Aubrite

**Specimens:** 20.1 g including a probe mount on deposit at *UNM*, Dustin Dickens holds the main mass.

**Northwest Africa 13305 (NWA 13305)**

(Northwest Africa)

Purchased: 2018 Mar

Classification: Ordinary chondrite (H7)

**Petrography:** (K. Metzler, *IfP*) Ordinary chondrite with distinct recrystallization texture. Large secondary feldspar grains (many with sizes >100  $\mu\text{m}$ ) which frequently poikilitically enclose olivine and pyroxene grains. Some mm-sized roundish inclusions, consisting of distinctly larger olivine and pyroxene grains with interstitial plagioclase may represent chondrule relicts.

**Geochemistry:** Mineral compositions and geochemistry: The mean olivine composition is  $\text{Fa}_{17.4\pm 0.2}$  ( $\text{Fa}_{17.2-17.7}$ ;  $n=14$ ). The mean low-Ca pyroxene composition is  $\text{Fs}_{15.3\pm 0.3}\text{Wo}_{2.9\pm 0.7}$  ( $\text{Fs}_{14.8-17.7}\text{Wo}_{1.3-4.0}$ ;  $n=15$ ); Mean CaO concentration in low-Ca pyroxene:  $1.5\pm 0.4$  (0.7-2.1) wt%.

**Classification:** H chondrite based on mineral chemistry. Petrologic type 7 based on the equilibrated state of olivine and pyroxene, and large grain size of secondary plagioclase.

**Specimens:** 60 g; José Antonio Sánchez Santana, Malaga, Spain

### Northwest Africa 13306 (NWA 13306)

(Northwest Africa)

Purchased: January 2020

Classification: Lunar meteorite (feldspathic breccia)

**History:** Purchased by Carlos Muñecas in January 2020 from a dealer in Guelmin, Morocco.

**Physical characteristics:** Abundant feldspathic clasts set in a dark gray groundmass with lesser amounts of fragmental pyroxene and olivine.

**Petrography:** Abundant feldspathic clasts set in a dark-gray groundmass with lesser amounts of fragmental pyroxene and olivine.

**Geochemistry:** Mineral compositions and geochemistry: Olivine:  $\text{Fa}_{20.2\pm 0.9}$ ,  $\text{Fe/Mn} = 89\pm 1$  ( $n=4$ ); Low-Ca pyroxene:  $\text{Fs}_{25.3\pm 0.8}\text{Wo}_{5.6\pm 0.5}$ ,  $\text{Fe/Mn} = 58\pm 6$  ( $n=4$ ); High-Ca pyroxene:  $\text{Fs}_{26.6\pm 1}\text{Wo}_{36.5\pm 0.6}$ ,  $\text{Fe/Mn} = 58\pm 1$  ( $n=2$ ); Plagioclase:  $\text{An}_{97.5\pm 0.8}\text{Or}_{0.2\pm 0.1}$  ( $n=6$ ).

**Classification:** Lunar feldspathic breccia

### Northwest Africa 13307 (NWA 13307)

(Northwest Africa)

Purchased: 2020 Apr

Classification: Ungrouped achondrite

**History:** Found in Mauritania, purchased by Rachid and Jaouad Chaoui in March 2020 from a Mauritanian dealer and subsequently sold to Luc Labenne.

**Physical characteristics:** A single stone (467 g) partly coated by black fusion crust. The fresh interior is a friable aggregate of colorless to pale gray, equant grains.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Protogranular aggregate (mean grain size  $\sim 1.2$  mm) composed predominantly of subequal amounts of diopside and enstatite with minor accessory daubreelite, ferroan alabandite and Ti-Cr-bearing troilite. Both pyroxenes exhibit fine, blebby and irrational exsolution of the other pyroxene phase, and also contain patchy, compositionally different domains. No metal or olivine was observed despite a diligent search.

**Geochemistry:** Enstatite ( $\text{Fs}_{0.2\pm 0.0}\text{Wo}_{1.7-4.5}$ ,  $\text{FeO/MnO} = 0.3$ ,  $N = 3$ ), diopside ( $\text{Fs}_{0.1\pm 0.0}\text{Wo}_{39.7-40.5}$ ,  $\text{FeO/MnO} = 0.2$ ,  $N = 2$ ), homogeneous low-Ca pyroxene domain within diopside ( $\text{Fs}_{0.2}\text{Wo}_{8.3}$ ,  $\text{FeO/MnO} = 0.3$ ).

**Classification:** Achondrite (ungrouped, magnesian websterite, reduced).

**Specimens:** 22.2 g including two polished thin sections at *UWB*; remainder held jointly by Mr. R. Chaoui and Mr. J. Chaoui.

**Northwest Africa 13308** (NWA 13308)

(Northwest Africa)

Purchased: 2019 Dec

Classification: HED achondrite (Eucrite, unbrecciated)

**History:** Purchased by John Divilbiss in December 2019 from Mike Miller, who had acquired the stone from a Moroccan dealer in 2017.**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) The specimen has a microgabbroic texture and is crosscut by multiple quenched shock melt veins enclosing crystal debris derived from the clasts. Minerals are exsolved pigeonite and calcic plagioclase with accessory silica polymorph, fayalite, Ti-Al chromite, ilmenite (some more Cr-rich), merrillite, baddeleyite, zircon and troilite.**Geochemistry:** Low-Ca pyroxene ( $\text{Fs}_{57.8-60.0}\text{Wo}_{2.5-4.8}$ ,  $\text{FeO/MnO} = 30-33$ ,  $N = 6$ ), high-Ca pyroxene ( $\text{Fs}_{25.9-26.7}\text{Wo}_{43.3-44.2}$ ,  $\text{FeO/MnO} = 29-32$ ,  $N = 6$ ), fayalite ( $\text{Fa}_{84.6-87.8}$ ,  $\text{FeO/MnO} = 45-51$ ,  $N = 2$ ), plagioclase ( $\text{An}_{89.2-90.5}\text{Or}_{0.4-0.5}$ ,  $N = 4$ ).**Classification:** Eucrite (unbrecciated, microgabbroic, shock melt-veined).**Specimens:** 20.3 g including one polished thin section at *UWB*; remainder with Mr. J. Develbiss.**Northwest Africa 13309** (NWA 13309)

(Northwest Africa)

Purchased: 2019 Sep

Classification: Ordinary chondrite (LL3.15)

**History:** Purchased by Mbark Arjdal in September 2019 from a dealer in Timbuktu, Mali.**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Well-formed, fairly closely packed, relatively unequilibrated, glass-bearing chondrules (apparent diameter  $900 \pm 560 \mu\text{m}$ ,  $N = 23$ ) plus some isolated mineral clasts are set in a sparse opaque matrix rich in kamacite, taenite and troilite.**Geochemistry:** Olivine ( $\text{Fa}_{16.2 \pm 8.3}$ , range  $\text{Fa}_{0.6-26.9}$ ,  $N = 9$ ;  $\text{Cr}_2\text{O}_3$  in ferroan olivines 0.07-0.55 wt.%, mean  $0.25 \pm 0.16$  wt.%,  $N = 33$ ), low-Ca pyroxene ( $\text{Fs}_{14.4 \pm 5.0}\text{Wo}_{1.5 \pm 1.8}$ , range  $\text{Fs}_{7.4-21.5}\text{Wo}_{0.3-4.7}$ ,  $N = 5$ ), subcalcic augite ( $\text{Fs}_{19.2}\text{Wo}_{31.1}$ ), diopside ( $\text{Fs}_{1.2}\text{Wo}_{44.5}$ ). Magnetic susceptibility  $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.51$ .**Classification:** Ordinary chondrite (LL3.15). Chondrule sizes and magnetic susceptibility support an LL rather than L class. Subtype based on  $\text{Cr}_2\text{O}_3$  contents of ferroan olivines per Figure 15 of [Grossman and Brearley \(2005\)](#).**Specimens:** 38.2 g including one polished thin section at *UWB*; remainder with Mr. M. Arjdal.**Northwest Africa 13310** (NWA 13310)

(Northwest Africa)

Purchased: 2020 Jan

Classification: HED achondrite (Eucrite, brecciated)

**History:** Purchased by Darryl Pitt in January 2020 from a dealer in Marrakech, Morocco.**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Breccia composed of mostly gabbroic eucrite clasts plus some clasts with fine grained, intersertal texture within a matrix of related crystalline debris. Minerals are exsolved pigeonite (pale orange in thin section) and calcic plagioclase (exhibiting undulose extinction to polycrystalline structure) together with



accessory silica polymorph, ilmenite, Ti-Al-chromite, troilite and zircon, plus secondary calcite, barite and iron hydroxides.

**Geochemistry:** Low-Ca pyroxene ( $\text{Fs}_{59.4-61.8}\text{Wo}_{4.7-1.7}$ ,  $\text{FeO/MnO} = 30-33$ ,  $N = 5$ ), high-Ca pyroxene ( $\text{Fs}_{26.5-27.8}\text{Wo}_{43.0-43.9}$ ,  $\text{FeO/MnO} = 30-32$ ,  $N = 5$ ), olivine grain ( $\text{Fa}_{66.1-66.5}$ ,  $\text{FeO/MnO} = 46$ ,  $N = 2$ ), plagioclase ( $\text{An}_{88.0-91.8}\text{Or}_{0.4-0.3}$ ,  $N = 4$ ).

**Classification:** Eucrite (breccia). Possibly paired with [NWA 13314](#).

**Specimens:** 27.0 g including one polished thin section at *UWB*; remainder with *DPitt*.

### Northwest Africa 13311 (NWA 13311)

(Northwest Africa)

Purchased: 2019 Sep

Classification: Carbonaceous chondrite (CK3)

**History:** Purchased by Mbark Arjdal in April 2019 from a dealer in Timbuktu, Mali.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Well-formed, relatively unequilibrated, granular, glass-bearing and Cr-magnetite-bearing chondrules (apparent diameter  $920 \pm 380 \mu\text{m}$ ,  $N = 23$ ) plus amoeboid, very fine grained CAI are set in a fine grained matrix ( $\sim 30$  vol.%, sepia brown in thin section) containing pentlandite and troilite. CAI contain gehlenite, aluminous diopside, pentlandite, albitic plagioclase and hedenbergite.

**Geochemistry:** Olivine ( $\text{Fa}_{31.4 \pm 14.3}$ , range  $\text{Fa}_{5.3-46.3}$ ,  $N = 8$ ), low-Ca pyroxene ( $\text{Fs}_{0.9 \pm 0.3}\text{Wo}_{0.9 \pm 0.2}$ , range  $\text{Fs}_{0.6-1.1}\text{Wo}_{0.8-1.1}$ ,  $N = 3$ ), augite ( $\text{Fs}_{1.7}\text{Wo}_{37.0}$ ;  $\text{Fs}_{0.5}\text{Wo}_{1.6}$ ;  $\text{Fs}_{23.3}\text{Wo}_{42.6}$ ;  $\text{Al}_2\text{O}_3 = 1.5-4.3$  wt.%,  $N = 3$ ), plagioclase ( $\text{An}_{84.6}\text{Or}_{0.0}$ ).

**Classification:** Carbonaceous chondrite (CK3).

**Specimens:** 39.3 g including one polished thin section at *UWB*; remainder with Mr. M. Arjdal.

### Northwest Africa 13312 (NWA 13312)

(Northwest Africa)

Purchased: 2019 Sep

Classification: Ungrouped achondrite

**History:** Purchased by Mbark Arjdal in September 2019 from a dealer in Timbuktu, Mali.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Fresh specimen with a complex igneous poikilitic texture and variable grain size composed predominantly of coarser grained zoned pyroxene oikocrysts (0.5-2 mm) enclosing subordinate olivine chadacrysts (0.1-0.3 mm), plus finer grained interstitial regions. Accessory phases are chromite, troilite, and very rare small grains of taenite and slightly stained kamacite; no phosphates were observed. Pyroxenes are zoned from orthopyroxene cores (exhibiting prominent polysynthetic twinning) to more ferroan pigeonite and subcalcic augite rims. Sporadic very large homogeneous macrocrysts (up to 0.6 cm across) of both olivine and orthopyroxene are also present. Interstitial regions consist of subparallel intergrowths of acicular calcic plagioclase, high-Ca pyroxene and silica polymorph accompanied by minor ilmenite, Ni-bearing pyrrhotite and pentlandite.

**Geochemistry:** Olivine ( $\text{Fa}_{20.4-35.1}$ ,  $\text{FeO/MnO} = 47-51$ ,  $N = 10$ ), orthopyroxene cores ( $\text{Fs}_{11.8-14.2}\text{Wo}_{0.2-0.3}$ ,  $\text{FeO/MnO} = 31-34$ ,  $N = 4$ ), low-Ca pyroxene rims ( $\text{Fs}_{23.7-35.2}\text{Wo}_{2.0-4.9}$ ,  $\text{FeO/MnO} = 28-32$ ,  $N = 6$ ), subcalcic augite ( $\text{Fs}_{32.0-40.8}\text{Wo}_{33.7-24.0}$ ,  $\text{FeO/MnO} = 25-27$ ,  $N = 5$ ), pigeonite ( $\text{Fs}_{29.4}\text{Wo}_{14.7}$ ;  $\text{Fs}_{45.1-47.0}\text{Wo}_{7.1-9.7}$ ;  $\text{FeO/MnO} = 26-30$ ;  $N = 3$ ), plagioclase ( $\text{An}_{68.2-86.4}\text{Or}_{2.3-0.7}$ ,  $N = 3$ ). Magnetic susceptibility  $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 3.07$ .

**Classification:** Achondrite (ungrouped, igneous, poikilitic, metal-poor).

**Specimens:** 9.7 g including one polished thin section at *UWB*; remainder with Mr. M. Arjdal.

**Northwest Africa 13313** (NWA 13313)

Mali

Purchased: 2019 Apr

Classification: Ordinary chondrite (L3-6)

**History:** Purchased by Mbark Arjdal in April 2019 from dealer in Timbuktu, Mali.**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Well-formed, fairly closely packed, relatively unequilibrated chondrules (apparent diameter  $830 \pm 450 \mu\text{m}$ ,  $N = 23$ ), plus some equilibrated Type 6 clasts containing sparse chondrules, are set in a finer grained matrix containing kamacite, taenite, Ti-chromite, chlorapatite, merrillite and troilite. A large fine grained, igneous-textured clast (1.9 cm across) is composed of reversely zoned olivine microphenocrysts plus extremely fine grained interstitial quench products (with Ca pyroxene-like bulk composition).**Geochemistry:** Olivine in chondrules ( $\text{Fa}_{25.6 \pm 5.6}$ , range  $\text{Fa}_{22.7-36.9}$ ,  $\text{Cr}_2\text{O}_3 < 0.03 \text{ wt.}\%$ ,  $N = 6$ ), low-Ca pyroxene ( $\text{Fs}_{21.6 \pm 3.1} \text{Wo}_{1.3 \pm 0.1}$ , range  $\text{Fs}_{19.9-26.2} \text{Wo}_{1.2-1.4}$ ,  $N = 4$ ), subcalcic augite ( $\text{Fs}_{6.0} \text{Wo}_{36.3}$ ), augite ( $\text{Fs}_{6.9 \pm 0.1} \text{Wo}_{45.8 \pm 0.5}$ , range  $\text{Fs}_{6.8-7.0} \text{Wo}_{46.1-45.4}$ ,  $N = 2$ ), olivine in Type 5 clast ( $\text{Fa}_{25.1}$ ), olivine in fine grained igneous clast (core  $\text{Fa}_{23.0}$ , rims 11.1-16.6;  $N = 3$ ). Magnetic susceptibility  $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.79$ .**Classification:** Ordinary chondrite (L3-6 breccia).**Specimens:** 29.2 g including one polished thin section at *UWB*; remainder with Mr. M. Arjdal.**Northwest Africa 13314** (NWA 13314)

(Northwest Africa)

Purchased: 2020 Jan

Classification: HED achondrite (Eucrite, brecciated)

**History:** Purchased by Darryl Pitt in January 2020 from a dealer in Marrakech, Morocco.**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Breccia composed of microgabbroic, diabasic and some finer grained subophitic eucrite clasts within a matrix of related crystalline debris. Minerals are exsolved pigeonite (pale orange in thin section) and calcic plagioclase (exhibiting undulose extinction to polycrystalline structure) together with accessory silica polymorph, ilmenite, Ti-Al-chromite and troilite.**Geochemistry:** Low-Ca pyroxene ( $\text{Fs}_{58.5-59.7} \text{Wo}_{3.1-7.0}$ ,  $\text{FeO}/\text{MnO} = 30-33$ ,  $N = 5$ ), high-Ca pyroxene ( $\text{Fs}_{25.9-26.4} \text{Wo}_{43.2-43.9}$ ,  $\text{FeO}/\text{MnO} = 29-33$ ,  $N = 5$ ), plagioclase ( $\text{An}_{89.6-90.7} \text{Or}_{0.3-0.5}$ ,  $N = 4$ ).**Classification:** Eucrite (breccia). Possibly paired with [NWA 13310](#).**Specimens:** 50.6 g including one polished thin section at *UWB*; remainder with *DPitt*.**Northwest Africa 13317** (NWA 13317)

Algeria

Find: May 2019

Classification: Ordinary chondrite (L3-5)

**Petrography:** Rock having with different lithologies. The bulk rock has  $\text{Fa}_{23.2 \pm 5.0}$  and  $\text{Fs}_{17.0 \pm 6.7}$ . The type 5 clasts have equilibrated olivine and low-Ca pyroxene with  $\sim \text{Fa}_{24}$  and  $\text{Fs}_{21}$ , respectively.

**Northwest Africa 13321** (NWA 13321)

Morocco

Find: 2018 Mar

Classification: Carbonaceous chondrite (CV3)

**Petrography:** Chondrite with large chondrules (~mm), AOAs, and CAIs set in an abundant fine-grained Fe-rich matrix. Opaque minerals include sulfides and metals. Metals are often included within the chondrules. Opaque areas between the chondrules contain abundant terrestrial alteration products.

**Geochemistry:** Most olivine in chondrules and AOAs is Fo-rich. The average composition of these olivines is  $Fa_{3.7\pm 4.6}$  (range:  $Fa_{0-23}$ ; N=22). Low-Ca pyroxene is  $Fs_{1.6\pm 0.7}$  (range  $Fs_{0-4}$ ; n=12).

**Classification:** Carbonaceous chondrite (CV3)

**Northwest Africa 13322** (NWA 13322)

Morocco

Find: October 2019

Classification: Carbonaceous chondrite (CV3)

**Petrography:** Chondrite with large chondrules (~1 mm), AOAs, and CAIs set in abundant fine-grained Fe-rich matrix. Main silicates include olivine, low-Ca, and Ca-pyroxene. Opaque areas are basically made of terrestrial alteration products, although some sulfides are still visible.

**Geochemistry:** Most olivine in chondrules and AOAs is Fo-rich. The average composition of these olivines is  $Fa_{3.7\pm 2.7}$  (range:  $Fa_{0-12}$ ; N=23). Low-Ca pyroxene is  $Fs_{2.0\pm 1.4}$  (range  $Fs_{0-6}$ ; n=12).

**Classification:** Carbonaceous chondrite (CV3)

**Northwest Africa 13323** (NWA 13323)

(Northwest Africa)

Purchased: 2020 Feb

Classification: Carbonaceous chondrite (CK3)

**History:** Purchased by Mbark Arjdal in February 2020 from a dealer in Timbuktu, Mali.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Well-formed granular and some BO chondrules (apparent diameter  $950 \pm 460 \mu\text{m}$ , N = 23) plus sparse very fine grained, irregularly-shaped CAI are set in a fine grained matrix (~25 vol.%, deep brown in thin section) containing troilite, altered Cr-magnetite and rare taenite. Chondrules contain rounded grains of Cr-magnetite, some of which has been altered to red-brown iron hydroxides.

**Geochemistry:** Olivine ( $Fa_{17.9\pm 18.4}$ , range  $Fa_{0.3-44.1}$ , N = 6), low-Ca pyroxene ( $Fs_{3.6\pm 5.0}Wo_{2.0\pm 2.4}$ , range  $Fs_{0.6-9.4}Wo_{0.5-4.8}$ , N = 3), pigeonite ( $Fs_{1.1}Wo_{11.5}$ ), subcalcic augite ( $Fs_{1.4}Wo_{29.2}$ ;  $Fs_{1.1}Wo_{35.8}$ ; N = 2), diopside ( $Fs_{0.8}Wo_{40.3}$ ), magnetite ( $Cr_2O_3 = 0.2-7.0 \text{ wt.}\%$ , N = 2).

**Classification:** Carbonaceous chondrite (CK3).

**Specimens:** 20.2 g including one polished thin section at *UWB*; remainder with Mr. M. Arjdal.

**Northwest Africa 13324** (NWA 13324)

(Northwest Africa)

Purchased: 2020 Jan

Classification: Ordinary chondrite (LL3.15)

**History:** Purchased by Adam Aaronson in Temara, Morocco in January 2020.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Closely-packed, well-formed, unequilibrated glass-bearing chondrules (apparent diameter  $800\pm 330\ \mu\text{m}$ ,  $N = 24$ ) are set in a sparse opaque matrix containing altered kamacite, taenite and troilite.

**Geochemistry:** Olivine ( $\text{Fa}_{14.2\pm 9.1}$ , range  $\text{Fa}_{1.2-38.4}$ ,  $N = 9$ ;  $\text{Cr}_2\text{O}_3$  in ferroan olivine 0.06-0.61 wt.%, mean  $0.27\pm 0.13$  wt.%,  $N = 31$ ), low-Ca pyroxene ( $\text{Fs}_{16.4\pm 6.7}\text{Wo}_{1.3\pm 1.4}$ , range  $\text{Fs}_{4.7-25.0}\text{Wo}_{0.4-3.9}$ ,  $N = 7$ ), pigeonite ( $\text{Fs}_{20.2}\text{Wo}_{8.0}$ ), subcalcic augite ( $\text{Fs}_{20.2\pm 8.4}\text{Wo}_{27.0\pm 2.6}$ , range  $\text{Fa}_{10.8-27.0}\text{Wo}_{29.9-24.7}$ ,  $N = 3$ ), augite ( $\text{Fs}_{4.3}\text{Wo}_{40.4}$ ). Magnetic susceptibility  $\log \chi (\times 10^{-9}\ \text{m}^3/\text{kg}) = 4.01$ .

**Classification:** Ordinary chondrite (LL3.15). Subtype based on  $\text{Cr}_2\text{O}_3$  contents of ferroan olivines per Figure 15 of [Grossman and Brearley \(2005\)](#).

**Specimens:** 33.5 g including one polished thin section at *UWB*; remainder with Aaronson.

### Northwest Africa 13325 (NWA 13325)

(Northwest Africa)

Purchased: 2019 Nov

Classification: HED achondrite (Eucrite, brecciated)

**History:** Purchased by Mark Lyon in November 2019 from a Moroccan dealer.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Breccia composed of texturally diverse eucrite clasts (up to 2.8 cm across) exhibiting gabbroic, diabasic, granulitic and partially recrystallized textures set within a fragmental matrix of related crystalline debris. Major minerals are low-Ca pyroxene, augite and calcic plagioclase, together with accessory silica polymorph, Ti-Al-bearing chromite, ilmenite, troilite and Ni-free iron metal. In coarser grained gabbroic and diabasic clasts low-Ca and high-Ca pyroxenes are in exsolution relationship and represent former pigeonite, but in granulitic and recrystallized clasts both pyroxenes are present as discrete grains. In partially recrystallized clasts pyroxene is finely polygranular but plagioclase is not.

**Geochemistry:** Low-Ca pyroxene ( $\text{Fs}_{56.8-58.3}\text{Wo}_{4.8-7.0}$ ,  $\text{FeO}/\text{MnO} = 29-31$ ,  $N = 5$ ), augite ( $\text{Fs}_{28.9-30.2}\text{Wo}_{40.1-41.0}$ ,  $\text{FeO}/\text{MnO} = 31-34$ ,  $N = 5$ ), plagioclase ( $\text{An}_{88.4-90.0}\text{Or}_{0.8-0.5}$ ,  $N = 5$ ).

**Classification:** Eucrite (genomict breccia).

**Specimens:** 212 g including one large polished thin section at *UWB*; remainder with Mr. M. Lyon.

### Northwest Africa 13326 (NWA 13326)

(Northwest Africa)

Purchased: 2019 Nov

Classification: Ordinary chondrite (LL3)

**History:** Purchased by Mbark Arjdal in November 2019 from a dealer in Timbuktu, Mali.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Closely packed, well-formed chondrules (apparent diameter  $970\pm 530\ \mu\text{m}$ ,  $N = 25$ ) are set within a sparse, relatively unaltered fine grained matrix containing accessory kamacite, taenite, chromite and troilite. A 1.1 cm long olivine-phyric igneous clast containing subhedral to euhedral olivine phenocrysts in a very fine grained groundmass is present in the studied thin section.

**Geochemistry:** Olivine ( $\text{Fa}_{27.0\pm 11.3}$ , range  $\text{Fa}_{3.1-38.2}$ ,  $N = 11$ ;  $\text{Cr}_2\text{O}_3$  in ferroan rims 0.03-0.06 wt.%,  $N = 4$ ), low-Ca pyroxene ( $\text{Fs}_{16.5\pm 8.1}\text{Wo}_{1.2\pm 0.9}$ , range  $\text{Fs}_{1.4-23.6}\text{Wo}_{0.3-2.4}$ ,  $N = 7$ ), pigeonite ( $\text{Fs}_{40.7}\text{Wo}_{5.3}$ ;  $\text{Fs}_{44.7}\text{Wo}_{10.5}$ ;  $N = 2$ ), augite ( $\text{Fs}_{9.9}\text{Wo}_{36.3}$ ). Magnetic susceptibility  $\log \chi (\times 10^{-9}\ \text{m}^3/\text{kg}) = 4.39$ .

**Classification:** Ordinary chondrite (LL3).

**Specimens:** 39.6 g including one polished thin section at *UWB*; remainder with Mr. M. Arjdal.

### Northwest Africa 13327 (NWA 13327)

(Northwest Africa)

Purchased: 2020 Feb

Classification: Martian meteorite (Shergottite)

**History:** Purchased by Eric *Twelker* in February 2020 from a Moroccan dealer at the Tucson Gem and Mineral Show.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Diabasic texture (mean grain size ~0.8 mm). Composed predominantly of prismatic grains of zoned clinopyroxene and lath-like maskelynite together with accessory silica polymorph, merrillite, chlorapatite, Cr-Mn-bearing ulvöspinel, ilmenite, pyrrhotite and baddeleyite. Minor secondary calcite is present.

**Geochemistry:** Subcalcic augite ( $\text{Fs}_{20.1-27.3}\text{Wo}_{29.1-35.4}$ ,  $\text{FeO/MnO} = 19-34$ ,  $N = 5$ ), ferroan subcalcic augite rim ( $\text{Fs}_{45.1}\text{Wo}_{30.7}$ ,  $\text{FeO/MnO} = 36$ ), ferroan pigeonite rims ( $\text{Fs}_{53.9-61.3}\text{Wo}_{13.4-15.7}$ ,  $\text{FeO/MnO} = 36-37$ ,  $N = 3$ ), maskelynite ( $\text{An}_{53.4-55.7}\text{Or}_{1.4-0.9}$ ,  $N = 4$ ).

**Classification:** Shergottite (diabasic).

**Specimens:** 20.5 g plus one polished thin section at *UWB*; remainder with Mr. E. *Twelker*.

### Northwest Africa 13328 (NWA 13328)

(Northwest Africa)

Purchased: 2020 Jan

Classification: LL4-5 melt breccia

**History:** Purchased by Mark Lyon in January 2020 from a Moroccan dealer.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Breccia composed of equilibrated lithic clasts (type 4 and type 5) containing relatively sparse but well-formed chondrules set within an opaque matrix containing indistinct chondrule remnants, chromite, chlorapatite and dispersed very fine grained, blebby metal (kamacite+taenite) and troilite.

**Geochemistry:** Olivine ( $\text{Fa}_{29.2\pm 0.8}$ , range  $\text{Fa}_{28.4-30.6}$ ,  $N = 6$ ), low-Ca pyroxene ( $\text{Fs}_{23.8\pm 0.8}\text{Wo}_{1.6\pm 0.4}$ , range  $\text{Fs}_{23.0-25.2}\text{Wo}_{1.2-2.1}$ ,  $N = 5$ ), augite ( $\text{Fs}_{10.5}\text{Wo}_{40.7}$ ).

**Classification:** Ordinary chondrite (LL4-5-melt breccia).

**Specimens:** 34.1 g including one polished thin section at *UWB*; remainder with Mr. M. Lyon.

### Northwest Africa 13329 (NWA 13329)

(Northwest Africa)

Purchased: 2020 Jan

Classification: Carbonaceous chondrite (CO3)

**History:** Purchased by Mark Lyon in January 2020 from a Moroccan dealer.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Relatively small, well-formed chondrules (apparent diameter  $300 \pm 220 \mu\text{m}$ ,  $N = 24$ ) plus sparse mineral fragments and very fine grained AOA are set in a fine grained matrix (~25 vol.%, red-brown in thin section) containing accessory altered kamacite and troilite. No CAI were observed.

**Geochemistry:** Olivine ( $\text{Fa}_{34.5\pm 30.8}$ , range  $\text{Fa}_{1.6-78.3}$ ,  $N = 8$ ;  $\text{Cr}_2\text{O}_3$  in ferroan rims 0.04-0.40 wt.%,  $N = 5$ ), low-Ca pyroxene ( $\text{Fs}_{0.7}\text{Wo}_{0.8}$ ;  $\text{Fs}_{25.6}\text{Wo}_{1.7}$ ;  $N = 2$ ), pigeonite ( $\text{Fs}_{1.5}\text{Wo}_{5.1}$ ;  $13.4\text{Wo}_{5.4}$ ;  $\text{Fs}_{5.8}\text{Wo}_{12.4}$ ;  $N = 3$ ), subcalcic augite ( $\text{Fs}_{1.2\pm 0.7}\text{Wo}_{37.3\pm 1.6}$ , range  $\text{Fs}_{0.7-1.7}\text{Wo}_{36.2-38.4}$ ,  $N = 2$ ), plagioclase ( $\text{An}_{95.9}\text{Or}_{0.1}$ ).

**Classification:** Carbonaceous chondrite (CO3).



**Specimens:** 24.5 g including one polished thin section at *UWB*; remainder with Mr. M. Lyon.

**Northwest Africa 13330** (NWA 13330)

(Northwest Africa)

Purchased: 2019 Nov

Classification: HED achondrite (Eucrite, brecciated)

**History:** Purchased by Shawn Kashay in November 2019 from Moroccan dealer Mostapha Hnini.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Highly shocked breccia composed of microgabbroic eucrite clasts plus related crystalline debris within a quench-textured, partly vesicular matrix (exhibiting some variations in grain size in different parts of the studied thin section). The major constituents are unexsolved pigeonite (pale orange in thin section) and calcic plagioclase, both of which have been recrystallized into aggregates of extremely small subgrains; accessory phases include silica polymorph, subcalcic augite, Ti-Al-bearing chromite, Cr-bearing ulvöspinel, ilmenite, rare troilite, and secondary calcite and Ca sulfate. Subgrains within recrystallized pigeonite exhibit normal core to rim compositional zoning.

**Geochemistry:** Microgabbroic lithic clast: pigeonite (cores  $\text{Fs}_{47.6-49.3}\text{Wo}_{9.4-10.4}$ ,  $\text{FeO/MnO} = 30-31$ ,  $N = 3$ ; rims  $\text{Fs}_{52.8-53.6}\text{Wo}_{11.2-13.6}$ ,  $\text{FeO/MnO} = 31-33$ ,  $N = 3$ ), plagioclase ( $\text{An}_{89.4-90.1}\text{Or}_{0.4-0.6}$ ,  $N = 4$ ). Melt matrix: pigeonite (cores  $\text{Fs}_{43.9-45.9}\text{Wo}_{9.7-10.8}$ ,  $\text{FeO/MnO} = 29-30$ ,  $N = 2$ ; rims  $\text{Fs}_{51.5-53.9}\text{Wo}_{15.2-15.4}$ ,  $\text{FeO/MnO} = 32-34$ ,  $N = 2$ ), subcalcic augite ( $\text{Fs}_{55.5}\text{Wo}_{31.4}$ ,  $\text{FeO/MnO} = 34$ ), plagioclase ( $\text{An}_{88.1}\text{Or}_{0.2}$ ).

**Classification:** Eucrite (melt-matrix breccia, microgabbroic, highly shocked).

**Specimens:** 33.3 g including one polished thin section at *PSF*; remainder with Mr. S. Kashay.

**Northwest Africa 13331** (NWA 13331)

(Northwest Africa)

Purchased: 2020 Jan

Classification: Ordinary chondrite (H7)

**History:** Purchased by Rachid Chaoui in January 2020 from a Mauritanian dealer.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) The specimen exhibits triple grain junction texture completely lacking any evidence of former chondrules, and is composed predominantly of olivine and low-Ca pyroxene with accessory augite, sodic plagioclase, altered kamacite, merrillite, taenite, troilite and chromite.

**Geochemistry:** Olivine ( $\text{Fa}_{16.3\pm 0.1}$ , range  $\text{Fa}_{16.2-16.5}$ ,  $N = 11$ ), low-Ca pyroxene ( $\text{Fs}_{14.4\pm 0.2}\text{Wo}_{2.3\pm 0.8}$ , range  $\text{Fs}_{14.2-14.7}\text{Wo}_{1.2-3.7}$ ,  $N = 11$ ), augite ( $\text{Fs}_{5.5\pm 0.3}\text{Wo}_{45.3\pm 0.4}$ , range  $\text{Fs}_{5.0-5.7}\text{Wo}_{44.9-45.9}$ ,  $N = 6$ ). Magnetic susceptibility  $\log \chi = 5.20$ .

**Classification:** Ordinary chondrite (H7).

**Specimens:** 27 g including one polished thin section at *UWB*; remainder with Z. Wang.

**Northwest Africa 13332** (NWA 13332)

(Northwest Africa)

Purchased: 2005

Classification: Carbonaceous chondrite (CK3)

**History:** Purchased by an anonymous collector from a dealer at the Munich Show in 2005, subsequently acquired by the Hollis Collection and then donated to *PSF*.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) This small stone has experienced considerable desert weathering resulting in pervasive staining by iron hydroxides. Well-

formed granular chondrules (apparent diameter  $1080 \pm 570 \mu\text{m}$ ,  $N = 21$ ) containing rounded grains of altered Cr-magnetite plus sparse very fine grained CAI are set in a fine grained matrix ( $\sim 25$  vol.%, deep red-brown in thin section) containing altered Cr-magnetite, kamacite and troilite. CAI are composed of mainly of gehlenite together with diopside, spinel, taenite, hercynite and pentlandite.

**Geochemistry:** Olivine ( $\text{Fa}_{36.2 \pm 20.2}$ , range  $\text{Fa}_{0.3-59.2}$ ,  $N = 6$ ), low-Ca pyroxene ( $\text{Fs}_{27.2 \pm 17.6} \text{Wo}_{0.6 \pm 0.1}$ , range  $\text{Fs}_{6.9-39.0} \text{Wo}_{0.5-0.6}$ ,  $N = 3$ ), subcalcic augite ( $\text{Fs}_{47.4} \text{Wo}_{20.7}$ ), diopside ( $\text{Fs}_{3.0} \text{Wo}_{40.0}$ ), plagioclase ( $\text{An}_{94.3} \text{Or}_{0.0}$ ), magnetite ( $\text{Cr}_2\text{O}_3 = 1.6$  wt.%).

**Classification:** Carbonaceous chondrite (CK3).

**Specimens:** The entire specimen including one polished thin section is at *PSF*.

### Northwest Africa 13333 (NWA 13333)

Morocco

Purchased: 2019

Classification: Ordinary chondrite (LL3)

**History:** Thierry Simard purchased the 957g sample from a meteorite dealer in Erfoud, Morocco, in 2019.

**Physical characteristics:** Sample is brownish-yellow in color, has a rounded, irregular shape and displays a heavily sand-blasted exterior with visible chondrules on the outer surface.

Abundant chondrules and clasts are visible on the cut face showing the interior of the sample.

**Petrography:** Description and classification (A. Love and J. Serensics, *App*) Sample is a breccia composed of poorly equilibrated, elongated chondrules (average aspect ratio of 1.54,  $n=27$ ) that share preferred orientation (average apparent diameter  $586 \mu\text{m}$ ,  $n=90$ ) set within a clastic host containing mineral and chondrule fragments and  $\sim 1$  vol% FeNi metal. Clinostatite is present.

**Geochemistry:** (J. Serensics, *App*) Olivine  $\text{Fa}_{22.5 \pm 6.6}$  (range  $\text{Fa}_{9.8-29.8}$ ),  $\text{Fe}/\text{Mn} = 51.6 \pm 9.8$ ,  $n=14$ .  $\text{Cr}_2\text{O}_3$  in type II chondrules has an average of  $0.1 \pm 0.1$  wt%,  $n=14$ ); low Ca-pyroxene  $\text{Fs}_{14.3 \pm 8.3} \text{Wo}_{1.7 \pm 2.8}$  (range  $\text{Fs}_{2.2-24.4} \text{Wo}_{0.2-2.2}$ ),  $n=14$ .

**Classification:** Ordinary chondrite (LL3, C-S5 W2) Based on texture, metal abundance, chondrule diameter and magnetic susceptibility this sample is an LL chondrite breccia. Maskelynite, yellow stained olivine melt pockets and shock veins indicate shock level of C-S5.

**Specimens:** Thierry Simard holds the main mass. An end cut, several smaller slices and fragments that comprise the 20.05 g type specimen and a polished thin section are on deposit at *App*.

### Northwest Africa 13334 (NWA 13334)

Northwest Africa

Purchased: 2009

Classification: Ureilite

**Physical characteristics:** Found as 109 small stones; coarse-grained, dark, with weathered, vein-like, interstitial materials.

**Petrography:** A somewhat coarse-grained but otherwise typical ureilite texture and mode, mostly olivine but roughly 1/4 pigeonite. Granular yet curvy-bounded silicate grains are up to 6 mm across, but 2 mm is more typical. Tiny metals are present in reduced rims within olivine. Minor vein-like interstitial matter is weathered, largely opaque (carbon-rich, probably).

**Geochemistry:** Mineral compositions and geochemistry: The olivine cores are  $\text{Fa}_{18.8\pm 0.1}$  (6 analyses), but rims are as Fe-poor as  $\text{Fa}_{2.1}$ . Minor elements in the olivine cores average  $0.62\pm 0.06$  wt%  $\text{Cr}_2\text{O}_3$ ,  $0.36\pm 0.08$  wt%  $\text{MnO}$ , and  $0.31\pm 0.05$  wt%  $\text{CaO}$ . The pyroxene is a pigeonite,  $\text{Fs}_{16.3}\text{Wo}_{6.3}$ , with no analytically significant range for major elements among 6 analyses. Minor elements in the pigeonite average  $1.14\pm 0.02$  wt%  $\text{Cr}_2\text{O}_3$ ,  $0.90\pm 0.03$   $\text{Al}_2\text{O}_3$ , and  $0.41\pm 0.06$  wt%  $\text{MnO}$ .

**Classification:** Ureilite

**Specimens:** a type specimen, 24.1 g, is at *UCLA*; also 24.9 g is at *UBayr*. Main mass: Sean Tutorow (Tutorow's web site: [www.eegooblago.com](http://www.eegooblago.com); Tutorow's email: [mexmeteor@hotmail.com](mailto:mexmeteor@hotmail.com)).

### Northwest Africa 13335 (NWA 13335)

Morocco

Find: July 2019

Classification: HED achondrite (Eucrite)

**Petrography:** The stone is a brecciated rock with igneous clasts and a melt rock lithology (perhaps related to impact). Main minerals are pyroxenes and plagioclase. Accessory minerals include chromite, silica, and metal.

**Geochemistry:** Low-Ca pyroxene is  $\text{Fs}_{59.8\pm 1.5}\text{Wo}_{2.3\pm 1.7}$  ( $\text{Fs}_{49.9-61.4}\text{Wo}_{1.3-14.5}$ ,  $N=69$ ), and Ca-pyroxene is  $\text{Fs}_{26.8\pm 2.9}\text{Wo}_{41.8\pm 3.8}$  ( $N=14$ ). The Fe/Mn ratio of the pyroxenes is 34.5 ( $n=84$ ). Plagioclase  $\text{An}_{80.8\pm 6.3}$  ( $N=7$ ).

**Classification:** Eucrite (brecciated)

### Northwest Africa 13336 (NWA 13336)

(Northwest Africa)

Purchased: 2020

Classification: Carbonaceous chondrite (CR2)

**History:** The meteorite was purchased from a meteorite dealer in Morocco.

**Physical characteristics:** Light-brownish rock with some fusion crust.

**Petrography:** The meteorite is a carbonaceous chondrite composed of abundant, often slightly flattened chondrules with an apparent mean diameter of about 800  $\mu\text{m}$  and about 30-40% almost black matrix. Chondrules are mostly of type I but two type II chondrules with highly unequilibrated olivine were observed in the section studied. Some chondrules are metal-decorated typical of CR.

**Geochemistry:** olivine in type I chondrules:  $\text{Fa}_{1.3\pm 0.4}$ ,  $\text{Cr}_2\text{O}_3$ :  $0.49\pm 0.05$  wt%,  $n=13$ ; low-Ca pyroxene:  $\text{Fs}_{2.8\pm 0.3}\text{Wo}_{0.5\pm 0.6}$ ,  $n=16$ ; olivine in type II chondrules:  $\text{Fa}_{28.3\pm 9.0}$  ( $\text{Fa}_{17.0-46.1}$ ,  $n=9$ ). Matrix analyses yield an average total of  $88.1\pm 1.2$  wt% (5  $\mu\text{m}$  defocused beam,  $N=10$ ) suggesting the presence of hydrous minerals.

### Northwest Africa 13337 (NWA 13337)

(Northwest Africa)

Purchased: 2019

Classification: Mesosiderite

**History:** The meteorite was purchased from a meteorite dealer in Morocco.

**Physical characteristics:** Dark grayish rock without fusion crust.

**Petrography:** The meteorite displays a grayish interior and is composed of silicate (about 50 vol%) and metallic (about 50 vol%) portions. The silicate fraction is predominantly composed

of exsolved pyroxene, up to 2.5 mm sized compositionally zoned low-Ca pyroxene, and calcic plagioclase. Minor phases are silica, ilmenite, Ti-chromite, FeS, and merrillite. The metallic lithology consists of most abundant kamacite and some taenite. No olivine has been detected in the section studied.

**Geochemistry:** compositionally zoned low-Ca pyroxene:  $\text{Fs}_{24.0\pm 7.2}\text{Wo}_{1.4\pm 0.7}$  ( $\text{Fs}_{17.5-37.8}\text{Wo}_{0.9-2.9}$ ,  $n=12$ ,  $\text{FeO/MnO}=23-32$ ); low-Ca pyroxene host to exsolutions:  $\text{Fs}_{39.3\pm 0.9}\text{Wo}_{3.1\pm 0.4}$  ( $\text{Fs}_{38.2-40.9}\text{Wo}_{2.5-3.7}$ ,  $n=13$ ,  $\text{FeO/MnO}=20-23$ ); Ca-pyroxene exsolutions:  $\text{Fs}_{17.6\pm 0.6}\text{Wo}_{42.9\pm 0.6}$  ( $\text{Fs}_{15.9-18.1}\text{Wo}_{42.1-44.7}$ ,  $n=12$ ,  $\text{FeO/MnO}=16-18$ ); calcic plagioclase:  $\text{An}_{91.3\pm 2.2}$  ( $\text{An}_{86.1-93.6}$ ,  $n=14$ )

### Northwest Africa 13339 (NWA 13339)

(Northwest Africa)

Purchased: 2019

Classification: Ordinary chondrite (LL3)

**History:** The meteorite was purchased from a meteorite dealer in Layoune, West Sahara.

**Physical characteristics:** Dark brownish rock without fusion crust.

**Petrography:** The meteorite shows a chondritic texture with well defined, mostly flattened and closely packed chondrules (mean diameter about 0.9 mm) in a more fine-grained brownish matrix that contains sulfides and rare FeNi metal.

### Northwest Africa 13343 (NWA 13343)

(Northwest Africa)

Purchased: 2019

Classification: HED achondrite (Eucrite, monomict)

**History:** The meteorite was purchased from a meteorite dealer in Morocco.

**Physical characteristics:** Many greyish fragments some of which partly covered with fusion crust.

**Petrography:** The meteorite is a coarse-grained basaltic breccia predominantly composed of exsolved pyroxene and often lath-shaped calcic plagioclase up to 1.5 mm in size. Minor phases include silica, chromite, FeS, and ilmenite. No metallic iron has been detected. The meteorite is heavily fractured.

**Geochemistry:** low-Ca pyroxene:  $\text{Fs}_{63.2\pm 0.4}\text{Wo}_{2.3\pm 0.4}$  ( $\text{Fs}_{62.5-63.8}\text{Wo}_{1.8-3.2}$ ,  $n=13$ ,  $\text{FeO/MnO}=27-30$ ); Ca-pyroxene:  $\text{Fs}_{27.6\pm 0.7}\text{Wo}_{44.1\pm 0.5}$  ( $\text{Fs}_{25.3-28.3}\text{Wo}_{43.6-45.8}$ ,  $n=16$ ,  $\text{FeO/MnO}=25-31$ ); calcic plagioclase:  $\text{An}_{89.2\pm 0.9}$  ( $\text{An}_{87.6-90.3}$ ,  $n=14$ )

### Northwest Africa 13344 (NWA 13344)

(Northwest Africa)

Purchased: 2020

Classification: HED achondrite (Eucrite)

**History:** The meteorite was purchased from a meteorite dealer in Morocco.

**Physical characteristics:** Light brownish fragment without fusion crust.

**Petrography:** The meteorite is an unbrecciated basalt predominantly composed of equigranular exsolved pyroxene and calcic plagioclase with average grains sizes of about 600  $\mu\text{m}$ . Silica grains up to 400  $\mu\text{m}$  in size are abundant. Minor phases include ilmenite, chromite, FeS, and metallic iron.

**Geochemistry:** low-Ca pyroxene:  $\text{Fs}_{59.9\pm 0.5}\text{Wo}_{2.9\pm 0.5}$  ( $\text{Fs}_{59.3-60.6}\text{Wo}_{2.2-3.6}$ ,  $n=12$ ,  $\text{FeO/MnO}=26-29$ ); Ca-pyroxene:  $\text{Fs}_{28.5\pm 0.3}\text{Wo}_{41.6\pm 0.8}$  ( $\text{Fs}_{28.1-29.0}\text{Wo}_{39.9-42.4}$ ,  $n=15$ ,  $\text{FeO/MnO}=25-28$ ); calcic plagioclase:  $\text{An}_{90.7\pm 0.5}$  ( $\text{An}_{89.6-91.5}$ ,  $n=13$ )

**Northwest Africa 13345** (NWA 13345)

(Northwest Africa)

Purchased: 2020

Classification: HED achondrite (Howardite)

**History:** The meteorite was purchased from a meteorite dealer in Mauritania.**Physical characteristics:** Individual almost completely covered by shiny fusion crust.**Petrography:** The meteorite is a polymict breccia composed of a large diversity of mostly angular mineral fragments and basaltic clasts set into a fine-grained clastic mineral matrix. Dominant minerals are diagenetic low-Ca pyroxene (about 60 vol%), Fe-rich low-Ca pyroxenes with augite exsolution lamellae, Fe-rich low-Ca pyroxene, magmatically zoned low-Ca pyroxenes, and calcic plagioclase all with highly variable grain sizes. Minor phases include silica, chromite, ilmenite, and metallic iron. The meteorite contains cm-sized coarse-grained basaltic clasts.**Geochemistry:** eucritic low-Ca pyroxene:  $\text{Fs}_{58.3\pm 0.2}\text{Wo}_{5.4\pm 0.1}$  ( $\text{Fs}_{58.0-58.7}\text{Wo}_{5.3-5.5}$ ,  $n=10$ ,  $\text{FeO/MnO}=28-31$ ); augite exsolution lamellae:  $\text{Fs}_{27.3\pm 0.2}\text{Wo}_{43.3\pm 0.2}$  ( $\text{Fs}_{26.9-27.6}\text{Wo}_{43.1-43.6}$ ,  $n=10$ ,  $\text{FeO/MnO}=30-33$ ); diagenetic low-Ca pyroxene:  $\text{Fs}_{27.4\pm 0.6}\text{Wo}_{3.3\pm 0.7}$  ( $\text{Fs}_{26.9-28.6}\text{Wo}_{2.3-3.8}$ ,  $n=10$ ,  $\text{FeO/MnO}=24-34$ ); low-Ca-pyroxene:  $\text{Fs}_{40.1\pm 0.3}\text{Wo}_{2.6\pm 0.1}$  ( $\text{Fs}_{39.5-40.4}\text{Wo}_{2.5-2.7}$ ,  $n=7$ ,  $\text{FeO/MnO}=26-28$ ); zoned low-Ca-pyroxene:  $\text{Fs}_{39.9\pm 8.0}\text{Wo}_{5.2\pm 0.3}$  ( $\text{Fs}_{31.4-49.7}\text{Wo}_{4.9-5.7}$ ,  $n=6$ ,  $\text{FeO/MnO}=25-31$ ); calcic plagioclase:  $\text{An}_{93.4\pm 0.7}$  ( $\text{An}_{92.7-94.5}$ ,  $n=10$ )**Northwest Africa 13346** (NWA 13346)

(Northwest Africa)

Purchased: 2020 May

Classification: Lunar meteorite (feldspathic breccia)

**History:** Purchased in May 2020 by Craig Zlmen from Mark Lyon, who in turn had bought the stone from a Moroccan dealer.**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Breccia composed of mineral clasts of anorthite, olivine, orthopyroxene, pigeonite and subcalcic augite, plus some basalt and gabbroic anorthositic lithic clasts and glass spherules, set in a finer grained matrix containing kamacite, taenite, fayalite, troilite and ilmenite. One feldspathic clast contains accessory Cr-pleonaste rimmed by Ti-chromite.**Geochemistry:** Olivine ( $\text{Fa}_{22.2-45.3}$ ,  $\text{FeO/MnO} = 86-104$ ,  $N = 5$ ), low-Ca pyroxene ( $\text{Fs}_{29.2}\text{Wo}_{3.9}$ ,  $\text{FeO/MnO} = 66$ ), pigeonite ( $\text{Fs}_{32.6-60.8}\text{Wo}_{17.2-23.0}$ ,  $\text{FeO/MnO} = 53-77$ ,  $N = 4$ ), subcalcic augite ( $\text{Fs}_{55.3}\text{Wo}_{33.0}$ ,  $\text{FeO/MnO} = 65$ ), anorthite ( $\text{An}_{95.5-96.3}\text{Or}_{0.5-0.6}$ ,  $N = 2$ ), fayalite ( $\text{Fa}_{92.3}$ ,  $\text{FeO/MnO} = 76$ ), kamacite ( $\text{Ni} = 5.5$  wt.%), taenite ( $\text{Ni} = 13.6$  wt.%).**Classification:** Lunar (feldspathic regolith breccia).**Specimens:** 10.0 g in the form of a polished endcut at *UWB*; remainder with Mr. C. Zlmen.**Northwest Africa 13347** (NWA 13347)

(Northwest Africa)

Purchased: 2019 Dec

Classification: HED achondrite (Diogenite)

**History:** Purchased by Rachid Chaoui in December 2019 from a Mauritanian dealer.**Physical characteristics:** A single partially crusted, pale yellowish-green stone (348 g).**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Aggregate of predominantly orthopyroxene with very minor chromite, troilite and Ni-poor metal.



**Geochemistry:** Orthopyroxene ( $\text{Fs}_{23.4-24.3}\text{Wo}_{2.8-1.3}$ ,  $\text{FeO/MnO} = 27-31$ ,  $N = 5$ ).

**Classification:** Diogenite.

**Specimens:** 21.5 g including one polished thin section at *UWB*; remainder with Mr. R. Chaoui.

### Northwest Africa 13348 (NWA 13348)

(Northwest Africa)

Purchased: 2020 Apr

Classification: Carbonaceous chondrite (CH3)

**History:** Purchased by Mark Lyon in April 2020 from a Moroccan dealer.

**Physical characteristics:** A single small (69 g), dark and fairly dense stone. A polished interior surface exhibits abundant fine grained metal.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Very small chondrules, chondrule fragments and silicate mineral clasts (apparent diameter  $45 \pm 19 \mu\text{m}$ ,  $N = 25$ ) accompanied by relatively abundant grains of metal (~25 vol.%) are set within an even finer grained matrix. Metal is predominantly kamacite with inclusions of taenite and Cr-troilite.

**Geochemistry:** Olivine ( $\text{Fa}_{17.5 \pm 15.5}$ , range  $\text{Fa}_{2.0-41.1}$ ,  $N = 7$ ), low-Ca pyroxene ( $\text{Fs}_{9.4 \pm 9.7}\text{Wo}_{2.9 \pm 2.0}$ , range  $\text{Fs}_{1.8-25.1}\text{Wo}_{0.0-4.6}$ ,  $N = 6$ ), pigeonite ( $\text{Fs}_{1.9}\text{Wo}_{7.9}$ ), subcalcic augite ( $\text{Fs}_{2.4}\text{Wo}_{29.1}$ ), augite ( $\text{Fs}_{10.0}\text{Wo}_{43.1}$ ), aluminous diopside ( $\text{Fs}_{0.5}\text{Wo}_{58.7}$ ,  $\text{Al}_2\text{O}_3 = 15.9 \text{ wt.}\%$ ), plagioclase ( $\text{An}_{86.4}\text{Or}_{0.1}$ ), kamacite (Ni 4.9 wt.%), Si-bearing kamacite (Ni 6.6 wt.%, Cr 0.7 wt.%, Si 6.0 wt.%).

Magnetic susceptibility  $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 5.34$ .

**Classification:** Carbonaceous chondrite (CH3).

**Specimens:** 14.1 g including one polished endcut at *UWB*; remainder with Mr. M. Lyon.

### Northwest Africa 13349 (NWA 13349)

(Northwest Africa)

Purchased: 2019 Jul

Classification: HED achondrite (Eucrite, monomict)

**History:** Purchased by Habib Naji in July 2019 from a dealer in Zouerat, Mauritania.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Monomict breccia composed of highly shocked gabbroic eucrite clasts and related crystalline debris set within a sparse fluidal, melt-textured matrix. Minerals are unexsolved pigeonite and anorthite together with accessory silica polymorph, Ti-chromite (with quite variable Ti and Al) and troilite (as fine inclusions within chromite). Pigeonite grains consist of myriad very small subgrains zoned from more magnesian cores to more ferroan rims. Plagioclase is birefringent but exhibits a variety of textures from undulose to polycrystalline to finely quenched.

**Geochemistry:** Pigeonite ( $\text{Fs}_{40.1-45.2}\text{Wo}_{4.0-11.5}$ ,  $\text{FeO/MnO} = 29-32$ ,  $N = 3$ ;  $\text{Fs}_{33.4}\text{Wo}_{21.4}$ ,  $\text{FeO/MnO} = 29$ ), ferroan low-Ca pyroxene ( $\text{Fs}_{56.3-57.5}\text{Wo}_{3.9-4.9}$ ,  $\text{FeO/MnO} = 32-34$ ,  $N = 2$ ), augite ( $\text{Fs}_{17.0}\text{Wo}_{45.2}$ ,  $\text{FeO/MnO} = 24$ ), anorthite ( $\text{An}_{91.4-92.3}\text{Or}_{0.2-0.3}$ ,  $N = 2$ ).

**Classification:** Eucrite (monomict breccia, gabbroic, highly shocked and partially melted).

The prevalence of compositionally zoned, unexsolved and highly recrystallized pyroxenes in this specimen is an anomalous feature.

**Specimens:** 36.8 g including one polished thin section at *UWB*; remainder with Mr. H. Naji.

### Northwest Africa 13350 (NWA 13350)

(Northwest Africa)

Purchased: 2019 Oct

Classification: Ordinary chondrite (L4)

**History:** Purchased by Grant Harkness in October 2019 from a dealer in Zagora, Morocco.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Well-formed chondrules (relatively small, except for one very large 3.6 mm diameter PO chondrule in the studied thin section) are set in a relatively coarse grained matrix containing stained kamacite, troilite, chromite, merrillite and taenite.

**Geochemistry:** Olivine ( $\text{Fa}_{25.6\pm 0.2}$ , range  $\text{Fa}_{25.3-25.8}$ ,  $N = 6$ ), low-Ca pyroxene ( $\text{Fs}_{21.3\pm 0.3}\text{Wo}_{1.3\pm 0.4}$ , range  $\text{Fs}_{20.9-21.6}\text{Wo}_{0.9-1.7}$ ,  $N = 5$ ), augite ( $\text{Fs}_{7.3\pm 0.4}\text{Wo}_{45.5\pm 0.5}$ , range  $\text{Fs}_{7.0-7.7}\text{Wo}_{45.0-46.0}$ ,  $N = 3$ ). Magnetic susceptibility  $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.74$ .

**Classification:** Ordinary chondrite (L4).

**Specimens:** 26.2 g including one polished thin section at *PSF*; remainder in the Harkness Collection.

### Northwest Africa 13351 (NWA 13351)

(Northwest Africa)

Purchased: 2020 May

Classification: Ungrouped achondrite

**History:** A batch of 31 identical appearing stones collected at the same location as the NWA 13272 stone was purchased from the same Mauritanian dealer by Rachid and Jaouad Chaoui in May 2020.

**Physical characteristics:** Like the NWA 13272 stone, these dark brown stones (total weight 4870 g) have a distinctive "knobby" exterior surface with shiny desert patina. Cut and polished interior surfaces exhibit only rare tiny grains of metal.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Fine grained with a poikilitic igneous texture. Composed predominantly of compositionally zoned pyroxene oikocrysts (with domains of orthopyroxene, pigeonite and subcalcic augite) enclosing chadacrysts of olivine, together with interstitial devitrified silicic glass plus accessory troilite, pyrrhotite, chromite, very rare kamacite (extensively altered to Fe hydroxides) and secondary barite.

**Geochemistry:** Olivine ( $\text{Fa}_{23.9-26.7}$ ,  $N = 5$ ), orthopyroxene ( $\text{Fs}_{17.3-18.0}\text{Wo}_{1.2-2.3}$ ,  $N = 3$ ), pigeonite ( $\text{Fs}_{18.1-19.7}\text{Wo}_{13.8-8.5}$ ,  $N = 2$ ), subcalcic augite ( $\text{Fs}_{12.8-15.5}\text{Wo}_{32.1-36.2}$ ,  $N = 3$ ), interstitial glass ( $\text{SiO}_2$  69.7 wt.%,  $\text{Al}_2\text{O}_3$  20.1 wt.%,  $\text{Na}_2\text{O}$  1.0 wt.%,  $\text{K}_2\text{O}$  0.57 wt.%,  $\text{P}_2\text{O}_5$  0.54 wt.%).

**Classification:** Achondrite (ungrouped, igneous). Paired with [NWA 13272](#).

**Specimens:** 25.5 g in the form of a polished endcut at *UWB*; remainder held jointly by Mr. R. Chaoui and Mr. J. Chaoui.

### Northwest Africa 13352 (NWA 13352)

Algeria

Purchased: 2018 Dec

Classification: HED achondrite (Eucrite, monomict)

**History:** Purchased by Mbark Arjdal in December 2018 from an Algerian dealer.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Monomict breccia composed of gabbroic eucrite clasts plus related crystalline debris. Minerals are exsolved pigeonite and calcic plagioclase together with accessory silica polymorph, ilmenite, Ti-Al chromite, troilite and stained Ni-free metal. Some thin, dark shock veinlets and minor secondary calcite are also present.

**Geochemistry:** Low-Ca pyroxene ( $\text{Fs}_{58.9-60.1}\text{Wo}_{2.4-3.0}$ ,  $\text{FeO/MnO} = 29-30$ ,  $N = 5$ ), augite ( $\text{Fs}_{25.2-26.4}\text{Wo}_{43.0-43.6}$ ,  $\text{FeO/MnO} = 29-31$ ,  $N = 5$ ), plagioclase ( $\text{An}_{89.1-90.1}\text{Or}_{0.3-0.2}$ ,  $N = 3$ ).

**Classification:** Eucrite (monomict breccia).

1  
2  
3 **Specimens:** 42.2 g including one polished thin section at *UWB*; remainder with Mr. M.  
4 Arjdal.  
5  
6  
7

8 **Northwest Africa 13353** (NWA 13353)

9 Algeria

10 Purchased: 2020 Mar

11 Classification: Carbonaceous chondrite (CO3)

12 **History:** Purchased by John Higgins in March 2020 from an Algerian dealer.

13 **Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Small well-formed chondrules  
14 (apparent diameter  $240 \pm 140 \mu\text{m}$ ,  $N = 22$ ) together with some angular, zoned olivine grains  
15 and sparse very fine grained CAI are set in a fine grained matrix ( $\sim 25 \text{ vol.}\%$ , brown in thin  
16 section) containing calcic plagioclase, kamacite and troilite plus minor secondary calcite and  
17 jarosite.  
18

19 **Geochemistry:** Olivine ( $\text{Fa}_{19.9 \pm 15.0}$ , range  $\text{Fa}_{0.8-38.2}$ ,  $N = 5$ ;  $\text{Cr}_2\text{O}_3$  in ferroan olivine = 0.02-0.09  
20 wt.%), orthopyroxene ( $\text{Fs}_{4.3 \pm 3.2}\text{Wo}_{2.1 \pm 1.8}$ , range  $\text{Fs}_{1.2-8.3}\text{Wo}_{0.3-4.2}$ ,  $N = 4$ ), augite  
21 ( $\text{Fs}_{4.0 \pm 3.9}\text{Wo}_{41.7 \pm 0.0}$ ,  $N = 2$ ).  
22

23 **Classification:** Carbonaceous chondrite (CO3).

24 **Specimens:** 20.4 g including one polished thin section at *UWB*; remainder with Mr. J.  
25 Higgins.  
26  
27

28 **Northwest Africa 13354** (NWA 13354)

29 (Northwest Africa)

30 Purchased: 2020 Jan

31 Classification: Primitive achondrite (Lodranite)

32 **History:** Purchased by Mark Lyon in January 2020 from a Moroccan dealer.

33 **Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Protogranular texture with a mean  
34 grainsize of  $\sim 400 \mu\text{m}$ . Composed mainly of relatively magnesian orthopyroxene, forsteritic  
35 olivine and diopside together with accessory stained kamacite, oligoclase, chromite, troilite  
36 and chlorapatite.  
37

38 **Geochemistry:** Orthopyroxene ( $\text{Fs}_{10.5-10.7}\text{Wo}_{2.9-3.2}$ ,  $\text{FeO/MnO} = 14-17$ ,  $N = 5$ ), olivine ( $\text{Fa}_{6.6-}$   
39  $8.0$ ,  $\text{FeO/MnO} = 12-13$ ,  $N = 5$ ), diopside ( $\text{Fs}_{5.1-5.4}\text{Wo}_{40.8-42.0}$ ,  $\text{FeO/MnO} = 8-9$ ,  $N = 5$ ),  
40 plagioclase ( $\text{An}_{20.9}\text{Or}_{1.4}$ ). Magnetic susceptibility  $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 5.55$ .  
41

42 **Classification:** Lodranite. This specimen is best regarded as a medium-grainsize member of  
43 the acapulcoite-lodranite clan.  
44

45 **Specimens:** 25.2 g including one polished thin section at *UWB*; remainder with Mr. M. Lyon.  
46  
47

48 **Northwest Africa 13355** (NWA 13355)

49 (Northwest Africa)

50 Purchased: 2020 May

51 Classification: HED achondrite (Eucrite, anomalous)

52 **History:** Purchased by Rachid Chaoui in May 2020 from a Mauritanian dealer.

53 **Physical characteristics:** A very dark ellipsoidal specimen (672 g) partly coated by a shiny  
54 patina and with one broken side (slightly weathered). The fresh interior is dark gray with  
55 some larger dark crystals barely visible.  
56

57 **Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) This specimen has an unbrecciated  
58 igneous texture, but is unique among eucrites in containing relatively large (up to 4 mm)  
59 subhedral phenocrysts of exsolved pigeonite with abundant thin exsolution lamellae of  
60

chromite. The prismatic phenocrysts are set in a groundmass of parallel-intergrown pigeonite and calcic plagioclase with accessory silica polymorph, Ti-chromite, ilmenite, troilite and baddeleyite.

**Geochemistry:** Low-Ca pyroxene host ( $\text{Fs}_{49.6-53.2}\text{Wo}_{1.8-3.0}$ ,  $\text{FeO/MnO} = 31-32$ ,  $N = 4$ ), augite exsolution lamellae ( $\text{Fs}_{23.1-25.0}\text{Wo}_{39.6-42.7}$ ,  $\text{FeO/MnO} = 29-31$ ,  $N = 2$ ), plagioclase ( $\text{An}_{79.2-85.5}\text{Or}_{6.5-0.6}$ ,  $N = 4$ ). Oxygen isotopes (K. Ziegler, *UNM*): analyses of acid-washed bulk subsamples by laser fluorination gave, respectively,  $\delta^{17}\text{O}$  1.665, 1.895, 1.871;  $\delta^{18}\text{O}$  3.693, 4.157, 4.105;  $\Delta^{17}\text{O}$  -0.285, -0.300, -0.296 per mil. These results plot beyond the main field for eucrites to more negative  $\Delta^{17}\text{O}$  values.

**Classification:** Eucrite (unbrecciated, pyroxene-phyric, anomalous). The porphyritic igneous texture, prominent chromite exsolution in pyroxenes and atypical oxygen isotopic composition are anomalous features. Chromite exsolution from pyroxene has been documented in ungrouped achondrite [GRA 06129](#) and some [Luna 24](#) specimens, but not previously in eucrites.

**Specimens:** 23 g including one polished thin section at *UWB*; remainder with Mr. R. Chaoui.

### Northwest Africa 13356 (NWA 13356)

(Northwest Africa)

Purchased: 2019 Aug

Classification: Ordinary chondrite (LL4)

**History:** Purchased by Mbark Arjdal in August 2019 from a dealer in Timbuktu, Mali.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Well-formed chondrules with a wide range in size (apparent diameter 0.1-3.5 mm) are set in a finer grained matrix containing goethite (after kamacite), chromite and troilite.

**Geochemistry:** Olivine ( $\text{Fa}_{28.6\pm 0.3}$ , range  $\text{Fa}_{28.3-28.9}$ ,  $N = 5$ ), low-Ca pyroxene ( $\text{Fs}_{23.2\pm 0.5}\text{Wo}_{2.5\pm 0.2}$ , range  $\text{Fs}_{22.3-23.7}\text{Wo}_{1.5-4.5}$ ,  $N = 6$ ), augite ( $\text{Fs}_{8.8\pm 0.5}\text{Wo}_{46.4\pm 0.1}$ , range  $\text{Fs}_{8.4-9.1}\text{Wo}_{46.3-46.5}$ ,  $N = 2$ ). Magnetic susceptibility  $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 3.24$ .

**Classification:** Ordinary chondrite (LL4).

**Specimens:** 28.6 g including one polished thin section at *UWB*; remainder with Mr. M. Arjdal.

### Northwest Africa 13357 (NWA 13357)

Algeria

Purchased: 2020 Mar

Classification: Carbonaceous chondrite (CK3-6)

**History:** Purchased by John Higgins in March 2020 from an Algerian dealer.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Very fresh specimen composed of discrete unequilibrated, granular, magnetite-bearing chondrules (apparent diameter  $1040\pm 680 \mu\text{m}$ ,  $N = 22$ ) plus some equilibrated Type 6 clasts and set in a finer grained matrix containing calcic plagioclase and Cr-magnetite. Type 6 clasts consist of sparse remnant chondrules within a recrystallized magnetite-bearing matrix.

**Geochemistry:** Olivine in Type 6 clasts ( $\text{Fa}_{34.4\pm 2.1}$ , range  $\text{Fa}_{32.0-38.9}$ ,  $\text{NiO} = 0.5-0.7 \text{ wt.}\%$ ,  $N = 7$ ), low-Ca pyroxene ( $\text{Fs}_{27.3\pm 0.1}\text{Wo}_{0.9\pm 0.0}$ , range  $\text{Fs}_{27.2-27.3}\text{Wo}_{0.9}$ ,  $N = 2$ ), augite ( $\text{Fs}_{9.5}\text{Wo}_{48.8}$ ), plagioclase ( $\text{An}_{82.1}\text{Or}_{0.4}$ ;  $\text{An}_{54.7}\text{Or}_{2.4}$ ;  $N = 2$ ), magnetite ( $\text{Cr}_2\text{O}_3 = 5.8 \text{ wt.}\%$ ), olivine in unequilibrated chondrule ( $\text{Fa}_{15.6\pm 6.7}$ , range  $\text{Fa}_{6.8-22.7}$ ,  $N = 5$ ).

**Classification:** Carbonaceous chondrite (CK3-6 breccia).

**Specimens:** 8.3 g including one polished thin section at *UWB*; remainder with Mr. J. Higgins.

**Northwest Africa 13358** (NWA 13358)

(Northwest Africa)

Purchased: 2019 May

Classification: Ordinary chondrite (L5)

**History:** Purchased by Mbark Arjdal in May 2019 from a dealer in Timbuktu, Mali.**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Sparse, indistinct chondrules are present within a recrystallized matrix (stained orange-brown in thin section) containing chromite, troilite, pyrrhotite, merrillite. Secondary terrestrial weathering products include goethite (replacing primary metal), patchy Fe-Ni-Mn-bearing phosphate (?arupite) within merrillite, and a Ca sulfate phase.**Geochemistry:** Olivine ( $Fa_{24.9\pm 0.2}$ , range  $Fa_{24.6-25.2}$ ,  $N = 5$ ), low-Ca pyroxene ( $Fs_{20.8\pm 0.1}Wo_{1.5\pm 0.2}$ , range  $Fs_{20.7-20.9}Wo_{1.2-1.7}$ ,  $N = 5$ ), augite ( $Fs_{7.9\pm 0.4}Wo_{44.8\pm 0.4}$ , range  $Fs_{7.6-8.3}Wo_{44.5-45.2}$ ,  $N = 3$ ). Magnetic susceptibility  $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.16$ .**Classification:** Ordinary chondrite (L5).**Specimens:** 51.5 g including one polished thin section at *UWB*; remainder with Mr. M. Arjdal.**Northwest Africa 13359** (NWA 13359)

(Northwest Africa)

Purchased: 2020 Mar

Classification: HED achondrite (Eucrite, polymict)

**History:** Purchased by John Divelbiss in March 2020 from Matthew Stream, who bought the stone from a Moroccan dealer at the 2020 Tucson Gem and Mineral Show.**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Complex breccia composed of angular mineral clasts of both exsolved and unexsolved pigeonite, augite and anorthite together with <10 vol.% diagenitic orthopyroxene (exhibiting undulose extinction) plus minor olivine, silica polymorph and more ferroan orthopyroxene set in a finer grained matrix containing chromite, ilmenite, Ni-free metal, kamacite, calcite and barite. Sparse lithic clasts of gabbroic eucrite and genomict breccia clasts are also present in the studied thin section. Most grains of anorthite and pigeonite exhibit recrystallization into very fine grained, polygranular aggregates.**Geochemistry:** Pigeonite host ( $Fs_{51.6-55.8}Wo_{5.1-8.7}$ ,  $FeO/MnO = 30-31$ ,  $N = 4$ ), augite exsolution lamellae ( $Fs_{28.4-29.8}Wo_{39.0-40.2}$ ,  $FeO/MnO = 30$ ,  $N = 2$ ), orthopyroxene ( $Fs_{40.4}Wo_{2.5}$ ,  $FeO/MnO = 29$ ), pigeonite (core  $Fs_{39.2}Wo_{7.7}$ ; rim  $Fs_{41.2}Wo_{15.5}$ ;  $FeO/MnO = 30-31$ ;  $N = 2$ ), augite  $Fs_{29.8}Wo_{39.0}$ ,  $FeO/MnO = 30$ ), anorthite ( $An_{92.2-94.8}Or_{0.1-0.3}$ ,  $N = 3$ ), diagenitic orthopyroxene ( $Fs_{26.5-29.9}Wo_{1.8-3.5}$ ; rim  $Fs_{33.6}Wo_{3.8}$ ;  $FeO/MnO = 27-32$ ,  $N = 4$ ), olivine ( $Fa_{27.1-34.5}$ ,  $FeO/MnO = 48-51$ ,  $N = 4$ ).**Classification:** Eucrite (polymict breccia).**Specimens:** 20.6 g including one polished thin section and one polished slice at *UWB*; remainder with Mr. J. Divelbiss.**Northwest Africa 13360** (NWA 13360)

Northwest Africa

Purchased: 2020 Jan

Classification: Martian meteorite (Shergottite)

**History:** Purchased in January 2020 by Noredine Azelmat from a Moroccan dealer.



**Physical characteristics:** Single stone lacking fusion crust. A slice of the interior reveals a relatively coarse-grained rock containing brown olivines and gray-green pyroxenes.

**Petrography:** (Daniel Sheikh, *FSU*) Sample exhibits a predominantly poikilitic texture (grain size Av.  $750 \pm 100 \mu\text{m}$ , up to 2.5 mm) composed of compositionally zoned low-Ca pyroxene oikocrysts enclosing sub-angular olivine chadacrysts. Also present include compositionally zoned, tabular, irregular grains of pigeonite and augite, as well as laths of maskelynite.

Accessory phases include chromite (some Ti-rich), ilmenite, pyrrhotite, merrillite, pentlandite, and Si-Al-rich glass. Sample contains minor carbonate weathering veins.

**Geochemistry:** Olivine ( $\text{Fa}_{35.0 \pm 1.8}$ , range  $\text{Fa}_{30.4-39.4}$ ,  $\text{FeO/MnO} = 48 \pm 5$ ,  $n=75$ ), low-Ca pyroxene ( $\text{Fs}_{21.3 \pm 0.4} \text{Wo}_{4.1 \pm 0.6}$ , range  $\text{Fs}_{20.5-22.5} \text{Wo}_{3.5-5.2}$ ,  $\text{FeO/MnO} = 30 \pm 3$ ,  $n=30$ ), pigeonite ( $\text{Fs}_{25.5 \pm 3.2} \text{Wo}_{9.2 \pm 2.8}$ , range  $\text{Fs}_{21.8-30.1} \text{Wo}_{6.1-15.4}$ ,  $\text{FeO/MnO} = 30 \pm 3$ ,  $n=31$ ), subcalcic augite ( $\text{Fs}_{16.4 \pm 0.8} \text{Wo}_{31.9 \pm 2.1}$ , range  $\text{Fs}_{15.2-17.7} \text{Wo}_{27.9-34.9}$ ,  $\text{FeO/MnO} = 22 \pm 2$ ,  $n=20$ ), maskelynite ( $\text{An}_{54.2 \pm 1.4} \text{Or}_{1.4 \pm 0.2}$ , range  $\text{An}_{51.3-56.3} \text{Or}_{1.1-1.7}$ ,  $n=20$ ).

**Classification:** Shergottite (poikilitic). Silicate chemistry, the presence of maskelynite, and FeO/MnO ratios of pyroxenes provide support for classification as shergottite. Predominant poikilitic texture argues for classification as poikilitic shergottite.

**Specimens:** 20.05 g at *UCLA*; main mass with Noreddine Azelmat.

#### Northwest Africa 13362 (NWA 13362)

(Northwest Africa)

Purchased: January 2020

Classification: Martian meteorite (Shergottite)

**History:** Purchased in January 2020 by Jasper Spencer from a moroccan dealer.

**Physical characteristics:** One stone covered by a dull, dark-colored fusion crust.

**Petrography:** (Daniel Sheikh, *FSU*) Sample is predominantly composed of slightly oriented maskelynite laths (Av.  $900 \pm 50 \mu\text{m}$ , up to 3 mm, 65 vol%) and complexly zoned, tabular, rounded, and irregularly-shaped grains (some twinned) of ferropigeonite and subcalcic augite (Av.  $350 \pm 50 \mu\text{m}$ , up to 1mm, 35 vol%). Accessory phases include titanomagnetite, ulvöspinel, Si-Al-K-Na rich glass, merrillite, chlorapatite, and pyrrhotite. Sample contains minor carbonate weathering veins.

**Geochemistry:** Ferropigeonite ( $\text{Fs}_{66.4 \pm 12.6} \text{Wo}_{16.4 \pm 3.2}$ , range  $\text{Fs}_{42.3-85.2} \text{Wo}_{9.2-21.9}$ ,  $\text{FeO/MnO} = 38 \pm 5$ ,  $n=41$ ), subcalcic augite ( $\text{Fs}_{41.1 \pm 10.1} \text{Wo}_{30.1 \pm 3.0}$ , range  $\text{Fs}_{24.0-54.0} \text{Wo}_{26.4-36.6}$ ,  $\text{FeO/MnO} = 34 \pm 5$ ,  $n=14$ ), maskelynite ( $\text{An}_{47.9 \pm 4.4} \text{Or}_{2.0 \pm 0.9}$ , range  $\text{An}_{39.6-53.5} \text{Or}_{1.0-4.2}$ ,  $n=28$ ).

**Classification:** Martian (shergottite) Silicate chemistry, the presence of maskelynite, and FeO/MnO ratios of pyroxenes provide support for classification as shergottite.

**Specimens:** 1 gram at *App*; main mass with Jasper Spencer.

#### Northwest Africa 13363 (NWA 13363)

Algeria

Find: 2020 Jan

Classification: Angrite

**History:** Found in January 2020 by Ali Muftah in Algeria. Later purchased from Ali Muftah in March 2020 by Youssef Bennani.

**Physical characteristics:** Sample is a single stone covered with a relatively fresh, dark-gray fusion crust containing visible vesicles.

**Petrography:** (D. Sheikh, *FSU*) This sample exhibits a fine-grained, subophitic texture (grain size up to  $200 \mu\text{m}$ , Av.  $100 \mu\text{m}$ ) composed primarily of twinned anorthite laths, Al-Ti-rich augite, and Ca-rich olivine (some are polycrystalline). Al-Ti-rich augite and Ca-rich olivine

grains often display strong compositional zoning; in the case of Ca-rich olivine, several grains are rimmed by kirschsteinite. Accessory mineral phases include Al-bearing titanomagnetite and troilite. Vesicles are visible throughout the thin section.

**Geochemistry:** Olivine ( $\text{Fa}_{50.6\pm 15.1}\text{Ln}_{4.4\pm 5.4}$ , range  $\text{Fa}_{32.2-79.7}\text{Ln}_{1.2-20.3}$ ,  $\text{FeO/MnO} = 79\pm 12$ ,  $n=38$ ), Kirschsteinite ( $\text{Fa}_{61.2\pm 1.4}\text{Ln}_{33.7\pm 1.4}$ , range  $\text{Fa}_{60.3-62.8}\text{Ln}_{32.3-34.9}$ ,  $\text{FeO/MnO} = 70\pm 12$ ,  $n=3$ ), Al-Ti-rich augite ( $\text{Fs}_{30.9\pm 12.1}\text{Wo}_{51.1\pm 0.9}$ , range  $\text{Fs}_{19.1-49.0}\text{Wo}_{49.3-52.7}$ ,  $\text{Al}_2\text{O}_3\text{wt}\% = 7.0\pm 1.0$ ,  $\text{TiO}_2\text{ wt}\% = 2.6\pm 1.4$ ,  $\text{FeO/MnO} = 101\pm 13$ ,  $n=17$ ), Anorthite ( $\text{An}_{99.6\pm 0.2}$ , range  $\text{An}_{99.4-99.8}$ ,  $n=20$ ).

**Classification:** Angrite. The Fe/Mn ratio and presence of anorthite, Ca-rich olivine, kirschsteinite, Al-Ti-rich augite, and vesicles in the sample point to the Angrite meteorite group.

**Specimens:** 11.2 grams at *UCLA*; main mass with Youssef Bennani.

### Northwest Africa 13364 (NWA 13364)

Morocco

Purchased: 2019

Classification: Carbonaceous chondrite (CV3)

**History:** The 227 g sample was purchased from Aziz Mouadine at the St. Marie aux Mines show in June, 2019.

**Physical characteristics:** Sample is dark-brown in color and has a blocky irregular shape. The exterior is devoid of fusion crust and chondrules are visible on the weathered exterior. The interior of the sample has a matrix that is a mixture of mottled gray and dark-red with lighter-colored chondrules and CAIs.

**Petrography:** Description and classification (A. Love, *App*) Sample has a chondritic texture composed of chondrules and CAIs and abundant AOA's set within an opaque matrix (~52 vol%). Chondrules have an average apparent diameter of 658  $\mu\text{m}$  ( $n=56$ ). Some pyroxenes contain ferroan olivine veins ( $\text{Fa}_{23-41}$ ). Additional minerals are: anorthitic plagioclase, hedenbergite, diopside, chromite, rare troilite, Ca-phosphate, and secondary calcite.

**Geochemistry:** (A. Love, *App*) Olivine ( $\text{Fa}_{6.0\pm 5.7}$ ,  $\text{Fe/Mn}=12.5-116.7$ ,  $n=16$ ); low Ca pyroxene ( $\text{Fs}_{1.1\pm 0.2}\text{Wo}_{0.9\pm 0.2}$ ,  $n=6$ ).

**Classification:** Carbonaceous Chondrite (CV3) Sample is an unequilibrated CV carbonaceous chondrite based on modal abundance of matrix, mineral compositions, chondrule diameter and magnetic susceptibility.

**Specimens:** Marc Jost (*SJS*) holds the main mass. An encut and part slice weighing 31.57 g and a polished thin section are on deposit at *App*.

### Northwest Africa 13365 (NWA 13365)

Morocco

Purchased: 2019

Classification: HED achondrite (Diogenite)

**History:** 5 stones weighing 230.2 g were found in Morocco prior to 2019. Marc Jost (*SJS*) purchased these samples from a meteorite dealer while at the 2019 Ensisheim Meteorite Show.

**Physical characteristics:** The samples are irregularly shaped, lack fusion crust and have a yellowish-brown exterior. The type specimen has a yellowish-orange interior that is brecciated and friable. The cut face shows angular-sub-rounded clasts up to 1.5 cm in long dimension.

**Petrography:** Description and classification (A. Love, *App*): Sample is an aggregate of fractured, 250-1024  $\mu\text{m}$  orthopyroxene grains which share  $120^\circ$  grain boundaries. Sparse areas with fine-grained brecciated texture were observed. Orthopyroxenes contain exsolved Cpx inclusions. Additional minerals are: chromite, silica polymorphs, FeS and rare Ni-free iron metal.

**Geochemistry:** Diogenite clasts: low-Ca pyroxene ( $\text{Fs}_{27.5\pm 0.2}\text{Wo}_{3.4\pm 0.5}$ ,  $\text{Fe}/\text{Mn}=26.4\pm 0.4$ ,  $\text{Mg}\#71.3\text{-}71.6$ ,  $n=8$ ); high-Ca pyroxene exsolution lamellae ( $\text{Fs}_{10.7\pm 0.5}\text{Wo}_{45.2\pm 1.0}$ ,  $\text{Fe}/\text{Mn}=19.6\pm 1.2$ ,  $N=6$ ).

**Classification:** HED (monomict diogenite breccia). Textures, FeO/MnO and Fs compositions of pyroxenes indicate this sample is a brecciated diogenite.

**Specimens:** Marc Jost (*SJS*) holds the main masses. 2 slices weighing 28.13 g and a polished mount are on deposit at *App*.

### Northwest Africa 13366 (NWA 13366)

Algeria

Purchased: 2019

Classification: Martian meteorite (Shergottite)

**History:** Purchased from a nomad in Algeria in 2019 and sent to Dustin Dickens at the Tucson Gem and Mineral Show, February 2020.

**Physical characteristics:** Single stone, saw cut reveals an ultramafic cumulate rock with ophitic to poikilitic textures with mm-size pale yellow and dark gray grains.

**Petrography:** (C. Agee, *UNM*) Microprobe examination shows approximately 60% olivine, 35% pyroxene, and 5% maskelynite. Two distinct pyroxene trends are present 1) Mg-rich low calcium pyroxene trending to slightly more Fe-rich pigeonite, 2) Mg-rich augite trending to more Ca-rich augite. Ilmenite, Fe-sulfide, and merrillite are minor ubiquitous phases.

**Geochemistry:** (C. Agee, *UNM*) Olivine  $\text{Fa}_{34.5\pm 2.6}$ ,  $\text{Fe}/\text{Mn}=50\pm 3$ ,  $n=15$ ; low Ca-pyroxene  $\text{Fs}_{24.4\pm 4.6}\text{Wo}_{5.9\pm 3.8}$ ,  $\text{Fe}/\text{Mn}=30\pm 2$ ,  $n=9$ ; augite  $\text{Fs}_{16.0\pm 1.2}\text{Wo}_{35.0\pm 3.1}$ ,  $\text{Fe}/\text{Mn}=24\pm 1$ ,  $n=4$ ; maskelynite  $\text{An}_{53.7\pm 1.1}\text{Ab}_{44.9\pm 1.2}\text{Or}_{1.4\pm 0.1}$ ,  $n=6$ .

**Classification:** Martian peridotitic shergottite. Macroscopic textural appearance similar to [NWA 1950](#) and [ALHA77005](#). Paired with [NWA 13250](#).

**Specimens:** 20 g on deposit at *UNM*, Dustin Dickens holds the main mass.

### Northwest Africa 13367 (NWA 13367)

Algeria

Purchased: 2020

Classification: Martian meteorite (Shergottite)

**History:** Purchased from a Moroccan dealer in April 2020.

**Physical characteristics:** Single stone, fusion crust, saw cuts reveals an ultramafic cumulate rock with ophitic to poikilitic textures with mm-size pale yellow and dark gray grains.

**Petrography:** (C. Agee, *UNM*) Microprobe examination shows approximately 50% olivine, 40% pyroxene, and 10-5% maskelynite. Two distinct pyroxene trends are present 1) Mg-rich low calcium pyroxene trending to slightly more Fe-rich pigeonite, 2) Mg-rich augite trending to more Ca-rich augite. Ilmenite, spinel, Fe-sulfide, and merrillite are minor ubiquitous phases.

**Geochemistry:** (C. Agee, *UNM*) Olivine  $\text{Fa}_{34.6\pm 2.0}$ ,  $\text{Fe}/\text{Mn}=49\pm 2$ ,  $n=10$ ; low Ca-pyroxene  $\text{Fs}_{22.5\pm 0.5}\text{Wo}_{4.7\pm 0.7}$ ,  $\text{Fe}/\text{Mn}=29\pm 2$ ,  $n=6$ ; augite  $\text{Fs}_{17.2\pm 0.9}\text{Wo}_{32.4\pm 2.8}$ ,  $\text{Fe}/\text{Mn}=24\pm 1$ ,  $n=4$ ; maskelynite  $\text{An}_{52.9\pm 2.3}\text{Ab}_{46.0\pm 2.2}\text{Or}_{1.1\pm 0.2}$ ,  $n=4$ , fusion crust  $\text{SiO}_2=46.5\pm 0.6$ ,  $\text{TiO}_2=0.9\pm 0.1$ ,

Al<sub>2</sub>O<sub>3</sub>=8.6±3.5, Cr<sub>2</sub>O<sub>3</sub>=0.7±0.1, MgO=18.0±3.5, FeO=15.3±0.5, MnO=0.4±0.1, Na<sub>2</sub>O=1.4±0.5 (all wt%), n=2.

**Classification:** Martian peridotitic shergottite. Macroscopic textural appearance similar to [NWA 1950](#) and [ALHA77005](#). Paired with [NWA 13250](#).

**Specimens:** 20 g on deposit at *UNM*, Marcin Cimala holds the main mass.

### Northwest Africa 13368 (NWA 13368)

Mauritania

Purchased: 2020 Jul

Classification: Martian meteorite (Nakhlite)

**History:** Purportedly found in Mauritania, purchased by Rachid Chaoui in July 2020 from a dealer in Nouakchott, Mauritania, and subsequently acquired by Ben Hoefnagels.

**Physical characteristics:** A single, rounded pyramidal stone (1105 g) partially coated by degraded black fusion crust. The fresh interior is deep olive green in color and somewhat friable.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) The specimen is composed predominantly of euhedral, prismatic cumulus grains of augite (up to 1.3 mm) with thin, more ferroan rims plus subordinate (~4 vol.%) larger grains of olivine (up to 8 mm, with thin, more ferroan rims) and sparse blocky grains of titanomagnetite (up to 0.7 mm) accompanied by a fine grained intercumulus assemblage of cruciform titanomagnetite, fayalite, hedenbergite, silica polymorph, pyrrhotite and alkali feldspathic glass. "Iddingsitic" material occurs in thin veinlets within cumulus olivine grains, and melt inclusions within augite grains contain daughter crystals of chloramphibole (potassic hastingsite).

**Geochemistry:** Augite (cores Fs<sub>22.9-23.0</sub>Wo<sub>39.2-39.7</sub>, FeO/MnO = 30-31, N = 3; rims Fs<sub>47.7-50.2</sub>Wo<sub>33.2-37.9</sub>, FeO/MnO = 35-41, N = 2), olivine (cores Fa<sub>61.5-62.7</sub>, FeO/MnO = 48-49, N = 4; rims Fa<sub>79.6-88.3</sub>, FeO/MnO = 37-44, N = 4), intercumulus hedenbergite (Fs<sub>50.6-53.5</sub>Wo<sub>41.2-40.6</sub>, FeO/MnO = 39-40, N = 2), intercumulus fayalite (Fa<sub>92.6-92.7</sub>, FeO/MnO = 36-37, N = 2), intercumulus alkali feldspathic glass (approximately Ab<sub>60.1</sub>An<sub>19.4</sub>Or<sub>20.4</sub>).

**Classification:** Nakhlite. This specimen is very similar in many respects to [MIL 03346](#) and paired specimens from Miller Range, Antarctica. However, it differs in containing sporadic, relatively large grains of titanomagnetite.

**Specimens:** 29 g including one polished mount at *UWB*; main mass with Mr. B. Hoefnagels.

### Northwest Africa 13369 (NWA 13369)

Adrar, Algeria

Purchased: 2020

Classification: Martian meteorite (Shergottite)

**History:** The 24.7 g sample was found near Adrar and subsequently purchased in Tindouf. Fabien *Kuntz* purchased the sample in January of 2020.

**Physical characteristics:** The 24.7g sample is dark greenish-gray, crystalline and lacks fusion crust. The cut face shows the interior is composed of interlocking green crystals of pyroxene poikilitically enclosing black olivines (shock-darkened).

**Petrography:** Description and Classification: (A. Love, *App*) Sample has a poikilitic igneous texture composed of (vol%): 2.23 mm (avg. l.d., n=3) oikocrysts of pyroxene (~21.4) with 317 μm (avg. l.d., n=22) rounded chadacrysts of olivine. Oikocrysts are surrounded by 748 μm (avg. l.d., n=20) euhedral prisms of olivine (~42.7); 913 μm (avg. l.d., n=23); prismatic, twinned pyroxene (~45.7); and 488 μm (avg. l.d., n=23) lath-shaped maskelynite (~5.3).

Additional minerals are merrillite, a Cl-apatite, chromite, ilmenite, titanomagnetite, pyrrhotite and secondary calcite.

**Geochemistry:** (A. Patchen-UTK) Olivine ( $\text{Fa}_{33.0\pm 3.3}$ ,  $\text{Mg}\#67.1\pm 3.3$ ,  $\text{Fe}/\text{Mn}=49.2\pm 2.0$ ,  $n=96$ ); low-Ca pyroxene ( $\text{Fs}_{21.3\pm 1.0}\text{Wo}_{3.3\pm 0.8}$ ,  $\text{Fe}/\text{Mn}=30.7\pm 1.2$ ,  $n=32$ ); pigeonite ( $\text{Fs}_{27.9\pm 2.7}\text{Wo}_{10.2\pm 2.7}$ ,  $\text{Fe}/\text{Mn}=28.8\pm 3.4$ ,  $n=131$ ); subcalcic augite ( $\text{Fs}_{18.3\pm 0.9}\text{Wo}_{28.8\pm 1.1}$ ,  $\text{Fe}/\text{Mn}=25.2\pm 1.1$ ,  $n=8$ ) augite ( $\text{Fs}_{16.6\pm 1.2}\text{Wo}_{34.1\pm 2.3}$ ,  $\text{Fe}/\text{Mn}=25.4\pm 1.4$ ,  $n=51$ ); plagioclase ( $\text{An}_{52.0\pm 4.6}\text{Or}_{1.6\pm 0.5}$ ,  $n=16$ ).

**Classification:** Martian (poikilitic shergottite). Based on mineral compositions (Fs, Wo, Mg# and Fe/Mn) and textures, this sample is a highly shocked (U-S5) poikilitic shergottite.

**Specimens:** *Kuntz* holds the main mass. A polished thin section and a sliced fragment weighing 5.71 g are on deposit at *App*.

### Northwest Africa 13370 (NWA 13370)

Morocco

Purchased: 2020

Classification: HED achondrite (Howardite)

**History:** In February of 2020, Fabien *Kuntz* purchased two stones with a total weight of 311.8 g from a meteorite prospector in Guelmim, Morocco.

**Physical characteristics:** A sample from each stone was submitted for classification. Both stones have a dark-brown, wind-ablated exterior. Clasts are visible on the exterior. The cut face shows sample is a breccia with visible orthopyroxene clasts, lithic clasts up to 2 mm and flecks of Fe metal.

**Petrography:** Description and Classification (A. Love, *App*) Sample is composed of (vol %): angular to rounded lithic clasts of eucrite (70) and diogenite (30) and similar mineral fragments set within a comminuted matrix of these materials. Lithic clasts are: cumulate and equilibrated basaltic eucrite; diogenite (including a poikilitic diogenite) and a highly magnesian olivine-orthopyroxene lithology ( $\text{Fa}_5\text{Fs}_{13}\text{Wo}_{0.3}$ ); and several shock-melted clasts (melt breccia - total melt). Eucritic pyroxenes are exsolved. Additional minerals are olivine chromite, ilmenite, troilite, plagioclase, Fe metal grains and a silica polymorph.

**Geochemistry:** (A. Love, *App*) Diogenite: orthopyroxene ( $\text{Fs}_{26.0\pm 5.1}\text{Wo}_{1.7\pm 1.1}$ ,  $\text{Fe}/\text{Mn}=32.2\pm 4.1$ ,  $n=12$ ); Olivine,  $\text{Fa}_{25.2\pm 14.8}$  ( $\text{Fa}_{5.6-47.7}$ ,  $\text{Fe}/\text{Mn}=40.6\pm 6.8$ ,  $n=9$ ). Eucrite: low-Ca pyroxene ( $\text{Fs}_{52.7\pm 10.0}\text{Wo}_{3.2\pm 1.2}$ ,  $\text{Fe}/\text{Mn}=29.4\pm 1.4$ ,  $n=5$ ); pigeonite ( $\text{Fs}_{42.7-49.7}\text{Wo}_{8.9-12.1}$ ,  $N=2$ ); high-Ca pyroxene ( $27.5\pm 7.0\text{Wo}_{40.8\pm 2.2}$ ,  $n=5$ ); plagioclase ( $\text{An}_{93.1\pm 2.4}\text{Or}_{0.2\pm 0.1}$ ,  $n=6$ ).

**Classification:** HED achondrite (howardite). Based on texture, modal abundances, unequilibrated mineral compositions, Fe/Mn and Mg# of orthopyroxenes and olivines, this sample is a howardite with a shock stage corresponding to M-S2 and low weathering grade.

**Specimens:** *Kuntz* holds the main masses. Two slices weighing 29.78 g and a polished thin section are on Deposit at *App*.

### Northwest Africa 13371 (NWA 13371)

Chwichiya, Morocco

Purchased: 2018

Classification: Carbonaceous chondrite (CM2)

**History:** Sergey Vasiliev purchased 5 individuals under the name Oued Haouza (CM2) at the Munich mineral show in 2018.

**Physical characteristics:** Samples are rounded to irregularly shaped and are partially coated in black, flow-lined and bubbled fusion crust. The interior of the samples is black with small, light-gray chondrules.



**Petrography:** Description and Classification (A. Love, *App*) Sample has a brecciated chondritic texture composed of lithologies that show varying levels of alteration. The sample is composed of (vol %): chondrules (12) with average apparent diameter of 161  $\mu\text{m}$  (n=146); CAI's (8); chondrule fragments and mineral grains (3) set within a fine-grained, FeO-rich, opaque matrix (77). Dust mantles are present on a portion of chondrules. Phyllosilicates are present within chondrule mesostasis and mixed with tochilinite in portions of the matrix. FeNi metal occurs as rounded inclusions within silicates only. Additional minerals are: troilite, chromite and magnetite.

**Geochemistry:** (A. Love, *App*) Olivine,  $\text{Fa}_{25.4\pm 17.2}$  ( $\text{Fa}_{0.3-48.9}$ ),  $\text{Cr}_2\text{O}_3$  in ferroan olivines  $0.4\pm 0.1$ , n=17; low-Ca pyroxene,  $\text{Fs}_{5.8\pm 9.5}\text{Wo}_{1.2\pm 0.7}$  ( $\text{Fs}_{0.8-36.1}\text{Wo}_{0.7-3.0}$ , n=12).

**Classification:** Carbonaceous chondrite (CM2) Textures, mineralogy and matrix abundance suggest this is a CM2. Presence of altered mesostasis and tochilinite-phyllosilicate intergrowths suggests CM2.

**Specimens:** Sergey Vasiliev holds the main masses. 2 whole stones totaling 5g and a polished thin section are on deposit at *App*.

### Northwest Africa 13372 (NWA 13372)

Morocco

Purchased: 2019

Classification: Ordinary chondrite (H3-6)

**History:** Purchased by S.Crivello and I.Pardini at the 2019 Genoa Mineral Show from a Moroccan dealer. Reportedly from the Dakhla region.

**Physical characteristics:** Consists of four irregularly shaped masses, 2.45 kg, 3.15 kg, 1.136 kg and 518 g, found within meters of each other. All four masses are coated in red-brown desert varnish, at least in part. The largest mass also has light tan caliche and weathered fusion crust.

**Petrography:** (C. Herd, *UAb*) Optical and microprobe examination of a polished thin section shows well-defined chondrules with some brecciation. A single 5 mm equilibrated (type 6) clast was observed in the thin section. Iron oxide veins and iron oxide staining are present throughout. Shock effects include undulatory extinction with  $>2^\circ$  angular variation.

**Geochemistry:** (C. Herd, *UAb*) Data obtained by EMP examination of carbon-coated thin section: Olivine  $\text{Fa}_{20.3\pm 2.3}$  (n=87); Low-Ca Pyroxene  $\text{Fs}_{15.1\pm 4.5}\text{Wo}_{1.0\pm 0.5}$  (n=61).

**Classification:** Ordinary chondrite, H3-6. Equilibrated clasts within a type 3 matrix. Matrix subtype between 3.7 and 3.9 based on standard deviation of olivine and low-Ca pyroxene analyses.

**Specimens:** Type specimen of 46.1 g, including one thin section, is at *UAb*. Main masses with S. Crivello and I. Pardini.

### Northwest Africa 13373 (NWA 13373)

Mauritania

Find: 2018

Classification: Ordinary chondrite (H5)

**History:** Collected by a nomad in an undetermined place in northern Mauritania during 2018. Purchased by Geologist Juan Avilés Poblador in Spring 2019 on behalf of *UALic* (Earth Sciences Department, Laboratory of Applied Petrology).

**Physical characteristics:** The single, 919.7 g irregularly shaped stone has as red-brown exterior. Veins are visible on cut surfaces.

**Petrography:** (C. Herd and H. Shek, *UAb*) Optical and microprobe examination of a polished thin section shows well-delineated chondrules cross-cut locally by veins. Minor iron staining is present. Olivine has sharp optical extinction with  $<2^\circ$  angular variation. Veins do not appear to involve significant shock melting.

**Geochemistry:** (C. Herd and H. Shek, *UAb*) Data obtained by EMP examination of carbon-coated thin section: Olivine  $\text{Fa}_{19.4\pm 0.6}$  (n=94); Low-Ca Pyroxene  $\text{Fs}_{17.6\pm 1.2}\text{Wo}_{1.0\pm 0.2}$  (n=81).

**Classification:** Ordinary chondrite, H5

**Specimens:** Type specimen of 91.1 g, including one thin section, is at *UAb*. Main mass at *UAlic*.

#### Northwest Africa 13374 (NWA 13374)

Mauritania

Find: 2018

Classification: Ordinary chondrite (L6)

**History:** Collected by a nomad in an undetermined place in northern Mauritania during 2018. Purchased by Geologist Juan Avilés Poblador in Spring 2019 on behalf of the *UAlic* (Earth Sciences Department, Laboratory of Applied Petrology).

**Physical characteristics:** The single, 3073 g irregularly shaped stone has as dark brown exterior. Cut surfaces reveal a brecciated texture.

**Petrography:** (C. Herd and H. Shek, *UAb*) Optical and microprobe examination of a polished thin section shows poorly-defined chondrules and numerous dark veins. Several large and numerous small iron oxide veinlets are present throughout. Shock effects include undulatory extinction and planar fractures in olivine, veins, and shock-darkened areas.

**Geochemistry:** (C. Herd and H. Shek, *UAb*) Data obtained by EMP examination of carbon-coated thin section: Olivine  $\text{Fa}_{25.1\pm 0.9}$  (n=72); Low-Ca Pyroxene  $\text{Fs}_{21.5\pm 1.0}\text{Wo}_{1.3\pm 0.2}$  (n=50).

**Classification:** Ordinary chondrite, L6

**Specimens:** Type specimen of 91.3 g, including one thin section, is at *UAb*. Main mass at *UAlic*.

#### Northwest Africa 13375 (NWA 13375)

Mauritania

Find: 2018

Classification: Ordinary chondrite (L6)

**History:** Collected by a nomad in an undetermined place in northern Mauritania during 2018. Purchased by Geologist Juan Avilés Poblador in Spring 2019 on behalf of the *UAlic* (Earth Sciences Department, Laboratory of Applied Petrology).

**Physical characteristics:** The single, 1382 g stone has a light red-brown exterior. Cut surfaces reveal a brecciated texture with sub cm-scale clasts set in a dark matrix.

**Petrography:** (C. Herd and H. Shek, *UAb*) Optical and microprobe examination of a polished thin section shows a brecciated texture consisting of clasts of variable size with poorly-defined chondrules, cross-cut by numerous dark veins. Iron oxide veining is pervasive. Shock effects include strong mosaicism, PDFs and planar fractures in olivine, veins, and shock-darkened areas.

**Geochemistry:** (C. Herd and H. Shek, *UAb*) Data obtained by EMP examination of carbon-coated thin section: Olivine  $\text{Fa}_{25.6\pm 1.0}$  (n=69); Low-Ca Pyroxene  $\text{Fs}_{22.0\pm 1.0}\text{Wo}_{1.4\pm 0.2}$  (n=39).

Compositions are consistent between clasts.

**Classification:** Ordinary chondrite, L6, monomict breccia.

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3 **Specimens:** Type specimen of 26.7 g, including one thin section, is at *UAb*. Main mass  
4 at *UAlic*.  
5  
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7

8 **Northwest Africa 13376** (NWA 13376)

9 Morocco

10 Find: 2018

11 Classification: Ordinary chondrite (LL3)

12 **History:** Collected by a nomad in an undetermined location in southern Morocco in the fall of  
13 2018. Purchased by Geologist Juan Avilés Poblador in Spring 2019 on behalf of  
14 the *UAlic* (Earth Sciences Department, Laboratory of Applied Petrology)

15 **Physical characteristics:** The stone is broken into three pieces totaling 7 kg. Chondrules are  
16 visible through the dark brown to reddish exterior.

17 **Petrography:** (C. Herd and H. Shek, *UAb*) Optical and microprobe examination of a polished  
18 thin section shows well-defined chondrules in a clastic matrix. Several large and numerous  
19 small iron oxide veinlets are present throughout, and metal has been strongly oxidized. Shock  
20 effects include weak mosaicism and planar fractures in olivine.

21 **Geochemistry:** (C. Herd and H. Shek, *UAb*) Data obtained by EMP examination of carbon-  
22 coated thin section: Olivine  $\text{Fa}_{23.0\pm 10.9}$ ,  $\text{Cr}_2\text{O}_3 = 0.07\pm 0.09$  (n=62); Low-Ca Pyroxene  
23  $\text{Fs}_{11.5\pm 7.2}\text{Wo}_{0.8\pm 0.6}$  (n=69).

24 **Classification:** Ordinary chondrite, LL3. Estimated subtype 3.4. based on standard deviation  
25 of olivine and low-Ca pyroxene analyses, and presence of chondrule glass.

26 **Specimens:** Type specimen of 51.8 g, including one thin section, is at *UAb*. Main mass  
27 at *UAlic*.  
28  
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33 **Northwest Africa 13377** (NWA 13377)

34 (Northwest Africa)

35 Purchased: 2019

36 Classification: Ordinary chondrite (H5)

37 **History:** Purchased by Sean Tutorow in September 2019 via email photos from a source in  
38 Morocco and delivered during the 2020 Tucson Gem and Mineral Show.

39 **Physical characteristics:** Saw cut of a full slice reveals numerous closely packed small  
40 chondrules and abundant metal/sulfide/Fe-oxide grains set in a brown colored matrix.

41 **Petrography:** Microprobe examination of a polished mount shows numerous small  
42 equilibrated chondrules; plagioclase up to 20  $\mu\text{m}$  in size, abundant Fe,Ni metal and oxidized  
43 metal.  
44

45 **Geochemistry:** (C. Agee, *UNM*) Olivine  $\text{Fa}_{18.4\pm 0.3}$ ,  $\text{Fe}/\text{Mn}=38\pm 2$ , n=6; low-Ca pyroxene  
46  $\text{Fs}_{16.3\pm 0.3}\text{Wo}_{1.3\pm 0.2}$ ,  $\text{Fe}/\text{Mn}=23\pm 1$ , n=7.

47 **Classification:** Ordinary chondrite (H5)

48 **Specimens:** 20 g including a probe mount on deposit at *UNM*, Sean Tutorow holds the main  
49 mass.  
50  
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54 **Northwest Africa 13378** (NWA 13378)

55 (Northwest Africa)

56 Purchased: 2019

57 Classification: Ordinary chondrite (H5)

58 **History:** Purchased by Sean Tutorow in September 2019 via email photos from a source in  
59 Morocco and delivered during the 2020 Tucson Gem and Mineral Show.  
60

**Physical characteristics:** Saw cut of an end piece reveals numerous closely packed small chondrules and abundant metal/sulfide/Fe-oxide grains set in an orange-brown colored matrix.

**Petrography:** Microprobe examination of a polished mount shows numerous small texturally equilibrated chondrules; plagioclase up to 20  $\mu\text{m}$  in size, abundant Fe,Ni metal, oxidized metal, and oxide veinlets.

**Geochemistry:** (C. Agee, *UNM*) Olivine  $\text{Fa}_{19.1\pm 0.2}$ ,  $\text{Fe/Mn}=39\pm 2$ ,  $n=12$ ; low-Ca pyroxene  $\text{Fs}_{17.6\pm 2.3}\text{Wo}_{1.1\pm 0.2}$ ,  $\text{Fe/Mn}=23\pm 1$ ,  $n=6$ .

**Classification:** Ordinary chondrite (H5)

**Specimens:** 46 g including a probe mount on deposit at *UNM*, Sean Tutorow holds the main mass.

### Northwest Africa 13379 (NWA 13379)

(Northwest Africa)

Purchased: 2019

Classification: Ordinary chondrite (LL5)

**History:** Purchased by Sean Tutorow in September 2019 via email photos from a source in Morocco and delivered during the 2020 Tucson Gem and Mineral Show.

**Physical characteristics:** Saw cuts reveal many light gray chondrules set in a darker gray groundmass, scattered small opaques were observed throughout.

**Petrography:** Microprobe examination of a polished mount shows texturally equilibrated chondrules, many porphyritic, some greater than 1 mm in diameter; plagioclase up to 20  $\mu\text{m}$  in size, minor amounts of Fe,Ni metal present.

**Geochemistry:** (C. Agee, *UNM*) Olivine  $\text{Fa}_{28.1\pm 0.5}$ ,  $\text{Fe/Mn}=56\pm 4$ ,  $n=10$ ; low-Ca pyroxene  $\text{Fs}_{23.2\pm 2.3}\text{Wo}_{2.1\pm 0.3}$ ,  $\text{Fe/Mn}=35\pm 1$ ,  $n=5$ .

**Classification:** Ordinary chondrite (LL5)

**Specimens:** 25.3g g including a probe mount on deposit at *UNM*, Sean Tutorow holds the main mass.

### Northwest Africa 13380 (NWA 13380)

(Northwest Africa)

Purchased: 2019

Classification: Ordinary chondrite (H7)

**History:** Purchased by Sean Tutorow in September 2019 via email photos from a source in Morocco and delivered during the 2020 Tucson Gem and Mineral Show.

**Physical characteristics:** Saw cuts reveal gray-brown mosaic of silicate grains, many bright metal grains visible.

**Petrography:** Microprobe examination shows texturally equilibrated grains of olivine, pyroxene, and plagioclase with many triple junctions. Olivines show no significant compositional variation, however pyroxenes show some variation in Fs. Grain size ranges ~50-300  $\mu\text{m}$ . Metal makes up approximately 15% of this meteorite, numerous oxide veinlets are present, minor apatite detected. No chondrules were observed.

**Geochemistry:** (C. Agee, *UNM*) Olivine  $\text{Fa}_{18.6\pm 0.1}$ ,  $\text{Fe/Mn}=38\pm 2$ ,  $n=6$ ; low-Ca pyroxene  $\text{Fs}_{16.6\pm 2.3}\text{Wo}_{2.1\pm 0.3}$ ,  $\text{Fe/Mn}=23\pm 1$ ,  $n=6$ .

**Classification:** Ordinary chondrite (H7)

**Specimens:** 23.2 g including a probe mount on deposit at *UNM*, Sean Tutorow holds the main mass.

**Northwest Africa 13381** (NWA 13381)

(Northwest Africa)

Purchased: 2020 Jun

Classification: Carbonaceous chondrite (CK3)

**History:** Purchased by Rachid Chaoui in June 2020 from a Mauritanian dealer.**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Separated, granular, glass-bearing unequilibrated chondrules containing Cr-magnetite plus fine grained CAI are set in a relatively abundant fine grained matrix containing Cr-magnetite, troilite and pentlandite. Hedenbergite, spinel and ilmenite are present in one CAI.**Geochemistry:** Olivine ( $\text{Fa}_{30.2\pm 15.1}$ , range  $\text{Fa}_{2.6-44.0}$ ,  $N = 9$ ), low-Ca pyroxene ( $\text{Fs}_{2.0\pm 1.3}\text{Wo}_{2.2\pm 2.2}$ , range  $\text{Fs}_{0.8-3.4}\text{Wo}_{4.6-0.4}$ ,  $N = 5$ ), augite ( $\text{Fs}_{0.5}\text{Wo}_{45.2}$ ), magnetite ( $\text{Cr}_2\text{O}_3 = 1.2 \text{ wt.}\%$ ,  $3.1 \text{ wt.}\%$ ,  $N = 2$ ).**Classification:** Carbonaceous chondrite (CK3).**Specimens:** 22.1 g including one polished thin section at *UWB*; remainder with Mr. R. Chaoui.**Northwest Africa 13382** (NWA 13382)

(Northwest Africa)

Purchased: 2016 Feb

Classification: Ordinary chondrite (L3)

**History:** Purchased by Blaine *Reed* in February 2016 from a Moroccan dealer at the Tucson Gem and Mineral Show.**Petrography:** (A. Irving, *UWS* and J. Boesenberg, *BrownU*) This specimen consists in part of well-formed, slightly unequilibrated chondrules set in a finer grained matrix containing stained metal, troilite, chromite and apatite. Also present are some very fine grained quenched and/or recrystallized melt rock clasts consisting mainly of very small, normally-zoned olivine grains. orthopyroxene and ragged metal grains.**Geochemistry:** Main Type 3 lithology: Olivine ( $\text{Fa}_{24.7\pm 0.8}$ , range  $\text{Fa}_{22.9-25.6}$ ,  $N = 8$ ), low-Ca pyroxene ( $\text{Fs}_{20.8\pm 1.0}\text{Wo}_{1.6\pm 0.2}$ , range  $\text{Fs}_{19.9-22.9}\text{Wo}_{0.8-1.9}$ ,  $N = 7$ ), augite ( $\text{Fs}_{10.4}\text{Wo}_{43.4}$ ). Melt rock clasts: olivine (cores  $\text{Fa}_{9.1}$ ,  $\text{Fa}_{10.2}$ ; rim  $\text{Fa}_{19.8}$ ), low-Ca pyroxene ( $\text{Fs}_{6.9}\text{Wo}_{0.8}$ ).**Classification:** Ordinary chondrite (L3 with melt rock clasts).**Specimens:** 47.8 g including one polished thin section at *PSF*; remainder with Mr. B. *Reed*.**Northwest Africa 13383** (NWA 13383)

(Northwest Africa)

Purchased: 2019 Feb

Classification: Ureilite

**History:** Purchased by Blaine *Reed* in February 2019 from a Moroccan dealer at the Tucson Gem and Mineral Show.**Petrography:** (A. Irving, *UWS* and J. Boesenberg, *BrownU*) Protogranular texture of non-equant olivine and pigeonite grains showing preferred dimensional orientation. Olivine has reduced, more magnesian rims associated with very fine grained Fe metal. No carbon phases were observed in the studied thin section.**Geochemistry:** Olivine (cores  $\text{Fa}_{20.3-24.5}$ ,  $N = 13$ ; rims  $\text{Fa}_{9.6-18.8}$ ,  $N = 6$ ;  $\text{Cr}_2\text{O}_3$  in all olivine =  $0.6-0.8 \text{ wt.}\%$ ), pigeonite ( $\text{Fs}_{11.8-19.5}\text{Wo}_{10.2-12.4}$ ,  $N = 9$ ;  $\text{Fs}_{10.9}\text{Wo}_{15.2}$ ;  $\text{Fs}_{13.5}\text{Wo}_{6.4}$ ).**Classification:** Ureilite.



**Specimens:** 20.7 g including one polished thin section at *PSF*; remainder with Mr. B. *Reed*.

**Northwest Africa 13384** (NWA 13384)

(Northwest Africa)

Purchased: 2018 Sep

Classification: Ordinary chondrite (L5)

**History:** Purchased by Blaine *Reed* in September 2018 from a Moroccan dealer at the Denver Show.

**Petrography:** (A. Irving, *UWS* and J. Boesenberg, *BrownU*) Sparse chondrules are set in a recrystallized matrix containing altered metal, troilite, chromite and apatite.

**Geochemistry:** Olivine ( $\text{Fa}_{24.9\pm 1.0}$ , range  $\text{Fa}_{24.1-26.8}$ ,  $N = 6$ ), low-Ca pyroxene ( $\text{Fs}_{20.8\pm 0.1}\text{Wo}_{1.4\pm 0.1}$ , range  $\text{Fs}_{20.7-21.0}\text{Wo}_{1.2-1.5}$ ,  $N = 5$ )

**Classification:** Ordinary chondrite (L5).

**Specimens:** 29.0 g including one polished thin section at *PSF*; remainder with Mr. B. *Reed*.

**Northwest Africa 13385** (NWA 13385)

Drâa-Tafilalet, Morocco

Purchased: 2015

Classification: CVred3

**History:** Mohamed Boukbot found the samples in the desert 3.8 km NE of the town of Mezguida, Drâa-Tafilalet, Morocco. Many samples were distributed to a number of dealers and subsequently purchased by John Higgins in 2015.

**Physical characteristics:** Type specimens are dark-light brown and have an irregular-shaped exterior. The cut face shows the interior is composed of abundant chondrules and refractory inclusions. The color variation of the interior of some stones show regions stained by FeOH minerals indicating variable weathering.

**Petrography:** Description and classification (A. Love, *App*): Sample shows brecciated chondritic texture composed of distinct chondrules with an average diameter of 640  $\mu\text{m}$  ( $n=51$ ), fragments, refractory inclusions (CAIs and AOAs) and a single xenolithic clast set within a fine-grained opaque oxidized matrix (~55 vol%). Some porphyritic chondrules contain rounded inclusions of FeNi metal. The  $2 \times 3\text{mm}$  lithic clast contains unequilibrated chondrules with an average diameter of 112  $\mu\text{m}$  ( $n=10$ ).

**Geochemistry:** (A. Love, *App*) Olivine  $\text{Fa}_{6.4\pm 8.0}$  ( $\text{Fa}_{0.3-33.0}$ ,  $n=18$ ); low-Ca pyroxene  $\text{Fs}_{1.2\pm 0.4}\text{Wo}_{1.8\pm 1.4}$  ( $\text{Fs}_{0.7-2.2}\text{Wo}_{0.8-2.8}$ ,  $n=12$ ); high-Ca pyroxene  $\text{Fs}_{1.8}\text{Wo}_{31.1}$  ( $n=1$ ). Sulfides contain  $0.31\pm 0.24$  wt% Ni,  $n=18$ .

**Classification:** Carbonaceous chondrite (CVred3). Chondrule diameter, modal abundance of matrix, and abundant CAIs indicate sample is CV3. Presence of FeNi metal in silicates, wt% Ni in sulfides and magnetic susceptibility indicate the sample belongs to the CVred group ([Bonal et al. \(2020\)](#), [Gattacceca et al. \(2020\)](#)).

**Specimens:** John Higgins holds the main mass. Many slices and endcuts totaling 37.82 g and a polished thin section and mount are on deposit at *App*.

**Northwest Africa 13386** (NWA 13386)

Morocco

Find: 2019

Classification: Ordinary chondrite (L5)

**History:** Purchased online in 2019 by Daniel Sheikh from a seller in Morocco.

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2  
3 **Physical characteristics:** Sample contains a weathered dark-brown fusion crust.  
4 **Petrography:** (D. Sheikh, *FSU*) Sample is an equilibrated ordinary chondrite with blurred  
5 chondrule boundaries (Av.  $700\pm 50$   $\mu\text{m}$ ,  $n=4$ ) and contains olivine, orthopyroxene, Fe-Ni  
6 metal, troilite, iron oxide, and secondary recrystallized plagioclase ( $15\pm 5$   $\mu\text{m}$ ).  
7 **Geochemistry:** Olivine ( $\text{Fa}_{22.9\pm 0.6}$ ,  $n=17$ ), Orthopyroxene ( $\text{Fs}_{21.3\pm 0.6}\text{Wo}_{1.3\pm 0.2}$ ,  $n=15$ ).  
8 **Classification:** Ordinary Chondrite (L5) Based on Fa and Fs homogeneity, secondary  
9 recrystallized plagioclase grain size, and magnetic susceptibility.  
10 **Specimens:** 75.1 grams at *UCLA*; main mass with Daniel Sheikh.  
11  
12  
13

#### 14 Northwest Africa 13387 (NWA 13387)

15 Morocco

16 Find: 2019

17 Classification: Ordinary chondrite (L5)

18 **History:** Purchased online in 2019 by Daniel Sheikh from a seller in Morocco.

19 **Physical characteristics:** Sample contains a weathered dark-brown fusion crust.

20 **Petrography:** (D. Sheikh, *FSU*) Sample is an equilibrated ordinary chondrite with blurred  
21 chondrule boundaries (Av.  $720\pm 50$   $\mu\text{m}$ ,  $n=5$ ) and contains olivine, orthopyroxene, Fe-Ni  
22 metal, troilite, iron oxide, and secondary recrystallized plagioclase ( $15\pm 5$   $\mu\text{m}$ ).  
23

24 **Geochemistry:** Olivine ( $\text{Fa}_{23.7\pm 0.7}$ ,  $n=15$ ), Orthopyroxene ( $\text{Fs}_{21.5\pm 0.8}\text{Wo}_{1.3\pm 0.1}$ ,  $n=14$ ).  
25

26 **Classification:** Ordinary Chondrite (L5) Based on Fa and Fs homogeneity, secondary  
27 recrystallized plagioclase grain size, and magnetic susceptibility.  
28

29 **Specimens:** 31.8 grams at *UCLA*; main mass with Daniel Sheikh.  
30  
31

#### 32 Northwest Africa 13388 (NWA 13388)

33 Morocco

34 Find: 2019

35 Classification: Ordinary chondrite (L5)

36 **History:** Purchased online in 2019 by Daniel Sheikh from a seller in Morocco.

37 **Physical characteristics:** Sample contains a dark-brown fusion crust.

38 **Petrography:** (D. Sheikh, *FSU*) Sample is an equilibrated ordinary chondrite with blurred  
39 chondrule boundaries (Av.  $700\pm 50$   $\mu\text{m}$ ,  $n=6$ ) and contains olivine, orthopyroxene, Fe-Ni  
40 metal, troilite, iron oxide, and secondary recrystallized plagioclase ( $12\pm 4$   $\mu\text{m}$ ).  
41

42 **Geochemistry:** Olivine ( $\text{Fa}_{22.8\pm 0.5}$ ,  $n=14$ ), Orthopyroxene ( $\text{Fs}_{20.9\pm 0.8}\text{Wo}_{1.2\pm 0.3}$ ,  $n=15$ ).  
43

44 **Classification:** Ordinary Chondrite (L5) Based on Fa and Fs homogeneity, secondary  
45 recrystallized plagioclase grain size, and magnetic susceptibility.  
46

47 **Specimens:** 21.01 grams at *UCLA*; main mass with Daniel Sheikh.  
48  
49

#### 50 Northwest Africa 13389 (NWA 13389)

51 Morocco

52 Find: 2019

53 Classification: Ordinary chondrite (L5)

54 **History:** Purchased online in 2019 by Daniel Sheikh from a seller in Morocco.

55 **Physical characteristics:** Sample contains a dark-brown fusion crust.

56 **Petrography:** (D. Sheikh, *FSU*) Sample is an equilibrated ordinary chondrite with blurred  
57 chondrule boundaries (Av.  $650\pm 50$   $\mu\text{m}$ ,  $n=5$ ) and contains olivine, orthopyroxene, Fe-Ni  
58 metal, troilite, iron oxide, and secondary recrystallized plagioclase ( $20\pm 5$   $\mu\text{m}$ ).  
59

60 **Geochemistry:** Olivine ( $\text{Fa}_{23.1\pm 0.6}$ ,  $n=18$ ), Orthopyroxene ( $\text{Fs}_{21.2\pm 0.7}\text{Wo}_{1.1\pm 0.2}$ ,  $n=16$ ).  
61

**Classification:** Ordinary Chondrite (L5) Based on Fa and Fs homogeneity, secondary recrystallized plagioclase grain size, and magnetic susceptibility.

**Specimens:** 29.7 grams at *UCLA*; main mass with Daniel Sheikh.

### Northwest Africa 13390 (NWA 13390)

Mauritania

Purchased: 2017 Apr 13

Classification: Lunar meteorite (frag. breccia)

**History:** Purchased April 13, 2017, by Dustin Dickens from a nomad in Mauritania.

**Physical characteristics:** A single stone with no fusion crust. Cut surface reveals a fragmental breccia set in a dark-gray ground mass.

**Petrography:** (D. Dickens) This meteorite is a clast-rich polymict breccia with lithic fragments embedded in a fine-grained moderately vesiculated groundmass. Fragmental clast sizes range from <0.1-6 mm and are primarily basaltic. Kamacite and ilmenite are present. This meteorite is shocked with some impact melt textures present.

**Geochemistry:** (C. Agee, *UNM*; D. Dickens) Olivine  $Fa_{28.5\pm 5.68}$ ,  $Fe/Mn=98\pm 6$ ,  $n=14$ ; pigeonite  $Fs_{35.8\pm 11.6}Wo_{8.0\pm 5.1}$ ,  $Fe/Mn=60\pm 6$ ,  $n=10$ ; high-Ca pyroxene  $Fs_{25.0\pm 3.3}Wo_{30.9\pm 8.6}$ ,  $Fe/Mn=57\pm 8$ ,  $n=3$ ; plagioclase  $An_{96.3\pm 3.0}Ab_{4.7\pm 2.6}Or_{0.3\pm 0.4}$ ,  $n=7$ ; shock melt (20  $\mu m$  defocused electron beam, proxy for bulk meteorite composition):  $SiO_2=44.8\pm 1.0$ ,  $Al_2O_3=26.0\pm 2.9$ ,  $CaO=15.3\pm 1.2$ ,  $MgO=5.6\pm 1.2$ ,  $FeO=4.5\pm 0.3$ ,  $TiO_2=0.39\pm 0.09$ ,  $Cr_2O_3=0.11\pm 0.02$ ,  $MnO=0.07\pm 0.02$ ,  $Na_2O=0.42\pm 0.04$ ,  $K_2O=0.17\pm 0.14$  (all wt%),  $Fe/Mn=61\pm 2$ ,  $n=4$ ,  $Mg\#=55.4$ .

**Classification:** Lunar Fragmental Breccia

**Specimens:** 20 g including a probe mount on deposit at *UNM*, Oliver Dickens holds the main mass.

### Northwest Africa 13392 (NWA 13392)

(Northwest Africa)

Purchased: 2020

Classification: Ordinary chondrite (LL5-6)

**History:** The meteorite was purchased from a meteorite dealer in Tindouf, Algeria.

**Physical characteristics:** Brownish rock partly covered with fusion crust.

**Petrography:** Chondritic breccia composed of up to 1.5 cm sized LL6-type fragments (plagioclase grain size is about 80  $\mu m$ ) set into LL5-type matrix (plagioclase grain size is about 30  $\mu m$ ).

### Northwest Africa 13394 (NWA 13394)

(Northwest Africa)

Purchased: 2020

Classification: Ordinary chondrite (LL6, melt breccia)

**History:** The meteorite was purchased from a meteorite dealer in Smara, West Sahara.

**Physical characteristics:** Eleven dark brownish fragments without fusion crust.

**Petrography:** The meteorite is a breccia composed of recrystallized melt regions and few chondritic clasts with sparse relict chondrules. Predominant phase include olivine, low-Ca pyroxene, Ca-pyroxene, sodic and sometimes exsolved plagioclase (grain size about 60  $\mu m$ ), metal, and FeS. Metal and sulfides often form blebs. Olivine shows strong mosaicism.

**Northwest Africa 13395** (NWA 13395)

(Northwest Africa)

Purchased: 2020

Classification: HED achondrite (Eucrite, monomict)

**History:** The meteorite was purchased from a meteorite dealer in Tindouf, Algeria.**Physical characteristics:** Many grayish fragments with the largest one weighing 34 g. Some fragments are partly covered with fusion crust.**Petrography:** The meteorite is a fragmental breccia composed of exsolved pyroxene (up to 400  $\mu\text{m}$ ) and calcic plagioclase (up to 500  $\mu\text{m}$ ) grains set into a more fine-grained clastic matrix. Minor phases include silica, chromite, ilmenite, FeS, and metallic iron. Some veins are filled with secondary calcite. The meteorite is heavily fractured and contains shock melt veins.**Geochemistry:** Low-Ca pyroxene:  $\text{Fs}_{59.4\pm 0.5}\text{Wo}_{2.6\pm 0.4}$  ( $\text{Fs}_{58.3-60.0}\text{Wo}_{2.2-3.3}$ ,  $n=13$ ,  $\text{FeO/MnO}=26-28$ ); Ca-pyroxene:  $\text{Fs}_{26.5\pm 0.4}\text{Wo}_{43.2\pm 0.3}$  ( $\text{Fs}_{25.6-27.2}\text{Wo}_{42.7-43.8}$ ,  $n=15$ ,  $\text{FeO/MnO}=25-30$ ); calcic plagioclase:  $\text{An}_{89.9\pm 0.4}$  ( $\text{An}_{89.5-90.5}$ ,  $n=14$ )**Northwest Africa 13397** (NWA 13397)

Morocco

Find: 2019

Classification: Ordinary chondrite (LL3)

**Petrography:** (J. Gattacceca, *CEREGE*) Chondrite with well-delineated packed chondrules (average apparent diameter  $940\pm 430$   $\mu\text{m}$ ,  $n=27$ ). Opaques are Fe,Ni metal and troilite.**Geochemistry:** Olivine  $\text{Fa}_{18.9\pm 7.5}$ , range  $\text{Fa}_{3.3-25.8}$ , Fa PMD 35%,  $\text{Cr}_2\text{O}_3$   $0.33\pm 0.07$  ( $n=10$ ). Low-Ca pyroxene  $\text{Fs}_{14.4\pm 7.9}\text{Wo}_{0.9\pm 0.7}$  ( $n=6$ ).**Classification:** Ordinary chondrite (LL3). LL group based on chondrule size and magnetic susceptibility.**Northwest Africa 13400** (NWA 13400)

(Northwest Africa)

Purchased: 2016 Dec

Classification: Carbonaceous chondrite (C3, ungrouped)

**Petrography:** (K. Metzler, *IfP*) Carbonaceous chondrite, consisting of closely packed, metal-bearing chondrules (apparent size up to 2.8 mm), chondrule fragments, and CAIs (apparent size up to 3.8 mm) with low amounts of interchondrule matrix (17 vol%). The mean apparent chondrule size is 480  $\mu\text{m}$  ( $n=512$ ).**Geochemistry:** Mineral compositions and geochemistry: The mean olivine composition is  $\text{Fa}_{14.7\pm 1.3}$  ( $\text{Fa}_{10.2-16.0}$ ,  $n=30$ ); the mean low-Ca pyroxene composition is  $\text{Fs}_{6.6\pm 3.7}\text{Wo}_{1.0\pm 0.1}$  ( $\text{Fs}_{1.2-15.9}\text{Wo}_{0.8-1.2}$ ,  $n=20$ ). Oxygen isotopic composition (R. Greenwood, *OU*):  $\delta^{17}\text{O}=-4.017\text{‰}$ ,  $\delta^{18}\text{O}=-0.021\text{‰}$ ,  $\Delta^{17}\text{O}=-4.006\text{‰}$ .**Classification:** Carbonaceous chondrite (ungrouped). Petrologic type 3.9 based on the percentage mean deviation (PMD) of Fa values (8.8%). Classified as ungrouped due to the low mean Fa and Fs values of olivine and low amount of matrix compared to e.g., CV chondrites. Chondrule size does not fit with either CV, CK or CK chondrites that are the closest groups in terms of oxygen isotopic composition.**Northwest Africa 13401** (NWA 13401)

(Northwest Africa)

Purchased: January 2020

Classification: Martian meteorite (Shergottite)

**History:** Purchased in January 2020 by Jasper Spencer from a Moroccan dealer.

**Physical characteristics:** Two stones with near absent fusion crust.

**Petrography:** (Daniel Sheikh, *FSU*) Sample is composed of maskelynite (Av.  $750 \pm 100 \mu\text{m}$ , up to 2 mm, 40 vol%) and complexly zoned, tabular, and irregularly-shaped grains (some twinned) of subcalcic augite and pigeonite (Av.  $400 \pm 50 \mu\text{m}$ , up to 1 mm, 60 vol%).

Accessory phases include titanomagnetite, Si-Al-Na-K-rich glass, and pyrrhotite. Sample contains minor carbonate weathering veins.

**Geochemistry:** Subcalcic augite ( $\text{Fs}_{34.3 \pm 6.5} \text{Wo}_{30.7 \pm 1.7}$ , range  $\text{Fs}_{22.3-46.5} \text{Wo}_{27.5-33.5}$ ,  $\text{FeO/MnO} = 32 \pm 5$ ,  $n=27$ ), pigeonite ( $\text{Fs}_{49.2 \pm 7.0} \text{Wo}_{13.9 \pm 2.2}$ , range  $\text{Fs}_{36.9-59.8} \text{Wo}_{10.6-19.7}$ ,  $\text{FeO/MnO} = 34 \pm 4$ ,  $n=28$ ), maskelynite ( $\text{An}_{45.5 \pm 4.5} \text{Or}_{2.7 \pm 1.1}$ , range  $\text{An}_{40.1-51.7} \text{Or}_{1.3-4.6}$ ,  $n=23$ ).

**Classification:** Martian (shergottite) Silicate chemistry, the presence of maskelynite, and FeO/MnO ratios of pyroxenes provide support for classification as shergottite.

**Specimens:** 14 grams at *UCLA*; main mass with Jasper Spencer.

#### Northwest Africa 13404 (NWA 13404)

Laayoune, Morocco

Find: 2019

Classification: Ordinary chondrite (L6)

**Petrography:** (J. Gattacceca) highly recrystallized chondrite with triple junctions.

#### Northwest Africa 13408 (NWA 13408)

Algeria

Find: 2018

Classification: Lunar meteorite (feldspathic breccia)

**History:** Purchased in 2020 by Matthew Stream from Said Bachir in Algeria.

**Physical characteristics:** Sample contains minor fusion crust. An interior slice reveals an assortment of light and dark-coloured clasts.

**Petrography:** (D. Sheikh, *FSU*) Sample is a feldspathic breccia composed primarily of sub-angular anorthitic clasts ( $< 1 \text{ cm}$ ) set in a dark, fine-grained matrix. Other phases present include pigeonite, olivine, sub-calcic augite, low-Ca pyroxene, and Si-Na-Ca-Mg-rich glass.

**Geochemistry:** Olivine ( $\text{Fa}_{57.4 \pm 16.5}$ , range  $\text{Fa}_{45.8-69.0}$ ,  $\text{FeO/MnO} = 95 \pm 5$ ,  $n=2$ ), Pigeonite ( $\text{Fs}_{32.0 \pm 2.4} \text{Wo}_{12.4 \pm 3.7}$ , range  $\text{Fs}_{28.1-34.8} \text{Wo}_{8.0-17.2}$ ,  $\text{FeO/MnO} = 44 \pm 3$ ,  $n=7$ ), Low-Ca Pyroxene ( $\text{Fs}_{36.7} \text{Wo}_{4.0}$ ,  $\text{FeO/MnO} = 53$ ,  $n=1$ ), Sub-Calcic Augite ( $\text{Fs}_{23.5} \text{Wo}_{31.2}$ ,  $\text{FeO/MnO} = 38$ ,  $n=1$ ), Anorthite ( $\text{An}_{96.5 \pm 0.7}$ , range  $\text{An}_{95.1-97.5}$ ,  $n=24$ ).

**Classification:** Lunar (feldspathic breccia).

**Specimens:** 20.81 grams at *UCLA*; main mass with Matthew Stream.

#### Northwest Africa 13410 (NWA 13410)

Tindouf, Algeria

Find: 2017

Classification: Ordinary chondrite (L6)

**History:** Two pieces that comprise the 99.22 g sample were found near Tindouf, Algeria, in May 2017. Dave Lehman and his partner obtained the sample in 2019.



**Physical characteristics:** The sample was found as two pieces that fit together to comprise an irregular shaped stone with a dark brown weathered exterior with a light orangish brown interior.

**Petrography:** Description and classification (A. Love, *App*) Sample has a recrystallized chondritic texture. Chondrules have an average apparent diameter of 631.5  $\mu\text{m}$ ,  $n=8$ . Secondary plagioclase has an average grain length of 70  $\mu\text{m}$ ,  $n=16$ .

**Geochemistry:** (A. Love, *App*) Olivine ( $\text{Fa}_{24.7\pm 0.2}$ ,  $\text{Fe/Mn}=45.8\pm 1.7$ ,  $n=3$ ), low-Ca pyroxene ( $\text{Fs}_{21.6\pm 0.2}\text{Wo}_{1.9\pm 0.2}$ ,  $n=3$ ).

**Classification:** Ordinary chondrite (L6, C-S3, W4) Sample is an L chondrite based on mineral compositions, and magnetic susceptibility. Based on grainsize of secondary plagioclase and equilibrated compositions, this sample is an L6.

**Specimens:** Dave Lehman and partner hold the main masses. A 2 0g sample and mounted piece are on deposit at *App*.

### Northwest Africa 13411 (NWA 13411)

Western Sahara, Morocco

Purchased: 2018

Classification: OC5-an

**History:** The 190.96 and 73.03 g samples were found near Adrar, Algeria, by a meteorite prospector in 2018. Dave Lehman and his partner acquired the samples from the finder.

**Physical characteristics:** Samples are irregularly shaped and brown. Interior of sample is orangish brown and contains abundant chondrules and weathered metal and sulfides.

**Petrography:** Description and Classification (A. Love, *App*) Sample has a chondritic texture composed of numerous close-packed equilibrated chondrules set within a comminuted matrix of the chondritic lithology. This matrix is crosscut by ubiquitous FeNiOH veinlets. When viewed using backscattered electron imaging, the olivines and pyroxene have almost identical gray-scale colors. The sample is composed of BO, PO (dominant), PP (clinostenatite is rare but present) and rare Al-rich chondrules with an average apparent diameter of  $395\pm 219$   $\mu\text{m}$  ( $n=131$ ). Some pyroxenes are zoned from enstatite cores to augite rims. The sample contains secondary plagioclase with an average grainsize of 29  $\mu\text{m}$  ( $n=15$ ). Additional minerals are: chromite, K-rich feldspar, apatite, kamacite, taenite, troilite and gypsum. Despite a comprehensive search for reduced sulfide and phosphide phases commonly associated with enstatite and forsterite chondrites, none were found in this sample.

**Geochemistry:** (A. Love, *App*) Olivine ( $\text{Fa}_{8.35\pm 0.15}$ ,  $\text{Fe/Mn}=16.97\pm 0.58$ ,  $n=18$ ), low-Ca pyroxene ( $\text{Fs}_{8.47\pm 0.26}\text{Wo}_{1.09\pm 0.32}$ ,  $\text{Fe/Mn}=10.78\pm 0.39$ ,  $n=18$ ); high-Ca pyroxene rims ( $\text{Fs}_{3.44\pm 0.08}\text{Wo}_{46.93\pm 2.71}$ ,  $n=4$ ). plagioclase of variable composition ( $\text{Ab}_{18.17-83.41}\text{Or}_{0.66-12.88}$ ,  $n=6$ ); FeNi metal ( $6.71\pm 0.21\text{wt}\%$  Ni and  $1.09\pm 0.02\text{wt}\%$  Co,  $n=9$ ). Oxygen Isotopes: (Karen Ziegler, *UNM*) analyses of acid-washed subsamples by laser fluorination gave (all per mill):  $\delta^{17}\text{O}=4.199, 3.277, 3.836, 3.592, 3.666, 3.102$ ;  $\delta^{18}\text{O}=5.891, 5.520, 6.526, 5.464, 6.433, 5.240$ ;  $\Delta^{17}\text{O}=1.089, 0.362, 0.390, 0.707, 0.269, 0.335$ .

**Classification:** Ordinary chondrite (OC5-an, C-S2, W3) Based on chondritic texture and presence of weathered and unweathered metal, this sample has similarities with ordinary chondrites. Based on mineral compositions and oxygen isotopes, this is an anomalous ordinary chondrite. Equilibrated compositions and grainsize of secondary plagioclase indicate this sample corresponds to petrologic type 5. Oxygen isotope compositions plot at a distance from the slope 1 line for equilibrated ordinary chondrites. Mean  $\Delta^{17}\text{O}$  composition is below the standard range for unequilibrated H chondrites and the standard deviation of the  $\Delta^{17}\text{O}$  is higher than that recorded in the entire range of unequilibrated ordinary chondrites. Co

concentrations in kamacite fall between values measured in L and LL chondrites (Rubin, 1990).

**Specimens:** Dave Lehman and a partner hold the main mass. Two slices totaling 25.08g and a polished thin section and mount are on deposit at *App*.

#### Northwest Africa 13412 (NWA 13412)

(Northwest Africa)

Purchased: 2020

Classification: Carbonaceous chondrite (CV3)

**History:** The meteorite was purchased from a meteorite dealer in Morocco.

**Physical characteristics:** Almost black individual lacking any fusion crust.

**Petrography:** Carbonaceous chondrite composed of chondrules (mean diameter about 0.8 mm; up to 1.5 mm sized), CAIs (up to 3 mm sized), and olivine amoeboids all set into a fine-grained almost black matrix. The meteorite is relatively fresh. No chondrules showing reddish staining have been observed.

#### Northwest Africa 13413 (NWA 13413)

(Northwest Africa)

Purchased: 2020

Classification: HED achondrite (Howardite)

**History:** The meteorite was purchased from a meteorite dealer in Morocco.

**Physical characteristics:** Dark-grayish rock with some fusion crust.

**Petrography:** The meteorite is a polymict breccia composed of mineral and few basaltic clasts set into a fine-grained clastic matrix. Main minerals are up to 3 mm sized diagenetic orthopyroxene (about 15%), compositionally zoned low-Ca pyroxene, exsolved pyroxene and calcic plagioclase. Minor phases include silica, chromite, ilmenite, FeS, fayalitic olivine, and kamacite.

**Geochemistry:** Diagenetic pyroxene:  $\text{Fs}_{24.2\pm 0.5}\text{Wo}_{2.0\pm 0.3}$  ( $\text{Fs}_{23.3-25.0}\text{Wo}_{1.6-2.2}$ ,  $\text{FeO/MnO}=24-29$ ,  $n=12$ ); zoned low-Ca pyroxene:  $\text{Fs}_{25.2\pm 2.8}\text{Wo}_{2.3\pm 0.2}$  ( $\text{Fs}_{22.7-29.8}\text{Wo}_{2.1-2.8}$ ,  $\text{FeO/MnO}=25-31$ ,  $n=12$ ); eucritic low-Ca pyroxene host crystals to augite lamellae:  $\text{Fs}_{58.2\pm 0.7}\text{Wo}_{3.1\pm 0.4}$  ( $\text{Fs}_{57.1-59.7}\text{Wo}_{2.7-4.0}$ ,  $\text{FeO/MnO}=24-26$ ,  $n=13$ ); augite exsolution lamellae:  $\text{Fs}_{24.5\pm 1.9}\text{Wo}_{42.7\pm 0.7}$  ( $\text{Fs}_{20.1-26.7}\text{Wo}_{41.9-44.5}$ ,  $\text{FeO/MnO}=322-27$ ,  $n=14$ ); olivine:  $\text{Fa}_{38.4\pm 0.2}$  ( $\text{Fa}_{38.1-38.6}$ ,  $\text{FeO/MnO}=46\pm 1$ ,  $n=5$ ); calcic plagioclase:  $\text{An}_{89.5\pm 7.0}$  ( $\text{An}_{71.0-94.6}$ ,  $n=14$ )

#### Northwest Africa 13414 (NWA 13414)

(Northwest Africa)

Purchased: 2020

Classification: Ordinary chondrite (L6, melt breccia)

**History:** The meteorite was purchased from a local meteorite dealer in Zagora, Morocco.

**Physical characteristics:** Almost black individual lacking any fusion crust.

**Petrography:** The meteorite is a melt breccia composed of L6 chondritic regions with very few recognizable chondrules (plagioclase grain size about 80  $\mu\text{m}$ ) and abundant up to 1.5 cm wide recrystallized melt rock veins and pockets with characteristic FeNi metal and sulfide spherules.

#### Northwest Africa 13415 (NWA 13415)

(Northwest Africa)

Purchased: 2019

Classification: HED achondrite (Eucrite)

**History:** The meteorite was purchased from a local meteorite dealer in Tindouf, Algeria.

**Physical characteristics:** Dark brownish individual with minor fusion crust.

**Petrography:** The meteorite is an unbrecciated fine-grained volcanic rock with some interspersed more coarse-grained regions. Dominant minerals are exsolved pyroxene and calcic plagioclase with grain sizes of 30-50  $\mu\text{m}$  in fine-grained parts and 200-500  $\mu\text{m}$  in coarse-grained regions. Minor phases include silica, chromite, FeS, ilmenite, and metallic Fe.

**Geochemistry:** low-Ca pyroxene:  $\text{Fs}_{63.1\pm 0.5}\text{Wo}_{6.9\pm 0.5}$  ( $\text{Fs}_{62.3-64.0}\text{Wo}_{5.8-7.4}$ ,  $n=15$ ,  $\text{FeO/MnO}=29-31$ ); Ca-pyroxene:  $\text{Fs}_{32.4\pm 0.5}\text{Wo}_{42.4\pm 0.5}$  ( $\text{Fs}_{31.6-33.2}\text{Wo}_{41.3-43.3}$ ,  $n=16$ ,  $\text{FeO/MnO}=32-36$ ); calcic plagioclase:  $\text{An}_{89.3\pm 1.4}$  ( $\text{An}_{87.9-91.9}$ ,  $n=14$ )

### Northwest Africa 13416 (NWA 13416)

(Northwest Africa)

Purchased: 2015 Sep

Classification: Ordinary chondrite (L5)

**History:** Purchased by Blaine *Reed* in September 2015 from a Moroccan dealer at the Denver Show.

**Petrography:** (A. Irving, *UWS* and J. Boesenberg, *BrownU*) Sparse chondrules are set in a recrystallized matrix containing altered metal, troilite, chromite and chlorapatite.

**Geochemistry:** Olivine ( $\text{Fa}_{24.8\pm 0.3}$ , range  $\text{Fa}_{24.5-25.2}$ ,  $N = 6$ ), low-Ca pyroxene ( $\text{Fs}_{20.7\pm 0.2}\text{Wo}_{1.6\pm 0.2}$ , range  $\text{Fs}_{20.4-20.9}\text{Wo}_{1.2-1.8}$ ,  $N = 6$ )

**Classification:** Ordinary chondrite (L5).

**Specimens:** 44.7 g including one polished thin section at *PSF*; remainder with Mr. B. *Reed*.

### Northwest Africa 13417 (NWA 13417)

(Northwest Africa)

Purchased: 2012 Sep

Classification: Ordinary chondrite (H3-6)

**History:** Purchased by Blaine *Reed* in September 2012 from a Moroccan dealer at the Denver Show.

**Petrography:** (A. Irving, *UWS* and J. Boesenberg, *BrownU*) Most of this specimen consists of well-formed chondrules (apparent diameter  $600\pm 390$   $\mu\text{m}$ ,  $N = 24$ ) set in a finer grained matrix containing altered metal, troilite, chromite and apatite. One type 6 lithic clast (1 cm across) containing rare chondrule remnants is present in the studied thin section.

**Geochemistry:** Olivine ( $\text{Fa}_{18.8\pm 2.9}$ , range  $\text{Fa}_{16.8-23.8}$ ,  $N = 5$ ;  $\text{Cr}_2\text{O}_3$  in ferroan olivine ( $\text{Fa}_{23.8-40.2}$ ) 0.01-0.11 wt.%, mean  $0.05\pm 0.04$  wt.%,  $N = 5$ ), low-Ca pyroxene ( $\text{Fs}_{12.3\pm 3.9}\text{Wo}_{1.2\pm 1.3}$ , range  $\text{Fs}_{8.7-17.8}\text{Wo}_{0.3-3.0}$ ,  $N = 4$ ), pigeonite ( $\text{Fs}_{20.4}\text{Wo}_{10.1}$ ), subcalcic augite ( $\text{Fs}_{21.1}\text{Wo}_{27.4}$ ), augite ( $\text{Fs}_{13.0}\text{Wo}_{41.4}$ ). Magnetic susceptibility  $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 5.02$ .

**Classification:** Ordinary chondrite (H3-6 breccia).

**Specimens:** 24.7 g including one polished thin section at *PSF*; remainder with Mr. B. *Reed*.

### Northwest Africa 13418 (NWA 13418)

(Northwest Africa)

Purchased: 2019 Oct

Classification: Ordinary chondrite (L5)

**History:** Purchased by Grant Harkness in October 2019 from a dealer in Zagora, Morocco.

**Petrography:** (A. Irving, *UWS* and J. Boesenberg, *BrownU*) Sparse chondrules are set in a recrystallized matrix containing stained metal, troilite, chromite and apatite.

**Geochemistry:** Olivine ( $\text{Fa}_{24.9\pm 0.4}$ , range  $\text{Fa}_{24.3-25.3}$ ,  $N = 4$ ), low-Ca pyroxene ( $\text{Fs}_{20.5\pm 0.2}\text{Wo}_{1.6\pm 0.1}$ , range  $\text{Fs}_{20.2-20.7}\text{Wo}_{1.4-1.7}$ ,  $N = 4$ ), augite ( $\text{Fs}_{8.0\pm 1.2}\text{Wo}_{44.7\pm 1.0}$ , range  $\text{Fs}_{6.6-8.7}\text{Wo}_{45.9-44.0}$ ,  $N = 3$ ).

**Classification:** Ordinary chondrite (L5).

**Specimens:** 48.08 g including one polished thin section at *PSF*; remainder in the Harkness Collection.

#### Northwest Africa 13419 (NWA 13419)

(Northwest Africa)

Purchased: 2008 Jun

Classification: Primitive achondrite (Acapulcoite)

**History:** Purchased by Adam Aaronson in June 2008 from a dealer in Erfoud, Morocco.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Protogranular aggregate (mean grain size  $\sim 400\ \mu\text{m}$ ) of predominantly olivine and orthopyroxene with subordinate diopside and altered kamacite ( $\sim 15\ \text{vol.}\%$ ), plus accessory chromite and merrillite. Secondary goethite is present along grain boundaries.

**Geochemistry:** Olivine ( $\text{Fa}_{10.9\pm 1.4}$ , range  $\text{Fa}_{8.4-12.2}$ ,  $\text{FeO/MnO} = 22-24$ ,  $N = 8$ ), orthopyroxene ( $\text{Fs}_{11.1-11.3}\text{Wo}_{1.6-3.2}$ ,  $\text{FeO/MnO} = 13-14$ ,  $N = 4$ ), diopside ( $\text{Fs}_{4.3-4.7}\text{Wo}_{44.0-45.5}$ ,  $\text{FeO/MnO} = 8-9$ ,  $N = 4$ ). Magnetic susceptibility  $\log \chi (\times 10^{-9}\ \text{m}^3/\text{kg}) = 4.80$ .

**Classification:** Acapulcoite.

**Specimens:** 10.7 g including one polished thin section at *UWB*; remainder with *Aaronson*.

#### Northwest Africa 13420 (NWA 13420)

(Northwest Africa)

Purchased: 2019 Oct

Classification: Ordinary chondrite (L6)

**History:** Purchased by Grant Harkness in October 2019 from a dealer in Zagora, Morocco.

**Petrography:** (A. Irving, *UWS* and J. Boesenberg, *BrownU*) Largely recrystallized with rare remnant chondrules. Accessory phases are stained metal, troilite, chromite and apatite.

**Geochemistry:** Olivine ( $\text{Fa}_{24.5\pm 0.2}$ , range  $\text{Fa}_{24.1-24.7}$ ,  $N = 4$ ), low-Ca pyroxene ( $\text{Fs}_{21.0\pm 0.4}\text{Wo}_{1.5\pm 0.2}$ , range  $\text{Fs}_{20.5-21.6}\text{Wo}_{1.1-1.7}$ ,  $N = 6$ ).

**Classification:** Ordinary chondrite (L6).

**Specimens:** 23.57 g including one polished thin section at *PSF*; remainder in the Harkness Collection.

#### Northwest Africa 13421 (NWA 13421)

(Northwest Africa)

Purchased: 2019 Oct

Classification: Ordinary chondrite (H4)

**History:** Purchased by Grant Harkness in October 2019 from a dealer in Zagora, Morocco.

**Petrography:** (A. Irving, *UWS* and J. Boesenberg, *BrownU*) Well-formed chondrules are set in a relatively coarse grained matrix containing altered metal, troilite, chromite and chlorapatite.

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3 **Geochemistry:** Olivine ( $\text{Fa}_{19.3\pm 0.2}$ , range  $\text{Fa}_{19.1-19.5}$ ,  $N = 5$ ), low-Ca pyroxene  
4 ( $\text{Fs}_{17.2\pm 0.5}\text{Wo}_{1.5\pm 0.2}$ , range  $\text{Fs}_{16.7-17.9}\text{Wo}_{1.1-1.7}$ ,  $N = 5$ ).

5 **Classification:** Ordinary chondrite (H4).

6 **Specimens:** 60.68 g including one polished thin section at *PSF*; remainder with Jason  
7 Whitcomb.  
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11 **Northwest Africa 13422** (NWA 13422)

12 (Northwest Africa)

13 Purchased: 2019 Oct

14 Classification: Ordinary chondrite (L5)

15 **History:** Purchased by Grant Harkness in October 2019 from a dealer in Zagora, Morocco.

16 **Petrography:** (A. Irving, *UWS* and J. Boesenberg, *BrownU*) Sparse chondrules are set in a  
17 recrystallized matrix containing stained metal, troilite, chromite and apatite.

18 **Geochemistry:** Olivine ( $\text{Fa}_{24.7\pm 0.2}$ , range  $\text{Fa}_{24.4-25.0}$ ,  $N = 5$ ), low-Ca pyroxene  
19 ( $\text{Fs}_{20.9\pm 0.6}\text{Wo}_{1.3\pm 0.2}$ , range  $\text{Fs}_{20.0-21.9}\text{Wo}_{1.0-1.6}$ ,  $N = 6$ ).

20 **Classification:** Ordinary chondrite (L5).

21 **Specimens:** 26.44 g including one polished thin section at *PSF*; remainder in the Harkness  
22 Collection.  
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27 **Northwest Africa 13423** (NWA 13423)

28 (Northwest Africa)

29 Purchased: 2019 Oct

30 Classification: Ordinary chondrite (H4)

31 **History:** Purchased by Grant Harkness in October 2019 from a dealer in Zagora, Morocco.

32 **Petrography:** (A. Irving, *UWS* and J. Boesenberg, *BrownU*) Well-formed chondrules are set  
33 in a relatively coarse grained matrix containing altered metal, troilite, chromite and  
34 chlorapatite.

35 **Geochemistry:** Olivine ( $\text{Fa}_{19.1\pm 0.3}$ , range  $\text{Fa}_{18.7-19.4}$ ,  $N = 5$ ), low-Ca pyroxene  
36 ( $\text{Fs}_{16.9\pm 0.1}\text{Wo}_{1.3\pm 0.2}$ , range  $\text{Fs}_{16.7-17.1}\text{Wo}_{1.1-1.5}$ ,  $N = 5$ ).

37 **Classification:** Ordinary chondrite (H4).

38 **Specimens:** 36.75 g including one polished thin section at *PSF*; remainder with Jason  
39 Whitcomb.  
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44 **Northwest Africa 13424** (NWA 13424)

45 (Northwest Africa)

46 Purchased: 2019 Oct

47 Classification: Ordinary chondrite (L4)

48 **History:** Purchased by Grant Harkness in October 2019 from a dealer in Zagora, Morocco.

49 **Petrography:** (A. Irving, *UWS* and J. Boesenberg, *BrownU*) Well-formed chondrules are set  
50 in a relatively coarse grained matrix containing stained metal, troilite, chromite and apatite.

51 **Geochemistry:** Olivine ( $\text{Fa}_{24.2\pm 0.7}$ , range  $\text{Fa}_{23.4-25.1}$ ,  $N = 5$ ), low-Ca pyroxene  
52 ( $\text{Fs}_{20.9\pm 0.8}\text{Wo}_{1.4\pm 0.4}$ , range  $\text{Fs}_{20.0-22.0}\text{Wo}_{1.0-2.2}$ ,  $N = 6$ ).

53 **Classification:** Ordinary chondrite (L4).

54 **Specimens:** 22.34 g including one polished thin section at *PSF*; remainder in the Harkness  
55 Collection.  
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**Northwest Africa 13425** (NWA 13425)

(Northwest Africa)

Purchased: 2019 Oct

Classification: Ordinary chondrite (H4)

**History:** Purchased by Grant Harkness in October 2019 from a dealer in Zagora, Morocco.**Petrography:** (A. Irving, *UWS* and J. Boesenberg, *BrownU*) Well-formed chondrules are set in a relatively coarse grained matrix containing altered metal, troilite, chromite and chlorapatite.**Geochemistry:** Olivine ( $\text{Fa}_{19.4\pm 0.4}$ , range  $\text{Fa}_{19.0-19.9}$ ,  $N = 5$ ), low-Ca pyroxene ( $\text{Fs}_{17.0\pm 0.8}\text{Wo}_{1.5\pm 0.2}$ , range  $\text{Fs}_{16.3-19.7}\text{Wo}_{0.6-1.0}$ ,  $N = 5$ ).**Classification:** Ordinary chondrite (H4).**Specimens:** 33.42 g including one polished thin section at *PSF*; remainder with Jason Whitcomb.**Northwest Africa 13426** (NWA 13426)

(Northwest Africa)

Purchased: 2020

Classification: Lunar meteorite

**History:** Many stones totaling 137.3 g were found and subsequently purchased from a meteorite prospector in Tindouf, Algeria, in March, 2020.**Physical characteristics:** Samples are coated with a layer of light-orange caliche, and have a dark-colored interior containing clastic crystalline debris.**Petrography:** Description and classification (A. Love, *App*): Sample is a breccia composed of rounded to angular 25.1-2241  $\mu\text{m}$  (avg. length 272  $\mu\text{m}$ ,  $n=145$ ) mineral grains and lithic clasts with poikilitic, basaltic and brecciated textures set within a melt matrix. Sample contains clear glassy spheres, fragments and glassy schlieren textured objects. Additional minerals are FeNi grains, a silica polymorph, chromite, ilmenite, titanomagnetite and troilite.**Geochemistry:** (A. Love, *App*) Olivine  $\text{Fa}_{30.1\pm 10.0}$  ( $\text{Fa}_{19.7-40.5}$ ,  $\text{Fe}/\text{Mn}=80.3\pm 6.2$ ,  $n=8$ ); low-Ca pyroxene  $\text{Fs}_{21.2\pm 2.5}\text{Wo}_{3.2\pm 0.2}$  ( $\text{Fs}_{19.5-23.0}\text{Wo}_{3.1-3.4}$ ,  $\text{Fe}/\text{Mn}=48.8\pm 1.3$ ,  $n=2$ ); pigeonite  $\text{Fs}_{32.4\pm 4.9}\text{Wo}_{11.6\pm 3.9}$  ( $\text{Fs}_{23.0-37.7}\text{Wo}_{5.9-18.0}$ ,  $\text{Fe}/\text{Mn}=51.9\pm 2.8$ ,  $n=5$ ); high-Ca pyroxene  $\text{Fs}_{29.1\pm 7.7}\text{Wo}_{29.7\pm 4.0}$  ( $\text{Fs}_{21.4-38.4}\text{Wo}_{21.8-32.1}$ ,  $\text{Fe}/\text{Mn}=54.0\pm 5.9$ ,  $n=6$ ); plagioclase  $\text{An}_{96.4\pm 0.9}\text{Or}_{0.2\pm 0.2}$  ( $n=7$ ).**Classification:** Lunar (feldspathic breccia). Based on textures, melt matrix component and mineral compositions, this sample is a feldspathic breccia.**Specimens:** *Kuntz* holds the main masses. A polished thin section and 10 fragments weighing 21.53 g are on deposit at *App*.**Northwest Africa 13428** (NWA 13428)

(Northwest Africa)

Purchased: 2019

Classification: HED achondrite (Diogenite, polymict)

**History:** Purchased by Nicholas *Gessler* in 2019 from a Moroccan dealer.**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Breccia composed of angular mineral clasts in a very fine grained matrix. No polyminerallitic lithic clasts were observed in the studied thin section. The most abundant components are diogenitic orthopyroxene and subordinate olivine, together with <10 vol.% of eucritic low-Ca pyroxene, augite and calcic plagioclase. Accessory phases include silica polymorph, Ti-free chromite, kamacite, ilmenite and troilite.

**Geochemistry:** Diogenitic orthopyroxene (Fs<sub>23.9-25.3</sub>Wo<sub>2.1-3.3</sub>, FeO/MnO = 28-29, N = 3), olivine (Fa<sub>26.1-28.5</sub>, FeO/MnO = 45-49, N = 3), eucritic low-Ca pyroxene (Fs<sub>57.9-58.2</sub>Wo<sub>3.3-6.7</sub>, FeO/MnO = 29-33, N = 2), eucritic augite (Fs<sub>27.7-30.2</sub>Wo<sub>40.9-40.1</sub>, FeO/MnO = 32-34, N = 2), plagioclase (An<sub>83.6-91.6</sub>Or<sub>0.6-0.3</sub>, N = 4).

**Classification:** Diogenite (polymict breccia).

**Specimens:** 21.6 g plus one polished thin section at *UWB*; remainder with Mr. N. Gessler.

#### Northwest Africa 13429 (NWA 13429)

(Northwest Africa)

Purchased: 2020 Jun

Classification: Ordinary chondrite (L7)

**History:** Purchased by Didi Baidari in July 2020 from a dealer in Nouakchott, Mauritania.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Metamorphic granoblastic texture. Aggregate of olivine, orthopyroxene, crystalline albitic plagioclase, augite, chromite, troilite and altered kamacite. No chondrules were observed. Some cross-cutting thin, very fine grained shock veinlets (purplish gray in thin section) are present.

**Geochemistry:** Olivine (Fa<sub>25.6±0.8</sub>, range Fa<sub>24.3-26.8</sub>, N = 6), low-Ca pyroxene (Fs<sub>21.6±0.9</sub>Wo<sub>3.4±1.0</sub>, range Fs<sub>20.8-22.2</sub>Wo<sub>2.8-5.1</sub>, N = 5), augite (Fs<sub>12.5±0.6</sub>Wo<sub>36.5±1.9</sub>, range Fs<sub>12.1-13.2</sub>Wo<sub>38.3-34.5</sub>, N = 3).

**Classification:** Ordinary chondrite (L7).

**Specimens:** 61.6 g including one polished thin section at *UWB*; remainder with Z. Wang.

#### Northwest Africa 13430 (NWA 13430)

(Northwest Africa)

Purchased: 2019

Classification: HED achondrite (Howardite)

**History:** Purchased by Nicholas Gessler in 2019 from a Moroccan dealer.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Breccia composed of some diabasic eucrite clasts plus abundant related crystalline debris, together with ~15 vol.% of diogenitic low-Ca pyroxene and accessory silica polymorph, fayalite, hedenbergite, ilmenite and troilite. Diogenitic low-Ca pyroxene grains are relatively ferroan and have rims against the matrix consisting of much more ferroan low-Ca pyroxene or subcalcic augite.

**Geochemistry:** Diogenitic low-Ca pyroxene (cores Fs<sub>31.1-33.1</sub>Wo<sub>5.6-6.0</sub>, FeO/MnO = 27-28, N = 3; rim Fs<sub>61.5</sub>Wo<sub>5.3</sub>, FeO/MnO = 34), subcalcic augite (Fs<sub>50.3</sub>Wo<sub>23.9</sub>; Fs<sub>67.1</sub>Wo<sub>20.2</sub>; FeO/MnO = 31, N = 2; rim on diogenitic pyroxene Fs<sub>62.4</sub>Wo<sub>22.3</sub>, FeO/MnO = 32), augite (Fs<sub>41.3</sub>Wo<sub>35.4</sub>, FeO/MnO = 30-39), hedenbergite (Fs<sub>59.4</sub>Wo<sub>36.2</sub>, FeO/MnO = 39), fayalitic olivine (Fa<sub>70.7-85.6</sub>, FeO/MnO = 41-44, N = 3), plagioclase (An<sub>87.1-92.3</sub>Or<sub>0.5-0.2</sub>, N = 4).

**Classification:** Howardite.

**Specimens:** 27.4 g plus one polished thin section at *UWB*; remainder with Mr. N. Gessler.

#### Northwest Africa 13431 (NWA 13431)

(Northwest Africa)

Purchased: 2019 Mar

Classification: Ordinary chondrite (H4)

**History:** Purchased by John Divelbiss in March 2019 from Sean Tutorow, who had acquired the specimen from a Moroccan dealer.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Well-formed chondrules are set in a relatively coarse grained, recrystallized matrix containing kamacite (altered), taenite, troilite, sodic plagioclase, low-Ti chromite, merrillite and chlorapatite.

**Geochemistry:** Olivine ( $\text{Fa}_{18.5\pm 0.1}$ , range  $\text{Fa}_{18.4-18.6}$ ,  $N = 4$ ), low-Ca pyroxene ( $\text{Fs}_{15.9\pm 0.7}\text{Wo}_{1.0\pm 0.7}$ , range  $\text{Fs}_{14.9-16.3}\text{Wo}_{0.3-1.6}$ ,  $N = 4$ ), augite ( $\text{Fs}_{7.2}\text{Wo}_{34.1}$ ;  $\text{Fs}_{5.9}\text{Wo}_{45.7}$ ;  $N = 2$ ).

**Classification:** Ordinary chondrite (H4).

**Specimens:** 32.5 g including one polished thin section at *UWB*; remainder with Mr. J. Divelbiss.

### Northwest Africa 13432 (NWA 13432)

(Northwest Africa)

Purchased: 2020 Mar

Classification: Primitive achondrite (Winonaite)

**History:** Purchased by Darryl Pitt in March 2020 from a Moroccan dealer.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Metamorphic triple grain junction texture (mean grainsize  $\sim 250\ \mu\text{m}$ ). Aggregate of olivine, orthopyroxene, fluoro-edenitic amphibole (as oikocrysts enclosing other mineral grains), sodic plagioclase, diopside and kamacite plus minor fluorapatite, graphite and schreibersite.

**Geochemistry:** Olivine ( $\text{Fa}_{3.0-3.3}$ ,  $\text{FeO/MnO} = 16-22$ ,  $N = 5$ ), orthopyroxene ( $\text{Fs}_{3.5-3.8}\text{Wo}_{1.7-1.9}$ ,  $\text{FeO/MnO} = 12-14$ ,  $N = 5$ ), diopside ( $\text{Fs}_{1.1-1.3}\text{Wo}_{44.8-45.8}$ ,  $\text{FeO/MnO} = 9-12$ ,  $N = 3$ ), plagioclase ( $\text{An}_{20.8}\text{Ab}_{76.5}\text{Or}_{2.6}$ ). A total of 53 WDS analyses were obtained on the fluoro-edenite amphibole: it is very homogeneous in composition throughout the studied thin section. It has a mean formula (with (OH) by difference):  $(\text{Na}_{0.836}\text{K}_{0.101})(\text{Ca}_{1.749}\text{Na}_{0.176}\text{Fe}^{2+}_{0.068}\text{Mn}_{0.007})(\text{Mg}_{4.799}\text{Ti}_{0.104}\text{Cr}_{0.04}\text{Al}_{0.036}\text{Fe}^{2+}_{0.021})(\text{Si}_{6.954}\text{Al}_{1.046})\text{O}_{22}[\text{F}_{1.905}(\text{OH})_{0.078}\text{Cl}_{0.016}]$ . Oxygen isotopes (K. Ziegler, *UNM*): analyses of acid-washed subsamples by laser fluorination gave, respectively,  $\delta^{17}\text{O}$  2.272, 2.016, 2.196;  $\delta^{18}\text{O}$  5.328, 4.855, 5.196;  $\Delta^{17}\text{O}$  -0.541, -0.548, -0.548 per mil (all data linearized).

