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The Meteoritical Bulletin, no. 108

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METEORITICS & PLANETARY SCIENCE

The Meteoritical Bulletin, No. 108

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Keywords:	Classification, Meteorite fall, Meteorite classification
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Table S1-MetBull108.xls.xml	

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Jérôme Gattacceca
e-mail:gattacceca@cerege.fr

Aix-en-Provence, April 29, 2020

Dear Editor,

Please find attached the files for the Meteoritical Bulletin n°108.

The text for the printed version is short, and there is a complete version for the online one (submitted as supplementary material).

Yours sincerely,

Jérôme Gattacceca
CNRS, CEREGE, Aix-en-Provence

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The Meteoritical Bulletin, No. 108

Jérôme Gattacceca[1], Francis M. McCubbin[2], Audrey Bouvier[3], Jeffrey Grossman[4]

[1]CNRS, Aix Marseille Univ, IRD, Coll France, INRAE, CEREGE, Aix-en-Provence, France

[2]NASA Johnson Space Center, Mail Code XI, 2101 NASA Parkway, Houston, TX 77058, USA.

[3]Universität Bayreuth, Bayerisches Geoinstitut, Bayreuth, Germany

[4]Reston, Virginia

Abstract

Meteoritical Bulletin 108 contains 2141 meteorites including 12 falls (Aguas Zarcas, Benenitra, Jalangi, Komaki, Ksar El Goraane, Mhabes el Hamra, Natun Balijan, Oued Sfayat, Shidian, Taqtaq-e Rasoul, Tocache, Viñales), with 1640 ordinary chondrites, 149 carbonaceous chondrites, 134 HED achondrites, 45 lunar meteorites, 38 ureilites, 27 iron meteorites, 23 martian meteorites, 22 primitive achondrites, 19 Rumuruti chondrites, 15 mesosiderites, 10 enstatite chondrites, 7 ungrouped achondrites, 4 pallasites, 4 ungrouped chondrites, and 4 angrites. 909 meteorites are from Africa, 747 from Antarctica, 279 from South America, 148 from Asia, 29 from North America, 18 from Oceania, 6 from Europe (including 2 from Russia), and 5 from unknown locations.

1. Trends and specificities

Meteoritical Bulletin 108 (MB108) contains the 2141 meteorites reported to and accepted by the Nomenclature Committee of the Meteoritical Society in 2019. This is a relatively low number compared to the average of the past few years, mostly because of a

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lower number of Antarctic meteorites (Figure 1). 909 meteorites are from Africa, 747 from Antarctica, 279 from South America, 148 from Asia, 29 from North America, 18 from Oceania, 6 from Europe (including 2 from Russia), and 5 from unknown locations. The number of Northwest Africa (NWA) meteorites classified remains steady at around 700 meteorites per year. Meteorites from Africa (mostly NWA and other Saharan meteorites) and Antarctica make up 42% and 35% of the total number of meteorites in MB108, respectively. As for the last few years, Chile, with 275 meteorites (13%) is now the main meteorite source outside of north Africa and Antarctica.

The meteorites in MB108 include12 falls (Aguas Zarcas, Benenitra, Jalangi, Komaki, Ksar El Goraane, Mhabes el Hamra, Natun Balijan, Oued Sfayat, Shidian, Taqtaq-e Rasoul, Tocache, Viñales), 1640 ordinary chondrites (OCs), 149 carbonaceous chondrites (including 50 CV, 40 CM, 29 CO, 22 CK, 4 CR), 134 HED achondrites, 45 lunar meteorites, 38 ureilites, 27 iron meteorites, 23 martian meteorites, 22 primitive achondrites, 19 Rumuruti chondrites, 15 mesosiderites, 10 enstatite chondrites, 7 ungrouped achondrites, 4 pallasites, 4 ungrouped chondrites, and 4 angrites. Except the variations in the number of OCs, which is mostly driven by the number of Antarctic meteorites, these numbers have been remarkably stable over the last four years (Figure 2a), including for the different carbonaceous chondrite groups (Figure 2b).

The 2141 meteorites in MB108 total over 3.4 tons of material, including 16 meteorites over 50 kg, and 5 over 100 kg. Of particular significance for 2019, like in previous years, is the large number of lunar meteorites (45), totaling 253 kg, with 5 meteorites over 10 kg

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and 2 over 50 kg (Figure 3a). Thirty-eight of these lunar meteorites are from northwest Africa and coordinates are known for 6 of them.

In 2019, 23 martian meteorites totaling 24 kg were approved, including 3 meteorites over 4 kg (Figure 3a). All these meteorites are from northwest Africa, and coordinates are known for 3 of them. Twenty-one are shergottites, one is a nakhlite (NWA 12542), one is a polymict breccia paired with NWA 7034 (Rabt Sbayta 012).

The total numbers of classified lunar and martian meteorites published until and including MB108 are 428 and 262, respectively, and growing at a steady rate of 40 and 20 meteorites per year, respectively (Figure 3b).

2. Notable meteorites

Two CM2 falls are reported: Aguas Zarcas (with a total mass of 27 kg, the second largest one after Murchison), and Shidian. Viñales (L6) was a notable fall of over 50 kg. Other meteorites that are notable for their mass, rarity, or scientific interest include Caleta el Cobre 028 (105 kg EL6, the 5th largest enstatite chondrite), NWA 12691 (104 kg lunar feldspathic breccia, the largest ever found), Tassédet 004 (405 kg H5 melt-breccia), NWA 12388 (180 kg L-melt rock), NWA 12322 (35 kg CV3, the 3rd largest CV), NWA 11610 (28 kg CO3), NWA 12320 (4.5 kg angrite, the 2nd largest angrite), two primitive CO3 (NWA 12930, Dhofar 2097), NWA 12474 (CR3), NWA 12587 (72 kg eucrite, the 3rd largest eucrite), and Sierra Gorda 013 (804 g CBa).

3. New features in the Meteorite Bulletin Database

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The online Meteorite Bulletin Database now allows searching for and listing meteorites whose description includes oxygen isotopic composition. This is accessible by selecting "oxygen isotopes" instead of "normal table" in one of the display menus.

The online Meteorite Bulletin Database also allows searching for meteorites that have information about their strewnfield characteristics (masses and coordinates of individual stones). As to date, this information is available, at least partly, for 31 meteorites. Submissions of new data on the strewnfields of witnessed falls are welcome, and may be sent to the Database Editor (see the MetBull FAQ for more information: https://www.lpi.usra.edu/meteor/FAQ.php)

4. Alphabetical text entries for non-Antarctic meteorites

See online version of this article

5. New Dense Collection Areas (DCA)

In 2019, 13 new DCA were created in Chad (Bardaï), China (Dunlike, Hongshagang, Huangtuya, Korla, Shanshan, Tamusubulage, Wubao), Libya (Hamadat Zegher), Morocco (Hassi Arsane), United States (Sunfair, Daveytown) and Western Sahara (Swayyah).

343 active DCA are defined to date, containing a total of 67222 meteorites. The average number of meteorites per DCA is 196 meteorites. The median number of meteorites per DCA is 4 only, reflecting a very uneven distribution of meteorites among DCA. Only 37 DCA contain more than 100 meteorites, and the 23 most populated DCA (most of them in

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Antarctica) contain 90% of the total DCA meteorites. A full list of all approved DCAs, with maps, can be found at https://www.lpi.usra.edu/meteor/DenseAreas.php.

6. Listing of institutes and collections

Nine new type specimen repositories from eight countries were approved in 2019:

BGI - Botswana Geoscience Institute, Lobatse, Botswana

CUG - Planetary Science Institute, China University of Geosciences, Wuhan, China

LeMans - Musée Vert, Muséum d'histoire naturelle du Mans, Le Mans, France

Wits - University of the Witwatersrand, Johannesburg, South Africa

MCNB - Museu de Ciències Naturals de Barcelona, Spain

KirkU - Faculty of Aeronautics and Space Sciences, Kirklareli University, Turkey

NASU - National Museum of Natural History, National Academy of Sciences, Kyiv, Ukraine

LVNHM - Las Vegas Natural History Museum, Las Vegas, United States

Marietta - Marietta College, Marietta, United States

To date, 441 repositories in 82 countries are registered by the Nomenclature Committee. Among these, 82 have been approved as repositories for meteorite type specimens.

An up-to-date index of collections and approved repositories (next to a green check mark) cited in the Meteorite Bulletin can be found here: https://www.lpi.usra.edu/meteor/MetBullAddresses.php?grp=country

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In accordance with §7.1 of the *Guidelines for Meteorite Nomenclature*, type specimens of all new meteorites "... must be deposited in institutions that have well-curated meteorite collections and long-standing commitments to such curation." The minimum mass of a type specimen should be 20% of the total mass or 20 g, whichever is the lesser amount. For larger meteorites, the Nomenclature Committee *strongly* recommends the following: for 0.4 to 10 kg samples, at least 5% of total mass should be deposited in an approved repository, and for meteorites > 10 kg, at least 500 g should be deposited. However, these larger type specimen requirements are mandatory for meteorites declared to be in Special Pairing Groups (§4.2c).

Supporting information

Supplementary information of this article may be found in the online version of this article:

- Table S1 of data including Antarctic meteorites
- A complete copy of the text entries for non-Antarctic meteorites.

This complete copy can also be found on the Meteoritical Bulletin Archive page at http://meteoriticalsociety.org/?page_id=57. Information about the approved meteorites can be obtained from the Meteoritical Bulletin Database (MBD) available online at https://www.lpi.usra.edu/meteor/.

Acknowledgments

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These meteorites were reviewed and approved by the Meteorite Nomenclature Committee of the Meteoritical Society. In 2019, committee members were Audrey Bouvier (Chair of the Nomenclature Committee), Jérôme Gattacceca (Meteorite Bulletin Editor), Francis McCubbin (Meteorite Bulletin Deputy Editor), Jeffrey Grossman (Meteorite Bulletin Database Editor), Brigitte Zanda (Vice-President of the Meteoritical Society), Emma Bullock, Hasnaa Chennaoui-Aoudjehane, Vinciane Debaille, Massimo D'Orazio, Tasha Dunn, Mitsumi Komatsu, and Bingkui Miao.

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Figure captions

Figure 1: Number of meteorites from Antarctica, northwest Africa, and other areas reported in the last 10 Meteoritical Bulletins.

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Figure 2: A) Number of approved meteorites by main categories over the last 4 years (ordinary chondrites not shown). B) Number of approved carbonaceous chondrites by groups over the last 4 years.

Figure 3: A) Number of lunar and martian meteorites reported in the last 13 Meteoritical Bulletins. B) Cumulative number of lunar and martian meteorites with time.

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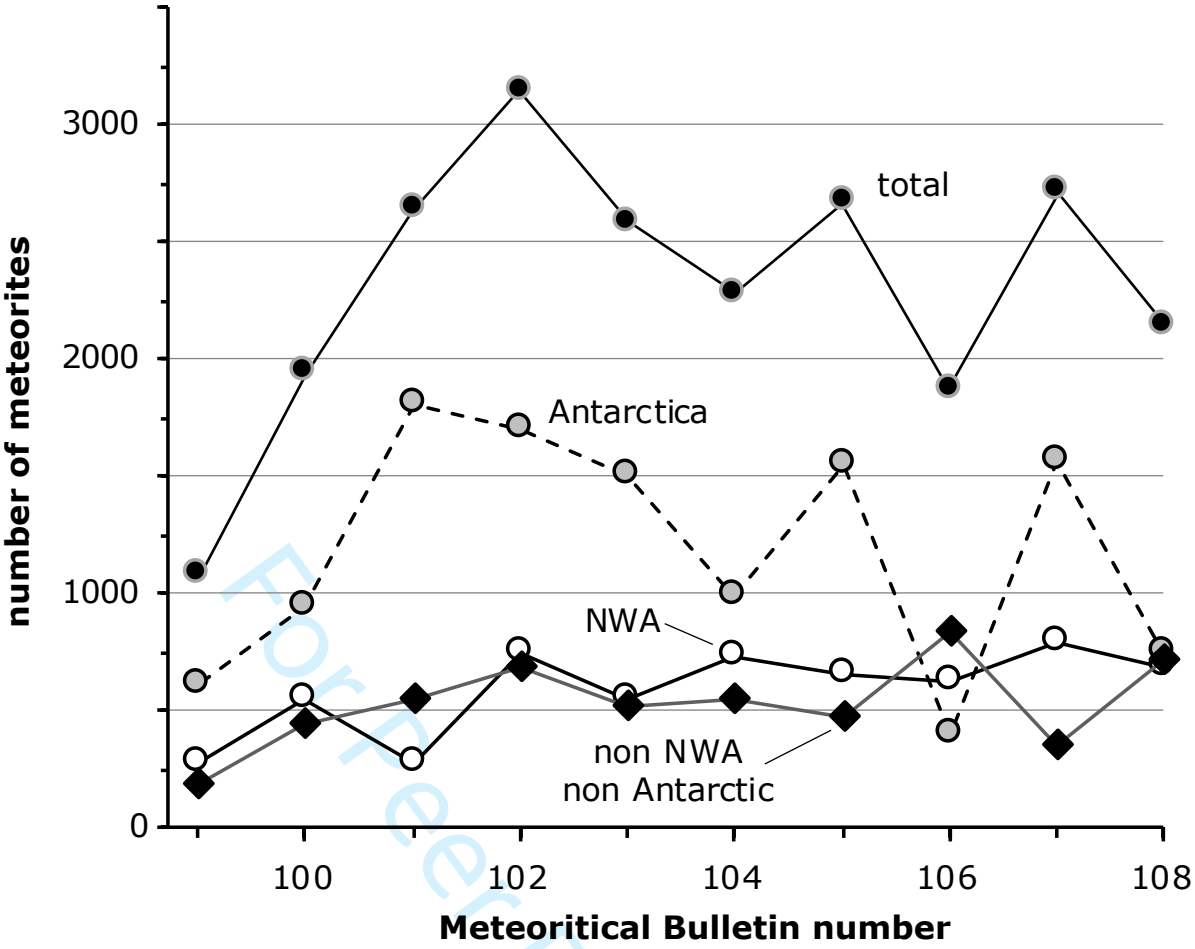

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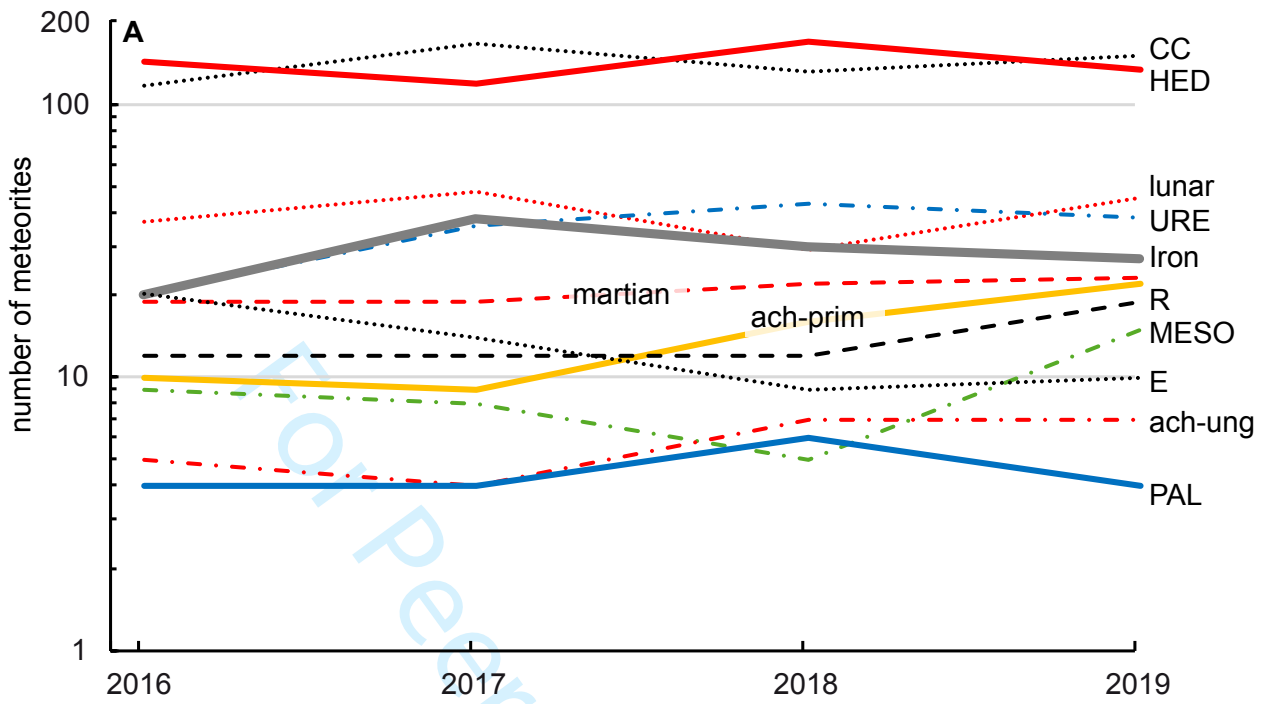

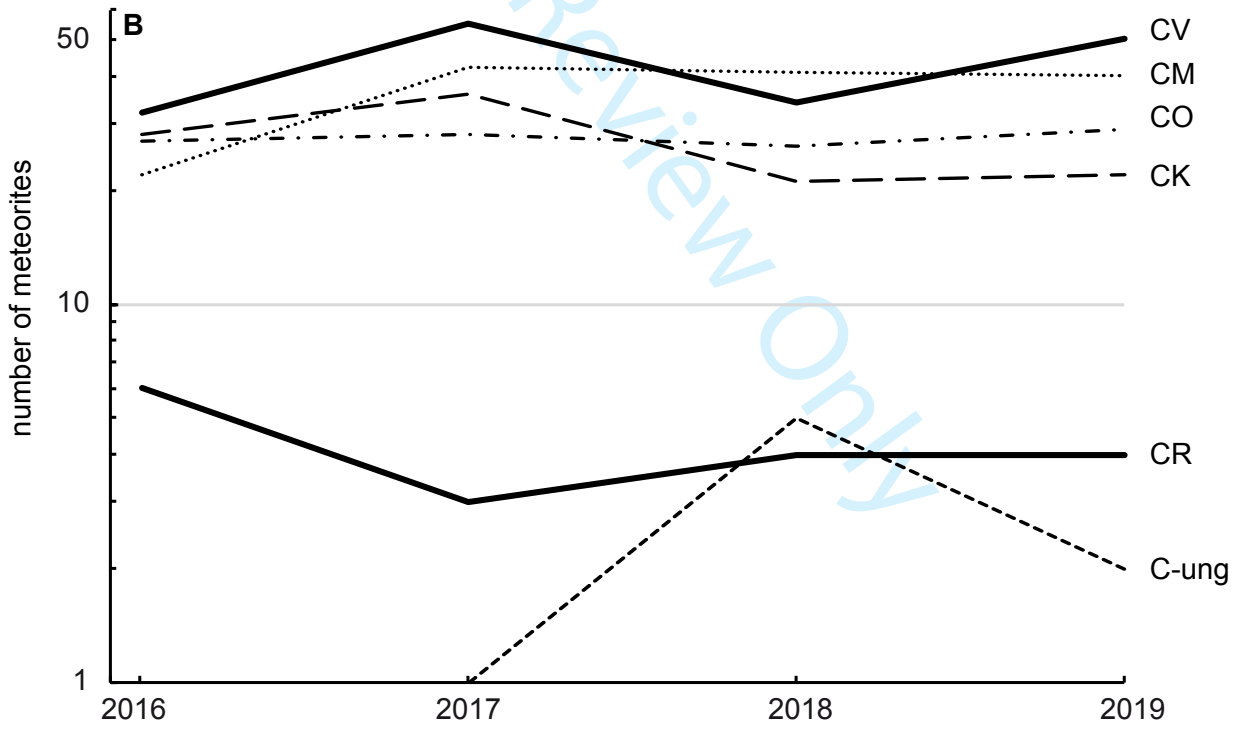

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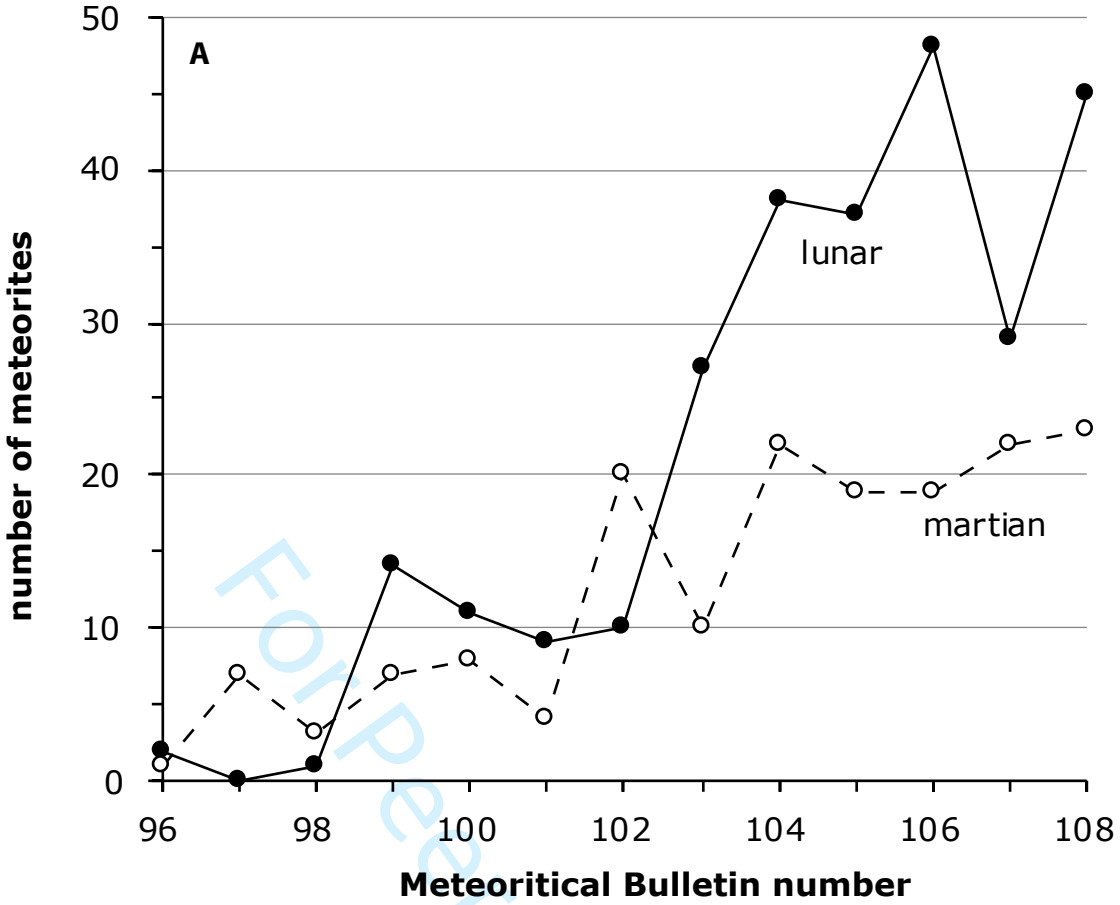

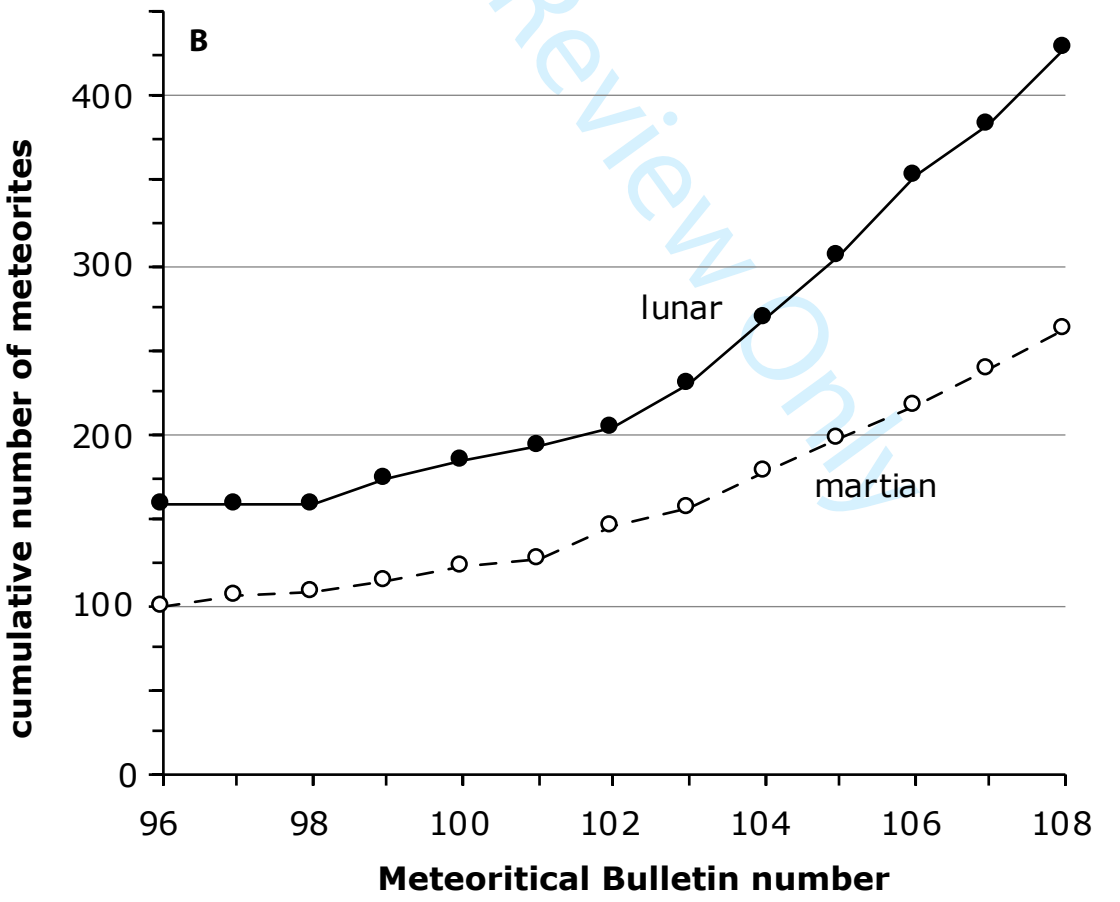

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Supporting online material

1. Alphabetical text entries for non-Antarctic meteorites

Abai 42°41.11'N, 70°4.35'E
Chimkent, Kazakhstan
Find: 2016 Mar 20
Classification: Iron meteorite (IIAB)

History: Single piece of iron was found by Mr. Skinder at the Altyn-Kazgan hill fort (3rd-7th century CE) during an electromagnetic survey at a depth of 0.4 m, 6 km NW of Abai village on March 20, 2016, in the Turkistan Region, Keless (Saryagash) Dis. The meteorite was situated deep in the cultural layer. The absence of additional specimens in this district may indicate that the sample was brought to the place of its discovery by residents of the first millennium CE.

Physical characteristics: The meteorite of angular flattened shape is 8 × 6.5 × 3 cm in size. The meteorite has regmaglypted surface covered by a shell of the carbonates and iron oxides. Fusion crust is partly preserved. Total weight is 666 g.

Petrography: the meteorite is composed of kamacite grains 2-14 mm in size with thin taenite and schreibersite lamellae and inclusions of rhabdite. The average kamacite band width is 5.85±2.95 mm (n=17).

Geochemistry: Mineral compositions and geochemistry: (N. N. Kononkova, *Vernad*, EMP) kamacite: Ni =6.11±0.60 (N=13), Co = 0.51±0.07 (N=13), P = 0.14± 0.04 (N=13); taenite: Ni = 24.99±2.68 (N=6) (all in wt%); schreibersite: Ni = 31.0±3.0 (N=5), P = 15.2±0.2 (N=5); rabdite: Ni = 39.4±1.1 (N=3), P = 15.2±0.2 (N=3) (all in wt%); (ICP-AS, I. A. Gromyak, ICP-MS, E. S. Toropchenova, A.V. Zhilkina, *Vernad*, bulk sample) Ni 6.23 wt %, Co 0.42 wt %, P 0.22 wt %; Au 3.24, Ga 83.7, Ge 186, Cr 19.6, W 0.23, As 14.0 (all in ppm).

Classification: Iron, IIB complex, Ogg

Specimens: A 113.4 g sample, 12.4 g in 5 subsamples and polished section are on deposit at *Vernad*. Main mass is on deposit at *DMUH*.

Aguas Zarcas 10°23'29.03"N, 84°20'28.58"W
Alajuela, Costa Rica
Confirmed fall: 2019 Apr 23
Classification: Carbonaceous chondrite (CM2)

History: (G.J. Soto; P. Madrigal, O. Lücke, Escuela Centroamericana de Geología, Universidad de Costa Rica; M. Farmer, Arizona) At 21:07 local time on 23 April 2019, a meteorite fall was reported in Aguas Zarcas, San Carlos county, Alajuela province, Costa Rica. The fireball traveled WNW to ESE and was caught on cameras of the National Seismological Network (RSN) at the summit of Poás and Turrialba volcanoes, and from the Volcanological and Seismological Observatory of Costa Rica (OVSICORI). Sightings were reported from Quepos (Central Pacific) in the

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south and north to La Palmera in San Carlos. The first piece recovered, 1152 g, crashed through a house at 10°23’29.03"N, 84°20’28.58"W. A dog house was hit by a 280 g piece at 10°24’9.35"N 84°21’51.26"W. The BRAMON (Brazilian Meteors Observation Network), UNESP (São Paulo State University) and *USP* (University of São Paulo) teams determined the atmospheric trajectory of the bolide from four security videos and dashcam cameras. The bolide had an entry angle of 73° relative to the ground, traveling 20.7 km in the 4-s analyzed interval, with an atmospheric velocity of 14 km/s. Analysis shows a projected elliptical strewn-field with major axis length of 6.3 and minor axis of 3.3 km. Hundreds of stones were recovered within the projected strewn-field. The bolide orbit was determined, with the follow preliminary elements: semi-major axis 2.7 AU, eccentricity 0.63, inclination 3.09°, pericenter longitude of 185.3° and ascending node 33.4°. Current total recovered mass is around 27 kg, of which ~11 kg was collected before rain fell over the fall site.

Physical characteristics: (L. Garvie, *ASU*) Hundreds of fusion-crusted stones ranging from 0.1 to 1868 g. Stones under ~50 g are typically angular to blocky and lack regmaglypts. Also found were several plate-like, oriented stones. For example, one oriented plate is 13 cm wide and 1 cm thick. Many stones are oriented with a domed leading edge and well-developed roll-over lip along the rim of the trailing edge. Larger stones, especially those near 1 kg, show broad regmaglypts, some well developed. The fusion crust on several of the trailing edge surfaces is iridescent. Pre-rain material crushed in a few ml of water emits a powerful "Murchison-like" odor, though with a more prominent compost-like scent.

Petrography: (L. Garvie, *ASU*) The interior of the stones is uniformly dark gray and studded with small light-colored speckles. Stones are brecciated and dominated by two lithologies: chondrule poor, constituting ~80 areal% of the broken surfaces examined (~2 kg of material), and chondrule rich. Chondrules constitute ~10 areal% of the chondrule-poor lithology and ~40 areal% in the chondrule-rich lithology. Some broken surfaces show clasts of the chondrule-rich lithology in the chondrule-poor type. Clasts with lower chondrule to matrix ratio also present; for example, one 3 g half stone shows <1 areal% chondrules. A probe mount of the dominant chondrule-poor lithology (sample area 1.5 × 2.2 cm) shows scattered small chondrules (mean 275 µm, n=40), with prominent fine-grained rims. Rare chondrules to 2 mm. Fe-Ni metal, which is Cr-bearing, was only found as rounded grains in one 100-µm type I chondrule. The section contains several Al-rich CAIs to 300 µm. The matrix is dominated by two components of roughly equal proportions: anhedral clumps (typically 50 microns) that are Fe and S rich (e.g., 37.5 wt% Fe and 5.8 wt% S, with microprobe total of 93%), surrounded by fine-grained material poorer in Fe and S (e.g., 12.8 wt% Fe, 13.9 wt% Mg, and 0.5 wt% S, with microprobe total of 80.0%). Powder XRD from five stones (one chondrule rich) shows patterns dominated by serpentine. In two stones, the serpentine 001 reflection sits on a broad peak centered at 0.843 nm. Reflections for tochilinite and calcite occur in all patterns. The intensities of olivine and pyroxene reflections were generally low, but most prominent in the chondrules-rich stone.

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Geochemistry: Oxygen isotopes (K. Ziegler, *UNM*): 7 pre-rain fragments analyzed by laser fluorination gave $\delta^{18}O$= 10.342, 10.807, 11.591, 12.314, 12.249, 12.669, 9.748; $\delta^{17}O$= 2.381, 2.932, 3.360, 3.843, 3.995, 3.959, 2.143; $\Delta^{17}O$=-3.080, -2.775, -2.759, -2.659, -2.472, -2.730, -3.004 (linearized, all per mil, TFL slope=0.528). Microprobe (L. Garvie, *ASU*): $Fa_{0.4-41.0}$, n=10.
Classification: Geochemistry and oxygen isotopic data consistent with CM2.
Specimens: 248 g *ASU*; *MFarmer* - 6.5 kg; Achim Karl - 2.5 kg; Robert *Ward* - 3.2 kg; Kevin Kichinka - 489 g.

Aksai Chin 002 (AC 002) 35° 3'30"N, 79°12'15"E
Xinjiang, China
Find: July 2012
Classification: Ordinary chondrite (L~5)
History: (Ziyao Wang) Discovered by Wang Rongqing while doing field work in Aksai Chin in July 2012. It was donated to R. Bartoschewitz as a fragment of the Aksai *Chin* H chondrite in Nov. 2018, but was recognized as an L chondrite.
Physical characteristics: Red-brown flat stone of 11.5 g.
Petrography: (R. Bartoschewitz, *Bart*) brown recrystallized matrix with defined chondrules (0.3-1.5 mm) and irregular metal and sulfide.
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.62
Classification: Ordinary chondrite (L~5, W3)
Specimens: 3.69 g on deposit at *Kiel*, *Bart* holds the main mass.

Alaer 004 40°22'35.09"N, 81°21'48.29"E
Xinjiang, China
Find: 2007
Classification: Ordinary chondrite (LL~6)
History: (Ziyao Wang) Purchased by Ziyao Wang from Xingang Fan in Aksu, Xinjiang in 2018. This meteorite was discovered in the Taklimakan region, close to Alaer in 2007.
Physical characteristics: (Ziyao Wang) 5 small black stones without fusion crust totaling 11 g
Petrography: (R. Bartoschewitz, *Bart*) brown, recrystallized matrix, with poorly developed gray chondrules ~ 1 mm) and few small metal specks
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 3.99
Classification: Ordinary chondrite (LL~6, W3)
Specimens: 2.2 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 2.3 g with *Bart*.

Amhirich 28.9828°N, 10.0779°W

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Guelmim-Smara, Morocco
Find: 2013 Mar 12
Classification: HED achondrite (Howardite)

History: Ali Salm, a taxi driver in Guelmim, and amateur meteorite hunter, went hunting for meteorites close to the city of Guelmim on March 12, 2013. Arriving south of a hill about 100 m west of souk Amhirich (Amhirich market) he found a broken stone looking like a meteorite. He brought it back to Habib Naji, a meteorite dealer in Guelmim, in order to have it authenticated. Habib N. took some pictures and collected the information about the find. He sent a reference sample to Albert Jambon in Paris.

Physical characteristics: One fragile, broken stone, covered with remnants of a dark-brown fusion crust, orange colored where the crust is missing. Light-gray breccia with lithic (basaltic) and crystal clasts up to several mm. A few pyroxene crystals are exsolved.

Petrography: Polymict breccia with mm-sized clasts of low- and high-Ca pyroxene (a few of them exsolved). Plagioclase, minor olivine, and silica are also present. A few impact-melted basaltic clasts with tiny metal inclusions occur as well. The impact melt is partially crystallized. Dominant pyroxene (70 vol%), plagioclase (23 vol%), plus chromite. Diogenitic fraction estimated at about 30 vol%.

Geochemistry: Dominant pyroxenes: $Fs_{37}Wo_2$ (FeO/MnO =33) and $Fs_{49}Wo_{25}$(FeO/MnO= 46). Eucritic olivine Fa_{46} (FeO/MnO= 70). Variable compositions of plagioclase from diogenitic (An_{80}) to eucritic (An_{95}). Silica. Typical diogenitic chromite (Cr_2O_3= 60%).

Classification: Howardite

Specimens: Main mass with Habib Naji

Antarctica 002

Antarctica
Find: 1992-1993
Classification: Ordinary chondrite (L5)

History: A single specimen weighing 390 g was collected by a Canadian pilot supporting ANSMET searching during the 1992-93 season, from an unspecified location within Antarctica.

Physical characteristics: The single, irregular mass is ~50% covered in fusion crust. Iron staining is prevalent. Dark grey veins are visible on interior surfaces.

Petrography: (C. Herd, *UAb*) Optical and microprobe examination of a polished thin section shows a readily-delineated chondrules in a recrystallized matrix. Shock effects include undulatory extinction and weak mosaicism in olivine. Iron staining is prevalent. 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 carbon-coated thin section: Olivine $Fa_{24.1\pm1.4}$ (n=56); low-Ca pyroxene $Fs_{20.9\pm0.6}Wo_{1.5\pm0.4}$ (n=63).

Classification: Ordinary chondrite, L5

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Specimens: Entire specimen, including one thin section is at *UAb*. Difference between recovered weight and type specimen is due to cutting losses.

Antarctica 003

Antarctica
Find: 1992-1993
Classification: Ordinary chondrite (H5)

History: A single specimen weighing 205 g was collected by a Canadian pilot supporting ANSMET searching during the 1992-93 season, from an unspecified location within Antarctica.

Physical characteristics: The single, triangular mass is completely covered in fusion crust. Iron staining is evident on the exterior and on cut surfaces.

Petrography: (C. Herd, *UAb*) Optical and microprobe examination of a polished thin section shows a brecciated texture with readily-delineated chondrules and chondrule fragments in a fine-grained matrix. Shock effects include undulatory extinction with > 2° angular variation in olivine. Minor iron staining is present throughout. 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 carbon-coated thin section: Olivine $Fa_{18.7\pm0.6}$ (n=31); low-Ca pyroxene $Fs_{16.9\pm1.1}Wo_{1.3\pm0.8}$ (n=38).

Classification: Ordinary chondrite, H5

Specimens: Entire specimen, including one thin section is at *UAb*. Difference between recovered weight and type specimen is due to cutting losses.

Antarctica 004

Antarctica
Find: 1992-1993
Classification: Ordinary chondrite (L6)

History: A single specimen weighing 70 g was collected by a Canadian pilot supporting ANSMET searching during the 1992-93 season, from an unspecified location within Antarctica.

Physical characteristics: The single, rounded mass is covered in fusion crust and has minor iron staining. Interior surfaces show evidence for brecciation.

Petrography: (C. Herd, *UAb*) Optical and microprobe examination of a polished thin section shows a brecciated texture, including areas darkened by comminution, with poorly defined chondrules in a recrystallized matrix. Shock effects include strong mosaicism, PDFs and PFs in olivine. Minor iron staining is present throughout. 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 carbon-coated thin section: Olivine $Fa_{24.5\pm0.7}$ (n=35); Low-Ca Pyroxene $Fs_{20.9\pm0.4}Wo_{1.5\pm0.2}$ (n=25).

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Classification: Ordinary chondrite, L6
Specimens: Entire specimen, including one thin section is at *UAb*. Difference between recovered weight and type specimen is due to cutting losses.

Antarctica 005

Antarctica
Find: 1992-1993
Classification: Ordinary chondrite (L5)

History: Three fragments collectively weighing 540 g were collected by a Canadian pilot supporting ANSMET searching during the 1992-93 season, from an unspecified location within Antarctica.
Physical characteristics: The three fragments fit together into a single, highly fractured and weathered mass partially covered in fusion crust with abundant iron staining.
Petrography: (C. Herd, *UAb*) Optical and microprobe examination of a polished thin section shows readily-delineated chondrules in a recrystallized matrix. Minor brecciation is apparent. Sharp optical extinction with <2° angular variation in olivine. Iron staining and veins are prevalent. 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 carbon-coated thin section: Olivine $Fa_{24.4\pm1.0}$ (n=38); Low-Ca Pyroxene $Fs_{20.7\pm0.6}Wo_{1.3\pm0.4}$ (n=31).
Classification: Ordinary chondrite, L5
Specimens: Entire specimen, including one thin section is at *UAb*. Difference between recovered weight and type specimen is due to cutting losses.

Antarctica 006

Antarctica
Find: 1992-1993
Classification: Ordinary chondrite (L5)

History: A single specimen weighing 84 g was collected by a Canadian pilot supporting ANSMET searching during the 1992-93 season, from an unspecified location within Antarctica.
Physical characteristics: The single, irregular mass is ~70% covered in fusion crust. Iron staining is prevalent. Interior surfaces show evidence for brecciation.
Petrography: (C. Herd, *UAb*) Optical and microprobe examination of a polished thin section shows a highly brecciated texture with a few readily-delineated chondrules in a cataclastic matrix. Shock effects include weak mosaicism and PFs 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 carbon-coated thin section: Olivine $Fa_{24.4\pm0.3}$ (n=53); Low-Ca Pyroxene $Fs_{20.7\pm0.3}Wo_{1.3\pm0.6}$ (n=45).

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Classification: Ordinary chondrite, L5
Specimens: Entire specimen, including one thin section is at *UAb*. Difference between recovered weight and type specimen is due to cutting losses.

Arabian Peninsula 007 (AP 007)
Saudi Arabia
Purchased: 2017 Nov
Classification: Lunar (frag. breccia)
History: A single weathered stone lacking a fusion crust was found in 2015 by a pair of local meteorite hunters in the Al Jouf region of Saudi Arabia. Purchased by Dustin Dickens in November 2017 while on expedition in the region.
Physical characteristics: Dark, sand-blasted exterior. Dark homogeneous groundmass with sub-mm sized clasts. Mm-width melt veins visible across exterior. No fusion crust.
Petrography: (T. S. Hayden, M. Anand, *OU*) The meteorite is a clast-rich fragmental breccia containing numerous mineral and lithic fragments embedded in a fine-grained matrix. The lithic clast population consists primarily of basaltic clasts, dominated by Ca-rich pyroxene and plagioclase and olivine. There is a large (~2.3mm) granulite clast which appears to be of the ferroan anorthosite suite, with accessory apatite and ulv_spinel. The size range of the lithic clasts is 0.24-3.41mm. Mineral clasts and fragments are mainly pyroxene, olivine, plagioclase and chromite. Some regolith material (vesicular) present also.
Geochemistry: Mineral composition and Geochemistry: (T. S. Hayden, M. Anand, *OU*) Feldspar ($An_{96.4\pm0.8}Ab_{3.5\pm0.8}$, N = 79), Pigeonite ($Fs_{32.1\pm3.2}Wo_{13.6\pm3.2}$, Fe/Mn=59.4±4, N=41), Augite ($Fs_{25.8\pm5.6}Wo_{28.6\pm7.5}$, Fe/Mn=57.1±6.8, N=18), Olivine ($Fa_{41.6\pm9.8}$, Fe/Mn=103.3±10, N=116). O isotopes (measured at *OU*): $\delta^{17}O$ = 3.484‰, $\delta^{18}O$ = 6.646‰, $\Delta^{17}O$=-0.002‰ (linearized using a slope of 0.5247).
Classification: Lunar fragmental regolith breccia
Specimens: Specimen: 21g type specimen held at *OU*. Main mass held by Dustin Dickens.

Argan 003 40°10’06.17"N, 88°47’29.41"E
Xinjiang, China
Find: Nov 2018
Classification: Ordinary chondrite (L~6)
History: (Ziyao Wang) Purchased by Ziyao Wang from the finder Tailu Zhao (Shanshan County, Xinjiang) in Shanshan/Xinjiang in 2018. Discovered in Nov 2018.
Physical characteristics: 78.1g black nearly round stone with fusion crust
Petrography: (R. Bartoschewitz, *Bart*) olive-brown, recrystallized matrix, with melt veins, nearly completely recrystallized chondrules, and nearly completely oxidized metal and sulfide. Vugs are mostly filled with iron-hydroxides and sulfates.

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Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ (× 10^{-9} m^3/kg) = 4.21
Classification: Ordinary chondrite (L~6, W5)
Specimens: 15.8 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 13 g with *Bart*.

Argan 004 40°12'14.58"N, 88°42'32.78"E
Xinjiang, China
Find: Nov 2018
Classification: Ordinary chondrite (L~4)
History: (Ziyao Wang) Purchased by Ziyao Wang from the finder Tailu Zhao (Shanshan County, Xinjiang) in Shanshan/Xinjiang in 2018. Discovered in Nov 2018.
Physical characteristics: Black, irregularly shape stone of 58.4 g with rusty surface
Petrography: (R. Bartoschewitz, *Bart*) brown, recrystallized matrix, with well-developed chondrules (0.3-1 mm, av. 0,8 mm), completely oxidized metal and sulfide. Vugs are mostly filled with iron-hydroxides and sulfates.
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ (× 10^{-9} m^3/kg) = 4.56
Classification: Ordinary chondrite (L~4, W5)
Specimens: 13.9 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 7 g with *Bart*.

Argan 005 40°14'30.47"N, 88°47'09.64"E
Xinjiang, China
Find: Nov 2018
Classification: Ordinary chondrite (H~5)
History: (Ziyao Wang) Purchased by Ziyao Wang from the finder Tailu Zhao (Shanshan County, Xinjiang) in Shanshan/Xinjiang in 2018. Discovered in Nov 2018.
Physical characteristics: Black-brown, long, elongated stone of 53.3 g with rusty surface
Petrography: (R. Bartoschewitz, *Bart*) brown, recrystallized matrix, with well-developed chondrules (0.2-0.8 mm, av. 0,5 mm), completely oxidized metal and sulfide. Vugs are mostly filled with iron-hydroxides and sulfates.
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ (× 10^{-9} m^3/kg) = 4.74
Classification: Ordinary chondrite (H~5, W5)
Specimens: 11.0 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 11 g with *Bart*.

Arraias 12°57.29'S, 46°55.03'W

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Tocantins, Brazil
Find: 2015 Apr
Classification: Iron meteorite (IIAB)

History: Discovered in April 2015 near the town of Arraias, in the Mata da Ursa region, by a gold prospector named Vicente, in an excavation of gold tailings. He warned his boss about the finding, Mr. Jose Domingos Scarpellini, who subsequently took the meteorite to Curitiba.

Physical characteristics: A mass of 25 kg and approximate dimensions of 12 × 15 × 24 cm, rather smooth, but with large and irregular regmaglypts. There are no signs of fusion crust and it presents a weathered surface showing some with an oxide crust of about 1 mm

Petrography: (Zucolotto, M.E., MN/UFRJ) The etched section shows a typical hexahedrite structure with bright and frosty kamacite areas and several sets of Neumann lines crossing the entire surface. There is no sign of fusion crust and heat affected zone. Troilites are present as small nodules. Phosphides occur as numerous rhabdite crystals as both prisms and plates.

Geochemistry: 5.42% Ni; 0.45% Co; 57.4 ppm Ga; <200ppm Ge; 30.8 ppm Ir; 0.512 ppm Au (INAA, J.T. Wasson, *UCLA*). Kamacite 5.34% Ni; 0.41% Co. Phosphides 27% Ni; 14.7% P (EPMA Amanda Tosi LABSONDA/IGEO/UFRJ)

Classification: Iron, IIAB

Specimens: 80g *MNRJ*, 25 kg Curitiba, Thais Scarpellini

Ayagoz ~47°50'E, ~80°26'E
Semipalatinsk, Kazakhstan
Find: 2000
Classification: Iron meteorite (IIIE)

History: A large iron meteorite was found in prairie by a horse rider in 2000, ~12 km south of Ayagoz. A 38.9 kg piece and a 7 kg piece were brought to two different dealers by Jevgenijs Suhanovs in Ayagoz city. Samples from both pieces were analyzed to confirm they came from the same meteorite.

Physical characteristics: The main mass is covered with light-brown rust. Cut surface reveals a fresh metallic interior.

Petrography: Examination of etched sections reveals a coarse octahedrite structure (Og) with kamacite bandwidth 1.35±0.37 mm (N=15). Neumann bands are common. Kamacite displays epsilon-structure. Black plessite is common. Notable minerals include schreibersite (common), chromite, troilite, daubreelite.

Geochemistry: (M. D'Orazio, *DST-PI*): Composition of the metal (ICP-MS; D'Orazio and Folco, 2003) is Ni=8.79, Co=0.484 (both in wt%), Cu=113, Ga=17.6, Ge=35, As=4.9, Mo=7.1, Ru=5.4, Rh=1.57, Pd=3.4, Sn=0.07, Sb=0.15, Ir=0.30, Pt=6.7, Au=0.83 (all in ppm).

Classification: Iron (IIIE)

Specimens: Type specimen and two polished sections at *CEREGE*

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Aydar 002 27°45’09.6"N, 10°30’48.0"W
South, Morocco
Find: 2014
Classification: HED achondrite (Eucrite)
History: A single stone of 70 g, possibly paired with others found within 20 km. Found in 2014 in the valley of Afra by Elhossin Elguirah and bought from Mohamed Elguirah in Tan Tan in January 2016.
Physical characteristics: Crusted stone. Interior is light gray.
Petrography: Brecciated igneous rock with variolitic texture. Main minerals are plagioclase and orthopyroxene. Acessory troilite, metal, chromite.
Geochemistry: Orthopyroxene $Fs_{61.1\pm1.0}Wo_{2.6\pm1.0}$, FeO/MnO=32.2±1.0 (n=3). Augite exsolution $Fs_{27.0}Wo_{43.4}$ (n=2). Plagioclase $An_{87.6}Ab_{12.0}Or_{0.4}$ (n=3).
Classification: Eucrite, brecciated.
Specimens: Type specimen at *CEREGE*. Main mass with Jean Redelpserger.

Aydar 003 27°40’06.09"N, 10°06’25.33"W
South, Morocco
Purchased: 2018
Classification: Carbonaceous chondrite (CM1/2)
History: Found between 2016 and 2018. Bought from Abdelaziz Alhyane.
Physical characteristics: Crusted stones. The fusion crust shows a network of cracks. Cut surface reveals dark interior
Petrography: (J. Gattacceca, *CEREGE*) Small altered chondrules (average apparent diameter about 270 µm) and altered mineral fragments and fine grained CAIs set in an abundant fine-grained phyllosilicate-rich matrix (about 75 vol%). Olivine has been almost entirely serpentinized. Opaque minerals are FeS and magnetite. No metal was found. Transmission Infrared spectroscopy (L. Bonal, *IPAG*) of matrix grains reveals a water and Si-O bands attributable to phyllosilicates.
Geochemistry: Olivine is serpentinized, with microprobe totals of 85.9%±1.1% (n=9). Unaltered olivine crystals give $Fa_{1.4}$ and $Fa_{17.9}$ (n=2). Defocalized (10 µm) microprobe totals in the matrix 75.5±5.5% (n=7).
Classification: Carbonaceous chondrite (CM1/2). Petrologic type 1/2 from the almost total serpentinization of silicates but absence of narrow -OH band typically seen in phyllosilicates of the smectite group commonly observed seen in type 1 chondrites. Possibly paired with NWA 11322and NWA 8534.
Specimens: Type specimen at *CEREGE*. Main mass with Jean Redelsperger.

Balcarce 37°50’38.9"S, 58°21’50.0
Buenos Aires, Argentina
Find: 2000 Jun 2
Classification: Ordinary chondrite (H4)

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History: As indicated in Turone (2001), several pieces, including the main mass of 1780 g, were found at the base of Cerro Amarante in June 2000. The total mass was 2280 g. Presently the main mass of 1366 g is in a private collection.
Petrography: M.E. Varela and M. Saavedra (*ICATE*). Different types of chondrules are visible: BO, RP and POP with apparent diameter up to 1.2 mm. Chondrule fragments and isolated euhedral crystals of olivine and pyroxene up to 600 µm are common. Most chondrules have well defined edges. When present, chondrule mesostasis is recrystallized. Both the metal and the sulfides have irregular shapes with sizes ranging from 20 µm to 1.2 mm. Polycrystalline troilite grains are scarce. Shock features include olivine undulatory extinction, planar fractures and the presence of polycrystalline troilite. Weathering is moderate.
Geochemistry: Mineral composition: A total of 80 analyses covered 10 areas in the two thin section studied. Olivine, $Fa_{18.3}$; Pyroxene, $Fs_{16.6}Wo_{0.5.}$ Minor phases: high-Ca pyroxene $Fs_{7.8}Wo_{38.4.}$
Classification: Ordinary chondrite (H4)
Specimens: Type specimen of 33.12 g is on deposit in the *MLP*. 54.8 g and four thin section are on deposit at *ICATE*. The main mass, 1366 g, is in the Eduardo Jawerbaum collection.

Bardaï 001 21°45’21"N , 16°50’57"E
Borkou-Ennedi-Tibesti, Chad
Find: 2005
Classification: Ordinary chondrite (H3-5)
History: Belgian members of an NGO working in Ndrali, Tibesti, found this meteorite in a flat, sand- and gravel-covered area, 30 km north of Ndrali settlement. The nine fragments were dispersed over about 2 km. One of the finders sold the meteorite to Vincent Jacques on his return to Belgium.
Physical characteristics: The largest piece weighs 5.2 kg. All pieces are mostly covered by a dark-brown fusion crust with visible regmaglypts.
Petrography: Light-dark breccia texture, with rounded equilibrated light clasts (cm-sized or smaller) set in a dark, unequilibrated lithology with well delineated chondrules. The host lithology contains melt pockets, melt veins, and metal veins. The dark host lithology dominates.
Geochemistry: Equilibrated clasts: $Fa_{19.6\pm1.0}$ (n=5), $Fs_{16.8\pm1.5}Wo_{1.6\pm0.2}$ (n=5). Unequilibrated host lithology $Fa_{18.4\pm3.0}$ (n=6), $Fs_{14.8\pm4}Wo_{1.4\pm0.2}$ (n=7).
Classification: Ordinary chondrite H3-5 (or possibly H3-6)
Specimens distributed between *CEREGE* (10.6 g), *RBINS* Brussels (45.7 g) and *MNHNP* (25.5 g).

Barnstable 41.6969048°N, -70.3911813°W
Massachusetts, United States
Find: 2018 Aug 18
Classification: Ordinary chondrite (H4)

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History: The main mass was found on the surface resting in decomposing leaves surrounded with wild native blueberry bushes; other fragments were found similarly, covered with leaves with margins encased in soil, and some were found beneath the surface 1-4" deep. The first 1113 g fragment was found on August 18, 2018, and the main mass was discovered on September 11, 2018; remaining fragments were found between those date through 2018. All fragments were found in close proximity, in an area approximately 25' × 5', with smallest fragments toward one end.
Physical characteristics: Specimen has a smooth surface with shallow regmaglypts. The main mass is 28 × 20.5 × 13 cm in size and appears oriented (shield orientation), with frothy roll over lip on one side. Some fragments have bits of remnant fusion crust, others show secondary fusion crust. White chondrules visible on most broken surfaces.
Petrography: In addition to olivine and low-Ca pyroxene, there is minor Ca pyroxene ($Fs_{6.9\pm0.7}Wo_{44.2\pm0.7}$; n = 2) and plagioclcase ($Ab_{83.1\pm0.7}Or_{5.7\pm0.6}$; n = 6). Olivine and low-Ca pyroxene are homogeneous. Very few low-Ca pyroxene grains exhibit polysynthetic twinning. Chondrules are readily discernable and include the following textural types: BO, RP, PO, PP, POP, GOP. Only about 10-15% of the olivine grains show undulose extinction. There are no planar fractures. There are no coarse metal grains. All of the metallic Fe-Ni has been altered to limonite/goethite. There are a few feathered troilite grains remaining; also present are minor patches of clay minerals at the boundaries of mafic silicate grains. There is moderate silicate darkening in the specimen due to the presence of thin silicate-opaque veinlets. Also occurring are 30-40-µm-size chromite-plagioclase assemblages with 2-5-µm-size chromite grains. There are also small chromite veinlets containing plagiolcase patches within some olivine grains. The rock appears to have been shocked and annealed.

Benenitra 23°26.786'S, 45°4.692'E
Toliara, Madagascar
Confirmed fall: 27 July 2018
Classification: Ordinary chondrite (L6)
History: Reports of a meteor that detonated in a loud explosion, and stones falling from the sky into the town of Benenitra (pop. ~30,000) on the evening of July 27, 2018, were received by a visiting geologist, Timothy Marais, on July 30, 2018. He was shown photographs and several small fragments, two of which he purchased, weighing 99 and 14 g. Roger Gibson and Lewis Ashwal in the School of Geosciences at the University of the Witwatersrand confirmed a meteorite origin for these specimens using petrographic analysis and EMPA. Confirmation of the date and time of the fall was obtained independently when an upper atmosphere infrasound event was identified on a bearing south-southwest of the CTBTO station IS33 near Antananarivo, Madagascar, at 17h16 GMT on July 27 by Dr. Andry Ramanantsoa (Laboratory of Seismology and Infrasound, University of Antananrivo). A weak ground tremor at approximately 17h17 GMT was identified in the data from the seismograph at the Sakaraha (SKRH) station approximately 80 km northwest of

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Benenitra by Dr Ranto Raveloson (*Wits*), and was interpreted to be related to the airburst. Magnetic susceptibility measurements were performed by Prof. Susan Webb (*Wits*).

Physical characteristics: Two broken fragments containing small remnants of bluish-black to brown-black fusion crust and weighing 14 g and 82 g (after thin sectioning) consist of a light-gray matrix with disseminated metal (<1 mm) and some visible chondrules (<5 mm). The edge of the larger fragment, which contains a thin (<0.5 mm), dark-gray melt vein, was sectioned. Photographs taken by local residents show more than a dozen other fragments ranging in mass from ~100-1000 g; these show mostly intact fusion crusts with only limited chipping of edges. Samples range from subangular to subrounded to disc-shaped, with both sharp and rounded edges. Fusion crusts on these samples are generally smooth, with a few shallow regmaglypts.

Petrography: (L.D. Ashwal and R.L. Gibson, *Wits*) Modal abundances: 50% olivine, 25% low-Ca pyroxene, 5% high-Ca pyroxene, 10% feldspar, 7% troilite, 2% kamacite, 1% taenite, and trace amounts of chromite and a silica-rich phase. Recognizable chondrules range in size between 1 and 4.5 mm in diameter, and include porphyritic olivine and/or pyroxene, barred olivine, radial pyroxene and cryptocrystalline types, although their original textures have been variably modified by secondary thermal effects. Feldspar is almost entirely crystalline, and occurs as irregular grains up to 100 µm across, many of which display twinning. Pyroxenes are untwinned, and most grains exhibit straight extinction, although minor undulatory extinction is present in some grains. Low-Ca pyroxene shows parallel extinction with respect to cleavage traces. High-Ca pyroxene occurs as irregular grains up to 20 µm across; exsolution lamellae were observed in a few grains. Shock features include planar and irregular fractures in olivine, undulatory extinction in feldspar and pyroxenes, and anastomosing opaque shock veins up to 75 µm thick.

Geochemistry: Mineral compositions: (L.D. Ashwal and A. Ziegler) Olivine ($Fa_{24.0\pm0.8}$), low-Ca pyroxene ($Fs_{20.4\pm0.9}Wo_{1.4\pm0.4}$), high-Ca pyroxene ($Fs_{8.0\pm0.8}Wo_{42.4\pm1.0}$), feldspar ($Ab_{79.1\pm3.1}An_{13.3\pm1.9}Or_{7.6\pm1.5}$), troilite (Fe = 63.3±0.2, S = 36.5±0.3), kamacite (Ni = 5.7±0.7; Co = 0.85±0.05), taenite (Ni = 27.8±1.0).

Classification: Ordinary chondrite (L6), Shock level S3, Weathering level W0.

Specimens: 82 g (R.L. Gibson, *Wits*), 25.8 g at *TCU* (donated by Rob Wesel), reports of one or more pieces with masses of up to 15 kg are unconfirmed.

Bhanupratappur 20°7’27’’N, 80°58’26’’E
Madhya Pradesh, India
Find, possible fall: 2006 Jun 17 (IST 09:50 Hrs)
Classification: Ordinary chondrite (L4)

History: One piece of the sample (374 g) was retrieved from a reported fall site and collected by an officer of *GSI*, Central Region, Nagpur. According to the local villagers, a small depression or pit was made on the ground where the meteorite fell (Survey of India Toposheet No. 64D/15). The specimen was handed over to the *GSI* officer by the Tahsilder of Bhanupratappur on 7 July 2006.

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Physical characteristics: The meteorite sample (size ~5.5 × 8 × 5 cm) is mostly covered with fusion crust (thickness ~ 1 mm). The sample is rectangular. In hand specimen, few chondrules are visible by naked eyes. Several anastomosing opaque melt veins are observed.

Petrography: This meteorite is composed of olivine + orthopyroxene (Opx >> Cpx) + clinopyroxene + feldspathic glass + Fe-Ni metals (kamacite and taenite) + troilite. The chondrules are composed of olivine and orthopyroxene, with the interstitial spaces (mesostasis) occupied by feldspathic glass. The size of chondrules varies from 300 - 1000 µm (diameter). Types of chondrules include Porphyritic Olivine (PO), Granular Pyroxene (GP), Porphyritic Pyroxene (PP), Porphyritic Olivine Pyroxene (POP), and Granular Olivine (GO), but chondrule margins are not well defined. Chondrules are fragmented in places. Matrix is relatively fine grained and thoroughly recrystallized. Troilite and kamacite form an intergrowth like texture, in which kamacite blebs and droplets are dessiminated throughout the troilite grain. Fragments of olivine and orthopyroxene are enclosed within opaque melt veins (length >> width; maximum width of the vein ~ 2 mm). Numerous metal (Fe-Ni) droplets (micron to submicrometer scale) are confined within these melt veins / veinlets.

Geochemistry: The mineral chemical data of different textural variants of olivine is $Fa_{25-29}Fo_{71-75}$; clinoenstatite, $En_{72-77.5}Fs_{20.6-26.3}Wo_{1-4}$; clinopyroxene (diopside), $Wo_{42.7-48.3}En_{44.5-47}Fs_{7-12}$; and feldspathic glass (albite to anorthoclase), $Ab_{67.8-85}An_{10.4-14.8}Or_{4.3-17.4}$.

Classification: Different textural variants of olivine and orthopyroxene show near consistent mineral chemical compositional range (XMg) suggesting Bhanupratappur is an equilibrated ordinary chondrite (L4) having shock stage ~S4-S5.

Specimens: The specimen was officially submitted to the National Meteorite Repository (NMR), *GSI*, Kolkata on 1 May 2007 by the officer, *GSI*, Nagpur, Maharashtra, India.

Biduna Blowhole 005 31°04’50.8"S, 131°15’30.9"E
South Australia, Australia
Find: 19 May 2012
Classification: Ordinary chondrite (H4)

History: Single sample found on the windblown edge of a large claypan by J. Kuyken.

Physical characteristics: Mottled red and black sample with 35% fusion crust and several cracks.

Petrography: (A. Tomkins, *Monash*) Chondrules edges are sharp, glassy chondrules are barely recrystallized; these and chondrule mesostaces have sub-µm crystallites. Chondrules vary significantly in size and composition (varieties include RP, BO, PO, PP, POP, GOP, C, glassy). Olivine has weak undulose extinction; there is mild shock melting and some troilite has been mobilised along fractures. There are sparse troilite halos around chondrules. About 80% of the metal has been destroyed by rusting, whereas most troilite remains.

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Geochemistry: (A. Tomkins, *Monash*) Microprobe analyses: olivine $Fa_{18.6-20.6}$, mean $Fa_{19.46}$, std=0.67, n=9; Low-Ca pyroxene $Fs_{16.5-17.8}$, mean $Fs_{17.28}$, std=0.42, n=9.
Classification: Ordinary Chondrite (H4, S3, W3)

Biduna Blowhole 006 31°04'53.7"S, 131°15'03.5"E
South Australia, Australia
Find: 19 May 2012
Classification: Ordinary chondrite (H6)
History: Single sample found on the windblown edge of a large claypan by A. Tait.
Physical characteristics: Flat dark brown-black sample with 40% fusion crust.
Petrography: (L. Bowlt, *Monash*) Remnant chondrules have very diffuse edges and are poorly defined. They range in size up to 0.5 mm and sit in a weathered, fragmented and recrystallized matrix. The sample contains some porous domains. Mineralogy includes olivine, pyroxene, plagioclase, Fe-Ni metal and troilite. Chondrule types include CC, PO, PP and BO. Distinct plagioclase grains are coarse, many exceeding 50 µm. Olivine grains have sharp extinction and shock lamellae, and there is no evidence of mosaicism or maskelynite. Weathering is patchy; both Fe-Ni metal and troilite have been completely weathered out in some patches and in other regions weathering is 70-80%.
Geochemistry: (L. Bowlt, *Monash*) Olivine $Fa_{17.8-18.2}$, mean=$Fa_{18.0}$, std=0.16, n=5; Low-Ca pyroxene $Fs_{15.1-17.4}$, mean=$Fs_{15.8}$, std=0.97 , n=5.
Classification: Ordinary Chondrite (H6, S3, W3)

Black Rock 003 40°58.266'N, 119°02.134'W
Nevada, United States
Find: 2003 Oct 25
Classification: Ordinary chondrite (H3)
History: This stone was recovered by Robert *Verish* along the eroded margin of a dry lake.
Physical characteristics: This 25.1 g chondritic stone is a dark-brown, weathered fragment with only one side that is a relict-exterior surface, and is lacking fusion-crust.
Petrography: (Daniel Sheikh, *FSU*) Composed of small to medium-sized chondrules (average ~0.35 mm) in a fine-grained matrix.
Geochemistry: Olivine, $Fa_{18.55\pm5.3}$ ($Fa_{11.36-26.16}$, N=25); orthopyroxene, $Fs_{12.75\pm3.8}Wo_{1.75\pm0.3}$ ($Fs_{7.24-17.81}Wo_{1.23-2.62}$, N=25).
Classification: Ordinary Chondrite (H3.8) Estimated subtype H3.8 due to Fa s.d.=5.3 and Fs s.d.=3.8 from Huss et al. (2004).
Specimens: 7.82 grams at *UCLA*; main mass with *Verish*.

Black Rock 005 40°58.009'N, 119°02.455'W
Nevada, United States

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Find: 2003 Oct 25
Classification: Ordinary chondrite (L5)

History: This stone was recovered by Robert *Verish* along the eroded margin of a dry lake.

Physical characteristics: This 32.1 g fragment is half of a whole stone with an orange-brown interior and a black, 2 mm fusion crust on the well-rounded exterior surface.

Petrography: (D. Sheikh, *FSU*) Chondrule boundaries blurred (800±50 um, N=2). Recrystallized matrix with plagioclase (10-15 ?m).

Geochemistry: Olivine, $Fa_{22.13\pm0.9}$ (N=25); orthopyroxene, $Fs_{19.56\pm0.5}Wo_{1.93\pm0.2}$, (N=25).

Classification: Ordinary Chondrite (L5)

Specimens: 12.02 grams at *UCLA*; main mass with *Verish*.

Black Rock 008 40°57.877'N, 119°02.462'W
Nevada, United States
Find: 2006 Nov 04
Classification: Ordinary chondrite (L5)

History: This stone was recovered by Robert *Verish* along the eroded margin of a dry lake.

Physical characteristics: This 37.1 g fragment is half of a whole stone, with a dark-brown interior and a brown, relict fusion-crust on the exterior surface.

Petrography: (D. Sheikh, *FSU*) Chondrules absent. Recrystallized matrix with plagioclase (10-30 µm).

Geochemistry: Olivine, $Fa_{23.67\pm0.9}$ (N=25); orthopyroxene, $Fs_{19.24\pm0.9}Wo_{1.77\pm0.3}$ (N=25).

Classification: Ordinary Chondrite (L5)

Specimens: 12.37 grams at *UCLA*; main mass with *Verish*.

Black Rock 009 40°57.340'N, 119°02.116'W
Nevada, United States
Find: 2008 Sep 05
Classification: Ordinary chondrite (L5)

History: This stone was recovered by Robert *Verish* along the eroded margin of a dry lake.

Physical characteristics: This 4.0 g chondritic stone is a dark-brown, weathered fragment.

Petrography: (D. Sheikh, *FSU*) Chondrules absent. Recrystallized matrix with plagioclase (10-15 µm).

Geochemistry: Olivine, $Fa_{24.60\pm0.9}$ (N=25); orthopyroxene, $Fs_{22.05\pm0.9}Wo_{1.82\pm0.4}$ (N=25).

Classification: Ordinary Chondrite (L5)

Specimens: 2.40 grams at *UCLA*; main mass with *Verish*.

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Black Rock 010 40°57.769'N, 119°02.415'W
Nevada, United States
Find: 2008 Sep 05
Classification: Ordinary chondrite (L5)

History: This stone was recovered by Robert *Verish* along the eroded margin of a dry lake.

Physical characteristics: This 5.0 g chondritic stone is a dark-brown, weathered fragment.

Petrography: (D. Sheikh, *FSU*) Chondrule boundaries blurred (750 µm, N=1). Recrystallized matrix with plagioclase (10-30 µm).

Geochemistry: Olivine, $Fa_{22.47\pm0.9}$ (N=25); orthopyroxene, $Fs_{21.78\pm0.9}Wo_{1.82\pm0.6}$ (N=25).

Classification: Ordinary Chondrite (L5)

Specimens: 2.50 grams at *UCLA*; main mass with *Verish*.

Blackhawk Mountain (b) 34°24.8'N, 116°46.4'W
California, United States
Find: 2016 Jun 18
Classification: Ordinary chondrite (L6)

History: While visually searching for meteorites near the toe of the Blackhawk Landslide in Lucerne Valley, Mark Bittmann recovered a 52.4 g fragment of a chondritic stone which had only a slight attraction to a magnet. Found 2.3 miles west of the Bessemer Mine Road on the surface of an alluvial fan, that is mapped as "older alluvium", and not on the more recent, disturbed-surface of the nearby landslide. A conscientious search by a team of recovery experts did not result in any additional finds.

Physical characteristics: The flat, half-dome-shaped, brownish-orange fragment has two surfaces; one is a well-preserved exterior surface, by evidence of having retained the curvature of an outside corner and a relict fusion-crust. The second is a hackly, more recently broken, lighter-colored, brownish-orange surface. The cross-sections of chondrules are readily visible through the relict fusion-crust, but not discernible on the broken/hackly surface. A cut surface reveals a mottled pattern of various sized chondrules (1-3 mm) and metal-grains (up to 1.5 mm) in a yellowish-orange groundmass. Metal-grains (and troilite) have stained the neighboring matrix to a dark-brown color.

Petrography: (D. Sheikh, *FSU*) Chondrule boundaries blurred (496 µm, N=1). Recrystallized coarse-grained matrix with plagioclase (>60 µm).

Geochemistry: Olivine, $Fa_{24.0\pm0.2}$ (N=25); orthopyroxene, $Fs_{21.6\pm0.2}Wo_{1.7\pm0.2}$ (N=25).

Classification: Ordinary Chondrite (L6)

Specimens: 10.6 grams at *UCLA*; main mass with *Verish*.

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Bluewing 038 40°14.540'N, 118°56.157'W
Nevada, USA
Find: 10 April 2000
Classification: Ordinary chondrite (H5)
History: Found in 2000 April 10 by meteorite hunter Paul *Gessler* whilehe was visually searching the surface of the dry lake.
Physical characteristics: Dark-brown roundish fragment of a chondritic stone. Cut surface reveals gray-brown interior with "unique sparkles".
Petrography: (D. Sheikh, *FSU*) Chondrules (200-1200 µm, N=10). Recrystallized matrix with plagioclase (10-15 µm).
Geochemistry: Olivine, $Fa_{17.7\pm0.8}$ (N=25); orthopyroxene, $Fs_{15.9\pm0.9}Wo_{2.2\pm0.3}$ (N=25).
Classification: Ordinary Chondrite (H5)
Specimens: 21.7 grams at *UCLA*; main mass with *Verish*.

Bluewing 039 40°16.663'N, 118°56.800'W
Nevada, USA
Find: 2014 May 27
Classification: Ordinary chondrite (H4)
History: Found in 2014 May 27 by Robert *Verish*, while he was visually searching the surface of the dry lake for meteorites.
Physical characteristics: Brown, orange-segment-shaped, weathered fragment, with chondrules standing out in relief in a friable matrix. Cut surface reveals a mottled interior in various shades of brown.
Petrography: (D. Sheikh, *FSU*) Composed of small to medium-sized chondrules (average ~0.35 mm) in a fine-grained matrix.
Geochemistry: Olivine, $Fa_{17.6\pm1.1}$ (N=25); orthopyroxene, $Fs_{15.7\pm1.3}Wo_{1.6\pm0.6}$ (N=25).
Classification: Ordinary Chondrite (H4)
Specimens: 8.4 grams at *UCLA*; main mass with *Verish*.

Bojiyare 1°27.26'N, 39°54.37'E
North-Eastern, Kenya
Find: 3 Aug 2018
Classification: Ordinary chondrite (L5)
History: Multiple stones were found on August 3, 2018, by AbdiNasir Gulleid. He found this in the village of Bojiyare, Kenya, while on his way to do maintenance work on a communication mast nearby. Mahamed Nur Ogle contacted *Cascadia* via email, with information about numbers of pieces and masses. Images with weights for eleven pieces totaling 102 kg were sent to *Cascadia*. The largest of these pieces is 56.4 kg. According to the information sent, the imaged and weighed samples represent a small portion of the total find, most of which (approximately 300 kg) are in storage near the find location, suggesting a total mass of about 400 kg. The terrain is described as arid/desert with red soil.

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Physical characteristics: Exterior has remnant patches of weathered fusion crust. Broken exterior surface has patches of caliche and reddish brown soil. Interior is brownish gray, with paler indistinct chondrules and abundant metal and sulfide visible.
Petrography: (M. Hutson, A. Ruzicka, *Cascadia*) In thin section, chondrules are easily recognizable. Feldspathic material is generally less than 20 µm across and contains crystallites of pyroxene and chromite. Metal and sulfide are intergrown in a fine-grained mixture sometimes described as a "fizz texture" or "mosaic texture".
Geochemistry: Mineral compositions and geochemistry: Olivine ($Fa_{25.8\pm0.4}$, N=21), low-Ca pyroxene ($Fs_{21.7\pm0.4}Wo_{1.4\pm0.4}$, N=15).
Classification: L5 based on iron contents in olivine and, and size of feldspathic material.
Specimens: *Cascadia* holds 160 g in four pieces, in addition to a polished thin section and a mounted butt. Abdullahi Bashir Maalim holds the main mass in Wajir, Kenya.

Buena Vista Valley 40°16.001'N, 117°56.097'W
Nevada, United States
Find: 2013 Oct 18
Classification: Ordinary chondrite (H5)
History: A 66 g whole chondritic stone was recovered by Robert *Verish* on the margin of a dry lake.
Physical characteristics: This specimen is a whole, dark brownish-black stone with an exterior that is covered with a weathered fusion-crust. This stone is pear-shaped, but flat. The interior of this stone is a uniform dark-brown. Cut surfaces are flecked with metal-grains that are evenly scattered between many parallel, rust-filled fractures.
Petrography: (D. Sheikh, *FSU*) Chondrule boundaries blurred (300 µm, N=1). Recrystallized coarse-grained matrix with plagioclase (20-40 µm). Interconnected iron-oxide veins.
Geochemistry: Olivine $Fa_{19.51\pm0.20}$ (N=25); orthopyroxene $Fs_{18.4\pm0.2}Wo_{2.1\pm0.1}$ (N=25).
Classification: Ordinary Chondrite (H5)
Specimens: 64.8 grams at *UCLA*.

Calama 029 22°24'355"S, 068°34'401"W
Antofagasta, Chile
Find: 2017 Oct 14
Classification: Ordinary chondrite (LL7)
History: Meteorite (590 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 Calama.
Petrography: Classification (S. Berzin and K. Dugushkina, *RAS-UB*). Petrographic observation of a polished thin section revealed a fine-grained recrystallized texture

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and one relict chondrule. The meteorite consists of olivine 65%, orthopyroxene 15%, clinopyroxene 5-7%, plagioclase 10%, chromite 2-3%, troilite 3-4%, Fe-Ni-metal <0.5%. Also contains accessory apatite and ilmenite. Olivine grains are 50-300 µm in size, however large olivine grains up to 800 µm are present. Such olivine grains contain plagioclase, troilite and metal inclusions. One relict barred olivine (BO) chondrule was found in thin section. This chondrule has recrystallized boundaries and contains orthopyroxene and clinopyroxene. This indicates intense recrystallizaton. Optical features (sharp extinction of olivine) indicate that the sample is very weakly or not shocked (S1). There is oxidation of metal and troilite, and incipient alteration of mafic silicates.

Geochemistry: EDX analyses and electron microprobe analyses by S. Berzin, K. Dugushkina and I. Danilenko, *RAS-UB*, analyses Cu isotope composition by M. Chervyakovskaya, *RAS-UB*. The primary paragenesis includes olivine $Fa_{31\pm1.5}$ (N=15), orthopyroxene $En_{73\pm0.6}Fs_{25\pm0.6}Wo_{2\pm0.2}$ (N=12), plagioclase $An_{20\pm0.7}$ (N=9), clinopyroxene $En_{45\pm1.0}Fs_{11\pm2.2}Wo_{44\pm1.2}$ (N=9), chromite, ilmenite, chlor-apatite, troilite and FeNi-metal. Olivine contains MnO 0.4 wt.%. Plagioclase contains K_2O 0.6-1.3 wt.%. The average composition of chromite (N=4): Cr_2O_3 53.39±0.43%, TiO_2 3.77±0.08%, Al_2O_3 5.17±0.04%, FeO 33.30±0.35%, MgO 1.67±0.07%, MnO 0.43±0.07%, V_2O_3 0.71±0.03%, ZnO 0.33±0.07%. The average composition of FeNi-metal (N=5): Fe 49.4±1.5%, Ni 49.0±1.5 %, Co 1.99±0.16%.

Classification: Ordinary chondrite (LL7). This meteorite has a small content of FeNi-metal (<0.5%) compared to most LL chondrites.

Specimens: Main mass 580 g and 10 g cut-offs, plus a thin section, *UrFU*.

Calama 031 22°08.90'S, 68°37.72'W

Antofagasta, Chile

Find: 23 Oct 2018

Classification: Carbonaceous chondrite (CO3)

History: many pieces of the meteorite were found by Mr. M. Nepomiluev

Physical characteristics: all samples of the meteorite have a brown fusion crust

Petrography: M. A. Ivanova (*Vernad*) The meteorite consists of chondrules, their fragments, and a fine grained matrix. Chondrules, mostly porphyritic and barred, are up to 0.23 mm in size. Olivine and pyroxene in chondrules are embedded in glassy mesostasis. CAIs containing spinel, hibonite and melilite occur in the matrix. Small blebbs of Fe,Ni-metal and sulfide grains occur in the matrix. Shock stage is S2, based on undulatory extinction of olivine grains, weathering grade is low.

Geochemistry: Mineral compositions and geochemistry: M. A. Ivanova (*Vernad*) Olivine: $Fa_{0.63-75.3}$ (N=56), orthopyroxene: $Fs_{0.8-45.8}Wo_{0.63-4.4}$ (N=23), Ca-pyroxene: $Fs_{1.4-25.1}Wo_{19.3-46.7}$ (N=11). Oxygen isotopic compositions: (*OU*) $\delta^{17}O$=-4.126, -4.44; $\delta^{18}O$=-0.544, -0.874; $\Delta^{17}O$= -3.843, -3.986 (all ‰).

Classification: based on the texture, chondrule sizes, mineral chemistry and bulk oxygen isotopic composition, the meteorite belongs to type CO3.

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Specimens: several pieces of the meteorite (165 g total), and 1 polished thin sections are deposited in *Vernad*. Mt. M. Nepomiluev (ramatahatta2@mail.ru) hold the main mass of the meteorite.

Calama 032 22°27.39'S, 68°48.58'W
Antofagasta, Chile
Find: 24 Mar 2019
Classification: Ordinary chondrite (H5)
Geochemistry: Mineral composition and Geochemistry: EDS-WDS analyses (V.I. Taskaev, *IGEM* RAS). The primary chondrite paragenesis includes olivine $Fa_{18.72\pm0.36}$ (N=10), orthopyroxene $Fs_{16.1\pm0.3}Wo_{1.19\pm0.19}$ (N=10),Composition of kamacite(in wt., %): Fe 92.65, Ni 6.29, Co 0.78 and taenite (in wt., %, N=2): Fe 49.71, Ni 49.07, Co 0.35
Classification: (Pavel Yu. Plechov, *FMMR*). Ordinary chondrite. H5, S1, W1
Specimens: Mr. M. Nepomiluev holds main mass 22.4 g. 5.6 g and thin section, *FMMR*.

Calama 033 22°08.81'S, 68°37.37'W
Antofagasta, Chile
Find: 29 Mar 2019
Classification: Ordinary chondrite (H6)
Geochemistry: Mineral composition and Geochemistry: EDS-WDS analyses (V.I. Taskaev, *IGEM* RAS). The primary chondrite paragenesis includes olivine $Fa_{18.48\pm1.12}$ (N=14) orthopyroxene $Fs_{16.1\pm1.0}Wo_{1.6\pm0.38}$ (N=14)
Classification: (Pavel Yu. Plechov, *FMMR*). Ordinary chondrite, H6, S1, W1
Specimens: Mr. T. Kryachko holds main mass 99.2 g. 27.2 g and thin section, *FMMR*.

Calama 048 22°25.371'S, 068°40.746'W
Antofagasta, Chile
Find: 2017 Feb 23
Classification: Carbonaceous chondrite (CO3)
Physical characteristics: Sawn surface shows a dark interior with many small chondrules. Stone shows little weathering.
Petrography: Thin section shows abundant chondrules (predominantly of type I) and small CAIs set in a fine-grained matrix. The average chondrule apparent size is 160±50 µm (N=60), with a few chondrules up to 1 mm.
Geochemistry: Olivine in the range $Fa_{0.3-52.5}$ (mean $Fa_{15.9\pm10.1}$, N=32). Cr_2O_3 in ferroan olivine 0.4±0.2 wt.% (N=15). Low-Ca pyroxene in the range $Fs_{1.0-13.6}$ (mean $Fs_{1.5\pm0.8}Wo_{1.4\pm0.7}$, N=16).

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Calate 016 21°34.21'S, 69°38.62'W
Antofagasta, Chile
Find: 19 Oct 2016
Classification: Carbonaceous chondrite (CK5)
Petrography: The meteorite is composed of fine-grained recrystallized matrix, chondrules, chondrule and mineral fragments. The matrix is comprised by olivine, minor feldspar and pyroxene grains with abundant magnetite and rare troilite. No CAIs were observed.
Geochemistry: Ni in olivine is 0.35±0.03 wt%; Magnetite (wt%): Cr 3.1±0.2; Ti 0.48±0.02; Al 0.69±0.01 (N=12).

Calate 017 21°34.97'S, 69°36.83'W
Antofagasta, Chile
Find: 19 Oct 2017
Classification: Ordinary chondrite (L5)
Geochemistry: Mineral composition and Geochemistry: EDS-WDS analyses (V.I. Taskaev, *IGEM* RAS). The primary chondrite paragenesis includes olivine $Fa_{25.11\pm1.46}$ (N=13) orthopyroxene $Fs_{20.1\pm0.6}Wo_{1.52\pm0.25}$ (N=12)
Classification: (Pavel Yu. Plechov, *FMMR*). Ordinary chondrite, L5, S1, W2
Specimens: Mr. M. Nepomiluev holds main mass about 1.9 kg. 40 g and thin section, *FMMR*.

Caleta el Cobre 028 (CeC 028) ~24°20'S, ~70°15'W
Antofagasta, Chile
Find: 2018 Dec
Classification: Enstatite chondrite (EL6)
History: Found in December 2018 in the Atacama desert.
Physical characteristics: Dark-brown stone with remnants of fusion crust. Many fragments found spread along a few meters downslope. The main fragment weighs 46 kg.
Petrography: (J. Gattacceca, *CEREGE*) Highly recrystallized texture with dominant enstatite (55 vol%, typical size 200 µm) and plagioclase (14 vol%, typical size 100 µm). Some enstatite crystals have lobate boundaries. Metal makes up about 30 vol% of the meteorite, sometimes as large cm sized lumps. Sulfides (troilite and Mn,Mg sulfides, up to 200 µm, abundance about 4 vol%) are found associated to metal, or as separate grains. Metal and sulfides are also found as µm-sized grains witin some silicates. No chondrule relict was observed.
Geochemistry: Enstatite $Fs_{0.6\pm0.3}Wo_{1.3\pm0.1}$ (n=5). Plagioclase $An_{15.7\pm0.2}Ab_{80.6\pm1.7}Or_{3.7\pm1.8}$ (n=5). Kamacite (wt%) Fe 91.2±1.3, Ni 5.7±1.1, Co 0.17±0.10, Si 1.62±0.18 (n=3). Mn,Mg sulfides (wt%) Fe 18.5±0.5, S 45.0±0.2, Mn 18.9±2.1, Mg 16.3±0.7, Ca 0.89±0.13, Cr 0.15±0.09 (n=3). Troilite Cr=0.58 wt%, Ti=0.53 wt%.

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Classification: Enstatite chondrite EL6. Type 6 from the absence of relict chondrule. EL group from the Si content of metal. The meteorite is unusually metal-rich with about 30 vol% metal. This meteorite was found only 6 km from Caleta el Cobre 024 EL6 chondrite.
Specimens: Type specimen at *CEREGE*. Main mass with ArtMet.

Caleta el Cobre 030 (CeC 030) 24°15'S, 70°31'W
Antofagasta, Chile
Find: 2019
Classification: Iron meteorite (ungrouped)
History: Found in 2019 in the Atacama desert
Physical characteristics: A single brownish mass. Cut surface reveals fresh metallic interior.
Petrography: Etching of a polished section reveals a coarse octahedrite texture with net and cellular plessite.
Geochemistry: (J.T. Wasson, *UCLA*): INAA data, Ni = 75.3, Co = 4.45 (both mg/g), Cu = 162, Ga = 27.0, As = 8.49, W= 1.12, Re = 682, Ir = 6.57, Pt = 8.66, Au = 0.95 (all µg/g).
Classification: Iron, ungrouped. Ungrouped designation based on composition; no close compositional relatives among 105 other ungrouped irons.
Specimens: Type specimen (28 g) at *CEREGE*. 17 g at *UCLA*. Main mass with ArtMet.

Caleta el Cobre 031 (CeC 031) 24°15'S, 70°31'S
Antofagasta, Chile
Find: 2018 Apr
Classification: Ordinary chondrite (L3)
History: Found in the Atacama desert.
Petrography: (J. Gattacceca, *CEREGE*) Chondrite with well-delineated packed chondrules. Opaque are metal and troilite.
Geochemistry: Olivine $Fa_{24.7\pm2.7}$, range $Fa_{18.9\text{-}29.5}$, Fa PMD 7% (n=8). Low-Ca pyroxene $Fs_{19.5\pm6.8}Wo_{0.5\pm0.1}$, range $Fs_{12.9\text{-}35.8}$ (n=8).
Classification: Ordinary chondrite (L3).
Specimens: Type specimen and a polished section at *CEREGE*. Main mass at ArtMet Collection

Caleta el Cobre 032 (CeC 032) 24°15'S, 70°31'W
Antofagasta, Chile
Find: 2018 Apr
Classification: Ordinary chondrite (L4)
History: Found in the Atacama desert.

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Petrography: (J. Gattacceca, *CEREGE*) Chondrite with well-delineated, packed chondrules with average apparent diameter 770±240 µm (n=20). Opaque are metal and troilite.
Geochemistry: Olivine $Fa_{24.8\pm13}$, range $Fa_{22.0\text{-}26.4}$, Fa PMD 4.2% (n=8). Low-Ca pyroxene $Fs_{14.4\pm6.2}Wo_{1.3\pm1.1}$, range $Fs_{4.9\text{-}21.1}$ (n=10).
Classification: Ordinary chondrite (L4).
Specimens: Type specimen and a polished section at *CEREGE*. Main mass at ArtMet Collection

Caleta el Cobre 033 (CeC 033) 24°15'S, 70°31'W
Antofagasta, Chile
Find: 2018 Dec
Classification: Carbonaceous chondrite (CO3)
History: Found in the Atacama desert.
Physical characteristics: Brownish stones.
Petrography: (J. Gattacceca, *CEREGE*) Chondrules with average apparent diameter 220±200 µm (n=44) and small CAIs set in an abundant fine-grained iron rich matrix (38 vol% from point couting, n=251). Opaques are metal and sulfides
Geochemistry: Olivine $Fa_{28.9\pm14.8}$, range $Fa_{2.0\text{-}50.3}$, Cr_2O_3 0.18±0.11 wt% (n=13). Low-Ca pyroxene $Fs_{28.4\pm20.7}Wo_{1.7\pm1.5}$ (n=10).
Classification: Carbonaceous chondrite (CO3)
Specimens: Type specimen and a polished section at *CEREGE*. Main mass at ArtMet Collection

Caleta el Cobre 036 (CeC 036) 24°17.678'S, 70°19.746'W
Antofagasta, Chile
Find: 2018 Dec
Classification: Ordinary chondrite (L6)
Petrography: (J. Gattacceca, *CEREGE*) Melt rock supported breccia with type 6 ordinary chondrite clasts. Opaques are metal and sulfides. Chondrule average apparent diameter around 700 µm.

Catalina 303 25°14'S, 69°43'W
Antofagasta, Chile
Find: 2009 Dec 13
Classification: Mesosiderite
Physical characteristics: Dark brown stone. Cut surface reveals abundant metal.
Petrography: Crystalline rock with plagioclase and pyroxene with typical grain size 200 µm. Metal is abundant. Ilmenite, chromite and silica polymorph are present.
Geochemistry: Orthopyroxene $Fs_{38.6\pm0.4}Wo_{3.8\pm1.8}$, FeO/MnO 25.0±1.8 (n=6). Plagiocalse $An_{93.3}Ab_{6.5}Or_{0.2}$ (n=2).
Classification: Mesosiderite

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Specimens: Type specimen at *CEREGE*. Main mass with Eric Christensen

Catalina 316 25°14'S, 69°43'W
Antofagasta, Chile
Find: 2017 Oct
Classification: Ordinary chondrite (L6)
Physical characteristics: Dark brown stone. Cut surface reveals a black interior with abundant metal and vugs about 500 µm.
Petrography: (J. Gattacceca, *CEREGE*) This ordinary chondrite is very recrystallized with only faint remnants of chondrules. It is characterized by abundant shock veins, opaque veinlets, opaque grains with a eutectic mixture of metal and sulfide. Shock darkening is pervasive.
Classification: Ordinary chondrite (L6). Shock darkened.
Specimens: Type specimen at *CEREGE*. Main mass at ArtMet collection.

Catalina 319 24°56'05.8''S, 069°58'55.5''W
Antofagasta, Chile
Find: 2017 Feb 19
Classification: Ordinary chondrite (L3)
History: Found on granodiorite pediment surface by a six-person team.
Petrography: (J. Gattacceca, *CEREGE*) Chondrite with well-defined, packed chondrules. Opaques are Fe,Ni metal and troilite.
Geochemistry: Olivine $Fa_{16.5\pm9.1}$, Fa PMD 51%, Cr_2O_3 0.06±0.05 wt%. Low-Ca pyroxene $Fs_{19.5\pm6.6}Wo_{0.7\pm0.2}$ (n=5).
Classification: Ordinary chondrite (L3). L group from magnetic susceptibility.
Specimens: Type specimen at *CEREGE*. Main mass with Sergey Vasiliev.

Chug Chug 010 22°29.856'S, 69°09.416'W
Antofagasta, Chile
Find: 2018 Oct 16
Classification: Ordinary chondrite (H5)
History: The meteorite (one piece) was found on October 16, 2018, by Ilya Chaplygin during a desert search organized by Timur Kryachko.
Physical characteristics: Single stone 224.5 g of angular shape with uneven, shiny dark-brown surface. No fusion crust was observed. Fresh cut reveals dark-brown interior with abundant chondrules and no visible metal. Bottom part is covered with pinkish light-colored desert dust.
Petrography: (Pavel Yu. Plechov, *FMMR*). Petrographic observation of a polished section shows that main part of the meteorite contains many clear pronounced chondrules. Chondrules sizes vary from 200 to 500 µm with rare large chondrules (up to 1500 µm). Plagioclase grains ($An_{9.6-13.9}$) are about 10-50 µm. These features indicate a petrological type of 5 for the meteorite. Olivine has no undulatory

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extinction, as well as the absence of opaque shock veins and melt pockets indicates a shock stage of S1. Silicates are not weathered, and troilite is almost fresh whereas metal is significantly oxidized (weathering grade, W2).
Geochemistry: Mineral composition and Geochemistry: EDS analyses (Pavel Yu. Plechov, *FMMR*). The primary chondrite paragenesis includes olivine $Fa_{18.49\pm0.47}$ (N=17), Low-Ca pyroxene $Fs_{16.0\pm0.6}Wo_{0.94\pm0.12}$ (N=7), plagioclase $Ab_{83.5}An_{11.8}Or_{4.3}$ (N=2), clinopyroxene $En_{50.0}Fs_{5.4}Wo_{44.7.}$ Phosphate is Cl-apatite. Troilite is close to ideal stoichiometry.
Classification: (Pavel Yu. Plechov, *FMMR*). Ordinary chondrite. H5, S1, W2.
Specimens: Ilya Chaplygin holds main mass about 200 g. 31.8 g and thin section, *FMMR*.

Chug Chug 013 22°28.76'S, 69°05.988'W
Antofagasta, Chile
Find: 04 Apr 2018
Classification: Ordinary chondrite (H5)
History: Meteorite (1 piece) was found on April 4, 2018, by Ilya Chaplygin during a desert meteorite search organized by Timur Kryachko.
Physical characteristics: Single brown stone with angular shape and remnants of dark-brown fusion crust. Fresh cut is dark gray and shows abundant metal. Dimentions 4 × 3 × 1.5 cm.
Geochemistry: Mineral composition and Geochemistry: EDS-WDS analyses (V.I. Taskaev, *IGEM* RAS). The primary chondrite paragenesis includes olivine $Fa_{18.54\pm0.39}$ (N=12), Low-Ca pyroxene $Fs_{16.3\pm0.6}Wo_{1.43\pm0.29}$ (N=13), plagioclase $Ab_{81.8}An_{12.6}Or_{5.5}$ (N=3). Composition of kamacite (in wt.%, N=2): Fe 93.34, Ni 5.1, Co 0.5. Taenite (in wt., %, N=6) contain 30.55 and 0.24 wt.% of Ni and Co respectively. Troilite is close to ideal FeS.
Classification: (Pavel Yu. Plechov, *FMMR*). Ordinary chondrite. H5, S1, W1
Specimens: Mr. I. Chaplygin holds main mass 29.36 g. 7.94 g and thin section, *FMMR*.

Chug Chug 014 22°28.956'S, 69°12.62'W
Antofagasta, Chile
Find: 21 Oct 2018
Classification: Ordinary chondrite (L4)
History: Meteorite was found on October 31, 2018, by Ilya Chaplygin during a desert meteorite search organized by Timur Kryachko.
Physical characteristics: Single brown stone 780 g with angular shape and rare remnants of black fusion crust. Fresh cut of the meteorite exhibits brown interior and fresh metal. Bottom part is covered with light-colored desert material. Dimensions 9 × 7 × 7 cm.
Geochemistry: Mineral composition and Geochemistry: EDS-WDS analyses (V.I. Taskaev, *IGEM* RAS). The primary chondrite paragenesis includes olivine

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$Fa_{25.75\pm2.22}$ (N=10), Low-Ca pyroxene $Fs_{20.2\pm0.4}Wo_{1.59\pm0.22}$ (N=15). Composition of kamacite (in wt.%, N=4): Fe 93.32, Ni 5.97, Co 0.71. Taenite contain(in wt.%, N=4) 35.54 and 0.26 wt.% of Ni and Co respectively. Troilite is close to ideal FeS.
Classification: (Pavel Yu. Plechov, *FMMR*). Ordinary chondrite. L4, S1, W1
Specimens: Mr. I. Chaplygin holds main mass about 744 g. 36 g and thin section, *FMMR*.

Chug Chug 015 22°29.573'S, 69°14.896'W
Antofagasta, Chile
Find: 2018 Oct 16
Classification: Ordinary chondrite (H5/6)
History: Meteorite (1 piece) was found on October 16, 2018, by Ilya Chaplygin during a desert meteorite search organized by Timur Kryachko.
Physical characteristics: Single stone, 3055 g, with angular shape, flat sides, and rounded edges, covered with dull dark-brown fusion crust partly missing on the edges. One side is broken revealing solid brown surface. Bottom part is covered with light-colored desert material. Fresh cut of the meteorite is dark gray and exhibits lots of fine grained metal. Dimensions 10.5 × 15 × 8.5 cm.
Petrography: (P. Yu. Plechov, *FMMR*). The meteorite contains rare relics of barred-olivine chondrules about 300 µm in diameter. Olivine, low-Ca pyroxene, plagioclase and metallic blebs are the main minerals in matrix. Metallic blebs (200-400 µm) have irregular shape and consist of kamacite, taenite and troilte. Plagioclase grains are about 50 µm. This indicates a petrological type of 5 or 6 for the meteorite. Olivine has no undulatory extinction, and opaque shock veins and melt pockets are absent, indicating a shock stage of S1. Rare dark-yellowish cracks (up to 1 mm in length) occur. Olivine, pyroxene, chromite, metal and troilite are fresh and not weathered. No oxidation rims around troilite or metal (weathering grade W0).
Geochemistry: Mineral composition and Geochemistry: EDS analyses (V.I. Taskaev, *IGEM* RAS). The primary chondrite paragenesis includes olivine $Fa_{18.8\pm0.3}$ (N=20), orthopyroxene $Fs_{15.9\pm0.7}Wo_{1.3\pm0.2}$ (N=15), plagioclase $Ab_{82.1}An_{11.5}Or_{6.4}$ (N=2), clinopyroxene $En_{49.3}Fs_{5.5}Wo_{45.1}$ (N=1). Composition of kamacite (in wt.%, N=12): Fe 93.5, Ni 5.6, Co 0.6. Taenite (N=9) contain 43.1 and 0.1 wt.% of Ni and Co, respectively.
Classification: (P. Yu. Plechov, *FMMR*). Ordinary chondrite, H5/6, W0, S1
Specimens: Mr. I. Chaplygin holds main mass 2.5 kg. 475 g, *FMMR*.

Chwichiya 003 27°05'26"N, 11°10'12"W
Saguia el Hamra, Western Sahara
Find: 2018 Dec
Classification: Carbonaceous chondrite (CM2)
Physical characteristics: Many dark, irregular fragments. Cut surface reveals a dark interior.

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Petrography: (J. Gattacceca, *CEREGE*) Chondrite with small chondrules (average apparent size about 250 µm) set in an abundant (79 vol% by point counting) fine-grained iron-rich matrix containg phyllosilicates and carbonates. Opaque minerals are FeS, magnetite, rare metal.
Geochemistry: Olivine $Fa_{23.0\pm24.1}$, range $Fa_{0.9\text{-}54.1}$ (n=11). Low-ca pyroxene $Fs_{2.1\pm1.2}Wo_{1.0\pm0.3}$ (n=4). Defocused (10 µm) microprobe total in the matrix is 87.7±2.4 (n=9).
Classification: Carbonaceous chondrite (CM2).
Specimens: Type specimen at *CEREGE*. Main mass with Pierre-Marie Pelé

Chwichiya 004 27°23'42.89"N, 11°42'12.82"W
Saguia el Hamra, Western Sahara
Find: 2019 Apr 24
Classification: Ordinary chondrite (LL7)
History: Found by Hammo Oualguirah on April 24, 2019. Bought from Mohamed Elguirah by Jean Redelsperger.
Physical characteristics: Several greyish stones, without fusion crust.
Petrography: (J. Gattacceca, *CEREGE*) Recrystallized chondrite. No relict chondrules observed. Olivine (to 200 µm) has lobate contours. Plagioclase typical size 100 µm.
Geochemistry: Olivine $Fa_{30.0}$ (n=2). Low-Ca pyroxene $Fs_{24.8\pm0.0}Wo_{3.2\pm0.2}$ (n=3).
Classification: Ordinary chondrite (LL7). Type 7 based on texture and Wo content of low-Ca pyroxene.
Specimens: Type specimen at *CEREGE*. Main mass with Jean Redelsperger.

Colgate 47.25°N, 97.66°W
North Dakota, United States
Find: 1999
Classification: Ordinary chondrite (H4)
History: A single 39 kg stone was found in 1999 by Tod Erickson while removing rip-rap from his home basement excavation, in Colgate, North Dakota. These rocks had been gathered from local farmers rock piles to fill the basement excavation so the walls would not collapse, as the owner was not going to put a structure on it for some years. When removing the rocks before construction, Tod Erickson found the meteorite. He noted its unusual color and weathered surface, and brought it to *UND*.
Petrography: Ordinary chondrite with average chondrule diameter 310 µm (n=50).
Classification: The meteorite has been checked against Euclid and Drayton (H chondrites from Minnesota and North Dakota) and is not paired.
Specimens: Main mass with T. Ericsson family, Colgate, North Dakota. Type specimen (250 g and 3 thin sections) *UND* Geology.

Daban 43°35'25.85"N, 118°39'54.69"E

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Nei Mongol, China
Find: 2017 Mar
Classification: Ordinary chondrite (L~5)

History: (Ziyao Wang) Discovered by Xianghui Zheng in the desert near Daban (Bairin Youqi), Chifeng city, Inner Mongolia, in Mar 2017.

Physical characteristics: (Ziyao Wang) Light-yellow stone, with fusion crust

Petrography: (R. Bartoschewitz, *Bart*) brown-yellow recrystallized matrix with recognizable chondrules (0.4-2 mm, av. 0.7 mm).

Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.73

Classification: Ordinary chondrite (L~5, W2)

Specimens: 13.4 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 7 g with *Bart*.

Danilovka 52°0.6'N, 44°58.65'E
Saratovskaya oblast', Russia
Find: Jun 1995
Classification: Ordinary chondrite (L6)

History: Single stone was found by anonymous person on the plowed field that belongs to Danilovka village. After the recovering the stone was kept in the backyard of the finder's home up to 2019.

Physical characteristics: The stone of 5660 g has faceted shape with broken surface from one side. The surface has patchy dark- to red-brown color. Fusion crust is partially preserved.

Petrography: (C. A. Lorenz , *Vernad*) The meteorite is composed of fine- to medium- grained recrystallized olivine, minor pyroxene, troilite and feldspar with numerous recrystallized relics of chondrule fragments. The feldspar grains size is up to 120 µm. Accessory phases are FeNi metal and chromite. Olivine grains have irregular and planar fractures and demonstrate weak undulatory optical extinction. Occasional micrometer-sized pockets of silicate and troilite melt were observed in a single linear fracture crossing a whole section.

Geochemistry: Mineral compositions and Geochemistry: (N. N. Kononkova, EPMA, *Vernad*.) Olivine $Fa_{25.6\pm0.2}$ (N=5); orthopyroxene $Fs_{20.5\pm0.2}Wo_{1.7\pm0.3}$ (N=5)

Classification: Ordinary chondrite of the chemical group L, type 6 (S2, W2)

Specimens: A type specimen of 144.8 g and thin polished section are on deposit in *Vernad*. Main mass of 5.5 kg is in the private collection of Mr. Daniel Ashenbrenner.

Dar al Gani 1070 (DaG 1070) 27°01.01'N, 16°23.0'E
Al Jufrah, Libya
Find: August 1998
Classification: Ureilite

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History: One stone with a total mass of 119.7 g, having remnant fusion crust with a few visible remaining flow-lines, was found by an anonymous finder in August 1998 in the Dar al Gani region, Libya.
Petrography: (A. Bischoff, *IfP*) The thin section is dominated by medium to coarse-grained anhedral grains of olivine and pyroxene showing grain contacts with abundant 120° triple junctions. Olivine is by far the most abundant silicate, while pyroxene is quite rare. Olivines have thin reduction rims and abundant terrestrial oxides are in the boundary areas. Graphite is present. The sample is strongly weathered.
Geochemistry: Mineral comopositions and geochemistry: (K. Klemm; A. Bischoff, *IfP*) : Olivine cores are $Fa_{17.7\text{-}20.0}$ (n=4) and the reduced rims have low FeO (down to $Fa_{3.2}$). Low-Ca pyroxene has a composition of $Fs_{17.2\pm0.3}Wo_{6.4\pm0.2}$, n=3).
Classification: Ureilite based on mineralogy, texture, and mineral chemistry.

Daveytown 001 41°19.911'N, 117°52.214'W
Nevada, United States
Find: 2014 May 31
Classification: Ordinary chondrite (L5)
History: This stone was recovered by Robert *Verish* while he was searching for meteorites on a small drylake, on a north-facing stranding-surface.
Physical characteristics: This 30.05 g, well-rounded, oriented individual has a smooth, black-brown fusion-crusted exterior, with one side having a subtle overlipping. Cut surface shows a uniformly dark-brown interior
Petrography: (D. Sheikh, *FSU*) Chondrules (200-800 µm, N=15). Recrystallized matrix with plagioclase (10-30 µm).
Geochemistry: Olivine, $Fa_{23.5\pm0.7}$ (N=25); orthopyroxene, $Fs_{21.1\pm0.7}Wo_{1.7\pm0.6}$ (N=25).
Classification: Ordinary Chondrite (L5)
Specimens: 6.24 grams at *UCLA*; main mass with *Verish*.

Daveytown 002 41°19.547'N, 117°52.298'W
Nevada, United States
Find: 2014 May 31
Classification: Ordinary chondrite (L5)
History: This stone was recovered by Robert *Verish* while he was searching for meteorites on a small drylake, on a north-facing stranding-surface.
Physical characteristics: This 15.65 g, well-rounded, whole stone has a smooth, orange-stained exterior with several patches of relict fusion-crust. Cut surface exposes a dark-brown interior with abundant troilite grains.
Petrography: (D. Sheikh, *FSU*) Chondrules (200-400 µm, N=17). Recrystallized matrix with plagioclase (10-30 µm).
Geochemistry: Olivine, $Fa_{23.5\pm0.6}$ (N=25); orthopyroxene, $Fs_{21.7\pm0.7}Wo_{2.0\pm0.4}$, (N=25).
Classification: Ordinary Chondrite (L5)
Specimens: 4.13 grams at *UCLA*; main mass with *Verish*.

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Daveytown 003 41°20.541'N, 117°51.327'W
Nevada, United States
Find: 2014 May 31
Classification: Ordinary chondrite (H5)
History: This stone was recovered by Robert *Verish* while he was searching for meteorites on a small drylake, on a north-facing stranding-surface.
Physical characteristics: The original exterior to this find is non-existant, so it cannot be determined whether this 9.35 g charcoal-gray stone is a fragment or was a whole-stone. Groundmass is apparently friable since many chondrules stand-out in high relief on the current exterior. The interior is colored gray-brown.
Petrography: (D. Sheikh, *FSU*) Chondrule boundaries blurred (500 µm, N=1). Recrystallized matrix with plagioclase (10-20 µm).
Geochemistry: Olivine, $Fa_{19.7\pm0.6}$ (N=25); orthopyroxene, $Fs_{18.7\pm0.9}Wo_{2.0\pm0.5}$, (N=25).
Classification: Ordinary Chondrite (H5)
Specimens: 2.38 grams at *UCLA*; main mass with *Verish*.

Daveytown 004 41°19.539'N, 117°52.321'W
Nevada, United States
Find: 2015 Aug 14
Classification: Ordinary chondrite (H5)
History: This stone was recovered by Robert *Verish* while he was searching for meteorites on a small drylake, on a north-facing stranding-surface.
Physical characteristics: The original exterior to this find is non-existant, so it cannot be determined whether this 7.25 g charcoal-gray stone is a fragment or was a whole-stone. Groundmass is apparently friable since many chondrules stand-out in high relief on the current exterior. The interior is colored gray-brown.
Petrography: (F. Sheikh, *FSU*) Chondrule boundaries blurred (600±50 µm, N=2). Recrystallized matrix with plagioclase (10-15 µm).
Geochemistry: Olivine, $Fa_{19.2\pm0.6}$ (N=25); orthopyroxene, $Fs_{18.7\pm0.9}Wo_{1.7\pm0.5}$, (N=25).
Classification: Ordinary Chondrite (H5)
Specimens: 1.45 grams at *UCLA*; main mass with *Verish*.

Daveytown 005 41°19.539'N, 117°52.347'W
Nevada, United States
Find: 2015 Aug 14
Classification: Ordinary chondrite (H5)
History: This stone was recovered by Robert *Verish* while he was searching for meteorites on a small drylake, on a north-facing stranding-surface.

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Physical characteristics: This 15.25 g fragment has one side covered in a thick rough-surfaced, blackish-brown fusion-crust, while the other sides expose a rusty-brown interior.
Petrography: (D. Sheikh, *FSU*) Chondrule boundaries blurred (400±50 µm, N=2). Recrystallized matrix with plagioclase (10-15 µm).
Geochemistry: Olivine, $Fa_{19.3\pm0.9}$ (N=25); orthopyroxene, $Fs_{18.9\pm0.9}Wo_{1.9\pm0.4}$, (N=25).
Classification: Ordinary Chondrite (H5)
Specimens: 4.07 grams at *UCLA*; main mass with *Verish*.

Daveytown 006 41°19.552'N, 117°52.316'W
Nevada, United States
Find: 2018 Oct 03
Classification: Ordinary chondrite (H4)
History: This stone was recovered by Robert *Verish* while he was searching for meteorites along the margin of a sand-dune field.
Physical characteristics: The physical description for this 6.6 g chondritic stone is identical to Daveytown 003 and 004, such as, many chondrules stand-out in high relief on the exterior surface.
Petrography: (D. Sheikh, *FSU*) Composed of small to medium-sized chondrules (average ~0.4 mm) in a fine-grained matrix.
Geochemistry: Olivine, $Fa_{18.8\pm0.8}$ (N=25); orthopyroxene, $Fs_{18.3\pm1.3}Wo_{1.7\pm0.1}$, (N=25).
Classification: Ordinary Chondrite (H4)
Specimens: 1.32 grams at *UCLA*; main mass with *Verish*.

Daveytown 007 41°19.441'N, 117°51.232'W
Nevada, United States
Find: 2018 Oct 10
Classification: Ordinary chondrite (L5)
History: This stone was recovered by Robert *Verish* while he was searching for meteorites along the margin of a sand-dune field.
Physical characteristics: This 23.0 g chondritic stone is a rusty-brown, weathered individual with a relict fusion-crust exterior surface, and a cut surface displays a brown interior with orange chondrules.
Petrography: (D. Sheikh, *FSU*) Chondrule boundaries blurred (1300±100 µm, N=2). Recrystallized matrix with plagioclase (10-20 µm).
Geochemistry: Olivine, $Fa_{23.0\pm0.9}$ (N=25); orthopyroxene, $Fs_{19.0\pm0.7}Wo_{2.6\pm0.9}$, (N=25).
Classification: Ordinary Chondrite (L5)
Specimens: 6.55 grams at *UCLA*; main mass with *Verish*.

Dhofar 2096 (Dho 2096) 18°34.621'N, 54°10.259'E
Zufar, Oman
Find: 2014 Nov

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Classification: Carbonaceous chondrite (CK6)
Petrography: Chondrite with recrystallized texture. Chondrules (mm sized) are integrated in a recrystallized matrix. Opaques are Cr-bearing magnetite and sulfides. No metal was observed.
Geochemistry: Olivine $Fa_{28.4\pm0.2}$, NiO 0.38±0.04 wt% (n=3)
Classification: Carbonaceous chondrite (CK6)
Specimens: Type specimen at *CEREGE*. Main mass with *Kuntz*.

Dhofar 2097 (Dho 2097) 18°35.932'N, 54°04.634'E
Zufar, Oman
Find: 2014 Nov
Classification: Carbonaceous chondrite (CO3.1)
Petrography: Chondrite with small chondrules (~300 μm) set in abundant, fine-grained, iron-rich matrix. Opaques are FeNi metal and troilite.
Geochemistry: Olivine $Fa_{16.0\pm15.2}$, range $Fa_{1.4\text{-}44.6}$, Fa PMD 78% (n=13). Cr_2O_3 in ferroan olivine 0.25±0.17 wt% (n=11). Orthopyroxene $Fs_{3.0\pm1.9}Wo_{2.0\pm0.8}$ (n=5). Defocused matrix analyses: FeO 34.7 wt%, total 90.7 wt%. Magnetic susceptibility log χ (× 10^{-9} m^3/kg) = 4.02.
Classification: Carbonaceous chondrite (CO3.1). Subtype from Cr_2O_3 content of ferroan olivine.
Specimens: Type specimen at *CEREGE*. Main mass with *Kuntz*.

Dhofar 2098 (Dho 2098) 19°15.35'N, 54°34.76'E
Zufar, Oman
Find: 2007 Apr 16
Classification: Ordinary chondrite (H~4)
History: Discovered about 12 km NNE of Qitbit on Apr. 16, 2007
Physical characteristics: Many dark brown fragments totaling 348 g
Petrography: (R. Bartoschewitz, *Bart*) brown recrystallized matrix with well-developed chondrules (av. ~0.5 mm), and completely oxidized metal and sulfide. Vugs and cracks are filled with Fe-hydroxides and carbonates.
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ (× 10^{-9} m^3/kg) = 4.87
Classification: Ordinary chondrite (H~4, W5)
Specimens: 21.5 g on deposit at *Kiel*, 38 g with *Bart*.

Dhofar 2099 (Dho 2099) 19°08.47'N, 54°32.53'E
Zufar, Oman
Find: 2005 March 09
Classification: Ordinary chondrite (L~5)
History: Discovered about 60 km SW of Mughshin on March 9, 2005

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Physical characteristics: Many dark brown fragments totaling 206 g, some of them with fusion crust
Petrography: (R. Bartoschewitz, *Bart*) brown recrystallized partly blackened matrix with well developed chondrules (0.3-1.3, av. 0.7 mm), irregular metal and troilite specks
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.92
Classification: Ordinary chondrite (L~5, W3)
Specimens: 20.2 g on deposit at *Kiel*, 24 g with *Bart*.

Dhofar 2100 (Dho 2100) 18°31.06'N, 54°22.76'E
Zufar, Oman
Find: 2014 March 03
Classification: Ordinary chondrite (L~5)
History: Discovered about 35 km ESE of Mughshin on March 3, 2014
Physical characteristics: Many dark brown fragments totaling 619 g
Petrography: (R. Bartoschewitz, *Bart*) brown recrystallized matrix with recognizable chondrules (0.3-1.3, av. 0.7 mm), and completely oxidized metal and sulfide. Vugs and cracks are filled with Fe-hydroxides and carbonates.
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.65
Classification: Ordinary chondrite (L~5, W5)
Specimens: 25.1 g on deposit at *Kiel*, 58 g with *Bart*.

Dhofar 2101 (Dho 2101) 19°03'35.5"N, 54°27'19.5"E
Zufar, Oman
Find: 2016
Classification: Lunar meteorite
History: The meteorite was found in 2016 during a field trip in the Oman desert.
Physical characteristics: Flattened brownish stone without fusion crust.
Petrography: The meteorite is a feldspathic breccia composed of mineral fragments and basaltic clasts in a fine-grained groundmass. Most abundant minerals are calcic plagioclase and pigeonite; less abundant are augite and Fe-rich olivine. Accessories include FeS, ilmenite, and chromite. The meteorite contains calcite-filled veins due to terrestrial alteration.
Geochemistry: olivine: $Fa_{43.1\pm3.5}$ ($Fa_{34.9-45.7}$, FeO/MnO=105±12, n=20); pigeonite: $Fs_{32.9\pm2.4}Wo_{10.5\pm2.6}$ ($Fs_{28.7-36.5}Wo_{6.1-15.8}$, FeO/MnO=59±6, n=20); Ca-pyroxene: $Fs_{20.2\pm2.1}Wo_{35.0\pm3.9}$ ($Fs_{16.1-23.8}Wo_{27.9-41.0}$, FeO/MnO=54±8, n=11); calcic plagioclase: $An_{96.5\pm0.5}$ ($An_{95.4-97.0}$, n=13)
Classification: Lunar feldspathic breccia

Dry Creek 44°02.523'N, 101°55.491'W

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South Dakota, United States
Find: Aug 2018
Classification: Ordinary chondrite (H5)

History: In August 2018, Lloyd Griswold found a single 5 kg stone in a hay field on his property in Haakon County, South Dakota, approximately 8.5 km north of Cottonwood.

Physical characteristics: Exterior of type specimen has weathered brown-black fusion crust, with glossy patches. A broken surface is covered with whitish caliche. Two cut faces are visible: the surfaces of both are reddish brown. Only the larger cut face has remnant patches of metal visible. A thin section was created from one of these metal-containing remnant patches.

Petrography: (M. Hutson, A. Ruzicka, *Cascadia*) In thin section approximately 70% of the opaque minerals have been replaced by iron hydroxide weathering products. This material is opaque in transmitted light and both surrounds and crosscuts chondrules, chondrule fragments, and individual mineral grains. Plagioclase feldspar grains observed in BSE images are typically 20-25 µm across, with two grains up to 50 µm across.

Geochemistry: Mineral compositions and geochemistry: Olivine ($Fa_{19.5\pm0.2}$, N=14), low-Ca pyroxene ($Fs_{17.4\pm0.2}Wo_{1.5\pm0.2}$, N=12).

Classification: H5 based on iron contents in olivine and pyroxene and size of plagioclase feldspar grains.

Specimens: *Cascadia* holds 179.4 g in six pieces, in addition to a polished thin section and a mounted butt.

Duguitala 40°25’30.27"N, 108°40’32.09"E
Nei Mongol, China
Find: 2016
Classification: Ordinary chondrite (H~5)

History: (Ziyao Wang) Discovered by Yongsheng Wang in the Ordos Desert, Inner Mongolia, in 2016

Physical characteristics: Gray stone of 82 g without fusion crust.

Petrography: (R. Bartoschewitz, *Bart*) dark-gray, porous matrix with few poorly developed lighter chondrules and irregular metal and sulfide aggregates. Some matrix vugs show silicate crystals.

Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 5.44

Classification: Ordinary chondrite (H~5, W1)

Specimens: 16.6 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 13 g with *Bart*.

Dunlike 001 39°39’08.02"N, 89°34’07.63"E
Xinjiang, China
Find: Nov 2018

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Classification: Ordinary chondrite (H~5)
History: (Ziyao Wang) Purchased by Ziyao Wang from Tailu Zhao (Shanshan County, Xinjiang) in Shanshan (Xinjiang) in 2018. This meteorite was discovered in the Hongliugou, Haitou area, in Nov. 2018.
Physical characteristics: brown stone of 34.4 g without fusion crust
Petrography: (R. Bartoschewitz, *Bart*) brown, recrystallized matrix, with defined gray chondrules (0.2-1 mm, av. 0.6 mm), and completely oxidized metal and sulfide. Vugs and cracks are mostly filled with iron-hydroxides and sulfates.
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.65
Classification: Ordinary chondrite (H~5, W5)
Specimens: 7.5 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 5 g with *Bart*.

Dunlike 002 39°37'08.09"N, 89°34'12.58"E
Xinjiang, China
Find: Nov 2018
Classification: Ordinary chondrite (L~6)
History: (Ziyao Wang) Purchased by Ziyao Wang from Tailu Zhao (Shanshan County, Xinjiang) in Shanshan (Xinjiang) in 2018. This meteorite was discovered in the Hongliugou, Haitou area, in Nov. 2018.
Physical characteristics: brown stone of 34.8 g without fusion crust
Petrography: (R. Bartoschewitz, *Bart*) olive-brown, recrystallized matrix, with poorly defined chondrules (av. ~0.8 mm), and sulfide
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.28
Classification: Ordinary chondrite (L~6, W4)
Specimens: 7.8 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 7 g with *Bart*.

Dunlike 003 39°36'16.67"N, 89°31'19.54"E
Xinjiang, China
Find: Nov 2018
Classification: H~3
History: (Ziyao Wang) Purchased by Ziyao Wang from Tailu Zhao (Shanshan County, Xinjiang) in Shanshan (Xinjiang) in 2018. This meteorite was discovered in the Hongliugou, Haitou area, in Nov. 2018.
Physical characteristics: brown stone of 26.9 g without fusion crust
Petrography: (R. Bartoschewitz, *Bart*) brown, rusty matrix, with well-defined chondrules (0.2-1.4 mm, av. ~0.6 mm), and completely oxidized metal and sulfide.
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.98
Classification: Ordinary chondrite (H~3, W5)

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Specimens: 6.7 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 4 g with *Bart*.

Dunlike 004 ~39°37'N, ~89°34'E
Xinjiang, China
Find: 2018 Nov
Classification: Ordinary chondrite (L~4)
History: (Ziyao Wang) Purchased by Ziyao Wang from Dongfang Deng. This meteorite was discovered close to Hongliugou in Nov. 2018.
Physical characteristics: (Ziyao Wang) Brown yellow hemispherical stone of 201 g without fusion crust
Petrography: (R. Bartoschewitz, *Bart*) brown-gray recrystallized matrix with well-developed chondrules (0.6-2 mm, av. 0.9 mm), metal and sulfide completely oxidized.
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.70
Classification: Ordinary chondrite (L~4, W5)
Specimens: 21.9 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 22 g with *Bart*.

Dunlike 005 ~39°37'N, ~89°34'E
Xinjiang, China
Find: 2018 Nov
Classification: Ordinary chondrite (LL~5)
History: (Ziyao Wang) Purchased by Ziyao Wang from Dongfang Deng. This meteorite was discovered close to Hongliugou in Nov. 2018.
Physical characteristics: (Ziyao Wang) Dark gray-yellow stone of 27 g without fusion crust
Petrography: (R. Bartoschewitz, *Bart*) brown-gray recrystallized matrix with well developed chondrules (0.4-1.5 mm, av. 0.9 mm), metal and sulfide completely oxidized.
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.37
Classification: Ordinary chondrite (LL~5, W4)
Specimens: 5.76 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 22 g with *Bart*.

Dunlike 006 ~39°37'N, ~89°34'E
Xinjiang, China
Find: 2019
Classification: Ordinary chondrite (L~6)

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History: (Ziyao Wang) Purchased by Ziyao Wang from Dongfang Deng This meteorite was discovered close to Hongliugou in 2019.
Physical characteristics: (Ziyao Wang) Six dark-brown, irregular stones totaling 102 g
Petrography: (R. Bartoschewitz, *Bart*) brown recrystallized matrix with poorly defined chondrules, metal nearly complete oxidized.
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.36
Classification: Ordinary chondrite (L~6, W4)
Specimens: 20.07 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 14 g with *Bart*.

Eboliang 002 38°12’08"N, 92°50’32"E
Qinghai, China
Find: 2013 Jul
Classification: Ordinary chondrite (L~6)
History: (Ziyao Wang) Discovered by Peng Zhenhong in July 2013.
Physical characteristics: (Ziyao Wang) dark brown fragment of 25.3 g
Petrography: (R. Bartoschewitz, *Bart*) dark-brown matrix with poorly defined chondrules between 0.5 and 2 mm; metal completely oxidized.
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.44
Classification: Ordinary chondrite (L~6, W5)
Specimens: 6.1 g on deposit at *Kiel*, *Bart* holds the main mass.

Eboliang 003 38°12’08"N, 92°50’32"E
Qinghai, China
Find: 2013 Jul
Classification: Ordinary chondrite (L~6)
History: (Ziyao Wang) Discovered by Peng Zhenhong in July 2013.
Physical characteristics: (Ziyao Wang) dark-brown fragment of 23.4 g
Petrography: (R. Bartoschewitz, *Bart*) dark-brown matrix with poorly defined chondrules; metal completely oxidized.
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.62
Classification: Ordinary chondrite (L~6, W5)
Specimens: 6.8 g on deposit at *Kiel*, *Bart* holds the main mass.

Edmore 43°22’24.81"N, 84°58’30.37"W
Michigan, United States
Find, doubtful fall: 1939
Classification: Iron meteorite (IIIAB)

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History: "Seen to fall" and recovered on a farm in Michigan, supposedly in 1939. It was used as a doorstop to the barn on the farm. Original finder/owner told the current owner the story of recovery when he bought the farm. When the current owner sold the farm he took the meteorite with him and then to Central Michigan University, who submitted a piece to the *SI* for classification.
Physical characteristics: Light-brown fusion crust covers part of the meteorite. Modest to moderate weathering.
Petrography: This meteorite is a medium octahedrite, with kamacite lamellae of ~0.8 mm. Taenite between kamacite exhibits pronounced zoning. Schreibersite grains up to 4 mm show extensive fracturing. No fusion crust is evident on the section examined. Weathering is modest in the section.
Geochemistry: (J.T. Wasson, *UCLA*): INAA data, Ni = 89.1, Co = 5.41 (both mg/g), Cr=17, Cu=120, Pt=4.5, Ga=20.9, As=14.1, W=0.34, Ir=0.70, Au=1.621 (all µg/g), Re <50 ng/g.
Classification: Iron, IIIAB.
Specimens: Type specimen at *SI*

El Médano 395 (EM 395) 24°53'S, 70°23'W
Antofagasta, Chile
Find: November 2018
Classification: Primitive achondrite (Brachinite)
History: A single 2288 g stone was recovered near the top of a large hill from the desert pavement by Steve Arnold in November 2018 on a meteorite hunting expedition in the El Médano region of the Atacama Desert.
Physical characteristics: The sample is dark brownish-orange in color, has a tabular shape and covered by a weathered patina. A cut face shows the interior is composed of dark-reddish interlocking crystals.
Petrography: Description and classification (A. Love, *App*): Sample displays a protogranular xenomorphic texture composed of 300-2500 µm olivine (93 vol%) and diopside (5.5 vol%), oxidized Fe metal, chromite (0.64 vol%), sulfide (0.25 vol%) and plagioclase (0.57 vol%). Diopside has irregularly shaped grain boundaries.
Geochemistry: (A.Love, *App*) Olivine: $Fa_{33.3\pm0.4}$, Fe/Mn=71.6, Mg#67, CaO=0.1Wt%, N=16; High-Ca pyroxene: $Fs_{8.0\pm0.5}Wo_{46.8\pm0.8}$ Fe/Mn=47.2, Mg#85, N=10; Plag: $An_{47.3}Or_{0.0}$; Cr-Spinel: Cr#66, Mg#26, Fe/Mn=61.7. Oxygen isotopes (K. Ziegler, *UNM*): analyses of 3 acid-washed subsamples by laser fluorination gave, respectively, $\delta^{17}O$ = 2.170, 2.020, 2.329 ; $\delta^{18}O$ =4.582, 4.290, 4.897 ; $\Delta^{17}O$ = -0.250, -0.245, -0.256 (all per mil). Oxygen isotopes are depleted in 17O and plot in the region below the TFL.
Classification: Textures, mineral compositions, oxygen isotopes and magnetic susceptibility suggest this is a brachinite.
Specimens: Steve Arnold holds the main mass. One slice weighing 20.45 g and a polished thin section and mount are on deposit at *App*.

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El Médano 396 (EM 396) 24°51'S, 70°32'W
Antofagasta, Chile
Find: 2017 Jun
Classification: Ordinary chondrite (H3)
Physical characteristics: Dark stone. Cut surface reveals dark interior with lighter clasts
Petrography: Apparent chondrule diameter 390±280 µm (n=35)
Geochemistry: Olivine $Fa_{22.6\pm4.2}$, PMD=15%, range $Fa_{18.7\text{-}30.0}$, Cr_2O_3=0.03±0.02wt%, n=8. Low-ca pyroxene $Fs_{11.7\pm6.8}Wo_{1.4\pm0.7}$ range $Fs_{2.1\text{-}17.5}Wo_{0.5\text{-}2.0}$ (n=3)
Specimens: 30.25 g and a polished section at *CEREGE*. Main mass at *MMC*.

El Médano 397 (EM 397) 24°51'S , 70°32'W
Antofagasta, Chile
Find: 2016 Nov
Classification: Carbonaceous chondrite (CO3)
History: The meteorite was found in November 2016 in the Atacama desert by Rodrigo Martinez while looking for meteorites
Physical characteristics: Brown stone. Cut face reveals brownish interior with small chondrules
Petrography: Chondrules (predominantly of type I) and small CAIs set in a fine-grained Fe-rich matrix. Average chondrule apparent size about 170±90 µm. Opaques are metal and troilite.
Geochemistry: Olivine $Fa_{15.9\pm15.7}$, PMD=83%, range $Fa_{0.7\text{-}43.8}$ (n=8), Cr_2O_3 in ferroan olivine is 0.13±0.06 wt% (n=7). low-Ca pyroxene $Fs_{2.0}Wo_{1.9}$ (n=1)
Classification: Carbonaceous chondrite (CO3)
Specimens: 45 g and a polished section at *CEREGE*. Main mass at *MMC*.

El Médano 398 (EM 398) 24°51'S, 70°32'W
Antofagasta, Chile
Find: 2017 Jun 19
Classification: Carbonaceous chondrite (CO3)
Physical characteristics: Dark stone. Cut surface reveals dark interior and fresh metal.
Petrography: Chondrite with small chondrules (~200 µm) set in an abundant fine-grained iron-rich matrix. Opaque minerals are mostly FeNi.
Geochemistry: Olivine $Fa_{14.5\pm5.7}$, Fa PMD 97%, range $Fa_{0.8\text{-}44.5}$ (n=8). Cr_2O_3 in ferroan olivine 0.11±0.04 wt% (n=4). Orthopyroxene $Fs_{1.4}Wo_{1.1}$ (n=1). Defocused matrix analyses FeO 40.0 wt%, total 95.3 wt%. Magnetic susceptibility log χ (× 10^{-9} m^3/kg) = 4.38.
Classification: Carbonaceous chondrite (CO3)
Specimens: Type specimen at *CEREGE*. Main mass at *MMC*.

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El Médano 404 (EM 404) ~24°51'S, ~70°32'W
Antofagasta, Chile
Find: 2016 Apr 09
Classification: Ordinary chondrite (LL5-6)
Physical characteristics: Full stone with fresh fusion crust
Petrography: (J. Gattacceca, *CEREGE*) Brecciated ordinary chondrite with cm-sized clasts in a cataclastic matrix. Type 5 and 6 material is present. Melt pockets and opaque veinlets are found.
Classification: Ordinary choondrite (breccia, LL5-6).
Specimens: Type specimen at *CEREGE*. Main mass at *MMC*

El Médano 406 (EM 406) 24°42.089'S, 70°4.766'W
Antofagasta, Chile
Find: 2018 Apr
Classification: Ordinary chondrite (H3)
Petrography: (J. Gattacceca, *CEREGE*) Well-defined packed chondrules with average apparent diameter 430±280 µm (n=28). Opaques are metal and sulfides.
Geochemistry: Olivine $Fa_{15.6\pm6.7}$, PMD 32%, Cr_2O_3 0.025±0.015 wt% (n=6). Low-Ca pyroxene $Fs_{14.0\pm0.3.3}Wo_{1.5\pm0.2}$ (n=2).
Classification: Ordinary chondrite (H3)
Specimens: 39 g and a polished section at *CEREGE*. Main mass at ArtMet Collection

Gerdekkaya 40.130°N, 35.056°E
Corum, Turkey
Find: 28 Apr 2018
Classification: Iron meteorite (IAB-sLL)
History: The meteorite was found by people clearing rocks from a field that was being plowed to get ready for planting. Because this rock was so heavy, the two discoverers realized that they probably had a meteorite and notified Cevdet Erdogan, a relative in the USA who provided the type specimen.
Physical characteristics: Edges weathered, metal and silicates relatively fresh.
Petrography: Petrographic description. Sample is not well polished nor etched. Inclusions that are mixes of FeS and silicates are common on each of the four faces examined on this small (ca. 2 cm) block. These inclusions consist of disorganized mixes of silicates and FeS. Impact cannot be reuled out, but terrestrial heating is suspected. Kamacite boundaries are present, but no organized octahedral structure was recognized. The degree of terrestrial oxidation is minor to moderate.
Geochemistry: Metal composition (based on one INAA): Co, 4.88 mg/g; Ni, 76 mg/g; Ga, 70.0 µg/g; As, 15.3 µg/g; W, 0.80 µg/g; Ir 2.90 µg/g; Au, 1.63 µg/g. The

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silicates are typical for IAB-sLL; most are low-Ca pyroxenes with a mean composition of 5.6 mol%Fs, 1.2 mol% An.
Classification: The meteorite is a member of IAB-sLL. It has several close relatives with similar Ir. Co, Ni and Au including Nova 058, Comanche (iron), Kaalijarv and Pine River.

Gruz'ke 48°32'N, 32°03'E
Kirovograd, Ukraine
Find: 27 March 2007
Classification: Ordinary chondrite (H4)
History: The meteorite was collected by Kyiv geophisicists P. Nyemensky, Y.Rozanovich, and O.Pakhovchak during a geophysical field expedition. For more than two years the "strange" stone was preserved in Kirovska expedition (Kyiv) as a probable meteorite. In July 2009 a small part of the sample was polished and a section given to *NASU* for study.
Physical characteristics: The stone is 3423 g, 18.0 × 13.0 × 8.5 cm in size, and fusion crusted. The crust is brown with regmaglypts and with evidences of weathering.
Petrography: (V.P. Semenenko, *NASU*) The chondrite is composed of a dark-colored lithology with a ordinary chondritic texture. The majority of the chondrules have porphyritic or barred olivine structures. The chondrule glass is slightly devitrified. Major phases are olivine and pyroxene. Minor phases are feldspar, kamacite, taenite, troilite and Ca- pyroxene. Rare grains of chromite, native copper, merrilite, Cl-apatite, ilmenite and silica are present. The sample contains evidences of shock metamorphism. The main of them are the structures of plastic deformations, shock heating and melting. The chondrite is slightly weathered.
Geochemistry: (V.P. Semenenko, A.L. Girich, N.V. Kychan, S.N. Shirinbekova) olivine $Fa_{17.9-19.3}$ (av. $Fa_{18.6}$, N=10), low Ca pyroxene $Fs_{15.9-17.4}Wo_{0.93-1.88}$, (av. $Fs_{16.5}Wo_{1.35}$, N=28); Ca-rich pyroxene $Fs_{5.94-6.89}Wo_{45.2-46.4}$, (av. $Fs_{6.31}Wo_{45.7}$, N=3); feldspar $Ab_{76.2-84.6}Or_{4.47-9.64}$ (av.$Ab_{81.9}Or_{6.01}$, N=11); chromite (wt.% - 3.74 MgO, 6,73 Al_2O_3, 2.35 TiO_2, 0.63 V_2O_3), kamacite (wt.% - 6.68-8.32 Ni, 0.27- 0.53 Co), taenite (48.5-54.8Ni, 0.02-0.13Co), goethite (9.82NiO, 0.39S).
Classification: H chondrite (H4, S4, W2)
Specimens: The main mass 3227 is located in *NASU* and 134 in the Committee of Meteorites NAS of Ukraine, Kyiv

Hamadat Zegher 001 (HZ 001) 27.10403°N, 11.17683°E
Awbari, Libya
Purchased: 2018
Classification: Carbonaceous chondrite (CM2)
History: Purchased by the main mass holder from a local meteorite dealer in Morocco.

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Physical characteristics: Many small fragments some of which are partly covered by fusion crust.
Petrography: The meteorite is a brecciated carbonaceous chondrite composed of small chondrules (mean diameter about 250 µm), CAIs, and mineral fragments often surrounded by fine-grained dust rims. The Fe-rich matrix contains sulfides, abundant almost pure calcite and fibrous phyllosilicates.
Geochemistry: Carbonates contain about 1 wt.% FeO and 0.15 wt.% MgO

Hami 009 42°16'42.10"N, 93° 25'28.38"E
Xinjiang, China
Find: 12. Nov 2016
Classification: Ordinary chondrite (LL~4)
History: (Ziyao Wang) The meteorite was discovered by Zijian Wang SW of Hami city, Xinjiang province on 12. Nov. 2016.
Physical characteristics: (Ziyao Wang) Brown stone of 82 g without fusion crust
Petrography: (R. Bartoschewitz, *Bart*) brown and dark-gray, recrystallized matrix, with well-defined chondrules (0.4-8 mm, av. 1 mm) and irregular, tiny metal and sulfide specks.
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.23
Classification: Ordinary chondrite (LL~4, W2)
Specimens: 17.0 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 7.4 g with *Bart*.

Hami 016 ~42°21'N, ~93°15'E
Xinjiang, China
Find: 2015
Classification: Ordinary chondrite (H~5)
History: Discovered by Yongsheng Wang in the Hami dense collection area in 2015
Physical characteristics: fractured brown stone without fusion crust of 47.3 g
Petrography: (R. Bartoschewitz, *Bart*) brown, recrystallized matrix, with defined chondrules (0.3-1 mm, av. ~0.6 mm), and nearly completely oxidized metal and sulfide. Vugs and cracks are mostly filled with iron-hydroxides.
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.78
Classification: Ordinary chondrite (H~5, W5)
Specimens: 12.1 g on deposit at *Kiel*, *Bart* holds the main mass.

Hami 017 42°17'11.12"N, 93°26'19.09"E
Xinjiang, China
Find: 2016
Classification: Ordinary chondrite (L~5)

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History: (Ziyao Wang) The meteorite was discovered by Zijian Wang near Hami city (Xinjiang province) in 2016.
Physical characteristics: Two brown stones with totally 326.8 g
Petrography: (R. Bartoschewitz, *Bart*) brown, recrystallized matrix, with developed chondrules (0.4-1 mm, av. 0.6 mm) and irregular metal and sulfide inclusions
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.86
Classification: Ordinary chondrite (L~5, W3)
Specimens: 22.2 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 118 g with *Bart*.

Hami 018 42°22’13.35"N, 93°15’17.29"E
Xinjiang, China
Find: 2015
Classification: Ordinary chondrite (L~5)
History: (Ziyao Wang) Discovered by Yongsheng Wang in the desert near Hami city (Xinjiang province) in 2015.
Physical characteristics: Brown irregular stone of 216.7 g
Petrography: (R. Bartoschewitz, *Bart*) brown, recrystallized matrix, with developed gray chondrules (0.3-1.8 mm, av. 0.8 mm) and small irregular metal and sulfide inclusions
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.90
Classification: Ordinary chondrite (L~5, W2)
Specimens: 20.5 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 24 g with *Bart*.

Hami 019 42° 9’36.41"N, 93°28’54.37"E
Xinjiang, China
Find: 2015
Classification: Ordinary chondrite (H~4)
History: (Ziyao Wang) Discovered by Yongsheng Wang in the desert near Hami city (Xinjiang province) in 2015.
Physical characteristics: Brown irregular stone of 844.4 g
Petrography: (R. Bartoschewitz, *Bart*) brown oxidized matrix with well-developed light- and dark-gray chondrules (0.4-2 mm, av. 0.6 mm) and irregular metal and sulfide inclusions
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.90
Classification: Ordinary chondrite (H~4 breccia, W4)
Specimens: 24.3 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 111 g with *Bart*.

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Hami 020 42°35’18.73"N, 93°14’48.98"E
Xinjiang, China
Find: 2019 Mar
Classification: Ordinary chondrite (L~6)
History: (Ziyao Wang) Discovered by Wentao Yang (Urumqi) in the desert near Hami (Xinjiang Province) in Mar 2019
Physical characteristics: (Ziyao Wang) Brownish yellow stone 261 g with about 30% fusion crust
Petrography: (R. Bartoschewitz, *Bart*) yellowish brown recrystallized matrix with poor recognizable chondrules. Metal is mainly weathered to Fe-hydroxides.
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.54
Classification: Ordinary chondrite (L~6, W4)
Specimens: 25.3 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 34 g with *Bart*.

Hassi Arsane 001 28°03.2539’N, 10°16.8079’W
South, Morocco
Find: 2019 Mar 15
Classification: HED achondrite (Eucrite, monomict)
History: Found by Ahmed Ourbaa on March 15, 2019. Bought from Zaid Oualguirah by Jean Redelsperger in May 2019.
Physical characteristics: A single crusted stone. Cut face reveals a light gray, brecciated interior.
Petrography: (J. Gattacceca, *CEREGE*) Brecciated Igneous rock with mineral and lithic clasts (subophitic texture, about 500 µm in size) set in a clastic matrix. Main minerals are exsolved pyroxene and plagioclase. Others minerals: chromite, silica polymorph, troilite. No metal was observed.
Geochemistry: Low-Ca pyroxene $Fs_{63.1\pm1.3}Wo_{2.7\pm1.1}$, FeO/MnO=32.9±2.3 (n=10). Plagioclase $An_{90.4\pm1.2}Ab_{9.2\pm1.1}Or_{0.3\pm0.2}$ (n=6).
Classification: Achondrite (Eucrite-mmict)
Specimens: Type specimen at *CEREGE*. Main mass with Jean Redelsperger.

Hongshagang 001 39° 1’19.10"N, 102°32’43.23"E
Gansu, China
Find: Dec 2018
Classification: Ordinary chondrite (L~6)
History: (Ziyao Wang) Discovered by Yingbin Zhu and Zhifeng Wang in the desert in Hongshagang Village, Jinchang City (Gansu Province) in Dec. 2018
Physical characteristics: (Ziyao Wang) Gray brown stone of 27 g

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Petrography: (R. Bartoschewitz, *Bart*) gray, brown-stained, recrystallized matrix, with gray, defined chondrules (0.4-1.5 mm, av. ~0.8 mm), irregular metal and sulfide. Vugs and cracks are partly filled with iron-hydroxides.
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.45
Classification: Ordinary chondrite (L~6, W3)
Specimens: 7.7 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 5 g with *Bart*.

Huangtuya 001 42°17'12.34"N, 91°44'25.64"E
Xinjiang, China
Find: 2017
Classification: Ordinary chondrite (H~6)
History: (Ziyao Wang) Discovered by Wentao Yang (Urumqi) in the desert near Dahaidao, Xinjiang Province, in 2017
Physical characteristics: Dark gray flat stone of 427.8 g
Petrography: (R. Bartoschewitz, *Bart*) gray-brown, recrystallized matrix, with poorly recognizable chondrules and irregular metal and sulfide inclusions
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 5.17
Classification: Ordinary chondrite (H~6, W3)
Specimens: 25.6 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 48 g with *Bart*.

Jalangi 24°05'55''N , 88°41'28''E
West Bengal, India
Confirmed fall: 2012 Jul 08 (05:15 AM IST)
Classification: Ordinary chondrite (L5/6)
History: According to local observers, the meteorite came from the southwest, with repeated detonating and whizzing sound. The stone fell on soft soil in a jute field, making an impact pit of about six inches in diameter and eight inches in depth. From the recorded data, it appears that the meteorite fragmented at least two to three times before hitting the ground, indicating the existence of more pieces of the same meteorite. *GSI* officers searched the locality for additional fragments, but could not find any. It may be possible that some pieces were lost in the adjacent Jalangi or Ganges river. The meteorite was taken into the custody of the local police station within three hours of the fall. The District Magistrate and the Superintendent of the Police, Murshidabad district, West Bengal both were contacted by the Director, Central Petrological Laboratories (CPL), *GSI*, Central Headquarters, Kolkata-700016 to confirm the news about the meteorite fall. The State Government officers agreed to hand over the sample to *GSI*. Two officers from *GSI*, Dr. M. Moitra and Dr. S. Nandy, Senior Geologists, immediately rushed to the spot and collected the meteorite piece weighing about 2 kg from the State Government officers (BDO,

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Jalangi Block and OC, Jalangi Police Station) on 10 July 2012 (Source: Geological Survey of India, Meteorite Fall Near Jalangi, Murshidabad, W. Bengal on 08.07.2012., www.portal.gsi.gov.in/gsiImages/information/meteorite_fall_jalangi.pdf).

Physical characteristics: The meteorite is roughly pyramidal in shape, with a flat base and four complete surfaces (long axis ~ 11 cm), covered almost fully by thin black to brown colored fusion crust (thickness ~1-2 mm). The surfaces are smooth, well ablated, with traces of flow lines. Well-developed surface grooves and regmaglypts are observed. A few shallow regmaglypts, along with one slightly deep and compound variety, was noted on frontal surfaces. A number of well defined, visible chondrules and minute metallic specks were also recorded. Anastomosing thin opaque melt veins and veinlets were also observed.

Petrography: This meteorite is composed of olivine + orthopyroxene + feldspathic glass + Fe-Ni metals (kamacite and taenite) + troilite ± magnetite ± merrillite ± apatite. The chondrules are olivine and orthopyroxene, with the interstitial spaces (mesostasis) occupied by feldspathic glass ± pyroxene. The size of chondrules varies from 300-1000 μm (diameter). The shape of chondrules varies from near circular - elliptical to sub-elliptical and angular. Chondrules types are Barred Olivine (BO), Porphyritic Pyroxene (PP), Porphyritic Olivine (PO), Porphyritic Olivine Pyroxene (POP) and Granular Olivine (GO), and individual chondrule margins are moderately well delineated. Matrix is relatively fine grained and thoroughly recrystallized. Matrix:chondrules ~60:40. Matrix is brecciated in places. Fragments of olivine and orthopyroxene are enclosed within opaque melt veins (length >> width; maximum width of the vein ~1 mm). Numerous metal (Fe-Ni) droplets (micrometer to submicrometer scale) are confined within these melt veins / veinlets. The feldspathic melt glass (plagioclase composition) is relatively fine grained, patchy and dessiminated in the matrix. Rarely it also forms glassy chondrules (diameter ~400 μm).

Geochemistry: Olivine, $Fa_{24-27}Fo_{73-76}$; clinoenstatite, $En_{74.8-77}Fs_{21-23.4}Wo_{1-2}$; clinopyroxene (pigeonite), $En_{72}FS19.3Wo_{8.7}$; and feldspathic glass (albite to oligoclase), $Ab_{75-85}An_{9.4-21}Or_{3-8.6}$ with FeOT content <= 1.00 wt%). Kamacite contains Fe ~88-93% and Ni ~7-12%; taenite contains Fe ~45% and Ni ~55%.

Classification: Different textural variants of olivine and orthopyroxene exhibit near consistent mineral chemical compositional range (XMg) suggesting Jalangi is an equilibrated ordinary chondrite (L5-6).

Specimens: The District Magistrate and the Superintendent of the Police, Murshidabad district, West Bengal, India both were contacted by the Director, Central Petrological Laboratories (CPL), Geological Survey of India, Central Headquarters, Kolkata-700016 to confirm the news about the meteorite fall. The sample was handed over to *GSI* officers, Kolkata by the State Government officers of Murshidabad district, West Bengal [Block Development Officer (BDO), Jalangi Block and Officer In-Charge (OC), Jalangi Police Station] on 10th July 2012. The sample was registered as ordinary chondrite on 17th July 2012 at NMR, *GSI*, Kolkata. (Source: Geological Survey of India, Meteorite Fall Near Jalangi,

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Murshidabad, W. Bengal on 08.07.2012., www.portal.gsi.gov.in/gsiImages/information/meteorite_fall_jalangi.pdf).

Jdiriya 002 27°36.8356'N, 10°26.8614'W
Saguia el Hamra, Western Sahara
Find: 2019 Apr 23
Classification: HED achondrite (Eucrite, monomict)
History: Found by Zaid Oualguirah on April 23, 2019. Bought from Zaid Oualguirah by Jean Redelsperger in May 2019.
Physical characteristics: A single crusted stone. Cut face reveals a light gray, brecciated interior.
Petrography: (J. Gattacceca, *CEREGE*) Igneous rock with subophitic texture. Typical grain size 150 µm. Main minerals are exsolved pyroxene and plagioclase. Others minerals: chromite, silica polymorph, troilite. No metal was observed.
Geochemistry: Low-Ca pyroxene $Fs_{61.2\pm1.4}Wo_{2.9\pm1.2}$, FeO/MnO=32.5±0.5 (n=4). Plagioclase $An_{86.1}Ab_{13.3}Or_{0.5}$ (n=2).
Classification: Achondrite (Eucrite-mmict)
Specimens: Type specimen at *CEREGE*. Main mass with Jean Redelsperger.

Karpovka 48°40.11'N, 43°46.51'E
Volgogradskaya oblast', Russia
Find: May 2007
Classification: Ordinary chondrite (L5)
History: A single stone was found by S. B. Tarasov and P.A. Gordeev 8-10 km from the village of Karpovka in the Volgograd region. During a picnic, they had noticed an interesting stone in a small depression on the ground.
Physical characteristics: The meteorite has a dark-brown fusion crust and is slightly covered by iron hydroxides.
Petrography: (Ivanova M.A., *Vernad*): The meteorite consists of chondrules, chondrule fragments, and matrix. The chondrules range in size from 0.3 to 0.8 mm in diameter, averaging 0.65 mm. The chondrule margins are indistinct. The meteorite contains many textural types of chondrules including BO, PO, POP, and PP. The main minerals are olivine, pyroxene, FeNi-metal, sulfides, chromites and iron hydroxides.
Geochemistry: Mineral compositions and geochemistry: Olivine $Fa_{24.9}$; and orthopyroxene $Fs_{22.0}Wo_{1.5}$.
Classification: ordinary chondrite (L5), W2, S2.
Specimens: One sample of 71.6 g, three fragments of 3 g in total, and two thin sections are on deposit at *Vernad*. S. B. Tarasov and P.A. Gordeev hold the main mass of the meteorite.

Kerman 251 30°27'13"N, 58°27'25"E

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Kerman, Iran
Find: 2018
Classification: Ordinary chondrite (L3)

Physical characteristics: Crusted stone

Petrography: (J. Gattacceca, *CEREGE*) Well-defined packed chondrules with average apparent diameter 610±530 µm (n=39). Opaques are metal and sulfides

Geochemistry: Olivine $Fa_{8.8\pm3.4}$, Fa PMD 34%, Cr_2O_3 0.33±0.34 wt% (n=4). Low-Ca pyroxene $Fs_{9.4\pm6.9}Wo_{1.1\pm0.7}$ (n=3).

Classification: Ordinary chondrite (L3). L group from chondrule size.

Specimens: Type specimen at *CEREGE*. Main mass with Bahman Izadi.

Keysville 33°11.317'N, 82°14.367'W
Georgia, United States
Find: 2018 May 21
Classification: Ordinary chondrite (L6)

History: A single stone was found by Mr. Greg Ivey and his granddaughter Karmon West and grandson Landon West about 3 miles west of Keysville, Georgia, off Highway 305, by the side of a dirt road, near a creek, while they were hunting for arrowheads.

Physical characteristics: Physical characteristics: Meteorite appears to be oriented. Surface is covered with an orange-brown weathering rind that varies from 0 to approximately 2 mm in thickness. Remnant patches of brown-black fusion crust showing polygonal shrinkage cracks are present.

Petrography: (M. Hutson, *Cascadia*) In thin section, many indistinct chondrules are visible. Phases observed include olivine, low-Ca orthopyroxene, plagioclase feldspar, high-Ca clinopyroxene, maskelynite, Fe-Ni metal, troilite, chromite, copper, merrillite, chlor-apatatite. While the majority of feldspathic material is crystalline feldspar, areas of chromite-plagioclase/glass intergrowths, and maskelynite were observed. Silicates display bimodal coloring: areas containing coarser silicates have a slight yellow staining; fine-grained silicates appear gray. Three irregularly shaped areas stand out in appearance from the rest of the section, and contain coarse (>=100 microns) yellow-stained silicates, including twinned plagioclase feldspar intimately mixed with approximately equal amounts of similarly-sized opaque minerals. Troilite is noticeably more abundant than Fe-Ni metal, and shows a slight change in color along fractures. Approximately 50% of the metal has been replaced by iron hydroxides.

Geochemistry: Mineral compositions and geochemistry: Olivine ($Fa_{25.7\pm0.6}$, N=31), low-Ca orthopyroxene ($Fs_{22.0\pm0.6}Wo_{1.4\pm0.2}$, N=21), high-Ca clinopyroxene ($Fs_{8.5\pm0.5}Wo_{45.2\pm0.3}$, N=7), plagioclase feldspar ($Ab_{82.9\pm1.9}Or_{4.6\pm1.4}$, N=14), maskelynite ($Ab_{71.6\pm1.2}Or_{10.5\pm0.9}$, N=12).

Classification: Ordinary chondrite (L6) based on olivine and low-Ca orthopyroxene contents and texture. May be paired with Thomson (L6), which was observed to fall in 1888 roughly 39 km to the northwest, or more unlikely to Claxton (L6), which was observed to fall in 1984 roughly 127 km to the southeast.

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Specimens: *Cascadia* holds 80.3 g in 4 pieces, two polished thin sections, and two mounted butts. Dave Gheesling holds the main mass.

Knardna 002 31°00'07.0"S, 130°54'33.2"E
South Australia, Australia
Find: 16 May 2012
Classification: Ordinary chondrite (H4)
History: Found by A Langendam on a claypan
Physical characteristics: Dark red-black rounded sample with 65% fusion crust.
Petrography: (A. Tomkins, *Monash*) The matrix and mesostases are fine-grained and barely recrystallized. Chondrules edges are distinct, and vary significantly in size and composition (varieties include RP, BO, PO, PP, POP, GOP, C). Very small plagioclase grains (< 10 µm) can be distuinguished in reflected light. Olivine has weak undulose extinction; there is no shock melting. Metal grains are completed destroyed by rusting, and some troilite remains.
Geochemistry: (A. Tomkins, *Monash*) Microprobe analyses: olivine $Fa_{19.2-20.4}$, mean $Fa_{19.7}$, std=0.26, n=8; Low-Ca pyroxene $Fs_{16.4-18.9}$, mean $Fs_{17.38}$, std=0.40, n=12.
Classification: Ordinary Chondrite (H4, S2, W4)

Komaki 35°18'38"N, 136°56'59"E
Chubu, Japan
Confirmed fall: 2018 Sep 26
Classification: Ordinary chondrite (L6)
History: Around 22:30 on September 26, 2018, a detonating sound was heard at a private house in Komatsuji, Komaki city, Aichi prefecture, Japan. No fireball was observed because of the cloudy weather, with intermittent rain. Next morning, several fragments including 81 g and 23 g were found on the roof and in the garden. A 550 g mass was also found at the next-door house. The meteorite apparently hit the roof, bounced to the next house, penetrated the roof of the carport, and hit the roof of the car. It finally came to rest in front of the entrance door. The meteorite was brought to *NMNS* on October 6, where cosmogenic Na-22 and Al-26 gamma rays were detected by the pure Ge detector.
Physical characteristics: The 550 g mass is a rounded disk shape. One side is fully covered by fusion crust and the other is about half covered. The 81 g and 23 g fragments fit together with the 550 g mass, hence the meteorite was one mass that fragmented due to the impact on the roof.
Petrography: A polished thin section and a polished mount were made from a 1 g fragment at *NIPR*. Olivine compositions are $Fa_{23.9-25.5}$ (mean $Fa_{24.7}$, N=31), and low-Ca pyroxene compositions are $Fs_{20.0-21.3}$ (mean $Fs_{20.7}$, N=19). The presence of plagioclase >50 µm indicates that the petrologic type is 6. The presence of mottled extinction and planar fractures in olivine indicates that the shock stage is S3.

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Geochemistry: Using a 50 mg fragment, rare gas analyses were made at *KyuU*. The Ne-21 cosmic-ray exposure age is 25.1±0.6 Ma, and the K-Ar gas retension age is 4.4±0.2 Ga.
Classification: L6
Specimens: *NMNS*: 81 g for display, 20 g for type specimen; *NIPR*: 1 polished thin section, 1 polished mount

Korla 001 41°33’55.04"N, 86° 41’41.39"E
Xinjiang, China
Find: 19. Mar 2016
Classification: Ordinary chondrite (H~6)
History: (Ziyao Wang) Discovered by the geologist Wang Rongqing (Changji/Xinjiang) during field work in the Korla area on 19 Mar 2016.
Physical characteristics: (Ziyao Wang) Black-brown stone of 253 g without fusion crust
Petrography: (R. Bartoschewitz, *Bart*) brown and dark-gray, recrystallized matrix, with poorly defined chondrules (0.2-1.3 mm, av. 0.5 mm) and irregular tiny metal specks (av. 0.1 mm).
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.90
Classification: Ordinary chondrite (H~6, W4)
Specimens: 20.1 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 28 g with *Bart*.

Ksar El Goraane 32°11’13.2’’N, 003°42’04.6’’W
Draâ Tafilalet, Morocco
Confirmed fall: 28 October 2018 22:30 GMT+1
Classification: Ordinary chondrite (H5)
History (H. Chennaoui Aoudjehane *FSAC*, M. Aoudjehane): On October 28th, 2018 around 22:30 (GMT+1) a fireball was spotted by many people from the southeastern and eastern parts of Morocco. The sighting was reported to H. Chennaoui the following day by Y. Oulmaleh who went to the fall site, then by A. Bouferra. A field mission was organized by H. Chennaoui and M. Aoudjehane on November 11, 2018. to the fall area to record the coordinates of recovered pieces and the testimonies of local inhabitants. M. Touhami El Hafidi from Errachidia helped with the field work. Hammou Oubalaid, a shepherd who was out of his tent, described a very shiny light first, yellow then red, relatively low in the sky. It was coming from the east and headed west in the direction of Kaddoussa barrage. It was followed by 5 sonic booms, then a whistling sound that lasted 1 second, followed by a noise comparable to the unloading of a truck of rocks for about 5 s. The sound had awakened his sheep. Mohamed Oubalaid was inside his tent with his wife and his children when they saw a very bright illumination similar to daytime entering the tent. Then they heard 5 sonic booms. Then they heard many muffled sounds like rocks collapse. Many

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people from the village Ksar El Goraane and the area of the fall reported the same details on the fireball sighting: shiny like the sun, a yellow color, followed by red, between 4 and 5 sonic booms, and the whistling and noises that followed. Zaid Bouidergi, a meteorite hunter, was in Errachidia for the annual exhibition. He was outside and saw on October 28 around 22:30 a brilliant fireball on the North East of Errachidia that went out after a few seconds. A day after, October 29, in the morning, the first piece, weighting at 185 g, was recovered by Lahcen Oubalaid very close to his tent and around 5 km east of Ksar El Goraane village (N32°11'13.2''; W003°42'04.6'' Alt 1169 m). On the same day, other pieces were collected. Many Moroccan hunters went there to search for more. 5 g were found by Lahcen Oubalaid and 32 g were found by Addi Oulgaddou from Boudnib. Many small pieces were found in the Essnam plateau. A few days later, a 350 g piece was found SE of Ksar El Goraane village by Abderrahim Rahoui. The plateau where most pieces were found is called Izanarzen plateau, E of Ksar El Goraane village, S of Jebel Tabouaroust lakbir and close to Jebel Tabouaroust Essghir. The strewnfield is around 15 km from the ENE to WSW direction.

Physical characteristics: (H. Chennaoui Aoudjehane, *FSAC*) Complete pieces of 350 g, 32 g and 5 g totally covered by black matte to a bit shiny fusion crust. Small pieces show primary and secondary fusion crust. The interior is dark gray. Metal and sulfides are fine grained. Texture is fine grained and homogeneous, with no brecciation visible. Small sized (up to one mm) chondrules are visible. The rock is friable.

Petrography: (C. Agee, *UNM*) Microprobe examination of a polished mount shows numerous porphyritic chondrules set in a recrystallized groundmass. Plagioclase grains are ubiquitous with sizes up to 25 um in diameter. Abundant FeNi-metal and troilite observed throughout. Magnetic susceptibility log χ ($\times 10^{-9}$ m^3/kg)=5.28 to 5.42.

Geochemistry: (C. Agee, *UNM*) Olivine $Fa_{19.0\pm0.2}$, Fe/Mn=38±2, n=31; low-Ca pyroxene $Fs_{16.5\pm0.2}Wo_{1.4\pm0.3}$, n=16.

Classification: Ordinary chondrite (H5)

Specimens: 40.4 g at *FSAC* (20.4 g provided by the "Moroccan association of meteorites", and small pieces totaling 20 g provided by Abderrahim Rahoui). 0.9 g at *UNM*; 21.2 g including one polished thin section at *UWB*.

Kumtag 039 41°33'28.06"N, 93°13'16.18"E
Xinjiang, China
Find: 16 Sept 2013
Classification: Ordinary chondrite (L6, melt breccia)

History: (Ziyao Wang) Discovered by the geologist Wang Jianming (Jiuquan/Gansu) during field work in the Kumtag Desert on Sept. 16, 2013.