**Classification:** Winonaite. This specimen is unusual because of the presence of fluoro-amphibole, as also observed in winonaite [Hammadah al Hamra 193](#) (Floss et al., 2007).

**Specimens:** 23.8 g including one polished thin section at *UWB*; remainder with *DPitt*.

### Northwest Africa 13433 (NWA 13433)

Mauritania

Purchased: 2020 Aug

Classification: HED achondrite (Eucrite, unbrecciated)

**History:** Two fitting stones (20840 g, 3855 g) found together at an undisclosed location in Mauritania were purchased by Rachid Chaoui in August 2020 from a Mauritanian dealer.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) The studied specimen is quite fresh with a subophitic texture (mean grainsize  $\sim 0.6\ \text{mm}$ ), and is composed predominantly of calcic plagioclase and exsolved pigeonite with accessory silica polymorph, ilmenite, low-Ti chromite and troilite.

**Geochemistry:** Low-Ca pyroxene host ( $\text{Fs}_{58.3-61.4}\text{Wo}_{2.2-4.8}$ ,  $\text{FeO/MnO} = 29-31$ ,  $N = 3$ ), augite exsolution lamellae ( $\text{Fs}_{27.1-29.3}\text{Wo}_{40.1-42.5}$ ,  $\text{FeO/MnO} = 31-34$ ,  $N = 4$ ), plagioclase ( $\text{An}_{87.8-89.3}\text{Or}_{0.5-0.4}$ ,  $N = 3$ ).

**Classification:** Eucrite (unbrecciated, diabasic).

**Specimens:** 22.1 g including one polished thin section at *UWB*; remainder with Mr. R. Chaoui.

**Northwest Africa 13434** (NWA 13434)

(Northwest Africa)

Purchased: 2020 February

Classification: HED achondrite (Eucrite, melt breccia)

**History:** The meteorite was purchased from a Moroccan dealer at the mineral show in Munich, Germany.

**Physical characteristics:** Dark grayish rock without fusion crust.

**Petrography:** The meteorite is a melt breccia predominantly composed of large up to 700  $\mu\text{m}$  sized exsolved pyroxene grains set into a feldspar-dominated matrix. Pyroxenes are partly to completely recrystallized and often display mottled compositional zoning. In recrystallized regions feldspar typically shows fibrous textures indicative for crystallization from a melt. No lithic clasts have been found. Minor phases include silica, chromite, FeS, and zircon. No metallic iron has been found. Some regions show brownish staining due to terrestrial weathering; secondary barite is present.

**Geochemistry:** low-Ca pyroxene:  $\text{Fs}_{57.6\pm 1.8}\text{Wo}_{4.1\pm 1.6}$  ( $\text{Fs}_{55.0-60.4}\text{Wo}_{1.9-6.6}$ ,  $n=17$ ,  $\text{FeO}/\text{MnO}=27-31$ ); Ca-pyroxene:  $\text{Fs}_{25.6\pm 0.6}\text{Wo}_{43.7\pm 0.6}$  ( $\text{Fs}_{24.9-27.2}\text{Wo}_{41.6-44.4}$ ,  $n=18$ ,  $\text{FeO}/\text{MnO}=26-34$ ); calcic plagioclase:  $\text{An}_{93.0\pm 0.7}$  ( $\text{An}_{91.8-94.2}$ ,  $n=14$ )

**Northwest Africa 13435** (NWA 13435)

(Northwest Africa)

Purchased: 2020 Feb

Classification: HED achondrite (Diogenite)

**History:** The meteorite was purchased from a local meteorite dealer in Zagora, Morocco.

**Physical characteristics:** Many light brownish fragments ranging from less than one gram to 115 g lacking any fusion crust.

**Petrography:** The meteorite is a monomict breccia predominantly composed of blocky up to 3.5 mm sized orthopyroxene grains and rare more fine-grained cataclastic regions. Minor phases include plagioclase, chromite, FeS, and symplectic chromite-silica-intergrowths. No metallic iron has been found.

**Geochemistry:** low-Ca pyroxene:  $\text{Fs}_{27.6\pm 0.1}\text{Wo}_{3.2\pm 0.4}$  ( $\text{Fs}_{27.2-27.8}\text{Wo}_{2.9-4.0}$ ,  $n=16$ ,  $\text{FeO}/\text{MnO}=25-28$ ); calcic plagioclase:  $\text{An}_{91.8\pm 1.6}$  ( $\text{An}_{88.9-93.4}$ ,  $n=12$ )

**Northwest Africa 13436** (NWA 13436)

(Northwest Africa)

Purchased: 2020 February

Classification: HED achondrite (Eucrite, polymict)

**History:** The meteorite was purchased from a local meteorite dealer in Marrakesh, Morocco.

**Physical characteristics:** Dark grayish rock with patches of fusion crust covering about 20-30% of the surface.

**Petrography:** The meteorite is a polymict breccia composed of mineral, basaltic, and fine-grained recrystallized clasts set into a clastic matrix. Dominant minerals are exsolved pyroxene and calcic plagioclase with grain sizes of 10-30  $\mu\text{m}$  in fine-grained clasts and 100-400  $\mu\text{m}$  in coarse-grained regions. Minor phases include silica, chromite, FeS, ilmenite, and merrillite. No metallic Fe was detected. The meteorite contains several shock melt veins.

**Geochemistry:** low-Ca pyroxene:  $Fs_{56.4\pm 0.3}Wo_{2.2\pm 0.1}$  ( $Fs_{55.8-57.2}Wo_{2.0-2.4}$ ,  $n=14$ ,  $FeO/MnO=28-31$ ); Ca-pyroxene:  $Fs_{22.8\pm 0.6}Wo_{45.2\pm 0.5}$  ( $Fs_{21.7-23.9}Wo_{44.6-45.9}$ ,  $n=13$ ,  $FeO/MnO=25-29$ ); calcic plagioclase:  $An_{90.4\pm 0.9}$  ( $An_{89.2-91.6}$ ,  $n=14$ )

### Northwest Africa 13437 (NWA 13437)

(Northwest Africa)

Purchased: 2020 February

Classification: Carbonaceous chondrite (CV3)

**History:** The meteorite was purchased from a local meteorite dealer in Guelmin, Morocco.

**Physical characteristics:** Almost black egg-shaped rock without fusion crust.

**Petrography:** Carbonaceous chondrite composed of large chondrules (mean diameter about 0.8 mm; up to 2 mm sized), CAIs (up to 4.5 mm sized), and olivine amoeboids all set into a fine-grained almost black matrix. The meteorite is relatively fresh with only very few chondrules showing light brownish staining.

### Northwest Africa 13438 (NWA 13438)

(Northwest Africa)

Purchased: 2020 February

Classification: Carbonaceous chondrite (CO3)

**History:** The meteorite was purchased from a local meteorite dealer in Zagora, Morocco.

**Physical characteristics:** Dark brownish rock without fusion crust.

**Petrography:** The meteorite shows a dark brownish interior and is predominantly composed of abundant small and mostly porphyritic chondrules, CAIs, and mineral fragments set into a fine-grained matrix. Chondrules have a mean diameter of about 0.2 mm. Opaques phases are metal and troilite and their respective weathering products.

### Northwest Africa 13439 (NWA 13439)

Morocco

Purchased: 2018

Classification: HED achondrite (Eucrite)

**History:** Thierry Simard purchased the 660 g sample in Zagora, Morocco, in November 2018.

**Physical characteristics:** Approximately 40% of the sample is covered in a dark brown, wind-ablated fusion crust. The remainder of the stone is light grey in color and crystalline.

The cut face shows the interior of the sample is light grey and has a basaltic texture.

**Petrography:** (A. Love, *App*) Sample is unbrecciated, ophitic textured and transected by thin shock veins and planar dislocations. Some pyroxene grains have been recrystallized into finer-grained mosaics and both pyroxenes and plagioclase show clouding from fine-grained opaques. Pyroxenes are exsolved and inverted. Additional minerals are: Si polymorph, troilite, ilmenite, chromite, rare apatite. clouding from fine-grained opaques. Pyroxenes are exsolved and inverted. Additional minerals are: Silica polymorph, troilite, ilmenite, chromite, rare apatite.

**Geochemistry:** (A. Love, *App*) Low Ca pyroxene ( $Fs_{62.7\pm 0.3}Wo_{1.9\pm 0.1}$ ,  $Fe/Mn=30.1\pm 0.2$ ,  $Mg\#36.0\pm 0.3$ ,  $n=8$ ); high Ca pyroxene ( $Fs_{27.2\pm 0.5}Wo_{44.1\pm 0.4}$ ,  $Fe/Mn=30.0\pm 0.4$ ,  $n=8$ ); plagioclase ( $An_{87.9\pm 2.7}Or_{0.5\pm 0.3}$ ,  $n=6$ ).

**Classification:** HED achondrite (Eucrite) Based on textures, equilibrated compositions,  $Mg\#$  and  $Fe/Mn$  ratios of pyroxenes, this sample is an equilibrated basaltic eucrite.



**Specimens:** T. Simard holds the main mass. Several slices, a polished thin section and mount comprise the 20.02g type specimen that is on deposit at *App*.

#### Northwest Africa 13440 (NWA 13440)

Algeria

Find: 2018

Classification: Martian meteorite (Shergottite)

**History:** 4 stones weighing a total of 309.95 g were found in an area known as Laricha by a meteorite prospector in May of 2018. Dave Lehman and a partner obtained the specimens in 2020.

**Physical characteristics:** Samples are crusted and uncrusted. Where preserved, fusion crusted samples show broad, shallow regmaglypts. and flow-lines. The exterior and interior of all samples have an igneous texture composed of fractured coarse-grained, dark green, lath-shaped and blocky crystals enclosing smaller patches of irregular-shaped light grey translucent crystals. This assemblage is crosscut by sporadic dark-colored, vesicular melt pockets.

**Petrography:** (A. Love, *App*) Sample has an ophitic texture composed of (vol%): coarse-grained (laths up to 8.5mm), euhedral laths of twinned clinopyroxene (64) enclosing lath-shaped to subhedral regions of maskelynite (33), merrillite (1), mesostasis (1) and opaques (1). Pigeonite contains blebs of augite and is zoned to more ferroan rims. Pyroxene lacks the complex zoning present in other basaltic shergottites. Pyroxenes laths contain thin exsolution lamellae and show preferred orientation. Additional minerals are: elongate rods of merrillite, Ti-magnetite with  $\mu\text{m}$ -sized exsolution lamellae of ilmenite, chromite, pyrrhotite and rare baddeleyite.

**Geochemistry:** (A. Patchen, *UTenn*) Pigeonite Cores ( $\text{Fs}_{38.4\pm 4.3}\text{Wo}_{11.8\pm 1.7}$ ,  $\text{Fe}/\text{Mn}=31.1\pm 1.9$ ,  $\text{Mg}\#56.4\pm 5.3$ ,  $n=90$ ); Augite ( $\text{Fs}_{27.5\pm 2.7}\text{Wo}_{32.8\pm 1.9}$ ,  $\text{Fe}/\text{Mn}=31.1\pm 1.8$ ,  $\text{Mg}\#59.2\pm 1.8$ ,  $n=17$ ); Pigeonite rims ( $\text{Fs}_{58.8\pm 7.2}\text{Wo}_{15.2\pm 4.7}$ ,  $\text{Fe}/\text{Mn}=36.3\pm 1.5$ ,  $\text{Mg}\#30.8\pm 6.7$ ,  $n=68$ ); Maskelynite ( $\text{An}_{50.3\pm 5.1}\text{Or}_{2.0\pm 0.1.0}$ ,  $n=66$ ).

**Classification:** (Martian) gabbroic shergottite. Based on coarse-grained size of sample, mineralogy, compositions and shock features, this sample is a gabbroic shergottite M-S5, low weathering.

**Specimens:** Dave Lehman and his partner hold the main masses. 4 slices and many small fragments totaling 21.77 g comprise the type specimen. The type specimen and 2 polished thin sections are on deposit at *App*.

#### Northwest Africa 13441 (NWA 13441)

Algeria

Find: 2019

Classification: Martian meteorite (Shergottite)

**History:** The same group of camel herders, who found Rafsa 001, found 4 samples weighing a total of 84.69 g in December of 2019 near Rafsa, Oum El Assel, Algeria.

**Physical characteristics:** Samples are rounded to tabular in shape and range in color from dark green-to brownish dark green. The samples lack fusion crust but show a defined porphyritic igneous texture on the exterior.

**Petrography:** (A. Love, *App*) Sample has a porphyritic, intergranular texture composed of (vol%): (13) subhedral to euhedral olivine phenocrysts (avg. grain size  $1125\mu\text{m}$ ,  $n=23$ ) set within a groundmass composed of (avg. grainsize  $313\mu\text{m}$ ) polysynthetic twinned clinopyroxene laths (64), euhedral to subhedral olivine (10), maskelynite (13) and trace

amounts of merrillite and opaques. Sample shows a weak preferred orientation of olivine phenocrysts and clinopyroxene laths. Additional minerals are: augite (present as irregular shaped inclusions within pyroxenes, Ni-bearing pyrrhotite, ilmenite and Ti-rich and Ti-poor chromite.

**Geochemistry:** (A. Patchen, *UTenn*) Olivine phenocrysts (cores  $Fa_{27.8-33.8}$ ,  $Fe/Mn=47-55$ ,  $n=28$ ; rims  $Fa_{31.5-41.6}$ ,  $Fe/Mn=49-57$ ,  $n=32$ ); groundmass olivine ( $Fa_{33.3-37.5}$ ,  $Fe/Mn=51.1-55.4$ ,  $n=42$ ); pigeonite ( $Fs_{23.0-30.9}Wo_{6.7-11.9}$ ,  $Fe/Mn=27.3-32.5$ ,  $n=140$ ); maskelynite ( $An_{45.4-66.3}Or_{0.4-1.4}$ ,  $n=53$ ).

**Classification:** (Martian) Olivine-phyric shergottite. Mineral compositions, porphyritic texture and shock effects, suggest sample is an olivine-phyric shergottite. Sample shows a high level of shock (M-S5) and low level of weathering.

**Specimens:** D. Lehman and his partner hold the main masses. A polished thin section and several slices weighing 16.95 g are on deposit at *App*.

### Northwest Africa 13442 (NWA 13442)

(Northwest Africa)

Purchased: March 2020

Classification: Carbonaceous chondrite (CO3.0)

**History:** Purchased in March 2020 by Fabien *Kuntz* in Zagora.

**Physical characteristics:** Multiple fragments with fusion crust.

**Petrography:** (D. Sheikh, *FSU*) Small chondrules ( $150\pm 50$   $\mu m$ , ~60 vol.%), isolated mineral fragments, and CAIs set in a mostly opaque matrix (~40 vol.%).

**Geochemistry:** Olivine ( $Fa_{21.9\pm 16.3}$ , range  $Fa_{0.4-57.3}$ ,  $FeO/MnO = 68\pm 40$ ,  $n=55$ ),  $Cr_2O_3$  in ferroan olivine ( $Cr_2O_3$  wt% =  $0.33\pm 0.14$ ,  $n=35$ ), Low-Ca Pyroxene ( $Fs_{3.6\pm 4.9}Wo_{1.2\pm 0.7}$ , range  $Fs_{1.0-18.4}Wo_{0.4-3.2}$ ,  $n=12$ ).

**Classification:** Carbonaceous chondrite (CO3.0).  $Cr_2O_3$  content of ferroan olivines suggest a low petrologic subtype similar to [Y-81020](#) (CO3.0) and [Colony](#) (3.0) as reported in [Grossman and Brearley \(2005\)](#).

**Specimens:** 20.04 grams at *UCLA*; main mass with *Kuntz*.

### Northwest Africa 13443 (NWA 13443)

(Northwest Africa)

Purchased: 2020 Mar

Classification: Carbonaceous chondrite (CO3.1)

**History:** Purchased in March 2020 by Fabien *Kuntz* in Zagora.

**Physical characteristics:** Multiple fragments with fusion crust.

**Petrography:** (D. Sheikh, *FSU*) Small chondrules ( $120\pm 60$   $\mu m$ , ~60 vol.%), isolated mineral fragments, and CAIs set in a mostly opaque matrix (~40 vol.%).

**Geochemistry:** Olivine ( $Fa_{17.9\pm 15.9}$ , range  $Fa_{0.4-40.9}$ ,  $FeO/MnO = 74\pm 36$ ,  $n=27$ ),  $Cr_2O_3$  in ferroan olivine ( $Cr_2O_3$  wt% =  $0.25\pm 0.08$ ,  $n=17$ ), Low-Ca Pyroxene ( $Fs_{4.4\pm 5.7}Wo_{1.8\pm 1.2}$ , range  $Fs_{0.8-17.4}Wo_{0.3-3.7}$ ,  $n=8$ ).

**Classification:** Carbonaceous chondrite (CO3.1).  $Cr_2O_3$  content of ferroan olivines suggest a low petrologic subtype that is approximately midway between [Rainbow](#) (CO3.2) and [Colony](#) (CO3.0) as reported in [Grossman and Brearley \(2005\)](#).

**Specimens:** 20.21 grams at *UCLA*; main mass with *Kuntz*.

### Northwest Africa 13445 (NWA 13445)

(Northwest Africa)

Purchased: 2019 Oct

Classification: Ordinary chondrite (L4)

**History:** Purchased by John Divelbiss in October 2019 from a Moroccan dealer.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Well-formed chondrules are set in a relatively coarse grained recrystallized matrix containing taenite, altered kamacite (in places accompanied by lawrencite), troilite, taenite, low-Ti chromite and chlorapatite.

**Geochemistry:** Olivine ( $\text{Fa}_{23.6\pm 0.2}$ , range  $\text{Fa}_{23.3-23.8}$ ,  $N = 4$ ), low-Ca pyroxene ( $\text{Fs}_{20.4\pm 1.0}\text{Wo}_{1.3\pm 0.1}$ , range  $\text{Fs}_{19.7-22.2}\text{Wo}_{1.2-1.4}$ ,  $N = 5$ ), augite ( $\text{Fs}_{6.4\pm 0.1}\text{Wo}_{46.2\pm 0.3}$ , range  $\text{Fs}_{6.3-6.5}\text{Wo}_{46.0-46.4}$ ,  $N = 2$ ).

**Classification:** Ordinary chondrite (L4).

**Specimens:** 27.1 g including one polished thin section at *UWB*; remainder with Mr. J. Divelbiss.

### Northwest Africa 13446 (NWA 13446)

Algeria

Purchased: 2020 Jun

Classification: Ungrouped achondrite

**History:** Purportedly found in Algeria and purchased by Habib Naji in June 2020 from a dealer in Adrar, Algeria.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) The specimen has an igneous cumulate texture and consists predominantly of zoned olivine (~90 vol.%) with intercumulus assemblages composed of low-Ca pyroxene (mostly pigeonite), subcalcic augite and sodic plagioclase-like glass with accessory chromite, troilite and very rare spherical grains of metal (kamacite and taenite).

**Geochemistry:** Olivine ( $\text{Fa}_{19.8\pm 3.7}$ , range  $\text{Fa}_{15.8-27.9}$ ,  $\text{FeO/MnO} = 47-54$ ,  $N = 11$ ), low-Ca pyroxene ( $\text{Fs}_{28.8}\text{Wo}_{4.6}$ ,  $\text{FeO/MnO} = 26$ ), pigeonite ( $\text{Fs}_{26.6\pm 4.4}\text{Wo}_{10.4\pm 4.7}$ , range  $\text{Fs}_{18.3-30.6}\text{Wo}_{6.5-18.9}$ ,  $\text{FeO/MnO} = 26-30$ ,  $N = 6$ ), subcalcic augite ( $\text{Fs}_{34.2\pm 6.7}\text{Wo}_{27.2\pm 5.0}$ , range  $\text{Fs}_{27.3-43.3}\text{Wo}_{23.0-34.2}$ ,  $\text{FeO/MnO} = 27-35$ ,  $N = 4$ ), plagioclase-like glass ( $\text{Ab}_{65.4-86.0}\text{An}_{15.7-5.8}\text{Or}_{18.9-8.2}$ ,  $N = 4$ ), kamacite ( $\text{Ni} = 1.6$  wt.%), taenite ( $\text{Ni} = 36.4$  wt.%). Oxygen isotopes (K. Ziegler, *UNM*): analyses of acid-washed subsamples by laser fluorination gave, respectively,  $\delta^{17}\text{O}$  3.638, 3.614, 3.623;  $\delta^{18}\text{O}$  4.887, 4.859, 4.947;  $\Delta^{17}\text{O}$  1.058, 1.049, 1.012 per mil (all data linearized).

**Classification:** Achondrite (igneous, ultramafic, ungrouped). This specimen is an almost metal-free, olivine-dominated igneous achondrite with oxygen isotope affinities to L chondrites. Olivine exhibits compositional zoning from core values typical of H chondrites to rim values more typical of L chondrites, and intercumulus pyroxene also exhibits zoning from pigeonite cores to subcalcic augite rims.

**Specimens:** 54 g including one polished thin section at *UWB*; remainder with Mr. H. Naji.

### Northwest Africa 13447 (NWA 13447)

(Northwest Africa)

Purchased: 2020 Mar

Classification: Ordinary chondrite (H3)

**History:** Purchased by John Divelbiss in March 2020 from Matthew Stream, who had acquired the specimen from a Moroccan dealer at the 2020 Tucson Gem and Mineral Show.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Fairly closely-packed, well-formed unequilibrated chondrules (apparent diameter  $700\pm 490$   $\mu\text{m}$ ,  $N = 23$ ) are set in a recrystallized

matrix containing altered kamacite, taenite (some Cu-bearing), troilite, silica polymorph and chlorapatite.

**Geochemistry:** Olivine ( $Fa_{14.0\pm 6.5}$ , range  $Fa_{0.6-18.2}$ ,  $N = 8$ ;  $Cr_2O_3$  in ferroan examples  $<0.04$  wt.%), low-Ca pyroxene ( $Fs_{13.2\pm 3.6}Wo_{1.8\pm 1.9}$ , range  $Fs_{8.7-17.3}Wo_{0.3-4.7}$ ,  $N = 5$ ), augite ( $Fs_{6.6\pm 2.5}Wo_{40.1\pm 2.8}$ , range  $Fs_{4.8-8.4}Wo_{38.1-42.0}$ ,  $N = 2$ ).

**Classification:** Ordinary chondrite (H3).

**Specimens:** 26.8 g including one polished thin section at *UWB*; remainder with Mr. J. Divelbiss.

#### Northwest Africa 13448 (NWA 13448)

(Northwest Africa)

Purchased: 2017 Dec

Classification: Ordinary chondrite (LL3)

**History:** Purchased by Mbark Arjdal from a meteorite dealer in Algeria in December 2017.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Well-formed unequilibrated chondrules (apparent diameter  $970\pm 730$   $\mu m$ ,  $N = 24$ ) are set in a recrystallized matrix containing altered kamacite, taenite and troilite.

**Geochemistry:** Olivine ( $Fa_{29.3\pm 13.6}$ , range  $Fa_{3.2-41.5}$ ,  $N = 8$ ;  $Cr_2O_3$  in ferroan examples 0.04-0.09 wt.%, mean  $0.06\pm 0.02$  wt.%,  $N = 7$ ), low-Ca pyroxene ( $Fs_{11.0\pm 7.4}Wo_{1.6\pm 2.0}$ , range  $Fs_{1.6-22.3}Wo_{0.2-4.7}$ ,  $N = 5$ ), augite ( $Fs_{9.3\pm 0.1}Wo_{40.9\pm 1.4}$ , range  $Fs_{9.2-9.4}Wo_{39.9-41.9}$ ,  $N = 2$ ).

**Classification:** Ordinary chondrite (LL3).

**Specimens:** 22.0 g including one polished thin section at *UWB*; remainder with Mr. M. Arjdal.

#### Northwest Africa 13449 (NWA 13449)

(Northwest Africa)

Purchased: 2019

Classification: Carbonaceous chondrite (CK5)

**History:** A batch of 6 identical-appearing stones was purchased by Nicholas Gessler in 2019 from a Moroccan dealer.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Sparse separated, magnetite-bearing chondrules are set in a matrix containing Cr-magnetite and calcic plagioclase.

**Geochemistry:** Olivine ( $Fa_{33.3\pm 0.3}$ , range  $Fa_{33.0-33.5}$ ,  $N = 4$ ), low-Ca pyroxene ( $Fs_{25.5\pm 1.8}Wo_{3.2\pm 0.6}$ , range  $Fs_{24.2-26.8}Wo_{2.6-3.7}$ ,  $N = 2$ ), augite ( $Fs_{11.2\pm 1.0}Wo_{48.8\pm 1.1}$ , range  $Fs_{10.5-11.9}Wo_{48.0-49.5}$ ,  $N = 2$ ), plagioclase ( $An_{35.0}Or_{4.4}$ ;  $An_{81.5}Or_{0.4}$ ;  $N = 2$ ), magnetite ( $Cr_2O_3 = 4.6$  wt.%, 4.7 wt.%,  $N = 2$ ).

**Classification:** Carbonaceous chondrite (CK5).

**Specimens:** 20.4 g plus one polished thin section at *UWB*; remainder with Mr. N. Gessler.

#### Northwest Africa 13450 (NWA 13450)

Algeria

Purchased: 2020 Jun

Classification: Lunar meteorite (feldspathic breccia)

**History:** Purportedly found in Algeria and purchased in Tindouf, Algeria in June 2020. David Lehman is the American agent for the owners.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Breccia composed of mineral clasts of anorthite, olivine, low-Ca pyroxene and augite, plus sparse anorthositic lithic clasts, in a

finer grained matrix containing ilmenite, chromite (with variable Ti content), troilite and rare metal (with kamacitic and taenitic subdomains).

**Geochemistry:** Olivine ( $\text{Fa}_{42.6-55.8}$ ,  $\text{FeO/MnO} = 87-98$ ,  $N = 5$ ), low-Ca pyroxene ( $\text{Fs}_{36.0-52.8}\text{Wo}_{2.2-4.6}$ ,  $\text{FeO/MnO} = 56-58$ ,  $N = 3$ ), augite ( $\text{Fs}_{14.5-25.1}\text{Wo}_{39.9-43.5}$ ,  $\text{FeO/MnO} = 40-58$ ,  $N = 3$ ), anorthite ( $\text{An}_{96.3-97.9}\text{Or}_{0.1}$ ,  $N = 3$ ).

**Classification:** Lunar (feldspathic breccia).

**Specimens:** 24.0 g including a polished mount at *UWB*; remainder with Mr. D. Lehman.

#### Northwest Africa 13451 (NWA 13451)

(Northwest Africa)

Purchased: 2019

Classification: Carbonaceous chondrite (CV3)

**History:** A batch of 16 identical-appearing stones was purchased by Nicholas *Gessler* in 2019 from a Moroccan dealer.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Well-formed chondrules (mostly granular; apparent diameter  $980 \pm 570 \mu\text{m}$ ,  $N = 24$ ) and fine grained CAI are set in a fine grained matrix (~40 vol.%, orange in thin section).

**Geochemistry:** Olivine ( $\text{Fa}_{27.8 \pm 30.2}$ , range  $\text{Fa}_{0.3-58.5}$ ,  $N = 6$ ), low-Ca pyroxene ( $\text{Fs}_{0.8 \pm 0.2}\text{Wo}_{2.2 \pm 1.4}$ , range  $\text{Fs}_{0.6-0.9}\text{Wo}_{1.3-3.9}$ ,  $N = 3$ ), diopside ( $\text{Fs}_{0.4}\text{Wo}_{41.4}$ ), plagioclase ( $\text{An}_{84.8}\text{Or}_{0.0}$ ). magnetite ( $\text{Cr}_2\text{O}_3 = 0.1 \text{ wt.}\%$ ,  $3.1 \text{ wt.}\%$ ,  $N = 2$ ).

**Classification:** Carbonaceous chondrite (CV3).

**Specimens:** 23.1 g plus one polished thin section at *UWB*; remainder with Mr. N. *Gessler*.

#### Northwest Africa 13452 (NWA 13452)

(Northwest Africa)

Purchased: 2019

Classification: Rumuruti chondrite (R4-6)

**History:** A batch of 26 identical-appearing stones was purchased by Nicholas *Gessler* in 2019 from a Moroccan dealer.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Fresh specimen composed predominantly of separated, well-formed equilibrated chondrules plus sparse Type 6 lithic clasts set in a fine grained matrix (~40%, black in thin section) containing Ti chromite and pentlandite. A few chondrules in the studied thin section contain olivine with more magnesian cores and more ferroan rims. Metal is absent.

**Geochemistry:** Olivine in chondrules ( $\text{Fa}_{39.0-39.4}$ , range  $\text{Fa}_{39.3 \pm 0.2}$ ,  $N = 3$ ), olivine core in chondrule ( $\text{Fa}_{12.9}$ ), olivine rim in chondrule ( $\text{Fa}_{42.9}$ ), olivine in Type 6 clast ( $\text{Fa}_{39.3}$ ), low-Ca pyroxene ( $\text{Fs}_{30.8 \pm 0.3}\text{Wo}_{1.4 \pm 0.3}$ , range  $\text{Fs}_{30.5-31.0}\text{Wo}_{1.2-1.7}$ ,  $N = 3$ ), augite ( $\text{Fs}_{11.5 \pm 0.1}\text{Wo}_{45.7 \pm 0.1}$ , range  $\text{Fs}_{11.4-11.5}\text{Wo}_{45.6-45.7}$ ,  $N = 2$ ), plagioclase ( $\text{An}_{81.2}\text{An}_{12.3}\text{Or}_{6.4}$ ).

**Classification:** R4-6 chondrite breccia.

**Specimens:** 21.8 g plus one polished thin section at *UWB*; remainder with Mr. N. *Gessler*.

#### Northwest Africa 13453 (NWA 13453)

(Northwest Africa)

Purchased: 2019

Classification: Carbonaceous chondrite (CK5)

**History:** Purchased by Nicholas *Gessler* in 2019 from a Moroccan dealer.



**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Sparse separated, magnetite-bearing chondrules are set in a matrix containing stained Cr-magnetite (some with exsolved chromite and ilmenite lamellae) and calcic plagioclase. No low-Ca pyroxene was found despite a careful search.

**Geochemistry:** Olivine ( $\text{Fa}_{31.9\pm 0.2}$ , range  $\text{Fa}_{31.7-32.1}$ ,  $N = 5$ ), augite ( $\text{Fs}_{9.2\pm 0.5}\text{Wo}_{47.9\pm 0.8}$ , range  $\text{Fs}_{8.8-9.7}\text{Wo}_{47.3-48.8}$ ,  $N = 3$ ), plagioclase ( $\text{An}_{46.1}\text{Or}_{2.5}$ ;  $\text{An}_{87.5}\text{Or}_{0.3}$ ;  $N = 2$ ), magnetite ( $\text{Cr}_2\text{O}_3 = 4.9$  wt.%, 5.0 wt.%,  $N = 2$ ).

**Classification:** Carbonaceous chondrite (CK5).

**Specimens:** 20.8 g including one polished thin section at *UWB*; remainder with Mr. N. Gessler.

#### Northwest Africa 13454 (NWA 13454)

(Northwest Africa)

Purchased: 2019

Classification: Rumuruti chondrite (R3)

**History:** Two identical stones (302 g, 208 g) were purchased by Nicholas Gessler in 2019 from a Moroccan dealer.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Separated, well-formed chondrules (some glass-bearing; apparent diameter  $550 \pm 380$   $\mu\text{m}$ ,  $N = 22$ ) plus sparse R3 lithic clasts and rare very small CAI are set in a fine grained matrix containing albitic plagioclase, pentlandite and rare sperrylite. Metal is absent.

**Geochemistry:** Olivine ( $\text{Fa}_{33.8\pm 15.1}$ , range  $\text{Fa}_{2.0-50.3}$ ,  $N = 10$ ), low-Ca pyroxene ( $\text{Fs}_{21.6\pm 14.9}\text{Wo}_{2.3\pm 2.2}$ , range  $\text{Fs}_{2.3-37.0}\text{Wo}_{0.6-5.5}$ ,  $N = 4$ ), pigeonite ( $\text{Fs}_{30.6}\text{Wo}_{9.5}$ ), subcalcic augite ( $\text{Fs}_{10.3}\text{Wo}_{33.9}$ ).

**Classification:** R3 chondrite.

**Specimens:** 21.3 g plus one polished thin section at *UWB*; remainder with Mr. N. Gessler.

#### Northwest Africa 13455 (NWA 13455)

(Northwest Africa)

Purchased: 2019

Classification: Carbonaceous chondrite (CO3-an)

**History:** The meteorite was purchased from a meteorite dealer in Morocco, possibly from the same lot as [NWA 12957](#).

**Physical characteristics:** Many small almost black fragments some of which covered by fusion crust.

**Petrography:** The meteorite is a brecciated carbonaceous chondrite composed of small chondrules (mean diameter about 250  $\mu\text{m}$ ), mineral fragments, and rare CAIs embedded in a fine-grained Fe-rich matrix. Some objects are surrounded by accretionary dust rims. Opaque phases include metal, sulfides, and magnetite. Olivine and low-Ca pyroxene are highly unequilibrated. Phyllosilicates and carbonates appear to be absent.

**Geochemistry:**  $\text{Cr}_2\text{O}_3$  in ferroan olivine:  $0.30\pm 0.09$  wt%,  $N=8$ ; mean values of defocused matrix analyses (beam diameter 5  $\mu\text{m}$ ; all wt%;  $N=25$ ):  $\text{SiO}_2$ : 28.7,  $\text{TiO}_2$ : 0.05,  $\text{Na}_2\text{O}$ : 0.32,  $\text{Cr}_2\text{O}_3$ : 0.50,  $\text{MgO}$ : 14.3,  $\text{MnO}$ : 0.17,  $\text{FeO}$ : 36.4,  $\text{Al}_2\text{O}_3$ : 2.86,  $\text{NiO}$ : 2.16,  $\text{P}_2\text{O}_5$ : 0.65, S: 2.37, Total: 88.48; Oxygen isotopes (K. Ziegler, *UNM*): 3 acid-washed fragments analyzed by laser fluorination gave:  $\delta^{18}\text{O}=-7.200, -8.292, -5.533$ ;  $\delta^{17}\text{O}=-8.959, -9.822, -8.533$ ;  $\Delta^{17}\text{O}=-5.157, -5.444, .5.612$  (all per mil)

**Classification:** Carbonaceous chondrite (CO3-an). The type 3 due to highly unequilibrated silicates and the absence of phyllosilicates and carbonates. Anomalous designation is from the oxygen isotopic composition. Pairing with NWA 12957 seems likely.

#### Northwest Africa 13456 (NWA 13456)

(Northwest Africa)

Purchased: 2019

Classification: Carbonaceous chondrite (C2)

**History:** The meteorite was purchased from a meteorite dealer in Guelmim, Morocco.

**Physical characteristics:** Almost black individual with some fusion crust.

**Petrography:** The meteorite displays a black interior, appears to be unbrecciated and is composed of chondrules with mean apparent diameter  $150 \pm 80 \mu\text{m}$  (N=48), mineral fragments, and CAIs set into an abundant fine-grained matrix. Most components are surrounded by fine-grained dust rims and many chondrules are heavily corroded. The matrix is a network of very Fe-rich phases including abundant Fe-sulfides and fibrous phyllosilicates. Carbonates are absent.

**Geochemistry:** Mean values of defocused matrix analyses (beam diameter  $5 \mu\text{m}$ ; all wt%; N=12): SiO<sub>2</sub>: 19.4, TiO<sub>2</sub>: 0.03, Na<sub>2</sub>O: 0.24, Cr<sub>2</sub>O<sub>3</sub>: 0.20, MgO: 7.3, MnO: 0.14, CaO: 0.08, FeO: 49.7, Al<sub>2</sub>O<sub>3</sub>: 3.08, NiO: 1.41, P<sub>2</sub>O<sub>5</sub>: 0.62, S: 1.62, Total: 83.82. Oxygen isotopes (K. Ziegler, *UNM*): 3 acid-washed fragments analyzed by laser fluorination gave:  $\delta^{18}\text{O}=0.913, 0.886, 1.678$ ;  $\delta^{17}\text{O}=-3.171, -4.028, -3.953$ ;  $\Delta^{17}\text{O}=-3.653, -4.496, -4.838$  (all per mil).

**Classification:** Carbonaceous chondrite (C2). Type 2 designation due to the presence of phyllosilicates. Oxygen isotopic composition is incompatible with CM.

#### Northwest Africa 13457 (NWA 13457)

(Northwest Africa)

Purchased: June, 2020

Classification: HED achondrite (Eucrite)

**History:** The meteorite was purchased from a local meteorite dealer in Algeria.

**Physical characteristics:** Light-brownish rock without fusion crust.

**Petrography:** The meteorite is an unbrecciated coarse-grained achondrite of dominantly up to 1 mm sized exsolved pyroxene and calcic plagioclase grains. Low-Ca pyroxene contains both, sub-micrometer sized and up to  $200 \mu\text{m}$  wide augite exsolution lamellae. Minor phases are silica, chromite, FeS, and FeNi metal.

**Geochemistry:** low-Ca pyroxene:  $\text{Fs}_{52.0 \pm 0.6} \text{Wo}_{7.1 \pm 0.7}$  ( $\text{Fs}_{51.3-53.1} \text{Wo}_{6.2-8.1}$ , n=12, FeO/MnO=27-29); Ca-pyroxene:  $\text{Fs}_{26.2 \pm 0.2} \text{Wo}_{40.8 \pm 0.1}$  ( $\text{Fs}_{25.9-26.5} \text{Wo}_{40.6-41.0}$ , n=13, FeO/MnO=24-29); calcic plagioclase:  $\text{An}_{92.1 \pm 0.6}$  ( $\text{An}_{91.0-93.1}$ , n=13); Oxygen isotopes (K. Ziegler, *UNM*): 3 acid-washed fragments analyzed by laser fluorination gave:  $\delta^{18}\text{O}=3.657, 4.125, 3.787$ ;  $\delta^{17}\text{O}=1.655, 1.875, 1.717$ ;  $\Delta^{17}\text{O}=-0.276, -0.303, -0.283$  (all per mil)

**Classification:** Achondrite (eucrite).

#### Northwest Africa 13458 (NWA 13458)

Dakhla, Morocco

Purchased: March 2008

Classification: Ordinary chondrite (H5)

**History:** The meteorite was purchased by Svend Buhl from Moroccan meteorite dealer Abdellah Afiness in March 2008 in Agadir, Morocco. Takafumi Niihara purchased whole rock from Svend Buhl in March 2020.

**Physical characteristics:** Total mass is 6.5 kg. 1 single stone. 80-90% of the meteorite is covered with fusion crust.

**Petrography:** (T. Mikouchi and T. Niihara, *UTok*; H. Ono, *Chiba*) Chondrule size is 0.5-1.0 mm. Plagioclase is 10-50  $\mu\text{m}$ .

**Geochemistry:** Mineral compositions: Electron microprobe analysis shows that olivine is  $\text{Fa}_{17.5-18.6}$  (N=33) and orthopyroxene is  $\text{Fs}_{15.4-16.4}\text{Wo}_{1.0-3.5}$  (N=4).

**Classification:** H5

**Specimens:** A 24 g type specimen is on deposit at *UTok*.

### Northwest Africa 13459 (NWA 13459)

South, Morocco

Find: 2017

Classification: Martian meteorite (Shergottite)

**History:** The meteorite was purchased in Tucson, USA, by Zhouping Guo.

**Physical characteristics:** The meteorite is irregular in shape. Most of the surface of the meteorite is covered with black fusion crust. The interior is grayish brown with clear, glassy maskelynite grains, and sporadically-distributed dark glass shock pockets.

**Petrography:** Petrology (Z.Xia, B.Miao, Q.Deng, *GUT*): The meteorite has a fine-grained basaltic texture, which is mainly composed of pyroxene and maskelynite. The accessory minerals are chromite, Fe-Ti oxide, troilite, vesicular glass and phosphate. Pyroxene is an idiomorphic crystal in the form of prisms, which is composed of highly fractured pigeonite and augite, with a particle size of 0.2-2mm, and obvious chemical zoning can be observed. The maskelynite is relatively broken. Plagioclase is completely transformed into maskelynite.

**Geochemistry** (Z.Xia, B.Miao, Q.Deng, *GUT*): Pyroxenes show two compositional trends: pigeonite ( $\text{En}_{27.5-58.7}\text{Fs}_{29.6-59.0}\text{Wo}_{9.2-13.6}$ , average  $\text{En}_{43.3}\text{Fs}_{44.6}\text{Wo}_{12.1}$ ,  $\text{FeO/MnO}=35.3; 4.6$ , n=6) and augite ( $\text{En}_{28.0-45.0}\text{Fs}_{22.8-55.4}\text{Wo}_{16.6-33.3}$ ; average  $\text{En}_{38.7}\text{Fs}_{33.7}\text{Wo}_{27.6}$ ;  $\text{FeO/MnO}=31.6-3.7$ , n=4). Maskelynite ( $\text{An}_{42.3-48.0}\text{Ab}_{50.0-54.7}\text{Or}_{1.8-3.0}$ , average  $\text{An}_{46.1}\text{Ab}_{51.7}\text{Or}_{2.2}$ , n=5).

**Classification:** Martian (basaltic shergottite)

**Specimens:** A polished section and about 6.5 g sample are stored in the Institution of Meteorites and Planetary Materials Research of *GUT*, the main mass is exhibited in the Geological Museum of Guilin.

### Northwest Africa 13460 (NWA 13460)

South, Morocco

Find: 2017

Classification: Martian meteorite (Shergottite)

**History:** The meteorite was purchased in Tucson, USA by Zhouping Guo.

**Physical characteristics:** The shape of the meteorite is irregular. There is black fusion crust partly covering its surface. The interior is generally grey. Glassy maskelynite and a small amount of black glass pockets can be observed.

**Petrography:** Petrology (Z.Xia, B.Miao, Q.Deng, *GUT*): The meteorite has a diabasic structure, which is mainly composed of pigeonite (~50 vol%), augite (~15 vol%), maskelynite (~25 vol%) and accessory minerals (~10 vol%). The accessory minerals are mainly composed of chromite, Fe-Ti oxide, troilite, vesicular glass and phosphate. Pigeonite and augite (typical size 0.1-1.6mm) are automorphic in the form of slab columns, and obvious

component zoning can be observed. The meteorite experienced a strong impact metamorphism, which caused the plagioclases to be completely transformed into maskelynites, and pyroxenes and maskelynites were relatively broken.

**Geochemistry** (Z.Xia, B.Miao, Q.Deng, *GUT*): Pyroxenes show two compositional trends: pigeonite ( $\text{En}_{31.2-55.7}\text{Fs}_{32.2-55.8}\text{Wo}_{10.2-14.3}$ , average  $\text{En}_{42.9}\text{Fs}_{44.5}\text{Wo}_{12.6}$ ,  $\text{FeO/MnO}=34.2-4.4$ ,  $n=9$ ) and augite ( $\text{En}_{23.6-45.8}\text{Fs}_{26.6-60.5}\text{Wo}_{15.8-31.7}$ , average  $\text{En}_{34.5}\text{Fs}_{40.9}\text{Wo}_{24.6}$ ;  $\text{FeO/MnO}=32.0-3.3$ ,  $n=5$ ). Maskelynite ( $\text{An}_{39.8-45.8}\text{Ab}_{51.2-55.7}\text{Or}_{2.7-4.6}$ , average  $\text{An}_{43.2}\text{Ab}_{53.4}\text{Or}_{3.4}$ ,  $n=9$ ).

**Classification:** Martian (basaltic shergottite)

**Specimens:** A polished section and 1.78 g sample are stored in the Institution of Meteorites and Planetary Materials Research of *GUT*.

### Northwest Africa 13461 (NWA 13461)

(Northwest Africa)

Purchased: August, 2020

Classification: Ordinary chondrite (LL5-6)

**History:** The meteorite was purchased from a dealer in Morocco.

**Physical characteristics:** Two brownish to orange fragments with patches of black fusion crust.

**Petrography:** The meteorite is a strongly altered chondritic breccia composed of LL6 type clasts (plagioclase grain size about 80  $\mu\text{m}$ ) set into LL5 type matrix (plagioclase grain size about 40  $\mu\text{m}$ ).

### Northwest Africa 13462 (NWA 13462)

(Northwest Africa)

Purchased: Aug 2020

Classification: HED achondrite (Eucrite, melt breccia)

**History:** The meteorite was bought by the main mass holder from Mohamed Ali Loud, Spain.

**Physical characteristics:** Dark-grayish rock with some fusion crust.

**Petrography:** The meteorite displays a fresh dark-grayish interior and is eucrite-melt breccia composed of up to 0.7 mm sized basaltic and mineral clasts set into shock melted matrix. Exsolved pyroxenes and lath shaped calcic plagioclase partly converted into maskelynite are the dominant minerals. The shock melt is mostly recrystallized and some regions show flow textures. Minor phases include silica, FeS, chromite, ilmenite and metallic iron.

**Geochemistry:** low-Ca pyroxene:  $\text{Fs}_{67.4\pm 1.1}\text{Wo}_{3.3\pm 0.9}$  ( $\text{Fs}_{65.5-68.7}\text{Wo}_{2.3-5.1}$ ,  $n=13$ ,  $\text{FeO/MnO}=29-32$ ); Ca-pyroxene:  $\text{Fs}_{24.8\pm 0.4}\text{Wo}_{41.8\pm 0.3}$  ( $\text{Fs}_{23.7-25.6}\text{Wo}_{42.4-41.0}$ ,  $n=13$ ,  $\text{FeO/MnO}=27-31$ ); calcic plagioclase:  $\text{An}_{89.4\pm 0.6}$  ( $\text{An}_{87.8-90.2}$ ,  $n=15$ )

### Northwest Africa 13463 (NWA 13463)

(Northwest Africa)

Purchased: Oct 2018

Classification: Ureilite

**History:** The meteorite was purchased from a Moroccan dealer at the mineral show in Munich, Germany.

**Physical characteristics:** Brownish rock without fusion crust.

**Petrography:** The meteorite shows a coarse-grained cumulate texture of olivine and pigeonite grains up to 3 mm in sizes. Both, olivine and pyroxene display characteristic reduced rims and the meteorite contains some flaky graphite.

**Geochemistry:** reduced rims in olivine:  $Fa_{4.8-9.1}$ ; olivine contains  $0.88 \pm 0.04$  wt%  $Cr_2O_3$  and  $0.38 \pm 0.01$  wt% CaO; reduced rims in pyroxene:  $Fs_{6.2-11.3}Wo_{5.1-11.2}$ ; pigeonite contains  $1.34 \pm 0.05$  wt%  $Cr_2O_3$  and  $0.58 \pm 0.02$  wt%  $Al_2O_3$

**Northwest Africa 13464** (NWA 13464)

(Northwest Africa)

Purchased: June 2018

Classification: Carbonaceous chondrite (CO3)

**History:** The meteorite was purchased from a dealer in Morocco.

**Physical characteristics:** Dark brownish rock without fusion crust.

**Petrography:** The meteorite shows a dark brownish interior and is predominantly composed of abundant chondrules (mean diameter about 200  $\mu m$ ), CAIs, and mineral fragments set into a fine-grained matrix. Chondrules are highly unequilibrated and sometimes surrounded by fine-grained dust rims. Some sulfides and FeNi metal are present in matrix and chondrules. Orange staining of chondrules and calcite filled cracks attest to severe terrestrial alteration.

**Geochemistry:**  $Cr_2O_3$  in ferroan olivine  $0.24 \pm 0.09$  (n=7).

**Classification:** Carbonaceous chondrite (CO3). Estimated subtype CO3.1 according to  $Cr_2O_3$  content of ferroan olivines which is between [Rainbow](#) (CO3.2) and [Colony](#) (CO3.0) as reported in [Grossman and Brearley \(2005\)](#).

**Northwest Africa 13465** (NWA 13465)

(Northwest Africa)

Purchased: 2019

Classification: Ordinary chondrite (H5)

**History:** The meteorite was bought by the main mass holder from a staff member of the Dinosaur Museum in Aathal, Switzerland.

**Physical characteristics:** Many dark brownish fragments largely covered by fusion crust.

**Petrography:** The plagioclase grain size is about 30  $\mu m$ .

**Northwest Africa 13466** (NWA 13466)

(Northwest Africa)

Purchased: 2019

Classification: Carbonaceous chondrite (CK6)

**History:** The meteorite was bought by the main mass holder from an Algerian meteorite dealer.

**Physical characteristics:** Two dark brownish rocks without fusion crust.

**Petrography:** The meteorite displays a brownish partly reddishly stained interior and is predominantly composed of fine-grained recrystallized matrix dominated by ferrous olivine. Only few chondrules were encountered. Minor phases include low-Ca pyroxene, Ca-pyroxene, intermediate plagioclase, and FeNi-sulfides. Cr-rich magnetite is abundant; metal is virtually absent.

**Geochemistry:** olivine:  $Fa_{31.5 \pm 0.5}$  ( $FeO/MnO=108 \pm 9$ , n=12); low-Ca pyroxene:

$Fs_{27.0 \pm 0.3}Wo_{1.8 \pm 0.8}$ , n=2; Ca-pyroxene:  $Fs_{9.4 \pm 0.5}Wo_{46.3 \pm 0.2}$ , n=9

**Northwest Africa 13467** (NWA 13467)

(Northwest Africa)



Purchased: 2020

Classification: Martian meteorite (Shergottite)

**History:** The meteorite was bought by the main mass holder from a Moroccan meteorite dealer.

**Physical characteristics:** Dark brownish rock largely covered by fusion crust.

**Petrography:** The meteorite displays a fresh grayish to light greenish interior and has a fine-grained gabbroic texture predominantly composed of up to 600  $\mu\text{m}$  sized calcic pyroxene, Fe-rich olivine, and often lath-shaped maskelynite grains. All these silicates show strong irregular compositional zoning. Some myrmekitic breakdown assemblages consisting of low-Ca pyroxene and iron oxides as well as patches of Si-rich mesostasis are present. Minor phases include ilmenite, ulvospinel, and pyrrhotite. The meteorite is highly shocked and contains shock melt pockets.

**Geochemistry:** Ca-pyroxene:  $\text{Fs}_{42.5\pm 7.6}\text{Wo}_{30.3\pm 2.4}$  ( $\text{Fs}_{29.2-53.2}\text{Wo}_{27.6-35.9}$ ,  $\text{FeO/MnO}=35\pm 4$ ,  $n=12$ ); Fe-rich olivine:  $\text{Fa}_{78.0\pm 9.3}$  ( $\text{Fa}_{61.9-91.7}$ ,  $\text{FeO/MnO}=33\pm 9$ ,  $n=19$ ); maskelynite:  $\text{An}_{58.8\pm 2.9}\text{Ab}_{41.0\pm 2.8}\text{Or}_{0.2\pm 0.1}$  ( $\text{An}_{53.6-63.3}\text{Ab}_{36.7-46.2}\text{Or}_{0.1-0.5}$ ,  $n=21$ ); Si-rich mesostasis contains up to 3.5 wt%  $\text{Al}_2\text{O}_3$

**Classification:** Martian (fine-grained gabbroic shergottite)

#### Northwest Africa 13468 (NWA 13468)

(Northwest Africa)

Purchased: July 2020

Classification: Rumuruti chondrite (R3-6)

**History:** The meteorite was bought by the main mass holder from an Algerian meteorite dealer.

**Physical characteristics:** Dark-brownish individuals without fusion crust.

**Petrography:** The meteorite displays a dark-brownish interior and is composed of up to 1 cm sized darker colored type 3 clasts set into type 6 matrix; some black impact melt fragments are present. Equilibrated Fe-rich olivine dominates the matrix. Olivine and low-Ca pyroxene are compositionally unequilibrated in type 3 clasts. Chondrules have an average diameter of about 400  $\mu\text{m}$ . More minor phases include low-Ca pyroxene, Ca-pyroxene, sodic plagioclase, sulfides, and Ti-bearing chromite; no metal has been detected. The meteorite contains some shock veins.

**Geochemistry:** type 6 lithology: olivine:  $\text{Fa}_{37.9\pm 0.3}$  ( $\text{FeO/MnO}=76\pm 4$ ,  $n=14$ ); low-Ca pyroxene:  $\text{Fs}_{28.8\pm 0.2}\text{Wo}_{1.2\pm 0.3}$  ( $\text{FeO/MnO}=49\pm 4$ ,  $n=12$ ); Ca-pyroxene:  $\text{Fs}_{11.9\pm 0.9}\text{Wo}_{44.6\pm 1.8}$  ( $\text{FeO/MnO}=44\pm 6$ ,  $n=10$ ); type 3 lithology: olivine:  $\text{Fa}_{32.8\pm 11.6}$  ( $\text{Fa}_{8.6-45.2}$ ,  $\text{FeO/MnO}=72\pm 14$ ,  $n=15$ ); low-Ca pyroxene:  $\text{Fs}_{22.4\pm 7.4}\text{Wo}_{1.1\pm 0.7}$  ( $\text{Fs}_{10.8-31.6}\text{Wo}_{0.5-3.2}$ ,  $\text{FeO/MnO}=54\pm 10$ ,  $n=16$ )

#### Northwest Africa 13469 (NWA 13469)

(Northwest Africa)

Purchased: July 2020

Classification: HED achondrite (Eucrite, melt breccia)

**History:** The meteorite was bought by the main mass holder from an Algerian meteorite dealer.

**Physical characteristics:** Dark-grayish rock with some fusion crust.

**Petrography:** The meteorite is a melt-supported eucritic breccia composed of up to 0.4 mm sized basaltic and mineral clasts set into abundant shock melt. Dominant minerals are exsolved pyroxene and calcic plagioclase partly converted into maskelynite. Minor phases

1  
2  
3 include silica, FeS, chromite, ilmenite, and secondary barite. No metallic iron has been  
4 detected.

5 **Geochemistry:** low-Ca pyroxene:  $\text{Fs}_{59.8\pm 0.7}\text{Wo}_{2.4\pm 0.4}$  ( $\text{Fs}_{57.9-60.7}\text{Wo}_{2.0-3.7}$ ,  $n=14$ ,  $\text{FeO/MnO}=26-$   
6 30); Ca-pyroxene:  $\text{Fs}_{26.0\pm 0.7}\text{Wo}_{44.0\pm 0.7}$  ( $\text{Fs}_{25.2-28.3}\text{Wo}_{42.5-44.9}$ ,  $n=14$ ,  $\text{FeO/MnO}=25-32$ ); calcic  
7 plagioclase:  $\text{An}_{90.4\pm 0.6}$  ( $\text{An}_{88.9-91.6}$ ,  $n=15$ )  
8  
9

10  
11 **Northwest Africa 13470** (NWA 13470)

12 (Northwest Africa)

13 Purchased: Sept 2020

14 Classification: HED achondrite (Eucrite)

15 **History:** The meteorite was bought by the main mass holder from a local meteorite dealer in  
16 Mauretania.

17 **Physical characteristics:** Light-grayish rock with minor fusion crust.

18 **Petrography:** The meteorite displays a greyish to light greenish interior and is a polymict  
19 breccia composed of up to 1 cm sized basaltic, black impact melt, and mineral clasts set into a  
20 fine-grained clastic matrix. Mineral phases are predominantly exsolved pyroxene and calcic  
21 plagioclase; some magmatically zoned low-Ca pyroxenes are present attesting to a low degree  
22 of thermal metamorphism. Minor phases include silica, ilmenite, chromite, and troilite. No  
23 metallic iron has been detected. The meteorite contains shock melt veins.

24 **Geochemistry:** zoned low-Ca pyroxene:  $\text{Fs}_{40.7\pm 9.4}\text{Wo}_{5.9\pm 0.7}$  ( $\text{Fs}_{29.2-52.9}\text{Wo}_{5.1-7.5}$ ,  $\text{FeO/MnO}=24-$   
25 33,  $n=18$ ); low-Ca pyroxene host to augite exsolution lamellae:  $\text{Fs}_{58.8\pm 0.4}\text{Wo}_{1.6\pm 0.1}$  ( $\text{Fs}_{57.9-}$   
26 59.7 $\text{Wo}_{1.4-1.7}$ ,  $\text{FeO/MnO}=28-30$ ,  $n=13$ ); Ca-pyroxene exsolution lamellae:  
27  $\text{Fs}_{24.4\pm 0.7}\text{Wo}_{42.9\pm 0.7}$  ( $\text{Fs}_{23.7-26.0}\text{Wo}_{41.3-43.8}$ ,  $\text{FeO/MnO}=25-29$ ,  $n=12$ ); calcic plagioclase:  
28  $\text{An}_{88.8\pm 0.4}$  ( $\text{An}_{87.9-89.3}$ ,  $n=13$ )  
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30  
31  
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34 **Northwest Africa 13471** (NWA 13471)

35 (Northwest Africa)

36 Purchased: Sept 2020

37 Classification: HED achondrite (Eucrite, melt breccia)

38 **History:** The meteorite was bought by the main mass holder from a local meteorite dealer in  
39 Mauretania.

40 **Physical characteristics:** Dark-grayish rock without fusion crust.

41 **Petrography:** The meteorite is a melt breccia predominantly composed of large up to 1 cm  
42 sized basaltic and mineral clasts embedded into a recrystallized shock melt matrix. Exsolved  
43 pyroxene and calcic plagioclase are the dominant mineral phases. Minerals surrounded by  
44 melt show resorption features, are partly to completely recrystallized and often display  
45 mottled compositional zoning. In recrystallized regions feldspar often shows fibrous textures  
46 indicative for crystallization from a melt. Minor phases include silica, FeS, chromite, and  
47 ilmenite. No metallic iron has been found.

48 **Geochemistry:** low-Ca pyroxene:  $\text{Fs}_{61.5\pm 1.6}\text{Wo}_{2.7\pm 0.6}$  ( $\text{Fs}_{60.5-65.6}\text{Wo}_{1.9-3.7}$ ,  $n=14$ ,  $\text{FeO/MnO}=26-$   
49 29); Ca-pyroxene:  $\text{Fs}_{25.8\pm 2.5}\text{Wo}_{43.8\pm 0.7}$  ( $\text{Fs}_{23.4-32.6}\text{Wo}_{42.1-44.6}$ ,  $n=16$ ,  $\text{FeO/MnO}=25-31$ ); calcic  
50 plagioclase:  $\text{An}_{89.5\pm 0.8}$  ( $\text{An}_{87.9-91.0}$ ,  $n=14$ )  
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56 **Northwest Africa 13472** (NWA 13472)

57 Mauritania

58 Find: 2018

59 Classification: Ordinary chondrite (LL4-6)  
60

**History:** Collected by a nomad in an undetermined place in northern Mauritania during 2018. Purchased by Geologist Juan Avilés Poblador in Spring 2019 on behalf of the University of Alicante (Earth Sciences Department, Laboratory of Applied Petrology).

**Physical characteristics:** The single, 814 g stone has a tan colour and is partially covered by a dark fusion crust. Cut surfaces reveal a brecciated texture, including clasts up to ~3 cm across.

**Petrography:** (C. Herd, *UAb*) Optical and microprobe examination of a polished thin section shows two ~10 mm wide equilibrated clasts in a matrix of well-delineated chondrules. Minor iron staining is present. Olivine in the matrix has sharp optical extinction with  $<2^\circ$  angular variation (S1); in the clasts it has weak mosaicism and planar fractures (S4).

**Geochemistry:** (C. Herd and A. Locock, *UAb*) Data obtained by EMP examination of carbon-coated thin section: Olivine  $\text{Fa}_{29.3\pm 0.9}$  (n=144); Low-Ca Pyroxene  $\text{Fs}_{24.1\pm 0.8}\text{Wo}_{1.3\pm 0.5}$  (n=64).

**Classification:** Ordinary chondrite, LL4-6

**Specimens:** Type specimen of 46.9 g, including one thin section, is at *UAb*. Main mass at *UAlic*.

#### Northwest Africa 13473 (NWA 13473)

(Northwest Africa)

Purchased: 2018 Dec

Classification: Ordinary chondrite (H4)

**History:** Purchased by Mbark Arjdal in December 2018 from a dealer in Timbuktu, Mali.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Well-formed, relatively small equilibrated chondrules are set in a relatively coarse grained, recrystallized matrix containing kamacite (extensively altered to Fe hydroxides), merrillite and troilite (partially altered).

**Geochemistry:** Olivine ( $\text{Fa}_{19.0\pm 0.2}$ , range  $\text{Fa}_{18.7-19.1}$ , N = 5), low-Ca pyroxene ( $\text{Fs}_{16.6\pm 0.2}\text{Wo}_{1.6\pm 1.3}$ , range  $\text{Fs}_{16.4-16.6}\text{Wo}_{1.0-3.9}$ , N = 5), clinopyroxene ( $\text{Fs}_{7.8\pm 0.6}\text{Wo}_{37.8\pm 2.6}$ , range  $\text{Fs}_{7.3-8.5}\text{Wo}_{35.2-40.3}$ , N = 3).

**Classification:** Ordinary chondrite (H4).

**Specimens:** 17.5 g including one polished thin section at *UWB*; remainder with Mr. M. Arjdal.

#### Northwest Africa 13474 (NWA 13474)

Morocco

Purchased: 2020 Mar

Classification: Martian meteorite (Shergottite)

**History:** Purportedly found in southern Morocco and purchased in Tindouf, Algeria in March 2020. David Lehman is the American agent for the owners.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Coarse grained assemblage of predominantly twinned pyroxene (low-Ca pyroxene, pigeonite and subcalcic augite) and olivine (exhibiting very limited zoning, some grains enclosed in pyroxene) together with interstitial maskelynite (~15 vol.%, some with a curvilinear lath-like habit). Accessory phases include chromite (with variable Ti/Cr), ilmenite, merrillite, pyrrhotite, pentlandite and rare baddeleyite. Melt inclusions surrounded by subradial re-expansion cracks are common in olivine grains, and have rims of aluminous clinopyroxene enclosing assemblages of K-Na-rich feldspathic glass, plagioclase, chlorapatite needles, Fe-Ni sulfides and ilmenite.

**Geochemistry:** Olivine ( $\text{Fa}_{43.0-45.6}$ ,  $\text{FeO/MnO} = 51-53$ , N = 6), low-Ca pyroxene ( $\text{Fs}_{24.6-25.6}\text{Wo}_{3.5-6.4}$ ,  $\text{FeO/MnO} = 28-31$ , N = 5), pigeonite ( $\text{Fs}_{27.3-35.1}\text{Wo}_{9.2-12.2}$ ,  $\text{FeO/MnO} = 27-31$ , N =

6), subcalcic augite ( $\text{Fs}_{17.4-20.3}\text{Wo}_{35.1-35.5}$ ,  $\text{FeO/MnO} = 27$ ,  $N = 3$ ), maskelynite ( $\text{An}_{48.2-55.7}\text{Or}_{1.7-2.6}$ ,  $N = 3$ ).

**Classification:** Shergottite (olivine gabbroic).

**Specimens:** 20.3 g including one polished thin section at *UWB*; remainder with Mr. D. Lehman.

#### Northwest Africa 13475 (NWA 13475)

(Northwest Africa)

Purchased: 2019 May

Classification: Ordinary chondrite (L5, melt breccia)

**History:** Purchased by John Higgins in May 2019 from a Mauritanian dealer.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Breccia consisting of equilibrated Type 5 clasts (largely recrystallized with sparse chondrules) set in a sparse fine grained matrix (~10 vol.%), portions of which exhibit melt textures (notably tiny sulfide-metal composite spherules). Accessory phases include albitic plagioclase, troilite, kamacite, taenite, low-Ti chromite and merrillite.

**Geochemistry:** Olivine ( $\text{Fa}_{24.7\pm 0.5}$ , range  $\text{Fa}_{23.9-25.2}$ ,  $N = 5$ ), low-Ca pyroxene ( $\text{Fs}_{21.1\pm 0.21}\text{Wo}_{1.5\pm 0.3}$ , range  $\text{Fs}_{21.0-21.3}\text{Wo}_{1.0-1.7}$ ,  $N = 5$ ), clinopyroxene ( $\text{Fs}_{8.8\pm 2.3}\text{Wo}_{44.3\pm 1.6}$ , range  $\text{Fs}_{6.9-8.2}\text{Wo}_{44.5-45.8}$ ,  $N = 2$ ).

**Classification:** Ordinary chondrite (L5 melt breccia).

**Specimens:** 164 g including one polished thin section at *UWB*; remainder with Mr. J. Higgins.

#### Northwest Africa 13476 (NWA 13476)

(Northwest Africa)

Purchased: 2020 Aug

Classification: Ureilite

**History:** Purchased by John Divilbiss in August 2020 from Matthew Stream, who acquired it from a Moroccan dealer.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Protogranular aggregate of olivine (~70 vol.%) and low-Ca pyroxene (~30 vol.%). Olivine exhibits reduced, more magnesian rims associated with very fine grained Fe metal (some containing small granules of schreibersite). Accessory phases identified include graphite, troilite and Cr-troilite. The presence of microdiamond is also inferred from the extreme difficulty in cutting this specimen (the owner reported that several diamond saw blades were severely damaged in attempts to remove the type material).

**Geochemistry:** Olivine (cores  $\text{Fa}_{18.5\pm 0.1}$ ,  $N = 4$ ; rims  $\text{Fa}_{3.1-5.7}$ ,  $N = 4$ ), low-Ca pyroxene ( $\text{Fs}_{16.1\pm 0.1}\text{Wo}_{4.8\pm 0.1}$ ,  $N = 5$ ;  $\text{Fs}_{9.2}\text{Wo}_{6.2}$ ).

**Classification:** Ureilite.

**Specimens:** 22.4 g including one polished thin section at *UWB*; remainder with Mr. J. Divilbiss.

#### Northwest Africa 13477 (NWA 13477)

(Northwest Africa)

Purchased: 2020 Jun

Classification: Carbonaceous chondrite (CO3)

**History:** Purchased by John Higgins in June 2020 from an Algerian dealer.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Abundant well-formed chondrules (apparent diameter  $260 \pm 150$   $\mu\text{m}$ ,  $N = 24$ ) together with subordinate very fine grained CAI and mineral fragments are set in a relatively sparse fine grained matrix ( $\sim 15$  vol.%, orange-brown in thin section) containing troilite, kamacite and taenite.

**Geochemistry:** Olivine ( $\text{Fa}_{21.7 \pm 17.1}$ , range  $\text{Fa}_{2.8-38.8}$ ,  $N = 4$ ;  $\text{Cr}_2\text{O}_3$  in ferroan olivine 0.03-0.46 wt.%, mean  $0.12 \pm 0.15$  wt.%,  $N = 8$ ), low-Ca pyroxene ( $\text{Fs}_{16.6 \pm 0.2}\text{Wo}_{1.6 \pm 1.3}$ , range  $\text{Fs}_{16.4-16.6}\text{Wo}_{1.0-3.9}$ ,  $N = 5$ ), clinopyroxene ( $\text{Fs}_{7.8 \pm 0.6}\text{Wo}_{37.8 \pm 2.6}$ , range  $\text{Fs}_{7.3-8.5}\text{Wo}_{35.2-40.3}$ ,  $N = 3$ ).

**Classification:** Carbonaceous chondrite (CO3).

**Specimens:** 22.4 g including one polished thin section at *UWB*; remainder with Mr. J. Higgins.

### Northwest Africa 13478 (NWA 13478)

(Northwest Africa)

Purchased: 2020 Sep

Classification: Lunar meteorite (feldspathic breccia)

**History:** Purchased by Mark Lyon in September 2020 from a Mauritanian dealer.

**Physical characteristics:** The specimen exhibits whitish to beige, angular mineral clasts set within a dark brown matrix.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Breccia composed of mineral clasts of anorthite, olivine, pigeonite (with ferropigeonite rims) and exsolved pigeonite set in a dark matrix containing kamacite, taenite, troilite, ilmenite, silica polymorph and fayalite, plus minor secondary barite and calcite.

**Geochemistry:** Olivine ( $\text{Fa}_{23.1-43.4}$ ,  $\text{FeO/MnO} = 86-117$ ,  $N = 6$ ), pigeonite ( $\text{Fs}_{19.1-21.1}\text{Wo}_{7.1-11.5}$ ;  $\text{Fs}_{33.5}\text{Wo}_{18.7}$ ;  $\text{FeO/MnO} = 47-56$ ,  $N = 3$ ), ferropigeonite rims ( $\text{Fs}_{60.8-75.7}\text{Wo}_{20.1-23.5}$ ,  $\text{FeO/MnO} = 67-70$ ,  $N = 2$ ), low-Ca pyroxene host ( $\text{Fs}_{46.3}\text{Wo}_{3.5}$ ,  $\text{FeO/MnO} = 63$ ), augite exsolution lamella ( $\text{Fs}_{20.1}\text{Wo}_{43.8}$ ,  $\text{FeO/MnO} = 51$ ), augite host ( $\text{Fs}_{24.6}\text{Wo}_{40.4}$ ,  $\text{FeO/MnO} = 63$ ), low-Ca pyroxene exsolution lamella ( $\text{Fs}_{51.8}\text{Wo}_{4.5}$ ,  $\text{FeO/MnO} = 74$ ), fayalite ( $\text{Fa}_{97.1}$ ,  $\text{FeO/MnO} = 81$ ), anorthite ( $\text{An}_{95.4-97.5}\text{Or}_{0.1-0.3}$ ,  $N = 4$ ).

**Classification:** Lunar (feldspathic breccia).

**Specimens:** 13.5 g including one polished slice at *UWB*; remainder with Mr. M. Lyon.

### Northwest Africa 13479 (NWA 13479)

(Northwest Africa)

Purchased: 2020 Aug

Classification: Carbonaceous chondrite (C2, ungrouped)

**History:** Purchased by Rachid Chaoui in August 2020 from a Mauritanian dealer.

**Petrography:** (A. Irving, *UWS*, P. Carpenter, *WUSL*; L. Garvie, *ASU*) Small, well-formed chondrules (apparent diameter  $250 \pm 210$   $\mu\text{m}$ ,  $N = 23$ ) and sparse very fine grained, amoeboid CAI are set within a very fine grained matrix ( $\sim 65$  vol.%, opaque in thin section). Phases identified by EPMA include kamacite (as droplets and separated grains), Fe and Fe-Ni sulfides (typically intergrown and altered), an  $\text{Fe}_2\text{O}_3$  oxide phase, and an apparently hydrous, Fe-rich silicate phase with bladed morphology. Powder X-ray diffraction confirms the presence of phyllosilicates, tochilinite, regularly interstratified tochilinite/cronstedtite and maghemite, plus minor calcite and dolomite.

**Geochemistry:** Olivine ( $\text{Fa}_{24.1 \pm 14.4}$ , range  $\text{Fa}_{1.0-44.7}$ ,  $N = 5$ ;  $\text{Cr}_2\text{O}_3$  in ferroan olivine 0.27-0.53 wt.%, mean wt.%, sd wt.%,  $N = 7$ ), low-Ca pyroxene ( $\text{Fs}_{3.2 \pm 2.8}\text{Wo}_{2.5 \pm 2.3}$ , range  $\text{Fs}_{0.8-6.2}\text{Wo}_{0.8-5.6}$ ,  $N = 4$ ), clinopyroxene ( $\text{Fs}_{5.1 \pm 0.1}\text{Wo}_{35.0 \pm 0.4}$ , range  $\text{Fs}_{5.0-5.1}\text{Wo}_{34.7-35.2}$ ,  $N = 2$ ). Oxygen isotopes (K. Ziegler, *UNM*): analyses of acid-washed subsamples by laser fluorination gave,



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2  
3 respectively,  $\delta^{17}\text{O}$  -8.313, -7.758, -7.724;  $\delta^{18}\text{O}$  -4.447, -2.727, -3.473;  $\Delta^{17}\text{O}$  -5.966, -6.318, -  
4 5.890 per mil (all data linearized).

5 **Classification:** Carbonaceous chondrite (C2 ungrouped). The presence of phyllosilicates and  
6 tochilinite establishes this specimen as a C2 chondrite, yet its oxygen isotopic composition  
7 plots far from the established array for CM2 chondrites (to much more  $^{16}\text{O}$ -rich  
8 compositions) and even further from values for CR2 chondrites. Although the oxygen isotopic  
9 composition is close to those for a few CV chondrites, an affinity to CV or CK chondrites is  
10 excluded on other grounds (notably the relatively small mean chondrule size and absence of  
11 Cr-magnetite). Chondrule sizes are within the range for CO chondrites, but oxygen isotopes  
12 plot well below the array for CO chondrites (to more negative  $\Delta^{17}\text{O}$  values). The presence of  
13 maghemite is an additional anomalous feature.

14 **Specimens:** 6.1 g including one polished thin section at *UWB*; remainder with Mr. R. Chaoui.  
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19 **Northwest Africa 13480** (NWA 13480)

20 (Northwest Africa)

21 Purchased: 2020 Sep

22 Classification: HED achondrite (Eucrite, monomict)

23 **History:** Purchased by Terry *Boudreaux* in September 2020 from a dealer in Zagora,  
24 Morocco.

25 **Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Very fresh specimen composed of  
26 gabbroic eucrite clasts with subophitic textures set within a finer grained, metamorphic-  
27 textured recrystallized matrix. The major phases are exsolved pigeonite and anorthite  
28 accompanied by accessory ilmenite (some associated with small grains of zircon), Ti-  
29 chromite, low-Ti chromite and minor olivine (as inclusions in low-Ca pyroxene). The host  
30 phase in exsolved pyroxene grains is pigeonite rather than orthopyroxene and exsolution  
31 lamellae are subcalcic augite.

32 **Geochemistry:** Pigeonite ( $\text{Fs}_{48.4-51.5}\text{Wo}_{5.1-7.3}$ ,  $\text{FeO/MnO} = 33-35$ ,  $N = 6$ ), subcalcic augite  
33  $\text{Fs}_{26.1-29.7}\text{Wo}_{32.9-39.8}$ ,  $\text{FeO/MnO} = 30-33$ ,  $N = 4$ ), olivine ( $\text{Fa}_{62.6-63.3}$ ,  $\text{FeO/MnO} = 53-54$ ,  $N = 2$ ),  
34 anorthite ( $\text{An}_{91.6-92.3}\text{Or}_{0.2-0.3}$ ,  $N = 4$ ).

35 **Classification:** Eucrite (monomict gabbroic breccia, recrystallized).

36 **Specimens:** 37.1 g including one polished thin section at *UWB*; remainder with Mr.  
37 T. *Boudreaux*.  
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43 **Northwest Africa 13481** (NWA 13481)

44 (Northwest Africa)

45 Purchased: 2014 Jan

46 Classification: Ordinary chondrite (H4)

47 **History:** Purchased in Rissani by Pierre-Marie Pelé

48 **Petrography:** (J. Gattacceca, *CEREGE*) Chondrite with packed well-delineated chondrules  
49 with average apparent diameter  $640 \pm 260 \mu\text{m}$  ( $n=27$ ). Opaque minerals are metal and troilite.

50 **Classification:** Ordinary chondrite (H4).

51 **Specimens:** Type specimen at *CEREGE*. Main mass with Pierre-Marie Pelé.  
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56 **Northwest Africa 13482** (NWA 13482)

57 Algeria

58 Find: 2019 Sep

59 Classification: CK5-6  
60

**History:** Found in Algeria close to Ouargla

**Physical characteristics:** Crusted stone. Cut surface reveals two fine-grained lithologies: a black one and a gray one.

**Petrography:** (J. Gattacceca, *CEREGE*) Carbonaceous with two distinct lithologies: one with a petrographic type 5, the other highly recrystallized, type 6 or possibly type 7, with no relict chondrules and triple junctions with euhedral olivine (100  $\mu\text{m}$ ), plagioclase (60  $\mu\text{m}$ ), and Cr-magnetite (20  $\mu\text{m}$ ). Olivine is the dominant mineral. Opaque minerals are Cr-rich magnetite and sulfides.

**Geochemistry:** Type 5 lithology: olivine  $\text{Fa}_{34.1\pm 0.5}$ ,  $\text{NiO} = 0.63\pm 0.08$  wt% (n=3), Ca-pyroxene  $\text{Fs}_{16.5}\text{Wo}_{47.3}$  (n=1). Type 6 lithology: olivine  $\text{Fa}_{37.5\pm 0.4}$ ,  $\text{NiO} = 0.84\pm 0.26$  (n=4), magnetite  $\text{Cr}_2\text{O}_3 = 6.90$  wt%.

**Classification:** Carbonaceous chondrite (CK5-6).

**Specimens:** Type specimen at *CEREGE*. Main mass with Jérémy Bassemon.

#### Northwest Africa 13483 (NWA 13483)

Algeria

Find: 2019

Classification: Carbonaceous chondrite (CK5)

**History:** Purchased from a dealer in Morocco

**Physical characteristics:** Crusted stones. Cut surface reveal a dark gray interior with a lighter angular lighter clast.

**Petrography:** (J. Gattacceca, *CEREGE*) Recrystallized chondrite. Opaques minerals: magnetite, sulfides. The matrix is recrystallized, with plagioclase average size below 50  $\mu\text{m}$ .

**Geochemistry:** Olivine  $\text{Fa}_{32.2\pm 1.1}$ ,  $\text{NiO} 0.58\pm 0.13$  wt% (n=3). Low-Ca pyroxene  $\text{Fs}_{23.2}\text{Wo}_{3.5}$  (n=1). Magnetite  $\text{Cr}_2\text{O}_3$  6.0 wt%.

**Classification:** Carbonaceous chondrite (CK5).

**Specimens:** Type specimen at *CEREGE*. Main mass with Isabelle Pothier.

#### Northwest Africa 13484 (NWA 13484)

(Northwest Africa)

Find: 2017

Classification: Lunar meteorite (feldspathic breccia)

**Physical characteristics:** Greyish fragments.

**Petrography:** (J. Gattacceca, *CEREGE*) Brecciated igneous rock with fractured mineral clasts to 300  $\mu\text{m}$  set in a glassy mesostasis of feldspathic composition. The mesostasis has abundant ~20  $\mu\text{m}$  vesicles. FeNi metal is present as ~10  $\mu\text{m}$  grains.

**Geochemistry:** Olivine  $\text{Fa}_{32.9}$ ,  $\text{FeO/MnO} = 144$  (n=1). Pyroxene : low-Ca pyroxene  $\text{Fs}_{23.7}\text{Wo}_{5.5}$  (n=2), Ca-pyroxene  $\text{Fs}_{22.1}\text{Wo}_{33.8}$  (n=1),  $\text{FeO/MnO} = 50.3\pm 5.7$  (n=3). Mesostasis  $\text{An}_{94.9}\text{Ab}_{4.9}\text{Or}_{0.2}$  (n=3).

**Classification:** Achondrite (lunar, feldspathic breccia)

**Specimens:** Type specimen at *CEREGE*. Main mass with J. Bassemon.

#### Northwest Africa 13485 (NWA 13485)

Algeria

Find: 2019

Classification: HED achondrite (Eucrite, unbrecciated)

**History:** Found in Algeria close to Ouargla

**Physical characteristics:** Partially crusted stones (the largest one 545 g). Interior is fine-grained and gray, with visible plagioclase crystals.

**Petrography:** (J. Gattacceca, *CEREGE*) Fractured but unbrecciated igneous rock with subophitic texture. Main minerals are zoned pyroxene (with  $\mu\text{m}$  scale rim enriched in iron) and plagioclase.

**Geochemistry:** Pyroxene: low-Ca pyroxene  $\text{Fs}_{41.1\pm 8.4}\text{Wo}_{6.9\pm 1.5}$  (n=5), Ca-pyroxene  $\text{Fs}_{47.3}\text{Wo}_{21.2}$ ,  $\text{Fs}_{61.0}\text{Wo}_{31.4}$ , overall pyroxene  $\text{FeO/MnO } 29.9\pm 3.0$  (n=7). Plagioclase  $\text{An}_{91.0}\text{Ab}_{8.7}\text{Or}_{0.3}$  (n=2).

**Classification:** Achondrite (eucrite-unbr)

**Specimens:** Type specimen at *CEREGE*. Main mass with J. Bassemon.

#### Northwest Africa 13486 (NWA 13486)

Algeria

Find: 2019

Classification: Martian meteorite (Shergottite)

**Physical characteristics:** Light grey relatively coarse crystalline rock.

**Petrography:** (J. Gattacceca, *CEREGE*) Igneous rock with doleritic texture. Main minerals are zoned pyroxene and maskelynite, with grain size  $\sim 500 \mu\text{m}$ . Other minerals: silica polymorph ( $100 \mu\text{m}$ ), Fe-Ti oxides ( $100 \mu\text{m}$ ).

**Geochemistry:** Pyroxene  $\text{Fs}_{38.4\pm 11.4}\text{Wo}_{19.1\pm 7.3}$ ,  $\text{FeO/MnO} = 32.6\pm 3.4$  (n=6). Plagioclase  $\text{An}_{61.3}\text{Ab}_{38.3}\text{Or}_{0.4}$  (n=2).

**Classification:** Achondrite (shergottite).

**Specimens:** Type specimen at *CEREGE*. Main mass with J. Bassemon.

#### Northwest Africa 13487 (NWA 13487)

(Northwest Africa)

Purchased: 2019 Jun

Classification: Mesosiderite

**History:** Bought in Ensisheim in June 2019 from Norddine Azelmat.

**Physical characteristics:** A dark brown irregular stone.

**Petrography:** (J. Gattacceca, *CEREGE*) Brecciated rock with a silicate fraction composed of plagioclase and low-Ca pyroxene (typical size  $200 \mu\text{m}$ ), and less abundant Ca-pyroxene. Abundant contorted multi-mm sized metal grains ( $\sim 30 \text{ vol}\%$ ). Other minerals: troilite, merrillite,  $\text{SiO}_2$ .

**Geochemistry:** Pyroxene  $\text{Fs}_{31.3\pm 0.1}\text{Wo}_{2.2\pm 0.1}$ ,  $\text{FeO/MnO} = 24.1$  (n=2). Plagioclase  $\text{An}_{91.6}\text{Ab}_{8.2}\text{Or}_{0.3}$  (n=2).

**Classification:** Mesosiderite.

**Specimens:** Type specimen at *CEREGE*. Main mass with Jean Redelsperger.

#### Northwest Africa 13488 (NWA 13488)

Tarfaya, Morocco

Purchased: 2020

Classification: Carbonaceous chondrite (CK6)

**History:** Bought from Abdellah Afiniss in Agadir in 2020.

**Physical characteristics:** Three crusted fitting pieces forming a single full crusted stone. Cut surface reveals a dark-gray interior with large chondrules.

**Petrography:** (J. Gattacceca, *CEREGE*) Recrystallized chondrite with plagioclase average size above 50  $\mu\text{m}$ . Main opaque mineral is Cr-rich magnetite.

**Geochemistry:** Olivine  $\text{Fa}_{29.8\pm 0.0}$ , NiO 0.40 wt% (n=3). Magnetite has 3.8 wt%  $\text{Cr}_2\text{O}_3$ .

**Classification:** Carbonaceous chondrite (CK6).

**Specimens:** Type specimen at *CEREGE*. Main mass with Jean Redelsperger.

#### Northwest Africa 13489 (NWA 13489)

(Northwest Africa)

Purchased: 2019 May

Classification: Primitive achondrite (Brachinite)

**Physical characteristics:** Multiple fragments, some with fusion crust

**Petrography:** (J. Gattacceca, *CEREGE*) Granulitic texture. Main minerals are olivine (dominant, grain size 300  $\mu\text{m}$ ), Ca- pyroxene (typical size 200  $\mu\text{m}$ ), plagioclase (typical size 300  $\mu\text{m}$ ). Other minerals: troilite (to 300  $\mu\text{m}$ ), chromite (to 100  $\mu\text{m}$ , with lobate contacts in plagioclase), rare metal as  $\mu\text{m}$ -sized grains within silicates. No low-Ca pyroxene was observed.

**Geochemistry:** Olivine  $\text{Fa}_{32.5\pm 0.2}$ ,  $\text{FeO/MnO}=74.4\pm 8.7$  (n=7). Ca-pyroxene  $\text{Fs}_{11.3\pm 0.3}\text{Wo}_{44.0\pm 0.2}$ ,  $\text{FeO/MnO}=44.6\pm 7.2$  (n=7). Plagioclase  $\text{An}_{34.9}\text{Ab}_{62.2}\text{Or}_{2.9}$  (n=4). Chromite Cr# 0.74 (n=2).

**Classification:** Achondrite (brachinite)

**Specimens:** Type specimen at *CEREGE*. Main mass with *Kuntz*.

#### Northwest Africa 13490 (NWA 13490)

(Northwest Africa)

Purchased: 2019 Oct

Classification: Carbonaceous chondrite (CO3)

**Petrography:** (J. Gattacceca, *CEREGE*) Chondrite with small chondrules (average apparent diameter  $\sim 200$   $\mu\text{m}$ ) and small CAIs set in abundant matrix ( $\sim 30$  vol%). Opaque minerals are metal, troilite and magnetite.

**Geochemistry:** Olivine  $\text{Fa}_{24.9\pm 13.9}$ , Fa PMD 49% (n=14).  $\text{Cr}_2\text{O}_3$  in ferroan olivine  $0.11\pm 0.10$  wt% (n=11). Low-Ca pyroxene  $\text{Fs}_{4.3\pm 1.2}\text{Wo}_{1.5\pm 0.0}$  (n=3).

**Classification:** Carbonaceous chondrite (CO3). Estimated subtype 3.2-3.5 based on Fa PMD and  $\text{Cr}_2\text{O}_3$  content of ferroan olivine.

**Specimens:** Type specimen at *CEREGE*. Main mass with *Kuntz*.

#### Northwest Africa 13491 (NWA 13491)

(Northwest Africa)

Purchased: 2019 Oct

Classification: Carbonaceous chondrite (CO3)

**History:** Bought from a dealer from northwest Africa.

**Petrography:** (J. Gattacceca, *CEREGE*) Chondrite with small chondrules (average apparent diameter  $180\pm 80$   $\mu\text{m}$ , n=21) and small CAIs set in abundant matrix (38vol% by point counting, n=105). Opaque minerals are metal, troilite and magnetite.

**Geochemistry:** Olivine  $\text{Fa}_{20.2\pm 13.7}$ , Fa PMD 61% (n=8).  $\text{Cr}_2\text{O}_3$  in ferroan olivine  $0.16\pm 0.07$  wt% (n=7). Low-Ca pyroxene  $\text{Fs}_{134}\text{Wo}_{4.9}$  (n=1).

#### Northwest Africa 13492 (NWA 13492)

(Northwest Africa)

Purchased: 2019 Oct

Classification: HED achondrite (Eucrite)

**History:** Bought from a dealer from northwest Africa.

**Petrography:** (J. Gattacceca, *CEREGE*) Brecciated igneous rock with mostly subophitic texture. Grain size is ~1.5 mm grain size although some clasts have smaller grain size. Main minerals are low-Ca pyroxene (exsolved) and plagioclase. Other minerals: silica polymorph (to 100  $\mu\text{m}$ ), ilmenite, troilite, metal.

**Geochemistry:** Low-Ca pyroxene  $\text{Fs}_{65.5\pm 1.9}\text{Wo}_{2.2\pm 0.5}$ ,  $\text{FeO/MnO} = 31.3\pm 0.8$  (n=5). Plagioclase  $\text{An}_{87.0}\text{Ab}_{12.6}\text{Or}_{0.4}$  (n=2).

**Classification:** Achondrite (eucrite). The low-Ca pyroxene is unusually iron rich ( $\text{Fs}_{65.6}$ ).

### Northwest Africa 13493 (NWA 13493)

(Northwest Africa)

Purchased: 2019 Oct

Classification: HED achondrite (Eucrite)

**History:** Bought from a dealer from northwest Africa.

**Petrography:** (J. Gattacceca, *CEREGE*) Igneous rock with doleritic texture. Grain size ~500  $\mu\text{m}$ . Main minerals are low-Ca pyroxene (exsolved) and plagioclase. Other minerals: ilmenite, metal, silica polymorph.

**Geochemistry:** Low-Ca pyroxene  $\text{Fs}_{60.0\pm 0.9}\text{Wo}_{2.1\pm 0.1}$ ,  $\text{FeO/MnO} = 33.1\pm 1.4$  (n=3). Plagioclase  $\text{An}_{88.3}\text{Ab}_{11.2}\text{Or}_{0.5}$  (n=2).

**Classification:** Achondrite (eucrite).

### Northwest Africa 13494 (NWA 13494)

(Northwest Africa)

Purchased: 2020 Jan

Classification: HED achondrite (Eucrite)

**Petrography:** (J. Gattacceca, *CEREGE*) Brecciated igneous rock with subophitic texture. Main minerals are pyroxene (exsolved) and maskelynite with typical size 250  $\mu\text{m}$ . Some clasts have smaller grain size. Other minerals: chromite, ilmenite, troilite, metal, silica polymorph.

**Geochemistry:** Low-Ca pyroxene  $\text{Fs}_{63.9\pm 1.8}\text{Wo}_{3.1\pm 1.5}$ ,  $\text{FeO/MnO} = 32.5\pm 1.5$  (n=5). Maskelynite  $\text{An}_{88.6}\text{Ab}_{11.3}\text{Or}_{0.2}$ .

**Classification:** Achondrite (eucrite).

### Northwest Africa 13495 (NWA 13495)

(Northwest Africa)

Purchased: 2020 Feb

Classification: Carbonaceous chondrite (CO3)

**Petrography:** (J. Gattacceca, *CEREGE*) Chondrite with small chondrules (average apparent diameter  $160\pm 80$   $\mu\text{m}$ , n=23) and CAIs (to 300  $\mu\text{m}$ ) set in an abundant fine-grained iron-rich matrix (42 vol% by point counting). Opaque are metal and troilite.

**Geochemistry:** Olivine  $\text{Fa}_{23.9\pm 16.3}$ , range  $\text{Fa}_{1.4-50.0}$ ,  $\text{Fa PMD} = 61\%$ ,  $\text{Cr}_2\text{O}_3$  0.14 $\pm$ 0.10 wt% (n=25). Low-Ca pyroxene  $\text{Fs}_{3.4\pm 1.9}\text{Wo}_{2.2\pm 0.9}$  (n=3).

**Classification:** Carbonaceous chondrite (CO3). Estimated subtype 3.2-3.5 based on  $\text{Fa PMD}$  and  $\text{Cr}_2\text{O}_3$  content of ferroan olivine.



**Northwest Africa 13496** (NWA 13496)

(Northwest Africa)

Purchased: 2020 Feb

Classification: Mesosiderite

**Petrography:** (J. Gattacceca, *CEREGE*) Igneous rock with pyroxene dominant over plagioclase. Typical grain size 500  $\mu\text{m}$ . Abundant metal as mm-sized contorted grains, and  $\mu\text{m}$ -sized inclusions in silicates. Other minerals: troilite to 100  $\mu\text{m}$ , silica polymorph to 50  $\mu\text{m}$ , chromite.

**Geochemistry:** Low-Ca pyroxene  $\text{Fs}_{34.8\pm 0.3}\text{Wo}_{2.9\pm 0.2}$ ,  $\text{FeO/MnO} = 24.7\pm 0.6$  (n=3). Plagioclase  $\text{An}_{89.8}\text{An}_{10.0}\text{Or}_{0.2}$  (n=2).

**Classification:** Mesosiderite.

**Northwest Africa 13497** (NWA 13497)

(Northwest Africa)

Purchased: 2020 Feb

Classification: HED achondrite (Eucrite)

**Petrography:** (J. Gattacceca, *CEREGE*) Igneous rock with subophitic texture. Typical grain size  $\sim 500$  (up to 1.5 mm). Main minerals are pyroxene (some exsolved) and plagioclase. Other minerals: chromite, ilmenite, rare metal, troilite.

**Geochemistry:** Pyroxenes: low-Ca pyroxene  $\text{Fs}_{41.3\pm 0.8}\text{Wo}_{4.0\pm 1.3}$ ,  $\text{FeO/MnO} = 28.9\pm 2.2$  (n=4). Plagioclase  $\text{An}_{92.7}\text{Ab}_{6.9}\text{Or}_{0.4}$  (n=1).

**Classification:** Achondrite (eucrite).

**Northwest Africa 13498** (NWA 13498)

(Northwest Africa)

Purchased: 2020 Feb

Classification: Ordinary chondrite (L3)

**Petrography:** (J. Gattacceca, *CEREGE*) Chondrite with large, packed, and imbricated chondrules ( $\sim 700$   $\mu\text{m}$ ). Opaque minerals are metal and troilite.

**Geochemistry:** Olivine  $\text{Fa}_{17.6\pm 7.8}$ , range  $\text{Fa}_{4.2-36.9}$ ,  $\text{Fa PMD} = 33\%$ ,  $\text{Cr}_2\text{O}_3$   $0.12\pm 0.17$  wt% (n=17). low-Ca pyroxene  $\text{Fs}_{11.2\pm 7.1}\text{Wo}_{0.9\pm 0.8}$ , range  $\text{Fs}_{2.1-25.8}$  (n=13).

**Classification:** Ordinary chondrite (L3). Texture reminiscent of "cluster chondrites". L group based on magnetic susceptibility and chondrule size. Estimated subtype 3.2-3.5 based on  $\text{Fa PMD}$  and  $\text{Cr}_2\text{O}_3$  content of ferroan olivine.

**Northwest Africa 13499** (NWA 13499)

Algeria

Purchased: 2020 Jan

Classification: HED achondrite (Eucrite)

**Petrography:** (J. Gattacceca, *CEREGE*) Igneous rock with subophitic texture. Main minerals are pyroxene (exsolved) and plagioclase with typical grain size 600  $\mu\text{m}$ . Other minerals: metal, troilite, chromite, ilmenite. Vesicles up to 200  $\mu\text{m}$  are present.

**Geochemistry:** Low-Ca pyroxene  $\text{Fs}_{42.9\pm 0.9}\text{Wo}_{3.7\pm 0.9}$  (n=7), Ca-pyroxene  $\text{Fs}_{25.0}\text{Wo}_{35.5}$  (n=2),  $\text{Fs}_{16.5}\text{Wo}_{44.9}$  (n=2),  $\text{FeO/MnO} = 27.8\pm 2.0$  (n=11). Plagioclase  $\text{An}_{92.2\pm 0.5}\text{Ab}_{7.5\pm 0.4}\text{Or}_{0.4\pm 0.0}$  (n=4).

**Classification:** Achondrite (eucrite).

**Northwest Africa 13500** (NWA 13500)

(Northwest Africa)

Purchased: 2020 Jan

Classification: Ordinary chondrite (L(LL)3)

**Petrography:** (J. Gattacceca, *CEREGE*) Chondrite with "cluster chondrite" texture [Metzler K., 2015, MAPS 47:2193-2217]. Average apparent chondrule diameter  $720 \pm 300 \mu\text{m}$  (n=34).**Geochemistry:** Olivine  $\text{Fa}_{16.9 \pm 10.6}$ , range  $\text{Fa}_{4.5-36.7}$ , Fa PMD = 56%,  $\text{Cr}_2\text{O}_3$   $0.09 \pm 0.13 \text{ wt}\%$  (n=14). Low-Ca pyroxene  $\text{Fs}_{14.8 \pm 7.7}\text{Wo}_{1.5 \pm 1.5}$  (n=5).**Classification:** Ordinary chondrite L(LL)3. The L group is favored based on magnetic susceptibility, but neither chondrule size nor magnetic susceptibility can exclude the LL classification. Hence the L(LL) classification. Estimated subtype 3.2-3.5 based on Fa PMD and the  $\text{Cr}_2\text{O}_3$  content of ferroan olivine.**Northwest Africa 13501** (NWA 13501)

(Northwest Africa)

Purchased: 2016 Apr

Classification: Ordinary chondrite (H3.10)

**Petrography:** (J. Gattacceca, *CEREGE*) Chondrite with well-defined, packed chondrules. Chondrule average apparent diameter  $400 \pm 270 \mu\text{m}$  (n=44). Olivine are zoned compositionally. Opaques are metal and troilite.**Geochemistry:** Olivine  $\text{Fa}_{11.2 \pm 10.1}$ , Fa PMD = 76% (n=12),  $\text{Cr}_2\text{O}_3$  in ferroan olivine  $0.38 \pm 0.21 \text{ wt}\%$  (n=10). Low-Ca pyroxene  $\text{Fs}_{8.3}\text{Wo}_{1.1}$  (n=2).**Classification:** Ordinary chondrite. H group based on magnetic susceptibility interpreted in the light of weathering grade and chondrule size. Subtype based on  $\text{Cr}_2\text{O}_3$  content of ferroan olivine.**Specimens:** Type specimen at *CEREGE*. Main mass with *Kuntz*.**Northwest Africa 13502** (NWA 13502)

(Northwest Africa)

Purchased: 2019 Oct

Classification: Ordinary chondrite (H6)

**Petrography:** (J. Gattacceca, *CEREGE*) Highly recrystallized ordinary chondrite. Plagioclase up to  $150 \mu\text{m}$ . Chromite to  $100 \mu\text{m}$ .**Geochemistry:** Plagioclase  $\text{An}_{12.7}\text{Ab}_{79.9}\text{Or}_{7.5}$  (n=1). Chromite Cr# 0.86.**Specimens:** Type specimen at *CEREGE*. Main mass with *Kuntz*.**Northwest Africa 13503** (NWA 13503)

(Northwest Africa)

Purchased: 2019 Oct

Classification: Carbonaceous chondrite (CK3)

**Physical characteristics:** Dark brown stone. Cut surface shows a dark interior with large chondrules and CAIs set in abundant matrix.**Petrography:** (J. Gattacceca, *CEREGE*) Chondrite with large well-defined chondrules (average apparent diameter  $\sim 750 \mu\text{m}$ ) and CAIs set in abundant fine-grained iron-rich matrix. Opaque are mainly magnetite and sulfides.

**Geochemistry:** Olivine  $\text{Fa}_{21.5\pm 8.3}$ , Fa PMD = 37%, NiO  $0.21\pm 0.18$  wt% (n=6). Ca-pyroxene  $\text{Fs}_{13.0}\text{Wo}_{50.7}$  (n=1). Magnetite has 2.29 wt%  $\text{Cr}_2\text{O}_3$  (n=2).

**Classification:** Carbonaceous chondrite (CK3).

**Specimens:** Type specimen at *CEREGE*. Main mass with *Kuntz*.

#### Northwest Africa 13504 (NWA 13504)

(Northwest Africa)

Purchased: 2019 Oct

Classification: Ordinary chondrite (L3.10)

**History:** Bought from a dealer from northwest Africa.

**Physical characteristics:** Single oriented stone.

**Petrography:** (J. Gattacceca, *CEREGE*) Chondrite with packed large and well-delineated chondrules (average apparent diameter  $730\pm 340$   $\mu\text{m}$ , n=43). Opaque minerals are metal and troilite.

**Geochemistry:** Olivine  $\text{Fa}_{20.2\pm 14.3}$ , Fa PMD = 61% (n=15),  $\text{Cr}_2\text{O}_3$  in ferroan olivine  $0.28\pm 0.21$  wt% (n=14). Low-Ca pyroxene  $\text{Fs}_{14.3\pm 9.9}\text{Wo}_{2.0\pm 2.1}$  (n=16).

**Classification:** Ordinary chondrite L3.10. Likely L group based on magnetic susceptibility interpreted in the light of weathering grade and chondrule size. Subtype based on  $\text{Cr}_2\text{O}_3$  content of ferroan olivine.

**Specimens:** Type specimen at *CEREGE*. Main mass with *Kuntz*.

#### Northwest Africa 13505 (NWA 13505)

(Northwest Africa)

Purchased: 2019 Oct

Classification: Carbonaceous chondrite (CK5)

**History:** Bought from a dealer from northwest Africa.

**Physical characteristics:** Dark brown stone. Cut surface shows a dark interior with large chondrules set in abundant matrix.

**Petrography:** (J. Gattacceca, *CEREGE*) Chondrite with large chondrules (average apparent diameter  $710\pm 300$ , n=12) set in a recrystallized matrix with plagioclase typical size 40  $\mu\text{m}$ . The main opaque phases are Cr-rich magnetite and sulfides. Rare metal.

**Geochemistry:** Olivine  $\text{Fa}_{31.2\pm 0.2}$ , NiO  $0.48\pm 0.08$  wt% (n=6). Ca-pyroxene  $\text{Fs}_{10.8}\text{Wo}_{48.5}$  (n=1). Plagioclase  $\text{An}_{43.6}\text{Ab}_{53.7}\text{Or}_{2.6}$  (n=2). Magnetite has 3.76 wt%  $\text{Cr}_2\text{O}_3$  (n=2).

**Classification:** Carbonaceous chondrite (CK5)

**Specimens:** Type specimen at *CEREGE*. Main mass with *Kuntz*.

#### Northwest Africa 13509 (NWA 13509)

(Northwest Africa)

Purchased: 2018 Sep

Classification: Ordinary chondrite (LL4-6)

**History:** Purchased by John Higgins in September 2018 from a Mauritanian dealer.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Very fresh recrystallized breccia composed of Type 6 lithic clasts (containing rare remnant chondrules) plus large (up to 5 mm in diameter), well-formed, equilibrated discrete chondrules (Type 4) in a fine grained, highly recrystallized matrix containing troilite, pentlandite, taenite and chromite.

**Geochemistry:** Olivine ( $31.2 \pm 0.2$ , range  $\text{Fa}_{30.9-31.5}$ ,  $N = 5$ ), low-Ca pyroxene ( $\text{Fs}_{25.4 \pm 0.1} \text{Wo}_{1.8 \pm 0.3}$ , range  $\text{Fs}_{25.3-25.6} \text{Wo}_{1.3-2.0}$ ,  $N = 5$ ), augite ( $\text{Fs}_{10.5 \pm 0.3} \text{Wo}_{43.7 \pm 0.3}$ , range  $\text{Fs}_{10.2-10.7} \text{Wo}_{43.5-44.1}$ ,  $N = 3$ ).

**Classification:** Ordinary chondrite (LL4-6 breccia, highly recrystallized).

**Specimens:** 45 g including one polished thin section at *UWB*; remainder with Mr. J. Higgins.

#### Northwest Africa 13516 (NWA 13516)

(Northwest Africa)

Purchased: 2020 Sep

Classification: HED achondrite (Eucrite, unbrecciated)

**History:** Purportedly found in the Adrar region, Algeria. Bought from a meteorite dealer in Tindouf, Algeria.

**Physical characteristics:** Isometric individual without fusion crust.

**Petrography** (K. Metzler, *I/P*): Unbrecciated coarse-grained basalt with ophitic to subophitic texture, consisting of about 60% pyroxene and 40% plagioclase. Pyroxene with augite exsolution lamellae (typical width 1-4  $\mu\text{m}$ ). Accessories are a silica polymorph, ilmenite, chromite, and traces of Ni-poor metal.

**Geochemistry:** Mineral compositions and geochemistry: Composition of low-Ca pyroxene:  $\text{Fs}_{55.1 \pm 0.7} \text{Wo}_{3.2 \pm 0.3}$  ( $\text{Fs}_{54.1-56.3} \text{Wo}_{2.7-3.6}$ ); mean Fe/Mn (at.): 33.1;  $n=10$ . Composition of Ca-rich pyroxene (exsolution lamellae):  $\text{Fs}_{25.8 \pm 1.5} \text{Wo}_{39.0 \pm 2.2}$  ( $\text{Fs}_{24.7-29.0} \text{Wo}_{35.1-41.2}$ );  $n=9$ . Composition of plagioclase:  $\text{An}_{88.3 \pm 1.3} \text{Or}_{0.2 \pm 0.3}$  ( $\text{An}_{86.7-90.6} \text{Or}_{0.0-0.5}$ );  $n=10$ .

**Classification:** Unbrecciated eucrite

#### Northwest Africa 13517 (NWA 13517)

(Northwest Africa)

Purchased: 2009 Jun

Classification: Martian meteorite (shergottite)

**History:** Purchased from a Moroccan mineral dealer at the meteorite show in Ensisheim, France

**Physical characteristics:** Subrounded meteorite fragments without fusion crust.

**Petrography:** (K. Metzler, *I/P*) Igneous rock with gabbroic texture, consisting of about 70% pyroxene (grain sizes up to  $\sim 1.5$  mm) and 30% Plagioclase (maskelynite; grain sizes up to  $\sim 2$  mm). Pyroxene shows very thin exsolution lamellae ( $< 1$   $\mu\text{m}$  thickness) and patchy zoning with augitic (mostly pyroxene cores) and pigeonitic (mostly pyroxene rims) compositions. Plagioclase is completely transformed to maskelynite by shock metamorphism. Shock melt pockets are present, showing a swirly pattern of intermingled melts of pyroxene and plagioclase. Faylitic olivine occurs along grain boundaries. Accessories are ilmenite, Cl-apatite, merrillite,  $\text{SiO}_2$ , and small amounts of FeS.

**Geochemistry:** Mineral compositions and geochemistry: Composition of augitic pyroxene areas (mostly pyroxene cores):  $\text{Fs}_{22.3 \pm 0.8} \text{Wo}_{33.4 \pm 1.7}$  ( $\text{Fs}_{21.0-23.7} \text{Wo}_{30.5-37.0}$ ); mean Fe/Mn (at.): 30.4;  $n=12$ . Composition of pigeonitic pyroxene areas (mostly pyroxene rims):  $\text{Fs}_{56.6 \pm 1.6} \text{Wo}_{13.8 \pm 0.7}$  ( $\text{Fs}_{53.3-58.4} \text{Wo}_{12.8-14.9}$ ); mean Fe/Mn (at.): 38.2;  $n=12$ . Composition of olivine:  $\text{Fa}_{85.4 \pm 0.4}$  ( $\text{Fa}_{84.6-85.9}$ );  $n=7$ . Composition of plagioclase (maskelynite):

$\text{An}_{53.9 \pm 3.1} \text{Or}_{1.0 \pm 0.5}$  ( $\text{An}_{46.6-58.2} \text{Or}_{0.3-1.9}$ );  $n=18$ .

**Classification:** Martian (Shergottite)

#### Northwest Africa 13518 (NWA 13518)

(Northwest Africa)

Purchased: 2020 Mar

Classification: Rumuruti chondrite (R4-5)

**History:** Purportedly found in 2019 at the border between Algeria and Mali. Purchased by Mohamed Ali (972 g) and Miguel Angel Contreras (1662 g) from a Saharai dealer in Mauritania in March 2020.

**Physical characteristics:** Many pieces between a few grams and >500 g, some with fusion crust.

**Petrography:** (K. Metzler, *IffP*) Chondritic genomict breccia, consisting of dark host material and light chondritic clasts up to ~2 cm. The host material is of petrologic type 4. It consists of chondrules and chondrule fragments, embedded in recrystallized interchondrule material. Relictic Mg-rich olivine cores can be occasionally observed. The light clasts are strongly metamorphosed and represent type 5 material with clearly recognizable chondrules.

**Geochemistry:** Mineral compositions and geochemistry: Dark host material : Mean olivine composition:  $Fa_{38.7\pm 0.2}$  ( $Fa_{38.4-39.0}$ );  $n=10$ ; mean low-Ca pyroxene composition  $Fs_{19.8\pm 6.7} Wo_{1.0\pm 1.0}$  ( $Fs_{7.6-29.9} Wo_{0.2-2.9}$ );  $n=8$ . Light clast of petrologic type 5: mean olivine composition  $Fa_{38.8\pm 0.3}$  ( $Fa_{38.1-39.2}$ );  $n=8$ ; mean low-Ca pyroxene composition:  $Fs_{29.9\pm 0.4} Wo_{1.3\pm 0.5}$  ( $Fs_{29.1-30.6} Wo_{0.6-2.2}$ );  $n=10$ . Accessories in both lithologies are troilite and pentlandite; no metal was found.

**Classification:** R chondrite based on mineral chemistry. Genomict breccia, consisting of clasts of petrologic type 5 (equilibrated olivine and pyroxene), embedded in host material of petrologic type 4 (equilibrated olivine and unequibrated pyroxene).

### Northwest Africa 13519 (NWA 13519)

(Northwest Africa)

Purchased: 2020

Classification: Ordinary chondrite (L3-5)

**History:** Purchased by Oz Backman in 2020 at the Tucson Gem and Mineral Show from Mohamed Ismaili.

**Physical characteristics:** Single stone with dark-brown fusion crust.

**Petrography:** (D. Sheikh, *FSU*) Sample is an ordinary chondrite genomict breccia containing both equilibrated clasts (type 5) and unequibrated clasts (type 3) set in a fine-grained matrix. Chondrules (Av.  $\sim 700\pm 50$   $\mu m$ ); accessory phases include troilite, chromite with Ti, iron oxides, and secondary recrystallized plagioclase ( $25\pm 5$   $\mu m$ ; only found in equilibrated clasts).

**Geochemistry:** Type 3 olivine ( $Fa_{16.9\pm 6.8}$ , range  $Fa_{10.0-34.3}$ ,  $n=33$ ), Type 5 olivine ( $Fa_{24.5\pm 0.6}$ , range  $Fa_{23.5-25.9}$ ,  $n=32$ ), Type 5 low-Ca pyroxene ( $Fs_{20.9\pm 0.7} Wo_{1.7\pm 0.3}$ , range  $Fs_{19.4-22.5} Wo_{0.9-2.0}$ ,  $n=20$ ).

**Classification:** Ordinary Chondrite (L3-5) Sample is a genomict breccia based on the observation of both type 3 clasts with unequibrated olivine grains and type 5 clasts with equilibrated olivine and low-ca pyroxene grains.

**Specimens:** 20.5 grams at *UCLA*; main mass with Oz Backman.

### Northwest Africa 13520 (NWA 13520)

(Northwest Africa)

Purchased: 2008

Classification: Ordinary chondrite (L(H)3)

**History:** Purchased by Pat Brown in 2008 from an unknown NWA dealer in Tucson, Arizona.

**Physical characteristics:** Single partially-crusted stone; fusion crust is light brown.



**Petrography:** (D. Sheikh, *FSU*) Sample is an ordinary chondrite composed of abundant chondrules (Av.  $850 \pm 100 \mu\text{m}$ ,  $n=30$ ) set in a mostly opaque, slightly fine-grained matrix. Accessory phases include troilite and iron oxides.

**Geochemistry:** Olivine ( $\text{Fa}_{16.9 \pm 6.4}$ , range  $\text{Fa}_{3.4-23.9}$ ,  $n=21$ ),  $\text{Cr}_2\text{O}_3$  in ferroan olivine ( $0.05 \pm 0.03$  wt%, range  $<0.03$  to  $0.13$ ,  $n=18$ ) Low-Ca Pyroxene ( $\text{Fs}_{9.4 \pm 5.4} \text{Wo}_{1.1 \pm 1.2}$ , range  $\text{Fs}_{1.2-17.6} \text{Wo}_{0.1-3.8}$ ,  $n=16$ ).

**Classification:** Ordinary Chondrite (L(H)3)  $\text{Cr}_2\text{O}_3$  in ferroan olivines is  $\sim 0.05$  wt%, suggesting a high type 3 subtype ( $\sim 3.8$ ). While a few olivine grains are centered around  $\text{Fa}_{23}$ , suggesting an L group, the majority of them are FeO-poor compared to L3 chondrites. No olivine grains above  $\text{Fa}_{24}$  were found. Likewise, no low-ca pyroxene grains were found above  $\text{Fs}_{17}$ . The observation of FeO-poor silicates relative to L3 chondrites leads to the L(H)3 classification.

**Specimens:** 28.98 grams at *UCLA*; main mass with Pat Brown.

### Northwest Africa 13521 (NWA 13521)

(Northwest Africa)

Purchased: 2020

Classification: Ordinary chondrite (L5)

**History:** Exported from northwest African source in 2019 by Juan Aviles Poblador in Spain before being acquired by Topher Spinnato at the 2020 Tucson Gem and Mineral Show. Later given to Cameron Smith.

**Physical characteristics:** Single stone with dark-brown fusion crust.

**Petrography:** (D. Sheikh, *FSU*) Sample is an ordinary chondrite composed of few blurred chondrules set in a fine-grained recrystallized matrix containing secondary recrystallized plagioclase ( $35 \pm 10 \mu\text{m}$ ). Accessory phases include Fe-Ni metal, troilite, chromite, and iron oxides.

**Geochemistry:** Olivine ( $\text{Fa}_{24.1 \pm 0.6}$ , range  $\text{Fa}_{22.7-25.0}$ ,  $n=16$ ), Low-Ca pyroxene ( $\text{Fs}_{20.5 \pm 0.5} \text{Wo}_{1.2 \pm 0.2}$ , range  $\text{Fs}_{19.9-21.1} \text{Wo}_{0.9-1.5}$ ,  $n=10$ ).

**Classification:** Ordinary Chondrite (L5)

**Specimens:** 20.2 g at *UCLA*; main mass with Cameron Smith.

### Northwest Africa 13522 (NWA 13522)

Morocco

Find: 2018

Classification: Carbonaceous chondrite (CV3)

**History:** Purchased in 2020 by Matthew Stream from a seller in Morocco.

**Physical characteristics:** Single stone with dark-brown fusion crust.

**Petrography:** (D. Sheikh, *FSU*) Sample is a carbonaceous chondrite composed of abundant chondrules (Av. 1 mm, up to 4 mm), CAIs (Av. 2 mm, up to 6 mm), and isolated mineral fragments set in a mostly opaque, slightly fine-grained matrix. Accessory phases include pentlandite, and magnetite. Magnetite has  $1.0 \pm 0.3$  wt%  $\text{Cr}_2\text{O}_3$ .

**Geochemistry:** Olivine ( $\text{Fa}_{14.0 \pm 20.6}$ , range  $\text{Fa}_{0.5-75.9}$ ,  $n=62$ ), Low-Ca Pyroxene ( $\text{Fs}_{1.4 \pm 0.5} \text{Wo}_{1.0 \pm 0.2}$ , range  $\text{Fs}_{0.6-2.4} \text{Wo}_{0.8-1.5}$ ,  $n=15$ ).

**Classification:** Carbonaceous Chondrite (CV3)

**Specimens:** 4 grams at *UCLA*; main mass with Matthew Stream.

### Northwest Africa 13523 (NWA 13523)

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3 Algeria

4 Find: 2019

5 Classification: HED achondrite (Eucrite, brecciated)

6 **History:** Purchased in 2020 by Matthew Stream from a seller in Algeria.

7 **Physical characteristics:** Single stone with minor fusion crust.

8 **Petrography:** (D. Sheikh, *FSU*) Sample is a brecciated eucrite composed of cumulate eucrite  
9 clasts, basaltic eucrite clasts, anorthositic clasts, and isolated mineral fragments set in a fine-  
10 grained matrix. Accessory phases include chromite (some Ti-rich), troilite, SiO<sub>2</sub>-rich glass,  
11 and ilmenite.

12 **Geochemistry:** Low-Ca Pyroxene (Fs<sub>41.1±2.9</sub> Wo<sub>2.2±1.0</sub>, range Fs<sub>31.6-45.2</sub> Wo<sub>1.0-4.1</sub>, FeO/MnO =  
13 31±4, n=47), Pigeonite (Fs<sub>38.3±2.8</sub> Wo<sub>10.4±3.5</sub>, range Fs<sub>34.5-42.1</sub> Wo<sub>6.5-17.4</sub>, FeO/MnO = 30±3, n=9),  
14 Augite (Fs<sub>20.7±2.7</sub> Wo<sub>41.2±0.1</sub>, range Fs<sub>18.7-22.6</sub> Wo<sub>41.1-41.3</sub>, FeO/MnO = 26±3, n=2), Calcic  
15 Plagioclase (An<sub>88.0±4.9</sub>, range An<sub>80.1-96.3</sub>, n=18).

16 **Classification:** HED Achondrite (Eucrite, brecciated)

17 **Specimens:** 20.77 grams at *UCLA*; main mass with Matthew Stream.  
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### 23 Northwest Africa 13524 (NWA 13524)

24 (Northwest Africa)

25 Find: 2019

26 Classification: Ordinary chondrite (LL6)

27 **History:** Purchased in 2020 by Matthew Stream from a seller in Northwest Africa.

28 **Physical characteristics:** Single stone with dark-brown fusion crust.

29 **Petrography:** (D. Sheikh, *FSU*) Sample is an ordinary chondrite composed of few blurred  
30 chondrules set in a fine-grained recrystallized matrix containing secondary recrystallized  
31 plagioclase (55±5 μm). Accessory phases include Fe-Ni metal, troilite, chromite (some Ti-  
32 rich), and iron oxides.

33 **Geochemistry:** Olivine (Fa<sub>27.5±0.4</sub>, range Fa<sub>26.5-28.2</sub>, n=30), Low-Ca pyroxene  
34 (Fs<sub>23.0±0.6</sub> Wo<sub>1.6±0.4</sub>, range Fs<sub>22.2-24.6</sub> Wo<sub>1.1-2.5</sub>, n=11).

35 **Classification:** Ordinary Chondrite (LL6)

36 **Specimens:** 20.3 g at *UCLA*; main mass with Matthew Stream.  
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### 41 Northwest Africa 13525 (NWA 13525)

42 (Northwest Africa)

43 Purchased: 2019

44 Classification: Ordinary chondrite (LL6)

45 **History:** Purchased in 2019 by Abdeltif Mechaguen from a seller in Morocco.

46 **Physical characteristics:** Single stone with dark-brown fusion crust.

47 **Petrography:** (D. Sheikh, *FSU*) Sample is a brecciated ordinary chondrite composed of  
48 angular clasts (1-7 mm) set in a fine-grained recrystallized matrix containing secondary  
49 recrystallized plagioclase (55±5 μm). Accessory phases include Fe-Ni metal, troilite, chromite  
50 (some Ti-rich), and iron oxides.

51 **Geochemistry:** Olivine (Fa<sub>30.3±0.3</sub>, range Fa<sub>29.9-31.0</sub>, n=19), Low-Ca pyroxene  
52 (Fs<sub>24.4±0.2</sub> Wo<sub>1.8±0.2</sub>, range Fs<sub>24.2-24.5</sub> Wo<sub>1.6-1.9</sub>, n=3).

53 **Classification:** Ordinary Chondrite (LL6)

54 **Specimens:** 20.8 g at *UCLA*; main mass with Abdeltif Mechaguen.  
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### 60 Northwest Africa 13526 (NWA 13526)

Morocco

Find: 2016

Classification: Rumuruti chondrite (R5)

**History:** Purchased in 2020 by Matthew Stream from a seller in Morocco.

**Physical characteristics:** Single stone with dark-brown fusion crust.

**Petrography:** (D. Sheikh, *FSU*) Chondrite with chondrules (up to 1.5mm) set in a fine-grained brown matrix containing secondary recrystallized sodic plagioclase ( $25\pm 5\ \mu\text{m}$ ). Accessory phases include pentlandite, chromite, and iron oxides.

**Geochemistry:** Olivine ( $\text{Fa}_{40.4\pm 0.9}$ , range  $\text{Fa}_{37.8-42.3}$ ,  $n=58$ ), High-Ca Pyroxene ( $\text{Fs}_{10.0\pm 0.8}\text{Wo}_{46.0\pm 0.8}$ , range  $\text{Fs}_{9.2-11.9}\text{Wo}_{45.2-47.8}$ ,  $n=13$ ).

**Classification:** Rumuruti Chondrite (R5)

**Specimens:** 5.1 g at *UCLA*; main mass with Matthew Stream.

#### Northwest Africa 13527 (NWA 13527)

Algeria

Find: 2019

Classification: Ordinary chondrite (LL3)

**History:** Purchased in 2020 by Shawn Kashay from Mostafa Hnini.

**Physical characteristics:** Single stone with dark-brown fusion crust.

**Petrography:** (D. Sheikh, *FSU*) Sample is an ordinary chondrite composed of abundant chondrules (Av. 1 mm, up to 3 mm) set in a fine-grained matrix. Accessory phases include Fe-Ni metal, troilite, carbonates, and Fe-oxides.

**Geochemistry:** Olivine ( $\text{Fa}_{18.1\pm 10.5}$ , range  $\text{Fa}_{0.8-42.4}$ ,  $n=49$ ), low-Ca pyroxene ( $\text{Fs}_{13.5\pm 9.3}\text{Wo}_{1.2\pm 0.4}$ , range  $\text{Fs}_{1.9-24.7}\text{Wo}_{0.6-2.0}$ ,  $n=26$ ).

**Classification:** Ordinary Chondrite (LL3)

**Specimens:** 7.3 g at *UCLA*; main mass with Shawn Kashay.

#### Northwest Africa 13528 (NWA 13528)

(Northwest Africa)

Purchased: 2014

Classification: Carbonaceous chondrite (CK5)

**History:** Purchased in 2014 by Jasper Spencer from a seller in Morocco.

**Physical characteristics:** Single stone with dark-brown fusion crust.

**Petrography:** (D. Sheikh, *FSU*) Sample is a carbonaceous chondrite composed of blurred chondrules (Av.  $\sim 1$  mm,  $n=4$ ) set in a fine-grained matrix containing secondary recrystallized intermediate plagioclase ( $15\pm 5\ \mu\text{m}$ ). Accessory phases include pentlandite and Cr-rich magnetite.

**Geochemistry:** Olivine ( $\text{Fa}_{30.1\pm 0.4}$ , range  $\text{Fa}_{29.4-30.8}$ ,  $n=28$ ), Low-Ca Pyroxene ( $\text{Fs}_{26.9\pm 0.3}\text{Wo}_{1.3\pm 0.2}$ , range  $\text{Fs}_{26.6-27.1}\text{Wo}_{1.0-1.4}$ ,  $n=3$ ).

**Classification:** Carbonaceous Chondrite (CK5)

**Specimens:** 2.1 grams at *UCLA*; main mass with Jasper Spencer.

#### Northwest Africa 13529 (NWA 13529)

Morocco

Purchased: 2018 Apr

Classification: Ordinary chondrite (H4)

**History:** Purchased in Morocco by Sergey Vasiliev and Marc Jost in April 2018.

**Physical characteristics:** Total mass 1690 g. The crust is gray and reddish-brown in weathered surface. The interior of the meteorite is dark gray with visible, abundant chondrules and metal particles.

**Petrography:** (P. Yu. Plechov, *FMMR*). Petrographic observation of a polished section shows that the meteorite consists of chondrules with sizes from 150 to 700  $\mu\text{m}$  in an oxidized matrix. Chondrules have sharp boundaries. PO-IIA-type prevails among chondrules (also present POP-chondrules and in fewer non porphyric chondrules). Feldspar is submicrometer size in chondrule matrix. Matrix contains a lot partially oxydized of troilite and metal blebs. These features indicate that meteorite corresponds to petrologic type 4. Olivine has no undulatory extinction, there are no shock veins or melt pockets.

**Geochemistry:** Mineral composition and Geochemistry: EDS analyses (P. Yu. Plechov, *FMMR*). Olivine  $\text{Fa}_{17.6\pm 0.3}$  (N=6), Low-Ca pyroxene  $\text{Fs}_{13.5\pm 2.2}\text{Wo}_{0.47\pm 0.12}$  (N=5). Kamacite Fe 93.26 wt%, Ni 6.65 wt%, Co 0.96 wt%. Taenite (N=2) Ni 51.32 wt%, Co 0.36 wt.%.  $\text{H}_2\text{O}$   $2.8\pm 0.7$  wt%, C 0.17 wt.% (CNH elemental analyzer).

**Classification:** (P. Yu. Plechov, *FMMR*). Ordinary chondrite. H4, S1, W2.

**Specimens:** 31 g and thin section, *FMMR*.

#### Northwest Africa 13530 (NWA 13530)

Morocco

Purchased: 2018 Jul

Classification: Carbonaceous chondrite (CV3)

**Petrography:** The chondrite is characterized by large chondrules (mm-sized) and CAIs (to 1.5 cm).

**Geochemistry:** Olivine  $\text{Fa}_{4.92\pm 7.11}$  (range:  $\text{Fa}_{0.56-20.2}$ ; N=19). Low-Ca pyroxene  $\text{Fs}_{1.66\pm 0.38}\text{Wo}_{4.32\pm 3.66}$  (range  $\text{Fs}_{1.19-2.43}\text{Wo}_{0.66-9.44}$ , n=11).

**Classification:** Carbonaceous chondrite (CV3)

#### Northwest Africa 13531 (NWA 13531)

(Northwest Africa)

Purchased: 2017 Mar

Classification: Lunar meteorite (feldspathic breccia)

**History:** Writeup history: History: Roger Kilchenmann obtained this meteorite in March 2017 from Noredine Azelmat of Morocco as part of an online trade for a lot of NWA meteorites.

**Physical characteristics:** Exterior covered with weathering rind and remnant fusion crust. Cut face reveals predominantly light toned interior with darker veins and pockets, with small ( $\leq 1$  mm) white clasts.

**Petrography:** (M. Hutson, A. Ruzicka, *Cascadia*): Two lithologies are visible in thin section; both are breccias consisting of feldspathic clasts set in a finer-grained matrix dominated by pigeonite and plagioclase. The two lithologies differ in size of feldspathic clasts (up to 2 mm across in lithology 1, up to 0.7 mm across in lithology 2) and matrix texture (blocky plagioclase grains up to 0.1-0.2 mm across in lithology 1, lath-like plagioclase grains  $< 0.1$  mm long in lithology 2). An ovoid shaped patch of clast-laden brownish glass about 1 mm in length and thin glassy melt veins occur along the boundary between the two lithologies. Mineral phases present include plagioclase feldspar, pigeonite, augite, olivine, Cl-containing phosphate, ilmenite, Ti-rich spinel, chromite, troilite, and rare tiny ( $\leq 10$   $\mu\text{m}$  across) FeNi metal.

**Geochemistry:** Mineral compositions and geochemistry: (M. Hutson, A. Ruzicka, *Cascadia*; K. Ziegler, *UNM*): Oxygen isotopes on acid treated samples in per mil, relative to V-SMOW

linearized values):  $\delta^{17}\text{O}' = 3.083 \pm 0.031$ ,  $\delta^{18}\text{O}' = 5.933 \pm 0.052$ ,  $\Delta^{17}\text{O}' = -0.050 \pm 0.005$  (N=3). Plagioclase compositions of clasts are variable, but the range of compositions in the two lithologies overlap. Lithology 1 clasts:  $\text{An}_{87-96}\text{Or}_{0.7-1.5}$  (N=18, 2 clasts); Lithology 2 clasts:  $\text{An}_{89-95}\text{Or}_{0.7-1.1}$  (N=21, 3 clasts). Matrix plagioclase for the two lithologies is also similar. Lithology 1 matrix:  $\text{An}_{91.3 \pm 2.3}\text{Or}_{0.9 \pm 0.6}$  (N=23); Lithology 2 matrix:  $\text{An}_{92.7 \pm 2.2}\text{Or}_{0.9 \pm 0.9}$  (N=27). Matrix pigeonite ( $\text{Wo}_{5-20}$ ) and olivine grains are more magnesian in lithology 1 than in lithology 2. Lithology 1 matrix pigeonite:  $\text{Fs}_{29.9 \pm 3.1}$ ,  $\text{Mg\#} = 67.9 \pm 3.2$  (N=17); Lithology 2 matrix pigeonite:  $\text{Fs}_{31.7 \pm 1.9}$ ,  $\text{Mg\#} = 64.2 \pm 1.1$  (N=13); Lithology 1 matrix olivine:  $\text{Fa}_{39.8 \pm 2.2}$ ,  $\text{Mg\#} = 60.2 \pm 2.1$  (N=11); Lithology 2 matrix olivine:  $\text{Fa}_{43.4 \pm 0.9}$ ,  $\text{Mg\#} = 56.5 \pm 0.9$  (N=15).  
**Classification:** Lunar feldspathic breccia based on texture and mineralogy.  
**Specimens:** *Cascadia* holds 7.9 g in pieces, as well as a polished thin section and butt.

### Northwest Africa 13532 (NWA 13532)

(Northwest Africa)

Purchased: 2017

Classification: Mesosiderite-B2/3

**History:** John Shea and Christopher Colvin purchased the meteorite in 2017 from Mike Miller. John Shea sent material to *Cascadia* for classification and transferred his remaining material to Christopher Colvin.

**Physical characteristics:** Exterior of the sample is irregular, with higher areas that are smoother and darker than the lower areas, which are rougher, pitted, and dark brown. Projecting areas show metal. Cut face shows a subequal mix of metal and silicates.

**Petrography:** (M. Hutson, A. Ruzicka, *Cascadia*): In thin section, the sample consists of metal (with minor troilite along with about 10-20% weathering products) and mm- to cm-sized silicate clasts, primarily low-Ca pyroxene set in a predominantly granular matrix composed chiefly of low-Ca pyroxene, plagioclase feldspar and a silica polymorph. Matrix grades into clasts. Some orthopyroxene clasts are zoned, with more magnesian cores. At least one olivine clast is present with a moderately developed corona structure. Silica polymorph grains are equant to tabular and typically less than 100 microns across, although some laths are up to 1 mm long. Calcic pyroxene occurs as elongate patches within low-Ca pyroxene and at grain margins. Chromite and merrillite are accessory minerals. Overall, orthopyroxene is more abundant than plagioclase feldspar.

**Geochemistry:** Mineral compositions and geochemistry: Low-Ca pyroxene:

$\text{Fs}_{30.9 \pm 6.2}\text{Wo}_{2.2 \pm 0.8}$ , N=35; High-Ca pyroxene  $\text{Fs}_{15.7 \pm 0.9}\text{Wo}_{42.9 \pm 0.7}$ , N=12; olivine  $\text{Fa}_{37.2 \pm 0.1}$ , N=4; plagioclase  $\text{An}_{90.7 \pm 2.2}\text{Or}_{0.7 \pm 0.1}\text{Ab}_{8.6 \pm 2.1}$ , N=14.

**Classification:** Type B based on observation that pyroxene is more abundant than plagioclase. Type 2/3 B mesosiderite based on texture and mineralogy.

**Specimens:** *Cascadia* holds 22.5 g in two pieces, as well as a polished thin section and butt.

### Northwest Africa 13533 (NWA 13533)

(Northwest Africa)

Purchased: 2018 Mar 06

Classification: Ordinary chondrite (L6)

**History:** Purchased in Portland, Oregon from Patrick *Thompson* as an unclassified meteorite from northwest Africa that was obtained in Tucson, Arizona.

**Physical characteristics:** Single flattened individual that is covered in fusion crust except for broken face that has a weathering patina. A cut face reveals metal grains and chondritic



texture with spatially variable weathering stains (more developed towards one face). Two shock veins are subparallel to the two main flat faces of the individual.

**Petrography:** (K. Maccini, A. Ruzicka, *Cascadia*): In thin section, chondritic texture with indistinct chondrules are visible. Chief phases include olivine and low-Ca pyroxene, opaques (chiefly metal with lesser troilite) comprising up to ~7 area%, and maskelynite. One end of the section is notably stained; the rest of the sample has limited patches of weather staining centered on metal. In the prevailing low-stained portion of the sample, weathering products compose <5 area%. Shock stages based on olivine correspond to a conventional shock stage of S4 and a weighted shock stage (Jamsja and Ruzicka, 2010) of  $3.7 \pm 0.6$  (N=40).

**Geochemistry:** Mineral compositions and geochemistry: Olivine and low-Ca pyroxene grains are highly equilibrated:  $\text{Fa}_{24.3 \pm 1.0}$  N=70;  $\text{Fs}_{21.2 \pm 0.9} \text{Wo}_{1.3 \pm 0.4}$ , N=29.

**Classification:** Ordinary chondrite (L6) based on olivine fayalite and pyroxene ferrosilite content and overall texture.

**Specimens:** *Cascadia* holds 457.2 g in three pieces, including the main mass, a slice, an end cut, as well as a polished thin section and butt.

### Northwest Africa 13534 (NWA 13534)

(Northwest Africa)

Purchased: 2020

Classification: Ordinary chondrite (L4)

**Petrography:** (K. Metzler, *IfP*) Ordinary chondrite, consisting of chondrules (up to 2.4 mm), chondrule fragments, Fe-Ni metal grains and troilite, embedded in a fine-grained matrix. The mean apparent chondrule size is 503  $\mu\text{m}$  (n=41).

**Geochemistry:** Mineral compositions and geochemistry: The mean olivine composition is  $\text{Fa}_{23.6 \pm 1.1}$  ( $\text{Fa}_{21.6-24.9}$ ; n=12); the mean low-Ca pyroxene composition is  $\text{Fs}_{16.7 \pm 3.7} \text{Wo}_{0.5 \pm 0.2}$  ( $\text{Fs}_{8.1-20.7} \text{Wo}_{0.2-0.9}$ ; n=15).

**Classification:** L chondrite based on metal content and apparent chondrule size. Petrologic type based on the equilibrated state of olivine and unequilibrated state of low-Ca pyroxene.

### Northwest Africa 13535 (NWA 13535)

(Northwest Africa)

Purchased: 2009 Jun

Classification: Ordinary chondrite (L4)

**History:** Purchased from a Moroccan mineral dealer at the meteorite show in Ensisheim, France

**Physical characteristics:** Angular fragment with black appearance without fusion crust.

**Petrography:** (K. Metzler, *IfP*) Unbrecciated shock-darkened ordinary chondrite with clearly visible chondrules of various textural types.

**Geochemistry:** Mineral compositions and geochemistry: The mean olivine composition is  $\text{Fa}_{23.3 \pm 0.5}$  ( $\text{Fa}_{22.5-24.1}$ ; n=13). The mean low-Ca pyroxene composition is  $\text{Fs}_{19.5 \pm 2.9} \text{Wo}_{1.0 \pm 1.0}$  ( $\text{Fs}_{16.1-27.3} \text{Wo}_{0.1-3.7}$ ; n=12).

**Classification:** L chondrite based on olivine and pyroxene chemistry. Petrologic type 4 based on the equilibrated state of olivine and unequilibrated state of low-Ca pyroxene.

### Northwest Africa 13536 (NWA 13536)

(Northwest Africa)

Purchased: 2019

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3 Classification: Ordinary chondrite (H4)

4 **History:** The meteorite was purchased from a local dealer in Morocco.

5 **Physical characteristics:** Dark brownish fragment without fusion crust.

6 **Petrography:** The meteorite displays a chondritic texture with small, mostly rounded,  
7 separated chondrules (mean diameter about 0.3 mm) in a more fine-grained dark matrix that  
8 contains sulfides and abundant FeNi metal. Olivine is equilibrated; low-Ca-pyroxene is  
9 unequilibrated.  
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13 **Northwest Africa 13537 (NWA 13537)**

14 (Northwest Africa)

15 Purchased: 2019

16 Classification: Ordinary chondrite (L4)

17 **History:** The meteorite was purchased from a local dealer in Morocco.

18 **Physical characteristics:** Dark brownish fragment without fusion crust.

19 **Petrography:** The meteorite displays a chondritic texture with well defined, mostly flattened  
20 and packed chondrules (mean diameter about 0.6 mm) and dark fine-grained matrix  
21 containing sulfides and FeNi metal. Olivine is compositionally equilibrated; low-Ca pyroxene  
22 is unequilibrated.  
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27 **Northwest Africa 13542 (NWA 13542)**

28 (Northwest Africa)

29 Purchased: 2020

30 Classification: Carbonaceous chondrite (CV3)

31 **History:** The meteorite was purchased from a dealer in Algeria.

32 **Physical characteristics:** Many dark-grayish fragments without fusion crust.

33 **Petrography:** The meteorite displays a fresh almost black interior and is composed of  
34 chondrules (mean diameter about 0.9 mm; up to 1.9 mm sized), CAIs (up to 4 mm sized), and  
35 olivine amoeboids all set into a fine-grained matrix. Contains both, type I and type II  
36 chondrules. No chondrules showing reddish staining have been observed. Opaque phases are  
37 metal often occurring as blebs in chondrules, and sulfides. Both phases are sometimes altered  
38 to iron oxides.  
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43 **Northwest Africa 13543 (NWA 13543)**

44 (Northwest Africa)

45 Purchased: 2020

46 Classification: Carbonaceous chondrite (CV3)

47 **History:** The meteorite was purchased from a dealer in Algeria.

48 **Physical characteristics:** Many light-grayish to greenish fragments, some of them with  
49 patches of fusion crust.

50 **Petrography:** The meteorite displays a grayish to dark-greenish interior and is composed of  
51 chondrules (mean diameter about 1 mm; up to 2.5 mm sized), large up to 1 cm sized CAIs,  
52 and olivine amoeboids embedded into a fine-grained, brownish-black matrix. Contains both,  
53 type I and type II chondrules. Several chondrules show reddish staining due to terrestrial  
54 alteration. Opaque phases are metal often occurring as blebs in chondrules, and sulfides. Both  
55 phases are sometimes altered to iron oxides.  
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**Northwest Africa 13544** (NWA 13544)

(Northwest Africa)

Purchased: 2020

Classification: Carbonaceous chondrite (CK5)

**History:** The meteorite was purchased from a dealer in Algeria.**Physical characteristics:** Dark-grayish individual with some fusion crust.**Petrography:** The meteorite displays a grayish to greenish interior and is predominantly composed of recrystallized olivine-dominated matrix with some separated and still well defined chondrules (mean diameter 0.8 mm). Cr-rich magnetite is abundant. More minor phases include intermediate plagioclase, low-Ca pyroxene, and FeS; metal was not detected.**Geochemistry:** olivine:  $\text{Fa}_{30.2\pm 0.2}$  ( $\text{FeO/MnO}=99\pm 12$ ,  $n=12$ ); low-Ca pyroxene: $\text{Fs}_{25.7\pm 0.2}\text{Wo}_{0.6\pm 0.1}$ ,  $n=9$ **Northwest Africa 13545** (NWA 13545)

(Northwest Africa)

Purchased: 2020

Classification: HED achondrite (Eucrite)

**History:** The meteorite was purchased from a dealer in Algeria.**Physical characteristics:** Light brownish fragment with some fusion crust.**Petrography:** The meteorite is an unbrecciated medium-grained basalt predominantly composed of exsolved pyroxene (average grain sizes of about 400  $\mu\text{m}$ ) and larger, often lath-shaped calcic plagioclase (average grain sizes of about 800  $\mu\text{m}$ ). Minor phases include silica, chromite, troilite ; no metallic iron has been detected.**Geochemistry:** low-Ca pyroxene:  $\text{Fs}_{58.4\pm 0.5}\text{Wo}_{6.1\pm 0.6}$  ( $\text{Fs}_{57.7-59.3}\text{Wo}_{5.3-7.0}$ ,  $n=16$ ,  $\text{FeO/MnO}=27-30$ ); Ca-pyroxene:  $\text{Fs}_{29.7\pm 0.1}\text{Wo}_{41.2\pm 0.2}$  ( $\text{Fs}_{29.5-30.0}\text{Wo}_{40.9-41.5}$ ,  $n=12$ ,  $\text{FeO/MnO}=29-32$ ); calcic plagioclase:  $\text{An}_{89.5\pm 0.4}$  ( $\text{An}_{88.9-90.5}$ ,  $n=13$ )**Northwest Africa 13546** (NWA 13546)

(Northwest Africa)

Purchased: 2020

Classification: Lunar meteorite (feldspathic breccia)

**History:** The meteorite was purchased from a dealer in Morocco.**Physical characteristics:** Many small greyish fragments some of which covered with fusion crust.**Petrography:** The meteorite displays a grayish interior and is a feldspathic breccia composed of mineral fragments, basaltic, gabbroic, and impact melt clasts cemented by a fine-grained partly shock-melted groundmass. Most abundant minerals are calcic plagioclase, olivine of highly variable composition, and exsolved pyroxene; less abundant are and complex zoned pyroxenes. Accessories include ilmenite, and FeNi-metal. The meteorite contains shock melt veins and pockets.**Geochemistry:** olivine:  $\text{Fa}_{21.3\pm 11.1}$  ( $\text{Fa}_{9.9-44.3}$ ,  $\text{FeO/MnO}=79\pm 8$ ,  $n=26$ ); fayalite:  $\text{Fa}_{95.5\pm 0.2}$ ,  $\text{FeO/MnO}=85\pm 3$ ,  $n=6$ ; low-Ca host to augite exsolution lamellae:  $\text{Fs}_{49.2\pm 0.6}\text{Wo}_{4.3\pm 0.7}$  ( $\text{Fs}_{47.8-50.3}\text{Wo}_{3.5-5.7}$ ,  $\text{FeO/MnO}=56\pm 3$ ,  $n=11$ ); augite exsolution lamellae:  $\text{Fs}_{23.3\pm 0.8}\text{Wo}_{41.0\pm 0.6}$  ( $\text{Fs}_{22.4-25.1}\text{Wo}_{39.3-41.5}$ ,  $\text{FeO/MnO}=53\pm 6$ ,  $n=10$ ); complex zoned pyroxene:  $\text{Fs}_{38.1\pm 10.0}\text{Wo}_{21.5\pm 13.8}$  ( $\text{Fs}_{25.8-49.6}\text{Wo}_{5.6-39.0}$ ,  $\text{FeO/MnO}=50\pm 3$ ,  $n=11$ ); calcic plagioclase:  $\text{An}_{97.6\pm 0.3}$  ( $\text{An}_{97.1-97.9}$ ,  $n=14$ )**Classification:** Lunar meteorite (feldspathic breccia); likely paired with [NWA 11273](#)

**Northwest Africa 13547** (NWA 13547)

(Northwest Africa)

Purchased: 2020

Classification: Carbonaceous chondrite (CM2)

**History:** The meteorite was purchased from a dealer in Morocco.**Physical characteristics:** Black individual with some fusion crust.**Petrography:** The meteorite is a chondritic breccia composed of small (about 0.1-0.4 mm in diameter) chondrules, chondrule pseudomorphs, mineral fragments and rare CAIs most of which are surrounded by fine-grained dust rims set into an abundant fine-grained matrix. Matrix constituents include phyllosilicates with fibrous appearance, carbonates, and rare sulfides. Only few FeNi spheres were found enclosed within forsteritic olivine. No pyroxene has been detected.**Geochemistry:** mean values of defocused matrix analyses (beam diameter 5  $\mu\text{m}$ ; all wt%; N=12): SiO<sub>2</sub>: 28.3, TiO<sub>2</sub>: 0.03, Na<sub>2</sub>O: 0.18, Cr<sub>2</sub>O<sub>3</sub>: 0.43, MgO: 16.2, MnO: 0.10, FeO: 21.6, Al<sub>2</sub>O<sub>3</sub>: 2.46, NiO: 1.94, P<sub>2</sub>O<sub>5</sub>: 0.14, S: 2.21, Total: 73.59**Northwest Africa 13548** (NWA 13548)

(Northwest Africa)

Purchased: 2020

Classification: HED achondrite (Eucrite, melt breccia)

**History:** The meteorite was purchased from a dealer in Algeria.**Physical characteristics:** Dark greyish fragment with some fusion crust.**Petrography:** The meteorite displays a dark-grayish interior and is a melt breccia composed of up to 1.0 cm sized basaltic clasts and up to 0.5 mm sized mineral clasts set into black melt rock matrix. Predominant minerals are exsolved pyroxenes and often lath shaped calcic plagioclase. The fine-grained and mostly recrystallized shock melt shows flow structures. Mineral grains in contact with the melt are partly resorbed. Minor phases include silica, chromite, ilmenite, FeS, Zircon and metallic iron.**Geochemistry:** low-Ca pyroxene: Fs<sub>60.8±0.8</sub>Wo<sub>2.6±0.3</sub> (Fs<sub>58.4-62.0</sub>Wo<sub>2.2-3.4</sub>, n=15, FeO/MnO=27-30); Ca-pyroxene: Fs<sub>25.5±0.4</sub>Wo<sub>44.5±0.4</sub> (Fs<sub>25.0-26.8</sub>Wo<sub>43.6-45.2</sub>, n=14, FeO/MnO=26-33); calcic plagioclase: An<sub>89.4±1.4</sub> (An<sub>87.9-92.2</sub>, n=12)**Northwest Africa 13549** (NWA 13549)

(Northwest Africa)

Purchased: 2020

Classification: HED achondrite (Eucrite)

**History:** The meteorite was purchased from a dealer in Morocco.**Physical characteristics:** Dark-grayish fragment with some fusion crust.**Petrography:** The meteorite is an unbrecciated basalt composed of fine- and coarse-grained regions dominated by exsolved pyroxenes and often lath-shaped calcic plagioclase. Grain sizes vary from about 80 to 500  $\mu\text{m}$  for pyroxene and about 50 to 700  $\mu\text{m}$  for plagioclase. Minor phases include silica, chromite, ilmenite, and FeS; no metallic iron has been detected.**Geochemistry:** low-Ca pyroxene: Fs<sub>55.2±0.4</sub>Wo<sub>7.9±0.5</sub> (Fs<sub>54.6-56.0</sub>Wo<sub>7.1-8.8</sub>, n=11, FeO/MnO=28-30); Ca-pyroxene: Fs<sub>29.7±1.0</sub>Wo<sub>40.1±1.4</sub> (Fs<sub>27.8-31.3</sub>Wo<sub>38.3-43.1</sub>, n=11, FeO/MnO=26-29); calcic plagioclase: An<sub>84.5±1.4</sub> (An<sub>81.5-85.7</sub>, n=12)**Northwest Africa 13550** (NWA 13550)

Northwest Africa

Purchased: 02/2018

Classification: Pallasite

**History:** Purchased by Giorgio Tomelleri at the Erfoud market in February 2018. Main mass purchased from Giorgio Tomelleri and held by *MSN-FI*.

**Physical characteristics:** A single piece of metallic appearance remarkably oxidized totaling 264 g, without fusion crust

**Petrography:** (V. Moggi Cecchi, G. Pratesi, S. Caporali, *UniFi*): The meteorite is composed of up to 1 cm sized subrounded and partly fragmented olivine grains surrounded by a matrix of brownish iron oxides also present along the olivine grain boundaries and cracks. Iron-nickel alloys are completely weathered to Fe-hydroxides. On a polished thin section partially altered troilite spots are visible.

**Geochemistry:** EMP (V. Moggi Cecchi, G. Pratesi, S. Caporali, *UniFi*): Olivine  $Fa_{6.3\pm 0.2}$  (n=9). Oxidized metal (El. Wt.%): ~57 % Fe, ~3 % Ni. Troilite (El. Wt.%): S: 43.8; Fe: 50.4; O: 3.0, Cr: 2.2;

**Classification:** Pallasite (PMG)

**Specimens:** The main mass, 1 thick section and 1 thin section are on deposit at MSN-Fi

#### Northwest Africa 13551 (NWA 13551)

(Northwest Africa)

Purchased: 2020

Classification: Ordinary chondrite (H6)

**History:** The meteorite was found near Tindouf, Algeria, and purchased from the main mass holder from a Moroccan dealer.

**Physical characteristics:** Dark brownish fragment without fusion crust.

**Petrography:** The plagioclase grain size is about 60  $\mu\text{m}$ .

#### Northwest Africa 13552 (NWA 13552)

(Northwest Africa)

Purchased: 2020

Classification: Ordinary chondrite (H5)

**History:** The meteorite was found near Smara, Western Sahara, and purchased from the main mass holder from a Moroccan dealer.

**Physical characteristics:** Dark brownish fragment with minor fusion crust.

**Petrography:** The plagioclase grain size is about 30  $\mu\text{m}$ .

#### Northwest Africa 13553 (NWA 13553)

(Northwest Africa)

Purchased: 2020

Classification: Ordinary chondrite (L5)

**History:** The meteorite was found near Lahmada, Western Sahara, and purchased from the main mass holder from a Moroccan dealer.

**Physical characteristics:** Dark brownish fragment without fusion crust.

**Petrography:** The plagioclase grain size is about 40  $\mu\text{m}$ .

#### Northwest Africa 13555 (NWA 13555)



(Northwest Africa)

Purchased: 2020

Classification: Ordinary chondrite (LL6)

**History:** The meteorite was found near Dakhla, Western Sahara, and purchased by the main mass holder from Mr. Fattouh Alithe.

**Physical characteristics:** Dark brownish fragment without fusion crust.

**Petrography:** The plagioclase grain size is about 90  $\mu\text{m}$ .

#### Northwest Africa 13556 (NWA 13556)

(Northwest Africa)

Purchased: 2020

Classification: Ordinary chondrite (LL6)

**History:** The meteorite was found near Dakhla, Western Sahara, and purchased from the main mass holder from a Moroccan dealer.

**Physical characteristics:** Dark brownish fragment without fusion crust.

**Petrography:** The plagioclase grain size is about 70  $\mu\text{m}$ .

#### Northwest Africa 13557 (NWA 13557)

(Northwest Africa)

Purchased: 2020

Classification: Carbonaceous chondrite (CK6)

**History:** The meteorite was purchased from a dealer in Morocco.

**Physical characteristics:** Dark-grayish fragment partly covered by fusion crust.

**Petrography:** The meteorite displays a dark-grayish interior and is predominantly composed of fine-grained recrystallized matrix dominated by ferrous olivine. Chondrules are only rarely encountered. One CAI is present in the section studies. Minor phases include intermediate plagioclase, low-Ca pyroxene, Ca-pyroxene, and FeNi-sulfides. Cr-rich magnetite is abundant; no metal has been found.

**Geochemistry:** olivine:  $\text{Fa}_{30.0\pm 0.2}$  ( $\text{FeO}/\text{MnO}=96\pm 10$ ,  $n=12$ ); low-Ca pyroxene:

$\text{Fs}_{25.9\pm 1.0}\text{Wo}_{0.9\pm 0.1}$ ,  $n=10$ ; Ca-pyroxene:  $\text{Fs}_{16.0\pm 1.4}\text{Wo}_{48.7\pm 0.4}$ ,  $n=10$

#### Northwest Africa 13558 (NWA 13558)

(Northwest Africa)

Purchased: 2020

Classification: Ordinary chondrite (H6)

**History:** The meteorite was purchased from a dealer in Morocco.

**Physical characteristics:** Dark brownish fragment without fusion crust.

**Petrography:** The plagioclase grain size is about 60  $\mu\text{m}$ .

#### Northwest Africa 13559 (NWA 13559)

(Northwest Africa)

Purchased: 2020

Classification: Carbonaceous chondrite (CO3)

**History:** The meteorite was purchased from a dealer in Morocco.

**Physical characteristics:** Dark-brownish fragment without fusion crust.

**Petrography:** The meteorite shows a dark brownish to almost black interior and is predominantly composed of abundant chondrules (mean diameter about 200  $\mu\text{m}$ ), CAIs, and mineral fragments set into a fine-grained matrix. Olivine and low-Ca pyroxene in chondrules are highly unequilibrated; some chondrules and CAIs are surrounded by fine-grained dust rims. Some sulfides and FeNi metal are present in matrix and chondrules.

#### Northwest Africa 13560 (NWA 13560)

(Northwest Africa)

Purchased: 2020

Classification: Ordinary chondrite (H5)

**History:** The meteorite was purchased from a dealer in Morocco.

**Physical characteristics:** Dark brownish fragment with some fusion crust.

**Petrography:** The plagioclase grain size is about 30  $\mu\text{m}$ .

#### Northwest Africa 13561 (NWA 13561)

(Northwest Africa)

Purchased: 2020

Classification: Martian meteorite (polymict breccia)

**History:** The meteorite was purchased from a dealer in Morocco.

**Physical characteristics:** Small black individual partly covered with fusion crust.

**Petrography:** The meteorite displays a black interior and is a polymict breccia composed of basaltic, impact melt, and mineral clasts set into a very fine-grained clastic matrix. Most abundant mineral phases in clasts and matrix are pyroxene and feldspar, both of highly variable composition. In basaltic clasts, plagioclase is often lath-shaped. Minor phases include silica, ilmenite, magnetite, and Ti,Cr-magnetite.

**Geochemistry:** low-Ca pyroxene:  $\text{Fs}_{25.8\pm 0.7}\text{Wo}_{3.8\pm 0.4}$  ( $\text{Fs}_{24.6-26.6}\text{Wo}_{3.2-4.9}$ ,  $n=11$ ,  $\text{FeO/MnO}=32\pm 2$ ); low-Ca host to augite exsolution lamellae:  $\text{Fs}_{45.1\pm 0.7}\text{Wo}_{5.9\pm 0.6}$  ( $\text{Fs}_{44.3-46.3}\text{Wo}_{5.4-7.0}$ ,  $n=9$ ,  $\text{FeO/MnO}=32-35$ ); augite exsolution lamellae:  $\text{Fs}_{18.0\pm 0.2}\text{Wo}_{42.2\pm 0.4}$  ( $\text{Fs}_{17.6-18.4}\text{Wo}_{41.6-42.9}$ ,  $n=15$ ,  $\text{FeO/MnO}=26-32$ ); complex zoned pyroxenes:  $\text{Fs}_{32.4\pm 4.2}\text{Wo}_{6.9\pm 2.9}$  ( $\text{Fs}_{27.8-39.1}\text{Wo}_{4.8-12.5}$ ,  $n=10$ ,  $\text{FeO/MnO}=32-36$ ); feldspar:  $\text{An}_{43.9\pm 4.6}\text{Ab}_{54.5\pm 4.4}\text{Or}_{1.6\pm 0.2}$  ( $\text{An}_{36.7-49.4}\text{Ab}_{49.3-61.4}\text{Or}_{1.3-2.0}$ ,  $n=11$ ).

**Classification:** Martian meteorite (basaltic breccia). Likely paired with [NWA 7034](#) and respective clan members.

#### Northwest Africa 13562 (NWA 13562)

(Northwest Africa)

Purchased: 2020

Classification: Primitive achondrite (Lodranite)

**History:** The meteorite was purchased from a dealer in Morocco.

**Physical characteristics:** Light-brownish fragment with minor fusion crust.

**Petrography:** The meteorite shows a coarse-grained granular texture predominantly composed of up to 4 mm sized magnesian olivine and low-Ca pyroxene grains. Some regions are brecciated. More minor phases include Ca-pyroxene, chromite, kamacite, and FeS. Ca-pyroxene is mostly presents as fine exsolution lamellae in low-Ca pyroxene. No feldspar was found in the section studied.

**Geochemistry:** olivine:  $Fa_{10.7\pm 0.2}$  ( $FeO/MnO=32\pm 3$ ,  $n=10$ ); low-Ca pyroxene:  $Fs_{10.7\pm 0.4}Wo_{2.4\pm 0.3}$ , ( $FeO/MnO=21\pm 2$ ,  $n=10$ ); Ca-pyroxene:  $Fs_{3.7\pm 0.1}Wo_{45.6\pm 0.4}$ , ( $FeO/MnO=12\pm 1$ ,  $n=14$ )

**Northwest Africa 13563** (NWA 13563)

(Northwest Africa)

Purchased: 2020

Classification: Ordinary chondrite (L6)

**History:** The meteorite was purchased from a dealer in Morocco.

**Physical characteristics:** Dark brownish fragment almost completely covered with fusion crust.

**Petrography:** The plagioclase grain size is about 60  $\mu m$ .

**Northwest Africa 13564** (NWA 13564)

(Northwest Africa)

Purchased: 2020

Classification: Pallasite

**History:** The meteorite was purchased from a dealer in Morocco.

**Physical characteristics:** Rusty, brownish fragment without fusion crust.

**Petrography:** The meteorite is composed of up to 1.5 sized subrounded olivine grains surrounded by a matrix composed of partly altered FeNi-metal and Fe-oxides.

**Geochemistry:** olivine:  $Fa_{11.4\pm 0.1}$  ( $Fa_{11.3-11.5}$ ,  $FeO/MnO=37\pm 3$ ,  $n=5$ )

**Northwest Africa 13565** (NWA 13565)

Mauritania

Purchased: 2020

Classification: Mesosiderite

**History:** Carlos Muñecas (Expometeoritos) purchased the sample from a dealer in Mauritania in 2020.

**Physical characteristics:** The sample is dark in color, has a rounded-irregular shape, and has a metallic exterior. The cut face shows a metal-rich breccia containing dispersed silicate clasts within a host of interconnected metal grains.

**Petrography:** Description and Classification (A. Love, *App*): Sample is a breccia composed of (vol%): cm-sized, angular-irregular-shaped lithic and mineral clasts (~35) set within a network of irregularly shaped, mm-sized metal grains (~65). Lithic clasts have fine-grained (avg. grain size 0.5 mm), brecciated textures. Modal percentages (vol%) of silicates: orthopyroxene (69), plagioclase (25), olivine (2) and an irregular-lath-shaped silica polymorph (4). Some matrix pyroxenes are inverted and show blebby and lamellar exsolution. Olivine show thin reaction coronas. Plagioclase occurs as rounded grains and Si-polymorph occurs as angular grains. Brecciated texture is still visible and many fine-grained areas have an average grainsize <50  $\mu m$ . Grain boundaries between silicates show some sutured textures. Additional minerals are: kamacite, taenite, lath-shaped Si polymorph, apatite, troilite, chromite, trace ilmenite.

**Geochemistry:** (A. Love, *App*) Olivine ( $Fa_{24.6-31.0}$ ,  $Fe/Mn=39.5-35.4$ ,  $n=2$ ), zoned low-Ca pyroxene ( $Fs_{31.8\pm 7.2}Wo_{3.9\pm 2.8}$ ,  $Fe/Mn=25.5\pm 2.6$ ,  $n=7$ ); pigeonite ( $Fs_{48.5}Wo_{10.5}$ ,  $n=1$ ); high-Ca pyroxene ( $Fs_{17.0}Wo_{41.3}$ ,  $n=1$ ). plagioclase ( $An_{94.3\pm 2.5}Or_{0.6\pm 0.1}$ ,  $n=5$ ).

**Classification:** Mesosiderite (estimated class A2). Mesosiderite Class A based on texture, metal abundance, magnetic susceptibility and modal silicate abundance of plagioclase and Opx. Metamorphic class 2 based on thin reaction coronas, fine-grained comminuted regions between clasts, lack of significant recrystallization textures of silicates and presence of pigeonite.

**Specimens:** Carlos Muñecas (Expometeoritos) holds the main mass. A slice weighing 24.5 g and a polished mount are on deposit at *App*.

#### Northwest Africa 13566 (NWA 13566)

Morocco

Purchased: 2020

Classification: Ordinary chondrite (LL4)

**History:** The sample was purchased by Carlos Muñecas (Expometeoritos) in 12 July 2020 from a dealer in Ouarzazate, Morocco.

**Physical characteristics:** Sample has a triangular prism shape and has a dark brown, wind-ablated exterior. The cut face of the interior is dark gray and shows dispersed metal grains in a chondritic textured host.

**Petrography:** Description and classification (A. Love, *App*) Chondrules (with an average apparent diameter of 640  $\mu\text{m}$ , n=59) set within a nearly opaque, recrystallized matrix containing abundant FeS veinlets. Plagioclase occurs as isolated intergrowths. Additional minerals: apatite, chromite, troilite, pentlandite, rare (<1%) FeNi metal.

**Geochemistry:** (A. Love, *App*) Olivine (Fa<sub>35.3±0.7</sub>, Fe/Mn=66.5±0.9, n=10); low-Ca Pyroxene (Fs<sub>28.0±3.6</sub>Wo<sub>1.2±0.5</sub> (Fs<sub>17.2-30.2</sub>Wo<sub>0.5-2.4</sub>), Fe/Mn=44.6±3.8, n=11); pigeonite (Fs<sub>23.9</sub>Wo<sub>13.5</sub>, Fe/Mn=28.7, n=1); high-Ca pyroxene (Fs<sub>13.5</sub>Wo<sub>31.5</sub>, Fe/Mn=37.7, n=1).

**Classification:** Ordinary chondrite (Shock darkened LL4, C-S3, W1). Fa and Fs are outside the normal range for LL chondrites. Fe/Mn of olivine and pyroxene and average chondrule diameter fall just outside the range of LL ordinary chondrites. Magnetic susceptibility falls within the range for LL chondrites.

**Specimens:** Carlos Muñecas (Expometeoritos) holds the main mass. A slice weighing 20.1 g and a polished thin section are on deposit at *App*.

#### Northwest Africa 13567 (NWA 13567)

Morocco

Purchased: 2020

Classification: Ordinary chondrite (LL3.1)

**History:** Carlos Muñecas (Expometeoritos) purchased the sample from a dealer in Ouarzazate, Morocco on 12 July 2020.

**Physical characteristics:** Sample has an irregular triangular shape and is ~50% covered in a dark brown weathered fusion crust. The cut face shows the interior is composed of numerous rounded chondrules and clasts set in a fine-grained metal-bearing matrix.

**Petrography:** Description and Classification (A. Love, *App*) Dominant unequilibrated chondritic host containing sparse matrix lumps and rare equilibrated and xenolithic clasts. Host contains well-defined, rimmed chondrules (average apparent diameter of 863  $\mu\text{m}$ , n=87) and fragments set within an opaque matrix with metal and sulfide. Additional minerals are: troilite, rare phosphates and anorthitic plagioclase. Common yellow mesostasis and low CL indicates sample is ?3.1.

**Geochemistry:** (A. Love, *App*) Olivine (Fa<sub>15.7±11.0</sub> (Fa<sub>0.3-38.6</sub>), Fe/Mn=38.5±18.6, CaO (type I chondrules) 0.2±0.2wt%, mean concentration of Cr<sub>2</sub>O<sub>3</sub> (ferroan olivine with Fa>2) is

0.3±0.24wt% (n=23); low-Ca Pyroxene (Fs<sub>14.6±6.3</sub>Wo<sub>1.3±0.9</sub> (Fs<sub>5.7-25.1</sub>Wo<sub>0.4-3.4</sub>), Fe/Mn=25.0±12.2, n=10).

**Classification:** Ordinary chondrite (LL3.1 C-S2 W3). LL based on magnetic susceptibility and chondrule diameter. Based on range of Fa and mean and ? values of Cr<sub>2</sub>O<sub>3</sub> contents within ferroan olivine, the sample is LL3.1 (Grossman and Brearley, 2005).

**Specimens:** Carlos Muñecas (Expometeoritos) holds the main mass. A slice weighing 26.18g and polished thin section are on deposit at *App*.

#### Northwest Africa 13568 (NWA 13568)

Tindouf, Algeria

Purchased: 2020

Classification: Lunar meteorite

**History:** Many samples, associated with the main mass of 625 g, (total 825 g) were found in the vicinity of Tindouf, Algeria. All material was purchased by Adrián Contreras from a meteorite dealer in the area.

**Physical characteristics:** Samples are dark in color with light orange patches caliche and have blocky irregular shapes. The cut face shows the interior is a breccia of lithic and mineral clasts set dark gray matrix with regions of small vesicles.

**Petrography:** Description and classification (A. Love, *App*) Polymict breccia dominated by angular, irregularly shaped, 1 mm to 3 cm sized mineral, lithic and vitrified clasts set within a melt matrix composed of isotropic to partially devitrified translucent glass and angular mineral fragments. Gabbroic lithic clasts are dominant, fragmental clasts set in opaque glass. Additional minerals are: troilite, FeNi metal.

**Geochemistry:** (A. Love, *App*) Olivine, Fa<sub>26.0±7.1</sub> (Fa<sub>18.0-37.0</sub>, Fe/Mn=81.5±7.1, n=11); low-Ca pyroxene, Fs<sub>29.4±11.8</sub>Wo<sub>3.3±0.8</sub> (Fs<sub>17.1-48.8</sub>Wo<sub>2.4-4.8</sub>, Fe/Mn=52.9±4.9, n=21); pigeonite, Fs<sub>38.7±6.2</sub>Wo<sub>13.8±3.3</sub> (Fs<sub>29.1-45.3</sub>Wo<sub>9.7-19.1</sub>, Fe/Mn=55.0±3.3, n=9); high-Ca pyroxene, Fs<sub>32.5±7.9</sub>Wo<sub>30.1±4.2</sub>(Fs<sub>22.3-41.0</sub>Wo<sub>21.8-34.2</sub>, Fe/Mn=54.7±5.1, n=6); plagioclase, An<sub>97.0±0.6</sub>Or<sub>0.0±0.10</sub> (n=9).

**Classification:** Lunar (feldspathic breccia M-S3, low weathering). Based on textures, melt matrix component and mineral compositions, this sample is a feldspathic breccia.

**Specimens:** Adrián Contreras holds the 58 2 g main mass. A polished thin section and 2 slices and several fragments weighing 31.26 g are on deposit at *App*.

#### Northwest Africa 13569 (NWA 13569)

Morocco

Purchased: 2020

Classification: Carbonaceous chondrite (CV3)

**History:** Carlos Muñecas (Expometeoritos) purchased the sample from a dealer in Guelmim, Morocco, on 20 July, 2020.

**Physical characteristics:** Sample is irregularly shaped and dark brown, with yellowish-orange chondrules. The cut face shows the interior is composed of dispersed metal-bearing chondrules and CAIs in an opaque matrix.

**Petrography:** Description and classification (A. Love, *App*) Sample shows chondritic texture composed of well-formed chondrules with an average apparent diameter of 547 μm (n=47) and CAIs set in a reddish brown matrix (~50 vol%) dominated by phyllosilicates (with low analytical totals). Metal and sulfide occurs mostly within chondrules. Glassy mesostasis is observed, but rare. Additional minerals are: calcite, troilite, chromite, phosphate. Mass magnetic susceptibility was measured using a ZH Instruments SM-30 pocket MS meter.



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3 Quadruplicate measurements of seven samples produced  $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 3.94$ .

4 Magnetic susceptibility falls within the range measured for CV chondrites.

5 **Geochemistry:** (A. Love, *App*) Olivine ( $\text{Fa}_{14.6\pm 13.8}$ , range  $\text{Fa}_{2.1-44.5}$ ,  $\text{Fe}/\text{Mn}=62.9\pm 35.1$ ,  $n=16$ );  
6 low-Ca Pyroxene ( $\text{Fs}_{17.3\pm 0.3}\text{Wo}_{1.6\pm 0.1}$ ,  $\text{Fe}/\text{Mn}=22.3\pm 0.5$ ,  $n=10$ ); plagioclase ( $\text{An}_{12.0\pm 0.3}\text{Or}_{4.8\pm 0.7}$ ,  
7  $n=5$ ).

8 **Classification:** Carbonaceous chondrite (CV3, C-S2). Sample is a carbonaceous chondrite  
9 based on the abundance of matrix and CAIs. Magnetic susceptibility and presence of metal  
10 suggests the sample is CV3 reduced.

11 **Specimens:** Carlos Muñecas (Expometeoritos) holds the main mass. 3 slices weighing 4.9 g  
12 and a polished thin section are on deposit at *App*.  
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### 16 Northwest Africa 13570 (NWA 13570)

17 Morocco

18 Purchased: 2014

19 Classification: HED achondrite (Eucrite, brecciated)

20 **History:** Sergey Vasiliev and Marc Jost purchase the 23.7g specimen from a meteorite dealer  
21 while at the 2014 Ensisheim meteorite show.