Physical characteristics: (Ziyao Wang and R. Bartoschewitz, *Bart*) Gray-brown stone of 188.2 g without fusion crust

Petrography: (R. Bartoschewitz, *Bart*) Gray homogeneous matrix with vugs up to 2 mm. Microporphyrytic and relict mineral grains and chondrules, consistent with

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type L6, are set in a µm-sized melt matrix. Metal and sulfide occur as rounded objects up to 1 mm.
Geochemistry: (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine $Fa_{23.6\pm0.7}$ (n=13); pyroxene $Fs_{20.0\pm0.5}Wo_{2.1\pm1.1}$ (n=5); chromite CRAL86, FFM73 (n=2). Pyrrhotite Ni=2 wt.-% (n=4). Magnetic susceptibility log χ (× 10^{-9} m^3/kg) = 4.37
Classification: Ordinary chondrite (L6-melt breccia)
Specimens: 20.6 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 17.1 g with *Bart*. Polished thin sections *Bart* and *IfP*

Kumtag 042 41°27'21.85"N, 93°37'20.85"E
Xinjiang, China
Find: 2012 Aug 26
Classification: Ordinary chondrite (L4-6)
History: (Ziyao Wang) Discovered by the geologist Wang Jianming (Hami/Xinjiang) during field work in the Kumtag Desert on 26 Aug 2012.
Physical characteristics: (Ziyao Wang) One dark black-brown stone 65 g. No fusion crust recognizable.
Petrography: (R. Bartoschewitz, *Bart*) breccia of three different lithologies: 1. gray-black matrix with well defined lighter chondrules (0.2-2.0 mm, av. 0.6 mm). 2. Gray-brown recrystallized matrix with chondrules (0.4-1.0 mm, av. 0.6 mm). 3. Black-gray matrix with many vugs (< 0.3 mm) and chondrules (0.4-2.0 mm) of same color. Metal and sulfide inclusions in all three lithologies are irregular.
Geochemistry: (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine $Fa_{24.5\pm0.8}$ (n=33); pyroxene $Fs_{20.1\pm0.4}$ (n=4), $Wo_{1.8\pm0.5}$; feldspar $An_{11}Or_5$ (n=7); chromite CRAL86, FFM76 (n=3); merrillite. Kamacite Ni=6.2, Co=1.0 wt.-% (n=2). Magnetic susceptibility log χ (× $10^{-9}m^3$/kg) = 5.07
Classification: Ordinary chondrite (L4-6 breccia, S4, W1)
Specimens: 13.0 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 9 g with *Bart*.

Kumtag 050 41°46'6.37"N, 93°44'33.89"E
Xinjiang, China
Find: 2017
Classification: Ordinary chondrite (L~6)
History: (Ziyao Wang) Discovered by the geologist Jianming Wang (Hami/Xinjiang) during field work in the Kumtag Desert in 2017
Physical characteristics: Brown irregular stone of 482 g
Petrography: (R. Bartoschewitz, *Bart*) gray-brown, recrystallized matrix, with poorly defined chondrules (0.4-5 mm, av. ~0.8 mm), irregular metal and sulfide
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ (× 10^{-9} m^3/kg) = 4.76
Classification: Ordinary chondrite (L~6, W3)

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Specimens: 20.1 g on deposit at *Kiel*, Jianming Wang holds the main mass, 78 g with Ziyao Wang and 61 g with *Bart*.

Kumtag 051 41°35’56.20"N, 93°35’40.24"E
Xinjiang, China
Find: 2013
Classification: Ordinary chondrite (L~3)
History: (Ziyao Wang) Discovered by the geologist Jianming Wang (Hami/Xinjiang) during field work in the Kumtag Desert in 2013.
Physical characteristics: fractured brown-black stone without fusion crust of 76.1 g.
Petrography: (R. Bartoschewitz, *Bart*) dark-gray matrix with well-developed, lighter chondrules (0.3-2 mm, av. 0.8 mm) and irregular metal and sulfide inclusions.
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.87
Classification: Ordinary chondrite (L~3, W1)
Specimens: 15.3 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 18 g with *Bart*.

Kumtag 052 41°37’52.11"N, 93°40’38.83"E
Xinjiang, China
Find: 2013
Classification: Ordinary chondrite (L~4)
History: (Ziyao Wang) Discovered by the geologist Jianming Wang (Hami/Xinjiang) during field work in the Kumtag Desert in 2013
Physical characteristics: fractured brown-black stone without fusion crust of 67.8 g
Petrography: (R. Bartoschewitz, *Bart*) dark-gray matrix with well-developed, lighter chondrules (0.3-3 mm, av. 0.8 mm) and few small metal and sulfide specks
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.64
Classification: Ordinary chondrite (L~4 breccia, W2)
Specimens: 13.6 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 16.8 g with *Bart*.

Kumtag 053 41°50’43.63"N, 93°48’49.41"E
Xinjiang, China
Find: 2015
Classification: Ordinary chondrite (H~5)
History: (Ziyao Wang) Discovered by the geologist Jianming Wang (Hami/Xinjiang) during field work in the Kumtag Desert in 2015

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Physical characteristics: Brown, nearly square stone of 1207.6 g without fusion crust
Petrography: (R. Bartoschewitz, *Bart*) light-brown matrix with well-developed chondrules (0.3-1.5 mm, av. 0.6 mm) and irregular metal and sulfide inclusions
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.93-5.17
Classification: Ordinary chondrite (H~5 breccia, W2)
Specimens: 23.1 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 138 g with *Bart*.

Kumtag 054 41°37'4.58"N, 93°48'12.92"E
Xinjiang, China
Find: 2018
Classification: Ordinary chondrite (LL~6)
History: (Ziyao Wang) Discovered by the geologist Jianming Wang (Hami/Xinjiang) during field work in the Kumtag Desert in 2018
Physical characteristics: Dark-brown, flat stone of 107 g
Petrography: (R. Bartoschewitz, *Bart*) brown, recrystallized matrix, with poorly defined chondrules, irregular metal and sulfide. Vugs and cracks are partly filled with iron-hydroxides.
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.05
Classification: Ordinary chondrite (LL~6, W3)
Specimens: 20.0 g on deposit at *Kiel*, Jianming Wang and Ziyao Wang holds the main mass, and 18 g with *Bart*.

Kumtag 057 41°30'N, 93°33'E
Xinjiang, China
Find: 2012
Classification: Ordinary chondrite (L~6)
History: Discovered by Jianming Wang in the Kumtag 002 strewn field in 2012. Ziyao Wang purchased it in 2017 and donated it to R. Bartoschewitz in 2018.
Physical characteristics: Dark brown flat fragment with weathering cracks of 71.07 g
Petrography: (R. Bartoschewitz, *Bart*) brown matrix with poorly defined chondrules, few remnant metal and many sulfide specks; corrosion vugs show oxidation minerals.
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.69
Classification: Ordinary chondrite (L~6, W4)
Specimens: 17.9 g on deposit at *Kiel*, *Bart* holds the main mass.

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Kumtag 058 41°30'N, 93°33'E
Xinjiang, China
Find: 2012
Classification: Ordinary chondrite (L~6)
History: Discovered by Jianming Wang in the Kumtag 002 strewn field in 2012. Ziyao Wang purchased it in 2017 and donated it to R. Bartoschewitz in 2018.
Physical characteristics: Leather brown rounded fragment of 100.5 g
Petrography: (R. Bartoschewitz, *Bart*) brown matrix with poorly defined chondrules, metal and sulfide specks.
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.50
Classification: Ordinary chondrite (L~6, W3)
Specimens: 20.4 g on deposit at *Kiel*, *Bart* holds the main mass.

Laboulaye 34°5.19283'S, 63°23.2655'W
Cordoba, Argentina
Find: prior to 2004
Classification: Ordinary chondrite (H5)
History: Originally found by a farm owner in a field, the main mass was purchased from the finder in Laboulaye in 2004.
Physical characteristics: Consists of two stones, 2674 g and 150 g.
Petrography: (C. Herd and M. Holt, *UAb*) Optical and microprobe examination of a polished thin section shows well-delineated chondrules of a variety of textural types. Plagioclase grains are approximately 10 to 20 microns in diameter. Metal is largely replaced by oxides, although sulfides are intact. Shock effects include minor veining, and undulatory extinction with >2° angular variation in olivine. Weathering grade according to Zurfluh et al. (2016); shock stage according to Fritz et al. (2017).
Geochemistry: (C. Herd and M. Holt, *UAb*) Data obtained by EMP examination of carbon-coated thin section: Olivine $Fa_{17.9\pm0.6}$ (n=43); Low-Ca Pyroxene $Fs_{16.3\pm1.0}Wo_{1.3\pm0.7}$ (n=35).
Classification: Ordinary chondrite, H5
Specimens: Type specimen of 30.4 g, including one thin section, is at *UAb*. 2 stones totaling 2794 g with Joshua Earth & Space Museum.

La'gad 003 27.606°N, 8.761°W
Saguia el Hamra, Western Sahara
Find: 2015
Classification: Lunar meteorite (feldspathic breccia)
History: Found in 2015 by nomads on a small hill named Grarat-Zawi, and purchased by Darryl Pitt on behalf of *MMGM* from Mauritanian dealers in the period August-October 2015.
Physical characteristics: A single, very large stone (27.249 kg) found as a group of many pieces which fit together (but with several missing pieces). The specimen lacks

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fusion crust, but individual pieces have thin coatings of light-brown weathering products. Fresh interiors exhibit angular, whitish clasts within a dark-gray matrix.
Petrography: (A. Irving and S. Kuehner, *UWS*) Breccia composed predominantly of mineral clasts plus rare glass clasts and basalt clasts in a finer grained, partly vesicular matrix. Minerals are anorthite, olivine, pigeonite, orthopyroxene, exsolved pigeonite, subcalcic augite, Al-rich chromite, ilmenite and baddeleyite. Minor amounts of secondary calcite and barite are present.
Geochemistry: Olivine ($Fa_{30.0-52.6}$, FeO/MnO = 84-110, N = 4), pigeonite ($Fs_{28.2-38.2}Wo_{9.8-14.7}$, FeO/MnO = 50-54, N = 3), orthopyroxene ($Fs_{19.3}Wo_{4.5}$, FeO/MnO = 57), subcalcic augite ($Fs_{49.6}Wo_{28.3}$, FeO/MnO = 59), plagioclase ($An_{95.2-97.1}Or_{0.1-0.2}$, N = 3). Bulk composition (R. Korotev, *WUSL*) INAA of 10 subsamples from different portions of the reassmbled mass gave the following mean abundances: (in wt.%) FeO 5.95±0.88, Na_2O 0.34±0.02, BaO 0.51; (in ppm) Sc 13.6±2.6, Cr 930±210, Ni 140±160, La 2.3±0.6, Sm 1.0±0.2, Eu 0.75±0.06, Yb 0.85±0.14, Lu 0.13±0.02, Hf 0.65±0.13, Th 0.37±0.11.
Classification: Lunar (feldspathic regolith breccia). Based on closely similar bulk chemical compositional data (determined by Dr. R. Korotev at *WUSL* utilizing the same INAA methods), it is likely that the NWA 10509 stone and the material classified as NWA 10798 are paired portions of the same disaggregated meteorite. Another lunar feldspathic meteorite from a different location in the same dense collection area received the name La'gad, but analyses by Dr. Korotev demonstrate that the La'gad stones differ from the material described here, especially in having much higher (by a factor of 6) abundances of Th and other lithophile elements.
Specimens: 33.21 g including two polished endcuts at *UWB*; main mass at *MMGM*.

Lahmada 020 27.411°N, 9.845°W
Saguia el Hamra, Western Sahara
Find: 2018 Nov
Classification: Lunar meteorite (feldspathic breccia)
History: Found at a location north of Jdiriya, Morocco, near Oued Skikima, in November 2018. Material was obtained by Ahmad Bouragaa and Aziz Habibi, and some was purchased by Mark Lyon and Mendy Ouzillou in November 2018.
Physical characteristics: Multiple pieces (total 12.168 kg) of the same distinctive very fine grained, dark gray microvesicular material with sparse, irregularly distributed small milky clasts.
Petrography: (A. Irving and S. Kuehner, *UWS*) Sparse, very small mineral clasts of anorthite, olivine, pigeonite and augite occur within a dominant extremely fine grained, microvesicular matrix containing accessory kamacite, troilite and minor barite.
Geochemistry: Olivine ($Fa_{34.0-35.8}$, FeO/MnO = 86-94, N = 2), pigeonite ($Fs_{22.7-28.6}Wo_{8.2-8.8}$, FeO/MnO = 49-59, N = 2), augite ($Fs_{17.1-17.4}Wo_{38.5-36.6}$, FeO/MnO = 51-54, N = 2), anorthite ($An_{95.8-96.9}Wo_{0.4-0.2}$, N = 2).
Classification: Lunar (feldspathic regolith melt breccia).

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Specimens: 20.62 g including a polished slice and one polished thin section at *UWB*; remainder with A. Bouragaa, A. Habibi, M. Lyon and M. Ouzillou.

Lahmada 021 27°27'41"N, 9°50'43.2"W
Saguia el Hamra, Western Sahara
Find: 2018 Oct 20
Classification: Carbonaceous chondrite (CO3)
History: Found on October 20, 2018, by Brahim Riguirah and Brahim Oubrik. Bought from Modamed Elguirah in December 2018.
Physical characteristics: Three dark stones without fusion crust
Petrography: (J. Gattacceca, *CEREGE*) Chondrite with well-defined chondrules (apparent average diameter 180±130 µm, n=36) set in an abundant fine-grained iron-rich matrix (42 vol%). Small CAIs are present. Main opaque mineral is Fe,Ni metal.
Geochemistry: Olivine $Fa_{22.8\pm21.5}$, Fa PMD 87% (n=10), Cr_2O_3 in ferroan olivine 0.28±0.11 wt% (n=6). Low-Ca pyroxene $Fs_{3.1\pm1.1}Wo_{1.7\pm1.6}$ (n=4). Low-Ca pyroxene $Fs_{9.4\pm6.9}Wo_{1.1\pm0.7}$ (n=3).
Classification: Carbonaceous chondrite (CO3). Cr_2O_3 content of olivine (Grosmann and Brearley, 2005) and high magnetic susceptibility (Rochette et al., 2008) suggest a low petrographic subtype similar to that of Kainsaz.
Specimens: Type specimen at *CEREGE*. Main mass with Jean Redelsperger.

Lahmada 046 27°24'N, 9°50'W
Saguia el Hamra, Western Sahara
Find: 2018 Oct 11
Classification: Lunar meteorite (feldspathic breccia)
History: Purchased from Hamza Lharbi in Morocco in March 2018.
Physical characteristics: Gray rock without fusion crust. Cut surface reveals black interior with mm-sized, whitish clasts.
Petrography: (J. Gattacceca, *CEREGE*) Sparse mineral clasts (anorthite, olivine, pyroxene) in a melt-rock matrix. Melt rock has numerous vesicles with typical sizes 50 µm. Troilite and rare metal are found in the melt rock.
Geochemistry: Anorthite $An_{96.8}Ab_{3.0}Or_{0.2}$ (n=2). Augite $Fs_{16.8\pm0.3}Wo_{36.3\pm0.1}$, FeO/MnO = 59.0 (n=2). Olivine $Fa_{33.4\pm1.5}$, FeO/MnO=72.3±7.2 (n=3)
Classification: Lunar (feldspathic melt breccia). Possibly paired with Lahmada 020.
Specimens: Type specimen at *CEREGE*. Main mass with Pierre-Marie Pelé.

Lahmada 047 27.372987°N, 9.929881°W
Saguia el Hamra, Western Sahara
Purchased: 2018
Classification: Lunar meteorite (feldspathic breccia)
History: Purchased in Morocco in 2018.

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Physical characteristics: Dark-gray irregular fragments. Cut face shows a dark-gray interior.
Petrography: (J. Gattacceca, *CEREGE*) Sparse mineral clasts (anorthite, olivine, pyroxene) in a melt-rock matrix. Melt rock has numerous vesicles with typical sizes 40 µm. Troilite and rare metal are found in the melt rock fraction.
Geochemistry: Anorthite $An_{97.0}Ab_{2.8}Or_{0.3}$ (n=2). Augite $Fs_{17.0}Wo_{36.8}$, FeO/MnO = 54 (n=1). Olivine $Fa_{37.5\pm0.4}$, FeO/MnO=110±6 (n=2).
Classification: Lunar (feldspathic melt breccia). Possibly paired with Lahmada 020.
Specimens: Type specimen at *CEREGE*. Main mass with Isabelle Pothier.

Lenghu 005 38°21'56.96"N, 93°26'45.89"E
Qinghai, China
Find: 2017
Classification: Ordinary chondrite (L~6)
History: (Ziyao Wang) Discovered by Zhenghong Peng near Eboliang (Qinghai,) in 2017.
Physical characteristics: Reddish brown flat stone of 241.8 g
Petrography: (R. Bartoschewitz, *Bart*) brown, recrystallized matrix, with poorly developed, mainly elongated chondrules (>1 mm) and nearly completely oxidized metal and sulfide.
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.39
Classification: Ordinary chondrite (L~6, W4)
Specimens: 24.5 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 32 g with *Bart*.

Lenghu 006 38°41'56.38"N, 93°36'39.91"E
Qinghai, China
Find: 2015
Classification: Ordinary chondrite (H~6)
History: (Ziyao Wang) Discovered by Yongsheng Wang near Lenghu Town (Qinghai) in 2015.
Physical characteristics: Brown nearly round stone of 91.8 g without fusion crust
Petrography: (R. Bartoschewitz, *Bart*) light-brown, recrystallized matrix, poorly developed chondrules, and melt veins. Metal and sulfide nearly completely oxidized.
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.59
Classification: Ordinary chondrite (H~6, W4)
Specimens: 19.2 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 14 g with *Bart*.

Leninskoe 45°14.54'N, 34°0.19'E

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Crimean, Ukraine
Find: 2 Mar 2019
Classification: Ordinary chondrite (H5)

History: Single stone was found by Mr. A. Kasianov on a plowed field near the Leninskoe settlement.

Physical characteristics:The stone of 1832 g of total mass has angular shape and dark-brown surface.

Petrography: (C. A. Lorenz , *Vernad*) The meteorite has chondritic texture. It is composed of chondrules (BO, BP, RP, POP) and chondrule fragments deposited in recrystallized silicate matrix together with metal and sulfide grains. The matrix contains the mineral and chondrule fragments, interstitial to which are iron hydroxides. Most of metal and troilite grains have attached rims of Fe hydroxide or partially replaced by that.

Geochemistry: Mineral compositions and Geochemistry: (N. N. Kononkova, EPMA, *Vernad*.) Olivine $Fa_{18.1\pm0.2}$ (N=5); orthopyroxene $Fs_{16.5\pm0.1}Wo_{1.2\pm0.2}$ (N=5)

Classification: Ordinary chondrite of the chemical group H, type 5 (S1, W3)

Specimens: A type specimen of 381.8 g and thin polished section are on deposit in *Vernad*. Main mass is on deposit in *DMUH*.

Leoncin 52°24’48’’N, 20°32’22.6’’E
Warszawa, Poland
Find, possible fall: 2012 Aug
Classification: Ordinary chondrite (LL4-6)

History: A bang was heard in a late afternoon, in August 2012, by two men. They found something on a metallic roof, which was part of outbuilding. The meteorite may have hit the roof, leaving a hole. THe meteorite did not fall into the hole. It was collected and sold by using an online Polish auction portal (Allegro.pl). It was bought on 26 March 2017 by Maciej Burski, a member of the Polish Meteoritical Society.

Physical characteristics: The meteorite is in 5 pieces, including one thin section. The biggest piece is 70 g. Two smaller are 14.4 g and 5.6 g. The rest mass is unknown. The fusion crust is black and typical for a chondrite.

Petrography: Chondrules are up to 3 mm in apparent diameter. The meteorite is a monomict breccia.

Geochemistry: Px and Ol are 71 vol%. of the metorite. Plagioclase is up 12.4 vol%, $Ab_{83.5\text{-}86.06}Or_{2.54\text{-}5.33}An_{9.42\text{-}12.50.}$ Troilite is up to 7.7 vol%. Metallic phases are 1.1 vol%. Cr-spinel is up to 0.6 vol%. Accessory minerals are represented by: Cl-apatite, merrillite and ilmenite. The ilmenite has traces of Mn and Mg. Augite is $Fs_{9.8}Wo_{44.8}En_{46}$,0. Metallic phases are represented by a Co rich, Ni poor phase (Ni 3.24-4.21%, Co 4.34-4.92%), taenite (Ni 38.90-43.07%, Co 0.88-1.58%), and tetrataenite (Ni 51.28%, Co 0.61%).

Classification: Ordinary chondrite LL4-6 based on Ol and Px composition and low content of metallic phases. An unusual high Co low Ni metal phase is present. Mössbauer spectroscopy confirmed LL classification.

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Specimens: The main mass is represented by 60 g specimen. It is in Maciej Burski's private collection. Two specimens and one thin-section are stored by *USil*, and they are 14.4 g and 5.6 g, respectively. The last specimen is in a private collection of Marcin Cimala.

Lop Nur 004 40°17'50.40"N, 90°06'40.45"E
Xinjiang, China
Find: Nov 2018
Classification: Ordinary chondrite (L~6)
History: (Ziyao Wang) Purchased by Ziyao Wang from the finder Tailu Zhao (Shanshan County, Xinjiang) in Shanshan/Xinjiang in 2018. This meteorite was discovered in Nov. 2018.
Physical characteristics: black, nearly round stone of 3067 g with rusty surface
Petrography: (R. Bartoschewitz, *Bart*) brown, recrystallized matrix, with well-developed chondrules. Metal and sulfide nearly completely oxidized, and vugs are partly filled with sulfates.
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.08
Classification: Ordinary chondrite (L~6, W5)
Specimens: 20.0 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 139 g with *Bart*.

Lop Nur 005 40°17'20.23"N, 90°13'01.13"E
Xinjiang, China
Find: Nov 2018
Classification: Ordinary chondrite (L~4)
History: (Ziyao Wang) Purchased by Ziyao Wang from the finder Tailu Zhao (Shanshan County, Xinjiang) in Shanshan/Xinjiang in 2018. This meteorite was discovered in Nov. 2018.
Physical characteristics: black-brown nearly round stone of 189 g with rusty surface
Petrography: (R. Bartoschewitz, *Bart*) brown matrix with well-developed gray chondrules (0.3-1.5 mm, av. 0.8 mm) and few metal and sulfide specks
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.48
Classification: Ordinary chondrite (L~4, W4)
Specimens: 21.4 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 20 g with *Bart*.

Lop Nur 006 40°19'17.11"N, 90°15'29.44"E
Xinjiang, China
Find: Nov 2018

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Classification: Ordinary chondrite (H~4)
History: (Ziyao Wang) Purchased by Ziyao Wang from the finder Tailu Zhao (Shanshan County, Xinjiang) in Shanshan/Xinjiang in 2018. This meteorite was discovered in Nov. 2018.
Physical characteristics: Gray black stone of 256.6 g
Petrography: (R. Bartoschewitz, *Bart*) brown matrix with well-developed gray chondrules (0.2-1.5 mm, av. 0.5 mm). Metal and sulfide completely oxidized, and vugs and cracks are mostly filled with iron-hydroxides and sulfates.
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.77
Classification: Ordinary chondrite (H~4, W5)
Specimens: 21.9 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 41 g with *Bart*.

Lop Nur 007 40°27'52.96"N, 90°07'49.67"E
Xinjiang, China
Find: Nov 2018
Classification: Ordinary chondrite (H~4)
History: (Ziyao Wang) Purchased by Ziyao Wang from the finder Tailu Zhao (Shanshan County, Xinjiang) in Shanshan/Xinjiang in 2018. This meteorite was discovered in Nov. 2018.
Physical characteristics: Light yellow stone of 193.4 g with many cracks
Petrography: (R. Bartoschewitz, *Bart*) brown matrix, with well-developed gray chondrules (0.2-1.5 mm, av. 0.5 mm). Metal and sulfide completely oxidized, and vugs and cracks are mostly filled with iron-hydroxides and sulfates.
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.79
Classification: Ordinary chondrite (H~4, W5)
Specimens: 20.2 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 21 g with *Bart*.

Lop Nur 008 40°34'17.11"N, 90°12'36.41"E
Xinjiang, China
Find: Nov 2018
Classification: Ordinary chondrite (L~6)
History: (Ziyao Wang) Purchased by Ziyao Wang from the finder Tailu Zhao (Shanshan County, Xinjiang) in Shanshan/Xinjiang in 2018. This meteorite was discovered in Nov. 2018.
Physical characteristics: black-brown stone of 35 g without fusion crust
Petrography: (R. Bartoschewitz, *Bart*) brown, recrystallized matrix, with nearly completely recrystallized chondrules and few sulfide. Metal is completly oxidized and fills the vugs beside sulfates.

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Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ (× 10^{-9} m^3/kg) = 4.02
Classification: Ordinary chondrite (L~6, W5)
Specimens: 7.1 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 5 g with *Bart*.

Lop Nur 009 40°31'17.70"N, 90°04'26.97"E
Xinjiang, China
Find: Nov 2018
Classification: Ordinary chondrite (L~4)
History: (Ziyao Wang) Purchased by Ziyao Wang from the finder Tailu Zhao (Shanshan County, Xinjiang) in Shanshan/Xinjiang in 2018. This meteorite was discovered in Nov. 2018.
Physical characteristics: black stone of 49 g without fusion crust
Petrography: (R. Bartoschewitz, *Bart*) brown, recrystallized matrix, with well-defined chondrules (0.4-1,5 mm, av. 0,8 mm), completely oxidized metal and sulfide. Vugs are mostly filled with iron-hydroxides and sulfates.
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ (× 10^{-9} m^3/kg) = 4.69
Classification: Ordinary chondrite (L~4, W5)
Specimens: 10.2 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 7 g with *Bart*.

Lop Nur 010 40°29'57.05"N, 90°10'37.76"E
Xinjiang, China
Find: Nov 2018
Classification: Ordinary chondrite (H~5)
History: (Ziyao Wang) Purchased by Ziyao Wang from the finder Tailu Zhao (Shanshan County, Xinjiang) in Shanshan/Xinjiang in 2018. This meteorite was discovered in Nov. 2018.
Physical characteristics: black nearly square stone of 47 g with fusion crust
Petrography: (R. Bartoschewitz, *Bart*) brown stained, recrystallized matrix, with well developed gray chondrules (0.3-0.7 mm, av. 0,5 mm), metal and sulfide.
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ (× 10^{-9} m^3/kg) = 5.08
Classification: Ordinary chondrite (H~5, W4)
Specimens: 10.4 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 4 g with *Bart*.

Lop Nur 011 40°19'17.11"N, 90°11'17.31"E
Xinjiang, China
Find: Nov 2018

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Classification: HED achondrite (Diogenite)
History: (Ziyao Wang) Purchased by Ziyao Wang from the finder Tailu Zhao (Shanshan County, Xinjiang) in Shanshan/Xinjiang in 2018. This meteorite was discovered in the Lop Nur area in Nov. 2018.
Physical characteristics: (Ziyao Wang) Small light yellow stone of 16.2 g with very thin, pale fusion crust
Petrography: (R. Bartoschewitz, *Bart*) Monomict breccia predominantly composed of blocky, up to 3 mm sized orthoproxene grains and more fine-grained cataclastic regions. Minor phases include clinopyroxene, chromite, and troilite. Neither plagioclase, olivine, nor metallic iron have been found in the section studied.
Geochemistry: (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Ca-poor pyroxene $Fs_{31.8\pm0.4}Wo_{4.0\pm0.5}$ (n=18); Ca pyroxene $En_{63}Fs_{30}Wo_7$ (n=1); chromite CRAL82, FFM93 (n=3); troilite. Magnetic susceptibility log χ ($\times 10^{-9}$ m^3/kg) = 2.79
Classification: Diogenite
Specimens: 3.3 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 3.7 g with *Bart*.

Lop Nur 012 ~40°30'N, ~90°20'E
Xinjiang, China
Find: 2018
Classification: Ordinary chondrite (L~4)
History: Discovered by Tailu Zhao in the Lop Nur DCA in 2018. Ziyao Wang purchased it in 2019 and donated it to R. Bartoschewitz.
Physical characteristics: Brown fragment of 15.25 g
Petrography: (R. Bartoschewitz, *Bart*) brown matrix with well-defined chondrules (0.4-2 mm, av. 0.7 mm), metal and sulfide completely oxidized, corrosion vugs show sulfates.
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.89
Classification: Ordinary chondrite (L~4, W5)
Specimens: 4.3 g on deposit at *Kiel*, *Bart* holds the main mass.

Lop Nur 013 ~40°30'N, ~90°20'E
Xinjiang, China
Find: 2018
Classification: Ordinary chondrite (L~4)
History: Discovered by Tailu Zhao in 2018. Ziyao Wang purchased it in 2019 and donated it to R. Bartoschewitz.
Physical characteristics: Brown fragment of 27.87 g
Petrography: (R. Bartoschewitz, *Bart*) brown matrix with well defined chondrules (0.4-2 mm, av. 0.8 mm), metal and sulfide completely oxidized.
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.65

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Classification: Ordinary chondrite (L~4, W5)
Specimens: 5.6 g on deposit at *Kiel*, *Bart* holds the main mass.

Lop Nur 014 ~40°30'N, ~90°20'E
Xinjiang, China
Find: 2018
Classification: Ordinary chondrite (L~4)
History: Discovered by Tailu Zhao in 2018. Ziyao Wang purchased it in 2019 and donated it to R. Bartoschewitz.
Physical characteristics: Brown fragment of 14.9 g
Petrography: (R. Bartoschewitz, *Bart*) brown matrix with well defined chondrules (0.4-2 mm, av. 0.8 mm), metal and sulfide completely oxidized. Probably paired with Lop Nur 013.
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.60
Classification: Ordinary chondrite (L~4, W5)
Specimens: 3.8 g on deposit at *Kiel*, *Bart* holds the main mass.

Los Vientos 262 (LoV 262) 24°48'36.1''S, 69°55'12.3''W
Antofagasta, Chile
Find: 2017 Nov
Classification: Ordinary chondrite (L6, melt breccia)
Physical characteristics: Brecciated chondrite with abundant shock veins and cm size melt pockets. The melt pockets contain abundant µm sized FeS/FeNi eutectic droplets. Plagioclase size >50 µm.
Petrography: Equilibrated chondritic clast set in a melt rock matrix with abundant opaque droplets 10 µm in size.
Specimens: Type specimen 25.58 g at *CEREGE*. Main mass with *ARTMET*.

Los Vientos 263 (LoV 263) 24°40'S, 69°45'W
Antofagasta, Chile
Find: 2018 Jan 18
Classification: Pallasite (ungrouped)
History: Found by Luc *Labenne* in the Los Vientos collection area.
Physical characteristics: One stone
Petrography: (R. Hewins, S. Pont, B. Zanda, *MNHNP*) The grain size is about 2-3 mm. Approximately equal quantities of metal, olivine and pyroxene. Fine inclusions of troilite and chromite in the silicates.
Geochemistry: Mineral compositions and Geochemistry: (R. Hewins and S. Pont, *MNHNP*; J. Gattacceca and C. Sonzogni, *CEREGE*; M. Humayun, *FSU* Oxygen isotopic composition (J) from analysis of one acid-washed 1.5 mg aliquot of a powdered 10 mg bulk silicate sample is $\delta^{17}O$=2.09‰,

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$\delta^{18}O$=4.34‰, $\Delta^{17}O$=-0.187‰ (linearized, slope 0.5247, analytical uncertainties 0.08‰, 0.12‰, 0.03‰, respectively). The $\delta^{18}O$ distinguishes this meteorite from main-group pallasites. The kamacite contains 5.7% Ni (EMP), 5.65% Ni, s.d. 0.05 (ICP-MS), making it distinct from metal in other pallasites. The chromite has low Al like Brahin. The olivine is $Fo_{86.9}Fa_{13.1}$ and pyroxene $En_{87.4}Fs_{11.4}Wo_{1.2.}$
Classification: (R. Hewins *MNHN*) Pallasite (ungrouped).
Specimens: The main mass is held by *Labenne* Meteorites. The type specimen consists of 21 g at *MNHNP*.

Los Vientos 266 (LoV 266) 24°39.972'S, 69°55.608'W
Antofagasta, Chile
Find: 2017 Feb 20
Classification: Ordinary chondrite (H3.15)
History: Found by driving in a plain while meteorite prospecting with a six-person team.
Petrography: Olivine $Fa_{17.2\pm10.0}$, Fa PMD=49%, range $Fa_{1.8-38.7}$ (n=17). Cr_2O_3 in ferroan olivine 0.24±0.14 (n=16). Orthopyroxene $Fs_{12.3\pm7.4}Wo_{0.8\pm0.5}$ (n=11). Based on the structural order of the polyaromatic matter assessed by Raman spectroscopy (Lydie Bonal, *IPAG*), this meteorite appears as metamorphosed as Bishunpur (type 3.15). The Raman spectroscopy parameters of interest are FWHM-D (cm^{-1})=175.2±11.7, ID/IG=1.00±0.02, N=7 (see Bonal et al. 2016, figure 6).
Geochemistry: Chondrite with well-delineated chondrules (average apparent diameter 400±260, n=26) set in a fine-grained matrix (19 vol% by point counting, n=149). Opaques are FeNi metal and sulfides. Metal is present as blebs in the matrix up to 600 µm.
Classification: Ordinary chondrite (H3.15). Ordinary chondrite based on mineralogy, matrix abundance. H based on magnetic susceptibility (interpreted in the light of the weathering grade W2) and chondrule size. Subtype 3.15 based on Raman spectroscopy and the Cr_2O_3 content of ferroan olivine.
Specimens: Type specimen at *CEREGE*. Main mass with Sergey Vasiliev.

Los Vientos 288 (LoV 288) 24°41'S, 69°46'W
Antofagasta, Chile
Find: 2010 Jul 06
Classification: Ordinary chondrite (LL3)
Petrography: (J. Gattacceca, *CEREGE*) Chondrite with packed well defined chondrules (average apparent diameter 780±380 µm, n=32). Opaques are metal and troilite.
Geochemistry: Olivine $Fa_{28.0\pm2.6}$, PMD 7%, Cr_2O_3 0.015±0.019 wt% (n=11). Low-Ca pyroxene $Fs_{21.2\pm3.9}Wo_{1.0\pm1.1}$ (n=9).

Los Vientos 290 (LoV 290) 24°38'0.9''S, 69°53'37.9''W

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Antofagasta, Chile
Find: 26 Feb 2017
Classification: HED achondrite (Howardite)
History: Found on granodiorite pediment surface by a three-person team.
Physical characteristics: Cut face reveals light-gray interior with darker clasts to 5 mm.
Petrography: (J. Gattacceca, *CEREGE*) Lithic and mineral clasts (to several mm) set in clastic matrix. Main minerals are low-Ca pyroxene, plagioclase. Other minerals: kamacite, ilmenite, chromite, troilite. Both diogenite (Fs_{22} to Fs_{32}) and eucrite (Fs_{38} to Fs_{66}) material is found. Eucrite material abundance is about 20 vol%.
Geochemistry: Overall low-Ca pyroxene $Fs_{32.5\pm9.7}Wo_{2.8\pm1.4}$, FeO/MnO=33.0±5.1 (n=18). Diogenite low-Ca pyroxene $Fs_{26.6\pm3.7}Wo_{2.2\pm0.9}$ (n=12). Eucrite low-Ca pyroxene $Fs_{44.3\pm6.6}Wo_{4.1\pm1.4}$ (n=6). Plagioclase $An_{85.7\pm6.9}Ab_{13.4\pm6.3}Or_{0.9\pm0.8}$ (n=6), range $An_{75.7\text{-}93.3}$. Eucrite opthitic lithic clast: low-Ca pyroxene $Fs_{65.7}Wo_{2.9}$ (n=1), plagioclase $An_{90.1\pm1.4}Ab_{9.4\pm1.4}Or_{0.5\pm0.0}$ (n=4).
Classification: Achondrite (howardite).

Los Vientos 291 (LoV 291) 24°39’28.8’’S, 069°55’49.2’’W
Antofagasta, Chile
Find: 20 Feb 2017
Classification: Ordinary chondrite (H3)
History: Found on gravel surface by a six-person team.
Geochemistry: Olivine $Fa_{19.7\pm1.7}$, PMD 6%, Cr_2O_3 0.04±0.03 wt%. Low-Ca pyroxene $Fs_{15.9\pm2.0}Wo_{1.7\pm0.7}$ (n=5).

Los Vientos 292 (LoV 292) 24°39’43.3’’S, 069°49’19.1’’W
Antofagasta, Chile
Find: 2017 Nov 12
Classification: Ordinary chondrite (L6, melt breccia)
History: Found on granodiorite pediment surface
Petrography: (J. Gattacceca, *CEREGE*) Melt breccia with type 6 clasts supported by a melt-rock matrix.
Geochemistry: Type 6 clasts: olivine $Fa_{26.0}$ (n=2), orthopyroxene $Fs_{21.8}Wo_{1.5}$ (n=2)

Los Vientos 306 (LoV 306) 24°48.78’S, 69°57.09’W
Antofagasta, Chile
Find: 14 Feb 2019
Classification: Ureilite
History: A single stone was found in the desert by an anonymous finder.
Physical characteristics: A meteorite of faceted shape with partly preserved, brown-colored fusion crust.

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Petrography: (Lorenz C. A., *Vernad*) The rock has coarse-grained (3-5 mm) lineated texture and composes mainly of olivine, minor pyroxene grains (1-3 mm) and graphite laths occurring along the silicate grain boundaries. Olivine crystals are finely granulated and rich in fine metal inclusions near the contacts with graphite. Pyroxene grains are rich in metal and glass inclusions. Metal and sulphide form rare narrow veinlets often interconnecting the graphite laths. The veinlets are partially replaced by iron hydroxides.
Geochemistry: Mineral compositions and geochemistry:Mineral compositions and geochemistry: (N.N. Kononkova, EMP, *Vernad*) Olivine $Fo_{79.6}$ (Fe/Mn=44.6) zoned to $Fo_{99.5}$ (CaO = 0.23±0.09 wt%; Cr_2O_3 = 0.44±0.2 wt%; N=5); Pyroxene $En_{78.8-92.6}Wo_{3.1-6.4}$ (Al_2O_3 = 1.11±0.04 wt%; Cr_2O_3 = 0.9±0.23 wt%; Fe/Mn=22; N=5) and $En_{68.4}Wo_{30.3.}$
Classification: achondrite (ureilite). Weathering is moderate.
Specimens: Cut piece of 8 g and thin polished sample are on deposit in *Vernad*.

Los Vientos 308 (LoV 308) 24°42.346'S, 69°54.996'W
Antofagasta, Chile
Find: 2017 Feb 20
Classification: Ordinary chondrite (H3-5)
History: Found on a plain by a six-person team.
Petrography: (J. Gattacceca) Brecciated ordinary chondrite with type 5 clasts and shock darkened clasts set in a type 3 host lithology.
Geochemistry: Type 3 host lithology: $Fa_{19.0\pm2.3}$, Fa PMD 9%, Cr_2O_3 0.07±0.09 wt% (n=6), low-Ca pyroxene $Fs_{12.9\pm5.4}Wo_{0.6\pm0.3}$ (n=5). Type 5 clasts: olivine $Fa_{19.4}$ (n=1), orthopyroxene $Fs_{17.7}Wo_{1.0}$ (n=1).
Specimens: Type specimen at *CEREGE*. Main mass with Thomas *Kurtz*.

Los Vientos 315 (LoV 315) 24°40'17.0''S, 069°55'49.6''W
Antofagasta, Chile
Find: 2017 Feb
Classification: Ordinary chondrite (H3)
History: Found on granodiorite pediment surface while meteorite prospecting with six-person team.
Petrography: (J. Gattacceca, *CEREGE*) Packed well-delineated chondrules (average apparent diameter 430±210 µm, n=36). Opaque are metal and sulfides, present as composite blebs up to 200 µm in the matrix.
Geochemistry: Olivine $Fa_{18.4\pm6.4}$, Fa PMD 29%, Cr_2O_3 0.22±0.15 wt% (n=16). Low-Ca pyroxene $Fs_{13.0\pm2.3}Wo_{0.4\pm0.1}$ (n=4). Ca-pyroxene $Fs_{20.9}Wo_{23.0}$ (n=1).
Classification: Ordinary chondrite (H3). H group from chondrule size. Cr_2O_3 content of olivine suggest a low petrographic sub-type 3.15 (Grossman and Brearley, 2005).

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Los Vientos 321 (LoV 321) 24°41'S, 69°46'W
Antofagasta, Chile
Find: 2018 Apr
Classification: Ordinary chondrite (LL3)
History: Found in the Atacama desert.
Petrography: (J. Gattacceca, *CEREGE*) Chondrite with well-delineated, packed chondrules. Opaque are metal and troilite.
Geochemistry: Olivine $Fa_{23.8\pm8.6}$, range $Fa_{14.0\text{-}37.2}$, Fa PMD 33% (n=12). Low-Ca pyroxene $Fs_{15.6\pm13.5}Wo_{1.4\pm1.2}$, range $Fs_{1.0\text{-}38.2}$ (n=7).
Classification: Ordinary chondrite (LL3). LL group from magnetic susceptibility.
Specimens: Type specimen and a polished section at CERGEGE. Main mass at ArtMet collection.

Los Vientos 322 (LoV 322) 24°41'S, 69°46'W
Antofagasta, Chile
Find: 2018 April
Classification: Carbonaceous chondrite (CO3)
History: Found in the Atacama desert.
Petrography: (J. Gattacceca, *CEREGE*) Chondrules with average apparent diameter 220±90 µm (n=39) set in an abundant fine-grained iron rich matrix (23 vol% from point couting, n=176). Opaques are metal and sulfides
Geochemistry: Olivine $Fa_{17.5\pm7.3}$, range $Fa_{4.8\text{-}23.6}$, Fa PMD 39%, Cr_2O_3 0.12±0.08 wt% (n=11). Low-Ca pyroxene $Fs_{4.4\pm1.5}Wo_{1.1\pm0.1}$ (n=2).
Classification: Carbonaceous chondrite (CO3)
Specimens: Type specimen and a polished section at *CEREGE*. Main mass at ArtMet Collection

Los Vientos 326 (LoV 326) 24°41'03.4''S, 069°52'37.2''W
Antofagasta, Chile
Find: 2017 Feb 27
Classification: Ordinary chondrite (L6)
History: Found on granodiorite pediment surface by a six-person team.
Petrography: (J. Gattacceca, *CEREGE*) Highly recrystallized chondrite with some triple junctions. Plagioclase typical size 150 µm, up to 300 µm.
Classification: Ordinary chondrite (L6)
Specimens: Type specimen at *CEREGE*. Main mass with Sergey Vasiliev.

Los Vientos 331 (LoV 331) 24°40.91897'S, 69°46.029'W
Antofagasta, Chile
Find: 2018 Nov 18
Classification: Ordinary chondrite (H6)

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Petrography: Chondrules and chondrule fragments are discernable but poorly delineated and chondrule fragments blend in with the recrystallized matrix. Metal accounts for 8 vol %. Metal grains average at 400 µm in length and show a preferred orientation. This is also seen in sulphides (~4 vol %). Approximately 50% of opaque grains show oxide rims and minor oxide veins are observed. Plagioclase grains are mostly 30-100 µm in length.
Geochemistry: Mineral compositions and geochemistry: All analyses by EPMA. Metal: predominantly kamacite, with 6.1 ± 0.8 wt% Ni and 0.48±0.05 wt% Co. Taenite is present with 33.3-50.88 wt% Ni, and 0.10±0.02 wt% Co. Olivine: $Fa_{18.0\pm0.6}$ (N=42). Pyroxene: $Fs_{16.0\pm1.1}En_{82.9\pm1.2}Wo_{1.1\pm0.3}$ (N=25).

Loulan Yizhi 009 ~40°30'N, ~89°54'E
Xinjiang, China
Find: 2013
Classification: Ordinary chondrite (L6)
History: (Ziyao Wang) Purchased by Ziyao Wang from an ornamental stone dealer in Hami/Xinjiang in 2013. The anonymous finder reported that this meteorite was discovered in the Lop Nur area, close to ruins of Loulan Yizhi in 2013.
Physical characteristics: (Ziyao Wang) Dark gray-brown lustering stone of 41.3 g without fusion crust
Petrography: (R. Bartoschewitz, *Bart*) Strong recrystallized matrix with poor recognizable chondrules. Metal and sulfide filled cracks and darkened the meteorite.
Geochemistry: (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine $Fa_{24.2\pm0.4}$ (n=16); pyroxene $Fs_{20.1\pm0.4}Wo_{1.8\pm0.5}$ (n=4); Ca pyroxene $En_{74}Fs_{19}Wo_7$ (n=1); chromite CRAL86, FFM76 (n=1); apatite. Magnetic susceptibility log χ (× 10^{-9} m^3/kg) = 4.55
Classification: Ordinary chondrite (L6, S4 shock darkened, W4)
Specimens: 8.36 g on deposit at Münster, Ziyao Wang holds the main mass, and 6 g with *Bart*. Polished thin sections *Bart* and *IfP*

Loulan Yizhi 010 40°26'22.67"N, 89°39'09.12"E
Xinjiang, China
Find: Nov 2018
Classification: Ordinary chondrite (LL~5)
History: (Ziyao Wang) Purchased by Ziyao Wang from the finder Tailu Zhao (Shanshan County, Xinjiang) in Shanshan/Xinjiang in 2018. This meteorite was discovered in Nov. 2018.
Physical characteristics: Yellow brown, irregularly shaped stone of 202 g
Petrography: (R. Bartoschewitz, *Bart*) brown, recrystallized matrix, with poorly defined chondrules, metal and sulfide
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ (× 10^{-9} m^3/kg) = 3.71
Classification: Ordinary chondrite (LL~5, W4)

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Specimens: 20.9 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 23 g with *Bart*.

Loulan Yizhi 011 40°21'47.84"N, 89°41'17.75"E
Xinjiang, China
Find: Nov 2018
Classification: Ordinary chondrite (L~4)
History: (Ziyao Wang) Purchased by Ziyao Wang from the finder Tailu Zhao (Shanshan County, Xinjiang) in Shanshan/Xinjiang in 2018. This meteorite was discovered in Nov. 2018.
Physical characteristics: brown irregular stone of 167.7 g
Petrography: (R. Bartoschewitz, *Bart*) brown recrystallized matrix, with well-defined chondrules (0.4-2 mm, av. 1 mm), and nearly completely oxidized metal and sulfide. Vugs and cracks are mostly filled with iron-hydroxides and sulfates.
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.76
Classification: Ordinary chondrite (L~4, W5)
Specimens: 20.2 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 22 g with *Bart*.

Loulan Yizhi 012 ~40°26'N, ~89°36'E
Xinjiang, China
Find: Nov 2018
Classification: Ordinary chondrite (L~4)
History: (Ziyao Wang) Purchased by Ziyao Wang from Tailu Zhao (Shanshan County, Xinjiang) in Shanshan/Xinjiang in 2018. This meteorite was discovered by Tailu Zhao and Dongfang Deng in Nov 2018.
Physical characteristics: (Ziyao Wang) Small brown-black stone of 13.1 g.
Petrography: (R. Bartoschewitz, *Bart*) brown, recrystallized matrix, with well-defined gray and white chondrules (0.3-1.5 mm, av. 0.6 mm), and completely oxidized metal and sulfide
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.12
Classification: Ordinary chondrite (L~4, W5)
Specimens: 2.8 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 3 g with *Bart*.

Loulan Yizhi 013 ~40°26'N, ~89°36'E
Xinjiang, China
Find: Nov 2018
Classification: Ordinary chondrite (H~5)

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History: (Ziyao Wang) Purchased by Ziyao Wang from Tailu Zhao (Shanshan County, Xinjiang) in Shanshan/Xinjiang in 2018. This meteorite was discovered by Tailu Zhao and Dongfang Deng in Nov 2018.
Physical characteristics: (Ziyao Wang) Small brown-black stone of 19 g.
Petrography: (R. Bartoschewitz, *Bart*) brown, recrystallized matrix, with well-defined gray chondrules (0.3-1.5 mm, av. 0.5 mm), and completely oxidized metal and sulfide. Vugs and cracks are mostly filled with iron-hydroxides and sulfates.
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.90
Classification: Ordinary chondrite (H~5, W5)
Specimens: 3.9 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 5 g with *Bart*.

Loulan Yizhi 014 ~40°26'N, ~89°36'E
Xinjiang, China
Find: Nov 2018
Classification: Ordinary chondrite (H~4)
History: (Ziyao Wang) Purchased by Ziyao Wang from Tailu Zhao (Shanshan County, Xinjiang) in Shanshan/Xinjiang in 2018. This meteorite was discovered by Tailu Zhao and Dongfang Deng in Nov 2018.
Physical characteristics: (Ziyao Wang) Small black stone of 4.8 g.
Petrography: (R. Bartoschewitz, *Bart*) brown, recrystallized matrix, with well-defined gray chondrules (0.3-1.5 mm, av. 0.6 mm), and completely oxidized metal and sulfide. Vugs and cracks are mostly filled with iron-hydroxides and sulfates.
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.87
Classification: Ordinary chondrite (H~4, W5)
Specimens: 0.96 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 1 g with *Bart*.

Loulan Yizhi 015 ~40°26'N, ~89°36'E
Xinjiang, China
Find: Nov 2018
Classification: Ordinary chondrite (H~5)
History: (Ziyao Wang) Purchased by Ziyao Wang from Tailu Zhao (Shanshan County, Xinjiang) in Shanshan/Xinjiang in 2018. This meteorite was discovered by Tailu Zhao and Dongfang Deng in Nov 2018.
Physical characteristics: (Ziyao Wang) Small brown stone of 22.5 g.
Petrography: (R. Bartoschewitz, *Bart*) brown, recrystallized matrix, with very poorly recognizable chondrules, and completely oxidized metal and sulfide
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.57
Classification: Ordinary chondrite (H~5, W5)

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Specimens: 5.0 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 5 g with *Bart*.

Loulan Yizhi 016 ~40°26'N, ~89°36'E
Xinjiang, China
Find: Nov 2018
Classification: Ordinary chondrite (L~5)
History: (Ziyao Wang) Purchased by Ziyao Wang from Tailu Zhao (Shanshan County, Xinjiang) in Shanshan/Xinjiang in 2018. This meteorite was discovered by Tailu Zhao and Dongfang Deng in Nov 2018.
Physical characteristics: (Ziyao Wang) Small brown stone of 11.8 g.
Petrography: (R. Bartoschewitz, *Bart*) brown, recrystallized matrix, with recognizable chondrules (0.3-1.2 mm, a. 0.8 mm), and completely oxidized metal and sulfide. Vugs and cracks are mostly filled with iron-hydroxides
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 3.96
Classification: Ordinary chondrite (L~5, W5)
Specimens: 2.44 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 3 g with *Bart*.

Loulan Yizhi 017 ~40°26'N, ~89°36'E
Xinjiang, China
Find: Nov 2018
Classification: Ordinary chondrite (H~4)
History: (Ziyao Wang) Purchased by Ziyao Wang from the finder Tailu Zhao (Shanshan County, Xinjiang) in Shanshan/Xinjiang in 2018. This meteorite was discovered in Nov 2018.
Physical characteristics: (Ziyao Wang) Small brown-black stone of 7.1 g.
Petrography: (R. Bartoschewitz, *Bart*) brown, recrystallized matrix, with well-defined gray chondrules (0.3-1.5 mm, av. 0.5 mm), and completely oxidized metal and sulfide. Vugs and cracks are mostly filled with iron-hydroxides and sulfates.
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.73
Classification: Ordinary chondrite (H~4, W5)
Specimens: 1.9 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 1 g with *Bart*.

Loulan Yizhi 018 ~40°26'N, ~89°36'E
Xinjiang, China
Find: Nov 2018
Classification: Ordinary chondrite (H~4)

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History: (Ziyao Wang) Purchased by Ziyao Wang from Tailu Zhao (Shanshan County, Xinjiang) in Shanshan/Xinjiang in 2018. This meteorite was discovered by Tailu Zhao and Dongfang Deng in Nov 2018.
Physical characteristics: (Ziyao Wang) Small brown-black stone of 19.9 g.
Petrography: (R. Bartoschewitz, *Bart*) brow,n recrystallized matrix, with well-defined gray chondrules (0.3-1.5 mm, av. 0.5 mm), and completely oxidized metal and sulfide. Vugs and cracks are mostly filled with iron-hydroxides and sulfates.
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.66
Classification: Ordinary chondrite (H~4, W5)
Specimens: 4.8 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 3 g with *Bart*.

Loulan Yizhi 019 ~40°26'N, ~89°36'E
Xinjiang, China
Find: Nov 2018
Classification: Ordinary chondrite (H~5)
History: (Ziyao Wang) Purchased by Ziyao Wang from Tailu Zhao (Shanshan County, Xinjiang) in Shanshan/Xinjiang in 2018. This meteorite was discovered by Tailu Zhao and Dongfang Dengi n Nov 2018.
Physical characteristics: (Ziyao Wang) Small black Flat shape stone of 18.3 g with fusion crust
Petrography: (R. Bartoschewitz, *Bart*) brown, recrystallized matrix, with defined gray chondrules (0.2-0.7 mm, av. 0.5 mm), and completely oxidized metal and sulfide. Vugs and cracks are mostly filled with iron-hydroxides and sulfates.
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.53
Classification: Ordinary chondrite (H~5, W5)
Specimens: 3.8 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 3 g with *Bart*.

Loulan Yizhi 020 ~40°26'N, ~89°36'E
Xinjiang, China
Find: Nov 2018
Classification: Ordinary chondrite (H~5)
History: (Ziyao Wang) Purchased by Ziyao Wang from Tailu Zhao (Shanshan County, Xinjiang) in Shanshan/Xinjiang in 2018. This meteorite was discovered by Tailu Zhao and Dongfang Deng in Nov 2018.
Physical characteristics: (Ziyao Wang) Small brown-black stone of 6.9 g.
Petrography: (R. Bartoschewitz, *Bart*) brown, recrystallized matrix, with defined gray chondrules (0.2-1.2 mm, av. 0.6 mm), and completely oxidized metal and sulfide. Vugs and cracks are mostly filled with iron-hydroxides and sulfates.

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Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ (× 10^{-9} m^3/kg) = 4.59
Classification: Ordinary chondrite (H~5, W5)
Specimens: 1.6 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 1 g with *Bart*.

Loulan Yizhi 021 ~40°26'N, ~89°36'E
Xinjiang, China
Find: Nov 2018
Classification: Ordinary chondrite (H~5)
History: (Ziyao Wang) Purchased by Ziyao Wang from Tailu Zhao (Shanshan County, Xinjiang) in Shanshan/Xinjiang in 2018. This meteorite was discovered by Tailu Zhao and Dongfang Deng in Nov 2018.
Physical characteristics: (Ziyao Wang) Small black stone of 5.8 g.
Petrography: (R. Bartoschewitz, *Bart*) brown, recrystallized matrix, with poorly defined gray chondrules (0.5-1 mm, av. 0.8 mm), and completely oxidized metal and sulfide. Vugs and cracks are mostly filled with iron-hydroxides and sulfates.
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ (× 10^{-9} m^3/kg) = 4.77
Classification: Ordinary chondrite (H~5, W5)
Specimens: 1.16 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 1 g with *Bart*.

Loulan Yizhi 022 ~40°26'N, ~89°36'E
Xinjiang, China
Find: Nov 2018
Classification: Ordinary chondrite (L~6)
History: (Ziyao Wang) Purchased by Ziyao Wang from Tailu Zhao (Shanshan County, Xinjiang) in Shanshan/Xinjiang in 2018. This meteorite was discovered by Tailu Zhao and Dongfang Deng in Nov 2018.
Physical characteristics: (Ziyao Wang) Small brown stone of 5.9 g.
Petrography: (R. Bartoschewitz, *Bart*) brown, recrystallized matrix, with poorly defined chondrules, and completely oxidized metal and sulfide. Vugs and cracks are mostly filled with iron-hydroxides and sulfates.
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ (× 10^{-9} m^3/kg) = 4.52
Classification: Ordinary chondrite (L~6, W5)
Specimens: 1.3 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 1 g with *Bart*.

Loulan Yizhi 023 ~40°26'N, ~89°36'E
Xinjiang, China

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Find: Nov 2018
Classification: Ordinary chondrite (H~5)

History: (Ziyao Wang) Purchased by Ziyao Wang from Tailu Zhao (Shanshan County, Xinjiang) in Shanshan/Xinjiang in 2018. This meteorite was discovered by Tailu Zhao and Dongfang Deng in Nov 2018.

Physical characteristics: (Ziyao Wang) Small, light-yellow stone of 4.5 g without fusion crust

Petrography: (R. Bartoschewitz, *Bart*) brown, recrystallized matrix, with defined gray chondrules (0.3-0.6 mm, av. 0.5 mm), and completely oxidized metal and sulfide. Vugs and cracks are mostly filled with iron-hydroxides and sulfates.

Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.52

Classification: Ordinary chondrite (H~5, W5)

Specimens: 1.0 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 1 g with *Bart*.

Loulan Yizhi 024 ~40°26'N, ~89°36'E
Xinjiang, China
Find: Nov 2018
Classification: Ordinary chondrite (L~4)

History: (Ziyao Wang) Purchased by Ziyao Wang from Tailu Zhao (Shanshan County, Xinjiang) in Shanshan/Xinjiang in 2018. This meteorite was discovered by Tailu Zhao and Dongfang Deng in Nov 2018.

Physical characteristics: (Ziyao Wang) Small brown stone of 6.4 g without fusion crust

Petrography: (R. Bartoschewitz, *Bart*) brown, recrystallized matrix, with well-defined gray and white chondrules (0.4-1.5 mm, av. 0.8 mm), and completely oxidized metal and sulfide

Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.51

Classification: Ordinary chondrite (L~4, W5)

Specimens: 1.9 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 1 g with *Bart*.

Loulan Yizhi 025 ~40°26'N, ~89°36'E
Xinjiang, China
Find: Nov 2018
Classification: Ordinary chondrite (H~5)

History: (Ziyao Wang) Purchased by Ziyao Wang from Tailu Zhao (Shanshan County, Xinjiang) in Shanshan/Xinjiang in 2018. This meteorite was discovered by Tailu Zhao and Dongfang Deng in Nov 2018.

Physical characteristics: (Ziyao Wang) Small brown-black stone of 4.5 g without fusion crust

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Petrography: (R. Bartoschewitz, *Bart*) brown, recrystallized matrix, with well-defined gray and white chondrules (0.2-0.7 mm, av. 0.5 mm), and completely oxidized metal and sulfide. Vugs and cracks are mostly filled with iron-hydroxides and sulfates.
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.58
Classification: Ordinary chondrite (H~5, W5)
Specimens: 1.1 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 1 g with *Bart*.

Loulan Yizhi 026 ~40°26'N, ~89°36'E
Xinjiang, China
Find: Nov 2018
Classification: Ordinary chondrite (L~6)
History: (Ziyao Wang) Purchased by Ziyao Wang from Tailu Zhao (Shanshan County, Xinjiang) in Shanshan/Xinjiang in 2018. This meteorite was discovered by Tailu Zhao and Dongfang Deng in Nov 2018.
Physical characteristics: (Ziyao Wang) Small black stone of 6.1 g, without fusion crust
Petrography: (R. Bartoschewitz, *Bart*) black-gray matrix with poorly recognizable chondrules, and completely oxidized metal and sulfide.
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.44
Classification: Ordinary chondrite (L~6, W5)
Specimens: 1.9 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 1 g with *Bart*.

Loulan Yizhi 027 ~40°26'N, ~89°36'E
Xinjiang, China
Find: Nov 2018
Classification: Ordinary chondrite (L~5)
History: Discovered by Tailu Zhao (Shanshan County, Xinjiang) on Nov. 25, 2018.
Physical characteristics: brown glossy stone of 73.6 g
Petrography: (R. Bartoschewitz, *Bart*) brown, recrystallized matrix, with defined gray chondrules (0.3-2 mm, av. ~0.8 mm), and completely oxidized metal and sulfide. Vugs and cracks are mostly filled with iron-hydroxides and sulfate.
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.79
Classification: Ordinary chondrite (L~5, W5)
Specimens: 19.1 g on deposit at *Kiel*, *Bart* holds the main mass.

Loulan Yizhi 029 ~40°26'N, ~89°54'E

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Xinjiang, China
Find: unknown
Classification: Ordinary chondrite (H~4)

History: (Ziyao Wang) Tailu Zhao from Shanshan discovered this stone close to the Louland Yizhi ancient city. Find date and exact coordinates were not documented. Ziyao Wang obtained this stone in December 2018 and donated it to R. Bartoschewitz.

Physical characteristics: One brown heavy corroded stone grown together with hardened desert soil of 35 g

Petrography: (R. Bartoschewitz, *Bart*) brown recrystallized matrix with well developed chondrules (0.4-2 mm, av. 0.6 mm), metal and sulphide completely oxidized, cracks show crystalls of sulphates and carbonates.

Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.94

Classification: Ordinary Chondrite (H~4, W6)

Specimens: 7.4 g on deposit at *Kiel*, 20 g with *Bart*.

Loulan Yizhi 030 ~40°26'N, ~89°54'E
Xinjiang, China
Find: unknown
Classification: Ordinary chondrite (L~4)

History: (Ziyao Wang) Tailu Zhao from Shanshan discovered this stone close to the Louland Yizhi ancient city. Find date and exact coordinates were not documented. Ziyao Wang obtained this stone in December 2018. After cutting the smaller part of the stone got lost, the remnant piece was donated it to R. Bartoschewitz.

Physical characteristics: One brown heavy corroded stone of 14 g

Petrography: (R. Bartoschewitz, *Bart*) brown recrystallized matrix with well defined chondrules (0.4-2 mm, av. 0.9 mm), metal and sulfide completely oxidized. Often former feldspar/mesostasis is leached from chondrules. Cracks sometimes filled with sulfates.

Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.55

Classification: Ordinary Chondrite (L~4, W6)

Specimens: 2.85 g on deposit at *Kiel*, 5 g with *Bart*.

Loulan Yizhi 031 ~40°26'N, ~89°54'E
Xinjiang, China
Find: 2018
Classification: Ordinary chondrite (LL~5)

History: (Ziyao Wang) Purchased by Ziyao Wang from Jianming Wang in Hami/Xinjiang in 2019. This meteorite was discovered in 2018.

Physical characteristics: (Ziyao Wang) One yellow-brown stone of 97.7 g without fusion crust

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Petrography: (R. Bartoschewitz, *Bart*) Light-brown oxidized matrix with few recognizable gray chondrules (0.4-1.5 mm) and few metal and sulphide specks.
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.20
Classification: Ordinary chondrite (LL~5, W3)
Specimens: 22.7 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 24 g with *Bart*.

Loulan Yizhi 032 ~40°26'N, ~89°54'E
Xinjiang, China
Find: 2018
Classification: Ordinary chondrite (L~4)
History: (Ziyao Wang) Purchased by Ziyao Wang from Jianming Wang in Hami/Xinjiang in 2019. This meteorite was discovered in 2018.
Physical characteristics: (Ziyao Wang) Brown stone of 40.2 g
Petrography: (R. Bartoschewitz, *Bart*) Yellow-brown, heavily oxidized matrix with well defined gray chondrules (0.3-1.2 mm). Metal and sulfide are completely oxidized.
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.60
Classification: Ordinary chondrite (L~4, W5)
Specimens: 8.1 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 10 g with *Bart*.

Loulan Yizhi 033 ~40°26'N, ~89°54'E
Xinjiang, China
Find: 2018
Classification: Ordinary chondrite (L~4)
History: (Ziyao Wang) The geologist Jianming Wang bought two stones from a merchant dealing in stones in Hami. Both stones were discovered close to each other in 2018. Jianming Wang obtained them in Hami/Xinjiang in 2019 and donated them to R. Bartoschewitz.
Physical characteristics: Two brown stones of 23.73 g (12.02 and 11.71 g) with evaporation minerals on surface cracks
Petrography: (R. Bartoschewitz, *Bart*) Yellow-brown heavy oxidized matrix with well defined gray chonrules (0.3-1.2 mm). Metal and sulfide are completely oxidized.
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.57
Classification: Ordinary chondrite (L~4, W5)
Specimens: 4.8 g on deposit at *Kiel*, *Bart*. holds the main mass

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Loulan Yizhi 036 ~40°26'N, ~89°36'E
Xinjiang, China
Find: 2019
Classification: Ordinary chondrite (L~6)
History: (Ziyao Wang) Purchased by Ziyao Wang from Dongfang Deng in Shanshan/Xinjiang in 2019. This meteorite was discovered in the Loulanyizhi dense collection area in 2019.
Physical characteristics: (Ziyao Wang) irregularly shaped stone, 4.2 kg, with some black fusion crust on the front and a lot of yellow rust on the bottom
Petrography: (R. Bartoschewitz, *Bart*) brown recrystallized matrix with indistinct chondrules. Metal and sulfide are completely oxidized.
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.56
Classification: Ordinary chondrite (L~6, W4)
Specimens: 21.8 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 157 g with *Bart*.

Loulan Yizhi 037 ~40°21'N, ~89°41'E
Xinjiang, China
Find: 2018 Nov
Classification: Ordinary chondrite (L~6)
History: (Ziyao Wang) Purchased by Ziyao Wang from Dongfang Deng (Shanshan County, Xinjiang) in Shanshan/Xinjiang in 2019. This meteorite was discovered by Dongfang Deng in the Loulan Yizhi dense collection area in Nov 2018.
Physical characteristics: (Ziyao Wang) light-gray stone of 7.8 kg, without fusion crust.
Petrography: (R. Bartoschewitz, *Bart*) gray recrystallized matrix with indistinct chondrules (av. 0.8 mm), metal and sulfide.
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.91
Classification: Ordinary chondrite (L~6, W3)
Specimens: 25.3 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 147 g with *Bart*.

Loulan Yizhi 038 ~40°30'N, ~89°54'E
Xinjiang, China
Find: 2019
Classification: Ordinary chondrite (LL~5)
History: (Ziyao Wang) Purchased by Ziyao Wang from Dongfang Deng in Shanshan/Xinjiang in 2019. This meteorite was discovered in the Loulanyizhi dense collection area in 2019.
Physical characteristics: (Ziyao Wang) flat stone of 313 g with some black fusion crust.

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Petrography: (R. Bartoschewitz, *Bart*) gray recrystallized matrix with chondrules (0.4 - 1.5, av. 0.9 mm), sulfide and metal.
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 3.73
Classification: Ordinary chondrite (LL~5, W2)
Specimens: 22.5 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 49 g with *Bart*.

Loulan Yizhi 039 ~40°25'N, ~89°55'E
Xinjiang, China
Find: 2019
Classification: Ordinary chondrite (L~6)
History: (Ziyao Wang) Purchased by Ziyao Wang from Weiwei Wang and Tailu Zhao in Shanshan/Xinjiang in 2019. This meteorite was discovered in the Loulanyizhi dense collection area in 2019.
Physical characteristics: (Ziyao Wang) irregularly shaped stone of 2.1 kg, with black fusion crust
Petrography: (R. Bartoschewitz, *Bart*) gray to brown recrystallized matrix with indistinct chondrules, metal and sulfide.
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.60
Classification: Ordinary chondrite (L~6, W3)
Specimens: 20.3 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 110 g with *Bart*.

MacKay Glacier 14001 (MCY 14001) 77°14.084'S, 158°07.606'E
Antarctica
Find: 2015 Jan 14
Classification: Carbonaceous chondrite (CM2)
Physical characteristics: 1.5 × 1.5 × 1 cm, angular shape, uncrusted, dark colour, chondrule in relief (15 vol%)
Petrography: Chondrule abundance: 20%. Average apparent chondrule diameter: 250 µm. CAI Abundance: 7%. Phyllosilicate in chondrule mesostasis; modest alteration of mafic silicates in chondrules. Abundant phyllosilicates in matrix. Silica plus Al_2O_3 = 13 wt%, FeO = 53 wt% and MgO = 13 wt%.
Geochemistry: Olivine: $Fa_{0.3-57}$, Low-Ca pyroxene $Fs_{0.6-5}Wo_{0.15-5}$
Classification: Carbonaceous chondrite (CM2). Paired with MCY 14004 and MCY 14014.

MacKay Glacier 14004 (MCY 14004) 77°14.063'S, 158°03.742'E
Antarctica
Find: 2015 Jan 15

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Classification: Carbonaceous chondrite (CM2)
Physical characteristics: 2 × 1.5 × 1 cm angular shape, partly fusion crusted, dark colour, small chondrules (~20% vol.) in relief on broken surfaces
Classification: Carbonaceous chondrite (CM2). Paired with MCY 14001 and MCY 14014.

MacKay Glacier 14014 (MCY 14014) 77°13.977'S, 158°04.732'E
Antarctica
Find: 2015 Jan 19
Classification: Carbonaceous chondrite (CM2)
Physical characteristics: 2 × 1.5 × 1 cm angular shaped stone with remnants of fusion crust; dark color.
Petrography: The sections consist of a few small chondrules (up to 0.3 mm), mineral grains and CAIs (3 vol%) set in a black matrix; rare metal (0.5-1 vol%) and sulfide grains are present. Phyllosilicates in chondrule mesostasis; modest alteration of mafic silicates in chondrules, abundant phyllosilicates in matrix.
Geochemistry: Olivines Fa_{1-0}, with many around Fa_1. Major elements composition of the matrix have low totals (82.2 wt%, n=5) due to the occurrence of hydrated minerals.
Classification: Carbonaceous chondrite (CM2)

Mhabes el Hamra 26.2269568°N, 7.8181461°W
Tiris Zemmour, Mauritania
Probable fall: 2018 Dec 23
Classification: Ordinary chondrite (H4/5)
History: Three shepherds (Salek Mohamed, Sidi Ahmed Taleb and Baji Ayoub) were searching for desert truffles in the Tiris Zemmour region of northern Mauritania on December 23, 2018, when they heard a loud sonic boom at 9:30 am. After 36 hours of searching they found five freshly broken stones which fit together to make one complete stone near the village of Mhabes el Hamra. One week later, all of the material was acquired by Aziz Habibi.
Physical characteristics: The recovered pieces (total weight 23100 g) have black fusion crust on exterior surfaces and light gray interiors with abundant fresh metal visible.
Petrography: (A. Irving and S. Kuehner, *UWS*) Some well-formed, relatively small chondrules occur within a moderately recrystallized matrix containing abundant metal (kamacite plus taenite) and accessory merrillite. The meteorite is texturally transitional between petrographic types 4 and 5.
Geochemistry: Olivine ($Fa_{18.6-19.1}$, N = 3), orthopyroxene ($Fs_{15.9-16.2}Wo_{1.1.1-1.4}$, N = 3), clinopyroxene ($Fs_{5.5.9-6.0}Wo_{45.2-45.0}$, N = 2), plagioclase ($An_{11.3-14.9}Ab_{83.6-81.6}Or_{5.1-3.5}$, N = 2). Cosmogenic radionuclides (Å. Rosén, B. Hofmann, *NMBE*, GeMSE): Gamma-spectroscopy performed January 30 to February 11, 2019, on a 23.82 g sample showed the presence of several short-lived cosmogenic

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radionuclides: ^{46}Sc, ^{56}Co, ^{58}Co, ^{7}Be ($t_{1/2}$= 53 d; 58.9.6+10.4/-8.4 dpm/kg) and ^{48}V ($t_{1/2}$= 16 d; 22.9+5.7/-2.6 dpm/kg). Recalculated to December 23, 2018, the $^{22}Na/^{26}Al$ activity ratio is 1.98±0.17. The ^{26}Al activity of 41.6+7.8/-2.1 dpm/kg and absence of detected ^{60}Co (<0.8 dpm/kg) indicates low shielding.
Classification: Ordinary chondrite (H4/5). Cosmogenic radionuclide results confirm that this is a fresh fall.
Specimens: 20.2 g including one polished thin section at *UWB*; remainder with A. Habibi.

Natun Balijan 27.856°N, 95.878°E
Assam, India
Fall: 2017 Jun 05 (04:30 PM IST)
Classification: Ordinary chondrite (L4)
History: Eyewitnesses reported that the Sadiya meteorite fell at about angle of 60º in the S15ºW to N15ºE direction. Detonating sound was heard and the meteorite fell on cultivated land (older flood plains) of the Lohit river. The depth of penetration was about 45 cm and a pit of ~40 cm diameter was formed. The diameter of the pit gradually narrows to about 12 cm with depth. One piece of sample was retrieved from the fall site. Shri Somnath Sharma, Director (Geology), State Unit: Assam, *GSI*, North Eastern Region (NER), Guwahati- 781005, Assam, India obtained the sample from the office of the Deputy Commissioner (Govt. of Assam), Tinsukia district, Assam, India.
Physical characteristics: The meteorite is nearly spherical (diameter ~15 cm), covered with well-preserved fusion crust (thickness ~1-2 mm), and has near rounded edges. Well-developed surface grooves and regmaglypts are present. Chondrules are also visible to the naked eyes.
Petrography: This meteorite is composed of olivine + orthopyroxene + clinopyroxene + feldspathic glass + Fe-Ni metals (kamacite and taenite) + troilite ± magnetite ± merrillite. The chondrules contain olivine and orthopyroxene, with interstitial spaces (mesostasis) occupied by feldspathic glass + feather-like clinopyroxene. The size of chondrules varies from 400-1000 µm (diameter). The shape of chondrules varies from near circular-elliptical to sub-elliptical and rarely as angular. Chondrule types include Barred Olivine (BO), Porphyritic Pyroxene (PP), Porphyritic Olivine (PO), Porphyritic Olivine Pyroxene (POP) and Granular Olivine (GO), and individual chondrule margins are moderately well defined. Matrix is relatively fine grained and thoroughly recrystallized.
Geochemistry: Olivine, $Fo_{73-75}Fa_{25-27}$; clinoenstatite, $En_{69-76.7}Fs_{22-30}Wo_{1-4}$; clinopyroxene (augite - diopside), $Wo_{27-48.8}\,En_{43.7-59}\,Fs_{7.3-13.4}$); and feldspathic glass (albite to oligoclase), $Ab_{79.4-86}An_{10-11}Or_{4-10}$ with FeO_T content <= 1 wt%.). Kamacite contains Fe ~84-93% and Ni ~6.5-16% , and taenite contains Fe ~46% and Ni ~ 54%.
Classification: Different textural variants of olivine and orthopyroxene exhibit near consistent mineral chemical compositional range (X_{Mg}) suggesting Natun Balijan is an equilibrated ordinary chondrite (L4) with localized chemical inhomogeneity.

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Specimens: The specimen initially was kept in the safe custody of the office of the Deputy Commissioner (Govt. of Assam), Tinsukia district, Assam, India. Subsequently as per the instruction of the Joint Secretary (to the Govt. of Assam), Science and Technology Department, Dispur, Guwahati-781006, Assam, India vides letter no. STE 164/2001/121 dated 28th July 2017 the sample was handed over to the *GSI* by the Deputy Commissioner (Govt. of Assam), Tinsukia district, Assam. Shri Somnath Sharma, Director (Geology), State Unit: Assam, *GSI*, North Eastern Region (NER), Guwahati- 781005, Assam colleted the sample on behalf of the Director General, *GSI* from the office of the Deputy Commissioner (Govt. of Assam), Tinsukia district, Assam, India. The specimen was officially handed over to the Meteorite & Planetary Science Division (MPSD), 15, A & B Kyd Street, *GSI*, Kolkata on 14.08.2017 by Shri Somnath Sharma, Director (Geology).

North Trigo Peaks 33°28.13'N, 114°26.070'W
Arizona, United States
Find: 1992
Classification: Ordinary chondrite (L5)

History: Purchased by Norm Lehrman on 28 January 2005 from the finder, Charles Graff of Kemp, Texas, a gold-prospector, who had it in a display case at Quartzsite, Arizona. The finder did not recognize his find as being a meteorite until after meeting Prof. Jim Kriegh several years later. Several reports of other masses having been found from this locality have not been corroborated.

Physical characteristics: A single rusty-brown, moderately-weathered whole stone.

Petrography: (A. Rubin, *UCLA*) Chondrules are readily delineated. Olivine and low-Ca pyroxene grains exhibit sharp optical extinction. None of the low-Ca pyroxene grains exhibits polysynthetic twinning, indicating that these grains are orthopyroxene.

Geochemistry: olivine $Fa_{20.5\pm0.4}$ (n=8); low-Ca pyroxene $Fs_{20.5\pm0.4}$ (n=2); $Wo_{1.9\pm0.4}$ (n=2)

Classification: Ordinary chondrite (L5). Distinguishable from Gold Basin (L4-L6, S3-S5, W2-W5) due to the lower shock stage.

Specimens: A total of 25.0 grams of material and one polished thin section are on deposit at *UCLA*. Field ID = NL-AZ-01; *UCLA* ID = LC1419 The main mass is held by Norm Lehrman of Spokane, Washington.

Northwest Africa 441 (NWA 441)
Morocco
Purchased: 2019
Classification: Carbonaceous chondrite (CO3)

History: Purchased in November 2019 by Nick *Gessler* from an anonymous dealer in Morocco.

Physical characteristics: Unusual morphology. Shaped like a wedge of cheese with the central point missing. Top surface is flat and bottom surface is flat and parallel

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except for some ragged breaks. A third parallel crack bisects the thickness. The sides are quite flat and at right angles to the parallel surfaces. The exterior appears to be entry ablated and wind and sand polished except for the breaks. There is no caliche.
Petrography: (D. Sheikh, *FSU*) Small chondrules (~150±50 µm) and rare CAI (~100 µm) are set in a dark-colored matrix. Sample contains olivine, orthopyroxene, troilite, Fe-oxides, and rare Fe-Ni metal.
Geochemistry: Olivine ($Fa_{32.6\pm14.3}$, range $Fa_{14.8-52.3}$, n=15), Low-Ca Pyroxene ($Fs_{3.3\pm1.6}Wo_{1.4\pm0.6}$, range $Fs_{1.2-5.9}Wo_{0.7-2.6}$, n=21).
Classification: Carbonaceous chondrite (CO3).
Specimens: 22 grams at *UCLA*; main mass with Nick *Gessler*.

Northwest Africa 2191 (NWA 2191)
(Northwest Africa)
Purchased: Jan 2018
Classification: HED achondrite (Eucrite, monomict)
History: The meteorite was exported from Morocco to Tucson where it was purchased by N. *Gessler*.
Physical characteristics: About 4/5 of the surface was fusion crusted; 1/4 was covered with caliche. Cut surfaces show the groundmass has a distinctive, pale-greenish grey color, except where broken by abundant (~5%) millimeter-sized patches and streaks of root-beer brown, likely oxidization zones around former scattered Fe-metals.
Petrography: The sample shows very limited, localized brecciation. It consists dominantly of pyroxene and plagioclase, along with subequal proportions of silica, olivine and ilmenite, and lesser troilite, metal (and more abundant Fe-oxide apparent products of metal weathering) and apatite. Grain sizes are diverse from place to place. Grain lengths are locally up to1 mm but more commonly a small fraction of that, and several enclaves consist of dominantly equant grains of order 5-10 µm across. The original igneous texture was dominantly subophitic, but was uneven and is now somewhat obscured due to thermal metamorphism (and possibly metasomatism), which manifests as thin exsolution lamellae mainly in pyroxene cores, complex "cloudiness" of microinclusions, and localized annealing textures.
Geochemistry: Low-Ca pyroxene clusters near $Fs_{68}Wo_{1.8}$, augite near $Fs_{31}Wo_{43}$, both unusually ferroan for a eucrite. Pyroxene FeO/MnO averages (118 analyses) 32.6. Plagioclase (31 analyses) is An_{59-94}, average An_{75+}/-12. Olivine (7 analyses) is uniformly $Fa_{86-88.}$ The aphanitic enclaves show phase compositions indistinguishable from the coarsest areas of the rock. X-ray maps document that within the larger pyroxenes strong Ca zoning survived through the thermal metamorphism. Surviving metal is extremely Ni-poor (undetectable by EDS analysis). The bulk composition, determined by INAA and fused-bead EPMA, with similar results from 2 chips totaling 700 mg, backed up by analyses of fusion crust, is uncommonly evolved for a eucrite: bulk Mg/(Mg+Fe) ~ 28 mol%, 1.4 wt% TiO_2, 0.63 wt% Na_2O, and Ga ~ 2.7 µg/g (further confirming evolved-eucrite affinity, by implying 1000Ga/Al = 0.047, commensurate with Na/Al = 0.084).

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Classification: Eucrite, monomict breccia.
Specimens: Main mass with *Gessler*, type specimen, including multiple thin sections, at *UCLA*.

Northwest Africa 2402 (NWA 2402)
(Northwest Africa)
Purchased: May 2017
Classification: Lunar meteorite
History: The meteorite was exported from Morocco to Tucson where it was purchased by N. *Gessler*.
Physical characteristics: Weathered reddish-black fusion crust on one side. Dark-gray matrix with abundant clasts, frequently angular in outline, up to 8 mm, varying from white to near-black.
Petrography: The texture is an immature regolith breccia, gradational with polymict nonregolithic (fragmental) breccia. A finite but very sparse abundance of regolithic spheroids (two identified in a large thin section) is the main indication for an immature regolith breccia. The groundmass is mafic-rich. Clasts vary in mode from Ti-poor basaltic to anorthositic (9/10 plagioclase, granulitic). Pyroxene is the dominant mafic silicate; and in the groundmass, in the basaltic clasts, and in relatively coarse mineral clasts, mostly shows a similar fine, roughly µm-scale, exsolution. Lithic clast textures include vitrophyric, fine-scale poikilitic (impact melt?), granulitic, and medium-grained basaltic. One unusual clast, 0.4 × 0.2 mm, consists of a symplectitic intergrowth of roughly 50% ferroan olivine, 35% silica and 15% augite (with very fine-scale exsolution lamellae of low-Ca pyroxene) and 0.5% ilmenite.
Geochemistry: On the pyroxene quadrilateral, compositions (28 analyses) scatter evenly across the space bounded by $Fs_{22}Wo_9$, $Fs_{54}Wo_6$, $Fs_{52}Wo_{21}$ and $Fs_{38}Wo_{39}$; the last being the pyroxene of the olivine-silica-pyroxene simplectitic clast. Pyroxene FeO/MnO averages 65.5. The olivine of the sympectitic clast is uniformly Fa_{83}. Olivine elsewhere is as magnesian as Fa_{28}. Plagioclase (8 analyses) ranges from An_{88} to An_{97}, the latter extreme coming from the same poikilitic highland clast that yielded the Fa_{28} olivine. Two glassy spheroids have VLT-mare compositions similar to glasses in Yamato 793274. The bulk composition, determined by INAA and fused-bead EPMA applied to 2 chips totaling 760 mg, has 18 wt% Al_2O_3, 12.2 wt% FeO and Mg/(Mg+Fe) = 57 mol%, a combination that (along with the spheroids, and the compositional spread and slight exsolution in much of the pyroxene) suggests a significant VLT-mare component. The bulk TiO_2 is only 0.58 wt%. The bulk-rock concentration of the arch incompatible element Th is 1.0 µg/g. Geochemically as well as petrographically, this sample strongly resembles the first highland-mare mixed breccia, Yamato 793274.
Classification: Lunar mixed highland-mare breccia
Specimens: Main mass with *Gessler*, type specimen at *UCLA*.

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Northwest Africa 2403 (NWA 2403)
(Northwest Africa)
Purchased: Jan 2016
Classification: HED achondrite (Eucrite, unbrecciated)

History: The meteorite was exported from Morocco to Tucson where it was purchased by N. *Gessler*.

Physical characteristics: 85% fusion crusted, locally dull with crazing and flow lines, elsewhere wind-polished and semi-glossy. The sawn interior is fine-grained, medium gray.

Petrography: The texture is unbrecciated subophitic, with grains typically 1 mm long, maximally 2 mm. Along with the usual eucrite preponderance of pyroxene and plagiolcase, minor ilmenite and silica, and very minor troilite, the rock contains scattered rather coarse Fe-metals, one of which is 1 mm long and vein-like in shape.

Geochemistry: Low-Ca pyroxene clusters near $Fs_{59}Wo_2$, augite near $Fs_{25}Wo_{44}$, both typical for a noncumulate eucrite. Pyroxene FeO/MnO averages (9 analyses) 31.8. Two plagioclase analyses show $An_{81-85.}$ The bulk composition, determined by INAA and fused-bead EPMA applied to 2 chips totaling 680 mg, is fairly nondescript for a eucrite, with bulk Mg/(Mg+Fe) ~ 40 mol%, 0.9 wt% TiO_2, and 0.55 wt% Na_2O.

Classification: Eucrite, unbrecciated.

Specimens: Main mass with *Gessler*, type specimen at *UCLA*.

Northwest Africa 2405 (NWA 2405)
(Northwest Africa)
Purchased: Jan 2018
Classification: HED achondrite (Eucrite, brecciated)

History: The meteorite was exported from Morocco to Tucson where it was purchased by N. *Gessler*.

Physical characteristics: 20% fusion crusted. The interior displays a distinctive structure of angular pale tan clasts of basalt (3/4) set in a subordinate proportion (1/4) of dark grey, vein-like (shock-melted) materials, with vein widths ranging from indiscerniblly thin to approximately, locally, 3 mm.

Petrography: The rock consists predominantly of clasts of little-brecciated subophitic basalt, with grain sizes generally near 1 mm, with a typical pyroxene and plagioclase dominated eucritic mode, and displaying typical eucritic thermal-metamorphic exsolution in pyroxene. The shock state of the clastic matter varies; locally, its plagioclase has been partially maskelynitized. The subordinate component of shock-melt vein material that choaotically criss-crosses the rock is much finer grained.

Geochemistry: Low-Ca pyroxene clusters near $Fs_{61}Wo_2$, augite near $Fs_{27}Wo_{43}$, both typical for a noncumulate eucrite. Pyroxene FeO/MnO averages (26 analyses) 31.5. Plagioclase (8 analyses) is $An_{88-90.}$ The bulk composition, determined by INAA and fused-bead EPMA applied to 2 chips totaling 650 mg, is fairly nondescript for a eucrite, with bulk Mg/(Mg+Fe) ~ 38 mol%, 0.6 wt% TiO_2, and 0.44 wt% Na_2O; and

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shows little difference between a chip dominated (~70%) by dark shock-vein matter and a chip of preponderantly (~95%) pale tan clastic matter.
Classification: Eucrite, brecciated.
Specimens: Main mass with *Gessler*, type specimen at *UCLA*.

Northwest Africa 2409 (NWA 2409)
(Northwest Africa)
Purchased: Jan 2018
Classification: HED achondrite (Eucrite, unbrecciated)
History: The meteorite was exported from Morocco to Tucson where it was purchased by N. *Gessler*.
Physical characteristics: 70% of surface was a glossy fusion crust. Virtually no caliche on surface. The interior shows a uniform, unbrecciated, relatively coarse-grained basalt; light grey overall, with medium-gray pyroxene and white plagioclase.
Petrography: The texture is unbrecciated subophitic, relatively coarse for a eucrite with grains typically 2-3 mm across, up to 4 mm long. The mode shows a typical eucrite preponderance of pyroxene and plagiolcase, with minor ilmenite and silica, and very minor troilite.
Geochemistry: Low-Ca pyroxene clusters near $Fs_{58}Wo_3$, augite near $Fs_{25}Wo_{44}$, both typical for a noncumulate eucrite. Pyroxene FeO/MnO averages (23 analyses) 29.8. Plagioclase (10 analyses) is An_{87-92}. The bulk composition, determined by INAA and fused-bead EPMA applied to 2 chips totaling 650 mg, is uncommonly Ti-poor for a noncumulate eucrite, with bulk Mg/(Mg+Fe) ~ 40 mol%, 0.4 wt% TiO_2, and 0.43 wt% Na_2O.
Classification: Eucrite, unbrecciated.
Specimens: Main mass with *Gessler*, type specimen at *UCLA*.

Northwest Africa 2420 (NWA 2420)
(Northwest Africa)
Purchased: Jan 2017
Classification: Lunar meteorite
History: The meteorite was exported from Morocco to Tucson where it was purchased by N. *Gessler*.
Physical characteristics: Dark grey matrix with lighter gray to white clasts up to 7 mm.
Petrography: Overall, the sample consists preponderantly of plagioclase, although mafic silicates are comparably abundant in some clasts. The texture is a fine-grained and obviously polymict breccia, but hard to precisely classify. The groundmass is especially fine grained and locally vesicular. But most of the rock consists of diverse lithic and mineral clasts that survived the breccia-forming process. The clasts include earlier-generation impact melt products akin to "crystalline lunar spherules". Glass (i.e., clearly regolithic) spheroids are not found. Several patches of brown, swirly,

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vesicular glass suggest a possible minor component of regolithic derivation, but the brown color is less diagnostic in a meteoritic find than it would be an Apollo breccia.
Geochemistry: Low-Ca pyroxene (11 analyses) is compositionally diverse, e.g., $Fs_{30}Wo_{11}$, $Fs_{51}Wo_{9}$, with average FeO/MnO = 55.9; while 2 augite analyses are $Fs_{20}Wo_{41}$ and $Fs_{26}Wo_{40.}$ Plagioclase (9 analyses) is $An_{95.4-96.8}$, average $An_{96.1.}$ The bulk composition, determined by INAA and fused-bead EPMA applied to 2 chips totaling 670 mg, is uncommonly aluminous (31 wt% Al_2O_3) even for a lunar highland breccia, and also ferroan with bulk Mg/(Mg+Fe) = 57 mol%. For the middle REE Sm, as a representative incompatible element, the sample has 0.9 µg/g, and for the arch-incompatible Th, 0.2 µg/g.
Classification: Lunar highland polymict breccia
Specimens: Main mass with *Gessler*, type specimen at *UCLA*.

Northwest Africa 2638 (NWA 2638)
(Northwest Africa)
Purchased: 2004
Classification: Ordinary chondrite (H4)
History: Purchased by Adam *Hupe* in 2004 from a dealer in Erfoud, Morocco.
Petrography: (A. Irving, *UWS* and J. Boesenberg, *BrownU*; T. Bunch and J. Wittke, *NAU*) Well-formed, relatively small chondrules are set in a relatively coarse grained matrix containing abundant altered metal.
Geochemistry: Olivine ($Fa_{17.9\pm0.2}$ (range $Fa_{17.7-18.3}$, N = 5), low-Ca pyroxene ($Fs_{15.5\pm1.5}Wo_{0.4\pm0.1}$ (range $Fs_{13.8-16.6}Wo_{0.5-0.3}$, N = 3).
Classification: Ordinary chondrite (H4).
Specimens: 11.5 g including one polished thin section at *PSF*; remainder with AHupé.

Northwest Africa 2653 (NWA 2653)
Northwest Africa
Purchased: 2004
Classification: CV7
History: Acquired by Rob Wesel in 2004 as part of a parcel of specimens purchased from Moroccan dealers by a consortium of collectors.
Petrography: (A. Irving and S. Kuehner, *UWS*; T. Bunch and J. Wittke, *NAU*) Triple grain junction texture devoid of chondrules or chondrule remnants. Mostly composed of fine-grained (<0.5 mm, mean 0.185 mm) polygonal, subhedral grains with the exception of several larger (1.2-3.0 mm) orthopyroxene grains that contain very small (<0.1 mm) olivine inclusions. Minerals are compositionally homogeneous olivine, orthopyroxene, clinopyroxene and intermediate plagioclase (100 to 700 µm) with accessory merrillite, chlorapatite, chromite, troilite, altered kamacite and taenite. Secondary goethite (formed by terrestrial weathering) occurs as thin veinlets and thin coatings on grain boundaries.

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Geochemistry: Olivine ($Fa_{22.0-22.2}$, FeO/MnO = 65-83, N = 3), orthopyroxene ($Fs_{19.1-19.6}Wo_{2.7-2.2}$, FeO/MnO = 39-43, N = 3), clinopyroxene ($Fs_{7.8-8.3}Wo_{44.8-44.5}$, FeO/MnO = 29-43, N = 2), plagioclase ($An_{53.2-53.4}Or_{2.3-2.4}$, N = 2), chromite (Cr/(Cr+Al) = 84.5), taenite (Ni = 18.9 wt. %). Oxygen isotopes (K. Ziegler, *UNM*): analyses of acid-washed subsamples by laser fluorination gave, respectively $\delta^{17}O$ -2.333, 1.162, -3.523; $\delta^{18}O$ 2.673, 7.086, 1.227; $\Delta^{17}O$ -3.744, -2.579, -4.171 per mil.
Classification: Carbonaceous chondrite (CV7). This highly recrystallized, chondrule-free material is paired with Northwest Africa 3133; oxygen isotopes for both specimens plot on the trend line for CV chondrites. The bulk elemental abundances, chromium isotopes and tungsten isotopes for NWA 3133 (and by inference for NWA 2653) overlap with corresponding values for Allende and other CV chondrites.
Specimens: 10.2 g including one polished thin section and a polished slice at *PSF*; the remaining material is with Mr. R. Wesel.

Northwest Africa 3188 (NWA 3188)
(Northwest Africa)
Purchased: 2006
Classification: Ordinary chondrite (H6)
History: Purchased by Carsten Giessler in 2006 from a Moroccan dealer.
Petrography: (A. Irving, *UWS* and J. Boesenberg, *BrownU*) Largely recrystallized with triple grain junction to poikiloblastic texture. Holly-leaf shaped opaque phases are relatively abundant and rare remnant chondrules are present.
Geochemistry: Olivine ($Fa_{18.9\pm0.1}$ (range $Fa_{18.8-18.9}$, N = 3), low-Ca pyroxene ($Fs_{17.0\pm0.2}Wo_{1.3\pm0.2}$ (range $Fs_{16.7-17.2}Wo_{1.5-1.1}$, N = 4).
Classification: Ordinary chondrite (H6). Although this specimen has the attributes of a Type 6 chondrite, it is texturally transitional to Type 7.
Specimens: 35 g including one polished thin section at *PSF*; remainder with Mr. C. Giessler.

Northwest Africa 4414 (NWA 4414)
(Northwest Africa)
Purchased: 2006 Jan
Classification: Carbonaceous chondrite (CV3)
History: Purchased by Greg *Hupe* in January 2006 from a dealer in Erfoud, Morocco.
Petrography: (A. Irving, *UWS* and J. Boesenberg, *BrownU*; T. Bunch and J. Wittke, *NAU*) Relatively large, well-formed chondrules (apparent diameter 1110±860 µm, N = 24; some with concentric rims) and irregularly shaped, fine-grained CAI are set in a finer grained matrix (~25 vol.%, red-brown in thin section).
Geochemistry: Olivine, $Fa_{14.7\pm23.6}$ (range $Fa_{2.2-62.7}$, N = 6); orthopyroxene, $Fs_{0.7\pm0.4}Wo_{1.0\pm0.2}$ (range $Fs_{0.2-1.0}Wo_{0.7-1.1}$, N = 3).
Classification: Carbonaceous chondrite (CV3).

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Specimens: 22.7 g including one polished thin section at *PSF*; remainder with GHupé.

Northwest Africa 4438 (NWA 4438)
(Northwest Africa)
Purchased: 2006
Classification: Ordinary chondrite (LL3)
History: Purchased by Marcin Cimala in 2006 from a dealer in Erfoud, Morocco.
Petrography: (A. Irving, *UWS* and J. Boesenberg, *BrownU*) Well-formed chondrules (apparent diameter 760±300 µm, N=22) are set in a sparse, finer-grained matrix containing altered metal.
Geochemistry: Olivine ($Fa_{23.6\pm11.6}$ (range $Fa_{5.8-40.2}$, N = 6); Cr_2O_3 in ferroan examples 0.01-0.44 wt.%, mean 0.10±0.13 wt.%, N = 9), low-Ca pyroxene ($Fs_{7.3}Wo_{2.1}$; $Fs_{8.8}Wo_{2.5}$), subcalcic augite ($Fs_{8.2}Wo_{27.7}$).
Classification: Ordinary chondrite (LL3). LL group based on magnetic susceptibility.
Specimens: 21.6 g including one polished thin section at *PSF*; remainder with Mr. M. Cimala.

Northwest Africa 4759 (NWA 4759)
(Northwest Africa)
Purchased: 2007
Classification: Carbonaceous chondrite (CV3)
History: The meteorite was purchased in 2007 from a local meteorite dealer in Erfoud, Morocco.
Physical characteristics: Thirteen brownish fragments without fusion crust.
Petrography: The meteorite displays a grayish to light-brownish interior and is composed of up to 3 mm sized chondrules, whitish CAIs, and olivine amoeboids set into a fine-grained almost opaque matrix. Chondrules often show brownish staining due to terrestrial weathering; type II chondrules are absent.

Northwest Africa 4760 (NWA 4760)
(Northwest Africa)
Purchased: 2007
Classification: Ureilite
History: The meteorite was purchased in 2007 from a local meteorite dealer in Erfoud, Morocco.
Physical characteristics: Dark-brownish individual without fusion crust.
Petrography: The meteorite shows a cumulate texture of up to 2 mm sized Cr-rich olivine and pigeonite crystals often sharing 120 degree grain boundaries. It contains some flaky graphite; olivine displays characteristic reduced rims. Fractures are partly filled with brownish alteration products.

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Geochemistry: reduced rims in olivine: $Fa_{2.0-9.1}$; Cr_2O_3 in ol: ~0.7 wt%

Northwest Africa 4766 (NWA 4766)
(Northwest Africa)
Purchased: 2007
Classification: Martian meteorite (Shergottite)
History: The meteorite was purchased from a local meteorite dealer in Tagounite, Morocco.
Physical characteristics: Fifteen grayish fragments partly covered with fusion crust.
Petrography: The meteorite shows a diabasic texture of predominantly up to 2 mm sized pigeonite and augite and equally sized maskelynite grains. Pyroxenes display complex patchy compositional zoning and often contain fine exsolution lamellae. Minor phases include ilmenite often intergrown with titanomagnetite, merrillite, and pyrrhotite. The meteorite is highly shocked and contains abundant shock melt veins and pockets.
Geochemistry: pigeonite: $Fs_{41.7\pm5.1}Wo_{13.0\pm2.2}$ ($Fs_{32.9-50.1}Wo_{9.0-17.7}$, n=15, FeO/MnO=29-38); augite: $Fs_{25.7\pm1.9}Wo_{31.7\pm2.3}$ ($Fs_{23.8-29.2}Wo_{28.7-35.2}$, n=12, FeO/MnO=27-33); maskelynite: $An_{53.5\pm2.0}Ab_{44.5\pm1.9}Or_{2.0\pm0.4}$, n=14
Classification: Martian (diabasic shergottite)

Northwest Africa 4844 (NWA 4844)
(Northwest Africa)
Purchased: 2006 Apr
Classification: Enstatite chondrite (EL melt rock)
Petrography: (J. Gattacceca, *CEREGE*) Highly recrystallized rock. No relict chondrule was observed. Main minerals are enstatite with typical size 150 µm and plagioclase to 100 µm. Metal and sulfides (including daubréelite) are found as µm sized spherical grains. Abundant vesicles with typical size 50 µm. Abundant terrestrial weathering products.
Geochemistry: Enstatite $Fs_{0.7\pm0.1}Wo_{1.4\pm0.1}$ (n=3). Plagioclase $An_{16.4}Ab_{79.2}Or_{4.3}$ (n=2).
Classification: EL chondrite melt rock. Likely paired with Al Haggounia 001.
Specimens: Type specimen at *CEREGE*. 22.1 g including one polished thin section at *PSF*. Main mass with *Kuntz*.

Northwest Africa 4885 (NWA 4885)
(Northwest Africa)
Purchased: 2006
Classification: HED achondrite (Eucrite, brecciated)
History: The meteorite was purchased in 2006 from a local meteorite dealer in Erfoud, Morocco.
Physical characteristics: Five greyish fragments partly covered with fusion crust

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Petrography: Brecciated eucrite composed of coarse-grained basaltic clasts set into more fine-grained matrix. Dominant minerals are exsolved pyroxene and calcic plagioclase. Minor phases include silica, chromite, ilmenite, and FeS; no metallic Fe was found.
Geochemistry: low-Ca pyroxene: $Fs_{53.1\pm2.1}Wo_{9.1\pm2.7}$ ($Fs_{50.4-65.0}Wo_{5.6-12.4}$, n=10, FeO/MnO=29-31); Ca-pyroxene: $Fs_{35.1\pm6.7}Wo_{32.9\pm7.7}$ ($Fs_{26.0-42.3}Wo_{24.1-43.3}$, n=12, FeO/MnO=27-32); calcic plagioclase: $An_{86.4\pm5.8}$ ($An_{78.6-91.3}$, n=11)

Northwest Africa 4886 (NWA 4886)
(Northwest Africa)
Purchased: 2006
Classification: HED achondrite (Eucrite, brecciated)
History: The meteorite was purchased in 2006 from a local meteorite dealer in Rissani, Morocco.
Physical characteristics: Greyish fragment partly covered with fusion crust.
Petrography: Breccia composed of basaltic clasts with mineral grains of 50-400 µm and up to 1 mm sized black melt clasts set into a clastic mineral matrix. Dominant minerals are exsolved pyroxenes and often laths-shaped calcic plagioclase. Minor phases are silica, chromite, FeS, ilmenite, and zircon. No metallic Fe has been found.
Geochemistry: low-Ca pyroxene: $Fs_{50.7\pm7.8}Wo_{6.3\pm1.6}$ ($Fs_{30.7-57.3}Wo_{3.0-9.9}$, n=15, FeO/MnO=26-32); Ca-pyroxene: $Fs_{38.3\pm9.2}Wo_{31.3\pm7.8}$ ($Fs_{26.6-52.5}Wo_{20.7-42.8}$, n=4, FeO/MnO=28-31); calcic plagioclase: $An_{85.5\pm1.8}$ ($An_{83.1-88.1}$, n=11)

Northwest Africa 4889 (NWA 4889)
(Northwest Africa)
Purchased: 2005
Classification: Mesosiderite
History: The meteorite was purchased in 2005 from a local meteorite dealer in Zagora, Morocco.
Physical characteristics: Fourteen dark-brownish fragments without fusion crust.
Petrography: The meteorite is a breccia composed of silicate and metallic regions of highly variable portions. The metallic lithology consists of kamacite and taenite, the silica fraction is dominated by up to 2 µm sized low-Ca pyroxene, less abundant olivine, calcic plagioclase and minor silica and merrillite. Pyroxene often shows compositional zoning.
Geochemistry: olivine: $Fa_{9.2\pm0.7}$ ($Fa_{8.2-10.6}$, n=20, FeO/MnO=32-47); low-Ca pyroxene: $Fs_{34.6\pm3.9}Wo_{7.0\pm2.0}$ ($Fs_{30.0-40.6}Wo_{4.9-10.8}$, n=15, FeO/MnO=20-25); calcic plagioclase: $An_{93.5\pm0.3}$ ($An_{93.0-94.0}$, n=15)

Northwest Africa 4890 (NWA 4890)
(Northwest Africa)
Purchased: 2006

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Classification: HED achondrite (Eucrite)

History: The meteorite was purchased in 2006 from a local meteorite dealer in Rissani, Morocco.

Physical characteristics: Grayish fragment partly covered with fusion crust.

Petrography: The meteorite is an unbrecciated basalt predominantly composed of exsolved pyroxenes and calcic plagioclase with highly variable grain sizes ranging from 50 µm to 1.5 mm. Minor phases are silica, chromite, FeS, ilmenite, and metallic Fe.

Geochemistry: low-Ca pyroxene: $Fs_{57.1\pm2.8}Wo_{7.3\pm3.3}$ ($Fs_{51.1-60.2}Wo_{3.9-14.6}$, n=11, FeO/MnO=29-32); Ca-pyroxene: $Fs_{32.0\pm3.9}Wo_{38.4\pm4.9}$ ($Fs_{30.0-44.4}Wo_{23.1-41.1}$, n=12, FeO/MnO=29-32); calcic plagioclase: $An_{88.8\pm0.6}$ ($An_{88.2-90.3}$, n=11)

Northwest Africa 4893 (NWA 4893)

(Northwest Africa)

Purchased: 2007

Classification: HED achondrite (Eucrite)

History: The meteorite was purchased in 2007 from a local meteorite dealer in Tagounite, Morocco.

Physical characteristics: Greyish fragment partly covered with fusion crust.

Petrography: The meteorite is a polymict breccia composed of up to 1 cm sized basaltic and up to 4 mm sized dark impact melt clasts set into a fine-grained clastic matrix. Dominant minerals are exsolved pyroxene and calcic plagioclase with grain sizes between 50 and 500 µm. Minor phases include silica, chromite, ilmenite, and FeS. No metallic iron was found.

Geochemistry: low-Ca pyroxene: $Fs_{47.9\pm11.3}Wo_{6.2\pm1.3}$ ($Fs_{29.7-68.6}Wo_{2.6-8.9}$, n=63, FeO/MnO=26-35); Ca-pyroxene: $Fs_{35.7\pm2.9}Wo_{37.4\pm3.2}$ ($Fs_{30.0-41.6}Wo_{30.5-42.6}$, n=20, FeO/MnO=26-33); calcic plagioclase: $An_{87.5\pm4.}$ ($An_{80.9-92.3}$, n=13)

Northwest Africa 4896 (NWA 4896)

(Northwest Africa)

Purchased: 2007

Classification: Ureilite

History: The meteorite was purchased in 2007 from a local meteorite dealer in Tagounite, Morocco.

Physical characteristics: Brownish fragments without fusion crust.

Petrography: The meteorite is a coarse-grained augite-bearing ureilite composed of up to 2.5 mm sized Cr-rich olivine and Ca-pyroxene crystals showing a cumulate texture. It contains some flaky graphite; olivine displays characteristic reduced rims.

Geochemistry: reduced rims in olivine: $Fa_{4.9-8.8}$; Cr_2O_3 in ol: ~0.5 wt%

Northwest Africa 4902 (NWA 4902)

(Northwest Africa)

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Purchased: 2007
Classification: Enstatite chondrite (EH melt rock)

History: The meteorite was purchased in 2007 from a local meteorite dealer in Rissani, Morocco.

Physical characteristics: Brownish individual without fusion crust.

Petrography: The meteorite is an enstatite melt-rock composed of individual, up to 1 mm sized, rounded to sub-rounded, enstatite grains supported by abundant interstitial melt. The melt is largely recrystallized to albitic feldpar and minor residual groundmass and often contains Mg-sulfide spherules. Minor phases include daubreelite, niningerite, oldhamite, schreibersite, and troilite. Kamacite is Si-rich.

Geochemistry: Si in FeNi-metal is about 4.3 wt.% (N=8)

Classification: EH due to the presence of niningerite and the high silica content of FeNi metal.

Northwest Africa 4906 (NWA 4906)
(Northwest Africa)
Purchased: 2007
Classification: Carbonaceous chondrite (CV3)

History: The meteorite was purchased from a local meteorite dealer in Erfoud, Morocco.

Physical characteristics: Greyish fragment without fusion crust.

Petrography: The meteorite displays a dark-grayish interior and is composed of chondrules (mean diameter about 0.9 mm; up to 2 mm sized), up to 5 mm sized CAIs, and olivine amoeboids all set into a dark fine-grained matrix. Type II chondrules are absent. Some chondrules show reddish staining due to terrestrial weathering.

Northwest Africa 4929 (NWA 4929)
Morocco
Find: 2007
Classification: Primitive achondrite (Brachinite)

History: Two pieces purchased in July and a third one in September 2007 in Erfoud, Morocco.

Physical characteristics: One complete stone broken into three pieces that fit together (weathered fracture), for a total weight of 1214 g (263+371+580). Partly covered with a slightly weathered, dark-brown fusion crust.

Petrography: A. Jambon, O. Boudouma and D. Badia; (*UPVI*) Mineral mode (from BSE imaging) Olivine 88% orthopyroxene 6.5%, augite 1%, chromite 2.3% and plagioclase 1.7%. Accessories include weathered kamacite and Ni rich metal. Typical polygonal granular texture; grain size 0.2-0.4 mm.

Geochemistry: Olivine $Fa_{33\pm1}$, FeO/MnO = 66 (n=24). Orthopyroxene $En_{70}Fs_{27}Wo_2$ FeO/MnO = 41, augite $En_{46}Fs_{11}Wo_{44}$ FeO/MnO = 28, chromite Cr/(Cr+Al) = 0.79, Mg/(Mg+Fe)=0.22 and TiO_2 = 1.05 wt%. Plagioclase $An_{30.}$ Oxygen isotopic composition (J. Gattacceca, C. Sonzogni, *CEREGE*) from

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analysis of two acid-washed 1.5 mg aliquots of a powdered 70 mg bulk sample is $\delta^{17}O$=2.49‰, $\delta^{18}O$=5.33‰, $\Delta^{17}O$=-0.30‰ (linearized, slope 0.5247, analytical uncertainties 0.08‰, 0.12‰, 0.03‰ respectively).
Classification: Achondrite (Brachinite)
Specimens: A total of 20.2 g of sample and one polished section is on deposit at *UPVI*. Moroccan Import Asnières, France holds the main mass.

Northwest Africa 5384 (NWA 5384)
(Northwest Africa)
Purchased: 2007
Classification: Primitive achondrite (Brachinite)
History: The meteorite was purchased from a Morrocan meteorite dealer on the meteorite fair in Biel, Switzerland.
Physical characteristics: Brownish fragment without fusion crust.
Petrography: The achondrite shows a protogranular texture of dominantly olivine with subordinate orthopyroxene and augite. The silicates are compositionally equilibrated and sometimes show 120 degree triple junctions. Minor phases include chromite, kamacite, and FeS. No feldspar was observed.
Geochemistry: olivine: $Fa_{33.3\pm0.2}$, FeO/MnO=66±3, n=15; low-Ca pyroxene: $Fs_{28.9\pm1.0}Wo_{2.8\pm0.5}$, FeO/MnO=48±4, Cr_2O_3 = 0.72 wt%, Al_2O_3 = 1.02 wt%, n=11; Ca-pyroxene: $Fs_{9.7\pm0.1}Wo_{46.7\pm0.3}$, FeO/MnO=39±7, n=20
Classification: Brachinite; likely paired with NWA 5400 group members

Northwest Africa 5924 (NWA 5924)
(Northwest Africa)
Purchased: 2009
Classification: Primitive achondrite (Lodranite)
History: The meteorite was purchased from a local meteorite dealer in Erfoud, Morocco.
Physical characteristics: Light brownish rock with some fusion crust.
Petrography: The meteorite is a coarse-grained breccia predominantly composed of up to 1.5 mm sized angular to subrounded olivine, orthopyroxene, and clinopyroxene grains. Minor phases include FeNi metal, troilite, and chromite. Some veins filled with secondary calcite are present. No plagioclase detected.
Geochemistry: olivine: $Fa_{10.9\pm0.1}$, FeO/MnO=26±2, n=13; low-Ca pyroxene: $Fs_{9.5\pm0.4}Wo_{1.5\pm0.3}$, FeO/MnO=14±1, n=15; Ca-pyroxene: $Fs_{3.8\pm0.2}Wo_{44.8\pm0.7}$, FeO/MnO=9±1, Cr_2O_3 = 0.97 wt%, n=15
Classification: Lodranite (breccia)

Northwest Africa 6021 (NWA 6021)
(Northwest Africa)
Purchased: 2009

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Classification: Carbonaceous chondrite (CO3)

History: The meteorite was purchased from a local meteorite dealer in Erfoud, Morocco.

Physical characteristics: Brownish individual partly covered with fusion crust.

Petrography: The meteorite is composed of abundant small chondrules, CAIs, and mineral fragments set into a fine-grained brownish matrix. Chondrules are dominantly of porphyritic type I and type II and have an apparent mean diameter of about 0.2 mm. Some sulfides and FeNi metal grains are present in matrix and chondrules. Some chondrules show orange staining due to terrestrial alteration.

Northwest Africa 6022 (NWA 6022)

(Northwest Africa)

Purchased: 2009

Classification: Rumuruti chondrite (R4)

History: The meteorite was purchased from a local meteorite dealer in Erfoud, Morocco.

Physical characteristics: Brownish individual without fusion crust.

Petrography: The meteorite is composed of well separated chondrules (mean diameter about 300 μm) set into abundant brownish matrix. Fe-rich olivine is the dominant mineral phase; more minor phases include low-Ca pyroxene, Ca-pyroxene, sodic feldspar, pentlandite, and troilite. Olivine is compositionally equilibrated, low-Ca pyroxene shows compositional zoning. No metal has been detected; the meteorite appears unbrecciated in the section studied.

Northwest Africa 6024 (NWA 6024)

(Northwest Africa)

Purchased: 2009

Classification: HED achondrite (Diogenite)

History: The meteorite was purchased from a local meteorite dealer in Erfoud, Morocco.

Physical characteristics: Greyish individual partly covered with fusion crust.

Petrography: The meteorite is a monomict breccia predominantly composed of blocky up to 1 mm sized orthoproxene crystals and abundant fine-grained cataclastic interstitial regions. Minor phases include calcic plagioclase, silica, chromite, FeS, and metallic iron. Some shock melt veins are present.

Geochemistry: low-Ca pyroxene: $Fs_{26.6\pm0.4}Wo_{3.6\pm0.5}$ ($Fs_{25.5-27.2}Wo_{2.8-4.6}$, n=19, FeO/MnO=28-33); calcic plagioclase: $An_{91.3\pm0.9}$ ($An_{89.7-92.7}$, n=14)

Northwest Africa 6025 (NWA 6025)

(Northwest Africa)

Purchased: 2009

Classification: Carbonaceous chondrite (CV3)

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History: The meteorite was purchased from a local meteorite dealer in Erfoud, Morocco.
Physical characteristics: Eight brownish fragments without fusion crust.
Petrography: Chondrite composed of up to 3 mm sized chondrules (mean diameter about 1 mm), up to 2 mm sized CAIs, and olivine amoeboids all set into a fine-grained brownish to black matrix. Type II chondrules are absent. Several chondrules show reddish staining due to terrestrial alteration.

Northwest Africa 6145 (NWA 6145)
(Northwest Africa)
Purchased: 2009 Nov
Classification: Rumuruti chondrite (R5)
History: Purchased from a Moroccan mineral dealer at the mineral show in Munich, Germany
Petrography: (K. Metzler, *IfP*) Equilibrated chondrite, consisting of chondrules and chondrule fragments set in a recrystallized matrix. Some shock veins are present. Chondrule sizes mostly between 300 and 500 µm, up to 1.5 mm.
Geochemistry: Mineral compositions and geochemistry: Mean olivine composition $Fa_{39.0\pm0.3}$ (38.4-39.4); n=20. Mean low-Ca pyroxene composition $Fs_{30.5\pm0.3}$ $Wo_{1.2\pm0.1}$ ($Fs_{30.1-30.9}$ $Wo_{1.0-1.4}$); n=5. Mean Ca-pyroxene composition $Fs_{11.6\pm0.3}$ $Wo_{44.6\pm0.2}$ ($Fs_{11.2-12.1}$ $Wo_{44.2-44.9}$); n=10. Accessories are chromite, troilite and pentlandite; no metal was found.
Classification: R chondrite based on mineral chemistry. Petrologic type 5, based on equilibrated olivine and pyroxene and well-preserved chondrules.

Northwest Africa 6259 (NWA 6259)
(Northwest Africa)
Find: 2010 Feb
Classification: Iron meteorite (ungrouped)
Petrography: Petrographic description. Sample is neither well polished nor etched. Based on this sample, the structure is that of a Ni-rich ataxite. The only recognized inclusions are small troilite ovals with lengths in the range 2 to 6 mm and widths typically 2/3 of the length. A layer of dark oxide, probably a weathering product, surrounds these FeS blebs. The surface is heavily oxidized but the sawed and roughly polished faces oxidize only slowly in the storage container.
Geochemistry: Composition (based on duplicate INAA): Co, 6.08 mg/g; Ni, 422 mg/g; Cu, 3250 µg/g; Ga, 5.76 µg/g; As, 39.5 µg/g; Sb, 4595 ng/g; W, 0.15 µg/g; Ir 0.027 µg/g; Au, 3.40 µg/g. The meteorite has an extraordinary composition. The Sb content is the second highest known, second only to Oktibbeha County.
Classification: The meteorite is ungrouped with no close relatives. Because of the high As, Au, Sb and Cu it may be related to the IAB complex.

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Northwest Africa 6821 (NWA 6821)
(Northwest Africa)
Purchased: 2010
Classification: Ordinary chondrite (LL3)
History: The meteorite was purchased from a local meteorite dealer in Erfoud, Morocco.
Physical characteristics: Light brownish rock with some fusion crust.
Petrography: The meteorite displays a chondritic texture with well defined mostly rounded and slightly packed chondrules (mean diameter about 0.6 mm) in a fine-grained dark matrix that contains sulfides and FeNi metal.
Classification: Ordinary chondrite (LL3). LL based on magnetic susceptibility.

Northwest Africa 6823 (NWA 6823)
(Northwest Africa)
Purchased: 2010
Classification: Ureilite
History: The meteorite was purchased from a local meteorite dealer in Erfoud, Morocco.
Physical characteristics: Brownish fragment without fusion crust.
Petrography: The meteorite shows a protogranular texture of up to 3 mm sized olivine and pigeonite grains. Olivine displays characteristic reduced rims and the meteorite contains abundant flaky graphite.
Geochemistry: reduced rims in olivine: $Fa_{2.3-5.9}$; olivine contains 0.55±0.03 wt% Cr_2O_3 and 0.33±0.01 wt% CaO

Northwest Africa 6824 (NWA 6824)
(Northwest Africa)
Purchased: 2010
Classification: Carbonaceous chondrite (CV3)
History: The meteorite was purchased from a local meteorite dealer in Erfoud, Morocco.
Physical characteristics: Eighteen greyish fragments some of which almost completely covered with fusion crust.
Petrography: Carbonaceous chondrite composed of up separated well-defined chondrules (mean diamter about 1.0 mm), CAIs (up to 4 mm), and olivine amoeboids all set into a fine-grained almost brownish to black matrix. Type II chondrules are absent. Several chondrules show reddish staining due to terrestrial weathering.

Northwest Africa 6825 (NWA 6825)
(Northwest Africa)
Purchased: 2010
Classification: Rumuruti chondrite (R5)

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History: The meteorite was purchased from a local meteorite dealer in Erfoud, Morocco.
Physical characteristics: Fourteen dark greyish fragments partly covered with fusion crust.
Petrography: The meteorite is a R-type breccia composed of up to 1 cm sized angular to subrounded clasts set into a more fine-grained greyish clastic matrix. Chondrules are well preserved and have an average apparent mean diameter of about 400 µm. Fe-rich olivine is the dominant mineral in clasts and matrix. More minor phases include low-Ca pyroxene, augite, pentlandite, and sodic plagioclase; no metal has been detected. The meteorite contains shock melt veins.
Geochemistry: olivine: $Fa_{37.7\pm0.2}$ (n=18, FeO/MnO=82±5); low-Ca pyroxene: $Fs_{29.6\pm0.3}Wo_{1.7\pm0.2}$, n=4; Ca-pyroxene: $Fs_{11.2\pm0.4}Wo_{45.0\pm0.6}$, n=10

Northwest Africa 6826 (NWA 6826)
(Northwest Africa)
Purchased: 2009
Classification: Carbonaceous chondrite (CK5)
History: The meteorite was purchased from a local meteorite dealer in Erfoud, Morocco.
Physical characteristics: Greyish rock partly covered with fusion crust.
Petrography: The meteorite displays a greyish to slightly greenish interior and is predominantly composed of fine-grained recrystallized matrix mainly consisting of ferrous olivine. Some dispersed chondrules (mean diameter about 0.6 mm) are present. Minor phases include plagioclase, Ca-pyroxene, and troilite. Cr-rich magnetite is abundant; metal is virtually absent.
Geochemistry: olivine: $Fa_{32.5\pm0.3}$, n=16, FeO/MnO=117±13; low-Ca pyroxene: $Fs_{9.6\pm0.5}Wo_{46.9\pm0.5}$, n=10

Northwest Africa 6830 (NWA 6830)
(Northwest Africa)
Purchased: 2009
Classification: HED achondrite (Diogenite)
History: The meteorite was purchased in 2009 from a local meteorite dealer in Erfoud, Morocco.
Physical characteristics: Five greyish fragmentsl with some fusion crust.
Petrography: Orthopyroxenite predominantly composed of blocky up to 1 mm sized orthopyroxenes grains, few olivines, and interstitial plagioclase. Minor phases include silica, troilite, and metallic iron.
Geochemistry: orthopyroxene: $Fs_{24.9\pm0.3}Wo_{2.2\pm0.2}$ ($Fs_{24.4-25.6}Wo_{1.7-2.6}$, n=30, FeO/MnO=25-29); FeO/MnO in olivine: 37-42; calcic plagioclase: $An_{78.5\pm6.2}$ ($An_{66.5-84.8}$, n=22)
Classification: diogenite (olivine-bearing)

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Northwest Africa 6831 (NWA 6831)
(Northwest Africa)
Purchased: 2009
Classification: Lunar meteorite

History: The meteorite was purchased in 2009 from a local meteorite dealer in Erfoud, Morocco.

Physical characteristics: Dark greyish individual without fusion crust.

Petrography: The meteorite is a relatively fine-grained fragmental breccia composed of up to 1 mm sized lithic and mineral clasts consolidated by a vesicular vitreous groundmass. Lithic clasts include basaltic and melt clasts; mineral clasts are dominantly calcic plagioclase, ferroan olivine, low-Ca pyroxene, pigeonite, and Ca-pyroxene. Minor phases include chromite, ilmenite, fayalite, and FeS.

Geochemistry: olivine: $Fa_{40.7\pm5.5}$ ($Fa_{31.7-50.4}$, n=25, FeO/MnO=82-102); low-Ca pyroxene: $Fs_{23.7\pm0.2}Wo_{3.5\pm0.3}$ ($Fs_{23.5-24.0}Wo_{3.2-4.0}$, n=5, FeO/MnO=55-66); pigeonite: $Fs_{29.3\pm1.3}Wo_{11.7\pm2.1}$ ($Fs_{27.1-31.7}Wo_{8.3-14.8}$, n=9, FeO/MnO=47-61); Ca-pyroxene: $Fs_{60.7\pm3.6}Wo_{24.5\pm2.0}$ ($Fs_{54.6-67.3}Wo_{20.1-26.9}$, n=9, FeO/MnO=66-75); calcic plagioclase: $An_{92.6\pm1.3}$ ($An_{90.1-93.8}$, n=20)

Classification: lunar (feldspathic breccia)

Northwest Africa 6834 (NWA 6834)
(Northwest Africa)
Purchased: 2010
Classification: Ordinary chondrite (H7)

History: The meteorite was purchased from a local meteorite dealer in Erfoud, Morocco.

Physical characteristics: Brownish fragment without fusion crust.

Petrography: The meteorite displays a completely recrystallized texture of dominantly olivine and orthopyroxene grains, the latter with relativey high Wo-contents. 120 degree triple junctions are present. Plagioclase grains are up to 100 µm in size. No chondrules observed. Abundant Fe,Ni metal and troilite.

Northwest Africa 6838 (NWA 6838)
(Northwest Africa)
Purchased: 2010
Classification: Carbonaceous chondrite (CO3)

History: The meteorite was purchased from a local meteorite dealer in Erfoud, Morocco.

Physical characteristics: Dark brownish rock without fusion crust.

Petrography: The meteorite shows a light-brownish interior and is composed of abundant small chondrules, CAIs, and mineral fragments some of which surrounded by fine-grained dust rims set into a fine-grained matrix. Chondrules have a mean

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diameter of about 0.2 mm; few regions show brownish staining due to terrestrial weathering.

Northwest Africa 6839 (NWA 6839)
(Northwest Africa)
Purchased: 2010
Classification: Rumuruti chondrite (R3-6)
History: The meteorite was purchased from a local meteorite dealer in Erfoud, Morocco.
Physical characteristics: Brownish rock without fusion crust.
Petrography: The meteorite is a R-type breccia composed of light colored lithic type 6 fragments and dark impact melt clasts set into a slightly orange colored fine-grained type 3 groundmass with several chondrules and chondrule fragments being present. Olivine is the dominant mineral phase in all lithologies and particular Fe-rich in type 6 clasts. Minor phases include albitic feldspar, augite, chromite, pentlandite, and pyrrhotite. FeNi metal is virtually absent.
Geochemistry: type 3 lithology: olivine: $Fa_{27.4\pm12.8}$ ($Fa_{7.9-37.9}$, n=23); low-Ca pyroxene: $Fs_{15.5\pm6.9}Wo_{1.1\pm0.6}$ ($Fs_{6.7-25.7}Wo_{0.5-2.6}$, n=16); type 6 lithology: olivine: 38.9±0.4, n=10; low-Ca pyroxene: $Fs_{29.3\pm0.1}Wo_{1.7\pm0.1}$, n=2; Ca-pyroxene: $Fs_{10.4\pm0.2}Wo_{45.8\pm0.3}$, n=3

Northwest Africa 6840 (NWA 6840)
(Northwest Africa)
Purchased: 2010
Classification: Pallasite
History: The meteorite was purchased from a local meteorite dealer in Erfoud, Morocco.
Physical characteristics: Dark brownish fragment without fusion crust.
Petrography: The meteorite is composed of about 4 mm sized subrounded olivine grains surrounded by a matrix of partly layered brownish iron oxides or hydroxides. No pristine FeNi-metal has been found in the sample studied.

Northwest Africa 6842 (NWA 6842)
NWA
Purchased: 2007
Classification: Ordinary chondrite (LL3)
History: The meteorite was purchased from a local meteorite dealer in Erfoud, Morocco.
Physical characteristics: Brownish rock without fusion crust.
Petrography: The meteorite displays a chondritic texture with mostly flattened and densely packed chondrules (mean diameter about 0.9 mm) in a fine-grained brownish to black matrix that contains sulfides and rare FeNi metal.

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Northwest Africa 6848 (NWA 6848)
(Northwest Africa)
Purchased: 2011
Classification: R5-6

History: The meteorite was purchased in 2011 from a local meteorite dealer in Erfoud, Morocco.

Physical characteristics: Many small fragments partly to completely covered with fusion crust

Petrography: The meteorite is a breccia with up to 6 mm sized light coloured lithic fragments of petrological type 5 set into a fine-grained clastic groundmass of type 6. Ferroan olivine is the dominant mineral phase in clasts and matrix. Minor phases include albitic feldspar, low-Ca pyroxene, chromite, pentlandite and pyrrhotite. FeNi metal is virtually absent.

Northwest Africa 6964 (NWA 6964)
(Northwest Africa)
Purchased: 2011
Classification: HED achondrite (Eucrite, monomict)

History: The meteorite was purchased in 2011 from a local meteorite dealer in Erfoud, Morocco.

Physical characteristics: 41 up to 2 cm sized individuals most of which partly to completely covered by fusion crust.

Petrography: Monomict basaltic breccia predominantly composed of up to 400 µm sized exsolved pyroxenes and often lath-shaped calcic plagioclase. Minor phases include FeS, chromite, ilmenite, and silica. No metallic iron was found. The meteorite contains impact melt veins.

Geochemistry: low-Ca pyroxene: $Fs_{59.9\pm0.7}Wo_{2.6\pm0.8}$ ($Fs_{58.1-60.6}Wo_{1.8-4.4}$, n=15, FeO/MnO=29-31); Ca-pyroxene: $Fs_{26.5\pm0.4}Wo_{43.7\pm0.6}$ ($Fs_{25.7-27.5}Wo_{42.1-44.5}$, n=30, FeO/MnO=26-34); calcic plagioclase: $An_{90.1\pm0.6}$ ($An_{89.1-91.6}$, n=15)

Northwest Africa 6971 (NWA 6971)
(Northwest Africa)
Purchased: 2011
Classification: HED achondrite (Eucrite, monomict)

History: The meteorite was purchased in 2011 from a local meteorite dealer in Erfoud, Morocco.

Physical characteristics: Greyish individual partly covered with fusion crust.

Petrography: Coarse-grained basaltic breccia composed of up to 1.5 mm sized exsolved pyroxenes and calcic plagioclase. Minor phases include FeS, chromite, and silica. No metallic iron was found. Plagioclase is partly converted into maskelynite and the meteorite contains impact melt veins.

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Geochemistry: low-Ca pyroxene: $Fs_{50.8\pm1.2}Wo_{4.0\pm1.6}$ ($Fs_{48.9-53.2}Wo_{1.2-6.0}$, n=14, FeO/MnO=25-28); Ca-pyroxene: $Fs_{25.9\pm1.6}Wo_{38.8\pm1.6}$ ($Fs_{22.4-29.0}Wo_{36.3-42.9}$, n=19, FeO/MnO=22-30); calcic plagioclase: $An_{93.1\pm0.7}$ ($An_{91.9-94.0}$, n=15)

Northwest Africa 6972 (NWA 6972)
(Northwest Africa)
Purchased: 2011
Classification: HED achondrite (Eucrite, brecciated)
History: The meteorite was purchased in 2011 from a local meteorite dealer in Erfoud, Morocco.
Physical characteristics: Greyish individual partly covered with fusion crust.
Petrography: The meteorite is a fragmental breccia composed of rare basaltic clasts and abundant impact melt clasts set into a fine-grained clastic matrix. Basaltic clasts and matrix are dominantly composed of exsolved pyroxene and calcic plagioclase grains of variable grain sizes ranging from 20 to 400 µm. Several matrix pyroxenes display magmatic zoning. Minor phases include chromite, ilmenite, fayalite, silica, and metallic iron. The meteorite is highly shocked with plagioclase being completely converted into maskelynite.
Geochemistry: low-Ca pyroxene: $Fs_{38.2\pm11.8}Wo_{3.1\pm1.5}$ ($Fs_{21.8-59.4}Wo_{1.6-5.3}$, n=32, FeO/MnO=23-31); Ca-pyroxene: $Fs_{17.0\pm3.0}Wo_{44.6\pm1.5}$ ($Fs_{15.5-27.0}Wo_{39.8-45.7}$, n=12, FeO/MnO=19-27); calcic plagioclase: $An_{91.6\pm2.0}$ ($An_{86.8-94.4}$, n=25)

Northwest Africa 6973 (NWA 6973)
(Northwest Africa)
Purchased: 2011
Classification: Carbonaceous chondrite (CK5)
History: The meteorite was purchased in 2011 from a local meteorite dealer in Erfoud, Morocco.
Physical characteristics: Dark greyish individual almost completely covered with fusion crust.
Petrography: The meteorite displays a dark-greenish interior and is composed of several clearly defined chondrules and rare CAIs set into abundant recrystallized matrix. Ferroan olivine is the most abundant mineral phase; more minor phases include feldspar, low-Ca pyroxene, Ca-pyroxene and Cr-bearing magnetite. Metal was not observed.
Geochemistry: olivine: $Fa_{31.1\pm0.2}$, n=12, FeO/MnO=101±9; low-Ca pyroxene: $Fs_{26.3\pm0.2}Wo_{0.8\pm0.1}$, n=12; Ca-pyroxene: $Fs_{9.2\pm0.1}Wo_{46.4\pm0.2}$, n=4

Northwest Africa 6974 (NWA 6974)
(Northwest Africa)
Purchased: 2011
Classification: HED achondrite (Eucrite, brecciated)

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History: The meteorite was purchased in 2011 from a local meteorite dealer in Erfoud, Morocco.
Physical characteristics: Four greyish individuals almost completely covered with fusion crust.
Petrography: Fragmental breccia composed of abundant up to 1.5 cm sized basaltic and impact melt clasts set into a fine-grained clastic matrix. Basaltic clasts and matrix are dominantly composed of exsolved pyroxene and often lath-shaped calcic plagioclase grains ranging from 20 to 300 µm. Minor phases include ilmenite, fayalite, silica, FeS, and metallic iron.
Geochemistry: low-Ca pyroxene: $Fs_{49.4\pm15.2}Wo_{2.6\pm0.9}$ ($Fs_{22.0-62.4}Wo_{1.7-5.1}$, n=30, FeO/MnO=25-33); Ca-pyroxene: $Fs_{26.2\pm0.3}Wo_{44.2\pm0.2}$ ($Fs_{25.4-26.5}Wo_{43.9-44.5}$, n=8, FeO/MnO=28-31); calcic plagioclase: $An_{89.9\pm1.2}$ ($An_{87.8-91.4}$, n=15)

Northwest Africa 6975 (NWA 6975)
(Northwest Africa)
Purchased: 2011
Classification: HED achondrite (Eucrite, brecciated)
History: The meteorite was purchased in 2011 from a local meteorite dealer in Erfoud, Morocco.
Physical characteristics: Greyish individual partly covered with fusion crust.
Petrography: Fragmental breccia composed of up to 2 cm sized basaltic and impact melt clasts set into a fine-grained clastic matrix. Basaltic clasts and matrix are dominantly composed of exsolved pyroxene and often lath-shaped calcic plagioclase grains ranging from 20 to 500 µm. Minor phases include chromite, ilmenite, silica, and FeS. No metallic iron has been detected.
Geochemistry: low-Ca pyroxene: $Fs_{59.7\pm1.3}Wo_{5.2\pm1.2}$ ($Fs_{57.6-63.0}Wo_{1.8-6.5}$, n=12, FeO/MnO=26-30); Ca-pyroxene: $Fs_{29.6\pm0.8}Wo_{41.6\pm0.9}$ ($Fs_{28.3-31.1}Wo_{39.6-42.9}$, n=20, FeO/MnO=25-32); calcic plagioclase: $An_{89.2\pm4.8}$ ($An_{81.8-94.2}$, n=20)

Northwest Africa 6976 (NWA 6976)
(Northwest Africa)
Purchased: 2011
Classification: Carbonaceous chondrite (CM2)
History: The meteorite was purchased from a local meteorite dealer in Erfoud, Morocco.
Physical characteristics: Black individual lacking any fusion crust.
Petrography: Brecciated carbonaceous chondrite composed of chondrules (mean diameter about 0.25 mm), chondrule pseudomorphs, CAIs, and mineral fragments set into abundant Fe-rich matrix. Many of the components are surrounded by fine-grained dust rims. The fine-grained meteorite matrix consists of abundant sulfides, Ca-carbonates, and phyllosilicates confirmed by their flaky appearance and low matrix totals.
Geochemistry: Matrix analyses total: 89.9 wt% (10 µm defocused beam, n=10)

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Northwest Africa 7065 (NWA 7065)
(Northwest Africa)
Purchased: 2011
Classification: Ureilite
History: The meteorite was purchased in 2011 from a local meteorite dealer in Erfoud, Morocco.
Physical characteristics: Dark-brownish individual without fusion crust.
Petrography: The meteorite shows an equigranular cumulate texture of about 500 µm sized Cr-rich olivine and pigeonite crystals. It contains some flaky graphite; olivine displays characteristic reduced rims.
Geochemistry: reduced rims in olivine: $Fa_{1.3-5.3}$; Cr_2O_3 in ol: ~0.6 wt%

Northwest Africa 7066 (NWA 7066)
(Northwest Africa)
Purchased: 2011
Classification: Ureilite
History: The meteorite was purchased in 2011 from a local meteorite dealer in Erfoud, Morocco.
Physical characteristics: Dark-brownish individual without fusion crust.
Petrography: The meteorite shows a cumulate texture of about 1.5 mm sized Cr-rich olivine and pigeonite crystals. It contains some flaky graphite; olivine displays characteristic reduced rims.
Geochemistry: reduced rims in olivine: $Fa_{1.6-7.0}$; Cr_2O_3 in ol: ~0.6 wt%

Northwest Africa 7067 (NWA 7067)
(Northwest Africa)
Purchased: 2011
Classification: Carbonaceous chondrite (CV3)
History: The meteorite was purchased in 2011 from a local meteorite dealer in Erfoud, Morocco.
Physical characteristics: Dark-brownish individual with some patches of fusion crust.
Petrography: Carbonaceous chondrite composed of chondrules (mean diameter about 0.9 mm; up to 2 mm sized), CAIs (up to 6 mm sized), and olivine amoeboids all set into a fine-grained brownish to almost black matrix. Type II chondrules are absent.

Northwest Africa 7068 (NWA 7068)
(Northwest Africa)
Purchased: 2011

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Classification: Ordinary chondrite (L3)

History: The meteorite was purchased in 2011 from a local meteorite dealer in Morocco.

Physical characteristics: Dark-brownish individual without fusion crust.

Petrography: The meteorite displays a chondritic texture with mostly rounded and well-packed chondrules (mean diameter about 0.6 mm) in a more fine-grained dark matrix that contains sulfides and some FeNi metal.

Northwest Africa 7445 (NWA 7445)

(Northwest Africa)

Purchased: 2004

Classification: Ureilite

History: Purchased by D. *DGregory* in Tuscon, Arizona. Type specimen is catalogued at *ROM* as M52947.

Physical characteristics: (S. Korchinos *UTorG*, *ROM*) The total mass of the sample is 129.41 g, with the main piece having mass of 128.47 g. The main mass has a weathered fusion crust with pervasive fractures. The surface is mostly covered with rust.

Petrography: (S. Korchinos *UTorG*, *ROM*). The sample exhibits typical ureilite texture with closely packed, coarse-grained silicates meeting at triple junctions. Olivine grains exhibit minor planar fracturing, undulatory extinction, and minor reduction rims. Low-Ca pyroxene exhibits twinning and undulatory extinction. Modal abundances: major olivine approximately 70%, low-Ca pyroxene 25%, and carbon 5%. Raman analysis confirms both diamond and graphite phases, though diamond is more prevalent.

Geochemistry: Mineral compositions and geochemistry: EPMA quantitative WDS (S.Korchinos, UToRG, *ROM*): Olivine cores have $Fa_{24.0\pm1.3}$ (N = 17), CaO = 0.36±0.02 wt%, Cr_2O_3 = 0.75±0.07 wt%, and MnO = 0.40±0.02 wt%. Pyroxene cores: $Fs_{21.0\pm0.3}Wo_{6.6\pm0.1}$ (N = 10), CaO = 3.34±0.04 wt%, Cr_2O_3 = 1.08±0.05 wt%, MnO = 0.39±0.02 wt%.

Classification: Achondrite (ureilite). Low shock, moderate weathering.

Specimens: The main mass, thinly-sliced fragment, and thin section are held at the *ROM*.

Northwest Africa 11673 (NWA 11673)

(Northwest Africa)

Purchased: 2017 Nov

Classification: HED achondrite (Eucrite, brecciated)

History: Purchased by Darryl Pitt in November 2017 from a Mauritanian dealer.

Petrography: (A. Irving and S. Kuehner, *UWS*) Breccia consisting of a variety of lithic clasts and related debris in a finer grained matrix. Eucrite clasts exhibit diverse textures (including subophitic, microgabbroic and gabbroic). Other minerals are exsolved pigeonite, calcic plagioclase, silica polymorph, ilmenite, Ti-chromite,

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chromite and troilite. Except in one gabbroic eucrite clast in the studied thin section (where the plagioclase is birefringent with strongly undulose extinction), all of the plagioclase in this specimen has been transformed almost entirely to maskelynite (although very minor birefringent domains are present in places).
Geochemistry: Orthopyroxene host ($Fs_{56.6-58.7}Wo_{3.0-2.5}$, FeO/MnO = 30-33, N = 3), clinopyroxene exsolution lamellae ($Fs_{26.4-27.4}Wo_{41.5-40.7}$, FeO/MnO = 33-35, N = 2), plagioclase ($An_{88.5-92.2}Or_{0.7-0.4}$, N = 4).
Classification: Eucrite (genomict breccia, shocked).
Specimens: 22.5 g including one polished thin section at *UWB*; main mass with *DPitt*.

Northwest Africa 11843 (NWA 11843)
(Northwest Africa)
Purchased: 2018
Classification: Ordinary chondrite (LL7)
History: The meteorite was purchased from a local meteorite dealer in Morocco.
Physical characteristics: Dark-brownish individual partly covered with fusion crust.
Petrography: The meteorite shows a thoroughly recrystallized texture of predominantly olivine and low-Ca pyroxene with more minor albitic feldspar. Rarely some relict chondrule fragments are encountered. Opaque phases are troilite, Ni-bearing pyrrhotite, and FeNi metal. The meteorite contains some small and locally restricted regions that appear melted and recrystallized.
Geochemistry: albitic feldspar: $An_{11.7\pm2.7}Ab_{81.5\pm5.5}Or_{6.6\pm7.4}$, n=8

Northwest Africa 11911 (NWA 11911)
Morocco
Purchased: 2013
Classification: HED achondrite (Eucrite, polymict)
Physical characteristics: (T. Shisseh, *FSAC*) One brecciated stone with white and black interior. A black inclusion, clasts and rock fragments are visible to the naked eye.
Petrography: (T. Shisseh, *FSAC*; S. Pont, *MNHNP*) Breccia with basaltic clasts, impact melt clasts, rock fragments embedded in a clastic matrix. The main minerals are plagioclase, pyroxene and minor silica, with chromite, ilmenite and Fe-metal. The black inclusion is an impact melt measuring 2 × 5 mm. Plagioclase and pyroxene in the clastic matrix are up to 1 mm, some pyroxene grains are unequilibrated. Basaltic clasts up to 0.6 mm with ophitic to sub-ophitic plagioclase laths and pyroxene. Shock veins with entrained rounded plagioclase, pyroxene and silica. Faulting surface up to 2 mm.
Geochemistry: Mineral compositions and geochemistry: (T. Shisseh, *FSAC*; R. Hewins, B. Zanda, *MNHNP*) Low-Ca pyroxene $En_{39.48}Fs_{54.7}Wo_{5.8}$ to $En_{32.5}Fs_{47.9}Wo_{19.6}$ (N=8), High-Ca pyroxene $En_{30.4}Fs_{47.3}Wo_{22.4}$ to

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$En_{21.3}Fs_{35.6}Wo_{43.0}$ (N=6) Fe/Mn=32 in average. Plagioclase is $An_{85.8-95.1}Ab_{4.8-13.9}Or_{0.07-0.45}$ (N=4).
Classification: (T. Shisseh, *FSAC*; R. Hewins, *MNHNP*) Polymict eucrite breccia. The meteorite contains anorthite, and pyroxene with Fe/Mn ratios matching eucrite, plus typical eucrite textures.

Northwest Africa 11952 (NWA 11952)
(Northwest Africa)
Purchased: 2005
Classification: Ordinary chondrite (L3/4)
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*) Unequilibrated host lithology with rare equilibrated clasts. Host lithology: well-formed chondrules (apparent diameter 770±320 µm, some containing olivine with forsteritic cores) set in a matrix containing stained metal, merrillite and chlorapatite. One L6 lithic clast and one L7 lithic clast (completely recrystallized) were observed in the studied thin section.
Geochemistry: Olivine (core $Fa_{7.1}$; $Fa_{23.9-25.5}$, Cr_2O_3 <0.03 wt.%, N = 6), low-Ca pyroxene ($Fs_{2.7-20.2}Wo_{0.9-1.1}$, N = 3), clinopyroxene ($Fs_{10.5}Wo_{34.7}$; $Fs_{2.8}Wo_{45.6}$; N = 2).
Classification: Ordinary chondrite (L3/4).
Specimens: The entire specimen including one polished thin section is at *PSF*.

Northwest Africa 11961 (NWA 11961)
(Northwest Africa)
Purchased: 2018 Jan
Classification: Carbonaceous chondrite (C3, ungrouped)
History: Purchased by Greg *Hupe* in January 2018 from a Moroccan dealer at the Tucson Gem and Mineral Show.
Physical characteristics: Two identical brownish stones (total weight 324.3 g). Cut interior surfaces reveal light brown chondrules in a dark brown matrix containing fresh metal.
Petrography: (A. Irving and S. Kuehner, *UWS*; L. Garvie, *ASU*) Unequilibrated specimen. Composed of fairly closely packed, well formed granular chondrules (apparent diameter 840±500 µm, some with metal-rich rims) set in a fine-grained matrix (~15 vol.%, deep red-brown in thin section) containing minor secondary calcite. Orthopyroxene is rare relative to clinopyroxene, and anorthite is present both in chondrules and matrix; accessory phases include kamacite (~2 vol%) and troilite. Troilite is the only sulfide. No magnetite was observed. X-ray diffraction analysis of powdered samples detected no phyllosilicates and no crystalline clay minerals in the <1 µm size fraction. No CAI were observed in the studied thin section.
Geochemistry: Olivine ($Fa_{0.9-34.0}$, N = 3), orthopyroxene ($Fs_{2.1-2.3}Wo_{1.4-0.8}$, N = 3), clinopyroxene ($Fs_{0.9-2.7}Wo_{41.9-40.6}$, N = 2). Oxygen isotopes (K. Ziegler, *UNM*) Analyses of six acid-washed non homogenized subsamples by laser fluorination

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gave, respectively $\delta^{17}O$ -4.928, -4.401, -3.935, -2.101, -1.850, 2.263; $\delta^{18}O$ -2.475, -1.766, -0.748, 1.112, 1.717, 6.427 ; $\Delta^{17}O$ -3.621, -3.469, -3.540, -2.688, -2.757, -1.130 per mil.
Classification: Carbonaceous chondrite (C3, ungrouped). Oxygen isotopic compositions for this unequilibrated chondrite plot in the same sub-TFL region as for carbonaceous chondrites, but clearly not on the trends for CR, CV, CK, CO or CM chondrites.
Specimens: 20.2 g including one polished thin section at *UWB*; remainder with GHupe.

Northwest Africa 11981 (NWA 11981)
(Northwest Africa)
Purchased: 2005
Classification: Ordinary chondrite (H4)
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*) Relatively small, well-formed chondrules (apparent diameter 590±450 µm, N = 21) are set in a matrix containing fairly abundant altered metal, chlorapatite and merrillite.
Geochemistry: Olivine ($Fa_{19.1\pm0.4}$ (range $Fa_{18.7-19.9}$), Cr_2O_3 in ferroan examples <0.04 wt.%, N = 7), magnesian olivine core ($Fa_{5.1}$), low-Ca pyroxene ($Fs_{7.9\pm7.5}Wo_{1.6\pm1.5}$ (range $Fs_{2.6-16.4}Wo_{0.2-1.5}$), N = 3), high-Ca pyroxene ($Fs_{6.8}Wo_{45.3}$; $Fs_{8.9}Wo_{40.8}$).
Classification: Ordinary chondrite (H4).
Specimens: The entire specimen including one polished thin section is at *PSF*.

Northwest Africa 11985 (NWA 11985)
(Northwest Africa)
Purchased: 2005
Classification: Ordinary chondrite (L5)
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*) Sparse chondrules are present in a recrystallized matrix containing chlorapatite and merrillite.
Geochemistry: Olivine ($Fa_{25.2\pm0.3}$ (range $Fa_{25.0-25.4}$), N = 2), low-Ca pyroxene ($Fs_{23.1\pm3.1}Wo_{1.6\pm0.1}$ (range $Fs_{20.9-25.3}Wo_{1.7-1.5}$), N = 2), high-Ca pyroxene ($Fs_{7.3\pm0.2}Wo_{45.9\pm0.2}$ (range $Fs_{7.1-7.4}Wo_{46.0-45.7}$), N = 2).
Classification: Ordinary chondrite (L5).
Specimens: The entire specimen including one polished thin section is at *PSF*.

Northwest Africa 11987 (NWA 11987)
(Northwest Africa)

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Purchased: 2005
Classification: Ordinary chondrite (L3)

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*) Fairly closely packed, well-formed chondrules (apparent diameter 705±260 µm, N=20) are set in a finer-grained matrix containing stained metal.

Geochemistry: Olivine $Fa_{29.8\pm15.5}$ (range $Fa_{1.1-58.4}$), Cr_2O_3 in ferroan examples 0.04-0.27 wt.%, mean 0.11±0.08 wt.%, N = 7. Low-Ca pyroxene $Fs_{11.6\pm11.8}Wo_{0.3\pm0.1}$ (range $Fs_{3.2-19.9}Wo_{0.2-0.3}$), N = 2; $Fs_{54.8}Wo_{1.5}$. High-Ca pyroxene $Fs_{18.2}Wo_{36.1}$. Magnetic susceptibility log χ (× 10^{-9} m^3/kg) = 4.63.

Classification: Ordinary chondrite (L3).

Specimens: The entire specimen including one polished thin section is at *PSF*.

Northwest Africa 11990 (NWA 11990)
(Northwest Africa)
Purchased: 2005
Classification: Ordinary chondrite (L3)

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*) Fairly closely packed, well-formed chondrules (apparent diameter 840±480 µm, N = 20) are set in a finer grained matrix containing stained metal.

Geochemistry: Olivine ($Fa_{22.3\pm4.7}$ (range $Fa_{11.9-24.8}$), Cr_2O_3 in ferroan examples 0.04-0.30 wt.%, mean 0.09±0.11 wt.%, N = 7), low-Ca pyroxene ($Fs_{13.9\pm8.6}Wo_{1.3\pm1.5}$ (range $Fs_{2.8-20.9}Wo_{0.3-3.4}$), N = 4), high-Ca pyroxene ($Fs_{8.4}Wo_{44.4}$; $Fs_{10.8}Wo_{37.6}$). Magnetic susceptibility log χ (× 10^{-9} m^3/kg) = 4.78.

Classification: Ordinary chondrite (L3).

Specimens: The entire specimen including one polished thin section is at *PSF*.

Northwest Africa 12003 (NWA 12003)
Morocco
Purchased: February 2018
Classification: Carbonaceous chondrite (CK6)

History: Purchased from Adam *Aaronson* during the Tucson Gem and Mineral show February 2018.

Physical characteristics: Dark-gray stone with darker gray/black crust covering about 60%. Stone shows evidence of sand polishing.

Petrography: (C. Herd and L. Tunney, *UAb*) Optical and microprobe examination of a polished thin section shows an unbrecciated texture consisting of sparse porphyritic olivine chondrules set in a recrystallized matrix of olivine, plagioclase, high-Ca pyroxene, Cr-Ti-bearing magnetite, and Fe-Ni sulfide. Nearly all sulfide and

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some silicate has been replaced by fine-grained oxides. Average chondrule size 0.73 ± 0.25 mm (n=17).
Geochemistry: (C. Herd and L. Tunney, *UAb*) Data obtained by EMP examination of carbon-coated thin section: Olivine $Fa_{32.7\pm0.3}$ (FeO/MnO=117, mean NiO=0.57 wt%, n=21); high-Ca pyroxene $Fs_{9.1\pm0.8}Wo_{46.5\pm0.8}$ (FeO/MnO=65, n=3); plagioclase $An_{38.9\pm7.6}Or_{2.8\pm1.3}$ (range $An_{28.6\text{-}50.1}Or_{1.4\text{-}5.4}$, n=7). Chromite mean Cr #=0.61, TiO_2 = 0.35 wt% (n=10).
Classification: CK6 chondrite
Specimens: Type specimen of 9.4 g, including one thin section, at *UAb*. M. Ouzillou 37.2 g.

Northwest Africa 12005 (NWA 12005)
(Northwest Africa)
Purchased: 2017 Sep
Classification: Ordinary chondrite (LL6)
History: Purchased by Blaine *Reed* in September 2017 from a Moroccan dealer at the Denver Show.
Petrography: (A. Irving and S. Kuehner, *UWS*) Breccia consisting of highly recrystallized clasts in a finer grained matrix containing altered metal and chlorapatite. All but three clasts in the studied thin section are devoid of recognizable chondrules and exhibit metamorphic textures, but several possible chondrule remnants were noted.
Geochemistry: Olivine ($Fa_{30.8\text{-}31.0}$, N = 3), orthopyroxene ($Fs_{25.5\text{-}25.6}Wo_{1.9\text{-}1.8}$, N = 3), clinopyroxene ($Fs_{10.4\text{-}10.7}Wo_{44.2\text{-}43.1}$, N = 2).
Classification: Ordinary chondrite (LL6).
Specimens: 20.7 g including one polished thin section at *UWB*; remainder with Mr. B. *Reed*.

Northwest Africa 12006 (NWA 12006)
(Northwest Africa)
Purchased: 2018 Apr
Classification: HED achondrite (Eucrite, brecciated)
History: Purchased by Marc Jost in April 2018 from a dealer in Laayoune, Morocco.
Petrography: (A. Irving and S. Kuehner, *UWS*) Breccia composed of at least five different varieties of lithic eucrite clasts exhibiting a range of textures, grainsizes and degree of shock set within a matrix of related debris and minor secondary calcite. Minerals present include exsolved pigeonite, calcic plagioclase (unshocked in some clasts, undulose to polycrystalline in other clasts), silica polymorph, fayalitic olivine, Ti-chromite, ilmenite and troilite.
Geochemistry: Orthopyroxene host ($Fs_{60.9\text{-}62.4}Wo_{2.1\text{-}1.7}$, FeO/MnO = 33-34, N = 3), clinopyroxene exsolution lamellae ($Fs_{27.0\text{-}27.3}Wo_{42.8\text{-}43.6}$, FeO/MnO = 30-31, N = 2), fayalitic olivine ($Fa_{81.2\text{-}81.3}$, FeO/MnO = 41-42, N = 2), plagioclase ($An_{83.4\text{-}89.9}Or_{1.2\text{-}0.4}$, N = 2).

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Classification: Eucrite (brecciated).
Specimens: 27.7 g including one polished thin section at *UWB*; remainder held by *SJS*.

Northwest Africa 12205 (NWA 12205)
(Northwest Africa)
Purchased: 2013 Feb
Classification: Ureilite
Physical characteristics: Puck-shaped, dark-brown stone with remnant fusion crust on approx. half the surface. Remaining surface is broken with minor caliche and rust spots in some areas. Sample includes a polished thin section and billet.
Petrography: Sample is characterized by a lack of a reduction rim around olivine, as well as abundant low-Ca pyroxene. Triple junctions are observed throught the sample and an opaque phase interfills 100-200 µm silicates. Low-Ca pyroxenes form 3 mm sized aggregates. Porphyroblastic Ca-rich pyroxene is present. Modal abundances: olivine approx. 60%; low-Ca pyroxenes approx. 30%; remainder is opaque material.
Geochemistry: Olivine core: $Fa_{12.4\pm0.1}$ FeO/MnO = 21.88±1.38 (n=6). Augite: $Fs_{6.6\pm0.2}Wo_{36.9\pm0.2}$, (n=8). Pigeonite: $Fs_{10.9\pm0.1}Wo_{4.7\pm0.1}$, (n=4). $\delta^{17}O$ = 3.771 permil, $\delta^{18}O$ = 8.206 permil, $\Delta^{17}O$ = -0.877 permil.

Northwest Africa 12206 (NWA 12206)
(Northwest Africa)
Purchased: 2013 Feb
Classification: Ureilite
Physical characteristics: Small, irregularly shaped, dark-brown stone. Remnant crust on one face. No caliche or rust on surface. Sample includes a polished thin section.
Petrography: Predominantly olivine with minor reduction rims. Scattered low-Ca pyroxene grains throughout. Modal abundances: olivine approx. 90%; low-Ca pyroxenes approx. 5%; remainder is graphite.
Geochemistry: Olivine core: $Fa_{17.5\pm0.8}$, FeO/MnO = 37.38 ± 5.45 (n=3). Olivine rim: $Fa_{6.7\pm3.2}$, (n= 5). pigeonite: $Fs_{14.0\pm2.5}Wo_{5.6\pm0.8}$, (n=8) $\delta^{17}O$ = 2.3 permil, $\delta^{18}O$ = 7.0 permil, $\Delta^{17}O$ = -1.364 permil.

Northwest Africa 12207 (NWA 12207)
(Northwest Africa)
Purchased: 2013 Feb
Classification: Ureilite
Physical characteristics: Ovoid, dark-brown stone with minor fusion crust. No caliche or rust on surface. Sample includes a polished thin section and billet.

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Petrography: Predominantly olivine. The largest aggregate of low Ca pyroxene is 2 mm. Reduction of olivine is present near graphite rich regions. Modal abundances: olivine approx. 75%; low Ca pyroxene approx. 20 %; the remainder is graphite.
Geochemistry: Olivine: $Fa_{16.4\pm7.2}$ (n=4); Olivine core: $Fa_{21.1\pm0.2}$ (n=2); Olivine rim: $Fa_{11.7\pm8.3}$ (n=2). Pigeonite: $Fs_{13.9\pm4.3}Wo_{6.1\pm3.1}$ (n=5). $\delta^{17}O$ = 3.06 permil, $\delta^{18}O$ = 7.90 permil, $\Delta^{17}O$ = -1.05 permil.

Northwest Africa 12208 (NWA 12208)
(Northwest Africa)
Purchased: 2013 Feb
Classification: Ureilite
Physical characteristics: Ovoid, dark-brown stone with weathered fusion crust on one surface. The other surfaces are wind-ablated. Minor caliche and rust on surface. Sample includes polished thin section and billet.
Petrography: Predominantly olivine with significant reduction rims visible. Gypsum was noted in some cracks indicating terrestrial weathering however there is only minor iron staining apparent in the mineral grains. Modal abundances: olivine approx. 70%; graphite approx. 20%; the remainder is scattered low-Ca pyroxene grains.
Geochemistry: Olivine: $Fa_{14.0\pm4.3}$ (n=8); Olivine core: $Fa_{16.0\pm2.6}$ (n=6); Olivine rim: $Fa_{8.2\pm1.4}$ (n=2). Augite: $Fs_{5.5\pm0.1}Wo_{24.5\pm0.4}$, (n=2). Pigeonite: $Fs_{14.2\pm3.1}Wo_{8.7\pm1.5}$ (n=10. $\delta^{17}O$ = 2.71 permil, $\delta^{18}O$ = 7.5 permil, $\Delta^{17}O$ = -1.20 permil.

Northwest Africa 12209 (NWA 12209)
(Northwest Africa)
Purchased: 2013 Feb
Classification: Ureilite
Physical characteristics: Small, triangular, dark-brown stone with desert varnished surface. Minor caliche. Sample includes polished thin section and billet.
Petrography: Predominantly olivine with significant reduction rims. Graphite occurs along grain boundaries as well as in clots interstitial to the mineral grains. Modal abundances: olivine approx. 90%; 5% graphite; remainder is scattered low-Ca pyroxene grains.
Geochemistry: Olivine: $Fa_{16.3\pm4.6}$ (n=7); Olivine core: $Fa_{19.6\pm2.3}$ (n=4); Olivine rim: $Fa_{11.8\pm1.6}$ (n=3). Augite: $Fs_{4.5\pm2.3}Wo_{30.0\pm8.4}$, (n=2). Pigeonite: $Fs_{14.3\pm6.6}Wo_{5.3\pm2.4}$ (n=16). $\delta^{17}O$ = 3.402 permil, $\delta^{18}O$ = 8.206 permil, $\Delta^{17}O$ = -0.877 permil.

Northwest Africa 12213 (NWA 12213)
Algeria
Purchased: 2018 May
Classification: Ordinary chondrite (LL(L)3.2)

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History: Purportedly found in Algeria and purchased by Ben Hoefnagels in May 2018 from a dealer in Guelmim, Morocco.
Petrography: (A. Irving and S. Kuehner, *UWS*) Closely packed, well-formed chondrules (apparent diameter 700±390 µm, N = 20) are set in a finer grained matrix containing altered metal.
Geochemistry: Olivine ($Fa_{1.2-79.3}$, Cr_2O_3 in ferroan examples 0.05-0.46 wt.%, mean 0.16±0.10 wt.%, N = 32), orthopyroxene ($Fs_{2.8-19.9}Wo_{0.4-1.3}$, N = 4),pigeonite ($Fs_{17.8}Wo_{7.3}$), subcalcic augite ($Fs_{4.2}Wo_{36.4}$). Magnetic susceptibility log χ (× 10^{-9} m^3/kg) = 4.57.
Classification: Ordinary chondrite LL(L)3.2. Subtype based on the observed range in Fa content of olivine and the range and mean of Cr_2O_3 contents in ferroan olivines, which are very similar to the results for Krymka (Grossman and Brearley, 2005).
Specimens: 30.5 g including one polished thin section at *UWB*; remainder with Mr. B. Hoefnagels.

Northwest Africa 12214 (NWA 12214)
(Northwest Africa)
Purchased: 2018 Jan
Classification: HED achondrite (Eucrite, unbrecciated)
History: Purchased in Temara, Morocco by Adam *Aaronson* in January 2018.
Petrography: (A. Irving and S. Kuehner, *UWS*) Unbrecciated specimen with intersertal texture. Minerals are exsolved pigeonite (now composed of microcrystalline sub grains), plagioclase, silica polymorph, ilmenite, troilite and minor secondary calcite. Plagioclase has in part been converted to maskelynite and in part to polycrystalline plagioclase.. Cross-cutting dark shock melt veinlets are present. The plagioclase in NWA 12214 has in part been converted to isotropic maskelynite and in part to polycrystalline plagioclase
Geochemistry: Orthopyroxene host ($Fs_{60.8-60.9}Wo_{5.9-5.6}$, FeO/MnO = 31-32, N = 3), clinopyroxene exsolution lamellae ($Fs_{29.8-30.7}Wo_{41.8-41.3}$, FeO/MnO = 32, N = 2), plagioclase ($An_{89.0-89.5}Or_{0.5-0.7}$, N = 2).
Classification: Eucrite (unbrecciated, highly shocked).
Specimens: 20.9 g including one polished thin section at *UWB*; remainder with *Aaronson*.

Northwest Africa 12216 (NWA 12216)
Algeria
Purchased: 2018 May
Classification: Lunar meteorite (feldspathic breccia)
History: Found near Wad Alma, Algeria and purchased by Darryl Pitt in May 2018 from a Mauritanian dealer.
Physical characteristics: A small (34.4 g) unusually hard, dark-gray stone, mostly very fine grained and vesicular with sparse white clasts.