22 **Physical characteristics:** Sample is an ovoid-shaped fragment with a glossy, black, flow-  
23 lined fusion crust coating ~ 60% of the specimen. Areas not coated with fusion crust are light  
24 orange in color. The cut face of the sample shows a light-colored granular breccia.

25 **Petrography:** Description and classification (A. Love, *App*) Sample is a cataclastic breccia  
26 composed of (vol%): 400-1700 $\mu\text{m}$  mineral and lithic fragments of exsolved pyroxene (50),  
27 plagioclase (49) and opaques. Lithic fragments have cumulate textures. Sample also contains  
28 pyroxene-rimmed silica objects. Additional minerals are silica polymorph, chromite, ilmenite  
29 and apatite.

30 **Geochemistry:** (A. Love, *App*) low-Ca pyroxene ( $\text{Fs}_{39.7\pm 1.0}\text{Wo}_{4.9\pm 1.4}$ ,  $\text{Mg}\#58.3\pm 0.6$ ,  
31  $\text{Fe}/\text{Mn}=29.0\pm 0.8$ ,  $n=8$ ); high-Ca pyroxene ( $\text{Fs}_{13.1\pm 0.8}\text{Wo}_{33.5\pm 2.4}$ ,  $\text{Fe}/\text{Mn}=22.1\pm 0.6$ ,  $n=5$ ) and  
32 plagioclase ( $\text{An}_{95.0\pm 0.5}\text{Or}_{0.1\pm 0.0}$ ,  $n=8$ ).

33 **Classification:** (HED achondrite) monomict eucrite breccia M-S2, low weathering. Based on  
34 textures and mineral compositions, sample is a brecciated cumulate eucrite.

35 **Specimens:** Sergey Vasiliev and Marc Jost (*SJS*) hold the main mass. A 4.8g slice and  
36 polished thin section are on deposit at *App*.  
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### 43 Northwest Africa 13571 (NWA 13571)

44 Morocco

45 Purchased: 2013

46 Classification: HED achondrite (Eucrite, melt breccia)

47 **History:** Sergey Vasiliev and Marc Jost (*SJS*) purchased the 61.1 g specimen from a  
48 Mohammed Sbai in Ouzarzazate, Morocco, in April 2013.

49 **Physical characteristics:** Sample is an ovoid-shaped fragment. The exterior is partially  
50 coated with a greenish-orange rind that may be where the impact melt vein is exposed on the  
51 surface. The cut face of the sample shows a dark interior with an impact melt brecciated  
52 structure.  
53

54 **Petrography:** Sample shows breccia in breccia structure composed of angular to rounded  
55 clasts set within an opaque melt matrix. Clasts have brecciated textures composed of basaltic  
56 textured clasts set within a comminuted matrix crosscut by 2 mm thick opaque impact melt  
57 veins. Lithic fragments have subophitic textures with exsolved pyroxenes. Additional  
58 minerals are Si polymorph, chromite, ilmenite and apatite.  
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3 **Geochemistry:** (A. Love, *App*) low-Ca pyroxene,  $\text{Fs}_{61.5\pm 0.6}\text{Wo}_{2.7\pm 0.8}$  ( $\text{Mg}\#36.7\pm 0.4$ ,  
4  $\text{Fe}/\text{Mn}=30.0\pm 1.1$ ,  $n=25$ ); pigeonite,  $\text{Fs}_{55.9\pm 4.1}\text{Wo}_{11.0\pm 3.4}$  ( $\text{Fe}/\text{Mn}=30.2\pm 0.3$ ,  $n=2$ ); high-Ca  
5 pyroxene,  $\text{Fs}_{27.7\pm 3.5}\text{Wo}_{42.3\pm 4.1}$  ( $\text{Fe}/\text{Mn}=30.2\pm 0.8$ ,  $n=17$ ); plagioclase,  $\text{An}_{88.8\pm 2.2}\text{Or}_{0.4\pm 0.2}$  ( $n=24$ ).  
6 **Classification:** HED achondrite (eucrite impact melt breccia). Based on textures and mineral  
7 compositions, sample is a basaltic eucrite impact melt breccia.  
8 **Specimens:** Sergey Vasiliev and Marc Jost (*SJS*) hold the main mass. A type sample of  
9 composed of a slice and end cut weighing 12.23 g and a polished thin section are on deposit  
10 at *App*.  
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#### 15 Northwest Africa 13572 (NWA 13572)

16 Western Sahara

17 Purchased: 2020

18 Classification: HED achondrite (Howardite)

19 **History:** A nomad found the 1650 g sample in three pieces Western Sahara. Samples were  
20 purchased by Carlos Muñecas (Expometeoritos) in Errachidia, with the help of Hmad Ait  
21 Hssain in 2020.  
22

23 **Physical characteristics:** Samples occur as fragments from a larger, irregularly shaped mass.  
24 Exterior is coated in a layer of dark orange caliche. Dark wind ablated fusion crust coats  
25 approximately 30% of sample.

26 **Petrography:** Description and classification (A. Love, *App*) Polymict breccia composed of  
27 mm-sized, angular lithic and mineral clasts of eucrite and diogenite. Clast lithologies are:  
28 fine-grained basalts with zoned phenocrysts, recrystallized cumulate clasts, brecciated clasts,  
29 impact melt lithologies, pyroxene-rimmed Si clasts and diogenite mineral fragments and  
30 breccias. Additional minerals are: olivine, chromite, troilite, ilmenite and phosphates.

31 **Geochemistry:** (A. Love, *App*) Diogenite: Olivine,  $\text{Fa}_{55.2\pm 6.7}$  ( $\text{Fe}/\text{Mn}=50.3\pm 1.8$ ,  
32  $\text{Mg}\#=44.8\pm 6.7$ ,  $n=9$ ); low-Ca pyroxene,  $\text{Fs}_{27.8\pm 3.2}\text{Wo}_{3.4\pm 1.0}$  ( $\text{Fe}/\text{Mn}=30.3\pm 4.5$ ,  $\text{Mg}\#=71.2\pm 3.4$   
33  $n=14$ ); eucrite: low-Ca pyroxene,  $\text{Fs}_{44.5\pm 8.2}\text{Wo}_{3.7\pm 1.1}$  ( $\text{Fe}/\text{Mn}=30.5\pm 1.7$ ,  $n=14$ ); pigeonite,  
34  $\text{Fs}_{42.3\pm 9.5}\text{Wo}_{12.9\pm 10.1}$  ( $\text{Fe}/\text{Mn}=29.8\pm 1.7$ ,  $n=13$ ); high-Ca pyroxene,  
35  $\text{Fs}_{26.6\pm 12.0}\text{Wo}_{38.6\pm 7.7}$  ( $\text{Fe}/\text{Mn}=27.3\pm 3.3$ ,  $n=13$ ); plagioclase,  $\text{An}_{94.1\pm 1.2}\text{Or}_{0.1\pm 0.1}$  ( $n=7$ ).  
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38 **Classification:** HED achondrite (howardite M-S2, low weathering). Sample is an HED  
39 achondrite based on textures of clasts and Fe/Mn ratios in pyroxenes. Sample is a howardite  
40 based on subequal abundance of eucrite and diogenite.

41 **Specimens:** Carlos Muñecas (Expometeoritos) holds the 265 g main mass. A fragment  
42 weighing 22.24 g a mount and a polished thin section are on deposit at *App*.  
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#### 46 Northwest Africa 13573 (NWA 13573)

47 Morocco

48 Purchased: 2020

49 Classification: CVox3

50 **History:** Many samples weighing a total of 2880 g were found by a nomad in northwest  
51 Africa. These meteorites were purchased by Carlos Muñecas and Adrián Contreras in  
52 Errachidia, from Hmad Ait Hssain.  
53

54 **Physical characteristics:** Samples are dark in color, irregularly shaped, and have a partial  
55 coating of wind-ablated fusion crust. Chondrules and CAIs are visible on the cut face.

56 **Petrography:** Description and classification (A. Love, *App*): Chondrite composed of well-  
57 defined, dispersed chondrules (average apparent diameter of 696  $\mu\text{m}$ ,  $n=40$ ) and CAIs set  
58 w/in an opaque fine-grained matrix. Chondrules contain sulfide and oxide droplets and platy  
59 ferroan olivine. Additional minerals are: Ni-sulfide, spinel, plagioclase and apatite.  
60

**Geochemistry:** (A. Love, *App*) Olivine: Type I,  $Fa_{5.0\pm 2.9}$  ( $Fa_{1.2-9.8}$ ,  $Fe/Mn=58.4\pm 21.1$ ,  $n=11$ ); Type II,  $Fa_{23.0\pm 14.7}$  ( $Fa_{10.1-36.8}$ ,  $Fe/Mn=121.6\pm 36.0$ ,  $n=4$ ); low-Ca pyroxene,  $Fs_{1.8\pm 1.6}Wo_{1.3\pm 1.2}$  ( $Fe/Mn=11.2\pm 8.0$ ,  $n=16$ ); Ni content in sulfide is  $12.9\pm 11.1$  wt% ( $n=14$ ).  
**Classification:** Carbonaceous chondrite (CV3). Based on textures, and mineral compositions sample is a CV3. Based on magnetic susceptibility and Ni compositions of FeS grains sample belongs to the Ox-Allende subgroup [Gattacceca et al., 2020](#).  
**Specimens:** Adrián Contreras and Carlos Muñecas (Expometeoritos) hold the 614 g main mass. A fragment weighing 20.3 g and polished thin section are on deposit at *App*.

#### Northwest Africa 13574 (NWA 13574)

Morocco

Purchased: 2020

Classification: HED achondrite (Howardite)

**History:** A single stone weighing 1525 g was found by a nomad in Western Sahara. This meteorite was purchased in 2020 by Carlos Muñecas (Expometeoritos) in Errachidia, with the help of Hmad Ait Hssain.

**Physical characteristics:** Sample is irregularly shaped and shows broad regmaglypts. A black, contraction-cracked fusion crust covers approximately 70% of the sample. The interior is light gray and shows a fine-grained, brecciated texture.

**Petrography:** Description and classification (A. Love, *App*) Sample is a polymict breccia composed of a subequal, comminuted mixture of diogenite and eucrite mineral fragments with sparse angular lithic clasts up to 5mm. Lithic fragments are: basaltic and cumulate-textured eucrite, rare diogenite, shock-darkened and impact melt clasts. Pyroxenes are exsolved. Additional minerals are: ferroan olivine, an Si polymorph, apatite, chromite, ilmenite and troilite.

**Geochemistry:** (A. Love, *App*) Diogenite: Olivine ( $Fa_{33.5}$ ,  $Fe/Mn=46.0$ ,  $Mg\#=66.5$ ,  $n=1$ ); low-Ca Pyroxene ( $Fs_{22.2\pm 3.3}Wo_{2.6\pm 0.7}$ ,  $Fe/Mn=28.9\pm 2.5$ ,  $Mg\#=77.1\pm 3.6$ ,  $n=5$ ); eucrite: olivine ( $Fa_{82.2-96.6}$ ,  $Fe/Mn=43.4\pm 2.6$ ,  $Mg\# 3.4-17.7$ ); low-Ca Pyroxene ( $Fs_{43.4\pm 9.0}Wo_{4.8\pm 2.0}$ ,  $Fe/Mn=29.2\pm 2.1$ ,  $n=9$ ); pigeonite ( $Fs_{55.2\pm 7.0}Wo_{8.3\pm 1.7}$ ,  $Fe/Mn=29.9\pm 1.9$ ,  $n=11$ ); high-Ca pyroxene ( $Fs_{38.5\pm 13.3}Wo_{35.3\pm 6.3}$ ,  $Fe/Mn=33.7\pm 3.9$ ,  $n=12$ ); plagioclase ( $An_{92.8\pm 3.5}Or_{0.1\pm 0.1}$ ,  $n=9$ ).

**Classification:** Achondrite (howardite). Mineral compositions and textures indicate this sample is an HED achondrite. Subequal abundance of eucrite and diogenite mineral fragments indicate sample is a howardite.

**Specimens:** Carlos Muñecas (Expometeoritos) holds the main mass. Two fragments totaling 22.85 g and a polished thin section are on deposit at *App*.

#### Northwest Africa 13575 (NWA 13575)

Morocco

Purchased: 2020

Classification: Carbonaceous chondrite (CVox3)

**History:** Many samples of various sizes were found by a nomad in northwest Africa. These meteorites were by Adrián Contreras purchased the samples in Errachidia, Morocco, from Hmad Ait Hssain. Meteorites ranging in mass from a few grams to the main mass of 257 g.

**Physical characteristics:** Samples are dark in color, irregular-shaped and devoid of fusion crust. Chondrules and CAIs are visible on the exterior.

**Petrography:** Description and Classification (A. Love, *App*) Sample shows chondritic texture composed of dispersed chondrules (w/ and average apparent diameter of  $875\ \mu\text{m}$ ,  $n=19$ ) and CAI's in an opaque matrix. Additional minerals are: magnetite, Ni-rich sulfide, apatite.

**Geochemistry:** (A. Love, *App*) Olivine ( $Fa_{8.6\pm 10.5}$ , range  $Fa_{0.7-38.0}$ ,  $Fe/Mn=61.7\pm 46.8$ ,  $n=19$ ); low-Ca Pyroxene ( $Fs_{5.4\pm 4.5}Wo_{1.8\pm 1.0}$ ,  $Fe/Mn=15.6\pm 10.8$ ,  $n=4$ ); Ni content of sulfides= $15.7\pm 9.2$ ,  $n=9$ .

**Classification:** Carbonaceous chondrite (CVox3). Based on textures, and mineral composition sample is a CV3. Based on magnetic susceptibility and Ni content of sulfides sample belongs to the Ox-Bali subgroup ([Gattacceca et al., 2020](#)).

**Specimens:** Adrián Contreras holds the 257 g main mass. A 30.75 g fragment and a polished thin section are on deposit at *App*.

#### Northwest Africa 13579 (NWA 13579)

Niger

Find: 2019

Classification: Pallasite

**History:** Purchased in 2020 by Topher Spinnato and Oz Backman from a meteorite dealer in Niger.

**Physical characteristics:** The stones are brown in color and angular. Small patches of fusion crust are present. Amber, golden, and green olivine crystals are cleanly exposed at the surface.

**Petrography:** (D. Sheikh, *FSU*) 3-5mm fractured olivine grains set in a moderately weathered matrix of Fe-Ni metal and Fe-oxides.

**Geochemistry:** Olivine ( $Fa_{10.9\pm 0.2}$ , range  $Fa_{10.6-11.2}$ ,  $n=12$ ).

**Classification:** Pallasite

**Specimens:** 20.15 g at UCLA; main mass co-owned by Topher Spinnato and Oz Backman.

#### Northwest Africa 13580 (NWA 13580)

Algeria

Purchased: 2020

Classification: HED achondrite (Diogenite)

**History:** A single 700 g sample was found near Tindouf, Algeria, in 2019. Didi Baidari purchased the sample from a meteorite dealer in Tindouf.

**Physical characteristics:** The exterior of the ellipsoidal sample is wind-ablated and is an orangish-cream-colored and has brownish grains protruding through the surface. The interior shows a crystalline brecciated texture composed of cream colored and dark green crystals.

**Petrography:** Description and Classification (A. Love, *App*) Sample is a breccia composed of cumulate-textured clasts composed of (vol%): 2-5 mm grains of low-Ca pyroxene (66) and plagioclase (34) set within a recrystallized host of finer-grained (avg. grain-size 55 $\mu$ m) plagioclase and low-Ca pyroxene. Some pyroxenes show lamellar and blebby exsolution. Mineral phases within the recrystallized portion share 120° grain boundaries between adjacent minerals. Additional minerals are high-Ca pyroxene, chromite and troilite.

**Geochemistry:** Low-Ca Pyroxene ( $Fs_{31.5\pm 0.7}Wo_{3.7\pm 0.4}$ ,  $Fe/Mn=27.4\pm 0.9$ ,  $Mg\#=67.2\pm 0.7$ ,  $n=16$ ); high-Ca pyroxene ( $Fs_{16.0\pm 0.1}Wo_{39.5\pm 0.6}$ ,  $Fe/Mn=21.6\pm 1.3$ ,  $Mg\#=73.5\pm 0.2$ ,  $n=3$ ); plagioclase ( $An_{96.8\pm 0.2}Or_{0.0}$ ,  $n=10$ ); chromite ( $Cr\#=75.7\pm 3.7$ ,  $TiO_2=1.5\pm 0.1$ wt%,  $Mg\#=21.7\pm 1.24$ ,  $n=9$ ).

**Classification:** Achondrite (diogenite, noritic). Based on mineralogy, texture and Fe/Mn ratios within pyroxenes, sample is an HED achondrite. Composition of plagioclase, Fe/Mn ratios and Mg# of pyroxenes are intermediate between diogenites and cumulate eucrites. Ti Vs. Al of low Ca-pyroxenes plot within the field of diogenites. Ti, Al, Cr-content and Mg# of chromite fall in the range observed for diogenites. Abundance of plagioclase (34 vol%) within sample is anomalous for diogenites.

**Specimens:** Didi Baidari holds the main mass. 10 fragments weighing 23.89 g and a polished thin section and mount are on deposit at *App*.

### Northwest Africa 13581 (NWA 13581)

Algeria

Purchased: Dec. 2018

Classification: Martian meteorite (shergottite)

**History:** Purchased by Bo Zhang in Dec. 2018 from an anonymous dealer.

**Physical characteristics:** A single cone-shaped stone with fresh fusion crust and flowlines.

**Petrography:** The specimen is medium- to coarse-grained, exhibiting both poikilitic and non-poikilitic textures. In poikilitic regions, euhedral olivine is enclosed in coarse pyroxene (up to 3 mm). Non-poikilitic regions are composed of cumulate olivine (up to 1 mm), pyroxene and interstitial maskelynite. Other minerals include chromite, ilmenite, phosphate, troilite. Impact melt pockets are present.

**Geochemistry:** Olivine ( $\text{Fa}_{46.3-51.2}$ ,  $\text{FeO/MnO}=48.8-53.7$ ,  $n=24$ ); low-Ca pyroxene ( $\text{Fs}_{28.8-38.6}\text{Wo}_{6.0-12.0}$ ,  $\text{FeO/MnO}=31.1-38.8$ ,  $n=16$ ), Ca-rich pyroxene ( $\text{Fs}_{22.6-30.5}\text{Wo}_{21.2-34.9}$ ,  $\text{FeO/MnO}=30.2-31.9$ ,  $n=3$ ); maskelynite ( $\text{An}_{42.1-48.5}\text{Or}_{1.6-2.8}$ ,  $n=11$ ).

**Classification:** Composition of olivine and pyroxene are more ferrous than typical lherzolitic shergottites, but the texture (including pervasive maskelynitization) and chemical signatures (e.g., FeO and MnO of olivine and pyroxene, An and  $\text{K}_2\text{O}$  of maskelynite) are compatible with lherzolitic shergottites.

### Northwest Africa 13582 (NWA 13582)

(Northwest Africa)

Purchased: Jun. 2019

Classification: Lunar meteorite (feldspathic breccia)

**History:** Purchased by Bo Zhang in Jun. 2019 from an anonymous dealer.

**Physical characteristics:** Small vesicles are visible in the hand specimen.

**Petrography:** Lithic clasts and mineral fragments (0.01 to 2 mm) set in an anorthositic matrix. Lithic clasts include anorthositic, gabbroic, noritic and impact melted clasts. Mineral fragments are dominated by pyroxene and minor olivine. Plagioclase is highly Ca-rich ( $\text{K}_2\text{O} < 0.025$  wt%) while a few clasts contain relatively K-rich plagioclase ( $\text{K}_2\text{O} = 0.23-0.45$  wt%). Some pyroxene grains exhibit exsolved lamella. Vesicles are common. Other accessory minerals include ilmenite, troilite and FeNi metal.

**Geochemistry:** Plagioclase ( $\text{An}_{95.5-99.3}\text{Or}_{0-0.2}$ ,  $n=14$ ;  $\text{An}_{85.0-90.7}\text{Or}_{1.6-3.5}$ ,  $n=3$ ), olivine ( $\text{Fa}_{19.6-34.9}$ ,  $\text{FeO/MnO}=83.3-98.2$ ,  $n=7$ ), low-Ca pyroxene ( $\text{Fs}_{16.5-47.8}\text{Wo}_{2.4-13.2}$ ,  $\text{FeO/MnO}=48.2-62.7$ ,  $n=11$ ), Ca-rich pyroxene ( $\text{Fs}_{8.8-52.8}\text{Wo}_{27.2-44.3}$ ,  $\text{FeO/MnO}=43.6-73.4$ ,  $n=11$ ).

**Classification:** The texture and mineral composition are consistent with lunar feldspathic breccias.

### Northwest Africa 13583 (NWA 13583)

Tunisia

Purchased: Jul. 2019

Classification: HED achondrite (Eucrite)

**History:** Purchased by Bo Zhang in Jul. 2019 from an anonymous dealer.

**Physical characteristics:** A single large stone with a gray fusion crust and a few holes.



**Petrography:** The monomict brecciated specimen is composed dominantly of subhedral pyroxene and subhedral or lath-shaped plagioclase up to 0.5 mm. Pyroxene is extensively exsolved with  $\mu\text{m}$ -sized (<1 to 10  $\mu\text{m}$ ) lamellae. Accessory minerals include ilmenite, troilite and silica. Impact melt veins are present.

**Geochemistry:** Plagioclase ( $\text{An}_{85.6-97.6}\text{Or}_{0.1-1.3}$ ,  $n=10$ ), low-Ca pyroxene ( $\text{Fs}_{61.4-65.6}\text{Wo}_{1.4-5.8}$ ,  $\text{FeO/MnO}=31.6-37.0$ ,  $n=8$ ), Ca-rich pyroxene ( $\text{Fs}_{28.3-41.8}\text{Wo}_{31.7-42.5}$ ,  $\text{FeO/MnO}=29.4-33.0$ ,  $n=8$ ).

**Classification:** The brecciated texture, calcic plagioclase, relatively homogeneous composition of pyroxene are consistent with monomict eucrites.

#### Northwest Africa 13618 (NWA 13618)

Morocco

Purchased: 2019

Classification: Ordinary chondrite (L~4)

**History:** (Ziyao Wang) Purchased by Fangmei Wang from a Moroccan dealer at the China Mineral & Gem Show in *Beijing* City in Nov. 2019

**Physical characteristics:** (Ziyao Wang) Dark gray-yellow stone of 48 kg without fusion crust

**Petrography:** (R. Bartoschewitz) gray matrix with well-developed, darker gray to gray-black chondrules (0.3-2 mm, mean 0.7 mm), chondrule fragments and irregular metal and sulfide specks below 1 mm

**Geochemistry:** Magnetic susceptibility (R. Bartoschewitz, *Bart*)  $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.56$

**Classification:** Ordinary chondrite (L~4, W1)

**Specimens:** 24.3 g on deposit at *Kiel*, Fangmei Wang holds the main mass, and 77 g with *Bart*.

#### Northwest Africa 13619 (NWA 13619)

Morocco

Purchased: 2019

Classification: Ordinary chondrite (L~5)

**History:** (Ziyao Wang) Purchased by Chengguang Liang from a Moroccan dealer at the China Mineral & Gem Show in *Beijing* City in Nov. 2019

**Physical characteristics:** (Ziyao Wang) light-gray stone of 844 g without fusion crust

**Petrography:** (R. Bartoschewitz) gray recrystallized matrix with distinct chondrules (0.4-2 mm, mean 0.8 mm) and irregular metal and sulfide specks and patches up to 3 mm with rusty halos

**Geochemistry:** Magnetic susceptibility (R. Bartoschewitz, *Bart*)  $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.82$

**Classification:** Ordinary chondrite (L~5, W1)

**Specimens:** 23.0 g on deposit at *Kiel*, Chengguang Liang holds the main mass, and 83 g with *Bart*.

#### Northwest Africa 13620 (NWA 13620)

Morocco

Purchased: 2019

Classification: Ordinary chondrite (L~5)

**History:** (Ziyao Wang) Purchased by Weijiang from a Moroccan dealer at the China Mineral & Gem Show in *Beijing* City in Nov. 2019

**Physical characteristics:** (Ziyao Wang) Dark-yellow stone of 6 kg without fusion crust; weathering is significant

**Petrography:** (R. Bartoschewitz) gray matrix with distinct chondrules (0.4-2.5 mm, mean 0.8 mm), melt pockets and veins, and tiny metal and sulfide specks up to 1 mm

**Geochemistry:** Magnetic susceptibility (R. Bartoschewitz, *Bart*)  $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 5.17$

**Classification:** Ordinary chondrite (L~5, W2)

**Specimens:** 25.4 g on deposit at *Kiel*, Weijiang Wang holds the main mass, and 122 g with *Bart*.

### Northwest Africa 13621 (NWA 13621)

Mali

Purchased: 2020 Jan-Sep

Classification: Lunar meteorite (feldspathic breccia)

**History:** Additional stones (total 49 pieces) very similar to the unusual and distinctive specimens classified as [Tisserlitrine 001](#), and which were recovered at the same location in Mali, were acquired from several dealers by John Higgins (500 g), Fabien *Kuntz* (311 g), Dirk Ross (407 g), and an Algerian team represented by David Lehman (390 g). Comparative assessment and analyses of samples from each of these batches of stones were conducted to confirm their pairing with the previous material.

**Physical characteristics:** Most of the specimens have a flattened slab-like form and all have distinctive medium-brown, "knobby" exterior surfaces coated by desert patina. Interiors of stones are multi-colored (pink, tan, gray) with some darker gray and white clasts and small grains of metal.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Breccia composed of mineral clasts of anorthite, olivine, augite and pigeonite, plus sparse lithic clasts of microcrystalline anorthosite with fine grained mafic phases, are set in a fine grained microvesicular matrix containing accessory altered kamacite, troilite and rare pentlandite together with secondary calcite and barite. Olivine grains have been partially replaced by inhomogeneous phyllosilicate-rich assemblages characterized by systematically low oxide analytical sums (89-94 wt.% ) and deficiency in manganese (yielding elevated FeO/MnO ratios of 119-122).

**Geochemistry:** Olivine ( $\text{Fa}_{24.5-40.6}$ , FeO/MnO = 77-98, N = 7), pigeonite ( $\text{Fs}_{20.6-24.0}\text{Wo}_{5.8-6.8}$ , FeO/MnO = 46-50, N = 3), augite ( $\text{Fs}_{14.1-14.4}\text{Wo}_{37.3-41.4}$ , FeO/MnO = 50-54, N = 3), anorthite ( $\text{An}_{94.6-97.5}\text{Or}_{0.0-0.1}$ , N = 3).

**Classification:** Lunar (feldspathic regolithic breccia, partially hydrothermally-altered). The colors, textures, mineral compositions and distinctive secondary alteration in these specimens establish beyond doubt that they are paired stones to Tisserlitrine 001.

**Specimens:** 22.2 g including a polished endcut and one polished mount at *UWB*; 25 g plus one polished thin section at *PSF*; remaining material with Mr. J. Higgins, *Kuntz*, Mr. D. Ross and Mr. D. Lehman.

### Northwest Africa 13623 (NWA 13623)

(Northwest Africa)

Purchased: 2020 Sept

Classification: Mesosiderite

**History:** The meteorite was found near El Hank close to the border of Mali and Algeria and purchased by the main mass holders from a dealer in Morocco.

**Physical characteristics:** Three brownish fragments partly covered with fusion crust.

**Petrography:** Mesosiderite composed of silicate (about 60 vol%) and metallic (about 40 vol%) portions. In the metallic lithology kamacite dominates over taenite some of which altered to iron-oxides. The silica fraction is predominantly composed of up to 1 mm sized often compositionally zoned low-Ca pyroxene, less abundant Ca-pyroxene (mostly as blebs in orthopyroxene), calcic plagioclase, and minor silica and merrillite.

**Geochemistry:** zoned low-Ca pyroxene:  $\text{Fs}_{32.9\pm 4.5}\text{Wo}_{3.8\pm 0.5}$  ( $\text{Fs}_{26.7-39.4}\text{Wo}_{2.9-4.4}$ ,  $n=10$ ,  $\text{FeO/MnO}=22\pm 3$ ); Ca-pyroxene:  $\text{Fs}_{19.8\pm 0.5}\text{Wo}_{39.9\pm 0.1}$  ( $\text{Fs}_{19.0-20.4}\text{Wo}_{38.2-41.2}$ ,  $n=5$ ,  $\text{FeO/MnO}=17\pm 1$ ); calcic plagioclase:  $\text{An}_{94.1\pm 0.5}$  ( $\text{An}_{93.7-94.8}$ ,  $n=5$ )

### Northwest Africa 13624 (NWA 13624)

(Northwest Africa)

Purchased: 2020 Oct

Classification: Primitive achondrite (Winonaite)

**History:** The meteorite was purchased from a dealer in Morocco.

**Physical characteristics:** Three dark-brownish fragments partly covered with fusion crust. Large exposed metal areas are visible.

**Petrography:** The meteorite displays a recrystallized texture predominantly composed of typically 100 to 300  $\mu\text{m}$  sized low-Ca pyroxene, forsteritic olivine, augite, and some sodic feldspar grains with enstatite being the most abundant mineral phase. 120 degree triple junctions are frequent; no chondrules were observed. Kamacite, taenite, and troilite are mostly finely dispersed throughout the meteorite and veins are only rarely found. Contains minor apatite.

**Geochemistry:** olivine:  $\text{Fa}_{3.2\pm 0.1}$  ( $\text{Fa}_{3.2-3.4}$ ,  $\text{FeO/MnO}=16\pm 1$ ,  $n=6$ ); low-Ca pyroxene:  $\text{Fs}_{3.9\pm 0.1}\text{Wo}_{1.9\pm 0.1}$  ( $\text{Fs}_{3.8-4.0}\text{Wo}_{1.7-1.9}$ ,  $\text{FeO/MnO}=14\pm 2$ ,  $n=5$ ); Ca-pyroxene:  $\text{Fs}_{1.1\pm 0.1}\text{Wo}_{44.5\pm 0.9}$  ( $\text{Fs}_{1.0-1.4}\text{Wo}_{43.2-45.9}$ ,  $\text{FeO/MnO}=9\pm 3$ ,  $n=6$ ); feldspar:  $\text{An}_{22.6\pm 0.2}\text{Ab}_{74.9\pm 0.3}\text{Or}_{2.5\pm 0.1}$ ,  $n=3$

### Northwest Africa 13625 (NWA 13625)

(Northwest Africa)

Purchased: 2020 Oct

Classification: Lunar meteorite (feldspathic breccia)

**History:** The meteorite was purchased from a dealer in Morocco.

**Physical characteristics:** Dark-grayish fragment without fusion crust.

**Petrography:** Feldspathic breccia composed of mineral fragments, basaltic, and impact melt clasts cemented by a mostly shock-melted groundmass. Predominant minerals are calcic plagioclase, olivine, exsolved pyroxene, and pyroxenes showing complex patchy zoning. Minor phases are chromite, ilmenite, and FeS. No metallic was detected. Shock melt frequently shows schlieren and pronounced flow textures.

**Geochemistry:** olivine:  $\text{Fa}_{23.7\pm 7.3}$  ( $\text{Fa}_{16.9-44.1}$ ,  $\text{FeO/MnO}=83\pm 8$ ,  $n=16$ ); fayalite:  $\text{Fa}_{80.8\pm 0.1}$ ,  $\text{FeO/MnO}=95\pm 2$ ,  $n=2$ ; low-Ca pyroxene:  $\text{Fs}_{19.6\pm 0.2}\text{Wo}_{3.2\pm 0.7}$  ( $\text{Fs}_{19.3-19.8}\text{Wo}_{2.2-4.2}$ ,  $\text{FeO/MnO}=45\pm 4$ ,  $n=5$ ); Ca-pyroxene:  $\text{Fs}_{8.2\pm 0.3}\text{Wo}_{44.1\pm 0.8}$  ( $\text{Fs}_{7.6-8.6}\text{Wo}_{42.8-45.4}$ ,  $\text{FeO/MnO}=28\pm 2$ ,  $n=6$ ); complex zoned pyroxene:  $\text{Fs}_{38.3\pm 9.6}\text{Wo}_{15.4\pm 3.2}$  ( $\text{Fs}_{29.2-50.9}\text{Wo}_{9.3-18.6}$ ,  $\text{FeO/MnO}=55\pm 8$ ,  $n=5$ ); calcic plagioclase:  $\text{An}_{96.1\pm 0.8}$  ( $\text{An}_{95.2-97.0}$ ,  $n=7$ )

**Classification:** Lunar (feldspathic breccia)

### Northwest Africa 13627 (NWA 13627)

(Northwest Africa)

Purchased: 2020 Oct

Classification: Ordinary chondrite (H3)

**History:** The meteorite was purchased from a dealer in Morocco.

**Physical characteristics:** Dark-brownish fragment without fusion crust.

**Petrography:** The meteorite shows a chondritic texture with well separated mostly rounded chondrules (apparent mean diameter about 0.4 mm) in a fine-grained dark matrix that contains sulfides and abundant FeNi metal.

#### Northwest Africa 13628 (NWA 13628)

(Northwest Africa)

Purchased: 2020 Oct

Classification: HED achondrite (Eucrite)

**History:** The meteorite was found by Mr. Muhamad Salm and subsequently purchased by the main mass holder from a dealer in Adrar, Algeria.

**Physical characteristics:** Dark-grayish fragment without fusion crust.

**Petrography:** Predominantly composed of up 3 mm sized exsolved pyroxene and calcic plagioclase fragments cemented by abundant shock melt. Shock melt is partly recrystallized with lath-shaped plagioclase needles; embedded mineral fragment are partially resorbed. Minor phases are silica, chromite, and FeS; no metallic iron has been detected. The meteorite contains secondary barite and calcite-filled cracks.

**Geochemistry:** low-Ca pyroxene:  $\text{Fs}_{33.9\pm 0.3}\text{Wo}_{2.2\pm 0.1}$  ( $\text{Fs}_{33.5-34.6}\text{Wo}_{2.0-2.3}$ ,  $n=11$ ,  $\text{FeO/MnO}=25-28$ ); Ca-pyroxene:  $\text{Fs}_{12.6\pm 0.8}\text{Wo}_{44.9\pm 0.9}$  ( $\text{Fs}_{10.8-13.8}\text{Wo}_{44.0-47.0}$ ,  $n=13$ ,  $\text{FeO/MnO}=18-21$ ); calcic plagioclase:  $\text{An}_{92.9\pm 0.9}$  ( $\text{An}_{91.7-93.9}$ ,  $n=5$ )

#### Northwest Africa 13629 (NWA 13629)

(Northwest Africa)

Purchased: 2020 Oct

Classification: Ordinary chondrite (H5)

**History:** The meteorite was found by Mr. Muhamad Salm and subsequently purchased by the main mass holder from a dealer in Tindouf, Algeria.

**Physical characteristics:** Dark brownish fragment with some fusion crust.

**Petrography:** The plagioclase grain size is about 20  $\mu\text{m}$ .

#### Northwest Africa 13630 (NWA 13630)

(Northwest Africa)

Purchased: 2020

Classification: HED achondrite (Diogenite)

**History:** The meteorite was purchased from a dealer in Morocco.

**Physical characteristics:** Six fragments some of which almost completely covered with fusion crust.

**Petrography:** Fragmental breccia predominantly composed of up to 1.5 mm sized orthopyroxene crystals set into fine-grained related matrix. Some of the pyroxenes display magmatic zoning. Minor phases include olivine, calcic plagioclase, chromite, FeS, and FeNi-metal.

**Geochemistry:** zoned low-Ca pyroxene:  $\text{Fs}_{24.5\pm 1.5}\text{Wo}_{2.0\pm 0.6}$  ( $\text{Fs}_{22.9-27.7}\text{Wo}_{1.1-2.8}$ ,  $n=16$ ,  $\text{FeO/MnO}=26\pm 2$ ); olivine:  $\text{Fa}_{35.3\pm 0.1}$  ( $\text{Fa}_{35.1-35.6}$ ,  $n=16$ ,  $\text{FeO/MnO}=44\pm 2$ )

**Classification:** Diogenite (olivine-bearing)

**Northwest Africa 13631** (NWA 13631)

(Northwest Africa)

Purchased: 2016

Classification: Carbonaceous chondrite (CR2)

**History:** The meteorite was purchased from a dealer in Morocco.**Physical characteristics:** Dark-brownish fragment without fusion crust.**Petrography:** Carbonaceous chondrite composed of abundant, mostly rounded, sometimes slightly flattened chondrules with an apparent mean diameter of about 700  $\mu\text{m}$  and about 30% almost black matrix. Chondrules are predominately of type I; one type II chondrule present. Some chondrules are metal-decorated and contain 150-200  $\mu\text{m}$  sized metal blebs typical of CR. CAIs are sparse; only one has been encountered in the section studied. Low matrix totals suggest presence of hydrous mineral phases.**Geochemistry:** olivine in type I chondrules:  $\text{Fa}_{2.7\pm 0.7}$ ,  $\text{Cr}_2\text{O}_3$ :  $0.73\pm 0.12$  wt%,  $n=15$ ; low-Ca pyroxene:  $\text{Fs}_{3.3\pm 0.8}\text{Wo}_{0.8\pm 0.1}$ ,  $n=12$ ; olivine in type II chondrules:  $\text{Fa}_{19.3\pm 6.8}$  ( $\text{Fa}_{13.9-31.0}$ ,  $n=7$ ). Matrix analyses yield an average total of  $84.8\pm 1.1$  wt% (5  $\mu\text{m}$  defocused beam,  $N=12$ ) suggesting the presence of hydrous minerals.**Northwest Africa 13632** (NWA 13632)

Morocco

Purchased: 2019 Dec

Classification: Enstatite chondrite (EH6)

**History:** The meteorite was purchased by Ziyao Wang from Smara Addi in Tarfaia, Laayoune, Morocco, Dec. 2019**Physical characteristics:** The meteorite is weathered highly with some relict fusion crust. The surface color is gray-brown with rusty spots. The Fe-Ni metal and sulfides are visible in the cut.**Petrography:** The meteorite shows a granular recrystallized texture composed of enstatite (~65 vol.%, 0.1-0.5 mm in size), plagioclase (15 vol.%, 0.1-0.3 mm in size) and ~20 vol.% opaque minerals (including ~8 vol% Si-bearing kamacite and ~5 vol.% sulfides and schreibersite), no olivine is found. There are a few relict chondrules found in the section. Its weathering is strong with much of the kamacite and sulfides altered to brown limonite.**Geochemistry:** Enstatite:  $\text{En}_{97.91-98.46}\text{Fs}_{0.27-1.16}\text{Wo}_{0.93-1.45}$  ( $n=12$ ); Plagioclase:  $\text{An}_{13.62-14.93}\text{Or}_{2.72-4.62}$  ( $n=12$ ); Si-bearing kamacite: Fe=85.99-92.84 wt%, Ni=5.04-7.63 wt%, Si=2.53-3.36 wt% ( $n=16$ ); Schreibersite: 67.13-72.48 wt% Fe, 12.48-14.88 wt% Ni, 9.53-14.36 wt% P, 0.16-0.22 wt% Si, 0.17-0.30 wt% Co ( $n=12$ ); Troilite: 35.34-36.43 wt% S, 58.80-63.33 wt% Fe, 0.54-1.31 wt% Cr, 0.06-0.32 wt% Ti ( $n=10$ ); Cr-bearing sulfides: 52.1-53.1 wt% Fe, 38.89-40.00 wt% S, 3.88-4.78 wt% Cr ( $n=10$ ).**Classification:** Enstatite chondrite (EH6)**Specimens:** 72.9 g including one polished thin section are deposited in *GUT***Northwest Africa 13633** (NWA 13633)

Algeria

Purchased: 2020

Classification: Ordinary chondrite (LL3)

**History:** Purchased from Mostafa Hnini, reportedly found in Algeria in 2019.



**Physical characteristics:** One piece with no fusion crust. A sawn surface reveals many densely packed chondrules of variable size.

**Petrography:** (C. Agee, *UNM*) Microprobe examination of a polished mount shows numerous unequilibrated chondrules, apparent mean diameter  $1000 \pm 600 \mu\text{m}$  ( $n=13$ ), many with porphyritic, igneous-zoned olivines and pyroxenes, most with glass or mesostasis. Abundant fine-grained matrix throughout.

**Geochemistry:** (C. Agee, *UNM*) All chondrule olivine  $\text{Fa}_{18.7 \pm 9.4}$ , range  $\text{Fa}_{0.6-33.7}$ ,  $\text{Fe/Mn}=47 \pm 16$ ,  $\text{Cr}_2\text{O}_3=0.10 \pm 0.11 \text{ wt}\%$ ,  $n=20$ ; low-Ca pyroxene  $\text{Fs}_{13.7 \pm 6.6}\text{Wo}_{1.0 \pm 1.4}$ ,  $\text{Fe/Mn}=31 \pm 18$ ,  $n=10$ .

**Classification:** Ordinary chondrite (LL3), estimated subtype 3.4 based.

**Specimens:** 30 g on deposit at *UNM*, Simon de Boer holds the main mass.

#### Northwest Africa 13634 (NWA 13634)

Morocco

Purchased: 2017

Classification: HED achondrite (Howardite)

**History:** Purchased from AJ meteorites, found June 2017, Morocco.

**Physical characteristics:** Single stone partially covered in weathered fusion crust. A saw cut reveals a breccia with light and dark clasts set in a light-tan matrix.

**Petrography:** (C. Agee, *UNM*) This meteorite is a polymict breccia consisting of approximately 55% diogenite and 45% eucrite clasts. Accessory opaques, fayalitic olivine, and silica observed.

**Geochemistry:** (C. Agee, *UNM*) Diogenite low-Ca pyroxene  $\text{Fs}_{27.1 \pm 3.1}\text{Wo}_{3.1 \pm 0.4}$ ,  $\text{Fe/Mn}=28 \pm 2$ ,  $n=11$ ; eucrite low-Ca pyroxene  $\text{Fs}_{53.4 \pm 6.4}\text{Wo}_{5.6 \pm 3.4}$ ,  $\text{Fe/Mn}=31 \pm 2$ ,  $n=9$ ; plagioclase  $\text{An}_{90.2 \pm 2.7}$ ,  $n=7$ .

**Classification:** Howardite

**Specimens:** 20.1 g on deposit at *UNM*, Simon de Boer holds the main mass.

#### Northwest Africa 13635 (NWA 13635)

Algeria

Purchased: 2020

Classification: Ordinary chondrite (H6)

**History:** Reportedly found near Tablat, Algeria, in May 2020.

**Physical characteristics:** Eighteen identically appearing stones found together. All stones have fresh fusion crust. A broken surface reveals a fine-grained gray matrix with many scattered brown patches.

**Petrography:** (C. Agee, *UNM*) Microprobe examination of a polished mount shows a few small scattered chondrules set in recrystallized matrix. Abundant fresh, unweathered metal grains observed.

**Geochemistry:** (C. Agee, *UNM*) Olivine  $\text{Fa}_{18.5 \pm 0.1}$ ,  $\text{Fe/Mn}=38 \pm 2$ ,  $n=10$ ; low-Ca pyroxene  $\text{Fs}_{16.3 \pm 0.0}\text{Wo}_{1.5 \pm 0.1}$ ,  $\text{Fe/Mn}=22 \pm 1$ ,  $n=5$ .

**Classification:** Ordinary chondrite (H6)

**Specimens:** 25.9 g on deposit at *UNM*, Matthew Stream holds 17 stones 2318 g, Martin Lollar holds a 595.6 g stone.

#### Northwest Africa 13636 (NWA 13636)

Algeria

Purchased: 2018

Classification: HED achondrite (Eucrite, unbrecciated)

**History:** Reportedly found near Bechar, Algeria in 2018.

**Physical characteristics:** Five identically appearing stones found together. All stones have smooth sand blasted exterior surfaces. Saw-cut surfaces reveal a gray, fine-grained basaltic texture.

**Petrography:** (C. Agee, *UNM*) Microprobe examination of a polished mount shows a intergranular texture with approximately 50% pyroxene and 40% plagioclase. Plagioclase grains are lath-shaped up to 500  $\mu\text{m}$  in length. Accessory phases include chromite, Cr-rich ilmenite, and silica.

**Geochemistry:** (C. Agee, *UNM*) Low-Ca pyroxene  $\text{Fs}_{53.7\pm 3.6}\text{Wo}_{15.1\pm 5.0}$ ,  $\text{Fe/Mn}=33\pm 1$ ,  $n=16$ ; plagioclase  $\text{An}_{86.8\pm 0.9}\text{Ab}_{12.4\pm 0.9}$ ,  $n=8$ .

**Classification:** Basaltic eucrite, unbrecciated

**Specimens:** 21.9 g on deposit at *UNM*, Matthew Stream holds 278.92 g, John Divelbiss holds 595.6 g stone.

### Nova 062

California, United States

Find: 2016 Nov 11

Classification: Ordinary chondrite (L5)

**History:** A single 1500 g stone was purportedly found in California by Robert *Verish* on November 11, 2016.

**Physical characteristics:** Stone has a greenish-brown, relict fusion-crust. Parts of the fusion crust has been devitrified and weathered away, it readily reveals the fabric of the interior showing numerous matrix-supported chondrules of various color and size.

**Petrography:** (Daniel Sheikh, *FSU*) Chondrule boundaries blurred ( $750\pm 50\ \mu\text{m}$ ,  $N=6$ ). Recrystallized coarse-grained matrix with plagioclase (20-30  $\mu\text{m}$ ). Numerous interconnected iron-oxide veins. Troilite, FeNi-metal, and chromite are also present. (A. Rubin, *UCLA*) Troilite is polycrystalline. A 0.5  $\mu\text{m}$  grain of metallic copper found inside metal.

**Geochemistry:** Olivine,  $\text{Fa}_{24.4\pm 0.2}$  ( $N=25$ ); orthopyroxene,  $\text{Fs}_{22.1\pm 0.22}\text{Wo}_{2.0\pm 0.1}$  ( $N=25$ ).

**Classification:** Ordinary Chondrite (L5)

**Specimens:** 100 grams at *UCLA*; main mass with *Verish*.

### Nova 063

California, United States

Find: 2016 Dec 12

Classification: Ordinary chondrite (H5)

**History:** A single 18.25 g stone was purportedly found in California by Robert *Verish* on December 12, 2016.

**Physical characteristics:** A flat brownish-black fragment with a weathered fusion-crust. The one side not covered in fusion-crust has patches of a shiny-black desert-patina. The interior is just as dark as the exterior.

**Petrography:** (D. Sheikh, *FSU*) Chondrule boundaries blurred ( $600\pm 50\ \mu\text{m}$ ,  $N=2$ ). Recrystallized coarse-grained matrix with plagioclase (20-40  $\mu\text{m}$ ). Numerous interconnected iron-oxide veins. Troilite, FeNi-metal, and chromite are also present.

**Geochemistry:** Olivine,  $\text{Fa}_{19.8\pm 0.2}$  ( $N=25$ ); orthopyroxene,  $\text{Fs}_{18.9\pm 0.2}\text{Wo}_{1.9\pm 0.1}$  ( $N=25$ ).

**Classification:** Ordinary Chondrite (H5)

**Specimens:** 4.8 grams at *UCLA*; main mass with *Verish*.

**Nova 064**

California, United States

Find: 2016 Dec 13

Classification: Ordinary chondrite (H5)

**History:** A single 70.88 g stone was purportedly found in California by Robert *Verish* on December 13, 2016.

**Physical characteristics:** A very dark-brown stone with a 3-sided pyramid shape. One side appears to be covered in relict fusion-crust by evidence of tiny vesicles, but this observation was confounded when a saw-cut of the interior revealed numerous pores in a nearly friable groundmass.

**Petrography:** (D. Sheikh, *FSU*) Chondrule boundaries blurred ( $300\pm 100\ \mu\text{m}$ ,  $N=3$ ). Recrystallized coarse-grained matrix with plagioclase ( $40\text{--}45\ \mu\text{m}$ ). Numerous interconnected iron-oxide veins. Troilite, FeNi-metal, and chromite are also present.

**Geochemistry:** Olivine,  $\text{Fa}_{19.4\pm 0.2}$  ( $N=25$ ); orthopyroxene,  $\text{Fs}_{18.8\pm 0.2}\text{Wo}_{1.9\pm 0.1}$  ( $N=25$ ).

**Classification:** Ordinary Chondrite (H5)

**Specimens:** 14.3 g at *UCLA*; main mass with *Verish*.

**Nova 065**

(Unknown)

Find: 2016 Nov 23

Classification: Ordinary chondrite (L4)

**History:** On 2016 November 23, a 1144 g stone was purportedly found by Robert *Verish* in California.

**Physical characteristics:** A weathered, orange-brown stone. A 5-sided angular fragment, with one side fusion-crust, having deeply fluted regmaglypts. Other sides appear to have secondary fusion-crust but evidence is ephemeral due to devitrification, and the overall degree of weathering of the exterior.

**Petrography:** (D. Sheikh, *FSU*) Chondrules blurred ( $700\pm 50\ \mu\text{m}$ ,  $n=5$ ). Sample composed of olivine, low-Ca pyroxene, troilite, Fe-Ni metal, chromite, and Fe-oxides.

**Geochemistry:** Olivine ( $\text{Fa}_{24.3\pm 1.5}$ ,  $n=24$ ), low-Ca Pyroxene ( $\text{Fs}_{20.7\pm 1.5}\text{Wo}_{1.3\pm 0.5}$ ,  $n=18$ ).

**Classification:** Ordinary Chondrite (L4)

**Specimens:** 39.4 grams at *UCLA*; main mass with *Verish*.

**Novo Mesto** 45°49.01'N, 15°6.75'E

Slovenia

Confirmed fall: 28 Feb 2020

Classification: Ordinary chondrite (L5)

**History** (B. Ambrožič, *CENN*; J. Atanackov, *GeoZS*; M. Jeršek, *SMNH*): At 10:31 AM (local time; 9:31 UT) on 28 February 2020, a very large fireball exploded over southeast Slovenia. It was seen by a large number of eyewitnesses in Slovenia, Croatia, Austria, Hungary, and Italy. As of 7 May 2020, three meteorite fragments totaling 720 g have been recovered. The first stone (203 g) was found by Gregor Kos on March 4 in the driveway to his house in the village of Prečna, near the town of Novo mesto (hence the name of the meteorite). The second stone (469 g) was found on March 10, near the village of Mirna Peč by an anonymous finder. The third stone (48 g) was found on March 14, in a forest near Novo mesto by Gaja Ukar Ekart. Extensive search efforts took place within the preliminary estimated strewnfield, however, in

the second half of March all search efforts were temporarily paused due to the COVID-19 pandemic lockdown.

**Physical characteristics** (B. Ambrožič, *CENN*; M. Jeršek, *SMNH*): About half of the first meteorite fragment (203 g) is covered by a brownish-black fusion crust. On the surface, few chondrules (up to 10 mm in size) and metal grains are visible. A network of thin dark shock veins protruding the light greyish interior of the meteorite is visible. Orange-brownish oxide rims formed around metal grains are indicative of a low weathering stage. The second stone (469 g) is brecciated with light-colored more or less rounded clasts in a dark fine-grained matrix. Clasts vary in size from less than a millimeter to a few centimeters. Less than 10 % of the stone's surface is covered by a fusion crust. The third stone (48 g) is almost entirely covered with a fusion crust. On cut surface a network of shock veins and melt pockets is visible.

**Petrography** (B. Ambrožič, *CENN*; L. Ferrière, *NHMV*; M. Miler, *GeoZS*): The light lithology (represented by the 203 g stone and as clasts within the brecciated stone) is moderately to severely shocked and thermally metamorphosed. Chondrule boundaries are poorly defined. Most of the chondrules (fragments) are fractured and displaced and are dominated by barred olivine, radial pyroxene, and porphyritic olivine-pyroxene types. Chondrule size varies from 200 to up to 2500  $\mu\text{m}$ , with an average size of about 500  $\mu\text{m}$ . Olivine crystals shows distinct sets of planar deformation features. Plagioclase size from 5 to 50  $\mu\text{m}$ . Troilite (8 vol.%), Fe-Ni metal (2 vol.%), chromite (0.6 vol.%), and phosphates (0.3 vol.%), including chlorapatite and merrillite, are present. Chromite occurs as subhedral grains in the matrix and chondrules, and as euhedral crystals in chromite-plagioclase assemblages. Numerous shock veins and melt pockets occur. The brecciated lithology (description based on observations conducted on the 469 g stone) is composed of several different types of clasts in a fine-grained matrix. The first type of clasts are of the light lithology. The second type of clasts are chondrules and fragments of chondrules. The third type of clasts are composed of poorly sorted euhedral olivine and low-Ca pyroxene, Fe-Ni metal, troilite, and chromite grains in a glassy matrix. The fourth type of clasts, so-called "breccia in breccia", consists of very poorly sorted anhedral olivine and low-Ca pyroxene grains (0.5-200  $\mu\text{m}$ ), chondrule fragments, Fe-Ni metal, troilite, and chromite grains in very fine-grained matrix of olivine and pyroxene grains. The matrix between the different types of clasts is composed of Fe-Ni metal, troilite, plagioclase, and pyroxene glass.

**Geochemistry** (M. Miler, *GeoZS*; B. Ambrožič, *CENN*): For the light lithology: Olivine is  $\text{Fa}_{25.1\pm 0.7}$  (N=63). Low-Ca Pyroxene is  $\text{Fs}_{20.5\pm 1.4}\text{Wo}_{1.5\pm 0.1}$  (N=58). High-Ca pyroxene is  $\text{Fs}_{7.8\pm 0.6}\text{Wo}_{45.0\pm 0.8}$  (N=22). Plagioclase is  $\text{An}_{14.8\pm 5.7}\text{Ab}_{77.0\pm 1.1}\text{Or}_{8.2\pm 1.6}$  (N=7). Kamacite is Ni  $10.4\pm 3.6$  (N=4). Taenite Ni  $26.3\pm 3.7$  (N=12). Troilite is Fe  $61.1\pm 1.7$  (N=5). For the brecciated lithology: Olivine is  $\text{Fa}_{25.1\pm 0.8}$  (N=86). Low-Ca pyroxene is  $\text{Fs}_{21.2\pm 0.5}\text{Wo}_{1.5\pm 0.3}$  (N=54). High-Ca pyroxene is  $\text{Fs}_{8.1\pm 0.8}\text{Wo}_{44.4\pm 1.8}$  (N=17). Plagioclase is  $\text{An}_{5.6\pm 1.2}\text{Ab}_{85.7\pm 1.1}\text{Or}_{8.7\pm 0.6}$  (N=13). Kamacite is Ni  $13.2\pm 4.5$  (N=19). Taenite is Ni  $24.7\pm 3.1$  (N=7). Troilite is Fe  $61.1\pm 2.1$  (N=13). All data based on SEM-EDS investigations.

**Classification:** Ordinary chondrite (L5), shock stage (S5), weathering grade (W0/1).

**Specimens:** Three pieces with a total known mass of 720 g were found. The 203 g stone and 469 g are deposited at the *SMNH*.

**Noyon** 43°13'11.8"N, 102°39'56.7"E

Omnogovi, Mongolia

Find: 2018 Aug 25

Classification: Ordinary chondrite (LL(L)3)

**History:** Meteorite (one sample - 745.47 g) was found 25 August 2018 by the *UrFU - IAG-MAS* meteorite expedition-2018 in southern Gobi (Pastukhovich A.Yu., Kolunin R.N., Larionov M.Yu., Muraviev L.A., Petrova E.V., Yakovlev G.A., Naasa Ochir) in 45 km East of Noyon, the Ömnögovi aimag (province), Mongolia.

**Physical characteristics:** Size is 10x5x5 cm. The meteorite has roughly rounded shape. Exterior of the stone is desert polished. The surface and interior of the meteorite are gray to dark brown in color due to Fe-hydroxides. Fusion crust is locally present.

**Petrography:** Classification (Victor V. Sharygin, *SIGM* and *UrFU*). The meteorite shows a chondritic texture. The amount of chondrules and their fragments is more than 90 vol.%. Chondrules are well delineated. Average chondrule apparent diameter  $1008 \pm 442 \mu\text{m}$  ( $n=20$ ). Chondrule apparent diameter up to 2 mm. Chondrules are represented by BO, PO, POP, RP and CC textural types. Chondrules mainly consist of olivine, low-Ca-pyroxene and glassy-like (cryptocrystalline) matrix, diopside,  $\pm$ chromite and blebs of troilite and FeNi-metal. In all chondrules the mesostasis does not contain fresh glass, and is a finely devitrified aggregate of clinopyroxene and feldspar or nepheline-like phase. BSE images for some POP and PO chondrules show strong zonation for olivine and sometimes low-Ca-pyroxene, which can form skeletal/dendritic crystals. RP chondrules may contain  $\text{SiO}_2$  polymorph. All these indicate the high rate of quenching. Olivine and low-Ca-pyroxene are main minerals in fine-grained matrix; plagioclase was not observed. All petrographic features indicate a petrological type of 3 for the meteorite. Undulatory extinction and irregular fractures in olivine reveal a shock stage of S2. Majority of grains of FeNi-metal (30-400  $\mu\text{m}$ ) are mainly represented by kamacite, taenite and tetrataenite; but individual grains of kamacite also occur. Weathering products (hematite, goethite and other Fe-Ni-hydroxides, gypsum) are locally abundant and mainly occur as in situ partial alteration of FeNi-metal and troilite, and fill microfractures in all minerals (weathering grade – W2-3). The appearance of Ni-rich pyrrhotite and smythite maybe related to troilite alteration. Clinopyroxene, chromite, ilmenite, merrillite and chlorapatite (100-300  $\mu\text{m}$ ) occur locally in the matrix. Merrillite was also as rounded inclusions (up to 5  $\mu\text{m}$ ) in FeNi-metal and troilite. The abundances of FeNi-metal and sulfides are 3.5 and 4.3 vol.%, respectively (by point counting over 670  $\text{mm}^2$ , Pastukhovich A.Yu.).

**Geochemistry:** Mineral composition and Geochemistry: EDS-WDS analyses (V.V. Sharygin, *SIGM* and *UrFU*). The primary chondrite paragenesis includes olivine, low-Ca-pyroxene, Cr-bearing clinopyroxene ( $\text{Cr}_2\text{O}_3$  - up to 2.6 wt.%), plagioclase, spinel-supergroup minerals, ilmenite, chlorapatite, merrillite, FeNi-metal,  $\text{SiO}_2$  polymorph, troilite and maybe pyrrhotite. The main minerals drastically vary in composition. The averaged olivine is  $\text{Fa}_{21.47 \pm 7.10}$  ( $N=100$ ). The olivine grains from matrix have homogeneous composition –  $\text{Fa}_{26.78 \pm 0.95}$  ( $N=30$ ), max –  $\text{Fa}_{28.83}$ . However zoned olivine crystals in chondrules show a wider range:  $\text{Fa}_{19.31 \pm 7.50}$  ( $n=70$ ). The same situation exists with low-Ca-pyroxene: average -  $\text{Fs}_{13.51 \pm 7.98} \text{Wo}_{2.04 \pm 2.45}$  ( $N=63$ ); matrix –  $\text{Fs}_{18.53 \pm 6.5.13} \text{Wo}_{2.04 \pm 2.55}$  ( $N=19$ ), max –  $\text{Fs}_{24.6}$ ; chondrules ( $N=44$ ): average -  $\text{Fs}_{11.38 \pm 8.09} \text{Wo}_{2.05 \pm 2.43}$  ( $N=63$ ); core (min) –  $\text{Fs}_{2.87}$ , rim (max) –  $\text{Fs}_{36.85}$ . The maximal values of Fa and Fs in olivine and low-Ca pyroxene outline the LL group, whereas high standard deviations for these minerals in chondrules may indicate subtype 3.0-3.3. Plagioclase is rare and found only in matrix of some POP chondrules: anorthite  $\text{An}_{76.6} \text{Ab}_{21.7} \text{Or}_{1.7}$  ( $N=4$ ) occurs in the POP chondrules with zoned olivine, whereas albite  $\text{Ab}_{89.6} \text{An}_{5.1} \text{Or}_{5.4}$  ( $N=8$ ) is common of other POP chondrules. Spinel-supergroup minerals are represented by chromite  $\text{Cr}_{89.6} \text{Spl}_{4.5}$  ( $N=10$ , common in matrix and chondrules) and zoned Cr-rich spinel (in some chondrules) with composition from  $\text{Spl}_{58.6} \text{Cr}_{39.9}$  (core) to  $\text{Spl}_{82.0} \text{Cr}_{16.1}$  (rim). Ilmenite is  $\text{Ilm}_{87.3}$  ( $N=7$ ). Composition of metals (in wt.%): kamacite ( $N=25$ ) – Fe 93.62 $\pm$ 0.85, Ni – 5.63 $\pm$ 0.86, Co – 0.82 $\pm$ 0.13; taenite ( $N=10$ ) – Fe 60.76, Ni 38.93, Co 0.22; tetrataenite ( $N=12$ ) – Fe 49.52, Ni 50.33, Co 0.16. Nepheline-normative glassy-like aggregate (or nepheline ?) in a POP chondrule with zoned olivine has following



composition (in wt.%, N=12): SiO<sub>2</sub> 48.58, Al<sub>2</sub>O<sub>3</sub> 28.42, TiO<sub>2</sub> 1.18, Cr<sub>2</sub>O<sub>3</sub> 0.62, FeO 2.52, MgO 0.69, CaO 0.57, Na<sub>2</sub>O 14.97, K<sub>2</sub>O 2.28.

**Classification:** Ordinary chondrite. LL(L)3, S2, W2-3. In variations of Fa in olivine and Fs in low-Ca pyroxene in chondrules it seems to be related to 3.0-3.3 subtype. Chondrule size points to LL, but the metal content points to L, hence the LL(L) designation.

**Specimens:** 636 g sample – *IAG-MAS*; 102.72 g sample – *UrFU*; 6.75 g cut-off and thin section – *SIGM*.

**Oiuru 001** 22°24.2'N, 18°33.0'E

Murzuq, Libya

Find: 2016 Mar 25

Classification: Iron meteorite (IVB)

**History:** (Dieter *Heinlein*). While prospecting for gold in the desert region of Kufra, southern Libya, a chunk of iron was found buried in a depth of about two meters. The finding site is near Egay Zuma, not far from the village of Wath, close to the border between Libya and Chad.

**Physical characteristics:** (Dieter *Heinlein*). The mass of the irregular chunk of meteoritic iron is about 450 kg, the dimensions are 94 × 47 × 45 cm.

**Petrography:** Iron meteorite

**Geochemistry:** (Xiaosong Li, FRM II). Composition of the metal obtained by using INAA: Ni = 18.2, Co = 0.79 (both in wt%), Ga = 0.21, Ir = 15.7 (both in ppm) and very low Ge.

**Classification:** Iron, Ataxite, IVB

**Specimens:** Type Specimens: 20.9 g, *IfP*; the main mass is with the finder.

**Orlov Dol** 42.113271°N, 26.163802°E

Burgas, Bulgaria

Find: 2018

Classification: Iron meteorite (IID)

**History:** In the summer of 2018, Ivan Ivanov, Nedko Rusev, and Zhivko Andonov were walking an old country road near the village of Orlov Dol, when they noticed an unusual stone in the middle of the road. There had been heavy rain the previous day, which washed away the road. They removed the stone from the ground and found it to be metallic. They took it with them and left it in an old barn, not knowing what it could be. The stone stayed there for almost a year. On 2019 June 6, they attended a BGNMHA (Bulgarian Gold Nugget and Meteorite Hunting Association) meeting, and brought a small piece for analysis. XRF analysis indicated a high Ni content (13 wt%) and there was a visible Widmanstätten pattern on the surface. Subsequently, a sample was sent by George Penneff to Jerome Gattacceca (*CEREGE*) for further analysis and classification.

**Physical characteristics:** A single mass covered with rust.

**Petrography:** Etching of a polished section reveals a medium octahedrite texture with average kamacite bandwidth 0.83±0.21 mm. Martensitic areas and Neumann bands are present.

**Geochemistry:** (J.T. Wasson, *UCLA*): INAA data, Ni = 98.7, Co = 6.66 (both mg/g), Cu = 282, Ga = 70.5, As = 4.3, W = 2.97, Re = 1.977, Ir = 18.9, Pt = 20.9, Au = 0.602 (all µg/g).

**Classification:** Iron, IID

**Specimens:** Type specimen at *CEREGE*. Main mass with Ivan Ivanov.

1  
2  
3 **Oslo** 59°55'47.66''N, 10°46'17.96''E

4 Oslo, Norway

5 Probable fall: 2012 Mar 9

6 Classification: Ordinary chondrite (H3-6)

7  
8 **History:** The first piece of the meteorite was found by Anne-Margrethe Thomassen in her  
9 cabin house at Rodeløkka, Oslo, on March 12, 2012. The meteorite had hit the edge of the  
10 roof and split into two pieces, 550 g in total mass. The hole in the roof was not there a few  
11 days before, so the estimated fall date is March 9 or 10. Two independent sources also claim  
12 they heard a loud sound on the afternoon of March 9. No fireball that can be connected to the  
13 fall was reported by the Norwegian Meteorite network, but it was very cloudy in Oslo around  
14 those days. Some days later, a 700 g piece and a 26 g specimen were both found on  
15 Ekebergsetta, Oslo, located ~4 km away from Rodeløkka. In this location, near the Ekeberg  
16 kindergarten, a full piece 115 g in mass was found soon after. Many further pieces were also  
17 recovered during systematic, organized meteorite search; they total 150 g, but individual  
18 stones do not exceed 30 g. A further, but unofficial find of 4.65 kg at Grefsen, was reported in  
19 the media, but this putative meteorite has not been available for scientific investigations for  
20 verification (Bilet & Selbekk 2013). On 6 February 2014, i.e. two years later, another piece  
21 (2.8 kg) was found by Steinar Engh at Kjelsås, Stilla. The piece was stuck in the roof and was  
22 recovered during maintenance work.

23  
24 **Physical characteristics:** The type specimen in the collection of Natural History Museum in  
25 Oslo broke apart into two, separate roughly equal-sized stones. The specimen has clearly  
26 developed secondary fusion crust, indicating that fragmentation of larger body occurred in the  
27 atmosphere before fall. The specimen is fresh, not weathered and the interior seen on broken  
28 surfaces reveals brecciated light-dark structure with light clasts up to several cm in size  
29 embedded in dark matrix.

30  
31 **Petrography:** (A. Krzesinska, *UOslo*) The meteorite has brecciated light-dark structure with  
32 a major light-colored lithology and dark parts containing many cm-sized clasts of various  
33 appearances. The light part is classified as H6, with plagioclase grains up to 60  $\mu\text{m}$  in size.  
34 The dark material contains abundant chondrules and clasts of unequilibrated material set in  
35 cataclastic olivine-pyroxene matrix. In both lithologies, olivine crystals are fractured and  
36 reveal planar fractures and undulose extinction. No melt pockets or veins are present. Native  
37 copper locally occurs within plessite grains.

38  
39 **Geochemistry:** (A. Krzesinska and M. Erabmert, *UOslo*) Light part of the breccia is  
40 composed of olivine with  $\text{Fa}_{19.3}$  ( $\text{Fa}_{18.8-19.6}$ ,  $n=37$ ), orthopyroxene  $\text{Fs}_{16.6}\text{Wo}_{1.6}$  ( $\text{Fs}_{16.6-17.3}\text{Wo}_{1.0-1.9}$ ,  
41  $n=24$ ), plagioclase  $\text{An}_{13.3}\text{Or}_{5.6}$  ( $n=9$ , range  $\text{An}_{12.8-14.0}\text{Or}_{4.8-7.1}$ ) and kamacite (0.44-0.56 wt%  
42 Co), taenite and tetrataenite present. Accessory minerals include troilite, chromite (78.6 mol%  
43 Chr, 14.2 mol% Sp), ilmenite, diopside, Cl-apatite and merrillite. Chondrules in the dark  
44 lithology are composed of zoned olivine ( $\text{Fa}_{0.9-24.7}$ ,  $n=19$ ) and pyroxene ( $\text{Fs}_{2.5-16.5}\text{Wo}_{0.2-0.9}$ ,  
45  $n=14$ ) crystals. The composition of matrix in the dark lithology is more equilibrated than the  
46 chondrules and it reveals olivine with  $\text{Fa}_{18.9\pm 0.51}$ , and opx  $\text{Fs}_{16.9\pm 0.23}\text{Wo}_{1.4\pm 0.3}$ .

47  
48 **Classification:** Brecciated, ordinary chondrite of H3-6 type, based on composition of olivine,  
49 pyroxene as well as content and composition of kamacite. Light part is highly equilibrated H6  
50 material and dark part is of H3 type, however, individual cm-sized clasts in the dark part can  
51 be classified as H4 or H5 type material.

52  
53 **Specimens:** (H. Friis, M. Bilet, R. Selbekk, *UOslo*) Several specimens were recovered over  
54 the time. The first specimen (type specimen and main mass), weighting 550 g is in the  
55 collection of Natural History Museum in Oslo. Three thin sections are stored in the museum.  
56 Some more specimens of various sizes (totaling 4 kg) are in private collections, and based on  
57 unofficial reports, an additional 4.6 kg may exist.  
58  
59  
60

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2  
3  
4  
5  
6 **Oyo** 7.877°N, 3.963°E

7 Oyo, Nigeria

8 Find: 2019 Jan

9 Classification: Ordinary chondrite (LL4)

10 **History:** Three similar-appearing stones were found together 4.4 km NE of the town of Oyo,  
11 Nigeria at 7.877°N, 3.963°E and were purchased from the finder by Mbark Arjdal in January  
12 2019.

13 **Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Closely packed, well-formed  
14 chondrules are set in a sparse matrix containing altered kamacite, taenite, chromite, troilite  
15 and merrillite.

16 **Geochemistry:** Olivine ( $\text{Fa}_{28.3\pm 0.2}$ , range  $\text{Fa}_{28.1-28.5}$ ,  $N = 6$ ), low-Ca pyroxene  
17 ( $\text{Fs}_{23.4\pm 0.5}\text{Wo}_{1.6\pm 0.3}$ , range  $\text{Fs}_{23.0-24.3}\text{Wo}_{1.4-2.0}$ ,  $N = 6$ ), augite ( $\text{Fs}_{8.3\pm 0.3}\text{Wo}_{45.4\pm 0.1}$ , range  $\text{Fs}_{8.0-}$   
18  $8.5\text{Wo}_{45.3-45.5}$ ,  $N = 3$ ). Magnetic susceptibility  $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 3.41$ .

19 **Classification:** Ordinary chondrite (LL4).

20 **Specimens:** 54.2 g including one polished thin section at *UWB*; remainder with Mr. M.  
21 Arjdal.  
22  
23  
24  
25

26 **Pakepake 001** 38°02.04'N, 83°39.36'E

27 Xinjiang, China

28 Find: 2019 Jan

29 Classification: Ordinary chondrite (L6)

30 **History:** The meteorite was Found by Pengli Chen who is a meteorite hunter in gobi desert  
31 near to Niya ruin in January, 2019. The Niya ruin is the historic site of the Jingjue Kingdom  
32 from the 2nd century B.C. to the 5th century A.D., in Minfeng county , Southern of Xinjiang,  
33 China.  
34

35 **Physical characteristics:** Five specimens were recovered in the gobi desert. The individual  
36 specimen covered by black fusion crust weighs from 100 to 1500 g. The total mass is ~1.5 kg.

37 **Petrography:** (J. Ji, S. Hu and Y. Lin, *IGGCAS*) The meteorite has a typical chondritic  
38 texture, mainly composed of olivine, pyroxene, plagioclase, Fe-Ni metal and troilite, with  
39 minor other accessory minerals. The matrix displays a high degree of crystallization. Most  
40 plgioclase grains are larger than 50 mm in diameter. Some Fe-Ni metal grains have been  
41 oxidized along the rims. Shock melt veins and pocket were not identified across the section.

42 **Geochemistry:** Mineral compositions and geochemistry: (J. Ji, S. Hu and Y. Lin, *IGGCAS*)  
43 The olivine and pyroxene are homogeneous in chemical compositions. Olivine:  $\text{Fa}=24.2\pm 0.7$   
44 ( $n=27$ ), orthopyroxene:  $\text{Fs}_{20.8\pm 1.0}\text{Wo}_{1.4\pm 0.4}$  ( $n=28$ )  
45

46 **Classification:** (J. Ji, S. Hu and Y. Lin, *IGGCAS*) L6

47 **Specimens:** The main mass is held by Pengli Chen.  
48  
49  
50

51 **Paposo 064** 24°56'36.2''S, 70°02'02.1''W

52 Antofagasta, Chile

53 Find: 2017 Feb 27

54 Classification: Ureilite

55 **History:** Found on granodiorite pediment surface by a three-person team.

56 **Petrography:** (J. Gattacceca, *CEREGE*) Siliceous rock with blocky texture. Main mineral is  
57 low-Ca pyroxene with typical grain size 600  $\mu\text{m}$  and reduced rims. Metal is found at the  
58  
59  
60

silicate grain rims, and as aligned  $\mu\text{m}$  grains within silicate grains. Carbon material is present at the grain rims. Troilite.

**Geochemistry:** Low-Ca pyroxene  $\text{Fs}_{19.2\pm 0.3}\text{Wo}_{4.8\pm 0.1}$ ,  $\text{FeO/MnO} = 28.4\pm 0.9$  (n=3). Low-Ca pyroxene rim  $\text{Fs}_{13}\text{Wo}_{4.9}$  (n=1).

**Classification:** Ureilite

**Specimens:** Type specimen at *CEREGE*. Main mass with Andreas Koppelt.

**Pizhanka** 57°20.42'N, 48°30.15'E

Kirovskaya oblast', Russia

Find: May 2016

Classification: Iron meteorite (IAB-MG)

**History:** Single piece of iron (46.78 kg) was found by Mr. O.N. Rykov while he was plowing fields near Akhmanovo and Pizhanka in May 2016.

**Physical characteristics:** The meteorite has an elongated, irregular, heart-like shape; it is covered by a shell of iron oxides. Total weigh is 46.78 kg.

**Petrography:** The polished and etched section (150  $\text{cm}^2$ ) reveals coarse kamacite plates, ranging from 6 to 12 mm ( $8.18\pm 2.52$  mm, n=11), with sets of parallel Neumann lines and intergrowths of rhabdite needles. Patches of recrystallized kamacite are sparsely distributed on the surface, and particularly concentrated around a large troilite-graphite inclusions. Three large (15 × 25, 20 × 10, 12 × 15 mm) and some small knobby troilite nodules with swathing 1-3 mm schreibersite are present. Schreibersite occurs as scattered, cuneiform, skeletal crystals 0.3-2 mm in size, with 20-100  $\mu\text{m}$  wide, discontinuous grain-boundary veinlets.

**Geochemistry:** Mineral compositions and geochemistry: (N. N. Kononkova, *Vernad*, EMP) kamacite: Ni =  $7.40\pm 0.07$  (N=4), Co =  $0.53\pm 0.05$  (N=4), P =  $0.23\pm 0.02$  (N=4); taenite: Ni =  $29.9\pm 3.15$  (N=8) (all in wt%); schreibersite: Ni =  $37.3\pm 0.68$  (N=4), P =  $14.5\pm 0.29$  (N=4); rhabdite: Ni =  $47.0\pm 1.61$  (N=4), P =  $13.8\pm 0.65$  (N=4); (J.T. Wasson, *UCLA*): INAA data, Ni = 67.4, Co = 4.65 (both mg/g), Au = 1.593, Ga = 83.2, Ge = 422, Re = 0.254, Pt = 5.66, Ir = 2.74, Cr = 22, W = 1.02, As = 12.7, Cu = 119 (all  $\mu\text{g/g}$ ).

**Classification:** Iron, IAB-MG, Ogg

**Specimens:** Total 5616.88 g and thick section are on deposit at *Vernad*.

**Poltavskoe** 43°59.05'N, 44°45.59'E

Stavropol'skiy kray, Russia

Find: 2018 Apr 2

Classification: Ordinary chondrite (L6)

**History:** The meteorite was found by Mr. Nikolay Nikolaevich Saprykin in April 2018 in the protective forest belt between cultivated fields, 4.5 km to the south of Poltavskoe village (Kursky region of Stavropolsky kray, Russia).

**Physical characteristics:** A single incomplete stone of ellipsoidal shape of 2630 g. A surface is covered by well preserved fusion crust of greyish-brown color.

**Petrography:** The meteorite has recrystallized chondritic texture with the chondrule relics in the granular silicate mass. It is composed of olivine, pyroxene, minor feldspar, FeNi metal and troilite and accessory chromite. The meteorite contains melt pockets and shock melt veins. Olivine in the main mass of the meteorite has undulatory optical extinction and planar fractures, and mosaic extinction and planar deformation features near the shock veins.

**Geochemistry:** Mineral composition and geochemistry: Olivine is  $\text{Fa}_{24.0\pm 0.1}$  (N=12); Pyroxene is  $\text{Fs}_{20.2\pm 0.2}\text{Wo}_{1.4\pm 0.2}$  (N=13)

**Classification:** ordinary chondrite (L6).

**Specimens:** A thick slab of 368.4 g total mass and one polished thin section of the meteorite are on deposit at *Vernad*. Anonymous person holds the main mass.

**Qiakuertu** 46°25'16.15"N, 89°26'41.32"E

Xinjiang, China

Find: 2018 May 22

Classification: Ordinary chondrite (H5)

**History:** Found during a meteorite hunting campaign organized by meteorite hunters Yuxian Zhao and Kun Zhang.

**Geochemistry:** Olivine  $\text{Fa}_{18.5-18.7}$ , N=5; Low-Ca pyroxene  $\text{Fs}_{16.3-16.7}\text{Wo}_{0.98-1.35}$ , N=5 (EPMA)

**Rafsa 001** 28.736°N, 7.607°W

Tindouf, Algeria

Find: 2019 Feb

Classification: Martian meteorite (Shergottite)

**History:** A 70.9 g stone was found by a group of camel herders near Bou Akba in northwestern Algeria in February 2019. Some time later they found an identical-appearing 56.7 g stone about 700 m from the first one. In September 2019, both stones were purchased by Ben Hoefnagels through an American agent for the finders.

**Physical characteristics:** Both stones lack fusion crust and have weathered exteriors. Saw cuts reveal that both have thin weathering rinds, but the fresh interiors exhibit dark olivine phenocrysts in a fine-grained lighter-colored groundmass and sparse dark melt pockets containing vesicles (some partly filled with secondary terrestrial minerals).

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Euhedral to subhedral, zoned olivine phenocrysts (up to 2mm; with interior regions of orange-brown staining) are set in a groundmass composed mainly of polysynthetically-twinned, prismatic clinopyroxene and maskelynite with accessory orthopyroxene (as cores to some groundmass pyroxene grains), merrillite, Ti-chromite, Ti-free chromite, ilmenite, pyrrhotite and pentlandite. Sparse dark shock melt pockets (with swirly texture and secondary calcite in vesicular cavities) are present.

**Geochemistry:** Olivine (cores  $\text{Fa}_{28.8-30.4}$ ,  $\text{FeO/MnO} = 47-54$ , N = 5; rims  $\text{Fa}_{32.4-35.2}$ ,  $\text{FeO/MnO} = 50-54$ , N = 5), orthopyroxene core ( $\text{Fs}_{21.8}\text{Wo}_{3.8}$ ,  $\text{FeO/MnO} = 29$ ), pigeonite (cores  $\text{Fs}_{23.7-23.9}\text{Wo}_{8.6-10.4}$ ,  $\text{FeO/MnO} = 28-30$ , N = 4; rims  $\text{Fs}_{27.6-30.7}\text{Wo}_{9.0-10.3}$ ,  $\text{FeO/MnO} = 25-32$ , N = 4), high-Ca pyroxene ( $\text{Fs}_{16.8-17.6}\text{Wo}_{36.1-30.5}$ ,  $\text{FeO/MnO} = 25-29$ , N = 3), maskelynite ( $\text{An}_{62.6-64.9}\text{Or}_{0.3-0.5}$ , N = 3).

**Classification:** Shergottite (olivine-phyric).

**Specimens:** 21 g including one polished thin section at *UWB*; remainder with Mr. B. Hoefnagels.

**Reid 029** 30°19'S, 128°58'E

Western Australia, Australia

Find: 10 Aug 1975

Classification: Ordinary chondrite (L5)

**History:** A single fragment of 274 g was found at an ancient Aboriginal camping site

**Physical characteristics:** The fragment is partly crusted, large chondrules and angular chondrule fragments are visible on cut surfaces.



**Petrography:** (A. W. R. Bevan *WAM*) The stone comprises recognizable chondrules in a crystalline matrix. Olivine shows undulose extinction to incipient mosaicism. Metal and troilite particles are heavily weathered to oxyhydroxides of iron, and there is extensive oxide staining.

**Geochemistry:** Mineral compositions and geochemistry: (A. W. R. Bevan, *WAM*). Mineral compositions as determined by EMP: olivine  $Fa_{25.1}$ ; orthopyroxene  $Fs_{20.9}$ .

**Classification:** (L5); S3; W3.

**Specimens:** Main mass, slices totaling 92.6 g, and thin section, *WAM*

**Saint-Ouen-en-Champagne** 47°57'51''N, 0°9'40''W

Pays de la Loire, France

Probable fall: 29 Sep 1799

Classification: Ordinary chondrite (H5)

**History:** A 12 g sample labelled as Saint-Ouen-en-Champagne discovered in the Chadel collection in 2006 drew the attention of the meteoritical community on another, homonymous 39 g sample curated in *LeMans*, in the département of the eponymous commune. The curator Nicolas Morel found in the local learned literature several mentions of this fall, which occurred after a violent thunder clap on September 29, 1799, at 3 pm, in the farm Le Pin in Saint-Ouen-en-Champagne. The stone, which weighed 9 pounds 7 ounces, fell at the feet of a day laborer and was at first too hot to touch. It was subsequently divided among several naturalists, but only 51 g are currently extant.

**Physical characteristics:** fragment dull gray in color, studded with minuscule metallic grains, partly covered by a blackish/brown fusion crust

**Petrography** (T. Shissh, *FSAC* and S. Pont, *MNHP*): Polished section showing typical chondrite texture with moderate number of chondrules and abundant scattered metal. Fusion crust is up to 0.75 mm locally with abundant vesicles up to 100  $\mu$ m. Chondrules are up to 1 mm and rarely 2 mm. Many have well-defined borders and other do not. Chondrules types are porphyritic olivine-pyroxene (POP), barred olivine (BO), granular olivine-pyroxene (GOP) and possible remnant radiating pyroxene chondrules (RP). Olivine and orthopyroxene are the dominant phases with minor chromite, Ca-pyroxene, apatite and troilite. Metal and sulfides are interstitial to olivine and pyroxene and clustered in the form of large anhedral grains enclosing silicates. Few silicates are embedded in metal. No nodule-shaped metal was observed.

**Geochemistry:** Mineral composition and geochemistry (T. Shissh, H. Chennaoui Aoudjehane, *FSAC*): Olivine  $Fa_{18.22\pm 0.21}$  (N=12) Opx =  $En_{82}Fs_{16}Wo_2$  (N=3) Clinopyroxene =  $En_{48}Fs_6Wo_{46}$  (N=1) and  $En_{75}Fs_{15}Wo_8$  (N=2). Plagioclase is  $Ab_{80-83}An_{12-16}Or_{4-5}$ . Chromite compositions are  $Cr/(Cr+Al)=0.91$  and  $Fe/(Fe+Mg)=0.9$  (N=3). Kamacite with 6% Ni.

**Classification:** Ordinary chondrite (H5)

**Specimens:** 38 g, *LeMans*, type specimen; 12 g, A. *Carion*; 1 g, *MNHP*

**San Salvador River** 33°35.93'S, 58°7.83'W

Soriano, Uruguay

Find: 2015

Classification: Ordinary chondrite (H5)

**History:** The meteorite was found in 2015 by Rolando Bianchi Cendón about 11 km SE of the city of Dolores (Soriano Department, Uruguay), in alluvial deposits of the San Salvador River.

**Physical characteristics:** Physical Characteristics: Light to dark brown, elongated stone with numerous open fractures. A network of veins is visible on cut surfaces (filled with alteration product, mainly iron oxides).

**Petrography:** (L. Ferrière and S. Rajpriye, *NHMV*). This meteorite is a moderately weathered, fractured, and thermally metamorphosed chondrite. Chondrule boundaries and matrix are difficult to discern. The chondrules are mainly barred and porphyritic olivine-pyroxene types. Opaque phases include Fe-Ni metal (including tetrataenite, measuring up to 70  $\mu\text{m}$ ), metal oxides, and troilite. Accessories such as chromite, chlorapatite (heavily fractured, up to 100  $\mu\text{m}$ ), and merrillite (up to 200  $\mu\text{m}$ ) are also present. Fractures are common and are filled with alteration products, i.e., metal oxides of varying composition. A large fraction of the metal grains have been heavily altered and troilite grains are surrounded by iron oxides. A crust of alteration is seen at the surface, containing high-Ca pyroxene and a few quartz grains (of terrestrial origin). Exsolution lamellae occur in a number of troilite grains.

**Geochemistry:** (L. Ferrière, S. Rajpriye, and D. Topa, *NHMV*). Olivine:  $\text{Fa}_{19.05\pm 0.43}$  ( $\text{Fa}_{18.4-20.3}$ ) and  $\text{Fe/Mn}$ :  $39.43\pm 2.90$  (N=20). Low-Ca pyroxene  $\text{Fs}_{16.99\pm 0.83}$   $\text{Wo}_{1.34\pm 0.32}$  ( $\text{Fs}_{16.0-19.2}$   $\text{Wo}_{0.0-1.6}$ ) and  $\text{Fe/Mn}$ :  $24.32\pm 3.79$  (N=22). Plagioclase:  $\text{An}_{10.93\pm 0.46}$   $\text{Ab}_{84.37\pm 0.67}$   $\text{Or}_{4.70\pm 0.73}$  ( $\text{An}_{10.4-12.1}$   $\text{Ab}_{83.1-85.3}$   $\text{Or}_{4.0-6.5}$ ) (N=11). Kamacite: Ni  $5.43\pm 1.02$  (3.99-6.31), Co  $0.39\pm 0.15$  wt% (N=6). Taenite: Ni  $28.13\pm 4.79$  (20.83-35.61), Co  $0.14\pm 0.03$  wt% (N=9). Tetrataenite: Ni  $50.64\pm 1.27$  (48.06-52.20), Co  $0.07\pm 0.04$  wt% (N=11). Chromite: Cr#: 0.86, Fe#: 0.85.

**Classification:** Ordinary Chondrite (H5), S3, W3

**Specimens:** The main mass (765 g) is with the finder (Rolando Bianchi Cendón, Uruguay); Two fragments (*NHMV*-O1892 and *NHMV*-O1790, 31.29 g and 13.75 g, respectively) as well as one polished thin section (*NHMV*-O1791) and a polished thick section (*NHMV*-O1792) are at *NHMV*.

**Santa Filomena** 8°9'45.66"S, 40°36'50.54"W

Pernambuco, Brazil

Confirmed fall: 2020 Aug 19

Classification: Ordinary chondrite (H5-6)

**History:** (Andre L R Moutinho, Marcelo Zurita). A bright fireball appeared on the western region of Pernambuco state, Brazil, on August 19, 2020, 13:18:17 UTC. Four cameras from a weather forecast company named "Clima Ao Vivo" recorded the bolide in the cities of Floresta, Salgueiro, Belém de São Francisco and São José do Belmonte. The GOES-16 satellite also captured the bolide flash. Using the video data, the BRAMON (Brazilian Meteor Observation Network) performed the bolide triangulation and orbit calculation. The meteoroid entered the Earth atmosphere at 15.36 km/s, in a 43.1° inclination (relative to ground) travelling 61.3 km in 4 " and extinguished at 20.9 km height, 7.5 km east of the city of Santa Filomena. The meteoroid orbit was calculated as follows: semi-major axis 2.0 AU, eccentricity 0.94, inclination 0.26°, pericenter longitude 143.5° and ascending node 146.7°. Stones were recovered within a  $16.0 \times 2.7$  km ellipse compared to the predicted strewn field of  $40 \times 4$  km as calculated by Jim Goodall. Santa Filomena is located nearly at the middle of the strewn field. The majority of the stones, by weight, were recovered by local people. A 38.2 kg mass was found ~7 km from Santa Filomena on the Pernambuco-Piauí state border. A 2.81 kg oriented nosecone hammered a house in front of the main city church and plaza. Another 1.5 kg stone hit a Cohab house ~1 km NE of the plaza. Other stones were witnessed to fall by residents of the village of Caramari located few hundred meters North of the Cohab house. Stones were also found by researchers and meteorite hunters: Andre L. R. Moutinho (4 pcs, 57 g), "Meteoríticas" - UFRJ (3 pc, 83.2 g), Robert Ward (1 pc, 34 g), José C. Medeiros -

1  
2  
3 Astro Agreste (3 pcs, 62 g), Cartier Ramalho and Evandro Peixoto - CASF (3 pcs, 243g) and  
4 Luiz F. Castro - GASF (2 pcs, 118 g).

5 **Physical characteristics:** Recovered meteorites range in weight from <1 g to 38.2 kg, and the  
6 total mass recovered is at least 80 kg. Most stones are whole individuals with a high  
7 percentage of crust while a smaller percentage are fragments. The fusion crust is dull black  
8 and very fresh. The 2.81 kg specimen (*MNRJ*) is cone-shaped, regmaglypted and flight-  
9 oriented. The 38.2 kg is covered with regmaglypts and fully fusion crusted.

10 **Petrography:** (M. E. Zucolotto, MN/UFRJ and A. Tosi, IGEO/UFRJ) Five thin polished  
11 sections from brecciated and unbrecciated masses were examined. The unbrecciated specimen  
12 is composed of medium gray colored lithology and shows some scattered, faint, texturally  
13 equilibrated chondrules set within a recrystallized groundmass. The mean visible chondrule  
14 diameter is 0.5mm. The main phases are olivine and orthopyroxene. Olivine shows  
15 mosaicism, planar fractures and darkening. Small and rare feldspar grains are present and  
16 show undulatory extinction. Opaque phases include metals (kamacite, taenite) and troilite.  
17 Other accessory phases include phosphate and chromite. The brecciated lithology consists of  
18 a chondritic texture with medium-gray chondritic clasts in a dark-gray chondritic host that has  
19 similar texture and composition, but much darker in color. Plagioclase grains are present with  
20 sizes up to 50 microns in diameter. Highly recrystallized fragments (type 6) coexist with areas  
21 showing a chondritic texture (type 5) and fragments of impact darkening. No melt pockets or  
22 veins are present. Olivine shows weak mosaicism and darkening indicating shock stage S4.  
23 Kamacite is predominantly found in single crystals with well-defined and distorted Neumann  
24 lines. Troilite shows multiple twinning also indicating a shock stage S4.

25 **Geochemistry:** (A. Tosi, IGEO/UFRJ; M. Gomes, CPGq/UFRGS) Electron microprobe  
26 analysis yields: unbrecciated lithology: olivine  $Fa_{18.8.5 \pm 0.4}$  (25), low Ca pyroxene  $Fs_{17.1 \pm}$   
27  $0.4$   $Wo_{1.2 \pm 0.8}$  (18), plagioclase  $Ab_{71.9 \pm 9.3}$   $An_{12.7 \pm 6.3}$   $Or_{15.3 \pm 13.0}$  (10), Co in Kamacite  $0.112 \pm$   
28  $0.02$  (22). Equilibrated clasts:  $Fa_{19.6 \pm 0.5}$  (57), low Ca pyroxene  $Fs_{17.3 \pm 0.6}$  (93), plagioclase  
29  $Ab_{75.3 \pm 9.2}$   $An_{10.9 \pm 2.7}$   $Or_{13.8 \pm 11.4}$  (15). Oxygen isotopes (K. Ziegler, *UNM*) (linearized, all per  
30 mil rel. to V-SMOW, TFL slope=0.528): A total of 3 untreated (i.e., no acid-wash)  
31 fragments/subsamples were analyzed by laser fluorination. Sample weights for each  
32 measurement were between 1.5 and 2.5 mg.  $\delta^{18}O = 4.366, 4.618, 4.452$ ;  $\delta^{17}O = 2.958, 3.161,$   
33  $3.115$ ;  $\Delta^{17}O = 0.652, 0.723, 0.731$ , all permil.

34 **Classification:** H5-6 breccia ordinary chondrite. Weathering (W0) and moderately shocked  
35 (S4)

36 **Specimens:** *MNRJ* 2.81 kg and 40.2 g type specimen; 38.2 kg with finder; André L R.  
37 Moutinho ~1.2 kg; Michael Farmer ~3 kg; Roberto Vargas and Mark Lyon ~570 g  
38

39 **Shalim 025** 18°22.56'N, 55°10.42'E

40 Dhofar, Oman

41 Find: 2018 Dec 1

42 Classification: Monomict Eucrite

43 **History:** The meteorite was found in the desert of central Oman by Dr. Sobhi Nasir

44 **Physical characteristics:** Physical Description (P. Hill, *UWO*) The sample has a millimeter  
45 thick, dark brown fusion crust present on all faces except one cut face. This fusion crust has  
46 large regmaglypts on one of the sides, whereas the remaining sides are a smooth continuous  
47 surface. There are no contraction cracks present on this sample. The cut face has dark brown  
48 clasts surrounded by a beige white matrix. Several of the clasts exceed 1 cm in width. Certain  
49 portions of the crust show browning due to oxidization.

50 **Petrography** (P. Hill, *UWO*) The sample is a breccia containing numerous clasts of  
51 orthopyroxene and plagioclase. The clasts are poorly sorted and are sub-angular with one clast  
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reaching up to 2 cm but most less than 0.5 mm across. Orthopyroxene (~70% area) and plagioclase (~30% area) make up most of the clasts and the groundmass. Thin (5 to 40  $\mu\text{m}$  in width) exsolution lamellae of high Ca pyroxene are present within the grains of orthopyroxene. Troilite, native Fe, and Cr- and Ti-bearing oxides are present within both the clasts and the groundmass. No secondary alteration phases were observed and no FeO was identified using EDS suggesting the meteorite is fresh and hasn't undergone extensive terrestrial alteration. The sample does show undulose extinction in the grains of plagioclase and pyroxene and irregular fractures were observed, but not in high abundance. Based on the shock stages put forward by [Stöffler et al. \(2018\)](#), the presence of undulatory extinction in plagioclase and pyroxene suggests a shock pressure range from 5 to 10-12 GPa.

**Geochemistry:** Mineral composition and geochemistry (P. Hill, M. Beauchamp *UWO*) low-Ca pyroxene ( $\text{En}_{58.9\pm 1.0}\text{Fs}_{37.4\pm 1.2}\text{Wo}_{3.7\pm 2.2}$ ), high-Ca pyroxene ( $\text{En}_{41.2\pm 1.9}\text{Fs}_{15.8\pm 3.1}\text{Wo}_{43.1\pm 5.0}$ ), and plagioclase ( $\text{An}_{91.8\pm 0.7}\text{Ab}_{7.8\pm 0.6}\text{Or}_{0.4\pm 0.1}$ ).

**Classification:** Monomict eucrite

**Specimens:** 463 g type specimen, including polished thin section, are on deposit at *SQU*.

**Shinejinst** 44°37'15.6"N, 99°012'38.1"E

Bayankhongor, Mongolia

Find: 2018 Aug 30

Classification: Ordinary chondrite (H4)

**History:** Four fragments (156.17, 101.73, 208.17, and 227.35 g) were found on 30 and 31 August 2018 by the *UrFU - IAG-MAS* meteorite expedition-2018 in Southern Gobi (Pastukhovich A.Yu., Kolunin R.N., Larionov M.Yu., Muraviev L.A., Petrova E.V., Yakovlev G.A., Naasa Ochir) 10 km northwest of Shinejinst, Bayankhongor aimag (province), Mongolia.

**Petrography:** Classification (K. Dugushkina and S. Berzin, *RAS-UB*). Petrographic observation of a polished section shows a fine-grained inequigranular recrystallized matrix and chondrules (25%). Chondrite consists of olivine 50%, orthopyroxene 15%, clinopyroxene 10%, plagioclase 15%, chromite 3%, troilite 3-4%, Fe-Ni-metal 3-4%. Also chondrite contains accessory apatite and ilmenite. Predominate porphyritic olivine (PO) and porphyritic olivine-pyroxene (POP) chondrules. Chondrules mostly have even boundaries. Petrographic type is 4. Chromite-plagioclase assemblages are found in the recrystallized matrix. The assemblages range in size from 10-350  $\mu\text{m}$  and consist of 0.2-30-  $\mu\text{m}$ -size rounded, euhedral, subhedral and anhedral chromite grains surrounded by plagioclase or glass of plagioclase composition. Moderate oxidation of metal, about 20-60% being affected, alteration of mafic silicates is beginning (weathering grade - W2). The samples are transected by dark shock veins. Shock stage is S3/4.

**Geochemistry:** EDX analyses by K. Dugushkina, *RAS-UB*. The meteorite is composed olivine  $\text{Fa}_{20\pm 2.1}$  (N=37), low-Ca pyroxene  $\text{Fs}_{18\pm 0.4}\text{En}_{80\pm 0.4}\text{Wo}_{1\pm 0.3}$  (N=17), plagioclase  $\text{An}_{24\pm 3.5}$  (N=9), clinopyroxene  $\text{En}_{49\pm 3.6}\text{Fs}_{10\pm 1.7}\text{Wo}_{42\pm 2.8}$  (N=6), chromite, troilite, kamacite (Ni 5.5-6.8 wt%), taenite (Ni 19.7-36 wt%), apatite and ilmenite. Average composition of chromite (N=9):  $\text{Cr}_2\text{O}_3$  55.6 $\pm$ 0.9 wt%, FeO 28.4 $\pm$ 1.4 wt%, MgO 4.8 $\pm$ 1.1 wt%,  $\text{Al}_2\text{O}_3$  7.8 $\pm$ 0.8 wt%,  $\text{TiO}_2$  2.2 $\pm$ 0.2 wt%, MnO 0.7 $\pm$ 0.04 wt%,  $\text{SiO}_2$  0.5 $\pm$ 0.17 wt%, CaO 0.1 $\pm$ 0.02 wt%, NiO 0.2 $\pm$ 0.01 wt%.

**Classification:** Ordinary chondrite (H4)

**Specimens:** 591 g (3 samples) at *IAG-MAS*; 96.43 g sample and 5.30 g cut-off and thin section at *UrFU*.



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3 **Shiṣr 201** 18°37'35,08''N, 53°54'57,41''E

4 Zufar, Oman

5 Find: 2012

6 Classification: Ordinary chondrite (L6)

7  
8 **History:** The meteorite was found 2012 during a field trip in the Oman desert and purchased  
9 by Jens Bäumer from the anonymous finder.

10 **Physical characteristics:** Dark brownish fragment with some fusion crust.

11 **Petrography:** The plagioclase grain size is about 80 µm.  
12  
13

14  
15 **Shiṣr 202** 18°31.574'N, 53°52.936'E

16 Zufar, Oman

17 Find: 2008

18 Classification: Ordinary chondrite (L5)

19 **History:** The meteorite was found 2008 during a field trip in the Oman desert and purchased  
20 in 2020 by the main mass holder from a Polish meteorite dealer.

21 **Physical characteristics:** Dark-brownish fragment without fusion crust.

22 **Petrography:** The plagioclase grain size is about 40 µm.  
23  
24

25  
26 **Sierra Gorda 027** 22°30.27'S, 69°8.54'W

27 Antofagasta, Chile

28 Find: 24 Oct 2019

29 Classification: Ordinary chondrite (H5, melt breccia)

30  
31 **Petrography:** The meteorite is composed of chondrules, chondrule fragments and fragments  
32 of recrystallized aggregates of silicates, metal and sulfides; all the components are embedded  
33 in a fine-grained interstitial aggregate of pyroxene crystals and feldspar that resembles  
34 devitrified melt rock. The mineral grains and the chondrule fragments are intensively  
35 darkened due to occurrence of sub-micrometer troilite and metal inclusions that are highly  
36 abundant in the matrix as well. The main phases are olivine, pyroxene, metallic Fe, troilite  
37 and feldspar; minor chromite. Olivine has strong undulatory extinction.  
38  
39

40  
41 **Sierra Gorda 028** 22°30.09'S, 69°2.44'W

42 Antofagasta, Chile

43 Find: 25 Mar 2019

44 Classification: Ordinary chondrite (H/L5)

45  
46 **Petrography:** (Lorenz C.A., *Vernad*) The meteorite has chondritic texture and is composed of  
47 chondrule fragments, minor poorly lined chondrules, and metal and troilite grains, set in  
48 minor recrystallized granular matrix. Modal abundance of metal is 4 vol%, troilite 3 vol%.  
49 Silicate grains often have finest troilite network. Olivine has undulatory and mosaic  
50 extinction, irregular and planar fractures and planar deformation features. Feldspar is partly  
51 isotropic. Chromite-feldspar objects were found. The meteorite is rich in troilite- and metal-  
52 troilite veinlets and aggregates. Silicate glass-troilite-metal melt pockets and melt veins are  
53 present.  
54

55 **Classification:** The meteorite is classified as H/L5 chondrite based on pyroxene composition  
56 between that of H and L groups  
57  
58

59  
60 **Sierra Gorda 030** 22°30.393'S, 69°02.233'W



Antofagasta, Chile

Find: 2017 Oct 18

Classification: Ordinary chondrite (L5)

**History:** One fragment (375.66 g) was found 18 October 2017 by the *UrFU* meteorite expedition-2017 in Chile (Pastukhovich A.Yu., Larionov M.Yu., Kruglikov N.A., Kolumin R.N.) near Calama.

**Petrography:** Classification (K. Dugushkina and S. Berzin, *RAS-UB*). The meteorite consists mostly of a fine-grained, inequigranular, recrystallized matrix and chondrules (20%). Chondrite consists of olivine 70%, orthopyroxene 15%, clinopyroxene 5-7%, plagioclase 5-7%, chromite 1-2%, troilite 3-4%, Fe-Ni-metal 1-3%, with accessory apatite. Predominantly porphyritic olivine (PO) and porphyritic olivine-pyroxene (POP) chondrules. Chondrules have vague boundaries. There is a grid of thin, metal-troilite shock veins in fractures in olivine, pyroxene and plagioclase. Plagioclase is not melted. Shock stage is S3-4. Moderate oxidation of metal, about 20-60% being affected, alteration of mafic silicates is beginning. Metal and troilite are almost completely oxidized in the grid of thin shock veins. Weathering grade is W2.

**Geochemistry:** EDX analyses by K. Dugushkina, *RAS-UB*. Clinopyroxene  $\text{En}_{45}\text{Fs}_{12}\text{Wo}_{43\pm 1}$  (N=7), plagioclase  $\text{An}_{20\pm 0.7}$  (N=17), chromite, apatite, troilite, kamacite (Ni 5.7-6.8 wt%), taenite (Ni 28.17-35.2 wt%). The average composition of chromite (N=6):  $\text{Cr}_2\text{O}_3$  55.7±0.4%,  $\text{TiO}_2$  2.9±0.3%,  $\text{Al}_2\text{O}_3$  5.8±0.2%, FeO 32.3±0.6%, MgO 2.5±0.4%, MnO 0.4±0.3%,  $\text{SiO}_2$  0.4±0.2.

**Classification:** (K. Dugushkina, *RAS-UB*) L5, ordinary chondrite.

**Specimens:** 361.96 g in 2 samples, plus 13.7 g cut-off and thin section, *UrFU*

**Sierra Gorda 040** 22°30.71'S, 69°2.19'W

Antofagasta, Chile

Find: 28 Oct 2018

Classification: Ordinary chondrite (L6)

**Petrography:** The meteorite of recrystallized chondrite texture is crossed by clast-laden melt vein of several mm in thickness. The olivine of the meteorite main mass demonstrates undulatory extinction or weakly- to medium-developed mosaicism; planar deformation features in olivine are rare. These optic features of olivine point to the shock stage S4. The olivine in the melt vein demonstrates strong mosaicism; the ringwoodite and wadsleyite are widely distributed in the melt vein that corresponds to the shock stage S6.

**Sierra Gorda 041** 22°30.11'S, 69°3.17'W

Antofagasta, Chile

Find: 13 Oct 2018

Classification: Ordinary chondrite (L5)

**Petrography:** The meteorite has brecciated texture. The breccia is composed of fragments of two different lithologies. The dominant lithology is microporphyritic rock with rare relicts of chondrules and inclusions of metal Fe-Ni. The melt pockets and shock veins of silicate glass and opaque phases are present. The minor lithology is a shock-darkened chondrite composed by the chondrule fragments and recrystallized granular matrix corresponding to petrologic Type 5. The fragments of these rocks are glued together by silicate glass with inclusions of mineral fragments and opaque globules.

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3 **Sierra Gorda 043** 22°30.15'S, 69°3.22'W

4 Antofagasta, Chile

5 Find: 13 Oct 2018

6 Classification: Ordinary chondrite (L5, melt breccia)

7  
8 **Petrography:** The meteorite has brecciated texture with angular clasts 0.5-15 mm in size in a  
9 partly transparent, glass-rich melt rock with metal-sulfide blebs. The clasts are of petrologic  
10 type 5. Olivine in the clasts shows weak mosaicism and planar fractures.  
11  
12

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14 **Sierra Gorda 044** 22°30.324'S, 69°02.069'W

15 Antofagasta, Chile

16 Find: 18 Oct 2017

17 Classification: Ordinary chondrite (H5)

18 **History:** One fragment of meteorite (88.03 g) was found 18 October 2017 by  
19 the *UrFU* meteorite expedition-2017 in Chile (Pastukhovich A.Yu., Larionov M.Yu.,  
20 Kruglikov N.A., Kolunin R.N.) near city Calama.

21 **Physical characteristics:** Total mass is 88.03 g. The meteorite has roughly rounded shape.  
22 Exterior of the stone is desert polished. The surface and interior of the meteorite is light to  
23 dark brown in color due to Fe-hydroxides. No fusion crust was observed.

24 **Petrography:** Classification (KsK. eniya Dugushkina, *RAS-UB*). Chondrite with  
25 recrystallized texture. Predominantly porphyritic olivine (PO) and porphyritic olivine-  
26 pyroxene (POP) chondrules. Weathering grade is W2, moderate oxidation of metal. There is a  
27 network of thin metal-troilite shock veins in fractures in olivine and pyroxene. Plagioclase is  
28 melted. Shock stage is S4/5.

29 **Geochemistry:** EDX analyses by K. Dugushkina, *RAS-UB*. The chondrite paragenesis  
30 includes olivine  $Fa_{19.3\pm 3.0}$  (N=17), orthopyroxene  $En_{80.7\pm 2.8}Fs_{17.7\pm 2.5}Wo_{1.7\pm 0.4}$  (N=11),  
31 clinopyroxene  $En_{49.9\pm 2.1}Fs_{12.7\pm 0.5}Wo_{37.5\pm 2.1}$  (N=3), plagioclase  $An_{20.1\pm 3.3}$  (N=5), chromite,  
32 apatite, troilite, taenite (Ni 8.8-31.3 wt.%) and kamacite (Ni 6.3 wt.%). The average  
33 composition of chromite (N=5):  $Cr_2O_3$  57.0±1.3 wt%, FeO 29.9±0.8 wt%, MgO 3.3±0.4 wt%,  
34  $Al_2O_3$  5.5±0.2 wt%,  $TiO_2$  3.0±0.1 wt%,  $SiO_2$  0.8±0.2 wt%, NiO 0.5±0.3 wt%.

35 **Classification:** (K. Dugushkina, *RAS-UB*) H5, ordinary chondrite.

36 **Specimens:** 78.10 g sample and 7.93 g cut-off and thin section, *UrFU*  
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42 **Sierra Gorda 045** 22°30.15'S, 69°9.27'W

43 Antofagasta, Chile

44 Find: 2018 Oct 24

45 Classification: Ordinary chondrite (L4)

46 **Petrography:** (J. Gattacceca, *CEREGE*) Chondrite with packed, well-defined chondrules.  
47 Opaque are metal and sulfides.

48 **Geochemistry:** Olivine  $Fa_{23.9\pm 0.5}$ , Fa PMD = 1.7 %. Low-Ca pyroxene  
49  $Fs_{15.4\pm 6.1}Wo_{0.9\pm 0.3}$  (n=8). Ca-pyroxene  $Fs_{12.5}Wo_{30.4}$  (n=1).

50 **Classification:** Ordinary chondrite (L4).  
51  
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55 **Tanezrouft 090** (Tnz 090) 25.163°N, 0.289°E

56 Adrar, Algeria

57 Find, possible fall: 2019 Oct 1

58 Classification: Ordinary chondrite (L6)  
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**History:** On October 1, 2019, at around 11 pm, observers in the area south of Adrar, Algeria, witnessed a bright fireball event. After searching by hunters in the desert, multiple crusted and broken stones were found together on October 13 in an area close to Bir Zmila, northwest of the town of Ouallene. Naji Ben Faraji purchased the stones in Tindouf, Algeria on October 27, 2019.

**Physical characteristics:** A total of 16 pieces ranging in weight from 43 g to 1489 g (combined weight 6219 g). Most of the broken stones are partially coated by fresh black fusion crust, and the interiors are overall light gray with visible fresh metal and some thin, black shock melt veinlets.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Very fresh, highly recrystallized specimen with very sparse remnant chondrules and partial chondrules. Much of the studied thin section exhibits a poikiloblastic texture. Accessory phases include lightly stained kamacite, taenite, troilite, chromite, chlorapatite and merrillite.

**Geochemistry:** Olivine ( $\text{Fa}_{24.9\pm 0.2}$ , range  $\text{Fa}_{24.6-25.1}$ ,  $N = 6$ ), low-Ca pyroxene ( $\text{Fs}_{20.7\pm 0.3}\text{Wo}_{1.7\pm 0.1}$ , range  $\text{Fs}_{20.4-21.1}\text{Wo}_{1.6-1.8}$ ,  $N = 5$ ), augite ( $\text{Fs}_{8.0\pm 0.1}\text{Wo}_{44.6\pm 0.3}$ , range  $\text{Fs}_{7.9-8.1}\text{Wo}_{44.3-44.8}$ ,  $N = 3$ ).

**Classification:** Ordinary chondrite (L6).

**Specimens:** 20.3 g including one polished thin section at *UWB*; remainder held jointly by Mr. N. Ben Faraji and Mr. M. Brahim Sueilem.

**Tanezrouft 091** (Tnz 091) 24°15.85'N, 0°09.64'W

Adrar, Algeria

Purchased: 2020

Classification: Mesosiderite

**History:** Two stones totaling 4988 g were found near Adrar, Algeria. Carlos Muñecas Muñoz purchased the samples from a dealer in Morocco in 2020.

**Physical characteristics:** Samples are dark brown in color, rounded, and lack fusion crust. Rounded metal nodules protrude through the surface. A cut face shows the interior is composed of a breccia containing: metal grains, cm-sized rounded metal nodules and silicate clasts (up to 4 cm) and mineral grains (up to 0.5 cm).

**Petrography:** Description and Classification (A. Love, *App*): Sample is a breccia composed of (vol%): cm-sized rounded metal nodules (3); cm-sized rounded lithic clasts (10) with cumulate and brecciated textures, mineral clasts set within a matrix of poikiloblastic orthopyroxene plagioclase and silicates and metal (~35vol%). Modal percentages (vol%) of silicates (image thresholding of 20 backscattered electron images): orthopyroxene (60), plagioclase (31), olivine (5) and a lath-shaped silica polymorph (4). Matrix pyroxenes are inverted and show blebby and lamellar exsolution. Olivine shows well-developed reaction coronas some of which have replaced entire grains. Grain boundaries between silicates are sutured. Additional minerals are: kamacite, taenite, lath-shaped Si polymorph, apatite, troilite, chromite, trace ilmenite.

**Geochemistry:** (A. Love, *App*) Olivine,  $\text{Fa}_{36.6\pm 7.7}$  ( $\text{Fa}_{25.7-44.3}$ ,  $\text{Fe/Mn}=40.4\pm 2.5$ ,  $n=5$ ); zoned low-Ca pyroxene,  $\text{Fs}_{30.8\pm 2.5}\text{Wo}_{2.1\pm 0.7}$  ( $\text{Fe/Mn}=27.5\pm 1.4$ ,  $n=6$ ); matrix,  $\text{Fs}_{37.5\pm 1.3}\text{Wo}_{3.2\pm 0.1}$  ( $\text{Fe/Mn}=23.6\pm 0.5$ ,  $n=4$ ); high-Ca pyroxene,  $\text{Fs}_{18.1\pm 1.7}\text{Wo}_{40.6\pm 4.2}$  ( $n=3$ ). Plagioclase,  $\text{An}_{92.4\pm 0.4}\text{Or}_{0.1\pm 0.1}$  ( $n=5$ ).

**Classification:** Mesosiderite (estimated class) A3. Mesosiderite Class A based on texture, metal abundance, magnetic susceptibility and modal silicate abundance of plagioclase and Opx. Metamorphic class 3 based on recrystallization textures of silicates and absence of pigeonite.

**Specimens:** Carlos Muñecas (Expometeoritos) holds the 2525 g main mass. A 24.46 g slice and polished mount are on deposit at *App*.

**Tarda** 31° 49' 35"N, 4° 40' 46"W

Morocco

Confirmed fall: 2020

Classification: Carbonaceous chondrite (C2, ungrouped)

**History:** (H. Chennaoui Aoudjehane, *FSAC*, ATTARIK Foundation: A. *Aaronson*) On Tuesday, 25 August 2020, around 2:30 pm Moroccan time (GMT+1) a fireball was widely witnessed by people in southern Morocco from Alnif, Zagora, Tazarine, and Rich. The fireball trajectory was from the SW to NE. A search was immediately undertaken by local residents and meteorite hunters between Goulmima and Errachidia. Hundreds of people began searching on the same day, and the first piece was found the following day by Alalou Youssef close to his village of Tarda. The fall location is crossed by the national road linking Ouarzazate to Errachidia, and because of the easy access thousands of people soon traveled to the area. National TV channels [Al Oula](#) and [2M](#) recorded the activity. A field mission was organized to the fall site on 27 and 28 August 2020, with Dr Mohamed Aoudjehane, Prof. Faouziya Haissen and Prof. Hasnaa Chennaoui (members of the board of directors of ATTARIK Foundation), with the support of Prof. Hicham Si Mhamdi (Faculty of Sciences, Errachidia), Adam *Aaronson* and members of the Moroccan Association of Meteorites (Ahmed Bouferra, Mohamed and Zaid El Guireh). Several eyewitnesses from areas up to 150 km away were interviewed, and reported three " of a bright yellow, barrel-sized fireball with green edges. The meteor was followed by a thick trail of white smoke that remained suspended for several seconds. The fireball was reported to release little pieces around its edges, witnesses said the fireball was accompanied by a whistle, followed by multiple detonations. One eyewitness reported an almost vertical trajectory. Thousands of small, mostly complete stones were collected ranging from only a few milligrams to 99 g. Many pieces were recovered by hunters using magnets. The strewn field is about 3 km long and situated ~10 km east of Tarda centered at 31.8265°N, 4.6794°W.

**Physical characteristics:** Hundreds of small to medium-sized fusion crusted stones ranging from 0.1 g to 99 g. The majority of the fusion-crust stones are <1 g. Some flight-oriented stones show a blue iridescence on their trailing edge, similar to that observed with Aguas Zarcas. Many stones shattered upon impact with the ground. The stones have low density, are somewhat friable, and are particularly susceptible to moisture, and rapidly slake in contact with water or alcohol. Freshly picked up stones were said to have a charcoal-like odor. Small fragments crushed in water emit a powerful tar-like odor. The interiors of the stones are dull black with dispersed white or light-colored grains or clasts (up to ~1 mm in size). Magnetic susceptibility  $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.99, 4.83, 5.03$  (A. Irving, *UWS*), 4.80 (H. Chennaoui Aoudjehane, *FSAC*), 4.96 (D. Sheikh, *FSU*); average  $4.92 \pm 0.10$ ,  $n=5$ .

**Petrography:** (A. Irving, *UWS*; P. Carpenter, *WUSL*; L. Garvie, *ASU*; D. Sheikh, *FSU*) Optical and electron microprobe observations of three fragments in polished thin sections reveal a matrix-rich breccia containing small chondrules (granular, BO) and chondrule fragments, very fine grained AOA, grains of forsterite (exhibiting slight undulose extinction) and other clasts set in a dominant fine-grained matrix (~80 vol.%, opaque in thin section). Chondrule sizes measured in two thin sections:  $310 \pm 150 \mu\text{m}$ ,  $n=10$ ;  $450 \pm 200 \mu\text{m}$ ,  $n=5$ . No CAIs were identified. The dominant chondrule phase is forsterite (but spinel is present in two examples), and some are mantled by forsterite dust or exhibit partial replacement by Fe-Mn-dolomite, siderite or phyllosilicate material. A single igneous achondrite clast with subophitic texture was observed, and consists predominantly (~75 vol.%) of laths of twinned anorthite



with subordinate forsterite, enstatite and minor diopside. Electron microprobe surveys of thin sections and powder X-ray diffraction studies of several ~20 mg fragments show that the matrix is dominated by phyllosilicates, with lesser magnetite, pyrrhotite, pentlandite, troilite, carbonates (Fe-Mn-dolomite, Mg-rich siderite and siderite), and olivine. The phyllosilicates show broad basal reflections at 14.7 Å and 7.4 Å, consistent with smectite and serpentine or interstratified serpentine/smectite, respectively. No reflections for sulfates were recognized. Magnetite (<20 µm) is scattered throughout the sample in the form of framboids, platelets, and individual spherules; other accessory phases identified in the matrix by EPMA are troilite, Ni-bearing pyrrhotite, chromite and very rare kamacite.

**Geochemistry:** (D. Sheikh, *FSU*; P. Carpenter, *WUSL*): Forsterite (Fa<sub>1.0±0.6</sub>, range Fa<sub>0.2-2.9</sub>; CaO wt% = 0.2±0.1, range 0.1-0.4; Cr<sub>2</sub>O<sub>3</sub> wt% = 0.51±0.17, range 0.11-0.91; FeO/MnO = 10±6, range 3-24; n=35), ferroan olivine (Fa<sub>26.5±1.6</sub>, range Fa<sub>24.8-28.0</sub>; CaO wt% = 0.2±0.1, range 0.2-0.3; Cr<sub>2</sub>O<sub>3</sub> wt% = 0.44±0.06, range 0.40-0.51; FeO/MnO = 91±7, range 88-99; n=3). Achondrite clast: anorthite (An<sub>99.7±0.4</sub>, range An<sub>99.4-99.9</sub>, n=2), forsterite (Fa<sub>1.1</sub>, FeO/MnO = 7, n=1), enstatite (Fs<sub>1.1±0.1</sub> Wo<sub>3.2±0.5</sub>, range Fs<sub>1.0-1.2</sub> Wo<sub>2.7-3.7</sub>, FeO/MnO = 3, n=3), diopside (Fs<sub>1.7</sub> Wo<sub>44.0</sub>, FeO/MnO = 3, n=1). Bulk composition of the matrix measured using 1 µm-sized beam (in wt%): SiO<sub>2</sub> = 30.5±6.1, P<sub>2</sub>O<sub>5</sub> = 0.1±0.1, Cr<sub>2</sub>O<sub>3</sub> = 0.4±0.1, Na<sub>2</sub>O = 1.0±0.2, TiO<sub>2</sub> = 0.1±0.1, Al<sub>2</sub>O<sub>3</sub> = 2.1±0.5, FeO = 20.2±3.2, MnO = 0.3±0.3, MgO = 19.3±1.8, CaO = 0.5±0.5, K<sub>2</sub>O = 0.1±0.1, NiO = 2.0±1.0, S = 3.5±1.1, Sum 79.8±6.0, n=26. Oxygen isotopes (K. Ziegler, *UNM*) (linearized, all per mil relative to V-SMOW, TFL slope=0.528): A total of 7 untreated (i.e., no acid-wash) fragments were analyzed by laser fluorination. Sample weights for each measurement were between 2.0 and 4.7 mg. δ<sup>18</sup>O = 21.971, 17.924, 15.943, 20.842, 16.434, 17.034, 20.607; δ<sup>17</sup>O = 11.423, 9.124, 7.975, 10.613, 8.277, 8.859, 10.779; Δ<sup>17</sup>O = -0.178, -0.340, -0.443, -0.391, -0.401, -0.135, -0.102.

**Classification:** (C. Agee, *UNM*; K. Ziegler, *UNM*; A. Irving, *UWS*; L. Garvie, *ASU*; D. Sheikh, *FSU*; P. Carpenter, *WUSL*; H. Chennaoui Aoudjehane, *FSAC*; M. Zolensky, *JSC*; P. Schmitt-Kopplin, *HZM*) Carbonaceous chondrite (C2-ungrouped). The bulk mineralogy is consistent with a petrologic grade 2, based on the predominance of smectite and serpentine together with the presence of anhydrous mafic silicates, AOA, and chondrules. The oxygen isotopes give a bimodal distribution of the δ<sup>18</sup>O-values, with one group having values somewhat like those of the CI chondrites, and the other group like values for the Yamato-type (CY) carbonaceous chondrites (King et al., 2019). However, Δ<sup>17</sup>O values are lower than those for CI and CY chondrites, and plot below the TFL. These isotopic values do not overlap with those of any established carbonaceous chondrite group, hence the ungrouped designation.

**Specimens:** 18.4 g including one polished thin section and one polished thick section at *UWB*; 21 g and one polished thin section at *UNM*; 7 g provided by A. Aaronson and 6 g provided by J. Redelsperger at *FSAC*; 20 g at the Ministry of Energy, Mines and Environment, Rabat, Morocco provided by A. Aaronson; total 628 g with A. Aaronson (including 99 g, 82.4 g and 52.6 g stones); 540 g with M. Farmer and A. Karl, 260 g with J. Poblador; 480 g with D. Dickens; 145 g with M. Oulkouch; 146 g with J. Redelsperger; 31 g with B. Hoefnagels.

**Tassédet 005** ~18°50'N, ~7°00'E

Agadez, Niger

Find: 2018

Classification: Ordinary chondrite (L6)

**History:** (Ziyao Wang) A meteorite strewn field was discovered west of Arlit. Ziyao Wang and Wenxi Jin purchased more than 100 pieces of above 50 kg from that strewn field from Adnane Sami in Agadez, Niger in 2018.



**Physical characteristics:** (Ziyao Wang) More than 100 individuals and fragments between 3 kg and 5 g with fresh gray-brown fusion crust with contraction cracks. The total discovered mass exceeds 50 kg.

**Petrography:** (R. Bartoschewitz, *Bart*) Light gray matrix with well recognizable darker to dark gray chondrules (0.3-1.3 mm, av. 0.7 mm) of various types, and metal and sulfide particles that mainly present rusty halos.

**Geochemistry:** (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine  $Fa_{24.0\pm 0.2}$  (n=19); pyroxene  $Fs_{20.3\pm 0.4}Wo_{1.5\pm 0.1}$  (n=10); diopside  $En_{47}Fs_7Wo_{46}$ ; feldspar  $An_9Or_6$  (n=2); chromite CRAL86, FFM88; galaxite. Kamacite Ni=5.3-6.7 wt%, Co=0.6-0.9 wt% (n=3); troilite. Magnetic susceptibility (R. Bartoschewitz, *Bart*)  $\log \chi (\times 10^{-9} m^3/kg) = 4.81 \pm 0.09$  (n=10).

**Classification:** Ordinary chondrite (L6, S3, W1)

**Specimens:** 23.5 g at *Kiel* on deposit, Wenxi Jin and Ziyao Wang hold the main mass and 105 g with *Bart*.

**Tata 001** 29°44'42''N, 7°41'59''W

South, Morocco

Find: 2019

Classification: Lunar meteorite

**Physical characteristics:** A small greyish fragment. Cut surface reveals a dark interior.

**Petrography:** (J. Gattacceca, *CEREGE*) Brecciated igneous rock with fractured mineral clasts to 300  $\mu m$  set in a glassy mesostasis of feldspathic composition. Clasts are Ca-pyroxene (some with exsolutions) and plagioclase. The mesostasis has abundant  $\sim 20 \mu m$  vesicles. FeNi metal is present as  $\sim 10 \mu m$  grains.

**Geochemistry:** Ca-pyroxene  $Fs_{37.9\pm 14.0}Wo_{15.4\pm 8.6}$ , FeO/MnO 59.3 $\pm$ 11.8 (n=6). Plagioclase  $An_{96.7}Ab_{3.1}Or_{0.2}$  (n=2).

**Classification:** Achondrite (lunar, feldspathic breccia)

**Specimens:** Type specimen at *CEREGE*. Main mass with J. Bassemon.

**Tazhong 001** 39°21.14'N, 83°15.49'E

Xinjiang, China

Find: 2019 Jan

Classification: Ordinary chondrite (H5/6)

**History:** The meteorite was found by Pengli Chen who is a meteorite hunter in middle Taklimakan desert near to Tazhong town, Southern Xinjiang, in January, 2019. Tazhong town was built in desert because of the exploration of oil.

**Physical characteristics:** Ten specimens were collected in the Taklimakan desert. The specimens are covered by black fusion crust. The partial fusion crust surface is cemented by sand. The masses of specimens are in a range 50 to 1000 g. The total mass is  $\sim 2$  kg.

**Petrography:** (J. Ji, S. Hu and Y. Lin, *IGGCAS*) The meteorite has a typical chondritic texture. Few relict chondrules are observed across the section, ranging up to  $\sim 1$  mm in diameter. The major constituent minerals are olivine, pyroxene, plagioclase, Fe-Ni metal, and troilite, with minor chromite and phosphates. Some plagioclase grains are larger than 50  $\mu m$  in diameter. Fe-Ni metal grains have been partially oxidized.

**Geochemistry:** Mineral compositions and geochemistry: (J. Ji, S. Hu and Y. Lin, *IGGCAS*) The olivine and pyroxene are homogeneous in chemical compositions. Olivine:  $Fa=17.8\pm 0.9$  (n=57), orthopyroxene:  $Fs_{15.5\pm 1.1}Wo_{1.1\pm 0.46}$  (n=43)

**Classification:** (J. Ji, S. Hu and Y. Lin, *IGGCAS*) H5/6

**Specimens:** The main mass is held by Pengli Chen.

**Tazzarine 002** 30°30.3'N, 5°48.85'W

South, Morocco

Find: 2018

Classification: Ordinary chondrite (H5)

**History:** Collected by Geologist Juan Avilés Poblador in the winter of 2018 during an expedition through the north of Zagora on behalf of the University of Alicante (Earth Sciences Department, Laboratory of Applied Petrology).

**Physical characteristics:** The single, 5105 g stone is roughly shaped like a loaf of bread approximately 15 cm long, with a dark brown exterior. Cut surfaces reveal abundant chondrules, with some cm-scale darker zones.

**Petrography:** (C. Herd, *UAb*) Optical and microprobe examination of a polished thin section shows small (generally < 1000  $\mu\text{m}$ ), poorly-defined chondrules. Numerous small iron oxide veinlets are present throughout. Olivine has sharp optical extinction with <2° angular variation.

**Geochemistry:** (C. Herd and A. Locock, *UAb*) Data obtained by EMP examination of carbon-coated thin section: Olivine  $\text{Fa}_{19.4\pm 0.5}$  (n=95); Low-Ca Pyroxene  $\text{Fs}_{17.4\pm 1.0}\text{Wo}_{1.4\pm 1.0}$  (n=69).

**Classification:** Ordinary chondrite, H5

**Specimens:** Type specimen of 149.0 g, including one thin section, is at *UAb*. Main mass at *UAlic*.

**Tibertatine 001** 31°4'45.87"N, 3°11'6.65"W

Bechar, Algeria

Find: 2018 Oct

Classification: Carbonaceous chondrite (CO3)

**History:** The meteorite was found in the region of Bechar, Algeria, by the military.

**Physical characteristics:** A single piece of 126 g, completely covered by a fusion crust.

**Petrography:** (I. Kerraouch; A. Bischoff, *IfP*) Chondrules, chondrule fragments, and CAIs are embedded in a fine-grained brownish matrix, which has an abundance of about 30 vol%. The majority of chondrules have Fe-poor mineral constituents and the mean apparent chondrule size is about 200  $\mu\text{m}$ . The sample is moderately weathered.

**Geochemistry:** (K. Klemm; A. Bischoff, *IfP*) Mineral compositions and geochemistry: Random measurements of olivine grains revealed  $\text{Fa}_{19.1\pm 18.8}$  ( $\text{Fa}_{0.5-57.5}$ ); n=30. Random measurements of low-Ca pyroxene grains revealed  $\text{Fs}_{2.1\pm 1.0}\text{Wo}_{1.6\pm 1.5}$  ( $\text{Fs}_{0.6-4.4}\text{Wo}_{0.4-5.0}$ ); n=15.

**Classification:** CO3 chondrite based on small chondrule size, chondrule-matrix ratio, texture, and mineral chemistry.

**Specimens:** 4.55 g in *IfP*, 121 g in Algeria (*IST-USTHB*)

**Tiros** 18°54'37.03"S, 45°49'10.14"W

Minas Gerais, Brazil

Probable fall: 2020 May 8

Classification: HED achondrite (Eucrite, cumulate)

**History:** (M. Zurita, BRAMON, D. Andrade, OV/UFRJ) On May 8, 2020, at 06:25:15 UTC, a bright fireball was seen from some cities of Minas Gerais and São Paulo states, Brazil. A loud explosion sound was heard in at least 18 cities in the Triângulo Mineiro region. Eight weather cameras from "Clima Ao Vivo" recorded the fireball from seven cities in Minas

Gerais, São Paulo and Paraná states. The fireball flash was also detected by GLM instrument on GOES-16 satellite. Analyzing the videos the BRAMON (Brazilian Meteor Network) calculated that the meteor traveled on a southwest-to-northeast trajectory, with velocity of 18.5 km/s, in a 15.8 deg inclination (relative to ground) crossing 180.1 km in 9.76 " and extinguished at 29.7 km high, 9.2 km west of Tiros city, MG. A 84 × 7 km<sup>2</sup> strewn field was calculated by Jim Goodall covering a vast area between Tiros and Morada Nova de Minas city. Searches were performed by residents and by meteorite hunters, but with Covid 19 and the vast region covered by mountain and vegetation, no fragment was found. In early September when cutting the vegetation, he found a stone that drew his attention, but let it in the same place. On September 18, Mr. Titota found this shiny black stone just 150 m from the farmhouse and brought it to his wife's rock collection. He made a video and send to a friendship whatsapp group. The priest José Luis de Araujo Paiva, who participated in the group, suspected to be a meteorite and sent the video to Sandro Barcelos, from Tireense Noticias website, that published the video. The video was shared by @mulheresdeestrelas. Through the @mulheresdeestrelas website and Sandro, The Meteoríticas found the owner of the meteorite. The finder and his family assure that they never saw that rock before. Since the find place is only about 30 km from the calculated strewn field and due to the meteorite be so fresh, it is probably associated with the May fireball.

**Physical characteristics:** Single flight-oriented stone with glassy black fusion crust and flow lines.

**Petrography:** (M.E Zucolotto) Three thin sections were analyzed, it is a coarse-grained (~1 mm) eucrite with a cumulate texture. It Consists mainly of anorthitic plagioclase feldspar, ortho and clinopyroxene with minor amounts of ferroan olivine, SiO<sub>2</sub>, troilite, phosphate and ilmenite. At those small sections no chromite neither Fe-metal were observed. The most abundant pyroxene is pigeonite. Some grains exhibit subsolidus augite exsolution. From the plagioclase An content and the texture, it can be classified as a cumulate eucrite. It shows undulatory extinction and planar fractures in plagioclases and planar and irregular fractures and weak mosaicism in some pyroxene grains are indicatives of a shock stage S4.

**Geochemistry:** (A. Tosi, IGEO/UFRJ) Electron microprobe analysis yields: Low-Ca pyroxene:  $Fs_{39.8 \pm 11.5}Wo_{6.3 \pm 1.8}$ , Fe/Mn=34.1±1.5 (n=36). Rich-Ca pyroxene:  $Fs_{49.5 \pm 6.1}Wo_{24.8 \pm 7.9}$ , Fe/Mn=34.7±7.0 (n=60). Olivine:  $Fa_{64.7 \pm 0.6}$  (n=9). Plagioclase:  $An_{93.4 \pm 2.8}Ab_{6.4 \pm 2.7}Or_{0.2 \pm 0.1}$  (n=58).

**Classification:** Cumulate Eucrite. Weathering (W0) and moderately shocked (S4)

**Specimens:** Type specimen at *MNRJ*. Main mass with Mr. Titota

**Tisserlitine 001** 21.325°N, 0.729°E

Gao, Mali

Find: 2019 Dec

Classification: Lunar meteorite (feldspathic breccia)

**History:** Beginning in December 2019 many similar dark stones were found together in the Kidal region of Mali, close to the border with Algeria. One very large stone (40026 g), another stone (4037 g) and 44 smaller stones (combined weight 3642 g) (total weight 47705 g) were purchased by Aziz Habibi in January 2020 from an Algerian dealer and subsequently acquired by Darryl Pitt. Independently, ten other stones of the same distinctive material (combined weight 8536 g) plus many smaller fragments (combined weight 1169 g) were purchased by Mbark Arjidal in February and March 2020 from a relative of the same Algerian dealer.

**Physical characteristics:** All specimens (many of which have a flattened slab-like form) lack fusion crust and exhibit medium-brown, "knobby" exterior surfaces. Interiors of stones have

an overall tan to pinkish hue with obvious light gray, dark gray and whitish clasts plus some visible small grains of metal.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) Two separate endcut specimens were studied. Both are samples of the same breccia material, composed of mineral clasts of anorthite, olivine, pigeonite, subcalcic augite, augite and orthopyroxene, plus sparse lithic clasts of spinel troctolite, set in a fine grained microvesicular matrix containing accessory altered kamacite, troilite, taenite and pentlandite. Secondary calcite is present pervasively in one of the two specimens studied and in places may be replacing original glass. Olivine grains in both studied specimens have been partially replaced by inhomogeneous phyllosilicate-rich assemblages, which apparently are hydroxylated (as evidenced by systematically low oxide analytical sums of 88-90 wt.% and absence of measurable F and Cl), and which are very Mn-deficient (yielding very elevated FeO/MnO ratios in the range 150-250). Troctolitic clasts are composed predominantly of anorthite and olivine with accessory Cr-pleonaste, low-Ca pyroxene and/or higher-Ca pyroxene.

**Geochemistry:** Olivine ( $\text{Fa}_{17.3-32.1}$ ,  $\text{FeO/MnO} = 76-100$ ,  $N = 15$ ), anorthite ( $\text{An}_{95.4-99.0}\text{Or}_{0.2-0.0}$ ,  $N = 7$ ), pigeonite ( $\text{Fs}_{18.2-26.8}\text{Wo}_{12.4-4.7}$ ,  $\text{FeO/MnO} = 47-54$ ,  $N = 6$ ), orthopyroxene ( $\text{Fs}_{16.0-21.6}\text{Wo}_{2.2-3.7}$ ,  $\text{FeO/MnO} = 51-66$ ,  $N = 4$ ), subcalcic augite ( $\text{Fs}_{15.9}\text{Wo}_{31.0}$ ,  $\text{FeO/MnO} = 41$ ), augite ( $\text{Fs}_{7.6-7.9}\text{Wo}_{42.9-45.6}$ ;  $\text{Fs}_{13.8}\text{Wo}_{38.9}$ ;  $\text{FeO/MnO} = 36-48$ ,  $N = 3$ ). Troctolite clast: olivine ( $\text{Fa}_{18.2-21.2}$ ,  $\text{FeO/MnO} = 84-92$ ,  $N = 4$ ), anorthite ( $\text{An}_{97.7}\text{Or}_{0.0}$ ), pleonaste ( $\text{mg} = 0.721$ ,  $\text{cr} = 0.093$ ).

**Classification:** Lunar (feldspathic regolithic breccia, partially hydrothermally-altered).

**Specimens:** 37.6 g in the form of two polished endcuts at *UWB*; remainder with *DPitt* and Mr. M. Arjdal.

**Toconao 001** 22°58.68'S, 68°18.01'W

Antofagasta, Chile

Find: 26 Mar 2019

Classification: Ordinary chondrite (LL3)

**History:** The meteorite was found by Mr. T. Kryachko on March 26, 2019, during a visual search for the meteorites in the Atacama desert.

**Physical characteristics:** The meteorite shows numerous fragments of irregular shape. It is grayish-brown in color, with fusion crust is absent, and chondritic texture visible on the sample surface. Some of the fragments are patchy, covered by salts; some of them are fractured by sub-parallel fracture planes due to weathering processes.

**Petrography:** (Lorenz C. A.) The meteorite is composed of chondrules of RP, RO, BP, BO, POP, PO and C types. Average chondrule diameter is  $486 \pm 290 \mu\text{m}$  ( $N=280$ ). Minor components are chondrule fragments, mineral grains and essentially fine-grained, non-transparent matrix. The chondrules are well outlined and have sharp contacts with the matrix. Troilite-rich chondrules are widely distributed, silica-rich chondrule was found. The main phases are olivine, pyroxene, troilite and glass; metal is accessory. Several chondrules contain Al-rich clinopyroxene. Olivine has sharp optical extinction. A network of thin veins of weathering products crosses the meteorite.

**Geochemistry:** Mineral compositions and geochemistry: Olivine:  $\text{Fa}_{19.4 \pm 12.3}$  ( $N=70$ ), PMD Fa is 63.2%, CaO 0.01-0.58 wt%; pyroxene  $\text{Fs}_{8.3 \pm 7.6}\text{Wo}_{1.2 \pm 1.2}$  ( $N=30$ ), clinopyroxene  $\text{Fs}_{15.4 \pm 6.1}\text{Wo}_{23.4 \pm 8.2}$  ( $N=6$ ); Al-rich clinopyroxene (wt%,  $N=22$ ):  $\text{Al}_2\text{O}_3$  13.7 $\pm$ 4.3;  $\text{TiO}_2$  0.7 $\pm$ 0.4;  $\text{Cr}_2\text{O}_3$  0.3 $\pm$ 0.3; sulfide is troilite; Total Fe of the meteorite is 19.7 wt% (XRF, T. G.

Kuzmina, *Vernad*).

**Classification:** Based on a texture, PMD of Fa olivine and total Fe abundance the meteorite is classified as ordinary chondrite of LL group, petrological type 3.

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3 **Specimens:** Type specimen of 158 g and thin section are on deposit in *Vernad.* Mr. T. V.  
4 Kryachko holds main mass of the meteorite.  
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8 **Touat 004** 27°10'20.6''N, 0°44'50.0''W

9 Adrar, Algeria

10 Find: March 2019

11 Classification: Lunar meteorite (feldspathic breccia)

12 **History:** The sample was purchased in July 2020 via Internet contact as a single piece of 345  
13 g. Based on the information of the Moroccan dealer the rock was found in the Adrar region,  
14 Algeria, in March 2019.

15 **Physical characteristics:** The piece has a rough grayish appearance with no obvious fusion  
16 crust. Saw cuts reveal a breccia with numerous angular dark clasts. The rock appears to be a  
17 relative fine-grained breccia compared to many other lunar breccias. Most obvious are dark  
18 clasts up to ~5 mm in size and white veins and areas often including brownish components.

19 **Petrography:** (A. Bischoff and K. Klemm, *IfP*). Optical studies of a thin section show that it  
20 is a breccia of different clasts embedded in a fine-grained matrix. The most abundant  
21 lithology is a feldspar-rich granulitic breccia. Overall the rock appears to be a well-  
22 recrystallized rock. The lithic clasts primarily consist of highland components dominated by  
23 anorthositic lithologies. Plagioclase transformed into maskelynite and glassy areas are less  
24 common compared to their abundances in many other lunar breccias. The breccia contains  
25 large areas and veins of secondary terrestrial alteration materials (mostly carbonates) often  
26 including red-brownish mineral aggregates.

27 **Geochemistry:** (A. Bischoff and K. Klemm, *IfP*) Mineral compositions: Olivine  $\text{Fa}_{35.9\pm 2.1}$ ,  
28 range  $\text{Fa}_{32-39}$ ,  $\text{Fe/Mn}=109$ ,  $n=7$ ; low-Ca pyroxene  $\text{Fs}_{22.8\pm 2.0}\text{Wo}_{8.0\pm 3.4}$   $\text{Fe/Mn}=55$ ,  $n=13$ ;  
29 plagioclase:  $\text{An}_{95.4\pm 1.4}$ ,  $n=16$

30 **Classification:** Lunar meteorite (feldspathic breccia)  
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37 **Touat 005** 27.747222, -1.369722

38 Adrar, Algeria

39 Find: 2020

40 Classification: Lunar meteorite (feldspathic breccia)

41 **History:** These two stones were found by meteorite hunters driving off-road between  
42 Tabelbala, Algeria, and the [Erg Chech 002](#) find locality. Nearest towns to this find are Adrar  
43 and Tamentit, Algeria.

44 **Physical characteristics:** Two stones, identical in appearance, (2035 and 1675 g) were found  
45 together. This is a fragmental breccia with white plagioclase megacrysts and lithic clasts set in  
46 a dark shocked matrix. Plagioclase megacrysts are up to two centimeters in length and are  
47 translucent in thinly sliced slabs. No fusion crust is present.

48 **Petrography:** (C. Agee, *UNM*) Electron microprobe analysis and imaging reveals a  
49 fragmental breccia with large, sometimes euhedral anorthite crystals (megacrysts). The  
50 megacrysts appear to be shock-mosaicized or recrystallized with a significant amount of dark  
51 and light inclusions present, some of the observed inclusion veining in the megacrysts is  
52 possibly maskelynite. The compositions of the plagioclase megacrysts are slightly more  
53 anorthitic than the groundmass plagioclase fragments, although there is compositional overlap  
54 between the two that is within microprobe error. This is possibly a monomict breccia since the  
55 section analyzed had only one coherent population of pyroxenes and olivines that appear to be  
56 related by equilibrium igneous crystallization. The olivine and pyroxene compositions are  
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similar to that in ferroan anorthosites. Shock melt veins with vesicles were observed. Minor opaque phases are ilmenite and chromite.

**Geochemistry:** (C. Agee, *UNM*) Plagioclase megacrysts  $An_{97.2\pm 0.7}Ab_{2.6\pm 0.3}Or_{0.2\pm 0.1}$ ,  $n=6$ ; groundmass plagioclase  $An_{96.5\pm 0.3}Ab_{3.2\pm 0.3}Or_{0.2\pm 0.1}$ ,  $n=6$ ; low-Ca pyroxene  $Fs_{28.2\pm 5.9}Wo_{5.6\pm 3.1}$ ,  $Fe/Mn=59\pm 6$ ,  $n=6$ ; augite  $Fs_{18.7\pm 0.4}Wo_{43.2\pm 1.5}$ ,  $Fe/Mn=48\pm 1$ ,  $n=2$ ; olivine  $Fa_{36.7\pm 10.1}$ ,  $Fe/Mn=95\pm 3$ ,  $n=9$ ; shock melt vein  $SiO_2=43.6\pm 0.4$ ,  $Al_2O_3=31.1\pm 0.8$ ,  $FeO=3.7\pm 0.6$ ,  $MgO=3.3\pm 0.5$ ,  $MnO=0.05\pm 0.02$ ,  $CaO=17.3\pm 0.1$ ,  $Na_2O=0.32\pm 0.05$  all wt%,  $n=3$ .

**Classification:** Lunar feldspathic breccia with plagioclase megacrysts. Mafic minerals similar in composition to that present in ferroan anorthosites.

**Specimens:** 25.8 g on deposit at *UNM*, Mark Lyon holds the main masses.

**Touat 006** 27°03'N, 0°10'W

Adrar, Algeria

Purchased: 2019

Classification: HED achondrite (Eucrite, melt breccia)

**History:** The meteorite was found in the Adrar desert and was purchased as one piece of 670 g from a meteorite dealer in Mauritania

**Physical characteristics:** Dark-grayish rock with some light clasts and pores

**Petrography:** (A. Bischoff and K. Klemm, *IfP*) The meteorite is a eucrite-melt breccia composed of up to several mm sized eucritic clasts set into a fine-grained melt rock matrix. The locally schlieren-like melt matrix is mostly crystalline and contains abundant pores

**Geochemistry:** (A. Bischoff and K. Klemm, *IfP*): The rock contains low-Ca and Ca pyroxene. Low-Ca pyroxene is  $Fs_{58.7\pm 6.2}Wo_{4.7\pm 3.3}$  ( $Fs_{35.8-63.5}Wo_{1.8-12.9}$ ; mean  $Fe/Mn=33.8$ ;  $n=19$ ) and the Ca-pyroxene has  $Fs_{27.8\pm 0.7}Wo_{42.4\pm 1.1}$  ( $Fs_{26.6-28.9}Wo_{40.2-43.8}$ ;  $n=13$ ). Calcic plagioclase has a composition of  $An_{90.3\pm 1.0}$  ( $An_{88.6-91.6}$ ,  $n=11$ )

**Classification:** HED achondrite (Eucrite, melt breccia)

**Tungsten Mountain 054 (TM 054)** 39°41.3426'N, 117°37.2048'W

Nevada, United States

Find: 4 Aug 2001

Classification: Ordinary chondrite (H5)

**History:** While conducting meteorite recovery on a dry-lake in Edwards Creek Valley, Robert *Verish* found this stone fragment on 2001-08-04

**Physical characteristics:** An 11.5 g stony fragment, tabular-shaped (30 × 25 × 8 mm) having dark-brown, hackly exterior with black patina on some sides, and one tiny patch of relict fusion-crust. Basically, a typical-looking fragment of a H-chondrite from this this dry-lake in Edwards Creek Valley.

**Petrography:** (D. Sheikh, *FSU*) Low chondrule abundance (500-1000 μm,  $n=2$ ). Sample is composed of olivine, low-ca pyroxene, recrystallized plagioclase (average size 10±2 μm), troilite, Fe-Ni metal, Fe-oxides, and chromite.

**Geochemistry:** Olivine ( $Fa_{18.6\pm 0.4}$ ,  $n=9$ ), Low-Ca Pyroxene ( $Fs_{16.5\pm 0.5}Wo_{1.3\pm 0.3}$ ,  $n=13$ ).

**Classification:** Ordinary Chondrite (H5)

**Specimens:** 10.3 g at *UCLA*; main mass with *Verish*.

**Tungsten Mountain 055 (TM 055)** 39°41.3455'N, 117°37.1916'W

Nevada, United States

Find: 4 Aug 2001

Classification: Ordinary chondrite (H5)

**History:** While conducting meteorite recovery on a dry-lake in Edwards Creek Valley, Robert *Verish* found this stone fragment on 2001-08-04

**Physical characteristics:** A single 7.4 g stony fragment, tabular-shaped (32 × 25 × 8 mm) having dark-brown, hackly exterior with some black patina, and one tiny patch of relict fusion-crust. Basically, a typical-looking fragment of a H-chondrite from this this dry-lake in Edwards Creek Valley.

**Petrography:** (D. Sheikh, *FSU*) Low chondrule abundance (500-1000 μm, n=2). Sample is composed of olivine, low-ca pyroxene, recrystallized plagioclase (average size 6±1 μm), troilite, Fe-Ni metal, Fe-oxides, and chromite.

**Geochemistry:** Olivine (Fa<sub>19.0±0.8</sub>, n=15), Low-Ca Pyroxene (Fs<sub>16.5±0.7</sub>Wo<sub>1.3±0.2</sub>, n=17).

**Classification:** Ordinary Chondrite (H5)

**Specimens:** 7 g at *UCLA*; main mass with *Verish*.

**Tungsten Mountain 056 (TM 056)** 39°41.3442'N, 117°37.1896'W

Nevada, United States

Find: 4 Aug 2001

Classification: Ordinary chondrite (H5)

**History:** While conducting meteorite recovery on a dry-lake in Edwards Creek Valley, Robert *Verish* found this stone fragment on 2001-08-04

**Physical characteristics:** A single 28.8 g stony fragment, flat-oval shape (45 × 30 × 10 mm) having dark-brown, hackly exterior with some black patina, and one tiny patch of relict fusion-crust. Basically, a typical-looking fragment of a H-chondrite from this this dry-lake in Edwards Creek Valley.

**Petrography:** (D. Sheikh, *FSU*) Low chondrule abundance (300-1200 μm, n=7). Sample is composed of olivine, low-ca pyroxene, recrystallized plagioclase (average size 5±1 μm), troilite, Fe-Ni metal, Fe-oxides, and chromite.

**Geochemistry:** Olivine (Fa<sub>18.7±0.9</sub>, n=19), Low-Ca Pyroxene (Fs<sub>16.7±0.7</sub>Wo<sub>1.4±0.2</sub>, n=20).

**Classification:** Ordinary Chondrite (H5)

**Specimens:** 27.9 g at *UCLA*; main mass with *Verish*.

**Tungsten Mountain 057 (TM 057)** 39°41.3294'N, 117°37.1671'W

Nevada, United States

Find: 4 Aug 2001

Classification: Ordinary chondrite (H5)

**History:** While conducting meteorite recovery on a dry-lake in Edwards Creek Valley, Robert *Verish* found this stone fragment on 2001-08-04

**Physical characteristics:** A single 11.5 g stony fragment, rectangular-solid (23 × 21 × 11 mm) having dark-brown exterior with two sides fusion-crust. Cut surface reveals an orange and beige interior with small metal-grains and chondrules.

**Petrography:** (D. Sheikh, *FSU*) Low chondrule abundance (300-1000 μm, n=5). Sample is composed of olivine, low-ca pyroxene, recrystallized plagioclase (average size 6±2 μm), troilite, Fe-Ni metal, Fe-oxides, and chromite.

**Geochemistry:** Olivine (Fa<sub>18.7±0.4</sub>, n=14), Low-Ca Pyroxene (Fs<sub>16.3±0.4</sub>Wo<sub>1.3±0.2</sub>, n=13).

**Classification:** Ordinary Chondrite (H5)

**Specimens:** 9.9 g at *UCLA*; main mass with *Verish*.

**Tungsten Mountain 058 (TM 058)** 39°41.3333'N, 117°37.2057'W

Nevada, United States

Find: 4 Aug 2001

Classification: Ordinary chondrite (H5)

**History:** While conducting meteorite recovery on a dry-lake in Edwards Creek Valley, Robert *Verish* found this stone fragment on 2001-08-04**Physical characteristics:** A single 34.9 g stony fragment, shaped like a dried apricot (40 × 35 × 15 mm) having dark-brown, hackly exterior with some black patina, and a small patch of relict fusion-crust. A saw-cut reveals dark-tan interior with sparse metal-grains and small chondrules Basically, a typical-looking fragment of a H-chondrite from this this dry-lake in Edwards Creek Valley.**Petrography:** (D. Sheikh, *FSU*) Low chondrule abundance (500-700 μm, n=2). Sample is composed of olivine, low-ca pyroxene, recrystallized plagioclase (average size 7±1 μm), troilite, Fe-Ni metal, Fe-oxides, and chromite.**Geochemistry:** Olivine (Fa<sub>19.1±0.6</sub>, n=18), Low-Ca Pyroxene (Fs<sub>16.8±0.6</sub>Wo<sub>1.3±0.1</sub>, n=16).**Classification:** Ordinary Chondrite (H5)**Specimens:** 32.1 g at *UCLA*; main mass with *Verish*.**Tungsten Mountain 059 (TM 059)** 39°41.3069'N, 117°37.2672'W

Nevada, United States

Find: 4 Aug 2001

Classification: Ordinary chondrite (H5)

**History:** While conducting meteorite recovery on a dry-lake in Edwards Creek Valley, Robert *Verish* found this stone fragment on 2001-08-04**Physical characteristics:** A single 12 g stony fragment, four-sided (28 × 17 × 10 mm) with 3 sides forming a corner covered in 1mm-thick fusion-crust. Saw-cut reveals a light-brown interior with many metal-grains and visible chondrules.**Petrography:** (D. Sheikh, *FSU*) Low chondrule abundance (300-1000 μm, n=10). Sample is composed of olivine, low-ca pyroxene, recrystallized plagioclase (average size 10±2 μm), troilite, Fe-Ni metal, Fe-oxides, and chromite.**Geochemistry:** Olivine (Fa<sub>19.0±0.7</sub>, n=20), Low-Ca Pyroxene (Fs<sub>16.9±0.9</sub>Wo<sub>1.3±0.1</sub>, n=16).**Classification:** Ordinary Chondrite (H5)**Specimens:** 10.1 g at *UCLA*; main mass with *Verish*.**Tungsten Mountain 060 (TM 060)** 39°41.3092'N, 117°37.2650'W

Nevada, United States

Find: 4 Aug 2001

Classification: Ordinary chondrite (H5)

**History:** While conducting meteorite recovery on a dry-lake in Edwards Creek Valley, Robert *Verish* found this stone fragment on 2001-08-04**Physical characteristics:** A single 18.9 g stone, flat, with no fusion-crust (interior) fragment (35 × 20 × 6 mm) having dark-brown, hackly exterior with some subtle slickened-side. Basically, a typical-looking fragment of a H-chondrite from this this dry-lake in Edwards Creek Valley.**Petrography:** (D. Sheikh, *FSU*) Low chondrule abundance (300-1200 μm, n=12). Sample is composed of olivine, low-ca pyroxene, recrystallized plagioclase (average size 6±1 μm), troilite, Fe-Ni metal, Fe-oxides, and chromite.**Geochemistry:** Olivine (Fa<sub>18.7±0.6</sub>, n=20), Low-Ca Pyroxene (Fs<sub>16.6±0.3</sub>Wo<sub>1.3±0.2</sub>, n=14).

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3 **Classification:** Ordinary Chondrite (H5)

4 **Specimens:** 16 g at *UCLA*; main mass with *Verish*.

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8 **Tungsten Mountain 073** (*TM 073*) 39°40.7732'N, 117°37.7552'W

9 Nevada, United States

10 Find: 5 Aug 2001

11 Classification: Ordinary chondrite (H5)

12 **History:** While conducting meteorite recovery on a dry-lake in Edwards Creek Valley,  
13 Robert *Verish* found this stone fragment on 2001-08-05

14 **Physical characteristics:** A single 28.5 g stony fragment, pyrimidal in shape (40 × 30 × 23  
15 mm) having dark-brown, hackly exterior with some black patina. One side is covered in a  
16 patchy, rough-surfaced relict fusion -crust. Cut surface reveals many small metal-grains and  
17 small chondrules in a light-brown matrix.

18 **Petrography:** (D. Sheikh, *FSU*) Low chondrule abundance (900-1200 μm, n=3). Sample is  
19 composed of olivine, low-ca pyroxene, recrystallized plagioclase (average size 8±2 μm),  
20 troilite, Fe-Ni metal, Fe-oxides, and chromite.

21 **Geochemistry:** Olivine (Fa<sub>19.3±0.5</sub>, n=9), Low-Ca Pyroxene (Fs<sub>16.8±0.7</sub>Wo<sub>1.2±0.2</sub>, n=20).

22 **Classification:** Ordinary Chondrite (H5)

23 **Specimens:** 26.2 g at *UCLA*; main mass with *Verish*.

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28 **Tungsten Mountain 084** (*TM 084*) 39°41.2226'N, 117°37.3741'W

29 Nevada, United States

30 Find: 5 Aug 2001

31 Classification: Ordinary chondrite (H5)

32 **History:** While conducting meteorite recovery on a dry-lake in Edwards Creek Valley,  
33 Robert *Verish* found this stone fragment on 2001-08-05

34 **Physical characteristics:** Two physically-paired stony fragments, total weight 28.1 g,  
35 irregularly shaped (badly weathered) having dark-brown, hackly exterior with some black  
36 patina, but no fusion-crust. Basically, a typical-looking fragment of a H-chondrite from this  
37 this dry-lake in Edwards Creek Valley.

38 **Petrography:** (D. Sheikh, *FSU*) Low chondrule abundance (700-900 μm, n=2). Sample is  
39 composed of olivine, low-ca pyroxene, recrystallized plagioclase (average size 6±2 μm),  
40 troilite, Fe-Ni metal, Fe-oxides, and chromite.

41 **Geochemistry:** Olivine (Fa<sub>18.9±0.5</sub>, n=16), Low-Ca Pyroxene (Fs<sub>16.9±0.8</sub>Wo<sub>1.1±0.2</sub>, n=7).

42 **Classification:** Ordinary Chondrite (H5)

43 **Specimens:** 12.7 g at *UCLA*; main mass with *Verish*.

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49 **Tungsten Mountain 116** (*TM 116*) 39°41.2358'N, 117°37.3940'W

50 Nevada, United States

51 Find: 5 Aug 2001

52 Classification: Ordinary chondrite (H5)

53 **History:** While conducting meteorite recovery on a dry-lake in Edwards Creek Valley,  
54 Robert *Verish* found this stone fragment on 2001-08-05

55 **Physical characteristics:** One 7 g stony fragment, angular with an irregular shape (25 × 20 ×  
56 15 mm) having dark-brown, hackly exterior with a black patina, and small patches of relict  
57 fusion crust. Saw-cut reveals light-brown interior with many metal-grains and visible  
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chondrules. Basically, a typical-looking fragment of a H-chondrite from this this dry-lake in Edwards Creek Valley.

**Petrography:** (D. Sheikh, *FSU*) Low chondrule abundance (700-1200  $\mu\text{m}$ ,  $n=3$ ). Sample is composed of olivine, low-ca pyroxene, recrystallized plagioclase (average size  $9\pm 2$   $\mu\text{m}$ ), troilite, Fe-Ni metal, Fe-oxides, and chromite.

**Geochemistry:** Olivine ( $\text{Fa}_{18.8\pm 0.5}$ ,  $n=13$ ), Low-Ca Pyroxene ( $\text{Fs}_{16.6\pm 0.6}\text{Wo}_{1.2\pm 0.1}$ ,  $n=12$ ).

**Classification:** Ordinary Chondrite (H5)

**Specimens:** 5.3 g at *UCLA*; main mass with *Verish*.

**Tungsten Mountain 121** (*TM 121*)       $39^{\circ}41.2412'\text{N}$ ,  $117^{\circ}37.3834'\text{W}$

Nevada, United States

Find: 5 Aug 2001

Classification: Ordinary chondrite (H5)

**History:** While conducting meteorite recovery on a dry-lake in Edwards Creek Valley, Robert *Verish* found this stone fragment on 2001-08-05

**Physical characteristics:** One 2.6 g stony fragment, teardrop-shaped ( $15 \times 7 \times 7$  mm) having dark-brown, hackly exterior with a black patina, but no fusion-crust. Protruding through the exterior is one large ( $1 \times 0.75$  mm) oval chondrule. Saw-cut reveals light-brown interior with many metal-grains and visible chondrules. Basically, a typical-looking fragment of a H-chondrite from this this dry-lake in Edwards Creek Valley.

**Petrography:** (D. Sheikh, *FSU*) Low chondrule abundance (200-1000  $\mu\text{m}$ ,  $n=9$ ). Sample is composed of olivine, low-ca pyroxene, recrystallized plagioclase (average size  $6\pm 1$   $\mu\text{m}$ ), troilite, Fe-Ni metal, Fe-oxides, and chromite.

**Geochemistry:** Olivine ( $\text{Fa}_{18.7\pm 0.8}$ ,  $n=23$ ), Low-Ca Pyroxene ( $\text{Fs}_{16.4\pm 0.7}\text{Wo}_{1.0\pm 0.3}$ ,  $n=12$ ).

**Classification:** Ordinary Chondrite (H5)

**Specimens:** 1 g at *UCLA*; main mass with *Verish*.

**Tyro**       $\sim 37.0^{\circ}\text{N}$ ,  $\sim 95.8^{\circ}\text{W}$

Kansas, United States

Find: 1978

Classification: Ordinary chondrite (L6)

**History:** The meteorite was found by a farmer in a field in 1978, near the small town of Tyro, Kansas. It was given to his niece, Diane Crawford. It remained in their family until it was recognized as a meteorite by the Kansas Meteorite Society in October 2008.

**Petrography:** The rock is very recrystallized chondrite with discernable PO, POP and BO chondrules. Plagioclase grain size is  $\sim 60$   $\mu\text{m}$ .

**Classification:** Ordinary chondrite (L6, S3, W2)

**United Arab Emirates 030** (UAE 030)       $23^{\circ}36'13.12''\text{N}$ ,  $55^{\circ}09'01.56''\text{E}$

Abu Dhabi, United Arab Emirates

Find: 2012

Classification: Ordinary chondrite (L6)

**History:** The meteorite was found 2012 during a field trip to the United Arab Emirate desert and purchased by Jens Bäumer from the anonymous finder.

**Physical characteristics:** Dark brownish fragment with some fusion crust.

**Petrography:** The plagioclase grain size is about 80  $\mu\text{m}$ . Contains black shock melt veins.



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6 **Utting** 33°59.20'N, 114°0.10'W

7 Arizona, United States

8 Find: 2020 Jan 28

9 Classification: Ordinary chondrite (H4)

10 **History:** While searching for additional stones of the [Bouse](#) (L4-6) meteorite, a cluster of  
11 broken fragments was recovered by Robert *Verish* on January 28, 2020. Sample was taken  
12 from the 294 g specimen.

13 **Physical characteristics:** Many stones are dark-brown, angular fragments. Some stones have  
14 one or more sides which appear to be a thick, desert-varnished patina, which is  
15 indistinguishable from a relict fusion-crust. A cut surface reveals an interior with small,  
16 matrix-supported chondrules of various colors.

17 **Petrography:** (D. Sheikh, *FSU*) Chondrules moderately abundant (500±50 µm). Sample  
18 composed of olivine, low-Ca pyroxene, troilite, Fe-Ni metal, and Fe-oxides.

19 **Geochemistry:** Olivine (Fa<sub>17.8±0.2</sub>, n=16), low-Ca Pyroxene (Fs<sub>16.1±0.4</sub>Wo<sub>1.2±0.2</sub>, n=25).

20 **Classification:** Ordinary Chondrite (H4)

21 **Specimens:** 27.2 grams at *UCLA*; main mass with *Verish*.

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26 **Valle** 59°01'20.9"N, 7°15'28.1" E

27 Aust-Agder, Norway

28 Find, possible fall: 2013 Jun 9

29 Classification: Ordinary chondrite (H5)

30 **History:** (M. Bilet, H. Friis, *UOslo*) The meteorite was found on 9 June 2013 by Terje  
31 Fjeldheim, during a fishing trip in an open mountain area above tree line, near a small lake.  
32 The rock was in a small pit in the ground and was clearly discernible from the surrounding  
33 terrain. The meteorite was split into two pieces when discovered. A fireball was observed by  
34 the Norwegian Meteorite Camera Network on February 2, 2012, where the triangulation  
35 indicates an impact that overlaps with the location where this meteorite was discovered.

36 **Physical characteristics:** (A. Krzesinska, *UOslo*) Meteorite has thick black fusion crust  
37 covering whole specimen. On the broken surface, light interior is seen with chondritic texture.  
38 Minor weathering of FeNi minerals is seen on broken surface, on its outermost part and is  
39 manifested by rusty appearance.

40 **Petrography:** (A. Krzesinska, *UOslo*) Recrystallized chondritic texture manifested by  
41 presence of some chondrules, up to 800 µm in size, relatively well preserved with glassy-  
42 microcrystalline mesostasis. Some orthorhombic pyroxene present in fine-grained matrix.  
43 Weakly shocked, with olivine exhibiting only minor undulose extinction and irregular  
44 fractures.

45 **Geochemistry:** (A. Krzesinska, M. Erambert, *UOslo*) Equilibrated H chondrite. Olivine with  
46 Fa<sub>18.2±0.4</sub>, low-Ca pyroxene Fs<sub>16.1±0.3</sub>Wo<sub>1.60.4</sub>, glassy mesostasis of plagioclase composition  
47 (An<sub>10.0±0.5</sub>Or<sub>5.2±1.5</sub>) and diopside crystallites in places (Fs<sub>5.8±0.1</sub>Wo<sub>46.0±0.6</sub>), chromite (Fe,Cr-  
48 rich; Fe#=0.85, Cr#=0.88), merrillite (up to 2.8 wt% Na<sub>2</sub>O, 3.6 wt% of MgO and 0.38 wt%  
49 FeO), and Cl-apatite (up to 0.35 wt% Na<sub>2</sub>O and various content of Cl, up to pure Cl-apatite  
50 with 5.62 wt% Cl). Kamacite with 0.45-0.49 wt% Co, taenite and tetrataenite also present.

51 **Classification:** (A. Krzesinska, *UOslo*) Ordinary chondrite, H5 type based on composition of  
52 silicates and metal.

53 **Specimens:** (H. Friis, M. Bilet, *UOslo*): Specimen broken into two fragments (4700 in total),  
54 both in the collection of the Natural History Museum at *UOslo*. Two thin sections prepared  
55 out of it, and two epoxy mounts.

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5 **Villanueva** 35.238°N, 105.332°W

6 New Mexico, United States

7 Find: 1974

8 Classification: Ordinary chondrite (H6)

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10 **History:** Found by an anonymous (now deceased) person in 1974 about a mile southeast of  
11 where the Villa Nueva State Park is now located, southeast of Santa Fe, New Mexico. Some  
12 time later the man's niece brought the specimen (in two pieces that fit together) to a mineral  
13 shop (Mama's Minerals) in Albuquerque, New Mexico, where it was on display for many  
14 years. In November 2014 the smaller piece was acquired from the shop owner by  
15 Blaine Reed.

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17 **Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) The specimen is extensively  
18 recrystallized with rare remnant chondrules. Primary kamacite has been partly altered to  
19 goethite and thin veinlets of reddish-brown goethite crosscut the studied thin section. Other  
20 accessory phases are sodic plagioclase, taenite, low-Ti chromite, troilite and merrillite.

21 **Geochemistry:** Olivine ( $\text{Fa}_{19.1\pm 0.2}$ , range  $\text{Fa}_{18.8-19.3}$ ,  $N = 5$ ), low-Ca pyroxene  
22 ( $\text{Fs}_{16.7\pm 0.2}\text{Wo}_{1.5\pm 0.2}$ , range  $\text{Fs}_{16.5-16.9}\text{Wo}_{1.3-1.8}$ ,  $N = 4$ ), augite ( $\text{Fs}_{6.4\pm 0.2}\text{Wo}_{45.3\pm 0.4}$ , range  $\text{Fs}_{6.2-}$   
23  $6.5\text{Wo}_{45.6-45.0}$ ,  $N = 2$ ). Magnetic susceptibility  $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 4.88$ .