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Petrography: (A. Irving and S. Kuehner, *UWS*) Small mineral clasts of anorthite, low-Ca pyroxene, subcalcic augite and olivine are set in a very fine-grained, vesicular matrix containing ilmenite, Ti-poor chromite, kamacite and troilite.
Geochemistry: Olivine ($Fa_{19.9-37.1}$, FeO/MnO = 80-119, N = 3), low-Ca pyroxene ($Fs_{26.9}Wo_{4.9}$, FeO/MnO = 53), pigeonite ($Fs_{23.8}Wo_{7.1}$, FeO/MnO = 50), subcalcic augite ($Fs_{62.6}Wo_{28.7}$, FeO/MnO = 75; $Fs_{13.3}Wo_{39.1}$, FeO/MnO = 36), plagioclase ($An_{96.9-97.4}Wo_{0.2-0.1}$, N = 2).
Classification: Lunar (feldspathic regolithic breccia).
Specimens: 9.2 g including one polished endcut at *UWB*; remainder with *DPitt*.

Northwest Africa 12220 (NWA 12220)
(Northwest Africa)
Purchased: 2007 June
Classification: Rumuruti chondrite (R3-4)
History: Purchased from a Moroccan dealer at the meteorite show in Ensisheim, France.
Petrography: (K. Metzler, *IfP*) Chondritic breccia, consisting of light chondritic clasts, embedded in a matrix of isolated chondrules and chondritic debris. Many chondrules and chondrule fragments are unequilibrated and stem from lithologies of type 3. Light clasts are metamorphosed and belong to the petrologic type 4.
Geochemistry: Mineral compositions and geochemistry: Clasts of petrologic type 4: mean olivine composition $Fa_{39.3\pm0.6}$ ($Fa_{37.6-40.0}$); n=12; mean pyroxene composition $Fs_{13.1\pm2.3}Wo_{43.2\pm2.3}$ ($Fs_{9.8-16.6}Wo_{39.8-46.2}$); n=14. Fragments of petrologic type 3: range of observed olivine compositions $Fa_{2.5-20.8}$; n=16; range of observed low-Ca pyroxene compositions: $Fs_{1.7-18.4}Wo_{0.4-5.0}$; n=17. Mineral compositions and geochemistry: Clasts of petrologic type 4: mean olivine composition $Fa_{39.3\pm0.6}$ (37.6-40.0); n=12; mean pyroxene composition $Fs_{13.1\pm2.3}Wo_{43.2\pm2.3}$ ($Fs_{9.8-16.6}Wo_{39.8-46.2}$); n=14. Fragments of petrologic type 3: mean olivine composition $Fa_{13.5\pm5.5}$ ($Fa_{2.5-20.8}$); n=16; mean pyroxene composition $Fs_{7.1\pm6.8}Wo_{2.2\pm1.7}$ ($Fs_{1.7-18.4}Wo_{0.4-5.0}$); n=17.
Classification: R chondrite based on mineral chemistry. Genomict breccia, consisting of chondrules and chondrule fragments from type 3 lithologies (unequilibrated olivine and pyroxene) and type 4 clasts (equilibrated olivine and unequilibrated pyroxene).

Northwest Africa 12228 (NWA 12228)
Northwest Africa
Purchased: 2018
Classification: LL3-6 melt breccia
History: Purchased by Fred *Olsen* in 2018 in Tucson, AZ.
Petrography: (D. Sheikh, *FSU*) Apart from one relict barred olivine (1054 um), no chondrules are present. Subangular clasts (0.5-7 mm) embedded in a dark matrix of impact melt. Feldspar present (10-100 um). Contains rounded blebs of troilite and angular grains of taenite. Equilibrated and unequilibrated clasts present.

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Geochemistry: Equilibrated clasts: Olivine, $Fa_{29.9\pm0.5}$ (N=32); Low Calcium Pyroxene, $Fs_{26.9\pm0.7}Wo_{2.9\pm0.2}$ (N=25); High-Ca pyroxene, $Fs_{17.8\pm0.6}Wo_{31.6\pm0.9}$ (N=25); Sodic plagioclase, An_{12} (N=4). Unequilibrated clasts: Olivine, $Fa_{25.8\text{-}38.8}$; low-Ca pyroxene, $Fs_{23.6\text{-}36.5}Wo_{2.3\text{-}6.1}$.
Classification: Ordinary Chondrite (LL3-6 melt breccia)
Specimens: 9.7 grams at *UCLA*; main mass with *Olsen*.

Northwest Africa 12252 (NWA 12252)
Morocco, Laayoun, (Northwest Africa)
Purchased: May 2017
Classification: Ordinary chondrite (H3)
History: Collected by nomads in Western Sahara and purchased by Nicola Castellano at the Genova Mineral Fair in May 2017 from a Moroccan dealer.
Physical characteristics: A single piece weighing 752 g with traces of fusion crust.
Petrography: (V. Moggi Cecchi, G. Pratesi, S. Caporali, *UniFi*); The thin section displays a chondritic texture, with scattered GO, GOP, PO and POP chondrules, ranging in size from 400 to 800 µm, in a fine grained matrix. GOP chondrules are poikilitic, with olivine grains embedded in twinned clinopyroxene. POP chondrules display olivine grains and elongated pyroxene grains in a glassy mesostasis. Olivine is homogenesous both in chondrules and in the matrix. Orthopyroxene in chondrules is inhomogeneous, with a core-rim variability. Plagioclase is Na and K-rich. Opaque phases are consisting of Fe,Ni alloys and troilite as individual grains scattered in the matrix or rimming chondrules. An armored chondrule is visible.
Geochemistry: (V. Moggi Cecchi, G. Pratesi, S. Caporali, *UniFi*); Olivine ($Fa_{17.4\pm6.2}Fo_{82.7\pm5.9}$; Fe/Mn = 41.2, n=25); Orthopyroxene in chondrule rims and matrix ($Fs_{18.3\pm0.5}En_{79.9\pm0.5}Wo_{1.8\pm0.1}$, Fe/Mn = 24.1, n=13); Low-Ca px in grain cores ($Fs_{7.9\pm4.2}En_{91.6\pm3.9}Wo_{0.5\pm0.1}$, Fe/Mn = 15.1, n=7), High-Ca pyroxene ($Fs_{2.1\pm2.0}En_{52.4\pm5.3}Wo_{45.5\pm4.5}$, n=7); plagioclase ($An_{33.7}Or_{33.4}$);
Classification: Ordinary Chondrite (H3); S2; W4. Estimated subtype 3.6 based on texture and spread in olivine composition.
Specimens: A total of 41 g specimen is on deposit at *MSN-FI*. Castellano holds the main mass.

Northwest Africa 12261 (NWA 12261)
Algeria
Purchased: 2018 Aug
Classification: Ordinary chondrite (H3)
History: Found near Ain Saleh, Algeria, and purchased by Ben Hoefnagels in August 2018 from a Moroccan dealer.
Petrography: (A. Irving and S. Kuehner, *UWS*) Closely packed, relatively small, well-formed chondrules (420±280 µm, N = 20) are set in finer grained matrix containing merrillite and abundant metal. A large (1.6 cm across) equilibrated H5 clast is present in the studied thin section.

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Geochemistry: Olivine ($Fa_{0.9-23.5}$, Cr_2O_3 in ferroan examples 0.02-0.04 wt.%, mean 0.03±0.01 wt.%, N = 8), orthopyroxene ($Fs_{3.8-16.7}Wo_{0.4-1.2}$, N = 3), subcalcic augite ($Fs_{10.0}Wo_{27.6}$). Magnetic susceptibility log χ (× 10^{-9} m^3/kg) = 5.43.
Classification: Ordinary chondrite (H3).
Specimens: 25.5 g including one polished thin section at *UWB*; remainder with Mr. B. Hoefnagels.

Northwest Africa 12263 (NWA 12263)
(Northwest Africa)
Purchased: 2018 Jun
Classification: Ordinary chondrite (L3)
History: Purportedly found in Mali and purchased by Marc Jost from Abdelaziz Mouadine in Rissani, Morocco, in June 2018.
Petrography: (A. Irving and S. Kuehner, *UWS*) Very fresh specimen composed of very closely packed, well-formed chondrules (apparent diameter 880±400 µm, N = 20) set in a sparse finer grained matrix containing lightly stained metal.
Geochemistry: Olivine ($Fa_{0.6-35.4}$, Cr_2O_3 in ferroan examples 0.03-0.13 wt.%, mean 0.06±0.03 wt.%, N = 8), orthopyroxene ($Fs_{3.9-27.8}Wo_{0.3-1.4}$, N = 3), pigeonite ($Fs_{20.9}Wo_{20.0}$), diopside ($Fs_{2.1}Wo_{39.3}$). Magnetic susceptibility log χ (× 10^{-9} m^3/kg) = 4.69.
Classification: Ordinary chondrite (L3).
Specimens: 36.4 g including one polished thin section at *UWB*; remainder with *SJS*.

Northwest Africa 12264 (NWA 12264)
(Northwest Africa)
Purchased: 2018 Aug
Classification: Ungrouped achondrite
History: Purchased by Ben Hoefnagels in August 2018 from a dealer in Agadir, Morocco.
Petrography: (A. Irving and S. Kuehner, *UWS*; P. Carpenter, *WUSL*) Breccia composed almost entirely (>95 vol.%) of closely packed, angular grains of olivine (some up to 9 mm across, exhibiting undulose extinction) in a sparse olivine-rich matrix containing minor chromite, low-Ca pyroxene, plagioclase and rare exsolved pigeonite. Some symplectitic intergrowths of chromite and pyroxene are also present.
Geochemistry: Olivine ($Fa_{20.8-22.0}$, FeO/MnO = 74-88, N = 4), low-Ca pyroxene ($Fs_{17.6-17.7}Wo_{4.8-4.3}$, FeO/MnO = 64-69, N = 2), clinopyroxene host in exsolved pigeonite ($Fs_{26.6}Wo_{39.6}$, FeO/MnO = 51), orthopyroxene exsolution lamella ($Fs_{53.1}Wo_{4.5}$, FeO/MnO = 69), plagioclase ($An_{51.8}Or_{2.6}$). Oxygen isotopes (K. Ziegler, *UNM*): Analyses of acid-washed subsamples by laser fluorination gave, respectively, $\delta^{17}O$ -2.886, -3.489, -3.605; $\delta^{18}O$ 0.467, -0.028, -0.092; $\Delta^{17}O$ -3.133, -3.474, -3.557 per mil.

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Classification: Achondrite (ungrouped, dunitic breccia). Oxygen isotopes plot close to the values for the Milton pallasite (Jones et al., 2003) and between the trends for CR chondrites and CV chondrites.
Specimens: 10.4 g including one polished thin section at *UWB*; remainder with Mr. B. Hoefnagels.

Northwest Africa 12274 (NWA 12274)
Algeria
Purchased: 2016 5
Classification: HED achondrite (Eucrite, unbrecciated)
History: Purchased by Miao Bing-an in 2016 from Morocco.
Physical characteristics: A black fusion crust is visible on the surface of the meteorite, and some of the fusion crust is covered by yellow-brown soil. In addition, the hand specimen is unbrecciated and has weak magnetic properties (i.e., a magnet is weakly attracted to the meteorite).
Petrography (B. Miao, C. Zhang, *GUT*): The rock structure is igneous but not brecciated. Many types of minerals were found in this meteorite, such as Low-Ca pyroxene, high-Ca pyroxene, plagioclase, SiO_2, metal-Fe, chromite, ilmenite, troilite, rutile and baddeleyite.
Geochemistry (B. Miao, C. Zhang, *GUT*, EPMA): Low-Ca pyroxene (n=13): Fe/Mn=31.2±1.95, Mg#=36.8±1.0; $Fs_{60.7\pm1.7}Wo_{3.9\pm1.9}En_{35.4\pm1.0.}$ High-Ca pyroxene (n=12): Fe/Mn=30.7±3.0, Mg#=49.8±1.3; $Fs_{29.6\pm1.3}Wo_{41.1\pm1.3}En_{29.3\pm0.6.}$ Plagioclase (n=20): $An_{90.0\pm0.5}Or_{0.5\pm0.2}Ab_{9.5\pm0.5.}$
Classification: Based on texture and mineral composition, this meteorite is a basaltic unbrecciated eucrite.
Specimens: 32.6 g specimen and a polished thin section are deposited in *GUT*

Northwest Africa 12275 (NWA 12275)
Algeria
Purchased: 2016 5
Classification: HED achondrite (Eucrite, unbrecciated)
History: Purchased by Miao Bing-an in 2016 from Morocco.
Physical characteristics: Meteorite has visible black fusion crust and weak magnetic properties (i.e., a magnet is weakly attracted to the meteorite). Additionally, hand specimen is unbrecciated.
Petrography (B. Miao, C. Zhang, *GUT*): The structure is dense and with abundant small Fe metal grains. The structure is igneous and unbrecciated. Many minerals such as Low-Ca pyroxene, high-Ca pyroxene, plagioclase, SiO_2, metal-Fe, chromite, ilmenite, troilite, zircon, rutile and baddeleyite were found in this meteorite.
Geochemistry (B. Miao, C. Zhang, *GUT*, EPMA): Low-Ca pyroxene (n=13): Fe/Mn=29.7±1.5, Mg#=36.8±0.8; $Fs_{61.5\pm1.5}Wo_{2.7\pm1.3}En_{35.8\pm0.5.}$ High-Ca pyroxene (n=12): Fe/Mn=29.4±2.6, Mg#=50.9±1.2;$Fs_{28.8\pm1.2}Wo_{41.5\pm1.1}En_{29.7\pm0.4.}$ Plagioclase (n=20): $An_{90.1\pm0.7}Or_{0.4\pm0.2}Ab_{9.5\pm0.7.}$

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Classification: Based on texture and mineral composition, this meteorite is a basaltic unbrecciated eucrite.
Specimens: 43.3 g specimen and a polished thin section are deposited in *GUT*

Northwest Africa 12276 (NWA 12276)
Algeria
Purchased: 2016 5
Classification: HED achondrite (Eucrite, unbrecciated)
History: Purchased by Miao Bing-an in 2016 from Morocco.
Physical characteristics: The hand specimen is unbrecciated and the dense mineral particles are visible on the surface of the meteorite. In addition, there are some residual black fusion crust locally on the rock surface.
Petrography (B. Miao, C. Zhang, *GUT*): The rock structure is igneous and unbrecciated. Many types of minerals have been found in this meteorite, such as Low-Ca pyroxene, high-Ca pyroxene, plagioclase, SiO_2, metal-Fe, chromite, ilmenite, troilite, rutile and baddeleyite.
Geochemistry (B. Miao, C. Zhang, *GUT*, EPMA): Low-Ca pyroxene (n=13): Fe/Mn=28.9±0.9, Mg#=37.7±0.8; $Fs_{59.6\pm1.9}Wo_{4.2\pm2.1}En_{36.1\pm0.5.}$ High-Ca pyroxene (n=12): Fe/Mn=29.0±1.8, Mg#=50.9±1.0; $Fs_{28.9\pm1.1}Wo_{41.1\pm1.1}En_{30.0\pm0.3.}$ Plagioclase (n=20): $An_{90.2\pm0.5}Or_{0.5\pm0.2}Ab_{9.3\pm0.4.}$
Classification: Based on texture, mineral composition, it is a basaltic unbrecciated eucrite.
Specimens: 26.7 g specimen and a polished thin section are deposited in *GUT*

Northwest Africa 12277 (NWA 12277)
Algeria
Purchased: 2016 5
Classification: HED achondrite (Eucrite, unbrecciated)
History: Purchased by Miao Bing-an in 2016 from Morocco.
Physical characteristics: The surface of the unbrecciated hand specimen is covered with almost complete black fusion crust. Additionally, this meteorite has weak magnetic properties (i.e., a magnet is weakly attracted to the meteorite) and dense structure.
Petrography (B. Miao, Chuantong Zhang, *GUT*): The structure is dense and there are abundant small Fe metal grains. Minerals are slightly broken, but the structure is igneous and not brecciated. Many minerals such as Low-Ca pyroxene, high-Ca pyroxene, plagioclase, SiO_2, metal-Fe, chromite, ilmenite, troilite, zircon, rutile and baddeleyite were observed in this meteorite.
Geochemistry (B. Miao, C. Zhang, *GUT*, EPMA): Low-Ca pyroxene (n=13): Fe/Mn=29.1±1.4, Mg#=37.7±0.7;$Fs_{59.8\pm1.6}Wo_{3.9\pm1.8}En_{36.3\pm0.7.}$ High-Ca pyroxene (n=12): Fe/Mn=29.2±2.5, Mg#=50.7±1.5; $Fs_{29.0\pm1.3}Wo_{41.2\pm1.0}En_{29.8\pm0.5.}$ Plagioclase (n=20): $An_{90.1\pm0.6}Or_{0.4\pm0.2}Ab_{9.5\pm0.6.}$

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Classification: Based on texture and mineral composition, this meteorite is a basaltic unbrecciated eucrite.
Specimens: 31.8 g specimen and a polished thin section are deposited in *GUT*

Northwest Africa 12278 (NWA 12278)
Algeria
Purchased: 2016 5
Classification: HED achondrite (Eucrite, unbrecciated)
History: Purchased by Miao Bing-an in 2016 from Morocco.
Physical characteristics: The hand specimen is unbrecciated and its surface is covered with black fusion crust. In addition, the meteorite has weak magnetic properties (i.e., a magnet is weakly attracted to the meteorite).
Petrography (B. Miao, Chuantong Zhang, *GUT*): The structure of this meteorite is dense, igneous and unbrecciated. Many types of minerals were observed in this meteorite, such as Low-Ca pyroxene, high-Ca pyroxene, plagioclase, SiO_2, Fe-metale, chromite, ilmenite, troilite, rutile and baddeleyite.
Geochemistry (Bing-kui Miao, Chuantong Zhang, *GUT*, EPMA): Low-Ca pyroxene (n=15): Fe/Mn=30.0±1.8, Mg#=37.3±0.9;$Fs_{60.2\pm2.0}Wo_{4.0\pm2.0}En_{35.8\pm0.6}$. High-Ca pyroxene (n=11): Fe/Mn=30.2±1.7, Mg#=50.5±1.3; $Fs_{29.4\pm1.3}Wo_{40.6\pm1.2}En_{30.0\pm0.3}$. Plagioclase(n=20): $An_{90.1\pm0.5}Or_{0.5\pm0.2}Ab_{9.4\pm0.4}$.
Classification: Based on texture, mineral composition, it is a basaltic unbrecciated eucrite.
Specimens: 29.2 g specimen and a polished thin section are deposited in *GUT*

Northwest Africa 12296 (NWA 12296)
Morocco
Find: 2017
Classification: Rumuruti chondrite (R3-4)
Physical characteristics: The exterior fusion crust is dark brown and weathered. The interior is primarily reddish-brown with light gray to black clasts (0.1-1 mm).
Petrography: (D. Sheikh, *FSU*) Breccia consisting of unequilibrated (R3) and equilibrated (R4) clasts. Well-formed chondrules (0.2-0.8 mm). Iron-nickel sulfides present; no metal observed. Shock melt veins present.
Geochemistry: Olivine in type 3 clasts: $Fa_{32.6\pm11.7}$ ($Fa_{8.8-49.6}$, N=46); olivine in type 4 clasts: $Fa_{38.2\pm0.8}$ (N=23); low-ca pyroxene in type 3 clasts: $Fs_{20.5\pm7.4}Wo_{2.4\pm1.0}$ ($Fs_{11.2-35.8}Wo_{0.7-5.5}$, N=40); Ca-pyroxene in type 3 clasts: $Fs_{20.1\pm2.8}Wo_{25.7\pm6.0}$ ($Fs_{14.6-21.9}Wo_{17.6-31.4}$, N=6).
Classification: Rumuruti Chondrite (R3-4)
Specimens: 4.92 grams at *UCLA*; main mass with Matthew Stream.

Northwest Africa 12303 (NWA 12303)
Morocco

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Purchased: 2017
Classification: Ordinary chondrite (LL3)

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 brown flat stone of 56.2 g without fusion crust

Petrography: (R. Bartoschewitz, *Bart*) well defined chondrules (0.4-2.2 mm, av. 1 mm) of various types (PO, POP, RP, BO), chondrule fragments, and CAIs are set in dark-brown oxidized matrix.

Geochemistry: (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine $Fa_{23.4\pm7.4}$ (n=12); pyroxene $Fs_{20.6\pm7.0}Wo_{0.7\pm0.4}$ (n=10); $An_{15}Or<1$ (n=1); chromite CRAL78, FFM93 (n=3). Kamacite Ni=5.5, Co=1.4 (n=3); taenite Ni=36.2, Co=0,4 (n=1) (all wt.-%). Magnetic susceptibility log χ ($\times 10^{-9}$ m^3/kg) = 3.70

Classification: ordinary chondrite (LL3, S2)

Specimens: 11.3 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 7.5 g with *Bart*. Polished thin sections *Bart* and *IfP*

Northwest Africa 12304 (NWA 12304)
Algeria
Purchased: 2017
Classification: Ordinary chondrite (L5)

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) Strong eroded dark red stone of 269 g without fusion crust. On the surface chondrules are recognizable.

Petrography: (R. Bartoschewitz, *Bart*) poorly delinated chondrules (0.4-2 mm, av. 0.8 mm) of various types (PO, POP, RP, BO) and chondrule fragments are set in dark-brown oxidized matrix.

Geochemistry: (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine $Fa_{23.0\pm0.4}$ (n=14); pyroxene $Fs_{20.2\pm1.0}Wo_{1.5\pm0.3}$ (n=10); Ca pyroxene $En_{48}Fs_7Wo_{45}$ (n=1); chromite CRAL87, FFM87 (n=1); apatite. Magnetic susceptibility log χ ($\times 10^{-9}$ m^3/kg) = 4.32

Classification: ordinary chondrite (L5, S2, W4)

Specimens: 16.44 g at *Kiel* and 3.85 g at Münster on deposit, Ziyao Wang holds the main mass, and 30 g with *Bart*. Polished thin sections *Bart* and *IfP*

Northwest Africa 12305 (NWA 12305)
Mauritania
Purchased: 2018
Classification: Ordinary chondrite (L6)

History: (Ziyao Wang) Purchased by Ziyao Wang from Adnane Sami during the China (Hunan) Mineral & Gem Show in Chenzhou City in Sept. 2018.

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Physical characteristics: (Ziyao Wang) Two brown-black individuals of 13282 g and 217.5 g.
Petrography: (R. Bartoschewitz, *Bart*) black shock-darkened matrix with indistinct chondrules accompanied by melt pockets of µm-sized matrix.
Geochemistry: (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine $Fa_{25.0\pm2.4}$ (n=17); pyroxene $Fs_{20.7\pm0.8}Wo_{1.1\pm0.3}$ (n=4); $An_{13}Or_6$ (n=1); merrillite. Kamacite Ni=6.9, Co=1.0 wt-% (n=1). Magnetic susceptibility log χ (× 10^{-9} m^3/kg) = 4.78
Classification: ordinary chondrite (L6, with melt pockets)
Specimens: 22 g on deposit at Münster, Ziyao Wang holds the main mass, and 188 g with *Bart*. Polished thin sections *Bart* and *IfP*

Northwest Africa 12306 (NWA 12306)
Morocco
Purchased: 2018
Classification: Carbonaceous chondrite (CO3)
History: (Ziyao Wang) Purchased by Ziyao Wang from Fayssal Mezgouri during the China (Hubei) Mineral & Gem Show in Huangshi City in Sept 2018.
Physical characteristics: (Ziyao Wang) Dark black stone of 36.4 g with about 30% fusion crust
Petrography: (R. Bartoschewitz, *Bart*) Chondrules (average ~ 200 µm), chondrule fragments, and CAIs are embedded in a fine-grained brownish matrix (about 30 vol%).
Geochemistry: (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine $Fa_{12.8}$ (0.4-45.9; n=32); pyroxene $Fs_{3.4\pm2.1}Wo_{2.0\pm1.2}$ (n=6); Ca-pyroxene $En_{86}Fs_5Wo_9$. Kamacite Ni=4.8, Co=1.1 (n=4); taenite Ni=41.3, Co=0,4 (n=4) (all wt-%). Magnetic susceptibility log χ (× $10^{-9}m^3$/kg) = 4.48
Classification: carbonaceous chondrite (CO3, S3)
Specimens: 6.7 g at *Kiel* and 0.6 g at Münster on deposit, Ziyao Wang holds the main mass, and 8 g with *Bart*. Polished thin sections *Bart* and *IfP*

Northwest Africa 12307 (NWA 12307)
Morocco
Purchased: 2018
Classification: Ordinary chondrite (L6)
History: (Ziyao Wang) Purchased by Ziyao Wang from Fayssal Mezgouri during the China (Hubei) Mineral & Gem Show in Huangshi City in Sept 2018.
Physical characteristics: (Ziyao Wang) 34.1 g black stone with a smooth surface
Petrography: (R. Bartoschewitz, *Bart*) Poorly defined chondrules in strongly recrystallized matrix. The meteorite is heavily brecciated with melt pockets, mosaicism in olivine, and feldspar is mainly isotropic. Cleavages and fractures are blackened by penetrated metal and sulfide.

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Geochemistry: (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine $Fa_{24.1\pm0.4}$ (n=12); pyroxene $Fs_{20.5\pm0.5}Wo_{1.3\pm0.3}$ (n=7); feldspar $An_{23}Or_5$; Chromite CRAL86, FFM84; merrillite. Kamacite Ni=6.8, Co=1.2 wt-% (n=1). Magnetic susceptibility log χ (× 10^{-9} m^3/kg) = 4.81
Classification: Ordinary chondrite (L6, S4, W2)
Specimens: 6.42 g at *Kiel* and 0.43 g at Münster on deposit, Ziyao Wang holds the main mass, and 5 g with *Bart*. Polished thin sections *Bart* and *IfP*

Northwest Africa 12308 (NWA 12308)
Morocco
Purchased: 2018
Classification: Enstatite chondrite (EL3)
History: (Ziyao Wang) Purchased by Ziyao Wang from Fayssal Mezgouri during the China (Hubei) Mineral & Gem Show in Huangshi City in Sept 2018.
Physical characteristics: (Ziyao Wang) 57.8 g brown-black round stone with recognizable chondrules on the surface
Petrography: (R. Bartoschewitz, *Bart*) well-defined chondrules (0.2-2.4 mm, av. 0.7 mm) of various types and chondrule fragments are set in black matrix.
Geochemistry: (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine $Fa_{0.2\pm0.1}$ (n=3); pyroxene $Fs_{1.3\pm0.7}Wo_{0.3\pm0.1}$ (n=13); chromite CRAL100, FFM100; SiO_2. Kamacite Ni=6.4, Co=0.6, Si=0.5 (n=32); troilite Cr=0.9, Ti=0.2 (n=19); alabandite Fe=13 (n=1) (all wt-%); daubreelite, oldhamite. Magnetic susceptibility log χ (× 10^{-9} m^3/kg) = 5.45
Classification: Enstatite chondrite, EL3 ($EL3_a$ according to the scheme of Weyrauch et al., 2018).
Specimens: 11.8 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 10 g with *Bart*. Polished thin sections *Bart* and *IfP*

Northwest Africa 12309 (NWA 12309)
(Northwest Africa)
Purchased: 2015
Classification: Mesosiderite
History: (Ziyao Wang) Purchased by Ziyao Wang from Sbai Mohamed at the mineral show in *Beijing* in Nov. 2015
Physical characteristics: (Ziyao Wang) A 17.8 g dark yellowish stone
Petrography: (R. Bartoschewitz, *Bart*) composed mainly of orthopyroxene beside some pigeonite and feldspar. Metal is completly altered and Fe-hydroxides fill cracks.
Geochemistry: (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Pyroxene $Fs_{22.2\pm5.7}Wo_{2.0\pm1.3}$ (n=10); pigeonite $En_{58}Fs_{34}Wo_8$ (n=2); feldspar $An_{92}Or<1$ (n=1). Altered metal: Fe~50, Ni~3 (all wt-%). Magnetic susceptibility log χ (× 10^{-9} m^3/kg) = 4.66
Classification: Mesosiderite

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Specimens: 3.97 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 1.3 g with *Bart*.

Northwest Africa 12310 (NWA 12310)
Morocco
Purchased: 2018
Classification: Rumuruti chondrite (R4)
History: (Ziyao Wang) Purchased by Ziyao Wang from Mr. Ayman during the China (Hunan) Mineral & Gem Show in Chenzhou City in May 2018.
Physical characteristics: (Ziyao Wang) 74 g gray-yellow elongated stone.
Petrography: (R. Bartoschewitz, *Bart*) well delinated PO and BO chondrules (0.4-1.6 mm, av. 0.7 mm) and chondrule fragments are set in light-brown matrix.
Geochemistry: (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine $Fa_{38.8\pm0.4}$ (n=17) chromite CRAL83, FFM94 (n=1). Magnetic susceptibility log χ ($\times 10^{-9}$ m^3/kg) = 3.00
Classification: Rumuruti Chondrite (R4, S3, W4)
Specimens: 9.4 g at *Kiel* and 5.5 g at Münster on deposit, Ziyao Wang holds the main mass, and 4 g with *Bart*. Polished thin sections *Bart* and *IfP*

Northwest Africa 12311 (NWA 12311)
Morocco
Purchased: 2018
Classification: Ordinary chondrite (L6, melt breccia)
History: (Ziyao Wang) Purchased by Ziyao Wang from Adnane Sami during the China (Hunan) Mineral & Gem Show in Chenzhou City in May 2018.
Physical characteristics: (Ziyao Wang) Black-brown stone of 253 g with rusty fusion crust with adhering sand grains.
Petrography: (R. Bartoschewitz, *Bart*) Chondrule and mineral fragments of L6 petrology up to 20 mm are set in a dark melt-rock martix, with ~20 µm, mostly rounded metal/sulfide inclusions.
Geochemistry: (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine $Fa_{24.3\pm0.5}$ (n=16); pyroxene $Fs_{20.8\pm0.4}Wo_{1.6\pm0.2}$ (n=9); chromite CRAL86, FFM81. Magnetic susceptibility log χ ($\times 10^{-9}$ m^3/kg) = 4.77
Classification: Ordinary chondrite (L-melt rock with L6 fragments)
Specimens: 20.2 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 23 g with *Bart*. Polished thin sections *Bart* and *IfP*

Northwest Africa 12312 (NWA 12312)
Morocco
Purchased: 2017
Classification: Ordinary chondrite (L6)

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History: (Ziyao Wang) Purchased by Ziyao Wang from Mr. Ayman during the China (Hunan) Mineral & Gem Show in Chenzhou City in Nov. 2017.
Physical characteristics: (Ziyao Wang) 303 g red-brown and black stone without fusion crust
Petrography: (R. Bartoschewitz, *Bart*) chondrule relicts and mineral fragments in a recrystallized matrix. Meteorite is mostly shock-darkened with abundant shock veins. Feldspar is transformed to maskelynite.
Geochemistry: (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine $Fa_{25.7\pm0.6}$ (n=16); pyroxene $Fs_{20.9\pm0.1}Wo_{1.7\pm0.1}$ (n=2); feldspar $An_{19}Or_7$ (n=5); chromite CRAL87, FFM88 (n=2). Kamacite Ni=7.3, Co=0.8 wt-% (n=2). Magnetic susceptibility log χ ($\times 10^{-9}$ m^3/kg) = 4.79
Classification: Ordinary chondrite (L6, S5, W1)
Specimens: 21.2 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 26 g with *Bart*. Polished thin sections *Bart* and *IfP*

Northwest Africa 12314 (NWA 12314)
Morocco
Purchased: 2018
Classification: Ordinary chondrite (H~6)
History: (Ziyao Wang) Purchased by Ziyao Wang from Said Yousfi in Errachidia, Morocco, in Oct. 2018.
Physical characteristics: 190 g yellow elongated stone with some fusion crust.
Petrography: (R. Bartoschewitz, *Bart*) Gray, strongly recrystallized matrix, with poorly developed chondrules, and much homogenously distributed, irregular metal and sulfide.
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 5.49
Classification: Ordinary chondrite (H~6, W1)
Specimens: 22.7 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 21 g with *Bart*.

Northwest Africa 12315 (NWA 12315)
Morocco
Purchased: 2018
Classification: Ordinary chondrite (L4)
History: (Ziyao Wang) Purchased by Ziyao Wang from Naji Ben Faraji in Laayoune, Western Sahara, Oct. 2018.
Physical characteristics: (Ziyao Wang) One 166 g stone of irregular shape, fresh black fusion crust presents well developed flow lines.
Petrography: (R. Bartoschewitz, *Bart*) well defined globular, elongated and highly deformed chondrules (0.3-2 mm). Matrix with irregular metal and sulfide patches and veins. Metal veins bearing individual chondrules (0.4-1 mm).

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Geochemistry: (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine $Fa_{23.6\pm0.6}$ (n=13); pyroxene $Fs_{18.6\pm2.0}Wo_{1.2\pm1.1}$ (n=7); chromite CRAL92, FFM90; ilmenite MgO=2.55, MnO=1.78 and FeO=41.9 wt.-%. Kamacite Ni=5.5, Co=0.9 wt.-% (n=4). Magnetic susceptibility r=3.56 g/cm³, log χ (× 10^{-9} m^3/kg) = 5.21
Classification: Ordinary chondrite (L4, S4, W0)
Specimens: 20.7 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 19 g with *Bart*.

Northwest Africa 12316 (NWA 12316)
Morocco
Purchased: 2018
Classification: Ordinary chondrite (L~6)
History: (Ziyao Wang) Purchased by Ziyao Wang from Lahcenia Ait Ha in Erfoud, Morocco, in June 2018.
Physical characteristics: 173 g ray nearly spherical stone without fusion crust
Petrography: (R. Bartoschewitz, *Bart*) green-brown, recrystallized matrix, with poorly defined chondrules, melt pockets and melt veins.
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ (× 10^{-9} m^3/kg) = 5.07
Classification: Ordinary chondrite (L~6, W3)
Specimens: 21.5 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 21 g with *Bart*.

Northwest Africa 12317 (NWA 12317)
(Northwest Africa)
Purchased: April 2017
Classification: Carbonaceous chondrite (CO3)
History: Discovered by an anonymous person an purchased in Erfoud in April 2017
Petrography: (R. Bartoschewitz, *Bart*) Chondrules (avaerage ~ 200 µm), chondrule fragments, and CAIs are embedded in a fine-grained brownish matrix (about 20 vol%). Magnetic susceptibility logc=4.10.
Geochemistry: (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Random measurements of olivine grains revealed $Fa_{37.8\pm2.9}$ ($Fa_{29.2-44.8}$), n=24; feldspar $An_{60}Ab_{38}$ (n=1). Taenite Ni=38.4, Co=0.4 wt.-% (n=1).
Classification: Carbonaceous chondrite (CO3, S1)
Specimens: 20.2 g on deposit at *Kiel*, main mass anonymous

Northwest Africa 12318 (NWA 12318)
(Northwest Africa)
Purchased: 2008
Classification: Mesosiderite
History: Purchased from a meteorite dealer in Morocco in 2008

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Physical characteristics: Five yellow brown oxidized fragments and splinter of totally 102.5 g
Petrography: (R. Bartoschewitz, *Bart*) composed mainly of orthopyroxene (up to 3 mm) and feldspar (up to 0.2 mm). Metal is completly altered and Fe-hydroxides fill cracks.
Geochemistry: (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine $Fa_{16.5\pm1.2}$ (n=2); pyroxene $Fs_{24.0\pm5.1}Wo_{1.92\pm1.3}$ (n=12); pigeonite $En_{61}Fs_{33}Wo_{6}$ (n=2); feldspar $An_{92}Or<1$ (n=21). Magnetic susceptibility log χ ($\times 10^{-9}$ m^3/kg) = 4.29
Classification: Mesosiderite
Specimens: 17.86 g at Münster and 2.44 at *Kiel* on deposit, main mass with Alan Mazur and 8.6 g with *Bart*. Polished thin sections *Bart* and *IfP*

Northwest Africa 12319 (NWA 12319)
(Northwest Africa)
Find: 2018
Classification: Ungrouped achondrite
History: The meteorite was discovered in 2018 ans sold by a meteorite dealer in Agadir
Physical characteristics: Thirteen green-gray fragnents and small splinters of totaling 35.3 g, some ae partly covered by olive-green-brown fusion crust.
Petrography: (R. Bartoschewitz, *Bart*) brecciated dunite with pyroxene (<0.2 mm), plagioclase (<0,1 mm), chromite (<1.5 mm), and troilite.
Geochemistry: (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine $Fa_{12.9\pm2.8}$, (n=48), Fe/Mn=37; pyroxene $Fs_{22.0\pm5.0}Wo_{2.8\pm1.4}$ (n=4, Fe/Mn=27); augite $En_{46}Fs_{10}Wo_{44}$ (n=2); feldspar $An_{71}Or<1$ (n=4); chromite CRAL88, FFM69 (n=3); troilite. Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 3.01. O-isotopes (A. Pack, *UGött*): $\delta^{17}O$ = 1.681‰, $\delta^{18}O$ = 3.613‰, $\Delta^{17}O$(‰) = -0.198.
Classification: Achondrite, ungrouped. Fe/Mn and O-isotopes show relation to QUE 93148, NWA 12217, and NWA 12562. NWA 12319 is probably paired with NWA 12217 and NWA 12562
Specimens: 1.05 g at Münster and 5.07 at *Kiel* on deposit, main mass with Alan Mazur and 5 g with *Bart*.

Northwest Africa 12329 (NWA 12329)
(Northwest Africa)
Purchased: May 2015
Classification: Carbonaceous chondrite (CO3)
History: Purchased in Erfoud by Pierre-Marie Pelé
Physical characteristics: Brown stone. Cut face reveals brownish interior with small chondrules
Petrography: Chondrules with average size 170 µm (n=19) set in fine grained matrix (47 vol%, from point counting n=143). Abundant metal.

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Geochemistry: Olivine $Fa_{15.4\pm16.4}$, PMD=101%, range $Fa_{0.4-46.3}$ (n=12), Cr_2O_3 in ferroan olivine is 0.20±0.09 wt% (n=10). Low-ca pyroxene $Fs_{3.0\pm1.4}Wo_{1.0\pm0.1}$, range $Fs_{1.6-4.3}Wo_{0.9-1.1}$ (n=2). High-Ca pyroxene $Fs_{1.22}Wo_{52.4}$ (n=1)
Classification: Carbonaceous chondrite (CO3). Moderate weathering
Specimens: 21.5 g and a polished section at *CEREGE*. Main mass with Pierre-Marie Pelé

Northwest Africa 12332 (NWA 12332)
(Northwest Africa)
Purchased: March 2018
Classification: Ordinary chondrite (LL3)
Physical characteristics: Eleven stones from 2 to 107 g.
Petrography: Chondrite with well defined chondrules set in a fine grain matrix. Matrix 28 vol% from point counting (n=336). Average apparent chondrule size 710±420 µm (n=40). Strong weathering.
Geochemistry: Olivine $Fa_{10.3\pm6.1}$, PMD=51%, range $Fa_{1.9-21.4}$, Cr_2O_3=0.26±0.15wt%, n=10. Low-ca pyroxene $Fs_{10.3\pm4.9}Wo_{1.86\pm2.0}$, range $Fs_{8.9-21.7}Wo_{0.4-5.3}$ (n=4)
Classification: Ordinary chondrite, LL3. LL group from magnetic susceptibility.
Specimens: 20.96 g and a polished section at *CEREGE*. Main mass with *Kuntz*

Northwest Africa 12333 (NWA 12333)
(Northwest Africa)
Purchased: 2017 Mar 31
Classification: Rumuruti chondrite (R5)
History: Purchased in Erfoud by Pierre-Marie Pelé.
Physical characteristics: Dark stone, partially covered with fusion crust. Cut surface reveals dark interior with small chondrules.
Petrography: Highly recrystallized chondrite with average size plagioclase below 50 µm. Abundant sulfide. Accessory magnetite.
Geochemistry: Olivine $Fa_{39.6\pm0.4}$, range $Fa_{39.1-40.1}$, Cr_2O_3 in ferroan olivine is 0.0±0.1 wt%, NiO2=0.22±0.20 wt% (n=3). High-Ca pyroxene $Fs_{29.6}Wo_{68.7}$ (n=1). Chromite Cr#=0.85 (n=1).
Classification: Rumuruti chondrite (R5)
Specimens: 20.83 g and a polished section at *CEREGE*. Main mass with Pierre-Marie Pelé

Northwest Africa 12334 (NWA 12334)
(Northwest Africa)
Purchased: 2017
Classification: Ordinary chondrite (LL6, anomalous)
Petrography: Highly recrystallized chondrite with average size plagioclase 60 µm. Abundant sulfide, with rare magnetite.

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Geochemistry: Olivine $Fa_{34.1\pm0.3}$, NiO 0.17±0.05 wt% (n=8). Low-Ca pyroxene $Fs_{27.5}Wo_{2.4}$ (n=1). Chromite Cr#=0.88 (n=1). Plagioclase $An_{4.1}Ab_{80.0}Or_{15.9}$ (n=1). Oxygen isotopic composition (J. Gattacceca, C. Sonzogni, *CEREGE*) from analysis of one acid-washed 1.5 mg aliquot of a powdered 255 mg bulk sample is $\delta^{17}O$=4.01‰, $\delta^{18}O$=5.14‰ , $\Delta^{17}O$=1.31‰ (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 1 out of 1715 LL chondrite has a higher Fa content (NWA 11776, LL6-an, with $Fa_{35.7}$). Magnetic susceptibility is also lower than in other moderaltely weathered LL chondrites. The opaque mineralogy, featuring magnetite and pyrrhotite, is unusual for a LL chondrite.
Specimens: 33.9 g and a polished section at *CEREGE*. Main mass with R. Lenssen

Northwest Africa 12345 (NWA 12345)
Morocco
Purchased: 2016 Nov 18
Classification: HED achondrite (Howardite)
Physical characteristics: Stone has a dark fusion crust covered in reddish-orange weathering. It contains dark-gray to green angular clasts of varying size (0.1 mm to 4 mm in size) within a gray fine-grained matrix.
Petrography: (L. Jenkins *UWO*) This meteorite is a polymict breccia containing clasts of various lithologies and up to 4 mm in size (making up together about 20 vol% of the meteorite). Fine-grained to medium-grained clasts contain principally clinopyroxene, plagioclase, and silica (40% of clasts), others include orthopyroxene and olivine, with granoblastic or ophitic textures (60% of clasts). Matrix contains orthopyroxene, clinopyroxene with exsolution lamellae, plagioclase, and opaques (chromite, ilmenite, sulfides, and metal).
Geochemistry: (EPMA, M. Beauchamp, *UWO*): Eucrite host: low-Ca pyroxene $Fs_{54.0\pm3.8}Wo_{4.9\pm2.6}$, Fe/Mn=25.6±1.3 (n=6); augite $Fs_{28.2\pm1.0}Wo_{39.6\pm0.7}$, Fe/Mn=28.9±3.3 (n=4); and plagioclase $An_{90.2\pm2.4}$ (n=10). Diogenite clasts: Olivine $Fa_{43.7\pm0.1}$, Fe/Mn=47.7±1.3 (n=6); low-Ca pyroxenes $Fs_{26.2\pm2.9}Wo_{4.2\pm6.4}$, Fe/Mn=29.2±1.7 (n=10).
Classification: Achondrite (Howardite).
Specimens: 21.3 g including a thin section at *UWO*. S. Tutorow holds the main mass.

Northwest Africa 12355 (NWA 12355)
(Northwest Africa)
Purchased: April 2018
Classification: Ordinary chondrite (L3)

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Petrography: The meteorite displays a chondritic texture with well packed chondrules (mean diameter about 0.6 mm) in a fine-grained dark matrix that contains sulfides and FeNi metals.
Classification: Chondrule size and metal abundance consistent with L-group classification.

Northwest Africa 12360 (NWA 12360)
(Northwest Africa)
Purchased: April 2018
Classification: Ordinary chondrite (H3)
Petrography: The meteorite displays a chondritic texture with abundant chondrules (mean diameter about 0.4 mm) and chondrule fragments in a fine-grained dark matrix that contains sulfides and FeNi metals.
Classification: The chondrule size and the metal abundance indicates an H group classification.

Northwest Africa 12362 (NWA 12362)
(Northwest Africa)
Purchased: April 2018
Classification: Ordinary chondrite (H3)
Petrography: The meteorite displays a chondritic texture with chondrules (mean diameter about 0.4 mm) and chondrule fragments in a fine-grained dark matrix that contains sulfides and FeNi metal.
Classification: The small chondrule size and the high metal abundance indicates an H group classification

Northwest Africa 12363 (NWA 12363)
(Northwest Africa)
Purchased: 2018 April
Classification: Ordinary chondrite (L4-5)
Petrography: The rock is brecciated and consists of different lithologies with different degree of recrystallization. The type 4 fragments still have unequilibrated low-Ca- pyroxene. Low-Ca pyroxene of the equilibrated clasts is $Fs_{20.0\pm0.2}$.
Classification: Ordinary chondrite (L4-5)

Northwest Africa 12364 (NWA 12364)
(Northwest Africa)
Purchased: April 2018
Classification: Ordinary chondrite (L3)
Petrography: The meteorite displays a chondritic texture with well-packed chondrules (mean diameter about 0.6 mm) in a fine-grained dark matrix that contains

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sulfides and FeNi metal.

Geochemistry: Olivine Cr2O3 in type II chondrules is 0.15±0.09 (n=40).
Classification: Chondrule size and metal abundance indicate L group.

Northwest Africa 12370 (NWA 12370)
(Northwest Africa)
Purchased: 2018 Oct 25
Classification: Ordinary chondrite (H5)
History: The meteorite was purchased at the mineralogical exhibition (Mineralientage München, Germany) in October 25, 2018 from the Mr. Ait Ha Lahcen from Erfoud (Morocco).

Northwest Africa 12371 (NWA 12371)
Morocco
Purchased: 2011
Classification: Primitive achondrite (Acapulcoite)
History: Purchased by Doug Ross in 2011 from a dealer in Cumberland, Maryland.
Physical characteristics: Two stones, dark fusion crust, moderately weathered exterior. A saw cut reveals some small metal grains set in a dark-brown, fine-grained groundmass, some oxide staining; one dark clast appears in the middle of the larger stone.
Petrography: This meteorite exhibits a granoblastic texture with abundant triple junctions. Grain sizes are 100-300 µm in diameter. Olivine, pyroxene and plagioclase are uniformly distributed, but metal and sulfide are heterogeneous in distribution. Small (~10-20 µm) metal blebs are present, as is typical in acapulcoites. Weathering is moderate(B/C) with extensive staining of the thin section.
Geochemistry: Microprobe analyses of olivines show $Fa_{9.14\pm0.14}$ (n=11) consistent with acapulcoite.
Classification: Achondrite, acapulcoite
Specimens: Three small pieces (of one stone) totaling 6.94 g and a thin section (one inch round) are on deposit at *SI*. Doug Ross holds the main mass of 20.98 g.

Northwest Africa 12379 (NWA 12379)
Morocco
Find: 2017 Aug to 2018 Sep
Classification: Ungrouped chondrite
History: Found between August 2017 and September 2018 close to the border between Morocco and Algeria
Physical characteristics: (Luc *Labenne*) Five individuals covered by typical NWA iron meteorite desert patina and very well preserved inside.

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Petrography: (C. A. Jansen, Frank E. Brenker, J. Zipfel, *Senck*, A. N. Krot, *UH*) The meteorite is very metal-rich consisting of ~70 vol% Fe,Ni, ~25-30 vol% silicates, <5 vol% troilite and is completely free of matrix. Minor quantities of Fe-oxides, probably of terrestrial origin, are present. The silicate portion is dominated by abundant, well-rounded chondrules up to 1.2 mm, mostly POP, PO and PP types. Many chondrules are fragmented. Metal phases are predominantly kamacite; taenite and tetrataenite are rarer. Accessory troilite occurs as coarse isolated grains, occasionally associated with tetrataenite. Merrillite, chlorapatite and chromite are found inside metal grains and in peripheral parts of some chondrules.
Geochemistry: Mineral compositions and geochemistry: Porphyritic chondrules: olivine $Fa_{25.3\pm3}$ ($Fa_{18.1-28.5}$, median $Fa_{26.5}$, Cr_2O_3=0.03±0.02 wt%; FeO/MnO=53.6±5.9, N=36); low-Ca pyroxene $Fs_{14.7\pm3.7}Wo_{1.4\pm1.3}$ ($Fs_{3.2-18.7}Wo_{0.2-4.5}$, median $Fs_{15.8}Wo_{0.8}$, N=19). Isolated low-Ca pyroxene grains enclosed by metal and low-Ca pyroxene phenocrysts in some chondrules are replaced to various ° by Fe-rich olivine ($Fa_{27.3\pm0.6}$; FeO/MnO=53.8±4.1; N=13). This data was acquired by EPMA. Oxygen isotopes: (A. Pack, *UGött*) $\delta^{17}O$=3.69‰, $\delta^{18}O$=5.14‰, $\Delta^{17}O$=+0.96‰.
Classification: Chondrite (ungrouped). Based on the chemical composition of the silicate fraction as well as the common presence of chromite and phosphates in combination with oxygen isotopes the sample shows affinity to ordinary chondrites. The olivine Fa content is not homogenized throughout the sample and the standard deviation is within the range of type 3 ordinary chondrites. The high metal content, however, is inconsistent with ordinary chondrite. Based on its petrographic and geochemical properties and oxygen isotope data, this meteorite is probably paired with NWA 12273. Luc *Labenne* for providing important information and a second sample for oxygen isotope analyses.

Northwest Africa 12380 (NWA 12380)
(Northwest Africa)
Purchased: 2017
Classification: Ordinary chondrite (L3)
History: Specimen was purchased in Morocco in late 2017 by Brahim Tahiri and brought to Sean Tutorow before the 2018 Tucson Gem Show.
Physical characteristics: Physical Characteristics: Brownish and yellow-brown weathering patina occurs on rough exterior surfaces. Fractures filled with a yellow-white precipitate are visible cutting across the hand specimen. Interior is brown with crisply defined chondrules, and contains discreet light and dark colored clasts.
Petrography: (M. Hutson and A. Ruzicka, *Cascadia*) The host meteorite consists of sharply defined chondrules, chondrule fragments, and light-colored clasts up to 3 mm across set in a matrix comprised of angular fragments. Chondrules range in size from 0.14 to 2.5 mm, with a mean diameter of 0.74 mm (N=129). A single large (1 cm × 1 cm) dark clast that has a sharp contact with the host consists of well-defined chondrules (diameter 0.3-2.1 mm range, 0.83 mm mean, N=48) in an opaque matrix consisting of fine-grained material of differing texture and composition than the

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meteorite host. Two coarse-grained light colored clasts were examined in detail. One clast (approximately 2 × 3 mm in thin section) consists of a single large normally-zoned olivine grain approximately 2.5 mm long surrounded by smaller low-Ca pyroxene grains with high-Ca pyroxene overgrowths set in a feldspathic mesostasis. The other light-colored clast (approximately 1.3 × 1.5 mm in thin section) consists of coarse (up to 0.5 mm) twinned laths of low-Ca pyroxene poikilitically enclosing a few small olivine grains. In the meteorite roughly 80-90% of the opaque minerals have been replaced by Fe-hydroxides. A large vein of calcite cross-cuts the meteorite host but does not penetrate the dark clast.
Geochemistry: Mineral Compositions and Geochemistry: Olivine (host $Fa_{22.8\pm10.8}$, N=83; dark clast $Fa_{16.5\pm9.4}$, N=56; coarse olivine clast $Fa_{17.3\pm2.2}$, N=20), low-Ca pyroxene (host $Fs_{12.3\pm8.7}Wo_{1.1\pm1.1}$, N= 45; dark clast $Fs_{10.0\pm7.8}Wo_{1.2\pm1.4}$, N=31; coarse olivine clast $Fs_{17.3\pm2.2}Wo_{2.0\pm0.7}$, N=19; twinned pyroxene clast $Fs_{26.7\pm1.4}Wo_{1.5\pm0.5}$, N=10). Cr_2O_3 wt% in olivine (host 0.07±0.10, N=56; dark clast 0.14±0.08, N=40).
Classification: Ordinary chondrite L3. L group rather than LL based on chondrule diameter. Estimated subtype ~3.5 based on Fa statistics.
Specimens: *Cascadia* holds 21.4 g in two pieces, in addition to three polished thin sections and three mounted butts. Main mass held by Sean Tutorow.

Northwest Africa 12384 (NWA 12384)
(Northwest Africa)
Purchased: 2018 Nov
Classification: Lunar meteorite (basaltic breccia)
History: Purchased in Agadir, Morocco, in November 2018 by Aziz Habibi.
Physical characteristics: Two dense stones (total 244 g) coated by a thin, dark brown patina, but exhibiting a very fresh, gray interior with some visible basaltic clasts.
Petrography: (P. Carpenter, *WUSL* and A. Irving, *UWS*) The specimen is a breccia consisting of rounded mare basalt clasts with intersertal texture set in a matrix of related crystalline debris. Major mineral phases are olivine, pigeonite (some zoned to ferropigeonite) and anorthite with accessory ilmenite, merrillite, fluorapatite, troilite, zirconolite, tranquillityite and FeNi metal. The basalt clasts also contain K-rich mesostasis. A fine grained vesicular shock vein crosscuts the studied sample.
Geochemistry: Olivine in breccia matrix ($Fa_{30.0\text{-}50.4}$, FeO/MnO = 93-113, N = 6), pigeonite in breccia matrix ($Fs_{30.6\text{-}31.8}Wo_{10.4\text{-}22.7}$, FeO/MnO = 54-58, N = 2), pigeonite in basalt clast (cores $Fs_{28.9\text{-}29.4}Wo_{7.9\text{-}8.4}$, FeO/MnO = 50-56, N = 3; rims $Fs_{44.8\text{-}79.6}Wo_{16.3\text{-}20.4}$, FeO/MnO = 59-88, N = 3), subcalcic augite in breccia matrix ($Fs_{24.6}Wo_{31.5}$, FeO/MnO = 59), plagioclase in breccia matrix ($An_{81.1\text{-}95.6}Or_{1.1\text{-}0.1}$, N = 2), plagioclase in basalt clast ($An_{82.3\text{-}89.7}Or_{0.7\text{-}0.4}$, N = 4).
Classification: Lunar (mare basalt breccia).
Specimens: 22.3 g including one polished endcut and one polished thin section at *UWB*; remainder with Luc *Labenne*.

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Northwest Africa 12388 (NWA 12388)
(Northwest Africa)
Purchased: 2018 Apr 9
Classification: Ordinary chondrite (L, melt rock)
Petrography: The meteorite shows a porphyritic structure. The opaque matrix is composed of glass with traces of granular silicates and metal. The metal and sulfide are dispersed in circular droplets. Remnant chondrules are preserved.

Northwest Africa 12391 (NWA 12391)
(Northwest Africa)
Find: 2016
Classification: Ordinary chondrite (L5)
History: The specimen was bought from Zs. Kereszty.
Physical characteristics: A single brown stone (51.4 g) without fusion crust.
Petrography: (D. Rezes and A. Kereszturi, *CSFK*) The stone is composed of a light-gray lithology with orange-brown limonitic patches around the troilite, FeNi metal and opaque veins. It has typical chondritic texture. The average chondrule diameter is 0.7 mm. Olivine shows planar fractures. Olivine-mosaicism is not observable. Accessory minerals are chromite, Cl-apatite and whitlockite. There are black-colored thin shock veins in the lithology.
Geochemistry: (D. Rezes, A. Kereszturi and M. Szabo, *CSFK*) Mineral chemistry: Olivine $Fa_{22.5\pm0.7}$, N=18; Orthopyroxene $Fs_{19.0\pm0.84}Wo_{1.5\pm0.3}$, N=10; Feldspar $Ab_{82.76}$,N=6
Classification: Ordinary chondrite (L5), shock stage S3, weathering W3
Specimens: 5 g on deposit at *CSFK*, D. Rezes holds the main mass.

Northwest Africa 12392 (NWA 12392)
(Northwest Africa)
Purchased: 2018
Classification: Martian meteorite (Shergottite)
History: Purchased from Rachid Chaoui in Morocco, August 2018.
Physical characteristics: Single stone, lacking fusion crust. Saw cut reveals a mix of brown pyroxene grains and black maskelynite domains and shock melt.
Petrography: (C. Agee, *UNM*) Igneous rock with diabasic texture. The two major phases in this meteorite are pigeonite and maskelynite. The pigeonite has a modal abundance of approximately 75% and shows significant core to rim zoning in backscatter electron images. No augite was detected. Maskelynite has modal abundance of approximately 20%. Ubiquitous ilmenite and ulvöspinel are present. Shock melt veins with vesicles were observed throughout.
Geochemistry: (C. Agee, *UNM*) Pigeonite $Fs_{53.5\pm20.3}Wo_{13.7\pm6.4}$, core to rim range $Fs_{26.3}Wo_{4.5}$ Ð $Fs_{76.3}Wo_{16.8}$, Fe/Mn=36±5, n=13; maskelynite $An_{51.1\pm2.0}Ab_{48.0\pm1.8}Or_{0.9\pm0.6}$, n=7; Shock melt (20 µm defocused electron beam) SiO_2=50.2±2.0, TiO_2=0.81±12, Al_2O_3=10.2±3.7, Cr_2O_3=0.13±0.05, MgO=6.0±1.9,

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FeO=19.9±3.9, MnO=0.47±0.10, NiO=0.02±0.03, CaO=9.8±0.4, Na_2O=1.6±0.7, K_2O=0.10±0.03 (all wt%), n=7.
Classification: Pigeonite basalt, augite absent.
Specimens: 20.1 g including a probe mount on deposit at *UNM*, Jay Piatek holds the main mass.

Northwest Africa 12393 (NWA 12393)
(Northwest Africa)
Purchased: 2016
Classification: Lunar (olivine gabbronorite)
History: Purchased from Ahmad Buraga in Morocco, February 22, 2016.
Physical characteristics: Single stone, lacking fusion crust. Saw cut reveals a breccia of dark-brown and dark-green clasts with a few, scattered, light-colored, feldspathic fragments.
Petrography: (C. Agee, *UNM*) This meteorite is a chemically equilibrated, fragmental breccia with olivine, augite, low-Ca pyroxene, anorthitic plagioclase, and ubiquitous minor chromite. Following lunar petrologic nomenclature this is an olivine gabbronorite.
Geochemistry: (C. Agee, *UNM*) Olivine $Fa_{27.2\pm2.9}$, n=12; augite $Fs_{14.0\pm1.4}Wo_{39.8\pm1.8}$, Fe/Mn=50±7, n=4; low-Ca pyroxene $Fs_{22.5\pm1.9}Wo_{5.9\pm2.1}$, Fe/Mn=52±3, n=8; plagioclase $An_{96.3\pm0.9}Ab_{3.5\pm0.9}Or_{0.2\pm0.0}$, n=7.
Classification: Lunar (olivine gabbronorite)
Specimens: 20.4 g including a probe mount on deposit at *UNM*, Jay Piatek holds the main mass.

Northwest Africa 12394 (NWA 12394)
(Northwest Africa)
Purchased: 2016
Classification: Ordinary chondrite (LL6)
History: A 16.8 g sample was found in Morocco prior to 2017 and sold to a meteorite dealer. J. Donald Cline and John Sinclair purchased the sample during the 2016 Tucson Gem and Mineral show.
Physical characteristics: Sample is irregularly shaped, dark brown, and 99% covered in a dull, dark-brown fusion crust. The sample contains a few shallow regmaglypts and a faint, continuous rollover lip is visible on one side of the stone.
Petrography: Description and classification (A. Love, *App*): Sample contains indistinct chondrules (avg. dia 1250 µm) set within a recrystallized matrix. Chondrule mesostasis is completely recrystallized. Sample contains plagioclase crystals with an average length of 60µm.
Geochemistry: (A. Love, *App*) Olivine: $Fa_{29.6\pm0.2}$, n=8; low Ca pyroxene $Fs_{25.8\pm0.1}Wo_{1.5\pm0.1}$, n=8.
Classification: LL6, C-S3, W2. LL based on diameter of chondrules, olivine and pyroxene compositions and magnetic susceptibility. Type 6 based on texture,

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standard deviations of Fa and Fs compositions and size of plagioclase. Shock stage C-S3 based upon undulatory extinction and planar fractures in olivine.
Specimens: *PARI* holds the main mass. One endcut weighing 6.2g and a polished thin section are on deposit at *App*.

Northwest Africa 12395 (NWA 12395)
Morocco
Purchased: May 2018
Classification: Iron meteorite (IID)
History: Purchased in May 2018 from Goulmima-based Lahsen Ouabicha, via Internet. No other pieces similar to it were found, according to the dealer.
Physical characteristics: The meteorite is roughly oval in shape, and measures approximately 5 × 3 × 2 cm.
Petrography: (C. Herd, *UAb*) Optical investigation of a ~4.5 × 2.5 cm polished and etched slice reveals a well-developed Widmanstätten pattern consistent with a medium octahedrite (0.52±0.06 mm; n=38). Two lath-shaped schreibersite inclusions parallel to the Widmanstatten pattern are present. Terrestrial alteration appears to have only affected the exterior surface.
Geochemistry: ICP-MS data, using sample of North Chile (Filomena) as standard (C. Herd and G. Chen *UAb*): Ni = 10.3, Co = 0.69 (both wt%); Ir = 9.1, Ga = 75, Ge = 89, As = 9.3, W = 2.8, Re = 0.9, Os = 0.7, Pt = 16.9, Cu = 253, Au = 0.85 (all μg/g).
Classification: (C. Herd, *UAb*): IID iron, through comparison of bulk composition with data from Wasson and Huber (2006), medium octahedrite.
Specimens: Type specimen consisting of a 21 g representative slice at *UAb*. Main mass with Craig Zlimen.

Northwest Africa 12396 (NWA 12396)
(Northwest Africa)
Purchased: 2015
Classification: Mesosiderite
Physical characteristics: 2.5 × 1.5 × 2.0 cm in size. Sample is irregular in shape with preserved fusion crust.
Petrography: Composed mainly of Opx and Plg. Opx ranges from 30 to 1480 μm. Plg ranges in size from 30 to 170 μm. FeNi metal ranges from 15 to 1050 μm and sulfides from 30 μm to 350 μm. Opaques comprise approximately 20% of sample. Weakly shocked: plagioclase displays minor undulose extinction and no melt veins or melt pockets are visible. Moderately weathered: Fe Oxide veining common.
Geochemistry: Low Ca pyroxene: $Fs_{30.2\pm0.3}Wo_{3.0\pm0.6}$, FeO/MnO=27.7±0.8 n=48; feldspar: $An_{91.3\pm2.1}Ab_{8.4\pm2.0}$ n=13. Oxygen isotopes (Ziegler, *UNM*): $\delta^{17}O$ = 1.689±0.23, $\delta^{18}O$ = 3.745±0.42, $\Delta^{17}O$ = -0.289±0.01 per mil (n=3)
Classification: Mesosiderite
Specimens: Catalogued at the *ROM* as LM57787

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Northwest Africa 12397 (NWA 12397)
(Northwest Africa)
Purchased: 2014
Classification: Mesosiderite
Physical characteristics: 3 × 2 × 2.5 cm in size. A well rounded sample with red brown staining and visible surface weathering.
Petrography: Composed mainly of Opx and Plg. Opx ranges from few µm to 2740 µm. Plg ranges from few µm to 160 µm. FeNi metal ranges from 50 µm to 1480 µm and sulfides from 10 µm to 1070 µm. Opaques comprise approximately 20% of sample. Weakly Shocked: plagioclase displays minor undulose extinction and no melt veins or melt pockets are visible. Moderately weathered: pervasive Fe Oxide veining, some oxidation of metal and sulfides.
Geochemistry: Low Ca pyroxene: $Fs_{26.4\pm0.5}Wo_{2.2\pm0.4}$ n=37; Feldspar: $An_{91.7\pm1.6}Ab_{8.0\pm1.5}$, n= 23. Oxygen isotopes (Ziegler, *UNM*): $\delta^{17}O$=1.992±0.07, $\delta^{18}O$=4.323±0.42, $\Delta^{17}O$=-0.291±0.02 per mil (n=2)
Classification: Mesosiderite
Specimens: Catalogued at the *ROM* as LM57788

Northwest Africa 12398 (NWA 12398)
(Northwest Africa)
Purchased: 2018
Classification: HED achondrite (Diogenite)
History: The meteorite was purchased from a local meteorite dealer in Morocco.
Physical characteristics: Seven greyish fragments partly covered with fusion crust.
Petrography: The meteorite is a monomict breccia predominantly composed of blocky up to 1.3 mm sized orthoproxenes grains and fine-grained cataclastic regions. Minor phases include plagioclase, chromite, FeS, and metallic iron.
Geochemistry: Low-Ca pyroxene: $Fs_{24.8\pm0.2}Wo_{3.5\pm0.2}$ ($Fs_{24.4-25.2}Wo_{3.1-3.7}$, n=13, FeO/MnO=28-33); calcic plagioclase: $An_{87.7\pm1.5}$ ($An_{85.8-89.2}$, n=9)

Northwest Africa 12402 (NWA 12402)
(Northwest Africa)
Purchased: 2018
Classification: Carbonaceous chondrite (CO3)
History: The meteorite was purchased from a local meteorite dealer in Morocco.
Physical characteristics: Brownish individual 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 µm), CAIs, and mineral fragments set into a fine-grained matrix. Chondrules are highly unequilibrated and sometimes surrounded by fine-grained dust rims.

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Northwest Africa 12407 (NWA 12407)
(Northwest Africa)
Purchased: 2016
Classification: HED achondrite (Eucrite, polymict)
History: The meteorite was purchased from a local meteorite dealer in Morocco.
Petrography: The meteorite is a polymict breccia with basaltic and black melt clasts set into a fine-grained clastic mineral matrix. Dominant minerals are magmatically zoned low-Ca pyroxenes, Fe-rich low-Ca pyroxenes with augite exsolution lamellae and calcic plagioclase typically 300-400 µm in size. Minor phases include silica, chromite, FeS, ilmenite, and FeNi metal.
Geochemistry: magmatic low-Ca pyroxene: $Fs_{25.9\pm8.2}Wo_{2.1\pm1.0}$ ($Fs_{16.0-35.8}Wo_{1.0-3.8}$, n=16, FeO/MnO=25±4); pyroxene host to augite lamellae: $Fs_{54.8\pm2.7}Wo_{2.4\pm0.8}$ ($Fs_{49.0-58.2}Wo_{1.9-4.6}$, n=13, FeO/MnO=30±1); Ca-pyroxene: $Fs_{23.5\pm1.9}Wo_{42.0\pm0.9}$ ($Fs_{19.4-26.6}Wo_{40.0-43.2}$, n=13, FeO/MnO=27±1); calcic plagioclase: $An_{90.8\pm2.4}$ ($An_{87.0-93.2}$, n=13)

Northwest Africa 12412 (NWA 12412)
(Northwest Africa)
Purchased: 2013 Nov
Classification: Martian meteorite (Shergottite)
History: Purchased in Agadir by Vincent Jacques
Physical characteristics: A single fresh-looking stone showing dark-gray to dark-green color. Pyroxene laths are easily visible in the cut surface. Dark and shiny parts (maskelynite) are distributed between pyroxenes. Texture varies between different parts showing some dense, crystal-packed areas.
Petrography: Ophitic to sub-ophitic texture. Contains zoned (normal) high-Ca pyroxene, plagioclase (maskelynite), ilmenite, pyrrhotite, magnetite. Pyroxene average grain size is 500 µm.
Geochemistry: Pyroxenes $Fs_{35.5-48.5}Wo_{10.3-30.0}$, average $Fs_{43.6\pm4.3}Wo_{15.1\pm6.8}$ FeO/MnO = 33.9±1.9 (n=6). Oxygen isotopes (R. Greenwood, *OU*): $\Delta^{17}O$= 0.248±0.003 ‰; $\delta^{18}O$= 5.554±0.117 ‰ (n=2); $\delta^{17}O$= 3.196±0.059 ‰. (La/Sm)N (ICP-MS, *ULB*)=1. Mg#=0.47; CaO=8.9wt% (*ULB*).
Classification: Martian (shergottite, diabasic)
Specimens: Type specimen (1 fragment + 1 PTS) at the *RBINS* meteorite collection.

Northwest Africa 12413 (NWA 12413)
Morocco
Purchased: 2002
Classification: Ordinary chondrite (L5)
History: Purchased with numerous other unclassified NWA samples from Marvin Kilgore in 2002.

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Physical characteristics: The meteorite is mostly covered by fusion crust with a small piece (~10 cm) chipped away.
Petrography: The thin section shows chondrules of different textures but few have sharp boundaries.
Geochemistry: Average olivine is $Fa_{24.7.4\pm0.6}$ (n= 6); Pyroxene $Fs_{23.7\pm2.6}Wo_{1.4}$ (n=5)
Classification: Ordinary chondrite L5 with a weathering grade of W3 and a shock stage of S1.

Northwest Africa 12414 (NWA 12414)
Morocco
Purchased: 2002
Classification: Ordinary chondrite (L4)
History: Purchased with numerous other unclassified NWA samples from Marvin Kilgore in 2002
Physical characteristics: The meteorite is mostly covered by fusion crust and the rest shows weathering.
Petrography: The thin section shows chondrules of different textures and has a lithic fragment one edge.
Geochemistry: Avergae olivine is $Fa_{25.2.4\pm1.4}$ (n= 7); Pyroxene $Fs_{20.7\pm2.6}$ $Wo_{1.4}$ (n=7)
Classification: Ordinary chondrite L4 with a weathering grade of W2, and a shock stage of S2.

Northwest Africa 12415 (NWA 12415)
Morocco
Purchased: 2014
Classification: HED achondrite (Eucrite, melt breccia)
History: Purchased by Larry Atkins from Morocco in October 2014.
Physical characteristics: Single stone, no fusion crust; exterior shows numerous light-brown clasts set in a dark matrix of shock melt.
Petrography: (C. Agee, *UNM*) (C. Agee, *UNM*) Microprobe examination shows basaltic clasts with approximately 60% pyroxene and 35% plagioclase grains most in the range 200-400 µm.
Geochemistry: (C. Agee, *UNM*) Low-Ca pyroxene $Fs_{60.8\pm1.4}Wo_{3.0\pm1.3}$, Fe/Mn=31±1, n=7; high-Ca pyroxene $Fs_{27.4\pm1.0}Wo_{42.5\pm1.2}$, Fe/Mn=32±2, n=5; plagioclase $An_{89.4\pm0.3}$, n=5.
Classification: Eucrite-melt breccia, eucrite clasts are consistent with type 6 (Takeda and Graham, 1991) showing clear compositional separation of low and high calcium pyroxenes.
Specimens: 22 g including a probe mount on deposit at *UNM*, Larry Atkins holds the main mass.

Northwest Africa 12416 (NWA 12416)

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(Northwest Africa)
Purchased: 2018 Jul
Classification: Carbonaceous chondrite (C3, ungrouped)

History: The first batch of this material was purchased by Adam *Aaronson* in July 2018 in Temara, Morocco; subsequently additional material was purchased from the same Moroccan source by Mark Lyon and others.

Physical characteristics: The material consists of numerous small black, friable stones, some completely fusion crusted (total weight 875 g).

Petrography: (A. Irving and S. Kuehner, *UWS*; L. Garvie, *ASU*) Granular chondrules (apparent diameter 350±210 µm, N = 15) together with sparse mineral fragments and AOA (but no identifiable CAI or related mineral grains) are set in very fine grained matrix (~50 vol.%, black in thin section) containing minor kamacite and pentlandite. No phyllosilicates were detectable by X-ray diffraction.

Geochemistry: Olivine ($Fa_{1.0-67.1}$, N = 3), orthopyroxene ($Fs_{1.7-4.3}Wo_{0.9-3.1}$, N = 2), clinopyroxene ($Fs_{1.1}Wo_{23.2}$). Oxygen isotopes (K. Ziegler, *UNM*) Analyses of acid-washed subsamples by laser fluorination gave, respectively, $\delta^{17}O$ -10.290, -0.181, -11.117; $\delta^{18}O$ -6.827, 7.352, -7.023; $\Delta^{17}O$ -6.685, -4.063, -7.409 per mil.

Classification: Carbonaceous chondrite (ungrouped Type 3). Oxygen isotope compositions plot at more negative $\Delta^{17}O$ values than for CV, CK and most CM chondrites, and the absence of phyllosilicates excludes affinity to typical CM2 chondrites.

Specimens: 20.1 g including one polished thin section at *UWB*; 152 g at *ASU*; 361 g with Mr. M. Lyon; 137 g with Mr. M. Ouzillou; 205 g with Mr. A. *Aaronson*.

Northwest Africa 12417 (NWA 12417)
(Northwest Africa)
Purchased: 2018 Aug
Classification: Ureilite

History: Puchased in Rabat, Morocco, by Adam *Aaronson* in August 2018.

Petrography: (A. Irving and S. Kuehner, *UWS*) Protogranular aggregate of olivine (~75 vol.%) and pigeonite (~25 vol.%) with minor secondary calcite. Olivine exhibits reduced magnesian, Fe metal-bearing rims. We did not observe any graphite either optically or in BSE images (despite a search for it), and this specimen is not sufficiently hard to contain microdiamond.

Geochemistry: Olivine (cores $Fa_{19.8-20.1}$; rim $Fa_{6.4}$; N = 3), pigeonite ($Fs_{16.6-16.7}Wo_{9.7-9.6}$, N = 2), low-Ca pyroxene ($Fs_{14.0}Wo_{4.1}$).

Classification: Ureilite.

Specimens: Type specimen divided between *UWB* (9 g) and *ROM* (12 g). One polished thin section at *UWB*. Remainder with *DGregory*.

Northwest Africa 12418 (NWA 12418)
(Northwest Africa)
Purchased: 2018 Dec

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Classification: Martian meteorite (Shergottite)

History: Purchased by Ben Hoefnagels in December 2018 from a dealer in Zagora, Morocco.

Physical characteristics: A small (31.8 g) completely crusted stone. The fresh interior is light green in color with some visible glassy maskelynite.

Petrography: (A. Irving and S. Kuehner, *UWS*) Poikilitic texture. Composed predominantly of olivine and clinopyroxene (both exhibiting limited compositional zoning in Fe and Mg) with subordinate maskelynite and accessory ilmenite, Ti-chromite, Mg-merrillite and pyrrhotite. Minor cross-cutting veinlets of secondary calcite are present.

Geochemistry: Olivine (core $Fa_{33.9}$, FeO/MnO = 52; rim $Fa_{41.5}$, FeO/MnO = 50), pigeonite ($Fs_{26.0-26.1}Wo_{5.0-5.1}$; $Fs_{32.5-37.4}Wo_{14.5-9.7}$; FeO/MnO = 29-33; N = 5), subcalcic augite ($Fs_{21.4-21.6}Wo_{29.6-30.3}$, FeO/MnO = 28-29, N = 2), maskelynite ($An_{51.8-53.8}Or_{1.4-1.5}$, N = 2).

Classification: Martian (shergottite, poikilitic)

Specimens: 6.4 g including one polished thin section at *UWB*; remainder with Mr. B. Hoefnagels.

Northwest Africa 12419 (NWA 12419)

(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 and S. Kuehner, *UWS*) Sparse chondrules are present in a recrystallized matrix containing relatively abundant altered metal and accessory merrillite.

Geochemistry: Olivine ($Fa_{19.8-20.0}$, N = 3), orthopyroxene ($Fs_{16.7-16.8}Wo_{1.4-1.7}$, N = 3), clinopyroxene ($Fs_{6.7-7.3}Wo_{44.5-44.8}$, N = 2).

Classification: Ordinary chondrite (H5).

Specimens: The entire specimen including one polished thin section is at *PSF*.

Northwest Africa 12420 (NWA 12420)

(Northwest Africa)

Purchased: 2011 Feb

Classification: Mesosiderite

History: Puchased in Temara, Morocco, by Adam *Aaronson* in February 2011.

Petrography: (A. Irving and S. Kuehner, *UWS*) Aggregate of predominantly low-Ca pyroxene (orthopyroxene cores with slightly more calcic and more ferroan rims), calcic plagioclase and metal (about 50 vol%, kamacite with taenite) plus accessory chromite, Mg-merrillite, silica polymorph and troilite.

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Geochemistry: Orthopyroxene ($Fs_{21.6-23.8}Wo_{0.9-1.5}$, FeO/MnO = 31-33, N = 2), low-Ca pyroxene rim ($Fs_{31.7}Wo_{4.2}$, FeO/MnO = 26), plagioclase ($An_{86.4-89.5}Or_{0.7-0.5}$, N = 2).
Classification: Mesosiderite.
Specimens: 20.4 g including one polished endcut at *UWB*; remainder with *Aaronson*.

Northwest Africa 12421 (NWA 12421)
(Northwest Africa)
Purchased: 2005
Classification: Ordinary chondrite (H3)
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*) Well-formed chondrules (apparent diameter 560±340 µm, N = 21) occcur within a matrix containing relatively abundant altered metal and chlorapatite.
Geochemistry: Olivine ($Fa_{0.6-36.6}$, Cr_2O_3 in ferroan examples 0.02-0.12 wt.%, mean 0.06±0.04 wt.%, N = 6), orthopyroxene ($Fs_{3.3-21.0}Wo_{0.4-1.8}$, N = 3), subcalcic augite ($Fs_{21.6}Wo_{25.4}$), augite ($Fs_{8.8}Wo_{41.6}$).
Classification: Ordinary chondrite (H3).
Specimens: The entire specimen including one polished thin section is at *PSF*.

Northwest Africa 12422 (NWA 12422)
(Northwest Africa)
Find: 2018 Oct
Classification: Lunar meteorite (feldspathic breccia)
History: Found in October 2018 in the Assa-Zag region of Morocco and purchased by Craig Zlimen in November 2018 from a dealer in Zagora, Morocco.
Petrography: (A. Irving and S. Kuehner, *UWS*) Very fine grained assemblage of mineral clasts (including anorthite, orthopyroxene, augite, rare zoned olivine) in a partly vitreous ("swirly") and sparsely vesicular matrix containing kamacite, chromite and troilite.
Geochemistry: Anorthite ($An_{96.7-97.4}Or_{0.1}$, N = 2), orthopyroxene ($Fs_{24.6-26.6}Wo_{3.9-4.1}$, FeO/MnO = 54-58, N = 2), pigeonite ($Fs_{36.6}Wo_{9.7}$, FeO/MnO = 71), augite ($Fs_{15.3}Wo_{40.1}$, FeO/MnO = 38), olivine (core $Fa_{15.1}$, FeO/MnO = 96; rim $Fa_{24.7}$, FeO/MnO = 104).
Classification: Lunar (feldspathic regolith melt breccia).
Specimens: 9.5 g in the form of a polished endcut at *UWB*; remainder with Mr. C. Zlimen.

Northwest Africa 12423 (NWA 12423)
Algeria

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Purchased: 2018 Jul
Classification: Ureilite (anomalous)

History: Found in Algeria and purchased in Morocco in July 2018 by Lhcen Ouabicha and Zaid Sbitti.

Petrography: (A. Irving, *UWS* and P. Carpenter, *WUSL*) Aggregate of olivine (~50 vol.%) and low-Ca pyroxene (~50 vol.%) with accessory graphite, Cr-troilite and daubreelite. Some regions have a poikilitic texture, with rounded olivine chadacrysts enclosed in low-Ca pyroxene oikocrysts up to 7 mm across; other regions are composed of olivine exhibitinh triple grain junctions. Olivine grains have partial, more magnesian rims associated with fine grained, blebby Fe metal.

Geochemistry: Olivine ($Fa_{10.1-10.7}$, N = 3), low-Ca pyroxene ($Fs_{9.3-9.5}Wo_{3.5-4.9}$, N = 3). Oxygen isotopes (K. Ziegler, *UNM*) Analyses of acid-washed subsamples by laser fluorination gave, respectively, $\delta^{17}O$ 0.606, 0.669, 0.456; $\delta^{18}O$ 5.643, 5.704, 5.381; $\Delta^{17}O$ -2.374, -2.343, -2.385 per mil.

Classification: Ureilite (anomalous). Although oxygen isotopes are consistent with an affinity to ureilites, this specimen has several anomalous features: (1) much more magnesian mafic silicates than for typical ureilites, (2) a greater proportion of low-Ca pyroxene (opx and Ca-poor pigeonite) compared with typical ureilites, (3) in part a poikilitic texture, (4) daubreelite and Cr-troilite as accessory phases.

Specimens: 24.5 g including one polished thin section at *UWB*; remainder with Mr. L. Ouabicha and Mr. Z. Sbitti.

Northwest Africa 12424 (NWA 12424)
(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 and S. Kuehner, *UWS*) Closely-packed, well-formed chondrules are set in a very sparse matrix containing altered metal.

Geochemistry: Olivine (predominantly $Fa_{24.6-24.7}$; one core $Fa_{19.0}$; $Cr_2O_3 < 0.03$ wt.%; N = 3), low-Ca pyroxene ($Fs_{17.1-20.2}Wo_{0.3-0.6}$, N = 3), subcalcic augite ($Fs_{5.9}Wo_{31.8}$), augite ($Fs_{14.6}Wo_{39.0}$).

Classification: Ordinary chondrite (L4).

Specimens: The entire specimen including one polished thin section is at *PSF*.

Northwest Africa 12425 (NWA 12425)
Algeria
Find: 2014 Jul
Classification: HED achondrite (Eucrite, unbrecciated)

History: Found by a shepherd in July 2014 near Oum el Assel, Algeria, and subsequently acquired by David Lehman in September 2018 from an Algerian dealer.

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Petrography: (A. Irving and S. Kuehner, *UWS*) Fresh unbrecciated specimen with microgabbroic texture composed of predominantly exsolved pigeonite and maskelynite with accessory silica polymorph, ilmenite, chromite, merrillite, troilite and Ni-free metal. Small patches and thin cross-cutting veinlets of dark shock glass are present. Most exsolved pigeonite consists of orthopyroxene host with clinopyroxene exsolution lamellae, but also present are grains composed of clinopyroxene host with orthopyroxene exsolution lamellae.
Geochemistry: Orthopyroxene host ($Fs_{60.7-61.3}Wo_{2.2-1.8}$, FeO/MnO = 31, N = 2), clinopyroxene exsolution lamellae ($Fs_{26.3-29.8}Wo_{43.8-39.8}$, FeO/MnO =29-30, N = 2), maskelynite ($An_{89.9-90.0}Or_{0.6-0.5}$, N = 2).
Classification: Eucrite (unbrecciated, microgabbroic, maskelynite-bearing).
Specimens: 25.1 g including one polished thin section at *PSF*; remainder with Mr. D. Lehman.

Northwest Africa 12426 (NWA 12426)
(Northwest Africa)
Purchased: 2017 Dec
Classification: Ordinary chondrite (H5)
History: Purchased in December 2017 from Abdeltif Mechaguen of Ouarzazate, Morocco.
Physical characteristics: Single stone, fusion crust; saw cut reveals numerous faint chondrules. Abundant metal grains, some oxidation present.
Petrography: (C. Agee, *UNM*) Microprobe examination shows texturally equilibrated, recrystallized chondrules. Plagioclase grain size up to 50 µm in diameter.
Geochemistry: (C. Agee, *UNM*) Olivine $Fa_{17.3\pm0.3}$, Fe/Mn=35±2, n=30; low-Ca pyroxene $Fs_{15.2\pm0.2}Wo_{1.1\pm0.8}$, Fe/Mn=21±1, n=11.
Classification: Ordinary chondrite (H5)
Specimens: 22.5 g on deposit at *UNM*, *DPitt* holds the main mass.

Northwest Africa 12427 (NWA 12427)
(Northwest Africa)
Find: 2017
Classification: Lunar meteorite (feldspathic breccia)
History: Purchased in November 2017 in Nouakchott, Mauritania. Reportedly found in northeastern Western Sahara September 2017.
Physical characteristics: Single stone, no fusion crust; saw cut reveals a breccia with white feldspathic clasts set in a dark gray groundmass. Some of the feldspathic clasts appear to be aligned suggesting a mild deformation fabric.
Petrography: (C. Agee, *UNM*) Microprobe examination shows fragmental breccia with many anorthositic olivine gabbro clasts set in fine-grained, cataclastic groundmass. Melt veins and vesicles are present throughout.

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Geochemistry: (C. Agee, *UNM*) Olivine $Fa_{42.7\pm6.8}$, Fe/Mn=94±5, n=15; clinopyroxene $Fs_{31.4\pm6.7}Wo_{15.7\pm6.4}$, Fe/Mn=54±5, n=14; plagioclase $An_{96.9\pm0.2}$, n=6; shock melt veins (proxy for bulk composition) SiO_2=46.5±2.5, TiO_2=0.30±0.15, Cr_2O_3=0.15±0.10, Al_2O_3=27.9±6.3, MgO=5.2±3.4, FeO=5.5±3.2, MnO=0.08±0.06, CaO=15.6±2.6, Na_2O=0.27±0.07, K_2O=0.05±0.02 (all wt%), n=6.
Classification: Lunar, feldspathic breccia
Specimens: 20.2 g on deposit at *UNM*, *DPitt* holds the main mass.

Northwest Africa 12428 (NWA 12428)
(Northwest Africa)
Find: 2017 Oct
Classification: Lunar meteorite (feldspathic breccia)
History: Purchased in November 2017 in Nouakchott, Mauritania. Reportedly found in Algeria near the northern Mali border region, October 2017.
Physical characteristics: Single stone, no fusion crust; saw cut reveals a breccia with scattered light-colored clasts set in a predominantly dark gray groundmass.
Petrography: (C. Agee, *UNM*) Microprobe examination shows fragmental breccia with many diverse clasts set in fine-grained, cataclastic groundmass. Melt veins and vesicles are present throughout.
Geochemistry: (C. Agee, *UNM*) Olivine $Fa_{23.5\pm14.5}$, Fe/Mn=102±20, n=9; clinopyroxene $Fs_{25.4\pm12.0}Wo_{11.0\pm11.1}$, Fe/Mn=55±7, n=21; plagioclase $An_{96.5\pm0.3}$, n=14; shock melt veins (proxy for bulk composition) SiO_2=46.1±1.2, TiO_2=0.25±0.15, Cr_2O_3=0.16±0.08, Al_2O_3=24.3±2.5, MgO=9.6±2.9, FeO=6.3±2.7, MnO=0.09±0.03, CaO=13.7±1.0, Na_2O=0.38±0.11, K_2O=0.10±0.06 (all wt%), n=4.
Classification: Lunar, feldspathic breccia
Specimens: 23.8 g on deposit at *UNM*, *DPitt* holds the main mass.

Northwest Africa 12429 (NWA 12429)
(Northwest Africa)
Purchased: 2018 Jun
Classification: Ordinary chondrite (H6)
History: Purchased from a Moroccan mineral dealer at the mineral show in Sainte-Marie-aux-Mines, France
Petrography: (K. Metzler, *IfP*) Ordinary chondrite with recrystallization texture, high metal content and few visible chondrules. Secondary feldspar grains mostly >50 µm.
Geochemistry: Mineral compositions and geochemistry: The mean olivine composition is $Fa_{19.1\pm0.2}$ ($Fa_{18.8\text{-}19.5}$; n=12). The mean low-Ca pyroxene composition is $Fs_{16.8\pm0.3}Wo_{1.3\pm0.2}$ ($Fs_{16.1\text{-}17.2}Wo_{1.0\text{-}1.6}$; n=12).
Classification: H chondrite based on mineral chemistry. Petrologic type 6 based on the equilibrated state of olivine and pyroxene and grain size of secondary plagioclase.

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Northwest Africa 12430 (NWA 12430)
(Northwest Africa)
Purchased: Sept 2006
Classification: Ordinary chondrite (LL4-6)

History: Found in northwest Africa, donated to *Cascadia* July 2012.

Physical characteristics: In cut slices, exterior is black with brown patches, interior is gray with well-defined chondrules and dark- and light-colored angular clasts.

Petrography: (M. Hutson, A. Ruzicka, *Cascadia*) Thin section shows a host lithology composed of a mix of well-defined chondrules and chondrule fragments. Both plagioclase feldspar (less than 40 µm across) and feldspathic glass are present. The host lithology surrounds a dozen angular coarser-grained chondritic clasts, the largest of which (Clast 5) is approximately 4 × 5 mm in size. Clast 5 and Clast 4 (approximately 2 × 4 mm in size) were analyzed. Clast 5 is coarse-grained, with plagioclase feldspar grains up to 110 µm in length, and contains three barely discernable chondrules. Clast 4 contains two chondrules with indistinct edges and plagioclase feldspar grains between 40 and 60 µm in length.

Geochemistry: Mineral compositions and geochemistry: (M. Hutson and J. Graham-Davis, *Cascadia*) Olivine (host $Fa_{31.9\pm0.5}$, N=22; Clast 4 $Fa_{32.0\pm0.7}$, N=10; Clast 5 $Fa_{32.2\pm0.2}$, N=7), low-Ca pyroxene (host $Fs_{19.2\pm5.2}Wo_{1.1\pm0.1}$, N=15; Clast 4 $Fs_{26.0\pm0.5}Wo_{2.0\pm0.2}$, N=7; $Fs_{26.2\pm0.6}Wo_{2.0\pm0.3}$, N=5), plagioclase feldspar (Clast 4 $Ab_{85.1\pm0.9}Or_{3.3\pm0.7}$, N=6; Clast 5 $Ab_{85.2\pm1.2}Or_{3.7\pm0.3}$, N=3).

Classification: LL4-6 genomict breccia, based on iron contents in olivine and pyroxene and plagioclase feldspar grain size.

Specimens: *Cascadia* holds 22.6 g in two pieces, in addition to a polished thin section and a mounted butt.

Northwest Africa 12431 (NWA 12431)
(Northwest Africa)
Purchased: 12 Dec 2016
Classification: Ordinary chondrite (LL3)

Physical characteristics: Exterior surfaces of the type specimen are bumpy and covered with patches of brown-colored remnant fusion crust and light tan caliche. Interior surfaces are bluish-gray, with well-defined chondrules and abundant sulfide with some metal. One cut face shows a 6x3.5mm dark clast.

Petrography: (M. Hutson, A. Ruzicka, *Cascadia*) In thin section, the sample contains chondrules with a variety of sizes and textures, including some that are rimmed by sulfide. Along the edge of the section is a roughly triangular shaped clast (base approximately 4.9 mm × height approximately 4.9 mm), with a spinifex texture, consisting of acicular olivine set in a feldspathic matrix.

Geochemistry: Mineral compositions and geochemistry: (M. Hutson, R. Kostynick, A. Ruzicka, *Cascadia*) Host olivine ($Fa_{26.4\pm4.1}$, N=29, Fa coefficient of variation = 15.6); low-Ca pyroxene ($Fs_{16.2\pm7.2}Wo_{0.7\pm0.5}$, N=31).

Classification: LL3. Estimated subtype 3.8.

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Specimens: *Cascadia* holds 17.7 g in three pieces, in addition to a polished thin section.

Northwest Africa 12432 (NWA 12432)
(Northwest Africa)
Purchased: 12 Dec 2016
Classification: Ordinary chondrite (H5)
Physical characteristics: Exterior surfaces are dark brown; interior cut faces are medium-to-dark brown, with numerous lighter brown chondrules visible.
Petrography: (M. Hutson, A. Ruzicka, *Cascadia*) Extensive veins of iron hydroxides cut across the thin section, cross-cutting chondrules and causing the material between chondrules to be opaque in transmitted light.
Geochemistry: Mineral compositions and geochemistry: (M. Hutson, R. Kostynick, A. Ruzicka, *Cascadia*) Olivine ($Fa_{18.3\pm0.2}$, N=26; low-Ca pyroxene ($Fs_{16.3\pm0.2}Wo_{1.3\pm0.2}$, N=26).
Classification: H5 based on iron contents in olivine and pyroxene.
Specimens: *Cascadia* holds 47.2 g in three pieces, in addition to a polished thin section and a mounted butt.

Northwest Africa 12433 (NWA 12433)
(Northwest Africa)
Purchased: 2017
Classification: Ureilite
History: Specimen was purchased from Mirko Graul in 2017.
Physical characteristics: Exterior of rock is light brown with dark-gray patches of what appears to be remnant fusion crust; interior is dark gray and has coarse silicates, with almost no metal or sulfide visible.
Petrography: (A. Ruzicka, J. Graham-Davis) Contains olivine and pigeonite grains up to 1-2 mm across. Areas opaque in transmitted light occur interstitial to olivine and pyroxene and cross-cut these grains. Opaque areas are largely filled by weathering products or other fine-grained material and feature tabular to acicular grains of graphite up to 200 µm long.
Geochemistry: Mineral compositions and geochemistry: (M. Hutson, A. Ruzicka) Olivine grains have homogenous, ferroan cores ($Fa_{22.5\pm0.2}$, N = 18) and more magnesian rims ($Fa_{15.2\pm2.3}$, N = 18), low Ca-pyroxene is relatively homogenous ($Wo_{9.5\pm0.0}$,$Fs_{18.8\pm0.1}$, N = 15).
Classification: ureilite
Specimens: *Cascadia* holds 17.0 g in one piece, in addition to a polished thin section and a mounted butt. John Shea holds the main mass.

Northwest Africa 12434 (NWA 12434)
(Northwest Africa)

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Purchased: Nov 2016
Classification: Ordinary chondrite (L3)

History: Purchased in Erfoud, Morocco by Brahim Tahiri and Sean Tutorow while on expedition in November 2016.

Physical characteristics: The type specimen slice is medium to dark brown on cut faces. Well-defined chondrules and metal and sulfide are visible in lighter colored clumps, which are surrounded by darker brown areas lacking metal and sulfide, in which chondrules are not as visible. Larger light colored clasts are visible.

Petrography: (M. Hutson, A. Ruzicka, *Cascadia*) In thin section (CML1001-2), abundant chondrules, many with sulfide-rich rims, five agglomeratic olivine objects (AO objects), and four large clasts with distinctive textures are visible. Average chondrule size is 0.71 mm (N=73), excluding the four large clasts. Two of the clasts, object 2 (5.7x4.3 mm), and object 11 (2.3x2.2 mm--truncated at edge of thin section), are composed predominantly of zoned aligned olivine crystals and bars set in a matrix of feldspathic material and pigeonite, and rimmed by layer of aluminous low-Ca pyroxene. Object 3 (2.2 × 2.1 mm--truncated by the edge of the section) consists of deformed olivine bars with almost no mesostasis. BSE imaging and mineral analyses show that this clast is equilibrated. The largest (10.8 × 7.6 mm) clast in the section (object 17) has a texture resembling that of shock melt, with equant, zoned olivine and pyroxene grains set in a feldspathic matrix. Object 17 is rimmed by an FeO-rich fine-grained material resembling matrix described by Huss et al. (1981). An oval patch (1.4 × 1.1 mm) of this same material occurs inside the clast as well and contains small multimineralic clasts, including one (20 µm across) composed of kamacite, taenite, and merrillite, and two others (10 and 15 µm across) with cores that contain aluminous spinel, surrounded by layers of fassaitic pyroxene.

Geochemistry: Mineral compositions and geochemistry: (M. Hutson and A. Ruzicka, *Cascadia*) Olivine (host 19.7±10.1, N=53; object 2 $Fa_{15.7\pm4.8}$, N=27; object 3 $Fa_{25.3\pm0.6}$, N=15; object 11 $Fa_{19.2\pm5.1}$, N=29; object 17 $Fa_{24.2\pm8.4}$, N=15); low-Ca pyroxene (host $Fs_{15.4\pm9.3}Wo_{1.3\pm1.0}$, N=26; object 2 rim $Fs_{8.5\pm1.2}Wo_{2.5\pm0.8}$, N=25; object 11 rim $Fs_{7.5\pm1.7}Wo_{3.7\pm0.8}$, N=8; object 17 $Fs_{20.3\pm2.6}Wo_{1.2\pm0.6}$, N=8).

Classification: L3 based on iron contents of olivine and pyroxene in the host and size of chondrules.

Specimens: *Cascadia* holds 33.9 g in one piece, in addition to three polished thin sections and three mounted butts.

Northwest Africa 12437 (NWA 12437)
(Northwest Africa)
Purchased: 2013
Classification: Primitive achondrite (Acapulcoite/Lodranite)

History: Catalogued at the *ROM* under M58202.

Physical characteristics: Single stone with a weathered exterior and dark-brown fusion crust.

Petrography: (T.V. Kizovski, *ROM*) This specimen exhibits a poikilitic to granulitic texture of pyroxene and olivine grains. Rounded olivine grains varying in size from

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18-100 µm (n = 20) are commonly observed poikilitically enclosed by pyroxene oikocrysts (approximately 600 to 900 µm in size). Accessory phases include Fe-sulfides, Fe-Ni metal, iron oxide veinlets, spinels, apatite, and merrillite. Evidence of desert weathering includes the minor oxidation of metals and sulfides. The sample appears to be relatively unshocked. Minor irregular fracturing is observed in pyroxene and sharp extinction is observed in all silicate phases. Feldspar was not observed.

Geochemistry: Mineral compositions and geochemistry: (Y.Liu, *UTorG*; T.V. Kizovski, *ROM*) Olivine ($Fa_{11.7\pm0.2}$; Fe/Mn = 20.1±1.7; n=17), high-Ca pyroxene ($Fs_{4.6\pm0.4}Wo_{43.2\pm2.1}$; Fe/Mn = 8.1±0.7; n=13), low-Ca pyroxene($Fs_{10.8\pm0.2}Wo_{2.1\pm0.7}$; Fe/Mn = 12.3±1.9; n=13). Oxygen isotopes (K. Ziegler, *UNM*): analyses of acid-washed subsamples by laser fluorination gave $\delta^{17}O$ = 0.846, 0.921, 0.892; $\delta^{18}O$ = 3.618, 3.769, 3.690; $\Delta^{17}O$ = -1.065, -1.069, -1.057 per mil.

Classification: (T.V. Kizovski, *ROM*) Primitive achondrite (Acapulcoite/Lodranite)

Specimens: 6.14 g specimen including a thin section and grain mount at the *ROM*. D. *DGregory* holds the 23.08 g main mass.

Northwest Africa 12438 (NWA 12438)

(Northwest Africa)

Purchased: 2007

Classification: Ungrouped achondrite

History: Catalogued at the *ROM* under M58154.

Physical characteristics: Single stone with a black regmaglypted fusion crust over the exterior.

Petrography: (T.V. Kizovski, *ROM*) This specimen exhibits a proto-granular texture and is predominantly comprised of euhedral magnesian olivine (60%), with equal amounts of low and high-Ca pyroxenes (39%). Fe-metal fills the grain boundaries between all silicate phases. No feldspar or chondrules are present. The olivine grains vary in size from approximately 300 to 700 µm, and pyroxene grains vary in size from 550 to 800 µm. The stone shows signs of moderate desert weathering, with approximately 60% of metal oxidized. Extensive fracturing is observed in olivine and pyroxene grains with some pyroxenes exhibiting undulatory extinction.

Geochemistry: Mineral compositions and geochemistry: (Y.Liu, *UTorG*; T.V. Kizovski, *ROM*) Olivine ($Fa_{3.9\pm0.6}$; Fe/Mn = 16.1±2.7; n=27), high-Ca pyroxene ($Fs_{2.7\pm1.8}Wo_{36.7\pm0.8}$; Fe/Mn = 9.1±6.4; n=25), low-Ca pyroxene($Fs_{4.5\pm3.1}Wo_{4.3\pm1.0}$; Fe/Mn = 13.5±10.0; n=18). Oxygen isotopes (K. Ziegler, *UNM*): analyses of acid-washed subsamples by laser fluorination gave $\delta^{17}O$ = -1.336,-1.469,-1.531; $\delta^{18}O$ = 0.943, 0.720, 0.592; $\Delta^{17}O$ = -1.834, -1.849, -1.844 per mil. This sample is texturally and chemically similar to ungrouped achondrite NWA 8054, and they may be paired.

Classification: (T.V. Kizovski, *ROM*) Achondrite (ungrouped)

Specimens: 3.01 g specimen including a thin section and smaller fragments at the *ROM*. D. *DGregory* holds the 11.35 g main mass.

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Northwest Africa 12439 (NWA 12439)
(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 and S. Kuehner, *UWS*) Sparse chondrules occur within a recrystallized matrix containing stained metal.
Geochemistry: Olivine ($Fa_{18.6-18.8}$, N = 3), orthopyroxene ($Fs_{16.6-16.9}Wo_{1.2-1.3}$, N = 2), clinopyroxene ($Fs_{6.1-7.7}Wo_{45.0-41.5}$, N = 2).
Classification: Ordinary chondrite (H5).
Specimens: The entire specimen including one polished thin section is at *PSF*.

Northwest Africa 12440 (NWA 12440)
(Northwest Africa)
Purchased: 2005
Classification: Ordinary chondrite (H6)
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*) Breccia composed of recrystallized clasts with some chondrule remnants in a finer-grained matrix.
Geochemistry: Olivine ($Fa_{18.6-19.3}$, N = 3), orthopyroxene ($Fs_{16.4-17.1}Wo_{1.2-1.1}$, N = 2), clinopyroxene ($Fs_{5.8-6.7}Wo_{45.9-45.0}$, N = 2).
Classification: Ordinary chondrite (H6 breccia).
Specimens: The entire specimen including one polished thin section is at *PSF*.

Northwest Africa 12441 (NWA 12441)
(Northwest Africa)
Purchased: 2005
Classification: Ordinary chondrite (L3)
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*) Well-formed chondrules (apparent diameter 660±420 µm, N = 21) are set in a fine-grained matrix containing altered metal.
Geochemistry: Olivine ($Fa_{15.4\pm14.2}$ (range $Fa_{0.6-53.1}$); Cr_2O_3 in ferroan examples 0.03-0.11 wt.%, mean 0.08±0.03 wt.%, N = 7), orthopyroxene ($Fs_{11.3\pm9.2}Wo_{0.6\pm0.2}$ (range $Fs_{1.9-20.3}Wo_{0.4-0.7}$), N = 3), pigeonite ($Fs_{25.9}Wo_{18.6}$), clinopyroxene ($Fs_{13.8}Wo_{40.1}$). Magnetic susceptibility log χ ($\times 10^{-9}$ m^3/kg) = 4.81.
Classification: Ordinary chondrite (L3).
Specimens: The entire specimen including one polished thin section is at *PSF*.

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Northwest Africa 12442 (NWA 12442)
(Northwest Africa)
Purchased: 2018 Apr
Classification: Ureilite

History: Puchased in Alnif, Morocc,o by Adam *Aaronson* in April 2018.

Petrography: (A. Irving and S. Kuehner, *UWS*) Protogranular aggregate composed almost entirely (>90 vol.%) of olivine (with reduced magnesian rims) plus minor pigeonite, graphite and secondary calcite. Irregular interstitial regions along grain boundaries are composed of Fe metal, magnesian pigeonite, subcalcic augite and Si-rich glass.

Geochemistry: Olivine (cores $Fa_{21.8-21.9}$; rim $Fa_{11.6}$; N = 3), pigeonite ($Fs_{17.3}Wo_{11.7}$), grain boundary pigeonite ($Fs_{6.2-8.5}Wo_{10.7-10.6}$; $Fs_{5.4}Wo_{22.4}$; N = 3), grain boundary subcalcic augite ($Fs_{7.4}Wo_{27.0}$), grain boundary siliceous glass (SiO_2 68.9 wt.%, Al_2O_3 16.9 wt.%, CaO 5.7 wt.%, MgO 3.0 wt.%, FeO 1.0 wt.%, Na_2O 1.3 wt.%).

Classification: Ureilite (dunitic). The grain boundary polyphase assemblages composed of Fe metal+clinopyroxene+siliceous glass are a unique feature of this specimen.

Specimens: 20.6 g including one polished thin section at *UWB*; remainder with *Aaronson*.

Northwest Africa 12443 (NWA 12443)
(Northwest Africa)
Purchased: 2018 Jul
Classification: Carbonaceous chondrite (CV3)

History: Found by Mohamed Zergou about 26 km E of Tantan on July 25, 2018, and purchased by Mbark Arjdal.

Petrography: (A. Irving and S. Kuehner, *UWS*) Well-formed granular chondrules (apparent diameter 940±480 µm, N = 23) plus amoeboid fine grained CAI (one composed of wollastonite+andradite+corundum) are set in a very fine-grained matrix (~40 volume%, black in thin section). XRD of a powdered sample show the absence of phyllosilicates.

Geochemistry: Olivine ($Fa_{26.6\pm25.5}$ (range $Fa_{0.9-51.8}$), N = 3), enstatite ($Fs_{1.4\pm0.1}Wo_{2.3\pm2.1}$ (range $Fs_{1.4-1.5}Wo_{0.8-3.8}$), N = 2), diopside ($Fs_{1.0}Wo_{37.8}$).

Classification: Carbonaceous chondrite (CV3).

Specimens: 16.9 g including one polished thin section at *UWB*; remainder with Mr. M. Arjdal.

Northwest Africa 12444 (NWA 12444)
(Northwest Africa)
Purchased: 2018 Jul
Classification: Ordinary chondrite (LL3)

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History: Purchased by Ben Hoefnagels in July 2018 from a Moroccan dealer.
Petrography: (A. Irving and S. Kuehner, *UWS*) Closely packed, well formed, relatively large chondrules (apparent diameter 790±420 µm, N = 14) are set in a fine grained metal-poor matrix.
Geochemistry: Olivine ($Fa_{16.9\pm11.4}$ (range $Fa_{0.7-95.6}$); Cr_2O_3 in ferroan examples 0.07-0.15 wt.%, mean 0.11±0.03 wt.%, N = 10), low-Ca pyroxene ($Fs_{19.3\pm18.7}Wo_{0.7\pm0.3}$ (range $Fs_{2.0-39.1}Wo_{0.4-0.8}$), N = 3). Magnetic susceptibility log χ (× 10^{-9} m^3/kg) = 3.95.
Classification: Ordinary chondrite (LL3).
Specimens: 27.6 g including one polished endcut at *UWB*; remainder with B. Hoefnagels.

Northwest Africa 12446 (NWA 12446)
(Northwest Africa)
Purchased: 2005
Classification: Ordinary chondrite (L3)
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*) Composed of well-formed chondrules (apparent diameter 750 ± 290 µm, N = 22) set in a somewhat recrystallized matrix containing stained metal. One Type 5 lithic clast containing sparse chondrules in a recrystallized matrix is present in the studied thin section.
Geochemistry: Olivine ($Fa_{0.6-24.7}$, Cr_2O_3 <0.03 wt.%, N = 5), orthopyroxene ($Fs_{1.8-20.9}Wo_{0.5-1.9}$, N = 2), clinopyroxene ($Fs_{0.7-10.9}Wo_{37.4-37.7}$, N = 2).
Classification: Ordinary chondrite (L3).
Specimens: The entire specimen including one polished thin section is at *PSF*.

Northwest Africa 12447 (NWA 12447)
(Northwest Africa)
Find: 2004
Classification: Primitive achondrite (Brachinite)
History: Found in southern Morocco in 2004 and purchased by a German collector; the specimen was subsequently acquired by Craig Zlimen in August 2018.
Petrography: (A. Irving and S. Kuehner, *UWS*) Protogranular aggregate composed predominantly of olivine (with reduced magnesian rims) plus subordinate clinopyroxene and accessory intermediate plagioclase, chlorapatite, Ti-V-bearing chromite, kamacite, troilite and minor secondary barite. Grain boundaries and fractures are decorated with fine grained assemblages of Fe metal plus magnesian orthopyroxene.
Geochemistry: Olivine (cores $Fa_{28.8-30.6}$, FeO/MnO = 48-64; rim $Fa_{20.1}$, FeO/MnO = 36; N = 3), clinopyroxene ($Fs_{10.3-10.6}Wo_{44.9-44.8}$, FeO/MnO = 37-39, N = 2), orthopyroxene at grain boundaries ($Fs_{20.3}Wo_{0.8}$, FeO/MnO = 23), plagioclase ($An_{34.9-35.9}Or_{0.4}$, N = 2).

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Classification: Brachinite. This ultramafic achondrite has many mineralogical features in common with NWA 7388 and NWA 7605 (Irving et al., 2013) and may be related to those specimens.
Specimens: 23.6 g including one polished thin section at *UWB*; remainder with Mr. C. Zlimen.

Northwest Africa 12448 (NWA 12448)
(Northwest Africa)
Purchased: 2005
Classification: Ordinary chondrite (H4)
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*) Well-formed, relatively small chondrules are set in a relatively coarse grained matrix containing altered metal.
Geochemistry: Olivine ($Fa_{18.3\text{-}18.8}$, N = 3), orthopyroxene ($Fs_{14.6\text{-}16.5}Wo_{1.7\text{-}1.3}$, N = 3), clinopyroxene ($Fs_{6.0\text{-}7.1}Wo_{45.7\text{-}40.3}$, N = 2).
Classification: Ordinary chondrite (H4).
Specimens: The entire specimen including one polished thin section is at *PSF*.

Northwest Africa 12449 (NWA 12449)
Morocco
Purchased: 2012 Feb
Classification: Ordinary chondrite (H4)
History: Purchased from Moroccan meteorite dealer in 2012.
Physical characteristics: Physical Characteristics: Single stone, black rough irregular exterior with minor patches of caliche. Saw cut shows numerous chondrules and clasts set in a dark-green matrix.
Petrography: (K. Domanik and F. Stephan, *UAz*) Microprobe examination of a polished mount shows numerous distinct round to irregularly shaped equilibrated chondrules 200-800 µm in size. POP, PO, and BO chondrules predominate with a few RP chondrules also present. 10-50 µm plagioclase patches occur almost exclusively within chondrules and typically contain abundant small crystals of clinopyroxene. The matrix consists of smaller chondrule fragments and numerous veins and patches of moderately oxidized kamacite, taenite and troilite. Minor amounts of chromite and merillite are also present.
Geochemistry: Mineral compositions and geochemistry: (K. Domanik and F. Stephan, *UAz*) Olivine $Fa_{19.1\pm0.2}$, Fe/Mn=36.4±2.0, n=40; low-Ca pyroxene $Fs_{16.5\pm0.3}Wo_{1.6\pm0.6}$, Fe/Mn=22.9±1.8, n=26.
Classification: Ordinary Chondrite (H4), Weathering grade W2.
Specimens: 29.3 g including probe mount on deposit at *UAz*, Blaine *Reed* holds the main mass.

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Northwest Africa 12450 (NWA 12450)
Western Sahara
Purchased: 2018 Jun
Classification: Martian meteorite (Shergottite)

History: Found in June 2018 near Zbayra, purchased by Mbark Arjdal and donated to the *UWB* collection.

Physical characteristics: A small (14.2 g) fresh, fusion-crusted ellipsoidal stone broken on one end. The interior exhibits greenish olivine phenocrysts set in a matrix of pale prismatic pyroxene and glassy maskelynite.

Petrography: (A. Irving and S. Kuehner, *UWS*) Porphyritic texture. Olivine phenocrysts (up to 2.5 mm across, exhibiting very limited core to rim zoning) are set in a finer grained groundmass composed mainly of twinned pigeonite (exhibiting very limited irregular zoning) and maskelynite with accessory chromite (both Ti-poor and more Ti-rich), ilmenite, merrillite and pyrrhotite. A thin, dark shock glass veinlet crosscuts the specimen.

Geochemistry: Olivine (core $Fa_{27.0}$; rim $Fa_{36.0}$; FeO/MnO = 47-49; N = 2), pigeonite ($Fs_{24.1-32.9}Wo_{7.2-12.9}$, FeO/MnO = 30-36, N = 6), maskelynite ($An_{62.6-64.9}Or_{0.4}$, N = 2).

Classification: Martian (shergottite, olivine-phyric)

Specimens: The entire specimen including one polished thin section is at *UWB*.

Northwest Africa 12451 (NWA 12451)
(Northwest Africa)
Purchased: 2005
Classification: Ordinary chondrite (H4)

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*) Well-formed relatively small chondrules are set in a relatively coarse grained matrix containing abundant altered metal.

Geochemistry: Olivine ($Fa_{19.2-19.4}$, N = 3), orthopyroxene ($Fs_{11.1-18.1}Wo_{3.4-2.4}$, N = 2), clinopyroxene ($Fs_{4.4-9.4}Wo_{45.8-43.4}$, N = 2).

Classification: Ordinary chondrite (H4).

Specimens: The entire specimen including one polished thin section is at *PSF*.

Northwest Africa 12452 (NWA 12452)
(Northwest Africa)
Purchased: 2005
Classification: Ordinary chondrite (H4)

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*) Well-formed relatively small chondrules are set in a relatively coarse grained matrix containing abundant altered metal.

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Geochemistry: Olivine ($Fa_{18.8-19.0}$, N = 3), orthopyroxene ($Fs_{16.6-16.7}Wo_{1.4-1.1}$, N = 2), clinopyroxene ($Fs_{5.7-5.9}Wo_{45.8-47.3}$, N = 2).
Classification: Ordinary chondrite (H4).
Specimens: The entire specimen including one polished thin section is at *PSF*.

Northwest Africa 12453 (NWA 12453)
(Northwest Africa)
Purchased: 2005
Classification: Ordinary chondrite (L3)
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*) Well-formed chondrules (apparent diameter 690±250 µm, N = 21) are set in a finer grained matrix containing stained metal, merrillite and chlorapatite. Several small L5 and L6 clasts were observed in the studied thin section.
Geochemistry: Olivine ($Fa_{7.8-25.3}$, Cr_2O_3 < 0.03 wt.%, N = 6), orthopyroxene ($Fs_{3.2-20.4}Wo_{0.6-1.6}$, N = 3), clinopyroxene ($Fs_{7.0-7.2}Wo_{45.4-45.3}$, N = 2). Magnetic susceptibility log χ ($\times 10^{-9}$ m^3/kg) = 4.75.
Classification: Ordinary chondrite (L3).
Specimens: The entire specimen including one polished thin section is at *PSF*.

Northwest Africa 12454 (NWA 12454)
(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 and S. Kuehner, *UWS*) Some well-formed, relatively small chondrules occur within a recrystallized matrix containing abundant altered metal.
Geochemistry: Olivine ($Fa_{18.4-18.8}$, N = 3), orthopyroxene ($Fs_{16.2-17.8}Wo_{1.4-1.2}$, N = 2), clinopyroxene ($Fs_{5.1-6.3}Wo_{46.8-45.0}$, N = 2).
Classification: Ordinary chondrite (H4/5).
Specimens: The entire specimen including one polished thin section is at *PSF*.

Northwest Africa 12455 (NWA 12455)
(Northwest Africa)
Purchased: 2018 Nov
Classification: Carbonaceous chondrite (CR7)
History: Purchased by Ben Hoefnagels in November 2018 from a dealer in Agadir, Morocco.
Petrography: (A. Irving and S. Kuehner, *UWS*; P. Carpenter, *WUSL*) This specimen has a triple grain junction texture (grainsize 0.3-1.5 mm) completely devoid of

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chondrules, and is composed of olivine, orthopyroxene, intermediate plagioclase, chromite, altered kamacite, taenite, troilite, pentlandite, and minor secondary calcite. Modal metal content is ~5 vol.%; troilite is much less abundant, as small blebs, ~0.5 vol.%.
Geochemistry: Olivine ($Fa_{35.0-35.3}$, FeO/MnO = 83-94, N = 4), orthopyroxene ($Fs_{27.8-28.0}Wo_{3.5-4.0}$, FeO/MnO = 51-56, N = 4), plagioclase ($An_{48.2-48.9}Or_{1.1}$, N = 2), kamacite (Ni = 7.2 wt.%), taenite (Ni = 16.4 wt.%). Oxygen isotopes (K. Ziegler, *UNM*): analysis of acid-washed subsamples by laser fluorination gave, respectively: $\delta^{17}O$ 0.661, 0.470, 0.296, 0.359, 0.375, 0.303; $\delta^{18}O$ 4.314, 4.021, 3.637, 3.840, 3.939, 3.761; $\Delta^{17}O$ -1.617, -1.653, -1.625, -1.668, -1.705, -1.683 per mil. Chromium isotopes (M. Sanborn and Q. Yin, *UCD*): 54Cr is the same within analytical uncertainty as that for CR2 chondrite Renazzo reported by Sanborn et al. (2019).
Classification: Carbonaceous chondrite (CR7). This specimen exhibits a completely recrystallized texture with no evidence of remnant chondrules, and has oxygen isotopic compositions which plot on the established trend for CR chondrites.
Specimens: 22.3 g including two polished thin sections at *UWB*; remainder with Mr. B. Hoefnagels.

Northwest Africa 12456 (NWA 12456)
(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 and S. Kuehner, *UWS*) Largely recrystallized with rare remnant chondrules, relatively fresh metal and accessory merrillite.
Geochemistry: Olivine ($Fa_{25.0-25.1}$, N = 3), orthopyroxene ($Fs_{21.0-21.1}Wo_{1.5-1.2}$, N = 2), clinopyroxene ($Fs_{7.1-7.2}Wo_{45.6-45.5}$, N = 2).
Classification: Ordinary chondrite (L6).
Specimens: The entire specimen including one polished thin section is at *PSF*.

Northwest Africa 12457 (NWA 12457)
(Northwest Africa)
Purchased: 2005
Classification: Ordinary chondrite (L3)
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*) Well-formed chondrules (apparent diameter 700±310 µm, N = 22) are set in a finer matrix containing stained metal and merrillite. Several small L6 clasts were observed in the studied thin section.
Geochemistry: Olivine ($Fa_{0.8-25.1}$, Cr_2O_3 in ferroan examples 0.03-0.05 wt.%, N = 7), orthopyroxene ($Fs_{3.2-18.1}Wo_{0.2-0.3}$, N = 3), subcalcic augite ($Fs_{12.2}Wo_{27.3}$), augite ($Fs_{6.5-7.2}Wo_{41.0-46.2}$, N = 2). Magnetic susceptibility log χ ($\times 10^{-9}$ m^3/kg) = 4.85.

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Classification: Ordinary chondrite (L3).
Specimens: The entire specimen including one polished thin section is at *PSF*.

Northwest Africa 12459 (NWA 12459)
(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 and S. Kuehner, *UWS*) Sparse chondrules occur within a recrystallized matrix containing relatively abundant altered metal.
Geochemistry: Olivine ($Fa_{19.3-19.8}$, N = 3), orthopyroxene ($Fs_{16.9-17.2}Wo_{1.3-1.6}$, N = 2), clinopyroxene ($Fs_{6.1-6.3}Wo_{46.1-45.0}$, N = 2).
Classification: Ordinary chondrite (H5).
Specimens: The entire specimen including one polished thin section is at *PSF*.

Northwest Africa 12460 (NWA 12460)
(Northwest Africa)
Purchased: 2018 March
Classification: HED achondrite (Eucrite)
Petrography: Brecciated magmatic rock with subophitic texture. Main minerals are pyroxene (typical size 50 µm, exsolved) and plagioclase. Accessory troilite, chromite (to 250 µm), ilmenite, silica polymorph and FeNi metal.
Geochemistry: Low-Ca pyroxene $Fs_{36.9\pm14.9}Wo_{2.6\pm1.8}$, range $Fs_{20.5-62.5}$, FeO/MnO=31.2±2.8 (n=11). Plagioclase $An_{90.4}Ab_{9.1}Or_{0.5}$ (n=3). Olivine $Fa_{39.2}$ (n=1). Chromite Cr# 0.83.
Classification: Achondrite (eucrite, brecciated)
Specimens: Type specimen at *CEREGE*. Main mass with *Kuntz*.

Northwest Africa 12461 (NWA 12461)
(Northwest Africa)
Purchased: 2018 March
Classification: Carbonaceous chondrite (CO3)
Petrography: Chondrite with well defined small chondrules (average apparent diameter ~200 µm) set in an abundant fine-grained iron rich matrix. FeNi metal is the main opaque mineral.
Geochemistry: Olivine $Fa_{20.8\pm23.3}$, Fa PMD 102%, range $Fa_{0.8-64.6}$ (n=8). Cr_2O_3 in ferroan olivine 0.08±0.03 wt% (n=9).Orthopyroxene $Fs_{4.4\pm2.6}Wo_{0.7\pm0.2}$ (n=2). Magnetic susceptibility log χ ($\times 10^{-9}$ m^3/kg) = 4.06.
Classification: Carbonaceous chondrite (CO3)
Specimens: Type specimen at *CEREGE*. Main mass with *Kuntz*.

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Northwest Africa 12462 (NWA 12462)
(Northwest Africa)
Purchased: 2018 March
Classification: Ordinary chondrite (LL3.15)
Petrography: Chondrite with packed, well-defined chondrules.
Geochemistry: Olivine $Fa_{19.1\pm10.9}$, Fa PMD 49%, range $Fa_{0.8\text{-}37.4}$ (n=11). Cr_2O_3 in ferroan olivine 0.19±0.18 wt% (n=10). Low-Ca pyroxene $Fs_{9.13\pm5.5}Wo_{1.0\pm1.4}$ (n=8). Magnetic susceptibility log χ (× 10^{-9} m^3/kg) = 3.68.
Classification: Ordinary chondrite (LL3.15). LL group based on magnetic susceptibility. Subtype from Cr_2O_3 content of ferroan olivine.
Specimens: Type specimen at *CEREGE*. Main mass with *Kuntz*.

Northwest Africa 12463 (NWA 12463)
(Northwest Africa)
Purchased: 2018 March
Classification: Ordinary chondrite (LL3)
Petrography: Chondrite with packed and well delineated chondrules with average apparent diameter 1060±600 µm (n=24). Main opaques are metal, troilite, and their terrestrial weathering products. Chondrule mesostasis is devitrified.
Geochemistry: Olivine $Fa_{15.7\pm7.7}$, Fa PMD 41%, range $Fa_{5.3\text{-}28.5}$, Cr_2O_3 0.07±0.10 wt% (n=12).Orthopyroxene $Fs_{11.5\pm6.3}Wo_{0.9\pm1.1}$ (n=7). Magnetic susceptibility log χ (× 10^{-9} m^3/kg) = 4.16.
Classification: LL3. LL group from magnetic susceptibility.
Specimens: Type specimen at *CEREGE*

Northwest Africa 12464 (NWA 12464)
(Northwest Africa)
Purchased: 2018 March
Classification: Ordinary chondrite (LL3.15)
Petrography: Chondrite with packed, well-delineated chondrules, with average apparent diameter 690±360 µm (n=40). Main opaques are metal, troilite, and their terrestrial weathering products. Chondrule mesostasis is devitrified. Zoned olivine.
Geochemistry: Olivine $Fa_{12.8\pm9.1}$, Fa PMD 56%, range $Fa_{0.4\text{-}32.6}$ (n=16). Cr_2O_3 in ferroan olivine 0.20±0.18 wt% (n=12). Orthopyroxene $Fs_{8.2\pm7.4}Wo_{1.6\pm1.1}$ (n=7). Magnetic susceptibility log χ (× 10^{-9} m^3/kg) = 3.95.
Classification: LL3.15. LL group from magnetic susceptibility. Subtype from Cr_2O_3 content of ferroan olivine.
Specimens: Type specimen at *CEREGE*

Northwest Africa 12465 (NWA 12465)

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(Northwest Africa)
Purchased: 2018 Feb
Classification: Ordinary chondrite (LL6)
Physical characteristics: Crusted stone. Cut surface reveals light grey interiorwith fresh metal.
Geochemistry: Olivine $Fa_{29.5\pm2.3}$ (n=3), NiO=0.02±0.02wt%, PMD=7%, range 27.9-32.7, Cr_2O_3in ferroan olivine=0.04±0.03wt%, n=3. Low-ca pyroxene $Fs_{23.6\pm0.5}$ range $Fs_{23.1\text{-}24.2}Wo_{0.9\pm0.1}$, range 0.8-1.3 (n=2)
Specimens: 6.2 g and a polished section at *CEREGE*. Main mass with Abdelhanine Zagmout

Northwest Africa 12466 (NWA 12466)
Morocco
Purchased: 2014 Jan
Classification: HED achondrite (Eucrite)
Physical characteristics: Grayish stone.
Petrography: Igneous rock with unbrecciated, variolitic texture. Main mienrals are plagioclase and pyroxene. Accessories minerals, troilite, silica polymorph, chromite, metal and ilmenite.
Geochemistry: Low-Ca pyroxene $Fs_{61.3\pm0.8}Wo_{6.4\pm0.2}$, FeO/MnO= 29.6±1.5 (n=7). Augite exsolution $Fs_{32.2}Wo_{40.1}$ (n=2). Plagioclase $An_{90.3\pm0.4}Ab_{9.1\pm0.3}Or_{0.6\pm0.1}$ (n=4).
Classification: Eucrite
Specimens: 6.06 g and a polished section at *CEREGE*. Main mass with Pierre-Marie Pelé.

Northwest Africa 12467 (NWA 12467)
(Northwest Africa)
Purchased: 2015 Jun
Classification: HED achondrite (Eucrite)
History: Purchased in june 2015 at Sainte Marie aux Mines mineral show
Physical characteristics: Brownish crusted stone. Cut surface reveals light-gray interior.
Petrography: Igneous rock with brecciated variety of textures. Main minerals are pyroxene and plagioclase. Metal rich clasts. Accessory silica polymorph, metal, troilite, chromite and ilmenite.
Geochemistry: Low-Ca pyroxene $Fs_{44.5\pm8.2}Wo_{12.2\pm6.4}$ (n=13), range$Fs_{32.9\text{-}59.8}Wo_{21.8\text{-}4.1}$, FeO/MnO=31.8±1.8. Plagioclase $An_{86.0}Ab_{13.3}Or_{0.7}$ (n=2).
Classification: Eucrite
Specimens: 9.65 g and a polished section at *CEREGE*. Main mass with Pierre-Marie Pelé.

Northwest Africa 12468 (NWA 12468)

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(Northwest Africa)
Purchased: 2015 Jun
Classification: HED achondrite (Eucrite)

History: Purchased in june 2015 at Saint Marie aux Mines mineral show

Physical characteristics: Dark-brown crusted stone. Cut surface reveals light-gray interior.

Petrography: Igneous rock with brecciated texture, metal-rich clasts. Main minerals are pyroxene and plagioclase. Accessories minerals are silica polymorph, metal, polycristalline troilite and chromite.

Geochemistry: Low-Ca pyroxene $Fs_{46.3\pm6.2}Wo_{9.3\pm5.8}$ (n=7), range$Fs_{35.9\text{-}54.7}Wo_{21.3\text{-}1.8}$, FeO/MnO=33.6±2.2. Plagioclase $An_{93.9\pm0.5}Ab_{5.8\pm0.6}Or_{0.3\pm0.0}$ (n=3).

Classification: Achondrite (eucrite)

Specimens: 5.13 g and a polished section at *CEREGE*. Main mass with Pierre-Marie Pelé.

Northwest Africa 12469 (NWA 12469)
(Northwest Africa)
Purchased: 2017 Mar
Classification: Carbonaceous chondrite (CV3)

History: Purchased in Rissani by Pierre-Marie Pelé

Physical characteristics: Dark stone. Cut surface reveals chondrules and CAIs set in a dark matrix.

Petrography: Chondrules with average size 870 µm (n=19) and CAIs set in fine-grained matrix (48 vol% from point counting, n=168). Opaque minerals are sulfide and magnetite. Based on the structural order of the polyaromatic matter assessed by Raman spectroscopy, this meteorite is attributed a petrographic type >3.6. The Raman spectroscopy parameters of interest are FWHM-D (cm^{-1})=92.91±7.02, ID/IG= 1.383 ±0.005 (see Bonal et al. 2016).

Geochemistry: Olivine $Fa_{2.7\pm2.5}$, PMD=66%, range $Fa_{0.6\text{-}8.1}$ (n=6), Cr_2O_3 in ferroan olivine is 0.22±0.12wt% (n=5). Low-ca pyroxene $Fs_{4.9}Wo_{0.9}$ (n=1)

Classification: Carbonaceous chondrite (CV3, oxidized subgroup)

Specimens: 21.18 g and a polished section at *CEREGE*. Main mass with Pierre-Marie Pelé

Northwest Africa 12470 (NWA 12470)
(Northwest Africa)
Purchased: 2018 March
Classification: Rumuruti chondrite (R3-5)

Physical characteristics: Single stone partly covered by fusion crust. Cut surface reveals dark interior with small chondrules and abundant matrix.

Petrography: Brecciated chondrite with small chondrules (average apparent diameter about 300 µm) set in an abundant recrystallized matrix with plagioclase size

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about 20 µm. Unequilibrated clasts present. Sulfides are the dominant opaque mineral. Magnetite is present.
Geochemistry: Type 5 host lithology $Fa_{39.3}$, NiO 0.23 wt% (n=2). Plagioclase $An_{15.2}Ab_{81.7}Or_{3.1}$ (n=1). Unequilibrated clasts $Fa_{19.7\pm15.1}$, Fa PMD=71%, Cr_2O_3 0.09±0.09 wt% (n=4).
Classification: Rumuruti chondrite (R3-5)
Specimens: Type specimen at *CEREGE*. Main mass with *Kuntz*.

Northwest Africa 12471 (NWA 12471)
(Northwest Africa)
Purchased: 2018 March
Classification: Ureilite
Physical characteristics: Several similar looking brownish stones from subgram to 450 g.
Petrography: Blocky aggregate of pyroxene and plagioclase with typical grain size 800 µm. FeNi metal, and its terrestrial weathering products, is visibile as droplets in the silicates and along silicate grain rims. Carbon polymorph is present close to grain rims as patches up to 100 × x500 µm.
Geochemistry: Olivine $Fa_{22.5}$ (n=2), rim $Fa_{10.4}$ (n=1). Pyroxene $Fs_{18.9}Wo_{10.5}$ (n=2).
Classification: Ureilite
Specimens: Type specimen at *CEREGE*. Main mass with *Kuntz*.

Northwest Africa 12472 (NWA 12472)
(Northwest Africa)
Purchased: 2018 March
Classification: Rumuruti chondrite (R3)
Physical characteristics: Dark stone. Cut surface reveals dark interior with small chondrules.
Petrography: Brecciated chondrite with small chondrules set in abundant matrix. Sulfides are the dominant opaque mineral. Equilibrated clasts are present and have plagioclase size below 50 µm .
Geochemistry: $Fa_{29.6\pm9.6}$, Fa PMD=30%, NiO 0.62±0.42 wt%, Cr_2O_3 0.13±0.05 wt% (n=5). Type 5 clasts $Fa_{37.2}$ (n=2).
Classification: Rumuruti chondrite (R3-5)
Specimens: Type specimen at *CEREGE*. Main mass with *Kuntz*.

Northwest Africa 12474 (NWA 12474)
(Northwest Africa)
Purchased: 2003
Classification: Carbonaceous chondrite (CR3)
Physical characteristics: Dark stone. Cut surface reveals dark interior with chondrules.

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Petrography: Chondrite with well-defined chondrules set in an abundant fine-grained matrix (55 vol% from point counting, n=609). Average apparent chondrule diameter 650±310 µm (n=40). Strong weathering. Opaque minerals are FeNi metal, magneite, troilite, often forming composite opaque grains. The chondrules are layered with metal/sulfide rims; opaques are also found blebs up to 300 µm in size, and some metal blebs occur at the surfaces of chondrules. XRD does not show evidence for the presence of phyllosicates. Based on the structural order of the polyaromatic matter assessed by Raman spectroscopy (L. Bonal, *IPAG*), this meteorite appears slightly metamorphosed, less than Bishunpur (type 3.1). The Raman spectroscopy parameters of interest are FWHM-D (cm^{-1})=180.3±8.7, ID/IG=0.96±0.04, N=7 (see Bonal et al. 2016, figure 6). Terrestrial weathering is strong with alteration veins crosscutting the meteorite.
Geochemistry: Olivine $Fa_{1.9\pm0.8}$, PMD=35%, $Fa_{0.5-2.9}$, Cr_2O_3=0.4±0.2wt%, (n=5). Low-Ca pyroxene $Fs_{2.4\pm0.7}Wo_{1.2\pm0.4}$, range $Fs_{1.3-3.3}Wo_{0.6-1.8}$ (n=7). Plagioclase $An_{86.4\pm2.7}Ab_{13.5\pm2.8.0}Or_{0.0\pm0.1}$ (n=2). Magnetic susceptibility log χ ($\times 10^{-9}$ m^3/kg) = 4.69.
Classification: CR3. CR group based on petrography (chondrule size, metal abundance), and geochemistry. Type 3 based on the absence of phyllosilicates; subtype is ~3.1 based on Raman spectroscopy .
Specimens: 29 g and a polished section at CEREGE. Main mass with *Kuntz*.

Northwest Africa 12478 (NWA 12478)
Morocco, (Northwest Africa)
Find: 2017 Mar
Classification: Ordinary chondrite (LL5)
Physical characteristics: Crusted stone. Cut surface reveals light-gray interior with clasts and visible chondrules
Petrography: Type 5 ordinary chondrite with sub-rounded highly recrystallized (type 6) clasts up to 250 µm in size.

Northwest Africa 12479 (NWA 12479)
Sahara, (Northwest Africa)
Purchased: 2017 Mar
Classification: HED achondrite (Eucrite, brecciated)
History: Purchased by Pierre-Marie Pelé
Physical characteristics: Crusted stone with grey interior.
Petrography: Brecciated igneous rock with variolitic texture. Mineralogy: pyroxene, plagioclase, troilite, FeNi metal, chromite, silica polymorph.
Geochemistry: Low-Ca pyroxene $Fs_{60.9\pm1.6}Wo_{7.4\pm3.5}$, FeO/MnO 32.0±0.4 (n=4). Plagioclase $An_{91.1}Ab_{8.7}Or_{0.3}$ (n=1). Chromite Cr# 0.81. Magnetic susceptibility log χ ($\times 10^{-9}$ m^3/kg) = 3.69.
Classification: Achondrite (eucrite)
Specimens: Type specimen at *CEREGE*. Main mass with Pierre-Marie Pelé.

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Northwest Africa 12480 (NWA 12480)
(Northwest Africa)
Purchased: 2018 Nov
Classification: Primitive achondrite (Acapulcoite)
Physical characteristics: Cut surface reveals a greenish and metal-rich interior.
Petrography: Strongly recrystallized texture with orthopyroxene (typical size 400 µm), Ca-pyroxene, plagioclase (typical size 200 µm) displaying triple junctions. Opaques are FeNi metal and troilite. No chondrule remnant was observed. Modal abundances (by point counting): plagioclase (14 vol%), pyroxene (66 vol%), FeNi metal (12 vol%), troilite (6 vol%).
Geochemistry: Orthopyroxene $Fs_{11.2\pm0.2}Wo_{2.1\pm0.3}$, FeO/MnO=13.5±2.1 (n=4), augite $Fs_{4.7}Wo_{45.0}$ (n=2), plagioclase $An_{16.6}Ab_{79.0}Or_{4.4}$ (n=2).
Classification: Primitive achondrite (acapulcoite).
Specimens: Type specimen at *CEREGE*. Main mass with Nourddinez Azelmat

Northwest Africa 12481 (NWA 12481)
(Northwest Africa)
Purchased: 2018 March
Classification: HED achondrite (Eucrite, melt breccia)
Petrography: Brecciated igneous rock with lithic and mineral clasts set in a melt rock matrix. Main minerals are pyroxene (both exsolved and not exsolved) and plagioclase. Accessory silica polymorph (to 100 µm), troilite, FeNi metal.
Geochemistry: Pyroxene: low-Ca $Fs_{57.4\pm2.0}Wo_{4.7\pm2.5}$ (n=4), augite $Fs_{27.1\pm0.8}Wo_{42.8\pm0.8}$ (n=3), FeO/MnO=32.4±3.3 (n=7). Plagioclase $An_{89.8}Ab_{97}Or_{0.5}$ (n=2).
Classification: Eucrite-melt breccia.
Specimens: Type specimen at *CEREGE*. Main mass with *Kuntz*.

Northwest Africa 12482 (NWA 12482)
(Northwest Africa)
Purchased: 2018 March
Classification: Rumuruti chondrite (R3)
Physical characteristics: Single crusted stone.
Petrography: Chondrite with well-defined small chondrules (~300 µm) set in abundant matrix. Sulfides (pentlandite, pyrrhotite) are the main opaque minerals.
Geochemistry: Olivine $Fa_{28.0\pm14.9}$, Fa PMD 49%, NiO 0.13±0.04 wt%, Cr_2O_3 0.09±0.07 wt% (n=5). Orthopyroxene $Fs_{14.2\pm9.3}Wo_{1.1\pm0.3}$ (n=3). Chromite Cr#=0.85, TiO_2 3.42 wt%, Al_2O_3 5.16 wt%. Magnetic susceptibility log χ ($\times 10^{-9}$ m^3/kg) = 3.35.
Classification: Rumuruti chondrite (R3)
Specimens: Type specimen at *CEREGE*. Main mass with *Kuntz*.

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Northwest Africa 12483 (NWA 12483)
(Northwest Africa)
Purchased: 2018
Classification: Primitive achondrite (Winonaite)
History: The meteorite was purchased from a local meteorite dealer in Morocco.
Physical characteristics: Several brownish individuals without fusion crust.
Petrography: The meteorite displays a recrystallized texture with frequent 120 degree triple junctions and is dominantly composed of typically 100 to 200 µm sized enstatite, forsteritic olivine, and augite grains, with enstatite being the most abundant mineral phase. Minor phases include kamacite, schreibersite, daubreelite, and troilite. No chondrules present.
Geochemistry: olivine: $Fa_{1.4\pm0.3}$ ($Fa_{0.7\text{-}1.9}$, n=12, FeO/MnO=7±1); low-Ca pyroxene: $Fs_{3.0\pm0.1}Wo_{1.3\pm0.1}$ ($Fs_{2.8\text{-}3.3}Wo_{1.0\text{-}1.4}$, n=11, FeO/MnO=8±1); Ca-pyroxene: $Fs_{1.5\pm0.2}Wo_{44.2\pm0.4}$ ($Fs_{1.2\text{-}1.9}Wo_{43.7\text{-}45.1}$, n=12, FeO/MnO=6±1)

Northwest Africa 12484 (NWA 12484)
Niger
Purchased: 2018 Oct 05
Classification: Ordinary chondrite (L3)
Physical characteristics: Several crusted stones and fragments
Petrography: Chondrite with packed and well-delineated chondrules. Chondrule mesosatis is devitrified. Opaques are Fe,Ni metal, and troilite.
Geochemistry: Olivine $Fa_{24.2\pm5.6}$, Fa PMD=19%, Cr_2O_3 0.04±0.02 wt% (n=9). low-Ca pyroxene $Fs_{11.0\pm6.5}Wo_{0.9\pm1.4}$ (n=6). Magnetic susceptibility log χ ($\times 10^{-9}$ m^3/kg) = 4.64.
Classification: Ordinary chondrite (L3). L group form magnetic susceptibility.
Specimens: Type specimen at *CEREGE*

Northwest Africa 12485 (NWA 12485)
(Northwest Africa)
Find: 2018 Oct
Classification: HED achondrite (Eucrite, melt breccia)
History: Bought by Jean Redelsperger from Mohamed Elguirah in Guelmin in October 2018.
Physical characteristics: Gray stones, some crusted, with brecciated gray interior.
Petrography: Melt breccia with lithic clasts made of low-Ca pyroxene and minor chromite set in a feldspathic melt rock containing small Ca-Px crystals. The melt rock contain sulfide droplets.
Geochemistry: Low-Ca pyroxene clasts $Fs_{36.6\pm1.2}Wo_{5.7\pm2.4}$, FeO/MnO 29.4±2.5 (n=4). Feldspathic melt rock $An_{91.1}Ab_{8.7}Or_{0.3}$ (n=2). Chromite Cr#=0.81.
Classification: Eucrite-melt breccia.

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Specimens: Type specimen at *CEREGE*. Main mass with Jean Redelpserger.

Northwest Africa 12486 (NWA 12486)
(Northwest Africa)
Purchased: 2018
Classification: Ordinary chondrite (L~6)
History: Purchased at Hamburg Mineral Show Dec. 2018.
Physical characteristics: 1322.6 g leather-brown aeolian sculpted stone fragment with granular surface and metallic specks
Petrography: (R. Bartoschewitz, *Bart*) Brown stained recrystallized matrix with nearly complete recrystallized chondrules (0.4-5 mm), irregular metal inclusions and small sulfide specks.
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.65
Classification: Ordinary chondrite (L~6, W2)
Specimens: 20.6 g on deposit at *Kiel*, *Bart* holds the main mass.

Northwest Africa 12487 (NWA 12487)
(Northwest Africa)
Purchased: 2018
Classification: Ordinary chondrite (H~5)
History: Purchased at Hamburg Mineral Show Dec. 2018.
Physical characteristics: 121.4 g brown stone with about 50% black brown, rather fresh, fusion crust of ~0.3 mm. Surface without fusion crust is very strongly sculpted by erosion and metal spots are visible.
Petrography: (R. Bartoschewitz, *Bart*) Gray brown, recrystallized, very porosus matrix with chondrules (0.2-1.5 mm, av. 0.5 mm), metal and sulfide specks. Vugs (av. 1 mm) bear olivine, pyroxene and troilite crystallites up to 0.3 mm.
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 5.42
Classification: Ordinary chondrite (H~5, W1)
Specimens: 20.5 g on deposit at *Kiel*, *Bart* holds the main mass.

Northwest Africa 12488 (NWA 12488)
(Northwest Africa)
Purchased: 2018
Classification: Ordinary chondrite (L~5)
History: Purchased at Hamburg Mineral Show Dec. 2018.
Physical characteristics: 18.9 g brown flight oriented individual
Petrography: (R. Bartoschewitz, *Bart*) light gray-brown and gray mottled, brecciated, recrystallized matrix with well-defined chondrules (0.4-1.4 mm, av. ~0.7 mm), irregular metal and sulfide inclusions. Thickness of fusion crust is 0.1-1 mm.

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Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ (× 10^{-9} m^3/kg) = 4.64
Classification: Ordinary chondrite (L~5, W1)
Specimens: 3.9 g on deposit at *Kiel*, *Bart* holds the main mass.

Northwest Africa 12489 (NWA 12489)
(Northwest Africa)
Purchased: 2018
Classification: Ordinary chondrite (LL~6)
History: Purchased at Hamburg Mineral Show Dec. 2018.
Physical characteristics: 154.2 g yellow-brown stone with metallic specks on the surface
Petrography: (R. Bartoschewitz, *Bart*) Yellow brown recrystallized matrix with nearly complete recrystallized chondrules, metal and sulfide inclusions.
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ (× 10^{-9} m^3/kg) = 3.39
Classification: Ordinary chondrite (LL~6, W3)
Specimens: 23.3 g on deposit at *Kiel*, *Bart* holds the main mass.

Northwest Africa 12490 (NWA 12490)
(Northwest Africa)
Purchased: 2018
Classification: Ordinary chondrite (L~5)
History: Purchased at Hamburg Mineral Show Dec. 2018.
Physical characteristics: 80.8 brown stone with irregular granular surface
Petrography: (R. Bartoschewitz, *Bart*) yellow-brown, recrystallized matrix, with defined chondrules (0.4-2 mm, av. ~1 mm), irregular metal and sulfide inclusions
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ (× 10^{-9} m^3/kg) = 4.59
Classification: Ordinary chondrite (L~5, W2)
Specimens: 17.0 g on deposit at *Kiel*, *Bart* holds the main mass.

Northwest Africa 12491 (NWA 12491)
(Northwest Africa)
Purchased: 2018
Classification: Ordinary chondrite (L~6)
History: Purchased at Hamburg Mineral Show Dec. 2018.
Physical characteristics: 84.7 g brown stone covered with fusion crust
Petrography: (R. Bartoschewitz, *Bart*) Brown mottled, recrystallized, brecciated matrix, pervaded by black shock melt veins, with nearly complete recrystallized chondrules, metal and sulfide inclusions

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Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.92
Classification: Ordinary chondrite (L~6, W1)
Specimens: 18.7 g on deposit at *Kiel*, *Bart* holds the main mass.

Northwest Africa 12492 (NWA 12492)
(Northwest Africa)
Purchased: 2018
Classification: Ordinary chondrite (L~3)
History: Purchased at Hamburg Mineral Show Dec. 2018.
Physical characteristics: 63.5 g brown stone with recognizable, well-developed chondrules on the surface
Petrography: (R. Bartoschewitz, *Bart*) gray matrix with well outlined chondrules (0.3-1.5 mm, av. ~8 mm), irregular metal and sulfide inclusions
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.80
Classification: Ordinary chondrite (L~3, W0/1)
Specimens: 13.1 g on deposit at *Kiel*, *Bart* holds the main mass.

Northwest Africa 12494 (NWA 12494)
(Northwest Africa)
Purchased: 2018
Classification: HED achondrite (Eucrite, polymict)
History: Purchased at Hamburg Mineral Show Dec. 2018.
Physical characteristics: 160.0 g irregular fragment with cm-sized light irregular patches in a dark gray-green matrix
Petrography: (R. Bartoschewitz, *Bart*) microgabbroic and basaltic clasts are set in a cumulate basaltic brecciates matrix. Matrix feldspar is partly transformed to maskelynite.
Geochemistry: (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Pyroxene $Fs_{64.9\pm0.4}Wo_{2.2\pm0.4}$ (n=5), Fe/Mn=30; pigeonite $En_{32}Fs_{60}Wo_8$ (n=1); augite $En_{27\text{-}31}Fs_{49\text{-}28}Wo_{20\text{-}44}$ (n=8); feldspar $An_{83}Or<1$ (n=13); ilmenite; SiO_2. Kamacite Ni=1.3-7.6, Co=0.8 (n=3); taenite Ni=42.2, Co=0.2 (n=1) (all wt-%). Magnetic susceptibility log χ ($\times 10^{-9}$ m^3/kg) = 3.17
Classification: Achondrite (polymict eucrite)
Specimens: 20.0 g on deposit at *Kiel*, *Bart* holds the main mass.

Northwest Africa 12495 (NWA 12495)
(Northwest Africa)
Purchased: 2018
Classification: HED achondrite (Eucrite, polymict)
History: Purchased at Hamburg Mineral Show Dec. 2018.

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Physical characteristics: Two laterite-covered fragmens of 57.8 and 15.4 g with little fusion crust
Petrography: (R. Bartoschewitz, *Bart*) breccia of basaltic, cumulated and cataclastic clasts.
Geochemistry: (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Pyroxene $Fs_{32.5\pm5.4}Wo_{3.2\pm0.4}$ (n=5), Fe/Mn=30; pigeonite $En_{52}Fs_{40}Wo_{8}$ (n=5); feldspar $An_{84}Or<1$ (n=19); ilmenite; SiO_2. Kamacite Ni=3.6, Co=0.4 (n=3) (all wt-%); troilite. Magnetic susceptibility log χ ($\times 10^{-9} m^3/kg$) = 2.96
Classification: Achondrite (polymict eucrite)
Specimens: 15.0 g on deposit at *Kiel*, *Bart* holds the main mass.

Northwest Africa 12503 (NWA 12503)
Morocco
Purchased: 2018
Classification: Ordinary chondrite (H5)
History: (Ziyao Wang) Purchased by Ziyao Wang from Sbai Mohamed at the mineral show in *Beijing* in Nov. 2018
Physical characteristics: (Ziyao Wang) stone of 126.4 g without fusion crust
Petrography: (R. Bartoschewitz, *Bart*) recrystallized matrix with well defined chondrules (PO, PP; 0.4-1.5 mm). Metal is completely oxidized and fills cracks.
Geochemistry: (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine $Fa_{18.7\pm0.2}$ (n=19); pyroxene $Fs_{16.7\pm0.4}Wo_{1.3\pm0.1}$ (n=13). Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.91
Classification: Ordinary chondrite (H5, S2, W5)
Specimens: 20.2 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 27 g with *Bart*.

Northwest Africa 12504 (NWA 12504)
Morocco
Purchased: 2018
Classification: Ordinary chondrite (LL5)
History: (Ziyao Wang) Purchased by Ziyao Wang from Sbai Mohamed at the mineral show in *Beijing* in Nov. 2018
Physical characteristics: (Ziyao Wang) one irregular stone of 435 gram with fusion crust
Petrography: (R. Bartoschewitz, *Bart*) recrystallized matrix with recognizable chondrules (av. 0.9 mm), chondrule and mineral fragments.
Geochemistry: (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine $Fa_{28.9\pm1.7}$ (n=17); pyroxene $Fs_{23.8\pm1.0}Wo_{1.8\pm0.4}$ (n=11); Ca-pyroxene $En_{46}Fs_{10}Wo_{44}$ (n=1); chromite CRAL86, FFM92 (n=1); merrillite. Kamacite Ni=5.3, Co=1.5 (n=1); taenite Ni=35.5, Co=0.9 (n=3) (all wt-%). Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.31
Classification: Ordinary chondrite (LL5, S2, W2)

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Specimens: 20.1 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 53 g with *Bart*.

Northwest Africa 12506 (NWA 12506)
(Northwest Africa)
Purchased: 2017
Classification: Ureilite
History: (Ziyao Wang) Purchased by Ziyao Wang from Mustapha Oulkouch in Goulmima, Morocco, 2017.
Physical characteristics: (Ziyao Wang) one reddish-brown stone of 51 g without fusion crust.
Petrography: (R. Bartoschewitz, *Bart*) recrystallized silicate grains up to 2 mm with tiny metal inclusions (~50 µm). Silicate grains are surrounded by graphite (~1 mm), diamond (~50 µm), and metal (~200 µm).
Geochemistry: (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine $Fa_{17.1\pm1.6}$ (n=8); pyroxene $Fs_{12.0\pm3.3}Wo_{3.3\pm0.6}$ (n=5); pigeonite $En_{81}Fs_{12}Wo_{7}$ (n=2). Ni-poor kamacite Ni=0.7, Co=0.3 (n=3); Ni-rich kamacite Ni=3.7, Co=0.5, Si=1.2, Cr=0.2 (n=2) (all wt-%). Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.64
Classification: Ureilite
Specimens: 10.8 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 6 g with *Bart*.

Northwest Africa 12507 (NWA 12507)
(Northwest Africa)
Purchased: 2018
Classification: Ureilite
History: (Ziyao Wang) Purchased by Ziyao Wang from Aziz Habibi in Erfoud, Morocco, 2018.
Physical characteristics: (Ziyao Wang) one oblate stone of 10.5 g without fusion crust.
Petrography: (R. Bartoschewitz, *Bart*) olivine grains up to 5 mm with tiny metal inclusions and intgerstitial silicates, graphite, chromite, and metal.
Geochemistry: (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine $Fa_{10.6\pm0.2}$ (n=22); pyroxene $Fs_{9.8\pm0.2}Wo_{1.6\pm0.3}$ (n=5); augite $En_{51}Fs_{4}Wo_{45}$ (n=2); chromite CRAL82, FFM51 (n=2). Kamacite Ni=6.9, Co=0.6 (n=3); troilite Ni=0.2 (n=4) (all wt-%). Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.64
Classification: ureilite
Specimens: 2.3 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 2 g with *Bart*.

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Northwest Africa 12508 (NWA 12508)
Algeria
Purchased: 2018
Classification: HED achondrite (Eucrite)
History: (Ziyao Wang) Purchased by Ziyao Wang from Hamza Lharbi in Guelmim in Oct. 2018.
Physical characteristics: (Ziyao Wang) one yellow-white stone of 20.3 g with very few fusion crust.
Petrography: (R. Bartoschewitz, *Bart*) unbrecciated ophitic texture composed of predominantly exsolved pigeonite and feldspar.
Geochemistry: (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Pigeonite $En_{36}Fs_{57}Wo_7$ (n=15); augite $En_{30}Fs_{31}Wo_{39}$ (n=2); feldspar $An_{89}Or<1$ (n=11); chromite CRAL82, FFM98 (n=1); ilmenite, SiO_2. Kamacite Ni<0.1, Co=0.5 (n=2) (all wt-%); troilite. Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 2.79
Classification: Achondrite (eucrite, basaltic)
Specimens: 4.1 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 3 g with *Bart*.

Northwest Africa 12509 (NWA 12509)
Morocco
Purchased: 2018
Classification: HED achondrite (Eucrite)
History: (Ziyao Wang) Purchased by Ziyao Wang from Fayssal Mezgouri in Agadir, Morocco, Nov 2018.
Physical characteristics: (Ziyao Wang) one irregularly shaped stone of 114.5 g with recognizable brecciated structure on the surface, without fusion crust.
Petrography: (R. Bartoschewitz, *Bart*) recrystallized ophitic texture composed of pyroxene and feldspar cut by melt veins.
Geochemistry: (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Pyroxene $Fs_{60.3\pm0.8}Wo_{2.9\pm0.7}$ (n=11), Fe/Mn=31; pigeonite $En_{36}Fs_{59}Wo_4$ (n=2); augite $En_{31}Fs_{37}Wo_{32}$ (n=2); feldspar $An_{89}Or<1$ (n=8); chromite CRAL84, FFM98 (n=1); ilmenite. Kamacite Ni=5.1, Co=0.6 (n=2) (all wt-%); troilite. Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 3.39
Classification: Achondrite (eucrite, basaltic)
Specimens: 20.1 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 16 g with *Bart*.

Northwest Africa 12510 (NWA 12510)
Algeria
Purchased: 2018
Classification: Ordinary chondrite (L3)

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History: (Ziyao Wang) Purchased by Ziyao Wang from Adam Ait Hiba in Tan-Tan, Morocco, Oct 2018.
Physical characteristics: (Ziyao Wang) one dark-gray stone of 88 g with white-gray areas presenting rusty spots, without fusion crust
Petrography: (R. Bartoschewitz, *Bart*) well-defined chondrules (PO, PP, BO, RP, complex) of 0.3-2 mm (av. 0.7 mm) in light to dark matrix.
Geochemistry: (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine $Fa_{21.6\pm8.0}$ (n=17); pyroxene $Fs_{17.6\pm3.6}Wo_{1.6\pm0.9}$ (n=11); mesostasis An_8Or_8 (n=1); chromite CRAL87, FFM88 (n=1). Kamacite Ni=5.5, Co=1.0 (n=2); taenite Ni=41.7, Co=0.3 (n=2) (all wt-%). Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.55
Classification: Ordinary chondrite (L3, S2, W2)
Specimens: 20.7 g on deposit at *Kiel*, Yu Cao holds the main mass,19 g with Ziyao Wang and 12 g with *Bart*.

Northwest Africa 12511 (NWA 12511)
Morocco
Purchased: 2018
Classification: Ordinary chondrite (LL6)
History: (Ziyao Wang) Purchased by Ziyao Wang from Sbai Mohamed at the mineral show in *Beijing* in Nov. 2018
Physical characteristics: (Ziyao Wang) one globulare stone of 91 g with some black fusion crust
Petrography: (R. Bartoschewitz, *Bart*) very poorly defined chondrules in strong recrystallized matrix.
Geochemistry: (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine $Fa_{31.0\pm0.3}$ (n=7); pyroxene $Fs_{24.9\pm0.4}Wo_{2.1\pm0.3}$ (n=18); Ca-pyroxene $En_{46}Fs_{10}Wo_{44}$ (n=1); feldspar $An_{10}Or_5$ (n=4); chromite CRAL85, FFM91 (n=3). Taenite Ni=44.0, Co=2.0 (n=2) (all wt-%). Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 3.44
Classification: Ordinary chondrite (LL6, S2, W2)
Specimens: 19.0 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 12 g with *Bart*.

Northwest Africa 12513 (NWA 12513)
(Northwest Africa)
Purchased: 2018 Aug
Classification: HED achondrite (Eucrite, monomict)
History: Four similar stones (total 2545 g) were recovered ~50 m apart at a location in Algeria, and were purchased by Mbark Arjdal in August 2018 from an Algerian dealer.
Petrography: (A. Irving and S. Kuehner, *UWS*) Very fresh monomict gabbroic eucrite specimen composed of coarse grained lithic clasts in a sparse matrix of related

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crystalline debris. Major minerals are low-Ca pyroxene and calcic plagioclase together with accessory silica polymorph and ilmenite (associated with multiple small grains of zircon). Some pyroxene has unexsolved pigeonite cores whereas other pyroxenes have exsolved into augite lamellae within host orthopyroxene.
Geochemistry: Low-Ca pyroxene cores ($Fs_{31.9-32.1}Wo_{6.2-5.6}$, FeO/MnO = 29, N = 2), orthopyroxene host ($Fs_{60.6}Wo_{4.5}$, FeO/MnO = 34), clinopyroxene exsolution lamellae ($Fs_{26.2-29.1}Wo_{43.7-40.6}$, FeO/MnO = 31-35, N = 2), plagioclase ($An_{84.3-87.9}Or_{1.5-0.7}$, N = 2).
Classification: Eucrite (monomict breccia, gabbroic).
Specimens: 33.5 g including one polished thin section at *UWB*; remainder with Mr. M. Arjdal.

Northwest Africa 12514 (NWA 12514)
(Northwest Africa)
Purchased: 2005
Classification: Ordinary chondrite (L3)
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*) Well-formed chondrules (apparent diameter 800±260 µm, N = 22) are set in a finer matrix containing stained metal, merrillite and chlorapatite. A few small type 6 clasts were observed in the studied thin section.
Geochemistry: Olivine ($Fa_{13.8-28.3}$, average $Fa_{23.3\pm4.6}$, Cr_2O_3 in ferroan examples 0.03-0.11 wt.%, mean 0.06±0.03 wt.%, N = 7), orthopyroxene ($Fs_{4.6-17.8}Wo_{0.2-1.3}$, average $Fs_{12.1\pm6.8}Wo_{0.7\pm0.6}$, N = 3), clinopyroxene ($Fs_{6.7-7.1}Wo_{42.2-45.6}$, N = 2). Magnetic susceptibility log χ ($\times 10^{-9}$ m^3/kg) = 4.81.
Classification: Ordinary chondrite (L3).
Specimens: The entire specimen including one polished thin section is at *PSF*.

Northwest Africa 12515 (NWA 12515)
(Northwest Africa)
Purchased: 2018 Aug
Classification: Ordinary chondrite (L4)
History: Purchased by John Higgins and Igor Litovsky in August 2018 from a dealer in Zagora, Morocco.
Petrography: (A. Irving and S. Kuehner, *UWS*) Well-formed, equilibrated chondrules are set in a finer matrix containing altered metal.
Geochemistry: Olivine ($Fa_{24.6-25.4}$, N = 3), orthopyroxene ($Fs_{1.7-20.6}Wo_{0.6-1.5}$, N = 3), clinopyroxene ($Fs_{2.3}Wo_{38.5}$; $Fs_{2.8}Wo_{46.8}$; N = 2).
Classification: Ordinary chondrite (L4).
Specimens: 53 g including one polished thin section at *UWB*; remainder jointly with Mr. J. Higgins and Mr. I. Litovsky.

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Northwest Africa 12516 (NWA 12516)
(Northwest Africa)
Purchased: 2017 Mar
Classification: HED achondrite (Eucrite, monomict)

History: Purchased by Ben Hoefnagels in March 2017 from a dealer in Ouarzazate, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Breccia composed of microgabbroic eucrite clasts in a sparse matrix of related debris. Clasts consist of exsolved pigeonite (microgranular) and calcic plagioclase (polycrystalline) with accessory silica polymorph, ilmenite, Ti-bearing chromite, Ni-free metal, zircon and minor barite. The specimen is crosscut by some dark, very fine grained shock melt veinlets.

Geochemistry: Orthopyroxene host ($Fs_{59.6-60.5}Wo_{4.6-2.5}$, FeO/MnO = 33, N = 3), clinopyroxene exsolution lamellae ($Fs_{26.7-27.0}Wo_{42.7-43.1}$, FeO/MnO = 30-35, N = 2), plagioclase ($An_{88.8-89.1}Or_{0.2-0.4}$, N = 2).

Classification: Eucrite (monomict breccia, microgabbroic, shocked).

Specimens: 22 g including one polished thin section at *UWB*; remainder with Mr. B. Hoefnagels.

Northwest Africa 12517 (NWA 12517)
(Northwest Africa)
Purchased: 2017 Mar
Classification: Ordinary chondrite (LL4-6)

History: Purchased by Ben Hoefnagels in March 2017 from a dealer in Ouarzazate, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Well-formed, equilibrated chondrules plus some angular type-6 clasts (largely recrystallized with rare remnant chondrules) are set in a finer matrix containing altered metal.

Geochemistry: Olivine ($Fa_{29.0-30.4}$, N = 3), orthopyroxene ($Fs_{21.8-24.4}Wo_{1.2-1.9}$, N = 3), low-Ca pyroxene ($Fs_{7.8}Wo_{5.7}$), augite ($Fs_{9.3-10.3}Wo_{43.7-42.7}$, N = 2).

Classification: Ordinary chondrite (LL4-6).

Specimens: 21.7 g including one polished thin section at *UWB*; remainder with Mr. B. Hoefnagels.

Northwest Africa 12519 (NWA 12519)
(Northwest Africa)
Purchased: 2017 Feb
Classification: HED achondrite (Diogenite, polymict)

History: Purchased by John Higgins in February 2017 from a dealer in Laayoune, Morocco.

Petrography: (A. Irving and S. Kuehner, *UWS*) Breccia composed predominantly of angular mineral clasts derived from several diogenitic lithologies plus ~5 vol.%

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eucrite clasts in a finer grained matrix of related debris. Minerals are orthopyroxene (of at least two different compositions), olivine, anorthite, chromite, troilite, exsolved pigeonite, bytownitic plagioclase and silica polymorph.
Geochemistry: Diogenitic orthopyroxene ($Fs_{20.9}Wo_{1.8}$; $Fs_{28.8}Wo_{3.3}$; FeO/MnO = 25-29; N = 2), olivine ($Fa_{45.7-53.5}$, FeO/MnO = 55-57, N = 2), anorthite ($An_{93.7}Or_{0.2}$), orthopyroxene host ($Fs_{45.7-48.5}Wo_{2.9-2.7}$; $Fs_{63.3}Wo_{4.8}$; FeO/MnO = 29-31; N = 3), clinopyroxene exsolution lamellae ($Fs_{20.0-20.4}Wo_{42.7-43.3}$, FeO/MnO = 25-28, N = 2), plagioclase ($An_{85.1}Or_{0.9}$).
Classification: Diogenite (polymict breccia).
Specimens: 12.6 g including one polished thin section at *UWB*; remainder with Mr. J. Higgins.