24 **Classification:** Ordinary chondrite (H6).

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26 **Specimens:** 24.1 g including one polished thin section at *PSF*; 632 g with Mr. B. Reed; main  
27 mass with Ms. L. Randolph (Mama's Minerals).  
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31 **Wad Lahteyba** 27°22'23.153"N, 8°58'51.744"W

32 Morocco/Western Sahara

33 Confirmed fall: 2019 June 27

34 Classification: Ordinary chondrite (H5)

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36 **History:** (H. Chennaoui Aoudjehane, H. Al Harbi, FZ. Jadid) On Thursday, 27 June 2019, at  
37 5 pm (GMT+1) a fireball was seen by many people. Eyewitnesses reported a yellow to red  
38 color of the fireball during around 3 " on a SW to NE trajectory. No sonic booms were  
39 reported. Hundreds of hunters and nomads went to the area where they thought the fall  
40 occurred. First pieces were recovered on June 29, two days after the event. There were so  
41 many reports of the fall that the national Moroccan TV organized a [documentary](#) that was  
42 shown on the TV news. Many hunters (including "Ali Salem Sayad" and "Ali Amjkar") gave  
43 their testimonies to the TV journalists and talked about a potential strewnfield. Eyewitness Ali  
44 Tamaarirt saw the fireball from Oued Essakiya and Lhou Ousalah saw it from Lbbouirat.  
45 Additional information was given by Ali Hmida and Jaffar. So far, many pieces totaling  
46 around 20 kg were collected, the biggest one 4330 g.

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48 **Physical characteristics:** (H. Chennaoui Aoudjehane) Many small pieces from a few grams  
49 to 4 kg. Very fresh, thin, black and matte fusion crust covers the pieces. The interior is gray  
50 showing numerous chondrules. The rock is friable, and the external part of a small pieces is  
51 rough, showing a secondary fusion crust. Metal and sulfides are very thin. Magnetic  
52 susceptibility (H. Chennaoui Aoudjehane) measured with a SM30 instrument is  $\log \chi (\times 10^{-}$   
53  $9 \text{ m}^3/\text{kg}) = 5.29$ .

54  
55 **Petrography:** (C. Agee, *UNM*) Microprobe examination of a polished mount shows  
56 numerous porphyritic chondrules set in a recrystallized groundmass. Plagioclase grains are  
57 ubiquitous with sizes up to 25 microns in diameter. Abundant FeNi-metal and troilite  
58 observed throughout. Apatite and chromite are ubiquitous minor phases.  
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**Geochemistry:** (C. Agee, *UNM*) Olivine  $Fa_{18.6\pm 0.3}$ ,  $Fe/Mn=38\pm 3$ ,  $n=9$ ; low-Ca pyroxene  $Fs_{16.4\pm 0.1}Wo_{1.6\pm 0.1}$ ,  $n=7$ .

**Classification:** Ordinary chondrite, H5, S3, W0

**Specimens:** 20.2 g including microprobe mount at *UNM* (0.3 g) provided by Hamza Al Harbi, as well as 25.3 g provided by the "Moroccan Association of Meteorites" on deposit at *FSAC*. Vincent Jacques holds the main mass 4330 g plus some pieces totaling 218 g; 19g and 8.7g on a private collection in Casablanca.

**Wellman (f)** 33.13°N, 102.38°W

Texas, USA

Find: 2002

Classification: Ordinary chondrite (H3-4)

**History:** Found in 2002 by oil field geologist Rodney Michel in the region north of Highway 62 between Brownfield and Wellman, Texas, and subsequently purchased from the finder in February 2020 by Peter Allen.

**Petrography:** (A. Irving, *UWS* and P. Carpenter, *WUSL*) The specimen is a breccia composed of discrete, well-formed chondrules plus lithic chondrite clasts set in sparse matrix containing extensively altered kamacite, taenite, low-Ti chromite, merrillite and chlorapatite. Both unequilibrated Type 3 clasts (containing relatively small, well-formed glass-bearing chondrules) and equilibrated Type 4 clasts (containing well-formed chondrules with albitic plagioclase) are present. Silica polymorph is present in some low-Ca pyroxene chondrules.

**Geochemistry:** Olivine in equilibrated chondrules ( $Fa_{18.4\pm 0.3}$ , range  $Fa_{18.1-18.8}$ ,  $N = 4$ ), olivine in unequilibrated chondrules ( $Fa_{16.4\pm 8.6}$ , range  $Fa_{6.7-25.1}$ ,  $N = 4$ ), low-Ca pyroxene in both sorts of chondrules ( $Fs_{14.8\pm 9.3}Wo_{1.3\pm 1.3}$ , range  $Fs_{2.8-28.5}Wo_{0.2-3.4}$ ,  $N = 5$ ), diopside ( $Fs_{3.6}Wo_{36.7}$ ;  $Fs_{5.4}Wo_{46.1}$ ;  $N = 2$ ).

**Classification:** Ordinary chondrite (H3-4 breccia).

**Specimens:** 22.2 g including one polished thin section at *UWB*; remainder with Mr. P. Allen.

**Wubao 002** 42°17'47.80"N, 92°28'18.93"E

Xinjiang, China

Find: 2018

Classification: Ordinary chondrite (LL3)

**History:** (Ziyao Wang) Discovered by Wentao Yang (Urumqi) in the desert near Dahaidao (Xinjiang Province) in 2018

**Physical characteristics:** (Ziyao Wang) Gray-brown stone of 105 g without fusion crust

**Petrography:** (R. Bartoschewitz, *Bart*) well defined chondrules (~50 vol%) of 0.3-2 mm (av. 0.7 mm) and AOIs (~10 vo%) are set in a black opaque matrix with few irregular metal and sulfide aggregates up to 0.3 mm (<1 vol%).

**Geochemistry:** (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine  $Fa_{14.1\pm 7.7}$  ( $n=31$ ) (range  $Fa_{0.6-31.4}$ ),  $Fe/Mn=43$ ,  $Fe/Mg=0.17$ ; low Ca pyroxene  $Fs_{8.7\pm 5.7}Wo_{0.7\pm 0.7}$  ( $Fs_{1.5-15.6}Wo_{0.2-2.2}$ ,  $n=8$ ); pigeonite  $En_{77}Fs_{18}Wo_5$  ( $n=1$ ); feldspar  $An_{85}Ab_{15}$  ( $n=1$ ). Kamacite  $Ni=2.6-5.1$ ,  $Co=0.4-0.9$  wt% ( $n=8$ ). O-isotopes (A. Pack, *UGött*):  $\delta^{17}O(\text{‰}) = 4.151$ ,  $\delta^{18}O(\text{‰}) = 5.928$ . Magnetic susceptibility (R. Bartoschewitz, *Bart*)  $\log \chi$  ( $\times 10^{-9} \text{ m}^3/\text{kg}$ ) = 4.82 plots outside the LL range, as O-isotopes reflect.

**Classification:** Ordinary chondrite (LL3, S4, W0-1)

**Specimens:** 17.8 g at *Kiel* and 4.7 g at *UGött* on deposit, Ziyao Wang holds the main mass and 27 g with *Bart*.

**Zhengjiabu** 40°47'34"N, 124°27'58"E

Liaoning, China

Find, possible fall: 1982

Classification: Ordinary chondrite (H5)

**History:** Jin Zhicheng, Dandong city, remembers that when he was 12 years old in the summer of 1982, at about 9:30 pm one night when most local people were asleep, a bright fireball illuminated the sky and the ground, followed by an explosion with an echo that continued for a long time. The next day, local people unsuccessfully searched for the cause, and the event was mostly forgotten. Fourteen years later, Jin Zhicheng returned to Zhengjiabu village to support his family. On May 6, 1996, he discovered a big stone while plowing a field, buried 30-40 cm in the heavy soil. He felt that it might be the stone that fell 14 years ago and put it in the yard for a further 23 years, until he asked Ziyao Wang for support in 2019.

**Physical characteristics:** (Ziyao Wang) 17 kg completely crusted individual with regmaglypts, the crust is partly oxidized.

**Petrography:** (R. Bartoschewitz, *Bart*) chondrule margins are difficult to discern in the strong recrystallized matrix; metal and sulfide mainly show irregular inclusions.

**Geochemistry:** (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine  $Fa_{19.4\pm 0.3}$  (n=18); low-Ca pyroxene  $Fs_{17.2\pm 0.5}Wo_{1.6\pm 0.5}$  (n=15); Ca pyroxene  $En_{48}Fs_6Wo_{46}$  (n=1); feldspar  $An_{12}Or_6$  (n=3); chromite CRAL83-85, FFM87-84 (n=2); Cl-apatite and merrillite. Kamacite Ni=5.8-6.2, Co=0.7; taenite Ni=32-34, Co=0.2 (n=3) (all wt-%); troilite. Magnetic susceptibility (R. Bartoschewitz, *Bart*)  $\log \chi (\times 10^{-9} \text{ m}^3/\text{kg}) = 5.01$ .

**Classification:** Ordinary chondrite (H5, S2, W2)

**Specimens:** 20.8 g at *Kiel* on deposit, Zhicheng Jin holds the main mass, Ziyao Wang 25 g and 131 g with *Bart*.

**Zhob** 31°22'N, 69°34'E

Baluchistan, Pakistan

Confirmed fall: 2020 Jan 9

Classification: Ordinary chondrite (H3-4)

**History:** (M. Farmer, Arizona) A bright fireball followed by sonic booms was seen and heard around the northern part of the Baluchistan province of Pakistan, approximately 6:30 pm local time on 9 January 2020. Shortly thereafter, a stone fell through a house in a local village of the Mando Khel tribal area ~12 km NE of Zhob, Zhob District, Baluchistan province, Pakistan. The largest stone was found shortly after the fall by goat herders. Two more stones were subsequently found in this area.

**Physical characteristics:** To date, four fusion-crust stones have been found: 6.309, ~5.5, 4.924, and 2.231 kg. The stones are blocky to rounded, with broad shallow regmaglypts, and covered with black matte fusion crust. The 6.309 kg stone is broken, exposing ~15 × 9 cm of the interior, which displays a breccia of rounded to sub-rounded, light-colored clasts in a light-gray matrix. The clasts range from 1 cm to 5 × 4 cm. The stone is easy to break and weakly consolidated. The measured density of a 24 g fragment that contains both the lithologies is 3.18 g/cm<sup>3</sup>.

**Petrography:** (L. Garvie, *ASU*) The exposed surface of the 6.309 kg stone has an earthy luster, with scattered small (<1 mm) chondrules and rare troilite fragments to 4 mm. No shock veins are visible. Two polished mounts were examined from the gray matrix and a large light-colored clast, respectively. Gray matrix: Section dominated by chondrules and chondrule

fragments set in a fine-grained fragmental matrix. Chondrules abundant and clearly visible under a petrographic microscope and BSE imaging, with an apparent mean diameter of 460  $\mu\text{m}$  ( $n=36$ ). Some PO and PP chondrules show phenocrysts with clear zoning. A PO and BO chondrule contains transparent purple glass. Fe-Ni metal dominated by two grain types: the first is irregularly shaped, with holly-leaf-shaped outlines, to 200  $\mu\text{m}$  grains of kamacite that are single crystals exhibiting weakly developed Neumann bands; the second are rounded grains up to 150  $\mu\text{m}$ , with thin taenite rims enclosing cores of dark-etching plessite. Native copper is rare occurring as grains to 20  $\mu\text{m}$  between Fe-Ni metals and troilite. Troilite grains to 150  $\mu\text{m}$  are largely single crystals and lack shock lamellae. Chromite is a common accessory mineral, occurring as anhedral grains to 200  $\mu\text{m}$  and as fine-grained chondrule-like aggregates to 300  $\mu\text{m}$ . Light-colored clast: The petrography and chondrule size in this clast is similar to the gray matrix section, but differs in showing a coarser grained matrix with abundant feldspathic phase up to 20  $\mu\text{m}$ , and lacking chondrules with zoned olivine or pyroxene-bearing phenocrysts.

**Geochemistry:** (A. Wittmann, L. Garvie, *ASU*) Gray matrix - Olivine ( $n=23$ )  $\text{Fa}_{17.2\pm 6.6}$ , range  $\text{Fa}_{0.7-34.3}$ ,  $\text{Cr}_2\text{O}_3$  to 1.2 wt% and  $\text{CaO}$  to 0.5 wt%.  $\text{FeO/MnO} = 38.6\pm 7.9$ . Low-Ca pyroxene ( $n=20$ )  $\text{Fs}_{13.8\pm 5.3}\text{Wo}_{1.3\pm 1.1}$ ,  $\text{FeO/MnO} = 25.1\pm 10.3$ . High-Ca pyroxene ( $n=2$ )  $\text{Fs}_{1.1}\text{Ca}_{45.9}$  and  $\text{Fs}_{24.2}\text{Ca}_{30.5}$ . Light-colored clast - Olivine ( $n=14$ )  $\text{Fa}_{18.5\pm 0.24}$ , range  $\text{Fa}_{17.9-18.8}$ ,  $\text{FeO/MnO} = 37.8$ . Low-Ca pyroxene ( $n=17$ )  $\text{Fs}_{15.3\pm 0.3}\text{Wo}_{1.3\pm 0.1}$ ,  $\text{FeO/MnO} = 23.4$ . Kamacite: Ni 6.71-7.08 wt%, Co 0.44-0.48 wt%. Feldspathic phase (stoichiometry is poor, FeO is fairly high):  $\text{Ab}_{81.4-83.1}\text{An}_{10.7-12.6}\text{Or}_{4.3-6.5}$  ( $n=10$ ).

**Classification:** H3-4. Breccia of H4 clasts in an unequilibrated H3 host matrix. W0 and S2.

**Specimens:** The 6.309 and 2.231 kg stones are with *MFarmer*.

### Zinder 003

Niger

Find: June 2019

Classification: Eucrite melt breccia

**History:** The meteorite was purchased from a meteorite dealer in Morocco.

**Physical characteristics:** Dark-grayish rock with minor fusion crust.

**Petrography:** The meteorite is a eucrite-melt breccia composed of up to several mm sized basaltic clasts set into dark melt rock matrix, which is fine-grained and vesicular melt-textured. Basaltic clasts often contain lath-shaped calcic plagioclase. The fine-grained melt rock is mostly recrystallized and mineral grains in contact with the melt are partly resorbed; some regions show flow textures.

**Geochemistry:** The rock contains low-Ca and Ca pyroxene. Low-Ca pyroxene is  $\text{Fs}_{60.2\pm 2.0}\text{Wo}_{3.0\pm 1.8}$  ( $\text{Fs}_{54.3-62.4}\text{Wo}_{1.7-9.1}$ ;  $n=24$ ) and the Ca-pyroxene has  $\text{Fs}_{27.2\pm 1.9}\text{Wo}_{41.6\pm 2.6}$  ( $\text{Fs}_{24.9-30.2}\text{Wo}_{41.9-43.8}$ ;  $n=7$ ); the mean Fe/Mn ratio of the pyroxenes is 34.6 ( $n=31$ ). Calcic plagioclase has a composition of  $\text{An}_{89.7\pm 1.6}$  ( $\text{An}_{86.6-92.4}$ ,  $n=23$ )



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db_id	db_name	db_abbrev	db_amn	db_anttype	db_class	db_country
72659	Acfer 402				CV3	Algeria
73475	Adrar 004				H4	Algeria
73476	Adrar 005				L5	Algeria
73477	Adrar 006				H5	Algeria
73478	Adrar 007				H5	Algeria
73479	Adrar 008				L5/6	Algeria
73480	Adrar 009				H4	Algeria
73481	Adrar 010				L5	Algeria
73482	Adrar 011				L5	Algeria
73538	Akka 001				Acapulcoite	Morocco
72326	Al Farciya				L6	Western Sahara
70862	Antarctica 001		-	AP	L/LL4	Antarctica
71677	Asuka 09179	A 09179	J27	JB	Iron, IID	Antarctica
71678	Asuka 12016	A 12016	J27	JB	Iron, IIIAB	Antarctica
73471	Auckland				L5	New Zealand
71123	Aydar 004				Eucrite-br	Morocco
72708	Aydar 005				LL6	Morocco
72446	Baja California				Iron, IIIAB	Mexico
72485	Balambala				Iron, IIF	Kenya
73565	Balyer Bluff				LL6	Australia
72344	Baqiangzi				EL7	China
72873	Bayin Gobi 00BG 003				L~6	China
71059	Black Butte 00BB 001				H3-4	United States
71060	Black Butte 00BB 002				H3-4	United States
71063	Black Butte 00BB 003				H4	United States
72462	Blaubeuren				H4-5	Germany
71691	Boshruyeh 00				L6	Iran
70863	Calama 058				CR2	Chile
70864	Calama 062				Iron, IIAB	Chile
70900	Calama 070				L6	Chile
70901	Calama 071				H5	Chile
70943	Calama 072				H5	Chile
71064	Calama 073				L6	Chile
71066	Calama 074				L5	Chile
71169	Calama 075				H3	Chile
71196	Calama 076				Diogenite	Chile
71095	Calama 077				H4	Chile
71096	Calama 078				LL5	Chile
71590	Calama 079				H4	Chile
71592	Calama 080				H4	Chile
71611	Calama 081				H5	Chile
71652	Calama 082				Diogenite-pm	Chile
71644	Calama 083				H5	Chile
71645	Calama 084				H5	Chile
72323	Calama 085				H(L)3	Chile
71673	Calama 086				H5	Chile
71757	Calama 087				CO3	Chile
72370	Calama 088				H5	Chile
72372	Calama 089				L5	Chile
72391	Calama 090				L6	Chile
72408	Calama 091				H6	Chile
72409	Calama 092				H6	Chile
72410	Calama 093				H5	Chile
72757	Calama 094				L4	Chile

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72411	Calama 095	H5	Chile
72412	Calama 096	H5	Chile
72413	Calama 097	L6	Chile
72414	Calama 098	H4	Chile
72435	Calama 099	L5	Chile
72437	Calama 100	L6	Chile
72506	Calama 101	H5	Chile
72510	Calama 102	L6	Chile
72511	Calama 103	H6	Chile
72513	Calama 104	L6	Chile
72514	Calama 105	H3	Chile
72515	Calama 106	L5	Chile
72547	Calama 107	L5	Chile
72549	Calama 108	H6	Chile
72550	Calama 109	H5	Chile
72564	Calama 110	LL5	Chile
72570	Calama 111	H5	Chile
72574	Calama 112	L6	Chile
72591	Calama 113	L6	Chile
72612	Calama 114	L6-melt brecci	Chile
72595	Calama 115	H5	Chile
72635	Calama 116	H5	Chile
72636	Calama 117	H6	Chile
72637	Calama 118	L6	Chile
72638	Calama 119	H5	Chile
72792	Calama 120	H5	Chile
72793	Calama 121	L5	Chile
72794	Calama 122	L6	Chile
72795	Calama 123	H5	Chile
72796	Calama 124	H5	Chile
73493	Calama 125	L5	Chile
73494	Calama 126	L5	Chile
73495	Calama 127	H5	Chile
73496	Calama 128	H5	Chile
73497	Calama 129	H5	Chile
73498	Calama 130	H5	Chile
73499	Calama 131	H5	Chile
71105	Calate 019	L5	Chile
71106	Calate 020	L5	Chile
71107	Calate 021	H5	Chile
71108	Calate 022	H5	Chile
71109	Calate 023	H5	Chile
71619	Calate 024	H5	Chile
71620	Calate 025	H5	Chile
71621	Calate 026	L5	Chile
71622	Calate 027	H5	Chile
71675	Calate 028	L5	Chile
72628	Calate 029	L6	Chile
72629	Calate 030	LL5	Chile
72630	Calate 031	L5	Chile
72631	Calate 032	L6	Chile
71079	Caleta el Cobi CeC 037	L6-melt brecci	Chile
71170	Caleta el Cobi CeC 038	LL6	Chile
72392	Caleta el Cobi CeC 039	L6	Chile
72405	Caleta el Cobi CeC 040	H5	Chile

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72689	Caleta el Cobre CeC 041	L3	Chile
72852	Caleta el Cobre CeC 050	Achondrite-un	Chile
73512	Camel Donga	H6	Australia
71730	Carson Lake	H6	United States
71023	Catalina 338	H5	Chile
71024	Catalina 339	L5/6	Chile
71033	Catalina 340	H5	Chile
71037	Catalina 341	L6	Chile
71038	Catalina 342	H6	Chile
71082	Catalina 343	LL6	Chile
71085	Catalina 344	H4	Chile
72393	Catalina 345	H6	Chile
72404	Catalina 346	H5	Chile
72671	Catalina 347	H5	Chile
72672	Catalina 348	H5	Chile
72674	Catalina 349	H5	Chile
72677	Catalina 350	H5	Chile
72682	Catalina 351	H6	Chile
72683	Catalina 352	H5	Chile
72684	Catalina 353	H5	Chile
72534	Cavezzo	L5-an	Italy
70899	Chug Chug 01	L5	Chile
70902	Chug Chug 01	H6	Chile
70903	Chug Chug 01	H5	Chile
71176	Chug Chug 01	H4-an	Chile
70944	Chug Chug 02	LL6	Chile
70945	Chug Chug 02	LL5	Chile
71708	Chug Chug 02	L(H)3	Chile
71067	Chug Chug 02	H5	Chile
71171	Chug Chug 02	L6	Chile
71605	Chug Chug 02	H5	Chile
71606	Chug Chug 02	H5	Chile
71607	Chug Chug 02	H5	Chile
71609	Chug Chug 02	H5	Chile
71612	Chug Chug 02	L5	Chile
71613	Chug Chug 03	H6	Chile
71614	Chug Chug 03	H5	Chile
71615	Chug Chug 03	H5	Chile
71646	Chug Chug 03	L6	Chile
71671	Chug Chug 03	L6	Chile
71672	Chug Chug 03	L5	Chile
71674	Chug Chug 03	H5	Chile
71694	Chug Chug 03	L6	Chile
71695	Chug Chug 03	L6	Chile
71743	Chug Chug 03	H5	Chile
71745	Chug Chug 04	H5	Chile
71746	Chug Chug 04	H5	Chile
72368	Chug Chug 04	L5	Chile
72390	Chug Chug 04	LL6	Chile
72660	Chug Chug 04	L4	Chile
72436	Chug Chug 04	H6	Chile
72438	Chug Chug 04	L6	Chile
72509	Chug Chug 04	L6	Chile
72512	Chug Chug 04	H6	Chile
72548	Chug Chug 04	L6	Chile

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72551	Chug Chug 05				H4	Chile
72552	Chug Chug 05				L6	Chile
72553	Chug Chug 05				L6	Chile
72554	Chug Chug 05				L5	Chile
72555	Chug Chug 05				L6	Chile
72565	Chug Chug 05				H6	Chile
72566	Chug Chug 05				H5	Chile
72567	Chug Chug 05				L5	Chile
72568	Chug Chug 05				H6	Chile
72569	Chug Chug 05				L5	Chile
72571	Chug Chug 06				H5	Chile
72572	Chug Chug 06				L6	Chile
72573	Chug Chug 06				H5	Chile
72589	Chug Chug 06				L4	Chile
72590	Chug Chug 06				L3	Chile
72592	Chug Chug 06				H5	Chile
72593	Chug Chug 06				L6	Chile
72594	Chug Chug 06				H5	Chile
72624	Chug Chug 06				L5	Chile
72625	Chug Chug 06				L6	Chile
72627	Chug Chug 07				L6	Chile
72632	Chug Chug 07				H3	Chile
72633	Chug Chug 07				H3	Chile
72640	Chug Chug 07				L6	Chile
72641	Chug Chug 07				H5	Chile
72642	Chug Chug 07				H5	Chile
72643	Chug Chug 07				L6	Chile
72784	Chug Chug 07				L6	Chile
72785	Chug Chug 07				H5	Chile
72786	Chug Chug 07				H5	Chile
72787	Chug Chug 08				L5	Chile
72789	Chug Chug 08				H5	Chile
72791	Chug Chug 08				H5	Chile
69684	Chwichiya 002				C3.00-ung	Western Sahara
72489	Chwichiya 005				CO3	Western Sahara
72722	Chwichiya 006				ureilite	Western Sahara
71058	Cleghorn Lake				LL3	United States
72586	Coya Sur 006 CS 006				H5	Chile
72587	Coya Sur 007 CS 007				H5	Chile
71061	Crescent Valley CV 001				H4	United States
71062	Crescent Valley CV 002				H4	United States
72469	Deh-Salm 001				H6	Iran
71366	Devils Glacier DEV 17280	43(1)		A	L5	Antarctica
71367	Devils Glacier DEV 17281	43(1)		A	H5	Antarctica
71111	Dhofar 2094 Dho 2094				L6	Oman
71177	Dhofar 2102 Dho 2102				L6	Oman
71647	Dhofar 2103 Dho 2103				L6	Oman
72374	Dhofar 2104 Dho 2104				H4	Oman
72375	Dhofar 2105 Dho 2105				H5	Oman
72431	Dhofar 2106 Dho 2106				CM2	Oman
72376	Dhofar 2107 Dho 2107				L5	Oman
72476	Dhofar 2108 Dho 2108				L5/6	Oman
71584	Dominion Random 18019	43(1)		A	CO3	Antarctica
71585	Dominion Random 18069	43(1)		A	CO3	Antarctica
71586	Dominion Random 18070	43(1)		A	CO3	Antarctica

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71587	Dominion RanDOM 18242	43(1)	A	Lunar (bas. br	Antarctica
71588	Dominion RanDOM 18244	43(1)	A	Lunar (bas. br	Antarctica
71589	Dominion RanDOM 18293	43(1)	A	Eucrite-br	Antarctica
71753	Eboliang 004			L5	China
72576	Eboliang 005			H4	China
72466	El Hassan Ou EHOH 001			Eucrite-unbr	Mauritania
71022	El Médano 42 EM 423			L6	Chile
71025	El Médano 42 EM 424			L6	Chile
71026	El Médano 42 EM 425			H5	Chile
71027	El Médano 42 EM 426			H5/6	Chile
71028	El Médano 42 EM 427			H5	Chile
71029	El Médano 42 EM 428			H5/6	Chile
71030	El Médano 42 EM 429			L5	Chile
71031	El Médano 43 EM 430			H5	Chile
71032	El Médano 43 EM 431			H5	Chile
71034	El Médano 43 EM 432			L6	Chile
71035	El Médano 43 EM 433			H5	Chile
71036	El Médano 43 EM 434			H5	Chile
71039	El Médano 43 EM 435			L5	Chile
71040	El Médano 43 EM 436			H6	Chile
71041	El Médano 43 EM 437			H5	Chile
71042	El Médano 43 EM 438			H5	Chile
71043	El Médano 43 EM 439			H5	Chile
71044	El Médano 44 EM 440			H5	Chile
71045	El Médano 44 EM 441			H6	Chile
71046	El Médano 44 EM 442			L6	Chile
71086	El Médano 44 EM 443			L6	Chile
71144	El Médano 44 EM 444			EL6	Chile
71081	El Médano 44 EM 445			LL5	Chile
71173	El Médano 44 EM 446			L6	Chile
71174	El Médano 44 EM 447			L6	Chile
71698	El Médano 44 EM 448			H5	Chile
71701	El Médano 44 EM 449			H5	Chile
71702	El Médano 45 EM 450			L6	Chile
72397	El Médano 45 EM 451			H5	Chile
72398	El Médano 45 EM 452			H5	Chile
72399	El Médano 45 EM 453			L6	Chile
72400	El Médano 45 EM 454			L6	Chile
72401	El Médano 45 EM 455			L6	Chile
72402	El Médano 45 EM 456			L6	Chile
72403	El Médano 45 EM 457			L6	Chile
72406	El Médano 45 EM 458			H5	Chile
72543	El Médano 45 EM 459			H5	Chile
72544	El Médano 46 EM 460			H5	Chile
72545	El Médano 46 EM 461			L6	Chile
72678	El Médano 46 EM 462			H5	Chile
72845	El Médano 46 EM 463			CO3	Chile
72846	El Médano 46 EM 464			CO3	Chile
72847	El Médano 46 EM 465			CO3	Chile
71199	Elephant Moræ EET 16001	43(1)	A	L5	Antarctica
71200	Elephant Moræ EET 16003	43(1)	A	H5	Antarctica
71201	Elephant Moræ EET 16004	43(1)	A	L6	Antarctica
71202	Elephant Moræ EET 16005	43(1)	A	L5	Antarctica
71203	Elephant Moræ EET 16007	43(1)	A	LL6	Antarctica
71204	Elephant Moræ EET 16008	43(1)	A	L6	Antarctica



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71205	Elephant Moræ	EET 16009	43(1)	A	L6	Antarctica
71206	Elephant Moræ	EET 16010	43(1)	A	H6	Antarctica
71207	Elephant Moræ	EET 16011	43(1)	A	L6	Antarctica
71208	Elephant Moræ	EET 16012	43(1)	A	L5	Antarctica
71209	Elephant Moræ	EET 16013	43(1)	A	L5	Antarctica
71210	Elephant Moræ	EET 16014	43(1)	A	L6	Antarctica
71211	Elephant Moræ	EET 16015	43(1)	A	L5	Antarctica
71212	Elephant Moræ	EET 16017	43(1)	A	L5	Antarctica
71213	Elephant Moræ	EET 16018	43(1)	A	L5	Antarctica
71214	Elephant Moræ	EET 16019	43(1)	A	L6	Antarctica
71215	Elephant Moræ	EET 16022	43(1)	A	L6	Antarctica
71216	Elephant Moræ	EET 16023	43(1)	A	L6	Antarctica
71217	Elephant Moræ	EET 16024	43(1)	A	H6	Antarctica
71218	Elephant Moræ	EET 16025	43(1)	A	L5	Antarctica
71219	Elephant Moræ	EET 16026	43(1)	A	L6	Antarctica
71220	Elephant Moræ	EET 16027	43(1)	A	L6	Antarctica
71221	Elephant Moræ	EET 16028	43(1)	A	L6	Antarctica
71222	Elephant Moræ	EET 16030	43(1)	A	L6	Antarctica
71223	Elephant Moræ	EET 16031	43(1)	A	L6	Antarctica
71224	Elephant Moræ	EET 16032	43(1)	A	L6	Antarctica
71225	Elephant Moræ	EET 16033	43(1)	A	L6	Antarctica
71226	Elephant Moræ	EET 16034	43(1)	A	L5	Antarctica
71227	Elephant Moræ	EET 16035	43(1)	A	L6	Antarctica
71228	Elephant Moræ	EET 16036	43(1)	A	L5	Antarctica
71229	Elephant Moræ	EET 16037	43(1)	A	L6	Antarctica
71230	Elephant Moræ	EET 16038	43(1)	A	L6	Antarctica
71231	Elephant Moræ	EET 16041	43(1)	A	H4	Antarctica
71232	Elephant Moræ	EET 16042	43(1)	A	L6	Antarctica
71233	Elephant Moræ	EET 16051	43(1)	A	H5	Antarctica
71234	Elephant Moræ	EET 16052	43(1)	A	L6	Antarctica
71235	Elephant Moræ	EET 16053	43(1)	A	L6	Antarctica
71236	Elephant Moræ	EET 16054	43(1)	A	L6	Antarctica
71237	Elephant Moræ	EET 16055	43(1)	A	L5	Antarctica
71238	Elephant Moræ	EET 16056	43(1)	A	L6	Antarctica
71239	Elephant Moræ	EET 16057	43(1)	A	H5	Antarctica
71240	Elephant Moræ	EET 16058	43(1)	A	L5	Antarctica
71241	Elephant Moræ	EET 16059	43(1)	A	L5	Antarctica
71242	Elephant Moræ	EET 16060	43(1)	A	L6	Antarctica
71243	Elephant Moræ	EET 16061	43(1)	A	L5	Antarctica
71244	Elephant Moræ	EET 16062	43(1)	A	L5	Antarctica
71245	Elephant Moræ	EET 16063	43(1)	A	H4	Antarctica
71246	Elephant Moræ	EET 16064	43(1)	A	L5	Antarctica
71247	Elephant Moræ	EET 16065	43(1)	A	L6	Antarctica
71248	Elephant Moræ	EET 16066	43(1)	A	L5	Antarctica
71249	Elephant Moræ	EET 16067	43(1)	A	L5	Antarctica
71250	Elephant Moræ	EET 16068	43(1)	A	L5	Antarctica
71251	Elephant Moræ	EET 16069	43(1)	A	L6	Antarctica
71252	Elephant Moræ	EET 16070	43(1)	A	L6	Antarctica
71253	Elephant Moræ	EET 16071	43(1)	A	L5	Antarctica
71254	Elephant Moræ	EET 16072	43(1)	A	L5	Antarctica
71255	Elephant Moræ	EET 16073	43(1)	A	L5	Antarctica
71256	Elephant Moræ	EET 16074	43(1)	A	L5	Antarctica
71257	Elephant Moræ	EET 16075	43(1)	A	L6	Antarctica
71258	Elephant Moræ	EET 16076	43(1)	A	L5	Antarctica
71259	Elephant Moræ	EET 16077	43(1)	A	H6	Antarctica

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71260	Elephant Moræ	EET 16078	43(1)	A	H6	Antarctica
71261	Elephant Moræ	EET 16080	43(1)	A	L5	Antarctica
71262	Elephant Moræ	EET 16081	43(1)	A	L5	Antarctica
71263	Elephant Moræ	EET 16082	43(1)	A	L5	Antarctica
71264	Elephant Moræ	EET 16083	43(1)	A	L6	Antarctica
71265	Elephant Moræ	EET 16084	43(1)	A	LL6	Antarctica
71266	Elephant Moræ	EET 16085	43(1)	A	H6	Antarctica
71267	Elephant Moræ	EET 16086	43(1)	A	H6	Antarctica
71268	Elephant Moræ	EET 16087	43(1)	A	L5	Antarctica
71269	Elephant Moræ	EET 16088	43(1)	A	L5	Antarctica
71270	Elephant Moræ	EET 16089	43(1)	A	L5	Antarctica
71271	Elephant Moræ	EET 16090	43(1)	A	H5	Antarctica
71272	Elephant Moræ	EET 16091	43(1)	A	L6	Antarctica
71273	Elephant Moræ	EET 16092	43(1)	A	L5	Antarctica
71274	Elephant Moræ	EET 16093	43(1)	A	LL5	Antarctica
71275	Elephant Moræ	EET 16094	43(1)	A	L5	Antarctica
71276	Elephant Moræ	EET 16095	43(1)	A	H6	Antarctica
71277	Elephant Moræ	EET 16096	43(1)	A	L5	Antarctica
71278	Elephant Moræ	EET 16098	43(1)	A	L5	Antarctica
71279	Elephant Moræ	EET 16099	43(1)	A	L5	Antarctica
71280	Elephant Moræ	EET 16101	43(1)	A	H4	Antarctica
71281	Elephant Moræ	EET 16102	43(1)	A	L6	Antarctica
71282	Elephant Moræ	EET 16103	43(1)	A	L6	Antarctica
71283	Elephant Moræ	EET 16104	43(1)	A	L5	Antarctica
71284	Elephant Moræ	EET 16105	43(1)	A	L6	Antarctica
71285	Elephant Moræ	EET 16106	43(1)	A	L5	Antarctica
71286	Elephant Moræ	EET 16107	43(1)	A	L5	Antarctica
71287	Elephant Moræ	EET 16108	43(1)	A	L5	Antarctica
71288	Elephant Moræ	EET 16109	43(1)	A	L5	Antarctica
71289	Elephant Moræ	EET 16110	43(1)	A	L5	Antarctica
71290	Elephant Moræ	EET 16111	43(1)	A	L5	Antarctica
71291	Elephant Moræ	EET 16112	43(1)	A	L6	Antarctica
71292	Elephant Moræ	EET 16113	43(1)	A	L6	Antarctica
71293	Elephant Moræ	EET 16114	43(1)	A	H6	Antarctica
71294	Elephant Moræ	EET 16115	43(1)	A	L5	Antarctica
71295	Elephant Moræ	EET 16116	43(1)	A	L5	Antarctica
71296	Elephant Moræ	EET 16117	43(1)	A	L5	Antarctica
71297	Elephant Moræ	EET 16118	43(1)	A	L5	Antarctica
71298	Elephant Moræ	EET 16120	43(1)	A	H6	Antarctica
71299	Elephant Moræ	EET 16121	43(1)	A	L6	Antarctica
71300	Elephant Moræ	EET 16122	43(1)	A	L6	Antarctica
71301	Elephant Moræ	EET 16123	43(1)	A	H6	Antarctica
71302	Elephant Moræ	EET 16124	43(1)	A	H5	Antarctica
71303	Elephant Moræ	EET 16125	43(1)	A	L5	Antarctica
71304	Elephant Moræ	EET 16126	43(1)	A	L6	Antarctica
71305	Elephant Moræ	EET 16130	43(1)	A	L5	Antarctica
71306	Elephant Moræ	EET 16131	43(1)	A	L6	Antarctica
71307	Elephant Moræ	EET 16132	43(1)	A	H6	Antarctica
71308	Elephant Moræ	EET 16133	43(1)	A	H6	Antarctica
71309	Elephant Moræ	EET 16134	43(1)	A	H5	Antarctica
71310	Elephant Moræ	EET 16135	43(1)	A	L5	Antarctica
71311	Elephant Moræ	EET 16136	43(1)	A	L6	Antarctica
71312	Elephant Moræ	EET 16137	43(1)	A	L6	Antarctica
71313	Elephant Moræ	EET 16138	43(1)	A	H6	Antarctica
71314	Elephant Moræ	EET 16139	43(1)	A	L6	Antarctica

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71315	Elephant Moræ	EET 16140	43(1)	A	H6	Antarctica
71316	Elephant Moræ	EET 16141	43(1)	A	H6	Antarctica
71317	Elephant Moræ	EET 16142	43(1)	A	L4	Antarctica
71318	Elephant Moræ	EET 16143	43(1)	A	L6	Antarctica
71319	Elephant Moræ	EET 16144	43(1)	A	LL5	Antarctica
71320	Elephant Moræ	EET 16145	43(1)	A	H6	Antarctica
71321	Elephant Moræ	EET 16146	43(1)	A	H6	Antarctica
71322	Elephant Moræ	EET 16147	43(1)	A	L6	Antarctica
71323	Elephant Moræ	EET 16148	43(1)	A	H5	Antarctica
71324	Elephant Moræ	EET 16149	43(1)	A	H6	Antarctica
71325	Elephant Moræ	EET 16150	43(1)	A	L6	Antarctica
71326	Elephant Moræ	EET 16151	43(1)	A	L6	Antarctica
71327	Elephant Moræ	EET 16152	43(1)	A	L5	Antarctica
71328	Elephant Moræ	EET 16153	43(1)	A	L6	Antarctica
71329	Elephant Moræ	EET 16154	43(1)	A	L3	Antarctica
71330	Elephant Moræ	EET 16155	43(1)	A	L6	Antarctica
71331	Elephant Moræ	EET 16156	43(1)	A	L6	Antarctica
71332	Elephant Moræ	EET 16157	43(1)	A	L6	Antarctica
71333	Elephant Moræ	EET 16158	43(1)	A	L5	Antarctica
71334	Elephant Moræ	EET 16159	43(1)	A	L6	Antarctica
71335	Elephant Moræ	EET 16160	43(1)	A	L5	Antarctica
71336	Elephant Moræ	EET 16161	43(1)	A	H6	Antarctica
71337	Elephant Moræ	EET 16162	43(1)	A	L6	Antarctica
71338	Elephant Moræ	EET 16163	43(1)	A	H6	Antarctica
71339	Elephant Moræ	EET 16164	43(1)	A	H6	Antarctica
71340	Elephant Moræ	EET 16165	43(1)	A	L5	Antarctica
71341	Elephant Moræ	EET 16166	43(1)	A	L4	Antarctica
71342	Elephant Moræ	EET 16167	43(1)	A	H4	Antarctica
71343	Elephant Moræ	EET 16168	43(1)	A	Acapulcoite	Antarctica
71344	Elephant Moræ	EET 16169	43(1)	A	L5	Antarctica
71345	Elephant Moræ	EET 16175	43(1)	A	H6	Antarctica
71346	Elephant Moræ	EET 16176	43(1)	A	L6	Antarctica
71347	Elephant Moræ	EET 16177	43(1)	A	H6	Antarctica
71348	Elephant Moræ	EET 16178	43(1)	A	CK5	Antarctica
71349	Elephant Moræ	EET 16179	43(1)	A	L6	Antarctica
71350	Elephant Moræ	EET 16180	43(1)	A	H6	Antarctica
71351	Elephant Moræ	EET 16181	43(1)	A	H6	Antarctica
71352	Elephant Moræ	EET 16182	43(1)	A	L6	Antarctica
71353	Elephant Moræ	EET 16183	43(1)	A	H6	Antarctica
71354	Elephant Moræ	EET 16184	43(1)	A	H6	Antarctica
71355	Elephant Moræ	EET 16185	43(1)	A	L6	Antarctica
71356	Elephant Moræ	EET 16186	43(1)	A	H5	Antarctica
71357	Elephant Moræ	EET 16187	43(1)	A	H5	Antarctica
71358	Elephant Moræ	EET 16188	43(1)	A	H6	Antarctica
71359	Elephant Moræ	EET 16189	43(1)	A	LL6	Antarctica
71360	Elephant Moræ	EET 16190	43(1)	A	H6	Antarctica
71361	Elephant Moræ	EET 16191	43(1)	A	H6	Antarctica
71362	Elephant Moræ	EET 16192	43(1)	A	L5	Antarctica
71363	Elephant Moræ	EET 16193	43(1)	A	L6	Antarctica
71364	Elephant Moræ	EET 16194	43(1)	A	L6	Antarctica
71365	Elephant Moræ	EET 16195	43(1)	A	H6	Antarctica
72343	Erenhot				H~6	China
72645	Erenhot 002				L5	China
72475	Erg Chech 00: EC 002				Achondrite-un	Algeria
72840	Errachidia 003				Winonaite	Morocco

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71098	Flensburg				C1-ung	Germany
72710	Foum Agoutir				L4	Morocco
71122	Gadamis 001				Martian (sherg)	Libya
72767	Gandom Bery				H5	Iran
72768	Gandom Bery				H4	Iran
72874	Ganq 004				L~5	China
72875	Ganq 005				L~5	China
72876	Ganq 006				L~5	China
72877	Ganq 007				L~6	China
72450	Gatuto				L6	Kenya
72529	Ghadduwah 0				Lunar (anorth)	Libya
72467	Golden Gate I				H4	United States
71738	Gömüce				L6	Turkey
72646	Gonggar				L5	China
72614	Gouchi 001				R4	Niger
72870	Gourara 003				Eucrite-mmict	Algeria
71368	Grosvenor Mo GRO 17002	43(1)	A		H6	Antarctica
71369	Grosvenor Mo GRO 17003	43(1)	A		H6	Antarctica
71370	Grosvenor Mo GRO 17005	43(1)	A		H5	Antarctica
71371	Grosvenor Mo GRO 17007	43(1)	A		H6	Antarctica
71372	Grosvenor Mo GRO 17008	43(1)	A		H6	Antarctica
71373	Grosvenor Mo GRO 17009	43(1)	A		L3	Antarctica
71374	Grosvenor Mo GRO 17010	43(1)	A		H6	Antarctica
71375	Grosvenor Mo GRO 17011	43(1)	A		L6	Antarctica
71376	Grosvenor Mo GRO 17012	43(1)	A		H6	Antarctica
71377	Grosvenor Mo GRO 17013	43(1)	A		L6	Antarctica
71378	Grosvenor Mo GRO 17014	43(1)	A		H6	Antarctica
71379	Grosvenor Mo GRO 17015	43(1)	A		H5	Antarctica
71380	Grosvenor Mo GRO 17016	43(1)	A		H6	Antarctica
71381	Grosvenor Mo GRO 17017	43(1)	A		H5	Antarctica
71382	Grosvenor Mo GRO 17018	43(1)	A		L6	Antarctica
71383	Grosvenor Mo GRO 17019	43(1)	A		L5	Antarctica
71384	Grosvenor Mo GRO 17020	43(1)	A		H6	Antarctica
71385	Grosvenor Mo GRO 17021	43(1)	A		H5	Antarctica
71386	Grosvenor Mo GRO 17023	43(1)	A		H6	Antarctica
71387	Grosvenor Mo GRO 17024	43(1)	A		H6	Antarctica
71388	Grosvenor Mo GRO 17025	43(1)	A		H6	Antarctica
71389	Grosvenor Mo GRO 17026	43(1)	A		L3	Antarctica
71390	Grosvenor Mo GRO 17027	43(1)	A		L6	Antarctica
71391	Grosvenor Mo GRO 17028	43(1)	A		L4	Antarctica
71392	Grosvenor Mo GRO 17029	43(1)	A		H6	Antarctica
71393	Grosvenor Mo GRO 17030	43(1)	A		L5	Antarctica
71394	Grosvenor Mo GRO 17031	43(1)	A		H6	Antarctica
71395	Grosvenor Mo GRO 17032	43(1)	A		L5	Antarctica
71396	Grosvenor Mo GRO 17033	43(1)	A		H5	Antarctica
71397	Grosvenor Mo GRO 17034	43(1)	A		L6	Antarctica
71398	Grosvenor Mo GRO 17035	43(1)	A		H6	Antarctica
71399	Grosvenor Mo GRO 17036	43(1)	A		LL4	Antarctica
71400	Grosvenor Mo GRO 17037	43(1)	A		L5	Antarctica
71401	Grosvenor Mo GRO 17040	43(1)	A		H6	Antarctica
71402	Grosvenor Mo GRO 17041	43(1)	A		H6	Antarctica
71403	Grosvenor Mo GRO 17042	43(1)	A		H6	Antarctica
71404	Grosvenor Mo GRO 17043	43(1)	A		H5	Antarctica
71405	Grosvenor Mo GRO 17044	43(1)	A		H5	Antarctica
71406	Grosvenor Mo GRO 17045	43(1)	A		H6	Antarctica



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71407	Grosvenor Mc GRO 17046	43(1)	A	H6	Antarctica
71408	Grosvenor Mc GRO 17047	43(1)	A	H5	Antarctica
71409	Grosvenor Mc GRO 17050	43(1)	A	H4	Antarctica
71410	Grosvenor Mc GRO 17052	43(1)	A	L6	Antarctica
71411	Grosvenor Mc GRO 17053	43(1)	A	L5	Antarctica
71412	Grosvenor Mc GRO 17054	43(1)	A	L6	Antarctica
71413	Grosvenor Mc GRO 17055	43(1)	A	LL5	Antarctica
71414	Grosvenor Mc GRO 17056	43(1)	A	L5	Antarctica
71415	Grosvenor Mc GRO 17057	43(1)	A	L5	Antarctica
71416	Grosvenor Mc GRO 17058	43(1)	A	L5	Antarctica
71417	Grosvenor Mc GRO 17061	43(1)	A	H6	Antarctica
71418	Grosvenor Mc GRO 17062	43(1)	A	H5	Antarctica
71419	Grosvenor Mc GRO 17065	43(1)	A	H6	Antarctica
71420	Grosvenor Mc GRO 17066	43(1)	A	H5	Antarctica
71421	Grosvenor Mc GRO 17067	43(1)	A	H6	Antarctica
71422	Grosvenor Mc GRO 17068	43(1)	A	H6	Antarctica
71423	Grosvenor Mc GRO 17069	43(1)	A	H5	Antarctica
71424	Grosvenor Mc GRO 17071	43(1)	A	H6	Antarctica
71425	Grosvenor Mc GRO 17072	43(1)	A	H5	Antarctica
71426	Grosvenor Mc GRO 17073	43(1)	A	H5	Antarctica
71427	Grosvenor Mc GRO 17074	43(1)	A	H5	Antarctica
71428	Grosvenor Mc GRO 17075	43(1)	A	H5	Antarctica
71429	Grosvenor Mc GRO 17076	43(1)	A	H6	Antarctica
71430	Grosvenor Mc GRO 17077	43(1)	A	L4	Antarctica
71431	Grosvenor Mc GRO 17078	43(1)	A	H5	Antarctica
71432	Grosvenor Mc GRO 17079	43(1)	A	H6	Antarctica
71433	Grosvenor Mc GRO 17080	43(1)	A	LL6	Antarctica
71434	Grosvenor Mc GRO 17081	43(1)	A	L5	Antarctica
71435	Grosvenor Mc GRO 17082	43(1)	A	H6	Antarctica
71436	Grosvenor Mc GRO 17083	43(1)	A	H6	Antarctica
71437	Grosvenor Mc GRO 17084	43(1)	A	H6	Antarctica
71438	Grosvenor Mc GRO 17085	43(1)	A	L6	Antarctica
71439	Grosvenor Mc GRO 17086	43(1)	A	H5	Antarctica
71440	Grosvenor Mc GRO 17087	43(1)	A	L5	Antarctica
71441	Grosvenor Mc GRO 17088	43(1)	A	H5	Antarctica
71442	Grosvenor Mc GRO 17089	43(1)	A	H6	Antarctica
71443	Grosvenor Mc GRO 17090	43(1)	A	L6	Antarctica
71444	Grosvenor Mc GRO 17091	43(1)	A	H6	Antarctica
71445	Grosvenor Mc GRO 17092	43(1)	A	H6	Antarctica
71446	Grosvenor Mc GRO 17093	43(1)	A	H6	Antarctica
71447	Grosvenor Mc GRO 17094	43(1)	A	H5	Antarctica
71448	Grosvenor Mc GRO 17095	43(1)	A	H6	Antarctica
71449	Grosvenor Mc GRO 17096	43(1)	A	L6	Antarctica
71450	Grosvenor Mc GRO 17097	43(1)	A	H5	Antarctica
71451	Grosvenor Mc GRO 17100	43(1)	A	L6	Antarctica
71452	Grosvenor Mc GRO 17101	43(1)	A	H6	Antarctica
71453	Grosvenor Mc GRO 17103	43(1)	A	H5	Antarctica
71454	Grosvenor Mc GRO 17104	43(1)	A	L6	Antarctica
71455	Grosvenor Mc GRO 17105	43(1)	A	L5	Antarctica
71456	Grosvenor Mc GRO 17106	43(1)	A	H6	Antarctica
71457	Grosvenor Mc GRO 17107	43(1)	A	L6	Antarctica
71458	Grosvenor Mc GRO 17109	43(1)	A	H6	Antarctica
71459	Grosvenor Mc GRO 17110	43(1)	A	H6	Antarctica
71460	Grosvenor Mc GRO 17111	43(1)	A	L6	Antarctica
71461	Grosvenor Mc GRO 17112	43(1)	A	EH3	Antarctica



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71462	Grosvenor	Mc GRO	17113	43(1)	A	L5	Antarctica
71463	Grosvenor	Mc GRO	17114	43(1)	A	H6	Antarctica
71464	Grosvenor	Mc GRO	17115	43(1)	A	L5	Antarctica
71465	Grosvenor	Mc GRO	17116	43(1)	A	L6	Antarctica
71466	Grosvenor	Mc GRO	17117	43(1)	A	H5	Antarctica
71467	Grosvenor	Mc GRO	17118	43(1)	A	L6	Antarctica
71468	Grosvenor	Mc GRO	17120	43(1)	A	L4	Antarctica
71469	Grosvenor	Mc GRO	17121	43(1)	A	H6	Antarctica
71470	Grosvenor	Mc GRO	17122	43(1)	A	LL5	Antarctica
71471	Grosvenor	Mc GRO	17123	43(1)	A	H6	Antarctica
71472	Grosvenor	Mc GRO	17124	43(1)	A	L5	Antarctica
71473	Grosvenor	Mc GRO	17125	43(1)	A	H6	Antarctica
71474	Grosvenor	Mc GRO	17126	43(1)	A	H6	Antarctica
71475	Grosvenor	Mc GRO	17127	43(1)	A	L6	Antarctica
71476	Grosvenor	Mc GRO	17129	43(1)	A	L6	Antarctica
71477	Grosvenor	Mc GRO	17130	43(1)	A	H6	Antarctica
71478	Grosvenor	Mc GRO	17131	43(1)	A	L6	Antarctica
71479	Grosvenor	Mc GRO	17132	43(1)	A	H5	Antarctica
71480	Grosvenor	Mc GRO	17133	43(1)	A	H5	Antarctica
71481	Grosvenor	Mc GRO	17134	43(1)	A	H6	Antarctica
71482	Grosvenor	Mc GRO	17135	43(1)	A	L4	Antarctica
71483	Grosvenor	Mc GRO	17136	43(1)	A	H6	Antarctica
71484	Grosvenor	Mc GRO	17137	43(1)	A	H6	Antarctica
71485	Grosvenor	Mc GRO	17140	43(1)	A	L6	Antarctica
71486	Grosvenor	Mc GRO	17141	43(1)	A	L6	Antarctica
71487	Grosvenor	Mc GRO	17143	43(1)	A	L5	Antarctica
71488	Grosvenor	Mc GRO	17144	43(1)	A	L5	Antarctica
71489	Grosvenor	Mc GRO	17145	43(1)	A	L6	Antarctica
71490	Grosvenor	Mc GRO	17146	43(1)	A	L6	Antarctica
71491	Grosvenor	Mc GRO	17147	43(1)	A	L6	Antarctica
71492	Grosvenor	Mc GRO	17148	43(1)	A	H5	Antarctica
71493	Grosvenor	Mc GRO	17149	43(1)	A	H5	Antarctica
71494	Grosvenor	Mc GRO	17150	43(1)	A	H6	Antarctica
71495	Grosvenor	Mc GRO	17151	43(1)	A	L6	Antarctica
71496	Grosvenor	Mc GRO	17152	43(1)	A	H6	Antarctica
71497	Grosvenor	Mc GRO	17153	43(1)	A	H6	Antarctica
71498	Grosvenor	Mc GRO	17154	43(1)	A	L6	Antarctica
71499	Grosvenor	Mc GRO	17155	43(1)	A	H6	Antarctica
71500	Grosvenor	Mc GRO	17156	43(1)	A	L4	Antarctica
71501	Grosvenor	Mc GRO	17157	43(1)	A	H5	Antarctica
71502	Grosvenor	Mc GRO	17158	43(1)	A	H5	Antarctica
71503	Grosvenor	Mc GRO	17159	43(1)	A	L5	Antarctica
71504	Grosvenor	Mc GRO	17160	43(1)	A	H6	Antarctica
71505	Grosvenor	Mc GRO	17161	43(1)	A	L5	Antarctica
71506	Grosvenor	Mc GRO	17162	43(1)	A	L6	Antarctica
71507	Grosvenor	Mc GRO	17163	43(1)	A	H6	Antarctica
71508	Grosvenor	Mc GRO	17164	43(1)	A	H5	Antarctica
71509	Grosvenor	Mc GRO	17165	43(1)	A	H5	Antarctica
71510	Grosvenor	Mc GRO	17166	43(1)	A	L5	Antarctica
71511	Grosvenor	Mc GRO	17167	43(1)	A	L3	Antarctica
71512	Grosvenor	Mc GRO	17170	43(1)	A	H5	Antarctica
71513	Grosvenor	Mc GRO	17171	43(1)	A	H5	Antarctica
71514	Grosvenor	Mc GRO	17172	43(1)	A	H5	Antarctica
71515	Grosvenor	Mc GRO	17173	43(1)	A	H6	Antarctica
71516	Grosvenor	Mc GRO	17174	43(1)	A	H6	Antarctica

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71517	Grosvenor Mc GRO 17177	43(1)	A	L3	Antarctica
71518	Grosvenor Mc GRO 17178	43(1)	A	H6	Antarctica
71519	Grosvenor Mc GRO 17179	43(1)	A	H6	Antarctica
71520	Grosvenor Mc GRO 17183	43(1)	A	L5	Antarctica
71521	Grosvenor Mc GRO 17184	43(1)	A	H5	Antarctica
71522	Grosvenor Mc GRO 17187	43(1)	A	L6	Antarctica
71523	Grosvenor Mc GRO 17190	43(1)	A	L5	Antarctica
71524	Grosvenor Mc GRO 17191	43(1)	A	H6	Antarctica
71525	Grosvenor Mc GRO 17192	43(1)	A	H6	Antarctica
71526	Grosvenor Mc GRO 17193	43(1)	A	H6	Antarctica
71527	Grosvenor Mc GRO 17194	43(1)	A	H6	Antarctica
71528	Grosvenor Mc GRO 17196	43(1)	A	H6	Antarctica
71529	Grosvenor Mc GRO 17197	43(1)	A	H6	Antarctica
71530	Grosvenor Mc GRO 17198	43(1)	A	H6	Antarctica
71531	Grosvenor Mc GRO 17199	43(1)	A	H6	Antarctica
71532	Grosvenor Mc GRO 17201	43(1)	A	H5	Antarctica
71533	Grosvenor Mc GRO 17202	43(1)	A	H5	Antarctica
71534	Grosvenor Mc GRO 17203	43(1)	A	L5	Antarctica
71535	Grosvenor Mc GRO 17204	43(1)	A	H6	Antarctica
71536	Grosvenor Mc GRO 17205	43(1)	A	H6	Antarctica
71537	Grosvenor Mc GRO 17206	43(1)	A	H6	Antarctica
71538	Grosvenor Mc GRO 17207	43(1)	A	H6	Antarctica
71539	Grosvenor Mc GRO 17208	43(1)	A	H5	Antarctica
71540	Grosvenor Mc GRO 17209	43(1)	A	LL5	Antarctica
72881	Grove Mounta GRV 020205	-	C	H4	Antarctica
72882	Grove Mounta GRV 020206	-	C	H4	Antarctica
72883	Grove Mounta GRV 020207	-	C	H5	Antarctica
72884	Grove Mounta GRV 020208	-	C	H5	Antarctica
72885	Grove Mounta GRV 020209	-	C	H4	Antarctica
72886	Grove Mounta GRV 020213	-	C	H5	Antarctica
72887	Grove Mounta GRV 020215	-	C	H4	Antarctica
72888	Grove Mounta GRV 020218	-	C	H5	Antarctica
72889	Grove Mounta GRV 020223	-	C	L6	Antarctica
72890	Grove Mounta GRV 020229	-	C	H4	Antarctica
72891	Grove Mounta GRV 020233	-	C	H5	Antarctica
72892	Grove Mounta GRV 020235	-	C	H5	Antarctica
72893	Grove Mounta GRV 020244	-	C	H5	Antarctica
72894	Grove Mounta GRV 020246	-	C	H4	Antarctica
72895	Grove Mounta GRV 020247	-	C	H4	Antarctica
72896	Grove Mounta GRV 020248	-	C	H4	Antarctica
72897	Grove Mounta GRV 020255	-	C	H5	Antarctica
72898	Grove Mounta GRV 020260	-	C	H5	Antarctica
72899	Grove Mounta GRV 020263	-	C	H5	Antarctica
72900	Grove Mounta GRV 020264	-	C	H5	Antarctica
72901	Grove Mounta GRV 020265	-	C	H4	Antarctica
72902	Grove Mounta GRV 020267	-	C	H5	Antarctica
72903	Grove Mounta GRV 020268	-	C	H5	Antarctica
72904	Grove Mounta GRV 020269	-	C	H5	Antarctica
72905	Grove Mounta GRV 020270	-	C	H5	Antarctica
72906	Grove Mounta GRV 020271	-	C	H5	Antarctica
72907	Grove Mounta GRV 020272	-	C	H5	Antarctica
72908	Grove Mounta GRV 020278	-	C	H4	Antarctica
72909	Grove Mounta GRV 020279	-	C	H4	Antarctica
72910	Grove Mounta GRV 020282	-	C	LL6	Antarctica
72911	Grove Mounta GRV 020286	-	C	L6	Antarctica

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72912	Grove Mounta GRV 020289 -	C	L4	Antarctica
72913	Grove Mounta GRV 020294 -	C	L6	Antarctica
72914	Grove Mounta GRV 020295 -	C	L4	Antarctica
72915	Grove Mounta GRV 020296 -	C	L5	Antarctica
72916	Grove Mounta GRV 020298 -	C	L5	Antarctica
72917	Grove Mounta GRV 020299 -	C	L5	Antarctica
72918	Grove Mounta GRV 020306 -	C	L5	Antarctica
72919	Grove Mounta GRV 020308 -	C	L6	Antarctica
72920	Grove Mounta GRV 020309 -	C	L5	Antarctica
72921	Grove Mounta GRV 020313 -	C	L5	Antarctica
72922	Grove Mounta GRV 020316 -	C	L5	Antarctica
72923	Grove Mounta GRV 020320 -	C	L5	Antarctica
72924	Grove Mounta GRV 020321 -	C	H6	Antarctica
72925	Grove Mounta GRV 020322 -	C	L6	Antarctica
72926	Grove Mounta GRV 020324 -	C	L5	Antarctica
72927	Grove Mounta GRV 020326 -	C	L5	Antarctica
72928	Grove Mounta GRV 020330 -	C	L6	Antarctica
72929	Grove Mounta GRV 020332 -	C	L6	Antarctica
72930	Grove Mounta GRV 020336 -	C	L5	Antarctica
72931	Grove Mounta GRV 020338 -	C	L5	Antarctica
72932	Grove Mounta GRV 020341 -	C	L6	Antarctica
72933	Grove Mounta GRV 020342 -	C	L5	Antarctica
72934	Grove Mounta GRV 020343 -	C	L5	Antarctica
72935	Grove Mounta GRV 020344 -	C	L5	Antarctica
72936	Grove Mounta GRV 020345 -	C	L5	Antarctica
72937	Grove Mounta GRV 020348 -	C	L5	Antarctica
72938	Grove Mounta GRV 020350 -	C	H5	Antarctica
72939	Grove Mounta GRV 020352 -	C	H5	Antarctica
72940	Grove Mounta GRV 020357 -	C	L5	Antarctica
72941	Grove Mounta GRV 020358 -	C	L5	Antarctica
72942	Grove Mounta GRV 020360 -	C	L4	Antarctica
72943	Grove Mounta GRV 020363 -	C	L5	Antarctica
72944	Grove Mounta GRV 020364 -	C	L4	Antarctica
72945	Grove Mounta GRV 020366 -	C	L5	Antarctica
72946	Grove Mounta GRV 020367 -	C	L5	Antarctica
72947	Grove Mounta GRV 020368 -	C	L5	Antarctica
72948	Grove Mounta GRV 020370 -	C	L5	Antarctica
72949	Grove Mounta GRV 020371 -	C	L5	Antarctica
72950	Grove Mounta GRV 020372 -	C	L5	Antarctica
72951	Grove Mounta GRV 020373 -	C	L5	Antarctica
72952	Grove Mounta GRV 020374 -	C	L5	Antarctica
72953	Grove Mounta GRV 020375 -	C	L5	Antarctica
72954	Grove Mounta GRV 020376 -	C	L5	Antarctica
72955	Grove Mounta GRV 020377 -	C	L5	Antarctica
72956	Grove Mounta GRV 020378 -	C	L5	Antarctica
72957	Grove Mounta GRV 020379 -	C	L5	Antarctica
72958	Grove Mounta GRV 020381 -	C	L5	Antarctica
72959	Grove Mounta GRV 020382 -	C	L6	Antarctica
72960	Grove Mounta GRV 020383 -	C	L4	Antarctica
72961	Grove Mounta GRV 020387 -	C	L5	Antarctica
72962	Grove Mounta GRV 020388 -	C	L5	Antarctica
72963	Grove Mounta GRV 020389 -	C	L5	Antarctica
72964	Grove Mounta GRV 020390 -	C	L5	Antarctica
72965	Grove Mounta GRV 020391 -	C	L5	Antarctica
72966	Grove Mounta GRV 020393 -	C	L5	Antarctica

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72967	Grove Mounta GRV 020394 -	C	L5	Antarctica
72968	Grove Mounta GRV 020396 -	C	L5	Antarctica
72969	Grove Mounta GRV 020398 -	C	L5	Antarctica
72970	Grove Mounta GRV 020399 -	C	L5	Antarctica
72971	Grove Mounta GRV 020400 -	C	L5	Antarctica
72972	Grove Mounta GRV 020401 -	C	H5	Antarctica
72973	Grove Mounta GRV 020402 -	C	H4	Antarctica
72974	Grove Mounta GRV 020403 -	C	L5	Antarctica
72975	Grove Mounta GRV 020404 -	C	L5	Antarctica
72976	Grove Mounta GRV 020405 -	C	L5	Antarctica
72977	Grove Mounta GRV 020406 -	C	L5	Antarctica
72978	Grove Mounta GRV 020407 -	C	L5	Antarctica
72979	Grove Mounta GRV 020408 -	C	L5	Antarctica
72980	Grove Mounta GRV 020409 -	C	L6	Antarctica
72981	Grove Mounta GRV 020410 -	C	L4	Antarctica
72982	Grove Mounta GRV 020411 -	C	L5	Antarctica
72983	Grove Mounta GRV 020412 -	C	L6	Antarctica
72984	Grove Mounta GRV 020414 -	C	L5	Antarctica
72985	Grove Mounta GRV 020415 -	C	L5	Antarctica
72986	Grove Mounta GRV 020416 -	C	L4	Antarctica
72987	Grove Mounta GRV 020417 -	C	L5	Antarctica
72988	Grove Mounta GRV 020418 -	C	L5	Antarctica
72989	Grove Mounta GRV 020419 -	C	L4	Antarctica
72990	Grove Mounta GRV 020420 -	C	H5	Antarctica
72991	Grove Mounta GRV 020421 -	C	L5	Antarctica
72992	Grove Mounta GRV 020422 -	C	L5	Antarctica
72993	Grove Mounta GRV 020423 -	C	L5	Antarctica
72994	Grove Mounta GRV 020424 -	C	L5	Antarctica
72995	Grove Mounta GRV 020425 -	C	L5	Antarctica
72996	Grove Mounta GRV 020426 -	C	L5	Antarctica
72997	Grove Mounta GRV 020427 -	C	L5	Antarctica
72998	Grove Mounta GRV 020428 -	C	L4	Antarctica
72999	Grove Mounta GRV 020429 -	C	L5	Antarctica
73000	Grove Mounta GRV 020430 -	C	L5	Antarctica
73001	Grove Mounta GRV 020431 -	C	L5	Antarctica
73002	Grove Mounta GRV 020432 -	C	L5	Antarctica
73003	Grove Mounta GRV 020433 -	C	L4	Antarctica
73004	Grove Mounta GRV 020434 -	C	L5	Antarctica
73005	Grove Mounta GRV 020435 -	C	L5	Antarctica
73006	Grove Mounta GRV 020436 -	C	L4	Antarctica
73007	Grove Mounta GRV 020437 -	C	L5	Antarctica
73008	Grove Mounta GRV 020438 -	C	L5	Antarctica
73009	Grove Mounta GRV 020439 -	C	L5	Antarctica
73010	Grove Mounta GRV 020440 -	C	L5	Antarctica
73011	Grove Mounta GRV 020441 -	C	L5	Antarctica
73012	Grove Mounta GRV 020442 -	C	L6	Antarctica
73013	Grove Mounta GRV 020443 -	C	L5	Antarctica
73014	Grove Mounta GRV 020444 -	C	H5	Antarctica
73015	Grove Mounta GRV 020445 -	C	L5	Antarctica
73016	Grove Mounta GRV 020446 -	C	H4	Antarctica
73017	Grove Mounta GRV 020447 -	C	L5	Antarctica
73018	Grove Mounta GRV 020448 -	C	L5	Antarctica
73019	Grove Mounta GRV 020449 -	C	L5	Antarctica
73020	Grove Mounta GRV 020450 -	C	L5	Antarctica
73021	Grove Mounta GRV 020451 -	C	L5	Antarctica



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73022	Grove Mounta GRV 020452 -	C	L4	Antarctica
73023	Grove Mounta GRV 020453 -	C	L4	Antarctica
73024	Grove Mounta GRV 020454 -	C	L5	Antarctica
73025	Grove Mounta GRV 020455 -	C	L5	Antarctica
73026	Grove Mounta GRV 020456 -	C	L5	Antarctica
73027	Grove Mounta GRV 020457 -	C	L5	Antarctica
73028	Grove Mounta GRV 020458 -	C	L5	Antarctica
73029	Grove Mounta GRV 020459 -	C	L5	Antarctica
73030	Grove Mounta GRV 020460 -	C	L4	Antarctica
73031	Grove Mounta GRV 020461 -	C	L4	Antarctica
73032	Grove Mounta GRV 020462 -	C	L5	Antarctica
73033	Grove Mounta GRV 020463 -	C	L5	Antarctica
73034	Grove Mounta GRV 020464 -	C	L4	Antarctica
73035	Grove Mounta GRV 020465 -	C	L4	Antarctica
73036	Grove Mounta GRV 020466 -	C	L5	Antarctica
73037	Grove Mounta GRV 020467 -	C	L5	Antarctica
73038	Grove Mounta GRV 020468 -	C	L5	Antarctica
73039	Grove Mounta GRV 020469 -	C	L5	Antarctica
73040	Grove Mounta GRV 020470 -	C	L5	Antarctica
73041	Grove Mounta GRV 020471 -	C	L6	Antarctica
73042	Grove Mounta GRV 020472 -	C	L5	Antarctica
73043	Grove Mounta GRV 020473 -	C	L5	Antarctica
73044	Grove Mounta GRV 020474 -	C	L5	Antarctica
73045	Grove Mounta GRV 020475 -	C	L5	Antarctica
73046	Grove Mounta GRV 020476 -	C	L5	Antarctica
73047	Grove Mounta GRV 020477 -	C	L5	Antarctica
73048	Grove Mounta GRV 020478 -	C	L4	Antarctica
73049	Grove Mounta GRV 020479 -	C	L5	Antarctica
73050	Grove Mounta GRV 020480 -	C	H4	Antarctica
73051	Grove Mounta GRV 020481 -	C	L5	Antarctica
73052	Grove Mounta GRV 020482 -	C	L5	Antarctica
73053	Grove Mounta GRV 020483 -	C	L5	Antarctica
73054	Grove Mounta GRV 020484 -	C	L5	Antarctica
73055	Grove Mounta GRV 020485 -	C	L5	Antarctica
73056	Grove Mounta GRV 020486 -	C	L6	Antarctica
73057	Grove Mounta GRV 020487 -	C	L6	Antarctica
73058	Grove Mounta GRV 020488 -	C	L5	Antarctica
73059	Grove Mounta GRV 020489 -	C	L5	Antarctica
73060	Grove Mounta GRV 020490 -	C	L4	Antarctica
73061	Grove Mounta GRV 020491 -	C	L5	Antarctica
73062	Grove Mounta GRV 020492 -	C	L5	Antarctica
73063	Grove Mounta GRV 020493 -	C	L5	Antarctica
73064	Grove Mounta GRV 020494 -	C	L5	Antarctica
73065	Grove Mounta GRV 020495 -	C	L5	Antarctica
73066	Grove Mounta GRV 020496 -	C	L5	Antarctica
73067	Grove Mounta GRV 020497 -	C	L5	Antarctica
73068	Grove Mounta GRV 020498 -	C	L6	Antarctica
73069	Grove Mounta GRV 020499 -	C	L5	Antarctica
73070	Grove Mounta GRV 020500 -	C	L6	Antarctica
73071	Grove Mounta GRV 020501 -	C	L5	Antarctica
73072	Grove Mounta GRV 020502 -	C	L6	Antarctica
73073	Grove Mounta GRV 020503 -	C	L5	Antarctica
73074	Grove Mounta GRV 020504 -	C	L6	Antarctica
73075	Grove Mounta GRV 020505 -	C	L6	Antarctica
73076	Grove Mounta GRV 020506 -	C	L5	Antarctica



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73077	Grove Mounta GRV 020507 -	C	L6	Antarctica
73078	Grove Mounta GRV 020508 -	C	L5	Antarctica
73079	Grove Mounta GRV 020509 -	C	L6	Antarctica
73080	Grove Mounta GRV 020510 -	C	L5	Antarctica
73081	Grove Mounta GRV 020511 -	C	L6	Antarctica
73082	Grove Mounta GRV 020512 -	C	L4	Antarctica
73083	Grove Mounta GRV 020513 -	C	L6	Antarctica
73084	Grove Mounta GRV 020514 -	C	L5	Antarctica
73085	Grove Mounta GRV 020515 -	C	L5	Antarctica
73086	Grove Mounta GRV 020516 -	C	L4	Antarctica
73087	Grove Mounta GRV 020517 -	C	L5	Antarctica
73088	Grove Mounta GRV 020519 -	C	L6	Antarctica
73089	Grove Mounta GRV 020520 -	C	L5	Antarctica
73090	Grove Mounta GRV 020521 -	C	L5	Antarctica
73091	Grove Mounta GRV 020522 -	C	L5	Antarctica
73092	Grove Mounta GRV 020523 -	C	L5	Antarctica
73093	Grove Mounta GRV 020524 -	C	L6	Antarctica
73094	Grove Mounta GRV 020525 -	C	L5	Antarctica
73095	Grove Mounta GRV 020526 -	C	L4	Antarctica
73096	Grove Mounta GRV 020527 -	C	L5	Antarctica
73097	Grove Mounta GRV 020528 -	C	L5	Antarctica
73098	Grove Mounta GRV 020529 -	C	H6	Antarctica
73099	Grove Mounta GRV 020530 -	C	L5	Antarctica
73100	Grove Mounta GRV 020531 -	C	L5	Antarctica
73101	Grove Mounta GRV 020532 -	C	L5	Antarctica
73102	Grove Mounta GRV 020533 -	C	L6	Antarctica
73103	Grove Mounta GRV 020534 -	C	L5	Antarctica
73104	Grove Mounta GRV 020535 -	C	L6	Antarctica
73105	Grove Mounta GRV 020536 -	C	L5	Antarctica
73106	Grove Mounta GRV 020537 -	C	L5	Antarctica
73107	Grove Mounta GRV 020538 -	C	L5	Antarctica
73108	Grove Mounta GRV 020539 -	C	L4	Antarctica
73109	Grove Mounta GRV 020540 -	C	L5	Antarctica
73110	Grove Mounta GRV 020541 -	C	L6	Antarctica
73111	Grove Mounta GRV 020542 -	C	L5	Antarctica
73112	Grove Mounta GRV 020543 -	C	L5	Antarctica
73113	Grove Mounta GRV 020544 -	C	L5	Antarctica
73114	Grove Mounta GRV 020545 -	C	L5	Antarctica
73115	Grove Mounta GRV 020546 -	C	L5	Antarctica
73116	Grove Mounta GRV 020547 -	C	L5	Antarctica
73117	Grove Mounta GRV 020548 -	C	L5	Antarctica
73118	Grove Mounta GRV 020549 -	C	L5	Antarctica
73119	Grove Mounta GRV 020550 -	C	L6	Antarctica
73120	Grove Mounta GRV 020551 -	C	L6	Antarctica
73121	Grove Mounta GRV 020552 -	C	L6	Antarctica
73122	Grove Mounta GRV 020553 -	C	L6	Antarctica
73123	Grove Mounta GRV 020554 -	C	L5	Antarctica
73124	Grove Mounta GRV 020555 -	C	L5	Antarctica
73125	Grove Mounta GRV 020556 -	C	L5	Antarctica
73126	Grove Mounta GRV 020557 -	C	L5	Antarctica
73127	Grove Mounta GRV 020558 -	C	L6	Antarctica
73128	Grove Mounta GRV 020559 -	C	L5	Antarctica
73129	Grove Mounta GRV 020560 -	C	L4	Antarctica
73130	Grove Mounta GRV 020561 -	C	L5	Antarctica
73131	Grove Mounta GRV 020562 -	C	L5	Antarctica

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73132	Grove Mounta GRV 020563 -	C	L6	Antarctica
73133	Grove Mounta GRV 020564 -	C	L5	Antarctica
73134	Grove Mounta GRV 020565 -	C	L5	Antarctica
73135	Grove Mounta GRV 020567 -	C	L4	Antarctica
73136	Grove Mounta GRV 020568 -	C	L5	Antarctica
73137	Grove Mounta GRV 020575 -	C	L6	Antarctica
73138	Grove Mounta GRV 020577 -	C	L5	Antarctica
73139	Grove Mounta GRV 020578 -	C	L5	Antarctica
73140	Grove Mounta GRV 020579 -	C	L5	Antarctica
73141	Grove Mounta GRV 020580 -	C	H4	Antarctica
73142	Grove Mounta GRV 020582 -	C	L6	Antarctica
73143	Grove Mounta GRV 020588 -	C	L5	Antarctica
73144	Grove Mounta GRV 020591 -	C	L5	Antarctica
73145	Grove Mounta GRV 020592 -	C	L6	Antarctica
73146	Grove Mounta GRV 020593 -	C	L5	Antarctica
73147	Grove Mounta GRV 020596 -	C	L6	Antarctica
73148	Grove Mounta GRV 020597 -	C	L5	Antarctica
73149	Grove Mounta GRV 020598 -	C	L6	Antarctica
73150	Grove Mounta GRV 020602 -	C	L6	Antarctica
73151	Grove Mounta GRV 020603 -	C	L5	Antarctica
73152	Grove Mounta GRV 020604 -	C	L6	Antarctica
73153	Grove Mounta GRV 020605 -	C	L5	Antarctica
73154	Grove Mounta GRV 020606 -	C	L5	Antarctica
73155	Grove Mounta GRV 020607 -	C	L5	Antarctica
73156	Grove Mounta GRV 020608 -	C	L5	Antarctica
73157	Grove Mounta GRV 020609 -	C	L6	Antarctica
73158	Grove Mounta GRV 020610 -	C	L5	Antarctica
73159	Grove Mounta GRV 020611 -	C	L6	Antarctica
73160	Grove Mounta GRV 020612 -	C	L6	Antarctica
73161	Grove Mounta GRV 020613 -	C	L5	Antarctica
73162	Grove Mounta GRV 020614 -	C	L5	Antarctica
73163	Grove Mounta GRV 020616 -	C	L5	Antarctica
73164	Grove Mounta GRV 020617 -	C	L4	Antarctica
73165	Grove Mounta GRV 020618 -	C	L5	Antarctica
73166	Grove Mounta GRV 020620 -	C	L5	Antarctica
73167	Grove Mounta GRV 020621 -	C	L5	Antarctica
73168	Grove Mounta GRV 020622 -	C	L5	Antarctica
73169	Grove Mounta GRV 020623 -	C	L5	Antarctica
73170	Grove Mounta GRV 020624 -	C	L5	Antarctica
73171	Grove Mounta GRV 020625 -	C	H5	Antarctica
73172	Grove Mounta GRV 020626 -	C	L5	Antarctica
73173	Grove Mounta GRV 020627 -	C	L5	Antarctica
73174	Grove Mounta GRV 020628 -	C	L5	Antarctica
73175	Grove Mounta GRV 020629 -	C	L5	Antarctica
73176	Grove Mounta GRV 020630 -	C	L5	Antarctica
73177	Grove Mounta GRV 020631 -	C	L5	Antarctica
73178	Grove Mounta GRV 020632 -	C	L5	Antarctica
73179	Grove Mounta GRV 020633 -	C	L5	Antarctica
73180	Grove Mounta GRV 020634 -	C	L6	Antarctica
73181	Grove Mounta GRV 020635 -	C	L6	Antarctica
73182	Grove Mounta GRV 020636 -	C	L5	Antarctica
73183	Grove Mounta GRV 020637 -	C	L5	Antarctica
73184	Grove Mounta GRV 020638 -	C	L6	Antarctica
73185	Grove Mounta GRV 020639 -	C	L5	Antarctica
73186	Grove Mounta GRV 020640 -	C	L5	Antarctica

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73187	Grove Mounta GRV 020641 -	C	L5	Antarctica
73188	Grove Mounta GRV 020642 -	C	L5	Antarctica
73189	Grove Mounta GRV 020643 -	C	L5	Antarctica
73190	Grove Mounta GRV 020644 -	C	L5	Antarctica
73191	Grove Mounta GRV 020645 -	C	L5	Antarctica
73192	Grove Mounta GRV 020646 -	C	L5	Antarctica
73193	Grove Mounta GRV 020647 -	C	L5	Antarctica
73194	Grove Mounta GRV 020648 -	C	L5	Antarctica
73195	Grove Mounta GRV 020650 -	C	L5	Antarctica
73196	Grove Mounta GRV 020651 -	C	L5	Antarctica
73197	Grove Mounta GRV 020652 -	C	L5	Antarctica
73198	Grove Mounta GRV 020653 -	C	L5	Antarctica
73199	Grove Mounta GRV 020654 -	C	L5	Antarctica
73200	Grove Mounta GRV 020655 -	C	L5	Antarctica
73201	Grove Mounta GRV 020656 -	C	L5	Antarctica
73202	Grove Mounta GRV 020657 -	C	L5	Antarctica
73203	Grove Mounta GRV 020658 -	C	L5	Antarctica
73204	Grove Mounta GRV 020659 -	C	L5	Antarctica
73205	Grove Mounta GRV 020660 -	C	L6	Antarctica
73206	Grove Mounta GRV 020661 -	C	L5	Antarctica
73207	Grove Mounta GRV 020662 -	C	L5	Antarctica
73208	Grove Mounta GRV 020663 -	C	L5	Antarctica
73209	Grove Mounta GRV 020664 -	C	L6	Antarctica
73210	Grove Mounta GRV 020665 -	C	L6	Antarctica
73211	Grove Mounta GRV 020666 -	C	L5	Antarctica
73212	Grove Mounta GRV 020667 -	C	L6	Antarctica
73213	Grove Mounta GRV 020668 -	C	L5	Antarctica
73214	Grove Mounta GRV 020669 -	C	L5	Antarctica
73215	Grove Mounta GRV 020670 -	C	L5	Antarctica
73216	Grove Mounta GRV 020671 -	C	L5	Antarctica
73217	Grove Mounta GRV 020672 -	C	L5	Antarctica
73218	Grove Mounta GRV 020673 -	C	L5	Antarctica
73219	Grove Mounta GRV 020674 -	C	L5	Antarctica
73220	Grove Mounta GRV 020675 -	C	L5	Antarctica
73221	Grove Mounta GRV 020676 -	C	L5	Antarctica
73222	Grove Mounta GRV 020677 -	C	L5	Antarctica
73223	Grove Mounta GRV 020678 -	C	L5	Antarctica
73224	Grove Mounta GRV 020679 -	C	L5	Antarctica
73225	Grove Mounta GRV 020680 -	C	H6	Antarctica
73226	Grove Mounta GRV 020681 -	C	L5	Antarctica
73227	Grove Mounta GRV 020682 -	C	L5	Antarctica
73228	Grove Mounta GRV 020683 -	C	L5	Antarctica
73229	Grove Mounta GRV 020684 -	C	L6	Antarctica
73230	Grove Mounta GRV 020685 -	C	L4	Antarctica
73231	Grove Mounta GRV 020686 -	C	L5	Antarctica
73232	Grove Mounta GRV 020687 -	C	L6	Antarctica
73233	Grove Mounta GRV 020688 -	C	L4	Antarctica
73234	Grove Mounta GRV 020689 -	C	L5	Antarctica
73235	Grove Mounta GRV 020690 -	C	L4	Antarctica
73236	Grove Mounta GRV 020691 -	C	L5	Antarctica
73237	Grove Mounta GRV 020692 -	C	L5	Antarctica
73238	Grove Mounta GRV 020693 -	C	L6	Antarctica
73239	Grove Mounta GRV 020694 -	C	L6	Antarctica
73240	Grove Mounta GRV 020695 -	C	L5	Antarctica
73241	Grove Mounta GRV 020696 -	C	L5	Antarctica

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73242	Grove Mounta GRV 020697 -	C	L5	Antarctica
73243	Grove Mounta GRV 020698 -	C	L4	Antarctica
73244	Grove Mounta GRV 020699 -	C	L5	Antarctica
73245	Grove Mounta GRV 020701 -	C	L6	Antarctica
73246	Grove Mounta GRV 020702 -	C	H5	Antarctica
73247	Grove Mounta GRV 020703 -	C	L6	Antarctica
73248	Grove Mounta GRV 020704 -	C	L5	Antarctica
73249	Grove Mounta GRV 020705 -	C	L5	Antarctica
73250	Grove Mounta GRV 020706 -	C	L5	Antarctica
73251	Grove Mounta GRV 020707 -	C	L5	Antarctica
73252	Grove Mounta GRV 020708 -	C	L5	Antarctica
73253	Grove Mounta GRV 020709 -	C	L6	Antarctica
73254	Grove Mounta GRV 020710 -	C	L5	Antarctica
73255	Grove Mounta GRV 020711 -	C	L5	Antarctica
73256	Grove Mounta GRV 020712 -	C	L6	Antarctica
73257	Grove Mounta GRV 020713 -	C	L4	Antarctica
73258	Grove Mounta GRV 020714 -	C	L5	Antarctica
73259	Grove Mounta GRV 020715 -	C	L6	Antarctica
73260	Grove Mounta GRV 020716 -	C	L5	Antarctica
73261	Grove Mounta GRV 020717 -	C	L6	Antarctica
73262	Grove Mounta GRV 020718 -	C	L5	Antarctica
73263	Grove Mounta GRV 020719 -	C	L5	Antarctica
73264	Grove Mounta GRV 020720 -	C	L5	Antarctica
73265	Grove Mounta GRV 020721 -	C	L5	Antarctica
73266	Grove Mounta GRV 020722 -	C	L5	Antarctica
73267	Grove Mounta GRV 020723 -	C	L6	Antarctica
73268	Grove Mounta GRV 020724 -	C	L6	Antarctica
73269	Grove Mounta GRV 020725 -	C	L6	Antarctica
73270	Grove Mounta GRV 020726 -	C	L5	Antarctica
73271	Grove Mounta GRV 020727 -	C	L5	Antarctica
73272	Grove Mounta GRV 020728 -	C	L5	Antarctica
73273	Grove Mounta GRV 020729 -	C	L4	Antarctica
73274	Grove Mounta GRV 020730 -	C	L5	Antarctica
73275	Grove Mounta GRV 020731 -	C	L5	Antarctica
73276	Grove Mounta GRV 020732 -	C	L6	Antarctica
73277	Grove Mounta GRV 020734 -	C	L5	Antarctica
73278	Grove Mounta GRV 020735 -	C	L5	Antarctica
73279	Grove Mounta GRV 020737 -	C	L6	Antarctica
73280	Grove Mounta GRV 020738 -	C	L5	Antarctica
73281	Grove Mounta GRV 020739 -	C	L6	Antarctica
73282	Grove Mounta GRV 020740 -	C	L6	Antarctica
73283	Grove Mounta GRV 020741 -	C	L6	Antarctica
73284	Grove Mounta GRV 020742 -	C	L4	Antarctica
73285	Grove Mounta GRV 020743 -	C	L5	Antarctica
73286	Grove Mounta GRV 020744 -	C	L5	Antarctica
73287	Grove Mounta GRV 020745 -	C	L6	Antarctica
73288	Grove Mounta GRV 020746 -	C	L5	Antarctica
73289	Grove Mounta GRV 020747 -	C	L5	Antarctica
73290	Grove Mounta GRV 020748 -	C	L5	Antarctica
73291	Grove Mounta GRV 020749 -	C	L5	Antarctica
73292	Grove Mounta GRV 020750 -	C	L6	Antarctica
73293	Grove Mounta GRV 020751 -	C	L5	Antarctica
73294	Grove Mounta GRV 020752 -	C	L5	Antarctica
73295	Grove Mounta GRV 020753 -	C	L5	Antarctica
73296	Grove Mounta GRV 020754 -	C	L5	Antarctica



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73297	Grove Mounta GRV 020755 -	C	L5	Antarctica
73298	Grove Mounta GRV 020756 -	C	L6	Antarctica
73299	Grove Mounta GRV 020757 -	C	L6	Antarctica
73300	Grove Mounta GRV 020758 -	C	L6	Antarctica
73301	Grove Mounta GRV 020759 -	C	L6	Antarctica
73302	Grove Mounta GRV 020760 -	C	L6	Antarctica
73303	Grove Mounta GRV 020761 -	C	L5	Antarctica
73304	Grove Mounta GRV 020762 -	C	L6	Antarctica
73305	Grove Mounta GRV 020763 -	C	L4	Antarctica
73306	Grove Mounta GRV 020764 -	C	L5	Antarctica
73307	Grove Mounta GRV 020765 -	C	L5	Antarctica
73308	Grove Mounta GRV 020766 -	C	L5	Antarctica
73309	Grove Mounta GRV 020767 -	C	L6	Antarctica
73310	Grove Mounta GRV 020768 -	C	L5	Antarctica
73311	Grove Mounta GRV 020769 -	C	L5	Antarctica
73312	Grove Mounta GRV 020770 -	C	L5	Antarctica
73313	Grove Mounta GRV 020771 -	C	L5	Antarctica
73314	Grove Mounta GRV 020772 -	C	L5	Antarctica
73315	Grove Mounta GRV 020774 -	C	L5	Antarctica
73316	Grove Mounta GRV 020776 -	C	L5	Antarctica
73317	Grove Mounta GRV 020777 -	C	L5	Antarctica
73318	Grove Mounta GRV 020778 -	C	L5	Antarctica
73319	Grove Mounta GRV 020779 -	C	L5	Antarctica
73320	Grove Mounta GRV 020780 -	C	L5	Antarctica
73321	Grove Mounta GRV 020781 -	C	L4	Antarctica
73322	Grove Mounta GRV 020782 -	C	L5	Antarctica
73323	Grove Mounta GRV 020783 -	C	L5	Antarctica
73324	Grove Mounta GRV 020784 -	C	L6	Antarctica
73325	Grove Mounta GRV 020785 -	C	L5	Antarctica
73326	Grove Mounta GRV 020786 -	C	L6	Antarctica
73327	Grove Mounta GRV 020787 -	C	L5	Antarctica
73328	Grove Mounta GRV 020788 -	C	L5	Antarctica
73329	Grove Mounta GRV 020789 -	C	L6	Antarctica
73330	Grove Mounta GRV 020790 -	C	L6	Antarctica
73331	Grove Mounta GRV 020791 -	C	L6	Antarctica
73332	Grove Mounta GRV 020792 -	C	L5	Antarctica
73333	Grove Mounta GRV 020793 -	C	L6	Antarctica
73334	Grove Mounta GRV 020794 -	C	L6	Antarctica
73335	Grove Mounta GRV 020795 -	C	L5	Antarctica
73336	Grove Mounta GRV 020796 -	C	L5	Antarctica
73337	Grove Mounta GRV 020798 -	C	L5	Antarctica
73338	Grove Mounta GRV 020799 -	C	L4	Antarctica
73339	Grove Mounta GRV 020800 -	C	L6	Antarctica
73340	Grove Mounta GRV 020803 -	C	L5	Antarctica
73341	Grove Mounta GRV 020804 -	C	L6	Antarctica
73342	Grove Mounta GRV 020805 -	C	H6	Antarctica
73343	Grove Mounta GRV 020806 -	C	L6	Antarctica
73344	Grove Mounta GRV 020807 -	C	L5	Antarctica
73345	Grove Mounta GRV 020812 -	C	L5	Antarctica
73346	Grove Mounta GRV 020813 -	C	L5	Antarctica
73347	Grove Mounta GRV 020814 -	C	L6	Antarctica
73348	Grove Mounta GRV 020815 -	C	L5	Antarctica
73349	Grove Mounta GRV 020816 -	C	L6	Antarctica
73350	Grove Mounta GRV 020818 -	C	L5	Antarctica
73351	Grove Mounta GRV 020819 -	C	L5	Antarctica



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73352	Grove Mounta GRV 020822 -	C	L5	Antarctica
73353	Grove Mounta GRV 020825 -	C	L5	Antarctica
73354	Grove Mounta GRV 020827 -	C	L4	Antarctica
73355	Grove Mounta GRV 020828 -	C	L5	Antarctica
73356	Grove Mounta GRV 020829 -	C	L5	Antarctica
73357	Grove Mounta GRV 020830 -	C	L6	Antarctica
73358	Grove Mounta GRV 020831 -	C	L6	Antarctica
73359	Grove Mounta GRV 020832 -	C	L5	Antarctica
73360	Grove Mounta GRV 020833 -	C	L5	Antarctica
73361	Grove Mounta GRV 020834 -	C	L5	Antarctica
73362	Grove Mounta GRV 020835 -	C	L5	Antarctica
73363	Grove Mounta GRV 020836 -	C	L6	Antarctica
73364	Grove Mounta GRV 020837 -	C	L5	Antarctica
73365	Grove Mounta GRV 020838 -	C	L5	Antarctica
73366	Grove Mounta GRV 020839 -	C	L5	Antarctica
73367	Grove Mounta GRV 020840 -	C	L5	Antarctica
73368	Grove Mounta GRV 020841 -	C	L5	Antarctica
73369	Grove Mounta GRV 020842 -	C	L5	Antarctica
73370	Grove Mounta GRV 020843 -	C	H5	Antarctica
73371	Grove Mounta GRV 020844 -	C	H4	Antarctica
73372	Grove Mounta GRV 020845 -	C	L5	Antarctica
73373	Grove Mounta GRV 020846 -	C	L6	Antarctica
73374	Grove Mounta GRV 020847 -	C	L5	Antarctica
73375	Grove Mounta GRV 020848 -	C	L5	Antarctica
73376	Grove Mounta GRV 020849 -	C	H6	Antarctica
73377	Grove Mounta GRV 020850 -	C	H5	Antarctica
73378	Grove Mounta GRV 020851 -	C	L5	Antarctica
73379	Grove Mounta GRV 020852 -	C	L5	Antarctica
73380	Grove Mounta GRV 020853 -	C	L5	Antarctica
73381	Grove Mounta GRV 020854 -	C	L5	Antarctica
73382	Grove Mounta GRV 020855 -	C	L4	Antarctica
73383	Grove Mounta GRV 020856 -	C	L5	Antarctica
73384	Grove Mounta GRV 020857 -	C	H5	Antarctica
73385	Grove Mounta GRV 020858 -	C	LL5	Antarctica
73386	Grove Mounta GRV 020859 -	C	L5	Antarctica
73387	Grove Mounta GRV 020860 -	C	L5	Antarctica
73388	Grove Mounta GRV 020861 -	C	L6	Antarctica
73389	Grove Mounta GRV 020862 -	C	L5	Antarctica
73390	Grove Mounta GRV 020863 -	C	L5	Antarctica
73391	Grove Mounta GRV 020864 -	C	L5	Antarctica
73392	Grove Mounta GRV 020865 -	C	L5	Antarctica
73393	Grove Mounta GRV 020866 -	C	L5	Antarctica
73394	Grove Mounta GRV 020867 -	C	L6	Antarctica
73395	Grove Mounta GRV 020868 -	C	L4	Antarctica
73396	Grove Mounta GRV 020869 -	C	L5	Antarctica
73397	Grove Mounta GRV 020870 -	C	L5	Antarctica
73398	Grove Mounta GRV 020871 -	C	L6	Antarctica
73399	Grove Mounta GRV 020872 -	C	L5	Antarctica
73400	Grove Mounta GRV 020873 -	C	L5	Antarctica
73401	Grove Mounta GRV 020874 -	C	L5	Antarctica
73402	Grove Mounta GRV 020875 -	C	H4	Antarctica
73403	Grove Mounta GRV 020876 -	C	L5	Antarctica
73404	Grove Mounta GRV 020877 -	C	L6	Antarctica
73405	Grove Mounta GRV 020878 -	C	L6	Antarctica
73406	Grove Mounta GRV 020879 -	C	L5	Antarctica

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73407	Grove Mounta GRV 020880 -	C	L6	Antarctica
73408	Grove Mounta GRV 020881 -	C	L5	Antarctica
73409	Grove Mounta GRV 020882 -	C	L5	Antarctica
73410	Grove Mounta GRV 020883 -	C	L5	Antarctica
73411	Grove Mounta GRV 020884 -	C	L5	Antarctica
73412	Grove Mounta GRV 020885 -	C	L5	Antarctica
73413	Grove Mounta GRV 020886 -	C	L5	Antarctica
73414	Grove Mounta GRV 020887 -	C	L5	Antarctica
73415	Grove Mounta GRV 020888 -	C	L5	Antarctica
73416	Grove Mounta GRV 020889 -	C	L5	Antarctica
73417	Grove Mounta GRV 020890 -	C	L4	Antarctica
73418	Grove Mounta GRV 020891 -	C	L6	Antarctica
73419	Grove Mounta GRV 020892 -	C	L5	Antarctica
73420	Grove Mounta GRV 020893 -	C	L5	Antarctica
73421	Grove Mounta GRV 020894 -	C	L5	Antarctica
73422	Grove Mounta GRV 020895 -	C	L4	Antarctica
73423	Grove Mounta GRV 020896 -	C	L5	Antarctica
73424	Grove Mounta GRV 020897 -	C	L5	Antarctica
73425	Grove Mounta GRV 020898 -	C	L5	Antarctica
73426	Grove Mounta GRV 020899 -	C	L5	Antarctica
73427	Grove Mounta GRV 020900 -	C	L6	Antarctica
73428	Grove Mounta GRV 020901 -	C	L5	Antarctica
73429	Grove Mounta GRV 020902 -	C	L4	Antarctica
73430	Grove Mounta GRV 020903 -	C	L5	Antarctica
73431	Grove Mounta GRV 020904 -	C	L4	Antarctica
73432	Grove Mounta GRV 020905 -	C	L5	Antarctica
73433	Grove Mounta GRV 020907 -	C	L5	Antarctica
73470	Grove Mounta GRV 020908 -	C	L6	Antarctica
73434	Grove Mounta GRV 020909 -	C	L5	Antarctica
73435	Grove Mounta GRV 020910 -	C	L6	Antarctica
73436	Grove Mounta GRV 020911 -	C	L4	Antarctica
73437	Grove Mounta GRV 020912 -	C	L4	Antarctica
73438	Grove Mounta GRV 020913 -	C	L5	Antarctica
73439	Grove Mounta GRV 020914 -	C	L4	Antarctica
73440	Grove Mounta GRV 020915 -	C	L6	Antarctica
73441	Grove Mounta GRV 020916 -	C	L6	Antarctica
73442	Grove Mounta GRV 020920 -	C	L5	Antarctica
73443	Grove Mounta GRV 020923 -	C	L5	Antarctica
73444	Grove Mounta GRV 020927 -	C	L5	Antarctica
73445	Grove Mounta GRV 020928 -	C	L5	Antarctica
73446	Grove Mounta GRV 020929 -	C	L5	Antarctica
73447	Grove Mounta GRV 020930 -	C	L5	Antarctica
73448	Grove Mounta GRV 020931 -	C	L5	Antarctica
73449	Grove Mounta GRV 020933 -	C	L5	Antarctica
73450	Grove Mounta GRV 020934 -	C	L6	Antarctica
73451	Grove Mounta GRV 020935 -	C	L5	Antarctica
73452	Grove Mounta GRV 020937 -	C	L5	Antarctica
73453	Grove Mounta GRV 020938 -	C	L5	Antarctica
73454	Grove Mounta GRV 020939 -	C	L5	Antarctica
73455	Grove Mounta GRV 020944 -	C	L5	Antarctica
73456	Grove Mounta GRV 020945 -	C	L5	Antarctica
73457	Grove Mounta GRV 020946 -	C	L5	Antarctica
73458	Grove Mounta GRV 020947 -	C	L5	Antarctica
73459	Grove Mounta GRV 020948 -	C	H5	Antarctica
73460	Grove Mounta GRV 020949 -	C	L4	Antarctica

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73461	Grove Mounta GRV 020950 -	C	L5	Antarctica
73462	Grove Mounta GRV 020951 -	C	L5	Antarctica
73463	Grove Mounta GRV 020952 -	C	L5	Antarctica
73464	Grove Mounta GRV 020953 -	C	L5	Antarctica
73465	Grove Mounta GRV 020954 -	C	L5	Antarctica
73466	Grove Mounta GRV 020955 -	C	L5	Antarctica
73467	Grove Mounta GRV 020956 -	C	L5	Antarctica
73468	Grove Mounta GRV 020957 -	C	L4	Antarctica
73469	Grove Mounta GRV 020958 -	C	L5	Antarctica
72336	Gusev Crater		Iron	Mars
72337	Gusev Crater		Iron	Mars
71747	Halloran Sprin		Iron, IIIAB	United States
71717	Hardpan Flat		Ureilite	United States
73573	Hassi el Biod (HeB 001		Diogenite-an	Algeria
72756	Hassi el MadaHeM 001		LL4	Algeria
71756	Hongliu Daqu		H~6	China
71754	Hongshijing 00		LL4	China
70942	Huangtuya 00		Iron, IIIAB	China
73509	Hughes 059		H5	Australia
73510	Hughes 060		H5	Australia
73511	Hughes 061		H5	Australia
70923	Huntsman (b)		H3	United States
71640	Imilac 002		H6	Chile
71641	Imilac 003		L5	Chile
72598	Iran 001		L6	Iran
72599	Iran 002		H5	Iran
72600	Iran 003		L6	Iran
72601	Iran 004		L6	Iran
72602	Iran 005		L6	Iran
72603	Iran 006		L6	Iran
72604	Iran 007		H5	Iran
72605	Iran 008		H5	Iran
72700	Iran 009		LL5	Iran
70925	Istifane 006		L6	Morocco
72832	Jdiriya 003		Eucrite	Western Sahara
71178	Jiddat al Hara: JaH 1107		H6	Oman
71595	Jiddat al Hara: JaH 1108		LL6-melt breccia	Oman
72377	Jiddat al Hara: JaH 1109		H5	Oman
72415	Jiddat al Hara: JaH 1110		L5	Oman
68553	Kerman 205		H5	Iran
68554	Kerman 206		H5	Iran
68555	Kerman 207		H5	Iran
68556	Kerman 208		H5	Iran
68557	Kerman 209		H5	Iran
68558	Kerman 210		H5	Iran
68559	Kerman 211		H5	Iran
68560	Kerman 212		H5	Iran
68561	Kerman 213		H5	Iran
68562	Kerman 214		H4	Iran
68563	Kerman 215		H5	Iran
68564	Kerman 216		H4	Iran
68565	Kerman 217		H5	Iran
68566	Kerman 218		H5	Iran
68567	Kerman 219		H5	Iran
68568	Kerman 220		H5	Iran

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68569	Kerman 221	H5	Iran
68570	Kerman 222	H5	Iran
68571	Kerman 223	H5	Iran
68572	Kerman 224	H5	Iran
68573	Kerman 225	H5	Iran
68574	Kerman 226	H5	Iran
68575	Kerman 227	H3	Iran
68576	Kerman 228	H5	Iran
68577	Kerman 229	H5	Iran
68578	Kerman 230	L5	Iran
68579	Kerman 231	H3	Iran
68580	Kerman 232	H5	Iran
68581	Kerman 233	H5	Iran
68582	Kerman 234	H6	Iran
68583	Kerman 235	H4	Iran
68584	Kerman 236	H5	Iran
68585	Kerman 237	H5	Iran
68586	Kerman 238	L5	Iran
68587	Kerman 239	H5	Iran
68588	Kerman 240	H5	Iran
68589	Kerman 241	H5	Iran
68590	Kerman 242	H5	Iran
68591	Kerman 243	H5	Iran
68592	Kerman 244	H5	Iran
70921	Kerman 245	L5	Iran
68594	Kerman 246	H5	Iran
68595	Kerman 247	H5	Iran
68596	Kerman 248	H5	Iran
68597	Kerman 249	L5	Iran
72350	Kerman 253	H5	Iran
72351	Kerman 254	H5	Iran
72352	Kerman 255	H5	Iran
72607	Kolang	CM1/2	Indonesia
72340	Kuiyibage	H5	China
68443	Kumtag 041	L~5	China
68789	Kumtag 055	L6	China
70054	Kumtag 056	L5	China
70499	Kumtag 059	L5	China
72860	Kumtag 061	Brachinite	China
72577	Kumtag 062	L6	China
72578	Kumtag 063	H4	China
72575	Kumtag 064	L6	China
73472	Kuźnica	H5	Poland
72516	Laâyoune 001	L3	Western Sahara
73564	Lake Gwynne	H5	Australia
71198	Lenghu 007	L~6	China
71143	Limón Verde C	CK5	Chile
72396	Limón Verde C	L5/6	Chile
72508	Limón Verde C	H5	Chile
72345	Liuyuan 001	L~5	China
71080	Los Vientos 3!LoV 354	H6	Chile
71083	Los Vientos 3!LoV 355	H6	Chile
71084	Los Vientos 3!LoV 356	H5	Chile
71087	Los Vientos 3!LoV 357	H6	Chile
71088	Los Vientos 3!LoV 358	H5	Chile

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71089	Los Vientos 3fLoV 359	H4	Chile
71100	Los Vientos 3fLoV 360	LL4-6	Chile
71172	Los Vientos 3fLoV 361	H5	Chile
71597	Los Vientos 3fLoV 362	H4/5	Chile
71663	Los Vientos 3fLoV 363	L5	Chile
72658	Los Vientos 3fLoV 364	Eucrite	Chile
71692	Los Vientos 3fLoV 365	L6	Chile
71697	Los Vientos 3fLoV 366	H5	Chile
71703	Los Vientos 3fLoV 367	L6	Chile
72317	Los Vientos 3fLoV 368	LL4-6	Chile
72388	Los Vientos 3fLoV 369	L6	Chile
72407	Los Vientos 3fLoV 370	H5	Chile
72670	Los Vientos 3fLoV 371	L6	Chile
72673	Los Vientos 3fLoV 372	H5	Chile
72675	Los Vientos 3fLoV 373	L6	Chile
72676	Los Vientos 3fLoV 374	LL5	Chile
72800	Los Vientos 3fLoV 375	H5	Chile
72680	Los Vientos 3fLoV 376	L6	Chile
72681	Los Vientos 3fLoV 377	L5	Chile
72685	Los Vientos 3fLoV 378	H5	Chile
72705	Los Vientos 3fLoV 379	H4	Chile
72706	Los Vientos 3fLoV 380	L6	Chile
72690	Los Vientos 3fLoV 381	L6	Chile
72691	Los Vientos 3fLoV 382	L6	Chile
72848	Los Vientos 3fLoV 383	Howardite	Chile
72849	Los Vientos 3fLoV 384	Howardite	Chile
72850	Los Vientos 3fLoV 385	Ureilite	Chile
72851	Los Vientos 3fLoV 386	Eucrite	Chile
72693	Los Vientos 3fLoV 387	H4	Chile
72694	Los Vientos 3fLoV 388	L6	Chile
72698	Los Vientos 3fLoV 389	H4	Chile
70055	Loulan Yizhi 0	L6	China
70496	Loulan Yizhi 0	Ureilite	China
70500	Loulan Yizhi 0	H5	China
70873	Loulan Yizhi 0	LL~6	China
70874	Loulan Yizhi 0	L~4	China
70877	Loulan Yizhi 0	H~4	China
72606	Loulan Yizhi 0	L5-melt brecci	China
72579	Loulan Yizhi 0	L6	China
71699	Machuca 014	L5	Chile
71700	Machuca 015	L5	Chile
72395	Machuca 016	H5	Chile
72679	Machuca 017	L5	Chile
72349	Mahadeva	H5	India
73500	Marsa Alam 0. MA 020	H5	Egypt
73501	Marsa Alam 0. MA 021	H5	Egypt
73502	Marsa Alam 0. MA 022	H5	Egypt
73503	Marsa Alam 0. MA 023	H5	Egypt
73504	Marsa Alam 0. MA 024	H5	Egypt
71659	Matarka	L6	Morocco
70922	Mederdra	R4-5	Mauritania
72329	Meridiani Plan MP 002	Stony iron	Mars
72330	Meridiani Plan MP 003	Stony iron	Mars
72331	Meridiani Plan MP 004	Stony iron	Mars
72332	Meridiani Plan MP 005	Stony iron	Mars



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72333	Meridiani Plan MP 006				Iron, IAB com	Mars
72334	Meridiani Plan MP 007				Iron, IAB com	Mars
72335	Meridiani Plan MP 008				Iron	Mars
72778	Montes Claros				H5	Brazil
73563	Mount Marion				H5	Australia
71580	Mount Prestru PRE 17270	43(1)	A		L6	Antarctica
71581	Mount Prestru PRE 17273	43(1)	A		L6	Antarctica
71582	Mount Prestru PRE 17274	43(1)	A		L5	Antarctica
71583	Mount Prestru PRE 17276	43(1)	A		H6	Antarctica
73513	Mundrabilla 02				H5	Australia
72653	Narashino				H5	Japan
71541	Nodtvedt Nun: NOD 17220	43(1)	A		L5	Antarctica
71542	Nodtvedt Nun: NOD 17221	43(1)	A		L5	Antarctica
71543	Nodtvedt Nun: NOD 17222	43(1)	A		H6	Antarctica
71544	Nodtvedt Nun: NOD 17223	43(1)	A		H6	Antarctica
71545	Nodtvedt Nun: NOD 17224	43(1)	A		H5	Antarctica
71546	Nodtvedt Nun: NOD 17225	43(1)	A		H4	Antarctica
71547	Nodtvedt Nun: NOD 17226	43(1)	A		H6	Antarctica
71548	Nodtvedt Nun: NOD 17227	43(1)	A		H5	Antarctica
71549	Nodtvedt Nun: NOD 17228	43(1)	A		H4	Antarctica
71550	Nodtvedt Nun: NOD 17229	43(1)	A		H6	Antarctica
71551	Nodtvedt Nun: NOD 17230	43(1)	A		LL6	Antarctica
71552	Nodtvedt Nun: NOD 17231	43(1)	A		H4	Antarctica
71553	Nodtvedt Nun: NOD 17232	43(1)	A		H6	Antarctica
71554	Nodtvedt Nun: NOD 17233	43(1)	A		H6	Antarctica
71555	Nodtvedt Nun: NOD 17234	43(1)	A		H5	Antarctica
71556	Nodtvedt Nun: NOD 17235	43(1)	A		L6	Antarctica
71557	Nodtvedt Nun: NOD 17236	43(1)	A		H6	Antarctica
71558	Nodtvedt Nun: NOD 17237	43(1)	A		H6	Antarctica
71559	Nodtvedt Nun: NOD 17238	43(1)	A		H6	Antarctica
71560	Nodtvedt Nun: NOD 17239	43(1)	A		H5	Antarctica
71561	Nodtvedt Nun: NOD 17240	43(1)	A		H6	Antarctica
71562	Nodtvedt Nun: NOD 17242	43(1)	A		H6	Antarctica
71563	Nodtvedt Nun: NOD 17243	43(1)	A		H6	Antarctica
71564	Nodtvedt Nun: NOD 17244	43(1)	A		H6	Antarctica
71565	Nodtvedt Nun: NOD 17245	43(1)	A		H6	Antarctica
71566	Nodtvedt Nun: NOD 17246	43(1)	A		H4	Antarctica
71567	Nodtvedt Nun: NOD 17247	43(1)	A		H6	Antarctica
71568	Nodtvedt Nun: NOD 17248	43(1)	A		H4	Antarctica
71569	Nodtvedt Nun: NOD 17249	43(1)	A		H6	Antarctica
71570	Nodtvedt Nun: NOD 17250	43(1)	A		H6	Antarctica
71571	Nodtvedt Nun: NOD 17251	43(1)	A		H4	Antarctica
71572	Nodtvedt Nun: NOD 17252	43(1)	A		H6	Antarctica
71573	Nodtvedt Nun: NOD 17253	43(1)	A		H4	Antarctica
71574	Nodtvedt Nun: NOD 17254	43(1)	A		H6	Antarctica
71575	Nodtvedt Nun: NOD 17255	43(1)	A		H6	Antarctica
71576	Nodtvedt Nun: NOD 17256	43(1)	A		H6	Antarctica
71577	Nodtvedt Nun: NOD 17257	43(1)	A		LL5	Antarctica
71578	Nodtvedt Nun: NOD 17258	43(1)	A		H5	Antarctica
71579	Nodtvedt Nun: NOD 17259	43(1)	A		L6	Antarctica
72650	North Edward				L6	United States
71685	Northeast Afri: NEA 009				Martian (sherc	Libya
72385	Northeast Afri: NEA 010				R3-5	Libya
72386	Northeast Afri: NEA 011				Martian (sherc	Libya
72449	Northeast Afri: NEA 012				L3	Libya

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72536	Northeast Afri NEA 013	Diogenite	(Northeast Afr
72608	Northeast Afri NEA 014	Lunar (feldsp.	Libya
73566	Northeast Afri NEA 015	Martian (sherc	Libya
32154	Northwest Afri NWA 1281	Diogenite-pm	(Northwest Afr
32158	Northwest Afri NWA 1286	L4	(Northwest Afr
32317	Northwest Afri NWA 1458	H4	(Northwest Afr
33139	Northwest Afri NWA 2628	CK3	(Northwest Afr
33175	Northwest Afri NWA 2682	L3-6	(Northwest Afr
33189	Northwest Afri NWA 2696	Eucrite-br	(Northwest Afr
33477	Northwest Afri NWA 3144	CV3	(Northwest Afr
45410	Northwest Afri NWA 4295	EL-melt rock	Morocco
45458	Northwest Afri NWA 4454	H6	(Northwest Afr
45761	Northwest Afri NWA 4837	CV3	(Northwest Afr
45763	Northwest Afri NWA 4839	CV3	(Northwest Afr
47268	Northwest Afri NWA 5147	Howardite	(Northwest Afr
47271	Northwest Afri NWA 5150	H7	(Northwest Afr
49065	Northwest Afri NWA 5335	Mesosiderite	(Northwest Afr
49180	Northwest Afri NWA 5471	Brachinite	(Northwest Afr
49295	Northwest Afri NWA 5596	CO3	(Northwest Afr
49296	Northwest Afri NWA 5597	Diogenite	(Northwest Afr
50774	Northwest Afri NWA 5888	Pallasite	(Northwest Afr
50775	Northwest Afri NWA 5889	Winonaite	(Northwest Afr
50776	Northwest Afri NWA 5890	Winonaite	(Northwest Afr
50777	Northwest Afri NWA 5891	Pallasite	(Northwest Afr
51436	Northwest Afri NWA 6027	CK3	(Northwest Afr
52757	Northwest Afri NWA 6431	LL(L)3	(Northwest Afr
52771	Northwest Afri NWA 6445	CO3	(Northwest Afr
54690	Northwest Afri NWA 7051	Eucrite	Morocco
54897	Northwest Afri NWA 7145	CK4	(Northwest Afr
54919	Northwest Afri NWA 7167	CK4	(Northwest Afr
55687	Northwest Afri NWA 7357	Eucrite-cm	Morocco
55689	Northwest Afri NWA 7359	Diogenite	Morocco
55693	Northwest Afri NWA 7363	Eucrite-pmict	Morocco
56399	Northwest Afri NWA 7540	LL3	(Northwest Afr
61014	Northwest Afri NWA 8580	L3.15	(Northwest Afr
73525	Northwest Afri NWA 10189	CR2	Morocco
73526	Northwest Afri NWA 10841	H5	Morocco
73527	Northwest Afri NWA 10845	L/LL5	Morocco
71110	Northwest Afri NWA 10898	LL3.10	(Northwest Afr
71655	Northwest Afri NWA 11333	Ureilite	(Northwest Afr
72373	Northwest Afri NWA 11867	L3-7	(Northwest Afr
70613	Northwest Afri NWA 11983	L3-6	(Northwest Afr
70614	Northwest Afri NWA 11988	L3-6	(Northwest Afr
70615	Northwest Afri NWA 11989	L3-6	(Northwest Afr
68630	Northwest Afri NWA 12266	L3	(Northwest Afr
68447	Northwest Afri NWA 12302	CV3	Morocco
68458	Northwest Afri NWA 12313	H4	Morocco
69695	Northwest Afri NWA 12386	L5	(Northwest Afr
71656	Northwest Afri NWA 12445	Eucrite-an	(Northwest Afr
69369	Northwest Afri NWA 12458	L3-6	(Northwest Afr
68791	Northwest Afri NWA 12493	H3-5	(Northwest Afr
68795	Northwest Afri NWA 12497	H4	(Northwest Afr
68803	Northwest Afri NWA 12505	R3	Mauritania
70616	Northwest Afri NWA 12512	L3-6	(Northwest Afr
72654	Northwest Afri NWA 12518	LL3	(Northwest Afr

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72655	Northwest Afri NWA 12520	LL6-melt breccia	(Northwest Afri)
72858	Northwest Afri NWA 12523	CVred3	(Northwest Afri)
72859	Northwest Afri NWA 12524	CK5	(Northwest Afri)
72321	Northwest Afri NWA 12688	Ureilite	(Northwest Afri)
70204	Northwest Afri NWA 12727	LL3	Morocco
70946	Northwest Afri NWA 12735	LL6-an	(Northwest Afri)
70947	Northwest Afri NWA 12736	Achondrite-un	(Northwest Afri)
70058	Northwest Afri NWA 12780	LL7	Morocco
70059	Northwest Afri NWA 12781	CV3	Morocco
70060	Northwest Afri NWA 12782	CV3	Morocco
70064	Northwest Afri NWA 12786	L4-melt breccia	Morocco
70065	Northwest Afri NWA 12787	H3	Morocco
70071	Northwest Afri NWA 12793	L6	(Northwest Afri)
71704	Northwest Afri NWA 12794	L5-melt breccia	(Northwest Afri)
71624	Northwest Afri NWA 12868	Ureilite	Morocco
70497	Northwest Afri NWA 12894	L3	Morocco
70502	Northwest Afri NWA 12897	H4	(Northwest Afri)
70503	Northwest Afri NWA 12898	H6	(Northwest Afri)
70504	Northwest Afri NWA 12899	Eucrite	(Northwest Afri)
70505	Northwest Afri NWA 12900	H5	(Northwest Afri)
70506	Northwest Afri NWA 12901	L6	(Northwest Afri)
71625	Northwest Afri NWA 12907	Achondrite-pri	(Northwest Afri)
72301	Northwest Afri NWA 12940	Eucrite	Morocco
72302	Northwest Afri NWA 12941	Eucrite	Morocco
72303	Northwest Afri NWA 12942	Eucrite	Morocco
72304	Northwest Afri NWA 12943	Eucrite	Morocco
72305	Northwest Afri NWA 12944	Eucrite	Morocco
70948	Northwest Afri NWA 12957	C3.00-ung	(Northwest Afri)
71706	Northwest Afri NWA 12969	Achondrite-un	(Northwest Afri)
71626	Northwest Afri NWA 12984	Iron, ungrouped	Mauritania
71119	Northwest Afri NWA 13002	Eucrite-br	Algeria
70865	Northwest Afri NWA 13019	CK6	(Northwest Afri)
70866	Northwest Afri NWA 13021	Pallasite	(Northwest Afri)
70867	Northwest Afri NWA 13025	Pallasite	(Northwest Afri)
70868	Northwest Afri NWA 13026	Ureilite	(Northwest Afri)
70869	Northwest Afri NWA 13027	Eucrite	(Northwest Afri)
70870	Northwest Afri NWA 13028	CV3	(Northwest Afri)
70871	Northwest Afri NWA 13029	CO3	(Northwest Afri)
70872	Northwest Afri NWA 13030	CV3	(Northwest Afri)
71113	Northwest Afri NWA 13031	Martian (shergottite)	(Northwest Afri)
71114	Northwest Afri NWA 13032	Diogenite-pm	Algeria
71115	Northwest Afri NWA 13034	Eucrite-br	(Northwest Afri)
71116	Northwest Afri NWA 13035	CK4	Algeria
71117	Northwest Afri NWA 13036	Lunar (feldsp.)	Morocco
71118	Northwest Afri NWA 13038	Martian (shergottite)	(Northwest Afri)
70879	Northwest Afri NWA 13040	LL~3	(Northwest Afri)
70881	Northwest Afri NWA 13042	LL~4	Morocco
70888	Northwest Afri NWA 13049	L~6	(Northwest Afri)
70890	Northwest Afri NWA 13051	L~6	(Northwest Afri)
70891	Northwest Afri NWA 13052	H~4	(Northwest Afri)
70924	Northwest Afri NWA 13054	CV3	(Northwest Afri)
70892	Northwest Afri NWA 13055	LL3	(Northwest Afri)
70893	Northwest Afri NWA 13056	H5	(Northwest Afri)
70894	Northwest Afri NWA 13057	H5	(Northwest Afri)
71166	Northwest Afri NWA 13058	CO3	(Northwest Afri)

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71047	Northwest Afri NWA 13059	CO3	(Northwest Afri
71048	Northwest Afri NWA 13060	R3	(Northwest Afri
71049	Northwest Afri NWA 13061	Ureilite	(Northwest Afri
70895	Northwest Afri NWA 13062	L6	(Northwest Afri
71657	Northwest Afri NWA 13063	CO3	(Northwest Afri
71050	Northwest Afri NWA 13064	Eucrite	(Northwest Afri
71051	Northwest Afri NWA 13065	Eucrite	(Northwest Afri
71167	Northwest Afri NWA 13066	CO3	(Northwest Afri
71052	Northwest Afri NWA 13067	Eucrite	(Northwest Afri
71120	Northwest Afri NWA 13068	CO3	(Northwest Afri
70896	Northwest Afri NWA 13069	LL4	(Northwest Afri
70897	Northwest Afri NWA 13070	L3	(Northwest Afri
71168	Northwest Afri NWA 13071	CO3	(Northwest Afri
71053	Northwest Afri NWA 13072	Eucrite	(Northwest Afri
70898	Northwest Afri NWA 13073	L3	(Northwest Afri
71054	Northwest Afri NWA 13074	CK6	(Northwest Afri
70905	Northwest Afri NWA 13075	L5	(Northwest Afri
70906	Northwest Afri NWA 13076	L6	(Northwest Afri
71055	Northwest Afri NWA 13077	R3-5	Morocco
70907	Northwest Afri NWA 13078	L5	(Northwest Afri
70908	Northwest Afri NWA 13079	H6	(Northwest Afri
70909	Northwest Afri NWA 13080	H6	(Northwest Afri
70910	Northwest Afri NWA 13081	L5	(Northwest Afri
70911	Northwest Afri NWA 13082	H5	(Northwest Afri
70912	Northwest Afri NWA 13083	H4	(Northwest Afri
70913	Northwest Afri NWA 13084	L6	(Northwest Afri
70914	Northwest Afri NWA 13085	L5	(Northwest Afri
71121	Northwest Afri NWA 13087	Eucrite-pmict	(Northwest Afri
71056	Northwest Afri NWA 13088	L3.1	Morocco
70926	Northwest Afri NWA 13089	LL5	Morocco
70927	Northwest Afri NWA 13090	LL3	Morocco
70928	Northwest Afri NWA 13091	L6	Morocco
70929	Northwest Afri NWA 13092	H6	Morocco
70930	Northwest Afri NWA 13093	L6	Morocco
70931	Northwest Afri NWA 13094	H5	Morocco
70932	Northwest Afri NWA 13095	L6	Morocco
70933	Northwest Afri NWA 13096	H6	Morocco
70934	Northwest Afri NWA 13097	L6	Morocco
70935	Northwest Afri NWA 13098	H5	Morocco
70936	Northwest Afri NWA 13099	H5	Morocco
70915	Northwest Afri NWA 13100	LL6	(Northwest Afri
71124	Northwest Afri NWA 13101	Lunar (feldsp.	(Northwest Afri
71125	Northwest Afri NWA 13102	Mesosiderite	(Northwest Afri
71126	Northwest Afri NWA 13103	L6-melt brecci	(Northwest Afri
71127	Northwest Afri NWA 13104	Eucrite-mmict	(Northwest Afri
71128	Northwest Afri NWA 13105	L7	(Northwest Afri
71129	Northwest Afri NWA 13106	Martian (sherc	(Northwest Afri
71130	Northwest Afri NWA 13107	LL7	(Northwest Afri
71131	Northwest Afri NWA 13108	EL6	(Northwest Afri
70916	Northwest Afri NWA 13109	L4	(Northwest Afri
71132	Northwest Afri NWA 13110	Diogenite-pm	(Northwest Afri
70917	Northwest Afri NWA 13111	H4/5	(Northwest Afri
71133	Northwest Afri NWA 13112	Lunar (feldsp.	(Northwest Afri
70918	Northwest Afri NWA 13113	L4	Mali
71134	Northwest Afri NWA 13114	CV3	Algeria



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71135	Northwest Afri NWA 13115	Martian (sherc	(Northwest Afr
70919	Northwest Afri NWA 13116	H6	Mali
71136	Northwest Afri NWA 13117	Eucrite-mmict	(Northwest Afr
70920	Northwest Afri NWA 13118	L6	(Northwest Afr
71137	Northwest Afri NWA 13119	Lunar (Feldsp	Mauritania
71057	Northwest Afri NWA 13120	Lunar (feldsp.	Morocco
70937	Northwest Afri NWA 13126	L4	Morocco
70938	Northwest Afri NWA 13127	LL6	Morocco
70939	Northwest Afri NWA 13129	L5	Morocco
71139	Northwest Afri NWA 13130	CV3	(Northwest Afr
70940	Northwest Afri NWA 13131	H5	(Northwest Afr
70941	Northwest Afri NWA 13132	L5/6	Niger
71140	Northwest Afri NWA 13133	EL6	(Northwest Afr
71707	Northwest Afri NWA 13134	Martian (sherc	(Northwest Afr
71141	Northwest Afri NWA 13135	Ureilite	Morocco
71658	Northwest Afri NWA 13136	L3	Algeria
71142	Northwest Afri NWA 13137	H5-melt brecc	(Northwest Afr
71186	Northwest Afri NWA 13138	Lunar (feldsp.	(Northwest Afr
71069	Northwest Afri NWA 13139	H6	(Northwest Afr
71070	Northwest Afri NWA 13140	H4	(Northwest Afr
71187	Northwest Afri NWA 13141	Mesosiderite	Morocco
71071	Northwest Afri NWA 13142	H5	Morocco
71188	Northwest Afri NWA 13143	Howardite	Morocco
71072	Northwest Afri NWA 13144	L5-melt brecci	(Northwest Afr
71073	Northwest Afri NWA 13145	LL3	(Northwest Afr
71189	Northwest Afri NWA 13146	Eucrite	(Northwest Afr
71074	Northwest Afri NWA 13147	L4	(Northwest Afr
71190	Northwest Afri NWA 13148	Eucrite	(Northwest Afr
71191	Northwest Afri NWA 13149	Eucrite	(Northwest Afr
71192	Northwest Afri NWA 13150	CM2	(Northwest Afr
71075	Northwest Afri NWA 13151	LL7	(Northwest Afr
71076	Northwest Afri NWA 13152	LL3	(Northwest Afr
71077	Northwest Afri NWA 13153	LL7	Morocco
71078	Northwest Afri NWA 13154	H5	(Northwest Afr
71193	Northwest Afri NWA 13155	Ureilite	(Northwest Afr
71194	Northwest Afri NWA 13156	CK6	(Northwest Afr
71195	Northwest Afri NWA 13157	Pallasite	(Northwest Afr
71090	Northwest Afri NWA 13158	H3	(Northwest Afr
71150	Northwest Afri NWA 13159	L6-melt brecci	(Northwest Afr
71151	Northwest Afri NWA 13160	Eucrite	(Northwest Afr
71091	Northwest Afri NWA 13161	L3	(Northwest Afr
71152	Northwest Afri NWA 13162	R3-6	(Northwest Afr
71153	Northwest Afri NWA 13163	Diogenite	(Northwest Afr
71154	Northwest Afri NWA 13164	Eucrite	(Northwest Afr
71092	Northwest Afri NWA 13165	L6	(Northwest Afr
71155	Northwest Afri NWA 13166	Eucrite-melt b	(Northwest Afr
72656	Northwest Afri NWA 13167	C2-ung	(Northwest Afr
71093	Northwest Afri NWA 13168	L6	(Northwest Afr
71094	Northwest Afri NWA 13169	LL6	(Northwest Afr
71197	Northwest Afri NWA 13170	Achondrite-un	(Northwest Afr
71099	Northwest Afri NWA 13171	L3	Morocco
71101	Northwest Afri NWA 13172	L5	Algeria
71102	Northwest Afri NWA 13173	H5	(Northwest Afr
71103	Northwest Afri NWA 13174	LL5	Mauritania
71104	Northwest Afri NWA 13175	H5	Algeria



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71679	Northwest Afri NWA 13176	Diogenite	Algeria
72439	Northwest Afri NWA 13177	L3-6	Morocco
71627	Northwest Afri NWA 13178	CO3	Mali
71709	Northwest Afri NWA 13179	Martian	Algeria
71145	Northwest Afri NWA 13180	L4	Algeria
71628	Northwest Afri NWA 13181	Eucrite-br	(Northwest Afri
71146	Northwest Afri NWA 13182	LL3	Mali
71147	Northwest Afri NWA 13183	H5	(Northwest Afri
71148	Northwest Afri NWA 13184	L4/5	(Northwest Afri
71629	Northwest Afri NWA 13185	Lunar (feldsp.	(Northwest Afri
71149	Northwest Afri NWA 13186	L4	(Northwest Afri
71630	Northwest Afri NWA 13187	Martian (sherc	(Northwest Afri
71664	Northwest Afri NWA 13188	Achondrite-un	(Northwest Afri
71639	Northwest Afri NWA 13189	Mesosiderite	Morocco
71631	Northwest Afri NWA 13190	Martian (sherc	Algeria
71632	Northwest Afri NWA 13191	Lunar (feldsp.	Morocco
71161	Northwest Afri NWA 13192	L5	Morocco
71162	Northwest Afri NWA 13193	L5	(Northwest Afri
71163	Northwest Afri NWA 13194	L6	(Northwest Afri
71164	Northwest Afri NWA 13195	L6	(Northwest Afri
71165	Northwest Afri NWA 13196	L6	(Northwest Afri
71179	Northwest Afri NWA 13197	H5	(Northwest Afri
71180	Northwest Afri NWA 13198	LL6	(Northwest Afri
71181	Northwest Afri NWA 13199	H4	(Northwest Afri
71182	Northwest Afri NWA 13200	L3	(Northwest Afri
71183	Northwest Afri NWA 13201	L4/5	(Northwest Afri
71636	Northwest Afri NWA 13202	Chondrite-ung	(Northwest Afri
71184	Northwest Afri NWA 13203	L4	(Northwest Afri
71637	Northwest Afri NWA 13204	Martian (sherc	(Northwest Afri
71185	Northwest Afri NWA 13205	H4/5	(Northwest Afri
71638	Northwest Afri NWA 13206	Howardite	(Northwest Afri
71633	Northwest Afri NWA 13207	H5-6	(Northwest Afri
71634	Northwest Afri NWA 13208	Ureilite	(Northwest Afri
71593	Northwest Afri NWA 13209	H6	(Northwest Afri
71710	Northwest Afri NWA 13210	EL-melt rock	(Northwest Afri
71635	Northwest Afri NWA 13211	Eucrite	(Northwest Afri
71711	Northwest Afri NWA 13212	CK6	(Northwest Afri
71594	Northwest Afri NWA 13213	L3	(Northwest Afri
71712	Northwest Afri NWA 13214	Achondrite-un	(Northwest Afri
71713	Northwest Afri NWA 13215	Martian (sherc	(Northwest Afri
71714	Northwest Afri NWA 13216	Lunar (Feldsp	(Northwest Afri
71715	Northwest Afri NWA 13217	Martian (sherc	(Northwest Afri
71716	Northwest Afri NWA 13218	LL3.2	(Northwest Afri
71718	Northwest Afri NWA 13219	Eucrite-cm	Niger
71601	Northwest Afri NWA 13220	H3	(Northwest Afri
71602	Northwest Afri NWA 13221	L4	Mali
71719	Northwest Afri NWA 13222	H3	(Northwest Afri
71720	Northwest Afri NWA 13223	Eucrite-mmict	(Northwest Afri
71603	Northwest Afri NWA 13224	LL6	(Northwest Afri
71721	Northwest Afri NWA 13225	Lunar (feldsp.	(Northwest Afri
71722	Northwest Afri NWA 13226	H3-4	(Northwest Afri
71723	Northwest Afri NWA 13227	Martian (sherc	(Northwest Afri
71604	Northwest Afri NWA 13228	H3	(Northwest Afri
71648	Northwest Afri NWA 13229	Martian (sherc	(Northwest Afri
71726	Northwest Afri NWA 13230	Ureilite	(Northwest Afri

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71649	Northwest Afri NWA 13231	H4	(Northwest Afr
71618	Northwest Afri NWA 13232	L6	(Northwest Afr
71650	Northwest Afri NWA 13233	Eucrite-melt b	(Northwest Afr
71727	Northwest Afri NWA 13234	LL7	(Northwest Afr
71728	Northwest Afri NWA 13235	Howardite	(Northwest Afr
71651	Northwest Afri NWA 13236	LL6-melt brecc	(Northwest Afr
71725	Northwest Afri NWA 13237	Martian (sherc	(Northwest Afr
71732	Northwest Afri NWA 13238	LL4	(Northwest Afr
71682	Northwest Afri NWA 13239	Ureilite	(Northwest Afr
71683	Northwest Afri NWA 13240	CV3	(Northwest Afr
71684	Northwest Afri NWA 13241	Lodranite	(Northwest Afr
71661	Northwest Afri NWA 13242	L4	(Northwest Afr
71686	Northwest Afri NWA 13244	CV3	(Northwest Afr
72383	Northwest Afri NWA 13245	Eucrite-melt b	(Northwest Afr
72384	Northwest Afri NWA 13246	CK3	(Northwest Afr
71687	Northwest Afri NWA 13247	Winonaite	(Northwest Afr
71680	Northwest Afri NWA 13248	H5-melt brecc	Niger
72755	Northwest Afri NWA 13249	C2-ung	Libya
71681	Northwest Afri NWA 13250	Martian (sherc	Mauritania
71665	Northwest Afri NWA 13251	L-melt rock	Western Saha
71731	Northwest Afri NWA 13252	L6-melt brecci	Morocco
71642	Northwest Afri NWA 13253	H5	Morocco
71643	Northwest Afri NWA 13254	LL3	Morocco
71733	Northwest Afri NWA 13255	Diogenite	Morocco
71734	Northwest Afri NWA 13256	Lunar (feldsp.	Western Saha
71735	Northwest Afri NWA 13257	Martian (sherc	(Northwest Afr
71736	Northwest Afri NWA 13258	CV3	Morocco
71737	Northwest Afri NWA 13259	Lunar (feldsp.	(Northwest Afr
71662	Northwest Afri NWA 13260	H6	(Northwest Afr
72613	Northwest Afri NWA 13261	CK5	(Northwest Afr
71666	Northwest Afri NWA 13262	L3	(Northwest Afr
71739	Northwest Afri NWA 13263	Howardite	(Northwest Afr
71667	Northwest Afri NWA 13264	LL5	(Northwest Afr
71740	Northwest Afri NWA 13265	CV3	(Northwest Afr
72324	Northwest Afri NWA 13266	Enst achon	(Northwest Afr
71741	Northwest Afri NWA 13267	L6-melt brecci	(Northwest Afr
71668	Northwest Afri NWA 13268	H4/5	Algeria
71729	Northwest Afri NWA 13269	Eucrite-unbr	Mauritania
72325	Northwest Afri NWA 13270	LL3.5	Algeria
71742	Northwest Afri NWA 13271	LL3.15	(Northwest Afr
72310	Northwest Afri NWA 13272	Achondrite-un	(Northwest Afr
71669	Northwest Afri NWA 13273	L6	(Northwest Afr
72311	Northwest Afri NWA 13274	Achondrite-un	(Northwest Afr
71670	Northwest Afri NWA 13275	L6	(Northwest Afr
72312	Northwest Afri NWA 13276	Martian (sherc	(Northwest Afr
72313	Northwest Afri NWA 13277	L-melt rock	(Northwest Afr
72314	Northwest Afri NWA 13278	Aubrite	(Northwest Afr
72315	Northwest Afri NWA 13279	CV3	(Northwest Afr
72316	Northwest Afri NWA 13280	Eucrite-pmict	(Northwest Afr
71676	Northwest Afri NWA 13281	L5	Niger
71688	Northwest Afri NWA 13282	L3	Western Saha
72657	Northwest Afri NWA 13283	Lunar	(Northwest Afr
71689	Northwest Afri NWA 13284	H5	Morocco
71693	Northwest Afri NWA 13285	L5-6	Morocco
72306	Northwest Afri NWA 13286	Howardite	(Northwest Afr

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72307	Northwest Afri NWA 13287	Eucrite	(Northwest Afr
72308	Northwest Afri NWA 13288	Eucrite	(Northwest Afr
72309	Northwest Afri NWA 13289	Martian (sherc	(Northwest Afr
71749	Northwest Afri NWA 13290	H6	Algeria
71750	Northwest Afri NWA 13291	H5	(Northwest Afr
71751	Northwest Afri NWA 13292	H3	Algeria
71752	Northwest Afri NWA 13293	LL3	Algeria
72341	Northwest Afri NWA 13294	Eucrite	(Northwest Afr
72418	Northwest Afri NWA 13295	CV3	Algeria
72342	Northwest Afri NWA 13296	Eucrite-br	Algeria
72318	Northwest Afri NWA 13297	LL3	Algeria
72319	Northwest Afri NWA 13298	LL3	Morocco
72478	Northwest Afri NWA 13299	EH3	Algeria
72320	Northwest Afri NWA 13300	L5	Algeria
72348	Northwest Afri NWA 13302	Mesosiderite-/	Morocco
72338	Northwest Afri NWA 13303	Ureilite	(Northwest Afr
72339	Northwest Afri NWA 13304	Aubrite	(Northwest Afr
72347	Northwest Afri NWA 13305	H7	(Northwest Afr
72358	Northwest Afri NWA 13306	Lunar (feldsp.	(Northwest Afr
72359	Northwest Afri NWA 13307	Achondrite-un	(Northwest Afr
72360	Northwest Afri NWA 13308	Eucrite-unbr	(Northwest Afr
72361	Northwest Afri NWA 13309	LL3.15	(Northwest Afr
72362	Northwest Afri NWA 13310	Eucrite-br	(Northwest Afr
72363	Northwest Afri NWA 13311	CK3	(Northwest Afr
72364	Northwest Afri NWA 13312	Achondrite-un	(Northwest Afr
72365	Northwest Afri NWA 13313	L3-6	Mali
72366	Northwest Afri NWA 13314	Eucrite-br	(Northwest Afr
72420	Northwest Afri NWA 13317	L3-5	Algeria
72421	Northwest Afri NWA 13318	LL4-6	Morocco
72353	Northwest Afri NWA 13319	L5	Morocco
72354	Northwest Afri NWA 13320	H4	Morocco
72422	Northwest Afri NWA 13321	CV3	Morocco
72423	Northwest Afri NWA 13322	CV3	Morocco
72425	Northwest Afri NWA 13323	CK3	(Northwest Afr
72440	Northwest Afri NWA 13324	LL3.15	(Northwest Afr
72426	Northwest Afri NWA 13325	Eucrite-br	(Northwest Afr
72355	Northwest Afri NWA 13326	LL3	(Northwest Afr
72441	Northwest Afri NWA 13327	Martian (sherc	(Northwest Afr
72442	Northwest Afri NWA 13328	LL4-5 melt bre	(Northwest Afr
72427	Northwest Afri NWA 13329	CO3	(Northwest Afr
72428	Northwest Afri NWA 13330	Eucrite-br	(Northwest Afr
72429	Northwest Afri NWA 13331	H7	(Northwest Afr
72443	Northwest Afri NWA 13332	CK3	(Northwest Afr
72367	Northwest Afri NWA 13333	LL3	Morocco
72419	Northwest Afri NWA 13334	Ureilite	(Northwest Afr
72424	Northwest Afri NWA 13335	Eucrite	Morocco
72444	Northwest Afri NWA 13336	CR2	(Northwest Afr
72445	Northwest Afri NWA 13337	Mesosiderite	(Northwest Afr
72378	Northwest Afri NWA 13338	H6	(Northwest Afr
72379	Northwest Afri NWA 13339	LL3	(Northwest Afr
72380	Northwest Afri NWA 13340	H5	(Northwest Afr
72381	Northwest Afri NWA 13341	H5	(Northwest Afr
72382	Northwest Afri NWA 13342	LL6	(Northwest Afr
72432	Northwest Afri NWA 13343	Eucrite-mmict	(Northwest Afr
72433	Northwest Afri NWA 13344	Eucrite	(Northwest Afr

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72434	Northwest Afri NWA 13345	Howardite	(Northwest Afr
72452	Northwest Afri NWA 13346	Lunar (feldsp.	(Northwest Afr
72453	Northwest Afri NWA 13347	Diogenite	(Northwest Afr
72454	Northwest Afri NWA 13348	CH3	(Northwest Afr
72455	Northwest Afri NWA 13349	Eucrite-mmict	(Northwest Afr
72387	Northwest Afri NWA 13350	L4	(Northwest Afr
72456	Northwest Afri NWA 13351	Achondrite-un	(Northwest Afr
72457	Northwest Afri NWA 13352	Eucrite-mmict	Algeria
72458	Northwest Afri NWA 13353	CO3	Algeria
72459	Northwest Afri NWA 13354	Lodranite	(Northwest Afr
72470	Northwest Afri NWA 13355	Eucrite-an	(Northwest Afr
72447	Northwest Afri NWA 13356	LL4	(Northwest Afr
72471	Northwest Afri NWA 13357	CK3-6	Algeria
72448	Northwest Afri NWA 13358	L5	(Northwest Afr
72472	Northwest Afri NWA 13359	Eucrite-pmict	(Northwest Afr
72481	Northwest Afri NWA 13360	Martian (sherc	(Northwest Afr
72451	Northwest Afri NWA 13361	L6	Morocco
72465	Northwest Afri NWA 13362	Martian (sherc	(Northwest Afr
72463	Northwest Afri NWA 13363	Angrite	Algeria
72473	Northwest Afri NWA 13364	CV3	Morocco
72474	Northwest Afri NWA 13365	Diogenite	Morocco
72479	Northwest Afri NWA 13366	Martian (sherc	Algeria
72480	Northwest Afri NWA 13367	Martian (sherc	Algeria
72528	Northwest Afri NWA 13368	Martian (nakhl	Mauritania
72486	Northwest Afri NWA 13369	Martian (sherc	Algeria
72487	Northwest Afri NWA 13370	Howardite	Morocco
72488	Northwest Afri NWA 13371	CM2	Morocco
72477	Northwest Afri NWA 13372	H3-6	Morocco
72490	Northwest Afri NWA 13373	H5	Mauritania
72491	Northwest Afri NWA 13374	L6	Mauritania
72492	Northwest Afri NWA 13375	L6	Mauritania
72493	Northwest Afri NWA 13376	LL3	Morocco
72494	Northwest Afri NWA 13377	H5	(Northwest Afr
72495	Northwest Afri NWA 13378	H5	(Northwest Afr
72496	Northwest Afri NWA 13379	LL5	(Northwest Afr
72533	Northwest Afri NWA 13380	H7	(Northwest Afr
72535	Northwest Afri NWA 13381	CK3	(Northwest Afr
72497	Northwest Afri NWA 13382	L3	(Northwest Afr
72615	Northwest Afri NWA 13383	Ureilite	(Northwest Afr
72498	Northwest Afri NWA 13384	L5	(Northwest Afr
72538	Northwest Afri NWA 13385	CVred3	Morocco
72499	Northwest Afri NWA 13386	L5	Morocco
72500	Northwest Afri NWA 13387	L5	Morocco
72501	Northwest Afri NWA 13388	L5	Morocco
72502	Northwest Afri NWA 13389	L5	Morocco
72616	Northwest Afri NWA 13390	Lunar (frag. br	Mauritania
72503	Northwest Afri NWA 13391	LL5	(Northwest Afr
72504	Northwest Afri NWA 13392	LL5-6	(Northwest Afr
72505	Northwest Afri NWA 13393	L6	(Northwest Afr
72539	Northwest Afri NWA 13394	LL6-melt brecc	(Northwest Afr
72540	Northwest Afri NWA 13395	Eucrite-mmict	(Northwest Afr
72518	Northwest Afri NWA 13396	H5	Morocco
72519	Northwest Afri NWA 13397	LL3	Morocco
72520	Northwest Afri NWA 13398	H5	Mauritania
72521	Northwest Afri NWA 13399	H5	Mauritania



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72532	Northwest Afri NWA 13400	C3-ung	(Northwest Afri
72464	Northwest Afri NWA 13401	Martian (sherc	(Northwest Afri
72522	Northwest Afri NWA 13402	H5	Mauritania
72523	Northwest Afri NWA 13403	L6	Mauritania
72524	Northwest Afri NWA 13404	L6	Morocco
72525	Northwest Afri NWA 13405	H6	Mauritania
72526	Northwest Afri NWA 13406	H6	Morocco
72527	Northwest Afri NWA 13407	L5	Mauritania
72542	Northwest Afri NWA 13408	Lunar (feldsp.	Algeria
72541	Northwest Afri NWA 13410	L6	Algeria
73474	Northwest Afri NWA 13411	OC5-an	Morocco
72580	Northwest Afri NWA 13412	CV3	(Northwest Afri
72581	Northwest Afri NWA 13413	Howardite	(Northwest Afri
72582	Northwest Afri NWA 13414	L6-melt brecci	(Northwest Afri
72583	Northwest Afri NWA 13415	Eucrite	(Northwest Afri
72556	Northwest Afri NWA 13416	L5	(Northwest Afri
72661	Northwest Afri NWA 13417	H3-6	(Northwest Afri
72557	Northwest Afri NWA 13418	L5	(Northwest Afri
72662	Northwest Afri NWA 13419	Acapulcoite	(Northwest Afri
72558	Northwest Afri NWA 13420	L6	(Northwest Afri
72559	Northwest Afri NWA 13421	H4	(Northwest Afri
72560	Northwest Afri NWA 13422	L5	(Northwest Afri
72561	Northwest Afri NWA 13423	H4	(Northwest Afri
72562	Northwest Afri NWA 13424	L4	(Northwest Afri
72563	Northwest Afri NWA 13425	H4	(Northwest Afri
72584	Northwest Afri NWA 13426	Lunar	(Northwest Afri
72609	Northwest Afri NWA 13428	Diogenite-pm	(Northwest Afri
72610	Northwest Afri NWA 13429	L7	(Northwest Afri
72611	Northwest Afri NWA 13430	Howardite	(Northwest Afri
72585	Northwest Afri NWA 13431	H4	(Northwest Afri
72648	Northwest Afri NWA 13432	Winonaite	(Northwest Afri
72649	Northwest Afri NWA 13433	Eucrite-unbr	Mauritania
72723	Northwest Afri NWA 13434	Eucrite-melt b	(Northwest Afri
72724	Northwest Afri NWA 13435	Diogenite	(Northwest Afri
72725	Northwest Afri NWA 13436	Eucrite-pmict	(Northwest Afri
72726	Northwest Afri NWA 13437	CV3	(Northwest Afri
72727	Northwest Afri NWA 13438	CO3	(Northwest Afri
72718	Northwest Afri NWA 13439	Eucrite	Morocco
72720	Northwest Afri NWA 13440	Martian (sherc	Algeria
72719	Northwest Afri NWA 13441	Martian (sherc	Algeria
72618	Northwest Afri NWA 13442	CO3.0	(Northwest Afri
72619	Northwest Afri NWA 13443	CO3.1	(Northwest Afri
72620	Northwest Afri NWA 13445	L4	(Northwest Afri
72663	Northwest Afri NWA 13446	Achondrite-un	Algeria
72621	Northwest Afri NWA 13447	H3	(Northwest Afri
72622	Northwest Afri NWA 13448	LL3	(Northwest Afri
72664	Northwest Afri NWA 13449	CK5	(Northwest Afri
72665	Northwest Afri NWA 13450	Lunar (feldsp.	Algeria
72666	Northwest Afri NWA 13451	CV3	(Northwest Afri
72667	Northwest Afri NWA 13452	R4-6	(Northwest Afri
72668	Northwest Afri NWA 13453	CK5	(Northwest Afri
72669	Northwest Afri NWA 13454	R3	(Northwest Afri
73528	Northwest Afri NWA 13455	CO3-an	(Northwest Afri
73570	Northwest Afri NWA 13456	C2	(Northwest Afri
73484	Northwest Afri NWA 13457	Eucrite	(Northwest Afri



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72623	Northwest Afri NWA 13458	H5	Morocco
72716	Northwest Afri NWA 13459	Martian (sherg	Morocco
72717	Northwest Afri NWA 13460	Martian (sherg	Morocco
72687	Northwest Afri NWA 13461	LL5-6	(Northwest Afr
72758	Northwest Afri NWA 13462	Eucrite-melt b	(Northwest Afr
72759	Northwest Afri NWA 13463	Ureilite	(Northwest Afr
72760	Northwest Afri NWA 13464	CO3	(Northwest Afr
72688	Northwest Afri NWA 13465	H5	(Northwest Afr
72761	Northwest Afri NWA 13466	CK6	(Northwest Afr
72762	Northwest Afri NWA 13467	Martian (sherg	(Northwest Afr
72763	Northwest Afri NWA 13468	R3-6	(Northwest Afr
72764	Northwest Afri NWA 13469	Eucrite-melt b	(Northwest Afr
72765	Northwest Afri NWA 13470	Eucrite	(Northwest Afr
72766	Northwest Afri NWA 13471	Eucrite-melt b	(Northwest Afr
72715	Northwest Afri NWA 13472	LL4-6	Mauritania
72713	Northwest Afri NWA 13473	H4	(Northwest Afr
72770	Northwest Afri NWA 13474	Martian (sherg	Morocco
72771	Northwest Afri NWA 13475	L5-melt brecci	(Northwest Afr
73540	Northwest Afri NWA 13476	Ureilite	(Northwest Afr
72772	Northwest Afri NWA 13477	CO3	(Northwest Afr
72773	Northwest Afri NWA 13478	Lunar (feldsp.	(Northwest Afr
72774	Northwest Afri NWA 13479	C2-ung	(Northwest Afr
72775	Northwest Afri NWA 13480	Eucrite-mmict	(Northwest Afr
72712	Northwest Afri NWA 13481	H4	(Northwest Afr
72826	Northwest Afri NWA 13482	CK5-6	Algeria
72827	Northwest Afri NWA 13483	CK5	Algeria
72828	Northwest Afri NWA 13484	Lunar (feldsp.	(Northwest Afr
72829	Northwest Afri NWA 13485	Eucrite-unbr	Algeria
72830	Northwest Afri NWA 13486	Martian (sherg	Algeria
72831	Northwest Afri NWA 13487	Mesosiderite	(Northwest Afr
72833	Northwest Afri NWA 13488	CK6	Morocco
72834	Northwest Afri NWA 13489	Brachinite	(Northwest Afr
72835	Northwest Afri NWA 13490	CO3	(Northwest Afr
72836	Northwest Afri NWA 13491	CO3	(Northwest Afr
72837	Northwest Afri NWA 13492	Eucrite	(Northwest Afr
72838	Northwest Afri NWA 13493	Eucrite	(Northwest Afr
72839	Northwest Afri NWA 13494	Eucrite	(Northwest Afr
72841	Northwest Afri NWA 13495	CO3	(Northwest Afr
72842	Northwest Afri NWA 13496	Mesosiderite	(Northwest Afr
72843	Northwest Afri NWA 13497	Eucrite	(Northwest Afr
72704	Northwest Afri NWA 13498	L3	(Northwest Afr
72844	Northwest Afri NWA 13499	Eucrite	Algeria
72692	Northwest Afri NWA 13500	L(LL)3	(Northwest Afr
72853	Northwest Afri NWA 13501	H3.10	(Northwest Afr
72699	Northwest Afri NWA 13502	H6	(Northwest Afr
72854	Northwest Afri NWA 13503	CK3	(Northwest Afr
72855	Northwest Afri NWA 13504	L3.10	(Northwest Afr
72856	Northwest Afri NWA 13505	CK5	(Northwest Afr
72701	Northwest Afri NWA 13509	LL4-6	(Northwest Afr
72702	Northwest Afri NWA 13514	L5	Morocco
72777	Northwest Afri NWA 13515	H5	Morocco
72865	Northwest Afri NWA 13516	Eucrite-unbr	(Northwest Afr
72864	Northwest Afri NWA 13517	Martian (sherg	(Northwest Afr
72801	Northwest Afri NWA 13518	R4-5	(Northwest Afr
72779	Northwest Afri NWA 13519	L3-5	(Northwest Afr

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73554	Northwest Afri NWA 13520	L(H)3	(Northwest Afr
72780	Northwest Afri NWA 13521	L5	(Northwest Afr
73555	Northwest Afri NWA 13522	CV3	Morocco
72867	Northwest Afri NWA 13523	Eucrite-br	Algeria
72781	Northwest Afri NWA 13524	LL6	(Northwest Afr
72782	Northwest Afri NWA 13525	LL6	(Northwest Afr
72868	Northwest Afri NWA 13526	R5	Morocco
72783	Northwest Afri NWA 13527	LL3	Algeria
72869	Northwest Afri NWA 13528	CK5	(Northwest Afr
72798	Northwest Afri NWA 13529	H4	Morocco
73575	Northwest Afri NWA 13530	CV3	Morocco
72871	Northwest Afri NWA 13531	Lunar (feldsp.	(Northwest Afr
72872	Northwest Afri NWA 13532	Mesosiderite-f	(Northwest Afr
72799	Northwest Afri NWA 13533	L6	(Northwest Afr
72802	Northwest Afri NWA 13534	L4	(Northwest Afr
72857	Northwest Afri NWA 13535	L4	(Northwest Afr
72803	Northwest Afri NWA 13536	H4	(Northwest Afr
72804	Northwest Afri NWA 13537	L4	(Northwest Afr
72805	Northwest Afri NWA 13538	H5	(Northwest Afr
72806	Northwest Afri NWA 13539	H6	(Northwest Afr
72807	Northwest Afri NWA 13540	LL5	(Northwest Afr
72808	Northwest Afri NWA 13541	H5	(Northwest Afr
73556	Northwest Afri NWA 13542	CV3	(Northwest Afr
73557	Northwest Afri NWA 13543	CV3	(Northwest Afr
73541	Northwest Afri NWA 13544	CK5	(Northwest Afr
73542	Northwest Afri NWA 13545	Eucrite	(Northwest Afr
73543	Northwest Afri NWA 13546	Lunar (feldsp.	(Northwest Afr
73544	Northwest Afri NWA 13547	CM2	(Northwest Afr
73545	Northwest Afri NWA 13548	Eucrite-melt b	(Northwest Afr
73546	Northwest Afri NWA 13549	Eucrite	(Northwest Afr
73473	Northwest Afri NWA 13550	Pallasite	(Northwest Afr
72809	Northwest Afri NWA 13551	H6	(Northwest Afr
72810	Northwest Afri NWA 13552	H5	(Northwest Afr
72811	Northwest Afri NWA 13553	L5	(Northwest Afr
72812	Northwest Afri NWA 13554	H5	(Northwest Afr
72813	Northwest Afri NWA 13555	LL6	(Northwest Afr
72814	Northwest Afri NWA 13556	LL6	(Northwest Afr
73485	Northwest Afri NWA 13557	CK6	(Northwest Afr
72815	Northwest Afri NWA 13558	H6	(Northwest Afr
73486	Northwest Afri NWA 13559	CO3	(Northwest Afr
72816	Northwest Afri NWA 13560	H5	(Northwest Afr
73487	Northwest Afri NWA 13561	Martian (polyn	(Northwest Afr
73488	Northwest Afri NWA 13562	Lodranite	(Northwest Afr
72817	Northwest Afri NWA 13563	L6	(Northwest Afr
73489	Northwest Afri NWA 13564	Pallasite	(Northwest Afr
73530	Northwest Afri NWA 13565	Mesosiderite	Mauritania
73558	Northwest Afri NWA 13566	LL4	Morocco
73547	Northwest Afri NWA 13567	LL3.1	Morocco
73532	Northwest Afri NWA 13568	Lunar	Algeria
73572	Northwest Afri NWA 13569	CV3	Morocco
73548	Northwest Afri NWA 13570	Eucrite-br	Morocco
73533	Northwest Afri NWA 13571	Eucrite-melt b	Morocco
73534	Northwest Afri NWA 13572	Howardite	Western Saha
73535	Northwest Afri NWA 13573	CVox3	Morocco
73559	Northwest Afri NWA 13574	Howardite	Morocco

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73560	Northwest Afri NWA 13575	CVox3	Morocco
73490	Northwest Afri NWA 13576	H4	Morocco
72686	Northwest Afri NWA 13579	Pallasite	Niger
73571	Northwest Afri NWA 13580	Diogenite	Algeria
72861	Northwest Afri NWA 13581	Martian (sherg	Algeria
72862	Northwest Afri NWA 13582	Lunar (feldsp.	(Northwest Afr
72863	Northwest Afri NWA 13583	Eucrite	Tunisia
72878	Northwest Afri NWA 13618	L~4	Morocco
72879	Northwest Afri NWA 13619	L~5	Morocco
72880	Northwest Afri NWA 13620	L~5	Morocco
73529	Northwest Afri NWA 13621	Lunar (feldsp.	Mali
73549	Northwest Afri NWA 13623	Mesosiderite	(Northwest Afr
73550	Northwest Afri NWA 13624	Winonaite	(Northwest Afr
73551	Northwest Afri NWA 13625	Lunar (feldsp.	(Northwest Afr
73505	Northwest Afri NWA 13626	H5	(Northwest Afr
73506	Northwest Afri NWA 13627	H3	(Northwest Afr
73552	Northwest Afri NWA 13628	Eucrite	(Northwest Afr
73507	Northwest Afri NWA 13629	H5	(Northwest Afr
73561	Northwest Afri NWA 13630	Diogenite	(Northwest Afr
73562	Northwest Afri NWA 13631	CR2	(Northwest Afr
73553	Northwest Afri NWA 13632	EH6	Morocco
73536	Northwest Afri NWA 13633	LL3	Algeria
73567	Northwest Afri NWA 13634	Howardite	Morocco
73537	Northwest Afri NWA 13635	H6	Algeria
73568	Northwest Afri NWA 13636	Eucrite-unbr	Algeria
72482	Nova 062	L5	United States
72483	Nova 063	H5	United States
72484	Nova 064	H5	United States
72546	Nova 065	L4	(Unknown)
72430	Novo Mesto	L5	Slovenia
72322	Noyon	LL(L)3	Mongolia
72356	Oiuru 001	Iron, IVB	Libya
71097	Orlov Dol	Iron, IID	Bulgaria
72530	Oslo	H3-6	Norway
72537	Oyo	LL4	Nigeria
72460	Pakepake 001	L6	China
71598	Paposo 060	H4/5	Chile
71599	Paposo 061	H5	Chile
71600	Paposo 062	L5	Chile
71690	Paposo 063	L5	Chile
72825	Paposo 064	Ureilite	Chile
72695	Paposo 065	L6	Chile
72696	Paposo 066	H5	Chile
72697	Paposo 067	H5	Chile
71724	Pizhanka	Iron, IAB-MG	Russia
72328	Poltavskoe	L6	Russia
72647	Qiakuertu	H5	China
71112	Rafsa 001	Martian (sherg	Algeria
72389	Ravar 005	H5	Iran
72709	Ravar 006	H4	Iran
73508	Reid 029	L5	Australia
71021	Sahara 98129	H3-5	(Sahara)
71013	Sahara 98341	H4	(Sahara)
70949	Sahara 98377	LL5	(Sahara)
70950	Sahara 98378	L5/6	(Sahara)

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70951	Sahara 98379	L6	(Sahara)
70952	Sahara 98381	H5/6	(Sahara)
70953	Sahara 98382	H5/6	(Sahara)
71014	Sahara 98383	H3-5	(Sahara)
70954	Sahara 98384	LL5/6	(Sahara)
70955	Sahara 98385	LL5/6	(Sahara)
70956	Sahara 98386	H5	(Sahara)
70957	Sahara 98387	LL5/6	(Sahara)
70958	Sahara 98388	LL5/6	(Sahara)
70959	Sahara 98389	LL5/6	(Sahara)
70960	Sahara 98390	H5	(Sahara)
70961	Sahara 98391	H5/6	(Sahara)
70962	Sahara 98392	L6	(Sahara)
70963	Sahara 98393	L6	(Sahara)
70964	Sahara 98394	L6	(Sahara)
70965	Sahara 98395	L5/6	(Sahara)
70966	Sahara 98396	L5/6	(Sahara)
70967	Sahara 98397	H4-6	(Sahara)
70968	Sahara 98398	H4-5	(Sahara)
70969	Sahara 98400	H4-5	(Sahara)
71068	Sahara 98401	L5/6	(Sahara)
71015	Sahara 98403	H3-6	(Sahara)
71016	Sahara 98405	H3-6	(Sahara)
70970	Sahara 98406	L5/6	(Sahara)
70971	Sahara 98407	L5/6	(Sahara)
70972	Sahara 98408	H5/6	(Sahara)
70973	Sahara 98409	L5	(Sahara)
70974	Sahara 98410	H5	(Sahara)
70975	Sahara 98411	H5	(Sahara)
70976	Sahara 98412	L5	(Sahara)
70977	Sahara 98413	H4	(Sahara)
71017	Sahara 98414	H3-6	(Sahara)
70978	Sahara 98415	H6	(Sahara)
70979	Sahara 98416	L6	(Sahara)
70980	Sahara 98417	H4	(Sahara)
71018	Sahara 98418	H3	(Sahara)
70981	Sahara 98419	H5	(Sahara)
70982	Sahara 98420	L5-6	(Sahara)
70983	Sahara 98421	L5/6	(Sahara)
70984	Sahara 98422	L6	(Sahara)
70985	Sahara 98423	L6	(Sahara)
70986	Sahara 98424	H4-5	(Sahara)
70987	Sahara 98425	H5/6	(Sahara)
70988	Sahara 98426	H4-6	(Sahara)
70989	Sahara 98427	L6	(Sahara)
70990	Sahara 98428	L6	(Sahara)
70991	Sahara 98431	L6	(Sahara)
71019	Sahara 98432	L3	(Sahara)
70992	Sahara 98434	H4-5	(Sahara)
70993	Sahara 98435	L5	(Sahara)
70994	Sahara 98436	L5	(Sahara)
70995	Sahara 98437	H5	(Sahara)
70996	Sahara 98438	L6	(Sahara)
70997	Sahara 98439	L6	(Sahara)
70998	Sahara 98440	H4-5	(Sahara)

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70999	Sahara 98441	L5	(Sahara)
71000	Sahara 98442	L5-6	(Sahara)
71001	Sahara 98443	L5/6	(Sahara)
71002	Sahara 98444	H6	(Sahara)
71020	Sahara 98445	H3	(Sahara)
71003	Sahara 98449	H5	(Sahara)
71004	Sahara 98450	H4	(Sahara)
71005	Sahara 98451	L5-6	(Sahara)
71006	Sahara 98452	L5	(Sahara)
71007	Sahara 98453	H4	(Sahara)
71008	Sahara 98454	H5	(Sahara)
71009	Sahara 98455	L4/5	(Sahara)
71010	Sahara 98456	L6	(Sahara)
71011	Sahara 98457	H5	(Sahara)
71012	Sahara 98458	L5	(Sahara)
71138	Saint-Ouen-er	H5	France
71705	San Salvador	H5	Uruguay
72652	Santa Filomer	H5-6	Brazil
72394	Sayh al Uhayr SaU 608	L5	Oman
71623	Shalim 025	Eucrite-mmict	Oman
70861	Shinejinst	H4	Mongolia
71654	Shiṣr 200	L5	Oman
72416	Shiṣr 201	L6	Oman
73491	Shiṣr 202	L5	Oman
70904	Sierra Gorda (	H4	Chile
71160	Sierra Gorda (	H5-melt brecc	Chile
71660	Sierra Gorda (	H/L5	Chile
71065	Sierra Gorda (	L5	Chile
71591	Sierra Gorda (	L5	Chile
71608	Sierra Gorda (	L6	Chile
71610	Sierra Gorda (	L5	Chile
71616	Sierra Gorda (	H5	Chile
71617	Sierra Gorda (	H6	Chile
71696	Sierra Gorda (	L6	Chile
71744	Sierra Gorda (	H6	Chile
72369	Sierra Gorda (	H5	Chile
72588	Sierra Gorda (	L3	Chile
72596	Sierra Gorda (	L5	Chile
72597	Sierra Gorda (	L6	Chile
72626	Sierra Gorda (	L5	Chile
72634	Sierra Gorda (	L6	Chile
73514	Sierra Gorda (	L5-melt brecci	Chile
72769	Sierra Gorda (	H5	Chile
72703	Sierra Gorda (	L4	Chile
72788	Sierra Gorda (	L5	Chile
72790	Sierra Gorda (	L5	Chile
73492	Sierra Gorda (	H5	Chile
72468	Tanezrouft 09 Tnz 090	L6	Algeria
73531	Tanezrouft 09 Tnz 091	Mesosiderite	Algeria
72644	Tarda	C2-ung	Morocco
70057	Tassédet 005	L6	Niger
73539	Tata 001	Lunar	Morocco
72461	Tazhong 001	H5/6	China
72714	Tazzarine 002	H5	Morocco
73569	Tibertatine 00	CO3	Algeria



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72707	Tichiya 002			H5	Western Saha
73515	Tiros			Eucrite-cm	Brazil
72357	Tisserlitine 00			Lunar (feldsp.	Mali
71653	Toconao 001			LL3	Chile
72371	Toconao 002			L6	Chile
72507	Toconao 003			H5	Chile
72639	Toconao 004			H5	Chile
72797	Toconao 005			L5	Chile
72721	Touat 004			Lunar (feldsp.	Algeria
72866	Touat 005			Lunar (feldsp.	Algeria
73574	Touat 006			Eucrite-melt b	Algeria
71799	Tungsten Mou TM 054			H5	United States
71800	Tungsten Mou TM 055			H5	United States
71801	Tungsten Mou TM 056			H5	United States
71802	Tungsten Mou TM 057			H5	United States
71803	Tungsten Mou TM 058			H5	United States
71804	Tungsten Mou TM 059			H5	United States
71805	Tungsten Mou TM 060			H5	United States
71818	Tungsten Mou TM 073			H5	United States
71829	Tungsten Mou TM 084			H5	United States
71838	Tungsten Mou TM 116			H5	United States
71843	Tungsten Mou TM 121			H5	United States
71748	Tyro			L6	United States
72417	United Arab E UAE 030			L6	United Arab E
72617	Utting			H4	United States
72531	Valle			H5	Norway
72651	Villanueva			H6	United States
72327	Wad Lahteyba			H5	Western Saha
72776	Wellman (f)			H3-4	United States
70056	Wubao 002			LL3	China
36997	Yamato 98037 Y-980372	J27	J	H5	Antarctica
36999	Yamato 98037 Y-980374	J27	J	L6	Antarctica
37000	Yamato 98037 Y-980375	J27	J	L6	Antarctica
37002	Yamato 98037 Y-980377	J27	J	L6	Antarctica
37008	Yamato 98038 Y-980383	J27	J	H5	Antarctica
37009	Yamato 98038 Y-980384	J27	J	H5	Antarctica
37015	Yamato 98039 Y-980390	J27	J	L3	Antarctica
37017	Yamato 98039 Y-980392	J27	J	H5	Antarctica
37018	Yamato 98039 Y-980393	J27	J	H6	Antarctica
37036	Yamato 98041 Y-980411	J27	J	LL6	Antarctica
37044	Yamato 98041 Y-980419	J27	J	H6	Antarctica
37053	Yamato 98042 Y-980428	J27	J	H5	Antarctica
37058	Yamato 98043 Y-980434	J27	J	LL6	Antarctica
37061	Yamato 98043 Y-980437	J27	J	H6	Antarctica
37065	Yamato 98044 Y-980441	J27	J	LL6	Antarctica
37066	Yamato 98044 Y-980442	J27	J	H5	Antarctica
37067	Yamato 98044 Y-980443	J27	J	H6	Antarctica
37071	Yamato 98044 Y-980447	J27	J	L6	Antarctica
37082	Yamato 98045 Y-980458	J27	J	H5	Antarctica
37090	Yamato 98046 Y-980467	J27	J	L6	Antarctica
37099	Yamato 98047 Y-980476	J27	J	L3	Antarctica
37105	Yamato 98048 Y-980482	J27	J	LL6	Antarctica
37106	Yamato 98048 Y-980483	J27	J	LL6	Antarctica
37109	Yamato 98048 Y-980486	J27	J	L3	Antarctica
37110	Yamato 98048 Y-980487	J27	J	H4	Antarctica