Northwest Africa 12521 (NWA 12521)
(Northwest Africa)
Purchased: 2018 Nov
Classification: Ordinary chondrite (L3.1)
History: Purchased by Ben Hoefnagels in November 2018 from a dealer in Agadir, Morocco.
Petrography: (A. Irving and S. Kuehner, *UWS*) Very fresh specimen composed of well-formed chondrules (apparent diameter 860±430 µm, N = 24, excluding one large 5 mm chondrule in the studied thin section) plus some angular Type 3 lithic clasts (up to 1.6 mm across) set in a fine grained, metal-bearing matrix (~10 vol.%, black in thin section).
Geochemistry: Olivine $Fa_{17.2\pm12.3}$ (n=8, randomly selected), range $Fa_{1.7-59.4.}$ Cr_2O_3 in ferroan examples 0.03-1.30 wt.%, mean 0.22±0.24 wt.%, N = 30), orthopyroxene ($Fs_{1.5-33.2}Wo_{0.3-1.0}$, N = 3), pigeonite ($Fs_{26.8}Wo_{14.9}$), augite ($Fs_{17.1}Wo_{35.8}$). Magnetic susceptibility log χ ($\times 10^{-9}m^3/kg$) = 4.64.
Classification: Ordinary chondrite (L3.1). Based on lack of equilibration of mafic silicates, chondrule sizes and magnetic susceptibility this specimen is an L3 chondrite, and the distribution of Cr in ferroan olivines is consistent with an L3.1 chondrite (similar to Adrar 003, as documented by Grossman and Brearley, 2005).
Specimens: 20.2 g including one polished thin section at *UWB*; remainder with Mr. B. Hoefnagels.

Northwest Africa 12522 (NWA 12522)
Algeria
Purchased: 2018
Classification: Martian meteorite (Shergottite)
History: Two complete stones purchased by Jay Piatek from Abdelhadi Aithiba in Morocco, November 2018. The two stones were found together in the Algerian Desert near Ouargla, reportedly as part of a find of several stones with total mass of ~9 kg.

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Physical characteristics: The two stones, 1071 g and 57 g, are both covered in fusion crust. The larger stone has smooth, wind-polished fusion crust on about 10% of its surface. The rest of the stone appears to have been buried in the sand and not wind-polished, but has instead extremely fresh and shiny black fusion crust. Flow lines and roll-over edges are present in this fusion crust. The smaller stone may have been completely buried in the sand as it has only very fresh-appearing fusion crust and one small chipped area which exposes the interior. Broken surfaces on both stones reveal shiny maskelynite patches that are visible with the naked eye. A piece of the fusion crust was imaged using BSE, showing it to be highly vesicular with average thickness ~450 µm.

Petrography: (C. Agee, *UNM*) The two major phases in this meteorite are clinopyroxene and maskelynite. Ubiquitous minor phases are merrillite, apatite, titanomagnetite, ilmenite, and troilite. The clinopyroxene has a modal abundance of approximately 60%, with significant core to rim zoning observed in backscatter electron images, indicating an igneous crystallization trend with Mg-rich pigeonite cores, mantled by augite, and rimmed with ferropigeonite. Clinopyroxene average grain sizes are approximately 300-500 µm. Maskelynite has modal abundances of approximately 30%, and most grains are thin and elongate with maximum length ~1 mm. Merrillite is about five times more abundant than apatite in this sample.

Geochemistry: (C. Agee, *UNM*) Clinopyroxene $Fs_{43.8\pm19.1}Wo_{21.8\pm6.7}$, core to rim range $Fs_{30.2}Wo_{13.6}$ (Mg-pigeonite) - $Fs_{22.6}Wo_{38.7}$ (augite) - $Fs_{78.4}Wo_{4.6}$ (ferropigeonite), Fe/Mn=33±5, n=48; maskelynite $An_{50.7\pm2.7}Ab_{47.6\pm2.2}Or_{1.7\pm0.6}$, n=17; fusion crust (20 µm defocused electron beam) SiO_2=45.4±1.0, TiO_2=1.2±0.3, Al_2O_3=7.3±2.1, Cr_2O_3=0.10±0.10, MgO=7.0±3.9, FeO=21.0±1.4, MnO=0.52±0.04, CaO=9.9±0.0, Na_2O=1.5±0.5 (all wt%), n=11; merrillite CaO=46.4±0.4, P_2O_5=44.4±0.3, FeO=5.2±0.4, MgO=0.7±0.3, Na_2O=1.5±0.1, (all wt%), n=19; apatite CaO=53.3±0.3, P_2O_5=40.5±0.1, FeO=1.3±0.1, MgO=0.2±0.2, Na_2O=0.12±0.04, SiO_2=0.87±0.06, F=1.2±0.1, Cl=2.3±0.2, (all wt%), n=4; titanomagnetite FeO=54.0±3.0, Fe_2O_3=15.1±6.4, TiO_2=26.6±5.0, Al_2O_3=1.8±1.8±0.4, MnO=0.57±0.06, (all wt%), n=27; ilmenite FeO=49.4±0.7, TiO_2=48.5±1.4, MnO=0.77±0.03, (all wt%), n=4. Oxygen isotopes (K. Ziegler, *UNM*): acid-washed fragment analyzed by laser fluorination gave $\delta^{18}O$= 4.426; $\delta^{17}O$= 2.567; $\Delta^{17}O$= 0.230 (linearized, per mil, TFL slope=0.528).

Classification: Geochemically evolved pyroxene-phyric basalt, clinopyroxene compositional zoning trends are similar to QUE 94201, maskelynite composition is similar to Los Angeles.

Specimens: 21 g including a probe mount on deposit at *UNM*, Jay Piatek holds the main mass.

Northwest Africa 12525 (NWA 12525)

Algeria
Purchased: 2018
Classification: Martian meteorite (Shergottite)

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History: (Ziyao Wang) Purchased by Ziyao Wang from Simo Mezgouri in Agadir in Dec. 2018.
Physical characteristics: (Ziyao Wang) one dark-gray stone of 15 g with little fusion crust.
Petrography: (R. Bartoschewitz, *Bart*) ophitic texture composed of pyroxene (0.2-0.6 mm) and maskelynite (length 0.2-3 mm).
Geochemistry: (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Pyroxene $En_{46-8}Fs_{76-45}Wo_{25-9}$,FeO/MnO=37 (n=7); maskelynite $An_{54-38}Or_{3-4}$ (n=8). Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 3.81
Classification: Martian meteorite (shergottite, basaltic)
Specimens: 3.0 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 3 g with *Bart*.

Northwest Africa 12526 (NWA 12526)
(Northwest Africa)
Purchased: 2017
Classification: Primitive achondrite (Acapulcoite)
History: (Ziyao Wang) Purchased by Ziyao Wang from Aziz Habibi in Erfoud, Morocco 2017.
Physical characteristics: (Ziyao Wang) one brown stone of 13.4 g, many fine crystal faces on the surface, without fusion crust.
Petrography: (R. Bartoschewitz, *Bart*) Strongly recrystallized texture with olivine, pyroxene, and plagioclase. Polished thin section shows completely oxidized metal, while a larger cut fragment presents areas of fresh metal.
Geochemistry: (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine $Fa_{12.4\pm0.2}$, FeO/MnO=23 (n=5); pyroxene $Fs_{11.7\pm0.1}Wo_{2.2\pm0.3}$, FeO/MnO=13 (n=6); Ca-pyroxene $En_{51}Fs_5Wo_{44}$ (n=3); feldspar $An_{19}Or_3$ (n=9); chromite CRAL88, FFM68 (n=1). Oxidized metal: Fe~55, Ni~3, Co~0.2, P~0.3 (n=3) (all wt-%). Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.51
Classification: Primitive achondrite (acapulcoite)
Specimens: 2.7 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 2.9 g with *Bart*.

Northwest Africa 12527 (NWA 12527)
(Northwest Africa)
Purchased: 2017
Classification: Primitive achondrite (Acapulcoite)
History: (Ziyao Wang) Purchased by Ziyao Wang from Hamza Lharbi in Guelmim in 2017.
Physical characteristics: (Ziyao Wang) one dark-brown stone of 18.2 g with smooth appearance, without fusion crust.
Petrography: (R. Bartoschewitz, *Bart*) Strongly recrystallized texture with olivine, pyroxene, plagioclase, and interstitial metal and sulfide.

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Geochemistry: (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine $Fa_{7.7\pm0.2}$, FeO/MnO=16 (n=6); pyroxene $Fs_{8.3\pm0.2}Wo_{1.7\pm0.3}$, FeO/MnO=12 (n=9); Ca-pyroxene $En_{51}Fs_4Wo_{45}$ (n=2); feldspar $An_{15}Or_4$ (n=2); chromite CRAL53, FFM68 (n=1). Kamacite Ni=7.7, Co=0.7 (n=3) (all wt-%); plessite, troilite. Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.75
Classification: Primitive achondrite (acapulcoite)
Specimens: 3.7 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 2.7 g with *Bart*.

Northwest Africa 12528 (NWA 12528)
Morocco
Purchased: 2015
Classification: Ureilite
History: (Ziyao Wang) Purchased by Ziyao Wang from Aras Jonika in 2015, who obtained it in Agadir, Morocco
Physical characteristics: (Ziyao Wang) one brown stone of 43 g, without fusion crust.
Petrography: (R. Bartoschewitz, *Bart*) olivine (~4 mm) and pyroxene (~2 mm) grains with tiny metal inclusions and intgerstitial graphite, diamond, and metal.
Geochemistry: (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine $Fa_{20.2\pm1.2}$ (n=21); pigeonite $En_{74}Fs_{17}Wo_9$ (n=10). Kamacite Ni=4.4, Co=0.4 (n=2) (all wt-%). Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.45
Classification: Ureilite
Specimens: 8.62 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 6 g with *Bart*.

Northwest Africa 12530 (NWA 12530)
(Northwest Africa)
Purchased: 2018
Classification: Ordinary chondrite (L3-5)
History: One stone of 15.1 g was received by Erich *Haiderer* in Bavaria, Germany, in late 2018 from an anonymous Moroccan dealer, who reported that the rock came from the Sahara.
Petrography: (A. Bischoff, *IfP*) The rock is brecciated and has a chondritic texture with chondrules (mean diameter about 0.6 mm) in a fine-grained matrix that contains sulfides and FeNi metals. The metal abundance is about 4 vol% and certainly significantly below the abundance in H chondrites. Besides the chondrule size, the metal contents are consistent with an L-group classification. The sample shows only minor weathering.
Geochemistry: (K. Klemm; A. Bischoff, *IfP*) The breccia contains fragments of different petrologic type, some unequilibrated, but most are equilibrated and type L5. The equilibrated type-5 fragments have mean olivine and pyroxene compositions of $Fa_{22.8}$ and $Fs_{19.4}$, respectively. Random measurements of olivine grains revealed

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$Fa_{20.5\pm5.8}$ ($Fa_{5.2-24.4}$); n=9. Random measurements of low-Ca pyroxene grains revealed $Fs_{15.3\pm6.6}Wo_{1.2\pm0.7}$ ($Fs_{2.4-20.0}Wo_{0.3-2.4}$); n=10.
Classification: Ordinary chondrite (L3-5). The classification is based on chondrule size, metal abundance, brecciated texture, and mineral chemistry.

Northwest Africa 12531 (NWA 12531)
(Northwest Africa)
Purchased: 2018
Classification: HED achondrite (Eucrite, melt breccia)
History: Twenty-three identical stones with a total known weight of 530 g were found in Western Sahara in 2018. The samples were purchased from a prospector in Rissani in 2018 and subsequently obtained by David *DGregory* during the 2019 Tucson Gem and Mineral Show.
Physical characteristics: Samples are irregularly shaped, lack fusion crust and are dark gray with light-colored clasts. Vesicles are visible on surface. Some samples appear to be composed mostly of melt and contain higher density of vesicles.
Petrography: Description and classification (A. Love, *App*): A representative 23 g individual displaying the brecciated and vesicular melt textures was selected as the type specimen for description and analysis. The sample is a breccia composed of rounded clasts of coarse-grained (1.2 mm pyroxenes and 1 mm plagioclase), basaltic textured eucrite and related mineral debris set within a vesicular, quench-textured melt matrix. Clasts contain lithic fragments with embayed, exsolved pyroxenes surrounded by vesicular plagioclase. Additional minerals are: Si polymorphs, rare baddeleyite, phosphate, zircon, Ti-poor (3 wt% TiO_2) and rich (<18 wt% TiO_2) chromite which is sometimes inter-grown with ilmenite, troilite and Fe metal.
Geochemistry: (A. Love, *App*) Basaltic eucrite clasts: low Ca pyroxene $Fs_{55.2\pm5.3}Wo_{2.5\pm1.2}$ ($Fs_{48.8-63.6}Wo_{1.9-6.3}$), Fe/Mn=29.6, Mg#35.0-48.6, n=12; high Ca pyroxene $Fs_{22.6\pm2.8}Wo_{44.1\pm0.6}$, N=12; Plagioclase $An_{92.1\pm0.7}Or_{0.2\pm0.0}$, N=6. Melt Matrix: Pigeonite $Fs_{64.4\pm6.2}Wo_{18.6\pm3.8}$, Fe/Mn=34.7, Mg#=8.7-38.2, N=6.
Classification: Eucrite-melt breccia.
Specimens: David *DGregory* holds the remaining 22 individuals that comprise the mass of this meteorite. One partially cut stone weighing 21.15 g and a polished thin section comprise the type specimen and are on deposit at *App*.

Northwest Africa 12532 (NWA 12532)
(Northwest Africa)
Purchased: 2019
Classification: Ordinary chondrite (LL6)
History: One large uncrusted 2000g stone was found in Western Sahara in 2018. John Sinclair purchased the sample from a meteorite prospector at the Tucson Gem and Mineral Show in 2019.

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Physical characteristics: Sample lacks a fusion crust, is yellowish-orange in color and crystalline. Cut face shows a granoblastic texture and dark colored-opaque grains.
Petrography: Description and classification (A. Love, *App*): Sample shows a granoblastic texture composed of 517 µm olivine, low-Ca pyroxene, twinned Cpx and twinned plagioclase that meet at 120º grain boundaries. Additional minerals are phosphates, troilite, chromite, and oxidized FeNi metal grains.
Geochemistry: (A. Love, *App*) Olivine: $Fa_{27.6\pm0.1}$, Fe/Mn 51.9±1.3, n=10; low Ca pyroxene $Fs_{24.2\pm0.2}Wo_{1.8\pm0.0}$, Fe/Mn=34.8±0.6, n=8; high Ca pyroxene $Fs_{9.7\pm0.2}Wo_{43.6\pm0.3}$, N=3; plagioclase $Ab_{57.4\pm0.3}Or_{0.3\pm0.0}$, N=3.
Classification: LL6. Sample is an LL based on mineral compositions, and is type 6 based on recrystallized granoblastic texture.
Specimens: John Sinclair holds the main mass. One endcut weighing 20.05 g and a polished mount and thin section are on deposit at *App*.

Northwest Africa 12533 (NWA 12533)
Morocco
Purchased: 2018 Apr
Classification: Ordinary chondrite (H4/5)
History: A 220 g fragment of the meteorite was purchased by Curtis Bing from a dealer in the US (April, 2018). The dealer brought the sample in Marrakech, Morocco. The stone was a broken fragment surrounded by fusion crust. A polished thin section was carefully prepared from the fragment and subsequently examined using optical microscopy to identify the texture and mineralogy and electron microprobe for the mineral chemistry.
Physical characteristics: One piece. The color of the meteorite is pale brown.
Petrography (I. Baziotis, *AUA*): Textural observations of the thin section in both transmitted and reflected light showed that it is chondritic. It contains porphyritic and nonporphyritic chondrules, both Type I (Mg/(Mg+Fe)<90). The porphyritic olivine (PO) chondrules have rounded to oval shape ranging from 300 to 500 µm. The PMD for olivine is <5% (0.25). The PMD for low-Ca pyroxene is <1%. Both monoclinic and orthorhombic pyroxene are present. The groundmass consists of olivine, low Ca-pyroxene (orthopyroxene and pigeonite), high-Ca pyroxene, plagioclase and rare phosphates (merrillite). The olivine and plagioclase show sharp extinction, indicating shock stage S1. Shock veins were not observed. The rock matrix is cross-cut by numerous interconnected opaque veins. Black fusion crust covers the sample. Red-brown oxidation is visible on the exterior surface, around metal grains on cut surfaces and within the matrix.
Geochemistry: Feldspathic chondrule mesostasis $Ab_{87.6-82.8.}$ High-Ca Pyroxene $Fs_{6.1\pm0.7}Wo_{45.1\pm1.1}$ (n=18).
Classification (I. Baziotis, S. Xydous, *AUA*): Ordinary chondrite (H4/5, W2, S1).
Specimens: 20 g at *NHMV*

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Northwest Africa 12534 (NWA 12534)
Algeria
Find: 2018
Classification: Ordinary chondrite (LL7)

History: Purchased in September 2018 by Matthew Stream and Kenneth Stream from Didi Baidari, who had purchased it previously from an anonymous dealer in March 2018 in Algeria.

Physical characteristics: Dark brown stone with weathering veins around the exterior.

Petrography: (Daniel Sheikh, *FSU*) Poikiloblastic texture with no chondrules. Microprobe examination of a polished section shows 70% olivine, 12% low-ca pyroxene, 10% ca-pyroxene, 4% sodic plagioclase, 3% troilite, 1% chromite.

Geochemistry: Olivine, $Fa_{29.4\pm0.7}$, N=16; orthopyroxene, $Fs_{23.8\pm0.6}W$ 2.9±0.6, N=8. Sodic plagioclase, $An_{10\pm1}$, N=7. Oxygen isotopes (K. Ziegler, *UNM*): analyses of acid-washed subsamples by laser fluorination gave, respectively, $\delta^{17}O$ 4.075, 4.009, 3.988; $\delta^{18}O$ 5.462, 5.345, 5.288; $\Delta^{17}O$ 1.191, 1.187, 1.196 per mil.

Classification: Ordinary Chondrite (LL7). Completely recrystallized with no chondrules, Fa range and O isotopes consistent with LL.

Specimens: 5.03 grams at *UCLA*; main mass with Matthew Stream and Kenneth Stream.

Northwest Africa 12535 (NWA 12535)
(Northwest Africa)
Purchased: May 2018
Classification: Carbonaceous chondrite (CV3)

History: Purchased by Su Lei from a Moroccan dealer during the China (Hunan) International Mineral & Gem Expo (CMGE) in Chenzhou, China.

Physical characteristics: Single stone, sand blasted exterior. Saw-cut surfaces show numerous large chondrules and scattered CAIs set in a dark brown matrix. Many chondrules have a reddish color.

Petrography: (C. Agee, *UNM*) Microprobe examination of a polished mount shows primarily type I chondrules, fine-grained matrix makes up approximately 50% of this meteorite.

Geochemistry: (C. Agee *UNM*) Olivine $Fa_{5.9\pm5.0}$, Fe/Mn=88±81, Cr_2O_3=0.13±0.06 (wt%), n=20. low-Ca pyroxene $Fs_{3.1\pm2.7}Wo_{1.6\pm1.2}$, n=8; aluminous diopside $Fs_{1.1\pm0.0}Wo_{38.1\pm5.6}$, Al_2O_3=5.3±3.7 (wt%), n=2.

Classification: Carbonaceous chondrite CV3

Specimens: 22 g including a probe mount on deposit at *UNM*, Mendy Ouzillou holds 91.5 g, Su Lei holds the main mass.

Northwest Africa 12536 (NWA 12536)
(Northwest Africa)
Purchased: 2019 Jan

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Classification: Martian meteorite (Shergottite)
History: Purchased by Ben Hoefnagels in January 2019 from a Moroccan dealer.
Petrography: (A. Irving and S. Kuehner, *UWS*) Porphyritic texture. Phenocrysts of zoned olivine (up to 2 mm, containing tiny inclusions of chromite) are set in a relatively coarse grained groundmass composed mainly of twinned pigeonite and maskelynite together with minor orthopyroxene, Mg-bearing merrillite, ilmenite, chromite and pyrrhotite. Small pockets and cross-cutting veinlets of dark brown, glassy shock melt are present.
Geochemistry: Olivine (cores $Fa_{22.9\text{-}23.3}$, rim $Fa_{50.2}$, FeO/MnO = 49-53, N = 3), orthopyroxene ($Fs_{19.0}Wo_{2.4}$, FeO/MnO = 29), pigeonite ($Fs_{25.5\text{-}36.1}Wo_{6.8\text{-}10.2}$, FeO/MnO = 26-33, N = 4), maskleynite ($An_{57.2\text{-}66.7}Or_{0.7\text{-}0.4}$, N = 2).
Classification: Shergottite (olivine-phyric).
Specimens: 12.9 g including one polished thin section at *UWB*; remainder with Mr. B. Hoefnagels.

Northwest Africa 12537 (NWA 12537)
(Northwest Africa)
Purchased: 2018 Jul
Classification: HED achondrite (Eucrite, brecciated)
History: Purchased by Mbark Arjdal in July 2018 from an Algerian dealer.
Petrography: (A. Irving and S. Kuehner, *UWS*) Breccia composed of closely-packed eucrite clasts in a very sparse matrix (~2 vol.%). The clasts exhibit two very different textures: fine-grained ophitic and very fine-grained granulitic with larger pyroxene and plagioclase relics. Minerals are unexsolved pigeonite (of the same color in both lithologies), anorthite, silica polymorph, ilmenite and troilite.
Geochemistry: Pigeonite ($Fs_{51.4\text{-}53.0}Wo_{14.0\text{-}11.0}$, FeO/MnO = 32-35, N = 3), anorthite ($An_{90.6\text{-}90.8}Or_{0.4}$, N = 2).
Classification: Eucrite (genomict breccia).
Specimens: 7.3 g including one polished thin section at *UWB*; remainder with Mr. M. Arjdal.

Northwest Africa 12538 (NWA 12538)
(Northwest Africa)
Purchased: 2018 Nov
Classification: Ordinary chondrite (LL3)
History: Purchased by Ben Hoefnagels in November 2018 from a dealer in Agadir, Morocco.
Petrography: (A. Irving and S. Kuehner, *UWS*) Well-formed, closely packed chondrules (apparent diameter 740±410 µm, N = 23) are set in a fine grained matrix containing stained metal.
Geochemistry: Olivine ($Fa_{33.1\pm20.6}$ (1.7-59.4), Cr_2O_3 in ferroan examples 0.05-0.10 wt.%, mean 0.08±0.02 wt.%, N = 7), low-Ca pyroxene ($Fs_{10.7\pm8.1}$ (2.0-

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18.1)$Wo_{1.2\pm1.1}$ (0.2-2.4), N = 3), pigeonite ($Fs_{16.9}Wo_{17.5}$), diopside ($Fs_{2.7}Wo_{47.1}$). Magnetic susceptibility log χ (× 10^{-9} m^3/kg) = 3.54.
Classification: Ordinary chondrite (LL3).
Specimens: 20.4 g including one polished thin section at *UWB*; remainder with Mr. B. Hoefnagels.

Northwest Africa 12539 (NWA 12539)
Algeria
Purchased: 2018 Mar
Classification: HED achondrite (Diogenite)
History: Purportedly found in Algeria and purchased in Morocco in March 2018 by Lhcen Ouabicha and Zaid Sbitti.
Petrography: (A. Irving and S. Kuehner, *UWS*) Breccia composed predominantly of angular grains of orthopyroxene (exhibiting undulose extinction) with typical grain size 800 µm, together with accessory clinopyroxene, calcic plagioclase, silica polymorph, chromite and troilite set in a sparse finer grained matrix (~5 vol.%). No metal was observed.
Geochemistry: Orthopyroxene ($Fs_{23.6-23.7}Wo_{2.6-1.9}$, FeO/MnO = 30-32, N = 3), clinopyroxene ($Fs_{6.9-7.7}Wo_{46.4-45.7}$, FeO/MnO = 25-28, N = 2), plagioclase ($An_{81.1-82.6}Or_{0.3}$, N = 2).
Classification: Diogenite (breccia).
Specimens: 25.1 g including one polished thin section at *UWB*; remainder with L. Ouabicha and Z. Sbitti.

Northwest Africa 12540 (NWA 12540)
(Northwest Africa)
Purchased: 2018 Nov
Classification: HED achondrite (Eucrite, anomalous)
History: Purchased by Aziz Habibi in November 2018 from a Mauritanian dealer.
Petrography: (A. Irving and S. Kuehner, *UWS*; P. Carpenter, *WUSL*) Recrystallized breccia containing ~8 vol% (estimated from BSE imagery) of Fe-Ni metal (kamacite with taenite). Precursor angular grains of exsolved pigeonite and calcic plagioclase are discernible, but much of the plagioclase has been recrystallized into microgranular aggregates. Accessory phases include silica polymorph, ilmenite and troilite. Magnetic susceptibility log χ (× 10^{-9} m^3/kg) = 4.25 is more than one order of magnitude higher than in the usual eucrites (log χ (× 10^{-9} m^3/kg) = 2.95±0.30, n=70, Rochette et al. 2009) and in agreement with the observed metal content.
Geochemistry: Orthopyroxene host ($Fs_{46.3-48.8}Wo_{4.6-1.6}$, FeO/MnO = 25-26, N = 3), clinopyroxene exsolution lamellae ($Fs_{19.5-22.9}Wo_{42.7-38.8}$, FeO/MnO = 23-25, N = 3), plagioclase ($An_{88.3-89.8}Or_{0.3}$), kamacite (Ni = 4.3 wt.%), taenite (Ni = 51.0 wt.%). Oxygen isotopes (K. Ziegler, *UNM*): analyses of acid-washed subsamples by laser fluorination gave $\delta^{17}O$ 1.778, 1.909, 1.786; $\delta^{18}O$ 3.911, 4.120, 3.936; $\Delta^{17}O$ -0.287, -0.266, -0.292 per mil.

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Classification: Eucrite (anomalous, annealed metal-rich breccia). This specimen has an unusually high amount of Ni-bearing metal and also exhibits extensive post-brecciation annealing textures.
Specimens: 26.8 g including one polished thin section at *UWB*; remainder with Mr. A. Habibi.

Northwest Africa 12541 (NWA 12541)
(Northwest Africa)
Purchased: 2019 Feb
Classification: Ureilite
History: Purchased in February 2019 by Darryl Pitt from a Mauritanian dealer.
Petrography: (A. Irving and S. Kuehner, *UWS*) Protogranular aggregate (mean grain size 0.7 mm) of olivine and pigeonite with accessory blade-like grains of graphite. Olivine exhibits unusually narrow reduced, more magnesian marginal zones accompanied by tiny blebs of Fe metal.
Geochemistry: Olivine (cores $Fa_{15.5-15.6}$, N = 2; rim $Fa_{7.1}$), pigeonite ($Fs_{12.9-13.1}Wo_{9.4-9.3}$, N = 2).
Classification: Ureilite.
Specimens: 6.9 g in the form of a polished endcut at *UWB*; remainder with *DPitt*.

Northwest Africa 12542 (NWA 12542)
(Northwest Africa)
Purchased: 2019 Feb
Classification: Martian meteorite (Nakhlite)
History: Purchased by Ben Hoefnagels in February 2019 from Rachid Chaoui in partnership with a Mauritanian dealer.
Physical characteristics: A single fresh, black stone (1082 g) exhibiting oriented flow lines in remnant fusion crust on one side and portions of two other sides, and with small pits from desert wind ablation on other exterior surfaces.
Petrography: (A. Irving and S. Kuehner, *UWS*) Cumulate texture. Cumulus phases are larger grains of minimally zoned olivine (up to 2 mm) and chromian titanomagnetite (up to 1 mm) together with twinned, prismatic grains of augite (up to 2 mm long, with thin rims of ferroan augite). Intercumulus regions contain pyrrhotite, K-feldspar, intermediate plagioclase, ferrosilite, ferroan pigeonite, cruciform grains of titanomagnetite and very rare chlorapatite together with K-bearing glass. Secondary chlorophaeite-like material (orange in thin section) is present in some intercumulus regions and also filling fractures in olivine phenocrysts.
Geochemistry: Olivine ($Fa_{65.7-70.2}$, FeO/MnO = 50-55, N = 4), augite (cores $Fs_{22.8-28.9}Wo_{39.2-38.2}$, FeO/MnO = 34-37, N = 3; rim $Fs_{45.6}Wo_{40.2}$, FeO/MnO = 41), ferrosilite ($Fs_{54.9}Wo_{3.1}$, FeO/MnO = 36), ferroan pigeonite ($Fs_{65.2-66.1}Wo_{6.6-5.8}$, FeO/MnO = 23-28, N = 2), K-feldspar ($Or_{75.2}Ab_{23.6}An_{1.1}$), titanomagnetite ($Al_2O_3$ = 3.2 wt.%, Cr_2O_3 = 4.5 wt.%). Oxygen isotopes (K. Ziegler, *UNM*): analyses of acid-washed

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subsamples by laser fluorination gave $\delta^{17}O$ 3.133, 2.927, 2.950; $\delta^{18}O$ 5.463, 5.076, 5.096; $\Delta^{17}O$ 0.249, 0.247, 0.259 per mil.
Classification: Nakhlite.
Specimens: 20.6 g including one polished thin section at *UWB*; remainder with Mr. B. Hoefnagels.

Northwest Africa 12543 (NWA 12543)
Northwest Africa
Purchased: 2019
Classification: Primitive achondrite (Winonaite)
History: Reportedly found June 2018, purchased by Zuokai Ke in February 2019 from a Moroccan meteorite dealer.
Physical characteristics: Single stone, dark color, partial fusion crust on exterior. Saw-cut surfaces shows scattered fine-grained metal set in a mosaic of dark colored silicate minerals.
Petrography: (C. Agee, *UNM*) Microprobe examination of a polished mount shows a texturally equilibrated mosaic of forsterite, enstatite, and diopside with grain size in the range 100-300 µm, many triple junctions are present. Fe-Ni metal makes up approximately 5-10% of this meteorite, most grains are 100-300 µm in diameter, there are also fine veinlets of metal or Fe-oxide throughout. No feldspar was observed.
Geochemistry: (C. Agee *UNM*) Forsterite $Fa_{0.6\pm0.1}$, Fe/Mn=4±1, n=6; enstatite $Fs_{1.1\pm0.2}Wo_{1.8\pm0.2}$, Fe/Mn=2±0, n=3; diopside $Fs_{1.0\pm0.6}Wo_{47.0\pm0.6}$, Fe/Mn=2±1, n=3. Oxygen isotopes (K. Ziegler, *UNM*): 3 acid-washed fragments analyzed by laser fluorination gave $\delta^{18}O$=4.662, 5.118, 5.583; $\delta^{17}O$=1.88, 2.12, 2.345; $\Delta^{17}O$=-0.582, -0.582, -0.603 (linearized, all per mil, TFL slope=0.528).
Classification: Primitive achondrite (winonaite) based on presence of near-end member magnesian silicates and oxygen isotope values that coincide with the winonaite field.
Specimens: 24 g including a probe mount on deposit at *UNM*, Zuokai Ke holds the main mass.

Northwest Africa 12544 (NWA 12544)
Morocco
Purchased: 2016
Classification: Ordinary chondrite (L4)
History: Bought in Hamburg from a dealer from NWA.
Physical characteristics: Elongated blocky Individual with dark brown leathery fusion crust.
Petrography: (J. Gattacceca, *CEREGE*) Chondrite with well-delineated packed chondrules, with average apparent size about 700 µm.
Geochemistry: Olivine $Fa_{24.3\pm0.4}$ (n=6). Low-Ca pyroxene $Fs_{20.9\pm0.3}Wo_{1.1\pm0.1}$ (n=7).
Classification: Ordinary chondrite (L4).

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Specimens: Type specimen at *CEREGE*. Main mass with Andreas *Gren*.

Northwest Africa 12545 (NWA 12545)
Morocco
Find: 2018
Classification: Primitive achondrite (Brachinite)
History: The stone was purchased in Agadir in 2018.
Physical characteristics: A single light brown stone with cracks and without fusion crust. Cut face shows a homogeneous dark interior with small crystals.
Petrography: (J. Gattacceca, *CEREGE*) Dunitic rock with equigranular texture. Olivine, with typical size 250 µm, is the ultradominant mineral (about 90 vol%). Other minerals are Ca-pyroxene, chromite (to 200 µm). Symplectic associations of iron oxi-hydroxides (from weathering of primary metal) and orthopyroxene (10 µm) are found along grain boundaries. Most metal and sulfide are weathered. Metal survives in the form of grains to 20 µm in the silicates. No plagioclase was found.
Geochemistry: Olivine $Fa_{29.3\pm0.3}$, Fe/Mn=57.5±4.7 (n=4), Ca-pyroxene $Fs_{10.9\pm0.2}Wo_{45.1\pm0.5}$, Fe/Mn=51.0±17.5 (n=6), low-Ca pyroxene $Fs_{26.2}Wo_{1.1}$ (n=1), chromite Cr#=0.74.
Classification: Achondrite (brachinite). Likely paired with NWA 7904, NWA 10637, and NWA 11756.
Specimens: Type specimen at *CEREGE*. Main mass with Jean Redelsperger.

Northwest Africa 12546 (NWA 12546)
Chwichiva, Morocco
Find: 2018 Sep
Classification: Ordinary chondrite (LL7)
History: Found in september 2018 by Hammo Oulguirah. Bought in Agadir from finder.
Physical characteristics: Crusted stone with light grey interior.
Petrography: (J. Gattacceca, *CEREGE*) Highly recrystallized and brecciated chondrite. No relict chondrules was observed in the ~1 cm2 studied polished section. Plagioclase typical size 100 µm. Opaque minerals are Fe,Ni metal (mostyl under the form of zoned taenite), FeS, chromite.
Geochemistry: Plagioclase $An_{10.2\pm0.2}Ab_{86.2\pm0.4}Or_{3.7\pm0.2}$ (n=3). Chromite Cr#=0.87.
Classification: Ordinary chondrite (LL7). Type 7 from the texture, absence of chondrules, Wo content of orthopyroxene.
Specimens: Type specimen at *CEREGE*. Main mass with Jean Redelsperger.

Northwest Africa 12547 (NWA 12547)
Morocco
Purchased: 2019 Jan
Classification: Ordinary chondrite (L3, melt breccia)

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History: Purchased in Essaouira in January 2019
Petrography: (J. Gattacceca, *CEREGE*) Melt breccia with chondritic clasts supported by a melt rock matrix. Chondritic clasts are unequilibrated, matrix poor, metal rich. Chondrules average apparent size 830 µm (n=19).
Geochemistry: Olivine $Fa_{10.7\pm9.4}$, Fa PMD 79%, range $Fa_{0.7\text{-}25.5}$ (n=7), Cr_2O_3 0.09±0.08 wt% (n=6). Low-Ca pyroxene $Fs_{12.3\pm7.9}Wo_{1.1\pm1.5}$ (n=6).
Classification: Ordinary chondrite (L3-melt breccia). L group from magnetic susceptibility and chondrule size.
Specimens: Type specimen at *CEREGE*. 0.73 g at *ULB*. Main mass with *Kuntz*.

Northwest Africa 12548 (NWA 12548)
Mauritania
Purchased: 2019 Jan
Classification: Ordinary chondrite (H3)
History: Purchased in Zagora in January 2019
Petrography: (J. Gattacceca, *CEREGE*) Chondrite with packed, well-delineated chondrules, with average apparent diameter 380 µm (n=19). Opaque minerals are Fe,Ni metal and Fes.
Geochemistry: Olivine $Fa_{17.6\pm8.0}$, range $Fa_{0.8\text{-}25.7}$, Fa PMD 34% (n=11), Cr_2O_3 in ferroan olivine 0.11±0.21 (n=9). Low-Ca pyroxene $Fs_{18.2\pm1.2}Wo_{2.0\pm0.8}$ (n=6).
Classification: Ordinary chondrite (H3). H group from magnetic susceptibility and chondrule size.
Specimens: Type specimen at *CEREGE*. Main mass with *Kuntz*.

Northwest Africa 12549 (NWA 12549)
Morocco
Purchased: 2019 Jan
Classification: Ordinary chondrite (LL3)
History: Purchased in Zagora in January 2019
Petrography: (J. Gattacceca, *CEREGE*) Chondrite with packed, well-delineated chondrules. Opaque minerals are Fe,Ni metal and FeS.
Geochemistry: Olivine $Fa_{19.9\pm8.8}$, Fa PMD 40%, range $Fa_{9.0\text{-}35.8}$, Cr_2O_3 0.06±0.04 wt% (n=15). Low-Ca pyroxene $Fs_{5.9\pm1.0}Wo_{0.4\pm0.1}$ (n=4).
Classification: Ordinary chondrite (LL3). LL group from magnetic susceptibility.
Specimens: Type specimen at *CEREGE*. Main mass with *Kuntz*.

Northwest Africa 12550 (NWA 12550)
Morocco
Purchased: 2019 Jan
Classification: Martian meteorite (Shergottite)
History: Purchased in Essaouira in January 2019

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Physical characteristics: Single stone, 70% covered by fusion crust. Cut surface reveals a fine grained dark green interior.
Petrography: (J. Gattacceca, *CEREGE*) Crystalline rock with doleritic texture. Pyroxenes (typical size 200 µm, strongly zoned) are set in maskelynite (150 µm). Other minerals: Fe sulfide, ilmenite (30 µm).
Geochemistry: Pyroxene $Fs_{39.3\pm11.3}Wo_{18.8\pm6.2}$, range $Fs_{28.2\text{-}63.1}$, Fe/Mn=33.5±2.3 (n=11). Maskelynite $An_{52.2\pm0.9}Ab_{46.5\pm0.7}Or_{1.3\pm0.2}$ (n=3). Magnetic susceptibility log χ ($\times 10^{-9}$ m^3/kg) = 3.46.
Classification: Martian meteorite (Shergottite)
Specimens: Type specimen at *CEREGE*. 0.73 g at *ULB*. Main mass with *Kuntz*.

Northwest Africa 12551 (NWA 12551)
Morocco
Purchased: 2019 Jan
Classification: Rumuruti chondrite (R3)
History: Purchased in Zagora in January 2019
Physical characteristics: 29 stones ranging from 1.1 to 82.8 g. Cut surface reveals dark interior with small chondrules set in abundant dark matrix.
Petrography: (J. Gattacceca, *CEREGE*) Chondrite with small chondrules set in abundant matrix. Sulfides are abundant.
Geochemistry: Olivine $Fa_{30.8\pm10.8}$, Fa PMD 31%, range $Fa_{13.8\text{-}41.3}$, NiO 0.15±0.07 wt%. Low-Ca pyroxene $Fs_{30.8}Wo_{1.5}$ (n=1).
Classification: Rumuruti chondrite (R3)
Specimens: Type specimen at *CEREGE*. Main mass with *Kuntz*.

Northwest Africa 12552 (NWA 12552)
Mauritania
Purchased: 2019 Jan
Classification: Ordinary chondrite (H6, melt breccia)
History: Purchased in Nouakchott in January 2019
Physical characteristics: 8 stones ranging from 45 to 209g.
Petrography: (J. Gattacceca, *CEREGE*) Highly shocked and partialy molten type 6 chondritic clasts containing fizzed metal and troilite grains set in a melt rock matrix containing abundant eutectic assemblages of sulfide and metal.
Classification: Ordinary chondrite (H6-melt breccia)
Specimens: Type specimen at *CEREGE*. Main mass with *Kuntz*.

Northwest Africa 12553 (NWA 12553)
Morocco
Purchased: 2019 Jan
Classification: Carbonaceous chondrite (CV3)

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Petrography: (J. Gattacceca, *CEREGE*) Chondrite with large chondrules (~mm) and CAIs set in an abundant fine-grined iron-rich matrix. Opaque minerals are Fe,Ni metal, sulfide, magnetite.
Geochemistry: Olivine 17.2±16.1 (n=6). Low-Ca pyroxene $Fs_{4.4}Wo_{3.4}$ (n=2). Defocused (10 µm) microprobe total in the matrix is 95.8% (n=2).
Classification: Carbonaceous chondrite (CV3)
Specimens: Type specimen at *CEREGE*. Main mass with *Kuntz*.

Northwest Africa 12554 (NWA 12554)
Morocco
Purchased: 2019 Jan
Classification: Carbonaceous chondrite (CV3)
Petrography: (J. Gattacceca, *CEREGE*) Chondrite with large chondrules (~mm) and CAIs set in an abundant fine-grined iron-rich matrix. Opaque minerals are sulfide, magnetite, rare metal.
Geochemistry: Olivine 13.3±13.5 (n=6). Low-Ca pyroxene $Fs_{1.4}Wo_{1.2}$ (n=1). Defocused (10 µm) microprobe total in the matrix is 96.8% (n=2).
Classification: Carbonaceous chondrite (CV3)
Specimens: Type specimen at *CEREGE*. Main mass with *Kuntz*.

Northwest Africa 12562 (NWA 12562)
Algeria
Find: 2017
Classification: Ungrouped achondrite
History: A single stone (3930 g), reportedly found in Algeria in 2017, was purchased in Chenzhou, China, by Zuokai Ke in May 2018.
Physical characteristics: Single stone, with a small patch of fusion crust. The surface reveals a fragmental breccia with coarse cream-colored to pale-green grains up to 1 cm in size, crosscut by fine dark veinlets and surrounded by finer-grained light to dark-gray material. Some small clasts are stained by oxidation.
Petrography: (X. Gu, *CSUC*) The meteorite is composed of brecciated fragments of olivine (85%), pyroxene (8%), and plagioclase (5%), with accessory phases troilite (1%), tridymite (0.4%), chromite(0.3%), and kamacite and taenite (0.2%). The rock-forming minerals are euhedral with grain size generally between 100-800 µm, with some up to several mm. Grains are unzoned. Some material is brecciated to fragments of 10-50 µm. Vermicular chromite-pyroxene symplectites and exsolution lamellae of orthopyroxene-augite are common. Trace alkali feldspar, schreibersite, pentlandite, merrillite, fluorapatite, and ilmenite are observed.
Geochemistry: (X. Gu, *CSUC*) Plagioclase $An_{2.6-84.6}Or_{0.2-4.7}Ab_{14.8-92.8}$ (average: $An_{60.6\pm24.8}Or_{1.6\pm1.8}Ab_{37.8\pm23.7}$, n=85); olivine $Fa_{7.3-94.1}$ (average $Fa_{17.8\pm24.0}$, n=137), Fe/Mn=33.9-64.2 (average=42.9±6.9); low-Ca pyroxene $Fs_{8.0-68.0}Wo_{1.3-8.5}$ (average $Fs_{29.5\pm16.4}Wo_{3.5\pm1.6}$, n=78), Fe/Mn=21.5-35.6 (average=30.5±2.8); high-Ca pyroxene $Fs_{3.1-65.9}Wo_{9.0-47.2}$ (average $Fs_{28.4\pm17.4}Wo_{36.5\pm10.0}$, n=42). (Z. Vaci, *UNM*) Olivine

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$Fa_{17.0\pm11.6}$, Fe/Mn=40±3, n=63; low-Ca pyroxene $Fs_{27.3\pm10.4}Wo_{4.1\pm2.4}$, Fe/Mn=28±1, n=17; high-Ca pyroxene $Fs_{37.9\pm9.6}Wo_{8.3\pm6.1}$, Fe/Mn=27±2, n=7, chromite Al_2O_3=7.2±4.8, Cr_2O_3=58.4±6.0, MgO=5.0±1.1, MnO=0.7±0.1, FeO=25.7±2.1 TiO_2=0.7±0.4 (wt%), n=6. Oxygen isotopes (K. Ziegler, *UNM*): 3 acid-washed fragments analyzed by laser fluorination gave $\delta^{18}O$= 3.477, 3.492, 3.795; $\delta^{17}O$= 1.609, 1.619, 1.788; $\Delta^{17}O$= -0.227, -0.225, -0.216 (linearized, all per mil, TFL slope=0.528).

Classification: Ungrouped achondrite, dunite breccia. This meteorite is possibly a polymict breccia in that the dominant mineral fragments are mostly unzoned, but when individually sampled by microprobe analysis display a wide compositional range. The oxygen isotope values of this meteorite plot slightly higher than the eucrite fractionation line (EFL) and are also in the vicinity of the brachinites. The Fe/Mn of this meteorite is somewhat lower than found in HEDs and much lower than in angrites. Unlike most HEDs, it contains alkali feldspar and a wide range of plagioclase compositions. The range in olivine composition in this meteorite is much larger than found in the brachinites and it has much lower Fe/Mn than brachinites. Its mineralogy, oxygen isotopic composition, and secondary features such as Cr-symplectites are similar to the ungrouped dunitic achondrite NWA 12217, but its minerals show a much greater range in major element composition. It is also more extensively brecciated, with heavy fracturing and clast size ranging from µm to cm scale.

Specimens: 21 g including a probe mount on deposit at *UNM*, Zuokai Ke holds the main mass.

Northwest Africa 12563 (NWA 12563)

(Northwest Africa)

Purchased: 2015 May

Classification: Carbonaceous chondrite (CM2, anomalous)

History: Purchased in Agadir, with no details on provenance.

Physical characteristics: A 13g stone with a very fractured surface and one face covered with a highly vesicular fusion crust.

Petrography: (R. Hewins, S. Pont, *MNHNP*; P.-M. Vanetta, Univ. Lille) The chondrite consists of 14% chondrules and chondrule fragments, and 86% fine-grained matrix. Chondrules are Types IA, IAB and IIA. Rare refractory inclusions are partly altered spinel-rich CAI, and AOA. Metal and glass are almost totally altered, and pyroxene is partly altered. The matrix contains amorphous silicate, serpentine and chlorite; magnetite occurs as spherules, framboids and plaquettes; troilite and pentlandite in rosettes. There are some carbonate patches, but TCI are absent.

Geochemistry: Mineral compositions and geochemistry: (R. Hewins, S. Pont, *MNHNP*, P.-M. Zanetta, Univ. Lille) The average olivine of Type I chondrules is $Fo_{99.0}$ with Fe correlating with Cr and Mn. Type IAB chondrule and isolated pyroxene is generally $En_{98-94}Fs_{1-4}Wo_{1-2.}$ Type II olivine has a composition range of $Fo_{84-44.}$ Phyllosilicates are Al-rich (chlorite) and Al-poor (serpentine). The bulk

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oxygen isotopic composition (J. Gattacceca, C. Sonzogni, *CEREGE*) from analysis of one acid-washed 1.5 mg aliquot of a powdered 20 mg bulk sample: $\delta^{17}O$=4.26‰, $\delta^{18}O$=12.61‰ , $\Delta^{17}O$=-1.33‰ (linearized, slope 0.5247, analytical uncertainties 0.08‰, 0.12‰, 0.03‰ respectively), close to Essebi. Magnetic properties (J. Gattacceca, *CEREGE*) : magnetic susceptiblity log χ ($\times 10^{-9}$ m^3/kg) = 4.67 is close to the values for Bells and Essebi, C2-ungrouped, at 4.82 and 4.85, respectively. Saturation magnetization indicates 6.8 wt % of magnetite.

Classification: CM2-anomalous. Though this meteorite has chondrule and matrix abundances like CMs, its alteration minerals are different: serpentine, abundant chlorite and abundant magnetite, not serpentine, cronstedtite and tochilinite, and it is possible that it is an ungrouped carbonaceous chondrite. Chlorite is found in CR alteration, but is very minor in CMs. The meteorite lacks TCI intergrowths, yet has fresh olivine. The magnetite content of 6.8 wt. % (derived from saturation magnetization Ms=6.26 Am^2/kg) is 6 times higher than the average for CM chondrites that have Ms=1.14±0.56 Am^2/kg. The magnetic susceptibility is close to the values for Bells and Essebi, and higher than all except 4 of 52 chondrites classified as CM chondrites (Rochette et al., 2008). The oxygen isotopic composition plots at the upper end of the CO-CM trend line very close to Essebi.

Specimens: The main mass is held by *Labenne*. The type specimen is at *MNHNP*.

Northwest Africa 12564 (NWA 12564)

(Northwest Africa)

Purchased: 2019 Feb

Classification: Martian meteorite (Shergottite)

History: Purportedly found in Mauritania and purchased in February 2019 by Jaouad Chaoui and Rachid Chaoui from a Mauritanian dealer.

Petrography: (A. Irving and S. Kuehner, *UWS*) Diabasic texture (mean grainsize ~1 mm). Composed predominantly of complexly-zoned clinopyroxene and maskelynite with accessory titanomagnetite, ilmenite, chlorapatite, merrillite, and pyrrhotite. Myrmekitic intergrowths consisting of silica polymorph + relatively sodic plagioclase are associated with more calcic maskelynite and regions of K-rich glass containing blebs of pyrrhotite are also present.

Geochemistry: Subcalcic augite ($Fs_{22.5-48.6}Wo_{32.2-25.4}$, FeO/MnO = 30-36, N = 3), ferropigeonite ($Fs_{65.5}Wo_{15.9}$, FeO/MnO = 39), large maskelynite grains ($An_{48.6-53.0}Or_{2.3-2.0}$, N = 2), plagioclase in intergrowth with silica polymorph ($An_{34.0}Ab_{62.4}Or_{3.6}$).

Classification: Shergottite (aphyric, diabasic).

Specimens: 26.5 g including one polished thin section at *UWB*; remainder held jointly by J. Chaoui and R. Chaoui.

Northwest Africa 12565 (NWA 12565)

Morocco

Purchased: 2012

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Classification: Carbonaceous chondrite (CV3)

History: Purchased by David *DGregory* in Tucson, 2012. Catalogued at *ROM* as LM57457

Physical characteristics: Physical Characteristics: Specimen is a 143.7 g light-brown, sub-spherical stone with a thin, glassy fusion crust. On the exposed cut surface, multiple oxidized fractures visibly cross-cut the varying proportions of chondritic material. Few of the larger, mm-sized chondrules have oxidation rims.

Petrography: Specimen contains varying proportions of mm-sized chondrules with igneous rims (avg: 0.95±0.33 mm, n=70), calcium- and aluminum-rich inclusions (CAIs) and sub-mm mineral fragments set in an opaque and crystalline matrix. Chondrules are primarily magnesian, porphyritic, and contain forsterite and low-Ca pyroxene phenocrysts surrounded by feldspathic glass and relatively low amounts of Fe-Ni metal. Modal percentage of components is ~30% for chondrules, ~20% for CAIs, 4.5% for Fe-oxides and remaining is feldspathic glass. Specimen is weakly shocked (S3), determined by presence of intersecting sets of irregular fractures in olivine crystals, undulatory extinction in olivines and pyroxenes, and melt pockets. Minor oxide rims present around metal in chondrules, and small, irregular oxide veins occur throughout the chondritic components, indicative of minor weathering.

Geochemistry: Forsterite in chondrules has a mean composition of $Fa_{3.8\pm3.8}$, n=53. Specimen exhibits chemistry from generally Mg-rich cores progressing to more Fe-rich rims. Individual forsterite grains also exhibit chemical heterogeneity, characterized by Mg-rich forsterite cores with progressive Fe enrichment near grain boundaries. Pyroxene in chondrules has a composition of $Fs_{3.4\pm18.5}Wo_{15.8\pm5.7}$, n=73. Pyroxene in chondrules and individual phenocrysts exhibit chemical heterogeneity from relatively Mg-rich cores progressing to Fe enrichment at the boundaries. Metal droplets have taenite Ni content 47.5±2.7). Secondary grains are composed primarily of olivine and pyroxene, and trace amounts of plagioclase. Oxygen isotopes (K. Ziegler, UNM): acid-treated powders gave an average of $\delta^{17}O$=-2.240 ‰; $\delta^{18}O$=2.697 ‰; $\Delta^{17}O$=-3.664 ‰ (N=3).

Classification: Carbonaceous chondrite (CV3). O isotopes plot on a single trend near the CCAM trend line and fall within the CV group. Petrologic type 3 determined by chemical heterogeneity exhibited in olivine and pyroxene-group minerals in chondrules, which have greater than 5% mean deviations, expected for a highly unequilibrated chondrite. Additional characteristics indicative of a type 3 chondrite includes high proportions of monoclinic low-Ca pyroxene phenocrysts in the chondrules, absence of optically resolvable feldspar grains, and taenite Ni content. Chondrules are sharply defined, and the matrix is opaque.

Specimens: The *ROM* holds the main mass of the sample which weighs 143.17 g. The remaining specimen is composed of two fragments, thin section and a thin section billet.

Northwest Africa 12566 (NWA 12566)

Mauritania

Purchased: 2018

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Classification: Mesosiderite-C3

History: Reportedly found in Mauritania near Zouérat.

Physical characteristics: Single stone with dark fusion crust. Saw cut reveals an approximately equal mix of metal and silicate grains and clasts. Some metal and silicate grains are up to ~3 mm in size.

Petrography: (C. Agee, *UNM*) Microprobe examination of a polished mount detected primarily pyroxene and olivine; with minor amounts of plagioclase, Cr-rich spinel, and troilite. Metal consists of kamacite and taenite. No significant brecciation observed.

Geochemistry: (C. Agee, *UNM*) Olivine $Fa_{14.1\pm0.3}$, Fe/Mn=40±2, n=11; low-Ca pyroxene $Fs_{12.7\pm0.2}Wo_{3.0\pm0.2}$, Fe/Mn=24±2, n=10; high-Ca pyroxene $Fs_{5.6\pm0.1}Wo_{44.0\pm0.2}$, Fe/Mn=17±1, n=2; plagioclase $An_{83.3\pm0.7}Ab_{16.0\pm0.7}Or_{0.6\pm0.1}$, n=3; kamacite Fe=91.9±1.6, Ni=8.0±1.8 (wt%), n=4; taenite Fe=66.3, Ni=33.7 (wt%), n=1. Oxygen isotopes (K. Ziegler, *UNM*): 2 acid-washed fragments analyzed by laser fluorination gave $\delta^{18}O$= 3.209, 3.132; $\delta^{17}O$= 1.478, 1.425; $\Delta^{17}O$=-0.216, -0.229 (linearized, all per mil, TFL slope=0.528).

Classification: Mesosiderite-C3. Presence of olivine and only minor amounts of plagioclase is consistent with group C. Segregated metal, presence of some texturally and chemically equilibrated silicates, and absence of brecciation consistent with type 3.

Specimens: 24 g including a probe mount on deposit at *UNM*, Didi Badari holds the main mass.

Northwest Africa 12567 (NWA 12567)

(Northwest Africa)

Purchased: May 2017

Classification: Carbonaceous chondrite (CK5)

Petrography: This meteorite consists of fine-grained matrix (75 vol%), poorly defined chondrules (average apparent diameter 910±320 µm, n=14), low-Ca pyroxene grains, and plagioclase. No CAIs were observed. Metal, troilite and abundant Cr-rich magnetite are present in the matrix.

Geochemistry: Olivine $Fa_{25.0\text{-}26.6}$; Pyroxene $Fs_{18.3\text{-}19.8}$, $Wo_{0.4\text{-}1.3}$ (EPMA); Plagioclase $An_{17.5\text{-}22.3}$, $Or_{3.2\text{-}5.2}$ (EDAX).

Northwest Africa 12569 (NWA 12569)

(Northwest Africa)

Purchased: 2017 May

Classification: HED achondrite (Eucrite)

Petrography: Breccia with coarse-grained clasts in a finer-grained matrix. The matrix shows a doleritic texture. The size of pyroxene in the clasts is up to 2.4 mm while those in fine-grained matrix is up to 1.8 mm. The dominant minerals of the meteorite are plagioclase and pyroxene. Accessory mineral includes chromite,

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troilite and metal. Exsolution of the high calcium pyroxene from the low calcium pyroxene can be also observed.
Geochemistry: Low-Ca pyroxene $Fs_{59.5\pm0.9}$, $Wo_{3.1\pm1.3}$, n=7, FeO/MnO=34.0±6.7, n=10; High-Ca pyroxene $Fs_{27.6\pm3.5}Wo_{42.7\pm3.4}$, n=5; Plagioclase $An_{85.4\pm4.5}$, n=7 (EDAX).

Northwest Africa 12570 (NWA 12570)
(Northwest Africa)
Purchased: 2017 May
Classification: HED achondrite (Eucrite)
Petrography: The meteorite mainly consists of pyroxene, plagioclase, silica, metal and troilite. The matrix shows a doleritic texture, in which two types of clasts can be observed. The size of pyroxene in coarse-grained clast is up to 1.8mm while those in finer-grained clasts is up to 1.4 mm. Exsolved pyroxene can be also observed. The silica polymorph (5 vol%) is mainly present in the fine-grained clasts.
Geochemistry: Low-Ca pyroxene $Fs_{63.3\pm1.2}Wo_{2.2\pm1.0}$, FeO/MnO=33.9±1.3, n=4; High-Ca pyroxene $Fs_{28.9\pm1.5}Wo_{43.2\pm1.4}$, Fe/Mn=34.2±3.0, n=4; (EPMA).

Northwest Africa 12571 (NWA 12571)
(Northwest Africa)
Purchased: 2017 May
Classification: HED achondrite (Eucrite)
Petrography: The meteorite shows an igneous texture. The dominant mineral of the meteorite is plagioclase along with coarse pyroxene (up to 4.7 mm).
Geochemistry: Low-Ca pyroxene $Fs_{59.7\pm2.3}Wo_{3.7\pm2.1}$, n=6, FeO/MnO=37.0±4.7, n=10; High-Ca pyroxene $Fs_{27.5\pm3.7}Wo_{42.2\pm5.0}$, n=7; Plagioclase $An_{88.1\pm4.9}$, n=6 (EDAX).

Northwest Africa 12573 (NWA 12573)
(Northwest Africa)
Purchased: 2018 Oct
Classification: Primitive achondrite (Brachinite)
Petrography: The meteorite shows an equilibrated texture with triple junctions. The dominant minerals of the meteorite are olivine (grain size 0.46-1.00 mm) and pyroxene (grain size 0.26-0.53 mm). Accessory minerals include plagioclase (grain size 0.12-0.29 mm), troilite and metal.
Geochemistry: Olivine $Fa_{34.4\text{-}36.0}$, FeO/MnO=76.8-110.8, N=19; Pyroxene $Fs_{28.3\text{-}29.9}Wo_{3.1\text{-}4.3}$, FeO/MnO=50.2-69.0, N=8; Plagioclase $An_{47.1\text{-}49.3}$ (EPMA).

Northwest Africa 12574 (NWA 12574)
(Northwest Africa)

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Purchased: 2013
Classification: Ordinary chondrite (L5)

History: Reportedly found near Ait' Hani in May 2012 by Mustapha Oulkouch, purchased by Dustin Dickens in September 2013 at Goulmima, Morocco, later purchased by Topher Spinnato on January 19, 2019.

Physical characteristics: Single stone, dark brown, desert weathered exterior; one side shows smoothed entry orientation. Saw-cut surfaces show numerous chondrules set in a dark brown to reddish-brown groundmass.

Petrography: (C. Agee, *UNM*) Microprobe examination of a polished mount shows mostly porphyritic chondrules set in a recrystallized groundmass; some chondrules are fragmental. Plagioclase grains are ubiquitous with sizes up to 25 µm in diameter. Pervasive Fe-oxide veinlets throughout.

Geochemistry: (C. Agee *UNM*) Olivine $Fa_{23.9\pm0.4}$, Fe/Mn=49±2, n=23; low-Ca pyroxene $Fs_{20.2\pm0.2}Wo_{1.2\pm0.2}$, Fe/Mn=28±1, n=11.

Classification: Ordinary chondrite L5

Specimens: 23.75 g including a probe mount on deposit at *UNM*, Topher Spinnato holds the main mass.

Northwest Africa 12575 (NWA 12575)
(Northwest Africa)
Purchased: July 2016
Classification: Ordinary chondrite (LL6)

Petrography: Chondrules poorly defined. Feldspar grains mostly 30-90 µm.

Geochemistry: Oxygen isotopic composition measured by R. C. Greenwood (*OU*): $\delta^{17}O = 4.029$, $\delta^{18}O = 5.479$, $\Delta^{17}O = 1.180$ (all per mil).

Northwest Africa 12576 (NWA 12576)
(Northwest Africa)
Purchased: November 2016
Classification: Ordinary chondrite (LL6)

Petrography: Chondrules poorly defined. Feldspar grains mostly 30-100 µm.

Geochemistry: Oxygen isotopic composition measured by R. Greenwood (*OU*): $\delta^{17}O = 4.275$, $\delta^{18}O = 6.039$, $\Delta^{17}O = 1.135$ (all per mil).

Northwest Africa 12577 (NWA 12577)
(Northwest Africa)
Purchased: 2018 Sep
Classification: Ordinary chondrite (L4)

Petrography: (K. Metzler, *IfP*) Ordinary chondrite consisting of well-preserved chondrules of all main chondrule types, (mostly oxidized) metal, and small amounts (~10 vol%) of interchondrule matrix.

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Geochemistry: Mineral compositions and geochemistry: The mean olivine composition is $Fa_{23.0\pm0.3}$ ($Fa_{22.1-23.6}$; n=16). The mean low-Ca pyroxene composition is $Fs_{18.6\pm3.8}Wo_{1.5\pm1.1}$ ($Fs_{12.0-28.5}Wo_{0.5-3.8}$; n=14).
Classification: L chondrite based on olivine chemistry. Petrologic type 4 based on the equilibrated state of olivine and unequilibrated state of low-Ca pyroxene.

Northwest Africa 12578 (NWA 12578)
Morocco
Purchased: 2018 Apr
Classification: Ordinary chondrite (LL6)
History: One fresh-looking crusted piece was purchased in Zagora, Morocco, by Sergey Vasiliev from a Moroccan meteorite dealer in April 2018. After purchase, the piece was broken into 2 pieces.
Physical characteristics: Total mass of one piece is about 415 g. Fusion crust is partially preserved. The interior of the meteorite is greenish gray whereas surface is dark brown.
Petrography: (Pavel Yu. Plechov, *FMMR*). Olivine and Low-Ca pyroxene are equilibrated and chondrules are indistinct or absent. Rare relics of barred-olivine chondrules have size from 500 to 700 µm. Low-Ca Px grains have rounded shape (size 150-250 µm) and very uniform composition (about Fs_{25}). Metal consists of kamacite and taenite (with 44-45 wt.% Ni). Plagioclase grains ($An_{10.6}$) are about 50 µm or more. These features indicate petrological type 6 for the meteorite. Olivine has no undulatory extinction, and the absence of opaque shock veins and melt pockets indicates a shock stage of S1. Olivine, pyroxene and metal are fresh and unweathered (weathering grade W0).
Geochemistry: Mineral composition and Geochemistry: EDS-WDS analyses (Pavel Yu. Plechov, *FMMR*). The primary chondrite paragenesis includes olivine $Fa_{30.59\pm0.22}$ (N=20), orthopyroxene $Fs_{24.9\pm0.4}Wo_{2.34\pm0.14}$ (N=18), plagioclase $Ab_{84.7}An_{10.6}Or_{4.3}$ (N=8), Cr-bearing clinopyroxene $En_{46.0}Fs_{10.8}Wo_{43.1}$ (N=5), chromite $Crt_{77.9}Spl_{8.9}$ (N=4). Phosphates are both Cl-apatite and merrillite. Composition of kamacite (in wt.%, N=3): Fe 88.8, Ni 4.2, Co 7.0 (measured by WDS). Taenite (N=2) contain 44.5 and 2.1 wt.% of Ni and Co respectively. Troilite is close to ideal FeS.
Classification: Ordinary chondrite. LL6, S1, W0.
Specimens: Sergey Vasiliev holds one piece about 240 g. Another piece (166 g) and thin section, *FMMR*.

Northwest Africa 12581 (NWA 12581)
Morocco
Purchased: 2018 March
Classification: Ordinary chondrite (LL3.10)
Physical characteristics: Brownish stone. Cut surface reveals brown interior.

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Petrography: (J. Gattacceca, *CEREGE*) Chondrite with packed well defined chondrules (average apparent diameter 880±630 µm, n=33) with devitrified mesostatis.
Geochemistry: Olivine $Fa_{12.1\pm8.0}$ (n=19), PMD 57% (n=15), Cr_2O_3 in ferroan olivine 0.28±0.18 wt% (n=15). Low-Ca pyroxene $Fs_{14.5\pm13.6}Wo_{1.0\pm0.8}$ (n=6).
Classification: Ordinary chondrite (LL3.10). LL group based on magnetic susceptibility. Sub-type from the Cr_2O_3 content of ferran olivine.
Specimens: Type specimen at *CEREGE*. Main mass with *Kuntz*.

Northwest Africa 12582 (NWA 12582)
Morocco
Purchased: 2019 Jan
Classification: Ordinary chondrite (LL4)
Petrography: (J. Gattacceca, *CEREGE*) Chondrite with well-delineated packed chondrules. Opaques are metal and sulfides.
Geochemistry: Olivine $Fa_{27.4\pm1.5}$, PMD 4.1%, Cr_2O_3 0.02 wt% (n=5). Low-Ca pyroxene $Fs_{17.3\pm4.5}Wo_{1.3\pm1.2}$, Fs PMD 24% (n=7).

Northwest Africa 12585 (NWA 12585)
Morocco
Purchased: 2018 Feb
Classification: Ordinary chondrite (LL3)
Physical characteristics: Crusted stone. Cut surface reveals dark interior with fresh metal.
Petrography: (J. Gattacceca, *CEREGE*) Chondrite with packed well-delinetaed chondrules. Opaques are metal and troilite.
Geochemistry: Olivine $Fa_{22.2\pm4.1}$, PMD 16%, Cr_2O_3 0.05 (n=5). Low-Ca pyroxene $Fs_{12.0\pm8.9}Wo_{1.6\pm1.8.}$
Classification: Ordinary chondrite (LL3). LL group based on magnetic susceptibility.

Northwest Africa 12586 (NWA 12586)
Morocco
Purchased: 2017 Dec
Classification: Ordinary chondrite (LL3)
Physical characteristics: Crusted stone. Cut surface reveals dark interior
Petrography: (J. Gattacceca, *CEREGE*) Chondrite with packed well-delinetaed chondrules. Opaques are metal and troilite. Contains a 3 × 3 mm clast made of matrix exclusively.
Geochemistry: Olivine $Fa_{21.9\pm7.0}$, PMD 28%, Cr_2O_3 0.053±0.069 wt% (n=12). Low-Ca pyroxene $Fs_{15.4\pm8.8}Wo_{1.3\pm1.0}$ (n=9).

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Classification: Ordinary chondrite (LL3). LL group based on magnetic susceptibility.

Northwest Africa 12587 (NWA 12587)
(Northwest Africa)
Purchased: 2014
Classification: HED achondrite (Eucrite, monomict)
History: Purchased in Denver, September 2014. Reportedly found in northwest Africa.
Physical characteristics: Single mass; saw-cut reveals a mosaic of green pyroxene and white plagioclase grains crosscut by dark-gray shock melt veins.
Petrography: (C. Agee, *UNM*) This meteorite consists of approximately 50% pyroxene, 30% plagioclase and 20% shock melt. There is a single basaltic eucrite lithology present. The pyroxene is highly equilibrated with a distinct compositional separation between low- and high-Ca pyroxene.
Geochemistry: (C. Agee, *UNM*) low-Ca pyroxene $Fs_{59.5\pm1.3}Wo_{3.3\pm1.5}$, Fe/Mn=32±1, n=12; high-Ca pyroxene $Fs_{26.8\pm0.9}Wo_{43.1\pm1.0}$, Fe/Mn=32±1, n=9; plagioclase $An_{89.4\pm2.2}$, n=7.
Classification: Monomict eucrite
Specimens: 20.11 g on deposit at *UNM*, *MMGM* holds the main mass.

Northwest Africa 12589 (NWA 12589)
(Northwest Africa)
Purchased: 2018 Oct
Classification: Ordinary chondrite (LL7)
Petrography: (K. Metzler, *IfP*) Brecciated ordinary chondrite with chondritic lithic clasts up to 7 mm. Clasts are recrystallized and contain chondrule relicts. Many secondary feldspar grains with sizes of 100 µm and larger. Rare (oxidized) metal with a maximum size of 1 mm.
Geochemistry: Mineral compositions and geochemistry: (K. Metzler, *IfP*) The mean olivine composition is $Fa_{31.1\pm0.3}$ (30.2-31.5; n=14). The mean low-Ca pyroxene composition is $Fs_{25.2\pm0.3}$ $Wo_{2.9\pm0.5}$ ($Fs_{24.5-25.6}$ $Wo_{2.1-3.8}$; n=17).
Classification: LL chondrite based on mineral chemistry. Petrologic type 7 based on the equilibrated state of olivine and pyroxene, the large grain size of secondary plagioclase, and the high CaO concentration in low-Ca pyroxene.

Northwest Africa 12590 (NWA 12590)
Morocco
Purchased: 2018 Jun
Classification: Carbonaceous chondrite (CV3)

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History: Several fragments of the same material with total weight of 1805 g were purchased by Sergey Vasiliev from Moroccan meteorite dealer at the St. Marie-aux-Mines mineral show in June 2018.
Physical characteristics: Total mass of several pieces is about 1.8 kg. The interior of the meteorite is dark brownish-gray to dark gray whereas surface is dark brown with resinous luster.
Petrography: (Pavel Yu. Plechov, *FMMR*). Petrographic observation of a polished section shows that meteorite composed of chondrules (to 2 mm, average size about 1 mm) set in abundant matrix (about 50 vol%). Large chondrules often have clear pronounced magmatic rims (100-300 µm in width). PO-IA-type prevails among porphyric chondrules. Olivine has relic cores of $Fa_{0.4-9.9}$ whereas surrounding olivine and olivine in matrix is $Fa_{40-45.}$ Some olivine in PO chondrules contains small rectangular melilite inclusions. Primary magmatic glass is partially crystallized to submicron aggregate. Fluffy CAIs are common and consists of melilite, spinel and Al-diopside. Huge compact CAI in separate polished plate (about 18 mm) has perfect Wark-Lowering rim. Compact CAI consists of spinel, perovskite, grossmanite, Al-diopside, Ti-kushiroite in melilite matrix. No secondary nepheline, sodalite or phyllosilicates were occurred. Tiny drops (up to 2 µm) of hexamolybdenum and other PGE-rich minerals are occurred. Olivine has no undulatory extinction, as well as the absence of opaque shock veins and melt pockets indicates a shock stage of S1. Olivine, pyroxene and metal are absolutely fresh and not weathered (weathering grade W0).
Geochemistry: Mineral composition and Geochemistry: EDS-WDS analyses (Pavel Yu. Plechov, *FMMR*). The primary chondrite assemblage includes olivine in chondrules and matrix $Fa_{27.51\pm15.61}$ (N=59), orthopyroxene $Fs_{2.46\pm1.52}Wo_{3.02\pm2.03}$ (N=15) and partially crystallized glass. Composition of kamacite (in wt.%, N=4): Fe 91.7, Ni 5.65, Co 1.85. Taenite (N=10) contain 38.3 and 0.75 wt.% of Ni and Co respectively. Sulfides are troilite. Compact CAI consists of grossmanite ($Fs_{0.4}Wo_{70.87}$, Al_2O_3 = 21.22 wt.%, TiO_2 = 14.93 wt., N=11), Ti-kushiroite ($Fs_{0.3}Wo_{68.02}$, Al_2O_3 = 19.95wt.%, CaO = 24.35 wt., N=7), Al-diopside ($Fs_{0.59}Wo_{53.57}$, Al_2O_3-8.33 wt.%, N=1), spinel with varying contents of FeO (3-23 wt.%, N=15) and perovskite (Ca-27.5, Ti-33.6, N=2) in melilite (gehlenite) matrix. Measured H_2O is about 2.01±0.07 and C is 0.65 wt.% (by CNH elemental analyzer).
Classification: (Pavel Yu. Plechov, *FMMR*). Carbonaceous chondrite CV3, reduced sub-group, S1. Reduced subgrop from the composition of sulfides (troilite only), and metal:magnetite ratio.
Specimens: Sergey Vasiliev holds main mass. 39 g, thin section and polished plate with large compact CAI, *FMMR*.

Northwest Africa 12591 (NWA 12591)
Morocco
Find: 2015
Classification: Ordinary chondrite (L6)

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History: The specimen was found by nomads in Morocco. The stone was purchased by Adam Ait Hiba, then by Zsolt Kereszty in 2015 at Ensisheim Meteorite Show. In the end Balazs Kormos bought it in August 2018.
Physical characteristics: An individual pyramidal shaped dark brown stone (1169.2 g) with weathered fusion crust.
Petrography: (D. Rezes, *CSFK*) Chondrite with poorly delineated chondrules. Olivine shows planar fractures and weak mosaicism. Planar deformation features and shock-induced twinnings are rare. There are black-colored thin shock veins. Limonitic patches are observable in 90% of the thin section.
Geochemistry: (D. Rezes, A. Kereszturi and M. Szabo, *CSFK*) Mineral chemistry: Olivine $Fa_{24.64\pm0.25}$, N=18; Low-Ca pyroxene $Fs_{20.94\pm0.85}Wo_{1.57\pm0.25}$, N=26; Feldspar $Ab_{83.31\pm0.72}$, N=14
Classification: Ordinary chondrite (L6), shock stage S3, weathering W3
Specimens: 40 g on deposit at *CSFK*, B. Kormos holds the main mass.

Northwest Africa 12592 (NWA 12592)
Algeria
Purchased: 2017
Classification: Lunar (frag. breccia)
History: A single weathered stone lacking a fusion crust was found by nomads in Algeria and purchased by Dustin Dickens in Nouakchott, Mauritania in 2017 from an anonymous meteorite dealer.
Physical characteristics: Dark grey sandblasted exterior, with many irregular shaped fragments set in a fine grained vesiculated groundmass. No fusion crust.
Petrography: (T. S. Hayden, M. Anand, *OU*) The meteorite is a clast-rich fragmental breccia containing numerous mineral and lithic fragments embedded in a fine-grained vesiculated (regolith) matrix. The lithic clast population consists primarily of basaltic clasts, dominated by Ca-rich pyroxene and plagioclase, with minor olivine components. The size range of the lithic clasts is 0.19-1.9 mm. Mineral clasts are mainly pyroxene, olivine, plagioclase, chromite, troilite and Fe-Ni phases. Some impact melt textures present also.
Geochemistry: Mineral Composition and Geochemistry: (T. S. Hayden, M. Anand, *OU*) Feldspar ($An_{95.2\pm0.7}Ab_{4.7\pm0.7}$, N = 31), Pigeonite ($Fs_{43\pm3.3}Wo_{9.5\pm4.4}$, Fe/Mn=65.5±3.3, N=45), Augite ($Fs_{25\pm4.8}Wo_{35.7\pm6.1}$, Fe/Mn=59.5±5.6, N=54), Clinoferrosilite ($Fs_{48.6}Wo_5$, Fe/Mn = 67.4, N=1), Clinoenstatite ($Fs_{44.5\pm4.3}Wo_{4.4}$, Fe/Mn = 64.7±3.9, N=11), Olivine ($Fa_{47.6\pm16}$, Fe/Mn=104.5±10.8, N=33). O isotopes (measured at *OU*): Repetition 1: $\delta^{17}O$ = 3.266‰, $\delta^{18}O$ = 6.333‰, $\Delta^{17}O$=-0.052 (linearized using a slope of 0.5247), Repetition 2: $\delta^{17}O$ = 3.217‰, $\delta^{18}O$ = 6.174‰, $\Delta^{17}O$=-0.018‰ (linearized using a slope of 0.5247. Mean: $\delta^{17}O$ = 3.242 ± 0.035‰ (1-sigma), $\delta^{18}O$ = 6.254 ± 0.112‰ (1-sigma), $\Delta^{17}O$=-0.035±0.024 (1 sigma).
Classification: Lunar fragmental regolith breccia
Specimens: Specimen: 20 g specimen held at *OU*. Dustin Dickens holds the main mass.

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Northwest Africa 12593 (NWA 12593)
Mali
Purchased: 2017
Classification: Lunar (frag. breccia)

History: A single weathered stone lacking fusion crust found in Mali by nomads. Purchased by Dustin Dickens in Nouakchott, Mauritania, in 2017 from an anonymous meteorite dealer.

Physical characteristics: Dark, sand-blasted exterior, with many irregular shaped fragments set in a fine-grained dark groundmass. No fusion crust.

Petrography: (T. S. Hayden, M. Anand, *OU*) The meteorite is clast-rich fragmental breccia containing numerous mineral fragments and lithic clasts embedded in a fine-grained, vesiculated (regolith) matrix. The lithic clast population consists of basaltic clasts, granulite clasts and crystalline impact-melt breccias of olivine norite compositions. Size range of the clasts is 0.56-2.56 mm, and the main minerals are pyroxene, feldspar, olivine, silica, chromite, ilmenite, zircon and Ca phosphates (merrillite and apatite).

Geochemistry: Mineral composition and Geochemistry: (T. S. Hayden, M. Anand, *OU*) Feldspar ($An_{93.8\pm2.7}$, $Ab_{5.9\pm2.5}$, n=39), pigeonite ($Fs_{30.5\pm9.1}Wo_{13.1\pm3.4}$, FeO/MnO = 59.3±6.6, n=59), augite ($Fs_{23.1\pm6.1}Wo_{30.9\pm4.3}$, FeO/MnO = 54.2±4.4, n=18), olivine ($Fa_{38.2\pm11.7}$, FeO/MnO = 103.2±7.1, n= 40). O isotopes (measured at *OU*): Repetition 1: $\delta^{17}O$ = 3.328‰, $\delta^{18}O$ = 6.361‰, $\Delta^{17}O$=-0.005‰ (linearized using a slope of 0.5247 (of Miller, M. F. (2002) GCA 66(11)), Repetition 2: $\delta^{17}O$ = 3.203‰, $\delta^{18}O$ = 6.106‰, $\Delta^{17}O$=-0.004‰ (linearized using a slope of 0.5247. Mean: $\delta^{17}O$ = 3.266 ± 0.088‰ (1-sigma), $\delta^{18}O$ = 6.234 ± 0.180‰ (1-sigma), $\Delta^{17}O$=0.000±0.006‰ (1sigma).

Classification: Lunar fragmental regolith breccia

Specimens: Specimen: 24 g type specimen held at *OU*. Dustin Dickens holds the main mass.

Northwest Africa 12594 (NWA 12594)
Algeria
Purchased: 2018
Classification: Martian meteorite (Shergottite)

History: Found in Algeria in 2018 and purchased from a Moroccan dealer by Huapei Wang in 2018

Physical characteristics: These stones are (partially) covered by black fusion crust and appear to be very fresh and unaltered. Numerous vesicles are seen in the fusion crust. The interior is composed of yellow green grains with interstitial pale gray grains.

Petrography: The rock has a medium-grained subophitic texture. It consists of elongated prismatic pyroxene (up to 1.5 mm in length) and lath-like plagioclase (up to 1.8 mm in length), with accessory titanomagnetite, ilmenite, silica polymorph,

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merrillite, pyrrhotite, fayalite. Pyroxenes show patchy zoning from Mg-rich core to Mg-poor rim, with irregular boundaries. Ilmenite occurs as thin lamellae intergrown with titanomagnetite.

Geochemistry: Pyroxenes are zoned from augite cores ($En_{45.3}Wo_{25.6}$, FeO/MnO = 28.5) and pigeonite cores ($En_{40.3}Wo_{19.6}$ FeO/MnO = 32.3) to ferropigeonite rims ($En_{8.4}Wo_{14.5}$ FeO/MnO = 41.1). Plagioclase is characterized by homogeneous compositions of An_{52} $Or_{1.4.}$ Titanomagnetite (TiO_2 29.4 wt%, FeO 65.5 wt%, Al_2O_3 1.3 wt%); ilmenite (TiO_2 48.9 wt%, FeO 49.8 wt%).

Northwest Africa 12603 (NWA 12603)

(Northwest Africa)

Purchased: 2018 Dec

Classification: Lunar meteorite (feldspathic breccia)

History: Purchased from a Moroccan mineral dealer at the mineral show in Hamburg, Germany

Petrography: (K. Metzler, *IfP*) Polymict achondritic breccia, consisting of mineral fragments (olivine, pyroxene, plagioclase) and lithic clasts (anorthosites, melt rocks), set in a nearly black matrix of fine-grained related debris. Intermingled are clast-rich melt particles with ill-defined outlines. Breccia-in breccia clasts and melt spherules occur, as well. Pyroxenes with and without exsolution lamellae are observed. Accessories are ilmenite, troilite, and Fe,Ni metal.