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37112	Yamato 98048	Y-980489	J27	J	H6	Antarctica
37114	Yamato 98049	Y-980491	J27	J	H6	Antarctica
37115	Yamato 98049	Y-980492	J27	J	LL3	Antarctica
37126	Yamato 98050	Y-980503	J27	J	L4	Antarctica
37127	Yamato 98050	Y-980504	J27	J	H5	Antarctica
37137	Yamato 98051	Y-980514	J27	J	LL6	Antarctica
37139	Yamato 98051	Y-980516	J27	J	H6	Antarctica
37142	Yamato 98051	Y-980519	J27	J	H5	Antarctica
37144	Yamato 98052	Y-980521	J27	J	L6	Antarctica
37145	Yamato 98052	Y-980522	J27	J	L5	Antarctica
37148	Yamato 98052	Y-980525	J27	J	H6	Antarctica
37157	Yamato 98053	Y-980534	J27	J	H5	Antarctica
37158	Yamato 98053	Y-980535	J27	J	CM2	Antarctica
37161	Yamato 98053	Y-980538	J27	J	LL6	Antarctica
37162	Yamato 98053	Y-980539	J27	J	LL6	Antarctica
37170	Yamato 98054	Y-980547	J27	J	L6	Antarctica
37172	Yamato 98054	Y-980549	J27	J	H6	Antarctica
37174	Yamato 98055	Y-980551	J27	J	H6	Antarctica
37175	Yamato 98055	Y-980552	J27	J	L6	Antarctica
37176	Yamato 98055	Y-980553	J27	J	H5	Antarctica
37177	Yamato 98055	Y-980554	J27	J	L6	Antarctica
37179	Yamato 98055	Y-980556	J27	J	H6	Antarctica
37180	Yamato 98055	Y-980557	J27	J	H5	Antarctica
37181	Yamato 98055	Y-980558	J27	J	L5	Antarctica
37189	Yamato 98056	Y-980566	J27	J	L6	Antarctica
37192	Yamato 98056	Y-980569	J27	J	H6	Antarctica
37193	Yamato 98057	Y-980570	J27	J	L5	Antarctica
37197	Yamato 98057	Y-980574	J27	J	H5	Antarctica
37201	Yamato 98057	Y-980578	J27	J	H5	Antarctica
37213	Yamato 98059	Y-980590	J27	J	CR2	Antarctica
37217	Yamato 98059	Y-980594	J27	J	L4	Antarctica
37221	Yamato 98059	Y-980598	J27	J	H6	Antarctica
37222	Yamato 98059	Y-980599	J27	J	CO3	Antarctica
37223	Yamato 98060	Y-980600	J27	J	CO3	Antarctica
37224	Yamato 98060	Y-980601	J27	J	H5	Antarctica
37226	Yamato 98060	Y-980603	J27	J	H4	Antarctica
37231	Yamato 98060	Y-980608	J27	J	H4	Antarctica
37232	Yamato 98060	Y-980609	J27	J	H4	Antarctica
37233	Yamato 98061	Y-980610	J27	J	H4	Antarctica
37234	Yamato 98061	Y-980611	J27	J	L6	Antarctica
37236	Yamato 98061	Y-980613	J27	J	H5	Antarctica
37237	Yamato 98061	Y-980614	J27	J	H5	Antarctica
37238	Yamato 98061	Y-980615	J27	J	H6	Antarctica
37240	Yamato 98061	Y-980617	J27	J	H6	Antarctica
37243	Yamato 98062	Y-980620	J27	J	H5	Antarctica
37244	Yamato 98062	Y-980621	J27	J	H5	Antarctica
37245	Yamato 98062	Y-980622	J27	J	H4	Antarctica
37247	Yamato 98062	Y-980624	J27	J	H4	Antarctica
37249	Yamato 98062	Y-980626	J27	J	H4	Antarctica
37251	Yamato 98062	Y-980628	J27	J	H5	Antarctica
37252	Yamato 98062	Y-980629	J27	J	H5	Antarctica
37255	Yamato 98063	Y-980632	J27	J	L6	Antarctica
37256	Yamato 98063	Y-980633	J27	J	L6	Antarctica
37257	Yamato 98063	Y-980634	J27	J	L6	Antarctica
37260	Yamato 98063	Y-980637	J27	J	H6	Antarctica

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37261	Yamato 98063Y-980638	J27	J	H5	Antarctica
37264	Yamato 98064Y-980641	J27	J	H6	Antarctica
37266	Yamato 98064Y-980643	J27	J	H6	Antarctica
37267	Yamato 98064Y-980644	J27	J	L6	Antarctica
37268	Yamato 98064Y-980645	J27	J	L6	Antarctica
37273	Yamato 98065Y-980650	J27	J	H6	Antarctica
37274	Yamato 98065Y-980651	J27	J	H5	Antarctica
37275	Yamato 98065Y-980652	J27	J	H5	Antarctica
37276	Yamato 98065Y-980653	J27	J	H6	Antarctica
37282	Yamato 98065Y-980659	J27	J	H4	Antarctica
37284	Yamato 98066Y-980661	J27	J	H5	Antarctica
37289	Yamato 98066Y-980666	J27	J	L6	Antarctica
37290	Yamato 98066Y-980667	J27	J	L4	Antarctica
37293	Yamato 98067Y-980670	J27	J	L5	Antarctica
37294	Yamato 98067Y-980671	J27	J	H5	Antarctica
37299	Yamato 98067Y-980676	J27	J	H5	Antarctica
37300	Yamato 98067Y-980677	J27	J	H5	Antarctica
37301	Yamato 98067Y-980678	J27	J	L6	Antarctica
37302	Yamato 98067Y-980679	J27	J	H5	Antarctica
37309	Yamato 98068Y-980686	J27	J	L6	Antarctica
37314	Yamato 98069Y-980691	J27	J	H6	Antarctica
37315	Yamato 98069Y-980692	J27	J	H6	Antarctica
37319	Yamato 98069Y-980696	J27	J	H6	Antarctica
37322	Yamato 98069Y-980699	J27	J	L6	Antarctica
37333	Yamato 98071Y-980710	J27	J	H6	Antarctica
37337	Yamato 98071Y-980714	J27	J	H5	Antarctica
37338	Yamato 98071Y-980715	J27	J	H5	Antarctica
37340	Yamato 98071Y-980717	J27	J	H5	Antarctica
37341	Yamato 98071Y-980718	J27	J	L4	Antarctica
37342	Yamato 98071Y-980719	J27	J	L6	Antarctica
37343	Yamato 98072Y-980720	J27	J	H5	Antarctica
37344	Yamato 98072Y-980721	J27	J	H5	Antarctica
37345	Yamato 98072Y-980722	J27	J	H5	Antarctica
37347	Yamato 98072Y-980724	J27	J	H5	Antarctica
37355	Yamato 98073Y-980732	J27	J	H5	Antarctica
37356	Yamato 98073Y-980733	J27	J	L5	Antarctica
37357	Yamato 98073Y-980734	J27	J	H4	Antarctica
37358	Yamato 98073Y-980735	J27	J	H6	Antarctica
37366	Yamato 98074Y-980743	J27	J	L6	Antarctica
37369	Yamato 98074Y-980746	J27	J	H5	Antarctica
37371	Yamato 98074Y-980748	J27	J	H5	Antarctica
37373	Yamato 98075Y-980750	J27	J	H6	Antarctica
37374	Yamato 98075Y-980751	J27	J	H5	Antarctica
37380	Yamato 98075Y-980757	J27	J	H5	Antarctica
37383	Yamato 98076Y-980760	J27	J	CO3	Antarctica
37392	Yamato 98076Y-980769	J27	J	L6	Antarctica
37395	Yamato 98077Y-980772	J27	J	L5	Antarctica
37396	Yamato 98077Y-980773	J27	J	L5	Antarctica
37397	Yamato 98077Y-980774	J27	J	H5	Antarctica
37398	Yamato 98077Y-980775	J27	J	LL6	Antarctica
37400	Yamato 98077Y-980777	J27	J	H4	Antarctica
37401	Yamato 98077Y-980778	J27	J	L6	Antarctica
37403	Yamato 98078Y-980780	J27	J	H5	Antarctica
37404	Yamato 98078Y-980781	J27	J	H5	Antarctica
37406	Yamato 98078Y-980783	J27	J	L6	Antarctica

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37416	Yamato 98079Y-980793	J27	J	H5	Antarctica
37421	Yamato 98079Y-980798	J27	J	H5	Antarctica
37424	Yamato 98080Y-980801	J27	J	H5	Antarctica
37426	Yamato 98080Y-980803	J27	J	H6	Antarctica
37435	Yamato 98081Y-980812	J27	J	H6	Antarctica
37436	Yamato 98081Y-980813	J27	J	H5	Antarctica
37441	Yamato 98081Y-980818	J27	J	L6	Antarctica
37442	Yamato 98081Y-980819	J27	J	L6	Antarctica
37443	Yamato 98082Y-980820	J27	J	L6	Antarctica
37445	Yamato 98082Y-980822	J27	J	L6	Antarctica
37448	Yamato 98082Y-980825	J27	J	L6	Antarctica
37450	Yamato 98082Y-980827	J27	J	H5	Antarctica
37451	Yamato 98082Y-980828	J27	J	H4	Antarctica
37453	Yamato 98083Y-980830	J27	J	H5	Antarctica
37454	Yamato 98083Y-980831	J27	J	H5	Antarctica
37455	Yamato 98083Y-980832	J27	J	H5	Antarctica
37458	Yamato 98083Y-980835	J27	J	LL5	Antarctica
37461	Yamato 98083Y-980838	J27	J	L6	Antarctica
37465	Yamato 98084Y-980842	J27	J	L6	Antarctica
37466	Yamato 98084Y-980843	J27	J	L6	Antarctica
37469	Yamato 98084Y-980846	J27	J	H6	Antarctica
37471	Yamato 98084Y-980848	J27	J	L5	Antarctica
37472	Yamato 98084Y-980849	J27	J	L6	Antarctica
37481	Yamato 98085Y-980858	J27	J	H5	Antarctica
37487	Yamato 98086Y-980864	J27	J	H3	Antarctica
37488	Yamato 98086Y-980865	J27	J	H5	Antarctica
37492	Yamato 98086Y-980869	J27	J	H5	Antarctica
37493	Yamato 98087Y-980870	J27	J	H5	Antarctica
37497	Yamato 98087Y-980874	J27	J	L6	Antarctica
37503	Yamato 98088Y-980880	J27	J	L6	Antarctica
37511	Yamato 98088Y-980888	J27	J	L4	Antarctica
37513	Yamato 98089Y-980890	J27	J	H4	Antarctica
37515	Yamato 98089Y-980892	J27	J	H5	Antarctica
37517	Yamato 98089Y-980894	J27	J	H5	Antarctica
37518	Yamato 98089Y-980895	J27	J	H5	Antarctica
37519	Yamato 98089Y-980896	J27	J	H5	Antarctica
37520	Yamato 98089Y-980897	J27	J	H5	Antarctica
37529	Yamato 98090Y-980906	J27	J	H5	Antarctica
37532	Yamato 98090Y-980909	J27	J	L6	Antarctica
37533	Yamato 98091Y-980910	J27	J	H5	Antarctica
37534	Yamato 98091Y-980911	J27	J	L6	Antarctica
37535	Yamato 98091Y-980912	J27	J	L3	Antarctica
37536	Yamato 98091Y-980913	J27	J	H5	Antarctica
37537	Yamato 98091Y-980914	J27	J	H6	Antarctica
37538	Yamato 98091Y-980915	J27	J	H6	Antarctica
37542	Yamato 98091Y-980919	J27	J	H5	Antarctica
37546	Yamato 98092Y-980923	J27	J	H5	Antarctica
37548	Yamato 98092Y-980925	J27	J	H5	Antarctica
37554	Yamato 98093Y-980931	J27	J	H5	Antarctica
37555	Yamato 98093Y-980932	J27	J	H6	Antarctica
37556	Yamato 98093Y-980933	J27	J	H6	Antarctica
37590	Yamato 98096Y-980967	J27	J	H5	Antarctica
37595	Yamato 98097Y-980972	J27	J	H5	Antarctica
37596	Yamato 98097Y-980973	J27	J	H5	Antarctica
37597	Yamato 98097Y-980974	J27	J	H5	Antarctica

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37602	Yamato 98097Y-980979	J27	J	H5	Antarctica
37606	Yamato 98098Y-980983	J27	J	H4	Antarctica
37607	Yamato 98098Y-980984	J27	J	H4	Antarctica
37608	Yamato 98098Y-980985	J27	J	H4	Antarctica
37609	Yamato 98098Y-980986	J27	J	H4	Antarctica
37610	Yamato 98098Y-980987	J27	J	H4	Antarctica
37613	Yamato 98099Y-980990	J27	J	H4	Antarctica
37615	Yamato 98099Y-980992	J27	J	H4	Antarctica
37616	Yamato 98099Y-980993	J27	J	H4	Antarctica
37617	Yamato 98099Y-980994	J27	J	H4	Antarctica
37618	Yamato 98099Y-980995	J27	J	H4	Antarctica
37624	Yamato 98100Y-981001	J27	J	H4	Antarctica
37625	Yamato 98100Y-981002	J27	J	H4	Antarctica
37626	Yamato 98100Y-981003	J27	J	H4	Antarctica
37627	Yamato 98100Y-981004	J27	J	H4	Antarctica
37631	Yamato 98100Y-981008	J27	J	L6	Antarctica
37633	Yamato 98101Y-981010	J27	J	L6	Antarctica
37634	Yamato 98101Y-981011	J27	J	H6	Antarctica
37640	Yamato 98101Y-981017	J27	J	L6	Antarctica
37652	Yamato 98102Y-981029	J27	J	H4	Antarctica
37653	Yamato 98103Y-981030	J27	J	H4	Antarctica
37665	Yamato 98104Y-981043	J27	J	L6	Antarctica
37671	Yamato 98104Y-981049	J27	J	L6	Antarctica
37675	Yamato 98105Y-981053	J27	J	H4	Antarctica
37676	Yamato 98105Y-981054	J27	J	CV3	Antarctica
37681	Yamato 98105Y-981059	J27	J	H6	Antarctica
37682	Yamato 98106Y-981060	J27	J	Ureilite	Antarctica
37684	Yamato 98106Y-981062	J27	J	H6	Antarctica
37688	Yamato 98106Y-981066	J27	J	H4	Antarctica
37690	Yamato 98106Y-981068	J27	J	H5	Antarctica
37693	Yamato 98107Y-981071	J27	J	H6	Antarctica
37694	Yamato 98107Y-981072	J27	J	H6	Antarctica
37699	Yamato 98107Y-981077	J27	J	H6	Antarctica
37710	Yamato 98108Y-981088	J27	J	H4	Antarctica
37715	Yamato 98109Y-981093	J27	J	H4	Antarctica
37716	Yamato 98109Y-981094	J27	J	H4	Antarctica
37718	Yamato 98109Y-981096	J27	J	H4	Antarctica
37719	Yamato 98109Y-981097	J27	J	H4	Antarctica
37720	Yamato 98109Y-981098	J27	J	H4	Antarctica
37726	Yamato 98110Y-981104	J27	J	H4	Antarctica
37729	Yamato 98110Y-981107	J27	J	H4	Antarctica
37735	Yamato 98111Y-981113	J27	J	H4	Antarctica
37739	Yamato 98111Y-981117	J27	J	H4	Antarctica
37740	Yamato 98111Y-981118	J27	J	H5	Antarctica
37744	Yamato 98112Y-981122	J27	J	H4	Antarctica
37747	Yamato 98112Y-981125	J27	J	H5	Antarctica
37748	Yamato 98112Y-981126	J27	J	H5	Antarctica
37750	Yamato 98112Y-981128	J27	J	L6	Antarctica
37753	Yamato 98113Y-981131	J27	J	H6	Antarctica
37778	Yamato 98115Y-981156	J27	J	L6	Antarctica
37782	Yamato 98116Y-981160	J27	J	H4	Antarctica
37793	Yamato 98117Y-981171	J27	J	H3	Antarctica
37800	Yamato 98117Y-981178	J27	J	H4	Antarctica
37801	Yamato 98117Y-981179	J27	J	H4	Antarctica
37807	Yamato 98118Y-981185	J27	J	H4	Antarctica



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37812	Yamato 98119Y-981190	J27	J	H5	Antarctica
37814	Yamato 98119Y-981192	J27	J	H4	Antarctica
37815	Yamato 98119Y-981193	J27	J	H4	Antarctica
37819	Yamato 98119Y-981197	J27	J	H4	Antarctica
37827	Yamato 98120Y-981205	J27	J	H4	Antarctica
37853	Yamato 98123Y-981231	J27	J	H6	Antarctica
37861	Yamato 98123Y-981239	J27	J	H4	Antarctica
37865	Yamato 98124Y-981243	J27	J	H4	Antarctica
37866	Yamato 98124Y-981244	J27	J	H4	Antarctica
37870	Yamato 98124Y-981248	J27	J	H4	Antarctica
37877	Yamato 98125Y-981255	J27	J	H5	Antarctica
37879	Yamato 98125Y-981257	J27	J	H4	Antarctica
37881	Yamato 98125Y-981259	J27	J	L5	Antarctica
37883	Yamato 98126Y-981261	J27	J	CM2	Antarctica
37887	Yamato 98126Y-981265	J27	J	CM2	Antarctica
37892	Yamato 98127Y-981270	J27	J	CM2	Antarctica
37895	Yamato 98127Y-981273	J27	J	CO3	Antarctica
37898	Yamato 98127Y-981276	J27	J	L6	Antarctica
37903	Yamato 98128Y-981281	J27	J	CO3	Antarctica
37909	Yamato 98128Y-981287	J27	J	CO3	Antarctica
37914	Yamato 98129Y-981292	J27	J	CO3	Antarctica
37915	Yamato 98129Y-981293	J27	J	CO3	Antarctica
37916	Yamato 98129Y-981294	J27	J	CO3	Antarctica
37922	Yamato 98130Y-981300	J27	J	H4	Antarctica
37928	Yamato 98130Y-981306	J27	J	H4	Antarctica
37932	Yamato 98131Y-981310	J27	J	H5	Antarctica
37933	Yamato 98131Y-981311	J27	J	H4	Antarctica
37939	Yamato 98131Y-981317	J27	J	H5	Antarctica
37950	Yamato 98132Y-981328	J27	J	L6	Antarctica
37952	Yamato 98133Y-981330	J27	J	L6	Antarctica
37958	Yamato 98133Y-981336	J27	J	L6	Antarctica
37961	Yamato 98133Y-981339	J27	J	L5	Antarctica
37963	Yamato 98134Y-981341	J27	J	L5	Antarctica
37964	Yamato 98134Y-981342	J27	J	L5	Antarctica
37966	Yamato 98134Y-981344	J27	J	L5	Antarctica
37974	Yamato 98135Y-981352	J27	J	H5	Antarctica
37975	Yamato 98135Y-981353	J27	J	L5	Antarctica
37978	Yamato 98135Y-981356	J27	J	L6	Antarctica
37985	Yamato 98136Y-981363	J27	J	L6	Antarctica
37986	Yamato 98136Y-981364	J27	J	H5	Antarctica
37989	Yamato 98136Y-981367	J27	J	H4	Antarctica
37996	Yamato 98137Y-981374	J27	J	H5	Antarctica
37999	Yamato 98137Y-981377	J27	J	H5	Antarctica
38000	Yamato 98137Y-981378	J27	J	L6	Antarctica
38001	Yamato 98137Y-981379	J27	J	L6	Antarctica
38004	Yamato 98138Y-981382	J27	J	L6	Antarctica
38005	Yamato 98138Y-981383	J27	J	H5	Antarctica
38006	Yamato 98138Y-981384	J27	J	H6	Antarctica
38008	Yamato 98138Y-981386	J27	J	H5	Antarctica
38009	Yamato 98138Y-981387	J27	J	H6	Antarctica
38013	Yamato 98139Y-981391	J27	J	H5	Antarctica
38014	Yamato 98139Y-981392	J27	J	H5	Antarctica
38018	Yamato 98139Y-981396	J27	J	L6	Antarctica
38019	Yamato 98139Y-981397	J27	J	L6	Antarctica
38026	Yamato 98140Y-981404	J27	J	H5	Antarctica

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38031	Yamato 98140	Y-981409	J27	J	L6	Antarctica
38045	Yamato 98142	Y-981423	J27	J	L3	Antarctica
38046	Yamato 98142	Y-981424	J27	J	L6	Antarctica
38052	Yamato 98143	Y-981430	J27	J	L6	Antarctica
38062	Yamato 98144	Y-981440	J27	J	L4	Antarctica
38074	Yamato 98145	Y-981452	J27	J	L4	Antarctica
38076	Yamato 98145	Y-981454	J27	J	H5	Antarctica
38081	Yamato 98145	Y-981459	J27	J	H5	Antarctica
38083	Yamato 98146	Y-981461	J27	J	H6	Antarctica
38089	Yamato 98146	Y-981467	J27	J	L6	Antarctica
38090	Yamato 98146	Y-981468	J27	J	L6	Antarctica
38092	Yamato 98147	Y-981470	J27	J	H6	Antarctica
38095	Yamato 98147	Y-981473	J27	J	L4	Antarctica
38100	Yamato 98147	Y-981478	J27	J	L6	Antarctica
38101	Yamato 98147	Y-981479	J27	J	L6	Antarctica
38110	Yamato 98148	Y-981488	J27	J	L6	Antarctica
38141	Yamato 98151	Y-981518	J27	J	H4	Antarctica
38142	Yamato 98151	Y-981519	J27	J	CR2	Antarctica
38147	Yamato 98152	Y-981524	J27	J	H4	Antarctica
38154	Yamato 98153	Y-981531	J27	J	H6	Antarctica
38155	Yamato 98153	Y-981532	J27	J	L6	Antarctica
38160	Yamato 98153	Y-981537	J27	J	H6	Antarctica
38161	Yamato 98153	Y-981538	J27	J	H6	Antarctica
38178	Yamato 98155	Y-981555	J27	J	H6	Antarctica
38180	Yamato 98155	Y-981557	J27	J	L5	Antarctica
38193	Yamato 98157	Y-981570	J27	J	H5	Antarctica
38194	Yamato 98157	Y-981571	J27	J	H4	Antarctica
38197	Yamato 98157	Y-981574	J27	J	H5	Antarctica
38200	Yamato 98157	Y-981577	J27	J	L4	Antarctica
38201	Yamato 98157	Y-981578	J27	J	H5	Antarctica
38202	Yamato 98157	Y-981579	J27	J	H6	Antarctica
38215	Yamato 98159	Y-981592	J27	J	H4	Antarctica
38231	Yamato 98160	Y-981608	J27	J	LL6	Antarctica
38233	Yamato 98161	Y-981610	J27	J	H3	Antarctica
38241	Yamato 98161	Y-981618	J27	J	L6	Antarctica
38246	Yamato 98162	Y-981623	J27	J	L5	Antarctica
38249	Yamato 98162	Y-981626	J27	J	H6	Antarctica
38251	Yamato 98162	Y-981628	J27	J	L6	Antarctica
38258	Yamato 98163	Y-981635	J27	J	H5	Antarctica
38281	Yamato 98165	Y-981659	J27	J	H5	Antarctica
38283	Yamato 98166	Y-981661	J27	J	LL6	Antarctica
38297	Yamato 98167	Y-981675	J27	J	L6	Antarctica
38312	Yamato 98169	Y-981690	J27	J	L6	Antarctica
38315	Yamato 98169	Y-981693	J27	J	H6	Antarctica
38321	Yamato 98169	Y-981699	J27	J	L6	Antarctica
38326	Yamato 98170	Y-981704	J27	J	LL6	Antarctica
38330	Yamato 98170	Y-981708	J27	J	H5	Antarctica
38339	Yamato 98171	Y-981717	J27	J	H6	Antarctica
38355	Yamato 98173	Y-981733	J27	J	L6	Antarctica
38369	Yamato 98174	Y-981747	J27	J	H5	Antarctica
38370	Yamato 98174	Y-981748	J27	J	H5	Antarctica
38373	Yamato 98175	Y-981751	J27	J	L6	Antarctica
38377	Yamato 98175	Y-981755	J27	J	L6	Antarctica
38379	Yamato 98175	Y-981757	J27	J	H4	Antarctica
38382	Yamato 98176	Y-981760	J27	J	CM2	Antarctica

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38383	Yamato 98176Y-981761	J27	J	H6	Antarctica
38384	Yamato 98176Y-981762	J27	J	H4	Antarctica
38385	Yamato 98176Y-981763	J27	J	L6	Antarctica
38391	Yamato 98176Y-981769	J27	J	L6	Antarctica
38393	Yamato 98177Y-981771	J27	J	L6	Antarctica
38396	Yamato 98177Y-981774	J27	J	H4	Antarctica
38403	Yamato 98178Y-981781	J27	J	H4	Antarctica
38405	Yamato 98178Y-981783	J27	J	H3	Antarctica
38407	Yamato 98178Y-981785	J27	J	H5	Antarctica
38409	Yamato 98178Y-981787	J27	J	H4	Antarctica
38410	Yamato 98178Y-981788	J27	J	H5	Antarctica
38415	Yamato 98179Y-981793	J27	J	H4	Antarctica
38426	Yamato 98180Y-981804	J27	J	H5	Antarctica
38427	Yamato 98180Y-981805	J27	J	H5	Antarctica
38428	Yamato 98180Y-981806	J27	J	H5	Antarctica
38429	Yamato 98180Y-981807	J27	J	L6	Antarctica
38433	Yamato 98181Y-981811	J27	J	H5	Antarctica
38434	Yamato 98181Y-981812	J27	J	H5	Antarctica
38435	Yamato 98181Y-981813	J27	J	H4	Antarctica
38468	Yamato 98184Y-981846	J27	J	H4	Antarctica
38469	Yamato 98184Y-981847	J27	J	H4	Antarctica
38470	Yamato 98184Y-981848	J27	J	H4	Antarctica
38472	Yamato 98185Y-981850	J27	J	H4	Antarctica
38474	Yamato 98185Y-981852	J27	J	H4	Antarctica
38476	Yamato 98185Y-981854	J27	J	H4	Antarctica
38487	Yamato 98186Y-981865	J27	J	H4	Antarctica
38490	Yamato 98186Y-981868	J27	J	H4	Antarctica
38491	Yamato 98186Y-981869	J27	J	H4	Antarctica
38493	Yamato 98187Y-981871	J27	J	H5	Antarctica
38494	Yamato 98187Y-981872	J27	J	H5	Antarctica
38495	Yamato 98187Y-981873	J27	J	H4	Antarctica
38496	Yamato 98187Y-981874	J27	J	H4	Antarctica
38497	Yamato 98187Y-981875	J27	J	H4	Antarctica
38498	Yamato 98187Y-981876	J27	J	H4	Antarctica
38499	Yamato 98187Y-981877	J27	J	H4	Antarctica
38501	Yamato 98187Y-981879	J27	J	H4	Antarctica
38502	Yamato 98188Y-981880	J27	J	H4	Antarctica
38504	Yamato 98188Y-981882	J27	J	H5	Antarctica
38517	Yamato 98189Y-981895	J27	J	H5	Antarctica
38521	Yamato 98189Y-981899	J27	J	L6	Antarctica
38524	Yamato 98190Y-981902	J27	J	H5	Antarctica
38525	Yamato 98190Y-981903	J27	J	H4	Antarctica
38535	Yamato 98191Y-981913	J27	J	H6	Antarctica
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38588	Yamato 98196Y-981966	J27	J	H4	Antarctica
38589	Yamato 98196Y-981967	J27	J	H5	Antarctica
38592	Yamato 98197Y-981970	J27	J	H4	Antarctica

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38594	Yamato 98197	Y-981972	J27	J	L4	Antarctica
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38629	Yamato 98200	Y-982007	J27	J	H5	Antarctica
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38631	Yamato 98200	Y-982009	J27	J	H4	Antarctica
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38712	Yamato 98209	Y-982090	J27	J	H5	Antarctica
38714	Yamato 98209	Y-982092	J27	J	H4	Antarctica
38716	Yamato 98209	Y-982094	J27	J	H4	Antarctica
38717	Yamato 98209	Y-982095	J27	J	L5	Antarctica
38718	Yamato 98209	Y-982096	J27	J	H5	Antarctica
38722	Yamato 98210	Y-982100	J27	J	H4	Antarctica
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38784	Yamato 98216	Y-982162	J27	J	H6	Antarctica
38787	Yamato 98216	Y-982165	J27	J	H6	Antarctica
38803	Yamato 98218	Y-982181	J27	J	L6	Antarctica

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39153	Yamato 98253	Y-982531	J27	J	H4	Antarctica
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41076	Yamato 00031Y-000311	J27	J	Iron, IIIAB	Antarctica
41244	Yamato 00047Y-000479	J27	J	Iron, IAB-ung	Antarctica
41302	Yamato 00053Y-000537	J27	J	Iron, IAB-ung	Antarctica
41312	Yamato 00054Y-000547	J27	J	Iron, IAB-ung	Antarctica
41352	Yamato 00058Y-000587	J27	J	Iron, IAB-ung	Antarctica
41467	Yamato 00070Y-000703	J27	J	Iron, IIIAB	Antarctica
41608	Yamato 00084Y-000846	J27	J	Iron, IAB-ung	Antarctica
72711	Yazd 003			L6	Iran
72346	Zhengjiabu			H5	China
71596	Zhob			H3-4	Pakistan
72517	Zinder 003			Eucrite-melt b	Niger

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Baden-Wurtte	2020-07-07	0000-00-00		Baden-Wurtte	Private garder	
Khorasan	2020-03-28	0000-00-00		Khorasan	desertic surfac	
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Antofagasta	2020-11-28	0000-00-00		Antofagasta
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Antofagasta	2020-11-28	0000-00-00		Antofagasta
Antofagasta	2020-02-05	0000-00-00		Antofagasta
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Antofagasta	2020-02-23	0000-00-00		Antofagasta
Antofagasta	2020-02-23	0000-00-00		Antofagasta
Antofagasta	2020-02-23	0000-00-00		Antofagasta
Antofagasta	2020-02-23	0000-00-00		Antofagasta
Antofagasta	2020-02-23	0000-00-00		Antofagasta
Antofagasta	2020-03-21	0000-00-00		Antofagasta
Antofagasta	2020-10-10	0000-00-00		Antofagasta
Antofagasta	2020-10-10	0000-00-00		Antofagasta
Antofagasta	2020-10-10	0000-00-00		Antofagasta
Antofagasta	2020-10-10	0000-00-00		Antofagasta
Antofagasta	2020-01-31	2021-04-25	reclassified as	Antofagasta
Antofagasta	2020-02-12	0000-00-00		Antofagasta
Antofagasta	2020-06-27	0000-00-00		Antofagasta
Antofagasta	2020-06-27	0000-00-00		Antofagasta

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Antofagasta	2020-11-02	0000-00-00	Antofagasta
Antofagasta	2020-11-14	0000-00-00	Antofagasta
Western Austr	2020-11-28	0000-00-00	Western Austr
Colorado	2020-04-05	0000-00-00	Colorado
Antofagasta	2020-01-31	0000-00-00	Antofagasta
Antofagasta	2020-01-31	0000-00-00	Antofagasta
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Antofagasta	2020-01-31	0000-00-00	Antofagasta
Antofagasta	2020-06-27	0000-00-00	Antofagasta
Antofagasta	2020-06-27	0000-00-00	Antofagasta
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Emilia-Romag	2020-09-05	0000-00-00	Emilia-Romag Gravel
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Antofagasta	2020-04-05	0000-00-00	Antofagasta Desert
Antofagasta	2020-01-28	0000-00-00	Antofagasta
Antofagasta	2020-01-28	0000-00-00	Antofagasta
Antofagasta	2020-04-05	0000-00-00	Antofagasta
Antofagasta	2020-01-31	0000-00-00	Antofagasta
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Antofagasta	2020-02-23	0000-00-00	Antofagasta
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Antofagasta	2020-03-21	0000-00-00	Antofagasta
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Antofagasta	2020-04-05	0000-00-00	Antofagasta
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Antofagasta	2020-06-13	0000-00-00	Antofagasta
Antofagasta	2020-06-27	0000-00-00	Antofagasta
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Antofagasta	2020-07-03	0000-00-00	Antofagasta
Antofagasta	2020-07-03	0000-00-00	Antofagasta
Antofagasta	2020-08-02	0000-00-00	Antofagasta
Antofagasta	2020-08-02	0000-00-00	Antofagasta
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Antofagasta	2020-11-11	0000-00-00	Antofagasta	
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Saguia el Han	2020-02-17	0000-00-00	Saguia el Han	Guelmim
Saguia el Han	2020-08-02	0000-00-00	Saguia el Han	Morocco
Saguia el Han	2020-11-02	0000-00-00	Saguia el Han	Zagora, Moroc
California	2020-01-31	0000-00-00	California	saddle
Antofagasta	2020-09-19	0000-00-00	Antofagasta	
Antofagasta	2020-09-19	0000-00-00	Antofagasta	
Nevada	2020-01-31	0000-00-00	Nevada	drylake
Nevada	2020-01-31	0000-00-00	Nevada	drylake
Khorasan	2020-07-18	0000-00-00	Khorasan	desertic surfac
	2020-02-21	0000-00-00		
	2020-02-21	0000-00-00		
Zufar	2020-02-09	0000-00-00	Zufar	
Zufar	2020-02-16	0000-00-00	Zufar	
Zufar	2020-03-07	0000-00-00	Zufar	
Zufar	2020-06-14	0000-00-00	Zufar	
Zufar	2020-06-14	0000-00-00	Zufar	
Zufar	2020-07-03	0000-00-00	Zufar	
Zufar	2020-06-14	0000-00-00	Zufar	
Zufar	2020-07-19	0000-00-00	Zufar	Desert
	2020-02-21	0000-00-00		
	2020-02-21	0000-00-00		
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	2020-02-21	0000-00-00			
Qinghai	2020-12-21	0000-00-00	Qinghai	desert	
Qinghai	2020-09-05	0000-00-00	Qinghai		
Tiris Zemmou	2020-07-18	0000-00-00	Tiris Zemmou Imourene		Tindouf, Alger
Antofagasta	2020-01-31	0000-00-00	Antofagasta		
Antofagasta	2020-01-31	0000-00-00	Antofagasta		
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Antofagasta	2020-02-09	0000-00-00	Antofagasta		
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Antofagasta	2020-06-27	0000-00-00	Antofagasta		
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Antofagasta	2020-09-05	0000-00-00	Antofagasta		
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Antofagasta	2020-11-01	0000-00-00	Antofagasta		
Antofagasta	2020-11-14	0000-00-00	Antofagasta		
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Antofagasta	2020-11-14	0000-00-00	Antofagasta		
	2020-02-21	0000-00-00			
	2020-02-21	0000-00-00			
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	2020-11-19	0000-00-00		ice field	
	2020-11-19	0000-00-00		ice field	
	2020-11-19	0000-00-00		ice field	
	2020-05-17	0000-00-00		Gusev Crater	
	2020-05-17	0000-00-00		Gusev Crater	
California	2020-04-18	0000-00-00	California		
Nevada	2020-04-05	0000-00-00	Nevada	dry lake	
Ouargla	2020-12-18	0000-00-00	Ouargla		Algeria
Adrar	2020-11-11	0000-00-00	Adrar		Tindouf, Alger
Nei Mongol	2020-04-18	0000-00-00	Nei Mongol	desert	
Xinjiang	2020-12-21	0000-00-00	Xinjiang	desert	
Xinjiang	2020-01-20	0000-00-00	Xinjiang		
South Australi	2020-11-28	0000-00-00	South Australi		
South Australi	2020-11-28	0000-00-00	South Australi		
South Australi	2020-11-28	0000-00-00	South Australi		
Nebraska	2020-01-18	0000-00-00	Nebraska		
Antofagasta	2020-03-07	0000-00-00	Antofagasta		
Antofagasta	2020-03-07	0000-00-00	Antofagasta		
Semnan	2020-09-28	0000-00-00	Semnan		Iran
Semnan	2020-09-28	0000-00-00	Semnan		Iran
Semnan	2020-09-28	0000-00-00	Semnan		Iran
Damghan	2020-09-28	0000-00-00	Damghan		Iran
Kerman	2020-09-28	0000-00-00	Kerman		Iran
Kerman	2020-09-28	0000-00-00	Kerman		Iran
Damghan	2020-09-28	0000-00-00	Damghan		Iran
Kerman	2020-09-28	0000-00-00	Kerman		Iran
	2020-11-02	0000-00-00			Damghane
South	2020-01-18	0000-00-00	South		
Saguia el Han	2020-11-14	0000-00-00	Saguia el Han		
Al Wusta	2020-02-16	0000-00-00	Al Wusta		
Al Wusta	2020-02-23	0000-00-00	Al Wusta		
Zufar	2020-06-14	0000-00-00	Zufar		
Al Wusta	2020-06-27	0000-00-00	Al Wusta		
Kerman	2020-01-10	0000-00-00	Kerman		
Kerman	2020-01-10	0000-00-00	Kerman		
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Kerman	2020-01-10	0000-00-00	Kerman
Kerman	2020-01-10	0000-00-00	Kerman
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Kerman	2020-01-10	0000-00-00	Kerman
Kerman	2020-01-10	0000-00-00	Kerman
Kerman	2020-05-31	0000-00-00	Kerman Kalout region
Kerman	2020-05-31	0000-00-00	Kerman
Kerman	2020-05-31	0000-00-00	Kerman Kalout region
Sumatera Uta	2020-09-28	0000-00-00	Sumatera Uta
Xinjiang	2020-05-23	0000-00-00	Xinjiang Kuyibage
Xinjiang	2020-04-18	0000-00-00	Xinjiang desert
Xinjiang	2020-02-17	0000-00-00	Xinjiang desert
Xinjiang	2020-04-18	0000-00-00	Xinjiang desert
Xinjiang	2020-12-21	0000-00-00	Xinjiang desert
Xinjiang	2020-11-19	0000-00-00	Xinjiang Kumtag
Xinjiang	2020-09-05	0000-00-00	Xinjiang
Xinjiang	2020-09-05	0000-00-00	Xinjiang
Xinjiang	2020-09-05	0000-00-00	Xinjiang
Czestochowa	2020-11-22	0000-00-00	Czestochowa sandy path
Saguia el Han	2020-08-08	0000-00-00	Saguia el Han Moroccan Des
Western Austr	2020-12-16	0000-00-00	Western Austrnear Kanowne
Qinghai	2020-02-17	0000-00-00	Qinghai desert
Antofagasta	2020-02-09	0000-00-00	Antofagasta
Antofagasta	2020-06-27	0000-00-00	Antofagasta
Antofagasta	2020-08-02	0000-00-00	Antofagasta
Xinjiang	2020-05-23	0000-00-00	Xinjiang desert
Antofagasta	2020-01-31	0000-00-00	Antofagasta
Antofagasta	2020-01-31	0000-00-00	Antofagasta Gravel pedime
Antofagasta	2020-01-31	0000-00-00	Antofagasta Gravel pedime
Antofagasta	2020-01-31	0000-00-00	Antofagasta
Antofagasta	2020-01-31	0000-00-00	Antofagasta Gravel pedime



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Antofagasta	2020-01-31	0000-00-00	Antofagasta	Gravel pedime
Antofagasta	2020-02-05	0000-00-00	Antofagasta	
Antofagasta	2020-02-12	0000-00-00	Antofagasta	
Antofagasta	2020-02-23	0000-00-00	Antofagasta	Dessert
Antofogasta	2020-03-21	0000-00-00	Antofogasta	Limestone def
Antofagasta	2020-11-01	0000-00-00	Antofagasta	
Antofagasta	2020-03-28	0000-00-00	Antofagasta	
Antofagasta	2020-03-28	0000-00-00	Antofagasta	Gravel pedime
Antofagasta	2020-03-28	0000-00-00	Antofagasta	
Antofagasta	2020-05-02	0000-00-00	Antofagasta	
Antofagasta	2020-06-27	0000-00-00	Antofagasta	Gravel pedime
Antofagasta	2020-06-27	0000-00-00	Antofagasta	
Antofagasta	2020-11-01	0000-00-00	Antofagasta	Gravel pedime
Antofagasta	2020-11-01	0000-00-00	Antofagasta	Gravel pedime
Antofagasta	2020-11-01	0000-00-00	Antofagasta	
Antofagasta	2020-11-01	0000-00-00	Antofagasta	
Antofagasta	2020-11-12	0000-00-00	Antofagasta	
Antofagasta	2020-11-01	0000-00-00	Antofagasta	
Antofagasta	2020-11-01	0000-00-00	Antofagasta	
Antofagasta	2020-11-01	0000-00-00	Antofagasta	Gravel pedime
Antofagasta	2020-11-02	0000-00-00	Antofagasta	
Antofagasta	2020-11-02	0000-00-00	Antofagasta	
Antofagasta	2020-11-02	0000-00-00	Antofagasta	Gravel pedime
Antofagasta	2020-11-02	0000-00-00	Antofagasta	Gravel pedime
Antofagasta	2020-11-14	0000-00-00	Antofagasta	
Antofagasta	2020-11-14	0000-00-00	Antofagasta	
Antofagasta	2020-11-14	0000-00-00	Antofagasta	
Antofagasta	2020-11-14	0000-00-00	Antofagasta	
Antofagasta	2020-11-02	0000-00-00	Antofagasta	Gravel pedime
Antofagasta	2020-11-02	0000-00-00	Antofagasta	Gravel pedime
Antofagasta	2020-11-02	0000-00-00	Antofagasta	
Xinjiang	2020-04-18	0000-00-00	Xinjiang	desert
Xinjiang	2020-09-05	0000-00-00	Xinjiang	desert
Xinjiang	2020-04-18	0000-00-00	Xinjiang	desert
Xinjiang	2020-02-17	0000-00-00	Xinjiang	desert
Xinjiang	2020-02-17	0000-00-00	Xinjiang	desert
Xinjiang	2020-02-17	0000-00-00	Xinjiang	desert
Xinjiang	2020-09-28	0000-00-00	Xinjiang	
Xinjiang	2020-09-05	0000-00-00	Xinjiang	
Antofagasta	2020-03-28	0000-00-00	Antofagasta	
Antofagasta	2020-03-28	0000-00-00	Antofagasta	
Antofagasta	2020-06-27	0000-00-00	Antofagasta	
Antofagasta	2020-11-01	0000-00-00	Antofagasta	
Bihar	2020-05-31	0000-00-00	Bihar	Mahdeva
Al Bahr al Ahr	2020-11-28	0000-00-00	Al Bahr al Ahn	
Al Bahr al Ahr	2020-11-28	0000-00-00	Al Bahr al Ahn	
Al Bahr al Ahr	2020-11-28	0000-00-00	Al Bahr al Ahn	
Al Bahr al Ahr	2020-11-28	0000-00-00	Al Bahr al Ahn	
Al Bahr al Ahr	2020-11-28	0000-00-00	Al Bahr al Ahn	
Eastern	2020-03-21	0000-00-00	Eastern	Foum Zgouid
Trarza	2020-01-14	0000-00-00	Trarza	
	2020-05-17	0000-00-00		Meridiani Plan
	2020-05-17	0000-00-00		Meridiani Plan
	2020-05-17	0000-00-00		Meridiani Plan
	2020-05-17	0000-00-00		Meridiani Plan



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2020-09-05	0000-00-00		Libya
2020-09-28	0000-00-00		Libya
2020-12-16	0000-00-00		Paris
2020-09-05	0000-00-00		Zagora
2020-08-02	0000-00-00		Zagora
2020-08-02	0000-00-00		Zagora
2020-08-02	0000-00-00		Erfoud
2020-08-02	0000-00-00		Erfoud
2020-09-28	0000-00-00		Morocco
2020-09-28	0000-00-00		Rissani
2020-02-29	0000-00-00		Erfoud
2020-08-02	0000-00-00		Erfoud
2020-07-04	0000-00-00		Erfoud
2020-07-04	0000-00-00		Erfoud
2020-07-04	0000-00-00		Morocco
2020-07-04	0000-00-00		Morocco
2020-02-09	0000-00-00		Besancon, Fra
2020-03-10	0000-00-00		Erfoud, Moroc
2020-07-03	0000-00-00		Morocco
2020-07-03	0000-00-00		Outat el Hadj,
2020-02-29	0000-00-00		St. Marie aux l
2020-03-10	0000-00-00		Besancon, Fra
2020-03-10	0000-00-00		Erfoud, Moroc
2020-03-10	0000-00-00		Midelt, Morocc
2020-03-10	0000-00-00		Erfoud, Moroc
2020-08-02	0000-00-00		Tucson
2020-12-12	0000-00-00		Erfoud
2020-05-02	0000-00-00		Tucson Gem &
2020-07-19	0000-00-00		Temara
2020-07-19	0000-00-00		Erfoud
2020-04-05	0000-00-00		Mailed from M
2020-04-05	0000-00-00		Mailed from M
2020-04-05	0000-00-00		Mailed from M
2020-12-12	0000-00-00		Munich, Germ
2020-01-01	0000-00-00		Sainte-Marie-à
2020-12-05	0000-00-00		Erfoud
2020-12-05	0000-00-00		Erfoud
2020-12-05	0000-00-00		Erfoud
2020-02-09	0000-00-00		Northwest Afri
2020-03-21	0000-00-00		Foum Zguid
2020-08-02	0000-00-00		Munich
2020-08-02	0000-00-00		Munich
2020-08-02	0000-00-00		Munich
2020-08-02	0000-00-00		Munich
2020-08-02	0000-00-00		Morocco
2020-05-31	0000-00-00	desert	Chenzhou, Hu
2020-05-31	0000-00-00	desert	Agadir, Moroc
2020-01-20	0000-00-00		Ouarzazate, M
2020-03-21	0000-00-00		Algeria
2020-08-02	0000-00-00		Munich
2020-04-18	0000-00-00		Hamburg
2020-04-18	0000-00-00		Hamburg
2020-05-31	0000-00-00	desert	Erfoud, Moroc
2020-08-02	0000-00-00		Munich
2020-11-01	0000-00-00		Zagora

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3	2020-11-01	0000-00-00		Mauritania
4	2020-11-19	0000-00-00		Agadir
5	2020-11-19	0000-00-00		Agadir
6	2020-06-13	0000-00-00		Agadir, Moroc
7	2020-12-12	0000-00-00	Morocco	Erfoud
8	2020-01-31	0000-00-00		Morocco
9	2020-01-31	0000-00-00		Erfoud
10	2020-05-23	0000-00-00	desert	
11	2020-05-23	0000-00-00	desert	
12	2020-05-23	0000-00-00	desert	
13	2020-04-18	0000-00-00	desert	
14	2020-12-21	0000-00-00	desert	
15	2020-12-21	0000-00-00		Chenzhou
16	2020-04-05	0000-00-00	Desert	Osnabrück, G
17	2020-02-29	0000-00-00		Tucson Gem &
18	2020-12-21	0000-00-00	desert	Chenzhou?Ch
19	2020-06-13	0000-00-00		Bologna
20	2020-06-13	0000-00-00		Bologna
21	2020-07-03	0000-00-00		Munich
22	2020-06-13	0000-00-00		Munich
23	2020-06-13	0000-00-00		Munich
24	2020-02-29	0000-00-00		Morocco
25	2020-05-02	0000-00-00		Tucson Gem &
26	2020-05-02	0000-00-00		Tucson Gem &
27	2020-05-02	0000-00-00		Tucson Gem &
28	2020-05-02	0000-00-00		Tucson Gem &
29	2020-05-02	0000-00-00		Tucson Gem &
30	2020-05-02	0000-00-00		Tucson Gem &
31	2020-01-31	0000-00-00		
32	2020-04-05	0000-00-00		Nouakchott
33	2020-02-29	0000-00-00		
34	2020-02-09	0000-00-00		Morocco
35	2020-01-01	0000-00-00		Erfoud, Moroc
36	2020-01-01	0000-00-00		Morocco
37	2020-01-01	0000-00-00		Zagora, Moroc
38	2020-01-01	0000-00-00		Erfoud, Moroc
39	2020-01-01	0000-00-00		Erfoud, Moroc
40	2020-01-01	0000-00-00		Morocco
41	2020-01-01	0000-00-00		Morocco
42	2020-01-01	0000-00-00		Morocco
43	2020-01-01	0000-00-00		Morocco
44	2020-02-09	0000-00-00		Agadir
45	2020-02-09	0000-00-00	Adrar	
46	2020-02-09	0000-00-00		
47	2020-02-09	0000-00-00	Adrar	
48	2020-02-09	0000-00-00		Zagora
49	2020-02-09	0000-00-00		Zouerat, Maur
50	2020-02-17	0000-00-00	desert	Chenzhou, Ch
51	2020-04-18	0000-00-00	desert	Chenzhou, Ch
52	2020-11-19	0000-00-00	desert	Beijing, China
53	2020-12-21	0000-00-00	desert	Beijing, China
54	2020-04-18	0000-00-00	desert	Beijing, China
55	2020-01-18	0000-00-00		Morocco
56	2020-01-10	0000-00-00		Morocco
57	2020-01-10	0000-00-00		Morocco
58	2020-01-10	0000-00-00		Morocco
59	2020-01-10	0000-00-00		Morocco
60	2020-02-12	0000-00-00		Morocco

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2020-01-31	0000-00-00	Morocco
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2020-01-10	0000-00-00	Morocco
2020-03-21	0000-00-00	Morocco
2020-01-31	0000-00-00	Morocco
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2020-02-12	0000-00-00	Morocco
2020-01-31	0000-00-00	Morocco
2020-02-09	0000-00-00	Morocco
2020-01-10	0000-00-00	Zagora, Moroc
2020-01-10	0000-00-00	Morocco
2020-02-12	0000-00-00	Morocco
2020-01-31	0000-00-00	Zagora, Moroc
2020-01-10	0000-00-00	Internet
2020-01-31	0000-00-00	Zagora, Moroc
2020-01-10	0000-00-00	Morocco
2020-01-10	0000-00-00	Morocco
2020-01-31	0000-00-00	Morocco
2020-01-10	0000-00-00	Genova
2020-01-10	0000-00-00	Genova
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2020-01-10	0000-00-00	Genova
2020-01-10	0000-00-00	Genova
2020-01-10	0000-00-00	Genova
2020-01-10	0000-00-00	Genova
2020-02-09	0000-00-00	Arfoud
2020-01-31	0000-00-00	Morocco
2020-01-18	0000-00-00	Morocco
2020-01-18	0000-00-00	Morocco
2020-01-18	0000-00-00	Tucson
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2020-01-18	0000-00-00	Tucson
2020-01-18	0000-00-00	Tucson
2020-01-10	0000-00-00	Erfoud
2020-02-09	0000-00-00	Mauritania
2020-02-09	0000-00-00	Zagora
2020-02-09	0000-00-00	Agadir
2020-02-09	0000-00-00	Rissani
2020-02-09	0000-00-00	Agadir
2020-02-09	0000-00-00	Agadir
2020-02-09	0000-00-00	Rissani
2020-02-09	0000-00-00	Zagora
2020-01-10	0000-00-00	Munich
2020-02-09	0000-00-00	Zagora
2020-01-10	0000-00-00	Munich
2020-02-09	0000-00-00	Ensisheim
2020-01-10	0000-00-00	Timbuktu, Mal
2020-02-09	0000-00-00	Algeria



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		2020-01-10	0000-00-00			Timbuktu, Mal
		2020-02-09	0000-00-00			Zagora
		2020-01-10	0000-00-00			Munich
		2020-02-09	0000-00-00			Mauritania
	Southern Prov	2020-01-31	0000-00-00	Southern Prov		Tucson
		2020-01-18	0000-00-00			Said Hadnany
		2020-01-18	0000-00-00			Said Hadnany
		2020-01-18	0000-00-00			Adam Aarons
		2020-02-09	0000-00-00			Morocco
		2020-01-18	0000-00-00			Morocco
		2020-01-18	0000-00-00			Morocco
		2020-02-09	0000-00-00			Morocco
		2020-04-05	0000-00-00			Morocco
		2020-02-09	0000-00-00			Zagora
		2020-03-21	0000-00-00			
		2020-02-09	0000-00-00			Morocco
		2020-02-17	0000-00-00			Erfoud
		2020-01-31	0000-00-00			
		2020-01-31	0000-00-00			
		2020-02-17	0000-00-00			internet
		2020-01-31	0000-00-00			internet
		2020-02-17	0000-00-00			internet
		2020-01-31	0000-00-00			Rissani, Moroc
		2020-01-31	0000-00-00			Zagora, Moroc
		2020-02-17	0000-00-00			Guelmin, Morc
		2020-01-31	0000-00-00			Guelmin, Morc
		2020-02-17	0000-00-00			Guelmin, Morc
		2020-02-17	0000-00-00			Guelmin, Morc
		2020-02-17	0000-00-00			Guelmin, Morc
		2020-01-31	0000-00-00			Guelmin, Morc
		2020-01-31	0000-00-00			Guelmin, Morc
	Morocco	2020-01-31	0000-00-00	Morocco		Verona, italy
		2020-01-31	0000-00-00			Verona, italy
		2020-02-17	0000-00-00			Morocco
		2020-02-17	0000-00-00			Morocco
		2020-02-17	0000-00-00			Morocco
		2020-01-31	0000-00-00			Zagora, Moroc
		2020-02-09	0000-00-00			Munich, Germ
		2020-02-09	0000-00-00			Munich, Germ
		2020-01-31	0000-00-00			Munich, Germ
		2020-02-09	0000-00-00			Nouakchott, M
		2020-02-09	0000-00-00			Nouadhibou, M
		2020-02-09	0000-00-00			Erfoud, Moroc
		2020-01-31	0000-00-00			Morocco
		2020-02-09	0000-00-00			Morocco
		2020-11-01	0000-00-00			Morocco
		2020-01-31	0000-00-00			Hamburg, Ger
		2020-01-31	0000-00-00			Hamburg, Ger
		2020-02-17	0000-00-00			Erfoud
	South	2020-02-05	0000-00-00	Southern Prov		Chenzhou, Ch
	Bechar	2020-02-05	0000-00-00	Bechar		
		2020-02-05	0000-00-00			
		2020-02-05	0000-00-00			
		2020-02-05	0000-00-00			

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	2020-03-28	0000-00-00			
	2020-07-04	0000-00-00			Guelmin
	2020-02-29	0000-00-00			Nouakchott, M
	2020-04-05	0000-00-00			Zagora
	2020-02-09	0000-00-00			Algeria
	2020-02-29	0000-00-00			Tagounite
	2020-02-09	0000-00-00			Timbuktu, Mal
	2020-02-09	0000-00-00			Munich
	2020-02-09	0000-00-00			Munich
	2020-02-29	0000-00-00			Agadir
	2020-02-09	0000-00-00			Munich
	2020-02-29	0000-00-00			Morocco
	2020-03-21	0000-00-00			Morocco
	2020-03-03	0000-00-00			Verona, italy
	2020-02-29	0000-00-00			
Southern Prov	2020-02-29	0000-00-00	Southern Prov		Huizhou, Chin
Kem Kem	2020-02-12	0000-00-00	Kem Kem	Dahara	
	2020-02-12	0000-00-00		Sahara	
	2020-02-12	0000-00-00		Sahara	
	2020-02-12	0000-00-00		Sahara	
	2020-02-12	0000-00-00		Sahara	
	2020-02-16	0000-00-00			
	2020-02-16	0000-00-00			
	2020-02-16	0000-00-00			
	2020-02-16	0000-00-00			
	2020-02-16	0000-00-00			Erfoud
	2020-02-29	0000-00-00			Zagora
	2020-02-16	0000-00-00			Spain
	2020-02-29	0000-00-00			Agadir
	2020-02-16	0000-00-00			Agadir
	2020-02-29	0000-00-00			Zagora
	2020-02-29	0000-00-00			Hamburg, Ger
	2020-02-29	0000-00-00			Munich, Germ
	2020-02-23	0000-00-00			Munich, Germ
	2020-04-05	0000-00-00			Munich, Germ
	2020-02-29	0000-00-00			Hamburg, Ger
	2020-04-05	0000-00-00			Hamburg, Ger
	2020-02-23	0000-00-00			Morocco
	2020-04-05	0000-00-00			Laayoune,Â M
	2020-04-05	0000-00-00			Laayoune, Mo
	2020-04-05	0000-00-00			Morocco
	2020-04-05	0000-00-00			Morocco
	2020-04-05	0000-00-00			Morocco
	2020-04-05	0000-00-00			Mailed from M
	2020-02-23	0000-00-00			Zagora
	2020-02-23	0000-00-00			Algeria
	2020-04-05	0000-00-00			Zagora
	2020-04-05	0000-00-00			Mali
	2020-02-23	0000-00-00			Zagora
	2020-04-05	0000-00-00			Erfoud
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	2020-02-23	0000-00-00			Zagora
	2020-03-10	0000-00-00			Laayoune, Mo
	2020-04-05	0000-00-00			Erfoud, Moroc

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2020-03-21	0000-00-00		Libya
2020-03-28	0000-00-00		Khatari, Moroc
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2020-06-27	0000-00-00		Zagora
2020-03-28	0000-00-00		Smara
2020-03-28	0000-00-00	Akokan	Niger
2020-11-11	0000-00-00		Gadamis
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2020-04-05	0000-00-00		Munich Mineræ
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2020-05-02	0000-00-00		Zouerat, Maur
2020-03-21	0000-00-00		Zagora
2020-05-02	0000-00-00		Agadir; Tucso
2020-03-21	0000-00-00		Zagora
2020-05-02	0000-00-00		Mali and Maur
2020-05-02	0000-00-00		Morocco
2020-05-02	0000-00-00		Ouargla, Alger
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2020-03-28	0000-00-00		
2020-11-01	0000-00-00		Rissani, Moroc
purchased St. 2020-03-28	0000-00-00	purchased St.	Sainte-Marie æ
2020-03-28	0000-00-00		Zagora
2020-05-02	0000-00-00		Agadir

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	2020-06-13	0000-00-00			Zagora
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	2020-06-13	0000-00-00			Timbuktu, Mal
	2020-06-13	0000-00-00			Timbuktu, Mal
	2020-06-13	0000-00-00			Timbuktu, Mal
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	2020-07-03	0000-00-00			Sahara Deser Moroccan Dea
	2020-07-03	0000-00-00			West Sahara   Erfoud Dealer
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	2020-05-31	0000-00-00			West Sahara Moroccan Dea
	2020-07-03	0000-00-00			West Sahara Erfoud Dealer
	2020-07-03	0000-00-00			West Sahara Moroccan Dea
	2020-07-03	0000-00-00			Timbuktu, Mal
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	2020-07-03	0000-00-00			Morocco
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	2020-06-13	0000-00-00			Erfoud, Moroc
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	2020-06-14	0000-00-00			Layoune, Wes
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	2020-06-14	0000-00-00			Mauritania
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	2020-07-03	0000-00-00			Morocco

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	2020-07-04	0000-00-00			Timbuktu, Mal
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	2020-08-02	0000-00-00			Algeria
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Adrar	2020-08-02	0000-00-00		Adrar	Tindouf
	2020-08-02	0000-00-00			Guelmim
Chwichiya	2020-08-02	0000-00-00		Chwichiya	Munich Mineræ
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	2020-08-02	0000-00-00			Northwest Afri
	2020-08-02	0000-00-00			Northwest Afri
	2020-09-05	0000-00-00			(Northwest Afr
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	2020-10-10	0000-00-00			Tucson
	2020-08-02	0000-00-00			Denver
Drâa-Tafilalet	2020-09-05	0000-00-00		Drâa-Tafilalet	Morocco
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	2020-08-08	0000-00-00			Morocco
	2020-08-08	0000-00-00			Mauritania
	2020-08-08	0000-00-00			Mauritania



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	2020-07-07	0000-00-00		Morocco
	2020-08-08	0000-00-00		Mauritania
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Laayoune	2020-08-08	0000-00-00	Laayoune	Morocco
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	2020-08-08	0000-00-00		Mauritania
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Tindouf	2020-09-05	0000-00-00	Tindouf	Tindouf
Western Saha	2020-11-22	0000-00-00	Western Saha	
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	2020-09-19	0000-00-00		Zagora, Moroc
	2020-09-19	0000-00-00		Tindouf, Alger
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	2020-11-01	0000-00-00		Denver
	2020-09-05	0000-00-00		Zagora
	2020-11-01	0000-00-00		Erfoud
	2020-09-05	0000-00-00		Zagora
	2020-09-05	0000-00-00		Zagora
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	2020-09-05	0000-00-00		Zagora
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	2020-11-02	0000-00-00		Zagora, Moroc
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	2020-12-05	0000-00-00		Morocco
	2020-12-17	0000-00-00		Guelmim, Mor
	2020-11-28	0000-00-00		Algeria

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South	2020-11-02	0000-00-00	South	Tucson, USA
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Tindouf	2020-12-05	0000-00-00	Tindouf	Tindouf, Alger
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	2020-12-12	0000-00-00		Ensisheim
	2020-12-05	0000-00-00		Ouzarazate,
	2020-12-05	0000-00-00		Errachidia, Mc
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	2020-12-17	0000-00-00				Tindouf
	2020-11-19	0000-00-00				Mali
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	2020-11-19	0000-00-00		desert		Beijing, China
	2020-11-19	0000-00-00		desert		Beijing, China
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	2020-12-05	0000-00-00				Algeria, Moroc
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	2020-12-12	0000-00-00				Adrar, Algeria
	2020-11-28	0000-00-00				Tindouf, Alger
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California	2020-08-02	0000-00-00	California			California
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Omnogovi	2020-05-09	0000-00-00	Omnogovi		gravel surface	
Murzuq	2020-06-13	0000-00-00	Murzuq		Desert and mc	
Haskovo	2020-02-05	2020-12-18	Corrected stat	Burgas		
Oslo	2020-09-05	0000-00-00		Oslo		Rodeløkka an
Oyo	2020-09-05	0000-00-00		Oyo		Nigeria
Xinjiang	2020-07-07	0000-00-00		Xinjiang		
Antofagasta	2020-02-23	0000-00-00		Antofagasta		Dessert
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Antofagasta	2020-11-14	0000-00-00		Antofagasta		Gravel pedime
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Antofagasta	2020-11-02	0000-00-00		Antofagasta		Gravel pedime
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Kirovskaya ob	2020-04-05	0000-00-00		Kirovskaya ob		
Stavropol'skiy	2020-05-09	0000-00-00		Stavropol'skiy		
Xinjiang	2020-10-14	0000-00-00		Xinjiang		
Tindouf	2020-02-09	0000-00-00		Tindouf		Bou Akba Wisconsin
Kerman	2020-06-27	0000-00-00		Kerman		desertic surfac
Kerman	2020-11-02	0000-00-00		Kerman		
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	<b>tbl_date</b>	<b>tbl_lat</b>	<b>tbl_long</b>	<b>tbl_mass</b>	<b>tbl_pieces</b>	<b>tbl_class</b>	<b>tbl_shock</b>
1							
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4	2019 Nov	27°30'42.7"N	3°56'54.7"E	620.0	several	CV3	S3
5	Sep 2017	27°54'39.16"N	0° 7'43.33"E	14282.5	38	H4	S3
6	Sep 2017	27°41'50.01"N	0° 5'26.70"E	2468.5	1	L5	S3
7	Sep 2017	27°57'54.78"N	0° 8'40.42"E	1564	9	H5	S3
8	Sep 2017	27°51'43.86"N	0° 3'26.17"E	2226	19	H5	S3
9	Sep 2017	27°31'9.19"N	0°10'32.33"E	210.3	1	L5/6	S2
10	Sep 2017	27°37'16.66"N	0° 1'5.75"E	147	1	H4	S3
11	Sep 2017	27°40'57.97"N	0° 5'50.80"E	412	1	L5	S2
12	Sep 2017	27°36'59.86"N	0° 8'10.94"E	82	1	L5	S3
13	2020	29°04'48"N	8°51'26"W	20.96	1	Acapulcoite	
14	2019 Aug 20	27°01'27.59"N	9°44'39.59"W	~1300	Many	L6	S3
15	1992-1993			2303	2	L/LL4	S1
16	2009			95.8	1	Iron, IID	
17	2012			276.1	1	Iron, IIIAB	
18	2004 Jun 12	36°53.352'S	174°48.362'E	1302.65	1	L5	
19	2019	27.880°N	10.418°W	165.6	1	Eucrite-br	low
20	2019 Dec 20	27°52'48.77"N	10°25'06.42"W	230	1	LL6	
21	before July 20	28°N	113°W	10000	1	Iron, IIIAB	
22	2018 Jan	0°3.555'N	39°6.45'E	97000	1	Iron, IIF	low
23	2012 Dec 26	27°27'50.81"S	117°50'37.82"E	2080	2	LL6	S4
24	2012	43°54'09.2"N	93°12'13.2"E	1200	3	EL7	
25	Oct 2015	~41°19'N	~105°20'E	3920	1	L~6	
26	2015 Aug 8	41°24.061'N	118°13.198'W	27.5	1	H3-4	S3
27	2015 Aug 9	41°24.207'N	118°13.478'W	9.9	1	H3-4	S2
28	2018 Sep 27	41°23.3'N	118°7.8'W	4.4	1	H4	S2
29	1989	48°24'06.4"N	9°46'01.3"E	30670.0	2	H4-5	S2
30	2017	33.13734°N	57.04487°E	56000	2	L6	
31	2016-Oct-17	22°21.521'S	068°35.335'W	140	1	CR2	low
32	2017-Aug-27	22°25.615'S	068°39.164'W	442.6	1	Iron, IIAB	
33	30 Mar 2019	22°27.42'S	68°48.93'W	20	5	L6	S3
34	30 Mar 2019	22°27.70'S	68°49.61'W	141.8	1	H5	S2
35	20 Oct 2019	22°29.73'S	68°52.03'W	137	1	H5	S1
36	24 Mar 2019	22°28.88'S	68°48.00'W	1115	Many	L6	S2
37	18 Oct 2018	22°21.82'S	68°36.34'W	17	1	L5	S3
38	18 Oct 2019	22°29.05'S	68°48.17'W	220	Many	H3	S4
39	2019 Mar 30	22°29.320'S	68° 53.347'W	443	1	Diogenite	
40	2017 Oct 19	22°26.569'S	68°37.983'W	175.26	1	H4	S2
41	2017 Oct 14	22°22.855'S	68°35.996'W	1686.00	1	LL5	S2
42	2017 Oct 14	22°24.362 S	68°34.391 W	44.34	1	H4	S3
43	2017 Oct 24	22°27.941'S	68°38.858'W	148.52	2	H4	S1/2
44	9 Apr 2018	22°25.39'S	68°38.26'W	42.3	1	H5	S1
45	19 Oct 2019	22°8.50'S	68°37.37'W	2850	many	Diogenite-pm	
46	16 Oct 2019	22°26.93'S	68°37.98'W	238.1	many	H5	S1
47	16 Oct 2019	22°26.67'S	68°38.51'W	114	4	H5	S1
48	2017 Oct 19	22°26.854'S	68°36.489'W	1486	1	H(L)3	S2/3
49	30 Oct 2019	22°27.80'S	68°59.85'W	93.6	1	H5	S1
50	2018 Oct 27	22°28.25'S	68°51'W	36.13	1	CO3	
51	19 Oct 2019	22°10.81'S	68°37.17'W	37	1	H5	S1
52	29 Oct 2019	22°18.90'S	68°40.82'W	67	1	L5	S4
53	2018 Oct 26	22°29.15'S	68°51.05'W	205	51	L6	
54	22 July 2018	22°26.15S	68°50.01W	405	3	H6	S2
55	30 September	22°25.38S	68°48.51W	246	3	H6	S2
56	15 October 20	22°29.35S	68°51.26W	336	1	H5	S3
57	2018 Jul 22	22°26.36S	68°49.53W	79	3	L4	S1

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3	11 November	22°29.14S	68°51.51W	340	1	H5	S1
4	14 July 2018	22°26.11S	68°50.18W	54	2	H5	S3
5	30 September	22°26.01S	68°48.42W	40	3	L6	S3
6	17 September	22°26.34S	68°48.57W	110	3	H4	S2
7	17 Oct 2019	22°26.17'S	68°38.27'W	68	1	L5	S3
8	19 Oct 2019	22°8.21'S	68°37.23'W	160	1	L6	S4
9	19 Oct 2019	22°9.81'S	68°37.66'W	40	3	H5	S1
10	18 Oct 2019	22°27.26'S	68°49.08'W	30	1	L6	S1
11	16 Oct 2019	22°27.46'S	68°37.07'W	12	1	H6	S1
12	18 Oct 2019	22°27.98'S	68°49.29'W	18	1	L6	S3
13	18 Oct 2019	22°27.42'S	68°49.22'W	18	1	H3	S1
14	18 Oct 2019	22°27.47'S	68°49.21'W	55	1	L5	S2
15	8 Apr 2018	22°15.55'S	68°30.46'W	191	1	L5	S3
16	14 Oct 2018	22°26.16'S	68°45.02'W	640	2	H6	S1
17	28 Mar 2019	22°27.24'S	68°49.16'W	780	Many	H5	S2
18	19 Oct 2019	22°8.45'S	68°37.62'W	53	1	LL5	S1
19	19 Oct 2019	22°8.84'S	68°37.84'W	54	1	H5	S1
20	29 Oct 2019	22°16.54'S	68°38.69'W	28.4	1	L6	S3
21	30 Mar 2019	22°27.34'S	68°49.10'W	63	Many	L6	S3
22	9 Apr 2018	22°24.88'S	68°37.61'W	356	2	L6-melt brecci	S2
23	10 Oct 2018	22°28.92'S	68°47.94'W	13.5	1	H5	S2
24	17 Oct 2019	22°27.21'S	68°38.15'W	3.85	1	H5	S3
25	17 Oct 2019	22°27.20'S	68°38.48'W	61.35	2	H6	S2
26	19 Oct 2019	22°28.57'S	68°50.66'W	800	1	L6	S2
27	19 Oct 2019	22°28.45'S	68°50.65'W	3380	many	H5	S1
28	01 Apr 2019	22°29.19'S	68°44.24'W	15.6	1	H5	S2
29	01 Apr 2019	22°28.36'S	68°45.44'W	96.5	1	L5	S1
30	17 Oct 2019	22°27.12'S	68°38.18'W	173	5	L6	S4
31	19 Oct 2019	22°8.11'S	68°37.31'W	362	2	H5	S1
32	20 Oct 2019	22°29.10'S	68°50.21'W	79	1	H5	S1
33	30 Mar 2019	22°27.65'S	68°49.27'W	71.7	2	L5	S2
34	30 Mar 2019	22°27.72'S	68°49.27'W	13.08	2	L5	S3
35	30 Mar 2019	22°27.63'S	68°49.24'W	164.6	2	H5	S1
36	30 Mar 2019	22°28.68'S	68°49.17'W	104.8	6	H5	S1
37	1 Apr 2019	22°29.31'S	68°48.40'W	50	4	H5	S2
38	16 Oct 2019	22°27.19'S	68°38.64'W	219.7	many	H5	S1
39	20 Oct 2019	22°27.90'S	68°51.16'W	80	1	H5	S1
40	20 Oct 2016	21°34.97'S	69°38.48'W	7	1	L5	S1
41	21 Oct 2016	21°35.47'S	69°37.63'W	102	many	L5	S2
42	24 Oct 2016	21°35.44'S	69°38.28'W	22	1	H5	S1
43	25 Oct 2016	21°33.36'S	69°39.24'W	37	1	H5	S1
44	26 Oct 2016	21°34.65'S	69°36.90'W	9	1	H5	S1
45	20 Oct 2016	21°35.18'S	69°38.30'W	51	2	H5	S1
46	20 Oct 2016	21°35.70'S	69°37.72'W	75	1	H5	S2
47	21 Oct 2016	21°34.34'S	69°37.83'W	3.5	1	L5	S1
48	24 Oct 2016	21°37.00'S	69°37.13'W	21.6	Many	H5	S1
49	23 Oct 2016	21°35.73'S	69°37.89'W	3.6	1	L5	S1
50	20 Oct 2016	21°35.23'S	69°38.02'W	5	1	L6	S1
51	22 Oct 2016	21°35.27'S	69°38.17'W	3.5	1	LL5	S2
52	23 Oct 2016	21°36.73'S	69°37.18'W	2.1	1	L5	S2
53	25 Oct 2016	21°36.54'S	69°37.58'W	1.2	1	L6	S3
54	2018 Dec	24°14.016'S	70°18.986'W	1607	1	L6	
55	2018 Dec	24°08.781'S	70°21.324'W	3319	1	LL6	
56	2018 Dec	24°11.988'W	70°18.283'W	680	1	L6	
57	2018 Apr 14	24°11'32.4"S	70°21'30.5"W	14118	712	H5	

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3	2018 Dec	24°17.678'S	70°19.746'W	1046	1	L3	
4	2020 Apr 27	24°15'S	70°31'W	1590	1	Achondrite-un	
5	2007 Apr 24	30°19'S	126°37'E	49.28	1	H6	S3
6	1941	38°36.432'N	103°0.087'W	18370	1	H6	C-S3
7	22 Nov. 2017	25°14'S	69°43'W	13.9	1	H5	
8	22 Nov. 2017	25°14'S	69°43'W	17.7	1	L5/6	
9	12 Nov. 2017	25°14'S	69°43'W	29.9	1	H5	
10	22 Nov. 2017	25°14'S	69°43'W	12	1	L6	
11	22 Nov. 2017	25°14'S	69°43'W	14.3	1	H6	
12	2019 Nov 07	25°14'S	69°43'W	159	1	LL6	
13	2016 Nov 03	24°56'27.5"S	69°44'18.8"W	232	1	H4	
14	2014 Dec 22	25°14'S	69°43'W	22.2	1	H6	
15	2017 Nov 08	24°55'36.8"S	69°47'56.7"W	185	1	H5	
16	2010 Sep 30	25.039313°S	69.723858°W	158.7	1	H5	
17	2010 Sep 30	25.061942°S	69.711413°W	432.1	1	H5	
18	2014 Dec 20	24.91401407°	69.775555°W	609.9	1	H5	
19	2018 Oct 04	24°55'22.9"S	69°42'50.4"W	429	1	H5	
20	2019 Nov 25	24°56'29.9"S	69°44'35.4"W	4350	46	H6	
21	2019 Nov 25	24°56'21.3"S	69°44'05.4"W	593	6	H5	
22	2019 Nov 27	24°54'44.9"S	69°47'12.3"W	12	1	H5	
23	1 Jan 2020	44°49'44"N	10°58'20"E	55.3	2	L5-an	S2
24	5 Apr 2018	22°29.76'S	69°8.86'W	1520	Many	L5	S2
25	17 Oct 2018	22°29.49'S	69°6.72'W	95	1	H6	S2
26	2 Apr 2019	22°29.08'S	69°7.49'W	62.5	1	H5	S2
27	27 Oct 2018	22°29.46'S	69°07.57'W	5	1	H4-an	S1
28	22 Oct 2019	22°28.96'S	69°2.72'W	206	1	LL6	S1
29	28 Oct 2019	22°29.28'S	69°8.88'W	251	1	LL5	S1
30	21 Oct 2019	22°29.37'S	69°8.20'W	13	1	L(H)3	S3
31	21 Oct 2019	22°29.39'S	69°7.80'W	20	1	H5	S1
32	2018 Oct 13	22°29.86'S	69°2.66'W	55	1	L6	
33	29 Mar 2018	22°29.23'S	69°6.51'W	175	1	H5	S2
34	31 Mar 2018	22°29.37'S	69°10.15'W	361	1	H5	S1
35	1 Apr 2018	22°29.87'S	69°8.07'W	590	1	H5	S2
36	4 Apr 2018	22°28.70'S	69°6.51'W	324	many	H5	S1
37	16 Oct 2018	22°29.62'S	69°14.75'W	36.7	1	L5	S2
38	19 Oct 2018	22°28.77'S	69°7.79'W	1200	1	H6	S1
39	19 Oct 2018	22°28.68'S	69°7.80'W	1455	many	H5	S3
40	24 Oct 2018	22°29.00'S	69°7.87'W	625	1	H5	S1
41	22 Oct 2019	22°28.98'S	69°3.30'W	107.4	1	L6	S1
42	30 Oct 2019	22°28.81'S	69°0.83'W	1500	1	L6	S1
43	28 Oct 2019	22°29.70'S	69°7.70'W	46	1	L5	S1
44	28 Oct 2019	22°28.89'S	69°10.67'W	72.5	1	H5	S1
45	2018 Oct 13	22°29.86'S	69°2.66'W	9.29	1	L6	
46	2018 Oct 24	22°29.65'S	69°8.98'W	247.8	1	L6	
47	31 Mar 2018	22°29.38'S	69°10.18'W	86	1	H5	S1
48	04 Apr 2018	22°28.68'S	69°6.28'W	43	1	H5	S1
49	12 Oct 2018	22°29.56'S	69°8.04'W	163.3	2	H5	S1
50	19 Oct 2018	22°29.10'S	69°8.10'W	1080	Many	L5	S3
51	2018 Oct 20	22°29.97'S	69°2.37'W	12.7	1	LL6	
52	2018 Mar 18	22°29.969'S	69°10.181'W	1270	1	L4	S1
53	18 Oct 2019	22°29.13'S	69°15.72'W	338	2	H6	S3
54	25 Oct 2019	22°28.89'S	69°11.93'W	207.2	1	L6	S3
55	21 Oct 2019	22°29.65'S	69°7.65'W	44	1	L6	S1
56	17 Oct 2019	22°29.87'S	69°9.36'W	26	1	H6	S1
57	3 Apr 2018	22°28.93'S	69°5.35'W	2500	Many	L6	S3



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3	19 Oct 2018	22°29.07'S	69°7.52'W	2570	Many	H4	S1
4	21 Oct 2019	22°28.97'S	69°8.31'W	45	1	L6	S1
5	21 Oct 2019	22°29.65'S	69°7.71'W	26	1	L6	S1
6	22 Oct 2019	22°28.96'S	69°2.45'W	58	1	L5	S1
7	24 Oct 2019	22°29.13'S	69°12.63'W	21	1	L6	S2
8	24 Oct 2019	22°29.36'S	69°12.00'W	4.3	1	H6	S1
9	24 Oct 2019	22°29.35'S	69°12.17'W	47.6	1	H5	S2
10	24 Oct 2019	22°29.43'S	69°8.92'W	12.9	1	L5	S2
11	24 Oct 2019	22°29.39'S	69°8.64'W	36.5	1	H6	S1
12	30 Mar 2018	22°29.96'S	69°2.04'W	85.5	1	L5	S6
13	22 Oct 2019	22°28.74'S	69°2.22'W	80	1	H5	S2
14	22 Oct 2019	22°28.91'S	69°3.13'W	76	1	L6	S2
15	24 Oct 2019	22°29.49'S	69°12.24'W	59	1	H5	S3
16	17 Oct 2018	22°29.99'S	69°2.17'W	72	1	L4	S3
17	30 Mar 2018	22°27.82'S	69°0.001'W	67.8	1	L3	S1
18	28 Mar 2018	22°28.99'S	69°2.41'W	1712	Many	H5	S1
19	28 Mar 2018	22°28.86'S	69°1.96'W	1528	Many	L6	S1
20	30 Mar 2018	22°29.99'S	69°2.07'W	3100	Many	H5	S2
21	17 Oct 2019	22°29.5'S	69°8.14'W	58	1	L5	S1
22	17 Oct 2019	22°29.58'S	69°7.61'W	51	2	L6	S3
23	27 Mar 2019	22°29.76'S	69°2.26'W	79	1	L6	S4
24	5 Apr 2018	22°29.84'S	69°7.88'W	203	1	H3	S2
25	21 Oct 2018	22°29.94'S	69°10.40'W	202	1	H3	S1
26	21 Oct 2019	22°29.47'S	69°7.83'W	26.5	1	L6	S1
27	21 Oct 2019	22°29.46'S	69°7.68'W	27	1	H5	S1
28	21 Oct 2019	22°29.25'S	69°7.71'W	23.5	1	H5	S1
29	17 Oct 2018	22°29.93'S	69°2.02'W	198	1	L6	S3
30	21 Oct 2019	22°29.46'S	69°7.68'W	24.3	1	L6	S1
31	25 Oct 2019	22°29.24'S	69°9.55'W	73	1	H5	S3
32	25 Oct 2019	22°29.63'S	69°11.22'W	10	1	H5	S2
33	17 Oct 2018	22°29.88'S	69°2.38'W	49	1	L5	S5
34	23 Mar 2019	22°29.68'S	69°10.80'W	1310	many	H5	S3
35	31 Mar 2019	22°28.93'S	69°2.97'W	1650	many	H5	S1
36	2018 Jun 10	27°06'45.02"N	11°10'25.2"W	779	many	C3.00-ung	
37	2019	27°14.39' N	011° 40.12'W	249	1	CO3	C-S2
38	P 2020 Mar	27° 7'40.65"N	11°12'33.33"W	244	1	ureilite	low
39	2018 May 13	34°15.396'N	115°47.188'W	>1100	>150	LL3	S2
40	19 Oct 2019	22°8.34'S	69°37.73'W	168	2	H5	S2
41	15 Oct 2019	22°29.57'S	69°52.71'W	322	2	H5	S3
42	2013 Oct 16	40°25.924'N	116°30.754'W	2.47	2	H4	S2
43	2013 Oct 22	40°25.754'N	116°30.729'W	6.4	1	H4	S2
44	2019	31.25483°N	59.04573°E	3500	1	H6	
45	2017	-86.2629	-165.056	44.69	1	L5	
46	2017	-86.2636	-165.055	1.38	1	H5	
47	2010 Nov	18°49.60	54°43.33	14.5	1	L6	S2
48	2010	19°8.860'N	54°39.316'E	111	3	L6	S2
49	2010	18°36.424'N	54°6.637'E	122	1	L6	S2
50	2009	19°7.755'N	54°36.036'E	40	1	H4	S2
51	2009	18°42.557'N	54°21.904'E	124	1	H5	S2
52	2010	18°21.638'N	54°10.470'E	6	1	CM2	S1
53	2009	19°10.105'N	54°45.232'E	244	many	L5	S2
54	2011 Dec 6	18°40'43.6"N	54°17'15.4"E	5270	1	L5/6	S3
55	2018	-85.6562	167.246	52.791	1	CO3	
56	2018	-85.6294	166.968	35.9	1	CO3	
57	2018	-85.7	167.121	63.445	1	CO3	

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3	2018	-85.6514	167.23	15.92	1	Lunar (bas. br	
4	2018	-85.656	167.251	25.065	1	Lunar (bas. br	
5	2018	-85.6505	167.105	8.33	1	Eucrite-br	
6	2016	38°12'08"N	92°50'32"E	30.2	1	L5	S4
7	2018 Dec 12	38°26'15.05"N	92°29'59.14"E	25000	over 20	H4	
8	2019 Dec	25.229°N	08.624°W	12164	1	Eucrite-unbr	low
9	14 Nov. 2017	24°43.72'S	70°21.67'W	39.5	1	L6	
10	14 Nov. 2017	24°51'S	70°32'W	36.3	1	L6	
11	16 Nov. 2017	24°37.73'S	70°17.68'W	27.9	1	H5	
12	16 Nov. 2017	24°38.72'S	70°17.67'W	118.1	1	H5/6	
13	14 Nov. 2017	24°43.38'S	70°21.28'W	8.2	1	H5	
14	15 Nov. 2017	24°39.29'S	70°17.85'W	14.6	1	H5/6	
15	14 Nov. 2017	24°44.85'S	70°21.97'W	87.7	1	L5	
16	14 Nov. 2017	24°51'S	70°32'W	43.9	1	H5	
17	16 Nov. 2017	24°38.89'S	70°17.73'W	125	1	H5	
18	16 Nov. 2017	24°38.64'S	70°17.83'W	35.7	1	L6	
19	14 Nov. 2017	24°46.13'S	70°21.67'W	27.6	1	H5	
20	15 Nov. 2017	24°43.30'S	70°20.35'W	18.4	1	H5	
21	15 Nov. 2017	24°39.36'S	70°18.00'W	2.2	1	L5	
22	15 Nov. 2017	24°39.39'S	70°17.96'W	24	1	H6	
23	15 Nov. 2017	24°39.54'S	70°17.87'W	13.3	1	H5	
24	15 Nov. 2017	24°39.41'S	70°17.98'W	13	1	H5	
25	15 Nov. 2017	24°39.38'S	70°17.96'W	22.8	1	H5	
26	15 Nov. 2017	24°39.46'S	70°17.98'W	14.3	1	H5	
27	15 Nov. 2017	24°39.32'S	70°17.96'W	19.5	1	H6	
28	15 Nov. 2017	24°39.46'S	70°17.98'W	15	1	L6	
29	2017 Jun 19	24°49'08.3"S	70°03'05.8"W	54	1	L6	
30	14 Nov. 2017	24°44.75'S	70°21.49' W	167	1	EL6	
31	2019 Nov 05	24.665°S	70.289°W	410	1	LL5	
32	2017 May 17	24°48'36.5"S	70°04'13.8"W	48	1	L6	
33	2017 Nov 07	24°47'29.6"S	70°00'31.8"W	73	1	L6	
34	2017 Nov 06	24°51'S	70°32'W	194	1	H5	
35	2017 May 17	24°46'50.2"S	70°03'29.2"W	916	4	H5	
36	2017 Nov 07	24°51'S	70°32'W	94	1	L6	
37	2017 May 18	24°47'54.5"S	70°04'42.2"W	551	1	H5	
38	2017 May 18	24°47'17.4"S	70°03'47.9"W	927	1	H5	
39	2017 May 18	24°51'S	70°32'W	28	1	L6	
40	2017 May 18	24°51'S	70°32'W	30	1	L6	
41	2017 Jun 19	24°51'S	70°32'W	48	1	L6	
42	2017 Jun 19	24°51'S	70°32'W	12	1	L6	
43	2017 Nov 07	24°51'S	70°32'W	34	1	L6	
44	2019 Jan 10	24°46'12.1"S	70°06'27.9"W	666	1	H5	
45	2020	24°40.572'S	70°17.778'W	389	1	H5	S2
46	2020	24°41.080'S	70°18.340'W	298.9	1	H5	S2
47	2020	24°40.634'S	70°18.508'W	40	1	L6	S2
48	2019 Jan 10	24°48'01.3"S	70°05'53.6"W	1705	1	H5	
49	2016 Nov 04	24°51'S	70°32'W	3071	1	CO3	
50	2019 Jan 09	24°51'S	70°32'W	7090	1	CO3	
51	2019 Jan 10	24°51'S	70°32'W	5225	1	CO3	
52	2016	-76.2512	156.402	181.58	1	L5	
53	2016	-76.2364	156.693	220.52	1	H5	
54	2016	-76.2362	156.529	265.32	1	L6	
55	2016	-76.2386	156.529	251.98	1	L5	
56	2016	-76.2691	156.427	84.05	1	LL6	
57	2016	-76.241	156.38	90.47	1	L6	

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3	2016	-76.2552	156.391	105.74	1	L6
4	2016	-76.2392	156.544	114.33	1	H6
5	2016	-76.2553	156.39	90.89	1	L6
6	2016	-76.2514	156.401	102.81	1	L5
7	2016	-76.2402	156.535	79.77	1	L5
8	2016	-76.2765	156.526	82.66	1	L6
9	2016	-76.2405	156.367	52.06	1	L5
10	2016	-76.2572	156.414	110.69	1	L5
11	2016	-76.2483	156.375	55.65	1	L5
12	2016	-76.256	156.4	60.59	1	L6
13	2016	-76.2497	156.406	217.32	1	L6
14	2016	-76.256	156.416	337.63	1	L6
15	2016	-76.2674	156.568	160.72	1	H6
16	2016	-76.256	156.416	122.28	1	L5
17	2016	-76.253	156.384	91.59	1	L6
18	2016	-76.2593	156.409	59.48	1	L6
19	2016	-76.2566	156.36	60.46	1	L6
20	2016	-76.2548	156.359	24.7	1	L6
21	2016	-76.2574	156.361	22.92	1	L6
22	2016	-76.2578	156.389	31.92	1	L6
23	2016	-76.2523	156.365	17.63	1	L6
24	2016	-76.2708	156.423	55.68	1	L5
25	2016	-76.2514	156.357	28.11	1	L6
26	2016	-76.2535	156.352	27.7	1	L5
27	2016	-76.257	156.387	18.35	1	L6
28	2016	-76.2478	156.389	30.53	1	L6
29	2016	-76.2878	156.35	70.57	1	H4
30	2016	-76.2398	156.377	80.67	1	L6
31	2016	-76.2359	156.508	38.038	1	H5
32	2016	-76.2399	156.386	28.222	1	L6
33	2016	-76.2767	156.45	42.693	1	L6
34	2016	-76.2674	156.415	25.317	1	L6
35	2016	-76.2548	156.345	17.719	1	L5
36	2016	-76.2506	156.386	36.684	1	L6
37	2016	-76.2367	156.516	46.706	1	H5
38	2016	-76.2706	156.44	24.66	1	L5
39	2016	-76.2541	156.352	61.273	1	L5
40	2016	-76.2675	156.44	11.545	1	L6
41	2016	-76.261	156.39	13.26	1	L5
42	2016	-76.2561	156.408	12.474	1	L5
43	2016	-76.2518	156.366	14.85	1	H4
44	2016	-76.2536	156.356	14.542	1	L5
45	2016	-76.2522	156.353	25.869	1	L6
46	2016	-76.2599	156.397	29.738	1	L5
47	2016	-76.2536	156.387	19.483	1	L5
48	2016	-76.252	156.387	22.846	1	L5
49	2016	-76.2672	156.441	16.473	1	L6
50	2016	-76.2404	156.367	17.56	1	L6
51	2016	-76.2513	156.398	22.67	1	L5
52	2016	-76.2537	156.345	23.33	1	L5
53	2016	-76.2311	156.559	18.08	1	L5
54	2016	-76.2507	156.392	19.77	1	L5
55	2016	-76.2435	156.379	23.58	1	L6
56	2016	-76.2513	156.355	20.28	1	L5
57	2016	-76.2408	156.494	17.77	1	H6

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3	2016	-76.2406	156.558	6.7	1	H6
4	2016	-76.252	156.361	8.282	1	L5
5	2016	-76.2664	156.45	10.314	1	L5
6	2016	-76.267	156.441	9.71	1	L5
7	2016	-76.2496	156.373	5.645	1	L6
8	2016	-76.2802	156.355	14.145	1	LL6
9	2016	-76.2399	156.463	16.205	1	H6
10	2016	-76.2491	156.4	7.617	1	H6
11	2016	-76.2665	156.441	21.465	1	L5
12	2016	-76.2558	156.41	25.194	1	L5
13	2016	-76.2523	156.405	7.645	1	L5
14	2016	-76.2374	156.564	32.38	1	H5
15	2016	-76.2537	156.398	20.46	1	L6
16	2016	-76.2366	156.522	32.2	1	L5
17	2016	-76.2682	156.35	9.99	1	LL5
18	2016	-76.2476	156.539	11.26	1	L5
19	2016	-76.2414	156.527	9.25	1	H6
20	2016	-76.2553	156.39	9.07	1	L5
21	2016	-76.248	156.576	10.4	1	L5
22	2016	-76.2461	156.539	10.65	1	L5
23	2016	-76.2802	156.355	16.19	1	H4
24	2016	-76.2524	156.352	18.09	1	L6
25	2016	-76.2658	156.454	13.97	1	L6
26	2016	-76.2564	156.395	16.51	1	L5
27	2016	-76.2539	156.381	12.67	1	L6
28	2016	-76.2675	156.44	17.44	1	L5
29	2016	-76.2535	156.359	12.41	1	L5
30	2016	-76.2521	156.387	9.84	1	L5
31	2016	-76.2679	156.351	10.51	1	L5
32	2016	-76.2529	156.383	6.475	1	L5
33	2016	-76.2541	156.553	4.541	1	L5
34	2016	-76.2392	156.363	14.865	1	L6
35	2016	-76.2553	156.39	12.85	1	L6
36	2016	-76.2306	156.505	29.755	1	H6
37	2016	-76.2396	156.364	8.725	1	L5
38	2016	-76.2409	156.449	18.058	1	L5
39	2016	-76.2546	156.346	10.325	1	L5
40	2016	-76.2514	156.347	12.604	1	L5
41	2016	-76.2345	156.515	4.65	1	H6
42	2016	-76.259	156.391	3.72	1	L6
43	2016	-76.256	156.4	5.48	1	L6
44	2016	-76.2529	156.384	3.86	1	H6
45	2016	-76.2534	156.364	8.2	1	H5
46	2016	-76.263	156.365	2.53	1	L5
47	2016	-76.2414	156.534	4.24	1	L6
48	2016	-76.2542	156.35	4.22	1	L5
49	2016	-76.2506	156.388	4.47	1	L6
50	2016	-76.2403	156.502	2.87	1	H6
51	2016	-76.2353	156.518	3.76	1	H6
52	2016	-76.2556	156.548	3.13	1	H5
53	2016	-76.2535	156.548	4.03	1	L5
54	2016	-76.2544	156.35	3.48	1	L6
55	2016	-76.2657	156.454	2.47	1	L6
56	2016	-76.2509	156.549	2.46	1	H6
57	2016	-76.2547	156.345	4.15	1	L6

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3	2016	-76.2348	156.52	1.48	1	H6
4	2016	-76.2404	156.501	1.2	1	H6
5	2016	-76.2459	156.538	1.67	1	L4
6	2016	-76.24	156.51	2.05	1	L6
7	2016	-76.2352	156.532	2.24	1	LL5
8	2016	-76.2342	156.502	3.17	1	H6
9	2016	-76.2347	156.517	2.15	1	H6
10	2016	-76.2576	156.403	2.26	1	L6
11	2016	-76.2566	156.587	1.36	1	H5
12	2016	-76.2403	156.502	2.49	1	H6
13	2016	-76.2544	156.392	3.619	1	L6
14	2016	-76.2547	156.345	6.48	1	L6
15	2016	-76.2511	156.349	5.754	1	L5
16	2016	-76.2401	156.362	4.757	1	L6
17	2016	-76.2388	156.507	6.409	1	L3.5
18	2016	-76.2524	156.349	8.468	1	L6
19	2016	-76.2518	156.354	5.456	1	L6
20	2016	-76.2443	156.378	3.265	1	L6
21	2016	-76.2524	156.4	4.067	1	L5
22	2016	-76.2596	156.397	3.869	1	L6
23	2016	-76.2541	156.546	3.63	1	L5
24	2016	-76.2464	156.541	1.9	1	H6
25	2016	-76.2529	156.35	2.43	1	L6
26	2016	-76.2505	156.539	3.5	1	H6
27	2016	-76.2469	156.54	2.58	1	H6
28	2016	-76.2347	156.518	1.41	1	L5
29	2016	-76.2678	156.43	3.97	1	L4
30	2016	-76.2344	156.494	2.42	1	H4
31	2016	-76.2528	156.364	2.72	1	Acapulcoite
32	2016	-76.2503	156.574	4.49	1	L5
33	2016	-76.2367	156.487	2.93	1	H6
34	2016	-76.2511	156.349	2.39	1	L6
35	2016	-76.235	156.521	1.56	1	H6
36	2016	-76.2355	156.522	1.52	1	CK5
37	2016	-76.2351	156.519	1.07	1	L6
38	2016	-76.2346	156.512	1.14	1	H6
39	2016	-76.234	156.503	2.26	1	H6
40	2016	-76.249	156.396	1.14	1	L6
41	2016	-76.2409	156.524	1.27	1	H6
42	2016	-76.2375	156.5	2.13	1	H6
43	2016	-76.2582	156.571	1.31	1	L6
44	2016	-76.2477	156.539	1.47	1	H5
45	2016	-76.2398	156.488	2.75	1	H5
46	2016	-76.2349	156.578	1.49	1	H6
47	2016	-76.2548	156.345	1.36	1	LL6
48	2016	-76.2388	156.491	4.72	1	H6
49	2016	-76.2262	156.501	2.02	1	H6
50	2016	-76.2235	156.576	2.84	1	L5
51	2016	-76.2348	156.516	1.5	1	L6
52	2016	-76.2523	156.352	3.86	1	L6
53	2016	-76.2283	156.592	1.24	1	H6
54	2018	~43°40'N	~112° 0'E	117.9	1	H~6
55	2019 Apr 12	43°26'44"N	111°57'9"E	38000	15	L5
56	2020 May	26.032°N	1.611°W	31783	23	Achondrite-un low
57	P 2020 Mar	32°02.250'N	4°03.733'W	247	many	Winonaite



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3	2019 Sept 12	54°45.6873' N	9°22.7353' E	24.5	1	C1-ung
4	2017 Apr 03	27° 51.052'N	12° 9.670'W	279	1	L4
5	P 2019 May	30.203°N	9.535°E	7000	3	Martian (sherc high
6	3 Jan 2017	31°52.223'N	57°08.846'E	299.89	1	H5 S3/4
7	3 Jan 2017	31°54.296'N	57°02.350'E	78.75	4	H4 S3
8	22. June 2014	37°35'29.80"N	92°17'38.48"E	3903	5	L~5
9	22. June 2014	37°35'32.88"N	92°17'53.90"E	1184	1	L~5
10	June 2014	~37°35'30"N	~92°17'30"E	125.8	1	L~5
11	June 2014	~37°35'30"N	~92°17'40"E	150	1	L~6
12	2020 Apr 24	0.570°S	37.29°E	~25000	several	L6 S2
13	2020 Jan 7	26.803056	13.535278	265	1	Lunar (anorth) low
14	2011 May 1	32°08.999'N	111°06.817'W	16.7	1	H4
15	2018 Nov 20	36°23'18.3"N	29°44'08.6"E	1100	1	L6
16	2017 Jul 12	29°20'25.91"N	91°4'57.12"E	3544	1	L5
17	June 2019	13°49'15.4"N	9°00'10.8"E	189.0	1	R4 S3
18	2020	29°48.79'N	2°56.66'E	3273	1	Eucrite-mmict moderate
19	2017	-85.92	174.395	6.74	1	H6
20	2017	-85.916	174.404	99.35	1	H6
21	2017	-85.9283	174.4	10.06	1	H5
22	2017	-85.9184	174.41	35.07	1	H6
23	2017	-85.9214	174.408	39.26	1	H6
24	2017	-85.9196	174.39	44.56	1	L3.8
25	2017	-85.8499	174.15	17.609	1	H6
26	2017	-85.8516	174.173	12.412	1	L6
27	2017	-85.921	174.373	9.296	1	H6
28	2017	-85.8492	174.141	16.777	1	L6
29	2017	-85.8409	174.414	11.145	1	H6
30	2017	-85.9194	174.348	11.136	1	H5
31	2017	-85.8529	174.189	30.45	1	H6
32	2017	-85.8462	174.119	23.653	1	H5
33	2017	-85.9204	174.363	12.656	1	L6
34	2017	-85.9183	174.338	3.204	1	L5
35	2017	-85.9174	174.303	59.83	1	H6
36	2017	-85.8403	174.07	116.54	1	H5
37	2017	-85.8494	174.143	37.92	1	H6
38	2017	-85.8494	174.146	71.04	1	H6
39	2017	-85.8526	174.184	52.73	1	H6
40	2017	-85.9227	174.282	92.43	1	L3.4
41	2017	-85.9037	174.27	87.93	1	L6
42	2017	-85.8078	173.803	80.95	1	L4
43	2017	-85.9046	174.316	363.69	1	H6
44	2017	-85.7739	173.572	20.694	1	L5
45	2017	-85.9012	174.128	25.246	1	H6
46	2017	-85.8005	173.929	35.919	1	L5
47	2017	-85.9257	174.353	26.689	1	H5
48	2017	-85.8511	174.164	16.699	1	L6
49	2017	-85.8527	174.186	25.572	1	H6
50	2017	-85.7995	173.909	19.203	1	LL4
51	2017	-85.9054	174.722	40.973	1	L5
52	2017	-85.8511	174.165	195.164	1	H6
53	2017	-85.8531	174.19	186.291	1	H6
54	2017	-85.8525	174.184	133.935	1	H6
55	2017	-85.9006	174.258	175.33	1	H5
56	2017	-85.8459	174.116	154.461	1	H5
57	2017	-85.8489	174.136	158.66	1	H6

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3	2017	-85.8367	174.033	79.87	1	H6
4	2017	-85.9218	174.41	60.39	1	H5
5	2017	-85.8515	174.174	954.2	1	H4
6	2017	-85.8531	174.19	1578.3	1	L6
7	2017	-85.8516	174.173	2502.8	1	L5
8	2017	-85.8495	174.144	1168.61	1	L6
9	2017	-85.9049	174.295	3192.08	1	LL5
10	2017	-85.8512	174.166	524.29	1	L5
11	2017	-85.841	174.1	2144.7	1	L5
12	2017	-85.8393	174.096	9485	1	L5
13	2017	-85.9197	174.45	219.386	1	H6
14	2017	-85.8206	174.028	388.56	1	H5
15	2017	-85.8455	174.112	268.96	1	H6
16	2017	-85.901	174.152	142.33	1	H5
17	2017	-85.8004	173.913	275.54	1	H6
18	2017	-85.8522	174.182	174.84	1	H6
19	2017	-85.9149	174.396	114.85	1	H5
20	2017	-85.851	174.164	184.077	1	H6
21	2017	-85.9154	174.321	71.59	1	H5
22	2017	-85.8477	174.123	287.54	1	H5
23	2017	-85.8514	174.169	436.73	1	H5
24	2017	-85.9191	174.436	109.77	1	H5
25	2017	-85.921	174.413	150.23	1	H6
26	2017	-85.8089	173.913	101.7	1	L4
27	2017	-85.9163	174.363	104.8	1	H5
28	2017	-85.9109	174.361	111.48	1	H6
29	2017	-85.9166	174.795	138.87	1	LL6
30	2017	-85.9165	174.417	277.19	1	L5
31	2017	-85.9196	174.445	309.88	1	H6
32	2017	-85.9027	174.15	166.37	1	H6
33	2017	-85.8503	174.156	121.27	1	H6
34	2017	-85.9098	174.308	40.839	1	L6
35	2017	-85.8455	174.112	109.798	1	H5
36	2017	-85.9046	174.861	41.982	1	L5
37	2017	-85.8458	174.116	57.111	1	H5
38	2017	-85.8531	174.19	40.471	1	H6
39	2017	-85.8002	173.851	18.591	1	L6
40	2017	-85.9139	174.382	10.428	1	H6
41	2017	-85.9212	174.395	11.488	1	H6
42	2017	-85.9137	174.359	5.676	1	H6
43	2017	-85.9194	174.394	5.03	1	H5
44	2017	-85.9204	174.379	18.315	1	H6
45	2017	-85.9183	174.404	30.262	1	L6
46	2017	-85.9156	174.362	13.995	1	H5
47	2017	-85.9169	174.422	1168.46	1	L6
48	2017	-85.9199	174.445	2811.74	1	H6
49	2017	-85.8347	174.074	2703.04	1	H5
50	2017	-85.8499	174.15	688.39	1	L6
51	2017	-85.8424	174.09	694.32	1	L5
52	2017	-85.8225	174.166	250.76	1	H6
53	2017	-85.8472	174.123	564.73	1	L6
54	2017	-85.8378	174.055	467.59	1	H6
55	2017	-85.8519	174.177	6.71	1	H6
56	2017	-85.9216	174.384	8.5	1	L6
57	2017	-85.903	174.773	16.32	1	EH3

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2						
3	2017	-85.8985	174.116	32.07	1	L5
4	2017	-85.8056	173.811	22.96	1	H6
5	2017	-85.9212	174.383	15.66	1	L5
6	2017	-85.851	174.164	32.86	1	L6
7	2017	-85.8483	174.13	11.03	1	H5
8	2017	-85.8494	174.143	17	1	L6
9	2017	-85.9182	174.408	91.43	1	L4
10	2017	-85.9184	174.414	101.87	1	H6
11	2017	-85.9198	174.449	136.2	1	LL5
12	2017	-85.9165	174.407	70.14	1	H6
13	2017	-85.9215	174.406	24.21	1	L5
14	2017	-85.8778	174.484	39.64	1	H6
15	2017	-85.911	174.354	32.94	1	H6
16	2017	-85.9201	174.403	25.96	1	L6
17	2017	-85.9217	174.398	26.95	1	L6
18	2017	-85.9138	174.37	7.78	1	H6
19	2017	-85.9159	174.397	14.59	1	L6
20	2017	-85.915	174.388	8.51	1	H5
21	2017	-85.9211	174.374	14.01	1	H5
22	2017	-85.8492	174.141	14.02	1	H6
23	2017	-85.9183	174.337	9.75	1	L4
24	2017	-85.9158	174.415	18.34	1	H6
25	2017	-85.914	174.383	11.57	1	H6
26	2017	-85.8557	174.215	728.43	1	L6
27	2017	-85.8546	174.207	1188.99	1	L6
28	2017	-85.8546	174.206	697.48	1	L5
29	2017	-85.9183	174.414	160.67	1	L5
30	2017	-85.9383	174.399	186.24	1	L6
31	2017	-85.8017	173.874	290.11	1	L6
32	2017	-85.9169	174.421	250.31	1	L6
33	2017	-85.9008	174.265	189.84	1	H5
34	2017	-85.9111	174.373	136.28	1	H5
35	2017	-85.7983	173.877	64.88	1	H6
36	2017	-85.817	173.833	59.36	1	L6
37	2017	-85.8547	174.206	48.64	1	H6
38	2017	-85.8547	174.206	82.36	1	H6
39	2017	-85.8531	174.187	50.32	1	L6
40	2017	-85.8531	174.192	55.22	1	H6
41	2017	-85.8035	173.922	40.94	1	L4
42	2017	-85.8537	174.198	69.3	1	H5
43	2017	-85.8537	174.198	97.35	1	H5
44	2017	-85.8547	174.206	85.52	1	L5
45	2017	-85.8529	174.191	76.6	1	H6
46	2017	-85.8047	173.878	65.6	1	L5
47	2017	-85.8511	174.163	93.83	1	L6
48	2017	-85.8541	174.201	61.77	1	H6
49	2017	-85.853	174.189	116.16	1	H5
50	2017	-85.8552	174.21	150.48	1	H5
51	2017	-85.9238	174.257	174.11	1	L5
52	2017	-85.8532	174.192	121.65	1	L3.4
53	2017	-85.795	173.984	302.29	1	H5
54	2017	-85.8025	173.881	321.34	1	H5
55	2017	-85.8538	174.198	219.35	1	H5
56	2017	-85.8558	174.216	473.9	1	H6
57	2017	-85.851	174.165	94.16	1	H6

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3	2017	-85.8457	174.112	65.77	1	L3.4	
4	2017	-85.8519	174.177	89.41	1	H6	
5	2017	-85.8511	174.164	93.28	1	H6	
6	2017	-85.9061	174.731	17.766	1	L5	
7	2017	-85.7877	173.753	8.77	1	H5	
8	2017	-85.8529	174.188	118.514	1	L6	
9	2017	-85.8072	173.919	25.328	1	L5	
10	2017	-85.8533	174.195	29.47	1	H6	
11	2017	-85.853	174.19	45.995	1	H6	
12	2017	-85.8559	174.216	25.604	1	H6	
13	2017	-85.8036	173.894	38.739	1	H6	
14	2017	-85.8504	174.124	51.408	1	H6	
15	2017	-85.8533	174.193	19.48	1	H6	
16	2017	-85.8537	174.197	34.771	1	H6	
17	2017	-85.8553	174.212	32.036	1	H6	
18	2017	-85.8341	174.018	87.154	1	H5	
19	2017	-85.9135	174.207	74.281	1	H5	
20	2017	-85.9249	174.371	81.269	1	L5	
21	2017	-85.8499	174.15	18.968	1	H6	
22	2017	-85.851	174.165	48.284	1	H6	
23	2017	-85.8489	174.137	19.622	1	H6	
24	2017	-85.921	174.389	6.535	1	H6	
25	2017	-85.9214	174.385	8.19	1	H5	
26	2017	-85.9194	174.354	10.254	1	LL5	
27							
28	8 Jan 2003	72°59'33"S	75°12'23"E	0.67	1	H4	S2
29	8 Jan 2003	72°59'33"S	75°12'23"E	0.95	1	H4	S2
30	8 Jan 2003	72°59'33"S	75°12'23"E	1.66	1	H5	S2
31	8 Jan 2003	72°59'33"S	75°12'23"E	2.04	1	H5	S2
32	8 Jan 2003	72°59'33"S	75°12'23"E	1.27	1	H4	S2
33	8 Jan 2003	72°59'33"S	75°12'23"E	0.12	1	H5	S2
34	8 Jan 2003	72°59'33"S	75°12'23"E	2.37	1	H4	S2
35	8 Jan 2003	72°59'33"S	75°12'23"E	10.7	1	H5	S2
36	8 Jan 2003	72°59'15"S	75°12'36"E	5	1	L6	S2
37	9 Jan 2003	72°59'36"S	75°12'44"E	3.04	1	H4	S2
38	9 Jan 2003	72°58'59"S	75°13'45"E	0.42	1	H5	S4
39	9 Jan 2003	72°58'59"S	75°13'45"E	0.29	1	H5	S2
40	9 Jan 2003	72°58'59"S	75°13'45"E	2.92	1	H5	S3
41	9 Jan 2003	72°58'59"S	75°13'45"E	2.26	1	H4	S4
42	9 Jan 2003	72°58'59"S	75°13'45"E	1.71	1	H4	S4
43	9 Jan 2003	72°58'59"S	75°13'45"E	1.26	1	H4	S2
44	9 Jan 2003	72°58'59"S	75°13'45"E	0.75	1	H5	S2
45	9 Jan 2003	72°58'59"S	75°13'45"E	0.53	1	H5	S3
46	9 Jan 2003	72°58'59"S	75°13'45"E	0.34	1	H5	S2
47	9 Jan 2003	72°58'59"S	75°13'45"E	0.49	1	H5	S3
48	9 Jan 2003	72°58'59"S	75°13'45"E	0.39	1	H4	S4
49	9 Jan 2003	72°58'59"S	75°13'45"E	0.22	1	H5	S2
50	9 Jan 2003	72°58'59"S	75°13'45"E	0.18	1	H5	S3
51	9 Jan 2003	72°58'59"S	75°13'45"E	0.18	1	H5	S4
52	9 Jan 2003	72°58'59"S	75°13'45"E	0.21	1	H5	S4
53	9 Jan 2003	72°58'59"S	75°13'45"E	0.07	1	H5	S3
54	9 Jan 2003	72°58'59"S	75°13'45"E	0.06	1	H5	S3
55	10 Jan 2003	72°58'44"S	75°15'39"E	3.61	1	H4	S4
56	10 Jan 2003	72°58'44"S	75°15'39"E	4.79	1	H4	S2
57	10 Jan 2003	72°58'44"S	75°15'39"E	1.04	1	LL6	S2
58	10 Jan 2003	72°59'02"S	75°14'47"E	7.34	1	L6	S2
59							
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3	10 Jan 2003	72°59'02"S	75°14'47"E	3.76	1	L4	S2
4	10 Jan 2003	72°59'02"S	75°14'47"E	1.46	1	L6	S2
5	10 Jan 2003	72°59'02"S	75°14'47"E	0.95	1	L4	S2
6	10 Jan 2003	72°59'02"S	75°14'47"E	1.93	1	L5	S2
7	10 Jan 2003	72°59'02"S	75°14'47"E	1.49	1	L5	S2
8	10 Jan 2003	72°59'02"S	75°14'47"E	1.68	1	L5	S3
9	10 Jan 2003	72°59'02"S	75°14'47"E	2.22	1	L5	S2
10	10 Jan 2003	72°59'02"S	75°14'47"E	2.23	1	L6	S2
11	10 Jan 2003	72°59'02"S	75°14'47"E	1.67	1	L5	S2
12	10 Jan 2003	72°59'02"S	75°14'47"E	1.47	1	L5	S3
13	10 Jan 2003	72°59'02"S	75°14'47"E	1.93	1	L5	S3
14	10 Jan 2003	72°59'02"S	75°14'47"E	1.42	1	L5	S2
15	10 Jan 2003	72°59'02"S	75°14'47"E	1.6	1	H6	S2
16	10 Jan 2003	72°59'02"S	75°14'47"E	1.1	1	L6	S3
17	10 Jan 2003	72°59'02"S	75°14'47"E	1.02	1	L5	S3
18	10 Jan 2003	72°59'02"S	75°14'47"E	1.22	1	L5	S3
19	10 Jan 2003	72°59'02"S	75°14'47"E	1.02	1	L6	S3
20	10 Jan 2003	72°59'02"S	75°14'47"E	0.93	1	L6	S2
21	10 Jan 2003	72°59'02"S	75°14'47"E	0.93	1	L5	S3
22	10 Jan 2003	72°59'02"S	75°14'47"E	0.72	1	L5	S3
23	10 Jan 2003	72°59'02"S	75°14'47"E	0.93	1	L6	S3
24	10 Jan 2003	72°59'02"S	75°14'47"E	0.73	1	L5	S2
25	10 Jan 2003	72°59'02"S	75°14'47"E	0.85	1	L5	S3
26	10 Jan 2003	72°59'02"S	75°14'47"E	0.56	1	L5	S2
27	10 Jan 2003	72°59'02"S	75°14'47"E	0.61	1	L5	S2
28	10 Jan 2003	72°59'02"S	75°14'47"E	0.66	1	L5	S3
29	10 Jan 2003	72°59'02"S	75°14'47"E	0.61	1	H5	S2
30	10 Jan 2003	72°59'02"S	75°14'47"E	0.74	1	H5	S2
31	10 Jan 2003	72°59'02"S	75°14'47"E	0.77	1	L5	S2
32	10 Jan 2003	72°59'02"S	75°14'47"E	0.71	1	L5	S2
33	10 Jan 2003	72°59'02"S	75°14'47"E	0.56	1	L4	S4
34	10 Jan 2003	72°59'02"S	75°14'47"E	0.5	1	L5	S3
35	10 Jan 2003	72°59'02"S	75°14'47"E	0.51	1	L4	S4
36	10 Jan 2003	72°59'02"S	75°14'47"E	0.33	1	L5	S2
37	10 Jan 2003	72°59'02"S	75°14'47"E	0.34	1	L5	S2
38	10 Jan 2003	72°59'02"S	75°14'47"E	0.49	1	L5	S3
39	10 Jan 2003	72°59'02"S	75°14'47"E	0.25	1	L5	S3
40	10 Jan 2003	72°59'02"S	75°14'47"E	0.41	1	L5	S2
41	10 Jan 2003	72°59'02"S	75°14'47"E	0.5	1	L5	S4
42	10 Jan 2003	72°59'02"S	75°14'47"E	0.34	1	L5	S3
43	10 Jan 2003	72°59'02"S	75°14'47"E	0.43	1	L5	S4
44	10 Jan 2003	72°59'02"S	75°14'47"E	0.57	1	L5	S3
45	10 Jan 2003	72°59'02"S	75°14'47"E	0.41	1	L5	S3
46	10 Jan 2003	72°59'02"S	75°14'47"E	0.62	1	L5	S2
47	10 Jan 2003	72°59'02"S	75°14'47"E	0.43	1	L5	S3
48	10 Jan 2003	72°59'02"S	75°14'47"E	0.34	1	L5	S3
49	10 Jan 2003	72°59'02"S	75°14'47"E	0.35	1	L5	S3
50	10 Jan 2003	72°59'02"S	75°14'47"E	0.26	1	L6	S4
51	10 Jan 2003	72°59'02"S	75°14'47"E	0.33	1	L4	S2
52	10 Jan 2003	72°59'02"S	75°14'47"E	0.56	1	L5	S2
53	10 Jan 2003	72°59'02"S	75°14'47"E	0.5	1	L5	S2
54	10 Jan 2003	72°59'02"S	75°14'47"E	0.32	1	L5	S2
55	10 Jan 2003	72°59'02"S	75°14'47"E	0.3	1	L5	S2
56	10 Jan 2003	72°59'02"S	75°14'47"E	0.38	1	L5	S4
57	10 Jan 2003	72°59'02"S	75°14'47"E	0.58	1	L5	S3



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2							
3	10 Jan 2003	72°59'02"S	75°14'47"E	0.31	1	L5	S2
4	10 Jan 2003	72°59'02"S	75°14'47"E	0.35	1	L5	S4
5	10 Jan 2003	72°59'02"S	75°14'47"E	0.38	1	L5	S4
6	10 Jan 2003	72°59'02"S	75°14'47"E	0.28	1	L5	S3
7	10 Jan 2003	72°59'02"S	75°14'47"E	0.36	1	L5	S2
8	10 Jan 2003	72°59'02"S	75°14'47"E	0.28	1	H5	S2
9	10 Jan 2003	72°59'02"S	75°14'47"E	0.06	1	H4	S2
10	10 Jan 2003	72°59'02"S	75°14'47"E	0.32	1	L5	S2
11	10 Jan 2003	72°59'02"S	75°14'47"E	0.41	1	L5	S2
12	10 Jan 2003	72°59'02"S	75°14'47"E	0.34	1	L5	S2
13	10 Jan 2003	72°59'02"S	75°14'47"E	0.2	1	L5	S4
14	10 Jan 2003	72°59'02"S	75°14'47"E	0.29	1	L5	S2
15	10 Jan 2003	72°59'02"S	75°14'47"E	0.37	1	L5	S2
16	10 Jan 2003	72°59'02"S	75°14'47"E	0.36	1	L6	S3
17	10 Jan 2003	72°59'02"S	75°14'47"E	0.24	1	L4	S2
18	10 Jan 2003	72°59'02"S	75°14'47"E	0.33	1	L5	S3
19	10 Jan 2003	72°59'02"S	75°14'47"E	0.34	1	L6	S4
20	10 Jan 2003	72°59'02"S	75°14'47"E	0.4	1	L5	S4
21	10 Jan 2003	72°59'02"S	75°14'47"E	0.32	1	L5	S2
22	10 Jan 2003	72°59'02"S	75°14'47"E	0.35	1	L4	S2
23	10 Jan 2003	72°59'02"S	75°14'47"E	0.31	1	L5	S4
24	10 Jan 2003	72°59'02"S	75°14'47"E	0.42	1	L5	S2
25	10 Jan 2003	72°59'02"S	75°14'47"E	0.29	1	L4	S4
26	10 Jan 2003	72°59'02"S	75°14'47"E	0.23	1	H5	S2
27	10 Jan 2003	72°59'02"S	75°14'47"E	0.26	1	L5	S4
28	10 Jan 2003	72°59'02"S	75°14'47"E	0.23	1	L5	S3
29	10 Jan 2003	72°59'02"S	75°14'47"E	0.21	1	L5	S3
30	10 Jan 2003	72°59'02"S	75°14'47"E	0.23	1	L5	S4
31	10 Jan 2003	72°59'02"S	75°14'47"E	0.22	1	L5	S2
32	10 Jan 2003	72°59'02"S	75°14'47"E	0.25	1	L5	S2
33	10 Jan 2003	72°59'02"S	75°14'47"E	0.24	1	L5	S4
34	10 Jan 2003	72°59'02"S	75°14'47"E	0.18	1	L4	S3
35	10 Jan 2003	72°59'02"S	75°14'47"E	0.21	1	L5	S2
36	10 Jan 2003	72°59'02"S	75°14'47"E	0.23	1	L5	S2
37	10 Jan 2003	72°59'02"S	75°14'47"E	0.25	1	L5	S2
38	10 Jan 2003	72°59'02"S	75°14'47"E	0.26	1	L5	S4
39	10 Jan 2003	72°59'02"S	75°14'47"E	0.18	1	L4	S3
40	10 Jan 2003	72°59'02"S	75°14'47"E	0.18	1	L5	S4
41	10 Jan 2003	72°59'02"S	75°14'47"E	0.27	1	L5	S2
42	10 Jan 2003	72°59'02"S	75°14'47"E	0.21	1	L4	S2
43	10 Jan 2003	72°59'02"S	75°14'47"E	0.2	1	L5	S3
44	10 Jan 2003	72°59'02"S	75°14'47"E	0.19	1	L5	S3
45	10 Jan 2003	72°59'02"S	75°14'47"E	0.29	1	L5	S4
46	10 Jan 2003	72°59'02"S	75°14'47"E	0.23	1	L5	S3
47	10 Jan 2003	72°59'02"S	75°14'47"E	0.22	1	L5	S2
48	10 Jan 2003	72°59'02"S	75°14'47"E	0.18	1	L6	S2
49	10 Jan 2003	72°59'02"S	75°14'47"E	0.13	1	L5	S2
50	10 Jan 2003	72°59'02"S	75°14'47"E	0.17	1	H5	S3
51	10 Jan 2003	72°59'02"S	75°14'47"E	0.21	1	L5	S4
52	10 Jan 2003	72°59'02"S	75°14'47"E	0.24	1	H4	S2
53	10 Jan 2003	72°59'02"S	75°14'47"E	0.21	1	L5	S3
54	10 Jan 2003	72°59'02"S	75°14'47"E	0.15	1	L5	S2
55	10 Jan 2003	72°59'02"S	75°14'47"E	0.26	1	L5	S3
56	10 Jan 2003	72°59'02"S	75°14'47"E	0.21	1	L5	S2
57	10 Jan 2003	72°59'02"S	75°14'47"E	0.24	1	L5	S4
58	10 Jan 2003	72°59'02"S	75°14'47"E	0.21	1	L5	S2
59	10 Jan 2003	72°59'02"S	75°14'47"E	0.24	1	L5	S4
60	10 Jan 2003	72°59'02"S	75°14'47"E	0.24	1	L5	S4

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3	10 Jan 2003	72°59'02"S	75°14'47"E	0.15	1	L4	S3
4	10 Jan 2003	72°59'02"S	75°14'47"E	0.17	1	L4	S2
5	10 Jan 2003	72°59'02"S	75°14'47"E	0.21	1	L5	S4
6	10 Jan 2003	72°59'02"S	75°14'47"E	0.18	1	L5	S3
7	10 Jan 2003	72°59'02"S	75°14'47"E	0.2	1	L5	S2
8	10 Jan 2003	72°59'02"S	75°14'47"E	0.23	1	L5	S3
9	10 Jan 2003	72°59'02"S	75°14'47"E	0.13	1	L5	S2
10	10 Jan 2003	72°59'02"S	75°14'47"E	0.12	1	L5	S2
11	10 Jan 2003	72°59'02"S	75°14'47"E	0.14	1	L4	S3
12	10 Jan 2003	72°59'02"S	75°14'47"E	0.22	1	L4	S2
13	10 Jan 2003	72°59'02"S	75°14'47"E	0.15	1	L5	S2
14	10 Jan 2003	72°59'02"S	75°14'47"E	0.14	1	L5	S3
15	10 Jan 2003	72°59'02"S	75°14'47"E	0.19	1	L4	S2
16	10 Jan 2003	72°59'02"S	75°14'47"E	0.12	1	L4	S4
17	10 Jan 2003	72°59'02"S	75°14'47"E	0.16	1	L5	S3
18	10 Jan 2003	72°59'02"S	75°14'47"E	0.23	1	L5	S3
19	10 Jan 2003	72°59'02"S	75°14'47"E	0.24	1	L5	S3
20	10 Jan 2003	72°59'02"S	75°14'47"E	0.24	1	L5	S3
21	10 Jan 2003	72°59'02"S	75°14'47"E	0.14	1	L5	S3
22	10 Jan 2003	72°59'02"S	75°14'47"E	0.3	1	L5	S3
23	10 Jan 2003	72°59'02"S	75°14'47"E	0.2	1	L6	S4
24	10 Jan 2003	72°59'02"S	75°14'47"E	0.24	1	L5	S4
25	10 Jan 2003	72°59'02"S	75°14'47"E	0.18	1	L5	S3
26	10 Jan 2003	72°59'02"S	75°14'47"E	0.13	1	L5	S2
27	10 Jan 2003	72°59'02"S	75°14'47"E	0.18	1	L5	S2
28	10 Jan 2003	72°59'02"S	75°14'47"E	0.2	1	L5	S2
29	10 Jan 2003	72°59'02"S	75°14'47"E	0.11	1	L5	S2
30	10 Jan 2003	72°59'02"S	75°14'47"E	0.17	1	L4	S3
31	10 Jan 2003	72°59'02"S	75°14'47"E	0.18	1	L5	S2
32	10 Jan 2003	72°59'02"S	75°14'47"E	0.22	1	H4	S3
33	10 Jan 2003	72°59'02"S	75°14'47"E	0.2	1	L5	S3
34	10 Jan 2003	72°59'02"S	75°14'47"E	0.13	1	L5	S4
35	10 Jan 2003	72°59'02"S	75°14'47"E	0.16	1	L5	S2
36	10 Jan 2003	72°59'02"S	75°14'47"E	0.18	1	L5	S3
37	10 Jan 2003	72°59'02"S	75°14'47"E	0.17	1	L5	S2
38	10 Jan 2003	72°59'02"S	75°14'47"E	0.24	1	L6	S2
39	10 Jan 2003	72°59'02"S	75°14'47"E	0.14	1	L6	S3
40	10 Jan 2003	72°59'02"S	75°14'47"E	0.14	1	L5	S4
41	10 Jan 2003	72°59'02"S	75°14'47"E	0.17	1	L5	S2
42	10 Jan 2003	72°59'02"S	75°14'47"E	0.18	1	L4	S3
43	10 Jan 2003	72°59'02"S	75°14'47"E	0.16	1	L5	S2
44	10 Jan 2003	72°59'02"S	75°14'47"E	0.18	1	L5	S2
45	10 Jan 2003	72°59'02"S	75°14'47"E	0.17	1	L5	S3
46	10 Jan 2003	72°59'02"S	75°14'47"E	0.16	1	L5	S4
47	10 Jan 2003	72°59'02"S	75°14'47"E	0.15	1	L5	S3
48	10 Jan 2003	72°59'02"S	75°14'47"E	0.16	1	L5	S3
49	10 Jan 2003	72°59'02"S	75°14'47"E	0.16	1	L5	S3
50	10 Jan 2003	72°59'02"S	75°14'47"E	0.16	1	L5	S3
51	10 Jan 2003	72°59'02"S	75°14'47"E	0.14	1	L6	S2
52	10 Jan 2003	72°59'02"S	75°14'47"E	0.05	1	L5	S3
53	10 Jan 2003	72°59'02"S	75°14'47"E	0.12	1	L6	S2
54	10 Jan 2003	72°59'02"S	75°14'47"E	0.12	1	L5	S2
55	10 Jan 2003	72°59'02"S	75°14'47"E	0.13	1	L6	S3
56	10 Jan 2003	72°59'02"S	75°14'47"E	0.19	1	L5	S2
57	10 Jan 2003	72°59'02"S	75°14'47"E	0.14	1	L6	S3
58	10 Jan 2003	72°59'02"S	75°14'47"E	0.13	1	L6	S2
59	10 Jan 2003	72°59'02"S	75°14'47"E	0.1	1	L5	S3
60	10 Jan 2003	72°59'02"S	75°14'47"E	0.1	1	L5	S3

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3	10 Jan 2003	72°59'02"S	75°14'47"E	0.16	1	L6	S2
4	10 Jan 2003	72°59'02"S	75°14'47"E	0.12	1	L5	S2
5	10 Jan 2003	72°59'02"S	75°14'47"E	0.14	1	L6	S2
6	10 Jan 2003	72°59'02"S	75°14'47"E	0.08	1	L5	S3
7	10 Jan 2003	72°59'02"S	75°14'47"E	0.13	1	L6	S4
8	10 Jan 2003	72°59'02"S	75°14'47"E	0.08	1	L4	S3
9	10 Jan 2003	72°59'02"S	75°14'47"E	0.13	1	L6	S2
10	10 Jan 2003	72°59'02"S	75°14'47"E	0.13	1	L5	S3
11	10 Jan 2003	72°59'02"S	75°14'47"E	0.09	1	L5	S2
12	10 Jan 2003	72°59'02"S	75°14'47"E	0.06	1	L4	S5
13	10 Jan 2003	72°59'02"S	75°14'47"E	0.11	1	L5	S4
14	10 Jan 2003	72°59'02"S	75°14'47"E	0.15	1	L6	S3
15	10 Jan 2003	72°59'02"S	75°14'47"E	0.1	1	L5	S3
16	10 Jan 2003	72°59'02"S	75°14'47"E	0.1	1	L5	S2
17	10 Jan 2003	72°59'02"S	75°14'47"E	0.07	1	L5	S4
18	10 Jan 2003	72°59'02"S	75°14'47"E	0.1	1	L5	S2
19	10 Jan 2003	72°59'02"S	75°14'47"E	0.08	1	L6	S4
20	10 Jan 2003	72°59'02"S	75°14'47"E	0.06	1	L5	S4
21	10 Jan 2003	72°59'02"S	75°14'47"E	0.09	1	L4	S3
22	10 Jan 2003	72°59'02"S	75°14'47"E	0.09	1	L5	S4
23	10 Jan 2003	72°59'02"S	75°14'47"E	0.07	1	H6	S2
24	10 Jan 2003	72°59'02"S	75°14'47"E	0.09	1	L5	S4
25	10 Jan 2003	72°59'02"S	75°14'47"E	0.07	1	L5	S3
26	10 Jan 2003	72°59'02"S	75°14'47"E	0.09	1	L5	S4
27	10 Jan 2003	72°59'02"S	75°14'47"E	0.07	1	L5	S3
28	10 Jan 2003	72°59'02"S	75°14'47"E	0.1	1	L5	S3
29	10 Jan 2003	72°59'02"S	75°14'47"E	0.14	1	L6	S2
30	10 Jan 2003	72°59'02"S	75°14'47"E	0.1	1	L5	S4
31	10 Jan 2003	72°59'02"S	75°14'47"E	0.08	1	L6	S3
32	10 Jan 2003	72°59'02"S	75°14'47"E	0.09	1	L5	S4
33	10 Jan 2003	72°59'02"S	75°14'47"E	0.08	1	L5	S3
34	10 Jan 2003	72°59'02"S	75°14'47"E	0.1	1	L5	S2
35	10 Jan 2003	72°59'02"S	75°14'47"E	0.09	1	L4	S3
36	10 Jan 2003	72°59'02"S	75°14'47"E	0.1	1	L5	S4
37	10 Jan 2003	72°59'02"S	75°14'47"E	0.06	1	L6	S2
38	10 Jan 2003	72°59'02"S	75°14'47"E	0.07	1	L5	S2
39	10 Jan 2003	72°59'02"S	75°14'47"E	0.07	1	L5	S4
40	10 Jan 2003	72°59'02"S	75°14'47"E	0.06	1	L5	S3
41	10 Jan 2003	72°59'02"S	75°14'47"E	0.06	1	L5	S4
42	10 Jan 2003	72°59'02"S	75°14'47"E	0.06	1	L5	S4
43	10 Jan 2003	72°59'02"S	75°14'47"E	0.07	1	L5	S2
44	10 Jan 2003	72°59'02"S	75°14'47"E	0.06	1	L5	S2
45	10 Jan 2003	72°59'02"S	75°14'47"E	0.07	1	L5	S3
46	10 Jan 2003	72°59'02"S	75°14'47"E	0.06	1	L5	S2
47	10 Jan 2003	72°59'02"S	75°14'47"E	0.06	1	L6	S2
48	10 Jan 2003	72°59'02"S	75°14'47"E	0.05	1	L6	S2
49	10 Jan 2003	72°59'02"S	75°14'47"E	0.08	1	L6	S2
50	10 Jan 2003	72°59'02"S	75°14'47"E	0.05	1	L6	S2
51	10 Jan 2003	72°59'02"S	75°14'47"E	0.06	1	L5	S2
52	10 Jan 2003	72°59'02"S	75°14'47"E	0.07	1	L5	S2
53	10 Jan 2003	72°59'02"S	75°14'47"E	0.06	1	L5	S4
54	10 Jan 2003	72°59'02"S	75°14'47"E	0.07	1	L5	S4
55	10 Jan 2003	72°59'02"S	75°14'47"E	0.07	1	L6	S2
56	10 Jan 2003	72°59'02"S	75°14'47"E	0.05	1	L5	S2
57	10 Jan 2003	72°59'02"S	75°14'47"E	0.05	1	L4	S3
58	10 Jan 2003	72°59'02"S	75°14'47"E	0.04	1	L5	S3
59	10 Jan 2003	72°59'02"S	75°14'47"E	0.04	1	L5	S4
60	10 Jan 2003	72°59'02"S	75°14'47"E	0.04	1	L5	S4

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3	10 Jan 2003	72°59'02"S	75°14'47"E	0.08	1	L6	S3
4	10 Jan 2003	72°59'02"S	75°14'47"E	0.05	1	L5	S2
5	10 Jan 2003	72°59'02"S	75°14'47"E	0.05	1	L5	S4
6	11 Jan 2003	72°59'00"S	75°15'05"E	7.55	1	L4	S2
7	11 Jan 2003	72°59'02"S	75°15'06"E	1.65	1	L5	S3
8	11 Jan 2003	72°59'03"S	75°14'49"E	3.7	1	L6	S2
9	11 Jan 2003	72°59'01"S	75°14'50"E	4.76	1	L5	S3
10	11 Jan 2003	72°59'01"S	75°14'50"E	3.77	1	L5	S3
11	11 Jan 2003	72°59'01"S	75°14'50"E	3.65	1	L5	S2
12	11 Jan 2003	72°59'01"S	75°14'50"E	3.87	1	H4	S3
13	11 Jan 2003	72°59'01"S	75°14'50"E	2.03	1	L6	S3
14	11 Jan 2003	72°59'02"S	75°14'47"E	1.04	1	L5	S4
15	11 Jan 2003	72°59'02"S	75°14'47"E	0.74	1	L5	S2
16	11 Jan 2003	72°59'02"S	75°14'47"E	0.74	1	L6	S2
17	11 Jan 2003	72°59'02"S	75°14'47"E	0.72	1	L5	S2
18	11 Jan 2003	72°59'02"S	75°14'47"E	0.66	1	L6	S4
19	11 Jan 2003	72°59'02"S	75°14'47"E	0.66	1	L5	S4
20	11 Jan 2003	72°59'02"S	75°14'47"E	0.78	1	L6	S2
21	11 Jan 2003	72°59'02"S	75°14'47"E	0.77	1	L6	S4
22	11 Jan 2003	72°59'02"S	75°14'47"E	0.4	1	L5	S3
23	11 Jan 2003	72°59'02"S	75°14'47"E	0.56	1	L6	S2
24	11 Jan 2003	72°59'02"S	75°14'47"E	0.37	1	L5	S3
25	11 Jan 2003	72°59'02"S	75°14'47"E	0.34	1	L5	S3
26	11 Jan 2003	72°59'02"S	75°14'47"E	0.3	1	L5	S2
27	11 Jan 2003	72°59'02"S	75°14'47"E	0.3	1	L5	S3
28	11 Jan 2003	72°59'02"S	75°14'47"E	0.25	1	L6	S2
29	11 Jan 2003	72°59'02"S	75°14'47"E	0.32	1	L5	S3
30	11 Jan 2003	72°59'02"S	75°14'47"E	0.5	1	L6	S3
31	11 Jan 2003	72°59'02"S	75°14'47"E	0.38	1	L6	S3
32	11 Jan 2003	72°59'02"S	75°14'47"E	0.56	1	L5	S3
33	11 Jan 2003	72°59'02"S	75°14'47"E	0.32	1	L5	S3
34	11 Jan 2003	72°59'02"S	75°14'47"E	0.38	1	L5	S2
35	11 Jan 2003	72°59'02"S	75°14'47"E	0.34	1	L4	S3
36	11 Jan 2003	72°59'02"S	75°14'47"E	0.26	1	L5	S3
37	11 Jan 2003	72°59'02"S	75°14'47"E	0.49	1	L5	S4
38	11 Jan 2003	72°59'02"S	75°14'47"E	0.23	1	L5	S3
39	11 Jan 2003	72°59'02"S	75°14'47"E	0.23	1	L5	S4
40	11 Jan 2003	72°59'02"S	75°14'47"E	0.24	1	L5	S2
41	11 Jan 2003	72°59'02"S	75°14'47"E	0.27	1	L5	S2
42	11 Jan 2003	72°59'02"S	75°14'47"E	0.26	1	H5	S2
43	11 Jan 2003	72°59'02"S	75°14'47"E	0.23	1	L5	S3
44	11 Jan 2003	72°59'02"S	75°14'47"E	0.32	1	L5	S3
45	11 Jan 2003	72°59'02"S	75°14'47"E	0.3	1	L5	S2
46	11 Jan 2003	72°59'02"S	75°14'47"E	0.31	1	L5	S2
47	11 Jan 2003	72°59'02"S	75°14'47"E	0.26	1	L5	S2
48	11 Jan 2003	72°59'02"S	75°14'47"E	0.24	1	L5	S2
49	11 Jan 2003	72°59'02"S	75°14'47"E	0.27	1	L5	S3
50	11 Jan 2003	72°59'02"S	75°14'47"E	0.3	1	L5	S3
51	11 Jan 2003	72°59'02"S	75°14'47"E	0.29	1	L6	S2
52	11 Jan 2003	72°59'02"S	75°14'47"E	0.17	1	L6	S2
53	11 Jan 2003	72°59'02"S	75°14'47"E	0.19	1	L5	S2
54	11 Jan 2003	72°59'02"S	75°14'47"E	0.14	1	L5	S2
55	11 Jan 2003	72°59'02"S	75°14'47"E	0.17	1	L6	S2
56	11 Jan 2003	72°59'02"S	75°14'47"E	0.25	1	L5	S3
57	11 Jan 2003	72°59'02"S	75°14'47"E	0.23	1	L5	S2

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2							
3	11 Jan 2003	72°59'02"S	75°14'47"E	0.25	1	L5	S3
4	11 Jan 2003	72°59'02"S	75°14'47"E	0.24	1	L5	S4
5	11 Jan 2003	72°59'02"S	75°14'47"E	0.22	1	L5	S3
6	11 Jan 2003	72°59'02"S	75°14'47"E	0.11	1	L5	S3
7	11 Jan 2003	72°59'02"S	75°14'47"E	0.23	1	L5	S4
8	11 Jan 2003	72°59'02"S	75°14'47"E	0.1	1	L5	S3
9	11 Jan 2003	72°59'02"S	75°14'47"E	0.23	1	L5	S3
10	11 Jan 2003	72°59'02"S	75°14'47"E	0.18	1	L5	S2
11	11 Jan 2003	72°59'02"S	75°14'47"E	0.14	1	L5	S2
12	11 Jan 2003	72°59'02"S	75°14'47"E	0.15	1	L5	S2
13	11 Jan 2003	72°59'02"S	75°14'47"E	0.23	1	L5	S2
14	11 Jan 2003	72°59'02"S	75°14'47"E	0.28	1	L5	S2
15	11 Jan 2003	72°59'02"S	75°14'47"E	0.24	1	L5	S2
16	11 Jan 2003	72°59'02"S	75°14'47"E	0.16	1	L5	S2
17	11 Jan 2003	72°59'02"S	75°14'47"E	0.16	1	L5	S2
18	11 Jan 2003	72°59'02"S	75°14'47"E	0.15	1	L5	S3
19	11 Jan 2003	72°59'02"S	75°14'47"E	0.15	1	L5	S4
20	11 Jan 2003	72°59'02"S	75°14'47"E	0.16	1	L5	S2
21	11 Jan 2003	72°59'02"S	75°14'47"E	0.22	1	L6	S2
22	11 Jan 2003	72°59'02"S	75°14'47"E	0.13	1	L5	S3
23	11 Jan 2003	72°59'02"S	75°14'47"E	0.16	1	L5	S3
24	11 Jan 2003	72°59'02"S	75°14'47"E	0.12	1	L5	S3
25	11 Jan 2003	72°59'02"S	75°14'47"E	0.18	1	L6	S3
26	11 Jan 2003	72°59'02"S	75°14'47"E	0.15	1	L6	S3
27	11 Jan 2003	72°59'02"S	75°14'47"E	0.17	1	L5	S3
28	11 Jan 2003	72°59'02"S	75°14'47"E	0.16	1	L6	S2
29	11 Jan 2003	72°59'02"S	75°14'47"E	0.14	1	L5	S2
30	11 Jan 2003	72°59'02"S	75°14'47"E	0.18	1	L5	S2
31	11 Jan 2003	72°59'02"S	75°14'47"E	0.18	1	L5	S2
32	11 Jan 2003	72°59'02"S	75°14'47"E	0.14	1	L5	S3
33	11 Jan 2003	72°59'02"S	75°14'47"E	0.09	1	L5	S2
34	11 Jan 2003	72°59'02"S	75°14'47"E	0.06	1	L5	S2
35	11 Jan 2003	72°59'02"S	75°14'47"E	0.13	1	L5	S2
36	11 Jan 2003	72°59'02"S	75°14'47"E	0.12	1	L5	S3
37	11 Jan 2003	72°59'02"S	75°14'47"E	0.06	1	L5	S2
38	11 Jan 2003	72°59'02"S	75°14'47"E	0.16	1	L5	S3
39	11 Jan 2003	72°59'02"S	75°14'47"E	0.17	1	L5	S2
40	11 Jan 2003	72°59'02"S	75°14'47"E	0.07	1	L5	S3
41	11 Jan 2003	72°59'02"S	75°14'47"E	0.09	1	H6	S2
42	11 Jan 2003	72°59'02"S	75°14'47"E	0.15	1	L5	S3
43	11 Jan 2003	72°59'02"S	75°14'47"E	0.08	1	L5	S2
44	11 Jan 2003	72°59'02"S	75°14'47"E	0.14	1	L5	S2
45	11 Jan 2003	72°59'02"S	75°14'47"E	0.13	1	L6	S2
46	11 Jan 2003	72°59'02"S	75°14'47"E	0.14	1	L4	S2
47	11 Jan 2003	72°59'02"S	75°14'47"E	0.06	1	L5	S3
48	11 Jan 2003	72°59'02"S	75°14'47"E	0.14	1	L6	S2
49	11 Jan 2003	72°59'02"S	75°14'47"E	0.14	1	L4	S2
50	11 Jan 2003	72°59'02"S	75°14'47"E	0.14	1	L6	S2
51	11 Jan 2003	72°59'02"S	75°14'47"E	0.14	1	L4	S2
52	11 Jan 2003	72°59'02"S	75°14'47"E	0.15	1	L5	S3
53	11 Jan 2003	72°59'02"S	75°14'47"E	0.13	1	L4	S3
54	11 Jan 2003	72°59'02"S	75°14'47"E	0.04	1	L5	S4
55	11 Jan 2003	72°59'02"S	75°14'47"E	0.1	1	L5	S2
56	11 Jan 2003	72°59'02"S	75°14'47"E	0.14	1	L6	S3
57	11 Jan 2003	72°59'02"S	75°14'47"E	0.08	1	L6	S2
58	11 Jan 2003	72°59'02"S	75°14'47"E	0.07	1	L5	S2
59	11 Jan 2003	72°59'02"S	75°14'47"E	0.07	1	L5	S3
60	11 Jan 2003	72°59'02"S	75°14'47"E	0.07	1	L5	S3



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3	11 Jan 2003	72°59'02"S	75°14'47"E	0.06	1	L5	S3
4	11 Jan 2003	72°59'02"S	75°14'47"E	0.06	1	L4	S3
5	11 Jan 2003	72°59'01"S	75°15'04"E	0.54	1	L5	S4
6	11 Jan 2003	72°59'02"S	75°15'00"E	0.12	1	L6	S3
7	11 Jan 2003	72°59'02"S	75°15'00"E	0.11	1	H5	S2
8	11 Jan 2003	72°59'02"S	75°15'00"E	0.08	1	L6	S2
9	11 Jan 2003	72°59'02"S	75°15'00"E	0.08	1	L5	S3
10	11 Jan 2003	72°59'02"S	75°15'00"E	0.11	1	L5	S2
11	11 Jan 2003	72°59'02"S	75°15'00"E	0.07	1	L5	S3
12	11 Jan 2003	72°59'02"S	75°15'00"E	0.15	1	L5	S2
13	11 Jan 2003	72°59'02"S	75°15'00"E	0.09	1	L5	S3
14	11 Jan 2003	72°59'02"S	75°15'00"E	0.16	1	L6	S3
15	11 Jan 2003	72°59'02"S	75°15'00"E	0.16	1	L5	S3
16	11 Jan 2003	72°59'02"S	75°15'00"E	0.07	1	L5	S3
17	11 Jan 2003	72°59'02"S	75°15'00"E	0.1	1	L6	S4
18	11 Jan 2003	72°59'02"S	75°15'00"E	0.11	1	L4	S2
19	11 Jan 2003	72°59'02"S	75°15'00"E	0.1	1	L5	S4
20	11 Jan 2003	72°59'02"S	75°15'00"E	0.08	1	L6	S2
21	11 Jan 2003	72°59'02"S	75°15'00"E	0.08	1	L5	S3
22	11 Jan 2003	72°59'02"S	75°15'00"E	0.11	1	L6	S3
23	11 Jan 2003	72°59'02"S	75°15'00"E	0.04	1	L5	S2
24	11 Jan 2003	72°59'02"S	75°15'00"E	0.06	1	L5	S2
25	11 Jan 2003	72°59'02"S	75°15'00"E	0.1	1	L5	S3
26	11 Jan 2003	72°59'02"S	75°15'00"E	0.04	1	L5	S3
27	11 Jan 2003	72°59'02"S	75°15'00"E	0.06	1	L5	S3
28	11 Jan 2003	72°59'02"S	75°15'00"E	0.07	1	L6	S2
29	11 Jan 2003	72°59'02"S	75°15'00"E	0.05	1	L6	S3
30	11 Jan 2003	72°59'02"S	75°15'00"E	0.14	1	L6	S2
31	11 Jan 2003	72°59'02"S	75°15'00"E	0.15	1	L5	S3
32	11 Jan 2003	72°59'02"S	75°15'00"E	0.08	1	L5	S2
33	11 Jan 2003	72°59'02"S	75°15'00"E	0.06	1	L5	S3
34	11 Jan 2003	72°59'02"S	75°15'00"E	0.09	1	L4	S2
35	11 Jan 2003	72°59'02"S	75°15'00"E	0.04	1	L5	S2
36	11 Jan 2003	72°59'02"S	75°15'00"E	0.08	1	L5	S2
37	11 Jan 2003	72°59'02"S	75°15'00"E	0.14	1	L6	S2
38	11 Jan 2003	72°59'02"S	75°15'00"E	0.1	1	L5	S2
39	11 Jan 2003	72°59'02"S	75°15'00"E	0.09	1	L5	S2
40	11 Jan 2003	72°59'02"S	75°15'00"E	0.12	1	L6	S2
41	11 Jan 2003	72°59'02"S	75°15'00"E	0.12	1	L5	S3
42	11 Jan 2003	72°59'02"S	75°15'00"E	0.09	1	L6	S2
43	11 Jan 2003	72°59'02"S	75°15'00"E	0.09	1	L6	S2
44	11 Jan 2003	72°59'02"S	75°15'00"E	0.1	1	L6	S2
45	11 Jan 2003	72°59'02"S	75°15'00"E	0.05	1	L6	S3
46	11 Jan 2003	72°59'02"S	75°15'00"E	0.04	1	L4	S3
47	11 Jan 2003	72°59'02"S	75°15'00"E	0.05	1	L5	S4
48	11 Jan 2003	72°59'02"S	75°15'00"E	0.06	1	L5	S3
49	11 Jan 2003	72°59'02"S	75°15'00"E	0.05	1	L6	S4
50	11 Jan 2003	72°59'02"S	75°15'00"E	0.05	1	L5	S2
51	11 Jan 2003	72°59'02"S	75°15'00"E	0.11	1	L5	S2
52	11 Jan 2003	72°59'02"S	75°15'00"E	0.15	1	L5	S3
53	11 Jan 2003	72°59'02"S	75°15'00"E	0.15	1	L5	S2
54	11 Jan 2003	72°59'02"S	75°15'00"E	0.12	1	L6	S3
55	11 Jan 2003	72°59'02"S	75°15'00"E	0.05	1	L5	S2
56	11 Jan 2003	72°59'02"S	75°15'00"E	0.1	1	L5	S2
57	11 Jan 2003	72°59'02"S	75°15'00"E	0.16	1	L5	S2
58	11 Jan 2003	72°59'02"S	75°15'00"E	0.21	1	L5	S3
59	11 Jan 2003	72°59'02"S	75°15'00"E	0.21	1	L5	S3
60	11 Jan 2003	72°59'02"S	75°15'00"E	0.21	1	L5	S3

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3	11 Jan 2003	72°59'02"S	75°15'00"E	0.15	1	L5	S3
4	11 Jan 2003	72°59'02"S	75°15'00"E	0.15	1	L6	S2
5	11 Jan 2003	72°59'02"S	75°15'00"E	0.09	1	L6	S2
6	11 Jan 2003	72°59'02"S	75°15'00"E	0.09	1	L6	S2
7	11 Jan 2003	72°59'02"S	75°15'00"E	0.05	1	L6	S3
8	11 Jan 2003	72°59'02"S	75°15'00"E	0.08	1	L6	S3
9	11 Jan 2003	72°59'02"S	75°15'00"E	0.05	1	L5	S2
10	11 Jan 2003	72°59'02"S	75°15'00"E	0.09	1	L6	S2
11	11 Jan 2003	72°59'02"S	75°15'00"E	0.07	1	L4	S2
12	11 Jan 2003	72°59'02"S	75°15'00"E	0.04	1	L5	S2
13	11 Jan 2003	72°59'02"S	75°15'00"E	0.06	1	L5	S3
14	11 Jan 2003	72°59'02"S	75°15'00"E	0.05	1	L5	S3
15	11 Jan 2003	72°59'02"S	75°15'00"E	0.06	1	L6	S2
16	11 Jan 2003	72°59'02"S	75°15'00"E	0.04	1	L5	S3
17	11 Jan 2003	72°59'02"S	75°15'00"E	0.03	1	L5	S3
18	11 Jan 2003	72°59'02"S	75°15'00"E	0.04	1	L5	S2
19	11 Jan 2003	72°59'02"S	75°15'00"E	0.18	1	L5	S3
20	11 Jan 2003	72°59'02"S	75°15'00"E	0.26	1	L5	S3
21	11 Jan 2003	72°59'02"S	75°15'00"E	0.42	1	L5	S3
22	11 Jan 2003	72°59'02"S	75°15'00"E	0.38	1	L5	S3
23	11 Jan 2003	72°59'02"S	75°15'00"E	0.34	1	L5	S2
24	11 Jan 2003	72°59'02"S	75°15'00"E	0.26	1	L5	S3
25	11 Jan 2003	72°59'02"S	75°15'00"E	0.35	1	L5	S2
26	11 Jan 2003	72°59'02"S	75°15'00"E	0.38	1	L5	S3
27	11 Jan 2003	72°59'02"S	75°15'00"E	0.37	1	L4	S2
28	11 Jan 2003	72°59'02"S	75°15'00"E	0.29	1	L5	S4
29	11 Jan 2003	72°59'02"S	75°15'00"E	0.26	1	L5	S3
30	11 Jan 2003	72°59'02"S	75°15'00"E	0.3	1	L6	S2
31	11 Jan 2003	72°59'02"S	75°15'00"E	0.41	1	L5	S3
32	11 Jan 2003	72°59'02"S	75°15'00"E	0.29	1	L6	S2
33	11 Jan 2003	72°59'02"S	75°15'00"E	0.34	1	L5	S3
34	11 Jan 2003	72°59'02"S	75°15'00"E	0.26	1	L5	S3
35	11 Jan 2003	72°59'02"S	75°15'00"E	0.16	1	L6	S2
36	11 Jan 2003	72°59'02"S	75°15'00"E	0.18	1	L6	S3
37	11 Jan 2003	72°59'02"S	75°15'00"E	0.23	1	L6	S2
38	11 Jan 2003	72°59'02"S	75°15'00"E	0.24	1	L5	S2
39	11 Jan 2003	72°59'02"S	75°15'00"E	0.31	1	L6	S2
40	11 Jan 2003	72°59'02"S	75°15'00"E	0.21	1	L6	S3
41	11 Jan 2003	72°59'02"S	75°15'00"E	0.16	1	L5	S2
42	11 Jan 2003	72°59'02"S	75°15'00"E	0.16	1	L5	S3
43	11 Jan 2003	72°59'02"S	75°15'00"E	2.78	1	L5	S2
44	11 Jan 2003	72°59'02"S	75°15'00"E	1.89	1	L4	S4
45	11 Jan 2003	72°59'02"S	75°15'00"E	1.22	1	L6	S2
46	11 Jan 2003	72°59'02"S	75°15'00"E	0.57	1	L5	S3
47	11 Jan 2003	72°59'02"S	75°15'00"E	0.43	1	L6	S2
48	11 Jan 2003	72°59'02"S	75°15'00"E	1.88	1	H6	S2
49	11 Jan 2003	72°59'00"S	75°14'58"E	2	1	L6	S2
50	11 Jan 2003	72°59'00"S	75°14'58"E	1.92	1	L5	S3
51	11 Jan 2003	72°59'00"S	75°14'58"E	0.74	1	L5	S3
52	11 Jan 2003	72°59'00"S	75°14'58"E	0.85	1	L5	S3
53	11 Jan 2003	72°59'00"S	75°14'58"E	0.96	1	L6	S2
54	11 Jan 2003	72°59'00"S	75°14'58"E	0.79	1	L5	S3
55	11 Jan 2003	72°59'00"S	75°14'58"E	0.7	1	L6	S3
56	11 Jan 2003	72°59'00"S	75°14'58"E	0.51	1	L5	S3
57	11 Jan 2003	72°59'00"S	75°14'58"E	0.94	1	L5	S3
58	11 Jan 2003	72°59'00"S	75°14'58"E	0.94	1	L5	S3

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3	11 Jan 2003	72°59'00"S	75°14'58"E	0.35	1	L5	S3
4	11 Jan 2003	72°59'00"S	75°14'58"E	0.5	1	L5	S2
5	11 Jan 2003	72°59'00"S	75°14'58"E	0.37	1	L4	S2
6	11 Jan 2003	72°59'00"S	75°14'58"E	0.37	1	L5	S2
7	11 Jan 2003	72°59'00"S	75°14'58"E	0.37	1	L5	S3
8	11 Jan 2003	72°59'00"S	75°14'58"E	0.39	1	L6	S2
9	11 Jan 2003	72°59'00"S	75°14'58"E	0.28	1	L6	S2
10	11 Jan 2003	72°59'00"S	75°14'58"E	0.29	1	L5	S3
11	11 Jan 2003	72°59'00"S	75°14'58"E	0.37	1	L5	S3
12	11 Jan 2003	72°59'00"S	75°14'58"E	0.24	1	L5	S2
13	11 Jan 2003	72°59'00"S	75°14'58"E	0.26	1	L5	S4
14	11 Jan 2003	72°59'00"S	75°14'58"E	0.24	1	L6	S2
15	11 Jan 2003	72°59'00"S	75°14'58"E	0.38	1	L5	S2
16	11 Jan 2003	72°59'00"S	75°14'58"E	0.27	1	L5	S3
17	11 Jan 2003	72°59'00"S	75°14'58"E	0.3	1	L5	S2
18	11 Jan 2003	72°59'00"S	75°14'58"E	0.27	1	L5	S2
19	11 Jan 2003	72°59'00"S	75°14'58"E	0.26	1	L5	S3
20	11 Jan 2003	72°59'00"S	75°14'58"E	0.3	1	L5	S3
21	11 Jan 2003	72°59'00"S	75°14'58"E	0.22	1	H5	S3
22	11 Jan 2003	72°59'00"S	75°14'58"E	0.23	1	H4	S2
23	11 Jan 2003	72°59'00"S	75°14'58"E	0.2	1	L5	S2
24	11 Jan 2003	72°59'00"S	75°14'58"E	0.2	1	L6	S3
25	11 Jan 2003	72°59'00"S	75°14'58"E	0.16	1	L5	S3
26	11 Jan 2003	72°59'00"S	75°14'58"E	0.15	1	L5	S2
27	11 Jan 2003	72°59'00"S	75°14'58"E	0.29	1	H6	S2
28	11 Jan 2003	72°59'00"S	75°14'58"E	0.24	1	H5	S3
29	11 Jan 2003	72°59'00"S	75°14'58"E	0.21	1	L5	S2
30	11 Jan 2003	72°59'00"S	75°14'58"E	0.21	1	L5	S3
31	11 Jan 2003	72°59'00"S	75°14'58"E	0.36	1	L5	S3
32	11 Jan 2003	72°59'00"S	75°14'58"E	0.21	1	L5	S3
33	11 Jan 2003	72°59'00"S	75°14'58"E	0.19	1	L4	S2
34	11 Jan 2003	72°59'00"S	75°14'58"E	0.21	1	L5	S3
35	11 Jan 2003	72°59'00"S	75°14'58"E	0.19	1	H5	S3
36	11 Jan 2003	72°59'00"S	75°14'58"E	0.17	1	LL5	S3
37	11 Jan 2003	72°59'00"S	75°14'58"E	0.22	1	L5	S2
38	11 Jan 2003	72°59'00"S	75°14'58"E	0.22	1	L5	S3
39	11 Jan 2003	72°59'00"S	75°14'58"E	0.15	1	L6	S1
40	11 Jan 2003	72°59'00"S	75°14'58"E	0.29	1	L5	S3
41	11 Jan 2003	72°59'00"S	75°14'58"E	0.25	1	L5	S2
42	11 Jan 2003	72°59'00"S	75°14'58"E	0.17	1	L5	S3
43	11 Jan 2003	72°59'00"S	75°14'58"E	0.15	1	L5	S3
44	11 Jan 2003	72°59'00"S	75°14'58"E	0.19	1	L5	S2
45	11 Jan 2003	72°59'00"S	75°14'58"E	0.12	1	L6	S3
46	11 Jan 2003	72°59'00"S	75°14'58"E	0.14	1	L4	S3
47	11 Jan 2003	72°59'00"S	75°14'58"E	0.22	1	L5	S3
48	11 Jan 2003	72°59'00"S	75°14'58"E	0.12	1	L5	S3
49	11 Jan 2003	72°59'00"S	75°14'58"E	0.12	1	L6	S3
50	11 Jan 2003	72°59'00"S	75°14'58"E	0.14	1	L5	S3
51	11 Jan 2003	72°59'00"S	75°14'58"E	0.12	1	L5	S2
52	11 Jan 2003	72°59'00"S	75°14'58"E	0.12	1	L5	S3
53	11 Jan 2003	72°59'00"S	75°14'58"E	0.12	1	L5	S3
54	11 Jan 2003	72°59'00"S	75°14'58"E	0.2	1	H4	S3
55	11 Jan 2003	72°59'00"S	75°14'58"E	0.14	1	L5	S3
56	11 Jan 2003	72°59'00"S	75°14'58"E	0.09	1	L6	S3
57	11 Jan 2003	72°59'00"S	75°14'58"E	0.12	1	L6	S2
58	11 Jan 2003	72°59'00"S	75°14'58"E	0.09	1	L5	S3
59	11 Jan 2003	72°59'00"S	75°14'58"E	0.09	1	L5	S3
60	11 Jan 2003	72°59'00"S	75°14'58"E	0.09	1	L5	S3

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3	11 Jan 2003	72°59'00"S	75°14'58"E	0.15	1	L6	S3
4	11 Jan 2003	72°59'00"S	75°14'58"E	0.09	1	L5	S2
5	11 Jan 2003	72°59'00"S	75°14'58"E	0.14	1	L5	S2
6	11 Jan 2003	72°59'00"S	75°14'58"E	0.1	1	L5	S3
7	11 Jan 2003	72°59'00"S	75°14'58"E	0.13	1	L5	S3
8	11 Jan 2003	72°59'00"S	75°14'58"E	0.12	1	L5	S4
9	11 Jan 2003	72°59'00"S	75°14'58"E	0.11	1	L5	S4
10	11 Jan 2003	72°59'00"S	75°14'58"E	0.08	1	L5	S2
11	11 Jan 2003	72°59'00"S	75°14'58"E	0.06	1	L5	S3
12	11 Jan 2003	72°59'00"S	75°14'58"E	0.1	1	L5	S4
13	11 Jan 2003	72°59'00"S	75°14'58"E	0.08	1	L4	S3
14	11 Jan 2003	72°59'00"S	75°14'58"E	0.1	1	L6	S2
15	11 Jan 2003	72°59'00"S	75°14'58"E	0.12	1	L5	S2
16	11 Jan 2003	72°59'00"S	75°14'58"E	0.1	1	L5	S2
17	11 Jan 2003	72°59'00"S	75°14'58"E	0.09	1	L5	S2
18	11 Jan 2003	72°59'00"S	75°14'58"E	0.09	1	L4	S2
19	11 Jan 2003	72°59'00"S	75°14'58"E	0.05	1	L5	S2
20	11 Jan 2003	72°59'00"S	75°14'58"E	0.07	1	L5	S3
21	11 Jan 2003	72°59'00"S	75°14'58"E	0.08	1	L5	S3
22	11 Jan 2003	72°59'00"S	75°14'58"E	0.04	1	L5	S3
23	11 Jan 2003	72°59'00"S	75°14'58"E	0.08	1	L6	S2
24	11 Jan 2003	72°59'00"S	75°14'58"E	0.06	1	L5	S4
25	11 Jan 2003	72°59'00"S	75°14'58"E	0.06	1	L4	S2
26	11 Jan 2003	72°59'00"S	75°14'58"E	0.07	1	L5	S2
27	11 Jan 2003	72°59'00"S	75°14'58"E	0.05	1	L4	S2
28	11 Jan 2003	72°59'00"S	75°14'58"E	0.07	1	L5	S2
29	11 Jan 2003	72°59'00"S	75°14'58"E	0.06	1	L5	S2
30	11 Jan 2003	72°59'00"S	75°14'58"E	0.04	1	L6	S2
31	11 Jan 2003	72°59'00"S	75°14'58"E	0.06	1	L5	S2
32	11 Jan 2003	72°59'00"S	75°14'58"E	0.05	1	L6	S2
33	11 Jan 2003	72°59'00"S	75°14'58"E	0.07	1	L4	S3
34	11 Jan 2003	72°59'00"S	75°14'58"E	0.07	1	L4	S3
35	11 Jan 2003	72°59'00"S	75°14'58"E	0.06	1	L5	S2
36	11 Jan 2003	72°59'00"S	75°14'58"E	0.06	1	L4	S4
37	11 Jan 2003	72°59'00"S	75°14'58"E	0.04	1	L6	S2
38	11 Jan 2003	72°59'00"S	75°14'58"E	0.04	1	L6	S3
39	11 Jan 2003	72°59'02"S	75°14'47"E	1.61	1	L6	S3
40	11 Jan 2003	72°59'02"S	75°14'47"E	1.92	1	L5	S2
41	11 Jan 2003	72°59'02"S	75°14'47"E	1.1	1	L5	S4
42	11 Jan 2003	72°59'02"S	75°14'47"E	0.71	1	L5	S2
43	11 Jan 2003	72°59'02"S	75°14'47"E	0.73	1	L5	S2
44	11 Jan 2003	72°59'02"S	75°14'47"E	0.71	1	L5	S2
45	11 Jan 2003	72°59'02"S	75°14'47"E	0.49	1	L5	S3
46	11 Jan 2003	72°59'02"S	75°14'47"E	0.56	1	L5	S2
47	11 Jan 2003	72°59'02"S	75°14'47"E	0.51	1	L5	S3
48	11 Jan 2003	72°59'02"S	75°14'47"E	0.4	1	L6	S3
49	11 Jan 2003	72°59'02"S	75°14'47"E	0.42	1	L5	S3
50	11 Jan 2003	72°59'02"S	75°14'47"E	0.32	1	L5	S3
51	11 Jan 2003	72°59'02"S	75°14'47"E	0.36	1	L5	S3
52	11 Jan 2003	72°59'02"S	75°14'47"E	0.2	1	L5	S2
53	11 Jan 2003	72°59'02"S	75°14'47"E	0.33	1	L5	S2
54	11 Jan 2003	72°59'02"S	75°14'47"E	0.38	1	L5	S2
55	11 Jan 2003	72°59'02"S	75°14'47"E	0.43	1	L5	S2
56	11 Jan 2003	72°59'02"S	75°14'47"E	0.24	1	L5	S4
57	11 Jan 2003	72°59'02"S	75°14'47"E	0.32	1	H5	S2
58	11 Jan 2003	72°59'02"S	75°14'47"E	0.29	1	L4	S3
59	11 Jan 2003	72°59'02"S	75°14'47"E	0.29	1	L4	S3
60	11 Jan 2003	72°59'02"S	75°14'47"E	0.29	1	L4	S3

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3	11 Jan 2003	72°59'02"S	75°14'47"E	0.34	1	L5	S2
4	11 Jan 2003	72°59'02"S	75°14'47"E	0.31	1	L5	S3
5	11 Jan 2003	72°59'02"S	75°14'47"E	0.2	1	L5	S2
6	11 Jan 2003	72°59'02"S	75°14'47"E	0.31	1	L5	S3
7	11 Jan 2003	72°59'02"S	75°14'47"E	0.19	1	L5	S2
8	11 Jan 2003	72°59'02"S	75°14'47"E	0.2	1	L5	S4
9	11 Jan 2003	72°59'02"S	75°14'47"E	0.22	1	L5	S3
10	11 Jan 2003	72°59'02"S	75°14'47"E	0.26	1	L4	S4
11	11 Jan 2003	72°59'02"S	75°14'47"E	0.26	1	L5	S2
12	2 Jun 2006	14.60107°S	175.526855°E	42000	1	Iron	
13	2 Jun 2006	14.60107°S	175.526855°E	40000	1	Iron	
14	March 2019	35°25.63'N	115°55.62'W	18150	1	Iron, IIIAB	low
15	2015 Aug 06	41°7.0'N	118°19.0'W	2.6	1	Ureilite	moderate
16	P 2020 Jan 2	28°46'16.10"N	05°30'10.00"E	763	1	Diogenite-an	low
17	2019 Aug 01	28.772° N	01.539° W	6115	many	LL4	S2
18	2019 May 11	40°57'25.79"N	98°32'49.35"E	2900	7	H~6	
19	2017	40°16'13.63"N	92° 0'54.63"E	710	1	LL4	S2
20	2016 Sep 23	42°38'45"N	91°15'20"E	5345	1	Iron, IIIAB	
21	1975	30°8'S	129°8'E	192.4	several	H5	S3
22	1982	30°7'46.03"S	129°8'47.84"E	39.3	1	H5	S3
23	1986	30°34'S	129°0.7'E	226.1	1	H5	S2
24	1977	41°13.498'N	103°1.595'W	10215	1	H3	S5
25	2018 Nov 18	24°17.36'S	68°55.03'W	24.3	1	H6	S2
26	28 Nov 2018	24°16.99'S	68°53.39'W	65.3	1	L5	S3
27	2019			33720	1	L6	
28	2019			3899	1	H5	
29	2019			4890	1	L6	
30	2019			24758	1	L6	
31	2019			5156	1	L6	
32	2019			8998	1	L6	
33	2018			19976	1	H5	
34	2019			4094	1	H5	
35	2019			7640	1	LL5	
36	2017 Feb 12	31°34.91'N	5°32.32'W	177.0	1	L6	S5
37	2019 Dec 18	27°36'59.42"N	10°26'48.85"W	21.4	1	Eucrite	
38	2010	19°40.668'N	55°44.913'E	299	1	H6	S1
39	2010	19°37.511'N	55°47.111'E	107	1	LL6-melt brecc	S2
40	2009	19°23.774'N	55°20.792'E	246	many	H5	S1
41	2012	19°47'48.18"N	55°53'30.34"E	741	1	L5	S2
42	13 Mar 2017	30°46.41'N	57°47.71'E	52.2	1	H5	S1
43	13 Mar 2017	30°46.41'N	57°47.71'E	10.2	1	H5	S2
44	13 Mar 2017	30°46.41'N	57°47.71'E	6.8	5	H5	S1
45	13 Mar 2017	30°46.41'N	57°47.71'E	14.8	1	H5	S1
46	13 Mar 2017	30°46.41'N	57°47.71'E	35.6	1	H5	S2
47	13 Mar 2017	30°46.41'N	57°47.71'E	23.0	1	H5	S1
48	13 Mar 2017	30°46.41'N	57°47.71'E	20.6	1	H5	S1
49	13 Mar 2017	30°46.41'N	57°47.71'E	51.9	15	H5	S1
50	13 Mar 2017	30°46.41'N	57°47.71'E	9.9	8	H5	S2
51	13 Mar 2017	30°46.41'N	57°47.71'E	19.9	1	H4	S3
52	13 Mar 2017	30°46.41'N	57°47.71'E	28.8	1	H5	S1
53	13 Mar 2017	30°46.41'N	57°47.71'E	16.7	1	H4	S2
54	13 Mar 2017	30°46.41'N	57°47.71'E	14.5	5	H5	S2
55	14 Mar 2017	30°44.15'N	57°48.83'E	10.6	1	H5	S2
56	14 Mar 2017	30°44.15'N	57°48.83'E	5.5	2	H5	S2
57	14 Mar 2017	30°43.35'N	57°49.30'E	1.6	1	H5	S2



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3	14 Mar 2017	30°45.12'N	57°48.59'E	13.2	1	H5	S2
4	14 Mar 2017	30°45.12'N	57°48.59'E	106.3	45	H5	S2
5	14 Mar 2017	30°46.41'N	57°47.71'E	4.0	1	H5	S2
6	14 Mar 2017	30°46.41'N	57°47.71'E	2.5	1	H5	S2
7	14 Mar 2017	30°44.62'N	57°48.49'E	9.9	1	H5	S2
8	14 Mar 2017	30°39.92'N	57°50.37'E	229.0	1	H5	S1
9	14 Mar 2017	30°42.42'N	57°49.40'E	954.9	1	H3	S1
10	15 Mar 2017	30°40.67'N	57°50.57'E	134.7	1	H5	S1
11	15 Mar 2017	30°35.45'N	57°52.87'E	4.3	2	H5	S1
12	15 Mar 2017	30°40.67'N	57°50.57'E	230.5	3	L5	S1
13	15 Mar 2017	30°39.85'N	57°50.93'E	404.6	1	H3	S2
14	15 Mar 2017	30°39.85'N	57°50.93'E	3.5	1	H5	S2
15	15 Mar 2017	30°46.23'N	57°48.20'E	88.6	1	H5	S2
16	15 Mar 2017	30°46.23'N	57°48.20'E	207.2	1	H6	S2
17	15 Mar 2017	30°46.23'N	57°48.20'E	125.4	1	H4	S2
18	15 Mar 2017	30°46.23'N	57°48.20'E	70.7	4	H5	S2
19	15 Mar 2017	30°46.23'N	57°48.20'E	16.6	3	H5	S2
20	15 Mar 2017	30°47.28'N	57°47.88'E	76.9	1	L5	S1
21	16 Mar 2017	30°35.52'N	57°51.80'E	8.6	1	H5	S1
22	16 Mar 2017	30°46.42'N	57°49.15'E	14.6	5	H5	S2
23	18 Mar 2017	30°39.98'N	57°58.15'E	255.0	1	H5	S2
24	19 Mar 2017	30°46.00'N	57°47.52'E	31.2	1	H5	S2
25	19 Mar 2017	30°45.83'N	57°47.52'E	68.9	1	H5	S2
26	19 Mar 2017	30°45.73'N	57°47.60'E	13.2	1	H5	S2
27	19 Mar 2017	30°45.70'N	57°47.62'E	9.1	1	L5	S2
28	19 Mar 2017	30°45.55'N	57°47.74'E	90.7	14	H5	S2
29	19 Mar 2017	30°45.36'N	57°47.71'E	54.0	2	H5	S2
30	19 Mar 2017	30°45.36'N	57°47.71'E	4.7	3	H5	S2
31	17 Mar 2017	30°32.73'N	57°45.93'E	17.0	1	L5	S2
32	2017 Jan 9	30°45.353'N	57°48.126'E	29.4	1	H5	S2
33	2017 Jan 9	30°45.299'N	57°48.005'E	534.28	11	H5	S2
34	2017 Jan 9	30°45.477'N	57°48.085'E	35.3	3	H5	S2
35	1 Aug 2020	1°53'18.8"N	98°39'39.6"E	2550	4	CM1/2	
36	2018	38°5.02'N	77°9.51'E	6650	1	H5	S2
37	21. Aug 2012	41°31'2.12"N	93°36'35.08"E	53	1	L~5	S4
38	2013	41°35'51.44"N	93°47'42.43"E	235.3	1	L6	S4
39	2019 Mar	41°42'3.15"N	93°43'26.98"E	1020	3	L5	
40	2012	41°37'8.50"N	93°41'23.56"E	11300	1	L5	S3
41	27 Oct. 2019	41°16'9.20"N	93°14'14.10"E	2540	1	Brachinite	
42	2019 Dec 8	41°31'56.14"N	93°19'49.80"E	70000	over 200	L6	
43	2019 Oct 27	41°17'42.75"N	93°19'20.36"E	7100	3	H4	
44	2020 Mar 27	41°25'57"N	93°29'37"E	470	1	L6	
45	2008	51°02'10.64"N	19°05'33.31"E	2143	1	H5	S1
46	Nov 2019	27.095770	-13.123126	1183.0	1	L3	S2
47	2003	30°31'57"S	121°36'27"E	210	1	H5	S4
48	2019 Sept 11	38°24'52.48"N	93°47'56.08"E	605	1	L~6	
49	20 Oct 2019	22°30.07'S	68°51.74'W	3	1	CK5	S2
50	2017 May 08	22°45'27.9"S	68°30'06.8"W	60	1	L5/6	
51	20 Oct 2019	22°30.28'S	68°51.76'W	7	1	H5	S2
52	1 May 2019	41°59'28.11"N	95° 6'59.35"E	51	1	L~5	
53	2019 Nov 01	24°41'S	69°46'W	104	1	H6	
54	2017 Feb 20	24°39'04.5"S	069°55'34.2"V	10.7	1	H6	
55	2017 Feb 21	24°38'54.0"S	069°53'03.0"V	33	4	H5	
56	2019	24°41'S	69°46'W	342000	1470	H6	
57	21 Feb 2017	24°41'47.2"S	069°55'27.5"V	243.3	1	H5	

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3	2017 Nov 12	24°39'09.7"S	069°48'50.5"W	174	1	H4	
4	2018 Jan 25	24°36.28'S	69°51.37'W	277.5	7	LL4-6	C-S3
5	2017 Jan 29	24°53'17.5"S	69°54'24.0"W	101	1	H5	
6	10 Dec 2019	24°36'S	69°54'W	29.1	1	H4/5	S3
7	4 Nov 2019	24°38.659'S	69°52.231'W	14	1	L5	S1
8	2019 Feb 1	24°40.108'S	69°53.504'W	180	1	Eucrite	low
9	2010 Apr 16	24°46.525'S	69°44.300'W	63.6	1	L6	
10	2017 Feb 21	24°41'04.0"S	069°54'38.5"V	160	1	H5	
11	2017 Nov 07	24°41'S	69°46'W	253	1	L6	
12	2018 Jan 5	24°36.427'S	69°51.355'W	1059.8	1	LL4-6	C-S3
13	21 Feb 2017	24°39'22.1"S	069°53'09.1"V	508	5	L6	
14	2019 Nov 12	24°36'48.8"S	69°51'51.1"W	187	1	H5	
15	2017 Feb 19	24°42'22.7"S	069°54'06.4"V	11.2	1	L6	
16	2017 Feb 21	24°40'00.8"S	069°52'43.5"V	1155	4	H5	
17	2014 Dec 21	24°41'S	69°46'W	203.4	1	L6	
18	2014 Dec 22	24.89421404269.935475942		11.98	1	LL5	
19	2019 Nov 12	24°37'26.4"S	69°51'57.9"W	312	10	H5	
20	2019 Nov 12	24°36'41.0"S	69°51'57.7"W	2035	42	L6	
21	2019 Nov 13	24°39'10.1"S	69°52'02.7"W	61	1	L5	
22	20 Feb 2017	24°39'54.6"S	069°56'11.8"V	77.7	1	H5	
23	2010 Sep 29	24.703192°S	69.865290°W	264.1	4	H4	
24	2010 Sep 29	24.691729°S	69.922737°W	140.8	1	L6	
25	2017 Feb 20	24°38'31.8"S	069°56'05.3"V	18.4	1	L6	
26	2017 Feb 20	24°39'45.4"S	069°52'58.9"V	377.8	1	L6	
27	2019 Nov 11	24°41'S	69°46'W	230	6	Howardite	
28	2019 Nov 12	24°41'S	69°46'W	174	3	Howardite	
29	2020 Apr 04	24°41'S	69°46'W	65	4	Ureilite	
30	2020 Apr 16	24°41'S	69°46'W	1946	1	eucrite	
31	2017 Feb 19	24°42'21.9"S	069°54'06.8"V	25	1	H4	
32	2017 Feb 20	24°39'32.8"S	069°55'50.6"V	35.3	1	L6	
33	2010 Mar 22	24° 48.531'S	69° 43.741'W	149.3	2	H4	
34	2019	~40°26'N	~89°54'E	59	1	L6	S3
35	28 Mar 2019	~40°09'N	~89°39'E	7000	2	Ureilite	
36	2018	~40°37'N	~89°52'E	4700	1	H5	S1
37	2019	~40°09'N	~89°39'E	515	1	LL~6	
38	2019	~40°30'N	~89°40'E	63.1	1	L~4	
39	2019	~40°30'N	~89°40'E	11.2	1	H~4	
40	2019 Jun 28	40°24'16.59"N	89°54'51.01"E	302	1	L5-melt breccia	
41	2019 Aug 20	40°0'39.93"N	89°5'57.71"E	190000	over 100	L6	
42	2016 Jul 04	22°45'18.6"S	68°25'05.0"W	451	1	L5	
43	2017 Apr 24	22°45'15.6"S	68°29'50.7"W	159	1	L5	
44	2016 Sep 16	22°45'31.0"S	68°25'27.5"W	273	1	H5	
45	2019 Jul 06	22°44'36.6"S	68°29'38.2"W	184	1	L5	
46	2019 Jul 22	26°28'56.28"N	86°35'53.17"E	~15000	1	H5	S2
47	18 Oct 2020	25°04.58'N	34°51.66'E	285	1	H5	S1
48	19 Oct 2020	25°19.48'N	34°43.29'E	9.8	1	H5	S2
49	19 Oct 2020	25°19.31'N	34°43.58'E	65.7	3	H5	S1
50	19 Oct 2020	25°19.50'N	34°43.27'E	7.7	1	H5	S3
51	25 Oct 2020	25°00.54'N	34°54.15'E	8.3	1	H5	S1
52	2018 Jan 5	33°15'N	02°45'W	538	1	L6	S3
53	2019 July 17	16.8539806	-15.9293383	1552	1	R4-5	S2
54	27 May 2004	1.951°S	5.512°W	20-25	1	Stony iron	
55	21 Dec 2006	2.049°S	5.504°W	2500-3100	1	Stony-iron	
56	18 Nov 2008	2.076°S	5.512°W	427-528	1	Stony-iron	
57	12 May 2009	2.106°S	5.520°W	373-462	1	Stony-iron	

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2							
3	31 Jul 2009	2.120°S	5.521°W	240000	1	Iron, IAB com <sub>p</sub>	
4	1 Oct 2009	2.121°S	5.532°W	100000	1	Iron, IAB com <sub>p</sub>	
5	14 Oct 2009	2.120°S	5.533°W	65000	1	Iron	
6	2018 Sept	15°45'46.53"S	51°31'1.75"W	14915	1	H5	S4
7	2010 Sept	31°5'53"S	121°28'42"E	38.3	1	H5	S4
8	2017	-86.5374	-164.878	27.72	1	L6	
9	2017	-86.5315	-164.885	49.47	1	L6	
10	2017	-86.5393	-164.888	96.69	1	L5	
11	2017	-86.5344	-164.866	121.86	1	H6	
12	2013	30°46'17.99"S	127°44'32.16"E	66.53	1	H5	S4
13	2020 Jul 2	35°41'26"N	140°01'51"E	350	2	H5	S1
14	2017	-86.4691	-162.551	2.277	1	L5	
15	2017	-86.5166	-162.557	1.583	1	L5	
16	2017	-86.4471	-162.627	7.578	1	H6	
17	2017	-86.5258	-162.53	6.069	1	H6	
18	2017	-86.4517	-162.599	4.97	1	H5	
19	2017	-86.4722	-162.563	10.044	1	H4	
20	2017	-86.4463	-162.638	7.066	1	H6	
21	2017	-86.4554	-162.59	4.776	1	H5	
22	2017	-86.4722	-162.563	12.026	1	H4	
23	2017	-86.4533	-162.605	5.255	1	H6	
24	2017	-86.5263	-162.407	4.71	1	LL6	
25	2017	-86.4722	-162.562	4.22	1	H4	
26	2017	-86.526	-162.529	3.97	1	H6	
27	2017	-86.4501	-162.623	2.89	1	H6	
28	2017	-86.5165	-162.525	1.6	1	H5	
29	2017	-86.476	-162.375	0.94	1	L6	
30	2017	-86.4381	-162.669	10.17	1	H6	
31	2017	-86.4554	-162.595	7.01	1	H6	
32	2017	-86.4574	-162.583	4.35	1	H6	
33	2017	-86.4611	-162.57	7.78	1	H5	
34	2017	-86.4555	-162.591	7.641	1	H6	
35	2017	-86.4533	-162.604	6.801	1	H6	
36	2017	-86.436	-162.691	4.178	1	H6	
37	2017	-86.437	-162.683	12.314	1	H6	
38	2017	-86.4623	-162.569	6.785	1	H6	
39	2017	-86.4464	-162.64	18.535	1	H4	
40	2017	-86.4361	-162.69	18.23	1	H6	
41	2017	-86.4723	-162.562	32.864	1	H4	
42	2017	-86.4227	-162.754	24.379	1	H6	
43	2017	-86.5202	-162.521	4.8	1	H6	
44	2017	-86.4722	-162.563	4.26	1	H4	
45	2017	-86.5166	-162.527	2.22	1	H6	
46	2017	-86.4723	-162.562	5.47	1	H4	
47	2017	-86.4467	-162.631	7.14	1	H6	
48	2017	-86.4467	-162.631	3.69	1	H6	
49	2017	-86.4371	-162.677	7.61	1	H6	
50	2017	-86.4132	-162.63	30.15	1	LL5	
51	2017	-86.4159	-162.615	81.01	1	H5	
52	2017	-86.4722	-162.562	30.87	1	L6	
53	1976	35.055° N	117.811° W	3000	1	L6	S1
54	P 2020 Jan			244.5	20	Martian (sherc high	
55	P 2019 Jan			647	1	R3-5	S2
56	P 2020 Jan			161.2	2	Martian (sherc high	
57	P 2019 Aug			635	1	L3	S2

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3	P 2020 May	3250	1	Diogenite-mel	high
4	P 2020 Aug	1601	1	Lunar (feldsp.	low
5	P 2020 Dec	610	1	Martian (sherc	high
6	P 2002	468	2	Diogenite-pm	low
7	P 2002	370	1	L4	S2
8	P 2002	275	1	H4	S2
9	P 2004	248	1	CK3	S2
10	P 2004	636	1	L3-6	S2
11	P 2004	~15000	many	Eucrite-br	low
12	P 2004 Aug	1053	1	CV3	S2
13	P 2006 Mar	312	5	EL-melt rock	high
14	P 2006 Feb	322	1	H6	S2
15	P 2006	128	1	CV3	S2
16	P 2006	28	1	CV3	S2
17	P 2007	968	1	Howardite	low
18	P 2007	2510	1	H7	S2
19	P 2008	1257	many	Mesosiderite	low
20	P 2008	538	21	Brachinite	low
21	P 2007	780	1	CO3	S1
22	P 2007	171.5	2	Diogenite	moderate
23	P 2008	8	1	Pallasite	low
24	P 2008	6.2	3	Winonaite	low
25	P 2009	71.2	36	Winonaite	low
26	P 2005	16.9	1	Pallasite	low
27	P 2009	47	1	CK3	S2
28	P 2009 Feb	891	1	LL(L)3	S2
29	P 2010	571	1	CO3	S2
30	P 2011	1200.96	1	Eucrite	moderate
31	P 2011	66	1	CK4	S2
32	P 2011	144	1	CK4	S2
33	P 2019	271	1	Eucrite-cm	High
34	P 2019	423	1	Diogenite	moderate
35	P 2019	4050	Several hundr	Eucrite-pmict	moderate
36	P 2011 Oct 26	267	1	LL3	C-S3
37	P 2014 Jun 25	102	1	L3.15	S3
38	2014	82	1	CR2	low
39	P 2014	10.9	1	H5	S2
40	P 2014	6.2	1	L/LL5	S2
41	P 2015	682.29	1	LL3.10	S3
42	P 2017 Mar	56000	1	Ureilite	low
43	P 2005	23.41	1	L3-7	S2
44	P 2005	193.1	1	L3-6	S2
45	P 2005	87.64	1	L3-6	S2
46	P 2005	40.54	1	L3-6	S2
47	P 2018 Jun	1277	1	L3	S2
48	P 2017	50	1	CV3	S2
49	P 2018	439	1	H4	S2
50	P 2018 Mar	1481	2	L5	
51	P 2018 Aug	797	21	Eucrite-an	moderate
52	P 2005	249	1	L3-6	S2
53	P 2018	701.5	1	H3-5	S2
54	P 2018	99.5	1	H4	S4
55	P 2017	81	1	R3	
56	P 2005	193	1	L3-6	S2
57	P 2018 Aug	1479	10	LL3	S2

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3	P 2018 Nov		16000	1		LL6-melt breccia	S2	
4	P 2017		171	1		CVred3		
5	P 2018 Apr		349	2		CK5		
6	P 20 Apr 2017		140	1		Ureilite		
7	P 2018		4530	1		LL3	S2	
8	P 2018		285	1		LL6-an		
9	P 2015		10.91	1		Achondrite-un		
10	P 2019		8.5	1		LL7		
11	P 2019		34	1		CV3		
12	P 2018		92.5	1		CV3	S2	
13	P 2018		422	1		L4-melt breccia		
14	P 2019		196	1		H3	S2	
15	P 2019		50	1		L6		
16	P 2019		7.0	1		L5-melt breccia		
17	P 2004		536.28	1		Ureilite	moderate	
18	P 2013		202	1		L3	S2	
19	P 2019		240	1		H4	S2	
20	P 2016		995	1		H6	S2	
21	P 2016		79	2		Eucrite	moderate	
22	P 2017		3030	1		H5	S1	
23	P 2019		791	1		L6	S1	
24	P 2019		724	2		Achondrite-pri	high	
25	P 2012		2.12	1		Eucrite	low	
26	P 2012		217.58	4		Eucrite	moderate	
27	P 2014		32.65	1		Eucrite	high	
28	P 2011		814.13	2		Eucrite	moderate	
29	P 2006		6.19	2		Eucrite	moderate	
30	P 2018		43	several		C3.00-ung		
31	P 2019 May		5832	1		Achondrite-un	low	
32	2017		850	1		Iron, ungrouped	low	
33	P 2019		697	1		Eucrite-br	low	
34	P 2016		40.6	1		CK6	S2	
35	P 2014		64.5	18		Pallasite	S1	
36	P 2016		1700	32		Pallasite	S1	
37	P 2019		370	1		Ureilite	low	
38	P 2019		395	1		Eucrite	moderate	
39	P 2019		849	1		CV3	S1	
40	P 2019		35.7	1		CO3	S1	
41	P 2019		380	many		CV3	S2	
42	P 2018 Mar		211	4		Martian (shergottite)	high	
43	2019 Jun		654.9	1		Diogenite-pm	low	
44	2018 Aug		958	1		Eucrite-br	moderate	
45	2019 May		818	2		CK4	S2	
46	P 2020 Sep	24.502°N	13.767°W	1815	many	Lunar (feldsp.)	high	
47	P 2019 Nov		587	1		Martian (shergottite)	high	
48	P 2019		15000	many		LL~3		
49	P 2019		372	3		LL~4		
50	P 2019		54	1		L~6		
51	P 2019		150	1		L~6		
52	P 2019		7.2	1		H~4		
53	P 2019		238	1		CV3	S1	
54	P 2019		114	1		LL3	S1	
55	P 2019		110	1		H5	S1	
56	P 2019		38	1		H5	S1	
57	P 2019		57	1		CO3	S1	
58	P 2019							
59	P 2019							
60	P 2019							



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3	P 2019	296	1	CO3	S1
4	P 2019	420	1	R3	S1
5	P 2019	50	1	Ureilite	low
6	P 2019	14	1	L6	S2
7	P 2019	60	many	CO3	S1
8	P 2019	6300	many	Eucrite	low
9	P 2019	13	1	Eucrite	moderate
10	P 2019	144	1	CO3	S1
11	P 2019	70	1	Eucrite	low
12	P 2019	80	1	CO3	S1
13	P 2016	361	1	LL4	S1
14	P 2015	315	2	L3	S2
15	P 2015	140	1	CO3	S1
16	P 2018	180	1	Eucrite	moderate
17	P 2015	820	1	L3	S2
18	P 2016	40	1	CK6	S1
19	P 2019	269	1	L5	S2
20	P 2019	497	1	L6	S2
21	P 2016	70	1	R3-5	S4
22	P May 2018	99	1	L5	S4
23	P May 2018	181	1	H6	S1
24	P May 2018	129	1	H6	S2
25	P May 2018	74	1	L5	S3
26	P May 2019	858	1	H5	S1
27	P May 2019	895	1	H4	S1
28	P May 2019	580	1	L6	S2
29	P May 2019	793	1	L5	S3
30	P March 2018	350	2	Eucrite-pmict	
31	P 2017	1866.52	1	L3.1	S2
32	P 2019 Mar 27	479	1	LL5	S2
33	P 2019 Mar 27	1182	1	LL3	S3
34	P 2014 Feb	133.9	1	L6	S3
35	P 2014 Feb	174.2	1	H6	
36	P 2014 Feb	497.1	1	L6	
37	P 2014 Feb	326	1	H5	
38	P 2014 Feb	328	1	L6	
39	P 2014 Feb	346.0	1	H6	
40	P 2014 Feb	162.9	1	L6	
41	P 2014 Feb	218.2	1	H5	
42	P 2014 Feb	656.6	1	H5	
43	P 2019	440	1	LL6	S2
44	2017 Jan	68796	several	Lunar (feldsp.	low
45	P 2019 Aug	139.3	1	Mesosiderite	low
46	P 2018 Mar	30000	many	L6-melt brecci	S2 (clas
47	P 2019 Apr	175	1	Eucrite-mmict	low
48	P 2018 Mar	2000	many	L7	low
49	P 2019 May	320	1	Martian (sherg	high
50	P 2018 Mar	2320	1	LL7	S2
51	P 2019 Mar	860	1	EL6	S2
52	P 2005	286	1	L4	S2
53	P 2019 Aug	46.9	1	Diogenite-pm	low
54	P 2005	220	1	H4/5	S2
55	P 2019 Jun	386	1	Lunar (feldsp.	low
56	P 2019 Aug	1485	many	L4	S2
57	P 2019 Apr	1787	several	CV3	S2

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3	P 2019 Nov	1524	1	Martian (sherc high	
4	P 2019 Aug	15400	many	H6	S2
5	P 2019 Aug	102.2	1	Eucrite-mmict low	
6	P 2005	44.3	1	L6	S2
7	P 2019	7 kg	3	Lunar (Feldsp high	
8	2015	818.7	1	Lunar (feldsp.	
9	P 2012	212.6	1	L4	S2
10	P 2012	395	1	LL6	S3
11	P Feb 2015	7800	1	L5	S2
12	P 2019	2319	1	CV3	S1
13	P 2019	20000	Many	H5	S6
14	P 2017	180000	Many	L5/6	S3/4
15	unknown	90000	Many	EL6	moderate
16	2012	15	2	Martian (sherc high	
17	P 2018 Apr	58.3	1	Ureilite	low
18	2017	147	1	L3	S2
19	P 2019	1382	2	H5-melt brecc	S3
20	P 2019	16.70	1	Lunar (feldsp.	
21	P 2018	87	1	H6	
22	P 2018	7.07	1	H4	
23	2018	391	9	Mesosiderite	
24	P 2016	4000	1	H5	
25	2018	307	3	Howardite	
26	P 2016 Jan	137	1	L5-melt brecci	
27	P 2019 May	957	1	LL3	
28	P 2019 Sep	287	1	Eucrite	
29	P 2019 Sep	403	1	L4	
30	P 2019 Sep	151	1	Eucrite	
31	P 2019 Sep	251	several	Eucrite	
32	P 2019 Sep	5.91	several	CM2	
33	P 2019 Sep	200	1	LL7	
34	P 2019 Sep	87	1	LL3	
35	P 2014 May	19.06	1	LL7	
36	P May 2016	296	2	H5	
37	P 2019 Sept	472	1	Ureilite	
38	P 2019 Sept	184	1	CK6	
39	P 2019 Sept	1393	2	Pallasite	
40	P 2019	118.3	1	H3	S2
41	P 2019	1392.5	many	L6-melt brecci	S3
42	P 2019	128.2	1	Eucrite	low
43	P 2019	317.6	1	L3	S1
44	P 2019	335	1	R3-6	S2
45	P 2019	416	1	Diogenite	low
46	P 2019	284	1	Eucrite	low
47	P 2019	3170	1	L6	S2
48	P 2019	400	1	Eucrite-melt b	moderate
49	P 2019	1027	5	C2-ung	S1
50	P 2019	248	1	L6	S3
51	P 2019	199	1	LL6	S2
52	P May 2015	70	1	Achondrite-un	
53	P 2017 Jun 1€	7100	1	L3	S1
54	2018	86.81	1	L5	C-S3
55	2017	47.44	1	H5	C-S3
56	2016	82.47	1	LL5	C-S3
57	2018	280.66	1	H5	C-S3

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3	2019	222.52	3	Diogenite	moderate
4	2019	1247	28	L3-6	C-S3
5	P 2019 Aug	1876	many	CO3	S2
6	P 2019 Aug	175	1	Martian	high
7	P 2019 Jun	945	2	L4	S2
8	P 2019 Jun	31	several	Eucrite-br	low
9	P 2019 Aug	83	1	LL3	S2
10	P 2005	55.9	1	H5	S2
11	P 2005	40.5	1	L4/5	S2
12	P 2019 Mar	300	several	Lunar (feldsp.	high
13	P 2005	40.5	1	L4	S2
14	P 2019 Sep	1600	2	Martian (sherç	high
15	P 2018 Jun	646	1	Achondrite-un	
16	P 2017 Mar	132	17	Mesosiderite	
17	2019	49	10	Martian (sherç	high
18	2015	134.86	1	Lunar (feldsp.	
19	August 1999	59	1	L5	
20	1998	9	1	L5	
21	1999	52.2	1	L6	
22	1999	45.30	1	L6	
23	1999	57.30	1	L6	
24	P 2019 Mar	678.9	many	H5	S2
25	P 2019 Mar	367.5	1	LL6	S4
26	P 2019 Mar	1424.9	1	H4	S3
27	P 2019 Mar	555.1	1	L3	S2
28	P 2019 Oct	18020	1	L4/5	S2
29	P 2020 Jan	396	2	Chondrite-ung	S2
30	P 2020 Jan	6976	1	L4	S2
31	P 2019 Oct	76.8	1	Martian (sherç	high
32	P 2019 May	2557	1	H4/5	S2
33	P 2019 Dec	414	1	Howardite	low
34	P 2019	81	1	H5-6	S2
35	P 2019	164.8	3	Ureilite	low
36	P 2019	42.6	1	H6	S1
37	P 2019	1150	10	EL-melt rock	low
38	P 2019	55	12	Eucrite	low
39	P 2019	18.7	1	CK6	S2
40	P 2019	4000	1	L3	S2
41	P 2019	2.5	1	Achondrite-un	moderate
42	P 2019	150	1	Martian (sherç	strong
43	P 2019	100.15	18	Lunar (Feldsp	high
44	P 2019	50	5	Martian (sherç	high
45	P 2014	368	7	LL3.2	S1
46	P 2019 Augus	113	1	Eucrite-cm	High
47	P 2019 Oct	630	1	H3	S2
48	P 2019 Sep	1097	4	L4	S2
49	P 2019 Oct	270	1	H3	S2
50	P 2019 Nov	638	1	Eucrite-mmict	high
51	P 2019 Oct	131	1	LL6	S2
52	P 2015	200.4	4	Lunar (feldsp.	low
53	P 2019 Oct	174	1	H3-4	S2
54	P 2019 Nov	2300	1	Martian (sherç	high
55	P 2019 Oct	142	1	H3	S2
56	P 2019	107	1	Martian (sherç	high
57	P 2019	820	1	Ureilite	low

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3	P 2019	380	1	H4	S2
4	P 2019	1343	1	L6	S2
5	P 2019	868	1	Eucrite-melt b	high
6	P 2019	341	5	LL7	S1
7	P 2019	1344	1	Howardite	high
8	P 2020	708	1	LL6-melt brecc	S2
9	P 2014	36.46	1	Martian (sherc)	high
10	P 2019 Jun	162.1	1	LL4	S2
11	P 2019 Aug	287	1	Ureilite	low
12	P 2019 Dec	4000	1	CV3	S2
13	P 2019 Nov	123.9	1	Lodranite	low
14	P 2019 Jun	1237	5	L4	S2
15	P 2016 Mar	350	1	CV3	S2
16	P 2019 Mar	966	many	Eucrite-melt b	high
17	P 2019 Nov	717	1	CK3	S2
18	P 2019 Nov	314.1	1	Winonaite	low
19	P 2018 Mar	70000	many	H5-melt brecc	
20	P March 2019	4700	1	C2-ung	low
21	P 2019 Dec	2572	1	Martian (sherc)	high
22	P 2008	101	1	L-melt rock	S4
23	P 2019	99.3	1	L6-melt brecci	C-S5/6
24	P 2019	210.6	1	H5	C-S2
25	P 2019	236.8	1	LL3	C-S2
26	2019	65.2	1	Diogenite	moderate
27	2019	3000	10	Lunar (feldsp.	moderate
28	P 2018	1500	10	Martian (sherc)	high
29	2019	340	11	CV3	S2
30	P 2018 Oct 26	24.4	1	Lunar (feldsp.	
31	P 2019	21155	1	H6	S3
32	P 2019	1185.4	1	CK5	low
33	P 2016	29.7	1	L3	S2
34	P 2019	118	1	Howardite	strong
35	P 2019	214	1	LL5	S2
36	P 2019	700	many	CV3	S1
37	P 2018	750	1	Enst achon	S1
38	P 2020	4150	1	L6-melt brecci	S3
39	2013	333.2	1	H4/5	S2
40	P 2019	740	2	Eucrite-unbr	low
41	2019 Feb 7	33	1	LL3.5	S3
42	P 2019 Aug	20.9	1	LL3.15	S2
43	P 2019 Dec	1603	1	Achondrite-un	low
44	P 2019 Oct	6056	1	L6	S2
45	P 2019	255.5	8	Achondrite-un	low
46	P 2019 Oct	3880	1	L6	S2
47	P 2019 Dec	3652	4	Martian (sherc)	high
48	P 2019	277	several	L-melt rock	
49	P 2019 Nov	564	1	Aubrite	low
50	P 2019 Apr	6418	5	CV3	S2
51	P 2019 Jun	987	1	Eucrite-pmict	low
52	2019	50000	200	L5	S3
53	2018	181	1	L3	S3
54	P 2019	200.6	8	Lunar	moderate
55	2015 Jun	581	19	H5	
56	P 2019 Oct	399.6	1	L5-6	
57	P 2019	1050	1	Howardite	low

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3	P 2017	705.4	1	Eucrite	low
4	P 2019	633.2	1	Eucrite	low
5	P 2019	387.4	1	Martian (sherg	high
6	2019 Apr	16400	20	H6	S2
7	P April 2019	500	1	H5	S3
8	2019	533	2	H3	S2
9	2019	193	1	LL3	S2
10	P 2018	26.4	1	Eucrite	moderate
11	2019	203	1	CV3	S2
12	2019	319	1	Eucrite-br	low
13	P 2020	1973	Many	LL3	C-S3
14	P 2020	730	1	LL3	C-S3
15	P 2020	298.8	1	EH3	C-S3
16	P 2019	20.5	1	L5	C-S2
17	P 2020	402.8	1	Mesosiderite-/	low
18	P 2019	45	1	Ureilite	low
19	P 2019	263	3	Aubrite	moderate
20	P 2018 Mar	13080	1	H7	S1
21	P January 202	1560	8	Lunar (feldsp.	moderate
22	P 2020 Apr	467	1	Achondrite-un	low
23	P 2019 Dec	168.1	1	Eucrite-unbr	high
24	P 2019 Sep	5602	6	LL3.15	S2
25	P 2020 Jan	441	1	Eucrite-br	moderate
26	P 2019 Sep	875	1	CK3	S2
27	P 2019 Sep	45	1	Achondrite-un	low
28	P 2019 Apr	987	1	L3-6	S2
29	P 2020 Jan	2750	1	Eucrite-br	moderate
30	May 2019	92.6	2	L3-5	S4
31	May 2019	150.4	1	LL4-6	S2
32	2019 Oct	785.0	1	L5	S2
33	2019 Oct	435.0	several	H4	S2
34	2018 Mar	432.0	several	CV3	S2
35	October 2019	349.0	several	CV3	S3
36	P 2020 Feb	3957	1	CK3	S2
37	P 2020 Jan	5000	1	LL3.15	S2
38	P 2019 Nov	7842	1	Eucrite-br	low
39	P 2019 Nov	1235	1	LL3	S2
40	P 2020 Feb	346	1	Martian (sherg	high
41	P 2020 Jan	650	1	LL4-5 melt bre	S2 clast
42	P 2020 Jan	360	several	CO3	S2
43	P 2019 Nov	147.5	1	Eucrite-br	high
44	P 2020 Jan	563	1	H7	S2
45	P 2005	17.8	1	CK3	S2
46	P 2019	957	1	LL3	C-S5
47	P 2009	526	109	Ureilite	moderate
48	July 2019	406.2	1	Eucrite	
49	P 2020	290	1	CR2	S1
50	P 2019	467	1	Mesosiderite	S2
51	P 2019	355	1	H6	S2
52	P 2019	471	1	LL3	S2
53	P 2019	150	1	H5	S2
54	P 2019	170	1	H5	S1
55	P 2019	133.7	1	LL6	S3
56	P 2019	3000	many	Eucrite-mmict	moderate
57	P 2020	7.7	1	Eucrite	low



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3	P 2020	1245	1	Howardite	low
4	P 2020 May	48.7	1	Lunar (feldsp.	low
5	P 2019 Dec	348	1	Diogenite	low
6	P 2020 Apr	69	1	CH3	S2
7	P 2019 Jul	2097	1	Eucrite-mmict	high
8	P 2019 Oct	4316	1	L4	S2
9	P 2020 May	4870	31	Achondrite-un	low
10	P 2018 Dec	1297	many	Eucrite-mmict	low
11	P 2020 Mar	221.5	many	CO3	S2
12	P 2020 Jan	240	1	Lodranite	low
13	P 2020 May	672	1	Eucrite-an	low
14	P 2019 Aug	396	1	LL4	S2
15	P 2020 Mar	38.92	1	CK3-6	S2
16	P 2019 May	990	1	L5	S2
17	P 2020 Mar	96	1	Eucrite-pmict	high
18	P 2020 Jan	187	1	Martian (sherç	high
19	unknown	1040.0	1	L6	S3
20	P January 202	4	1	Martian (sherç	high
21	2020 Jan	54	1	Angrite	low
22	P 2019	227	1	CV3	C-S3
23	P 2019	230.2	5	Diogenite	low
24	P 2019	417	1	Martian (sherç	high
25	P 2020	249	1	Martian (sherç	high
26	P 2020 Jul	1105	1	Martian (nakhl	low
27	P 2020	24.7	1	Martian (sherç	U-S5
28	P 2020	311.8	2	Howardite	M-S2
29	P 2018	24.8	5	CM2	C-S2
30	P 2019	7254	4	H3-6	S2
31	2018	919.7	1	H5	S1
32	2018	3073	1	L6	S3
33	2018	1382	1	L6	S5
34	2018	7000	3	LL3	S4
35	P 2019	618.18	1	H5	S3
36	P 2019	797.04	1	H5	S3
37	P 2019	242.29	1	LL5	S3
38	P 2019	105.8	1	H7	moderate
39	P 2020 Jun	1335	1	CK3	S2
40	P 2016 Feb	875	1	L3	S2
41	P 2019 Feb	866.4	1	Ureilite	low
42	P 2018 Sep	465.3	1	L5	S2
43	P 2015	1040	many	CVred3	C-S2
44	2019	158	1	L5	S2
45	2019	79	1	L5	S2
46	2019	94	1	L5	S3
47	2019	82	1	L5	S3
48	P 2017 Apr 13	113	1	Lunar (frag. br	high
49	P 2020	374	1	LL5	S2
50	P 2020	393	1	LL5-6	S2
51	P 2020	944	many	L6	S2
52	P 2020	480	11	LL6-melt brecc	S4
53	P 2020	736	many	Eucrite-mmict	moderate
54	2015	177	1	H5	
55	2019	720	1	LL3	
56	2019	9252	1	H5	
57	2018	8865	1	H5	

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3	P 2016 Dec	605	1	C3-ung	S2
4	P January 202	67	2	Martian (sherc	high
5	2017	5636	1	H5	
6	2019	3318	1	L6	
7	2019	3800	1	L6	
8	2019	2658	1	H6	
9	2019	1482	1	H6	
10	2019	2822	1	L5	
11	2018	2000	12	Lunar (feldsp.	moderate
12	2017	99.22	2	L6	C-S3
13	P 2018	264.2	2	OC5-an	C-S2
14	P 2020	6	1	CV3	S1
15	P 2020	242	1	Howardite	low
16	P 2020	648.2	1	L6-melt brecci	S4
17	P 2019	286	1	Eucrite	low
18	P 2015 Sep	1834	1	L5	S2
19	P 2012 Sep	349.6	1	H3-6	S2
20	P 2019 Oct	4654	1	L5	S2
21	P 2008 Jun	53	1	Acapulcoite	low
22	P 2019 Oct	3908	1	L6	S2
23	P 2019 Oct	11344	1	H4	S2
24	P 2019 Oct	4976	1	L5	S2
25	P 2019 Oct	3420	1	H4	S2
26	P 2019 Oct	103.8	1	L4	S2
27	P 2019 Oct	2596	1	H4	S2
28	P 2020	137.3	many	Lunar	moderate
29	P 2019	480	1	Diogenite-pm	low
30	P 2020 Jun	2020	5	L7	S4
31	P 2019	1276	1	Howardite	low
32	P 2019 Mar	308	1	H4	S2
33	P 2020 Mar	4459	5	Winonaite	low
34	P 2020 Aug	24695	2	Eucrite-unbr	low
35	P 2020 Februa	123.7	1	Eucrite-melt b	high
36	P 2020 Feb	277.3	many	Diogenite	low
37	P 2020 Februa	345.1	1	Eucrite-pmict	moderate
38	P 2020 Februa	133.8	1	CV3	S1
39	P 2020 Februa	63.5	1	CO3	S1
40	P 2018	660	1	Eucrite	
41	2018	309.95	4	Martian (sherc	high
42	2019	84.69	4	Martian (sherc	high
43	P March 2020	127	many	CO3.0	S2
44	P 2020 Mar	153	many	CO3.1	S2
45	P 2019 Oct	542	1	L4	S2
46	P 2020 Jun	6484	several	Achondrite-un	low
47	P 2020 Mar	269	1	H3	S2
48	P 2017 Dec	114.7	1	LL3	S2
49	P 2019	842	6	CK5	S2
50	P 2020 Jun	629	1	Lunar (feldsp.	low
51	P 2019	1120	16	CV3	S2
52	P 2019	440	26	R4-6	S2
53	P 2019	106	1	CK5	S2
54	P 2019	510	2	R3	S2
55	P 2019	150	many	CO3-an	S1
56	P 2019	169	1	C2	S1
57	P June, 2020	11780	1	Eucrite	low

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3	P March 2008	6500	1	H5	S2
4	2017	32.51	1	Martian (sherc	
5	2017	4.01	1	Martian (sherc	
6	P August, 202	1870	1	LL5-6	S2
7	P Aug 2020	277	1	Eucrite-melt b	high
8	P Oct 2018	264.7	1	Ureilite	low
9	P June 2018	446	1	CO3	S1
10	P 2019	1500	many	H5	S2
11	P 2019	677	2	CK6	S2
12	P 2020	80	1	Martian (sherc	high
13	P July 2020	280	several	R3-6	S2
14	P July 2020	27	1	Eucrite-melt b	high
15	P Sept 2020	104	1	Eucrite	low
16	P Sept 2020	100	1	Eucrite-melt b	high
17	2018	814	1	LL4-6	S4
18	P 2018 Dec	84	1	H4	S2
19	P 2020 Mar	218	1	Martian (sherc	high
20	P 2019 May	8438	5	L5-melt brecci	S2 clast
21	P 2020 Aug	251	1	Ureilite	high
22	P 2020 Jun	777	1	CO3	S2
23	P 2020 Sep	59	1	Lunar (feldsp.	low
24	P 2020 Aug	25.9	6	C2-ung	S2
25	P 2020 Sep	1495	2	Eucrite-mmict	low
26	P 2014 Jan	27.51	1	H4	
27	2019 Sep	311	several	CK5-6	
28	2019	350	2	CK5	
29	2017	240	many	Lunar (feldsp.	
30	2019	1675	several	Eucrite-unbr	
31	2019	21	10	Martian (sherc	
32	P 2019 Jun	58	1	Mesosiderite	
33	P 2020	39.3	3	CK6	
34	P 2019 May	253	many	Brachinite	
35	P 2019 Oct	299.4	1	CO3	
36	P 2019 Oct	144.5	1	CO3	
37	P 2019 Oct	129.5	1	Eucrite	
38	P 2019 Oct	111.6	1	Eucrite	
39	P 2020 Jan	64.3	1	Eucrite	
40	P 2020 Feb	572	1	CO3	
41	P 2020 Feb	123	many	Mesosiderite	
42	P 2020 Feb	528	5	Eucrite	
43	P 2020 Feb	68.8	1	L3	
44	P 2020 Jan	177.7	1	Eucrite	
45	P 2020 Jan	24.64	1	L(LL)3	
46	P 2016 Apr	197.8	1	H3.10	
47	P 2019 Oct	387.9	1	H6	
48	P 2019 Oct	138.6	1	CK3	
49	P 2019 Oct	74.1	1	L3.10	
50	P 2019 Oct	92.8	2	CK5	
51	P 2018 Sep	1239	2	LL4-6	S2
52	P 2020 Sep	2783	1	L5	
53	P 2020 Sep	3912	1	H5	
54	P 2020 Sep	546	1	Eucrite-unbr	M-S1
55	P 2009 Jun	49.7	2	Martian (Sherc	M-S4
56	P 2020 Mar	2634	67	R4-5	C-S3
57	P 2020	234	1	L3-5	S3

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3	P 2008	719	1	L(H)3	S2
4	P 2020	585	1	L5	S3
5	2018	19	1	CV3	S2
6	2019	255	1	Eucrite-br	moderate
7	2019	123	1	LL6	S3
8	P 2019	830	1	LL6	S2
9	2016	25	1	R5	S2
10	2019	35	1	LL3	S2
11	P 2014	5.8	1	CK5	S2
12	P 2018 Apr	1690	1	H4	S1
13	P 2018 Jul	350	1	CV3	
14	P 2017 Mar	22.9	1	Lunar (feldsp.	
15	P 2017	115	1	Mesosiderite-f	
16	P 2018 Mar 06	463.9	1	L6	S4
17	P 2020	3560	76	L4	C-S1
18	P 2009 Jun	4450	1	L4	C-S3
19	P 2019	280	1	H4	S1
20	P 2019	350	1	L4	S2
21	P 2019	490	1	H5	S1
22	P 2019	280	1	H6	S2
23	P 2019	2170	1	LL5	S2
24	P 2005	3500	1	H5	S2
25	P 2020	80	many	CV3	S1
26	P 2020	4400	many	CV3	S2
27	P 2020	2500	1	CK5	S1
28	P 2020	2700	1	Eucrite	low
29	P 2020	2300	many	Lunar (feldsp.	moderate
30	P 2020	17	1	CM2	low
31	P 2020	700	1	Eucrite-melt b	high
32	P 2020	25	1	Eucrite	low
33	P 02/2018	264	1	Pallasite	
34	P 2020	302	1	H6	S2
35	P 2020	140	1	H5	S1
36	P 2020	455	1	L5	S2
37	P 2020	89	1	H5	S1
38	P 2020	682	1	LL6	S1
39	P 2020	286	1	LL6	S2
40	P 2020	20	1	CK6	S2
41	P 2020	80	1	H6	S2
42	P 2020	172	1	CO3	S1
43	P 2020	2920	1	H5	S1
44	P 2020	1.5	1	Martian (polyn	moderate
45	P 2020	90	1	Lodranite	S2
46	P 2020	120	1	L6	S2
47	P 2020	75	1	Pallasite	S1
48	P 2020	1085	1	Mesosiderite	low
49	P 2020	825.5	1	LL4	C-S3
50	P 2020	1980	1	LL3.1	C-S2
51	P 2020	825	51	Lunar	M-S3
52	P 2020	24.2	1	CV3	C-S2
53	P 2014	23.7	1	Eucrite-br	M-S2
54	P 2013	61.1	1	Eucrite-melt b	M-S5
55	P 2020	1650	3	Howardite	M-S2
56	P 2020	2880	12	CVox3	low
57	P 2020	1525	2	Howardite	low

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3	P 2020		1912	6	CVox3	low			
4	P May 2019		400	1	H4				
5	2019		719	22	Pallasite	low			
6	P 2020		700	1	Diogenite	low			
7	P Dec. 2018		6300	1	Martian (Sherç				
8	P Jun. 2019		11280	1	Lunar (feldsp.				
9	P Jul. 2019		78000	1	Eucrite				
10	P 2019		48000	1	L~4				
11	P 2019		844	1	L~5				
12	P 2019		6000	many	L~5				
13	P 2020 Jan-St		1608	50	Lunar (feldsp.	low			
14	P 2020 Sept		1889	3	Mesosiderite	low			
15	P 2020 Oct		1161	3	Winonaite	S1			
16	P 2020 Oct		54	1	Lunar (feldsp.	moderate			
17	P 2020 Oct		138	1	H5	S1			
18	P 2020 Oct		51	1	H3	S1			
19	P 2020 Oct		67	1	Eucrite	moderate			
20	P 2020 Oct		420	1	H5	S2			
21	P 2020		85	6	Diogenite	moderate			
22	P 2016		81	4	CR2	S2			
23	P 2019 Dec		2828	72.9	EH6				
24	P 2020		605.3	1	LL3	S2			
25	P 2017		134.86	1	Howardite	high			
26	P 2020		2913.6	18	H6	S3			
27	P 2018		806.92	5	Eucrite-unbr	low			
28	2016 Nov 11		1500	1	L5	S4			
29	2016 Dec 12		18.25	1	H5	S3			
30	2016 Dec 13		70.88	1	H5	S3			
31	2016 Nov 23		1144	1	L4	S3			
32	28 Feb 2020	45°49.01'N 15°6.75'E	720	3	L5	S5			
33	2018 Aug 25	43°13'11.8"N 102°39'56.7"E	745.47	1	LL(L)3	S2			
34	2016 Mar 25	22°24.2'N 18°33.0'E	450000	1	Iron, IVB				
35	2018	42.113271°N 26.163802°E	151000	1	Iron, IID				
36	2012 Mar 9	59°55'47.66"N 10°46'17.96"E	4350	many	H3-6	S3			
37	2019 Jan	7.877°N 3.963°E	1975	3	LL4	S2			
38	2019 Jan	38°02.04'N 83°39.36'E	1823	5	L6	S3/4			
39	11 Dec 2019	24°58'34.0"S 70°07'44.2"W	6280.0	1	H4/5	S3			
40	11 Dec 2019	24°58'03.4"S 70°07'19.6"W	1220.8	2	H5	S2			
41	12 Dec 2019	24°58'32.6"S 70°07'28.2"W	17.9	1	L5	S3			
42	2017 Feb 17	24°57'15.1"S 070°02'07.7"V	36.9	1	L5				
43	2017 Feb 27	24°56'36.2"S 70°02'02.1"W	64.8	1	Ureilite				
44	2017 Feb 17	24°56.917'S 70°02.858'W	245	1	L6				
45	2017 Feb 17	24°57'18.6"S 070°01'51.3"V	1835	many	H5				
46	2009 Dec 12	25°0'S 70°28'W	226	2	H5				
47	May 2016	57°20.42'N 48°30.15'E	46780	1	Iron, IAB-MG				
48	2018 Apr 2	43°59.05'N 44°45.59'E	2630	1	L6	S3			
49	2018 May 22	46°25'16.15"N 89°26'41.32"E	1271	1	H5				
50	2019 Feb	28.736°N 7.607°W	127.6	2	Martian (sherç	high			
51	2018	31°57'00"N 56°54'55"E	1304	2	H5				
52	2019	31.70869°N 56.69564°E	4200	1	H4				
53	10 Aug 1975	30°19'S 128°58'E	274	1	L5	S3			
54	1998		1107.0	1	H3-5	S2			
55	1998		4.0	1	H4	S3			
56	1998		21.0	1	LL5	S4			
57	1998		5.0	1	L5/6	S4			



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3	1998	11.0	1	L6	S4
4	1998	22.0	1	H5/6	S1
5	1998	332.0	1	H5/6	S1
6	1998	15.0	1	H3-5	S2
7	1998	72.0	1	LL5/6	S4
8	1998	28.0	1	LL5/6	S4
9	1998	471.0	1	H5	S3
10	1998	26.0	1	LL5/6	S4
11	1998	16.0	1	LL5/6	S4
12	1998	187.0	1	LL5/6	S4
13	1998	420.0	1	H5	S2
14	1998	87.0	1	H5/6	S1
15	1998	260.0	1	L6	S4
16	1998	131.0	1	L6	S4
17	1998	111.0	1	L6	S4
18	1998	10.0	1	L5/6	S4
19	1998	12.0	1	L5/6	S4
20	1998	541.0	1	H4-6	S3
21	1998	107.0	1	H4-5	S3
22	1998	143.0	1	H4-5	S3
23	1998	120.0	1	L5/6	S4
24	1998	1102.0	1	H3-6	S3
25	1998	78.0	1	H3-6	S3
26	1998	145.0	1	L5/6	S3
27	1998	94.0	1	L5/6	S3
28	1998	51.0	1	H5/6	S1
29	1998	32.0	1	L5	S4
30	1998	582.0	1	H5	S1
31	1998	121.0	1	H5	S1
32	1998	72.0	1	L5	S1
33	1998	47.0	1	H4	S2
34	1998	123.0	1	H3-6	S2
35	1998	92.0	1	H6	S5
36	1998	90.0	1	L6	S4
37	1998	24.0	1	H4	S2
38	1998	95.0	1	H3	S2
39	1998	455.0	1	H5	S4
40	1998	2433.0	1	L5-6	S4
41	1998	2894.0	1	L5/6	S4
42	1998	1520.0	1	L6	S4
43	1998	152.0	1	L6	S4
44	1998	322.0	1	H4-5	S2
45	1998	3.0	1	H5/6	S2
46	1998	141.0	1	H4-6	S2
47	1998	207.0	1	L6	S4
48	1998	1830.0	1	L6	S1
49	1998	1322.0	1	L6	S4
50	1998	135.0	1	L3	S3
51	1998	175.0	1	H4-5	S2
52	1998	1720.0	1	L5	S4
53	1998	3225.0	1	L5	S3
54	1998	473.0	1	H5	S3
55	1998	35.0	1	L6	S3
56	1998	29.0	1	L6	S3
57	1998	190.0	1	H4-5	S3

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3	1998		70.0	1	L5	S4	
4	1998		103.0	1	L5-6	S3	
5	1998		1502.0	1	L5/6	S3	
6	1998		52.0	1	H6	S5	
7	1998		432.0	1	H3	S3	
8	1998		1534.0	1	H5	S2	
9	1998		323.0	1	H4	S3	
10	1998		722.0	1	L5-6	S4	
11	1998		52.0	1	L5	S3	
12	1998		728.0	1	H4	S2	
13	1998		127.0	1	H5	S2	
14	1998		110.0	1	L4/5	S4	
15	1998		302.0	1	L6	S3	
16	1998		175.0	1	H5	S3	
17	1998		85.0	1	L5	S3	
18	29 Sep 1799	47°57'51"N 0°9'40"W	4600	1	H5		
19	2015	33°35.93'S 58°7.83'W	820	1	H5	S3	
20	2020 Aug 19	8°9'45.66"S 40°36'50.54"W	80000	Many	H5-6	S4	
21	2014 Nov 05	20°32'37.527" 56°40'35.984"	96.14	Many	L5		
22	2018 Dec 1	18°22.56'N 55°10.42'E	463	1	Monomict Euc	Weak	
23	2018 Aug 30	44°37'15.6"N 99°012'38.1"E	693.42	4	H4	S3/4	
24	02.11.2017	18°32'20.2"N 53°59'37.4"E	1259.5	2	L5	S3	
25	2012	18°37'35.08"N 53°54'57.41"E	1094	1	L6	S2	
26	2008	18°31.574'N 53°52.936'E	860	1	L5	S2	
27	14 Oct 2017	22°30.18'S 69°6.24'W	1800	1	H4	S1	
28	24 Oct 2019	22°30.27'S 69°8.54'W	36	1	H5-melt brecc		
29	25 Mar 2019	22°30.09'S 69°2.44'W	16	1	H/L5	S4	
30	12 Oct 2018	22°30.25'S 69°9.13'W	760	Many	L5	S3	
31	2017 Oct 18	22°30.393'S 69°02.233'W	375.66	1	L5	S3/4	
32	3 Apr 2018	22°30.25'S 69°2.87'W	120.8	3	L6	S2	
33	6 Apr 2018	22°30.27'S 69°8.90'W	175	1	L5	S2	
34	28 Oct 2018	22°30.11'S 69°3.10'W	321.5	1	H5	S1	
35	28 Oct 2018	22°30.19'S 69°4.83'W	1125	1	H6	S1	
36	2018 Oct 25	22°30.21'S 69°9.01'W	1.66	1	L6		
37	03 Apr 2018	22°30.01'S 69°3.26'W	101.8	1	H6	S1	
38	25 Oct 2018	22°30.25'S 69°9.59'W	959	Many	H5	S2	
39	24 Oct 2018	22°30.34'S 69°7.89'W	9	1	L3	S1	
40	30 Mar 2018	22°30.08'S 69°2.04'W	147.8	1	L5	S2	
41	28 Oct 2018	22°30.71'S 69°2.19'W	110	Many	L6	S4	
42	13 Oct 2018	22°30.11'S 69°3.17'W	53.3	1	L5	S5	
43	2 Apr 2018	22°30.98'S 69°07.46'W	260	1	L6	S1	
44	13 Oct 2018	22°30.15'S 69°3.22'W	94	1	L5-melt brecci	S4	
45	18 Oct 2017	22°30.324'S 69°02.069'W	88.03	1	H5	S4/5	
46	2018 Oct 24	22°30.15'S 69°9.27'W	432	13	L4		
47	20 Oct 2018	22°30.68'S 69°3.24'W	168	1	L5	S5	
48	25 Mar 2019	22°30.66'S 69°2.11'W	242	1	L5	S3	
49	20 Mar 2019	22°30.96'S 69°07.51'W	11.3	1	H5	S1	
50	2019 Oct 1	25.163°N 0.289°E	6219	16	L6	S2	
51	P 2020	24°15.85'N 0°09.64'W	4988	2	Mesosiderite	low	
52	2020 Aug 25	31.8265°N 4.6794°W	4000	many	C2-ung	low	
53	2018	~18°50'N ~7°00'E	>50000	many >100	L6	S3	
54	2019	29°44'42"N 7°41'59"W	1.91	1	Lunar		
55	2019 Jan	39°21.14'N 83°15.49'E	1600	10	H5/6	S3/4	
56	2018	30°30.3'N 5°48.85'W	5105	1	H5	S1	
57	2018 Oct	31°4'45.87"N 3°11'6.65"W	126	1	CO3	S2	

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3	2019 Dec 10	24°22'11.46"N13°58'55.08"W	649	1	H5		
4	2020 May 8	18°54'37.03"S45°49'10.14"W	400	1	Eucrite-cm	S4	
5	2019 Dec	21.325°N 0.729°E	57410	many	Lunar (feldsp.	low	
6	26 Mar 2019	22°58.68'S 68°18.01'W	815	Many	LL3	S1	
7	26 Oct 2019	22°58.69'S 68°18.01'W	15	1	L6	S2	
8	26 Oct 2019	22°58.98'S 68°18.56'W	9	1	H5	S1	
9	26 Oct 2019	22°59.39'S 68°17.43'W	66	1	H5	S1	
10	26 Oct 2019	22°59.36'S 68°17.40'W	191	1	L5	S1	
11	March 2019	27°10'20.6"N 0°44'50.0"W	345.0	1	Lunar (feldsp.		
12	2020	27.747222 -1.369722	3710	2	Lunar (feldsp.	high	
13	P 2019	27°03'N 0°10'W	670	1	Eucrite-melt b		
14	4 Aug 2001	39°41.3426'N 117°37.2048'W	11.5	1	H5	S3	
15	4 Aug 2001	39°41.3455'N 117°37.1916'W	7.4	1	H5	S3	
16	4 Aug 2001	39°41.3442'N 117°37.1896'W	28.8	1	H5	S3	
17	4 Aug 2001	39°41.3294'N 117°37.1671'W	11.5	1	H5	S3	
18	4 Aug 2001	39°41.3333'N 117°37.2057'W	34.9	1	H5	S3	
19	4 Aug 2001	39°41.3069'N 117°37.2672'W	12	1	H5	S3	
20	4 Aug 2001	39°41.3092'N 117°37.2650'W	18.9	1	H5	S3	
21	5 Aug 2001	39°40.7732'N 117°37.7552'W	28.5	1	H5	S3	
22	5 Aug 2001	39°41.2226'N 117°37.3741'W	28.1	2	H5	S3	
23	5 Aug 2001	39°41.2358'N 117°37.3940'W	7	1	H5	S3	
24	5 Aug 2001	39°41.2412'N 117°37.3834'W	2.6	1	H5	S3	
25	1978	~37.0°N ~95.8°W	895	1	L6	S3	
26	2012	23°36'13.12"N55°09'01.56"E	104.4	1	L6	S3	
27	2020 Jan 28	33°59.20'N 114°0.10'W	2200	many	H4	S2	
28	2013 Jun 9	59°01'20.9"N 7°15'28.1" E	4700	2	H5	S2	
29	1974	35.238°N 105.332°W	2278	1	H6	S2	
30	2019 June 27	27°22'23.153"8°58'51.744"W	~20000	many	H5	S3	
31	2002	33.13°N 102.38°W	252	1	H3-4	S2	
32	2018	42°17'47.80"N92°28'18.93"E	105	1	LL3	S4	
33	1998		1.952	1	H5		
34	1998		0.477	1	L6		
35	1998		1.987	1	L6		
36	1998		0.567	1	L6		
37	1998		0.377	1	H5		
38	1998		2.156	1	H5		
39	1998		1.256	1	L3		
40	1998		1.473	1	H5		
41	1998		1410.150	1	H6		
42	1998		1.110	1	LL6		
43	1998		1.390	1	H6		
44	1998		0.566	1	H5		
45	1998		2.863	1	LL6		
46	1998		2.447	1	H6		
47	1998		2.223	1	LL6		
48	1998		0.38	1	H5		
49	1998		0.902	1	H6		
50	1998		1.553	1	L6		
51	1998		1.53	1	H5		
52	1998		0.428	1	L6		
53	1998		0.766	1	L3		
54	1998		3.214	1	LL6		
55	1998		4.481	1	LL6		
56	1998		19.821	1	L3		
57	1998		0.69	1	H4		

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4	1998	2.016	1	H6
5	1998	4.822	1	LL3
6	1998	0.551	1	L4
7	1998	2.365	1	H5
8	1998	3.034	1	LL6
9	1998	1.543	1	H6
10	1998	1.17	1	H5
11	1998	2.07	1	L6
12	1998	3.245	1	L5
13	1998	1.39	1	H6
14	1998	1.528	1	H5
15	1998	2.379	1	CM2
16	1998	2.28	1	LL6
17	1998	3.035	1	LL6
18	1998	0.813	1	L6
19	1998	4.301	1	H6
20	1998	0.431	1	H6
21	1998	0.318	1	L6
22	1998	1.771	1	H5
23	1998	0.901	1	L6
24	1998	0.935	1	H6
25	1998	4.784	1	H5
26	1998	2.231	1	L5
27	1998	3.65	1	L6
28	1998	2.231	1	H6
29	1998	2.386	1	L5
30	1998	2.473	1	H5
31	1998	2.38	1	H5
32	1998	0.467	1	CR2
33	1998	1.938	1	L4
34	1998	2.717	1	H6
35	1998	2.807	1	CO3
36	1998	1.211	1	CO3
37	1998	0.51	1	H5
38	1998	1.515	1	H4
39	1998	2.05	1	H4
40	1998	0.77	1	H4
41	1998	0.810	1	H4
42	1998	0.287	1	L6
43	1998	0.661	1	H5
44	1998	1.150	1	H5
45	1998	0.561	1	H6
46	1998	0.636	1	H6
47	1998	1.524	1	H5
48	1998	2.067	1	H5
49	1998	3.064	1	H4
50	1998	2.671	1	H4
51	1998	3.385	1	H4
52	1998	0.805	1	H5
53	1998	2.189	1	H5
54	1998	0.484	1	L6
55	1998	1.510	1	L6
56	1998	0.916	1	L6
57	1998	1.808	1	H6
58	1998			
59	1998			
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5	1998	0.795	1	H6
6	1998	1.410	1	L6
7	1998	0.538	1	L6
8	1998	2.821	1	H6
9	1998	2.317	1	H5
10	1998	1.931	1	H5
11	1998	2.742	1	H6
12	1998	2.334	1	H4
13	1998	1.058	1	H5
14	1998	2.710	1	L6
15	1998	2.706	1	L4
16	1998	1.925	1	L5
17	1998	0.815	1	H5
18	1998	8.365	1	H5
19	1998	1.490	1	H5
20	1998	2.307	1	L6
21	1998	1.575	1	H5
22	1998	1.844	1	L6
23	1998	2.349	1	H6
24	1998	1.314	1	H6
25	1998	1.013	1	H6
26	1998	2.144	1	L6
27	1998	1.326	1	H6
28	1998	0.696	1	H5
29	1998	2.833	1	H5
30	1998	1.306	1	H5
31	1998	2.745	1	L4
32	1998	0.532	1	L6
33	1998	1.455	1	H5
34	1998	0.89	1	H5
35	1998	0.695	1	H5
36	1998	1.087	1	H5
37	1998	1.928	1	H5
38	1998	0.488	1	L5
39	1998	1.014	1	H4
40	1998	0.730	1	H6
41	1998	0.330	1	L6
42	1998	1.292	1	H5
43	1998	2.371	1	H5
44	1998	0.624	1	H6
45	1998	1.192	1	H5
46	1998	1.767	1	H5
47	1998	0.461	1	CO3
48	1998	0.565	1	L6
49	1998	1.322	1	L5
50	1998	0.574	1	L5
51	1998	1.335	1	H5
52	1998	0.784	1	LL6
53	1998	0.874	1	H4
54	1998	1.732	1	L6
55	1998	0.667	1	H5
56	1998	0.889	1	H5
57	1998	9.420	1	L6
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5	1998	2.315	1	H5
6	1998	1.396	1	H6
7	1998	2.131	1	H6
8	1998	2.047	1	H5
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10	1998	88.560	1	L6
11	1998	1.761	1	L6
12	1998	61.210	1	L6
13	1998	50.064	1	L6
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15	1998	1.012	1	H4
16	1998	1.157	1	H5
17	1998	2.662	1	H5
18	1998	1.385	1	H5
19	1998	2.605	1	LL5
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21	1998	2.959	1	L6
22	1998	2.217	1	L6
23	1998	2.968	1	H6
24	1998	2.151	1	L5
25	1998	0.785	1	L6
26	1998	2.005	1	H5
27	1998	0.309	1	H3
28	1998	1.154	1	H5
29	1998	1.234	1	H5
30	1998	1.120	1	H5
31	1998	2.083	1	L6
32	1998	2.423	1	L6
33	1998	2.219	1	L4
34	1998	1.990	1	H4
35	1998	0.514	1	H5
36	1998	1.004	1	H5
37	1998	2.428	1	H5
38	1998	0.805	1	H5
39	1998	2.199	1	H5
40	1998	0.927	1	H5
41	1998	2.502	1	L6
42	1998	0.963	1	H5
43	1998	2.559	1	L6
44	1998	1.046	1	L3
45	1998	0.714	1	H5
46	1998	0.431	1	H6
47	1998	0.606	1	H6
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49	1998	0.544	1	H5
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57	1998	2.424	1	H5
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7	1998	1.365	1	H4
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17	1998	1.343	1	H4
18	1998	1.783	1	L6
19	1998	1.751	1	L6
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22	1998	2.842	1	H4
23	1998	1.785	1	H4
24	1998	2.019	1	L6
25	1998	1.902	1	L6
26	1998	1.228	1	H4
27	1998	16.417	1	CV3
28	1998	1.897	1	H6
29	1998	1.711	1	Ureilite
30	1998	2.084	1	H6
31	1998	12.173	1	H4
32	1998	13.623	1	H5
33	1998	1.988	1	H6
34	1998	1.438	1	H6
35	1998	2.250	1	H6
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41	1998	2.43	1	H4
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43	1998	2.80	1	H4
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57	1998	1.045	1	H4
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7	1998	1.274	1	H4
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11	1998	2.217	1	H4
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18	1998	1.80	1	CM2
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22	1998	12.731	1	CO3
23	1998	1.254	1	CO3
24	1998	2.860	1	CO3
25	1998	1.117	1	CO3
26	1998	2.609	1	H4
27	1998	1.251	1	H4
28	1998	1.348	1	H5
29	1998	1.118	1	H4
30	1998	1.868	1	H5
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32	1998	2.395	1	L6
33	1998	16.655	1	L6
34	1998	1.188	1	L5
35	1998	1.210	1	L5
36	1998	1.016	1	L5
37	1998	1.465	1	L5
38	1998	1.063	1	H5
39	1998	2.349	1	L5
40	1998	5.512	1	L6
41	1998	2.102	1	L6
42	1998	1.809	1	H5
43	1998	2.091	1	H4
44	1998	2.404	1	H5
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18	1998	2.300	1	L6
19	1998	2.548	1	L6
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21	1998	2.423	1	CR2
22	1998	1.336	1	H4
23	1998	2.113	1	H6
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25	1998	1.101	1	H6
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32	1998	2.063	1	L4
33	1998	1.787	1	H5
34	1998	2.361	1	H6
35	1998	1.212	1	H4
36	1998	6.419	1	LL6
37	1998	1.184	1	H3
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42	1998	2.697	1	H5
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44	1998	1.206	1	LL6
45	1998	2.625	1	L6
46	1998	1.137	1	L6
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49	1998	2.093	1	LL6
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55	1998	1.714	1	L6
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32	1998	2.161	1	H5
33	1998	2.100	1	H4
34	1998	2.211	1	H4
35	1998	1.160	1	H4
36	1998	1.925	1	H4
37	1998	1.345	1	H4
38	1998	1.080	1	H4
39	1998	1.102	1	H4
40	1998	1.123	1	H5
41	1998	4.630	1	H5
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21	1998	2.438	1	H5
22	1998	2.354	1	H5
23	1998	1.763	1	H4
24	1998	2.384	1	H4
25	1998	1.641	1	H5
26	1998	1.49	1	H5
27	1998	1.423	1	H5
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34	1998	2.366	1	H3
35	1998	1.189	1	H5
36	1998	1.576	1	H5
37	1998	1.243	1	H4
38	1998	2.441	1	H4
39	1998	2.329	1	L5
40	1998	1.307	1	H5
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16	1998	2.572	1	H4
17	1998	2.8	1	H4
18	1998	1.803	1	H4
19	1998	1.753	1	H3
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21	1998	2.221	1	H5
22	1998	2.731	1	H6
23	1998	1.573	1	L6
24	1998	1.120	1	L6
25	1998	3.595	1	H5
26	1998	2.295	1	H6
27	1998	1.990	1	H4
28	1998	1.255	1	H5
29	1998	1.493	1	H5
30	1998	1.786	1	H5
31	1998	2.338	1	H5
32	1998	1.997	1	H5
33	1998	1.724	1	H5
34	1998	1.522	1	H4
35	1998	1.070	1	H5
36	1998	1.243	1	H5
37	1998	2.202	1	H4
38	1998	2.781	1	H4
39	1998	1.090	1	H6
40	1998	1.342	1	H6
41	1998	2.870	1	L6
42	1998	2.820	1	H6
43	1998	15.015	1	H6
44	1998	2.005	1	H6
45	1998	4.656	1	H5
46	1998	2.013	1	H6
47	1998	1.783	1	H6
48	1998	2.263	1	H6
49	1998	1.319	1	L6
50	1998	1.071	1	H5
51	1998	1.361	1	L5
52	1998	1.122	1	L6
53	1998	6.234	1	L6
54	1998	1.242	1	L6
55	1998	3.465	1	LL6
56	1998	1.145	1	H4
57	1998	3.219	1	L5
58	1998			
59	1998			
60	1998			

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3	1998			1.513	1	LL6		
4	1998			1.010	1	H5		
5	1998			1.623	1	LL6		
6	1998			2.503	1	H6		
7	1998			1.204	1	LL6		
8	1998			1.128	1	LL6		
9	1998			1.083	1	L6		
10	1998			1.358	1	L5		
11	1998			1.190	1	L5		
12	1998			1.567	1	L5		
13	1998			1.572	1	L6		
14	1998			1.956	1	H6		
15	1998			3.455	1	H6		
16	1998			1.538	1	H6		
17	1998			8.053	1	LL6		
18	1998			5.179	1	LL6		
19	1998			6.154	1	LL6		
20	1998			3205.000	1	H6		
21	1998			3639.000	1	H6		
22	1998			2150.000	1	L6		
23	1998			270.45	1	H6		
24	1998			244.33	1	H6		
25	1998			113.5	1	H6		
26	1998			10.631	1	CO3		
27	1998			904.74	1	H6		
28	1998			17.604	1	L6		
29	1998			19.666	1	L6		
30	1998			10.493	1	L6		
31	1998			9.830	1	H6		
32	1998			250.23	1	H5		
33	2000			842.6	1	Iron, IIIAB		
34	2000			517.4	1	Iron, IAB-ung		
35	2000			24.16	1	Iron, IAB-ung		
36	2000			106.8	1	Iron, IAB-ung		
37	2000			313.8	1	Iron, IAB-ung		
38	2000			224.3	1	Iron, IIIAB		
39	2000			4202	1	Iron, IAB-ung		
40	2018	31.76687°N	55.31202°E	1800	4	L6		
41	1982	40°47'34"N	124°27'58"E	17 kg	1	H5	S2	
42	2020 Jan 9	31°22'N	69°34'E	18964	4	H3-4	S2	
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	W4	4.2± 4.8 (n=24)	2.2± 1.0 (n=1)	3.6± 7.1 (n=1)		23.9	IfP
	W3	18.35	16.95	2.05		300	IST-USTHB
	W3	24.82	21.05	1.27		200	IST-USTHB
	W4	18.22	16.45	1.10		100	IST-USTHB
	W5	18.11	16.72	1.04		200	IST-USTHB
	W1	25.39	21.70	1.35		50	IST-USTHB
	W5	21.03	16.27	3.14		30	IST-USTHB
	W1	24.26	21.98	1.35		50	IST-USTHB
	W1	25.68	21.26	1.38		82	IST-USTHB
	minimal	10.6±0.2 (n=3)			5.11	4.5	CEREGE
	W0	25.3±0.4	21.3±0.1	Wo1.6±0.2	4.94	41.3	FSAC, UNM
	W1.0	26.4± 1.4 (n=119)	1.1± 4.0 (n=1)	1.2± 1.1 (n=8)		2288.7	UAb
						95.8	NIPR
						276.1	NIPR
		24.1±0.1 (n=8)	23.3±0.6 (n=4)	1.5±0.2		1302.65	AuckMus
	low		63.2-63.8; 29.2-3-2.4; 6.1-7.			22.9	UWB
	W2	31.8 (n=1)	25.9±0.2 (n=3)	1.9±0.2	3.65	29	CEREGE
	moderate					311	UAz
	low					261	UAb
	W2	27	22.4	1.7		1725.34	WAM
	W1	0.2±0.1 (n=19)	0.3±0.1 (n=6)	1.4±0.3	5.45	20.4	Kiel
	W4				4.37	21.3	Kiel
	W3					5.5	UCLA
	W3					2.2	UCLA
	W3	18.6±0.5	16.3±0.4	1.0±0.1		1.1	UCLA
	W3	18.4±0.3 (n = 1)	16.2±0.4 (n = 1)	1.5±0.2 (n = 1)		20.2	IfP
	W2				4.45	30.8	CEREGE
	medium					21	UPC
	minimal					39	UPC
	W3	23.6±0.4 (N=120)	0.2±0.2 (N=11)	5.2±0.2 (N=13)		7.6	Vernad
	W1	17.9±0.3 (N=116)	1.1±0.3 (N=11)	1.1±0.1 (N=11)		23.9	Vernad
	W2	18.3±0.2 (N=115)	7.0±0.3 (N=11)	4.1±0.22 (N=)		26.4	Vernad
	W2	24.4±1.1 (N=120)	2.0±0.26 (N=)	0.47±0.14 (N=)		185	Vernad
	W1	24.0±0.24 (N=20)	1.0±0.63 (N=)	1.64±0.28 (N=)		4	Vernad
	W2	19.6±1.87 (N=15)	0.9±0.98 (N=)	1.21±0.31 (N=)		44.2	Vernad
	minor		22.5±0.7 (n=7)	1.6±0.3	3.63	20.00	CEREGE
	W1	20±0.5 (N=23)	17±0.4 (N=14)	1±0.2 (N=14)		175.26	UrFU
	W2/3	27±0.5 (N=17)	22±0.4 (N=11)	1±0.2 (N=11)		1686.00	UrFU
	W3	20.3±0.6 (N=117)	8.0±0.8 (N=11)	2.0±0.2 (N=14)		44.34	UrFU
	W1	20.7±0.4 (N=117)	7.1±1.0 (N=11)	4.0±0.3 (N=13)		138.25	UrFU
	W3	17.3±0.18 (N=15)	6.0±0.4 (N=10)	9.0±0.5 (N=12)		8.5	Vernad
						564.3	Vernad
	W2	17.4±0.2 (N=115)	6.0±0.4 (N=11)	6.0±0.8 (N=12)		42.7	Vernad
	W2	17.2±0.2 (N=115)	4.0±0.3 (N=11)	0.0±0.2 (N=12)		23.4	Vernad
	W3	20.3±7.8 (N=320)	0.0±2.6 (N=11)	3.0±0.5 (N=15)		1486	UrFU
	W2	18.8±0.18 (N=16)	7.0±0.6 (N=11)	2.4±0.18 (N=)		21	Vernad
	moderate				4.45	7.6	CEREGE
	W1	17.9±0.2 (N=115)	9.0±0.6 (N=11)	3.0±0.1 (N=14)		13.3	Vernad.
	W2	23.7±0.3 (N=120)	3.0±0.7 (N=11)	3.0±0.2 (N=12)		14.5	Vernad.
	W1				4.59	21.8	CEREGE
	W2	19.1±0.3 (N=116)	8.0±0.4 (N=11)	5.0±0.3 (N=12)		26	UPC
	W2	19.2±0.3 (N=116)	9.0±0.4 (N=11)	5.0±0.3 (N=13)		23	UPC
	W1	18.5±0.4 (N=115)	6.0±0.5 (N=11)	1.0±0.4 (N=13)		20	UPC
	W2	25.2±1.8 (N=121)	8.0±1.6 (N=11)	6.0±1.1	4.72	17	UPC

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3	W2	18.2±0.4 (N=115.5±0.5 (N=11.0±0.4 (N=14		37		UPC	
4	W1	18.6±0.4 (N=117.0±0.5 (N=11.0±0.4 (N=14		11		UPC	
5	W2	25.2±0.4 (N=121.3±0.4 (N=11.4±0.3 (N=10		8		UPC	
6	W2	18.7±0.5 (N=116.0±0.5 (N=21.2±0.4 (N=20		22		UPC	
7	W4	24.0±0.15 (N=19.8±1.3 (N=11.5±0.3 (N=13		16.3		Vernad	
8	W3	23.9±0.32 (N=20.0±0.2 (N=11.5±0.1 (N=12		33.6		Vernad	
9	W3	17.9±0.3 (N=115.7±0.3 (N=11.3±0.2 (N=13		8.8		Vernad	
10	W1	24.7±0.5 (N=120.7±0.3 (N=11.3±0.2 (N=13		6		Vernad	
11	W1	18.1±0.3 (N=116.0±0.4 (N=11.3±0.3 (N=13		2.9		Vernad	
12	W1	24.6±0.3 (N=120.6±0.4 (N=11.4±0.3 (N=11		4.1		Vernad	
13	W1	15.8±7.3 (N=313.5±6.0 (N=10.9±0.5 (N=18		3.8		Vernad	
14	W2	24.5±0.4 (N=120.6±0.7 (N=11.5±0.2 (N=14		12		Vernad	
15	W3	23.7±0.3 (N=120.4±0.7 (N=11.2±0.2 (N=13		39.5		Vernad.	
16	W3	18.4±0.3 (N=116.0±0.2 (N=11.3±0.1 (N=12		107		Vernad.	
17	W2	17.9±0.2 (N=115.9±0.2 (N=11.2±0.1 (N=12		153.4		Vernad.	
18	W2	27.1±1.0 (N=122.0±0.44 (N=1.7±0.5 (N=15		10.9		Vernad.	
19	W2	18.1±0.4 (N=116.4±0.6 (N=11.3±0.1 (N=16		12.2		Vernad	
20	W3	24.8±0.3 (N=121.1±0.4 (N=11.4±0.3 (N=14		6		Vernad	
21	W1	23.9±0.2 (N=120.0±0.2 (N=11.2±0.2 (N=11		15.4		Vernad	
22	W2	24.2±0.3 (N=120.4±0.4 (N=11.4±0.1 (N=12		67.5		Vernad	
23	W1	18.2±0.4 (N=116.0±0.2 (N=11.6±0.2 (N=12		2.7		Vernad	
24	W3	18.1±0.2 (N=115.6±0.2 (N=11.2±0.1 (N=12		0.78		Vernad	
25	W1	18.9±0.5 (N=116.4±0.2 (N=11.3±0.2 (N=13		13.4		Vernad	
26	W2	23.8±0.3 (N=120.0±0.3 (N=11.3±0.2 (N=12		140.1		Vernad	
27	W1	17.9±0.4 (N=115.9±0.6 (N=11.2±0.1 (N=12		500.7		Vernad	
28	W2	17.9±0.2 (N=115.8±0.4 (N=11.1±0.2 (N=12		3.1		Vernad	
29	W2	23.0±0.1 (N=119.3±0.2 (N=11.9±0.8 (N=12		19.3		Vernad	
30	W2	24.2±0.5 (N=120.3±0.4 (N=11.5±0.3 (N=12		25.8		Vernad	
31	W1	17.9±0.2 (N=116.0±0.6 (N=11.1±0.1 (N=12		66.0		Vernad	
32	W1	16.6±0.9 (N=114.6±0.2 (N=10.9±0.2 (N=12		15.8		Vernad	
33	W2	24.0±0.3 (N=120.1±0.2 (N=11.3±0.2 (N=12		15.0		Vernad	
34	W2	23.6±0.4 (N=119.8±0.2 (N=11.5±0.2 (N=12		3.0		Vernad	
35	W1	18.1±0.3 (N=115.9±0.3 (N=10.8±0.1 (N=10		28.5		Vernad	
36	W2	17.2±0.3 (N=115.1±0.4 (N=10.9±0.1 (N=12		24.8		Vernad	
37	W3	18.0±0.4 (N=115.7±0.2 (N=11.1±0.1 (N=12		13.1		Vernad	
38	W3	17.4±0.1 (N=115.5±0.5 (N=11.3±0.2 (N=12		40.8		Vernad	
39	W3	19.0±0.2 (N=116.3±0.2 (N=11.3±0.2 (N=11		16.2		Vernad	
40	W2	24.0±0.1 (N=120.1±0.4 (N=11.6±0.2 (N=13		2.2		Vernad	
41	W5	24.4±0.5 (N=120.1±0.35 (N=1.3±0.1 (N=12		24.6		Vernad	
42	W2	17.2±0.1 (N=115.1±0.3 (N=11.1±0.1 (N=12		4.5		Vernad	
43	W4	17.7±0.3 (N=115.7±0.2 (N=11.4±0.2 (N=12		9.8		Vernad	
44	W4	16.6±0.3 (N=114.9±0.5 (N=11.0±0.2 (N=13		2.9		Vernad	
45	W3	17.4±0.2 (N=115.6±0.2 (N=11.4±0.2 (N=13		13.9		Vernad.	
46	W3	17.1±0.2 (N=115.0±0.3 (N=11.2±0.5 (N=15		16.1		Vernad.	
47	W3	24.0±0.5 (N=120.0±0.2 (N=11.4±0.2 (N=12		1.06		Vernad.	
48	W4	17.7±0.4 (N=115.6±0.3 (N=11.2±0.2 (N=13		6.37		Vernad.	
49	W3	23.9±0.26 (N=20.1±0.38 (N=1.68±0.83 (N=		1.66		Vernad	
50	W4	24.3±0.2 (N=120.4±0.3 (N=11.7±0.3 (N=12		3.1		Vernad	
51	W2	30.0±0.6 (N=123.9±0.5 (N=12.4±0.1 (N=11		1.6		Vernad	
52	W4	24.2±0.4 (N=120.2±0.3 (N=12.0±0.3 (N=12		0.65		Vernad	
53	W4	24.1±0.3 (N=120.1±0.2 (N=11.9±0.3 (N=12		0.6		Vernad	
54	W1	24.5 (n=1)	22.5 (n=1)	1.3	4.99	31.5	CEREGE
55	W3				4.09	42.4	CEREGE
56	W3				4.36	53.1	CEREGE
57	W2				5.11	101	CEREGE



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3	W1	24.5±5.3 (n=5	17.0±2.3 (n=4	0.9±0.6	4.70	76.7	CEREGE
4	low		5.8±0.2 (n=4)	2.3±0.1	4.67	34	CEREGE
5	W4	20.1	17.6	2.3		47.28	WAM
6	W3	17.9±0.2	15.7±0.1	1.3±0.1	4.55	38.90	App
7	W1				5.36	13.9	MNHNP
8	W1				4.84	17.7	MNHNP
9	W2				5.09	29.9	MNHNP
10	W3	24.96±0.51 (N=21.42±0.55 (N=0.99±1.40 (N=4.67				12	MNHNP
11	W2				5.17	14.3	MNHNP
12	W2				4.02	150	CEREGE
13	W2	18.9±1.0 (n=1	12.8±3.8 (n=1	1.3±1.3	4.79	26	CEREGE
14	W3				4.96	4.45	CEREGE
15	W1				5.39	25.8	CEREGE
16	W1				5.20	22	CEREGE
17	W1				5.16	23	CEREGE
18	W1				5.21	33	CEREGE
19	W1				4.94	31	CEREGE
20	W2				5.08	69	CEREGE
21	W1				5.02	34	CEREGE
22	W2				4.92	5	CEREGE
23	W2						
24	W0	23.8±0.2 (n=3	19.8±0.2 (n=1	1.3±0.1 (#1); 1		55.3	MSN-FI
25	W3	23.6±0.2 (N=119.7±0.2 (N=11.5±0.2 (N=12				177.6	Vernad
26	W1	18.6±0.3 (N=116.4±0.2 (N=11.2±0.2 (N=12				19.2	Vernad
27	W1	20.3±0.2 (N=115.7±2.0 (N=12.1±1.1 (N=14				12.5	Vernad
28	W3	10.2±0.28 (N=11.6±4.44 (N=0.64±0.47 (N=				1.54	Vernad
29	W2	30.3±0.4 (N=124.7±0.2 (N=11.9±0.1 (N=10				40.3	Vernad
30	W3	28.6±0.6 (N=123.7±1.7 (N=11.46±0.29 (N=				50.6	Vernad
31	W1	22.7±8.28 (N=14.5±7.61 (N=1.17±0.79 (N=				2.8	Vernad
32	W1	18.1±0.48	15.6±0.24 (N=1.2±0.18 (N=1			4.1	Vernad
33	W1				4.69	11	CEREGE
34	W1	17.9±0.56 (N=15.6±0.3 (N=10.9±0.2 (N=12				34.1	Vernad
35	W1	18.6±0.5 (N=115.4±0.4 (N=11.3±0.2 (N=12				64.6	Vernad
36	W2	17.8±0.2 (N=115.7±0.2 (N=11.1±0.1 (N=12				99.0	Vernad
37	W1	17.6±0.9 (N=115.6±0.2 (N=11.5±0.1 (N=1)				64.2	Vernad
38	W1	23.6±0.5 (N=119.9±0.4 (N=11.3±0.2 (N=17				7.4	Vernad
39	W2	18.2±0.4 (N=116.0±0.1 (N=11.4±0.1 (N=12				211.4	Vernad
40	W1	17.9±0.32 (N=16.0±0.4 (N=11.3±0.3 (N=14				290.1	Vernad
41	W3	18.1±0.2 (N=116.0±0.4 (N=11.2±0.3 (N=18				90.1	Vernad
42	W2	24.1±0.4 (N=120.2±0.2 (N=11.5±0.2 (N=11				22.9	Vernad
43	W2	24.5±0.25 (N=20.4±0.18 (N=1.5±0.18 (N=1				429.3	Vernad
44	W1	24.1±0.23 (N=20.0±0.14 (N=1.43±0.19 (N=				10.4	Vernad
45	W1	18.7±0.47 (N=16.4±0.18 (N=1.24±0.14 (N=				17.58	Vernad
46	W1				4.75	2.08	CEREGE
47	W1				4.63	21	CEREGE
48	W1	17.5±0.25 (N=15.8±0.54 (N=1.5±0.12 (N=1				17.8	Vernad
49	W2	16.5±0.24 (N=14.5±0.5 (N=11.11±0.50 (N=				9.17	Vernad
50	W3	18.4±0.46 (N=16.0±0.22 (N=1.27±0.18 (N=				37.48	Vernad
51	W2	23.8±0.3 (N=119.9±0.2 (N=11.3±0.1 (N=12				216	Vernad.
52	W4				3.61	3.0	CEREGE
53	W1	25.3±1.41 (N=12.6±5.5 (N=21.09±0.91 (N=				62	FMMR
54	W1	18.8±0.22 (N=16.5±0.5 (N=11.2±0.2 (N=13				67.9	Vernad
55	W1	24.0±0.24 (N=20.2±0.3 (N=11.5±0.1 (N=11				39.1	Vernad
56	W1	24.7±0.3 (N=120.8±0.6 (N=11.4±0.2 (N=16				9	Vernad
57	W1	18.5±0.6 (N=116.1±0.7 (N=11.2±0.2 (N=16				5.8	Vernad
58	W2	24.0±0.5 (N=120.3±0.4 (N=11.4±0.2 (N=12				490	Vernad.

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2						
3	W2	18.4±3.4 (N=118.1±7.6 (N=11.6±1.4 (N=13		510.5		Vernad.
4	W2	24.3±0.3 (N=120.3±0.3 (N=11.4±0.2 (N=15		11.4		Vernad.
5	W2	24.6±0.3 (N=120.6±0.3 (N=11.5±0.1 (N=12		5.2		Vernad.
6	W3	23.5±0.5 (N=119.9±0.5 (N=12.1±0.3 (N=15		11.7		Vernad.
7	W2	24.7±0.7 (N=120.3±0.5 (N=11.4±0.2 (N=14		4.29		Vernad.
8	W2	18.7±0.4 (N=116.3±0.2 (N=11.4±0.2 (N=12		1.95		Vernad
9	W1	18.4±0.7 (N=115.8±0.3 (N=11.1±0.2 (N=12		12.7		Vernad
10	W2	24.3±0.3 (N=120.2±0.3 (N=11.7±0.3 (N=12		4.7		Vernad
11	W2	18.5±0.3 (N=116.2±0.2 (N=11.3±0.2 (N=12		8.4		Vernad
12	W1	23.3±0.3 (N=119.4±0.2 (N=12.2±0.3 (N=12		17.1		Vernad
13	W1	18.0±0.4 (N=115.9±0.3 (N=11.4±0.3 (N=13		16		Vernad
14	W2	24.7±0.3 (N=120.9±0.4 (N=11.4±0.2 (N=15		16		Vernad
15	W1	17.7±0.9 (N=115.5±0.5 (N=11.1±0.3 (N=14		12.9		Vernad
16	W1	22.6±0.8 (N=112.0±3.8 (N=11.0±1.0 (N=14		14.4		Vernad
17	W1	20.6±4.6 (N=211.5±9.8 (N=21.1±0.8 (N=26		17.3		Vernad
18	W1	18.0±0.3 (N=115.9±0.2 (N=11.3±0.2 (N=12		345		Vernad
19	W2	24.0±0.3 (N=120.3±0.3 (N=11.3±0.2 (N=12		315		Vernad
20	W1	16.5±0.2 (N=114.9±0.7 (N=10.9±0.1 (N=13		654		Vernad
21	W1	23.4±0.3 (N=119.6±0.4 (N=11.3±2.0 (N=13		13.6		Vernad
22	W1	24.2±0.6 (N=120.2±0.2 (N=11.2±0.2 (N=12		12.8		Vernad
23	W1	23.8±0.2 (N=120.3±0.3 (N=11.5±0.2 (N=12		15.9		Vernad
24	W1	17.4±7.9 (N=114.8±4.0 (N=21.8±0.4 (N=20		37.8		Vernad
25	W2	16.3±7.8 (N=29.4±6.5 (N=201.5±1.3 (N=20		31.5		Vernad
26	W2	24.0±0.2 (N=120.1±0.1 (N=11.9±0.2 (N=11		7.1		Vernad.
27	W1	18.7±0.4 (N=116.5±0.2 (N=11.7±0.3 (N=11		11.2		Vernad.
28	W3	18.6±0.5 (N=116.3±0.3 (N=11.5±0.2 (N=13		7.6		Vernad.
29	W1	23.0±0.2 (N=119.4±0.3 (N=12.7±0.3 (N=12		53.8		Vernad.
30	W2	24.1±0.1 (N=120.1±0.2 (N=11.6±0.4 (N=12		5.3		Vernad
31	W1	18.4±0.4 (N=116.0±0.2 (N=11.3±0.1 (N=12		17.8		Vernad
32	W2	17.8±0.3 (N=115.8±0.2 (N=11.1±0.2 (N=12		2.2		Vernad
33	W1	23.1±0.2 (N=119.6±0.3 (N=12.3±0.2 (N=12		9.8		Vernad
34	W1	17.8±0.2 (N=115.6±0.2 (N=11.2±0.2 (N=12		232.0		Vernad
35	W1	17.8±0.2 (N=115.6±0.3 (N=11.1±0.1 (N=12		284.3		Vernad
36	moderate	37.6±16.7 (n= 3.1±3.0 (n=4) 0.8±0.3	4.38	39.2		CEREGE
37	high	22.5±16.0 4.7±3.8 1.2±1.0	4.92	23.55		App
38	moderate	21.4±0.2, n=1; 17.6±0.1, n=1; 9.7±0.1, n=12		24.4		MNB
39	W4	0.7-44.3 1.2-29.9 0.2-3.9	4.01	40		UCLA
40	W3	17.8±0.5 (N=115.8±0.3 (N=11.6±0.2 (N=12		25.1		Vernad
41	W1	18.0±0.4 (N=115.9±0.3 (N=11.2±0.2 (N=12		53.1		Vernad
42	W3	18.8±0.6 16.4±0.7 1.1±0.1		0.87		UCLA
43	W5	18.6±0.5 16.9±0.8 1.1±0.2		1.7		UCLA
44	W3		4.91	33.7		CEREGE
45	A/B	27 23	4.7	44.69		JSC
46	A/B	19	5.14	1.38		JSC
47	W4	25.7±0.2 (n=2 21.5±0.1 (n=2 1.4±0.3 (n=2)		20		OU
48	W3	23.2±0.3, n=1 20.2±0.7, n=1; 1.8±0.3, n=10		42.1		MNB
49	W3	23.8±0.3 (n=1 19.9±0.2 (n=1 1.7±0.1 (n=11		27.3		MNB
50	W1	18.6±1.4 (n=1 15.2±3.4 (n=9 1.5±0.4 (n=9)		9.9		MNB
51	W3	18.2±0.1 (n=7 16.6±0.5 (n=7 1.2±0.1 (n=7)		30.4		MNB
52	low	17.0±19.0 (0.75.3±1.9 (2.0-73.1±0.2 (2.7-3		1.3		MNB
53	W2	24.6±0.4 (n=7 20.9±0.1 (n=7 1.5±0.3 (n=7)		44.7		MNB
54	W4	25.1±0.3 (n=5 21.1±0.4 (n=5 1.5±0.4 (n=5)		27.5		IFP
55	A/B	1-44 1-7	4.64	52.791		JSC
56	A/B	1-41	4.73	35.9		JSC
57	A	3	4.81	63.445		JSC

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2					
3	A/B	31-52	4.28	15.92	JSC
4	A/B	20-64	4.2	25.065	JSC
5	A	30-63	2.87	8.33	JSC
6	W4	24.2±0.5 (n=3 20.9±1.3 (n=9 1.7±0.2	4.62	6.9	Kiel
7	W4	18.9±0.1 (n=5 17.1±0.4 (n=5 1.19±0.16 (n=		195	IGCAS
8	low	57.8-59.0; 26.5.3-4.1; 42.5-4		20.3	UWB
9	W2		4.47	39.5	MNHNP
10	W3	26.31±1.9 (N=20.70±0.47 (N1.66±0.21 (N=4.58		36.3	MNHNP
11	W2		5.21	27.9	MNHNP
12	W1		5.12	118.1	MNHNP
13	W3	18.78±0.05 (N16.56±0.41 (N1.16±0.33 (N=4.80		8.2	MNHNP
14	W1		5.47	14.6	MNHNP
15	W2	24.26±0.1 (N=20.77±0.21 (N1.57±0.19 (N=4.86		87.7	MNHNP
16	W2		4.92	43.9	MNHNP
17	W2		5.25	125	MNHNP
18	W1		5.25	125	MNHNP
19	W3	25.25±0.48 (N21.06±0.27 (N1.87±0.04 (N=4.57		35.7	MNHNP
20	W3	17.11±0.56 (N15.77±0.27 (N1.07±0.27 (N=4.73		27.6	MNHNP
21	W2	18.57±0.17 (N16.34±0.26 (N1.50±0.21 (N=5.13		18.4	MNHNP
22	W3	25.24±0.44 (N21.30±0.26 (N1.56±0.35 (N=4.40		2	MNHNP
23	W1		5.25	24	MNHNP
24	W1		5.12	13.3	MNHNP
25	W2		5.01	13	MNHNP
26	W2		5.04	22.8	MNHNP
27	W2	19.03±0.07 (N16.60±0.66 (N1.14±0.10 (N=4.81		14.3	MNHNP
28	W3	19.03±0.00 (N16.52±0.16 (N1.31±0.31 (N=4.67		19.5	MNHNP
29			4.62	15	MNHNP
30	W2		4.42	16.2	CEREGE
31	W2	0.39 ± 0.15 (N1.53 ± 0.07 (N5.24		135	MNHNP
32	W2		4.18	400	CEREGE
33	W1		4.57	12	CEREGE
34	W1		4.53	15.7	CEREGE
35	W3		4.97	24.6	CEREGE
36	W2		4.96	54.8	CEREGE
37	W1		4.56	19	CEREGE
38	W1		5.33	21	CEREGE
39	W1		5.36	33.5	CEREGE
40	W1		4.55	6	CEREGE
41	W2		4.59	7.1	CEREGE
42	W1		4.66	12.3	CEREGE
43	W2		4.70	3.7	CEREGE
44	W1		4.55	7	CEREGE
45	W1		5.05	22	CEREGE
46	W1		5.05	22	CEREGE
47	W2	18.4±0.1 (n=7 16.3±0.1 (n=7 1.5±0.1 (n=7)		22.3	MNB
48	W2	18.7±0.3 (n=7 16.2±0.2 (n=7 1.0±0.1 (n=7)		23.4	MNB
49	W2	23.9±0.1 (n=7 20.3±0.3 (n=7 2.0±0.2 (n=7)		8.1	MNB
50	W1		5.14	28	CEREGE
51		19.2±14.5 (n= 1.9 (n=2) 1.4	4.42	96	CEREGE
52	low	22.7±12.9 (n= 1.6 (n=2) 0.7	4.43	86	CEREGE
53	moderate	27.1±16.5 (n= 1.5±0.1 (n=7) 1.5±0.8	4.40	34	CEREGE
54	A/B	25 21	4.47	181.58	JSC
55	B/C	17 15	5.34	220.52	JSC
56	B	25 21	4.78	265.32	JSC
57	A/B	25 21	4.75	251.98	JSC
58	B	28 22	4.43	84.05	JSC
59	A/B	25 21	4.52	90.47	JSC
60	A/B	25 21	4.52	90.47	JSC

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2						
3	A/B	25	21	4.55	105.74	JSC
4	B	18	16	5.18	114.33	JSC
5	A/B	25	21	4.77	90.89	JSC
6	A/B	24	21	4.79	102.81	JSC
7	A/B	25	21	4.75	79.77	JSC
8	B	26	22	4.66	82.66	JSC
9	A/B	24	20	4.51	52.06	JSC
10	A/B	25	21	4.66	110.69	JSC
11	A/B	25	21	4.64	55.65	JSC
12	B	25	21	4.8	60.59	JSC
13	A/B	25	21	4.81	217.32	JSC
14	A/B	25	20	4.68	337.63	JSC
15	B/C	20	18	5.18	160.72	JSC
16	A/B	25	21	4.5	122.28	JSC
17	B	25	21	4.55	91.59	JSC
18	B	25	22	4.68	59.48	JSC
19	A/B	25	21	4.72	60.46	JSC
20	A/B	25	22	4.6	24.7	JSC
21	A/B	25	21	4.54	22.92	JSC
22	A/B	26	21	4.61	31.92	JSC
23	A/B	25	21	4.69	17.63	JSC
24	A/B	25	21	4.49	55.68	JSC
25	A/B	25	21	4.66	28.11	JSC
26	A/B	25	21	4.63	27.7	JSC
27	A/B	25	21	4.61	18.35	JSC
28	A/B	24	21	4.65	30.53	JSC
29	B	19	17	4.55	70.57	JSC
30	A/B	26	22	4.55	80.67	JSC
31	A/B	19	17	5.23	38.038	JSC
32	A/B	25	21	4.6	28.222	JSC
33	A/B	25	21	4.56	42.693	JSC
34	A/B	26	22	4.69	25.317	JSC
35	A/B	25	21	4.72	17.719	JSC
36	A/B	25	21	4.73	36.684	JSC
37	B	20	19	5.15	46.706	JSC
38	A/B	25	21	4.37	24.66	JSC
39	A/B	25	21	4.64	61.273	JSC
40	A/B	26	22	4.58	11.545	JSC
41	A/B	25	21	4.91	13.26	JSC
42	A/B		22	4.72	12.474	JSC
43	B	21		5.23	14.85	JSC
44	A/B	24	21	4.7	14.542	JSC
45	A/B	24	21	4.58	25.869	JSC
46	A/B	25		4.54	29.738	JSC
47	A/B	26	22	4.64	19.483	JSC
48	B	25	20	4.6	22.846	JSC
49	B	25	21	4.66	16.473	JSC
50	A/B	25	21	4.71	17.56	JSC
51	A/B	25	21	4.72	22.67	JSC
52	A/B	25	23	4.6	23.33	JSC
53	A/B	26	22	4.68	18.08	JSC
54	A/B	24	22	4.67	19.77	JSC
55	A/B	25	21	4.72	23.58	JSC
56	B	25	20	4.65	20.28	JSC
57	B	20		5.08	17.77	JSC

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2						
3	B	21	18	5.22	6.7	JSC
4	A/B	25	22	4.62	8.282	JSC
5	A/B	25		4.72	10.314	JSC
6	B	24	21	4.88	9.71	JSC
7	A/B	25	22	4.8	5.645	JSC
8	B	28	24	4.48	14.145	JSC
9	B	20	18	5.13	16.205	JSC
10	B	20	18	5.19	7.617	JSC
11	A/B	25	22	4.62	21.465	JSC
12	B	25	21	4.58	25.194	JSC
13	A/B	25	22	4.59	7.645	JSC
14	B	20	18	5.02	32.38	JSC
15	B	25	21	4.6	20.46	JSC
16	A/B	25	22	4.51	32.2	JSC
17	B	28	25	4.46	9.99	JSC
18	B	25	21	4.74	11.26	JSC
19	B/C	19	18	5.27	9.25	JSC
20	A/B	24	21	4.65	9.07	JSC
21	B/C	25	22	4.57	10.4	JSC
22	B/C	26	23	4.72	10.65	JSC
23	A/B	17	16	5.1	16.19	JSC
24	A/B	25	21	4.69	18.09	JSC
25	A/B	25	21	4.58	13.97	JSC
26	A/B	25	22	4.53	16.51	JSC
27	A/B	25	21	4.65	12.67	JSC
28	A/B	25	21	4.67	17.44	JSC
29	A/B	25	22	4.72	12.41	JSC
30	A/B	25	21	4.63	9.84	JSC
31	A/B	25	22	4.7	10.51	JSC
32	A/B	25	21	4.66	6.475	JSC
33	A/B	25	22	4.93	4.541	JSC
34	A/B	25	21	4.69	14.865	JSC
35	A/B	25	22	4.56	12.85	JSC
36	B	20	18	5.2	29.755	JSC
37	A/B	25	21	4.73	8.725	JSC
38	A/B	25		4.5	18.058	JSC
39	A/B	25	22	4.74	10.325	JSC
40	A/B	25	22	4.68	12.604	JSC
41	B/C	20	18	5.04	4.65	JSC
42	B	26	23	4.65	3.72	JSC
43	A/B	25	21	5.06	5.48	JSC
44	B	20	18	5.32	3.86	JSC
45	B/C	20	19	5.28	8.2	JSC
46	B	25	22	4.52	2.53	JSC
47	B/C	25	22	4.67	4.24	JSC
48	A/B	26	24	4.59	4.22	JSC
49	B	25	22	4.6	4.47	JSC
50	B/C	20	18	5.06	2.87	JSC
51	B/C	20	18	4.98	3.76	JSC
52	B	20	19	5.1	3.13	JSC
53	B	25		4.9	4.03	JSC
54	A/B	25	22	4.69	3.48	JSC
55	B	25	22	4.47	2.47	JSC
56	B/C	20	18	5.06	2.46	JSC
57	A/B	25	21	4.68	4.15	JSC



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2						
3	B/C	20	18	5.01	1.48	JSC
4	B/C	19	17	5.04	1.2	JSC
5	B	25	13-29	4.57	1.67	JSC
6	B/C	25	20	4.69	2.05	JSC
7	A/B	31	27	3.57	2.24	JSC
8	B/C	20	18	5.03	3.17	JSC
9	B/C	20	18	5.02	2.15	JSC
10	A/B	25	20	4.49	2.26	JSC
11	B/C	20	17	5.19	1.36	JSC
12	B/C	20	18	4.99	2.49	JSC
13	B	25	21	4.71	3.619	JSC
14	A/B	25	22	4.74	6.48	JSC
15	A/B	25	22	4.68	5.754	JSC
16	A/B	25	21	4.81	4.757	JSC
17	A/B	1-26	9-22	4.44	6.409	JSC
18	A/B	25	21	4.55	8.468	JSC
19	A/B	25	21	4.75	5.456	JSC
20	B	26		4.64	3.265	JSC
21	A/B	27	23	4.8	4.067	JSC
22	A/B	26	22	4.65	3.869	JSC
23	B	26	22	4.61	3.63	JSC
24	B/C	20	18	5.02	1.9	JSC
25	B	25	21	4.67	2.43	JSC
26	B/C	20	18	4.93	3.5	JSC
27	B/C	19	17	5.06	2.58	JSC
28	C	24		4.56	1.41	JSC
29	A/B	24	13-20	4.68	3.97	JSC
30	C	19	17	5.2	2.42	JSC
31	B/C	7	3-8	5.17	2.72	JSC
32	B	25	21	4.85	4.49	JSC
33	B/C	20	18	5.03	2.93	JSC
34	A/B	25	21	4.7	2.39	JSC
35	B/C	20	18	5.15	1.56	JSC
36	A/B	30	25	4.78	1.52	JSC
37	A/B	26	23	4.61	1.07	JSC
38		20	19	5.03	1.14	JSC
39	B/C	20	18	5.03	2.26	JSC
40		26	22	4.55	1.14	JSC
41	B/C	16	15	5.06	1.27	JSC
42	B/C	20	18	5.04	2.13	JSC
43	B/C	25	20	4.55	1.31	JSC
44	B/C	21	19	5	1.47	JSC
45	B/C	20	18	5.01	2.75	JSC
46	B/C	20	18	5.04	1.49	JSC
47	B	29		4.68	1.36	JSC
48	B/C	20	18	5.06	4.72	JSC
49	B/C	21	19	5.03	2.02	JSC
50	B/C	27	22	4.56	2.84	JSC
51	B/C	22	20	5.02	1.5	JSC
52	A/B	26	22	4.63	3.86	JSC
53	B/C	20	18	5.06	1.24	JSC
54	W3			4.90	21.1	Kiel
55	W2	25.1±0.6 (n=5)	21.4±0.7 (n=5)	1.43±0.26 (n=	2250	IGCAS
56	low		14.4-22.8; 20.2-3.3; 7.0; 3.3.06		50.1	UWB
57	moderate	1.2±0.2 (n=3)	4.7 (n=2)	2.2	5.17	CEREGE
58					21.3	

1							
2							
3	W0			6.7		IfP	
4	W2	25.0±0.5 (n=3)	20.6±0.4 (n=2)	1.3±0.9	4.43	25.27	CEREGE
5	low		23.4-23.7;	67.32.3-30.4;	20.1		UWB
6	W3	16.9±1.9 (N=31)	14.2±0.7 (N=11)	1.1±0.2 (N=17)		299.89	UrFU
7	W3	17.8±1.0 (N=31)	15.0±0.8 (N=11)	1.1±0.3 (N=14)		78.75	UrFU
8	W1			4.99 - 5.09	21.1		Kiel
9	W1			4.95	21.0		Kiel
10	W1			4.88	20.4		Kiel
11	W1			4.75	20.4		Kiel
12	W0	24.8±0.1 (n=5)	21.0±0.2 (n=5)	1.6±0.1	4.71	89.5	UWB/ASU
13	low	40.9±0.3	30.5±6.2	12.7±11.4		20.6	UNM
14	W3	18.1±0.2 (N=5)	16.0±0.2 (N=3)	1.1±0.4 (N=3)		3.7	UAz
15		24.5±0.3 (n=8)	21.3±1.1 (n=8)	1.5		27	KirkU
16	W3	25.08±0.48 (n=2)	1.24±1.28 (n=1)	1.74±0.23 (n=)		25	IGCAS
17	W4	39.4±0.4 (n=1)	26.3±4.8 (n=9)	1.2±0.9 (n=9)		20.5	IfP
18	low		51.5±1.9, 50.7	4.9±0.7, 7.4±13.02		20.21	UNM
19	B/C	18	16	5.16		6.74	JSC
20	B/C	20	17	5.19		99.35	JSC
21	B/C	19	17	4.59		10.06	JSC
22	B/C	19	17	4.9		35.07	JSC
23	B/C	19	17	5.19		39.26	JSC
24	B	6-23	3-24	4.39		44.56	JSC
25	B	20	18	5.167		17.609	JSC
26	B	25	21	4.438		12.412	JSC
27	B	20	17	5.13		9.296	SI
28	B	25	21	4.43		16.777	JSC
29	B	20	18	5.14		11.145	JSC
30	B	19	17	5.3		11.136	JSC
31	B	19	17	4.84		30.45	JSC
32	B/C	17	15	5.039		23.653	JSC
33	B	25	22	4.648		12.656	JSC
34	B	25	21	4.637		3.204	JSC
35	B/C	20		5.26		59.83	JSC
36	B	19	17	5.13		116.54	JSC
37	B/C	20	18	5		37.92	JSC
38	B/C	20	18	5.04		71.04	JSC
39	B/Ce	20	17	5.1		52.73	JSC
40	B	6-26	3-17	3.78		92.43	JSC
41	B/C	26	21	4.68		87.93	JSC
42	B	25	21	4.66		80.95	JSC
43	B/C	20	17	5.28		363.69	JSC
44	A/B	24	20	4.717		20.694	JSC
45	B	19	16	4.857		25.246	JSC
46	A/B	25	21	4.6		35.919	JSC
47	B	19	17	4.97		26.689	JSC
48	B	25	21	4.54		16.699	JSC
49	A/B	20	18	4.82		25.572	JSC
50	B	29	6-25	3.768		19.203	JSC
51	A/B	25	21	4.56		40.973	JSC
52	B/C	20	18	5.06		195.164	JSC
53	B/Ce	19	17	5.15		186.291	JSC
54	B	20	18	5.14		133.935	JSC
55	B	19	17	5.31		175.33	JSC
56	A/Be	19	17	4.98		154.461	JSC
57	B/Ce	20	18	5.15		158.66	JSC
58							
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3	B/C	20		5.18	79.87	JSC
4	B/C	21	19	5.08	60.39	JSC
5	B	19	3-17	5.12	954.2	JSC
6	B/Ce	25	21	4.69	1578.3	JSC
7	A/Be	25	20	4.91	2502.8	JSC
8	A/Be	25	24	4.76	1168.61	JSC
9	B	28		4.21	3192.08	JSC
10	A/Be	25	21	4.73	524.29	JSC
11	A/Be	25	21	4.66	2144.7	JSC
12	A/Be	25	22	4.92	9485	JSC
13	B/Ce	20	18	5.15	219.386	JSC
14	B	19	17	5.09	388.56	JSC
15	Be	20	19	4.97	268.96	JSC
16	B	21	19	5.2	142.33	JSC
17	B	19	19	5.3	275.54	JSC
18	B	20	18	5.17	174.84	JSC
19	Be		18	4.42	114.85	JSC
20	B/Ce	19	17	5.14	184.077	JSC
21	A/B	20	18	5.17	71.59	JSC
22	B/C	20	17	5.06	287.54	JSC
23	B/Ce	20	17	5.17	436.73	JSC
24	B	18	16	5.07	109.77	JSC
25	B/C	20	17	5.04	150.23	JSC
26	A/B	24	13-20	4.88	101.7	JSC
27	B/C	19	17	5.14	104.8	JSC
28	B/C	20	17	5.12	111.48	JSC
29	A/B	28	23	4.77	138.87	JSC
30	A/B	26	24	4.72	277.19	JSC
31	B/C	20	18	5.2	309.88	JSC
32	B/C	21	19	5.1	166.37	JSC
33	Be	20		5.05	121.27	JSC
34	B	25	21	4.797	40.839	JSC
35	Be	20	18	5.122	109.798	JSC
36	A/B	25	21	4.88	41.982	JSC
37	A/Be	19	17	4.978	57.111	JSC
38	Be	20	17	4.968	40.471	JSC
39	A/B	25	21	4.52	18.591	JSC
40	B/C	19	17	4.73	10.428	JSC
41	B/C		18	5.03	11.488	JSC
42	B/C	18	16	4.78	5.676	JSC
43	B/C	19	17	4.86	5.03	JSC
44	B/C	20	18	5.04	18.315	JSC
45	B/C	26	21	4.22	30.262	JSC
46	B	19	17	5.26	13.995	JSC
47	B/Ce	25	21	4.85	1168.46	JSC
48	B/Ce	20	18	5.26	2811.74	JSC
49	B/Ce	20	18	5.18	2703.04	JSC
50	B	25	22	4.789	688.39	JSC
51	A/Be	26	22	4.69	694.32	JSC
52	B	20	17	5.105	250.76	JSC
53	A/Be	27	23	4.66	564.73	JSC
54	Be		18	5.14	467.59	JSC
55	B/C	20	17	5.1	6.71	JSC
56	B/C	25	21	4.49	8.5	JSC
57	B/C	0.5	0-1	4.95	16.32	JSC

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3	B	26	21	3.93	32.07	JSC
4	B/C	18	16	5.24	22.96	JSC
5	B	24	21	4.75	15.66	JSC
6	B/C	25	23	4.36	32.86	JSC
7	B/C	19	17	4.89	11.03	JSC
8	B/C	25	21	4.5	17	JSC
9	Be	24	20	4.71	91.43	JSC
10	B/C	21	20	5.25	101.87	JSC
11	B	28	24	4.62	136.2	JSC
12	B/C	21	19	5.04	70.14	JSC
13	B/C	26	21	4.49	24.21	JSC
14	B/C	21	19	5.07	39.64	JSC
15	B	21	19	5.04	32.94	JSC
16	B/C	25	21	4.53	25.96	JSC
17	B	25	21	4.71	26.95	JSC
18	B/C	20	18	4.96	7.78	JSC
19	B/C	26	22	4.23	14.59	JSC
20	B/C	19	17	4.79	8.51	JSC
21	B	20	18	5.14	14.01	JSC
22	B/C	20	18	4.81	14.02	JSC
23	A/B	27	12-27	4.32	9.75	JSC
24	B/C	21	18	4.74	18.34	JSC
25	B	18	16	4.69	11.57	JSC
26	B	25	22	4.9	728.43	JSC
27	Be	25	22	4.75	1188.99	JSC
28	A/Be	25	21	4.82	697.48	JSC
29	A/B	25	21	4.46	160.67	JSC
30	A/B	25	21	4.73	186.24	JSC
31	A/B	25	22	4.88	290.11	JSC
32	Be	25	22	5	250.31	JSC
33	A/B	19	17	5.18	189.84	JSC
34	B/C	19	17	4.97	136.28	JSC
35	B/C	20	18	4.92	64.88	JSC
36	B/C	25	21	4.64	59.36	JSC
37	B/Ce	19	17	5.02	48.64	JSC
38	B/C	20	18	5.17	82.36	JSC
39	Be	25	21	4.7	50.32	JSC
40	B/C	20	18	5.11	55.22	JSC
41	B	24	20	4.64	40.94	JSC
42	B/Ce	21	18	4.99	69.3	JSC
43	Be	19	17	4.92	97.35	JSC
44	B/C	25	21	4.69	85.52	JSC
45	B/C	19	17	5.18	76.6	JSC
46	A/B	25	22	4.61	65.6	JSC
47	B	24	20	4.68	93.83	JSC
48	B/C	20	18	4.93	61.77	JSC
49	B/Ce	19		5.04	116.16	JSC
50	B/C	20	18	5.24	150.48	JSC
51	B	25	22	4.59	174.11	JSC
52	Be	1-35	5-12	4.08	121.65	JSC
53	A/B	19	17	5.23	302.29	JSC
54	B	19	19	5.28	321.34	JSC
55	B/Ce	20	18	5.25	219.35	JSC
56	B/Ce	20	19	5.25	473.9	JSC
57	B/Ce	19	17	5.05	94.16	JSC

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3	B/Ce	5-36	3-17	4.33	65.77	JSC
4	B/C	20	18	4.12	89.41	JSC
5	B/C	20	18	5.078	93.28	JSC
6	A/B	25	21	5.02	17.766	JSC
7	B	20	17	5.26	8.77	JSC
8	B	25	21	3.71	118.514	JSC
9	A/B	24	20	4.86	25.328	JSC
10	B/Ce	20	19	4.98	29.47	JSC
11	B/Ce	20	19	5.05	45.995	JSC
12	B/C	21	18	5.04	25.604	JSC
13	B/C	20	17	5.17	38.739	JSC
14	B/C	20	18	5.22	51.408	JSC
15	B/Ce	20	17	4.83	19.48	JSC
16	B/Ce	20	18	4.92	34.771	JSC
17	B/Ce	19	17	4.98	32.036	JSC
18	A/B	20	18	5.21	87.154	JSC
19	A/B	19	17	5.226	74.281	JSC
20	Be	26	22	4.7	81.269	JSC
21	Be	20	18	4.809	18.968	JSC
22	Be	20	17	5.201	48.284	JSC
23	Be	20	18	4.967	19.622	JSC
24	B	20	17	5.062	6.535	JSC
25	Be	20	17	4.908	8.19	JSC
26	A/B	28		4.435	10.254	JSC
27	W2	18.65±0.23 (n=16.18±0.42 (n=1.20±0.32 (n=			0.67	PRIC
28	W2	19.34±0.15 (n=17.09±0.27 (n=1.14±0.08 (n=			0.95	PRIC
29	W2	18.57±0.26 (n=18.84±0.61 (n=0.53±0.75 (n=			1.66	PRIC
30	W2	17.82±0.23 (n=15.79±0.22 (n=1.25±0.18 (n=			2.04	PRIC
31	W2	18.39±0.42 (n=16.3±0.51 (n=1.38±0.07 (n=			1.27	PRIC
32	W3	18.06±0.26 (n=16.39±0.37 (n=1.16±0.10 (n=			0.12	PRIC
33	W2	18.93±0.56 (n=17.63±0.17 (n=1.10±0.11 (n=			2.37	PRIC
34	W2	18.15±0.13 (n=15.86±0.01 (n=1.49±0.13 (n=			10.70	PRIC
35	W2	25.32±0.57 (n=21.06±0.56 (n=1.46±0.19 (n=			5.00	PRIC
36	W1	18.95±0.73 (n=16.09±0.25 (n=1.00±0.15 (n=			3.04	PRIC
37	W2	18.54±0.68 (n=16.69±0.37 (n=0.82±0.06 (n=			0.42	PRIC
38	W3	18.18±0.59 (n=15.91±0.32 (n=1.27±0.09 (n=			0.29	PRIC
39	W1	18.24±0.16 (n=15.9±0.47 (n=2.11±2.04 (n=			2.92	PRIC
40	W2	18.13±0.82 (n=19.35±0.08 (n=1.21±0.27 (n=			2.26	PRIC
41	W2	17.94±0.28 (n=15.26±0.67 (n=1.55±0.79 (n=			1.71	PRIC
42	W3	18.71±0.37 (n=15.9±0.67 (n=1.18±0.13 (n=			1.26	PRIC
43	W2	19.03±0.51 (n=17.11±0.64 (n=1.12±0.09 (n=			0.75	PRIC
44	W2	18.53±0.8 (n=15.6±0.32 (n=0.93±0.11 (n=			0.53	PRIC
45	W2	18.35±0.01 (n=18.77±0.12 (n=1.30±0.04 (n=			0.34	PRIC
46	W3	18.31±0.31 (n=16.03±0.65 (n=1.08±0.26 (n=			0.49	PRIC
47	W3	18.39±0.59 (n=16.66±0.07 (n=1.27±0.15 (n=			0.39	PRIC
48	W2	18.85±0.87 (n=17.99±0.5 (n=0.78±0.12 (n=			0.22	PRIC
49	W3	18.61±0.21 (n=16.94±0.49 (n=1.41±0.65 (n=			0.18	PRIC
50	W3	18.32±0.67 (n=16.39±0.55 (n=1.14±0.24 (n=			0.18	PRIC
51	W3	19.14±0.72 (n=17.88±0.74 (n=1.13±0.05 (n=			0.21	PRIC
52	W3	17.69±0.13 (n=16.74±0.77 (n=1.09±0.33 (n=			0.07	PRIC
53	W3	17.75±0.21 (n=17.86±0.74 (n=1.11±0.15 (n=			0.06	PRIC
54	W3	18.98±0.37 (n=16.28±0.53 (n=1.25±0.10 (n=			3.61	PRIC
55	W1	17.85±0.16 (n=15.72±0.09 (n=0.55±0.07 (n=			4.79	PRIC
56	W2	27.01±1.26 (n=21.26±0.24 (n=1.24±0.25 (n=			1.04	PRIC
57	W2	23.53±0.18 (n=20.21±0.88 (n=1.24±0.26 (n=			7.34	PRIC



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3	W3	24.43±0.18 (n=19.92±0.35 (n=1.99±0.90 (n=	3.76	PRIC	
4	W2	24.6±0.38 (n=20.8±0.89 (n=1.36±0.20 (n=	1.46	PRIC	
5	W3	24.27±0.77 (n=20.05±0.91 (n=1.34±0.18 (n=	0.95	PRIC	
6	W2	23.5±0.37 (n=19.72±0.51 (n=1.28±0.12 (n=	1.93	PRIC	
7	W2	23.89±0.3 (n=21.1±0.81 (n=1.51±0.21 (n=	1.49	PRIC	
8	W3	25.06±0.31 (n=21.37±0.73 (n=1.61±0.17 (n=	1.68	PRIC	
9	W2	23.7±0.71 (n=19.64±0.22 (n=1.36±0.10 (n=	2.22	PRIC	
10	W1	23.29±0.4 (n=19.48±0.03 (n=1.70±0.00 (n=	2.23	PRIC	
11	W2	24.78±0.38 (n=20.68±0.83 (n=1.30±0.30 (n=	1.67	PRIC	
12	W2	23.55±0.37 (n=19.68±0.49 (n=1.43±0.24 (n=	1.47	PRIC	
13	W2	24.5±0.72 (n=20.53±0.24 (n=1.53±0.36 (n=	1.93	PRIC	
14	W2	24.66±0.32 (n=20.76±0.53 (n=1.69±0.48 (n=	1.42	PRIC	
15	W2	18.92±0.67 (n=16.29±0.42 (n=1.27±0.26 (n=	1.60	PRIC	
16	W2	23.48±1.08 (n=19.31±0.27 (n=1.43±0.31 (n=	1.10	PRIC	
17	W2	24.07±0.73 (n=22.54±0.4 (n=1.47±0.23 (n=	1.02	PRIC	
18	W2	23.79±0.21 (n=20.22±0.26 (n=1.36±0.19 (n=	1.22	PRIC	
19	W3	24.23±0.2 (n=20.59±0.83 (n=1.50±0.44 (n=	1.02	PRIC	
20	W2	25.52±0.65 (n=21.35±0.78 (n=1.64±0.16 (n=	0.93	PRIC	
21	W3	24.43±0.44 (n=20.8±0.31 (n=1.36±0.24 (n=	0.93	PRIC	
22	W3	24.13±0.74 (n=20.61±0.65 (n=1.28±0.29 (n=	0.72	PRIC	
23	W2	23.89±0.85 (n=20.17±0.51 (n=1.23±0.14 (n=	0.93	PRIC	
24	W2	24.17±0.54 (n=19.89±0.72 (n=1.37±0.38 (n=	0.73	PRIC	
25	W3	23.99±0.34 (n=20.04±0.46 (n=1.49±0.24 (n=	0.85	PRIC	
26	W3	23.45±0.79 (n=20.03±0.96 (n=1.37±0.45 (n=	0.56	PRIC	
27	W2	23.42±0.39 (n=21.3±0.75 (n=1.41±0.31 (n=	0.61	PRIC	
28	W2	25.18±0.4 (n=21.01±0.29 (n=1.57±0.18 (n=	0.66	PRIC	
29	W2	20.93±0.7 (n=18.35±0.64 (n=1.37±0.26 (n=	0.61	PRIC	
30	W2	12.93±0.16 (n=11.98±0.37 (n=1.08±0.08 (n=	0.74	PRIC	
31	W2	24.09±0.35 (n=20.00±0.67 (n=1.70±0.11 (n=	0.77	PRIC	
32	W1	24.1±0.17 (n=20.28±0.22 (n=1.46±0.11 (n=	0.71	PRIC	
33	W3	24.29±0.86 (n=20.47±0.73 (n=1.81±0.14 (n=	0.56	PRIC	
34	W2	24.37±0.12 (n=20.1±0.34 (n=1.58±0.17 (n=	0.50	PRIC	
35	W2	23.67±0.49 (n=20.23±0.37 (n=1.40±0.28 (n=	0.51	PRIC	
36	W2	23.31±0.3 (n=19.52±0.58 (n=1.46±0.27 (n=	0.33	PRIC	
37	W2	23.66±0.24 (n=20.17±0.85 (n=1.38±0.25 (n=	0.34	PRIC	
38	W1	23.31±0.61 (n=19.43±0.42 (n=1.70±0.15 (n=	0.49	PRIC	
39	W1	24.1±0.85 (n=20.20±0.25 (n=1.21±0.24 (n=	0.25	PRIC	
40	W3	24.15±0.54 (n=20.01±0.43 (n=1.51±0.35 (n=	0.41	PRIC	
41	W3	24.03±0.07 (n=21.08±1.05 (n=1.52±0.36 (n=	0.50	PRIC	
42	W2	22.88±0.25 (n=19.88±0.17 (n=1.01±0.37 (n=	0.34	PRIC	
43	W2	24.28±0.42 (n=20.13±0.37 (n=1.53±0.14 (n=	0.43	PRIC	
44	W2	23.87±0.57 (n=19.85±0.51 (n=1.82±0.33 (n=	0.57	PRIC	
45	W2	24.25±0.17 (n=20.18±0.53 (n=1.64±0.12 (n=	0.41	PRIC	
46	W2	24.06±0.49 (n=20.57±0.5 (n=1.76±0.14 (n=	0.62	PRIC	
47	W1	24.11±0.22 (n=20.43±0.88 (n=1.55±0.15 (n=	0.43	PRIC	
48	W2	23.98±0.56 (n=20.39±0.56 (n=1.79±0.19 (n=	0.34	PRIC	
49	W2	24.04±0.31 (n=19.80±0.23 (n=1.45±0.48 (n=	0.35	PRIC	
50	W2	24.14±0.31 (n=21.91±0.23 (n=1.54±0.42 (n=	0.26	PRIC	
51	W2	22.99±0.25 (n=19.28±0.2 (n=1.24±0.25 (n=	0.33	PRIC	
52	W2	24.15±0.59 (n=20.55±0.35 (n=1.34±0.18 (n=	0.56	PRIC	
53	W2	23.9±0.45 (n=19.83±0.07 (n=1.50±0.29 (n=	0.50	PRIC	
54	W2	23.62±0.37 (n=19.45±0.18 (n=1.44±0.25 (n=	0.32	PRIC	
55	W2	23.25±0.31 (n=19.25±0.79 (n=1.42±0.25 (n=	0.30	PRIC	
56	W2	23.98±0.58 (n=20.55±0.62 (n=1.39±0.21 (n=	0.38	PRIC	
57	W2	24.31±0.32 (n=20.29±0.26 (n=1.55±0.13 (n=	0.58	PRIC	

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3	W3	24.1±0.22 (n=19.77±0.3 (n=1.35±0.31 (n=	0.31	PRIC	
4	W2	23.59±0.12 (n=19.85±0.43 (n=1.96±0.75 (n=	0.35	PRIC	
5	W2	24.2±0.35 (n=20.17±0.31 (n=1.38±0.10 (n=	0.38	PRIC	
6	W2	23.98±0.23 (n=20.09±0.12 (n=1.63±0.24 (n=	0.28	PRIC	
7	W1	23.8±0.34 (n=20.11±0.37 (n=1.59±0.35 (n=	0.36	PRIC	
8	W3	14.4±0.48 (n=11.56±0.08 (n=1.19±0.20 (n=	0.28	PRIC	
9	W2	19.78±0.53 (n=16.70±0.63 (n=1.26±0.39 (n=	0.06	PRIC	
10	W2	23.96±0.19 (n=20.56±0.87 (n=1.67±0.37 (n=	0.32	PRIC	
11	W2	24.14±0.9 (n=19.68±0.37 (n=1.36±0.30 (n=	0.41	PRIC	
12	W2	24.59±0.48 (n=20.93±0.69 (n=1.60±0.23 (n=	0.34	PRIC	
13	W2	23.41±0.2 (n=19.79±0.2 (n=1.25±0.23 (n=	0.20	PRIC	
14	W2	22.37±0.32 (n=18.61±0.48 (n=1.49±0.29 (n=	0.29	PRIC	
15	W3	23.51±0.43 (n=20.03±0.44 (n=1.66±0.33 (n=	0.37	PRIC	
16	W2	24.26±0.63 (n=20.21±0.33 (n=1.39±0.27 (n=	0.36	PRIC	
17	W2	24.46±0.39 (n=20.61±0.03 (n=1.47±0.22 (n=	0.24	PRIC	
18	W2	21.93±0.46 (n=18.46±0.42 (n=1.48±0.20 (n=	0.33	PRIC	
19	W2	24.26±0.28 (n=20.75±0.56 (n=1.65±0.25 (n=	0.34	PRIC	
20	W2	24.06±0.37 (n=20.53±0.96 (n=2.76±2.15 (n=	0.40	PRIC	
21	W1	23.9±0.39 (n=20.17±0.28 (n=1.42±0.31 (n=	0.32	PRIC	
22	W3	24.53±0.75 (n=20.24±0.32 (n=1.64±0.29 (n=	0.35	PRIC	
23	W2	24.49±0.7 (n=21.22±0.58 (n=1.55±0.25 (n=	0.31	PRIC	
24	W2	24.12±0.41 (n=20.10±0.29 (n=1.77±0.28 (n=	0.42	PRIC	
25	W2	23.57±0.18 (n=19.95±0.33 (n=1.38±0.23 (n=	0.29	PRIC	
26	W2	19.89±0.22 (n=16.54±0.33 (n=1.27±0.19 (n=	0.23	PRIC	
27	W3	23.69±0.44 (n=19.82±0.31 (n=1.55±0.39 (n=	0.26	PRIC	
28	W2	23.85±0.14 (n=20.08±0.77 (n=1.62±0.03 (n=	0.23	PRIC	
29	W2	23.43±0.15 (n=20.14±0.36 (n=1.39±0.45 (n=	0.21	PRIC	
30	W2	23.49±0.45 (n=20.84±1.03 (n=1.58±0.28 (n=	0.23	PRIC	
31	W2	23.83±0.44 (n=19.95±0.17 (n=1.76±0.18 (n=	0.22	PRIC	
32	W1	23.98±0.33 (n=20.08±0.45 (n=1.50±0.11 (n=	0.25	PRIC	
33	W2	23.04±0.36 (n=18.85±0.27 (n=1.65±0.15 (n=	0.24	PRIC	
34	W3	24.26±0.46 (n=20.59±0.6 (n=1.62±0.29 (n=	0.18	PRIC	
35	W2	24.47±0.24 (n=20.30±0.18 (n=1.50±0.23 (n=	0.21	PRIC	
36	W3	24.16±1.07 (n=20.26±0.27 (n=1.29±0.18 (n=	0.23	PRIC	
37	W3	23.02±0.3 (n=19.78±0.98 (n=1.31±0.18 (n=	0.25	PRIC	
38	W2	23.39±0.5 (n=19.79±0.26 (n=1.62±0.10 (n=	0.26	PRIC	
39	W2	24.31±0.28 (n=19.91±0.25 (n=1.46±0.36 (n=	0.18	PRIC	
40	W3	23.81±0.34 (n=20.08±0.34 (n=1.70±0.35 (n=	0.18	PRIC	
41	W2	22.87±0.22 (n=18.90±0.11 (n=1.28±0.33 (n=	0.27	PRIC	
42	W3	23.62±0.2 (n=19.91±0.35 (n=1.61±0.35 (n=	0.21	PRIC	
43	W2	24.03±0.18 (n=20.78±1.00 (n=1.36±0.31 (n=	0.20	PRIC	
44	W2	23.95±0.57 (n=20.67±0.62 (n=1.32±0.28 (n=	0.19	PRIC	
45	W2	23.75±0.53 (n=21.07±1.03 (n=1.58±0.35 (n=	0.29	PRIC	
46	W2	23.79±0.5 (n=20.08±0.33 (n=1.48±0.16 (n=	0.23	PRIC	
47	W2	23.08±0.16 (n=19.24±0.29 (n=1.25±0.18 (n=	0.22	PRIC	
48	W3	23.98±0.25 (n=20.47±0.47 (n=1.56±0.12 (n=	0.18	PRIC	
49	W2	23.42±0.66 (n=19.74±0.52 (n=1.72±0.12 (n=	0.13	PRIC	
50	W2	18.72±0.51 (n=14.92±0.40 (n=1.20±0.13 (n=	0.17	PRIC	
51	W3	23.06±0.6 (n=19.76±0.36 (n=1.23±0.17 (n=	0.21	PRIC	
52	W2	20.96±0.48 (n=16.8±0.43 (n=1.68±1.05 (n=	0.24	PRIC	
53	W2	24.01±0.51 (n=20.59±0.21 (n=1.38±0.20 (n=	0.21	PRIC	
54	W3	24.09±0.49 (n=20.31±0.37 (n=1.61±0.30 (n=	0.15	PRIC	
55	W1	22.33±0.52 (n=18.64±0.25 (n=1.26±0.29 (n=	0.26	PRIC	
56	W2	22.29±0.37 (n=19.29±0.48 (n=1.49±0.20 (n=	0.21	PRIC	
57	W3	22.61±0.12 (n=18.97±0.54 (n=1.66±0.14 (n=	0.24	PRIC	

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3	W2	23.79±0.4 (n=19.78±0.45 (n 1.54±0.05 (n=	0.15	PRIC	
4	W2	23.82±0.43 (n=20.47±0.58 (n 1.24±0.20 (n=	0.17	PRIC	
5	W2	23.56±0.24 (n=20.08±0.74 (n 1.56±0.35 (n=	0.21	PRIC	
6	W2	23.93±0.56 (n=19.86±0.13 (n 1.72±0.20 (n=	0.18	PRIC	
7	W2	24.1±0.47 (n=20.38±0.89 (n 1.53±0.15 (n=	0.20	PRIC	
8	W2	23.58±0.83 (n=20.23±0.79 (n 1.52±0.43 (n=	0.23	PRIC	
9	W2	22.3±0.22 (n=18.88±0.32 (n 1.49±0.06 (n=	0.13	PRIC	
10	W1	24.32±0.87 (n=19.65±0.43 (n 1.54±0.27 (n=	0.12	PRIC	
11	W2	24.08±0.36 (n=20.26±0.33 (n 1.72±0.39 (n=	0.14	PRIC	
12	W2	24.14±0.83 (n=20.55±0.72 (n 1.29±0.19 (n=	0.22	PRIC	
13	W2	24.05±0.32 (n=20.25±0.87 (n 1.45±0.05 (n=	0.15	PRIC	
14	W3	24.02±0.23 (n=20.47±0.71 (n 1.64±0.24 (n=	0.14	PRIC	
15	W1	23.41±0.31 (n=19.77±0.02 (n 1.69±0.07 (n=	0.19	PRIC	
16	W2	24.48±0.6 (n=20.41±0.52 (n 1.43±0.29 (n=	0.12	PRIC	
17	W2	22.97±0.36 (n=18.85±0.46 (n 1.63±0.17 (n=	0.16	PRIC	
18	W1	24.23±0.23 (n=20.54±0.48 (n 1.39±0.30 (n=	0.23	PRIC	
19	W1	25.3±0.76 (n=20.17±0.15 (n 1.47±0.34 (n=	0.24	PRIC	
20	W2	23.1±0.28 (n=19.23±0.89 (n 1.00±0.21 (n=	0.14	PRIC	
21	W2	24.02±0.15 (n=20.46±0.57 (n 1.49±0.09 (n=	0.30	PRIC	
22	W2	23.57±0.78 (n=20.15±0.40 (n 1.34±0.18 (n=	0.20	PRIC	
23	W2	23.8±0.49 (n=20.49±0.44 (n 1.33±0.30 (n=	0.24	PRIC	
24	W2	23.8±0.15 (n=20.17±0.30 (n 1.42±0.33 (n=	0.18	PRIC	
25	W1	23.25±0.22 (n=19.65±0.80 (n 1.30±0.24 (n=	0.13	PRIC	
26	W2	24.02±0.39 (n=19.98±0.20 (n 1.39±0.27 (n=	0.18	PRIC	
27	W2	21.37±0.54 (n=17.42±0.23 (n 1.37±0.23 (n=	0.20	PRIC	
28	W2	22.76±0.58 (n=19.12±0.33 (n 1.69±0.08 (n=	0.11	PRIC	
29	W2	23.16±0.35 (n=19.31±0.70 (n 1.25±0.34 (n=	0.17	PRIC	
30	W3	23.16±0.19 (n=19.98±0.74 (n 1.43±0.26 (n=	0.18	PRIC	
31	W2	8.98±0.39 (n=7.39±0.28 (n=0.88±0.14 (n=	0.22	PRIC	
32	W2	24.26±0.45 (n=20.9±0.44 (n=1.59±0.26 (n=	0.20	PRIC	
33	W2	23.9±0.23 (n=20.68±0.19 (n 1.21±0.32 (n=	0.13	PRIC	
34	W2	23.75±0.21 (n=20.21±0.31 (n 1.41±0.19 (n=	0.16	PRIC	
35	W2	24.22±0.49 (n=20.05±0.26 (n 1.52±0.08 (n=	0.18	PRIC	
36	W2	23.32±0.49 (n=20.15±1.10 (n 1.72±0.06 (n=	0.17	PRIC	
37	W1	24.32±0.12 (n=20.18±0.29 (n 1.53±0.29 (n=	0.24	PRIC	
38	W2	23.71±0.26 (n=20.11±0.40 (n 2.04±0.93 (n=	0.14	PRIC	
39	W2	23.77±0.35 (n=19.44±0.18 (n 1.55±0.06 (n=	0.14	PRIC	
40	W2	24.61±0.56 (n=20.12±0.16 (n 1.48±0.06 (n=	0.17	PRIC	
41	W2	24.12±0.48 (n=20.46±0.28 (n 1.76±0.24 (n=	0.18	PRIC	
42	W2	23.38±0.31 (n=19.97±0.37 (n 1.41±0.16 (n=	0.16	PRIC	
43	W2	24.18±0.48 (n=20.61±0.64 (n 1.27±0.18 (n=	0.18	PRIC	
44	W3	24.55±0.6 (n=20.23±0.62 (n 1.60±0.05 (n=	0.17	PRIC	
45	W1	23.9±0.25 (n=20.94±0.57 (n 1.21±0.37 (n=	0.16	PRIC	
46	W2	23.92±0.08 (n=19.85±0.37 (n 1.41±0.35 (n=	0.15	PRIC	
47	W2	23.86±0.77 (n=19.28±0.37 (n 1.43±0.19 (n=	0.16	PRIC	
48	W2	24.43±0.36 (n=20.42±0.52 (n 1.61±0.22 (n=	0.16	PRIC	
49	W2	21.29±0.73 (n=16.63±0.13 (n 1.10±0.07 (n=	0.14	PRIC	
50	W3	21.7±0.37 (n=18.26±0.47 (n 1.44±0.25 (n=	0.05	PRIC	
51	W2	23.71±0.17 (n=19.90±0.29 (n 1.53±0.07 (n=	0.12	PRIC	
52	W1	23.68±0.22 (n=20.83±0.85 (n 1.46±0.33 (n=	0.12	PRIC	
53	W2	24.21±0.62 (n=20.42±0.01 (n 1.10±0.48 (n=	0.13	PRIC	
54	W2	23.79±0.25 (n=20.31±0.78 (n 1.65±0.31 (n=	0.19	PRIC	
55	W2	24.25±0.83 (n=20.12±0.40 (n 1.50±0.16 (n=	0.14	PRIC	
56	W1	24.06±0.33 (n=21.3±0.39 (n=1.57±0.40 (n=	0.13	PRIC	
57	W2	24.26±0.39 (n=19.96±0.10 (n 1.57±0.37 (n=	0.10	PRIC	

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2					
3	W1	24.81±0.73 (n=20.39±0.49 (n=1.42±0.10 (n=	0.16	PRIC	
4	W2	24±0.74 (n=3)20.12±0.65 (n=1.67±0.13 (n=	0.12	PRIC	
5	W1	24.57±0.52 (n=25.25±21.61 (74.75±21.61 (	0.14	PRIC	
6	W3	24.54±0.53 (n=20.13±0.31 (n=1.36±0.22 (n=	0.08	PRIC	
7	W1	24±0.38 (n=3)20.75±1.03 (n=1.60±0.25 (n=	0.13	PRIC	
8	W2	23.6±0.7 (n=4)19.84±0.29 (n=1.44±0.28 (n=	0.08	PRIC	
9	W2	24.31±0.54 (n=20.37±0.15 (n=1.45±0.44 (n=	0.13	PRIC	
10	W2	23.78±0.35 (n=20.47±0.62 (n=1.60±0.11 (n=	0.13	PRIC	
11	W2	24.19±0.2 (n=20.18±0.38 (n=1.50±0.22 (n=	0.09	PRIC	
12	W2	23.89±0.28 (n=20.02±0.47 (n=1.71±0.16 (n=	0.06	PRIC	
13	W2	24.23±0.63 (n=21.18±0.95 (n=1.38±0.06 (n=	0.11	PRIC	
14	W2	24±0.49 (n=4)20.37±0.94 (n=1.34±0.13 (n=	0.15	PRIC	
15	W1	23.87±0.29 (n=19.66±0.44 (n=1.18±0.18 (n=	0.10	PRIC	
16	W2	24.48±0.45 (n=20.48±0.25 (n=1.53±0.08 (n=	0.10	PRIC	
17	W2	23.35±0.24 (n=19.43±0.28 (n=1.58±0.15 (n=	0.07	PRIC	
18	W2	23.84±0.75 (n=20.36±0.38 (n=1.61±0.13 (n=	0.10	PRIC	
19	W2	23.97±0.75 (n=20.00±0.84 (n=1.43±0.13 (n=	0.08	PRIC	
20	W2	23.99±0.27 (n=20.84±0.29 (n=1.38±0.21 (n=	0.06	PRIC	
21	W2	23.18±0.62 (n=19.81±0.4 (n=1.46±0.22 (n=	0.09	PRIC	
22	W2	24.06±0.48 (n=20.54±0.39 (n=1.52±0.29 (n=	0.09	PRIC	
23	W2	24.24±0.24 (n=20.41±0.20 (n=1.51±0.23 (n=	0.09	PRIC	
24	W2	18.84±0.21 (n=16.63±0.21 (n=1.41±0.12 (n=	0.07	PRIC	
25	W2	24.39±0.11 (n=20.11±0.28 (n=1.46±0.53 (n=	0.09	PRIC	
26	W2	23.97±0.2 (n=19.67±0.37 (n=2.16±1.52 (n=	0.07	PRIC	
27	W2	23.97±0.4 (n=20.22±0.13 (n=1.63±0.20 (n=	0.10	PRIC	
28	W2	23.64±0.7 (n=19.78±0.28 (n=1.45±0.37 (n=	0.14	PRIC	
29	W2	24.17±0.4 (n=19.75±0.23 (n=1.40±0.14 (n=	0.10	PRIC	
30	W2	23.86±0.39 (n=20.15±0.06 (n=1.69±0.09 (n=	0.08	PRIC	
31	W2	23.88±0.4 (n=19.89±0.41 (n=1.46±0.27 (n=	0.09	PRIC	
32	W2	24.6±0.46 (n=19.92±0.35 (n=1.53±0.12 (n=	0.08	PRIC	
33	W2	24.85±0.4 (n=20.91±0.49 (n=1.47±0.09 (n=	0.10	PRIC	
34	W2	24.33±0.38 (n=20.24±0.26 (n=1.20±0.44 (n=	0.09	PRIC	
35	W2	25.69±0.92 (n=20.73±1.03 (n=1.49±0.10 (n=	0.10	PRIC	
36	W2	24.42±0.8 (n=19.96±0.63 (n=1.26±0.23 (n=	0.06	PRIC	
37	W2	23.65±0.1 (n=20.46±0.30 (n=1.70±0.05 (n=	0.07	PRIC	
38	W3	25.14±0.45 (n=20.66±0.14 (n=1.89±0.05 (n=	0.07	PRIC	
39	W3	23.86±0.29 (n=20.00±0.23 (n=1.53±0.25 (n=	0.06	PRIC	
40	W2	23.26±0.21 (n=19.96±0.66 (n=1.60±0.17 (n=	0.06	PRIC	
41	W2	24.04±0.36 (n=19.98±0.21 (n=1.35±0.35 (n=	0.06	PRIC	
42	W2	24.12±0.53 (n=20.48±0.74 (n=1.17±0.18 (n=	0.07	PRIC	
43	W2	24±0.96 (n=3)20.53±0.31 (n=1.66±0.16 (n=	0.06	PRIC	
44	W2	23.86±0.1 (n=20.00±0.37 (n=1.44±0.29 (n=	0.07	PRIC	
45	W1	24.64±0.55 (n=21.11±0.86 (n=1.61±0.33 (n=	0.06	PRIC	
46	W2	24.1±0.47 (n=20.70±0.24 (n=1.04±0.94 (n=	0.05	PRIC	
47	W1	23.58±0.34 (n=20.46±0.95 (n=1.36±0.21 (n=	0.08	PRIC	
48	W2	24.01±0.6 (n=19.64±0.41 (n=1.57±0.20 (n=	0.05	PRIC	
49	W2	23.61±0.19 (n=20.19±0.32 (n=1.65±0.15 (n=	0.06	PRIC	
50	W2	23.71±0.5 (n=20.32±0.23 (n=1.25±0.23 (n=	0.07	PRIC	
51	W2	23.98±0.37 (n=20.26±0.52 (n=1.52±0.10 (n=	0.06	PRIC	
52	W2	23.32±0.29 (n=19.56±0.46 (n=1.22±0.22 (n=	0.07	PRIC	
53	W1	24.83±0.2 (n=20.64±0.16 (n=1.44±0.23 (n=	0.07	PRIC	
54	W2	24.02±1.05 (n=20.13±0.68 (n=1.52±0.36 (n=	0.05	PRIC	
55	W2	23.98±0.2 (n=19.88±0.13 (n=1.74±0.05 (n=	0.05	PRIC	
56	W2	24.12±0.81 (n=19.69±0.00 (n=1.30±0.29 (n=	0.04	PRIC	
57	W2	24.52±0.71 (n=20.52±0.58 (n=1.05±0.14 (n=	0.04	PRIC	

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2					
3	W2	23.55±0.17 (n=20.43±0.64 (n=1.46±0.36 (n=	0.08	PRIC	
4	W2	24.01±0.19 (n=20.73±0.73 (n=1.41±0.36 (n=	0.05	PRIC	
5	W2	24.17±0.44 (n=20.40±0.17 (n=1.60±0.19 (n=	0.05	PRIC	
6	W2	22.53±0.36 (n=17.51±0.25 (n=1.54±0.85 (n=	7.55	PRIC	
7	W2	24.04±0.21 (n=20.32±0.27 (n=1.56±0.28 (n=	1.65	PRIC	
8	W2	23.74±0.29 (n=19.70±0.19 (n=1.59±0.08 (n=	3.70	PRIC	
9	W2	24.64±1.04 (n=19.81±0.59 (n=1.49±0.32 (n=	4.76	PRIC	
10	W2	24.43±0.18 (n=20.49±0.54 (n=1.56±0.28 (n=	3.77	PRIC	
11	W2	24.39±0.42 (n=20.75±0.86 (n=1.34±0.34 (n=	3.65	PRIC	
12	W2	18.23±0.6 (n=16.9±0.85 (n=1.45±0.24 (n=	3.87	PRIC	
13	W1	24.15±0.61 (n=19.51±0.31 (n=1.79±0.74 (n=	2.03	PRIC	
14	W2	23.9±0.26 (n=20.22±0.67 (n=1.61±0.49 (n=	1.04	PRIC	
15	W2	24.12±0.39 (n=20.38±0.39 (n=1.57±0.28 (n=	0.74	PRIC	
16	W2	23.78±0.26 (n=20.32±0.27 (n=1.62±0.30 (n=	0.74	PRIC	
17	W2	24.21±0.75 (n=20.21±0.49 (n=1.47±0.33 (n=	0.72	PRIC	
18	W2	24.11±0.39 (n=20.27±0.55 (n=1.52±0.33 (n=	0.66	PRIC	
19	W3	24.54±0.46 (n=20.24±0.52 (n=1.51±0.27 (n=	0.66	PRIC	
20	W2	23.68±0.21 (n=20.26±0.54 (n=1.57±0.11 (n=	0.78	PRIC	
21	W3	23.94±0.46 (n=20.30±0.43 (n=1.39±0.37 (n=	0.77	PRIC	
22	W2	24.11±0.34 (n=20.11±0.69 (n=1.53±0.37 (n=	0.40	PRIC	
23	W2	23.96±0.63 (n=19.75±0.3 (n=1.33±0.36 (n=	0.56	PRIC	
24	W2	23.8±0.53 (n=19.86±0.67 (n=1.28±0.36 (n=	0.37	PRIC	
25	W2	23.81±0.3 (n=19.88±0.27 (n=1.48±0.25 (n=	0.34	PRIC	
26	W2	23.84±0.21 (n=20.08±0.37 (n=1.46±0.15 (n=	0.30	PRIC	
27	W3	22.39±0.29 (n=19.2±0.53 (n=1.44±0.16 (n=	0.30	PRIC	
28	W1	24.03±0.22 (n=20.12±0.37 (n=1.58±0.16 (n=	0.25	PRIC	
29	W2	24.08±0.48 (n=20.20±0.2 (n=1.64±0.24 (n=	0.32	PRIC	
30	W3	24.4±0.4 (n=20.24±0.61 (n=1.33±0.25 (n=	0.50	PRIC	
31	W2	24.13±0.47 (n=20.13±0.57 (n=1.66±0.13 (n=	0.38	PRIC	
32	W3	24.12±0.55 (n=19.73±0.31 (n=1.67±0.21 (n=	0.56	PRIC	
33	W2	24.11±0.37 (n=20.13±0.22 (n=1.53±0.41 (n=	0.32	PRIC	
34	W2	24.08±1.03 (n=20.37±0.33 (n=1.48±0.33 (n=	0.38	PRIC	
35	W2	23.4±0.71 (n=20.39±0.42 (n=1.54±0.28 (n=	0.34	PRIC	
36	W3	24±0.47 (n=4)20.26±0.12 (n=1.57±0.17 (n=	0.26	PRIC	
37	W2	23.73±0.34 (n=19.99±0.21 (n=1.49±0.16 (n=	0.49	PRIC	
38	W2	23.22±0.17 (n=19.61±0.13 (n=1.38±0.25 (n=	0.23	PRIC	
39	W2	24.58±0.81 (n=19.70±0.28 (n=1.57±0.08 (n=	0.23	PRIC	
40	W1	24.18±0.54 (n=20.53±0.34 (n=1.58±0.16 (n=	0.24	PRIC	
41	W2	24.05±0.27 (n=20.21±0.46 (n=1.36±0.32 (n=	0.27	PRIC	
42	W2	18.03±0.19 (n=15.82±0.33 (n=1.18±0.10 (n=	0.26	PRIC	
43	W2	23.27±0.24 (n=20.03±0.09 (n=1.43±0.22 (n=	0.23	PRIC	
44	W2	23.66±0.74 (n=21.61±0.68 (n=1.54±0.49 (n=	0.32	PRIC	
45	W3	23.75±0.14 (n=20.09±0.41 (n=1.49±0.39 (n=	0.30	PRIC	
46	W2	23.77±0.52 (n=20.12±1.19 (n=1.46±0.25 (n=	0.31	PRIC	
47	W3	24.25±0.21 (n=20.09±0.16 (n=1.64±0.16 (n=	0.26	PRIC	
48	W2	23.35±0.4 (n=20.08±0.23 (n=1.57±0.15 (n=	0.24	PRIC	
49	W3	23.91±0.27 (n=20.36±0.80 (n=1.67±0.24 (n=	0.27	PRIC	
50	W2	23.77±0.42 (n=19.78±0.24 (n=1.41±0.35 (n=	0.30	PRIC	
51	W3	24.33±0.6 (n=20.03±0.14 (n=1.59±0.12 (n=	0.29	PRIC	
52	W1	23.9±0.3 (n=20.31±0.23 (n=1.58±0.19 (n=	0.17	PRIC	
53	W2	24.02±0.26 (n=20.51±0.08 (n=1.59±0.17 (n=	0.19	PRIC	
54	W2	24.03±0.33 (n=20.77±0.91 (n=1.65±0.24 (n=	0.14	PRIC	
55	W2	24.07±0.81 (n=19.98±0.21 (n=1.54±0.2 (n=3	0.17	PRIC	
56	W2	23.97±0.5 (n=20.48±0.42 (n=2.22±0.68 (n=	0.25	PRIC	
57	W2	24.1±0.38 (n=19.76±0.67 (n=1.34±0.36 (n=	0.23	PRIC	



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2					
3	W2	23.67±0.53 (n=19.63±0.36 (n=1.59±0.34 (n=	0.25	PRIC	
4	W2	24.19±0.99 (n=20.13±0.25 (n=1.57±0.15 (n=	0.24	PRIC	
5	W2	24.16±0.73 (n=20.30±0.30 (n=1.37±0.28 (n=	0.22	PRIC	
6	W2	23.63±0.41 (n=19.12±0.25 (n=1.10±0.28 (n=	0.11	PRIC	
7	W2	24.05±0.38 (n=20.23±0.12 (n=1.55±0.29 (n=	0.23	PRIC	
8	W2	24.35±0.22 (n=20.19±0.11 (n=1.38±0.10 (n=	0.10	PRIC	
9	W2	24.03±1.02 (n=19.88±0.14 (n=1.49±0.14 (n=	0.23	PRIC	
10	W2	23.54±0.35 (n=20.12±0.21 (n=1.59±0.21 (n=	0.18	PRIC	
11	W3	23.36±0.47 (n=19.49±0.45 (n=1.41±0.20 (n=	0.14	PRIC	
12	W3	23.69±0.33 (n=19.89±0.30 (n=1.48±0.20 (n=	0.15	PRIC	
13	W3	23.01±0.27 (n=22.20±1.07 (n=1.27±0.33 (n=	0.23	PRIC	
14	W2	24.02±0.52 (n=19.94±0.65 (n=1.59±0.21 (n=	0.28	PRIC	
15	W2	23.85±0.33 (n=20.35±0.85 (n=1.33±0.38 (n=	0.24	PRIC	
16	W2	22.43±0.09 (n=19.24±0.14 (n=1.78±0.11 (n=	0.16	PRIC	
17	W2	24.2±0.16 (n=21.69±0.82 (n=1.58±0.15 (n=	0.16	PRIC	
18	W2	23.05±0.16 (n=19.82±0.27 (n=1.44±0.38 (n=	0.15	PRIC	
19	W2	23.97±0.64 (n=20.13±0.69 (n=1.15±0.77 (n=	0.15	PRIC	
20	W2	23.85±0.23 (n=20.02±0.30 (n=1.34±0.13 (n=	0.16	PRIC	
21	W2	24.19±0.2 (n=20.48±0.71 (n=1.33±0.19 (n=	0.22	PRIC	
22	W2	23.66±0.74 (n=20.05±0.16 (n=1.57±0.22 (n=	0.13	PRIC	
23	W1	24.33±0.66 (n=20.45±0.82 (n=1.28±0.20 (n=	0.16	PRIC	
24	W2	24.04±0.35 (n=20.52±0.55 (n=1.43±0.32 (n=	0.12	PRIC	
25	W2	23.7±0.3 (n=320.20±0.73 (n=1.45±0.25 (n=	0.18	PRIC	
26	W2	24.31±0.65 (n=20.36±0.41 (n=1.32±0.32 (n=	0.15	PRIC	
27	W2	23.33±0.31 (n=19.84±0.07 (n=1.33±0.30 (n=	0.17	PRIC	
28	W2	23.62±0.66 (n=20.75±0.79 (n=1.15±0.21 (n=	0.16	PRIC	
29	W2	23.22±0.33 (n=21.31±0.78 (n=1.55±0.16 (n=	0.14	PRIC	
30	W2	23.52±0.13 (n=18.53±0.22 (n=1.38±0.31 (n=	0.18	PRIC	
31	W2	23.48±0.5 (n=19.53±0.56 (n=1.6±0.21 (n=4	0.18	PRIC	
32	W1	23.21±0.51 (n=18.84±0.20 (n=1.49±0.31 (n=	0.14	PRIC	
33	W2	24.8±0.44 (n=20.16±0.15 (n=1.56±0.30 (n=	0.09	PRIC	
34	W3	23.14±0.53 (n=19.73±0.23 (n=1.41±0.18 (n=	0.06	PRIC	
35	W3	24.29±0.88 (n=20.18±0.37 (n=1.42±0.32 (n=	0.13	PRIC	
36	W3	23.61±0.06 (n=19.65±0.24 (n=1.67±0.26 (n=	0.12	PRIC	
37	W2	23.56±0.27 (n=19.31±0.27 (n=1.53±0.24 (n=	0.06	PRIC	
38	W3	23.49±0.83 (n=20.16±0.68 (n=1.66±0.17 (n=	0.16	PRIC	
39	W2	24.41±0.62 (n=20.19±0.43 (n=1.50±0.38 (n=	0.17	PRIC	
40	W3	24.87±0.37 (n=20.97±1.04 (n=1.33±0.37 (n=	0.07	PRIC	
41	W3	19.15±0.95 (n=15.65±0.30 (n=1.46±0.08 (n=	0.09	PRIC	
42	W2	22.71±0.91 (n=19.35±0.57 (n=1.25±0.08 (n=	0.15	PRIC	
43	W3	23.61±0.46 (n=19.54±0.51 (n=1.15±0.39 (n=	0.08	PRIC	
44	W3	24.23±0.3 (n=20.38±0.30 (n=1.52±0.11 (n=	0.14	PRIC	
45	W2	23.45±0.3 (n=20.02±0.22 (n=1.31±0.25 (n=	0.13	PRIC	
46	W2	23.21±0.25 (n=19.69±0.54 (n=1.43±0.39 (n=	0.14	PRIC	
47	W2	22.76±0.62 (n=19.45±0.67 (n=1.42±0.08 (n=	0.06	PRIC	
48	W2	22.62±0.21 (n=19.48±0.64 (n=1.33±0.15 (n=	0.14	PRIC	
49	W3	23.28±0.46 (n=20.17±0.71 (n=1.50±0.17 (n=	0.14	PRIC	
50	W2	22.58±0.29 (n=18.79±0.37 (n=1.28±0.64 (n=	0.15	PRIC	
51	W2	24.4±0.46 (n=21.17±1.05 (n=1.54±0.27 (n=	0.13	PRIC	
52	W3	23.93±0.35 (n=19.39±0.67 (n=2.04±0.12 (n=	0.04	PRIC	
53	W2	22.33±0.23 (n=19.25±0.47 (n=1.22±0.33 (n=	0.10	PRIC	
54	W2	23.3±0.33 (n=19.36±0.61 (n=2.17±0.96 (n=	0.14	PRIC	
55	W2	23.75±0.31 (n=19.87±0.29 (n=1.14±0.11 (n=	0.08	PRIC	
56	W2	24.43±0.69 (n=19.97±0.34 (n=1.71±0.19 (n=	0.07	PRIC	
57	W2	22.89±0.54 (n=18.75±0.24 (n=1.54±0.23 (n=	0.07	PRIC	

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2					
3	W3	22.64±0.26 (n:19.31±0.26 (n 1.8±0.41 (n=4	0.06	PRIC	
4	W2	23.65±0.36 (n:19.66±0.52 (n 1.25±0.33 (n=	0.06	PRIC	
5	W2	24.21±0.16 (n:20.13±0.62 (n 1.50±0.14 (n=	0.54	PRIC	
6	W3	24.54±0.62 (n:19.72±0.13 (n 1.38±0.11 (n=	0.12	PRIC	
7	W3	17.33±0.5 (n= 18.0±0.42 (n= 1.37±0.31 (n=	0.11	PRIC	
8	W2	23.83±0.23 (n:20.49±0.94 (n 1.23±0.21 (n=	0.08	PRIC	
9	W3	23.53±0.88 (n:19.78±0.22 (n 1.42±0.34 (n=	0.08	PRIC	
10	W1	23.21±0.56 (n:19.44±0.27 (n 1.23±0.26 (n=	0.11	PRIC	
11	W3	23.25±0.23 (n:19.67±0.45 (n 1.37±0.27 (n=	0.07	PRIC	
12	W2	24.28±0.56 (n:20.53±0.93 (n 1.55±0.17 (n=	0.15	PRIC	
13	W2	23.36±0.2 (n= 19.71±0.39 (n 1.71±0.28 (n=	0.09	PRIC	
14	W2	22.69±0.31 (n:20.10±0.82 (n 1.68±0.39 (n=	0.16	PRIC	
15	W2	23.87±0.27 (n:20.26±0.76 (n 1.41±0.42 (n=	0.16	PRIC	
16	W3	22.46±0.58 (n:18.62±0.15 (n 1.45±0.20 (n=	0.07	PRIC	
17	W2	22.71±0.3 (n= 19.98±0.12 (n 1.60±0.31 (n=	0.10	PRIC	
18	W3	24.42±0.38 (n:20.00±0.26 (n 1.55±0.16 (n=	0.11	PRIC	
19	W2	22.53±0.29 (n:19.04±0.10 (n 1.16±0.18 (n=	0.10	PRIC	
20	W2	22.94±0.05 (n:18.84±0.38 (n 1.30±0.15 (n=	0.08	PRIC	
21	W3	23.34±0.32 (n:19.69±0.12 (n 1.35±0.11 (n=	0.08	PRIC	
22	W3	24.52±0.22 (n:20.63±0.34 (n 1.57±0.18 (n=	0.11	PRIC	
23	W2	23.85±0.63 (n:19.24±0.29 (n 1.39±0.33 (n=	0.04	PRIC	
24	W2	23.76±0.25 (n:19.80±0.66 (n 1.36±0.15 (n=	0.06	PRIC	
25	W2	23.56±0.27 (n:20.05±0.86 (n 1.41±0.20 (n=	0.10	PRIC	
26	W2	24.43±0.4 (n= 20.13±0.32 (n 1.47±0.10 (n=	0.04	PRIC	
27	W2	24.56±0.52 (n:20.79±0.61 (n 1.65±0.34 (n=	0.06	PRIC	
28	W2	21.97±0.25 (n:18.64±0.43 (n 1.16±0.13 (n=	0.07	PRIC	
29	W2	24.1±0.84 (n= 20.33±0.34 (n 1.24±0.07 (n=	0.05	PRIC	
30	W2	23.59±0.39 (n:21.25±0.65 (n 1.34±0.30 (n=	0.14	PRIC	
31	W2	24.05±0.17 (n:20.08±0.43 (n 1.32±0.13 (n=	0.15	PRIC	
32	W2	23.76±0.43 (n:20.38±0.69 (n 1.62±0.16 (n=	0.08	PRIC	
33	W3	24.27±0.21 (n:19.54±0.52 (n 1.37±0.22 (n=	0.06	PRIC	
34	W2	23.71±0.53 (n:19.62±0.06 (n 1.33±0.12 (n=	0.09	PRIC	
35	W3	24.3±0.92 (n= 20.19±0.11 (n 1.26±0.25 (n=	0.04	PRIC	
36	W3	24.13±1.09 (n:20.18±0.64 (n 1.49±0.27 (n=	0.08	PRIC	
37	W2	23.88±0.24 (n:21.66±0.69 (n 1.39±0.18 (n=	0.14	PRIC	
38	W3	24.22±0.4 (n= 20.32±0.52 (n 1.46±0.24 (n=	0.10	PRIC	
39	W2	24.22±0.64 (n:20.02±0.72 (n 1.56±0.41 (n=	0.09	PRIC	
40	W2	23.92±0.94 (n:19.26±0.56 (n 1.53±0.18 (n=	0.12	PRIC	
41	W2	23.83±0.41 (n:19.73±0.72 (n 1.62±0.17 (n=	0.12	PRIC	
42	W2	24.31±0.43 (n:20.22±0.25 (n 1.76±0.11 (n=	0.09	PRIC	
43	W2	24.11±0.48 (n:20.28±0.40 (n 1.56±0.23 (n=	0.10	PRIC	
44	W3	23.24±0.27 (n:19.52±0.38 (n 1.41±0.25 (n=	0.05	PRIC	
45	W3	24.32±0.36 (n:20.50±0.41 (n 1.35±0.14 (n=	0.04	PRIC	
46	W3	23.72±0.19 (n:19.77±0.46 (n 1.27±0.19 (n=	0.05	PRIC	
47	W2	24.19±0.24 (n:20.22±0.52 (n 1.36±0.35 (n=	0.06	PRIC	
48	W3	24.26±0.79 (n:20.82±0.52 (n 1.55±0.49 (n=	0.05	PRIC	
49	W2	23.23±0.23 (n:20.66±1.03 (n 1.51±0.19 (n=	0.05	PRIC	
50	W3	23.26±0.31 (n:19.60±0.46 (n 1.28±0.23 (n=	0.11	PRIC	
51	W2	23.89±0.18 (n:20.06±0.30 (n 1.64±0.05 (n=	0.15	PRIC	
52	W2	23.72±0.25 (n:19.69±0.39 (n 1.46±0.16 (n=	0.15	PRIC	
53	W2	22.97±0.36 (n:19.92±0.44 (n 1.41±0.32 (n=	0.12	PRIC	
54	W3	23.55±0.83 (n:19.92±0.67 (n 1.00±0.10 (n=	0.05	PRIC	
55	W3	23.05±0.03 (n:19.80±0.86 (n 1.65±0.10 (n=	0.10	PRIC	
56	W2	22.23±0.56 (n:19.18±0.15 (n 1.35±0.34 (n=	0.16	PRIC	
57	W2	23.92±1.03 (n:20.02±0.64 (n 1.29±0.29 (n=	0.21	PRIC	

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2					
3	W2	25.41±0.45 (n=21.14±0.34 (n=1.38±0.36 (n=	0.15	PRIC	
4	W2	24.56±0.22 (n=19.65±0.71 (n=1.41±0.19 (n=	0.15	PRIC	
5	W2	24.05±0.87 (n=19.43±0.54 (n=1.63±0.24 (n=	0.09	PRIC	
6	W2	23.09±0.64 (n=19.59±0.91 (n=1.50±0.12 (n=	0.09	PRIC	
7	W3	23.89±0.85 (n=20.34±0.82 (n=1.49±0.35 (n=	0.05	PRIC	
8	W2	24.3±0.57 (n=20.39±0.69 (n=1.38±0.19 (n=	0.08	PRIC	
9	W2	23.13±0.47 (n=19.74±0.31 (n=1.27±0.33 (n=	0.05	PRIC	
10	W2	23.05±0.48 (n=20.03±0.64 (n=1.24±0.19 (n=	0.09	PRIC	
11	W3	23.95±0.42 (n=20.04±0.47 (n=1.17±0.31 (n=	0.07	PRIC	
12	W3	24.28±1.13 (n=20.15±0.67 (n=1.31±0.47 (n=	0.04	PRIC	
13	W2	24.09±0.74 (n=19.44±0.24 (n=1.34±0.27 (n=	0.06	PRIC	
14	W2	23.48±0.27 (n=19.42±0.79 (n=1.60±0.31 (n=	0.05	PRIC	
15	W2	23.5±0.48 (n=20.12±0.53 (n=1.50±0.18 (n=	0.06	PRIC	
16	W3	25.26±1.16 (n=20.55±0.45 (n=1.26±0.08 (n=	0.04	PRIC	
17	W3	23.97±0.4 (n=20.15±0.33 (n=1.45±0.22 (n=	0.03	PRIC	
18	W1	23.86±0.17 (n=20.09±0.27 (n=1.43±0.36 (n=	0.04	PRIC	
19	W2	23.52±0.3 (n=20.75±0.74 (n=1.30±0.21 (n=	0.18	PRIC	
20	W3	22.43±0.37 (n=19.15±0.27 (n=1.35±0.16 (n=	0.26	PRIC	
21	W3	23.95±0.41 (n=20.44±0.61 (n=1.45±0.13 (n=	0.42	PRIC	
22	W2	23.87±0.61 (n=22.74±0.04 (n=1.22±0.28 (n=	0.38	PRIC	
23	W1	24.42±0.72 (n=21.41±0.74 (n=1.24±0.03 (n=	0.34	PRIC	
24	W2	24.77±0.64 (n=21.53±0.23 (n=1.45±0.03 (n=	0.26	PRIC	
25	W3	23.12±0.28 (n=18.88±0.18 (n=1.60±0.26 (n=	0.35	PRIC	
26	W3	23.99±0.56 (n=19.95±0.25 (n=1.49±0.48 (n=	0.38	PRIC	
27	W2	23.64±0.43 (n=19.80±0.27 (n=1.62±0.06 (n=	0.37	PRIC	
28	W3	23.76±0.61 (n=19.62±0.57 (n=1.4±0.08 (n=2	0.29	PRIC	
29	W2	23.78±0.27 (n=20.38±0.47 (n=1.5±0.23 (n=4	0.26	PRIC	
30	W1	24.07±0.39 (n=19.58±0.44 (n=1.52±0.09 (n=	0.30	PRIC	
31	W3	23.99±0.3 (n=20.39±0.41 (n=1.53±0.20 (n=	0.41	PRIC	
32	W2	23.58±0.55 (n=19.84±0.55 (n=1.63±0.53 (n=	0.29	PRIC	
33	W1	23.23±0.71 (n=19.49±0.19 (n=1.46±0.31 (n=	0.34	PRIC	
34	W1	24.21±0.59 (n=20.02±0.37 (n=1.20±0.28 (n=	0.26	PRIC	
35	W1	23.68±0.36 (n=20.25±0.80 (n=1.53±0.08 (n=	0.16	PRIC	
36	W2	23.89±0.69 (n=19.52±0.37 (n=1.35±0.07 (n=	0.18	PRIC	
37	W3	23.86±0.03 (n=20.21±0.74 (n=1.54±0.09 (n=	0.23	PRIC	
38	W2	23.38±0.92 (n=19.34±0.58 (n=1.47±0.11 (n=	0.24	PRIC	
39	W2	24.01±0.94 (n=19.68±0.34 (n=2.05±0.66 (n=	0.31	PRIC	
40	W2	23.6±0.51 (n=20.38±0.59 (n=1.45±0.17 (n=	0.21	PRIC	
41	W2	23.62±0.45 (n=20.26±0.66 (n=1.57±0.18 (n=	0.16	PRIC	
42	W3	24.16±0.78 (n=20.11±0.34 (n=1.38±0.31 (n=	0.16	PRIC	
43	W2	23.82±0.44 (n=19.96±0.50 (n=1.56±0.07 (n=	2.78	PRIC	
44	W2	24.03±0.24 (n=20.39±0.39 (n=1.40±0.11 (n=	1.89	PRIC	
45	W2	23.77±0.46 (n=19.67±0.35 (n=1.43±0.12 (n=	1.22	PRIC	
46	W3	22.83±0.11 (n=19.33±0.56 (n=1.52±0.26 (n=	0.57	PRIC	
47	W2	23.74±0.85 (n=20.33±0.49 (n=1.26±0.17 (n=	0.43	PRIC	
48	W2	18.76±0.31 (n=17.15±0.82 (n=1.36±0.22 (n=	1.88	PRIC	
49	W1	24.46±0.41 (n=21.28±0.50 (n=1.71±0.42 (n=	2.00	PRIC	
50	W2	23.49±0.9 (n=19.53±0.27 (n=1.60±0.26 (n=	1.92	PRIC	
51	W2	23.34±0.52 (n=19.21±0.46 (n=1.50±0.33 (n=	0.74	PRIC	
52	W2	22.89±0.36 (n=19.09±0.55 (n=1.46±0.25 (n=	0.85	PRIC	
53	W3	23.13±0.1 (n=19.34±0.11 (n=1.18±0.13 (n=	0.96	PRIC	
54	W2	23.52±0.15 (n=19.81±0.81 (n=0.95±0.22 (n=	0.79	PRIC	
55	W1	23.3±0.25 (n=19.86±0.59 (n=1.52±0.20 (n=	0.70	PRIC	
56	W3	23.18±0.22 (n=19.77±0.17 (n=1.57±0.41 (n=	0.51	PRIC	
57	W2	23.63±0.34 (n=19.99±0.66 (n=1.24±0.23 (n=	0.94	PRIC	

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3	W2	22.29±0.52 (n=18.93±0.20 (n=1.26±0.08 (n=	0.35	PRIC	
4	W2	23.79±0.2 (n=20.32±0.36 (n=1.28±0.18 (n=	0.50	PRIC	
5	W2	23.04±0.21 (n=21.76±0.86 (n=1.65±0.28 (n=	0.37	PRIC	
6	W2	24.34±0.18 (n=20.70±0.46 (n=1.61±0.41 (n=	0.37	PRIC	
7	W2	23.86±1.01 (n=20.19±0.65 (n=1.38±0.16 (n=	0.37	PRIC	
8	W3	23.6±0.43 (n=20.70±0.21 (n=1.65±0.43 (n=	0.39	PRIC	
9	W2	23.55±0.25 (n=21.15±0.70 (n=1.19±0.28 (n=	0.28	PRIC	
10	W1	23.39±0.22 (n=19.35±0.11 (n=1.59±0.09 (n=	0.29	PRIC	
11	W3	23.32±0.43 (n=19.52±0.33 (n=1.42±0.24 (n=	0.37	PRIC	
12	W1	23.62±0.2 (n=19.58±0.20 (n=1.37±0.12 (n=	0.24	PRIC	
13	W3	23.34±0.23 (n=19.90±0.37 (n=1.69±0.16 (n=	0.26	PRIC	
14	W2	23.21±0.5 (n=20.34±0.89 (n=1.95±1.44 (n=	0.24	PRIC	
15	W1	24.02±0.26 (n=20.08±0.12 (n=1.42±0.26 (n=	0.38	PRIC	
16	W3	23.42±0.4 (n=20.01±0.26 (n=1.31±0.28 (n=	0.27	PRIC	
17	W2	23.13±0.25 (n=20.11±0.45 (n=1.24±0.19 (n=	0.30	PRIC	
18	W2	24.59±1.13 (n=19.66±0.31 (n=1.49±0.28 (n=	0.27	PRIC	
19	W1	23.4±0.81 (n=20.41±0.71 (n=1.17±0.13 (n=	0.26	PRIC	
20	W2	23.83±0.36 (n=18.81±0.14 (n=1.08±0.42 (n=	0.30	PRIC	
21	W2	19.12±0.2 (n=16.23±0.37 (n=1.22±0.34 (n=	0.22	PRIC	
22	W2	20.63±0.71 (n=17.77±0.65 (n=1.17±0.23 (n=	0.23	PRIC	
23	W3	23.71±0.36 (n=20.77±0.75 (n=1.05±0.21 (n=	0.20	PRIC	
24	W1	23.92±0.24 (n=20.28±0.29 (n=1.52±0.07 (n=	0.20	PRIC	
25	W1	23.83±0.51 (n=21.95±0.39 (n=1.63±0.26 (n=	0.16	PRIC	
26	W2	24.23±0.74 (n=20.76±1.32 (n=1.48±0.18 (n=	0.15	PRIC	
27	W3	17.19±0.6 (n=16.00±0.45 (n=1.51±0.27 (n=	0.29	PRIC	
28	W2	20.31±0.48 (n=17.70±0.34 (n=0.95±0.13 (n=	0.24	PRIC	
29	W3	24.4±0.28 (n=20.83±0.20 (n=1.51±0.08 (n=	0.21	PRIC	
30	W3	22.32±0.41 (n=19.21±0.21 (n=1.15±0.01 (n=	0.21	PRIC	
31	W3	25.15±0.15 (n=21.52±0.49 (n=1.48±0.43 (n=	0.36	PRIC	
32	W3	23.86±0.71 (n=19.86±0.79 (n=1.17±0.05 (n=	0.21	PRIC	
33	W2	23.29±0.25 (n=20.78±0.68 (n=1.25±0.31 (n=	0.19	PRIC	
34	W2	22.16±0.73 (n=23.68±0.15 (n=1.26±0.18 (n=	0.21	PRIC	
35	W2	20.65±0.37 (n=17.13±0.55 (n=1.21±0.15 (n=	0.19	PRIC	
36	W1	33.94±0.21 (n=29.68±1.15 (n=2.11±0.27 (n=	0.17	PRIC	
37	W2	23.09±0.76 (n=19.49±0.24 (n=1.45±0.26 (n=	0.22	PRIC	
38	W3	22.84±0.18 (n=19.60±0.44 (n=1.73±0.22 (n=	0.22	PRIC	
39	W2	23.04±0.36 (n=19.78±0.76 (n=2.29±1.67 (n=	0.15	PRIC	
40	W1	22±0.59 (n=4)18.60±0.39 (n=1.36±0.15 (n=	0.29	PRIC	
41	W2	20.74±0.1 (n=19.14±0.61 (n=1.59±0.33 (n=	0.25	PRIC	
42	W1	23.88±0.08 (n=20.34±0.43 (n=1.67±0.23 (n=	0.17	PRIC	
43	W2	24.63±0.87 (n=19.86±0.51 (n=1.46±0.25 (n=	0.15	PRIC	
44	W2	21.16±0.32 (n=19.20±0.65 (n=1.21±0.21 (n=	0.19	PRIC	
45	W3	23.23±0.44 (n=19.46±0.32 (n=1.79±0.80 (n=	0.12	PRIC	
46	W2	23.33±0.2 (n=19.66±0.72 (n=1.28±0.03 (n=	0.14	PRIC	
47	W2	23.06±0.18 (n=19.58±0.86 (n=1.43±0.27 (n=	0.22	PRIC	
48	W3	22.84±0.15 (n=19.55±0.11 (n=1.42±0.33 (n=	0.12	PRIC	
49	W1	23.09±0.37 (n=19.43±0.33 (n=1.54±0.22 (n=	0.12	PRIC	
50	W2	23.93±0.69 (n=19.84±0.83 (n=1.19±0.29 (n=	0.14	PRIC	
51	W2	23.63±0.14 (n=19.34±0.57 (n=1.37±0.34 (n=	0.12	PRIC	
52	W3	22.89±0.63 (n=19.73±0.82 (n=1.75±0.29 (n=	0.12	PRIC	
53	W3	16.92±0.51 (n=15.57±0.67 (n=0.60±0.01 (n=	0.20	PRIC	
54	W1	24.18±0.61 (n=20.87±0.74 (n=1.41±0.54 (n=	0.14	PRIC	
55	W2	23.23±0.44 (n=20.56±0.34 (n=1.22±0.37 (n=	0.09	PRIC	
56	W1	23.96±0.5 (n=19.76±0.57 (n=1.35±0.26 (n=	0.12	PRIC	
57	W2	23.39±0.21 (n=21.03±0.11 (n=1.15±0.11 (n=	0.09	PRIC	

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3	W2	23.28±0.52 (n=19.04±0.30 (n=2.31±0.81 (n=	0.15	PRIC	
4	W2	23.94±0.28 (n=20.25±0.38 (n=1.51±0.15 (n=	0.09	PRIC	
5	W2	23.47±0.38 (n=19.29±0.32 (n=1.43±0.20 (n=	0.14	PRIC	
6	W2	23.09±0.42 (n=19.84±0.45 (n=1.41±0.23 (n=	0.10	PRIC	
7	W3	23.1±0.02 (n=19.05±0.84 (n=1.36±0.43 (n=	0.13	PRIC	
8	W3	23.79±0.34 (n=20.06±0.80 (n=1.66±0.42 (n=	0.12	PRIC	
9	W3	23.64±0.38 (n=20.36±0.65 (n=1.71±0.36 (n=	0.11	PRIC	
10	W2	23.2±0.1 (n=20.62±0.16 (n=1.94±0.23 (n=	0.08	PRIC	
11	W2	24.56±0.89 (n=19.54±0.83 (n=1.37±0.10 (n=	0.06	PRIC	
12	W2	22.98±0.46 (n=19.43±0.64 (n=1.73±0.43 (n=	0.10	PRIC	
13	W3	23.86±0.24 (n=20.01±0.21 (n=1.30±0.28 (n=	0.08	PRIC	
14	W2	23.67±0.6 (n=20.70±0.24 (n=1.54±0.18 (n=	0.10	PRIC	
15	W3	24.84±0.93 (n=19.94±0.77 (n=1.29±0.30 (n=	0.12	PRIC	
16	W3	23.79±0.95 (n=19.60±0.78 (n=1.35±0.06 (n=	0.10	PRIC	
17	W3	23.95±0.42 (n=19.86±0.64 (n=1.48±0.06 (n=	0.09	PRIC	
18	W2	23.86±0.44 (n=20.23±0.39 (n=1.47±0.14 (n=	0.09	PRIC	
19	W2	22.95±1 (n=4)19.29±0.16 (n=0.49±0.69 (n=	0.05	PRIC	
20	W2	26.53±0.3 (n=21.99±0.41 (n=1.68±0.36 (n=	0.07	PRIC	
21	W2	23.73±0.61 (n=20.06±0.35 (n=1.36±0.10 (n=	0.08	PRIC	
22	W3	23.48±0.31 (n=18.97±0.30 (n=1.55±0.09 (n=	0.04	PRIC	
23	W2	23.47±0.48 (n=19.70±0.03 (n=1.20±0.28 (n=	0.08	PRIC	
24	W3	23.69±0.22 (n=19.85±0.24 (n=1.56±0.27 (n=	0.06	PRIC	
25	W2	22.45±0.4 (n=18.45±0.62 (n=1.30±0.27 (n=	0.06	PRIC	
26	W2	22.89±0.57 (n=19.68±0.54 (n=1.28±0.12 (n=	0.07	PRIC	
27	W2	22.82±0.08 (n=19.61±0.29 (n=1.42±0.24 (n=	0.05	PRIC	
28	W2	23.3±0.3 (n=4)20.16±0.48 (n=1.00±0.10 (n=	0.07	PRIC	
29	W2	22.99±0.32 (n=19.67±0.65 (n=1.35±0.19 (n=	0.06	PRIC	
30	W2	23.91±0.41 (n=20.73±0.96 (n=1.58±0.15 (n=	0.04	PRIC	
31	W1	23.4±0.25 (n=20.94±0.49 (n=1.14±0.06 (n=	0.06	PRIC	
32	W3	23.9±0.53 (n=19.56±0.30 (n=1.44±0.14 (n=	0.05	PRIC	
33	W2	23.56±0.24 (n=20.51±0.77 (n=1.19±0.23 (n=	0.07	PRIC	
34	W2	24.13±0.51 (n=20.44±0.62 (n=1.50±0.12 (n=	0.07	PRIC	
35	W3	23.91±0.25 (n=21.06±1.32 (n=1.40±0.21 (n=	0.06	PRIC	
36	W3	23.41±0.52 (n=19.74±0.30 (n=1.49±0.19 (n=	0.06	PRIC	
37	W3	23.37±0.12 (n=20.45±0.84 (n=1.88±0.51 (n=	0.04	PRIC	
38	W2	24.74±0.64 (n=20.86±0.94 (n=1.30±0.26 (n=	1.61	PRIC	
39	W2	22.63±0.3 (n=19.21±0.62 (n=1.43±0.76 (n=	1.92	PRIC	
40	W2	23.55±0.48 (n=20.12±0.66 (n=1.42±0.06 (n=	1.10	PRIC	
41	W2	22.99±0.16 (n=19.15±0.57 (n=2.43±1.86 (n=	0.71	PRIC	
42	W2	23.29±0.29 (n=19.84±0.88 (n=1.37±0.08 (n=	0.73	PRIC	
43	W2	23.78±0.44 (n=19.96±0.08 (n=1.49±0.50 (n=	0.71	PRIC	
44	W2	23.28±0.3 (n=19.88±0.88 (n=1.54±0.09 (n=	0.49	PRIC	
45	W1	23.74±0.4 (n=20.55±0.37 (n=1.22±0.17 (n=	0.56	PRIC	
46	W2	23.92±0.45 (n=19.64±0.33 (n=1.51±0.29 (n=	0.51	PRIC	
47	W2	23.64±0.48 (n=21.40±0.93 (n=1.14±0.03 (n=	0.40	PRIC	
48	W2	22.65±0.45 (n=19.32±0.52 (n=1.80±0.41 (n=	0.42	PRIC	
49	W3	23.45±0.23 (n=20.08±0.55 (n=1.54±0.12 (n=	0.32	PRIC	
50	W1	23.64±0.47 (n=20.29±0.86 (n=1.72±0.94 (n=	0.36	PRIC	
51	W2	23.11±0.82 (n=23.81±0.46 (n=0.22±0.39 (n=	0.20	PRIC	
52	W2	23.34±0.17 (n=19.73±0.51 (n=1.35±0.51 (n=	0.33	PRIC	
53	W2	23.32±0.23 (n=20.05±0.46 (n=1.25±0.31 (n=	0.38	PRIC	
54	W2	24.22±0.41 (n=20.42±0.37 (n=1.42±0.12 (n=	0.43	PRIC	
55	W2	23.45±0.51 (n=18.88±0.49 (n=1.34±0.57 (n=	0.24	PRIC	
56	W2	20.47±0.28 (n=18.89±0.73 (n=0.40±0.69 (n=	0.32	PRIC	
57	W2	22.46±0.22 (n=19.69±0.67 (n=1.51±0.22 (n=	0.29	PRIC	



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2							
3	W2	23.41±0.32	(n=20.32±0.72	(n=1.27±0.38	(n=	0.34	PRIC
4	W2	24.19±0.19	(n=20.33±0.41	(n=1.35±0.28	(n=	0.31	PRIC
5	W1	23.77±0.3	(n=20.76±0.68	(n=1.13±0.31	(n=	0.20	PRIC
6	W1	23.11±0.2	(n=19.52±0.66	(n=1.30±0.33	(n=	0.31	PRIC
7	W2	24.2±0.38	(n=19.96±0.67	(n=1.66±0.08	(n=	0.19	PRIC
8	W2	23.45±0.13	(n=19.87±0.21	(n=1.44±0.40	(n=	0.20	PRIC
9	W3	23.51±0.41	(n=20.00±0.55	(n=1.51±0.31	(n=	0.22	PRIC
10	W3	23.22±0.54	(n=19.66±0.53	(n=1.16±0.19	(n=	0.26	PRIC
11	W2	23.87±0.47	(n=20.27±0.56	(n=1.35±0.33	(n=	0.26	PRIC
12						0	Mars
13						0	Mars
14						1004	UAb
15	high					1.1	UCLA
16	moderate	16.48±0.14	14.15±0.14	8.8±0.1		21.3	MNB
17	moderate	28.9; 31.0; 25.23.7		2.8	2.98	24.1	UWB
18	W0/1	27.0±0.2	21.5±0.8	2.2±1.6	4.58	22.3	Kiel
19	W3				4.84	23.0	Kiel
20	W4	26.5±0.2	(n=219.3±3.9	(n=20.8±0.8	4.65	300	IGCAS
21						32.9	WAM
22	W3	18.6	15.6			39.3	WAM
23	W3	19.5	17.5	1.0		220	WAM
24	W3	18.9	17.0	1.24		48.1	UAz
25	W1	16.9±5.6	(N=111.3±6.4	(N=40.9±0.6	(N=48	22.2	Vernad
26	W2	18.9±0.2	16.3±0.2	(N=11.47±0.17	(N=	54.2	Vernad.
27	W3	24.3±0.42	20.2±0.3	(N=11.47±0.29	(N=	1100	CEREGE
28	W2				4.58	196	CEREGE
29	W1				5.23	329	CEREGE
30	W2				4.53	774	CEREGE
31	W2				4.54	101	CEREGE
32	W1				4.88	321	CEREGE
33	W1				4.94	46.5	CEREGE
34	W2				5.19	156	CEREGE
35	W2				4.96	451	CEREGE
36	W2				4.07	24.1	Cascadia
37	W1	25.1±0.2	(N=121.0±0.2	(N=11.6±0.2	(N=12	4.6	CEREGE
38			58.0±2.8	(n=66.0±3.3	3.33	26.2	MNB
39	W3	17.1±0.2,	n=114.7±0.1,	n=111.5±0.1,	n=10	20	MNB
40	W2	29.8±0.5	(n=123.9±0.1	(n=11.8±0.2	(n=12	29.3	MNB
41	W3	18.8±0.1	(n=716.6±0.4	(n=91.2±0.2	(n=9)	31.8	MNB
42	W3	24.9±0.3	(n=820.9±0.2	(n=81.8±0.1	(n=8)	21.07	MSN-FI
43	W3	19.0±0.6	(N=916.0±0.6	(N=51.4±0.1		9.27	MSN-FI
44	W2	20.6±0.5	(N=718.0±0.5	(N=61.2±0.1		2.10	MSN-FI
45	W3	19.3±0.7	(N=717.3±0.7	(N=91.4±0.1		13.16	MSN-FI
46	W2	20.8±0.6	(N=118.3±0.6	(N=91.5±0.1		30.90	MSN-FI
47	W4	20.8±0.5	(N=818.5±0.5	(N=61.5±0.1		20.10	MSN-FI
48	W3	20.8±0.7	(N=717.9±0.6	(N=71.7±0.1		18.52	MSN-FI
49	W3	20.8±0.4	(N=916.3±0.5	(N=11.3±0.1		42.71	MSN-FI
50	W3	20.7±0.5	(N=918.4±0.6	(N=11.3±0.1		6.91	MSN-FI
51	W3	20.8±0.6	(N=717.3±0.7	(N=71.5±0.1		6.71	MSN-FI
52	W3	20.1±0.5	(N=116.8±0.6	(N=61.3±0.1		12.15	MSN-FI
53	W3	20.5±0.6	(N=817.4±0.5	(N=71.1±0.1		6.70	MSN-FI
54	W3	19.3±0.5	(N=516.8±0.6	(N=51.5±0.1		9.74	MSN-FI
55	W3	20.5±0.6	(N=719.0±0.7	(N=61.4±0.1		3.73	MSN-FI
56	W3	19.8±0.7	(N=517.9±0.6	(N=61.0±0.1		2.12	MSN-FI
57	W3	20.8±0.5	(N=918.5±0.5	(N=51.1±0.1		0.53	MSN-FI
58	W3	20.8±0.5	(N=918.5±0.5	(N=51.1±0.1			
59	W3	20.5±0.6	(N=717.5±0.6	(N=51.4±0.1			
60	W3	20.5±0.6	(N=717.5±0.6	(N=51.4±0.1			

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3	W3	19.9±0.4 (N=617.7±0.7 (N=5 1.1±0.1		10.16		MSN-FI
4	W3	20.6±0.6 (N=118.0±0.6 (N=1 1.8±0.1		89.56		MSN-FI
5	W3	20.2±0.5 (N=617.7±0.6 (N=5 2.0±0.1		3.65		MSN-FI
6	W3	19.8±0.6 (N=517.7±0.5 (N=8 2.1±0.1		2.10		MSN-FI
7	W3	20.8±0.7 (N=717.8±0.6 (N=6 1.4±0.1		3.88		MSN-FI
8	W2	18.4±0.5 (N=716.0±0.6 (N=6 1.4±0.1		180.10		MSN-FI
9	W3	12.5±5.7(N=1 8.8±4.4(N=10) 0.9±0.1		754.31		MSN-FI
10	W3	20.3±0.6 (N=117.5±0.6 (N=7 0.9±0.1		125.90		MSN-FI
11	W3	20.2±0.5 (N=617.4±0.7 (N=6 1.0±0.1		3.44		MSN-FI
12	W2	25.0±0.7 (N=521.7±0.6 (N=6 1.6±0.1		69.80		MSN-FI
13	W3	15.4±7.3 (N=113.0±4.9 (N=10.8±0.1		336.20		MSN-FI
14	W3	19.4±0.6 (N=617.1±0.5 (N=7 1.5±0.1		3.46		MSN-FI
15	W3	19.3±0.5 (N=617.0±0.6 (N=5 1.4±0.1		35.63		MSN-FI
16	W3	19.7±0.6 (N=917.1±0.7 (N=8 1.4±0.1		74.50		MSN-FI
17	W3	19.2±0.5 (N=716.7±0.6 (N=5 1.4±0.1		45.70		MSN-FI
18	W3	19.1±0.6 (N=617.9±0.5 (N=6 1.2±0.1		54.67		MSN-FI
19	W3	19.7±0.7 (N=716.8±0.6 (N=6 1.3±0.1		12.17		MSN-FI
20	W3	25.7±0.7 (N=121.3±0.7 (N=1 1.5±0.1		76.90		MSN-FI
21	W3	20.0±0.5 (N=117.4±0.6 (N=1 1.5±0.1		3.13		MSN-FI
22	W3	20.7±0.6 (N=619.0±0.6 (N=7 1.0±0.1		12.08		MSN-FI
23	W3	19.5±0.5 (N=517.8±0.5 (N=6 1.1±0.1		198.30		MSN-FI
24	W3	20.8±0.6 (N=818.0±0.6 (N=9 1.5±0.1		9.98		MSN-FI
25	W3	20.0±0.7 (N=917.4±0.6 (N=6 1.3±0.1		56.70		MSN-FI
26	W3	20.8±0.6 (N=618.7±0.7 (N=5 1.3±0.1		12.30		MSN-FI
27	W3	23.6±1.0 (N=721.3±0.6 (N=6 1.5±0.1		8.17		MSN-FI
28	W3	19.2±0.6 (N=916.7±0.6 (N=7 1.2±0.1		72.24		MSN-FI
29	W3	20.2±0.5 (N=617.8±0.5 (N=6 1.6±0.1		16.60		MSN-FI
30	W3	20.8±0.7 (N=518.9±0.6 (N=5 1.2±0.1		1.25		MSN-FI
31	W3	26.0±0.6 (N=622.6±0.7 (N=6 1.3±0.1		10.50		MSN-FI
32	W2-3	19.51±0.13 (N17.37±0.38 (N1.29±0.15 (N=		14.7		UrFU
33	W3-4	19.32±0.19 (N17.29±0.28 (N1.45±0.21 (N=		521.54		UrFU
34	W2	19.68±0.20 (N17.03±0.23 (N1.42±0.22 (N=		24.7		UrFU
35		0.5-41.5 (n=1)		28.7		ASU
36	W3	17.9±0.2 (N=216.0±0.3 (N=11.3±0.2 (N=185.28		45		UCLA
37	W3		5.00	11.0		Kiel
38	W2	23.9±0.7 (n=2 20.3±0.6 (n=9 2.0±0.4	4.71	22.3		Kiel
39	W2	23.5±0.5 (n=2 19.1±0.3 (n=5 1.8±1.1	4.68	22.6		Kiel
40	W4	23.0±0.4 (n=2 19.5 (n=1) 1.5	4.85	21.3		Kiel
41		35.5±0.4 28.8±0.6 2.7±1.0		40		IGCAS
42	W4	25.0±0.2 (n=5 20.7±0.2 (n=4 2.02±0.18 (n=		400		IGCAS
43	W4	17.4±0.3 (n=5 14.7±0.3 (n=5 0.23±0.03 (n=		27		IGCAS
44	W3	25.1±0.3 (n=5 21.0±0.2 (n=5 1.28±0.16 (n=		30		IGCAS
45	W1	18.8 (19.2-18. 16.5 (16.7-16. 1.5 (1.7-0.98;		21		USil
46	W2-3	25.1±1.5 (n=3 14.1±5.7 (n=2 0.6±0.5 (n=25		21.3		IfP
47	W1	19.0 16.9 1.06		23.68		WAM
48	W4		4.87	22.1		Kiel
49	wi-1	30.9±0.26 (N=		1.23		Vernad
50	W1		4.74	12.3		CEREGE
51	W1	18.2±0.3 (N=116.3±0.6 (N=11.1±0.1 (N=13		1.8		Vernad
52	W1		4.68	10.26		Kiel
53	W1	18.4 (n=1) 16.4 (n=1) 1.0	5.32	150		CEREGE
54		19.4 (n=1) 17.6±0.1 (n=2 1.6±0.3	4.69	3.8		CEREGE
55	W3	19.1 (n=1) 17.0±0.5 (n=3 1.3±0.2	4.66	7.5		CEREGE
56	W3	19.7 (n=1) 17.4±0.2 (n=3 1.4±0.1	4.79	276.2		CEREGE
57	W1	19.0 (n=2) 18.0 (n=2) 0.95	5.04	22.6		CEREGE

1							
2							
3	W2	18.5±0.1 (n=3	17.1±0.5 (n=3	1.6±0.7	4.96	22.7	CEREGE
4	W2	27.7±0.8	16.1±7.4	0.9±0.6	4.11	25.57	App
5	W1				5.25	21.5	CEREGE
6	W2-3	17.9±0.5 (n=4	16.1±0.4 (n=6	1.1±0.2 (n=6)	5.1	5.8	IfP
7	W3	25.2±0.8 (N=220.6±0.3 (N=21.64±0.25 (N=				14	UrFU
8	low		58.7±0.2; 29.76.2±0.6; 41.7±2.76			20.88	App
9	W3				4.40	15	CEREGE
10	W1				5.22	25.7	CEREGE
11	W2				4.69	22.3	CEREGE
12	W2	28.0±0.5	18.1±5.0	0.9±0.8	4.11	23.54	App
13	W0/1				4.97	30.8	CEREGE
14	W2				5.03	31	CEREGE
15	W2				4.44	3.6	CEREGE
16	W1				5.22	43.7	CEREGE
17	W2				4.61	22	CEREGE
18	W3				4.09	2.5	CEREGE
19	W3				4.75	31.2	CEREGE
20	W1				4.70	31.2	CEREGE
21	W1				4.82	12.5	CEREGE
22	W1				5.15	15.5	CEREGE
23	W3	19.0±0.3 (n=4	16.4±0.4 (n=5	1.0±0.2	5.01	23	CEREGE
24	W3	25.8 (n=1)	21.8±0.2 (n=3	1.7±0.2	4.60	25	CEREGE
25	W3	25.2 (n=1)	20.9 (n=1)	1.8	4.66	5.88	CEREGE
26	W3	25.6 (n=1)	21.7±0.2 (n=3	1.6±0.0	4.29	20.3	CEREGE
27	low	58.4 (n=2)			3.69	20.5	CEREGE
28	low				3.32	23.2	CEREGE
29		18.5±0.2 (n=3			4.15	14	CEREGE
30	high		60.0±2.3 (n=5	3.6±1.9	2.81	38	CEREGE
31	W1	18.8±0.2 (n=5	17.4±1.9 (n=6	0.9±0.4	4.93	6.58	CEREGE
32	W2	25.8 (n=1)	21.5 (n=1)	1.3	4.70	7.75	CEREGE
33	W2				5.10	22	CEREGE
34	W3	24.6±0.5 (n=1	20.4±0.3 (n=1	1.5±0.3	4.58	12.4	Kiel
35		21.6±0.7 (n=2			4.45	20.2	Kiel
36	W4	18.3±0.3 (n=4	16.1±0.3 (n=2	1.1±0.2	4.98	20.2	Kiel
37	W2				3.23	26.0	Kiel
38	W4				4.55	12.65	Kiel
39	W2				5.02	2.70	Kiel
40	W2	25.2±0.6 (n=6	20.8±0.5 (n=5	1.7±0.2 (n=5)		20	IGCAS
41	W4	24.9±0.2 (n=5	20.8±0.2 (n=5	1.63±0.15 (n=		1700	IGCAS
42	W1				4.75	43	CEREGE
43	W1				4.71	22	CEREGE
44	W2				5.12	50	CEREGE
45	W1				4.78	21	CEREGE
46	W0	19.3	17.6-19.3	1.6-3.2		100	PRL
47	W3	18.2±0.7 (N=116.0±0.5 (N=11.2±0.2 (N=12				80	Vernad
48	W3	17.2±0.4 (N=115.4±0.4 (N=11.0±0.1 (N=12				3.8	Vernad
49	W3	16.8±0.3 (N=114.9±0.2 (N=11.0±0.4 (N=12				14.9	Vernad
50	W3	18.3±0.3 (N=116.1±0.4 (N=11.4±0.1 (N=12				2.1	Vernad
51	W3	17.8±0.2 (N=115.8±0.3 (N=11.3±0.2 (N=13				2.6	Vernad
52	W0	24.3±0.3 (23.8±0.5±0.2 (20.11.5±0.2 (1.1-1				22.2	NMBE
53	W3	39.2±0.8 (N=211.5±0.9 (N=145.0±1.1 (N=1				20	UPC
54						0	Mars
55						0	Mars
56						0	Mars
57						0	Mars
58						0	Mars
59						0	Mars
60						0	Mars

1							
2							
3					0		Mars
4					0		Mars
5					0		Mars
6	W2	18.6±0.6 (n=1	16.7±0.6 (n=1	1.1±0.5	25		MNRJ
7	W1	19.1	16.8	1.12	12.65		WAM
8	A/B	26	22		2.4	27.72	JSC
9	B/C	26			4.91	49.47	JSC
10	B	25	21		4.71	96.69	JSC
11	A/B	19	18		5.19	121.86	JSC
12	W2	20.2	17.8	1.3		64.32	WAM
13		17.7 (16.9-18.	15.8 (15.4-16.	1.5. (1.1-2.0, 1		63	NMNS
14	A/B	25	20		5.23	2.277	JSC
15	B	26	22		4.44	1.583	JSC
16	A/B	20	18		5.3	7.578	JSC
17	B	20	18		5.286	6.069	JSC
18	AB	18	16		5.3	4.97	JSC
19	B	17	15		5.282	10.044	JSC
20	A/B	20	19		5.186	7.066	JSC
21	A/B	20	18		5.187	4.776	JSC
22	B	17	15		5.28	12.026	JSC
23	A/B	21	19		5.261	5.255	JSC
24	B	29	24		4.579	4.71	JSC
25	A/B	20	18		5.32	4.22	JSC
26	B/C		19		5.25	3.97	JSC
27	B/C	21	18		5.31	2.89	JSC
28	B/C	21	19		5.27	1.6	JSC
29	A/B	25	22		4.66	0.94	JSC
30	B/C	20	17		5.21	10.17	JSC
31	B/C	20	18		5.35	7.01	JSC
32	B/C	20	18		5.29	4.35	JSC
33	B/C	20	18		5.24	7.78	JSC
34	B	21	20		5.215	7.641	JSC
35	B	20	18		5.157	6.801	JSC
36	B	21	19		5.22	4.178	JSC
37	B	21	19		5.27	12.314	JSC
38	B	19	18		5.23	6.785	JSC
39	B	21	19		5.29	18.535	JSC
40	B	19	18		5.24	18.23	JSC
41	A/B	17	15		5.06	32.864	JSC
42	B	20	18		5.14	24.379	JSC
43	B/C	20	17		5.32	4.8	JSC
44	B	20	17		5.28	4.26	JSC
45	B/C	20	18		5.28	2.22	JSC
46	B	21	19		5.14	5.47	JSC
47	B/C	21	19		5.24	7.14	JSC
48	B/C	20	19		5.29	3.69	JSC
49	B/C	20	18		5.29	7.61	JSC
50	A/B	27	23		4.6	30.15	JSC
51	A/B	19	17		4.58	81.01	JSC
52	B	26	22		5.26	30.87	JSC
53	W1	24.4±0.3 (n=1	20.6±0.2 (n=9	1.5±0.3	2438		UCLA
54	low		20.6-25.7; 37.	35.9-27.9; 12.	22.7		UWB
55	low	32.1±11.5	18.8±9.9	1.2±0.5	43.4		UWB
56	low		28.4-31.8; 21.	10.4-12.1; 35.	21.1		UWB
57	W2	19.6±11.4	12.5±6.6	1.1±1.2	4.63	21.7	UWB

1						
2						
3	low	33.9-39.3	17.7-18.5;36.70.9-1.1; 8.4-11	30.8		UWB
4	low	21.0-23.5	28.4-31.0; 36.3.1-3.3; 9.3; 2			
5	low	30.9-38.7	7.4-12.4 24.6-30.7	24.1		UWB
6	low	32.8-40.4	15.2-28.0; 48.1.2-3.4; 7.7-9.	23.8		22.8 g UCLA/C
7	W2	24.5±0.1	21.0±0.2 1.2±0.1	22.7		21 g UCLA/1.7
8	W2	19.6±0.8	17.3±0.9 1.5±0.1	21.7		20 g UCLA/1.7
9	low	20.3±13.3	13.8±11.4 1.0±0.1	26.2		PSF
10	W1	27.9±9.3	10.1±10.3 0.7±0.5	47.4		PSF
11	low		55.9-57.8; 26.2.6-4.6; 38.2-4	28.0		PSF
12	low	22.9±19.3	2.3±2.0 2.6±1.4	21.6		20 g AMNH/1.
13	W5		0.5±0.2 1.4±0.0	29.5		20.5 g UWB, 9
14	W1	19.4±0.1	16.9±0.2 1.3±0.2	22		PSF
15	moderate	15.3±17.3	1.0±0.2 1.0±0.1	20.2		PSF
16	low	18.7±17.3	1.5±0.5 0.7±0.2	6.0		PSF
17	low	75.8	23.6-32.1; 54.1.9-3.6; 1.5-4.	20.9		PSF
18	W2	18.7±0.4	16.4±0.2 3.7±0.4	26.3		PSF
19	moderate	30.3	29.6 4.6	20		MNB
20	moderate	28.3	9.5 43.6	21		MNB
21	W2	13.1±16.6 (0.82.3±0.7 (1.2-30.9±0.6 (0.3-2		23.7		MNB
22	moderate	30.0	25.4 2.7	20.2		MNB
23	high	6.9±0.1, n=11		1.6		MNB
24	moderate	4.6	6.8; 2.6 1.8; 45.6	1.3		MNB
25	moderate	4.0	6.0; 2.2 1.7; 46.4	14.6		MNB
26	moderate	7.5		3.4		MNB
27	low	31.1; 21.1	7.9; 1.2 1.4; 42.3	9.6		MNB
28	W1	0.9-44.3	1.8-19.7 1.4-0.9 4.47	22.7		PSF
29	low	15.4±20.3	6.8±5.1 2.8±1.9	21.0		PSF
30	moderate		3.13±2.24; 42.1.06±0.30; 1.6	20		ROM
31	low	31.4±0.2	26.0±0.1 1.0±0.1	15.4		PSF
32	low	33.4±0.3	27.3±0.3 1.4±0.1	21.4		PSF
33	moderate		34.3±1.1 (low-2.9±0.6 (low-C	24		UCLA
34	moderate		24.9±0.4 3.46±0.24	22		UCLA
35	moderate	65.0±1.1		35		UCLA
36	W2	15.9±8.5	7.9±6.7 0.8±0.7	20		IfP
37	W1	17.8±12.7	7.7±6.9 0.9±1.1	20		IfP
38	moderate	5.92±10.59 (n=3.07±0.92 (n=		82		UCLA
39	W2	20.0 (19.1-21.19.1 (17.8-21.1.5 (0.9-2.8, N		9.9		SI
40	W2	25.8 (25.2-26.24.2 (24.1-26.1.5 (0.0-2.0, N		5.6		SI
41	W2	18.4±11.7 11.0±9.1 1.7±1.0		23.95		UNM
42	low	14.4-14.5; 9.1 12.2-12.3 8.1-8.0		25.2		UWB
43	W1	22.6±9.1 5.1±3.8 0.4±0.2 4.73		23.41		PSF
44	W1	24.2±7.5 11.7±13.0 1.0±1.0		193.1		PSF
45	W2	27.8±3.9 20.6±0.3 1.6±1.0 4.65		87.64		PSF
46	W2	28.9±5.0 21.4±0.8 1.9±0.1		40.54		PSF
47	W2/3	19.1±14.2 8.3±9.0 0.7±0.8 4.57		35.7		UWB
48		18.4 (0.2-36.59.4±6.7 (n=11 0.6±0.5 3.43		10.2		Kiel
49	W4	16.0±1.2 (n=1 14.8±2.8 (n=1 0.8±0.7 4.99		14.8 + 5.9 g		Kiel + IfP
50		23.1 (L5); 22.121.7 (L5) 2.1 (L5)		40		IGCAS
51	low	73.8±6.5 (N=267.7±1.6 (n=6 3.1±1.3		38.2		UWB
52	W1	19.7±8.0 12.9±8.7 0.9±1.1		249		PSF
53	W1	18.9±2.4 (13.116.3±1.7 (n=3 1.2±0.6 5.55		26.1		Kiel
54	W0	18.5±0.6 (17.915.8±0.2 (n=5 1.7±0.2 5.44		23.9		Kiel
55		37.5±10.6 (8.214.2±10.6 (n= 1.8±4.0 3.52		16.3		Kiel
56	W1	25.4±7.3 10.1±9.9 1.0±0.6		193		PSF
57	W2	7.8-39.1 (n=8)1.8-20.7 (n=3)0.3-3.9		55		UWB



1							
2							
3	W0/1	30.8-31.2	25.1-25.5	2.2-1.6		83.5	UWB
4	moderate	13.5±8.3 (N=7)	1.7 (N=1)	1.3	3.81	21	CEREGE
5	moderate	32.0±0.2 (n=4)			4.58	22.0	CEREGE
6		11.4±1.5 (N=4)	10.6±0.2 (N=14)	7±0.3 (N=18)		27.7	Vernad.
7	W2	14.5±9.5 (n=3)	11.1±7.0 (n=1)	0.9±0.1; 1.9±0.		21.7	MSN-FI
8		33.6±0.2 (n=4)	27.1±0.1 (n=3)	1.9±0.2	3.24	23.3	CEREGE
9	low	12.2±0.6 (n=6)	10.9±0.2 (n=5)	4.7±0.1 (n=5)	4.23	2.27	CEREGE
10		31.1±0.4 (n=1)	25.8±1.2 (n=3)	3.5±0.9	3.31	1.73	Kiel
11		14.2 (1.1-22)	6.6 (2.2-18.6; 0.9 (0.2-3.5)		3.83	6.9	Kiel
12		10.2 (0.8-16.2)	12.1 (1.5-25.7)	1.4 (0.3-4.4)	3.40	20.0	Kiel
13	W2	24.2±0.9 (n=1)	20.2±6.2 (n=7)	1.5±0.2	4.57	21.9	Kiel
14	W5	16.3±4.9 (n=2)	18.8±5.0 (n=1)	0.9±0.8	5.06	22.3	Kiel
15	W5	23.4±0.4 (n=1)	19.5±0.3 (n=6)	1.1±0.2	3.54	12.3	Kiel
16	W1	24.0±1.9 (n=1)	18.4±1.7 (n=1)	3.2±1.4 (n=18)		2.1	IfP
17	low	10.6±4.2 (N=2)	12.6±0.2 (N=29)	9±0.1 (N=25)		23.84	ROM
18	W4	23.6±2.3 (n=1)	13.5±8.6 (n=9)	0.7±0.5	4.43	23.1	Kiel
19	W1	17.8±0.3 (N=6)	12.6±1.1 (N=10)	5±0.2		21	MSN-FI
20	W2	17.8±0.2 (N=8)	15.7±0.3 (N=6)	1.3±0.3		21	MSN-FI
21	moderate		62.1±0.3 (N=82)	8±0.2; 44.0±		24	MSN-FI
22	W3	19.2±0.3 (N=6)	16.3±0.3 (N=7)	1.2±0.1		20	MSN-FI
23	W4	24.7±0.4 (N=7)	20.7±0.2 (N=8)	1.4±0.1		21	MSN-FI
24	moderate	20.0±2.6	21.6±0.5, 22.6	3.0±0.2, 24.1±		20.4	UNM
25	low		40.68±13.81	1.35±0.42		0.42	ROM
26	moderate		43.66±14.83	4.90±3.19		20	ROM
27	low		42.98±14.37; 16.39±4.74; 28.			6.53	ROM
28	low to m		41.03±0.20; 3.3	4.0±1.29; 38.		20	ROM
29	moderate		33.68±0.64; 318	3.39±2.85; 30.		1.24	ROM
30	low	24.3±20.8 (n=8)	8±12.7 (n=1)	1.5±0.8	4.44	8.83	CEREGE
31	low	1.0±0.0	0.4-0.7; 0.3	0.9-1.1; 38.0		22.5	UWB
32	low					25.5	UCLA
33	moderate		53.7±2.8, 51.45	4±0.4, 8.7±2		26	UCLA
34	W2	30.0	25.4; 13.1	0.7; 44.6		9.2	MNB
35	strong	13.6±0.1 (n=1)				13.6	MNB
36	strong	13.3±0.1 (n=1)				23	MNB
37	low	21.4±0.5 (n=1)	18.0±0.1 (n=1)	7.0±0.1 (n=13)		20	MNB
38	moderate		58.7; 27.0	4.2; 42.4		22.9	MNB
39	moderate	8.7±7.6 (1.2-2)	1.8±1.0 (0.8-3)	1.6±1.3 (0.5-3)		21.3	MNB
40	low	10.8±16.0 (0.3)	1.7±0.7 (1.3-4)	1.6±0.8 (1.0-3)		7.5	MNB
41	moderate	14.8±15.3 (0.3)	0.8±0.1 (0.7-1)	1.1±0.1 (1.0-1)		22.3	MNB
42	low	34.5-35.8	20.5; 24.7-28.	3.2; 8.5-10.4;		20.1	UWB
43	low		18.3; 24.3-25.	2.0; 1.5-2.5; 1		26	UWB
44	low to m		60.7-63.6; 25.	1.9-3.8; 43.2-4		27	UWB
45	low	31.8±0.2	26.2±0.2	0.8±0.1		21	UWB
46	low	26.9-36.8	17.4-18.4; 23.	3.4-5.1; 20.3		21.6	UWB
47	low		26.1-28.3; 20.	6.7-11.9; 34.1		25.3	UWB
48	W4				4.06	21.2	Kiel
49	W2				4.45	20.9	Kiel
50	W1				4.98	10.8	Kiel
51	W2				4.81	20.5	Kiel
52	W1				5.17	1.5	Kiel
53	moderate	8.6±8.9 (0.6-22)	9±3.6 (1.5-10)	7±0.1 (0.4-0		21.7	MNB
54	W3	15.7±10.6 (0.4)	11.0±6.9 (1.7-0)	8±0.4 (0.3-1)	3.40	20	MNB
55	W3	18.4±0.2 (n=1)	16.8±0.2 (n=1)	1.6±0.1 (n=11)		38.0	MNB
56	W3	17.8±0.1 (n=1)	16.1±0.5 (n=1)	0.7±0.1 (n=15)		14.1	MNB
57	moderate	19.0±19.9 (2.0)	2.1±0.8 (1.3-4)	1.2±0.2 (0.9-1		12.4	MNB

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3	strong	19.8±25.6 (0.33.0±2.0 (1.2-50.8±0.2 (0.5-1	20	MNB	
4	W2	24.9 16.7 0.7	26.5	MNB	
5	moderate	8.7±0.1 (n=11 8.0±0.1 (n=11 8.2±0.1 (n=11	11	MNB	
6	W3	24.7±0.2 (n=1 20.9±0.2 (n=1 1.5±0.1 (n=11	2.8	MNB	
7	moderate	9.4±14.3 (0.5-7.6±9.2 (1.2-2 1.0±0.3 (0.8-1	12.3	MNB	
8	moderate	57.4; 25.2 2.7; 43.3	26.9	MNB	
9	moderate	57.7; 25.6 2.7; 43.0	2.7	MNB	
10	low	17.9±19.7 (1.31.4±0.5 (1.0-20.8±0.1 (0.7-1	21.2	MNB	
11	low	37.5; 48.4 7.6; 23.4	14.4	MNB	
12	low	15.6±17.0 (0.61.7±0.1 (1.5-20.9±0.1 (0.8-1	17.7	MNB	
13	W1	28.5±0.2 (n=1 20.4±3.4 (13.50.8±0.6 (0.3-1	24.9	MNB	
14	W1	14.1±10.1 (3.011.9±8.3 (1.6-1.2±0.6 (0.2-1 4.76	20.3	MNB	
15	W1	17.7±19.6 (1.72.6±1.8 (1.1-52.0±1.1 (1.0-3	24.6	MNB	
16	low	40.5; 54.3; 28.2.7; 2.8; 37.7	20.6	MNB	
17	W1	14.6±10.1 (1.912.1±7.3 (2.9-0.7±0.7 (0.3-3 4.66	30.1	MNB	
18	W1	28.9 24.7; 8.7 1.2; 46.4	9.1	MNB	
19	W2	23.5±0.1 (n=5 19.7±0.3 (n=5 0.6±0.1 (n=5)	269	MNB	
20	W2	24.6±0.1 (n=4 20.4±0.1 (n=5 1.4±0.1 (n=5)	497	MNB	
21	W2	38.7±0.7 29.6±0.3 1.5±0.4	14.2	UCLA	
22	W3	25.6±0.4 (N=622.3±0.4 (N=7 1.5±0.1	21.0	MSN-FI	
23	W3	18.6±0.5 (N=716.3±0.5 (N=6 1.6±0.1	20.5	MSN-FI	
24	W2	18.8±0.4 (N=616.5±0.4 (N=6 1.5±0.1	20.3	MSN-FI	
25	W3	26.6±0.5 (N=720.6±0.5 (N=7 1.2±0.1	20.1	MSN-FI	
26	W2	18.7±0.4 (N=616.7±0.4 (N=6 1.5±0.1	21.1	MSN-FI	
27	W3	19.1±0.4 (N=616.5±0.5 (N=7 1.3±0.1	20.1	MSN-FI	
28	W4	25.1±0.5 (N=720.9±0.4 (N=1 1.6±0.1	21.1	MSN-FI	
29	W4	24.4±0.4 (N=621.0±0.5 (N=6 1.5±0.1	22.0	MSN-FI	
30	A	49.3±11.3 (28 19.3±12.0 (3.8	30	MNHNP.	
31	W3	17.7±10.7 (N=11.5±10.1 (N=1.0±1.1 (N=82	90.3	Cascadia	
32	W2	29.0±0.2 (N=323.7±0.3 (N=21.4±0.4 (N=26	24.3	Cascadia	
33	W1	25.3±9.0 (N=112.8±9.5 (N=30.9±0.8 (N=33	33.0	Cascadia	
34	W2	25.3±0.7 (N=821.1±0.2 (N=8 1.6±0.2 (N=8)	43.7	UAz	
35	W2	18.9±0.2 16.8±0.4 1.7±0.1	22.4	UAz	
36	W2	25.4±1.2 n=10 20.8±0.3 n=10 1.6±0.3 n=10	31	UAz	
37	W3	18.7±0.2 (n=1 16.5±0.2 (n=1 0.99±0.11 (n=	41.6	UAz	
38	W3	25.2±1.0 (N=121.1±0.6 (N=11.6±0.3 (N=10	27.4	UAz	
39	W3	19.1±0.3 16.7±0.2 1.74±0.06	31.6	UAz	
40	W3	24.9±0.3 20.9±0.5 1.6±0.3	20.8	UAz	
41	W3	19.1±0.3 16.9±0.3 1.76±0.05	32.6	UAz	
42	W2	18.1±0.2 (n=1 15.4±0.6 (n=1 0.52±0.33 (n=	32.1	UAz	
43	W1	30.3±0.5 25.6±0.3 2.3±0.4	22.3	UWB	
44	low	21.5-47.7 38.5-43.0 7.1-5.3	24.9	UWB	
45	low	16.6-16.8; 34. 17.6-37.5 0.9-3.5	20.1	UWB	
46	W2	24.4±0.3 20.6±0.2 1.4±0.2	221	UWB	
47	low	60.7-62.0; 26. 3.4-1.9; 44.2-4	20.2	UWB	
48	W1	22.9±0.2 19.5±0.1 3.7±0.7	28.2	UWB	
49	low	33.0-33.4; 24. 15.0-14.2; 24.	20.5	UWB	
50	W1	27.7±0.4 22.8±0.1 2.1±0.0	20.6	UWB	
51	W3	0.1±0.0 1.4±0.0	23.6	UWB	
52	W2/3	25.1±1.3 20.9±0.4 1.6±0.2	286	PSF	
53	low	51.7-56.2 18.4-24.6; 59. 0.8-2.6; 4.1; 2	9.8	UWB	
54	W2	18.8±0.3 16.7±0.2 1.4±0.1	220	PSF	
55	low	37.8-49.1 33.8-37.2; 12. 2.5-1.8; 45.7-4	20.5	UWB	
56	W1	23.4±0.3 19.8±0.4 1.7±0.2	64.5	UWB	
57	moderate	22.9±16.6 0.5±0.1 0.7±0.1	66	UWB	

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3	low	87.5-88.8	32.0-32.4; 24.1	11.3-12.0; 32.0	21.0	UWB	
4	W1/2	19.7±0.2	17.3±0.3	1.4±0.2	199	UWB	
5	low		59.9-61.9; 26.1	1.7-3.8; 41.7-4	20.4	UWB	
6	W1/2	25.1±0.4	21.5±0.9	2.1±0.1	44.3	PSF	
7	moderate	25.6±10.7	24.4±8.9; 16.8	10.1±2.0; 31.7	28.7	UNM	
8					20	GUT	
9	W2	23.0±0.7	(n=2) 22.1±7.7	(n=1) 1.3±1.0	(n=18)	24.58	ROM
10	W2	31.4±1.1	(n=1) 24.1±0.8	(n=1) 2.1±0.4	(n=13)	29.22	ROM
11	W1	24.5±2.2	(n=2) 20.0±1.3	(n=3) 1.4±0.9	(n=33)	20.47	ROM
12	moderate	5.5±6.3	(0.6-1) 1.1±0.1	(0.8-1) 1.0±0.1	(0.8-1)	21.2	MNB
13	W1	18.4	16.1	1.4		160	IGGCAS
14	W2	25.4	21.5	1.5		402	IGGCAS
15	W4		0.5	1.4		618	IGGCAS
16	moderate		30-56, 58-21	11-15, 17-36		3	UCLA
17	low	19.5±0.13	(N=16) 1.1±0.3	(N=11) 1.6±0.3	(N=1)	13.6	FMMR
18	W2	28.8±8.8	(n=3) 15.6±9.1	(n=6) 1.0±0.5	4.76	21.78	UCLA
19	W2	18.0±0.6	16.4±0.6	1.1±0.2	5.57	58.72	UCLA
20	minor				2.94	3.5	CEREGE
21	W2				4.78	18	CEREGE
22	W3	18.3 (n=1)	16.8 (n=2)	1.3	4.78	2	CEREGE
23	minor					23	CEREGE
24	W3				4.94	125	CEREGE
25					3.52	23	CEREGE
26	W1	25.0±0.2	(n=3) 21.8±0.9	(n=2) 1.2±0.1	4.84	21	CEREGE
27	W4	24.8±9.6	(n=5) 13.2±8.4	(n=4) 1.6±1.1	4.27	34	CEREGE
28	minor				3.71	27.69	CEREGE
29	W2	24.6±1.1	(n=1) 17.6±4.4	(n=5) 1.6±1.2	4.88	29.87	CEREGE
30			61.0±1.8	(n=6) 3.7±1.8	3.42	22.10	CEREGE
31			62.2±0.8	(n=3) 3.3±1.0	2.67	21.64	CEREGE
32		8.2±10.2	(n=1) 1.9	(n=2) 1.0	4.20	1.20	CEREGE
33	W1	30.6 (n=1)	25.7 (n=2)	2.5	4.25	21.60	CEREGE
34	W1				4.50	18.04	CEREGE
35	W1	30.6 (n=2)	24.7±0.2	(n=4) 2.5±0.1	3.30	4.57	CEREGE
36	W1	19.2 (n=1)	17.4 (n=1)	1.4	5.37	20.1	CEREGE
37	moderate	21.5±0.1	(n=3)		4.64	27	CEREGE
38		32.9±1.2	(n=3) 25.9	(n=2) 2.9	4.51	21	CEREGE
39	minor	11.2±0.2	(n=3)			30	CEREGE
40	W3	14.8±9.9	(0.3-12.1) 7.7	(1.4-0.9) 0.6	(0.3-2) 4.79	20	MNB
41	W1	23.4±0.2	(n=1) 20±0.6	(n=13) 1.7±0.1	(n=13)	23.4	MNB
42	low		41.0; 34.4	5.8; 36.7		23.8	MNB
43	W1	15.8±10.5	(0.9) 11.0±7.9	(2.4-0.6) 0.6	(0.2-3) 4.69	36.1	MNB
44	moderate	23.5; 36.6	11.8; 10.7	1.3; 43.6		34.6	MNB
45	low		24.9	2.9		21.4	MNB
46	low		57.6; 24.9	2.5; 44.2		24.9	MNB
47	W2	23.0±0.1	(n=1) 19.2±0.1	(n=1) 1.5±0.1	(n=11)	204.2	MNB
48	low		59.2; 25.7	2.2; 43.8		20.8	MNB
49	low	21.5±21.3	(1.4) 0.7±0.2	(0.5-0) 0.9±0.1	(0.8-1) 4.17	20.2	MNB
50	W2	23.0±0.2	(n=1) 19.1±0.2	(n=1) 1.6±0.2	(n=11)	25.6	MNB
51	W2	26.7±0.1	(n=1) 23.3±0.2	(n=1) 1.9±0.1	(n=11)	27.2	MNB
52	strong	30.8±0.3	(N=7)		3.68	15	CEREGE
53	W1	21.9±6.2	(N=1) 19.3±7.8	(N=1) 3±2.9	(N=17)	100	GUT
54	W3	25.6±0.2	21.4±0.2	1.4±0.7	4.46	17.5	App
55	W1	19.1±0.4	16.7±0.4	2.5±1.9	4.83	9.5	App
56	W1	29.1±0.0	23.9±0.2	1.5±0.1	3.67	16.6	App
57	W3	19.1±0.1	17.0±0.1	1.2±0.1	4.71	20	App

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3	low		24.1±0.2; 7.8±2.0±0.5; 45.8±2.93	20.97		App
4	W1	22.7±3.4; 24.7±14.8±7.0; 18.11.4±2.0; 2.7±44.69		28.75		App
5	low	30.5±16.1	2.0±1.8	2.5±1.5	27.6	UWB
6	low	17.7-30.3	14.7-14.9; 20.1.2-1.4; 4.0-12		20.4	UWB
7	W2	24.7±0.1	20.8±0.2	1.6±0.2	47.8	UWB
8	low		52.9-57.1; 26.2.4-3.8; 38.6-4		6.2	UWB
9	W1	23.6±13.7	15.8±7.1	0.8±1.1	16.7	UWB
10	W1	18.1±0.2	16.4±0.4	1.1±0.4	55.9	PSF
11	W1	24.4±0.5	19.8±2.2	1.7±0.3	40.5	PSF
12	low	28.2-45.8	41.0-43.0; 27.2.4-2.9; 8.5-11		20.3	UWB
13	W2	25.0±0.3	20.6±0.2	1.7±0.1	40.5	PSF
14	low		20.3-23.3; 52.36.2-32.0; 14.:		20.1	UWB
15			25.4±6.6 (n=5 8.3±0.7	3.68	24.4	CEREGE
16			36.8±1.7 (n=3 7.1±3.0	5.48	26.8	CEREGE
17	strong					
18	low		52.7±8.5, 32.314.4±2.3, 30.73.53		10.02	UCLA
19					20	GUT
20	W3	26.1±0.5 (n=2 21.9±0.2 (n=2			59	SQU
21	W2	25.2±0.2 (n=2 21.1±0.3 (n=2			9	SQU
22	W2	26.1±0.3 (n=2 22.3±0.9 (n=2			52.2	SQU
23	W2	26.1±0.4 (n=2 21.9±0.3 (n=2			45.3	SQU
24	W2	26.2±0.5 (n=2 22.3±0.6 (n=2			57.3	SQU
25	W2	18.0±0.2 (N=3 15±1 (N=3)	4±1 (N=3)		64.3	UBayr
26	W2	31.4±1.6 (N=123.6±4.5 (N=15.7±12.6 (N=1			21.9	UBayr
27	W1	18.2±0.4 (N=16.3±0.7 (N=6) 43.9±2.2 (N=6			49.8	UBayr
28	W2	25.1±3.2 (N=117.8±3.6 (N=10.7±0.5 (N=1;			27.7	UBayr
29	W2	24.7±0.2	20.7±0.2	1.6±0.3	35.5	UWB
30	W0/1	24.6±3.9	15.8±1.4	1.5±0.9	20.0	UWB
31	W2	24.6±0.2	20.6±0.2	1.7±0.1	26.4	UWB
32	low		33.3-37.5; 24.9.3-12.2; 33.1		15.4	UWB
33	W1/2	17.5±0.4	15.5±0.3	1.1±0.1	27.4	UWB
34	low	24.0; 75.9	23.9-26.5; 58.1.8-2.7; 6.8-4.		20.4	UWB
35	W1	16.4±0.3 (n=1 13.3±0.1 (n=1 1.0±0.1 (n=10 5.39			17.5	MNB
36	moderate	21.2±0.1 (n=1 17.6±0.1 (n=1 9.4±0.1 (n=11			20.9	MNB
37	W1	17.5±0.3 (n=1 15.4±0.2 (n=1 1.2±0.2 (n=11			11	MNB
38	low		0.1±0.0 (n=12 1.3±0.1 (n=12		25.4	MNB
39	moderate		58.5; 25.8	2.6; 43.0	12.5	MNB
40	moderate	28.5	25.3; 9.4	0.7; 44.5	4.9	MNB
41	W1	13.4±10.8 (0.510.5±7.8 (0.9- 1.2±1.1 (0.2-4 4.73			25.2	MNB
42	moderate	3.3	1.3	45.1	0.5	MNB
43	low		54.7; 45.4	16.8; 25.4	22.8	MNB
44	moderate	31.5±8.8	36.0±13.7	11.9±9.6	20.4	UNM
45	moderate		57.7±2.8; 27.815.1±3.2; 33.0		11	UNM
46	W2	17.2±9.2	9.7±8.7; 12.2±0.6±0.4; 33.4±		20.6	UNM
47	moderate		36.4±0.7 (low-4.3±0.5 (low-C		24.3	UCLA
48	W0/1	18.7±3.5	15.9±0.4	0.9±0.7	44.5	PSF
49	W0/1	24.9±0.1	20.3±0.3	2.2±0.7	66.9	UWB
50	W0/1	21.4±6.2	15.4±2.9	1.0±0.3	27.4	PSF
51	low	92.6-96.2	35.7-47.1; 44.7.5-11.8; 18.6		20.0	UWB
52	W1	29.5±0.5	24.2±0.4	1.8±0.0	56.6	PSF
53	low	37.1; 58.2	17.6-23.3; 25.2.9-3.1; 8.9; 3		20.4	UWB
54	W0/1	17.9±8.4	15.0±2.3	0.5±0.2	28.0	PSF
55	low	35.5-51.6	25.6-28.2; 21.5.2-9.3; 31.3-3		21.6	UWB
56	W0/1	19.4±3.2	15.5±0.3	0.8±0.5	21.5	PSF
57	moderate		56.4; 27.4	15.8; 34.7	20.1	MNB
58	high	18.6	11.6	11	29.4	MNB

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3	W2	15.3±0.1 (n=11)	14.2±2.0 (7.8-1.4±0.5 (0.3-14.96	20.3	MNB	
4	W2	23.8±0.6 (n=12)	20.0±0.7 (n=11)	21.5	MNB	
5	moderate	52.8	10.0	20.5	MNB	
6	W1	31.1±0.2 (n=12)	24.9±0.2 (n=12)	29.9	MNB	
7	low	49.0	34.3; 59.8; 24.2.0; 1.8; 44.0	25.6	MNB	
8	W2	27.9±0.3 (n=5)	22.8±0.2 (n=5)	23.6	MNB	
9	low		51.6±6.6; 38.114.0±2.0; 32.7	7.36	UNM	
10	W1	32.6±0.1	25.9±0.3 1.6±0.2 3.38	20.4	UWB	
11	low	21.3-21.7	10.5-18.1 6.5-14.0	25.0	UWB	
12	low	14.6±15.7	0.9±0.8 2.2±1.5	30.2	UWB	
13	low	6.4-6.5	2.3-4.1; 1.9-2.1.3-2.4; 46.4-4	20.2	UWB	
14	W2	23.1±0.9	22.6±4.6 1.2±0.6	51.0	UWB	
15	low	27.2±16.6	3.3±3.7 2.2±2.1	20.5	UWB	
16	low		60.9-62.6; 27.2.4-4.6; 43.0-4	23.3	UWB	
17	moderate	26.8±11.2	19.5±8.4 1.2±0.5	20.9	UWB	
18	low	0.4-2.0	3.3-5.0 0.7-1.9	22.4	UWB	
19	W0/1	18.5±0.1	16.1±0.4 1.9±0.2	38.7	UWB	
20	low	24.4±21.6	12.0±13.7 1.6±1.0	20.1	UNM	
21	moderate	34.3±2.4	24.6±2.8, 15.87.3±2.1, 38.5±	22.7	UNM	
22	W0.0	24.4±0.9 (n=6)	19.2±1.3 (n=4)	20.8	UAb	
23	W4	24.8±1.4	21.4±0.4 1.6±0.2 4.51	20.1	App	
24	W3	17.5±0.1	16.2±0.1 1.1±0.1 4.99	20.59	App	
25	W1	16.2±11.6	12.6±8.1 1.0±0.7 3.83	24.6	App	
26	moderate		28.2±0.4, 14.04.0±0.3, 41.9±3.22	65.2	UCLA	
27	low	36.3.2±0.2	20.3±3.7, 33.23.0±1.8, 11.5±3.11	20.3	UCLA	
28	moderate		51.3±5.7, 34.215.0±3.1, 30.93.52	21.3	UCLA	
29	low	19.1±22.5	1.8±0.7 2.4±1.5 4.63	20.07	UCLA	
30		38.4±6.6 (n=1)	40.7±19.6 (n=1)	4.9	IfP	
31	W2	17.6±0.4	15.8 1.5	24.5	UNM	
32	moderate	32.3±1.0	8.2±1.1 49.5±0.8	21.9	UNM	
33	W3/4	16.3±10.4 (n=7)	7.9±7.4 (n=17)	29.7	23.7 g in ARE	
34	low		22.7; 27.7; 64.2.0; 2.7; 7.0; 3	22.3	MNB	
35	W3	28.0±0.5 (n=1)	22.6±0.2 (n=1)	26.6	MNB	
36	moderate	10.0±8.7 (0.5-1.8±0.2)	(1.5-2.1.4±1.1 (0.7-4	22.8	MNB	
37	low		0.3 0.3	21	MNB	
38	W2	23.4±0.3 (n=1)	19.8±0.2 (n=1)	47.3	MNB	
39	W3	16.81±0.45 (N14)	9.0±0.61 (N1)	20	CSFK	
40	low		51.0±1.6 2.4±0.7	58.4	UNM	
41	W1	18.2±11.1 (N=9)	6.6±6.2 (N=2)	7.65	UCLA	
42	W2	17.1±8.3 (N=4)	11.5±6.1 (N=1)	4.25	UCLA	
43	low to m	24.0-29.5	17.9-19.0; 18.2.0-3.8; 7.2-9.	22.1	UWB	
44	W2	24.8±0.3	20.8±0.2 1.3±0.3	54.0	PSF	
45	low	72.1-82.0	62.2-63.6; 34.6.3-6.8; 38.1-3	20.7	UWB	
46	W1	24.9±0.6	20.7±0.2 1.5±0.2	29.9	PSF	
47	low	33.1-37.1	21.5-22.8; 15.3.4-7.6; 27.6-3	21.5	UWB	
48	W0/1	25.4±3.0	22.2±0.2 3.2±0.4	20.1	UWB	
49	low	0.0±0.0	0.0-0.1; 0.0-0.0.9-1.1; 44.4-4	24.7	UWB	
50	low	11.8±14.2	7.7±6.0 2.2±1.3	20.9	UWB	
51	low	75.3	24.3-27.8; 34.2.7-4.1; 4.5-8.	27.2	UWB	
52	W2	22.8±0.3 (N=3)	19.5±0.3 (N=3)	55.73	UCLA	
53	W1	22.1±5.7 (N=2)	14.0±5.8 (N=1)	22.25	UCLA	
54	low	9.5-53.6	26.4-54.2; 30.2.0-4.7; 7.6-182.86	20.1	App	
55	W1		5.17	22	CEREGE	
56	W1		4.77	23.4	CEREGE	
57	moderate		27.7±4.4; 49.82.5±0.9; 3.6±23.43	20.1	App	



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3	low		60.3±0.4; 27.72.7±0.5; 42.4±3.79		26.2		App
4	low	43	34.2±4.1; 40.13.4±0.6; 16.3±2.72		21.9		App
5	low		48.2±7.9; 48.215.2±3.6; 32.33.15		21.87		App
6	W2	18.8±0.3 (N=216.3±0.2 (N=8 1.2±0.2 (N=8) 5.33			20.62		UCLA
7	W2	18.0±0.3 (N=215.9±0.2 (N=5 1.1±0.2 (N=5) 5.31			38.3		UCLA
8	W4	17.2±3.6 (N=313.9±3.9 (N=31 1.1±0.5 (N=33 5.17			22.41		UCLA
9	W2	18.3±10.8 (N=18.5±6.5 (N=11.2±0.7 (N=15 3.74			20.98		UCLA
10	low		60.7±1.9, 53.22.6±0.8, 12.1±		5.35		UCLA
11	low	30.0±21.2 (N=4.2±1.5 (N=8) 2.4±0.9 (N=8) 3.54			27.27		UCLA
12	low	80.1 (N=1)	60.5±1.1, 54.62.1±0.5, 10.8±3.24		22.51		UCLA
13	W1-3	16.7±10.2	12.9±10.1 0.9±0.7 4.33		130.3		App
14	W2	16.8±11.9; 14.16.2±13.6; 15.1.0±0.6; 1.3; 0.3.46			36.43		App
15	W2	0.6±0.2	4.1±4.3 0.6±0.5 5.60		31.27		App
16	W3	25.2±1.3	21.6±0.3 1.4±0.1 4.43		4.37		App
17	low	36.1±1.4	30.6±4.5; 17.22.0±0.5; 38.8 5.72		33.9		App
18	moderate	21.1±0.1	17.7±0.4 3.8±0.0		9		UNM
19	low		0.1±0.1, 0.0±0.1.3±0.3, 42.1±		20.1		UNM
20	W0/1	17.4±0.2 (n=1 15.3±0.3 (n=1 2.9±0.7			20		IfP
21	moderate	20.2±0.9	25.3±0.8 5.6±0.5		20		UPC
22	low		0.2±0.0; 0.1±0.1.7-4.5; 39.7-4		22.2		UWB
23	low	84.6-87.8	57.8-60.0; 25.2.5-4.8; 43.3-4		20.3		UWB
24	W1/2	16.2±8.3	14.4±5.0 1.5±1.8		38.2		UWB
25	low to m	66.1-66.5	59.4-61.8; 26.4.7-1.7; 43.0-4		27.0		UWB
26	low	31.4±14.3	0.9±0.3 0.9±0.2		39.3		UWB
27	low	20.4-35.1	11.8-14.2; 23.0.2-0.3; 2.0-4.		9.7		UWB
28	W1/2	25.6±5.6	21.6±3.1 1.3±0.1		29.2		UWB
29	low		58.5-59.7; 25.3.1-7.0; 43.2-4		50.6		UWB
30	W4	23.2±5.0 (n=1 17.0±6.7 (n=1 0.9±0.4 (n=12			21.2		IfP
31	W1	29.7±0.5 (n=1 23.5±1.0 (n=1 2.5±1.4 (n=15			22.1		IfP
32	W3-4	22.9±0.3 (n=9 19.3±0.2 (n=8 1.6±0.3 (n=8)			20.6		IfP
33	W4	18.8±0.8 (n=1 16.0±0.8 (n=1 1.1±0.2 (n=19			20.9		IfP
34	W2-3	3.7± 4.6 (n=2 1.6± 0.7 (n=1 0.9± 0.1 (n=12			22.4		IfP
35	W4	3.7± 2.7 (n=2 2.0± 1.4 (n=1 2.1± 1.6 (n=12			24.3		IfP
36	low	17.9±18.4	3.6±5.0 2.0±2.4		20.2		UWB
37	W2	14.2±9.1	16.4±6.7 1.3±1.4 4.01		33.5		UWB
38	low		56.8-58.3; 28.4.8-7.0; 40.1-4		212		UWB
39	W0/1	27.0±11.3	16.5±8.1 1.2±0.9 4.39		39.6		UWB
40	low		20.1-27.3; 45.29.1-33.0; 30.		20.5		UWB
41	W1	29.2±0.8	23.8±0.8 1.6±0.4		34.1		UWB
42	low	34.5±30.8	0.7; 25.6 0.8; 1.7		24.5		UWB
43	moderate		43.9-49.3; 51.9.4-10.8; 11.2		33.3		PSF
44	W1/2	16.3±0.1	14.4±0.2 2.3±0.8		27		UWB
45	high	36.2±20.2	27.2±17.6 0.6±0.1		17.8		PSF
46	W2	22.5±6.6	14.3±8.3 1.7±2.8 4.43		957		App
47	moderate	18.8 (cores), z 16.3	6.3		24 g		UCLA
48	W2		59.8±1.5 (n=6 2.3±1.7 (n=69		21.2		IfP
49	W2	1.3; 28.3	2.8 0.5		20		MNB
50	low		24.0; 39.3; 17.1.4; 3.1; 42.9		21.5		MNB
51	W2	19.2±0.1 (n=1 17.0±0.3 (n=1 1.5±0.1 (n=10			36		MNB
52	W2	14.9±10.4 (0.713.0±7.2 (1.1- 1.1±0.7 (0.2-3 4.13			22.8		MNB
53	W2	18.8±0.1 (n=7 16.6±0.4 (n=9 1.2±0.2 (n=9)			29.3		MNB
54	W1	18.1±0.1 (n=7 16.3±0.2 (n=7 1.6±0.1 (n=7)			20.7		MNB
55	W1	30.9±0.2 (n=9 25.3±0.3 (n=9 1.9±0.2 (n=9)			22.4		MNB
56	low		63.2; 27.6 2.3; 44.1		23.3		MNB
57	low		59.9; 28.5 2.9; 41.6		1.55		MNB

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2							
3	low		58.3; 27.3; 27.5.4; 43.3; 3.3;		27.6		MNB
4	low	22.2-45.3; 92.	29.2; 32.6-60.3.9; 17.2-23.0		10.0		UWB
5	low		23.4-24.3 2.8-1.3		21.5		UWB
6	W1	17.5±15.5	9.4±9.7 2.9±2.0 5.34		14.1		UWB
7	low		40.1-45.2; 56.4.0-11.5; 4.9-5		36.8		UWB
8	W1/2	25.6±0.2	21.3±0.3 1.3±0.4		26.2		PSF
9	low	23.9-26.7	17.3-18.0; 18.1.2-2.3; 13.8-8		25.5		UWB
10	low		58.9-60.1; 25.2.4-3.0; 43.0-4		42.2		UWB
11	low	19.9±15.0	4.3±3.2 2.1±1.8		20.4		UWB
12	low	6.6-8.0	10.5-10.7; 5.1.2.9-3.2; 40.8-4		25.2		UWB
13	low		49.6-53.2; 23.1.8-3.0; 39.6-4		23.0		UWB
14	W3	28.6±0.3	23.2±0.5 2.5±1.2 3.24		28.6		UWB
15	low	34.4±2.1	27.3±0.1 0.9±0.0		8.3		UWB
16	W3	24.9±0.2	20.8±0.1 1.5±0.2 4.15		51.5		UWB
17	low	27.1-34.5	26.6-33.6; 51.1.8-3.8; 5.1-8.		20.6		UWB
18	low	35.0±1.8	21.3±0.4, 25.5.4.1±0.6, 9.2±23.65		20.05		UCLA
19	W4	24.7±0.2 (n =	21.0±0.3 (n = 1.4±0.1 (n = 4		21.5		IfP
20	low		66.4±12.6, 41.16.4±3.2, 30.1		1		App
21	low	50.6±15.1 (N=30.9±12.1 (N=51.1±0.9 (N=13.18			11.2		UCLA
22	moderate	6.0±5.7	1.1±0.2 0.9±0.2 4.62		31.57		App
23	low		27.5±0.2; 10.7.3.4±0.5; 45.2±3.41		28.13		App
24	low	34.5±2.6	24.4±4.6, 16.0.5.9±3.8, 35.0±		20		UNM
25	low	34.6±2.0	22.5±0.5, 17.2.4.7±0.7, 32.4±		20		UNM
26	low	61.5-92.7	22.9-50.2 39.7-33.2 3.95		29		UWB
27	moderate	33.0±3.3	21.3±1.0; 27.0.3.3±0.8; 10.2±3.7		5.71		App
28	low	25.2±14.8	26.0±5.1; 52.7.1.7±1.1; 3.2±13.63		29.78		App
29	low	25.4±17.2	5.8±9.5 1.2±0.7 4.77		5		App
30	W2.0	20.3± 2.3 (n=815.1± 4.5 (n=61.0± 0.5 (n=61			46.1		UAb
31	W1.0	19.4±0.6 (n=917.6±1.2 (n=81.0±0.2 (n=81			91.3		UAb
32	W2.0	25.1±0.9 (n=721.5±1.0 (n=51.3±0.2 (n=50			91.1		UAb
33	W2.0	25.6±1.0 (n=622.0±1.0 (n=31.4±0.2 (n=39			26.7		UAb
34	W3.0	23.0±10.9 (n=11.5±7.2 (n=60.8±0.6 (n=69			51.8		UAb
35	W2	18.4±0.3	16.3±0.3 1.3±0.2		20		UNM
36	W2	19.1±0.2	17.6±2.3 1.1±0.2		46		UNM
37	W2	28.1±0.5	23.2±2.3 2.1±0.3		25.3		UNM
38	moderate	18.6±0.1	16.6±2.3 2.1±0.3		23.2		UNM
39	low	30.2±15.1	2.0±1.3 2.2±2.2		22.1		UWB
40	W1	24.7±0.8	20.8±1.0 1.6±0.2		47.8		PSF
41	low	20.3-24.5; 9.6	11.8-19.5 10.2-12.4		20.7		PSF
42	W2	24.9±1.0	20.8±0.1 1.4±0.1		29.0		PSF
43	moderate	6.4±8.0	1.2±0.4; 1.8 1.8±1.4; 31.1 4.23		37.82		App
44	W4	22.9±0.6 (N=121.3±0.6 (N=11.3±0.2 (N=154.64			75.1		UCLA
45	W4	23.7±0.7 (N=121.5±0.8 (N=11.3±0.1 (N=144.58			31.8		UCLA
46	W3	22.8±0.5 (N=120.9±0.8 (N=11.2±0.3 (N=154.89			21.01		UCLA
47	W3	23.1±0.6 (N=121.2±0.7 (N=11.1±0.2 (N=164.91			29.7		UCLA
48	moderate	28.5±5.7	33.3±10.8, 25.113.3±11.5, 30.1		20		UNM
49	W3	30.5±0.4 (n=724.8±0.4 (n=72.1±0.5 (n=7)			28.3		MNB
50	W3	30.3±0.1 (n=124.8±0.2 (n=12.4±0.2 (n=12			29.8		MNB
51	W3	24.5±0.1 (n=720.6±0.2 (n=71.7±0.1 (n=7)			34.6		MNB
52	W1	32.8±0.2 (n=126.4±0.3 (n=11.7±0.2 (n=103.77			31		MNB
53	moderate		59.4; 26.5 2.6; 43.2		31.5		MNB
54	W5			4.70	23		CEREGE
55	W2	18.9±7.5 (n=114.4±7.9 (n=60.9±0.7		4.37	22		CEREGE
56	W2			5.13	315		CEREGE
57	W1			5.14	216		CEREGE

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2							
3	W2/3	14.7±1.3 (n=36.6±3.7 (n=20 1.0±0.1			20		IfP
4	low	49.2±7.0, 34.3±13.9±2.2, 30.7			14		UCLA
5	W3		4.73		119		CEREGE
6	W2		4.48		180		CEREGE
7	W2/3		4.50		145		CEREGE
8	W3		4.88		78		CEREGE
9	W3		5.12		36		CEREGE
10	W2		4.55		45		CEREGE
11	low	57.4±16.5 36.7, 32.0±2.44.0, 12.4±3.7,			20.81		UCLA
12	W4	24.7±0.2 21.6±0.2 1.9±0.2 4.24			20		App
13	W3	8.3±0.1 8.5±0.3; 3.4±0.1±0.3; 46.9±5.01			25.08		App
14	low	5.3±4.6 (0.4-1 1.1±0.2 (0.9-1 1.3±0.1 (1.0-1			1.2		MNB
15	low	38.4 24.2; 25.2; 58 2.0; 2.3; 3.1; 4			20.1		MNB
16	W2	24.9±0.3 (n=12 21.0±0.2 (n=1 1.6±0.1 (n=12			29.2		MNB
17	low	63.1; 32.4 6.9; 42.4			45.4		MNB
18	W2	24.8±0.3 20.7±0.2 1.6±0.2			44.7		PSF
19	W2	26.2±11.3 12.3±3.9 1.2±1.3 5.02			24.7		PSF
20	W1	24.9±0.4 20.5±0.2 1.6±0.1			48.08		PSF
21	low	10.9±1.4 (n=8 11.1-11.3 1.6-3.2 4.80			10.7		UWB
22	W1	24.5±0.2 21.0±0.4 1.5±0.2			23.57		PSF
23	W1/2	19.3±0.2 17.2±0.5 1.5±0.2			60.68		PSF
24	W1	24.7±0.2 20.9±0.6 1.3±0.2			26.44		PSF
25	W2	19.1±0.3 16.9±0.1 1.3±0.2			36.75		PSF
26	W1	24.2±0.7 20.9±0.8 1.4±0.4			22.34		PSF
27	W2/3	19.4±0.4 17.0±0.8 1.5±0.2			33.42		PSF
28	low	30.1±10.0 21.2±2.5; 32.43.2±0.2; 11.6±			21.53		App
29	low	26.1-27.7 23.9-25.3; 57. 2.1-3.3; 3.3-6.			21.6		UWB
30	W2	25.6±0.8 21.6±0.9 3.4±1.0			61.6		UWB
31	low	70.7-85.6 31.1-33.1; 50. 5.6-6.0; 23.9;			27.4		UWB
32	W2	18.5±0.1 15.9±0.7 1.0±0.7			32.5		UWB
33	low	3.0-3.3 3.5-3.8; 1.1-1. 1.7-1.9; 44.8-4			23.8		UWB
34	low	58.3-61.4; 27. 2.2-4.8; 40.1-4			22.1		UWB
35	moderate	57.6; 25.6 4.1; 43.7			20.7		MNB
36	low	27.6 3.2			21.3		MNB
37	low	56.4; 22.8 2.2; 45.2			21.4		MNB
38	low	9.2±7.5 (0.5-2 1.6±0.2 (1.5-20.9±0.1 (0.8-0			20.3		MNB
39	W2	15.3±15.9 (1.3 1.9±0.7 (1.1-3 1.0±0.2 (0.8-1			14.7		MNB
40	low	62.7±0.3; 27.2 1.9±0.1; 44.1±			20.02		App
41	low	38.4±4.3; 27.5 11.8±1.7; 32.8 3.13			21.77		App
42	low	32.8±2.4; 35.9 25.7±1.7; 18.0 9.3±1.1; 33.5±2.82			16.95		App
43	W2	21.9±16.3 (N=3.6±4.9 (N=12 1.2±0.7 (N=12 4.62			20.04		UCLA
44	W2	17.9±15.9 (N=4.4±5.7 (N=8) 1.8±1.2 (N=8) 4.58			20.21		UCLA
45	W2	23.6±0.2 20.4±1.0 1.3±0.1			27.1		UWB
46	low	19.8±3.7 28.8; 26.6±4.44.6; 10.4±4.7;			54.0		UWB
47	W2	14.0±6.5 13.2±3.6 1.8±1.9 5.21			26.8		UWB
48	W2	29.3±13.6 11.0±7.4 1.6±2.0 3.95			22.0		UWB
49	low	33.3±0.3 25.5±1.8 3.2±0.8			20.4		UWB
50	low	42.6-55.8 36.0-52.8; 14. 2.2-4.6; 39.9-4			24.0		UWB
51	low	27.8±30.2 0.8±0.2 2.2±1.4			23.1		UWB
52	low	39.3±0.2 30.8±0.3 1.4±0.3			21.8		UWB
53	low	31.9±0.2 9.2±0.5 47.9±0.8			20.8		UWB
54	low	33.8±15.1 21.6±14.9 2.3±2.2			21.3		UWB
55	low	14.4±16.3 (1.11.4±0.6 (0.8-2 1.0±0.1 (0.9-1 4.28			20.3		MNB
56	low	12.2±17.3 (0.8 10.5±14.2 (1.12.5±0.9 (1.0-4 3.48			20.3		MNB
57	moderate	52.0; 26.2 7.1; 40.8 2.74			20.3		MNB

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2						
3	W1	18.1±0.5 (N=314.4±1.0 (N=41.7 (1.0-3.5, N		24		UTok
4				6.5		GUT
5				4.01		GUT
6	W4	29.8±0.2 (n=7 24.5±0.1 (n=7 2.4±0.1 (n=7)		21.9		MNB
7	low	67.4; 24.8 3.3; 41.8		30.4		MNB
8	low	20.1±0.1 (n=1 17.0±0.2 (n=1 7.6±0.1 (n=11		20.6		MNB
9	W3	16.8±20.1 (1.21.6±0.6 (1.1-3 1.1±0.2 (0.8-1		24.6		MNB
10	W1	18.5±0.2 (n=7 15.9±0.1 (n=7 1.3±0.1 (n=7)		23.9		MNB
11	moderate	31.5 27.0; 9.4 1.8; 46.3		22.5		MNB
12	low	78.0 42.5 30.3		16.2		MNB
13	moderate	37.9; 32.8 28.8; 11.9; 22. 1.2; 44.6; 1.1		20.8		MNB
14	low	59.8; 26.0 2.4; 44.0		5.7		MNB
15	moderate	40.7; 58.8; 24 5.9; 1.6; 42.9		20.0		MNB
16	moderate	61.5; 25.8 2.7; 43.8		20.8		MNB
17	W1.0	29.3± 0.9 (n=124.1± 0.8 (n=1 1.3± 0.5 (n=64		46.9		UAb
18	W3	19.0±0.2 16.6±0.2 1.6±1.3		17.5		UWB
19	low	43.0-45.6 24.6-25.6; 27. 3.5-6.4; 9.2-12		20.3		UWB
20	W1	24.7±0.5 21.1±0.1 1.5±0.3		164		UWB
21	low	18.5±0.2 16.1±0.1 4.8±0.1		22.4		UWB
22	low	21.7±17.1 16.6±0.2 1.6±1.3		22.4		UWB
23	low	23.1-43.4; 97. 19.1-21.1; 60. 7.1-11.5; 20.1		13.5		UWB
24	low	24.1±14.4 3.2±2.8 2.5±2.3		6.1		UWB
25	low	62.6-63.3 48.4-51.5; 26. 5.1-7.3; 32.9-3		37.1		UWB
26	W1	18.8±0.2 (n=5 16.4±0.2 (n=4 1.6±0.4 5.08		5.88		CEREGE
27	minimal	4.48		23		CEREGE
28	low	32.2±1.1 (n=3 23.2 (n=1) 3.5 4.48		24.3		CEREGE
29				3.38		CEREGE
30				2.72		CEREGE
31				2.95		CEREGE
32				4.43		CEREGE
33	low	31.3±0.1 (n=2 2.2±0.1 5.96		13		CEREGE
34		29.8±0.0 (n=3 4.73		7.90		CEREGE
35	high	32.5±0.2 (n=7 3.42		20.23		CEREGE
36	high	24.9±13.9 (n= 4.3±1.2 (n=3) 1.5±0.0 4.81		22		CEREGE
37	moderate	20.2±13.7 (n= 1.4 (n=1) 4.9 4.42		26.9		CEREGE
38		65.5±1.9 (n=5 2.2±0.5 3.21		21.1		CEREGE
39		60.0±0.9 (n=3 2.1±0.1 2.66		20.5		CEREGE
40	low	63.9±1.8 (n=5 3.1±1.5 3.24		13.2		CEREGE
41	high	23.9±16.3 (n= 3.4±1.9 (n=3) 2.2±0.9 3.71		33.9		CEREGE
42	moderate	34.8±0.3 (n=3 2.9±0.2 5.20		21.7		CEREGE
43		41.3±0.8 (n=4 4.0±1.3 3.24		21.6		CEREGE
44	W1	17.6±7.8 (n=1 11.2±7.1 (n=1 0.9±0.8 4.92		13.84		CEREGE
45	low	2.45		21.2		CEREGE
46	W4	4.17		5.22		CEREGE
47	W3	11.2±10.1 (n= 8.3 (n=2) 1.1 4.78		21.9		CEREGE
48	W1	19.6 (n=2) 17.3 (n=2) 1.3 5.37		20.7		CEREGE
49		21.5±8.3 (n=6 4.62		22.5		CEREGE
50	W3	20.2±14.3 (n= 14.3±9.9 (n=1 2.0±2.1 4.24		17.6		CEREGE
51	low	31.2±0.2 (n=6 5.42		20.2		CEREGE
52	W0/1	31.2±0.2 25.4±0.1 1.8±0.3 45				UWB
53	W2	25.2±0.3 (n=1 21.3±0.9 (n=1 1.7±0.4 (n=10 50				IGCAS
54	W2	19.1±1.4 (n=1 17.1±0.6 (n=1 1.4±0.3 (n=10 50				IGCAS
55	low	55.1±0.7, 25.8 3.2±0.3, 39.0±		20		IfP
56	low	85.4±0.4 22.3±0.8, 56.6 33.4±1.7, 13.8 10.2				IfP
57	Low	38.7±0.2; 38.8 19.8±6.7; 29.5 1.0±1.0; 1.3±0 20				IfP
58	W3	16.9±6.8, 24.5 20.9±0.7 1.7±0.3 20.5				UCLA
59						
60						

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2							
3	W2	16.9±6.4	9.4±5.4	1.1±1.2	4.3	28.98	UCLA
4	W3	24.1±0.6	20.5±0.5	1.2±0.2		20.2	UCLA
5	low	14.0±20.6	1.4±0.5	1.0±0.2		4	UCLA
6	moderate		41.1±2.9, 38.3±2.2±1.0, 10.4±			20.77	UCLA
7	W2	27.5±0.4	23.0±0.6	1.6±0.4		20.3	UCLA
8	W2	30.3±0.3	24.4±0.2	1.8±0.2		20.8	UCLA
9	W3	40.4±0.9	10.0±0.8	46.0±0.8		5.1	UCLA
10	W3	18.1±10.5	13.5±9.3	1.2±0.4	4.06	7.3	UCLA
11	W1	30.1±0.4	26.9±0.3	1.3±0.2		2.1	UCLA
12	W2	17.6±0.3 (N=613.5±2.2 (N=50.47±0.12 (N=				31	FMMR
13		4.92±7.11 (n= 1.66±0.38 (n= 4.32±3.66				20	IGCAS
14						7.9	Cascadia
15		37.2±0.1 (N=430.9±6.2 (N=32.2±0.8 (N=35				22.5	Cascadia
16	W1	24.3±1.0 (N=721.2±0.9 (N=21.3±0.4 (N=29				457.2	Cascadia
17	W1/2	23.6±1.1	16.7±3.7	0.5±0.2		20	IfP
18	W3	23.3±0.5	19.5±2.9	1.0±1.0		20	IfP
19	W3	17.6±0.1 (n=1 15.3±3.6 (5.7-0.9±0.5 (0.3-1				29.3	MNB
20	W1	23.8±0.7 (n=1 18.0±4.2 (7.8-0.6±0.1 (0:3-0				83.7	MNB
21	W2	18.5±0.2 (n=5 16.8±0.8 (n=1 1.0±0.3 (n=5)				37.7	MNB
22	W1	19.3±0.7 (n=5 16.6±0.2 (n=5 1.4±0.1 (n=5)				59.5	MNB
23	W1	26.9±0.1 (n=5 22.2±0.3 (n=5 1.1±0.4 (n=5)				42.1	MNB
24	W2	18.3±0.1 (n=6 16.4±0.4 (n=5 1.2±0.1 (n=5)				76.8	MNB
25	moderate	11.0±12.0 (0.61.2±0.2 (1.0-1 1.1±0.4 (0.9-2				16	MNB
26	moderate	13.3±16.2 (0.51.3±0.3 (1.0-1 1.3±0.3 (0.9-2				22.8	MNB
27	low	30.2	25.7	0.6		21.6	MNB
28	moderate		58.4; 29.7	6.1; 41.2		21.7	MNB
29	low	21.3; 95.5	49.2; 23.3; 38.4.3; 41.0; 21.5			21.1	MNB
30	low	12.5±18.5 (0.5				3.9	MNB
31	low		60.8; 25.5	2.6; 44.5		23.2	MNB
32	low		55.2; 29.7	7.9; 40.1		5.1	MNB
33		6.28±0.6 (N=1				20.5	MSN-FI
34	W2	17.6±0.1 (n=5 16.1±0.2 (n=5 1.6±0.3 (n=5)				28.1	MNB
35	W3	16.9±0.1 (n=5 15.0±0.2 (n=5 0.7±0.1 (n=5)				43.4	MNB
36	W2	23.8±0.2 (n=5 20.4±0.1 (n=5 1.6±0.1 (n=5)				35.8	MNB
37	W3	17.6±0.1 (n=5 16.0±0.1 (n=5 1.5±0.2 (n=5)				23.6	MNB
38	W1	31.6±0.2 (n=7 25.3±0.2 (n=6 1.6±0.2 (n=6)				36.7	MNB
39	W3	30.9±0.2 (n=6 25.1±0.2 (n=6 2.3±0.2 (n=6)				34.1	MNB
40	low	30.0	25.9; 16.0	0.9; 48.7		4.1	MNB
41	W3	18.8±0.4 (n=5 16.5±0.1 (n=5 1.6±0.1 (n=5)				34	MNB
42	W2	13.5±17.1 (0.61.9±0.9 (1.2-4 1.8±1.1 (1.0-4				20.7	MNB
43	W2	18.4±0.1 (n=5 16.3±0.2 (n=5 1.5±0.1 (n=5)				21.9	MNB
44	low		25.8, 45.1, 18.3.8; 5.9; 42.2;			0.32	MNB
45	W2	10.7	10.7; 3.7	2.4; 45.6		18	MNB
46	W2	23.8±0.1 (n=5 20.1±0.1 (n=5 1.6±0.1 (n=5)				20.5	MNB
47	moderate	11.4±0.1 (n=5				15.1	MNB
48	low	24.6-31.0	31.8±7.2; 48.53.9±2.8; 10.5; 6.13			24.5	App
49	W1	35.3±0.7	28.0±3.6; 14.0 1.2±0.5; 31.5 4.32			20.1	App
50	W3	15.7±11.0	14.6±6.3	1.3±0.9	4.01	26.18	App
51	low	26.0±7.1	29.4±11.8; 38.3.3±0.8; 13.8±2.98			31.26	App
52	moderate	14.6±13.8	17.3±0.3	1.6±0.1	3.94	4.9	App
53	low		39.7±1.0; 13.14.9±1.4; 33.5±2.54			4.8	App
54	low		61.5±0.6; 55.52.7±0.8; 11.0±2.77			12.23	App
55	low	55.2±6.7	27.8±3.2; 44.53.4±1.0; 3.7±13.15			22.24	App
56	moderate	5.0±2.9; 23.0±1.8±1.6	1.3±1.2	3.14		20.3	App
57	low	33.5 (Dio); (8222.2±3.3; 43.42.6±0.7; 4.8±23.70				22.85	App



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3	low	8.6±10.5 (n=1 5.4±4.5	1.8±1.0	4.30	30.75	App	
4		18.0±0.2 (n=8 16.6±0.6 (n=1 1.4±1.4 (n=10			50	IGCAS	
5	moderate	10.9±0.2 (N=1			20.15	UCLA	
6	low	31.5±0.7; 16.03.7±0.4; 39.5±2.76			23.89	App	
7		48.7±1.0 (n=233.9±2.6 (n=19.4±1.5 (n=16			20	PMO	
8		25.4±7.4 (n=729.9±10.6 (n=4.6±3.4 (n=11			20	PMO	
9		64.0±1.6 (n=82.5±1.6 (n=8);			20	PMO	
10	W1			4.56	24.3	Kiel	
11	W1			4.82	23.0	Kiel	
12	W2			5.17	25.4	Kiel	
13	moderate	24.5-40.6	20.6-24.0; 14.5-8-6.8; 37.3-4		22.2	UWB	
14	moderate		32.9; 19.8	3.8; 39.9	24	MNB	
15	low	3.2	3.9; 1.1	1.9; 44.5	25.6	MNB	
16	low	23.7; 80.8	19.6; 8.2; 38.33.2; 44.1; 15.3		10.8	MNB	
17	W3	18.0±0.2 (n=5 16.2±0.2 (n=5 1.5±0.1 (n=5)			22.2	MNB	
18	W1	15.8±9.5 (5.6-10.8±8.0 (1.5-1.2±0.4 (0.7-1			23.2	MNB	
19	high		33.9; 12.6	2.2; 44.9	13.7	MNB	
20	W2	18.0±0.1 (n=5 15.7±0.1 (n=5 1.3±0.1 (n=5)			22	MNB	
21	low	35.3	24.5	2.0	20.6	MNB	
22	W2	2.7; 19.3	3.3	0.8	16.5	MNB	
23			0.27-1.16 (n=	0.93-1.45	72.9	GUT	
24	W2	18.7±9.4	13.7±6.6	1.0±1.4	30	UNM	
25	moderate	88.4	27.1±3.1; 53.43.1±0.4; 5.6±3		20.1	UNM	
26	W1	18.5±0.1	16.3±0.0	1.5±0.1	25.9	UNM	
27	moderate		53.7±3.6	15.1±5.0	21.9	UNM	
28	W5	24.4±0.2 (N=222.1±0.2 (N=22.0±0.1 (N=25			30	UCLA	
29	W5	19.8±0.2 (N=218.9±0.2 (N=21.9±0.1 (N=25			4.8	UCLA	
30	W4	19.4±0.2 (N=218.8±0.2 (N=21.9±0.1 (N=25			14.3	UCLA	
31	W3	24.3±1.5	20.7±1.5	1.3±0.5	39.4	UCLA	
32	W0/1	25.1±0.7 (N=120.5±0.5 (N= 1.5±0.2 (N=114.85			423.86	SMNH	
33	W2-3	21.47±7.10 (1 13.51±7.98 (2 2.04±2.45 (0.1			102.72	UrFU	
34					20.9	IfP	
35					287	CEREGE	
36	W0	H6: 19.3±0.2 (H6: 16.9±0.2 (H6: 1.56±0.21			550	UOslo	
37	W2	28.3±0.2	23.4±0.5	1.6±0.3	3.41	54.2	UWB
38	W2	24.2	20.8	1.4	63	IGGCAS	
39	W1	16.7±0.4 (n=1 15.2±0.8 (n=8 1.0±0.6 (n=8) 5.5			56.0	IfP	
40	W2	19.5±0.2 (n=5 17.2±0.2 (n=5 1.3±0.3 (n=5) 5.1			70.6	IfP	
41	W3	25.2±0.4 (n=5 21.0±0.3 (n=5 1.2±0.2 (n=5) 4.2			3.6	IfP	
42	W1			4.72	11.06	CEREGE	
43	moderate		19.2±0.3 (n=3 4.8±0.1	4.92	13.72	CEREGE	
44	W3	24.9 (n=1)	21.8 (n=1)	1.6	4.66	20	CEREGE
45	W1			5.25	67.5	CEREGE	
46	W1			5.25	21	CEREGE	
47					5616.88	Vernad	
48	W1	24.0±0.1 (N=120.2±0.2 (N=11.4±0.2 (N=13			368.4	Vernad	
49	W4	18.64±0.08 (n=16.49±0.19 (n=1.18±0.16 (n=			50	IGCAS	
50	low	28.8-35.2	21.8; 23.7-30.3.8; 8.6-10.4; ;		21	UWB	
51	W4			4.61	21	CEREGE	
52	W1	17.6 (n=1)	16.5±0.8 (n=4 1.7±1.2	5.10	23.5	CEREGE	
53	W2	25.1	20.9		181.6	WAM	
54	W2	16.1±7.0 (n=2 10.1±6.2 (n=20.5±0.3 (n=22			30.8	IfP	
55	W3	18.6±0.7 (n=4 15.9±0.1 (n=3 1.6±0.1(n=3)			0.5	IfP	
56	W3	27.3±0.1 (n=5 22.5±0.3 (n=5 1.6±0.2 (n=5)			1.5	IfP	
57	W3	26.5±0.4 (n=5 21.8±0.7 (n=5 1.6±0.3 (n=5)			2.2	IfP	

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2				
3	W3	25.1±0.8 (n=5 21.4±1.1 (n=5 1.4±0.2 (n=5)	0.4	IfP
4	W2-3	19.0±0.5 (n=5 16.9±0.2 (n=5 1.3±0.2 (n=5)	0.8	IfP
5	W3	18.6±0.4 (n=5 16.3±0.2 (n=5 1.3±0.2 (n=5)	27.6	IfP
6	W2	17.0±4.3 (n=2 12.6±5.1 (n=2 1.6±2.0 (n=29	2.1	IfP
7	W2	28.1±0.5 (n=5 23.1±0.9 (n=5 1.6±0.3 (n=5)	5.4	IfP
8	W2-3	27.2±0.5 (n=5 23.1±1.1 (n=4 1.8±0.5 (n=4)	2.8	IfP
9	W2	19.2±0.6 (n=5 16.4±0.2 (n=5 1.2±0.1 (n=5)	18.6	IfP
10	W2-3	27.1±0.3 (n=4 22.4±0.3 (n=4 1.7±0.4 (n=4)	2.8	IfP
11	W2-3	27.5±0.4 (n=5 23.0±0.9 (n=3 1.9±0.2 (n=3)	2.6	IfP
12	W3	26.9±0.2 (n=4 22.8±0.3 (n=5 1.5±0.5 (n=5)	11.4	IfP
13	W3	19.2±0.3 (n=5 16.7±0.4 (n=4 1.2±0.3 (n=4)	7.8	IfP
14	W3	18.6±0.3 (n=5 16.4±0.2 (n=5 1.3±0.2 (n=5)	9.8	IfP
15	W2	25.1±0.6 (n=5 21.2±0.7 (n=5 1.3±0.3 (n=5)	21.9	IfP
16	W2	25.2±0.3 (n=5 20.9±0.2 (n=5 1.6±0.2 (n=5)	7.9	IfP
17	W2	24.9±0.3 (n=4 21.3±0.6 (n=5 1.4±0.3 (n=5)	11.7	IfP
18	W2-3	26.1±0.6 (n=4 21.5±0.5 (n=6 1.6±0.2 (n=6)	0.9	IfP
19	W3	25.3±0.5 (n=4 21.5±1.6 (n=5 1.6±0.3 (n=5)	0.8	IfP
20	W2	17.4±0.4 (n=3 15.5±0.8 (n=3 1.3±1.5 (n=30	29.7	IfP
21	W2	16.8±0.4 (n=2 14.8±0.8 (n=2 1.4±1.7 (n=29	10.5	IfP
22	W2	17.6±0.9 (n=1 15.8±0.7 (n=1 0.9±0.2 (n=13	15.9	IfP
23	W2-3	26.4±0.9 (n=5 20.7±0.4 (n=5 1.8±0.4 (n=5)	14.6	IfP
24	W2	18.6±3.6 (n=2 14.7±5.0 (n=2 1.6±1.7 (n=24	37.4	IfP
25	W2	18.6±2.8 (n=1 13.9±4.5 (n=1 1.4±1.2 (n=17	7.2	IfP
26	W2	24.8±0.6 (n=5 20.7±0.4 (n=4 1.7±0.1 (n=4)	14.9	IfP
27	W2	23.8±0.3 (n=4 19.7±0.4 (n=5 1.5±0.2 (n=5)	8.4	IfP
28	W2	18.9±0.4 (n=5 16.4±0.3 (n=4 1.2±0.1 (n=4)	5.8	IfP
29	W1-2	23.5±0.4 (n=5 20.1±0.4 (n=5 1.8±0.5 (n=5)	3.8	IfP
30	W3	18.7±0.3 (n=5 16.8±0.2 (n=5 1.2±0.2 (n=5)	29.7	IfP
31	W3	18.5±0.1 (n=5 16.7±0.4 (n=5 1.2±0.2(n=5)	13.2	IfP
32	W3	23.5±0.4 (n=5 20.1±0.4 (n=5 1.8±0.5 (n=5)	7.3	IfP
33	W3	17.2±0.3 (n=1 15.6±0.7 (n=1 1.6±1.4 (n=15	3.7	IfP
34	W2	14.4±7.9 (n=5 15.3±3.1 (n=5 1.2±0.5 (n=5)	14.6	IfP
35	W1-2	19.5±0.8 (n=5 17.0±0.8 (n=5 1.5±0.3(n=5)	9.9	IfP
36	W2	25.9±0.4 (n=5 21.0±0.7 (n=3 1.5±0.1(n=3)	8.6	IfP
37	W3	16.8±0.6 (n=5 14.9±0.5 (n=4 1.1±0.1(n=4)	3.3	IfP
38	W1-2	18.8±2.6 (n=1 15.9±3.9 (n=2 1.5±1.5 (n=20	9.8	IfP
39	W1	18.8±0.6 (n=5 16.5±0.6 (n=5 1.2±0.2(n=5)	19.2	IfP
40	W2	24.3±0.2 (n=5 20.3±1.1 (n=3 1.7±0.2(n=3)	37.5	IfP
41	W3	24.0±0.2 (n=5 20.5±0.3 (n=5 1.3±0.2(n=5)	36.5	IfP
42	W2-3	25.3±1.0 (n=4 20.9±0.3 (n=4 1.3±0.2(n=4)	27.7	IfP
43	W2	24.9±0.9 (n=4 20.2±0.8 (n=4 1.3±0.2(n=4)	16.1	IfP
44	W1	17.6±0.5 (n=6 16.0±0.7 (n=4 1.0±0.3(n=4)	18.7	IfP
45	W3	17.8±0.3 (n=4 15.8±0.5 (n=5 1.3±0.2(n=5)	0.4	IfP
46	W2	17.5±0.2 (n=5 15.7±0.3 (n=5 1.0±0.1(n=5)	8.2	IfP
47	W2-3	25.2±0.5 (n=5 20.9±0.2 (n=5 1.5±0.3(n=5)	19.6	IfP
48	W1-2	24.6±0.2 (n=5 20.6±0.1 (n=5 1.5±0.3(n=5)	29.9	IfP
49	W2	22.9±0.6 (n=5 19.2±0.7 (n=5 1.2±0.2(n=5)	22.2	IfP
50	W1-2	20.8±3.6 (n=1 9.7±7.2 (n=18 1.7±2.2 (n=18	14.0	IfP
51	W1	17.9±0.8 (n=5 15.6±0.4 (n=5 1.1±0.5(n=5)	18.1	IfP
52	W2	25.3±1.0 (n=5 20.9±0.5 (n=4 1.4±0.2(n=4)	25.4	IfP
53	W1-2	24.6±0.2 (n=5 20.6±0.1 (n=5 1.5±0.3(n=5)	33.9	IfP
54	W1	18.3±0.5 (n=5 16.1±0.4 (n=5 1.1±0.1(n=5)	27.3	IfP
55	W2-3	25.2±0.4 (n=5 21.5±0.9 (n=5 1.2±0.2(n=5)	4.2	IfP
56	W3	25.2±0.8 (n=4 21.1±0.8 (n=5 1.5±0.3(n=5)	3.2	IfP
57	W1-2	17.9±0.7 (n=5 16.5±0.8 (n=4 1.5±1.0(n=4)	16.7	IfP

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3	W1-2	24.7±1.1 (n=5)	20.4±0.3 (n=5)	1.4±0.2 (n=5)	5.8 IfP
4	W2	24.4±0.2 (n=4)	20.5±0.2 (n=5)	1.4±0.4 (n=5)	10.2 IfP
5	W4	24.4±0.2 (n=5)	20.3±0.3 (n=5)	1.2±0.2 (n=4)	24.7 IfP
6	W2	18.6±0.6 (n=5)	16.5±0.7 (n=5)	1.6±0.1 (n=5)	5.6 IfP
7	W2	18.6±1.5 (n=1)	12.5±4.4 (n=1)	1.0±0.8 (n=18)	19.1 IfP
8	W3	20.2±0.4 (n=5)	17.4±0.3 (n=3)	1.4±0.2 (n=3)	31.5 IfP
9	W2	17.8±0.7 (n=9)	15.6±0.6 (n=9)	1.3±1.8 (n=9)	19.8 IfP
10	W2-3	23.8±0.2 (n=4)	20.3±0.2 (n=3)	1.4±0.5 (n=3)	32.2 IfP
11	W3	25.9±1.2 (n=6)	21.4±0.5 (n=4)	1.1±0.2 (n=4)	5.5 IfP
12	W2	18.7±1.0 (n=9)	16.5±0.6 (n=5)	1.0±0.2 (n=5)	35.8 IfP
13	W3	18.9±0.5 (n=5)	16.7±0.5 (n=5)	1.3±0.2 (n=5)	12.8 IfP
14	W1	25.0±0.1 (n=4)	20.7±0.8 (n=4)	1.6±0.2 (n=4)	12.5 IfP
15	W3	24.6±0.2 (n=5)	21.0±1.0 (n=5)	1.3±0.2 (n=5)	32.7 IfP
16	W2	19.2±0.5 (n=5)	16.7±0.4 (n=5)	1.2±0.2 (n=5)	8.5 IfP
17	W3	25.4±0.9 (n=4)	21.5±0.3 (n=4)	1.5±0.3 (n=5)	14.0 IfP
18	W1	18.2±0.2 (N=116)	16.2±0.2 (N=3)	1.4±0.2 (N=3)	38 LeMans
19	W3	19.0±0.4 (N=217)	17.0±0.8 (N=)	1.3±0.3	45 NHMV
20	W0	18.8±0.4 (n=2)	17.4±0.4 (n=2)	1.22 ±0.8	40.2 MNRJ
21	W3			4.27	25.13 CEREGE
22	low	36.2±5.1 (N=15)	15.8±9.2 (N=13)		463 SQU
23	W2	20±2.1 (N=37)	18±0.5 (N=17)	1±0.3 (N=17)	101.73 g UrFU
24	W4	24.5±0.7 (n=1)	20.8±0.5 (n=1)	1.6±0.2 (n=10)	23.1 IfP
25	W2	24.2±0.2 (n=7)	20.7±0.2 (n=7)	1.9±0.2 (n=7)	52.4 MNB
26	W3	23.9±0.2, n=5	20.1±0.1, n=5	2.0±0.1, n=5	24.7 MNB
27	W2	16.1±0.2 (N=115)	11.1±4.8 (N=10)	0.8±0.6 (N=16)	229.8 Vernad
28	W1	17.9±0.36 (N=16)	16.0±0.24 (N=2)	0±0.44 (N=1)	7.3 Vernad.
29	W1	21.8±0.24 (N=18)	18.4±0.32 (N=)	1.37±0.34	3.2 Vernad
30	W3	24.1±0.48	20.3±0.25 (N=1)	1.3±0.19 (N=1)	152 Vernad
31	W2	26.6±0.3 (N=122)	12.0±0.7 (N=11)	5±0.3 (N=12)	375.66 UrFU
32	W1	23.1±0.3 (N=119)	11.6±0.3 (N=12)	4±0.4 (N=12)	23.7 Vernad
33	W2	24.2±0.3 (N=120)	12.3±0.2 (N=11)	4±0.1 (N=13)	32.9 Vernad
34	W2	17.8±0.5 (N=116)	11.0±0.7 (N=11)	5±0.5 (N=15)	64.9 Vernad
35	W2	18.2±0.22 (N=16)	11.0±0.2 (N=11)	3±0.2 (N=12)	149.0 Vernad
36	W2			4.52	2.5 CEREGE
37	W2	18.6±0.30 (N=16)	16.6±0.30 (N=)	1.21±0.16 (N=)	22.4 Vernad
38	W2	18.5±0.7 (N=116)	11.3±0.2 (N=11)	2±0.1 (N=12)	191.8 Vernad.
39	W2	21.1±7.2 (N=38)	6±5.7 (N=25)	0.9±0.9 (N=25)	1.8 Vernad
40	W1	22.9±0.3 (N=119)	11.3±0.4 (N=12)	2±0.2 (N=12)	23.4 Vernad
41	W1	23.3±0.4 (N=119)	11.6±0.4 (N=12)	2±0.1 (N=12)	23.8 Vernad
42	W1	23.4±0.3 (N=119)	11.7±0.4 (N=12)	2±0.2 (N=12)	14 Vernad
43	W1	24.1±0.3 (N=120)	12.0±0.2 (N=11)	5±0.2 (N=12)	52.6 Vernad
44	W1	23.1±0.2 (N=119)	11.5±0.3 (N=12)	7±0.3 (N=13)	21.3 Vernad
45	W2	19.3±3.0 (N=117)	11.7±2.5 (N=11)	7±0.4 (N=11)	88.03 UrFU
46	W1	23.9±0.5 (n=1)	15.4±6.1 (n=8)	0.9±0.3	4.60 22.9 CEREGE
47	W2	23.6±0.4 (N=119)	11.6±0.3 (N=12)	1±0.3 (N=12)	33.6 Vernad
48	W1	23.2±0.3 (N=119)	11.3±0.6 (N=12)	3±0.5 (N=12)	50.0 Vernad
49	W1	18.6±0.4 (N=116)	11.3±0.2 (N=11)	3±0.1 (N=12)	3.9 Vernad
50	W0/1	24.9±0.2	20.7±0.3	1.7±0.1	20.3 UWB
51	low	36.6±7.7	30.8±2.5; 37.5±2.1±0.7; 3.2±0.5±8.2		24.46 App
52	W0	1.0±0.6; 26.5±1.1±0.1; 1.7	3.2±0.5; 44.0	4.92	52.4 13 g FSAC, 2'
53	W1	24.0±0.2 (n=1)	20.3±0.4 (n=1)	1.5±0.1	4.81±0.09 23.5 Kiel
54				4.23	0.4 CEREGE
55	W2	17.8	15.5	1.1	53.5 IGGCAS
56	W2.0	19.4±0.5 (n=9)	17.4±1.0 (n=6)	1.4±1.0 (n=6)	149.0 UAb
57	moderate	19.1±18.8 (n=2)	1±1.0 (n=15)	1.6±1.5 (n=15)	125.6 IfP, USRB

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3	W1		5.20	21		CEREGE
4	W0	64.7±0.6 (n=9 39.8±11.5 (n=6.3±1.8 (n=36		80		MNRJ
5	moderate	18.2-32.1 16.0-46.2; 18.1-7-3.7; 12.4-4		37.6		UWB
6	W2	19.4±12.3 (N=8.3±7.6 (N=30 1.2±1.2 (N=30		158		Vernad.
7	W3	23.9±0.3 (N=120.3±0.4 (N=11.6±0.3 (N=13		4.8		Vernad.
8	W1	17.8±0.4 (N=115.2±0.3 (N=11.3±1.1 (N=17		1.99		Vernad
9	W3	17.4±0.2 (N=115.4±0.2 (N=11.5±0.1 (N=12		14.4		Vernad
10	W2	24.1±0.5 (N=120.3±0.2 (N=11.3±0.2 (N=12		30.2		Vernad
11		35.9±2.1 (n=7 22.8 ± 2.0 (n=8.0 ± 3.4 (n=1		20.2		IfP
12	moderate	36.7±10.1 28.2±5.9, 18.75.6±3.1, 43.2±		25.8		UNM
13				21.1		IfP
14	W4	18.6±0.4 (N=9 16.5±0.5 (N=11.3±0.3 (N=13		10.3		UCLA
15	W4	19.0±0.8 (N=116.5±0.7 (N=11.3±0.2 (N=17		7		UCLA
16	W4	18.7±0.9 (N=116.7±0.7 (N=21.4±0.2 (N=20		27.9		UCLA
17	W4	18.7±0.4 (N=116.3±0.4 (N=11.3±0.2 (N=13		9.9		UCLA
18	W4	19.1±0.6 (N=116.8±0.6 (N=11.3±0.1 (N=16		32.1		UCLA
19	W4	19.0±0.7 (N=216.9±0.9 (N=11.3±0.1 (N=16		10.1		UCLA
20	W4	18.7±0.6 (N=216.6±0.3 (N=11.3±0.2 (N=14		16		UCLA
21	W4	19.3±0.5 (N=9 16.8±0.7 (N=21.2±0.2 (N=20		26.2		UCLA
22	W4	18.9±0.5 (N=116.9±0.8 (N=7 1.1±0.2 (N=7)		12.7		UCLA
23	W4	18.8±0.5 (N=116.6±0.6 (N=11.2±0.1 (N=12		5.3		UCLA
24	W4	18.7±0.8 (N=216.4±0.7 (N=11.0±0.3 (N=12		1		UCLA
25	W2	24.2 20.3 1.9		21		UCLA
26	W2	23.9±0.2 (n=7 20.2±0.1 (n=7 1.6±0.1 (n=7)		22.1		MNB
27	W4	17.8±0.2 16.1±0.4 1.2±0.2		27.2		UCLA
28	W0/1	18.2±0.4 (n=3 16.1±0.3 (n=3 1.6±0.4 (n=36		4700		UOslo
29	W2/3	19.1±0.2 16.7±0.2 1.5±0.2 4.88		24.1		PSF
30	W0	18.6±0.3 (n=9 16.4±0.1 (n=7 1.6±0.1 5.29		45.5		FSAC, UNM
31	W3	16.4±8.6; 18.4 14.8±9.3 1.3±1.3		22.2		UWB
32	W0-1	14.1±7.7 (n=3 8.7±5.7 (n=8) 0.7±0.7 4.82		17.8 + 4.7		Kiel + UGött
33	B	19.7 (18.7-21. 17.3 (16.3-19.		1.952		NIPR
34	B	25.5 (24.1-28. 21.8 (20.5-22.		0.477		NIPR
35	B	25.7 (24.7-28. 22.0 (20.8-25.		1.987		NIPR
36	B	26.0 (24.7-29. 21.6 (19.8-24.		0.567		NIPR
37	B	19.1 (17.1-21. 16.9 (15.1-19.		0.377		NIPR
38	B	18.5 (17.2-19. 16.8 (15.6-17.		2.156		NIPR
39	B	25.6 (19.0-28. 16.0 (6.9-21.7		1.256		NIPR
40	B	18.9 (18.4-20. 16.5 (13.9-17.		1.473		NIPR
41	B	19.1 (17.6-20. 16.9 (15.7-17.		1410.150		NIPR
42	A	28.6 (26.8-30. 23.7 (22.4-25.		1.110		NIPR
43	C	18.8 (18.3-19. 16.8 (16.0-17.		1.390		NIPR
44	B	18.9 (17.9-20. 16.7 (15.6-17.		0.566		NIPR
45	B	30.6 (29.6-32. 24.9 (23.3-26.		2.863		NIPR
46	A	19.1 (18.2-22. 17.2 (15.7-18.		2.447		NIPR
47	B	30.9 (29.4-32. 25.0 (23.9-26.		2.223		NIPR
48	B	19.3 (18.3-20. 17.0 (15.7-19.		0.38		NIPR
49	B	19.0 (18.3-20. 16.6 (15.3-17.		0.902		NIPR
50	B	25.5 (24.1-27. 21.3 (20.3-22.		1.553		NIPR
51	B	20.2 (18.8-24. 17.4 (15.4-21.		1.53		NIPR
52	B	25.9 (23.8-27. 21.7 (20.4-22.		0.428		NIPR
53	A	26.4 (24.0-30. 16.1 (5.9-21.0		0.766		NIPR
54	A	29.0 (27.8-30. 24.0 (23.4-24.		3.214		NIPR
55	A	29.0 (27.8-31. 24.0 (23.6-24.		4.481		NIPR
56	A	25.5 (18.7-29. 21.6 (3.6-36.5		19.821		NIPR
57	C	19.3 (18.2-23. 16.9 (15.6-18.		0.69		NIPR

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2				
3	B	18.9 (17.8-24. 16.4 (14.7-17.	1.619	NIPR
4	B	20.4 (18.4-23. 18.2 (16.9-22.	2.016	NIPR
5	B	15.9 (0.7-44.8 11.3 (2.5-31.6	4.822	NIPR
6	B	25.2 (23.5-26. 21.2 (20.6-21.	0.551	NIPR
7	B	19.4 (18.7-22. 17.0 (14.8-18.	2.365	NIPR
8	A	31.0 (29.9-32. 25.3 (24.0-27.	3.034	NIPR
9	B	19.0 (18.1-20. 16.9 (15.7-18.	1.543	NIPR
10	B	18.7 (17.5-21. 16.7 (15.2-19.	1.17	NIPR
11	B	24.9 (23.9-26. 21.1 (19.3-21.	2.07	NIPR
12	B	25.2 (24.5-27. 21.1 (19.9-21.	3.245	NIPR
13	C	19.9 (18.1-20. 17.7 (16.1-19.	1.39	NIPR
14	B	18.5 (17.8-19. 16.5 (15.4-17.	1.528	NIPR
15	A	5.9 (0.4-35.3) 3.8 (0.7-10.4)	2.379	NIPR
16	A	30.4 (28.8-35. 25.2 (24.0-28.	2.28	NIPR
17	B	30.2 (29.4-31. 24.1 (21.9-25.	3.035	NIPR
18	B	25.4 (23.6-27. 22.0 (20.5-24.	0.813	NIPR
19	B	19.9 (19.0-21. 17.4 (16.7-19.	4.301	NIPR
20	B	19.8 (18.7-21. 17.8 (16.9-20.	0.431	NIPR
21	B	25.2 (22.4-28. 22.0 (20.6-25.	0.318	NIPR
22	B	19.0 (18.0-19. 17.0 (15.5-19.	1.771	NIPR
23	B	26.8 (24.8-31. 22.4 (19.3-24.	0.901	NIPR
24	B	18.8 (16.4-20. 16.7 (15.9-18.	0.935	NIPR
25	B	18.7 (17.2-20. 16.6 (14.8-18.	4.784	NIPR
26	B	25.3 (23.9-27. 21.3 (20.3-22.	2.231	NIPR
27	B	25.7 (23.8-27. 22.0 (20.3-26.	3.65	NIPR
28	C	18.5 (17.7-20. 16.6 (15.7-17.	2.231	NIPR
29	B	25.3 (24.3-28. 21.2 (20.0-22.	2.386	NIPR
30	B	19.3 (17.8-21. 17.4 (16.2-19.	2.473	NIPR
31	B	17.9 (17.1-19. 15.8 (14.0-16.	2.38	NIPR
32	B	3.5 (0.7-9.8) 1.4 (0.7-2.7)	0.467	NIPR
33	B	25.6 (24.0-27. 21.4 (20.5-22.	1.938	NIPR
34	B	18.7 (17.9-20. 16.8 (14.5-17.	2.717	NIPR
35	B	7.2 (0.5-39.1) 3.1 (1.0-12.5)	2.807	NIPR
36	A	11.1 (0.7-51.0 2.9 (0.6-6.0)	1.211	NIPR
37	B	18.9 (18.2-20. 16.6 (15.8-18.	0.51	NIPR
38	B	19.2 (18.0-20. 17.3 (16.6-20.	1.515	NIPR
39	B	19.6 (18.6-21. 17.2 (16.2-21.	2.05	NIPR
40	B	19.6 (18.7-22. 17.5 (15.2-20.	0.77	NIPR
41	B	19.5 (17.8-23. 16.6 (16.3-17.	0.810	NIPR
42	A	25.3 (24.1-27. 21.5 (20.5-23.	0.287	NIPR
43	B	19.4 (17.9-23. 16.5 (16.2-17.	0.661	NIPR
44	B	19.4 (18.4-22. 16.9 (16.3-18.	1.150	NIPR
45	B	19.0 (17.7-20. 16.6 (14.8-18.	0.561	NIPR
46	B	19.7 (18.5-20. 17.2 (15.6-17.	0.636	NIPR
47	B	18.7 (17.9-19. 16.7 (15.7-17.	1.524	NIPR
48	B	18.9 (17.4-21. 16.9 (15.8-18.	2.067	NIPR
49	B	18.6 (17.7-19. 16.6 (14.7-18.	3.064	NIPR
50	B	19.1 (18.2-21. 16.7 (15.5-17.	2.671	NIPR
51	B	19.1 (18.4-22. 16.6 (15.5-17.	3.385	NIPR
52	B	18.9 (18.2-20. 16.8 (15.9-17.	0.805	NIPR
53	B	19.5 (18.4-22. 17.2 (15.7-20.	2.189	NIPR
54	B	25.6 (24.1-28. 21.7 (20.3-23.	0.484	NIPR
55	B	25.9 (24.3-30. 21.4 (20.1-23.	1.510	NIPR
56	B	25.3 (24.2-27. 21.7 (20.2-23.	0.916	NIPR
57	B	19.0 (17.6-22. 16.6 (14.3-20.	1.808	NIPR



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2				
3	B	18.8 (17.6-19. 16.8 (15.6-18.	2.469	NIPR
4	B	19.7 (18.1-23. 17.5 (15.4-20.	2.442	NIPR
5	B	19.7 (18.4-22. 16.9 (16.2-17.	0.795	NIPR
6	B	25.3 (23.9-27. 21.0 (18.0-22.	1.410	NIPR
7	B	25.3 (24.2-27. 21.2 (20.6-21.	0.538	NIPR
8	C	18.9 (18.0-21. 16.6 (15.3-17.	2.821	NIPR
9	B	19.5 (18.1-22. 17.6 (16.3-19.	2.317	NIPR
10	B	18.1 (17.3-18. 16.3 (14.7-17.	1.931	NIPR
11	C	18.7 (17.6-19. 17.0 (16.0-19.	2.742	NIPR
12	B	19.0 (16.4-25. 16.3 (9.1-21.2	2.334	NIPR
13	B	19.2 (17.9-22. 16.6 (15.3-18.	1.058	NIPR
14	B	25.3 (24.3-27. 21.5 (19.9-24.	2.710	NIPR
15	B	23.1 (22.0-25. 19.7 (17.9-21.	2.706	NIPR
16	B	25.5 (24.7-30. 21.6 (21.0-24.	1.925	NIPR
17	B	19.0 (17.7-22. 17.1 (15.8-21.	0.815	NIPR
18	B	19.1 (17.8-20. 17.2 (16.1-19.	8.365	NIPR
19	B	18.4 (17.4-19. 16.3 (15.1-19.	1.490	NIPR
20	B	25.2 (23.6-27. 21.3 (20.5-22.	2.307	NIPR
21	B	19.4 (17.7-21. 17.1 (16.2-19.	1.575	NIPR
22	B	25.0 (23.5-26. 21.4 (20.4-23.	1.844	NIPR
23	B	19.8 (18.6-23. 17.3 (16.2-19.	2.349	NIPR
24	B	19.8 (18.0-20. 17.6 (16.4-19.	1.314	NIPR
25	C	19.4 (18.8-20. 17.3 (16.4-18.	1.013	NIPR
26	B	25.0 (23.5-27. 21.4 (19.4-24.	2.144	NIPR
27	A	18.6 (17.5-19. 16.4 (14.9-18.	1.326	NIPR
28	B	19.3 (18.4-20. 17.1 (15.9-20.	0.696	NIPR
29	B	18.9 (18.1-20. 16.8 (16.2-17.	2.833	NIPR
30	B	19.2 (18.4-20. 16.9 (15.7-19.	1.306	NIPR
31	C	24.0 (22.8-25. 20.5 (17.8-22.	2.745	NIPR
32	B	25.0 (23.2-26. 21.3 (18.9-24.	0.532	NIPR
33	B	19.1 (17.8-21. 16.9 (16.2-17.	1.455	NIPR
34	B	19.3 (18.5-21. 16.8 (16.0-18.	0.89	NIPR
35	B	19.3 (18.1-21. 16.4 (15.1-17.	0.695	NIPR
36	C	18.6 (17.4-20. 16.8 (15.9-19.	1.087	NIPR
37	B	19.0 (18.0-20. 16.9 (15.7-19.	1.928	NIPR
38	B	25.4 (24.5-27. 21.2 (19.7-21.	0.488	NIPR
39	B	18.3 (15.7-20. 16.3 (14.8-20.	1.014	NIPR
40	B	19.3 (18.2-20. 16.6 (15.6-17.	0.730	NIPR
41	A	24.9 (23.5-26. 21.0 (20.4-21.	0.330	NIPR
42	B	19.6 (17.6-24. 16.7 (15.9-17.	1.292	NIPR
43	B	19.2 (17.4-22. 17.0 (15.6-18.	2.371	NIPR
44	A	19.5 (18.9-20. 16.9 (15.8-17.	0.624	NIPR
45	B	19.1 (17.2-20. 16.8 (14.7-19.	1.192	NIPR
46	B	19.4 (17.9-22. 16.5 (16.1-16.	1.767	NIPR
47	A	4.4 (0.4-32.8) 2.9 (1.1-6.4)	0.461	NIPR
48	B	25.4 (24.2-26. 21.4 (20.4-23.	0.565	NIPR
49	B	25.0 (23.5-27. 21.2 (19.6-23.	1.322	NIPR
50	B	25.2 (24.1-26. 21.4 (20.2-23.	0.574	NIPR
51	B	20.0 (18.7-22. 17.4 (14.9-20.	1.335	NIPR
52	A	30.7 (29.5-31. 25.9 (24.3-27.	0.784	NIPR
53	B	19.5 (18.3-22. 16.9 (16.2-17.	0.874	NIPR
54	B	25.9 (24.5-28. 22.5 (20.9-25.	1.732	NIPR
55	B	19.8 (18.5-22. 17.5 (16.5-20.	0.667	NIPR
56	C	20.4 (19.2-22. 18.0 (16.7-20.	0.889	NIPR
57	B	26.0 (24.8-28. 22.1 (20.5-24.	9.420	NIPR

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2				
3	B	19.8 (18.7-21. 17.5 (16.1-18.	2.402	NIPR
4	B	19.3 (18.7-20. 17.2 (15.7-21.	1.922	NIPR
5	B	18.9 (17.8-19. 16.8 (15.9-19.	2.315	NIPR
6	B	19.4 (18.4-21. 16.8 (15.4-18.	1.396	NIPR
7	A	18.8 (17.5-19. 16.6 (14.8-17.	2.131	NIPR
8	B	19.0 (18.6-19. 16.8 (15.4-19.	2.047	NIPR
9	A	25.1 (24.2-26. 21.2 (20.4-23.	1.967	NIPR
10	A	25.0 (23.1-26. 21.2 (20.1-22.	88.560	NIPR
11	B	25.2 (22.6-26. 21.3 (19.9-23.	1.761	NIPR
12	A	25.2 (23.4-28. 21.3 (18.6-23.	61.210	NIPR
13	A	24.9 (23.1-26. 21.1 (19.5-23.	50.064	NIPR
14	B	17.2 (16.1-19. 15.3 (14.7-15.	2.352	NIPR
15	B	17.5 (15.9-18. 15.9 (14.5-17.	1.012	NIPR
16	B	19.1 (18.0-20. 16.6 (16.0-17.	1.157	NIPR
17	B	19.1 (18.1-21. 17.2 (16.5-18.	2.662	NIPR
18	B	19.2 (17.4-21. 16.1 (15.4-16.	1.385	NIPR
19	B	28.2 (27.0-34. 23.2 (22.4-24.	2.605	NIPR
20	B	25.3 (24.0-26. 21.3 (19.7-23.	0.489	NIPR
21	B	25.5 (22.8-27. 22.0 (19.2-25.	2.959	NIPR
22	B	25.4 (24.3-26. 21.9 (19.4-25.	2.217	NIPR
23	B	19.7 (18.6-20. 17.1 (15.2-20.	2.968	NIPR
24	B	25.1 (23.6-27. 21.3 (19.5-24.	2.151	NIPR
25	A	25.6 (24.3-27. 21.4 (21.1-21.	0.785	NIPR
26	B	19.1 (17.5-20. 17.5 (16.6-18.	2.005	NIPR
27	B	16.5 (2.6-20.2 16.2 (6.8-20.7	0.309	NIPR
28	C	19.2 (18.1-22. 16.9 (16.0-18.	1.154	NIPR
29	B	18.8 (17.5-20. 16.6 (15.6-18.	1.234	NIPR
30	B	19.0 (17.8-21. 16.4 (15.6-17.	1.120	NIPR
31	A	25.5 (23.9-27. 21.4 (20.0-25.	2.083	NIPR
32	B	25.4 (23.6-27. 21.3 (19.4-24.	2.423	NIPR
33	A/B	24.8 (23.4-27. 21.1 (17.8-25.	2.219	NIPR
34	B	18.1 (16.9-20. 15.9 (15.0-16.	1.990	NIPR
35	B	19.1 (18.0-20. 16.6 (15.9-17.	0.514	NIPR
36	B	19.2 (18.0-21. 17.0 (16.2-18.	1.004	NIPR
37	B/C	19.4 (18.5-22. 17.0 (15.9-20.	2.428	NIPR
38	B	19.3 (17.7-21. 17.3 (16.5-18.	0.805	NIPR
39	B	18.1 (16.5-18. 16.2 (14.9-16.	2.199	NIPR
40	B	19.3 (17.9-24. 16.8 (15.9-17.	0.927	NIPR
41	A	25.3 (23.9-28. 21.8 (20.0-24.	2.502	NIPR
42	B	19.5 (18.2-23. 17.0 (16.2-17.	0.963	NIPR
43	B	25.4 (24.5-26. 22.1 (20.7-25.	2.559	NIPR
44	C	16.2 (3.3-35.8 13.1 (2.4-38.1	1.046	NIPR
45	B/C	19.3 (18.4-20. 17.2 (15.4-20.	0.714	NIPR
46	C	20.3 (19.6-21. 18.1 (16.9-22.	0.431	NIPR
47	C	18.8 (17.9-19. 16.5 (15.1-18.	0.606	NIPR
48	B	19.2 (17.8-20. 17.1 (16.0-19.	0.478	NIPR
49	C	19.0 (17.3-22. 16.9 (16.3-17.	0.544	NIPR
50	B	19.5 (17.9-24. 16.6 (15.7-17.	1.240	NIPR
51	B	19.4 (18.0-22. 16.9 (16.2-18.	2.842	NIPR
52	B	20.1 (19.2-21. 17.4 (16.2-18.	2.427	NIPR
53	B	20.0 (18.4-21. 17.3 (15.8-20.	2.158	NIPR
54	B	19.6 (18.6-20. 17.3 (16.1-19.	1.049	NIPR
55	B	19.3 (17.7-22. 16.5 (15.2-17.	2.933	NIPR
56	B	19.3 (18.6-22. 17.0 (15.9-19.	1.798	NIPR
57	B	19.3 (17.5-21. 16.9 (15.8-17.	2.424	NIPR

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3	B	19.5 (18.1-24. 17.4 (15.2-20.	2.508	NIPR
4	B	19.2 (18.0-20. 16.9 (15.7-19.	2.875	NIPR
5	B	19.6 (18.0-23. 17.2 (14.6-21.	1.988	NIPR
6	B	19.2 (17.2-23. 16.5 (15.8-18.	1.032	NIPR
7	B	19.2 (17.8-20. 17.1 (16.0-21.	1.365	NIPR
8	B	19.6 (18.2-23. 16.9 (15.4-20.	1.442	NIPR
9	B	19.9 (18.3-23. 17.3 (15.9-19.	2.436	NIPR
10	B	19.4 (17.8-21. 16.9 (16.1-18.	2.062	NIPR
11	B	19.1 (17.8-21. 16.8 (15.8-17.	2.439	NIPR
12	B	19.4 (18.0-22. 16.5 (15.9-17.	2.158	NIPR
13	B	19.4 (18.4-23. 17.1 (16.3-19.	1.079	NIPR
14	B	19.3 (18.1-22. 17.4 (16.2-21.	1.447	NIPR
15	B	18.0 (16.4-19. 16.2 (14.6-19.	2.382	NIPR
16	B	17.9 (16.8-19. 16.3 (14.9-18.	1.215	NIPR
17	B	17.9 (17.2-18. 15.9 (14.6-17.	1.343	NIPR
18	B	25.0 (23.8-27. 21.5 (19.7-24.	1.783	NIPR
19	B	25.1 (24.1-26. 21.3 (20.2-23.	1.751	NIPR
20	B	19.3 (18.7-19. 17.5 (15.9-22.	1.756	NIPR
21	B	25.2 (23.7-28. 20.8 (18.9-23.	2.162	NIPR
22	B	19.0 (18.2-19. 16.9 (16.0-18.	2.842	NIPR
23	B	19.0 (18.1-20. 16.8 (14.7-19.	1.785	NIPR
24	B	25.5 (23.9-29. 21.4 (20.1-23.	2.019	NIPR
25	B	25.2 (23.7-27. 21.4 (20.1-23.	1.902	NIPR
26	C	19.4 (17.3-22. 17.1 (15.9-20.	1.228	NIPR
27	A	3.1 (0.6-8.6) 2.1 (0.8-5.4)	16.417	NIPR
28	B	19.6 (18.9-21. 17.3 (16.4-18.	1.897	NIPR
29	C	23.9 (12.2-34.	1.711	NIPR
30	C	19.2 (18.1-20. 16.9 (15.0-17.	2.084	NIPR
31	B	19.1 (17.8-22. 17.0 (15.1-20.	12.173	NIPR
32	B	18.8 (17.7-20. 17.0 (14.3-18.	13.623	NIPR
33	C	18.8 (16.6-20. 16.5 (15.7-17.	1.988	NIPR
34	B	19.7 (18.5-21. 17.4 (15.4-19.	1.438	NIPR
35	C	19.7 (18.0-21. 17.2 (15.8-18.	2.250	NIPR
36	B	19.6 (18.5-24. 16.8 (14.9-18.	1.75	NIPR
37	B	19.4 (18.1-22. 17.1 (16.0-19.	1.78	NIPR
38	B	19.6 (18.2-22. 16.8 (15.2-18.	1.85	NIPR
39	C	19.6 (17.3-22. 16.9 (16.1-17.	2.32	NIPR
40	B	19.1 (17.6-22. 16.7 (13.8-18.	2.9	NIPR
41	B	19.2 (18.1-22. 16.5 (15.3-19.	2.43	NIPR
42	B	19.1 (17.0-22. 17.0 (16.0-21.	2.0	NIPR
43	B	19.2 (17.4-21. 16.6 (16.1-17.	2.80	NIPR
44	B	19.3 (18.1-21. 16.7 (14.5-18.	1.84	NIPR
45	B	19.5 (18.3-24. 17.6 (16.6-20.	6.61	NIPR
46	B	19.8 (18.4-22. 17.0 (14.8-20.	2.195	NIPR
47	B	18.7 (17.1-20. 16.5 (15.4-18.	45.80	NIPR
48	B	19.3 (18.0-22. 16.8 (14.5-19.	1.692	NIPR
49	B	19.7 (17.7-23. 16.6 (15.8-18.	1.841	NIPR
50	B	26.1 (23.9-29. 21.8 (20.5-25.	1.28	NIPR
51	B	19.9 (18.5-23. 17.6 (15.5-20.	2.957	NIPR
52	B	25.1 (23.7-26. 20.9 (19.0-22.	2.505	NIPR
53	B	19.6 (18.5-22. 17.2 (15.8-22.	1.418	NIPR
54	B	8.1 (0.6-36.8) 3.5 (1.2-7.6)	1.725	NIPR
55	B	19.9 (18.3-23. 18.2 (16.5-19.	1.613	NIPR
56	B	19.8 (18.3-22. 17.0 (16.2-19.	1.593	NIPR
57	B	19.2 (17.7-21. 16.9 (16.2-18.	1.045	NIPR

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3	B	19.2 (18.0-23. 16.9 (14.8-20.	2.41	NIPR
4	B	19.5 (17.8-21. 17.0 (16.2-19.	1.354	NIPR
5	B	19.3 (17.9-22. 16.6 (15.0-18.	1.47	NIPR
6	B	19.2 (18.1-21. 16.9 (15.8-18.	1.822	NIPR
7	B	19.3 (18.0-23. 17.0 (16.0-19.	1.274	NIPR
8	C	18.4 (17.4-19. 16.3 (15.8-16.	2.122	NIPR
9	B	19.3 (18.2-21. 17.1 (16.0-21.	1.15	NIPR
10	B	19.4 (18.3-22. 16.8 (15.2-18.	1.529	NIPR
11	B	19.5 (18.2-22. 16.9 (15.7-19.	2.217	NIPR
12	B	19.7 (17.7-25. 16.2 (9.1-18.2	2.609	NIPR
13	B	18.3 (16.5-19. 16.4 (15.8-17.	567.58	NIPR
14	B	18.2 (17.1-22. 15.8 (14.6-16.	2.293	NIPR
15	B	26.2 (21.9-28. 21.3 (18.4-23.	1.71	NIPR
16	B	3.3 (0.4-28.2) 1.4 (0.7-4.0)	1.267	NIPR
17	B	7.7 (0.3-42.2) 2.7 (0.8-6.8)	3.968	NIPR
18	B	6.2 (0.2-30.3) 2.4 (0.7-6.4)	1.80	NIPR
19	B	17.2 (0.4-52.5 2.8 (0.7-11.6)	2.528	NIPR
20	B	25.6 (24.2-28. 21.8 (20.8-24.	1.129	NIPR
21	B	9.1 (0.3-52.3) 1.5 (1.5-1.5)	1.622	NIPR
22	B	2.5 (0.4-25.2) 2.5 (1.2-8.0)	12.731	NIPR
23	B	5.7 (0.2-44.6) 2.8 (1.0-8.7)	1.254	NIPR
24	B	6.5 (0.3-36.1) 2.3 (0.9-4.9)	2.860	NIPR
25	B	5.0 (0.4-30.7) 2.4 (0.8-5.8)	1.117	NIPR
26	C	18.5 (17.1-19. 16.4 (15.7-17.	2.609	NIPR
27	B	19.3 (18.2-22. 16.8 (15.6-18.	1.251	NIPR
28	B	19.3 (18.4-24. 17.4 (15.2-20.	1.348	NIPR
29	B	19.1 (18.5-20. 16.6 (15.1-18.	1.118	NIPR
30	B	18.4 (17.3-23. 16.8 (14.9-19.	1.868	NIPR
31	B	25.8 (23.9-29. 21.9 (20.6-25.	2.827	NIPR
32	B	25.3 (24.0-29. 21.3 (20.2-22.	2.395	NIPR
33	B	24.7 (22.0-26. 21.7 (20.5-24.	16.655	NIPR
34	B	25.4 (24.4-29. 21.3 (19.2-23.	1.188	NIPR
35	B	25.6 (24.9-26. 21.4 (20.7-22.	1.210	NIPR
36	B	25.3 (24.4-25. 21.4 (20.2-23.	1.016	NIPR
37	B	25.6 (25.0-26. 21.5 (20.4-23.	1.465	NIPR
38	B	19.5 (18.3-24. 17.0 (15.9-17.	1.063	NIPR
39	B	22.8 (21.1-24. 19.7 (18.4-21.	2.349	NIPR
40	B	25.3 (23.9-28. 22.0 (20.8-24.	5.512	NIPR
41	B	25.4 (23.3-30. 21.6 (19.5-24.	2.102	NIPR
42	C	19.6 (18.3-25. 16.9 (15.4-17.	1.809	NIPR
43	B	18.1 (16.7-23. 16.4 (15.5-18.	2.091	NIPR
44	B	19.6 (18.1-22. 17.4 (15.8-21.	2.404	NIPR
45	B	18.2 (16.6-22. 16.7 (15.3-19.	2.122	NIPR
46	B	24.8 (22.9-27. 20.6 (18.4-22.	1.717	NIPR
47	B	25.1 (23.7-28. 20.9 (19.7-22.	1.663	NIPR
48	B	25.5 (24.4-26. 21.3 (19.9-22.	1.537	NIPR
49	B	19.2 (17.9-23. 16.9 (16.3-17.	1.362	NIPR
50	B	18.9 (18.1-19. 16.8 (15.5-19.	2.535	NIPR
51	B	19.2 (18.1-21. 16.5 (14.9-20.	1.523	NIPR
52	B	19.2 (18.1-21. 16.9 (15.9-18.	1.227	NIPR
53	B	19.3 (18.1-22. 16.7 (15.0-20.	1.183	NIPR
54	B	18.9 (17.8-19. 16.7 (14.8-19.	1.891	NIPR
55	B	25.5 (24.3-28. 21.0 (20.1-21.	1.753	NIPR
56	B	24.7 (22.7-27. 20.7 (20.0-22.	1.697	NIPR
57	C	19.4 (18.4-21. 17.2 (16.1-19.	2.517	NIPR

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2				
3	B	25.5 (24.4-27.2) 21.6 (19.0-23.	1.365	NIPR
4	B	24.4 (22.3-27.1) 17.3 (4.3-42.7	1.8	NIPR
5	B	25.5 (24.0-28.2) 21.6 (20.1-23.	1.019	NIPR
6	B	25.2 (22.9-29.2) 21.5 (20.5-24.	1.472	NIPR
7	B	25.2 (24.1-27.2) 21.1 (19.6-22.	1.600	NIPR
8	B	25.9 (24.5-30.2) 22.1 (20.3-27.	1.529	NIPR
9	B	18.5 (17.0-21.1) 16.2 (14.8-17.	1.432	NIPR
10	B	19.8 (18.2-22.1) 17.4 (16.2-19.	1.043	NIPR
11	B	19.8 (17.9-22.1) 17.5 (16.2-18.	1.973	NIPR
12	B	25.4 (23.9-28.2) 21.2 (20.0-23.	17.465	NIPR
13	B	25.3 (24.1-28.2) 21.7 (20.2-25.	2.248	NIPR
14	C	18.6 (17.7-19.1) 16.5 (15.3-17.	2.919	NIPR
15	B	24.7 (23.8-26.2) 21.2 (19.6-24.	1.030	NIPR
16	A	25.3 (24.2-27.2) 21.9 (20.9-24.	1.659	NIPR
17	A	25.6 (24.4-26.2) 22.0 (20.4-25.	2.300	NIPR
18	B	25.5 (24.4-27.2) 21.5 (20.2-24.	2.548	NIPR
19	B	19.2 (18.2-21.1) 16.9 (15.9-18.	2.370	NIPR
20	B	5.5 (1.0-51.1) 2.7 (1.2-7.2)	2.423	NIPR
21	B	19.1 (17.2-20.1) 17.1 (16.2-19.	1.336	NIPR
22	B	20.0 (19.0-22.1) 17.4 (15.2-21.	2.113	NIPR
23	B	25.7 (23.6-29.2) 22.2 (20.7-27.	1.985	NIPR
24	B	20.3 (19.1-22.1) 18.3 (16.8-22.	1.101	NIPR
25	C	20.4 (19.0-22.1) 18.4 (17.3-22.	2.037	NIPR
26	C	18.9 (17.8-21.1) 16.6 (15.4-17.	2.819	NIPR
27	B	25.0 (23.6-27.2) 21.1 (19.5-23.	3.100	NIPR
28	B	18.1 (16.5-21.1) 17.0 (15.4-19.	2.627	NIPR
29	B	18.1 (16.7-21.1) 16.2 (15.2-19.	2.533	NIPR
30	B	18.1 (16.3-19.1) 16.6 (15.1-18.	2.281	NIPR
31	B	23.5 (22.2-26.2) 20.0 (19.1-22.	2.063	NIPR
32	B	19.5 (17.7-22.1) 17.4 (15.6-19.	1.787	NIPR
33	B	19.8 (19.0-20.1) 17.5 (16.3-20.	2.361	NIPR
34	C	19.3 (18.4-20.1) 17.2 (15.7-21.	1.212	NIPR
35	A	28.9 (28.2-30.2) 23.8 (23.0-25.	6.419	NIPR
36	B	18.0 (13.5-21.1) 15.7 (7.8-20.5	1.184	NIPR
37	A	24.8 (23.9-25.2) 21.5 (20.3-25.	1.257	NIPR
38	B	25.5 (24.3-28.2) 21.4 (20.3-23.	2.803	NIPR
39	A	19.5 (18.9-20.1) 17.2 (16.5-17.	1.175	NIPR
40	B	25.0 (22.1-26.2) 21.7 (19.3-24.	2.070	NIPR
41	B/C	19.6 (18.5-24.1) 17.4 (16.4-19.	2.697	NIPR
42	A/B	19.4 (18.1-22.1) 16.9 (15.8-19.	2.104	NIPR
43	B	31.5 (30.6-33.2) 25.4 (24.0-27.	1.206	NIPR
44	A	25.6 (24.5-27.2) 21.5 (20.3-23.	2.625	NIPR
45	B	25.4 (24.5-26.2) 21.6 (20.8-23.	1.137	NIPR
46	B	20.8 (18.1-24.1) 17.9 (16.7-19.	1.071	NIPR
47	B	25.3 (22.8-28.2) 21.4 (20.7-23.	2.568	NIPR
48	B	29.2 (28.2-32.2) 24.0 (21.0-25.	2.093	NIPR
49	B	19.4 (18.4-20.1) 17.0 (15.7-18.	1.336	NIPR
50	B	18.8 (17.9-21.1) 16.6 (15.5-17.	2.116	NIPR
51	B	25.6 (24.5-26.2) 21.5 (20.5-23.	1.014	NIPR
52	B	20.6 (19.2-24.1) 17.5 (15.4-18.	1.494	NIPR
53	B	19.5 (18.1-23.1) 17.2 (13.7-21.	1.651	NIPR
54	B	25.8 (24.5-29.2) 21.9 (19.9-23.	1.714	NIPR
55	B	25.1 (22.5-26.2) 21.5 (20.0-23.	1.956	NIPR
56	B	19.5 (18.2-23.1) 17.1 (15.4-20.	1.190	NIPR
57	B	6.9 (0.2-59.2) 4.6 (1.1-15.2)	3.994	NIPR



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2				
3	B	19.6 (18.3-25. 16.5 (15.7-17.	1.071	NIPR
4	B	19.0 (17.1-23. 17.0 (15.4-22.	6.631	NIPR
5	B	25.2 (24.2-28. 21.9 (20.5-26.	1.458	NIPR
6	B	25.5 (24.5-29. 21.9 (20.8-23.	2.792	NIPR
7	B	25.8 (24.1-28. 21.5 (19.4-23.	2.285	NIPR
8	B	19.6 (18.6-23. 17.1 (16.2-20.	1.075	NIPR
9	B	19.4 (18.4-21. 16.7 (14.5-19.	2.088	NIPR
10	B	19.2 (11.9-26. 15.7 (8.0-23.2	4.579	NIPR
11	B	19.4 (18.5-21. 16.8 (15.2-19.	2.476	NIPR
12	B	19.7 (18.1-22. 17.5 (16.7-20.	1.088	NIPR
13	B	19.4 (18.1-24. 17.0 (15.2-19.	1.030	NIPR
14	B	19.3 (18.7-20. 16.8 (15.6-18.	1.039	NIPR
15	B	19.1 (17.2-20. 17.0 (16.4-18.	1.665	NIPR
16	B	19.3 (17.9-21. 17.3 (15.8-20.	1.711	NIPR
17	B	19.5 (18.7-21. 16.9 (15.8-19.	1.504	NIPR
18	B	25.1 (23.3-28. 21.7 (19.7-25.	2.678	NIPR
19	B	19.6 (17.8-23. 17.6 (16.3-21.	1.112	NIPR
20	B	19.5 (17.3-23. 16.6 (15.7-17.	1.103	NIPR
21	B	19.2 (17.8-21. 16.7 (14.7-17.	1.082	NIPR
22	B	19.5 (17.8-24. 17.1 (15.4-20.	2.093	NIPR
23	B	19.3 (18.3-23. 16.8 (16.1-18.	3.478	NIPR
24	B	19.5 (17.4-22. 16.9 (16.2-19.	2.853	NIPR
25	B	19.1 (18.3-20. 16.6 (15.4-17.	2.475	NIPR
26	B	19.1 (18.4-20. 16.9 (16.1-17.	1.959	NIPR
27	B	19.5 (18.3-23. 16.6 (15.7-17.	1.022	NIPR
28	B	19.2 (18.4-21. 16.9 (15.8-18.	2.603	NIPR
29	B	19.1 (18.0-21. 16.6 (15.6-17.	1.937	NIPR
30	B	19.2 (18.4-20. 17.0 (16.3-19.	2.764	NIPR
31	B	19.2 (18.1-21. 17.2 (16.4-20.	2.295	NIPR
32	B	19.1 (17.7-20. 17.0 (16.2-21.	2.161	NIPR
33	B	19.2 (17.8-20. 17.1 (16.5-20.	2.100	NIPR
34	B	19.2 (18.3-20. 17.0 (15.9-18.	2.211	NIPR
35	B	19.2 (18.4-20. 17.0 (16.1-19.	1.160	NIPR
36	B	19.4 (18.2-21. 17.0 (16.5-18.	1.925	NIPR
37	C	19.4 (18.3-20. 16.9 (15.3-18.	1.345	NIPR
38	B	19.4 (17.9-21. 16.7 (15.0-18.	1.080	NIPR
39	B	19.2 (17.2-23. 16.8 (15.9-18.	1.102	NIPR
40	B	19.0 (18.5-20. 17.1 (16.1-19.	1.123	NIPR
41	B	18.7 (17.6-20. 16.9 (16.0-18.	4.630	NIPR
42	B	25.0 (23.7-28. 21.5 (20.7-23.	2.651	NIPR
43	B	19.2 (17.8-20. 17.2 (16.4-19.	1.01	NIPR
44	B	18.5 (17.7-20. 16.4 (15.4-18.	2.22	NIPR
45	B	19.0 (17.5-21. 16.9 (16.0-19.	1.83	NIPR
46	B	19.1 (17.8-21. 17.0 (16.2-18.	2.1	NIPR
47	B	19.1 (18.1-21. 17.3 (16.1-19.	5.81	NIPR
48	B	19.0 (18.0-20. 17.2 (15.8-19.	6.78	NIPR
49	B	19.3 (18.3-20. 17.3 (15.5-19.	2.15	NIPR
50	A	30.5 (29.3-31. 24.7 (23.3-25.	1.03	NIPR
51	B	18.6 (17.6-20. 16.6 (15.1-18.	2.12	NIPR
52	A	19.7 (18.3-20. 17.3 (16.4-18.	1.13	NIPR
53	B	19.8 (19.0-22. 17.5 (16.2-19.	2.05	NIPR
54	B	19.1 (18.4-20. 17.0 (15.7-18.	4.614	NIPR
55	B	19.4 (16.7-21. 17.0 (15.2-20.	2.824	NIPR
56	B	19.8 (17.7-22. 17.4 (16.3-20.	1.38	NIPR
57	A	19.2 (17.9-20. 17.1 (16.0-18.	1.12	NIPR

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2				
3	B	25.5 (24.4-26.2) 21.6 (20.0-23.0)	1.559	NIPR
4	B	19.7 (17.2-22.1) 17.3 (16.6-18.0)	1.742	NIPR
5	B	25.3 (14.6-29.1) 14.8 (3.8-32.4)	1.371	NIPR
6	B	19.7 (18.5-21.1) 17.5 (15.9-20.0)	1.552	NIPR
7	B	25.8 (24.2-29.1) 21.6 (19.2-23.0)	2.107	NIPR
8	B	19.1 (16.7-22.1) 16.9 (9.4-33.0)	2.619	NIPR
9	B	24.7 (22.8-27.1) 21.3 (20.3-23.0)	2.043	NIPR
10	B	19.4 (18.4-21.1) 17.3 (15.5-20.0)	1.491	NIPR
11	B	19.6 (18.8-20.1) 17.3 (16.1-19.0)	2.339	NIPR
12	B	19.5 (18.2-22.1) 17.5 (16.3-20.0)	1.186	NIPR
13	B	19.5 (18.0-21.1) 17.4 (16.3-19.0)	1.029	NIPR
14	B	19.6 (18.8-21.1) 17.4 (15.6-19.0)	2.360	NIPR
15	B	19.8 (17.4-23.1) 17.7 (16.1-19.0)	2.824	NIPR
16	B	19.8 (18.7-21.1) 17.6 (16.6-20.0)	1.460	NIPR
17	B	19.8 (18.7-21.1) 17.6 (16.6-20.0)	1.460	NIPR
18	C	16.9 (15.8-18.1) 14.8 (11.1-21.1)	1.85	NIPR
19	B	19.8 (18.2-22.1) 17.3 (15.4-19.0)	2.93	NIPR
20	B	19.5 (18.2-21.1) 17.1 (16.2-18.0)	1.500	NIPR
21	B	19.7 (18.4-21.1) 17.5 (16.6-20.0)	2.676	NIPR
22	B	19.7 (18.5-23.1) 17.2 (16.4-18.0)	2.438	NIPR
23	B	19.9 (19.0-22.1) 17.4 (16.2-18.0)	2.354	NIPR
24	B	19.7 (18.4-21.1) 17.6 (15.6-21.0)	1.763	NIPR
25	B	19.8 (19.1-21.1) 17.3 (15.9-20.0)	2.384	NIPR
26	B	19.8 (18.9-21.1) 17.4 (16.2-19.0)	1.641	NIPR
27	B	19.5 (18.7-22.1) 17.0 (16.4-18.0)	1.49	NIPR
28	B	19.7 (18.4-21.1) 17.2 (16.0-18.0)	1.423	NIPR
29	B	19.9 (18.5-22.1) 17.4 (16.2-20.0)	1.58	NIPR
30	B	19.5 (18.6-23.1) 17.2 (15.7-20.0)	1.007	NIPR
31	B	19.6 (18.2-21.1) 17.4 (16.6-19.0)	1.035	NIPR
32	B	19.9 (19.3-20.1) 17.4 (15.9-20.0)	1.09	NIPR
33	B	19.5 (18.4-20.1) 17.2 (16.0-20.0)	1.790	NIPR
34	B	19.5 (18.4-22.1) 17.0 (15.7-18.0)	1.322	NIPR
35	B	18.0 (8.1-21.9) 16.2 (2.8-28.0)	2.366	NIPR
36	B	19.4 (17.9-22.1) 17.3 (16.7-18.0)	1.189	NIPR
37	B	19.9 (18.9-22.1) 17.3 (16.4-19.0)	1.576	NIPR
38	B	19.7 (18.5-22.1) 17.1 (15.8-18.0)	1.243	NIPR
39	B	19.5 (18.7-21.1) 17.3 (16.3-20.0)	2.441	NIPR
40	B	25.9 (24.0-30.1) 21.8 (20.6-25.0)	2.329	NIPR
41	B	19.5 (17.1-22.1) 17.5 (16.1-22.0)	1.307	NIPR
42	B	19.5 (18.5-22.1) 17.6 (16.3-20.0)	2.633	NIPR
43	B	19.9 (18.5-22.1) 17.3 (15.1-19.0)	2.835	NIPR
44	B	19.9 (18.5-22.1) 17.3 (15.1-19.0)	2.835	NIPR
45	A	25.7 (24.4-26.2) 21.7 (20.0-23.0)	1.446	NIPR
46	B	19.5 (18.4-23.1) 17.0 (15.1-18.0)	2.088	NIPR
47	B	19.5 (17.6-22.1) 17.3 (16.1-18.0)	2.276	NIPR
48	B	19.3 (18.4-20.1) 17.1 (15.6-20.0)	2.172	NIPR
49	B	19.4 (18.0-20.1) 17.1 (15.8-21.0)	2.825	NIPR
50	B	19.8 (18.5-21.1) 17.4 (16.0-20.0)	1.393	NIPR
51	B	3.2 (2.8-3.6) 3.8 (3.3-7.0)	2.119	NIPR
52	B	25.6 (24.8-26.2) 22.0 (20.2-24.0)	2.048	NIPR
53	B	20.0 (18.5-23.1) 17.5 (16.4-19.0)	1.325	NIPR
54	C	17.8 (16.8-18.1) 16.0 (15.1-16.0)	2.912	NIPR
55	B	18.9 (17.7-20.1) 16.9 (15.4-18.0)	2.770	NIPR
56	B	19.3 (16.2-23.1) 16.9 (14.0-19.0)	2.880	NIPR
57	B	20.3 (19.4-21.1) 17.7 (16.5-18.0)	1.606	NIPR
58	B	20.5 (19.7-23.1) 17.8 (17.0-18.0)	1.530	NIPR
59	B	25.5 (23.5-30.1) 21.7 (19.8-22.0)	2.329	NIPR
60	B	25.5 (23.5-30.1) 21.7 (19.8-22.0)	2.329	NIPR

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2				
3	C	18.5 (17.3-19. 16.1 (15.2-17.	2.334	NIPR
4	B	19.5 (18.8-21. 17.0 (16.3-17.	2.554	NIPR
5	B	19.4 (18.7-20. 17.2 (16.3-18.	2.059	NIPR
6	B	19.3 (18.9-20. 17.3 (16.1-18.	2.376	NIPR
7	B	25.2 (24.3-26. 21.1 (19.9-22.	2.235	NIPR
8	B	18.8 (17.8-20. 16.7 (16.2-18.	2.1	NIPR
9	B	19.2 (18.4-20. 15.2 (9.1-20.1	2.289	NIPR
10	B	19.5 (18.3-20. 17.5 (16.4-20.	2.181	NIPR
11	B	19.5 (18.6-21. 17.0 (15.7-18.	2.480	NIPR
12	B	19.6 (18.4-23. 17.1 (15.0-19.	2.908	NIPR
13	B	19.4 (17.3-22. 17.2 (16.0-19.	2.412	NIPR
14	B	19.0 (17.7-21. 16.9 (15.5-18.	2.393	NIPR
15	B	19.6 (18.5-21. 17.1 (16.3-20.	2.154	NIPR
16	B	19.2 (17.8-19. 17.3 (16.1-19.	2.572	NIPR
17	B	19.4 (18.4-21. 17.1 (16.2-18.	2.8	NIPR
18	B	19.2 (18.1-21. 17.2 (16.2-19.	1.803	NIPR
19	B	16.8 (14.7-17. 15.9 (10.5-20.	1.753	NIPR
20	B	19.5 (18.8-20. 17.3 (16.2-18.	2.347	NIPR
21	B	19.3 (17.7-20. 16.9 (15.9-17.	2.221	NIPR
22	B	19.3 (17.6-21. 18.1 (16.1-21.	2.731	NIPR
23	B	25.5 (23.5-27. 22.2 (20.8-24.	1.573	NIPR
24	B	25.8 (24.5-27. 21.5 (20.6-22.	1.120	NIPR
25	B	16.2 (15.2-18. 14.7 (12.8-16.	3.595	NIPR
26	B	18.8 (17.7-20. 17.2 (15.8-20.	2.295	NIPR
27	B	18.6 (17.2-20. 16.6 (16.0-17.	1.990	NIPR
28	B	19.5 (17.9-21. 17.2 (15.8-19.	1.255	NIPR
29	B	17.5 (16.5-18. 15.3 (13.2-16.	1.493	NIPR
30	B	17.5 (16.4-18. 15.2 (14.0-16.	1.786	NIPR
31	B	17.5 (16.2-19. 15.3 (14.0-17.	2.338	NIPR
32	B	17.2 (15.8-18. 15.2 (14.5-16.	1.997	NIPR
33	B	17.6 (16.2-18. 15.5 (13.9-17.	1.724	NIPR
34	B	17.5 (15.9-18. 15.6 (13.5-18.	1.522	NIPR
35	B	19.6 (17.3-21. 17.4 (15.5-19.	1.070	NIPR
36	B	17.5 (16.0-18. 15.3 (14.5-16.	1.243	NIPR
37	B	17.4 (16.2-18. 15.5 (13.6-17.	2.202	NIPR
38	B	17.7 (16.7-18. 15.8 (14.0-16.	2.781	NIPR
39	B	19.2 (18.0-20. 17.2 (15.2-19.	1.090	NIPR
40	B	19.3 (17.9-22. 17.4 (15.9-20.	1.342	NIPR
41	B	25.3 (24.1-26. 21.7 (20.8-23.	2.870	NIPR
42	B	20.5 (19.1-21. 17.8 (16.3-18.	2.820	NIPR
43	B	19.4 (18.4-20. 16.9 (15.3-18.	15.015	NIPR
44	B	19.0 (18.2-20. 17.2 (16.0-20.	2.005	NIPR
45	B	19.1 (17.7-21. 17.1 (15.9-18.	4.656	NIPR
46	B	19.4 (18.6-20. 17.2 (16.6-18.	2.013	NIPR
47	B	19.8 (18.5-23. 17.3 (16.2-19.	1.783	NIPR
48	B	18.7 (18.0-20. 16.3 (13.5-18.	2.263	NIPR
49	B	25.1 (24.1-26. 21.0 (18.8-22.	1.319	NIPR
50	B	19.5 (18.5-21. 17.5 (16.6-21.	1.071	NIPR
51	B	25.6 (24.9-27. 21.2 (20.4-22.	1.361	NIPR
52	A	25.6 (24.7-26. 21.7 (19.1-24.	1.122	NIPR
53	B	26.5 (24.8-31. 22.2 (21.3-23.	6.234	NIPR
54	B	25.8 (25.1-26. 21.9 (19.4-24.	1.242	NIPR
55	B	28.5 (27.2-33. 23.5 (22.5-24.	3.465	NIPR
56	B	18.3 (10.3-19. 16.4 (15.2-19.	1.145	NIPR
57	B	25.9 (23.9-30. 21.5 (20.0-23.	3.219	NIPR

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2						
3	B	28.2 (27.3-30.23.9 (22.1-26.		1.513		NIPR
4	B	19.3 (18.0-21.17.3 (16.5-19.		1.010		NIPR
5	B	28.3 (26.9-30.23.6 (22.6-24.		1.623		NIPR
6	B	20.0 (19.0-22.17.4 (16.6-19.		2.503		NIPR
7	B	28.6 (27.4-30.23.7 (22.3-25.		1.204		NIPR
8	B	28.5 (27.2-30.23.7 (22.2-27.		1.128		NIPR
9	A	25.7 (24.1-27.22.2 (21.1-25.		1.083		NIPR
10	B	25.7 (24.9-28.21.7 (20.3-24.		1.358		NIPR
11	B	25.6 (24.7-27.21.8 (20.2-25.		1.190		NIPR
12	B	25.6 (23.9-30.21.7 (20.4-22.		1.567		NIPR
13	B	25.6 (24.0-28.21.5 (20.4-22.		1.572		NIPR
14	B	20.1 (18.9-21.18.0 (16.9-20.		1.956		NIPR
15	C	19.6 (18.3-20.17.9 (16.9-20.		3.455		NIPR
16	C	17.7 (16.9-18.16.0 (15.3-17.		1.538		NIPR
17	B	28.2 (27.0-30.23.3 (22.0-25.		8.053		NIPR
18	B	28.1 (25.6-29.23.2 (21.7-24.		5.179		NIPR
19	B	28.8 (26.4-31.23.6 (22.7-24.		6.154		NIPR
20	C	19.4 (18.5-20.17.2 (16.1-18.		3205.000		NIPR
21	B	19.5 (18.5-20.16.9 (15.2-18.		3639.000		NIPR
22	A	26.0 (24.8-26.22.0 (21.2-23.		2150.000		NIPR
23	C	19.7 (18.9-20.17.3 (16.6-18.		270.45		NIPR
24	C	19.9 (18.9-21.17.2 (15.4-18.		244.33		NIPR
25	C	19.5 (18.5-20.17.1 (15.7-17.		113.5		NIPR
26	A	11.8 (0.4-40.29.6 (0.9-41.4)		10.631		NIPR
27	B	19.6 (18.5-22.17.2 (14.0-21.		904.74		NIPR
28	A	25.6 (23.8-27.22.2 (20.8-24.		17.604		NIPR
29	B	25.2 (22.6-30.21.1 (20.2-22.		19.666		NIPR
30	A	25.0 (23.5-27.21.5 (20.7-23.		10.493		NIPR
31	B	19.6 (18.4-22.17.1 (16.1-19.		9.830		NIPR
32	B	19.5 (18.1-22.17.3 (16.6-19.		250.23		NIPR
33				842.6		NIPR
34				517.4		NIPR
35				24.16		NIPR
36				106.8		NIPR
37				313.8		NIPR
38				224.3		NIPR
39				4202		NIPR
40				21		CEREGE
41	W4	25.5 (n=1) 21.4±0.8 (n=2 1.7±0.1	4.61	20.8		Kiel
42	W2	19.4±0.3 (n=1 17.2±0.5 (n=1 1.6±0.5	5.01	54		ASU
43	W0	H3 17.2±6.6, IH3 13.8±5.3, IH3 1.3±1.1, H-		22.8		IfP
44		60.2±2.0; 27.23.0±1.8; 41.6±				
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<b>tbl_main</b>	<b>tbl_classifier</b>	<b>tbl_finder</b>	<b>tblcomment</b>
Decker Meteo	K. Klemm, A. I	anonymous	Working No.: De-06 submitted by K. Klemm, lFP; submitted by
Algiers Lab	Imene Kerraou		Submitted by Imene Kerraouch
Algiers Lab	Imene Kerraou		Submitted by Imene Kerraouch
Algiers Lab	Imene Kerraou		Submitted by Imene Kerraouch
Algiers Lab	Imene Kerraou		Submitted by Imene Kerraouch
Algiers Lab	Imene Kerraou		Submitted by Imene Kerraouch
Algiers Lab	Imene Kerraou		Submitted by Imene Kerraouch
Algiers Lab	Imene Kerraou		Submitted by Imene Kerraouch
Algiers Lab	Imene Kerraou		Submitted by Imene Kerraouch
J. Bassemon	J. Gattacceca,		work name CM56; submitted by Jérôme Gattacceca
Vincent Jacqu	C. Agee, UNM	Moroccan hun	Submitted by H. Chennaoui Aoudjehane
UAb	C. Herd, UAb		Field numbers A1 and A2; submitted by C. Herd
NIPR	A. Yamaguchi		Submitted by A. Yamaguchi
NIPR	A. Yamaguchi		Submitted by A. Yamaguchi
AuckMus	J. Scott, Otago	Phil and Bren	AWMM: Auckland War Memorial Museum, Geology Collectio
University of	A. Irving, UWS		Work name JAP19-1; submitted by A. Irving
Jean Redelspi	J. Gattacceca,	Esmail Elguira	work name JR079. Highly recrystallized. Single crusted stone
Aerolite Metec	D. Hill,UAZ,	N.Jose Rosa Ag	Submitted by D. Hill
Mahamed Nur	C. Herd and L		Submitted by C. Herd
WAM	A. W. R. Beva	M. Jefferson	Submitted by L. V. Forman (Curtin University, WAM)
Ziyao Wang	R. Bartoschew	Jianming Wan	working name WZ92; submitted by R. Bartoschewitz
Weichao Li an	R. Bartoschew	Xueming Tanç	working name WZ172; submitted by R. Bartoschewitz
Verish	D. Sheikh, FS	Robert Verish	Fieldname = N150808; lab ID# = V-BB01; submitted by Danie
Verish	D. Sheikh, FS	Robert Verish	Fieldname = N150809; lab ID# = V-BB02; submitted by Danie
Verish	D. Sheikh, FS	Robert Verish	Fieldname = N180927; lab ID# = V-Sod1; submitted by Danie
Finder	K. Klemm, A. I		Submitted by Klemm K.
Mohamadrez	J. Gattacceca,	Hojat Kamali	work name AP16; submitted by J. Gattacceca
Ion Ander Lan	J. Llorca, UPC	Ion Ander Lan	Field Name: Met-2016b-001; submitted by David Allepuz
Alexia Sampe	J. Llorca, UPC	Alexia Sampe	Field Name: ALE001; submitted by David Allepuz
Mr. I. Kryachk	Lorenz C. A., 'Mr. I. Kryachk		field name is Calama 5-24I; analyst T. Kryachko (Technograc
Mr. I. Kryachk	Lorenz C. A., 'Mr. I. Kryachk		field name is Calama 5-26I; analyst T. Kryachko (Technograc
Mr. M. Nepom	Lorenz C. A., 'Mr. I. Kryachk		field name is Calama 6-12I; analyst T. Kryachko (Technograc
Mr. I. Kryachk	Lorenz C. A., 'Mr. I. Kryachk		field name is Calama 5-13I; analyst T. Kryachko (Technograc
Mr. I. Kryachk	Lorenz C. A., 'Mr. I. Kryachk		field name is Calama 4-24I; analyst T. Kryachko (Technograc
Mr. T. Kryachk	Lorenz C. A., 'Mr. T. Kryachk		field name is Calama 6-18; analyst T. Kryachko (Technograd
Kuntz	J. Gattacceca,	Jimmy Pizarro	work name K453; submitted by Jérôme Gattacceca
UrFU	K. Dugushkina		Field name Kol-4; submitted by Kseniya Dugushkina, RAS-U
UrFU	K. Dugushkina	UrFU	Field name Lar-2; submitted by Kseniya Dugushkina (IGG UE
UrFU	K. Dugushkina	UrFU meteorit	Field name Past-7; submitted by Kseniya Dugushkina (UB R/
UrFU	K. Dugushkina	UrFU meteorit	Field name Past-10; submitted by Kseniya Dugushkina (UB F
I. Chaplygin, i	Lorenz C. A., 'Chaplygin Ilya		field name is 031, analyst T. Kryachko (Technograd, Moscov
Mr. I. Chaplyg	Lorenz C. A., 'Chaplygin Ilya		Analysts: N. N. Kononkova, Vernad; T. Kryachko (Technogra
Mr. I. Chaplyg	Lorenz C. A., 'Chaplygin Ilya		Field name is 069; Analyst T. Kryachko (Technograd, Mosco
Mr. I. Chaplyg	Lorenz C. A., 'Chaplygin Ilya		Field name is 071; Analyst T. Kryachko (Technograd, Mosco
UrFU	K. Dugushkina	UrFU meteorit	Field name Krug5; submitted by Kseniya Dugushkina (UB RA
Mr. T. Kryachk	Lorenz C. A., 'Mr. T. Kryachk		Field name is 6-85; analyst T. Kryachko (Technograd, Mosco
Mr. Evgeny T	J. Gattacceca,	Mr. Evgeny T	work name KY55; submitted by Jérôme Gattacceca
Mr. T. Kryachk	Lorenz C. A., 'Mr. T. Kryachk		Field name is 6-20; analyst T. Kryachko (Technograd, Mosco
Mr. I. Kryachk	Lorenz C. A., 'Mr. I. Kryachk		Field name is 6-83; analyst T. Kryachko (Technograd, Mosco
Mr. Evgeny T	J. Gattacceca,	Mr. Evgeny T	work name KY46; submitted by Jérôme Gattacceca
Alfonso Viera	J. Llorca, UPC	Alfonso Viera	Submitted by Jordi Llorca (UPC)
Alfonso Viera	J. Llorca, UPC	Alfonso Viera	Submitted by Jordi Llorca (UPC)
Alfonso Viera	J. Llorca, UPC	Alfonso Viera	Submitted by Jordi Llorca (UPC)
Alfonso Viera	Jordi Llorca, L	Alfonso Viera	Submitted by Jordi Llorca (UPC)



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3 Alfonso Viera J. Llorca, UPCAlfonso Viera Submitted by Jordi Llorca (UPC)  
4 Alfonso Viera J. Llorca, UPCAlfonso Viera Submitted by Jordi Llorca (UPC)  
5 Alfonso Viera J. Llorca, UPCAlfonso Viera Submitted by Jordi Llorca (UPC)  
6 Alfonso Viera J. Llorca, UPCAlfonso Viera Submitted by Jordi Llorca (UPC)  
7 I. Chaplygin, iLorenz C. A., 'Chaplygin Ilya field name is 072, analyst T. Kryachko (Technograd, Moscow)  
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10 Mr. Atali AgakLorenz C. A., 'Mr. Atali Agak Field name is A004; analyst A. Agakhanov (Fersman Minera  
11 Mr. Atali AgakLorenz C. A., 'Mr. Atali Agak Field name is A001; analyst A. Agakhanov (Fersman Minera  
12 Mr. Atali AgakLorenz C. A., 'Mr. Atali Agak Field name is A005; analyst A. Agakhanov (Fersman Minera  
13 Mr. Atali AgakLorenz C. A., 'Mr. Atali Agak Field name is A006; analyst A. Agakhanov (Fersman Minera  
14 Mr. Atali AgakLorenz C. A., 'Mr. Atali Agak Field name is A007; analyst A. Agakhanov (Fersman Minera  
15 Mr. T. KryachkLorenz C. A., 'Mr. T. Kryachk Field name is 3-62; analyst T. Kryachko (Technograd, Mosco  
16 Mr. I. KryachkLorenz C. A., 'Mr. I. Kryachk Field name is I4-16; analyst T. Kryachko (Technograd, Mosco  
17 Mr. I. KryachkLorenz C. A., 'Mr. I. Kryachk Field name is I5-22; analyst T. Kryachko (Technograd, Mosco  
18 Mr. Atali AgakLorenz C. A., 'Mr. Atali Agak Field name is A010; analyst A. Agakhanov (Fersman Minera  
19 Mr. Atali AgakIvanova M. A., 'Mr. Atali Agak Field name is A008; analyst A. Agakhanov (Fersman Minera  
20 Mr. Atali AgakIvanova M. A., 'Mr. Atali Agak Field name is A033; analyst A. Agakhanov (Fersman Minera  
21 Mr. M. NepomLorenz C. A., 'Mr. M. Nepom Field name is M4-21; analyst T. Kryachko (Technograd, Mos  
22 Mr. M. NepomLorenz C. A., 'Mr. M. Nepom Field name is M2-61; analyst T. Kryachko (Technograd, Mos  
23 Mr. M. NepomLorenz C. A., 'Mr. M. Nepom Field name is M3-2; analyst T. Kryachko (Technograd, Mosco  
24 I. Chaplygin, iLorenz C. A., 'Chaplygin Ilya field name is 070, analyst T. Kryachko (Technograd, Moscow  
25 I. Chaplygin, iLorenz C. A., 'Chaplygin Ilya field name is 074, analyst T. Kryachko (Technograd, Moscow  
26 I. Chaplygin, iLorenz C. A., 'Chaplygin Ilya field name is 080, analyst T. Kryachko (Technograd, Moscow  
27 I. Chaplygin, iLorenz C. A., 'Chaplygin Ilya field name is 081, analyst T. Kryachko (Technograd, Moscow  
28 I. Chaplygin, iRyazantsev KChaplygin Ilya field name is 066, analyst T. Kryachko (Technograd, Moscow  
29 I. Chaplygin, iRyazantsev KChaplygin Ilya field name is 067, analyst T. Kryachko (Technograd, Moscow  
30 I. Chaplygin, iRyazantsev KChaplygin Ilya field name is 075, analyst T. Kryachko (Technograd, Moscow  
31 I. Chaplygin, iRyazantsev KChaplygin Ilya field name is 082, analyst T. Kryachko (Technograd, Moscow  
32 I. Chaplygin, iRyazantsev KChaplygin Ilya field name is 087, analyst T. Kryachko (Technograd, Moscow  
33 I. Chaplygin, iLorenz C. A., 'Ilya Chaplygin field name is 060, analyst T. Kryachko (Technograd, Moscow  
34 I. Chaplygin, iLorenz C. A., 'Ilya Chaplygin field name is 061, analyst T. Kryachko (Technograd, Moscow  
35 I. Chaplygin, iLorenz C. A., 'Ilya Chaplygin field name is 062, analyst T. Kryachko (Technograd, Moscow  
36 I. Chaplygin, iLorenz C. A., 'Ilya Chaplygin field name is 063, analyst T. Kryachko (Technograd, Moscow  
37 I. Chaplygin, iLorenz C. A., 'Ilya Chaplygin field name is 068, analyst T. Kryachko (Technograd, Moscow  
38 I. Chaplygin, iLorenz C. A., 'Ilya Chaplygin field name is 073, analyst T. Kryachko (Technograd, Moscow  
39 I. Chaplygin, iLorenz C. A., 'Ilya Chaplygin field name is 086, analyst T. Kryachko (Technograd, Moscow  
40 Mr. T. KryachkLorenz C. A., 'Mr. T. Kryachk field name is Calate 1-6; analyst T. Kryachko (Technograd, M  
41 Mr. T. KryachkLorenz C. A., 'Mr. T. Kryachk field name is Calate 1-9; analyst T. Kryachko (Technograd, M  
42 Mr. T. KryachkLorenz C. A., 'Mr. T. Kryachk field name is Calate 1-15; analyst T. Kryachko (Technograd,  
43 Mr. T. KryachkLorenz C. A., 'Mr. T. Kryachk field name is Calate 1-17; analyst T. Kryachko (Technograd,  
44 Mr. T. KryachkLorenz C. A., 'Mr. T. Kryachk field name is Calate 1-18; analyst T. Kryachko (Technograd,  
45 Mr. T. KryachkLorenz C. A., 'Mr. T. Kryachk field name is Calate 1-4; analyst T. Kryachko (Technograd, M  
46 Mr. T. KryachkLorenz C. A., 'Mr. T. Kryachk field name is Calate 1-7; analyst T. Kryachko (Technograd, M  
47 Mr. T. KryachkLorenz C. A., 'Mr. T. Kryachk field name is Calate 1-8; analyst T. Kryachko (Technograd, M  
48 Mr. T. KryachkLorenz C. A., 'Mr. T. Kryachk field name is Calate 1-14; analyst T. Kryachko (Technograd,  
49 Mr. T. KryachkLorenz C. A., 'Mr. T. Kryachk Field name is 1-29; analyst T. Kryachko (Technograd, Mosco  
50 Mr. T. KryachkLorenz C. A., 'Mr. T. Kryachk Field name is ATA-23; analyst T. Kryachko (Technograd, Mo  
51 Mr. T. KryachkLorenz C. A., 'Mr. T. Kryachk Field name is ATA-28; analyst T. Kryachko (Technograd, Mo  
52 Mr. T. KryachkLorenz C. A., 'Mr. T. Kryachk Field name is ATA-37; analyst T. Kryachko (Technograd, Mo  
53 Mr. T. KryachkLorenz C. A., 'Mr. T. Kryachk Field name is ATA-43; analyst T. Kryachko (Technograd, Mo  
54 ArtMet collectiJ. Gattacceca, anonymous work name LM86/F33; Shock darkened chondrite with abund  
55 ArtMet collectiJ. Gattacceca, work name LM83/F22; submitted by Jérôme Gattacceca  
56 ArtMet collectiJ. Gattacceca, work name LM87/F34; submitted by Jérôme Gattacceca  
57 MMC J. Gattacceca, Rodrigo Martir work name RM648; submitted by Jérôme Gattacceca  
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ArtMet collecti J. Gattacceca, anonymous work name LM91/F43; submitted by Jérôme Gattacceca

MMC J. Gattacceca, Rodrigo Martir work name RM714; submitted by Jérôme Gattacceca

WAM A. W. R. Beva K. Hicks Submitted by L. V. Forman (Curtin University, WAM)

Jake Jacobs A. Love, App Frank Jacobs Submitted by Anthony Love

MNHNP E. Jacquet, B. Pierre Beck Field name: DM209; chromite/plagioclase intergrowths. Mosa

MNHNP E. Jacquet, B. Matthieu Gour Field name: DM210; submitted by B. Doisneau

MNHNP E. Jacquet, B. Pierre Beck Field name: JG59; submitted by B. Doisneau

MNHNP E. Jacquet, B. Millarca Valen Field name: MV112FLAT; Shock veins; submitted by B. Dois

MNHNP E. Jacquet, B. Mathieu Rosk Field name: DM207; Shock veins; submitted by B. Doisneau

CEREGE J. Gattacceca, Audrey Bouvie work name MA191; submitted by Jérôme Gattacceca

MMC J. Gattacceca, Rodrigo Martir work name RM564; submitted by Jérôme Gattacceca

Michael Warn J. Gattacceca, Michael Warn work name MW32; submitted by Jérôme Gattacceca

MMC J. Gattacceca, Rodrigo Martir work name RM645; submitted by Jérôme Gattacceca

Eric Christens J. Gattacceca, Eric Christens work name EJ711; submitted by Jérôme Gattacceca

Eric Christens J. Gattacceca, Eric Christens work name EJ713; submitted by Jérôme Gattacceca

Michael Warn J. Gattacceca, Michael Warn Oriented shield with flow lines. Work name MW21; submitted

MCL J. Gattacceca, Rodrigo Martir work name RM660; submitted by Jérôme Gattacceca

MCL J. Gattacceca, Rodrigo Martir work name RM688; submitted by Jérôme Gattacceca

MCL J. Gattacceca, Rodrigo Martir work name RM689; submitted by Jérôme Gattacceca

MCL J. Gattacceca, Rodrigo Martir work name RM693; submitted by Jérôme Gattacceca

MSN-FI V. Moggi Cec Davide Gaddi Submitted by Vanni Moggi Cecchi

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Mr. T. Kryachk Lorenz C. A., 'Mr. T. Kryachk The meteorite is monomict breccia; field name is Calama 4-3

Mr. T. Kryachk Lorenz C. A., 'Mr. T. Kryachk field name is Calama 5-79; analyst T. Kryachko (Technograd

Vernad M. A. Ivanova, Mr. T. V. Krya Submitted by Marina Ivanova

Mr. M. Nepom Lorenz C. A., 'Mr. M. Nepom field name is Calama 6-37M; analyst T. Kryachko (Technogra

Mr. M. Nepom Lorenz C. A., 'Mr. M. Nepom field name is Calama 6-55M; analyst T. Kryachko (Technogra

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Mr. T. Kryachk Lorenz C. A., 'Mr. T. Kryachk field name is Calama 6-37; analyst T. Kryachko (Technograd

Mr. Evgeny Ts J. Gattacceca, work name KY05; submitted by Jérôme Gattacceca

I. Chaplygin, i Lorenz C. A., 'Chaplygin Ilya field name is 001, analyst T. Kryachko (Technograd, Moscov

I. Chaplygin, i Lorenz C. A., 'Chaplygin Ilya field name is 005, analyst T. Kryachko (Technograd, Moscov

I. Chaplygin, i Lorenz C. A., 'Chaplygin Ilya field name is 010, analyst T. Kryachko (Technograd, Moscov

I. Chaplygin, i Lorenz C. A., 'Chaplygin Ilya field name is 019, analyst T. Kryachko (Technograd, Moscov

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I. Chaplygin, i Lorenz C. A., 'Chaplygin Ilya field name is 047, analyst T. Kryachko (Technograd, Moscov

Mr. I. Chaplyg Lorenz C. A., 'Chaplygin Ilya Field name is 088; Analyst T. Kryachko (Technograd, Mosco

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Mr. T. Kryachk Lorenz C. A., 'Mr. T. Kryachk Field name is 6-81; analyst T. Kryachko (Technograd, Mosco

Mr. T. Kryachk Lorenz C. A., 'Mr. T. Kryachk Field name is 6-78; analyst T. Kryachko (Technograd, Mosco

Mr. Evgeny Ts J. Gattacceca, Evgeny Tsys, work name KY03; submitted by J. Gattacceca

Mr. Evgeny Ts J. Gattacceca, Evgeny Tsys, work name KY35; submitted by J. Gattacceca

I. Chaplygin, i Lorenz C. A., 'Chaplygin Ilya field name is 006, analyst T. Kryachko (Technograd, Moscov

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Mr. Evgeny Ts J. Gattacceca, Mr. Evgeny Ts work name KY25; submitted by Jérôme Gattacceca

Ilya Chaplygin Pavel Yu. Ple Ilya Chaplygin field name 008i; submitted by Pavel Yu. Plechov, pplechov@

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Mr. T. Kryachk Lorenz C. A., 'Mr. T. Kryachk Field name is 3-41; analyst T. Kryachko (Technograd, Mosco

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3 Mr. I. Kryachk Lorenz C. A., 'Mr. I. Kryachk Field name is I4-25; analyst T. Kryachko (Technograd, Mosco  
4 Mr. Atali Agak Lorenz C. A., 'Mr. Atali Agak Field name is A013; analyst A. Agakhanov (Fersman Minera  
5 Mr. Atali Agak Lorenz C. A., 'Mr. Atali Agak Field name is A015; analyst A. Agakhanov (Fersman Minera  
6 Mr. Atali Agak Lorenz C. A., 'Mr. Atali Agak Field name is A017; analyst A. Agakhanov (Fersman Minera  
7 Mr. Atali Agak Lorenz C. A., 'Mr. Atali Agak Field name is A023; analyst A. Agakhanov (Fersman Minera  
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9 Mr. T. Kryach Ivanova M. A., Mr. T. Kryach Field name is 6-47; analyst T. Kryachko (Technograd, Mosco  
10 Mr. T. Kryach Ivanova M. A., Mr. T. Kryach Field name is 6-48; analyst T. Kryachko (Technograd, Mosco  
11 Mr. T. Kryach Ivanova M. A., Mr. T. Kryach Field name is 6-49; analyst T. Kryachko (Technograd, Mosco  
12 Mr. M. Nepom Ivanova M. A., Mr. M. Nepom Field name is M3-13; analyst T. Kryachko (Technograd, Mos  
13 Mr. Atali Agak Ivanova M. A., Mr. Atali Agak Field name is A016; analyst A. Agakhanov (Fersman Minera  
14 Mr. Atali Agak Ivanova M. A., Mr. Atali Agak Field name is A018; analyst A. Agakhanov (Fersman Minera  
15 Mr. Atali Agak Ivanova M. A., Mr. Atali Agak Field name is A022; analyst A. Agakhanov (Fersman Minera  
16 Mr. M. Nepom Lorenz C. A., 'Mr. M. Nepom PMD Fa=3.7%; Field name is M3-38; analyst T. Kryachko (T  
17 Mr. M. Nepom Lorenz C. A., 'Mr. M. Nepom PMD Fa=22.6%; Field name is M2-8; analyst T. Kryachko (T  
18 Mr. M. Nepom Lorenz C. A., 'Mr. M. Nepom Field name is M2-3; analyst T. Kryachko (Technograd, Mosco  
19 Mr. M. Nepom Lorenz C. A., 'Mr. M. Nepom Field name is M2-2; analyst T. Kryachko (Technograd, Mosco  
20 Mr. M. Nepom Lorenz C. A., 'Mr. M. Nepom Field name is M2-14; analyst T. Kryachko (Technograd, Mos  
21 Mr. T. Kryach Lorenz C. A., 'Mr. T. Kryach Field name is 6-6; analyst T. Kryachko (Technograd, Mosco  
22 Mr. T. Kryach Lorenz C. A., 'Mr. T. Kryach Field name is 6-7; analyst T. Kryachko (Technograd, Mosco  
23 Mr. M. Nepom Lorenz C. A., 'Mr. M. Nepom Field name is M4-15; analyst T. Kryachko (Technograd, Mos  
24 Mr. M. Nepom Lorenz C. A., 'Mr. M. Nepom PMD Fa is 45%; Field name is M2-46; analyst T. Kryachko (T  
25 Mr. M. Nepom Lorenz C. A., 'Mr. M. Nepom PMD Fa=47%; Field name is M3-62; analyst T. Kryachko (T  
26 Mr. T. Kryach Ivanova M. A., Mr. T. Kryach Field name is 6-29; analyst T. Kryachko (Technograd, Mosco  
27 Mr. T. Kryach Ivanova M. A., Mr. T. Kryach Field name is 6-31; analyst T. Kryachko (Technograd, Mosco  
28 Mr. T. Kryach Ivanova M. A., Mr. T. Kryach Field name is 6-35; analyst T. Kryachko (Technograd, Mosco  
29 Mr. M. Nepom Ivanova M. A., Mr. M. Nepom Field name is M3-42; analyst T. Kryachko (Technograd, Mos  
30 Mr. T. Kryach Ryazantsev K Mr. T. Kryach Field name is 6-30; analyst T. Kryachko (Technograd, Mosco  
31 Mr. T. Kryach Ryazantsev K Mr. T. Kryach Field name is 6-55; analyst T. Kryachko (Technograd, Mosco  
32 Mr. T. Kryach Ryazantsev K Mr. T. Kryach Field name is 6-59; analyst T. Kryachko (Technograd, Mosco  
33 Mr. M. Nepom Ryazantsev K Mr. M. Nepom Field name is M3-30; analyst T. Kryachko (Technograd, Mos  
34 I. Chaplygin, i Ryazantsev K Chaplygin Ilya field name is 053, analyst T. Kryachko (Technograd, Moscov  
35 I. Chaplygin, i Ryazantsev K Chaplygin Ilya field name is 064, analyst T. Kryachko (Technograd, Moscov  
36 Jean Redelsp J. Gattacceca, Elho Sbiti work name JR058/NA006-SP6; submitted by Jérôme Gattacceca  
37 John Higgins A. Love, App Iken Mohamer Submitted by Anthony Love  
38 Fabien Kuntz A. Greshake, I Submitted by Ansgar Greshake  
39 Verish D. Sheikh, FS Robert Verish Field ID = C180513-clustr ; Lab ID = Dead1; submitted by Da  
40 Mr. M. Nepom Lorenz C. A., 'Mr. M. Nepom Field name is M5-23A; analyst T. Kryachko (Technograd, Mo  
41 Mr. M. Nepom Lorenz C. A., 'Mr. M. Nepom Field name is M5-4; analyst T. Kryachko (Technograd, Mosco  
42 Verish D. Sheikh, FS Robert Verish Fieldname = N131008; lab ID# = V-CV01; submitted by Dani  
43 Verish D. Sheikh, FS Robert Verish Fieldname = N131022; lab ID# = V-CV02; submitted by Dani  
44 Amirali Kamal J. Gattacceca, Amirali Kamal work name Kerman 3500; submitted by Jérôme Gattacceca  
45 JSC SI ANSMET Submitted by AMN  
46 JSC SI ANSMET Submitted by AMN  
47 Graham Enso R. Greenwood, Graham Enso Submitted by Richard Greenwood  
48 anonymous A. Greshake, I Submitted by Ansgar Greshake  
49 anonymous A. Greshake, I Dark brownish individual lacking fusion crust; plagioclase gra  
50 anonymous A. Greshake, I Submitted by Ansgar Greshake  
51 anonymous A. Greshake, I Brownish fragment with some fusion crust. The plagioclase g  
52 anonymous A. Greshake, I Submitted by Ansgar Greshake  
53 anonymous A. Greshake, I Many brownish fragments some partly covered by fusion crus  
54 Decker Meteo K. Klemm, A. I Working No.: De-11; submitted by K. Klemm, IfP; submitted t  
55 JSC SI ANSMET Submitted by AMN  
56 JSC SI ANSMET Submitted by AMN  
57 JSC SI ANSMET Submitted by AMN



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3	JSC	SI	ANSMET	Submitted by AMN
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6	R. Bartoshev	R. Bartoshev	Peng Zhenhor	donation of Ziyao Wang. Working name WZD#01; non-hygro-
7	Binghan Liu	Li Shijie and F	Binghan Liu &	Submitted by Li shijie
8	M. Brahim Sur	A. Irving, UW	Work name MN X01;	submitted by A. Irving
9	MNHNP	E. Jacquet, B. Nicolas Amen	Field name: MV036;	submitted by B. Doisneau
10	MNHNP	E. Jacquet, B. Alex Corgne	Field name: MV027;	submitted by B. Doisneau
11	MNHNP	E. Jacquet, B. Matthieu Gour	Field name: DM95;	submitted by B. Doisneau
12	MNHNP	E. Jacquet, B. Lydie Bonal	Field name: DM94; One large clast visible.;	submitted by B. C
13	MNHNP	E. Jacquet, B. Matthieu Gour	Field name: DM54;	submitted by B. Doisneau
14	MNHNP	E. Jacquet, B. Pierre Beck	Field name: JG109;	submitted by B. Doisneau
15	MNHNP	E. Jacquet, B. Matthieu Gour	Field name: DM44;	submitted by B. Doisneau
16	MNHNP	E. Jacquet, B. Nicolas Amen	Field name: MV030;	submitted by B. Doisneau
17	MNHNP	E. Jacquet, B. Romain Tarte	Field name: JG124;	submitted by B. Doisneau
18	MNHNP	E. Jacquet, B. Lydie Bonal	Field name: DM84;	submitted by B. Doisneau
19	MNHNP	E. Jacquet, B. Lydie Bonal	Field name: DM48;	submitted by B. Doisneau
20	MNHNP	E. Jacquet, B. Jérôme Gatta	Field name: JG75;	submitted by B. Doisneau
21	MNHNP	E. Jacquet, B. Matthieu Gour	Field name: DM063;	submitted by B. Doisneau
22	MNHNP	E. Jacquet, B. Katherine Joy	Field name: DM068; Shock veins. Two types of areas: one is	
23	MNHNP	E. Jacquet, B. Matthieu Gour	Field name: DM069;	submitted by B. Doisneau
24	MNHNP	E. Jacquet, B. Matthieu Gour	Field name: DM073;	submitted by B. Doisneau
25	MNHNP	E. Jacquet, B. Katherine Joy	Field name: DM064;	submitted by B. Doisneau
26	MNHNP	E. Jacquet, B. Katherine Joy	Field name: DM077; Chromite/Plagioclase intergrowth visible	
27	MNHNP	E. Jacquet, B. Matthieu Gour	Field name: DM061;	submitted by B. Doisneau
28	MNHNP	E. Jacquet, B. Katherine Joy	Field name: DM078;	submitted by B. Doisneau
29	MMC	J. Gattacceca, Rodrigo Martir	work name RM617;	submitted by Jérôme Gattacceca
30	MNHNP	E. Jacquet, B. J. Gattacceca	Field name JG67;	submitted by E. Jacquet
31	CEREGE	J. Gattacceca, Lydie Bonal	work name MA160;	submitted by Jérôme Gattacceca
32	MMC	J. Gattacceca, Rodrigo Martir	work name RM601;	submitted by Jérôme Gattacceca
33	MMC	J. Gattacceca, Rodrigo Martir	work name RM636. Abundant shock veins. Likely paired with	
34	MMC	J. Gattacceca, Rodrigo Martir	work name RM627;	submitted by J. Gattacceca
35	MMC	J. Gattacceca, Rodrigo Martir	work name RM599;	submitted by J. Gattacceca
36	MMC	J. Gattacceca, Rodrigo Martir	work name RM633. Likely paired with LV 014.;	submitted by .
37	MMC	J. Gattacceca, Rodrigo Martir	work name RM602;	submitted by Jérôme Gattacceca
38	MMC	J. Gattacceca, Rodrigo Martir	work name RM603;	submitted by Jérôme Gattacceca
39	MMC	J. Gattacceca, Rodrigo Martir	Work name RM605a. Shock veins and melt pockets. Plagiocl	
40	MMC	J. Gattacceca, Rodrigo Martir	Work name RM605b. Shock veins and melt pockets. Plagiocl	
41	MMC	J. Gattacceca, Rodrigo Martir	Work name RM609. Shock veins. Likely paired with EI MÃ©d	
42	MMC	J. Gattacceca, Rodrigo Martir	Work name RM621. Shock veins and melt pockets. Plagiocla	
43	MMC	J. Gattacceca, Rodrigo Martir	Work name RM640. Shock veins and melt pockets. Plagiocla	
44	MMC	J. Gattacceca, Rodrigo Martir	work name RM668;	submitted by Jérôme Gattacceca
45	Philippe Schrr	A. Greshake, I	Philippe Schrr	Brownish individual lacking fusion crust. The plagioclase grai
46	Philippe Schrr	A. Greshake, I	Philippe Schrr	Brownish individual lacking fusion crust. The plagioclase grai
47	Philippe Schrr	A. Greshake, I	Philippe Schrr	Brownish individual lacking fusion crust. The plagioclase grai
48	MCL	J. Gattacceca, Rodrigo Martir	work name RM666;	submitted by Jérôme Gattacceca
49	Pierre-Marie F.	J. Gattacceca, Rodrigo Martir	work name RM568;	submitted by Jérôme Gattacceca
50	MMC	J. Gattacceca, Rodrigo Martir	work name RM664;	submitted by Jérôme Gattacceca
51	MMC	J. Gattacceca, Rodrigo Martir	work name RM667;	submitted by Jérôme Gattacceca
52	JSC	SI	ANSMET	Submitted by AMN
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56	JSC	SI	ANSMET	Submitted by AMN
57	Ziyao Wang a R. Bartoschew	anonymous	working name WZ156;	submitted by R. Bartoschewitz
58	Tejiri Garat	Li shijie and F.Jirigalatu, Wa	Submitted by Li shijie	
59	B. Hoefnagels	A. Irving, UW	Work name RC131.1;	submitted by A. Irving
60	Kuntz	J. Gattacceca,	work name K482;	submitted by Jérôme Gattacceca

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3	IfP	M. Patzek and Erik Due-Hansen	Submitted by A. Bischoff	
4	Kuntz	J. Gattacceca	work name K440; submitted by Jérôme Gattacceca	
5	A. Habibi	A. Irving, UWS	Work name AH 777; submitted by A. Irving	
6	UrFU	Kseniya Dugu	UrFU meteorit Field name Past-1; analysts - Kseniya Dugushkina (RAS-UB)	
7	UrFU	K. Dugushkin	UrFU meteorit Field name Past-2; analysts - Kseniya Dugushkina (RAS-UB)	
8	Liu Binghan	R. Bartoshev	Liu Binghan working name Ganq A (#1/#4/#5/#6/#8); submitted by R. Bar	
9	Liu Binghan	R. Bartoshev	Liu Binghan working name Ganq B (#3); most probably paired to "Ganq A	
10	R. Bartoshev	R. Bartoshev	Liu Binghan working name Ganq C (#7); most probably paired to "Ganq A	
11	Liu Binghan	R. Bartoshev	Liu Binghan working name Ganq D (#9); submitted by R. Bartoschewitz	
12	J. Higgins	A. Irving, UWS	J. Kakere/M. Work name JH20-3; submitted by A. Irving	
13	Abdelhadi Ait	C. Agee, UNV	Field name BD-15; submitted by C. Agee, UNM	
14	Ingrid "Twink"	D. Hill and K. Ingrid "Twink"	Field name was "Trash Flat". Not paired with other meteorites	
15	with finder	Mehmet Yesil	Mehmet Güng Submitted by Mehmet Yesiltas	
16	Deshi Wu	Li shijie and F. Deshi Wu	Submitted by Li shijie	
17	Decker Meteo	K. Klemm, A. I	Working No.: De-05; submitted by K. Klemm, IfP; submitted t	
18	Backman and	D. Sheikh, FS	Submitted by Daniel Sheikh	
19	JSC	SI	ANSMET	Submitted by AMN
20	JSC	SI	ANSMET	Submitted by AMN
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22	JSC	SI	ANSMET	Submitted by AMN
23	JSC	SI	ANSMET	Submitted by AMN
24	JSC	SI	ANSMET	Submitted by AMN
25	JSC	SI	ANSMET	Submitted by AMN
26	JSC	SI	ANSMET	Submitted by AMN
27	JSC	SI	ANSMET	Submitted by AMN
28	JSC	SI	ANSMET	Submitted by AMN
29	JSC	SI	ANSMET	Submitted by AMN
30	JSC	SI	ANSMET	Submitted by AMN
31	JSC	SI	ANSMET	Submitted by AMN
32	JSC	SI	ANSMET	Submitted by AMN
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42	JSC	SI	ANSMET	Submitted by AMN
43	JSC	SI	ANSMET	Submitted by AMN
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47	JSC	SI	ANSMET	Submitted by AMN
48	JSC	SI	ANSMET	Submitted by AMN
49	JSC	SI	ANSMET	Submitted by AMN
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51	JSC	SI	ANSMET	Submitted by AMN
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56	JSC	SI	ANSMET	Submitted by AMN
57	JSC	SI	ANSMET	Submitted by AMN
58	JSC	SI	ANSMET	Submitted by AMN
59	JSC	SI	ANSMET	Submitted by AMN
60	JSC	SI	ANSMET	Submitted by AMN

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3	JSC	SI	ANSMET	Submitted by AMN
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7	JSC	SI	ANSMET	Submitted by AMN
8	JSC	SI	ANSMET	Submitted by AMN
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10	JSC	SI	ANSMET	Submitted by AMN
11	JSC	SI	ANSMET	Submitted by AMN
12	JSC	SI	ANSMET	Submitted by AMN
13	JSC	SI	ANSMET	Submitted by AMN
14	JSC	SI	ANSMET	Submitted by AMN
15	JSC	SI	ANSMET	Submitted by AMN
16	JSC	SI	ANSMET	Submitted by AMN
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18	JSC	SI	ANSMET	Submitted by AMN
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57	JSC	SI	ANSMET	Submitted by AMN
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60	JSC	SI	ANSMET	Submitted by AMN



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16	JSC	SI	ANSMET	Submitted by AMN
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18	JSC	SI	ANSMET	Submitted by AMN
19	JSC	SI	ANSMET	Submitted by AMN
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21	JSC	SI	ANSMET	Submitted by AMN
22	JSC	SI	ANSMET	Submitted by AMN
23	JSC	SI	ANSMET	Submitted by AMN
24	JSC	SI	ANSMET	Submitted by AMN
25	JSC	SI	ANSMET	Submitted by AMN
26	JSC	SI	ANSMET	Submitted by AMN
27	JSC	SI	ANSMET	Submitted by AMN
28	PRIC	B. Miao, Z. Xi	CHINARE	Submitted by Bingkui Miao
29	PRIC	B. Miao, Z. Xi	CHINARE	Submitted by Bingkui Miao
30	PRIC	B. Miao, Z. Xi	CHINARE	Submitted by Bingkui Miao
31	PRIC	B. Miao, Z. Xi	CHINARE	Submitted by Bingkui Miao
32	PRIC	B. Miao, Z. Xi	CHINARE	Submitted by Bingkui Miao
33	PRIC	B. Miao, Z. Xi	CHINARE	Submitted by Bingkui Miao
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50	PRIC	B. Miao, Z. Xi	CHINARE	Submitted by Bingkui Miao
51	PRIC	B. Miao, Z. Xi	CHINARE	Submitted by Bingkui Miao
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53	PRIC	B. Miao, Z. Xi	CHINARE	Submitted by Bingkui Miao
54	PRIC	B. Miao, Z. Xi	CHINARE	Submitted by Bingkui Miao
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56	PRIC	B. Miao, Z. Xi	CHINARE	Submitted by Bingkui Miao
57	PRIC	B. Miao, Z. Xi	CHINARE	Submitted by Bingkui Miao
58	PRIC	B. Miao, Z. Xi	CHINARE	Submitted by Bingkui Miao
59	PRIC	B. Miao, Z. Xi	CHINARE	Submitted by Bingkui Miao
60	PRIC	B. Miao, Z. Xi	CHINARE	Submitted by Bingkui Miao

























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3	PRIC	B. Miao, Z. Xi& CHINARE	Submitted by Bingkui Miao
4	PRIC	B. Miao, Z. Xi& CHINARE	Submitted by Bingkui Miao
5	PRIC	B. Miao, Z. Xi& CHINARE	Submitted by Bingkui Miao
6	PRIC	B. Miao, Z. Xi& CHINARE	Submitted by Bingkui Miao
7	PRIC	B. Miao, Z. Xi& CHINARE	Submitted by Bingkui Miao
8	PRIC	B. Miao, Z. Xi& CHINARE	Submitted by Bingkui Miao
9	PRIC	B. Miao, Z. Xi& CHINARE	Submitted by Bingkui Miao
10	PRIC	B. Miao, Z. Xi& CHINARE	Submitted by Bingkui Miao
11	PRIC	B. Miao, Z. Xi& CHINARE	Submitted by Bingkui Miao
12	Mars	B. Cohen, GS Spirit rover	Submitted by B. Cohen, GSFC
13	Mars	B. Cohen, GS Spirit rover	Submitted by B. Cohen, GSFC
14	Peter Goldy	C. Herd, UAb	Submitted by C. Herd
15	Robert Verish	P Warren, UC Robert Verish	Fieldname = USA150806; lab ID# = V-HF-A. Verish's address:
16	Said Yousfi	A. Greshake, I	Submitted by Ansgar Greshake
17	N. Ben Faraji	A. Irving & P. C	Work name NBF MN40; submitted by A. Irving
18	Ziyao Wang	R. Bartoschew Ba Gena	working name WZ151; submitted by R. Bartoschewitz
19	Ziyao Wang	R. Bartoschew Wentao Yang	working name WZ111; submitted by R. Bartoschewitz
20	Gao jie	Peng H., Zhar Gao jie	Submitted by Li Shijie
21	SAM	A. W. R. Beva J. Clohessy	Submitted by L. V. Forman (Curtin University, WAM)
22	WAM	A. W. R. Beva A. J. Carlisle	Submitted by L. V. Forman (Curtin University, WAM)
23	WAM	A. W. R. Beva A. J. Carlisle	Submitted by L. V. Forman (Curtin University, WAM)
24	Jerry Spiker	K. Domanik arHarold L. Spil	Jerry Spiker (holder) contact information: New England Meteor
25	Vernad	Lorenz C. A., 'Mr. A. Razumi	Analyst S.E. Borisovsky (IGEM RAS); submitted by Lorenz C
26	Vernad.	Lorenz C. A., 'Mr. V. Hausto	Analyst S.E. Borisovsky (IGEM RAS); submitted by Lorenz C
27	Mehdi Zarrabi	J. Gattacceca, anonymous	work name MZ-M; submitted by Jérôme Gattacceca
28	Mehdi Zarrabi	J. Gattacceca, anonymous	work name MZ62; submitted by Jérôme Gattacceca
29	Mehdi Zarrabi	J. Gattacceca, anonymous	work name MZA10; submitted by Jérôme Gattacceca
30	Mehdi Zarrabi	J. Gattacceca, anonymous	work name MZAA01; submitted by Jérôme Gattacceca
31	Mehdi Zarrabi	J. Gattacceca, anonymous	work name MZAA05; submitted by Jérôme Gattacceca
32	Mehdi Zarrabi	J. Gattacceca, anonymous	work name MZAA06; submitted by Jérôme Gattacceca
33	Mehdi Zarrabi	J. Gattacceca, anonymous	work name MZAA07; submitted by Jérôme Gattacceca
34	Mehdi Zarrabi	J. Gattacceca, anonymous	work name MZAA09; submitted by Jérôme Gattacceca
35	Mehdi Zarrabi	J. Gattacceca,	work name MZA12; has shock-darkened, more recrystallized
36	John Shea	M. Hutson ancAdel Bouzad	Lab number CML 0977; submitted by Melinda Hutson
37	Jean Redelsp	J. Gattacceca, Zaid Oualguir	work name JR080; submitted by Jérôme Gattacceca
38	anonymous	Ansgar Gresh.	Submitted by Ansgar Greshake
39	anonymous	A. Greshake, I	Submitted by Ansgar Greshake
40	anonymous	A. Greshake, I	Many brownish fragments without fusion crust. The plagiocla:
41	Jens Bäumer	A. Greshake, I	Submitted by Ansgar Greshake
42	OAM	V. Moggi Cecc& Romano Serr	MSN-FI # I3297; Specific gravity 3.322; provisional Kerman 2
43	MSN-FI	V. Moggi Cecc& Majid Nemati	MSN-FI # I3298; Specific gravity 3.323; provisional Kerman 2
44	University of CV	V. Moggi Cecc& Gabriele Giuli	MSN-FI # I3299; Specific gravity 3.333; provisional Kerman 2
45	MSN-FI	V. Moggi Cecc& Majid Nemati	MSN-FI # I3300; Specific gravity 3.354; provisional Kerman 2
46	MSN-FI	V. Moggi Cecc& Lorenzo Cecc	MSN-FI # I3301; Specific gravity 3.342; provisional Kerman 2
47	MSN-FI	V. Moggi Cecc& Hojat Kamali	MSN-FI # I3302; Specific gravity 3.317; provisional Kerman 2
48	MSN-FI	V. Moggi Cecc& Majid Nemati	MSN-FI # I3303; Specific gravity 3.377; provisional Kerman 2
49	MSN-FI	V. Moggi Cecc& Giovanni Prati	MSN-FI # I3304; Specific gravity 3.287; provisional Kerman 2
50	MSN-FI	V. Moggi Cecc& Giovanni Prati	MSN-FI # I3305; Specific gravity 3.224; provisional Kerman 2
51	University of CV	V. Moggi Cecc& Gabriele Giuli	MSN-FI # I3306; Specific gravity 3.334; provisional Kerman 2
52	University of CV	V. Moggi Cecc& Gabriele Giuli	MSN-FI # I3307; Specific gravity 3.379; provisional Kerman 2
53	OAM	V. Moggi Cecc& Romano Serr	MSN-FI # I3308; Specific gravity 3.298; provisional Kerman 2
54	MSN-FI	V. Moggi Cecc& Majid Nemati	MSN-FI # I3309; Specific gravity 3.307; provisional Kerman 2
55	OAM	V. Moggi Cecc& Romano Serr	MSN-FI # I3310; Specific gravity 3.426; provisional Kerman 2
56	Di Martino	V. Moggi Cecc& Mario Di Marti	MSN-FI # I3311; Specific gravity 3.310; provisional Kerman 2
57	Di Martino	V. Moggi Cecc& Mario Di Marti	MSN-FI # I3312; Specific gravity 3.262; provisional Kerman 2

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3 MSN-FI V. Moggi CeccMajid Nemati MSN-FI # I3313; Specific gravity 3.253; provisional Kerman 2  
4 MSN-FI V. Moggi CeccMajid Nemati MSN-FI # I3314; Specific gravity 3.200; provisional Kerman 2  
5 MSN-FI V. Moggi CeccMajid Nemati MSN-FI # I3315; Specific gravity 3.324; provisional Kerman 2  
6 MSN-FI V. Moggi CeccMajid Nemati MSN-FI # I3316; Specific gravity 3.344; provisional Kerman 2  
7 University of CV. Moggi CeccGabriele Giuli MSN-FI # I3317; Specific gravity 3.346; provisional Kerman 2  
8 MSN-FI V. Moggi CeccHojat Kamali MSN-FI # I3318; Specific gravity 3.455; provisional Kerman 2  
9 MSN-FI V. Moggi CeccSaeed Soltani MSN-FI # I3319; Specific gravity 3.232; provisional Kerman 2  
10 MSN-FI V. Moggi CeccGiovanni Prati MSN-FI # I3320; Specific gravity 3.315; provisional Kerman 2  
11 MSN-FI V. Moggi CeccMajid Nemati MSN-FI # I3340; Specific gravity 3.404; provisional Kerman 2  
12 University of CV. Moggi CeccGabriele Giuli MSN-FI # I3321; Specific gravity 3.361; provisional Kerman 2  
13 MSN-FI V. Moggi CeccMajid Nemati MSN-FI # I3322; Specific gravity 3.396; provisional Kerman 2  
14 MSN-FI V. Moggi CeccMajid Nemati MSN-FI # I3341; Specific gravity 3.297; provisional Kerman 2  
15 University of CV. Moggi CeccGabriele Giuli MSN-FI # I3323; Specific gravity 3.315; provisional Kerman 2  
16 University of CV. Moggi CeccGabriele Giuli MSN-FI # I3324; Specific gravity 3.379; provisional Kerman 2  
17 Di Martino V. Moggi CeccMario Di Marti MSN-FI # I3325; Specific gravity 3.648; provisional Kerman 2  
18 MSN-FI V. Moggi CeccGiovanni Prati MSN-FI # I3326; Specific gravity 3.390; provisional Kerman 2  
19 MSN-FI V. Moggi CeccGiovanni Prati MSN-FI # I3327; Specific gravity 3.276; provisional Kerman 2  
20 MSN-FI V. Moggi CeccMajid Nemati MSN-FI # I3328; Specific gravity 3.343; provisional Kerman 2  
21 University of CV. Moggi CeccGabriele Giuli MSN-FI # I3329; Specific gravity 3.362; provisional Kerman 2  
22 MSN-FI V. Moggi CeccGiovanni Prati MSN-FI # I3330; Specific gravity 3.367; provisional Kerman 2  
23 MSN-FI V. Moggi CeccMoien Afzali MSN-FI # I3331; Specific gravity 3.360; provisional Kerman 2  
24 OAM V. Moggi CeccRomano Serrà MSN-FI # I3332; Specific gravity 3.372; provisional Kerman 2  
25 MSN-FI V. Moggi CeccLorenzo Cecc MSN-FI # I3333; Specific gravity 3.358; provisional Kerman 2  
26 MSN-FI V. Moggi CeccLorenzo Cecc MSN-FI # I3334; Specific gravity 3.354; provisional Kerman 2  
27 MSN-FI V. Moggi CeccVanni Moggi MSN-FI # I3335; Specific gravity 3.311; provisional Kerman 2  
28 MSN-FI V. Moggi CeccGiovanni Prati MSN-FI # I3336; Specific gravity 3.386; provisional Kerman 2  
29 University of CV. Moggi CeccGabriele Giuli MSN-FI # I3337; Specific gravity 3.410; provisional Kerman 2  
30 University of CV. Moggi CeccGabriele Giuli MSN-FI # I3338; Specific gravity 3.250; provisional Kerman 2  
31 MSN-FI V. Moggi CeccMoien Afzali MSN-FI # I3339; Specific gravity 3.312; provisional Kerman 2  
32 UrFU, SIGM. Victor V. SharUrFU meteorit Submitted by Victor V. Sharygin, SIGM and UrFU  
33 UrFU, SIGM. Victor V. SharUrFU meteorit Field name Madj-1-2; submitted by Victor V. Sharygin, SIGM  
34 UrFU, SIGM. Victor V. SharUrFU meteorit Field name Nick-3ST-2; submitted by Victor V. Sharygin, SIG  
35 Jay Piatek L. Garvie, ASI see karmaka.de for photographs of the fall site etc.; submitted  
36 Corey Kuo D. Sheikh, FS Submitted by Daniel Sheikh  
37 Ziyao Wang R. BartoschewJianming Wan working name WZ46; submitted by R. Bartoschewitz  
38 Ziyao Wang R. BartoschewJianming Wan working name WZ55; submitted by R. Bartoschewitz  
39 Ziyao Wang R. BartoschewWentao Yang working name WZ128; submitted by R. Bartoschewitz  
40 Ziyao Wang R. BartoschewJianming Wan working name WZ141; submitted by R. Bartoschewitz  
41 Wang Zijian alLi shijie and F.Wang Zijian & Submitted by Li shijie  
42 Yuxian Zhao Li shijie and F.Peng Wang, Y Submitted by Li shijie  
43 Pengli Chen Li shijie and F.Zijian Wang & Submitted by Li shijie  
44 Yuxian Zhao Li Shijie and FPeng Wang, Y Submitted by Li shijie  
45 M. Wozniak (L. Karwowski Jacek Szcępa Submitted by Lukasz Karwowski and Krzysztof Szopa  
46 Decker MeteoK. Klemm, A. I Working No.: De-02; submitted by K. Klemm, IfP; Abundant c  
47 In possession A. W. R. Beva R. Gadd Submitted by L. V. Forman (Curtin University, WAM)  
48 Ziyao Wang R. Bartoschew Yonglu Ma working name WZ150; submitted by R. Bartoschewitz  
49 Mr. M. NepomLorenz C. A., 'Mr. M. Nepom field name is Calama 6-24M; submitted by Lorenz C.A., Vern  
50 MMC J. Gattacceca,Rodrigo Martir work name RM594. Likely paired with Machuca 005.; submitt  
51 Mr. Atali AgakLorenz C. A., 'Mr. Atali Agak Field name is A012; analyst A. Agakhanov (Fersman Minera  
52 Ziyao Wang R. BartoschewJianming Wan working name WZ154; submitted by R. Bartoschewitz  
53 CEREGE J. Gattacceca,Vinciane Debaz work name MA110; submitted by Jérôme Gattacceca  
54 Peter Buhl J. Gattacceca,Peter Buhl work name PB06/07; submitted by Jérôme Gattacceca  
55 Peter Buhl J. Gattacceca,Peter Buhl work name PB11/12; Found on granodiorite pediment surface  
56 MMC J. Gattacceca,Rodrigo Martir work name RM670; 1470 fragments, the largest 111 kg.; sub  
57 Svend Buhl J. Gattacceca,Svend Buhl work name SB018; Found on granodiorite pediment surface l

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3 Sergey Vasile J. Gattacceca, S. Vasilev & S work name SE004; Found on granodiorite pediment surface;  
4 Marc Jost (S.J. A. Love, App Marc Jost Submitted by Anthony Love  
5 MMC J. Gattacceca, Rodrigo Martir work name RM574; submitted by Jérôme Gattacceca  
6 K. Wimmer K. Klemm, A. I Working name: LoV; submitted by Klemm K.  
7 UrFU K. Dugushkina & Mr. A. Pastukl Field name Past1; submitted by Kseniya Dugushkina (UB-RA  
8 Marc Josts (S. A. Love, App Marc Jost (S.J. Submitted by Anthony Love  
9 Eric Christens J. Gattacceca, Eric Christens work name EJ529; submitted by J. Gattacceca  
10 Peter Buhl J. Gattacceca, Peter Buhl work name PB14; submitted by J. Gattacceca  
11 MMC J. Gattacceca, Rodrigo Martir work name RM643. Abundant shock veins and melt pockets.  
12 Marc Jost (S.J. A. Love, App Marc Jost may be paired with LV360.; submitted by Anthony Love  
13 Andreas Kopp J. Gattacceca, Andreas Kopp work name AK020; submitted by Jérôme Gattacceca  
14 MMC J. Gattacceca, Rodrigo Martir work name RM686; submitted by Jérôme Gattacceca  
15 Andreas Kopp J. Gattacceca, Andreas Kopp Work name AK015. Brecciated; submitted by Jérôme Gattacceca  
16 Marc Jost J. Gattacceca, Marc Jost work name MC012; submitted by Jérôme Gattacceca  
17 Michael Warn J. Gattacceca, Michael Warn Shock veins. Likely paired with Los Vientos 014. Work name  
18 Michael Warn J. Gattacceca, Michael Warn work name MW33; submitted by Jérôme Gattacceca  
19 MCL J. Gattacceca, Rodrigo Martir work name RM683; submitted by Jérôme Gattacceca  
20 MCL J. Gattacceca, Rodrigo Martir work name RM685; submitted by Jérôme Gattacceca  
21 MCL J. Gattacceca, Rodrigo Martir work name RM687; submitted by Jérôme Gattacceca  
22 Svend Buhl J. Gattacceca, Svend Buhl work name SB013; submitted by Jérôme Gattacceca  
23 Eric Christens J. Gattacceca, Eric Christens work name EJ689. Four fragments spread over 1 m.; submit  
24 Eric Christens J. Gattacceca, Eric Christens work name EJ694; submitted by Jérôme Gattacceca  
25 Marc Jost J. Gattacceca, Marc Jost work name MC006. Found on granodiorite pediment surface  
26 Marc Jost J. Gattacceca, Marc Jost work name MC010-2. Found on granodiorite pediment surfac  
27 MMC J. Gattacceca, Rodrigo Martir work name RM682; submitted by Jérôme Gattacceca  
28 MMC J. Gattacceca, Rodrigo Martir work name RM684; submitted by Jérôme Gattacceca  
29 MMC J. Gattacceca, Rodrigo Martir work name RM707; submitted by Jérôme Gattacceca  
30 MMC J. Gattacceca, Rodrigo Martir work name RM708; submitted by Jérôme Gattacceca  
31 Svend Buhl J. Gattacceca, Svend Buhl work name SB008; submitted by Jérôme Gattacceca  
32 Svend Buhl J. Gattacceca, Svend Buhl work name SB011. Found on granodiorite pediment surface l  
33 Eric Christens J. Gattacceca, Eric Christens work name EJ458; submitted by Jérôme Gattacceca  
34 Ziyao Wang R. Bartoschew anonymous working name WZ132; submitted by R. Bartoschewitz  
35 Ziyao Wang, Y R. Bartoschew Aikeranmu Jia working name WZ137; submitted by R. Bartoschewitz  
36 Ziyao Wang R. Bartoschew anonymous working name WZ143; submitted by R. Bartoschewitz  
37 Jiachang Yu a R. Bartoschew Aikeranmu Jia working name WZ152; submitted by R. Bartoschewitz  
38 R. Bartoschew R. Bartoschew Ai Li Kayiti working name WZD#18; submitted by R. Bartoschewitz  
39 R. Bartoschew R. Bartoschew Ai Li Kayiti working name WZD#21; submitted by R. Bartoschewitz  
40 Yuxian Zhao Li shijie and F. Yuxian Zhao Submitted by Li shijie  
41 Xuefeng Yang Li shijie and F. Xuefeng Yang Submitted by Li shijie  
42 MMC J. Gattacceca, Rodrigo Martir work name RM561; submitted by J. Gattacceca  
43 MMC J. Gattacceca, Rodrigo Martir Work name RM581. Likely paired with Machuca 005. Troilite  
44 MMC J. Gattacceca, Rodrigo Martir work name RM563; submitted by Jérôme Gattacceca  
45 MCL J. Gattacceca, Rodrigo Martir Likely paired with Machuca 007. Work name RM672; submitt  
46 Bihar Science D. K. Panda, R Rajkumar Pra Submitted by A.D. Shukla  
47 Mr. T. Kryachl Lorenz C. A., 'Mr. T. Kryachl Field name is Marsa Alam-T-1; analyst T. Kryachko (Technoç  
48 Mr. T. Kryachl Lorenz C. A., 'Mr. T. Kryachl Field name is Marsa Alam-T-2; analyst T. Kryachko (Technoç  
49 Mr. T. Kryachl Lorenz C. A., 'Mr. T. Kryachl Field name is Marsa Alam-T-3; analyst T. Kryachko (Technoç  
50 Mr. T. Kryachl Lorenz C. A., 'Mr. T. Kryachl Field name is Marsa Alam-T-4; analyst T. Kryachko (Technoç  
51 Mr. T. Kryachl Lorenz C. A., 'Mr. T. Kryachl Field name is Marsa Alam-T-5; analyst T. Kryachko (Technoç  
52 Beat Booz, Fri B. Hofmann, N Submitted by Beda Hofmann  
53 MCM J. Llorca, UPC Jose Garcia Submitted by Jose Garcia  
54 Mars B. Cohen, GS Opportunity ro Submitted by B. Cohen, GSFC  
55 Mars B. Cohen, GS Opportunity ro Submitted by B. Cohen, GSFC  
56 Mars B. Cohen, GS Opportunity ro Submitted by B. Cohen, GSFC  
57 Mars B. Cohen, GS Opportunity ro Submitted by B. Cohen, GSFC



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3	Mars	B. Cohen, GS Opportunity ro	Submitted by B. Cohen, GSFC
4	Mars	B. Cohen, GS Opportunity ro	Submitted by B. Cohen, GSFC
5	Mars	B. Cohen, GS Opportunity ro	Submitted by B. Cohen, GSFC
6	Finder	M.E. ZucolottoDione Pantale	Submitted by A. Moutinho and A. Tosi; submitted by Andre L.
7	finder	A. W. R. Beva G. Munro	Submitted by L. V. Forman (Curtin University, WAM)
8	JSC	SI ANSMET	Submitted by AMN
9	JSC	SI ANSMET	Submitted by AMN
10	JSC	SI ANSMET	Submitted by AMN
11	JSC	SI ANSMET	Submitted by AMN
12	WAM	A. W. R. Beva G. Kelahar	Submitted by L. V. Forman (Curtin University, WAM)
13	Finders	A. Yamaguchi	Submitted by S. Yoneda, NMNS
14	JSC	SI ANSMET	Submitted by AMN
15	JSC	SI ANSMET	Submitted by AMN
16	JSC	SI ANSMET	Submitted by AMN
17	JSC	SI ANSMET	Submitted by AMN
18	JSC	SI ANSMET	Submitted by AMN
19	JSC	SI ANSMET	Submitted by AMN
20	JSC	SI ANSMET	Submitted by AMN
21	JSC	SI ANSMET	Submitted by AMN
22	JSC	SI ANSMET	Submitted by AMN
23	JSC	SI ANSMET	Submitted by AMN
24	JSC	SI ANSMET	Submitted by AMN
25	JSC	SI ANSMET	Submitted by AMN
26	JSC	SI ANSMET	Submitted by AMN
27	JSC	SI ANSMET	Submitted by AMN
28	JSC	SI ANSMET	Submitted by AMN
29	JSC	SI ANSMET	Submitted by AMN
30	JSC	SI ANSMET	Submitted by AMN
31	JSC	SI ANSMET	Submitted by AMN
32	JSC	SI ANSMET	Submitted by AMN
33	JSC	SI ANSMET	Submitted by AMN
34	JSC	SI ANSMET	Submitted by AMN
35	JSC	SI ANSMET	Submitted by AMN
36	JSC	SI ANSMET	Submitted by AMN
37	JSC	SI ANSMET	Submitted by AMN
38	JSC	SI ANSMET	Submitted by AMN
39	JSC	SI ANSMET	Submitted by AMN
40	JSC	SI ANSMET	Submitted by AMN
41	JSC	SI ANSMET	Submitted by AMN
42	JSC	SI ANSMET	Submitted by AMN
43	JSC	SI ANSMET	Submitted by AMN
44	JSC	SI ANSMET	Submitted by AMN
45	JSC	SI ANSMET	Submitted by AMN
46	JSC	SI ANSMET	Submitted by AMN
47	JSC	SI ANSMET	Submitted by AMN
48	JSC	SI ANSMET	Submitted by AMN
49	JSC	SI ANSMET	Submitted by AMN
50	JSC	SI ANSMET	Submitted by AMN
51	JSC	SI ANSMET	Submitted by AMN
52	JSC	SI ANSMET	Submitted by AMN
53	JSC	SI ANSMET	Submitted by AMN
54	JSC	SI ANSMET	Submitted by AMN
55	JSC	SI ANSMET	Submitted by AMN
56	UCLA	Alan Rubin Mike Brady	Submitted by Alan Rubin
57	M. Arjdal	A. Irving, UWE	Work name Arj ZM0; submitted by A. Irving
58	M. Arjdal	A. Irving, UWE	Work name Arj ZM 224; submitted by A. Irving
59	M. Arjdal	A. Irving, UWE	Work name Arj A1; submitted by A. Irving
60	M. Arjdal	A. Irving, UWE	Work name Arj ZM 271; submitted by A. Irving



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3	T. Boudreaux	A. Irving, UWS	Work name RC134.1; submitted by A. Irving
4			Work name SY59
5	P. Stahura	A. Irving, UWS	Work name MH-Q9; submitted by A. Irving
6	A. and G. Hupe	A. Irving, UWS	Work name H117; submitted by A. Irving
7	A. & G. Hupe	A. Irving, UWS	Work name H122; submitted by A. Irving
8	A. & G. Hupe	A. Irving, UWS	Work name H110; submitted by A. Irving
9	M. Farmer	A. Irving, S. K	Submitted by A. Irving
10	N. Oakes	A. Irving and S	Submitted by A. Irving
11	G. Hupe	A. Irving, UWS	Submitted by A. Irving
12	G. Hupe	A. Irving, UWS	Work name GH-15; submitted by A. Irving
13	A. Hupe	A. Irving, UWS	Work names NQ6, NQ18, NQ22, NQ24 and NQ26; submitted
14	N. Oakes	A. Irving, UWS	Submitted by A. Irving
15	M. Cimala	A. Irving, UWS	Work name MC029; submitted by A. Irving
16	M. Cimala	A. Irving, UWS	Work name MC031; submitted by A. Irving
17	T. Boswell	A. Irving, UWS	Submitted by A. Irving
18	T. Boswell	A. Irving, UWS	Work name #113; submitted by A. Irving
19	Fabien Kuntz	A. Greshake, I	Submitted by Ansgar Greshake
20	Stefan Ralew	A. Greshake, I	Submitted by Ansgar Greshake
21	Svend Buhl	A. Greshake, I	Submitted by Ansgar Greshake
22	Svend Buhl	A. Greshake, I	Submitted by Ansgar Greshake
23	FKuntz	A. Greshake, I	Submitted by Ansgar Greshake
24	Fabien Kuntz	A. Greshake, I	Submitted by Ansgar Greshake
25	Fabien Kuntz	A. Greshake, I	Submitted by Ansgar Greshake
26	Fabien Kuntz	A. Greshake, I	Submitted by Ansgar Greshake
27	Fabien Kuntz	A. Greshake, I	Submitted by Ansgar Greshake
28	Stefan Ralew	A. Greshake, I	Submitted by Ansgar Greshake
29	B. Reed	A. Irving and S	Work name 21853; submitted by A. Irving
30	Kuntz	A. Irving and S	K151; submitted by A. Irving
31	Dr. David Grej	K. Tait, I. Nick	Submitted by V. Di Cecco, ROM
32	A. Aaronson	A. Irving, S. K	Work name M1313; submitted by A. Irving
33	M. Cimala	A. Irving and S	Work name MC 094; submitted by A. Irving
34	Nick Gessler	P Warren, UC	Gessler's address: 2010 Calgary Lane, Los Angeles, CA 900
35	Nick Gessler	P Warren, UC	Gessler's address: 2010 Calgary Lane, Los Angeles, CA 900
36	Nick Gessler	P Warren, UC	Gessler's address: 2010 Calgary Lane, Los Angeles, CA 900
37	anonymous	K. Metzler, IfP	Submitted by K. Metzler, IfP
38	Anonymous	K. Metzler, IfP	Submitted by K. Metzler, IfP
39	UCLA	J. Utas, UCLA	Submitted by J. Utas
40	SI	M. Zolensky a	Remnant chondrules in a largely recrystallized rock, coarse p
41	SI	M. Zolensky a	Remnant chondrules in a largely recrystallized rock, coarse p
42	Sean Tutorow	C. Agee, UNM	Field name G672; submitted by C. Agee, UNM
43	M. Aid	A. Irving and S	Work name MA 201; submitted by A. Irving
44	PSF	A. Irving and S	Work name CHC18014; submitted by A. Irving
45	PSF	A. Irving and S	Work name CHC18023; submitted by A. Irving
46	PSF	A. Irving and S	Work name CHC18028; submitted by A. Irving
47	PSF	A. Irving and S	Work name CHC18029; submitted by A. Irving
48	B. Hoefnagels	A. Irving and S	Work name BH152; submitted by A. Irving
49	Ziyao Wang	R. Bartoschew anonymous	working name WZ25; submitted by R. Bartoschewitz
50	Ziyao Wang	R. Bartoschew anonymous	working name WZ40.; submitted by R. Bartoschewitz
51	Xu Dengqin	Peng H. and Z unknown	Submitted by Li Shijie
52	M. Arjdal	A. Irving and S	Work name Arj18-A10; submitted by A. Irving
53	PSF	A. Irving and S	Work name CHC18045; submitted by A. Irving
54	Bart	R. Bartoschew anonymous	NWA-RB02; submitted by R. Bartoschewitz
55	Bart	R. Bartoschew anonymous	NWA-RB10; submitted by R. Bartoschewitz
56	Ziyao Wang	R. Bartoschew anonymous	working name WZ86; submitted by R. Bartoschewitz
57	PSF	A. Irving and S	Work name CHC18048; submitted by A. Irving
58	J. Higgins	A. Irving and S	Work name JH18-4; submitted by A. Irving
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A. Habibi	A. Irving and S	Work name AH 702; submitted by A. Irving
Labenne Luc	J. Gattacceca,	work name LL25; submitted by Jérôme Gattacceca
Labenne Luc	L. Krämer Ruç	work name LL86; submitted by Jérôme Gattacceca
DMUH	Lorenz C. A., 'anonymous	Analyst Kononkova N. N. (Vernad); submitted by Lorenz C.A.
Tomelleri	V. Moggi Cecç	Field label Tagounite; submitted by Vanni Moggi Cecchi
Labenne	L. Krämer Ruç	work name LL84; submitted by Jérôme Gattacceca
Pierre-Marie F.J.	Gattacceca, anonymous	work name PM19U1; submitted by Jérôme Gattacceca
Ziyao Wang	R. Bartoshev anonymous	working name WZ114; submitted by R. Bartoschewitz
Ziyao Wang	R. Bartoshev anonymous	working name WZ115; submitted by R. Bartoschewitz
Ziyao Wang	R. Bartoshev anonymous	working name WZ116; submitted by R. Bartoschewitz
Ziyao Wang	R. Bartoshev anonymous	working name WZ119; submitted by R. Bartoschewitz
Wei Jiang	R. Bartoshev anonymous	working name WZ120; submitted by R. Bartoschewitz
R. Bartoshev	R. Bartoshev anonymous	working name WZD#10; submitted by R. Bartoschewitz
Sigrid Wenger	K.Klemm, Add anonymous	Working name SW-6.4g; submitted by Klemm K.
Gregory	S. Korchinov,	Submitted by V. Di Cecco, ROM
Haichuan Tan	R. Bartoshev anonymous	working name WZ138; submitted by R. Bartoschewitz
MSN-FI	V. Moggi Cecç Anonymous	Provisional name NWA 12897; Inventory # G75010; submitte
MSN-FI	V. Moggi Cecç Anonymous	Provisional name NWA 12899; Inventory # G75011; submitte
MSN-FI	V. Moggi Cecç Anonymous	Provisional name NWA 12899; Inventory # G75062; submitte
MSN-FI	V. Moggi Cecç Anonymous	Provisional name NWA 12900; Inventory # G75067; submitte
MSN-FI	V. Moggi Cecç Anonymous	Provisional name NWA 12901; Inventory # G75066; submitte
Zuokai Ke	C. Agee, UNV	Field name KE-45; submitted by C. Agee
Dr. Brendt Hy	K. Tait, I. Nick	Submitted by V. Di Cecco, ROM
Dr. David Gre	K. Tait, I. Nick	Submitted by V. Di Cecco, ROM
Dr. David Gre	K. Tait, I. Nick	Submitted by V. Di Cecco, ROM
Dr. David Gre	K. Tait, I. Nick	Submitted by V. Di Cecco, ROM
Simon De Boe	K. Tait, I. Nick	Submitted by V. Di Cecco, ROM
Isabelle Pothic	J. Gattacceca,	work name CM28; submitted by Jérôme Gattacceca
H. Najji	A. Irving, UWS	Work name HN-403; submitted by A. Irving
Penneff	D. Sheikh, FS	Submitted by Daniel Sheikh
Matthew Stre	D. Sheikh, FS	Submitted by Daniel Sheikh
anonymous	A. Greshake, I	Submitted by Ansgar Greshake
anonymous	A. Greshake, I	Submitted by Ansgar Greshake
anonymous	A. Greshake, I	Submitted by Ansgar Greshake
Harald Stehlik	A. Greshake, I	Submitted by Ansgar Greshake
Harald Stehlik	A. Greshake, I	Submitted by Ansgar Greshake
Said Yousfi	A. Greshake, I	Submitted by Ansgar Greshake
Said Yousfi	A. Greshake, I	Submitted by Ansgar Greshake
Said Yousfi	A. Greshake, I	Submitted by Ansgar Greshake
A. Habibi	A. Irving, UWS	Work name AH 720; submitted by A. Irving
Anonymous	A. Irving, UWS	Work name DL1008; submitted by A. Irving
Anonymous	A. Irving, UWS	Work name DL 1007; submitted by A. Irving
Anonymous	A. Irving, UWS	Work names DL 1006&1009; submitted by A. Irving
R. Chaoui/J.	C.A. Irving, UWS	Work names M2221, AB85, RC140.1; submitted by A. Irving
M. Arjdal	A. Irving, UWS	Work name Arj H4; submitted by A. Irving
Wei Jiang	R. Bartoshev anonymous	working name WZ149; submitted by R. Bartoschewitz
Ziyao Wang	R. Bartoshev anonymous	working name WZ157; submitted by R. Bartoschewitz
Ziyao Wang	R. Bartoshev anonymous	working name WZD#G04; submitted by R. Bartoschewitz
R. Bartoshev	R. Bartoshev anonymous	working name WZD#G06; submitted by R. Bartoschewitz
R. Bartoshev	R. Bartoshev anonymous	working name WZD#G07; submitted by R. Bartoschewitz
Philippe Schrr	A. Greshake, I	Submitted by Ansgar Greshake
Philippe Schrr	A. Greshake, I	Submitted by Ansgar Greshake
Philippe Schrr	A. Greshake, I	Brownish rock with some patches of fusion crust. Plagioclase
Philippe Schrr	A. Greshake, I	Brownish rock lacking any fusion crust. Plagioclase grain size
Philippe Schrr	A. Greshake, I	Submitted by Ansgar Greshake

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3	Philippe SchrrA. Greshake, I	Submitted by Ansgar Greshake
4	Philippe SchrrA. Greshake, I	Submitted by Ansgar Greshake
5	Philippe SchrrA. Greshake, I	Submitted by Ansgar Greshake
6	Philippe SchrrA. Greshake, I	Small dark brownish rock without fusion crust. Plagioclase gr
7	Philippe SchrrA. Greshake, I	Submitted by Ansgar Greshake
8	Mohamed LarA. Greshake, I	Submitted by Ansgar Greshake
9	Philippe SchrrA. Greshake, I	Submitted by Ansgar Greshake
10	Philippe SchrrA. Greshake, I	Submitted by Ansgar Greshake
11	Philippe SchrrA. Greshake, I	Submitted by Ansgar Greshake
12	Philippe SchrrA. Greshake, I	Submitted by Ansgar Greshake
13	Philippe SchrrA. Greshake, I	Submitted by Ansgar Greshake
14	anonymous A. Greshake, I	Submitted by Ansgar Greshake
15	anonymous A. Greshake, I	Submitted by Ansgar Greshake
16	anonymous A. Greshake, I	Submitted by Ansgar Greshake
17	anonymous A. Greshake, I	Submitted by Ansgar Greshake
18	anonymous A. Greshake, I	Submitted by Ansgar Greshake
19	anonymous A. Greshake, I	Submitted by Ansgar Greshake
20	MNB A. Greshake, I	Brownish rock lacking any fusion crust. Plagioclase grain size
21	MNB A. Greshake, I	Brownish rock partly covered with fusion crust. Plagioclase gr
22	Roberto VargzD. Sheikh, FS	Submitted by Daniel Sheikh
23	Castellano V. Moggi Cecchi Anonymous	Field C223; submitted by Vanni Moggi Cecchi
24	Castellano V. Moggi Cecchi Anonymous	Field C224; veined; submitted by Vanni Moggi Cecchi
25	Castellano V. Moggi Cecchi Anonymous	Field C226; veined; submitted by Vanni Moggi Cecchi
26	Castellano V. Moggi Cecchi Anonymous	Field C227; submitted by Vanni Moggi Cecchi
27	Castellano V. Moggi Cecchi Anonymous	Field C228; submitted by Vanni Moggi Cecchi
28	Castellano V. Moggi Cecchi Anonymous	Field C229; submitted by Vanni Moggi Cecchi
29	Castellano V. Moggi Cecchi Anonymous	Field C230; submitted by Vanni Moggi Cecchi
30	Castellano V. Moggi Cecchi Anonymous	Field C231; submitted by Vanni Moggi Cecchi
31	Pascal MaugeB. Doisneau, I	Submitted by E. Jacquet
32	Sean TutorowM. Hutson and	Lab number CML 1005; owner number G718; submitted by M
33	JPhillips and J.M. Hutson and	Lab number CML 1169; submitted by Melinda Hutson
34	JPhillips and J.M. Hutson and	Lab number CML 1170; submitted by Melinda Hutson
35	Fredric StephzT. Swindle	Working name FS012; submitted by T. Swindle
36	Fredric StephzAS Djakaria and	Working name SH1; submitted by T. Swindle
37	Fredric StephzS. Chapin, K. I	Working name SH2.; submitted by T. Swindle
38	Fredric StephzM. Deci, T. Le	Working name SH3; submitted by T. Swindle
39	Fredric StephzT. Burd and E	Working Name SH7; submitted by T. Swindle
40	Fredric StephzS. Nagumantr	Working Name SH8; submitted by T. Swindle
41	Fredric StephzA.M. Azman, I	Working name SH12; submitted by T. Swindle
42	Fredric StephzK. Van Atta, T	Working name SH14; submitted by T. Swindle
43	Fredric StephzD. Cantillo, M.	Working name SH15; submitted by T. Swindle
44	L. Labenne A. Irving, UWS	Work name LAB 100919; submitted by A. Irving
45	DPitt A. Irving, UWS	Work name MVCH 270C; submitted by A. Irving
46	UAlic A. Irving, UWS	Work name JAP19-2; submitted by A. Irving
47	A. Habibi A. Irving, UWS	Work name AH 724; submitted by A. Irving
48	A. Aaronson A. Irving, UWS	Work name M2206; submitted by A. Irving
49	A. Habibi A. Irving, UWS	Work name AH 729; submitted by A. Irving
50	A. Habibi A. Irving, UWS	Work name AH 170B; submitted by A. Irving
51	A. Aaronson A. Irving, UWS	Work name M2117; submitted by A. Irving
52	J. Achouri A. Irving, UWS	Work name JAch S5; submitted by A. Irving
53	PSF A. Irving, UWS	Work name CHC18044; submitted by A. Irving
54	University of A. Irving, UWS	Work name JAP19-3; submitted by A. Irving
55	PSF A. Irving, UWS	Work name CHC18047; submitted by A. Irving
56	Theatrum MurA. Irving, UWS	Work name LAB 051119A; submitted by A. Irving
57	M. Arjdal A. Irving, UWS	Work name Arj ZM 35; submitted by A. Irving
58	M. Arjdal A. Irving, UWS	Work name Arj ZM 113; submitted by A. Irving
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3	ArtAncient	A. Irving, UWS	Work name M2222; submitted by A. Irving
4	M. Arjdal	A. Irving, UWS	Work name Arj ZM 110; submitted by A. Irving
5	UALic	A. Irving, UWS	Work name JAP19-4; submitted by A. Irving
6	PSF	A. Irving, UWS	Work name CHC18050; submitted by A. Irving
7	Phillip Todd	C. Agee, UNM	Field name PT-1; submitted by C. Agee, UNM
8	Geological Mu	Z.Xia, B.Miao. Anonymously	The name "C-201901L" was used in Chinese conference befi
9	Gregory	C. Beros , UT	Submitted by V. Di Cecco, ROM
10	Gregory	C. Beros , UT	Submitted by V. Di Cecco, ROM
11	Gregory	V. Di Cecco, F	Submitted by V. Di Cecco, ROM
12	Boulaouane	T.A. Greshake, I	Submitted by Ansgar Greshake
13	Wei Jiang	J. Ji, S. Hu an	Submitted by J. Ji, S. Hu and Y. Lin, IGGCAS
14	Wei Jiang	J. Ji, S. Hu an	Submitted by J. Ji, S. Hu and Y. Lin, IGGCAS
15	Wei Jiang	J. Ji, S. Hu an	Submitted by J. Ji, S. Hu and Y. Lin, IGGCAS
16	M. Morgan, M Y.	Liu, JPL	Submitted by Yang Liu
17	Sergey Vasilie	P. Yu. Plechov	Submitted by Pavel Yu. Plechov, pplechov@gmail.com
18	Matthew Stre	D. Sheikh, FS	Submitted by Daniel Sheikh
19	Juan Aviles Pr	D. Sheikh, FS	Submitted by Daniel Sheikh
20	Jérémy Basse	J. Gattacceca,	work name CM31; submitted by Jérôme Gattacceca
21	Patrick Roust	J. Gattacceca,	work name CM36; submitted by Jérôme Gattacceca
22	Patrick Roust	J. Gattacceca,	work name CM39; submitted by Jérôme Gattacceca
23	George Penn	J. Gattacceca,	work name GP05; submitted by Jérôme Gattacceca
24	George Penn	J. Gattacceca,	work name GP06; submitted by Jérôme Gattacceca
25	George Penn	J. Gattacceca,	work name GP07; submitted by Jérôme Gattacceca
26	Kuntz	J. Gattacceca,	work name K429; Melt rock supported breccia. Chondritic cla
27	Kuntz	J. Gattacceca,	work name K430; submitted by Jérôme Gattacceca
28	Kuntz	J. Gattacceca,	work name K441; submitted by Jérôme Gattacceca
29	Kuntz	J. Gattacceca,	work name K443; submitted by Jérôme Gattacceca
30	Kuntz	J. Gattacceca,	work name K444; submitted by Jérôme Gattacceca
31	Kuntz	J. Gattacceca,	work name K446; submitted by Jérôme Gattacceca
32	Kuntz	J. Gattacceca,	work name K447; submitted by Jérôme Gattacceca
33	Kuntz	J. Gattacceca,	work name K448; submitted by Jérôme Gattacceca
34	Kuntz	J. Gattacceca,	work name K450; submitted by Jérôme Gattacceca
35	Lucian Cojoca	J. Gattacceca,	work name LC01; submitted by Jérôme Gattacceca
36	Lucian Cojoca	J. Gattacceca,	work name LC05; Crusted stone. Cut surface reveals light br
37	Labenne	J. Gattacceca,	work name LL87/LAB031219a; submitted by Jérôme Gattacc
38	Labenne	J. Gattacceca,	work name LL88/LAB031219b; submitted by Jérôme Gattacc
39	Labenne	J. Gattacceca,	work name LL89/LAB031219c; Subrounded olivine with typic
40	Fabien Kuntz	A. Greshake, I	Submitted by Ansgar Greshake
41	Fabien Kuntz	A. Greshake, I	Submitted by Ansgar Greshake
42	Fabien Kuntz	A. Greshake, I	Submitted by Ansgar Greshake
43	Fabien Kuntz	A. Greshake, I	Submitted by Ansgar Greshake
44	R. Lenssen	A. Greshake, I	Submitted by Ansgar Greshake
45	R. Lenssen	A. Greshake, I	Submitted by Ansgar Greshake
46	R. Lenssen	A. Greshake, I	Submitted by Ansgar Greshake
47	Marcin Cimal	A. Greshake, I	Dark brownish rock partly covered with fusion crust. The plag
48	Marcin Cimal	A. Greshake, I	Submitted by Ansgar Greshake
49	Philippe Schr	A. Greshake, I	Submitted by Ansgar Greshake
50	Hanno Strufe	A. Greshake, I	Dark brownish rock without fusion crust. The meteorite a an L
51	Hanno Strufe	A. Greshake, I	Dark grayish rock without fusion crust. The meteorite an LL6-
52	Labenne Luc	J. Gattacceca,	work name LL2015-50; submitted by Jérôme Gattacceca
53	Bing-an Miao	B. Miao, Z. Ba Anonymously	The name M17009 was used in Chinese conference paper br
54	Dave Lehman	A. Love, App Unknown	Submitted by Anthony Love
55	Dave Lehman	A. Love, App Unknown	Submitted by Anthony Love
56	Dave Lehman	A. Love, App Unknown	Submitted by Anthony Love
57	Dave Lehman	A. Love, App Unknown	Submitted by Anthony Love



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3	Dave Lehman	A. Love, App Unknown	Submitted by Anthony Love
4	Fabien Kuntz	A. Love, App Unknown	Submitted by Anthony Love
5	M. Arjdal	A. Irving, UWS	Work name Arj ZM 1; submitted by A. Irving
6	B. Hoefnagels	A. Irving, UWS	Work name BH212; submitted by A. Irving
7	M. Arjdal	A. Irving, UWS	Work names Arj ZM 76 and ZM 185; submitted by A. Irving
8	Akuadra Bijou	A. Irving, UWS	Work name GSP; submitted by A. Irving
9	M. Arjdal	A. Irving, UWS	Work name Arj AG1; submitted by A. Irving
10	PSF	A. Irving, UWS	Work name CHC18049; submitted by A. Irving
11	PSF	A. Irving, UWS	Work name CHC18051; submitted by A. Irving
12	A. Habibi	A. Irving, UWS	Work name AH 726; submitted by A. Irving
13	PSF	A. Irving, UWS	Work name CHC18052; submitted by A. Irving
14	M. Lyon/M. Fl	A. Irving, UWS	Work name Lyon19-2; submitted by A. Irving
15	Albert Jambor	J. Gattacceca,	work name BA18-01; submitted by Jérôme Gattacceca
16	Lucian Cojoca	J. Gattacceca,	workn name LC07; submitted by Jérôme Gattacceca
17	Miguel Angel	(D. Sheikh, FS	Submitted by Daniel Sheikh
18	GUT	H. Chen, Z. Xi	Anonymous Submitted by Bingkui Miao
19	SQU	A. Ali, SQU	Submitted by Arshad Ali
20	SQU	A. Ali, SQU	Submitted by Arshad Ali
21	SQU	A. Ali, SQU	Submitted by Arshad Ali
22	SQU	A. Ali, SQU	Submitted by Arshad Ali
23	SQU	A. Ali, SQU	Submitted by Arshad Ali
24	SQU	A. Ali, SQU	Submitted by Arshad Ali
25	S. Tutorow	N. Ma, UB	Unknown Field name G721.; submitted by A. Bouvier, UB
26	S. Tutorow	V. Szlachta, U	Unknown Field name G722.; submitted by A. Bouvier, UB
27	S. Tutorow	A. Krupp, UB	Unknown Field name G723.; submitted by A. Bouvier, UB
28	S. Tutorow	D. Souza, UB	Unknown Field name G724.; submitted by A. Bouvier, UB
29	D. Pitt	A. Irving, UWS	Work name MVCH 496; submitted by A. Irving
30	M. Lyon	A. Irving, UWS	Work name RC128.1; submitted by A. Irving
31	D. Pitt	A. Irving, UWS	Work name MVCH 497; submitted by A. Irving
32	L. Labenne	A. Irving, UWS	Work name LAB 241019; submitted by A. Irving
33	D. Pitt	A. Irving, UWS	Work name MVCH 498; submitted by A. Irving
34	T. Boudreaux	A. Irving, UWS	Work name TBx19-1; submitted by A. Irving
35	Hanno Strufe	A. Greshake, I	Submitted by Ansgar Greshake
36	Hanno Strufe	A. Greshake, I	Submitted by Ansgar Greshake
37	Hanno Strufe	A. Greshake, I	Brownish rock without fusion crust. The plagioclase grain size
38	Hanno Strufe	A. Greshake, I	Submitted by Ansgar Greshake
39	Hanno Strufe	A. Greshake, I	Submitted by Ansgar Greshake
40	Hanno Strufe	A. Greshake, I	Submitted by Ansgar Greshake
41	Hanno Strufe	A. Greshake, I	Submitted by Ansgar Greshake
42	Martin Neukar	A. Greshake, I	Submitted by Ansgar Greshake
43	Larbi Chnaoui	A. Greshake, I	Submitted by Ansgar Greshake
44	Larbi Chnaoui	A. Greshake, I	Submitted by Ansgar Greshake
45	Larry Atkins	C. Agee, UNM	Field name LA-101; submitted by C. Agee, UNM
46	Larry Atkins	C. Agee, UNM	Field name LA-102; submitted by C. Agee, UNM
47	Larry Atkins	C. Agee, UNM	Field name LA-103; submitted by C. Agee, UNM
48	Robert Verish	P Warren, UC	Verish's address: R. Verish, Meteorite-Recovery Lab, P.O. B
49	Harkness Coll	A. Irving, UWS	Work name HC7; submitted by A. Irving
50	M. Arjdal	A. Irving, UWS	Work name Arj ZM 136; submitted by A. Irving
51	Harkness Coll	A. Irving, UWS	Work name HC8; submitted by A. Irving
52	A. Habibi	A. Irving, UWS	Work name AH 727; submitted by A. Irving
53	Harkness Coll	A. Irving, UWS	Work name HC9; submitted by A. Irving
54	M. Hmani	A. Irving, UWS	Work name MH20-Q03; submitted by A. Irving
55	Harkness Coll	A. Irving, UWS	Work name HC10; submitted by A. Irving
56	M. Lyon	A. Irving, UWS	Work name Lyon19-3; submitted by A. Irving
57	Harkness Coll	A. Irving, UWS	Work name HC11; submitted by A. Irving
58	Larbi Chnaoui	A. Greshake, I	Submitted by Ansgar Greshake
59	anonymous	A. Greshake, I	Submitted by Ansgar Greshake
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3	Said Yousfi	A. Greshake, I	Submitted by Ansgar Greshake
4	Said Yousfi	A. Greshake, I	Dark brownish rock with some fusion crust. The plagioclase c
5	Said Yousfi	A. Greshake, I	Submitted by Ansgar Greshake
6	Boulaouane T.A.	Greshake, I	Submitted by Ansgar Greshake
7	Marcin Cimala	A. Greshake, I, Muhammad Im	Submitted by Ansgar Greshake
8	Marcin Cimala	A. Greshake, I	Submitted by Ansgar Greshake
9	John Humphri	C. Agee, UNM	Submitted by C. Agee
10	Anonymous	A. Irving, UWS	Submitted by A. Irving
11	M. Arjdal	A. Irving, UWS	Work name Arj ZM 86; submitted by A. Irving
12	R. Chaoui anc	A. Irving, UWS	Work name RC126.2; submitted by A. Irving
13	D. Pitt	A. Irving, UWS	Work name MVCH 489; submitted by A. Irving
14	M. Arjdal	A. Irving, UWS	Work name Arj ZM 112; submitted by A. Irving
15	A. Habibi	A. Irving, UWS	Work name AH 728; submitted by A. Irving
16	A. Habibi	A. Irving, UWS	Work name AH 738; submitted by A. Irving
17	F. Kuntz	A. Irving, UWS	Work name K444; submitted by A. Irving
18	D. Pitt	A. Irving, UWS	Work name MVCH 488; submitted by A. Irving
19	A. Habibi	A. Irving, UWS	Work name AH 723; submitted by A. Irving
20	Darryl Pitt	C. Agee, UNM	Field name MVCH486; submitted by C. Agee, UNM
21	DPitt	C. Agee, UNM	Field name MVCH487; submitted by C. Agee, UNM
22	anonymous	C. Herd, UAb	Submitted by C. Herd
23	Sergey Vasilie	A. Love, App	Submitted by Anthony Love
24	Marc Jost (SJ)	A. Love, App	Submitted by Anthony Love
25	Marc Jost (SJ)	A. Love, App	Submitted by Anthony Love
26	UCLA	D. Sheikh, FS	Submitted by Daniel Sheikh
27	Matthew Stre	D. Sheikh, FS	Submitted by Daniel Sheikh
28	Daoud Wabic	D. Sheikh, FS	Submitted by Daniel Sheikh
29	Juan Aviles P	D. Sheikh, FS	Submitted by Daniel Sheikh
30	Jürgen Naube	K. Klemm, Add	Submitted by Klemm K.
31	DPitt	C. Agee, UNM	Submitted by C. Agee
32	DPitt	C. Agee, UNM	Submitted by C. Agee
33	anonymous fir	K. Klemm, I. K	Working No. NWA 4-17; submitted by Imene Kerraouch (UST
34	Hanno Strufe	A. Greshake, I	Submitted by Ansgar Greshake
35	Hanno Strufe	A. Greshake, I	Brownish rock without fusion crust. LL5 breccia. Plagioclase (
36	Hanno Strufe	A. Greshake, I	Submitted by Ansgar Greshake
37	Marcin Cimala	A. Greshake, I	Submitted by Ansgar Greshake
38	Marcin Cimala	A. Greshake, I	Submitted by Ansgar Greshake
39	N. Rezsabek	D. Rezes, CSI	Work name: RNNWax1; submitted by D. Rezes; submitted b
40	Didi Baidari ar	C. Agee, UNM	Field name DB-7; submitted by C. Agee, UNM
41	Stephen Amar	D. Sheikh, FS	Submitted by Daniel Sheikh
42	Fabien Kuntz	D. Sheikh, FS	Submitted by Daniel Sheikh
43	R. Chaoui/J.	C.A. Irving, UWS	Work name RC126.3; submitted by A. Irving
44	P. Brown	A. Irving, UWS	Work name HC19; submitted by A. Irving
45	M. Lyon	A. Irving, UWS	Work name Lyon19-4; submitted by A. Irving
46	P. Brown	A. Irving, UWS	Work name HC20; submitted by A. Irving
47	A. Habibi/D.	G.A. Irving, UWS	Work names AH 737 and RC127.2; submitted by A. Irving
48	M. Lyon	A. Irving, UWS	Work name Lyon19-6; submitted by A. Irving
49	L. Ouabicha/Z	A. Irving, UWS	Work name ZS20-CH1; submitted by A. Irving
50	M. Lyon/C.	ShA. Irving, UWS	Work name Lyon19-5; submitted by A. Irving
51	M. Arjdal	A. Irving, UWS	Work name Arj ZM 240; submitted by A. Irving
52	Jesper Gronn	D. Sheikh, FS	Submitted by Daniel Sheikh
53	John Higgins	D. Sheikh, FS	Submitted by Daniel Sheikh
54	Marc Jost (SJ)	Anthony Love	Submitted by Anthony Love
55	Andreas Gren	L. Krämer Ruç unknown	work name AG002; Brown pimped fragments, some with dar
56	Kuntz	J. Gattacceca	work name K467; submitted by J. Gattacceca
57	Thierry Simar	A. Love, App Unknown	Submitted by Anthony Love

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3	Marc Jost (SJ: A. Love, App Unknown	Submitted by Anthony Love
4	Marc Jost (SJ: A. Love, App Unknown	Submitted by Anthony Love
5	Marc Jost (SJ: A. Love, App Unknown	Submitted by Anthony Love
6	Juan Aviles P: D. Sheikh, FS	Submitted by Daniel Sheikh
7	Juan Aviles P: D. Sheikh, FS	Submitted by Daniel Sheikh
8	Juan Aviles P: D. Sheikh, FS	Submitted by Daniel Sheikh
9	Stephen Amari: D. Sheikh, FS	Submitted by Daniel Sheikh
10	Shawn Kasha: D. Sheikh, FS	Submitted by Daniel Sheikh
11	Stephen Amari: D. Sheikh, FS	Submitted by Daniel Sheikh
12	Matthew Stre: D. Sheikh, FS	Submitted by Daniel Sheikh
13	John Higgins A. Love, App	Submitted by Anthony Love
14	Fabien Kuntz A. Love, App	Submitted by Anthony Love
15	Fabien Kuntz A. Love, App	Submitted by Anthony Love
16	Fabien Kuntz A. Love, App	Submitted by Anthony Love
17	Dave Lehman A. Love, App	Submitted by Anthony Love
18	Fabien Kuntz A. Love, App	Submitted by Anthony Love
19	Dustin Dicken C. Agee, UNM	Field name DD-59; submitted by C. Agee, UNM
20	Dustin Dicken C. Agee, UNM	Field name DD-61; submitted by C. Agee, UNM
21	Lahbib Alfara, K. Metzler, IfP	Submitted by K. Metzler, IfP
22	Carlos Muñec: J. Llorca, UPC	Submitted by Carlos Muñecas
23	L. Labenne A. Irving, UWS	Work name RC130.3; submitted by A. Irving
24	J. Divilbiss A. Irving, UWS	Work name JD20-1; submitted by A. Irving
25	M. Arjdal A. Irving, UWS	Work name Arj ZM 02; submitted by A. Irving
26	D. Pitt A. Irving, UWS	Work name MVCH 492; submitted by A. Irving
27	M. Arjdal A. Irving, UWS	Work name Arj L1; submitted by A. Irving
28	M. Arjdal A. Irving, UWS	Work name Arj ZM 205; submitted by A. Irving
29	M. Arjdal A. Irving, UWS	Work name Arj ZM 214; submitted by A. Irving
30	D. Pitt A. Irving, UWS	Work name MVCH 493; submitted by A. Irving
31	Decker Meteo: K. Klemm, A. I	Working No.: De-01; submitted by K. Klemm, IfP; submitted t
32	Decker Meteo: K. Klemm, A. I	Working No.: De-04; submitted by K. Klemm, IfP; The rock ha
33	Decker Meteo: K. Klemm, A. I	Working No.: De-09; submitted by K. Klemm, IfP; submitted t
34	Decker Meteo: K. Klemm, A. I	Working No.: De-10; submitted by K. Klemm, IfP; submitted t
35	Decker Meteo: K. Klemm and	Working No.: De-08; submitted by K. Klemm, IfP; submitted t
36	Decker Meteo: K. Klemm and	Working No.: De-07; submitted by K. Klemm, IfP; submitted t
37	M. Arjdal A. Irving, UWS	Work name Arj ZM 250; submitted by A. Irving
38	A. Aaronson A. Irving, UWS	Work name M2246; submitted by A. Irving
39	M. Lyon A. Irving, UWS	Work name Lyon20-1; submitted by A. Irving
40	M. Arjdal A. Irving, UWS	Work name Arj ZM 270; submitted by A. Irving
41	E. Twelker A. Irving, UWS	Work name ET20-1; submitted by A. Irving
42	M. Lyon A. Irving, UWS	Work name Lyon20-2; submitted by A. Irving
43	M. Lyon A. Irving, UWS	Work name Lyon20-3; submitted by A. Irving
44	S. Kashay A. Irving, UWS	Work name SK20-1; submitted by A. Irving
45	Z. Wang A. Irving, UWS	Work name RC129.3; submitted by A. Irving
46	PSF A. Irving, UWS	Work name CHC20001; submitted by A. Irving
47	Thierry Simari: A. Love, App	Submitted by Anthony Love
48	Sean Tutorow: P. Warren, UC	Submitted by Paul Warren
49	Decker Meteo: K. Klemm and	Working No.: De-03; submitted by K. Klemm, IfP; submitted t
50	Philippe Schrr: A. Greshake, I	Submitted by Ansgar Greshake
51	Marcin Cimala: A. Greshake, I	Submitted by Ansgar Greshake
52	Larbi Chnaoui: A. Greshake, I	Dark brownish rock with some fusion crust. The plagioclase c
53	Larbi Chnaoui: A. Greshake, I	Submitted by Ansgar Greshake
54	Larbi Chnaoui: A. Greshake, I	Dark brownish rock without fusion crust. The plagioclase grai
55	Larbi Chnaoui: A. Greshake, I	Dark brownish rock without fusion crust. The plagioclase grai
56	Larbi Chnaoui: A. Greshake, I	Dark grayish rock largely covered by fusion crust. The plagioc
57	Said Yousfi ar: A. Greshake, I	Submitted by Ansgar Greshake
58	Said Yousfi A. Greshake, I	Submitted by Ansgar Greshake
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R. Lenssen	A. Greshake, I	Submitted by Ansgar Greshake
C. Zliment	A. Irving, UWS	Work name ZLI26; submitted by A. Irving
R. Chaoui	A. Irving, UWS	Work name RC132.1; submitted by A. Irving
M. Lyon	A. Irving, UWS	Work name ZLI27; submitted by A. Irving
H. Najj	A. Irving, UWS	Work name HN-416; submitted by A. Irving
Harkness Coll	A. Irving, UWS	Work name HC-12; submitted by A. Irving
R. Chaoui/J. CA	A. Irving, UWS	Work name RC131.2; submitted by A. Irving
M. Arjdal	A. Irving, UWS	Work name Arj ZM 241; submitted by A. Irving
J. Higgins	A. Irving, UWS	Work name JH20-1; submitted by A. Irving
M. Lyon	A. Irving, UWS	Work name Lyon20-4; submitted by A. Irving
R. Chaoui	A. Irving, UWS	Work name RC124.1; submitted by A. Irving
M. Arjdal	A. Irving, UWS	Work name Arj ZM 256; submitted by A. Irving
J. Higgins	A. Irving, UWS	Work name JH20-2; submitted by A. Irving
M. Arjdal	A. Irving, UWS	Work name Arj ZM 237; submitted by A. Irving
J. Divelbiss	A. Irving, UWS	Work name JD20-2; submitted by A. Irving
Noredine Azr	D. Sheikh, FS	Submitted by Daniel Sheikh
Ralf Brinkschr	K. Klemm, A. I	(K. Klemm, A. Bischoff, IfP): H4-5; the rock is a brecciated H-
Jasper Spenc	Daniel Sheikh	Submitted by Daniel Sheikh
Youssef Benn	D. Sheikh, FS	Submitted by Daniel Sheikh
Marc Jost (SJ)	A. Love, App	Submitted by Anthony Love
Marc Jost (SJ)	A. Love, App	Submitted by Anthony Love
Dustin Dicken	C. Agee, UNM	Field name DD-65; submitted by C. Agee, UNM
Marcin Cimala	C. Agee, UNM	Field name MC-178; submitted by C. Agee, UNM
B. Hoefnagels	A. Irving, UWS	Work name RC134.1; submitted by A. Irving
Kuntz	A. Love, App	Submitted by Anthony Love
Fabien Kuntz	A. Love, App	Submitted by Anthony Love
Sergey Vasilie	A. Love, App	Submitted by Anthony Love
S. Crivello	C. Herd, UAb	Submitted by C. Herd
UAlic	C. Herd, UAb	Field number 21542; submitted by C. Herd
UAlic	C. Herd, UAb	Field number 21535; submitted by C. Herd
UAlic	C. Herd, UAb	Field number 6; submitted by C. Herd
UAlic	C. Herd, UAb	Field number 15A; submitted by C. Herd
Sean Tutorow	C. Agee, UNM	Field name G727; submitted by C. Agee, UNM
Sean Tutorow	C. Agee, UNM	Field name G728; submitted by C. Agee, UNM
Sean Tutorow	C. Agee, UNM	Field name G729; submitted by C. Agee, UNM
Sean Tutorow	C. Agee, UNM	Field name G730; submitted by C. Agee, UNM
R. Chaoui	A. Irving, UWS	Work name RC133.6; submitted by A. Irving
B. Reed	A. Irving, UWA	Work name BR110; submitted by A. Irving
B. Reed	A. Irving, UWA	Work name BR111; submitted by A. Irving
B. Reed	A. Irving, UWA	Work name BR112; submitted by A. Irving
John Higgins	A. Love, App Mohamed Bo	Submitted by Anthony Love
Daniel Sheikh	D. Sheikh, FS	Submitted by Daniel Sheikh
Daniel Sheikh	D. Sheikh, FS	Submitted by Daniel Sheikh
Daniel Sheikh	D. Sheikh, FS	Submitted by Daniel Sheikh
Daniel Sheikh	D. Sheikh, FS	Submitted by Daniel Sheikh
Dustin Dicken	D. Dickens	Submitted by Dustin Dickens
Boulaouane	T.A. Greshake, I	Brownish rock without fusion crust. The plagioclase grain size
Boulaouane	T.A. Greshake, I	Submitted by Ansgar Greshake
Boulaouane	T.A. Greshake, I	Many brownish fragments with the largest one weighing 186 g
Boulaouane	T.A. Greshake, I	Submitted by Ansgar Greshake
Boulaouane	T.A. Greshake, I	Submitted by Ansgar Greshake
Lucian Cojoca	J. Gattacceca, anonymous	work name LC19; submitted by Jérôme Gattacceca
anonymous	J. Gattacceca, anonymous	work name MZ38; submitted by Jérôme Gattacceca
anonymous	J. Gattacceca, anonymous	work name MZA01; submitted by Jérôme Gattacceca
anonymous	J. Gattacceca, anonymous	work name MZA04; submitted by Jérôme Gattacceca

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3	Mirko Graul, EK. Metzler, IfP	Submitted by K. Metzler, IfP
4	Jasper Spence; Daniel Sheikh	Submitted by Daniel Sheikh
5	anonymous J. Gattacceca, anonymous	work name MZA05; submitted by Jérôme Gattacceca
6	anonymous J. Gattacceca, anonymous	work name MZA17; submitted by Jérôme Gattacceca
7	anonymous J. Gattacceca, anonymous	work name MZA19; submitted by Jérôme Gattacceca
8	anonymous J. Gattacceca, anonymous	work name MZAA16; submitted by Jérôme Gattacceca
9	anonymous J. Gattacceca, anonymous	work name MZAA19; Plagioclase to 200 µm; submitted by Jérôme Gattacceca
10	anonymous J. Gattacceca, anonymous	work name MZAA20; submitted by Jérôme Gattacceca; Shoc
11	Matthew Streza; D. Sheikh, FS	Submitted by Daniel Sheikh
12	Dave Lehman; A. Love, App	Submitted by Anthony Love
13	Dave Lehman; A. Love, App	Submitted by Anthony Love
14	Philippe Schrr; A. Greshake, I	Submitted by Ansgar Greshake
15	Philippe Schrr; A. Greshake, I	Submitted by Ansgar Greshake
16	Hanno Strufe; A. Greshake, I	Submitted by Ansgar Greshake
17	Salamu Ali; A. Greshake, I	Submitted by Ansgar Greshake
18	B. Reed; A. Irving, UWS	Work name BR109; submitted by A. Irving
19	B. Reed; A. Irving, UWS	Work name BR108; submitted by A. Irving
20	Harkness Coll; A. Irving, UWS	Work name HC-13; submitted by A. Irving
21	A. Aaronson; A. Irving, UWS	Work name M847; submitted by A. Irving
22	Harkness Coll; A. Irving, UWS	Work name HC-14; submitted by A. Irving
23	Harkness Coll; A. Irving, UWS	Work name HC-15; submitted by A. Irving
24	Harkness Coll; A. Irving, UWS	Work name HC-17; submitted by A. Irving
25	Harkness Coll; A. Irving, UWS	Work name HC-16; submitted by A. Irving
26	Harkness Coll; A. Irving, UWS	Work name HC-18; submitted by A. Irving
27	Harkness Coll; A. Irving, UWS	Work name HC-21; submitted by A. Irving
28	Harkness Coll; A. Irving, UWS	Work name HC-21; submitted by A. Irving
29	Kuntz; A. Love, App	Submitted by Anthony Love
30	N. Gessler; A. Irving, UWS	Work name AB; submitted by A. Irving
31	Z. Wang; A. Irving, UWS	Work name IA-2; submitted by A. Irving
32	N. Gessler; A. Irving, UWS	Work name E; submitted by A. Irving
33	J. Divelbiss; A. Irving, UWS	Work name JD20-3; submitted by A. Irving
34	D. Pitt; A. Irving, UWS	Work name MVCH 502; submitted by A. Irving
35	R. Chaoui; A. Irving, UWS	Work name RC136.2; submitted by A. Irving
36	Kuntz; A. Greshake, I	Submitted by Ansgar Greshake
37	Kuntz; A. Greshake, I	Submitted by Ansgar Greshake
38	Kuntz; A. Greshake, I	Submitted by Ansgar Greshake
39	Kuntz; A. Greshake, I	Submitted by Ansgar Greshake
40	Kuntz; A. Greshake, I	Submitted by Ansgar Greshake
41	Kuntz; A. Greshake, I	Submitted by Ansgar Greshake
42	Thierry Simard; A. Love, App	Submitted by Anthony Love
43	Dave Lehman; A. Love, App	Submitted by Anthony Love
44	Dave Lehman; A. Love, App	Based on composition and petrography, this sample may be
45	Fabien Kuntz; D. Sheikh, FS	Submitted by Daniel Sheikh
46	Fabien Kuntz; D. Sheikh, FS	Submitted by Daniel Sheikh
47	J. Divelbiss; A. Irving, UWS	Work name JD20-4; submitted by A. Irving
48	H. Naji; A. Irving, UWS	Work name HN 630; submitted by A. Irving
49	J. Divelbiss; A. Irving, UWS	Work name JD20-5; submitted by A. Irving
50	M. Arjdal; A. Irving, UWS	Work name Arj B152; submitted by A. Irving
51	N. Gessler; A. Irving, UWS	Work name I; submitted by A. Irving
52	D. Lehman; A. Irving, UWS	Work name DL 1030; submitted by A. Irving
53	N. Gessler; A. Irving, UWS	Work name J; submitted by A. Irving
54	N. Gessler; A. Irving, UWS	Work name K; submitted by A. Irving
55	N. Gessler; A. Irving, UWS	Work name M; submitted by A. Irving
56	N. Gessler; A. Irving, UWS	Work name Q; submitted by A. Irving
57	N. Gessler; A. Irving, UWS	Work name Q; submitted by A. Irving
58	Philippe Schrr; A. Greshake, I	Submitted by Ansgar Greshake
59	Larbi Chnaoui; A. Greshake, I	Submitted by Ansgar Greshake
60	Said Yousfi; A. Greshake, I	Submitted by Ansgar Greshake



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T. Niihara (UTT. Mikouchi arAbdellah Afini: Submitted by T. Mikouchi (UTok)  
 GUT Z.Xia, B.Miao. Anonymously Submitted by Bingkui Miao  
 GUT Z.Xia, B.Miao. Anonymously Submitted by Bingkui Miao  
 Andreas ScheA. Greshake, I Submitted by Ansgar Greshake  
 R. Lenssen A. Greshake, I Submitted by Ansgar Greshake  
 jnmczurich A. Greshake, I Submitted by Ansgar Greshake  
 jnmczurich A. Greshake, I Submitted by Ansgar Greshake  
 Hans-Jakob SA. Greshake, I Submitted by Ansgar Greshake  
 Said Yousfi A. Greshake, I Submitted by Ansgar Greshake  
 Said Yousfi A. Greshake, I Submitted by Ansgar Greshake  
 Lucian CojocaA. Greshake, I Submitted by Ansgar Greshake  
 Lucian CojocaA. Greshake, I Submitted by Ansgar Greshake  
 Lucian CojocaA. Greshake, I Submitted by Ansgar Greshake  
 UAlie C. Herd, UAb Field number 8; submitted by C. Herd  
 M. Arjdal A. Irving, UWS Arj ZM137; submitted by A. Irving  
 D. Lehman A. Irving, UWS DL 1034; submitted by A. Irving  
 J. Higgins A. Irving, UWS JH20-6; submitted by A. Irving  
 J. Divelbiss A. Irving, UWS JD20-6; submitted by A. Irving  
 J. Higgins A. Irving, UWS JH20-4; submitted by A. Irving  
 M. Lyon A. Irving, UWS Lyon20-5; submitted by A. Irving  
 R. Chaoui A. Irving, UWS RC136.4; submitted by A. Irving  
 T. Boudreaux A. Irving, UWS RC136.3; submitted by A. Irving  
 Pierre-Marie FL. Krämer. J. ( work name Chon2G; submitted by Jérôme Gattacceca  
 Jérémy BasseJ. Gattacceca. work name CM45; submitted by Jérôme Gattacceca  
 Isabelle PothicJ. Gattacceca. work name CM46; submitted by Jérôme Gattacceca  
 J. Bassemon J. Gattacceca. work name CM49; submitted by Jérôme Gattacceca  
 J. Bassemon J. Gattacceca. work name CM57; submitted by Jérôme Gattacceca  
 J. Bassemon J. Gattacceca. work name CM59; submitted by Jérôme Gattacceca  
 Jean RedelspiJ. Gattacceca. work name JR077; submitted by Jérôme Gattacceca  
 Jean RedelspiJ. Gattacceca. work name JR083; submitted by Jérôme Gattacceca  
 Kuntz J. Gattacceca. work name K427; submitted by Jérôme Gattacceca  
 Kuntz J. Gattacceca. work name K465; submitted by Jérôme Gattacceca  
 Kuntz J. Gattacceca. work name K471; submitted by Jérôme Gattacceca  
 Kuntz J. Gattacceca. work name K473; submitted by Jérôme Gattacceca  
 Kuntz J. Gattacceca. work name K474; submitted by Jérôme Gattacceca  
 Kuntz J. Gattacceca. work name K477; submitted by Jérôme Gattacceca  
 Kuntz J. Gattacceca. work name K483; submitted by Jérôme Gattacceca  
 Kuntz J. Gattacceca. work name K484; submitted by Jérôme Gattacceca  
 Kuntz J. Gattacceca. work name K492; submitted by Jérôme Gattacceca  
 Kuntz J. Gattacceca. work name K493; submitted by Jérôme Gattacceca  
 Pierre-Marie FJ. Gattacceca. work name PM20AC1; submitted by Jérôme Gattacceca  
 Pierre-Marie FJ. Gattacceca. work name PM20AC2; submitted by Jérôme Gattacceca  
 Kuntz J. Gattacceca. work name K435; submitted by Jérôme Gattacceca  
 Kuntz J. Gattacceca. work name K466; submitted by Jérôme Gattacceca  
 Kuntz J. Gattacceca. work name K469; submitted by Jérôme Gattacceca  
 Kuntz J. Gattacceca. work name K472; submitted by Jérôme Gattacceca  
 Kuntz J. Gattacceca. work name K490; submitted by Jérôme Gattacceca  
 J. Higgins A. Irving, UWS Work name JH20-5; submitted by A. Irving  
 Wang WeiweiFan yan and I Submitted by Li shijie  
 Wang WeiweiFan yan and I Submitted by Li shijie  
 Salamu Ali, StK. Metzler, IfP Submitted by K. Metzler, IfP  
 IfP K. Metzler, IfP Submitted by K. Metzler, IfP  
 Miguel Angel IK. Metzler, IfP Submitted by K. Metzler, IfP  
 Oz Backman D. Sheikh, FS Submitted by Daniel Sheikh



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3	Pat Brown D. Sheikh, FS	Submitted by Daniel Sheikh
4	Cameron SmiiD. Sheikh, FS	Submitted by Daniel Sheikh
5	Matthew StreçD. Sheikh, FS	Submitted by Daniel Sheikh
6	Matthew StreçD. Sheikh, FS	Submitted by Daniel Sheikh
7	Matthew StreçD. Sheikh, FS	Submitted by Daniel Sheikh
8	Abdeltif Mech:D. Sheikh, FS	Submitted by Daniel Sheikh
9	Matthew StreçD. Sheikh, FS	Submitted by Daniel Sheikh
10	Shawn KashaD. Sheikh, FS	Submitted by Daniel Sheikh
11	Jasper SpenciD. Sheikh, FS	Submitted by Daniel Sheikh
12	Sergey VasiliePavel Yu.Plec	field name is FN371 and SM1804-24; submitted by Pavel Yu
13	Wang Peng Fan Yan, Du k	Submitted by Li Shijie
14	Roger KilchenM. Hutson anc	Lab number CML 0929; submitted by Alex Ruzicka
15	Christopher C.M. Hutson anc	Lab number CML 0976; submitted by Alex Ruzicka
16	Cascadia K. Maccini anc	Lab number CML 0995; submitted by Alex Ruzicka
17	Gregor Pacer,K. Metzler, IfP	Submitted by K. Metzler, IfP
18	anonymous K. Metzler, IfP	Shock-darkened; submitted by K. Metzler, IfP
19	Tomasz JakutA. Greshake, l	Submitted by Ansgar Greshake
20	Tomasz JakutA. Greshake, l	Submitted by Ansgar Greshake
21	Tomasz JakutA. Greshake, l	Dark brownish fragment without fusion crust. The plagioclase
22	Tomasz JakutA. Greshake, l	Dark brownish fragment without fusion crust. The plagioclase
23	Tomasz JakutA. Greshake, l	Dark brownish fragment without fusion crust. The plagioclase
24	Tomasz JakutA. Greshake, l	Dark brownish fragment with some fusion crust. The plagioclase
25	Marcin KazimiA. Greshake, l	Dark grayish fragment with some fusion crust. The plagioclase
26	Said Yousfi A. Greshake, l	Submitted by Ansgar Greshake
27	Said Yousfi A. Greshake, l	Submitted by Ansgar Greshake
28	Mohammed BA. Greshake, l	Submitted by Ansgar Greshake
29	Said Yousfi A. Greshake, l	Submitted by Ansgar Greshake
30	Larbi ChnaouiA. Greshake, l	Submitted by Ansgar Greshake
31	Larbi ChnaouiA. Greshake, l	Submitted by Ansgar Greshake
32	Larbi ChnaouiA. Greshake, l	Submitted by Ansgar Greshake
33	Philippe SchrrA. Greshake, l	Submitted by Ansgar Greshake
34	MSN-Fi V. Moggi Cecchi Anonymous	Submitted by Vanni Moggi Cecchi
35	Boulaouane TA. Greshake, l	Submitted by Ansgar Greshake
36	Boulaouane TA. Greshake, l	Submitted by Ansgar Greshake
37	anonymous A. Greshake, l	Submitted by Ansgar Greshake
38	anonymous A. Greshake, l	Submitted by Ansgar Greshake
39	Mohamed Ali A. Greshake, l	Dark brownish fragment without fusion crust. The plagioclase
40	Said Radi A. Greshake, l	Submitted by Ansgar Greshake
41	anonymous A. Greshake, l	Submitted by Ansgar Greshake
42	Philippe SchrrA. Greshake, l	Submitted by Ansgar Greshake
43	Philippe SchrrA. Greshake, l	Submitted by Ansgar Greshake
44	Philippe SchrrA. Greshake, l	Submitted by Ansgar Greshake
45	Naji Ben FarajA. Greshake, l	Submitted by Ansgar Greshake
46	Philippe SchrrA. Greshake, l	Submitted by Ansgar Greshake
47	Philippe SchrrA. Greshake, l	Submitted by Ansgar Greshake
48	Philippe SchrrA. Greshake, l	Submitted by Ansgar Greshake
49	Philippe SchrrA. Greshake, l	Submitted by Ansgar Greshake
50	Carlos Muñec A. Love, App	Submitted by Anthony Love
51	Carlos Muñec A. Love, App	Submitted by Anthony Love
52	Carlos Muñec A. Love, App	Submitted by Anthony Love
53	Adrian Contre A. Love, App	Submitted by Anthony Love
54	Carlos Muñec A. Love, App	Submitted by Anthony Love
55	Sergey Vasilie A. Love, App	Submitted by Anthony Love
56	Sergey Vasilie A. Love, App	Submitted by Anthony Love
57	Sergey Vasilie A. Love, App	Submitted by Anthony Love
58	Carlos Muñec A. Love, App	Submitted by Anthony Love
59	Carlos Muñec A. Love, App	Submitted by Anthony Love
60	Carlos Muñec A. Love, App	Submitted by Anthony Love

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Adrian Contre A. Love, App Submitted by Anthony Love

Zhu Hao Fan Yan Submitted by Li Shijie

Topher Spinn;D. Sheikh, FS Field ID=GoldenPallasite1; submitted by Daniel Sheikh

Didi Baidari Anthony Love Submitted by Anthony Love

Bo Zhang Wu Y., PMO Submitted by Hsu W.

Bo Zhang Wu Y. Submitted by Hsu W.

Bo Zhang Wu Y. Submitted by Hsu W.

Fangmei Wan R. Bartoshev anonymous working name WZ161; submitted by R. Bartoschewitz

Chengguang IR. Bartoshev anonymous working name WZ163; submitted by R. Bartoschewitz

Wei Jiang R. Bartoshev anonymous working name WZ165; submitted by R. Bartoschewitz

J. Higgins/D. IA. Irving, UWS Submitted by A. Irving

Hanno Strufe A. Greshake, I Submitted by Ansgar Greshake

Hanno Strufe A. Greshake, I Submitted by Ansgar Greshake

Larbi Chnaoui A. Greshake, I Submitted by Ansgar Greshake

Larbi Chnaoui A. Greshake, I Dark brownish fragment without fusion crust. The plagioclase

Larbi Chnaoui A. Greshake, I Submitted by Ansgar Greshake

Lucian Cojoca A. Greshake, I Muhammad Sal Submitted by Ansgar Greshake

Lucian Cojoca A. Greshake, I Muhammad Sal Submitted by Ansgar Greshake

Boulaouane T A. Greshake, I Submitted by Ansgar Greshake

Philippe Schrr A. Greshake, I Submitted by Ansgar Greshake

Ziyao Wang L.F. Xie and H Anonymous Submitted by Bingkui Miao

Simon de Boe C. Agee, UNV Field name SB1; submitted by C. Agee, UNM

Simon de Boe C. Agee, UNV Field name SB2; submitted by C. Agee, UNM

Matthew Strez C. Agee, UNV Field name MAS-4; submitted by C. Agee, UNM

John Divelbiss C. Agee, UNV Field name MAS-4; submitted by C. Agee, UNM

Verish D. Sheikh, FS Robert Verish Fieldname = UU161111X; submitted by Daniel Sheikh; subm

Verish D. Sheikh, FS Robert Verish Fieldname = UU161212F; submitted by Daniel Sheikh; subm

Verish D. Sheikh, FS Robert Verish Fieldname = UU161213H; submitted by Daniel Sheikh; subm

Verish D. Sheikh, FS Robert Verish Fieldname = UU161123H; submitted by Daniel Sheikh; subm

SMNH B. Ambrožic, (Gregor Kos (1 Submitted by B. Ambrožic

IAG-MAS Victor V. Shar UrFU-IAG-MA Submitted by Victor V. Sharygin, SIGM and UrFU

The main mas Xiaosong Li, F Anonymous Submitted by D. Heinlein

Ivan Ivanov J. Gattacceca Ivan Ivanov, N Submitted by Jérôme Gattacceca

UOslo, Steina A. Krzesinska Anne-Margret Submitted by Henrik Friis

M. Arjdal A. Irving, UWS Work name Arj ZM 337; submitted by A. Irving

Pengli Chen J. Ji, S. Hu an Pengli Chen [Suggested name was Niya]; submitted by J. Ji, S. Hu and Y.

E.Wimmer/K.K. Klemm, A. I Working name: Paposo-#1; submitted by Klemm K.

K. Wimmer K. Klemm, A. I Working name: Paposo-#; submitted by Klemm K.

K. Wimmer K. Klemm, A. I Working name: Paposo-#3; submitted by Klemm K.

Andreas Kopp J. Gattacceca Andreas Kopp work name AK006; submitted by J. Gattacceca

Andreas Kopp J. Gattacceca Andreas Kopp work name AK031; submitted by Jérôme Gattacceca

Thomas Kurtz J. Gattacceca Thomas Kurtz work name ST04. Found on fine gravel hillside from 20 m dis

Andreas Kopp J. Gattacceca Andreas Kopp work name AK003-005; submitted by Jérôme Gattacceca

Eric Christens J. Gattacceca Eric Christens work name EJ123; submitted by Jérôme Gattacceca

DMUH S. N. Teplyak Mr. Oleg N. R Submitted by A. M. Abdrakhimov (Vernad)

Anonymous Lorenz C. A., 'Mr. Nicolay N. Analyst T. Kryachko (Technograd, Moscow); submitted by Lo

Yuxian Zhao Li shijie and F. Yuxian Zhao Submitted by Li shijie

B. Hoefnagels A. Irving, UWS Work names DL1002&1003; BH222; submitted by A. Irving

Mohamadrez J. Gattacceca Hojat Kamali work name AP12; submitted by Jérôme Gattacceca

Amirali Kamal J. Gattacceca Amirali Kamal work name K4200/Ravar. Well-delineated packed chondrules

WAM A. W. R. Beva M. C. Carlisle Submitted by L. V. Forman (Curtin University, WAM)

Labenne K. Klemm and Rock with different lithologies; the equilibrated, type 5 clasts I

Labenne K. Klemm and Submitted by Klemm K.

Labenne K. Klemm and Submitted by Klemm K.

Labenne K. Klemm and Submitted by Klemm K.

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3	Labenne	K. Klemm and	SV, Br; submitted by Klemm K.
4	Labenne	K. Klemm and	Submitted by Klemm K.
5	Labenne	K. Klemm and	Br; submitted by Klemm K.
6	Labenne	K. Klemm and	Rock with different lithologies; the type 5 clasts have equilibria
7	Labenne	K. Klemm and	Br, IMC; submitted by Klemm K.
8	Labenne	K. Klemm and	Submitted by Klemm K.
9	Labenne	K. Klemm and	Submitted by Klemm K.
10	Labenne	K. Klemm and	Submitted by Klemm K.
11	Labenne	K. Klemm and	Sv; submitted by Klemm K.
12	Labenne	K. Klemm and	Submitted by Klemm K.
13	Labenne	K. Klemm and	Submitted by Klemm K.
14	Labenne	K. Klemm and	Submitted by Klemm K.
15	Labenne	K. Klemm and	Submitted by Klemm K.
16	Labenne	K. Klemm and	Sv, ringwoodite; submitted by Klemm K.
17	Labenne	K. Klemm and	Sv; submitted by Klemm K.
18	Labenne	K. Klemm and	Sv; submitted by Klemm K.
19	Labenne	K. Klemm and	Submitted by Klemm K.
20	Labenne	K. Klemm and	Sv; submitted by Klemm K.
21	Labenne	K. Klemm and	Br; submitted by Klemm K.
22	Labenne	K. Klemm and	Br; submitted by Klemm K.
23	Labenne	K. Klemm and	Br; submitted by Klemm K.
24	Labenne	K. Klemm and	Sv; submitted by Klemm K.
25	Labenne	K. Klemm and	Rock with different lithologies; the type 6 clasts have equilibria
26	Labenne	K. Klemm and	Rock with different lithologies; the type 6 clasts are clearly do
27	Labenne	K. Klemm and	Br, Sv; submitted by Klemm K.
28	Labenne	K. Klemm and	Sv, Br; submitted by Klemm K.
29	Labenne	K. Klemm and	Submitted by Klemm K.
30	Labenne	K. Klemm and	Br; submitted by Klemm K.
31	Labenne	K. Klemm and	Submitted by Klemm K.
32	Labenne	K. Klemm and	Submitted by Klemm K.
33	Labenne	K. Klemm and	Br; submitted by Klemm K.
34	Labenne	K. Klemm and	Submitted by Klemm K.
35	Labenne	K. Klemm and	Submitted by Klemm K.
36	Labenne	K. Klemm and	Rock with different lithologies; the type 6 clasts have equilibria
37	Labenne	K. Klemm and	Sv; submitted by Klemm K.
38	Labenne	K. Klemm and	Sv, ringwoodite; submitted by Klemm K.
39	Labenne	K. Klemm and	Br; submitted by Klemm K.
40	Labenne	K. Klemm and	The rock contains abundant small chondrules (300-400 $\mu\text{m}$ ) ;
41	Labenne	K. Klemm and	Br; submitted by Klemm K.
42	Labenne	K. Klemm and	Sv, Br; submitted by Klemm K.
43	Labenne	K. Klemm and	Submitted by Klemm K.
44	Labenne	K. Klemm and	Submitted by Klemm K.
45	Labenne	K. Klemm and	Submitted by Klemm K.
46	Labenne	K. Klemm and	Br, Sv; submitted by Klemm K.
47	Labenne	K. Klemm and	Br; submitted by Klemm K.
48	Labenne	K. Klemm and	Br; submitted by Klemm K.
49	Labenne	K. Klemm and	Sv; submitted by Klemm K.
50	Labenne	K. Klemm and	Submitted by Klemm K.
51	Labenne	K. Klemm and	Sv; submitted by Klemm K.
52	Labenne	K. Klemm and	Brecia. Abundant chondrules with a size of about 500-600 $\mu\text{m}$
53	Labenne	K. Klemm and	Br; submitted by Klemm K.
54	Labenne	K. Klemm and	Sv; submitted by Klemm K.
55	Labenne	K. Klemm and	Submitted by Klemm K.
56	Labenne	K. Klemm and	Submitted by Klemm K.
57	Labenne	K. Klemm and	Sv; submitted by Klemm K.
58	Labenne	K. Klemm and	Sv; submitted by Klemm K.
59	Labenne	K. Klemm and	Submitted by Klemm K.
60	Labenne	K. Klemm and	Br; submitted by Klemm K.

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Labenne K. Klemm and Sv; submitted by Klemm K.

Labenne K. Klemm and Br; submitted by Klemm K.

Labenne K. Klemm and Sv, shock darkened; submitted by Klemm K.

Labenne K. Klemm and Submitted by Klemm K.

Labenne K. Klemm and The rock contains abundant relatively small chondrules (300-

Labenne K. Klemm and Submitted by Klemm K.

Labenne K. Klemm and Submitted by Klemm K.

Labenne K. Klemm and Br; submitted by Klemm K.

Labenne K. Klemm and Submitted by Klemm K.

Labenne K. Klemm and Submitted by Klemm K.

Labenne K. Klemm and Submitted by Klemm K.

Labenne K. Klemm and Submitted by Klemm K.

Labenne K. Klemm and Br; submitted by Klemm K.

Labenne K. Klemm and Submitted by Klemm K.

Labenne K. Klemm and Submitted by Klemm K.

LeMans T. Shisseh, FS Submitted by T. Shisseh

The main masL. Ferrière and Rolando Bianco Field name was URU17\_Z.; submitted by L. Ferrière

Finder M.E. Zucolotto Many Submitted by A. Tosi and A. Moutinho; submitted by Amanda

Pierre-Marie FL. Kraemer. J. Anonymous work name OM14-001, Found within the SAU 001 strewnfield

SQU P. Hill, N. BanDr. Sobhi Nas Submitted by P. Hill

IAG-MAS Kseniya DuguUrFU-IAG-MA Submitted by Kseniya Dugushkina dugushkina.kseniya@mai

with finder K. Klemm, A. I Submitted by Klemm K.

Jens Bäumer A. Greshake, I Submitted by Ansgar Greshake

Lucian CojocaA. Greshake, I Submitted by Ansgar Greshake

Mr. I. Kryachk Lorenz C. A., 'Mr. I. Kryachk field name is Calama 2-18I; analyst T. Kryachko (Technograd,

Mr. M. Nepom Lorenz C. A., 'Mr. M. Nepom field name is Calama 6-41M; analyst T. Kryachko (Technograd,

Mr. I. Kryachk Lorenz C. A., 'Mr. I. Kryachk field name is Calama 5-17I; analyst T. Kryachko (Technograd,

Mr. I. Kryachk Lorenz C. A., 'Mr. I. Kryachk field name is Calama 4-8I; analyst T. Kryachko (Technograd,

UrFU K. Dugushkina UrFU meteorit Field name Past-8; submitted by Kseniya Dugushkina (UB R)

I. Chaplygin, i Lorenz C. A., 'Chaplygin Ilya field name is 012, analyst T. Kryachko (Technograd, Moscov

I. Chaplygin, i Lorenz C. A., 'Chaplygin Ilya field name is 024, analyst T. Kryachko (Technograd, Moscov

I. Chaplygin, i Lorenz C. A., 'Chaplygin Ilya field name is 050, analyst T. Kryachko (Technograd, Moscov

I. Chaplygin, i Lorenz C. A., 'Chaplygin Ilya field name is 051, analyst T. Kryachko (Technograd, Moscov

Mr. Evgeny Ts J. Gattacceca, Evgeny Tsys, work name KY41; submitted by J. Gattacceca

I. Chaplygin, i Lorenz C. A., 'Chaplygin Ilya field name is 014, analyst T. Kryachko (Technograd, Moscov

Mr. I. Kryachk Lorenz C. A., 'Mr. I. Kryachk Field name is I4-36; analyst T. Kryachko (Technograd, Moscov

Mr. M. Nepom Lorenz C. A., 'Mr. M. Nepom PMD Fa=34%; Field name is M3-71; analyst T. Kryachko (Te

Mr. M. Nepom Lorenz C. A., 'Mr. M. Nepom Field name is M2-10; analyst T. Kryachko (Technograd, Moscov

Mr. M. Nepom Lorenz C. A., 'Mr. M. Nepom Field name is M3-82; analyst T. Kryachko (Technograd, Moscov

Mr. M. Nepom Lorenz C. A., 'Mr. M. Nepom Field name is M3-9; analyst T. Kryachko (Technograd, Moscov

I. Chaplygin, i Lorenz C. A., 'Chaplygin Ilya field name is 011, analyst T. Kryachko (Technograd, Moscov

Mr. M. Nepom Ivanova M. A. Mr. M. Nepom Field name is M3-10; analyst T. Kryachko (Technograd, Moscov

UrFU K. Dugushkina UrFU meteorit Field name Past-9; analysts - Kseniya Dugushkina (RAS-UB)

Mr. Evgeny Ts J. Gattacceca, Mr. Evgeny Ts work name KY33; submitted by Jérôme Gattacceca

Mr. M. Nepom Ryazantsev K Mr. M. Nepom Field name is M3-54; analyst T. Kryachko (Technograd, Moscov

I. Chaplygin, i Ryazantsev K Chaplygin Ilya field name is 057, analyst T. Kryachko (Technograd, Moscov

I. Chaplygin, i Lorenz C. A., 'Ilya Chaplygin field name is 052, analyst T. Kryachko (Technograd, Moscov

N. Ben Faraji/A. Irving, UWS Work name NBF-MN47; submitted by A. Irving

Carlos Muñec A. Love, App Submitted by Anthony Love

Aaronson C. Agee, UNM Alalou Youssef Work names M2253, DDF01; submitted by H. Chennaoui Aoi

Wenxi Jin and R. Bartoshev anonymous working name WZ136; submitted by R. Bartoschewitz

J. Bassemon J. Gattacceca, work name CM58; submitted by Jérôme Gattacceca

Pengli Chen J. Ji, S. Hu and Pengli Chen Submitted by J. Ji, S. Hu and Y. Lin, IGGCAS

UALic C. Herd, UAb Field number 21266; submitted by C. Herd

IST-USTHB K. Klemm, I. K Working Name: Bechar; submitted by Imene Kerraouch



1  
2  
3 Jean Redelsp. J. Gattacceca, Lahcen Hamd work name JR078; submitted by Jérôme Gattacceca  
4 Finder M.E. Zucolotto, Mr. Titota Submitted by A. Tosi and M.E. Zucolotto; submitted by Aman  
5 A. Habibi/M. AA. Irving, UWS Work names AH 747 and Arj H10; submitted by A. Irving  
6 Mr. T. Kryachko, Lorenz C. A., 'Mr. T. Kryachko' field name is Calama 5-22; analyst T. Kryachko (Technograd  
7 Mr. T. Kryachko, Lorenz C. A., 'Mr. I. Kryachko' Field name is 6-60; analyst T. Kryachko (Technograd, Mosco  
8 Mr. Atali Agak, Lorenz C. A., 'Mr. Atali Agak' Field name is A027; analyst A. Agakhanov (Fersman Minera  
9 I. Chaplygin, Lorenz C. A., 'Chaplygin Ilya' field name is 092, analyst T. Kryachko (Technograd, Moscov  
10 I. Chaplygin, Ryazantsev K, Chaplygin Ilya field name is 091, analyst T. Kryachko (Technograd, Moscov  
11 Decker Meteor K. Klemm, A. I Working No.: De-13, suggested name Adrar004; submitted by  
12 Mark Lyon C. Agee, UNM Field name ML-1; submitted by C. Agee, UNM  
13 Decker Meteor K. Klemm, A. I Working No.: De-14; submitted by Klemm K.  
14 Verish D. Sheikh, FS Robert Verish Fieldname = ECVB01; lab ID# = V-B01; abbr. = TM 054; sub  
15 Verish D. Sheikh, FS Robert Verish Fieldname = ECVB02; lab ID# = V-B02; abbr. = TM 055; sub  
16 Verish D. Sheikh, FS Robert Verish Fieldname = ECVB03; lab ID# = V-B03; abbr. = TM 056; sub  
17 Verish D. Sheikh, FS Robert Verish Fieldname = ECVB04; lab ID# = V-B04; abbr. = TM 057; sub  
18 Verish D. Sheikh, FS Robert Verish Fieldname = ECVB05; lab ID# = V-B05; abbr. = TM 058; sub  
19 Verish D. Sheikh, FS Robert Verish Fieldname = ECVB07; lab ID# = V-B07; abbr. = TM 059; sub  
20 Verish D. Sheikh, FS Robert Verish Fieldname = ECVB08; lab ID# = V-B08; abbr. = TM 060; sub  
21 Verish D. Sheikh, FS Robert Verish Fieldname = ECVB09; lab ID# = V-B09; abbr. = TM 073; sub  
22 Verish D. Sheikh, FS Robert Verish Fieldname = ECVB10; lab ID# = V-B10; abbr. = TM 084; sub  
23 Verish D. Sheikh, FS Robert Verish Fieldname = ECVB11; lab ID# = V-B11; abbr. = TM 116; sub  
24 Verish D. Sheikh, FS Robert Verish Fieldname = ECVB13; lab ID# = V-B13; abbr. = TM 121; sub  
25  
26 Kansas Meteor A. Rubin, UCL Submitted by Alan Rubin  
27 Jens Bäumer A. Greshake, I Submitted by Ansgar Greshake  
28 Verish D. Sheikh, FS Robert Verish Fieldname = USA200128; submitted by Daniel Sheikh; subm  
29 UOslo Agata Krzesin, Terje Fjeldheim Submitted by Henrik Friis  
30 L. Randolph A. Irving, UWS Submitted by A. Irving  
31 Vincent Jacqu C. Agee, UNM Moroccan hunt Submitted by H. Chennaoui Aoudjehane  
32 P. Allen A. Irving, UWS Rodney Miche Submitted by A. Irving  
33 Ziyao Wang R. Bartoschew, Wentao Yang working name WZ131; submitted by R. Bartoschewitz  
34 NIPR A. Yamaguchi Submitted by A. Yamaguchi  
35 NIPR A. Yamaguchi Submitted by A. Yamaguchi  
36 NIPR A. Yamaguchi Submitted by A. Yamaguchi  
37 NIPR A. Yamaguchi Submitted by A. Yamaguchi  
38 NIPR A. Yamaguchi Submitted by A. Yamaguchi  
39 NIPR A. Yamaguchi Submitted by A. Yamaguchi  
40 NIPR A. Yamaguchi Submitted by A. Yamaguchi  
41 NIPR A. Yamaguchi Submitted by A. Yamaguchi  
42 NIPR A. Yamaguchi Submitted by A. Yamaguchi  
43 NIPR A. Yamaguchi Submitted by A. Yamaguchi  
44 NIPR A. Yamaguchi Submitted by A. Yamaguchi  
45 NIPR A. Yamaguchi Submitted by A. Yamaguchi  
46 NIPR A. Yamaguchi Submitted by A. Yamaguchi  
47 NIPR A. Yamaguchi Submitted by A. Yamaguchi  
48 NIPR A. Yamaguchi Shock vein; submitted by A. Yamaguchi  
49 NIPR A. Yamaguchi Submitted by A. Yamaguchi  
50 NIPR A. Yamaguchi Submitted by A. Yamaguchi  
51 NIPR A. Yamaguchi Submitted by A. Yamaguchi  
52 NIPR A. Yamaguchi Submitted by A. Yamaguchi  
53 NIPR A. Yamaguchi Submitted by A. Yamaguchi  
54 NIPR A. Yamaguchi Chromite-plagioclase clast; submitted by A. Yamaguchi  
55 NIPR A. Yamaguchi Submitted by A. Yamaguchi  
56 NIPR A. Yamaguchi Submitted by A. Yamaguchi  
57 NIPR A. Yamaguchi Submitted by A. Yamaguchi  
58 NIPR A. Yamaguchi Submitted by A. Yamaguchi  
59 NIPR A. Yamaguchi Submitted by A. Yamaguchi  
60 NIPR A. Yamaguchi Submitted by A. Yamaguchi





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3	NIPR	A. Yamaguchi	Submitted by A. Yamaguchi
4	NIPR	A. Yamaguchi	Submitted by A. Yamaguchi
5	NIPR	A. Yamaguchi	Submitted by A. Yamaguchi
6	NIPR	A. Yamaguchi	Submitted by A. Yamaguchi
7	NIPR	A. Yamaguchi	Darkened; submitted by A. Yamaguchi
8	NIPR	A. Yamaguchi	Submitted by A. Yamaguchi
9	NIPR	A. Yamaguchi	Submitted by A. Yamaguchi
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18	NIPR	A. Yamaguchi	Submitted by A. Yamaguchi
19	NIPR	A. Yamaguchi	Submitted by A. Yamaguchi
20	NIPR	A. Yamaguchi	Submitted by A. Yamaguchi
21	NIPR	A. Yamaguchi	Shock vein; submitted by A. Yamaguchi
22	NIPR	A. Yamaguchi	Submitted by A. Yamaguchi
23	NIPR	A. Yamaguchi	Shock vein; submitted by A. Yamaguchi
24	NIPR	A. Yamaguchi	Shock vein; submitted by A. Yamaguchi
25	NIPR	A. Yamaguchi	Submitted by A. Yamaguchi
26	NIPR	A. Yamaguchi	Submitted by A. Yamaguchi
27	NIPR	A. Yamaguchi	Shock vein; submitted by A. Yamaguchi
28	NIPR	A. Yamaguchi	Submitted by A. Yamaguchi
29	NIPR	A. Yamaguchi	Submitted by A. Yamaguchi
30	NIPR	A. Yamaguchi	Submitted by A. Yamaguchi
31	NIPR	A. Yamaguchi	Submitted by A. Yamaguchi
32	NIPR	A. Yamaguchi	Submitted by A. Yamaguchi
33	NIPR	A. Yamaguchi	Shock vein; submitted by A. Yamaguchi
34	NIPR	A. Yamaguchi	Submitted by A. Yamaguchi
35	NIPR	A. Yamaguchi	Submitted by A. Yamaguchi
36	NIPR	A. Yamaguchi	Submitted by A. Yamaguchi
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57	NIPR	A. Yamaguchi	Submitted by A. Yamaguchi
58	NIPR	A. Yamaguchi	Submitted by A. Yamaguchi
59	NIPR	A. Yamaguchi	Submitted by A. Yamaguchi
60	NIPR	A. Yamaguchi	Shock vein; submitted by A. Yamaguchi



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3	NIPR	A. Yamaguchi	Submitted by A. Yamaguchi
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17	NIPR	A. Yamaguchi	Submitted by A. Yamaguchi
18	NIPR	A. Yamaguchi	Submitted by A. Yamaguchi
19	NIPR	A. Yamaguchi	Shock vein; submitted by A. Yamaguchi
20	NIPR	A. Yamaguchi	Shock vein; submitted by A. Yamaguchi
21	NIPR	A. Yamaguchi	Submitted by A. Yamaguchi
22	NIPR	A. Yamaguchi	Melt pocket; submitted by A. Yamaguchi
23	NIPR	A. Yamaguchi	Submitted by A. Yamaguchi
24	NIPR	A. Yamaguchi	Submitted by A. Yamaguchi
25	NIPR	A. Yamaguchi	Shock vein; submitted by A. Yamaguchi
26	NIPR	A. Yamaguchi	Shock vein; submitted by A. Yamaguchi
27	NIPR	A. Yamaguchi	Submitted by A. Yamaguchi
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3	NIPR	A. Yamaguchi	Submitted by A. Yamaguchi
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5	NIPR	A. Yamaguchi	Shock vein; submitted by A. Yamaguchi
6	NIPR	A. Yamaguchi	Submitted by A. Yamaguchi
7	NIPR	A. Yamaguchi	Submitted by A. Yamaguchi
8	NIPR	A. Yamaguchi	Submitted by A. Yamaguchi
9	NIPR	A. Yamaguchi	Submitted by A. Yamaguchi
10	NIPR	A. Yamaguchi	Breccia; submitted by A. Yamaguchi
11	NIPR	A. Yamaguchi	Submitted by A. Yamaguchi
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30	NIPR	A. Yamaguchi	Submitted by A. Yamaguchi
31	NIPR	A. Yamaguchi	Submitted by A. Yamaguchi
32	NIPR	A. Yamaguchi	Shock vein; submitted by A. Yamaguchi
33	NIPR	A. Yamaguchi	Submitted by A. Yamaguchi
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54	NIPR	A. Yamaguchi	Breccia; submitted by A. Yamaguchi
55	NIPR	A. Yamaguchi	Shock vein; submitted by A. Yamaguchi
56	NIPR	A. Yamaguchi	Submitted by A. Yamaguchi
57	NIPR	A. Yamaguchi	Submitted by A. Yamaguchi
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21	NIPR	A. Yamaguchi	Submitted by A. Yamaguchi
22	NIPR	A. Yamaguchi	Submitted by A. Yamaguchi
23	NIPR	A. Yamaguchi	Breccia; submitted by A. Yamaguchi
24	NIPR	A. Yamaguchi	Submitted by A. Yamaguchi
25	NIPR	A. Yamaguchi	Submitted by A. Yamaguchi
26	NIPR	A. Yamaguchi	Submitted by A. Yamaguchi
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39	NIPR	A. Yamaguchi	Submitted by A. Yamaguchi
40	NIPR	A. Yamaguchi	Submitted by A. Yamaguchi
41	NIPR	A. Yamaguchi	Shock vein; submitted by A. Yamaguchi
42	NIPR	A. Yamaguchi	Submitted by A. Yamaguchi
43	NIPR	A. Yamaguchi	Shock vein; submitted by A. Yamaguchi
44	NIPR	A. Yamaguchi	Submitted by A. Yamaguchi
45	NIPR	A. Yamaguchi	Submitted by A. Yamaguchi
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59	NIPR	A. Yamaguchi	Submitted by A. Yamaguchi
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18 ons, Accession number GE15574.; submitted by Dr Hugh Grenfell

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21 e.; submitted by Jérôme Gattacceca  
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27 el Sheikh

28 el Sheikh

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34 d, Moscow); submitted by Lorenz C.A., Vernad

35 d, Moscow); submitted by Lorenz C.A., Vernad

36 d, Moscow); submitted by Lorenz C.A., Vernad

37 d, Moscow); submitted by Lorenz C.A., Vernad

38 d, Moscow); submitted by Lorenz C.A., Vernad

39 d, Moscow); submitted by Lorenz C.A., Vernad  
40 l, Moscow); submitted by Lorenz C.A., Vernad  
41

42 IB; submitted by Kseniya Dugushkina (UB RAS) dugushkina.kseniya@mail.ru

43 B RAS).; submitted by Kseniya Dugushkina (UB RAS) dugushkina.kseniya@mail.ru

44 AS) dugushkina.kseniya@mail.ru

45 RAS) dugushkina.kseniya@mail.ru

46 w); submitted by Lorenz C.A., Vernad

47 id, Moscow); submitted by Lorenz C. A. (Vernad)

48 w); the meteorite is brecciated; submitted by C. A. Lorenz, Vernad

49 w); submitted by C. A. Lorenz, Vernad

50 AS).; submitted by Kseniya Dugushkina (IGG UB RAS) dugushkina.kseniya@mail.ru

51 w); submitted by Lorenz C.A., Vernad  
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54 w); submitted by Lorenz C.A., Vernad

55 w); submitted by Lorenz C.A., Vernad  
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7 aicity in the sulfides. Shock veins.; submitted by B. Doisneau

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19 I by Jérôme Gattacceca

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25 d, Moscow); submitted by Lorenz C.A., Vernad  
26 0; analyst T. Kryachko (Technograd, Moscow); submitted by Lorenz C.A., Vernad  
27 l, Moscow); submitted by Lorenz C.A., Vernad

28  
29 ad, Moscow); submitted by Lorenz C.A., Vernad  
30 ad, Moscow); submitted by Lorenz C.A., Vernad  
31 l, Moscow); submitted by Lorenz C.A., Vernad  
32 l, Moscow); submitted by Lorenz C.A., Vernad

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34 w); submitted by Lorenz C.A., Vernad  
35 w); submitted by Lorenz C.A., Vernad  
36 w); submitted by Lorenz C.A., Vernad  
37 w); submitted by Lorenz C.A., Vernad  
38 w); submitted by Lorenz C.A., Vernad  
39 w); submitted by Lorenz C.A., Vernad  
40 w); submitted by Lorenz C.A., Vernad  
41 w); submitted by Lorenz C.A., Vernad  
42 w); submitted by Lorenz C.A., Vernad  
43 w); submitted by C. A. Lorenz, Vernad  
44 w); submitted by Lorenz C.A., Vernad  
45 w); submitted by Lorenz C.A., Vernad  
46 w); submitted by Lorenz C.A., Vernad

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49 w); submitted by Lorenz C.A., Vernad  
50 w); submitted by Lorenz C.A., Vernad  
51 w); submitted by Lorenz C.A., Vernad  
52 ow); submitted by Lorenz C.A., Vernad

53  
54 )gmail.com  
55 w); submitted by C. A. Lorenz, Vernad  
56 w); submitted by C. A. Lorenz, Vernad  
57 ological Museum), T. Kryachko; submitted by Lorenz C.A., Vernad  
58 ological Museum), T. Kryachko; submitted by Lorenz C.A., Vernad  
59 w); submitted by Lorenz C.A., Vernad



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6 microscopic; submitted by R. Bartoschewitz  
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12 Doisneau  
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23 ; dark with shock veins, the other is light without shock veins.; submitted by B. Doisneau  
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27 a. Shock veins.; submitted by B. Doisneau  
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34 1 El MÃ©dano 156.; submitted by JÃ©rÃ´me Gattacceca  
35  
36

37 J. Gattacceca  
38  
39  
40

41 lase to 200 Åµm. Likely paired with El MÃ©dano 156.; submitted by JÃ©rÃ´me Gattacceca

42 lase to 200 Åµm. Likely paired with El MÃ©dano 156.; submitted by JÃ©rÃ´me Gattacceca

43 dano 156.; submitted by JÃ©rÃ´me Gattacceca

44 ase to 200 Åµm. Likely paired with El MÃ©dano 156.; submitted by JÃ©rÃ´me Gattacceca

45 ase to 200 Åµm. Likely paired with El MÃ©dano 156.; submitted by JÃ©rÃ´me Gattacceca  
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47 in size is about 30 µm.; submitted by Ansgar Greshake

48 in size is about 20 µm.; submitted by Ansgar Greshake

49 in size is about 70 µm.; submitted by Ansgar Greshake  
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6 ); submitted by Kseniya Dugushkina (RAS-UB).; submitted by Kseniya Dugushkina (RAS-UB)  
7 ); submitted by Kseniya Dugushkina (RAS-UB).; submitted by Kseniya Dugushkina (RAS-UB)  
8 toscheckwitz  
9 \; submitted by R. Bartoscheckwitz  
10 \; submitted by R. Bartoscheckwitz  
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14 s found nearby.; submitted by Dolores Hill  
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17 by Klemm K.  
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16 s: R. Verish, Meteorite-Recovery Lab, P.O. Box 463084, Escondido, CA 92046; submitted by Paul W  
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25 critical Services, P.O. Box 440, Mendon, MA 01756.; submitted by K. Domanik

26 :A., Vernad

27 :A., Vernad  
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36 l clasts.; submitted by Jérôme Gattacceca  
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42 se grain size is about 30  $\mu\text{m}$ .; submitted by Ansgar Greshake  
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44 205; field LE1; submitted by Vanni Moggi Cecchi

45 206; field LE2; submitted by Vanni Moggi Cecchi

46 207; field LE3; submitted by Vanni Moggi Cecchi

47 208; field LE4; submitted by Vanni Moggi Cecchi

48 209; field LE5; submitted by Vanni Moggi Cecchi

49 210; field LE6; submitted by Vanni Moggi Cecchi

50 211; field LE7; submitted by Vanni Moggi Cecchi

51 212; field LE8; submitted by Vanni Moggi Cecchi

52 213; field LE9; submitted by Vanni Moggi Cecchi

53 214; field LE10; submitted by Vanni Moggi Cecchi

54 215; field LE11; submitted by Vanni Moggi Cecchi

55 216; field LE12; submitted by Vanni Moggi Cecchi

56 217; field LE13; submitted by Vanni Moggi Cecchi

57 218; field LE16; submitted by Vanni Moggi Cecchi

58 219; field LE17; submitted by Vanni Moggi Cecchi

59 220; field LE18; submitted by Vanni Moggi Cecchi  
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3 221; field LE19; submitted by Vanni Moggi Cecchi  
4 222; field LE20; submitted by Vanni Moggi Cecchi  
5 223; field LE21; submitted by Vanni Moggi Cecchi  
6 224; field LE22; submitted by Vanni Moggi Cecchi  
7 225; field LE24; submitted by Vanni Moggi Cecchi  
8 226; field LE25; submitted by Vanni Moggi Cecchi  
9 227; field LE26; submitted by Vanni Moggi Cecchi  
10 228; field LE27; submitted by Vanni Moggi Cecchi  
11 229; field LE27b; submitted by Vanni Moggi Cecchi  
12 230; field LE28; submitted by Vanni Moggi Cecchi  
13 231; field LE29; submitted by Vanni Moggi Cecchi  
14 232; field LE29/b; submitted by Vanni Moggi Cecchi  
15 233; field LE30; submitted by Vanni Moggi Cecchi  
16 234; field LE31; submitted by Vanni Moggi Cecchi  
17 235; field LE32; submitted by Vanni Moggi Cecchi  
18 236; field LE32/b; submitted by Vanni Moggi Cecchi  
19 237; field LE32/c; submitted by Vanni Moggi Cecchi  
20 238; field LE32/t; submitted by Vanni Moggi Cecchi  
21 239; field LE33; submitted by Vanni Moggi Cecchi  
22 240; field LE34; submitted by Vanni Moggi Cecchi  
23 241; field LE35; submitted by Vanni Moggi Cecchi  
24 242; field LE36; submitted by Vanni Moggi Cecchi  
25 243; field LE37; submitted by Vanni Moggi Cecchi  
26 244; field LE38; submitted by Vanni Moggi Cecchi  
27 245; field LE39; submitted by Vanni Moggi Cecchi  
28 246; field LE40; submitted by Vanni Moggi Cecchi  
29 247; field LE41; submitted by Vanni Moggi Cecchi  
30 248; field LE42; submitted by Vanni Moggi Cecchi  
31 249; field LE47; submitted by Vanni Moggi Cecchi  
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34 and UrFU  
35 3M and UrFU  
36 d by L. Garvie  
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48 chondrules ~500-600  $\mu\text{m}$  occur and a low metal abundance typical for L chondrites; submitted by Kler  
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51 iad  
52 ted by Jérôme Gattacceca  
53 (ological Museum), T. Kryachko; submitted by Lorenz C.A., Vernad  
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57 e by a six-person team.; submitted by Jérôme Gattacceca  
58 mitted by Jérôme Gattacceca  
59 by a six-person team. Well-delineated chondrules. Plagioclase average size below 50  $\mu\text{m}$ .; submitted  
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3 submitted by Jérôme Gattacceca  
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7 AS); submitted by Kseniya Dugushkina (RAS-UB) dugushkina.kseniya@mail.ru  
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11 . Likely paired with Los Vientos 014.; submitted by J. Gattacceca  
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18 MW23; submitted by Jérôme Gattacceca  
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24 ted by Jérôme Gattacceca  
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26 by a six-person team.; submitted by Jérôme Gattacceca  
27 ce by a six-person team.; submitted by Jérôme Gattacceca  
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33 by a six-person team.; submitted by Jérôme Gattacceca  
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45 is polycrystalline.; submitted by J. Gattacceca  
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47 ted by Jérôme Gattacceca  
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49 grad, Moscow); submitted by Lorenz C.A., Vernad  
50 grad, Moscow); submitted by Lorenz C.A., Vernad  
51 grad, Moscow); submitted by Lorenz C.A., Vernad  
52 grad, Moscow); submitted by Lorenz C.A., Vernad  
53 grad, Moscow); submitted by Lorenz C.A., Vernad  
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.. R. Moutinho and A. Tosi

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d by A. Irving

177; submitted by Paul Warren  
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177; submitted by Paul Warren

plagioclase is present.; submitted by M. Zolensky and Jessica Johnson, NASA JSC  
plagioclase and coarse diopside are present.; submitted by M. Zolensky and Jessica Johnson, NASA

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.., Vernad

ed by Vanni Moggi Cecchi  
ed by Vanni Moggi Cecchi  
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ed by Vanni Moggi Cecchi

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grain size about 30  $\mu\text{m}$ ; submitted by Ansgar Greshake  
e about 20  $\mu\text{m}$ ; submitted by Ansgar Greshake

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6 grain size about 80  $\mu\text{m}$ ; submitted by Ansgar Greshake  
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20 e about 25  $\mu\text{m}$ ; submitted by Ansgar Greshake  
21 grain size about 60  $\mu\text{m}$ ; submitted by Ansgar Greshake  
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32 Melinda Hutson  
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efore this submission.; submitted by Bingkui Miao

ists have small plagioclase (about 5  $\mu\text{m}$ ) in the matrix. Opaque are metal and sulfides.; submitted by .

own interior, with fresh metal; submitted by Jérôme Gattacceca

ceca

ceca

al size 5 mm set in a Fe,Ni metal matrix. Other minerals: troilite, chromite.; submitted by Jérôme Gatt

plagioclase grain size is about 70  $\mu\text{m}$ .; submitted by Ansgar Greshake

L6-type breccia crosscut by several black shock melt veins. The plagioclase grain size is about 70  $\mu\text{m}$   
-type breccia and the plagioclase grain size is about 80  $\mu\text{m}$ .; submitted by Ansgar Greshake

efore this submission.; submitted by Bingkui Miao



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e is about 70  $\mu\text{m}$ .; submitted by Ansgar Greshake

ox 463084, Escondido, CA 92046; submitted by Paul Warren

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grain size is about 70  $\mu\text{m}$ .; submitted by Ansgar Greshake

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THB)

grain size about 30  $\mu\text{m}$ .; submitted by Ansgar Greshake

y Daniel Rezes

rk brown fusion crust.; submitted by J. Gattacceca

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31 by Klemm K.  
32 as different equilibrated lithologies.; submitted by Klemm K.  
33 by Klemm K.  
34 by Klemm K.  
35 by Klemm K.  
36 by Klemm K.  
37 by Klemm K.  
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50 by Klemm K.  
51

52  
53 grain size is about 60  $\mu\text{m}$ .; submitted by Ansgar Greshake  
54

55 in size is about 30  $\mu\text{m}$ .; submitted by Ansgar Greshake

56 in size is about 30  $\mu\text{m}$ .; submitted by Ansgar Greshake

57 class grain size is about 60  $\mu\text{m}$ . Contains shock melt veins.; submitted by Ansgar Greshake  
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-group ordinary chondrite containing fragments of petrologic type 4 and type 5.; submitted by Klemm

e is about 40  $\mu\text{m}$ .; submitted by Ansgar Greshake

gram. The plagioclase grain size is about 60  $\mu\text{m}$ .; submitted by Ansgar Greshake

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9 éroïne Gattacceca  
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44 paired with Rafsa 001 (pers. comm. T. Irving, 2020).; submitted by Anthony Love  
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12 J. Plechov, pplechov@gmail.com  
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grain size is about 20  $\mu\text{m}$ .; submitted by Ansgar Greshake  
grain size is about 60  $\mu\text{m}$ .; submitted by Ansgar Greshake  
grain size is about 30  $\mu\text{m}$ .; submitted by Ansgar Greshake  
grain size is about 40  $\mu\text{m}$ .; submitted by Ansgar Greshake

grain size is about 30  $\mu\text{m}$ .; submitted by Ansgar Greshake

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grain size is about 30  $\mu\text{m}$ .; submitted by Ansgar Greshake

mitted by Daniel Sheikh  
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mitted by Daniel Sheikh  
mitted by Daniel Sheikh

. Lin, IGGCAS

stance by a six-person team.; submitted by Jérôme Gattacceca

orenz C.A., Vernad

s. Chondrule mesostatis is devitrified. Opaque are metal and sulfides.; submitted by Jérôme Gattacceca

have olivine with  $\text{Fa}_{18.3\pm 0.8}$ .; submitted by Klemm K.

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6 ated olivine with  $Fa_{18.6 \pm 0.7}$ ; submitted by Klemm K.  
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25 ated olivine with  $Fa_{19.3 \pm 0.4}$ ; submitted by Klemm K.  
26 dominant and have equilibrated olivine with  $Fa_{18.2 \pm 0.4}$ ; submitted by Klemm K.  
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35 ated olivine and pyroxene with  $Fa_{18.8}$  and  $Fs_{16.7}$ , respectively.; submitted by Klemm K.  
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40 and abundant metal, like in H chondrites; submitted by Klemm K.  
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52 n occur and the low metal abundance is typical for L chondrites.; submitted by Klemm K.  
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7 -400 µm) and abundant metal, like in H chondrites; submitted by Klemm K.  
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21 a Tosi and Andre L. R. Moutinho  
22 d, Many small pieces, most under 1g; submitted by Jérôme Gattacceca  
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24 il.ru  
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28 d, Moscow); submitted by Lorenz C.A., Vernad  
29 ad, Moscow); submitted by Lorenz C.A., Vernad  
30 d, Moscow); submitted by Lorenz C.A., Vernad  
31 , Moscow); submitted by Lorenz C.A., Vernad  
32 AS) dugushkina.kseniya@mail.ru  
33 w); submitted by Lorenz C.A., Vernad  
34 w); submitted by Lorenz C.A., Vernad  
35 w); submitted by Lorenz C.A., Vernad  
36 w); submitted by Lorenz C.A., Vernad  
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39 w); submitted by Lorenz C.A., Vernad  
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44 ow); submitted by Lorenz C.A., Vernad  
45 w); submitted by Lorenz C.A., Vernad  
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da Tosi and M. E. Zucolotto

I, Moscow); submitted by Lorenz C.A., Vernad  
w); submitted by Lorenz C.A., Vernad  
ological Museum), T. Kryachko; submitted by Lorenz C.A., Vernad  
w); submitted by Lorenz C.A., Vernad  
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y Klemm K.

mitted by Daniel Sheikh  
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by Klemm K.



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al mm in size.; submitted by Ivanova M. A., Vernad

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