Geochemistry: Mineral compositions and geochemistry: Olivine: $Fa_{35.8\pm8.8}$ (26.9-47.3); Fe/Mn (at.): 72-153; n=6. Pyroxene $Fs_{41.6\pm23.9}Wo_{10.3\pm5.0}$ ($Fs_{24.5-83.5}Wo_{3.1-15.8}$); Fe/Mn (at.): 48-94; n=5. Plagioclase $An_{96.7\pm0.8}$ ($An_{95.7-97.5}$); n=4. Chemistry of a melt spherule (wt%): SiO_2=42.6, TiO_2=0.6, Cr_2O_3=0.5, Al_2O_3=23.7 MgO=9.3, FeO=8.4, MnO=0.08, CaO=14.9.

Classification: Lunar feldspathic breccia.

Northwest Africa 12604 (NWA 12604)

(Northwest Africa)

Purchased: 2017 Oct 29

Classification: Lunar meteorite (feldspathic breccia)

History: Purchased 29 Oct 2017 at the Munich show from Aziz Habibi. According to Mr. Habibi the meteorite was unpaired.

Physical characteristics: A slice with a thickness of 2 mm was availabe. The interior of the sample appears fresh, the surface partly wind ablated and shiny - in part the minerals and clast are visible on the surface. No unequivocal fusion crust, on one side a fine layer of attached desert sand.

Petrography: Macroscopic: The cut surface of the interior appears black and dark gray, with well visible white clasts of plagioclase. Mafic minerals appear grey and black and are not easily discerned from the dark matrix. Many very fine white veines transect the sample. Microscopic. Complex and polyphase breccia with different generations of impact melts and fine grained matrices. More than 50% of the thin

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section appear black in polarized transmitted light and are thus interpreted as glass. On the EMPA different degree of devitrification and extremely fine (re?)crystallisation are visible in such glasses. The largest rock- or mineral-clasts are approx. 3 mm, the smallest grains <1 µm. Larger glass shards with included rock and mineral fragments up to 1 cm account for about 50% of the bulk, but glass is also frequent in the rest of the sample. A weak planar arrangement is visible, interpreted as a irregular layering due to fall out of impact material. Glass beads and agglutinates are present, indicative for lunar regolith. The main fraction of the sample stems from a feldspathic moon area (ANT-Suite, gabbro clast) but also basalt clasts (even mare type) are observed as minor components. A fraction of the plagioclase grains and clasts are completely transformed to maskelynite. Other grains show complex fracturing, fine grained recrystallisation and irregular extinction. Pyroxene frequently show undulous or patchy extinction. Aditional observed phases are illmenite, chrome-spinel and Fe-Ni metal. Terrestrial calcite fills veins and vesicles in agglutinates.

Geochemistry: Composition of Ca-poor pyroxene (pigeonite or othopyroxene) (n=42): $Fs_{27.30\pm10.56}Wo_{7.29\pm4.77}$ (range $Fs_{12.73-78.07}Wo_{2.61-19.94}$); Fe/Mg = 0.42, Fe/Mn 54.42 (one exceptionally Mg-rich point excluded from ratios). Composition of Ca-rich pyroxen (clinopyroxene) (n=15): $Fs_{31.00\pm19.24}Wo_{29.65\pm6.85}$ (range $Fs_{8.54-59.58}Wo_{20.56-38.36}$); Fe/Mg = 1.40, Fe/Mn 50.35. Olivine composition (n=27): $Fa_{30.54\pm9.71}$ (range $Fa_{19.25-60.92}$); Fe/Mg = 0.48, Fe/Mn 88.78. Plagioclase composition (n=73): $An_{95.80\pm1.20}Or_{0.34\pm0.24}$ (range $An_{90.71-97.74}Or_{0.01-1.28}$). Melt compositions vary strongly with xSi 29.7-46.5, xCa 9.9-17.6, xFe 3.8-16.3, xMg 7.5-21.1 and xTi 0.0-3.2. Fe/Mn ratios of silicate minerals are within the range of observed compositions for the moon but on the lower end of the range with single ratios as low as 33. Bulk analysis of cut surface by pXRF (wt%): Fe/Mg = 1.5±0.1, Fe/Mn 84.2±8.8 (n=10), Fe = 4.6 wt.% (n=10).

Classification: This meteorite is a mixed but mainly feldspathic glass-rich lunar regolith breccia, rich in glass and fragments with impact melts. Mineral compositions as well as Fe/Mg and Fe/Mn ratios of minerals and bulk Fe/Mn are proof for a lunar origin of the sample.

Specimens: A total of 21.7 g and one polished section at *NMBE*

Northwest Africa 12605 (NWA 12605)

(Northwest Africa)
Purchased: 2017 Jun 18
Classification: HED achondrite (Eucrite)

History: Purchased 18 Jun 2017 at Ensisheim Show from a seller named Mr. Ismaily.

Physical characteristics: A slice with a thickness of 3 mm was availabe. Surface as well as interior are well preserved and appear fresh. Fusion crust mostly preserved, flowlines visible. Porous interior. Some pores are filled around the surface with secondary minerals.

Petrography: Macroscopic: The cut surface of the interior appears gray-brown, a somewhat darker and irregular rim of 1-5 mm is visible along the surface. Mineral

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and lithic clasts up to 9 mm are well visible. The sample is noticeably porous. The largest lithic clast is comparably coarse grained (plag. up to 2 mm) and could be a part of a cumulate (no analysis available). A narrow whitish vein transects the slice. Microscopic: The thin section consists of larger lithic and mineral clasts within a fine grained matrix that appears reequilibrated. The brecciated nature of the sample is revealed by the presence of lithic clasts with contrasting fabrics. The matrix minerals appear to have coalesced into larger grains, thereby hiding their primary clastic origin. The porosity is also observable on the microscopic scale. Locally a very fine grained rim of minerals covers the pore sufaces. Observed minerals are Ca-poor pyroxene of ferrosilitic to pigeonitic composition (with fine exsolution lamellae mainly below 10um) and Ca-rich pyroxene of augitic composition (larger grains in part poikilitic). A silica phase is common and locally shows evidence of subgrain formation. Some lager plagioclase grains show a slight patchy and undulous extinction. Several larger pyroxene grains contain irregular fractures that end at the borders of the grains. Larger, coarser grained lithic clasts have a gabbroic texture and could be derived from cumulates. Additionally observed phases are troilite, Ti-rich chromite, ilmenite, zircon and iron metal. Terrestrial calcite was observed in veins.
Geochemistry: Composition of Ca-poor pyroxene (pigeonite or othopyroxene) (n=47): $Fs_{52.90\pm3.09}Wo_{7.55\pm3.92}$ (range $Fs_{42.78-56.16}Wo_{3.75-18.80}$); Fe/Mg = 1.34, Fe/Mn 28.61. Composition of Ca-rich pyroxen (clinopyroxene) (n=21): $Fs_{29.79\pm4.08}Wo_{35.61\pm5.23}$ (range $Fs_{25.66-40.88}Wo_{21.22-40.26}$); Fe/Mg = 0.96, Fe/Mn 27.84 No olivine found in thinsection. Plagioclase composition (n=45): $An_{90.10\pm2.50}Or_{0.42\pm0.16}$ (range $An_{83.4-93.59}Or_{0.23-1.04}$). Larger plagioclase grains show a slight increase in xAn towards the core. Bulk analysis of cut surface by pXRF (wt%): Fe/Mg = 4.12±0.44, Fe/Mn 29.8±0.5 (n=10), Fe = 13.0 wt.% (n=10). Oxygen isotopes: (R. Greenwood, *OU*): $\delta^{18}O$=3.775‰, $\delta^{17}O$=1.746‰ $\Delta^{17}O$=-0.217‰.
Classification: This meteorite is a reequilibrated basaltic eucrite breccia based on oxygen isotopes, mineral compositions and whole-rock pXRF-analyses. There is evidence for a slight Stannern trend.
Specimens: A total of 25.1 g and one polished section at *NMBE*

Northwest Africa 12606 (NWA 12606)
Midelt region, Morocco
Purchased: 2018
Classification: Ureilite
History: Specimen is cataloged at the Royal Ontario Museum as M59776 (formerly CC2).
Petrography: (I. Nicklin, *ROM*) Sample is primarily composed of olivine bearing reduction rims. Several large aggregates of olivine crystals, the largest measuring 10 by 5 mm, are set in a finer grained matrix of crystal fragments dominated by olivine with minor pyroxene. Approximate modal abundance: 90% olivine, 5% pyroxene, 5% graphite. Olivine shows undulose extinction.

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Geochemistry: Olivine: clast $Fa_{17.5\pm3.2}$, FeO/MnO=35.6±8.8 (n=12), matrix $Fa_{10.3\pm4.6}$, FeO/MnO=18.8±9.3 (n=11); Pyroxene: augite $Fs_{3.1\pm0.6}Wo_{34.4\pm7.6}$, FeO/MnO=9.5±1.9 (n=3); pigeonite $Fs_{6.9\pm1.5}Wo_{6.6\pm1.2}$, FeO/MnO = 22.3±4.3 (n=14)

Northwest Africa 12625 (NWA 12625)
(Northwest Africa)
Purchased: 2018 Sep
Classification: Ordinary chondrite (L3)
History: Purchased by Bob Falls in September 2018 from a Moroccan dealer at the Denver Show.
Petrography: (A. Irving and S. Kuehner, *UWS*) Very closely packed, well-formed chondrules (apparent diameter 730±260 µm, N = 22) are set in a sparse matrix containing minor stained metal.
Geochemistry: Olivine, $Fa_{27.0\pm11.5}$ ($Fa_{1.3-33.4}$), Cr_2O_3 in ferroan examples 0.04-0.08 wt.%, mean 0.06±0.1 wt.%, N = 7; orthopyroxene, $Fs_{5.6\pm6.4}Wo_{0.7\pm0.3}$ ($Fs_{1.7-13.0}Wo_{1.0-0.4}$), N = 3; subcalcic augite, $Fs_{20.2\pm3.5}Wo_{28.8\pm2.5}$ ($Fs_{17.7-22.6}Wo_{30.5-27.0}$), N = 2. Magnetic susceptibility log χ ($\times 10^{-9}$ m^3/kg) = 4.65.
Classification: Ordinary chondrite (L3).
Specimens: 43.5 g including one polished thin section at *UWB*; remainder with Mr. R. Falls.

Northwest Africa 12626 (NWA 12626)
(Northwest Africa)
Purchased: 2018 Nov
Classification: Carbonaceous chondrite (CO3)
History: Purchased by Craig Zlimen in November 2018 from a Moroccan dealer.
Petrography: (A. Irving, *UWS* and P. Carpenter, *WUSL*) Small, well-formed chondrules (apparent diameter 230±120 µm, N = 22), minerals fragments, AOA and very fine grained CAI are set in a fine grained matrix (~30 vol.%, orange-brown in thin section).
Geochemistry: Olivine ($Fa_{9.3\pm11.5}$ (0.3-27.4), Cr_2O_3 in ferroan examples 0.04-0.08 wt.%, N = 5), orthopyroxene, $Fs_{2.1\pm2.7}Wo_{1.6\pm0.6}$ ($Fs_{0.8-6.1}Wo_{1.1-2.3}$, N = 4), pigeonite ($Fs_{2.5}Wo_{5.3}$), subcalcic augite ($Fs_{1.2}Wo_{32.4}$), diopside ($Fs_{0.9}Wo_{40.9}$), hedenbergite ($Fs_{51.5}Wo_{46.4}$), plagioclase ($An_{66.7-73.8}Or_{0.8-0.2}$, N = 2).
Classification: Carbonaceous chondrite (CO3).
Specimens: 9.5 g including one polished thin section at *UWB*; remainder with Mr. C. Zlimen.

Northwest Africa 12627 (NWA 12627)
(Northwest Africa)
Purchased: 2019 Feb
Classification: HED achondrite (Eucrite, polymict)

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History: Purchased in February 2019 by Darryl Pitt from a Mauritanian dealer.
Petrography: (A. Irving, *UWS* and P. Carpenter, *WUSL*) Breccia containing some lithic eucrite clasts (with diabasic, fine-intersertal and granulitic textures) but mostly composed of related crystalline debris together with rare diogenitic orthopyroxene set in a finer grained matrix containing rare kamacite. Eucritic material consists of exsolved pigeonite, calcic plagioclase, ferroan pigeonite, silica polymorph, fayalite, ilimenite, troilite and baddeleyite.
Geochemistry: Augite host ($Fs_{36.3}Wo_{36.4}$ and $Fs_{40.4}Wo_{36.1}$, FeO/MnO = 33 and 35; N = 2), ferroan pigeonite ($Fs_{57.3}Wo_{8.1}$ and $Fs_{58.9}Wo_{10.7}$, FeO/MnO = 35 and 37, N =2), orthopyroxene host ($Fs_{62.8}Wo_{4.6}$, FeO/MnO = 37), diogenitic orthopyroxene ($Fs_{25.1}Wo_{2.7}$, FeO/MnO = 31), fayalite ($Fa_{82.6}$, FeO/MnO = 45), plagioclase ($An_{89.8-90.8}Or_{0.3}$, N = 2).
Classification: Eucrite (polymict breccia).
Specimens: 24.5 g including one polished thin section at *UWB*; remainder with *DPitt*.

Northwest Africa 12628 (NWA 12628)
(Northwest Africa)
Purchased: 2019 Mar
Classification: Ungrouped achondrite
History: Purchased in March 2019 by Ke Zuokai from Moroccan dealer Habib Naji.
Physical characteristics: A single fusion-crusted, beige-colored stone (73.5 g) found as seven broken fragments.
Petrography: (A. Irving and S. Kuehner, *UWS*) Intersertal igneous texture. Composed predominantly of patchily zoned clinopyroxene (pigeonite and subcalcic augite) and sodic plagioclase with accessory fayalitic olivine, silica polymorph, ilmenite, Ti-chromite, troilite, Ni-free metal (no Ni detected in the EDS spectra), and rare phosphates (merrillite and chlorapatite). Several thin shock melt veinlets are present.
Geochemistry: Pigeonite ($Fs_{24.8-28.2}Wo_{5.5-6.2}$, FeO/MnO=33-36, N=3), subcalcic augite ($Fs_{23.2}Wo_{25.6}$; $Fs_{26.5}Wo_{34.6}$; FeO/MnO=33-38; N = 2), fayalite ($Fa_{84.9-85.3}$, FeO/MnO=59-64, N=2), plagioclase ($Ab_{78.1-80.4}An_{18.1-20.7}Or_{1.2-1.5}$, N = 2). Oxygen isotopes (K. Ziegler, *UNM*): analysis of acid-washed subsamples by laser fluorination gave, respectively, $\delta^{17}O$ 4.075, 4.298, 4.089; $\delta^{18}O$ 5.427, 5.954, 5.452; $\Delta^{17}O$ 1.210, 1.154, 1.210 per mil.
Classification: Ungrouped igneous achondrite with isotopic affinities to LL chondrites.
Specimens: 15.0 g including one polished thin section at *UWB*; remainder with Mr. K. Zuokai.

Northwest Africa 12629 (NWA 12629)
(Northwest Africa)
Purchased: 2018 Jul

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Classification: Ordinary chondrite (L4)

History: Purchased in Zouerat, Mauritania by Mbark Arjdal in July 2018 from Mohamed Zergou.

Physical characteristics: A single, rather fragile stone with a somewhat weathered exterior (3897 g). Fresh interior surfaces exhibit well-formed chondrules in a finer matrix.

Petrography: (A. Irving, *UWS* and P. Carpenter, *WUSL*) Closely-packed, well-formed chondrules are set in a sparse matrix containing altered metal.

Geochemistry: Olivine, $Fa_{25.0\pm0.1}$ ($Fa_{24.9-25.0}$), N = 3; low-Ca pyroxene, $Fs_{22.9\pm3.6}Wo_{1.2\pm1.1}$ ($Fs_{20.4-29.5}Wo_{0.5-2.8}$), N = 3; subcalcic augite, $Fs_{15.3}Wo_{2.5}$; augite, $Fs_{10.4}Wo_{35.1}$.

Classification: Ordinary chondrite (L4).

Specimens: 71.9 g including one polished thin section at *UWB*; remainder with Mr. M. Arjdal.

Northwest Africa 12630 (NWA 12630)

Algeria

Purchased: 2019 Feb

Classification: Lunar meteorite (feldspathic breccia)

History: Two stones excavated at the site of the very large find near Tindouf, Algeria, were purchased by Doug Ingalls in February 2019 from a Moroccan dealer.

Petrography: (A. Irving, *UWS* and P. Carpenter, *WUSL*) Breccia composed of mineral clasts of anorthite, olivine, orthopyroxene, exsolved pigeonite and augite set in a much finer grained matrix containing magnesian ilmenite, troilite and sparse vesicles.

Geochemistry: Olivine $Fa_{37.3\pm28.8}$ ($Fa_{11.7-68.5}$, FeO/MnO = 82-99, N = 3), low-Ca pyroxene $20.1\pm4.0Wo_{3.8\pm0.8}$ ($Fs_{17.3-22.9}Wo_{3.2-4.4}$, FeO/MnO = 48-55, N - 2), augite ($Fs_{19.7}Wo_{40.4}$, FeO/MnO = 49), anorthite ($An_{96.9}Or_{0.0}$).

Classification: Lunar (feldspathic breccia).

Specimens: 20.6 g in the form of two polished endcuts at *UWB*; remainder with Mr. D. Ingalls.

Northwest Africa 12631 (NWA 12631)

(Northwest Africa)

Purchased: 2019 Feb

Classification: Ureilite

History: Purchased in February 2019 by Darryl Pitt from a Mauritanian dealer.

Petrography: (A. Irving, *UWS* and P. Carpenter, *WUSL*) Protogranular aggregate (mean grain size 0.6 mm) of olivine (~80 vol.%) and pigeonite (~20 vol.%) with minor accessory Cr-troilite and pentlandite. Olivine grains have narrow reduced magnesian rims associated with Fe metal blebs. No graphite was observed.

Geochemistry: Olivine (cores $Fa_{20.3-20.6}$; rims $Fa_{11.7-15.5}$; N = 7), pigeonite ($Fs_{17.2-17.5}Wo_{7.5-7.2}$, N = 3).

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Classification: Ureilite.
Specimens: 21.4 g including one polished thin section at *UWB*; remainder with *DPitt*.

Northwest Africa 12632 (NWA 12632)
(Northwest Africa)
Purchased: 2019 Feb
Classification: Martian meteorite (Shergottite)
History: Purchased in February 2019 by Darryl Pitt from a Mauritanian dealer.
Petrography: (A. Irving, *UWS* and P. Carpenter, *WUSL*) Coarse grained gabbroic specimen (mean grain size ~3 mm) composed predominantly of zoned clinopyroxene and maskelynite with accessory merrillite, chlorapatite, ulvöspinel, ilmenite, pyrrhotite and symplectitic intergrowths of fayalite+hedenbergite+silica polymorph. Very minor secondary calcite is present.
Geochemistry: Subcalcic augite ($Fs_{29.3}Wo_{28.2}$ and $Fs_{34.0}Wo_{25.7}$, FeO/MnO = 30 and 31, N = 2), ferropigeonite ($Fs_{74.1\pm5.9}Wo_{17.2\pm3.2}$, range $Fs_{68.0\text{-}82.1}Wo_{20.0\text{-}12.8}$, FeO/MnO = 40 to 42, N = 4), maskelynite ($An_{46.3\text{-}56.4}Or_{2.2\text{-}0.7}$, N = 2).
Classification: Shergottite (gabbroic).
Specimens: 13.3 g including one polished thin section at *UWB*; remainder with *DPitt*.

Northwest Africa 12633 (NWA 12633)
(Northwest Africa)
Purchased: 2018
Classification: Martian meteorite (Shergottite)
History: Found in the Sahara by nomads in 2018. Bought in Nouakchott, Mauritania, in 2018
Physical characteristics: Cut surface shows a fine grained, dark-green interior.
Petrography: (J. Gattacceca, *CEREGE*) Igneous rock with doleritic texture. Main minerals are zoned pyroxene and maskelynite. Other minerals: FeTi oxides, sulfides.
Geochemistry: Pyroxene $Fs_{26.0\pm9.7}Wo_{24.3\pm12.6}$, range $Fs_{14.2\text{-}43.3}$, FeO/MnO 38.7±4.8 (n=9). Plagioclase $An_{73.9\pm1.7}Ab_{25.6\pm16}Or_{0.5\pm0.1}$ (n=9). Magnetic susceptibility log χ ($\times 10^{-9}$ m^3/kg) = 3.74.
Classification: Martian meteorite (Shergottite)
Specimens: Type specimen at *CEREGE*, main mass Jambon.

Northwest Africa 12634 (NWA 12634)
Mauritania
Purchased: 2019 Jan
Classification: Ordinary chondrite (L/LL3)
History: Purchased in Nouakchott in January 2019

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Petrography: (J. Gattacceca, *CEREGE*) Chondrite with packed, well-delineated chondrules. Chondrule average apparent diameter is 740±390 µm (n=39). Olivine is zoned. Opaque minerals (Fe,Ni metal and troilite) are found as rounded composite grains. Metal abundance 5.1 vol% (point counting, n=316). Magnetic susceptibility log χ ($\times 10^{-9}$ m^3/kg) = 4.71.
Geochemistry: Olivine $Fa_{30.3\pm2.6}$, range $Fa_{25.0-33.1}$, Fa PMD 6.4%, Cr_2O_3 0.11±0.14 wt% (n=11). Low-Ca pyroxene $Fs_{13.5\pm5.2}Wo_{1.5\pm2.1}$ (n=12).
Classification: Ordinary chondrite (L/LL3). The meteorite has metal content (given by magnetic susceptibility and point counting) similar to L chondrites but olivine composition similar to LL chondrites
Specimens: Type specimen at *CEREGE*. Main mass with *Kuntz*.

Northwest Africa 12635 (NWA 12635)
Morocco
Purchased: 2013 Feb
Classification: Ureilite
History: Registered at the Royal Ontario Museum as LM58155
Petrography: (A. Cernok) Predominantly shock-fractured olivine with significant reduction rims. Low-Ca pyroxene fractured. Graphite and diamond occur in clots interstitial to the mineral grains, graphite also along grain boundaries. Modal abundances: olivine approx. 80%; 20% low-Ca pyroxene grains; 5% grain-boundary related graphite and diamond.
Geochemistry: Olivine: $Fa_{6.7\pm0.3}$ (n=21); Pigeonite: $Fs_{5.7\pm0.1}Wo_{6.4\pm0.3}$ (n=19). Oxygen Isotopes (K. Ziegler, *UNM*): $\delta^{17}O$ = 0.362, 0.525, 0.348 permil, $\delta^{18}O$ = 5.324, 5.588, 5.302 permil, $\Delta^{17}O$ = -2.449, -2.426, -2.451 permil (n=3).

Northwest Africa 12636 (NWA 12636)
Northwest Africa
Purchased: 2018
Classification: HED achondrite (Diogenite)
History: One stone weighing 967 g was found in Morocco prior to 2018. Blaine *Reed* purchased the sample from a meteorite dealer while at the 2018 Tucson Gem and Mineral Show.
Physical characteristics: The sample has a yellowish-brown exterior with a few small patches of black fusion crust. The sample has yellowish-orange interior that is brecciated and friable. The cut face shows angular-subrounded clasts up to 1.5cm in long dimension.
Petrography: Description and classification (A. Love, *App*): Sample is a breccia composed of diogenitic lithic fragments and coarser grained cataclastic clasts mixed within a comminuted host of similar materials. Lithic clasts are composed of interlocking, orthopyroxenes which share 120º grain boundaries. Orthopyroxenes contain Cpx inclusions and exsolution lamellae (up to 0.5µm) within crystals. Additional minerals are silica polymorphs, hercynitic chromite, FeS, and rare Ni-free

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iron metal. Orthopyroxenes within some lithic clasts exhibit normal extinction and equilibrium textures.
Geochemistry: (A. Love, *App*) low Ca pyroxene: $Fs_{27.2\pm0.6}Wo_{1.5\pm0.1}$, Fe/Mn=26.6±0.6, n=14; high Ca pyroxene $Fs_{10.5\pm0.4}Wo_{44.9\pm0.5}$, Fe/Mn=22.5±1.1,n=4.
Classification: Monomict diogenite breccia. Fe/Mn compositions of pyroxenes indicate this sample is diogenite meteorite. Textures and Fs compositions of pyroxenes indicate this sample is a diogenite.
Specimens: Blaine *Reed* holds the main mass. Two slices weighing 28.13 g and a polished mount are on deposit at *App*.

Northwest Africa 12642 (NWA 12642)
(Northwest Africa)
Purchased: 2017 Apr
Classification: Ordinary chondrite (L4)
History: Purchased by Ben Hoefnagels in April 2017 from an Australian dealer, who had acquired the material in Morocco.
Petrography: (A. Irving, *UWS* and P. Carpenter, *WUSL*) Fairly closely-packed, well-formed chondrules are set in a finer grained matrix containing altered metal.
Geochemistry: Olivine ($Fa_{25.3\pm0.1}$ (range $Fa_{25.1\text{-}25.4}$), N = 4), low-Ca pyroxene ($Fs_{20.0\pm1.7}Wo_{0.8\pm0.6}$ (range $Fs_{17.4\text{-}21.1}Wo_{0.4\text{-}1.7}$), N = 4), pigeonite ($Fs_{18.5}Wo_{6.4}$).
Classification: Ordinary chondrite (L4).
Specimens: 31.1 g including one polished thin section at *UWB*; remainder with Mr. B. Hoefnagels.

Northwest Africa 12643 (NWA 12643)
(Northwest Africa)
Purchased: 2019 Feb
Classification: Lunar meteorite (feldspathic breccia)
History: Purchased in February 2019 by Darryl Pitt from a Mauritanian dealer.
Petrography: (A. Irving, *UWS* and P. Carpenter, *WUSL*) Breccia composed of angular mineral grains of predominantly anorthite together with olivine, low-Ca pyroxene, augite, Ti-chromite and minor secondary barite.
Geochemistry: Plagioclase ($An_{96.4\text{-}96.6}Or_{0.1}$, N = 2), olivine ($Fa_{25.4\text{-}25.8}$, FeO/MnO = 92-93, N = 2), low-Ca pyroxene ($Fs_{20.6\text{-}20.9}Wo_{4.3\text{-}3.5}$, FeO/MnO = 51-52, N = 2), augite ($Fs_{10.5\text{-}10.6}Wo_{42.3\text{-}41.6}$, FeO/MnO = 33-35, N = 2).
Classification: Lunar (feldspathic breccia).
Specimens: 20.4 g including a polished endcut and a polished epoxy mount at *UWB*; remainder with *DPitt*.

Northwest Africa 12644 (NWA 12644)
(Northwest Africa)
Purchased: 2019 Feb

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Classification: Carbonaceous chondrite (CV3)
History: Purchased in February 2019 by Darryl Pitt from a Mauritanian dealer.
Petrography: (A. Irving and S. Kuehner, *UWS*) Well-formed chondrules (granular, BO and PO; apparent diameter 980±440 µm, N = 21) and large amoeboid, very fine grained CAI are set in a finer matrix (sepia-brown in thin section).
Geochemistry: Olivine ($Fa_{19.0\pm16.0}$ (range $Fa_{1.9\text{-}44.4}$), N = 6), subcalcic augite ($Fs_{0.9}Wo_{33.4}$), augite ($Fs_{1.9}Wo_{40.5}$).
Classification: Carbonaceous chondrite (CV3).
Specimens: 22.4 g including one polished thin section at *UWB*; remainder with *DPitt*.

Northwest Africa 12645 (NWA 12645)
(Northwest Africa)
Purchased: 2019 Feb
Classification: HED achondrite (Eucrite, monomict)
History: Purchased in February 2019 by Darryl Pitt from a Mauritanian dealer.
Petrography: (A. Irving, *UWS* and P. Carpenter, *WUSL*) Very fresh specimen containing sparse lithic clasts of diabasic eucrite, but made up predominantly of related crystalline debris. Major phases are unexsolved pigeonite and maskelynite together with accessory silica polymorph, fayalite, orthopyroxene, ferroan subcalcic augite, chlorapatite, ilmenite and troilite. Grains of pyroxene and maskelynite in the lithic clasts and those occurring as disaggregated debris exhibit a prominent preferred orientation.
Geochemistry: Pigeonite ($Fs_{46.5\text{-}50.8}Wo_{12.4\text{-}14.3}$, FeO/MnO = 28-30, N = 2), ferroan subcalcic augite ($Fs_{62.7}Wo_{26.0}$, FeO/MnO = 35), orthopyroxene ($Fs_{36.3}Wo_{4.4}$; $Fs_{42.7}Wo_{0.8}$; FeO/MnO = 30; N = 2), fayalite ($Fa_{75.6\text{-}78.5}$, FeO/MnO = 43), maskelynite ($An_{86.9\text{-}89.9}Or_{0.5\text{-}0.4}$, N = 2).
Classification: Eucrite (monomict breccia with laminar fabric, maskelynite-bearing).
Specimens: 24 g including one polished thin section at *UWB*; remainder with *DPitt*.

Northwest Africa 12646 (NWA 12646)
(Northwest Africa)
Purchased: 2019 Jan
Classification: LL4-7 melt breccia
History: Purchased by Bob Falls in January 2019 from a Moroccan dealer.
Petrography: (A. Irving, *UWS* and P. Carpenter, *WUSL*) The specimen is a breccia composed of clasts of relatively unshocked material (which is itself a breccia) within a much darker melt matrix. The unshocked breccia clasts contain a variety of equilibrated components with a range of textures from type 4 (with well-formed chondrules) to type 7 (recrystallized with no remnant chondrules). The melt matrix is very fine grained and contains numerous small grains of metal and sulfide.

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Geochemistry: Type 4 clast: Olivine ($Fa_{30.6}$), low-Ca pyroxene ($Fs_{25.0}Wo_{2.4}$), augite ($Fs_{9.0}Wo_{44.4}$). Type 7 clast: Olivine ($Fa_{30.6-30.9}$, N =3), orthopyroxene ($Fs_{24.7-24.9}Wo_{3.2-3.9}$, N = 3), augite ($Fs_{10.7}Wo_{43.2}$), plagioclase ($An_{7.7-14.0}Or_{2.5-5.1}$, N = 2). Melt matrix: Olivine ($Fa_{30.8-31.2}$, N = 2), orthopyroxene ($Fs_{25.2-25.5}Wo_{1.9-1.4}$, N = 2).
Classification: Ordinary chondrite (LL4-7 melt breccia).
Specimens: 103.6 g including one polished thin section at *UWB*; remainder with Mr. R. Falls.

Northwest Africa 12647 (NWA 12647)
(Northwest Africa)
Purchased: 2019 Feb
Classification: Primitive achondrite (Lodranite)
History: Purchased in February 2019 by Darryl Pitt from a Mauritanian dealer.
Petrography: (A. Irving, *UWS* and P. Carpenter, *WUSL*) Breccia composed mainly of angular mineral grains of olivine (exhibiting undulose extinction), orthopyroxene and clinopyroxene (twinned) together with accessory chromite, altered metal, chlorapatite and troilite. Sparse polymineralic aggregates are also present. Minor amounts of secondary calcite are present as veinlets. The olivine and pyroxene grains (both individual grains and in the polymineralic aggregates) are up to 4 mm in size.
Geochemistry: Olivine ($Fa_{10.3-10.7}$, FeO/MnO = 23-24,N = 4), orthopyroxene ($Fs_{10.1-10.6}Wo_{3.2-2.5}$, FeO/MnO = 14-16, N = 2), clinopyroxene ($Fs_{4.1-5.0}Wo_{44.5-40.7}$, FeO/MnO = 9-10, N = 3).
Classification: Lodranite (breccia).
Specimens: 20.3 g including one polished thin section at *UWB*; remainder with *DPitt*.

Northwest Africa 12648 (NWA 12648)
(Northwest Africa)
Purchased: 2019 Feb
Classification: Ordinary chondrite (H4)
History: Purchased in February 2019 by Darryl Pitt from a Mauritanian dealer.
Petrography: (A. Irving, *UWS* and P. Carpenter, *WUSL*) Well-formed, relatively small chondrules are set in a relatively coarse grained matrix containing stained metal.
Geochemistry: Olivine ($Fa_{17.9\pm0.1}$ (range $Fa_{17.8-17.9}$), N = 3), low-Ca pyroxene ($Fs_{15.6\pm0.1}Wo_{0.9\pm0.1}$ (range $Fs_{15.5-15.7}Wo_{0.8-0.9}$), N = 3).
Classification: Ordinary chondrite (H4).
Specimens: 21.2 g including one polished thin section at *UWB*; remainder with *DPitt*.

Northwest Africa 12650 (NWA 12650)
(Northwest Africa)

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Purchased: 2018 Jul
Classification: Ordinary chondrite (LL4)

History: Purchased by Ben Hoefnagels in July 2018 from a Moroccan dealer.

Petrography: (A. Irving, *UWS* and P. Carpenter, *WUSL*) Fairly closely packed, relatively large chondrules occur within a finer matrix containing altered metal, chlorapatite and merrillite.

Geochemistry: Olivine ($Fa_{27.0\pm0.0}$, N = 3), low-Ca pyroxene ($Fs_{21.0\pm2.0}Wo_{1.1\pm0.6}$ (range $Fs_{17.4\text{-}22.3}Wo_{1.8\text{-}0.6}$), N = 5), subcalcic augite ($Fs_{14.0}Wo_{27.8}$). Magnetic susceptibility log χ ($\times 10^{-9}$ m^3/kg) = 3.81.

Classification: Ordinary chondrite (LL4).

Specimens: 51 g including one polished thin section at *UWB*; remainder with Mr. B. Hoefnagels.

Northwest Africa 12651 (NWA 12651)
Morocco
Purchased: 2015
Classification: Carbonaceous chondrite (CM)

History: Several stones with a total mass of 365 g (largest 122 g) were purchased in Agadir on 2015 and June, 2016.

Physical characteristics: Two different lithologies are clearly apparent and visible with the naked eyes. The first has a dark gray/black matrix and the other is characterized by is brownish color.

Petrography: S. Ebert, A. Bischoff (*IfP*): The chondrite consists of about 25 vol% chondrules, chondrule fragments, and CAIs, and about 75 vol% of fine-grained material (matrix, fine grained rims; PCPs) . Mean chondrule apparent diameter is about 300 µm, typical for CM. The chondrules also have typical fine-grained rims.

Geochemistry: Mineral composition and geochemistry: S. Ebert, A. Bischoff (*IfP*): Olivine $Fa_{6.36\pm11.4}$ (n=30). Most chondrule olivines have Fa<4, maximum $Fa_{38.}$ Similarly, most low-Ca pyroxenes are enstatites (Fs<2), but extend up to $Fs_{6.}$

Classification: S. Ebert, A. Bischoff (*IfP*): The textural observations suggest a CM classification of this rock. The olivines do not show undulatory extinction (shock stage S1). Low abundances of metals are still visible in chondrules, preferentially enclosed in olivines, and also as rare and very small grains in the matrix. The sample is moderately to strongly weathered.

Specimens: 6.4 g including one polished thin section at the *IfP* and 20 g at the *MNHNP*. The main mass is held by *Labenne*.

Northwest Africa 12652 (NWA 12652)
(Northwest Africa)
Purchased: 2018
Classification: Ordinary chondrite (H3)

History: The meteorite was purchased from a Morrocan dealer at the mineral show in Hamburg, Germany.

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Petrography: The meteorite displays a chondritic texture with small well defined and mostly rounded chondrules (mean diameter about 0.4 mm) and fine-grained matrix containing sulfides and some FeNi metal. Most of the metal has been altered to Fe-oxides.

Northwest Africa 12653 (NWA 12653)
(Northwest Africa)
Purchased: 2018
Classification: Ordinary chondrite (H3)
History: The meteorite was purchased from a Morrocan dealer at the mineral show in Hamburg, Germany.
Petrography: The meteorite displays a chondritic texture with small well defined and unpacked chondrules (mean diameter about 0.3 mm) and fine-grained matrix containing sulfides and some FeNi metal. Most of the metal has been altered to Fe-oxides.

Northwest Africa 12654 (NWA 12654)
(Northwest Africa)
Purchased: 2018
Classification: Ordinary chondrite (L4)
History: The meteorite was purchased from a Morrocan dealer at the mineral show in Hamburg, Germany.
Petrography: The meteorite shows a chondritic texture with mostly rounded chondrules showing an apparent mean diameter about 0.7 mm.

Northwest Africa 12655 (NWA 12655)
(Northwest Africa)
Purchased: 2019
Classification: Ordinary chondrite (LL3-6)
History: The meteorite was purchased from a local meteorite dealer in Nouakchott, Mauritania.
Physical characteristics: Single stone completly covered by fusion crust.
Petrography: The meteorite is a chondritic breccia consisting of clastic LL3 type groundmass and chondrules with embedded up to 7 mm sized LL6 clasts. Plagioclase grain size in type 6 clasts is about 60 µm. Chondrules have a mean diameter of about 0.8 mm.
Geochemistry: type 3 lithology: olivine: $Fa_{13.1\pm10.9}$ ($Fa_{1.0-29.9}$, n =18); pyroxene: $Fs_{12.7\pm7.9}Wo_{0.8\pm0.4}$ ($Fs_{3.9-23.9}Wo_{0.3-1.7}$, n = 21); type 6 lithology: olivine: $Fa_{29.7\pm0.2}$, n=11; pyroxene: $Fs_{22.4\pm0.2}Wo_{0.6\pm0.1}$, n=11

Northwest Africa 12656 (NWA 12656)

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(Northwest Africa)
Purchased: 2018
Classification: Ordinary chondrite (L5)
History: The meteorite was purchased from a local meteorite dealer in Guelmim, Morocco.

Northwest Africa 12657 (NWA 12657)
(Northwest Africa)
Purchased: 2019
Classification: Ordinary chondrite (H5)
History: The meteorite was purchased from a local meteorite dealer in Morocco.

Northwest Africa 12658 (NWA 12658)
(Northwest Africa)
Purchased: 2019
Classification: Ordinary chondrite (L6)
History: The meteorite was purchased from a local meteorite dealer in Morocco.

Northwest Africa 12659 (NWA 12659)
(Northwest Africa)
Purchased: 2019
Classification: Ordinary chondrite (LL4)
History: The meteorite was purchased from a local meteorite dealer in Morocco.
Petrography: The meteorite shows a chondritic texture with densely packed and partly flattened chondrules (apparent mean diameter about 0.9 mm).

Northwest Africa 12660 (NWA 12660)
(Northwest Africa)
Purchased: 2017
Classification: Ordinary chondrite (LL6)
History: The meteorite was purchased from a local meteorite dealer in Morocco.

Northwest Africa 12661 (NWA 12661)
(Northwest Africa)
Purchased: 2019
Classification: Ordinary chondrite (LL6)
History: The meteorite was purchased from a local meteorite dealer in Morocco.

Northwest Africa 12662 (NWA 12662)
(Northwest Africa)

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Purchased: 2019
Classification: Ordinary chondrite (LL6)
History: The meteorite was purchased from a local meteorite dealer in Morocco.

Northwest Africa 12663 (NWA 12663)
(Northwest Africa)
Purchased: 2019
Classification: Ordinary chondrite (H5)
History: The meteorite was purchased from a moroccan meteorite dealer via internet.

Northwest Africa 12664 (NWA 12664)
Morocco
Purchased: 2017
Classification: Ordinary chondrite (L5)
History: the meteorite was purchased in Tucsony by Mt. S. V. Petukhov in February 2017 from Alexander Müller in the Mineral Shope in Dietingen
Classification: ordinary chondrite L5, S3, W3
Specimens: 1 thin section and four pieces of meteorite (88.6 g +23.5 g +10.2 g +2.7 g), 124.5 g in total and a thin section are located at *Vernad*; the main mass is located at the Museum of the History of the Universe (Dedovsk, Moscow region, Russia)

Northwest Africa 12665 (NWA 12665)
(Northwest Africa)
Purchased: 2018
Classification: Ordinary chondrite (H5, melt breccia)
History: The meteorite was purchased from a Morrocan dealer at the mineral show in Hamburg, Germany.
Physical characteristics: Seven black fragments partly covered with fusion crust.
Petrography: The meteorite displays an almost black interior and consists of abundant and partly recrystallized melt rock regions with characteristic FeNi metal and sufide spherules. Unmelted chondritic regions are type H5 (plagioclase grain size about 30 μm) and contain few relict chondrules; no metal or sulfide veins are observed.

Northwest Africa 12666 (NWA 12666)
(Northwest Africa)
Purchased: 2010
Classification: HED achondrite (Eucrite)
History: The meteorite was purchased from a local meteorite dealer in Agadir, Morocco.
Physical characteristics: Dark-grayish individual partly covered with fusion crust.

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Petrography: The meteorite is a breccia with up to 1 cm sized basaltic and black melt clasts set into a clastic mineral matrix. Dominant minerals are exsolved pyroxene and calcic plagioclase with average grain sizes of about 150 µm. Minor phases include silica, chromite, FeS, ilmenite, and metallic Fe.
Geochemistry: low-Ca pyroxene: $Fs_{60.9\pm0.5}Wo_{1.9\pm0.2}$ ($Fs_{59.7-61.6}Wo_{1.7-2.2}$, n=15, FeO/MnO=28-32); Ca-pyroxene: $Fs_{25.8\pm0.8}Wo_{42.6\pm0.9}$ ($Fs_{24.9-28.0}Wo_{40.8-44.2}$, n=16, FeO/MnO=27-32); calcic plagioclase: $An_{88.4\pm3.0}$ ($An_{84.9-93.5}$, n=14)

Northwest Africa 12667 (NWA 12667)
(Northwest Africa)
Purchased: 2018
Classification: Ureilite
History: The meteorite was purchased from a local meteorite dealer in Nouakchott, Mauritania.
Physical characteristics: Dark-brownish individual lacking any fusion crust.
Petrography: The meteorite displays a medium-grained cumulate texture of predominant up to 1 mm sized olivine grains and less abundant pigeonite. Contains some graphites flakes; olivine displays characteristic reduced rims.
Geochemistry: reduced rims in olivine: $Fa_{2.9-11.5}$; olivine contains 0.74±0.03 wt% Cr_2O_3 and 0.47±0.02 wt% CaO

Northwest Africa 12668 (NWA 12668)
(Northwest Africa)
Purchased: 2018
Classification: HED achondrite (Eucrite)
History: The meteorite was purchased from a local meteorite dealer in Laayoune, Mauritania.
Physical characteristics: Dark-grayish rock without fusion crust.
Petrography: The meteorite is a breccia with few basaltic clasts set into a coarse-grained clastic matrix predominantly composed of exsolved pyroxene and calcic plagioclase with average grain sizes of about 400 µm. Minor phases include silica, chromite, FeS, ilmenite, and barite; no metallic Fe has been found. The meteorite contains some shock melt veins.
Geochemistry: low-Ca pyroxene: $Fs_{60.7\pm0.7}Wo_{2.4\pm0.5}$ ($Fs_{58.9-61.8}Wo_{2.1-3.9}$, n=17, FeO/MnO=29-32); Ca-pyroxene: $Fs_{26.8\pm1.4}Wo_{43.2\pm1.5}$ ($Fs_{25.7-31.0}Wo_{38.3-44.1}$, n=12, FeO/MnO=30-34); calcic plagioclase: $An_{91.3\pm0.9}$ ($An_{89.5-93.1}$, n=13)

Northwest Africa 12669 (NWA 12669)
(Northwest Africa)
Purchased: 2018
Classification: HED achondrite (Eucrite)

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History: The meteorite was purchased from a local meteorite dealer in Laayoune, Mauritania.
Physical characteristics: Three grayish rocks with patches of fusion crust.
Petrography: The meteorite displays a grayish to light-greenish interior and is a breccia composed of up to 3 cm sized basaltic and impact melt clasts set into a fine-grained clastic matrix. Mineral phases are predominantly pyroxene with fine exsolution lamellae and calcic plagioclase with average grain sizes of about 80 µm. Minor phases include silica, ilmenite, chromite, troilite, and zircon. No metallic iron was detected.
Geochemistry: low-Ca pyroxene: $Fs_{52.4\pm1.2}Wo_{4.7\pm1.4}$ ($Fs_{49.7-53.9}Wo_{3.2-6.4}$, n=15, FeO/MnO=29-36); Ca-pyroxene: $Fs_{28.0\pm0.6}Wo_{39.7\pm0.5}$ ($Fs_{27.3-29.6}Wo_{38.2-40.7}$, n=13, FeO/MnO=28-33); calcic plagioclase: $An_{87.9\pm7.7}$ ($An_{70.2-94.5}$, n=17)

Northwest Africa 12670 (NWA 12670)
(Northwest Africa)
Purchased: 2018
Classification: Carbonaceous chondrite (CK3)
History: The meteorite was purchased from a local meteorite dealer in Laayoune, Mauritania.
Physical characteristics: Dark grayish to greenish individual with some fusion crust.
Petrography: The meteorite is composed of well separated and sharply defined chondrules (apparent mean diameter about 700 µm) set into abundant matrix dominated by ferrous olivine, plagioclase, and Cr-rich magnetite. Minor phases include Ca-pyroxene and FeNi-sulfides. While olivine and pyroxene appear equilibrated in the matrix, they show strong compositional zoning in chondrules.
Geochemistry: Fe-rich matrix olivine: $Fa_{33.0\pm0.3}$, FeO/MnO=127±11, n=12; unequilibrated olivine: $Fa_{16.0\pm13.8}$ ($Fa_{0.1-33.3}$, n=16); low-Ca pyroxene: $Fs_{13.4\pm11.7}Wo_{2.2\pm1.3}$ ($Fs_{1.3-29.4}Wo_{0.7-4.8}$, n=15); Ca-pyroxene: $Fs_{13.4\pm1.2}Wo_{49.3\pm0.1}$, n=5

Northwest Africa 12671 (NWA 12671)
(Northwest Africa)
Purchased: 2018
Classification: Carbonaceous chondrite (CK6)
History: The meteorite was purchased from a local meteorite dealer in Laayoune, Mauritania.
Physical characteristics: Many small dark greyish fragments some of which are partly covered with fusion crust.
Petrography: The meteorite displays a dark-grayish interior and predominantly consists of fine-grained recrystallized matrix dominated by ferrous olivine. Chondrules are only rarely encountered. Minor phases include intermediate plagioclase, low-Ca pyroxene, Ca-pyroxene, and FeNi-sulfides. Cr-rich magnetite is abundant; metal is virtually absent.

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Geochemistry: olivine: $Fa_{28.7\pm0.2}$ (FeO/MnO=100±10, n=11); low-Ca pyroxene: $Fs_{26.8\pm0.9}Wo_{0.5\pm0.1}$, n=12; Ca-pyroxene: $Fs_{8.4\pm0.3}Wo_{46.2\pm0.3}$, n=15

Northwest Africa 12672 (NWA 12672)
(Northwest Africa)
Purchased: 2018
Classification: Carbonaceous chondrite (CM2)
History: The meteorite was purchased from a local meteorite dealer in Morocco.
Physical characteristics: Three black fragments partly covered with fusion crust.
Petrography: Strongly brecciated matrix-dominated carbonaceous chondrite with chondrules (mean diameter about 300 µm), mineral fragments and few CAIs. Some of the components are dust-mantled. Matrix is Fe-rich and composed of Ca-carbonates, phyllosilicates, and Fe-sulfides. Cracks are often filled with terrestrial alteration products.

Northwest Africa 12673 (NWA 12673)
(Northwest Africa)
Purchased: 2018
Classification: Carbonaceous chondrite (CM2)
History: The meteorite was purchased from a local meteorite dealer in Morocco.
Physical characteristics: Many black fragments some of which are partly covered with fusion crust.
Petrography: The meteorite displays a black interior and is composed of small (mean diameter about 250 µm) chondrules, mineral fragments and CAIs set into an abundant fine-grained matrix. Many components are surrounded by fine-grained dust rims. Matrix is Fe-rich and contains abundant Fe-sulfides and Ca-carbonates and less abundant phyllosilicates (low analytical totals: matrix analyses yield an average total of 90.4 wt%, 5 µm defocused beam, N=5)

Northwest Africa 12674 (NWA 12674)
(Northwest Africa)
Purchased: 2019
Classification: Carbonaceous chondrite (CM2)
History: The meteorite was purchased from a local meteorite dealer in Morocco.
Physical characteristics: Six black fragments partly covered with fusion crust.
Petrography: Brecciated carbonaceous chondrite composed of small chondrules (mean diameter about 220 µm), CAIs, and mineral fragments some of which are surrounded by fine-grained dust rims. Matrix constituents include phyllosilicates (low analytical totals: matrix analyses yield an average total of 90.0 wt%, 5 µm defocused beam, N=5), Ca-carbonates, and pyrrhotite.

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Northwest Africa 12675 (NWA 12675)
(Northwest Africa)
Purchased: 2019
Classification: Carbonaceous chondrite (CV3)
History: The meteorite was purchased from a local meteorite dealer in Assamakka, Niger.
Physical characteristics: Large brownish to greenish individual without fusion crust.
Petrography: Carbonaceous chondrite composed of chondrules (mean diameter about 1 mm; up to 3 mm sized), CAIs (up to 8 mm sized), and olivine amoeboids all set into a fine-grained almost black matrix. Type II chondrules are absent. Many chondrules show reddish staining due to terrestrial weathering and cracks are filled with alteration products.

Northwest Africa 12676 (NWA 12676)
(Northwest Africa)
Purchased: 2019
Classification: Ordinary chondrite (H5, melt breccia)
History: The meteorite was purchased from a local meteorite dealer in Niger.
Physical characteristics: Three dark brownish fragments without fusion crust.
Petrography: The meteorite is a melt breccia composed of H5 chondritic regions (plagioclase grain size about 20 µm) and abundant up to 1 cm wide recrystallized melt rock veins and pockets with characteristic FeNi metal and sufide spherules. Some spheres are up to 6 mm in apparent diameter.

Northwest Africa 12677 (NWA 12677)
(Northwest Africa)
Purchased: 2018
Classification: Primitive achondrite (Acapulcoite)
History: Purchased by Larry Atkins from Morocco in October 2018.
Physical characteristics: 12 pieces that fit together to form a single stone, sandblasted exterior; saw cut surface reveals gray mosaic of silicate grains, many bright metal grains visible.
Petrography: (C. Agee, *UNM*) Microprobe examination shows texturally equilibrated grains of olivine, pyroxene, and plagioclase with many triple junctions. Grain size ranges ~50-400 µm. Metal makes up approximately 15% of this meteorite. Troilite and Cl-rich apatite are minor ubiquitous phases.
Geochemistry: (C. Agee, *UNM*) Olivine $Fa_{11.4\pm0.1}$, Fe/Mn=23±1, n=6; low-Ca pyroxene $Fs_{10.7\pm0.0}Wo_{2.0\pm0.3}$, Fe/Mn=13±0, n=3; high-Ca pyroxene $Fs_{4.5\pm0.4}Wo_{44.3\pm1.3}$, Fe/Mn=9±1, n=3; plagioclase $Ab_{80.4\pm0.5}An_{16.0\pm0.4}Or_{3.6\pm0.4}$, n=5.
Classification: Acapulcoite
Specimens: 21.8 g including a probe mount on deposit at *UNM*, Larry Atkins holds the main mass.

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Northwest Africa 12678 (NWA 12678)
(Northwest Africa)
Purchased: 2018
Classification: Ordinary chondrite (H5, melt breccia)
History: Purchased by Larry Atkins from Morocco in December 2018.
Physical characteristics: Two identically appearing pieces; saw-cut surfaces reveal a fragmental breccia, large portions of which consist of vesiculated melt rock. Significant oxidation visible.
Petrography: (C. Agee, *UNM*) Microprobe examination shows many melt rock veins crosscutting H5 chondrite domains with texturally equilibrated chondrules and recrystallized matrix. Plagioclase grain size up to 50 µm in diameter.
Geochemistry: (C. Agee, *UNM*) Olivine $Fa_{19.5\pm0.2}$, Fe/Mn=40±1, n=10; low-Ca pyroxene $Fs_{16.9\pm0.2}Wo_{1.5\pm0.4}$, Fe/Mn=22±2, n=6; plagioclase $Ab_{85.2\pm1.3}An_{11.3\pm0.2}Or_{3.5\pm1.4}$, n=3; shock melt SiO_2=43.8±3.2, TiO_2=0.13±0.02, Al_2O_3=2.9±0.6, Cr_2O_3=0.58±0.04, MgO=30.7±5.6, FeO=17.0±4.7, Mn=0.35±0.04, NiO=0.07±0.05, CaO=1.9±0.5, Na_2O=1.0±0.2, K_2O=0.21±0.13 (all wt%), n=4.
Classification: H5-melt breccia
Specimens: 27.5 g including a probe mount on deposit at *UNM*, Larry Atkins holds the main mass.

Northwest Africa 12679 (NWA 12679)
(Northwest Africa)
Purchased: 2019
Classification: Ordinary chondrite (H5, melt breccia)
History: Purchased by Larry Atkins from Morocco in January 2019.
Physical characteristics: Single stone; saw-cut surfaces reveal a fragmental breccia with melt rock veins crosscutting host chondrite. Metal grains scattered throughout. Oxidation staining visible.
Petrography: (C. Agee, *UNM*) Microprobe examination shows many melt rock veins crosscutting H5 chondrite domains with texturally equilibrated chondrules and recrystallized matrix. Plagioclase grain size up to 30 µm in diameter. Abundant Fe-Ni metal. Metal and sulfide blebs are present in shock melt veins. Numerous Fe-oxide veinlets are found throughout the meteorite.
Geochemistry: (C. Agee, *UNM*) Olivine $Fa_{19.0\pm0.6}$, Fe/Mn=38±2, n=10; low-Ca pyroxene $Fs_{16.5\pm0.5}Wo_{1.1\pm0.5}$, Fe/Mn=24±4, n=7; shock melt SiO_2=48.9±1.4, TiO_2=0.14±0.02, Al_2O_3=3.0±0.4, Cr_2O_3=0.63±0.08, MgO=29.8±2.0, FeO=13.1±0.5, Mn=0.41±0.01, CaO=2.4±0.4, Na_2O=0.98±0.14, K_2O=0.17±0.03 (all wt%), Fe/Mn=31±1, n=4.
Classification: H5-melt breccia
Specimens: 29.2 g including a probe mount on deposit at *UNM*, Larry Atkins holds the main mass.

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Northwest Africa 12680 (NWA 12680)
(Northwest Africa)
Purchased: 2018 Oct 5
Classification: Ordinary chondrite (L5, melt breccia)

History: Colvin purchased from Michael Gilmer (Galactic Stone and Ironworks) on October 5, 2018.

Physical characteristics: The exterior of the meteorite surrounds an 8 mm thick slice received by *Cascadia*. This ribbon of exterior consists of a weathered surface ranging from almost black to dark brown with patches of reddish oxide and pink/tan caliche. Cut faces show medium to dark gray, angular clasts, up to 2.3 × 1.8 cm in area, set in a dark gray to black matrix. Most clasts lack clearly defined chondrules in hand specimen. A small clast, which was not sectioned contains numerous readily distinguished chondrules.

Petrography: (M. Hutson, A. Ruzicka, *Cascadia*) A single blackened clast (approximately 2 × 0.6 cm area) fills most of the thin section, and a small triangular portion of another blackened clast (0.2 × 0.5cm; base × height) is visible in one corner of the section, with a melt-rich region along one edge of the section and between the clasts. Chondrules in both clasts are readily delineated. Silicates in both clasts are crosscut by small sulfide veins. Metal and sulfide grains appear fluidized with edges defined by the shapes of the surrounding silicate grains, and with some metal grains containing angular fragments of silicate grains. The melt region between clasts consists of weakly zoned olivine and pyroxene grains between about 20-40 µm across set in a much finer grained (< 5 µm across) matrix composed of grains of metal/sulfide, sulfide, and zoned pyroxene. This melt region contains larger metal-troilite grains, in which the troilite contains smaller blebs of metal. Coarser veins of mixed metal and sulfide cut across the melt regions. Areas containing networks of feldspathic glass are present.

Geochemistry: Mineral compositions and geochemistry: Olivine and pyroxene grains in the two clasts are essentially identical, and can be considered together: $Fa_{24.7\pm0.3}$, N=24; $Fs_{21.4\pm0.5}Wo_{1.4\pm0.5}$, N=22. Single zoned olivine and pyroxene grains in the melt region have slightly lower iron contents than those in the clasts: $Fa_{21.2\pm2.2}$, N=15; $Fs_{20.1\pm1.4}$, N=9.

Classification: Ordinary chondrite (L5-melt breccia) based on chemistry and texture. The two clasts are L5 chondrite fragments based on chemistry and texture. The presence in hand specimen of a small clast with more readily defined chondrules suggests that there may be clasts of a different petrographic type in the meteorite. The extensive melt matrix surrounding the clasts indicates this is a melt breccia.

Specimens: *Cascadia* holds 45.5 g in three pieces, in addition to a polished thin section and a mounted butt. The main mass is held by Colvin: Christopher Colvin, 20036 Fern Glen Ln. N., Forest Lake MN 55025).

Northwest Africa 12681 (NWA 12681)

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(Northwest Africa)
Purchased: 2016
Classification: HED achondrite (Eucrite)
History: The meteorite was purchased from a local meteorite dealer in Morocco.
Physical characteristics: Single stone partly covered with fusion crust.
Petrography: The meteorite is a fine-grained largely unbrecciated basalt predominantly composed of exsolved pyroxene and often lath-shaped calcic plagioclase with mean grain sizes of about 80 µm. Minor phases include silica, ilmenite, chromite, troilite, and metallic iron.
Geochemistry: low-Ca pyroxene: $Fs_{49.3\pm1.8}Wo_{13.3\pm2.2}$ ($Fs_{45.1-51.6}Wo_{10.4-18.3}$, n=25, FeO/MnO=31-35); Ca-pyroxene: $Fs_{36.4\pm0.5}Wo_{30.0\pm0.4}$ ($Fs_{35.6-37.0}Wo_{29.6-30.6}$, n=4, FeO/MnO=33); calcic plagioclase: $An_{88.2\pm2.2}$ ($An_{83.2-91.3}$, n=15)

Northwest Africa 12682 (NWA 12682)
(Northwest Africa)
Purchased: 2015
Classification: Ordinary chondrite (LL5)
History: The meteorite was purchased from a local meteorite dealer in Morocco.
Physical characteristics: Single stone partly covered with fusion crust.
Petrography: Plagioclase grain size about 40 µm. Breccia.

Northwest Africa 12683 (NWA 12683)
(Northwest Africa)
Purchased: 2016
Classification: Carbonaceous chondrite (CK5)
History: The meteorite was purchased from a local meteorite dealer in Morocco.
Physical characteristics: Single grayish to greenish rock with some fusion crust.
Petrography: The meteorite displays a grayish to greenish interior and is predominantly composed of recrystallized olivine-dominated matrix with some scattered chondrules still being discernable. Cr-rich magnetite is abundant. More minor phases include intermediate plagioclase, low-Ca pyroxene, and troilite; metal was not detected.
Geochemistry: olivine: $Fa_{30.6\pm0.2}$ (FeO/MnO=134±21, n=13); low-Ca pyroxene: $Fs_{26.0\pm0.5}Wo_{0.9\pm0.1}$, n=11

Northwest Africa 12684 (NWA 12684)
(Northwest Africa)
Purchased: unknown
Classification: Ordinary chondrite (LL6)
History: The meteorite was purchased from a local meteorite dealer in Morocco.
Physical characteristics: Three greyish fragments without fusion crust.

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Petrography: The meteorite is a LL6 breccia with abundant shock melt veins. Plagioclase grain size is about 70 µm.

Northwest Africa 12685 (NWA 12685)
(Northwest Africa)
Purchased: 2017
Classification: Rumuruti chondrite (R3)
History: The meteorite was purchased from a local meteorite dealer in Zagora, Morocco.
Physical characteristics: Thirty dark brownish individuals partly covered with fusion crust.
Petrography: The meteorite is a breccia with well defined chondrules (apparent mean diamter 400 µm) set into abundant matrix dominated by Fe-rich olivine. Compositionally unequilibrated olivine and pyroxene occur in chondrules and as single mineral fragments. More minor phases include Ca-pyroxene, sodic plagioclase, sulfides, and Ti-bearing chromite; no metal was detected. The meteorite contains recrystallized melt clasts.
Geochemistry: olivine: $Fa_{25.7\pm12.1}$ ($Fa_{9.1-38.2}$, n=32); low-Ca pyroxene: $Fs_{17.9\pm10.5}Wo_{1.0\pm0.8}$ ($Fs_{0.5-29.6}Wo_{0.3-3.5}$, n=21); Ca-pyroxene: $Fs_{11.4\pm1.0}Wo_{44.2\pm1.0}$ ($Fs_{9.7-12.9}Wo_{41.9-45.7}$, n=11)

Northwest Africa 12686 (NWA 12686)
(Northwest Africa)
Purchased: 2016
Classification: HED achondrite (Eucrite)
History: The meteorite was purchased from a local meteorite dealer in Morocco.
Physical characteristics: Single stone partly covered with fusion crust.
Petrography: The meteorite is a polymict breccia with fine-grained basaltic clasts (average mineral grain sizes about 80 µm) set into a coarse-grained basaltic matrix (average mineral grain sizes about 400 µm). Dominant minerals are exsolved pyroxene and calcic plagioclase. Minor phases include silica, ilmenite, chromite, troilite, and metallic iron.
Geochemistry: low-Ca pyroxene: $Fs_{62.9\pm1.0}Wo_{4.3\pm1.2}$ ($Fs_{61.2-64.2}Wo_{2.8-6.0}$, n=12, FeO/MnO=27-30); Ca-pyroxene: $Fs_{33.2\pm3.0}Wo_{38.6\pm3.3}$ ($Fs_{29.8-37.5}Wo_{33.6-42.3}$, n=10, FeO/MnO=29-35); calcic plagioclase: $An_{79.6\pm4.1}$ ($An_{72.2-84.2}$, n=15)

Northwest Africa 12689 (NWA 12689)
Morocco
Purchased: 2014
Classification: HED achondrite (Eucrite, brecciated)
History: A single stone of 629 g was purchased from a Moroccan dealer by Dr. R. McKenzie in 2014.

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Physical characteristics: Light-brown lithic clasts 0.5 to 1.5 cm across protrude through partly preserved, dark-brown fusion crust. Cut surface shows rounded lithic clasts, some of which contain feldspar laths up to ~1 mm long, surrounded by fine grained, dark-brown to black matrix.

Petrography: (L. Vonopartis and L. Ashwal, *Wits*) A monomict eucrite breccia with angular to rounded lithic clasts up to 15 mm across, in a glassy matrix that contains mineral fragments and broken lithic clasts 0.1 to 5 mm across. Most of the lithic clasts are composed of subequal proportions of coarse-grained, subhedral plagioclase laths up to 1.2 mm long, surrounded by irregular sub-ophitic grains of low-Ca pyroxene, many of which contain augite exsolution lamellae of variable thickness. The overall texture of these lithic clasts resembles terrestrial dolerites or coarse-grained basalts, but differs from the coarse, equigranular textures typical of unbrecciated cumulate eucrites. A small proportion of lithic clasts consist of fine-grained (0.01 to 0.05 mm) granoblastic aggregates of plagioclase and pyroxene, with angular mineral fragments up to 0.5 mm across. The matrix consists of dark brown, partly devitrified glass with some evidence for flow textures, which is charged with highly comminuted lithic and mineral fragments 0.01 to 0.5 mm across, very likely representing fragmental material derived from the larger lithic clasts. Both feldspars and pyroxenes in all components of the specimen show variable shock features, including kinked and offset twins, undulatory extinction and mosaicism; some plagioclases have been completely maskelynitized. Accessory minerals include chromite, ilmenite and a silica phase.

Geochemistry: Mineral compositions and geochemistry: (L. Vonopartis and L. Ashwal, *Wits*; D. Van Niekerk, Rhodes University; R. Greenwood, *OU*) Low-Ca pyroxene is homogeneous ($Fs_{59.6\pm1.4}Wo_{3.4\pm1.4}$) and contains augite exsolution lamellae ($Fs_{25.5\pm0.7}Wo_{44.1\pm1.6}$). Plagioclase is somewhat more variable ($Ab_{10.4\pm1.6}An_{88.9\pm1.7}Or_{0.6\pm0.2}$), but individual grains show no compositional zoning. Accessory chromite has Mg/(Mg+Fe) = 3.75 and Cr/(Cr+Al) = 80.29; ilmenite has MgO = 0.75±0.05 and MnO = 1.52±0.05. Dark brown glass in the matrix is basaltic, with SiO_2 = 49.1±0.6, Al_2O_3 = 19.4±2.1 and Mg/(Mg+Fe) = 34.4±2.2. Oxygen isotope analyses on 150 mg of powdered sample yielded: $\delta^{17}O$ = 1.855±0.45 ‰, $\delta^{18}O$ = 3.997±0.10 ‰, $\Delta^{17}O$ = -0.223±0.007 ‰.

Classification: (L. Vonopartis and L. Ashwal, *Wits*) Achondrite (eucrite). High degree of shock (S5), and low degree of weathering.

Specimens: Main mass 490 g held in private collection of Dr. R. McKenzie. Type specimen 86 g, and 3 chips (8, 10, 18 g) remaining after thin section preparation *Wits*. A 150 mg subsample from an 18 g chip was powdered and consumed for oxygen isotopic analyses at *OU*.

Northwest Africa 12690 (NWA 12690)

NWA
Find: 2018 Dec
Classification: Martian meteorite (Shergottite)

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History: The meteorite was reportedly found December 16, 2018, by a Malian nomad near Achemeleml and purchased in 2019 by Ben Hoefnagels in Niger. One fragment was analyzed by Ansgar Greshake at *MNB* and the analysis of a second fragment was initiated by Ben Hoefnagels and conducted by Paul Carpenter, WUSTL.
Physical characteristics: Large greenish individual with some fusion crust.
Petrography: The meteorite has a diabasic texture and is predominantly composed of up to 3 mm sized calcic pyroxenes that show complex patchy compositional zoning and equally sized maskelynite grains. Minor phases include ilmenite, ulvospinel, merrillite, and pyrrhotite. Some myrmekitic breakdown assemblages consisting of Fe-rich pyroxene, fayalite, and silica are present. The meteorite is highly shocked and contains abundant shock melt pockets.
Geochemistry: (A. Greshake, *MNB*) pigeonite: $Fs_{53.2\pm18.9}Wo_{13.6\pm2.6}$ ($Fs_{27.2-76.2}Wo_{8.9-18.1}$, n=26, FeO/MnO=26-42); augite: $Fs_{28.5\pm4.4}Wo_{28.7\pm5.9}$ ($Fs_{24.5-37.1}Wo_{20.8-35.2}$, n=15, FeO/MnO=26-34); maskelynite: $An_{62.3}Ab_{37.4}Or_{0.3}$, n=22; P. Carpenter (Washington University, St. Louis) Ca-pyroxene cores: $Wo_{24.8-35.0}En_{42.2-49.2}Fs_{21.0-26.2}$, N=3, FeO/MnO 28-30; Ca-pyroxene rims: $Wo_{14.7-40.3}En_{2.3-19.6}Fs_{57.4-72.0}$, N=3, FeO/MnO 38-43; fayalite: $Fa_{96.5}$, N=1, maskelynite: $An_{61.4}Ab_{38.4}Or_{0.2}$, N=1.
Classification: Martian (diabasic shergottite)
Specimens: 34.4 g are at *MNB* and 14.36 g are at *UWB*; 20 g with Mr. B. Hoefnagels. Main mass with anonymous owner.

Northwest Africa 12691 (NWA 12691)
(Northwest Africa)
Find: 2017 Jan
Classification: Lunar meteorite (feldspathic breccia)
History: Scores of specimens (total weight 103.770 kg) were found in January 2017 in Western Sahara or the Western Sahara/Algeria border region, and purchased by Darryl Pitt in February 2017 from a Mauritanian dealer. The largest specimens weigh 15.555 kg, 15.435 kg, 13.650 kg, 12.480 kg, 8.960 kg and 3.460 kg; nine specimens weigh between 1-4 kg, 31 specimens weigh between 100-500 g, and there are numerous smaller fragments.
Petrography: (A. Irving, *UWS* and P. Carpenter, *WUSL*) Breccia composed of angular mineral clasts of anorthite, olivine, pigeonite, subcalcic augite, chromite and ilmenite, together with some quench-textured lithic clasts, set in a sparsely vesicular, parly vitreous matrix containing minor troilite, kamacite and taenite.
Geochemistry: Olivine ($Fa_{21.5-47.7}$, FeO/MnO = 87-102, N = 4), pigeonite ($Fs_{38.5-43.0}Wo_{7.1-5.3}$, FeO/MnO = 57-58, N = 2), subcalcic augite ($Fs_{38.4}Wo_{24.0}$, FeO/MnO = 53), plagioclase ($An_{96.7}Or_{0.1}$).
Classification: Lunar (feldspathic breccia).
Specimens: 20.3 g including four polished endcuts from separate stones at *UWB*; remainder with *DPitt*.

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Northwest Africa 12692 (NWA 12692)
Mali
Purchased: March 2019
Classification: Ordinary chondrite (LL3.00)

History: Reportedly found in 2012 by nomads in Mali. Purchased in Morocco, March 2019.

Physical characteristics: Sixteen identically appearing stones with masses ranging from 2-157 g. Exterior surface is desert-weathered with some caliche, no fusion crust. A saw-cut surface reveals many densely packed chondrules, the largest of which is 7 mm in diameter. The largest chondrule (or clast) is irregular in shape and has vesicles. The matrix is black and a few sulfide/metal grains are visible.

Petrography: (C. Agee, *UNM*) Microprobe examination of a polished mount shows numerous unequilibrated chondrules, apparent mean diameter 600±575 µm (n=47), many with porphyritic, igneous-zoned olivines and pyroxenes, most with glass or mesostasis. Abundant fine-grained matrix is present throughout. Minor metal.

Geochemistry: (C. Agee, *UNM*) Chondrule olivine $Fa_{12.4\pm6.5}$, Fe/Mn=41±20, Cr_2O_3=0.40±0.11 wt%, n=31; chondrule low-Ca pyroxene $Fs_{3.1\pm1.8}Wo_{0.7\pm0.8}$, Fe/Mn=9±3 n=10. Ferroan chondrules with pyroxenes are rare: most pyroxenes analyzed were in Mg-rich type I chondrules, hence the low Fs mean value.

Classification: Ordinary chondrite (LL3.00). LL based on chondrule size and low abundance of metal. Type 3.00 based on ferroan olivine mean Cr_2O_3 content and sigma from Grossman and Brearley (2005) and by the presence of S-rich opaque matrix. Comparison of Cr_2O_3 in ferroan chondrule olivines with those done using the same microprobe and conditions at *UNM* gave: NWA 7731 (L3.00) Cr_2O_3=0.43±0.11 wt%, n=98; NWA 8276 (L3.00) Cr_2O_3=0.42±0.10 wt%; Semarkona (LL3.00) Cr_2O_3=0.41±0.09 wt%, n=45.

Specimens: 25 g on deposit at *CSFK*, probe mount at *UNM*, *ZKereszty* holds the main mass.

Northwest Africa 12693 (NWA 12693)
Mauritania
Purchased: 2018
Classification: Ordinary chondrite (H4)

History: Reportedly found in 2018 by nomads in Mauritania. Purchased in Ensisheim from a Moroccan meteorite dealer, 2018.

Physical characteristics: Single stone, tetrahedron shaped, covered with fresh black fusion crust and contraction cracks; flow lines present. A cut surface shows a breccia with two different appearing lithologies. The host lithology has many distinct chondrules set in a dark-gray matrix; the secondary lithology within the host are angular fragments that appear to be more oxidized, with significant iron staining and chondrules that are less distinct.

Petrography: (C. Agee, *UNM*) Microprobe examination of a polished mount shows numerous chondrules; BR, BO, GO, and porphyritic observed, some with mesostasis. Plagioclase grain size <2 µm. Abundant metal and sulfide is present throughout.

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Geochemistry: (C. Agee, *UNM*) Olivine $Fa_{19.2\pm3.1}$, Fe/Mn=40±9, n=17; low-Ca pyroxene $Fs_{16.4\pm0.3}Wo_{1.5\pm0.6}$, Fe/Mn=9±3 n=10.
Classification: Ordinary chondrite (H4). Olivine is not fully equilibrated, but the presence of fine-grained plagioclase indicate a metamorphic type 4 rather than 3.
Specimens: 20 g on deposit at *CSFK*, probe mount at *UNM*, *ZKereszty* holds the main mass.

Northwest Africa 12694 (NWA 12694)
Algeria
Purchased: 2018
Classification: HED achondrite (Howardite)
History: Reportedly found in 2018 by nomads in Algeria. Purchased in Ensisheim from a Moroccan meteorite dealer, 2018.
Physical characteristics: Single stone covered with fusion crust, some of which is slightly weathered, while some patches show shiny black glass with contraction cracks and flight-smooth edges; possibly oriented. The cut surface reveals a fragmental breccia of light and dark clasts set in a light-gray groundmass.
Petrography: (C. Agee, *UNM*) Microprobe examination of a polished mount shows a polymict breccia of basaltic eucrite grains (~60%) and diogenite grains (~40%). Most eucritic pyroxenes display exsolution lamellae and are typically finer-grained than the diogenitic pyroxene grains. Accessory olivine, chromite, silica, and troilite was observed.
Geochemistry: (C. Agee, *UNM*) Olivine $Fa_{50.7\pm4.3}$, Fe/Mn=45±2, n=2; eucritic pyroxene $Fs_{49.1\pm11.3}Wo_{13.7\pm12.7}$, Fe/Mn=31±2 n=12; diogenitic pyroxene $Fs_{24.6\pm3.2}Wo_{2.4\pm0.8}$, Fe/Mn=28±2 n=8; plagioclase $An_{90.6\pm5.5}$, n=8.
Classification: Howardite
Specimens: 20 g on deposit at *CSFK*, probe mount at *UNM*, *ZKereszty* holds the main mass.

Northwest Africa 12695 (NWA 12695)
(Northwest Africa)
Purchased: March 2015
Classification: Lunar meteorite (anorth)
History: Purchased from a meteorite dealer in Erfoud, Morocco.
Physical characteristics: Single stone consisting of approximately 80% white to light-gray colored, brecciated lithology and 20% dark-colored lithology containing fragments of white to light-gray colored clasts.
Petrography: (C. Agee,*UNM*) Microprobe examination was performed on a polished slab of the *UNM* deposit sample. The dominant lithology is an anorthosite with approximately 90-95% modal plagioclase with minor amounts of ubiquitous olivine, pyroxene, and ilmenite. The minor lithology is a fragmental breccia of primarily plagioclase, olivine, and pyroxene. Minor amounts of ilmenite, chromite, and silica-alkali feldspar intergrowths were also observed.

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Geochemistry: (C. Agee,*UNM*) Plagioclase $An_{96.2\pm0.8}Ab_{3.6\pm0.7}Or_{0.2\pm0.1}$, n=9; clinopyroxene $Fs_{31.9\pm10.0}Wo_{20.0\pm8.9}$, Fe/Mn=58±6, n=13; olivine $Fa_{38.5\pm2.0}$, Fe/Mn=103±2.
Classification: Lunar, anorthosite.
Specimens: 21.4 g on deposit at *UNM*, *DPitt* holds the main mass.

Northwest Africa 12696 (NWA 12696)
Algeria
Purchased: 2017
Classification: HED achondrite (Eucrite, melt breccia)
History: Reportedly found in Algeria. Approximately 200 identically appearing pieces were purchased during a period commencing October 2017 from dealers in Mauritania and Morocco through February 2018, after which it was sold at the Tucson Show by numerous meteorite dealers.
Physical characteristics: Saw cut reveals domains of vesiculated, dark gray, shock melt grading into a fragmental breccia of light-colored basaltic clasts.
Petrography: (C. Agee, *UNM*) Microprobe examination shows basaltic clasts with approximately 60% pyroxene and 35% plagioclase grains most in the range 200-500 µm. Many pyroxene grains have exsolution lamellae. Shock melt veins and pockets are found throughout, many containing fragmental pyroxene and plagioclase grains. Ubiquitous minor chromite, troilite, and ilmenite were observed.
Geochemistry: (C. Agee, *UNM*) Low-Ca pyroxene $Fs_{61.9\pm1.4}Wo_{2.5\pm0.8}$, Fe/Mn=31±1, n=8; high-Ca pyroxene $Fs_{30.6\pm5.9}Wo_{39.7\pm5.8}$, Fe/Mn=32±1, n=4; plagioclase $An_{88.4\pm2.1}$, n=6.
Classification: Eucrite-melt breccia, eucrite clasts are consistent with type 6 (Takeda and Graham, 1991) showing clear compositional separation of low and high calcium pyroxenes. Possibly paired with NWA 12342.
Specimens: 22.7 g on deposit at *UNM*, *DPitt* holds the main mass.

Northwest Africa 12697 (NWA 12697)
(Northwest Africa)
Purchased: 2018 Jun
Classification: Lunar meteorite (feldspathic breccia)
History: Purchased from a mineral dealer in Marrakech, Morocco. Purportedly found near Tindouf, Algeria.
Petrography: (K. Metzler, *IfP*) Polymict achondritic breccia, consisting of mineral fragments (olivine, pyroxene, plagioclase) and lithic clasts (anorthosites, melt rocks, basalt), set in a nearly black matrix of fine-grained related debris. Intermingled are clast-rich melt particles with ill-defined outlines. Pyroxenes with and without exsolution lamellae are observed. Accessories are Fe,Ni metal, ilmenite, and troilite.
Geochemistry: Mineral compositions and geochemistry: Olivine: $Fa_{35.4\pm8.0}$ (24.5-50.5); Fe/Mn (at.): 88-116; n=7. Pyroxene $Fs_{35.3\pm11.8}Wo_{12.3\pm5.9}$ ($Fs_{22.3-53.0}Wo_{3.9-21.8}$); Fe/Mn (at.): 44-87; n=11. Plagioclase $An_{95.7\pm2.3}$ ($An_{91.0-98.8}$); n=8.

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Classification: Lunar feldspathic breccia

Northwest Africa 12698 (NWA 12698)
(Northwest Africa)
Purchased: 2018
Classification: Carbonaceous chondrite (CR2)
History: Found in the Arg-Shash region located at the Mauritanian-Algerian border by desert nomads in spring 2018.
Physical characteristics: Single stone, ~90% fusion encrusted trapezoidal-shaped stone; saw cut reveals numerous chondrules up to 2 mm in diameter and scattered CAIs. Dark, gray-colored groundmass makes up about 30% of this meteorite; ubiquitous opaques visible.
Petrography: (C. Agee, *UNM*) Microprobe examination showed many porphyritic chondrules most of which were type I. Many chondrules are metal-rich; often decorated or mantled with metal. Abundant fine grained, hydrous matrix throughout. Aluminous diopside detected.
Geochemistry: (C. Agee, *UNM*) Forsterite $Fa_{2.4\pm2.3}$, Fe/Mn=27±19, Cr_2O_3=0.29±0.12 wt%, n=12; enstatite $Fs_{1.7\pm1.3}Wo_{1.7\pm1.2}$, Fe/Mn=12±10, n=12.
Classification: Carbonaceous chondrite (CR2), possibly paired with NWA 12197.
Specimens: 20.1 g on deposit at *UNM*, *DPitt* holds the main mass.

Northwest Africa 12699 (NWA 12699)
(Northwest Africa)
Purchased: 2018
Classification: Carbonaceous chondrite (CK3)
History: The meteorite was purchased from a local meteorite dealer in Erfoud, Morocco.
Physical characteristics: Dark brownish rock without fusion crust.
Petrography: The meteorite is composed of sparse well defined chondrules (apparent mean diameter about 600 µm) set into abundant matrix dominated by Fe-rich olivine, plagioclase, and Cr-rich magnetite. Minor phases include low-Ca pyroxene, Ca-pyroxene, and FeNi-sulfides. Olivine and pyroxene appear equilibrated in the matrix and show strong compositional zoning in chondrules and chondrule fragments. The meteorite is a breccia and contains abundant and up to 1 mm wide shock melt veins.
Geochemistry: Fe-rich matrix olivine: $Fa_{32.3\pm0.4}$, FeO/MnO=110±8, n=10; unequilibrated olivine: $Fa_{17.0\pm9.4}$ ($Fa_{0.9\text{-}31.7}$, n=19); low-Ca pyroxene: $Fs_{9.3\pm8.5}Wo_{1.3\pm0.2}$ ($Fs_{2.2\text{-}22.9}Wo_{0.9\text{-}1.6}$, n=7); Ca-pyroxene: $Fs_{10.3\pm1.0}Wo_{45.0\pm3.1}$, n=12

Northwest Africa 12700 (NWA 12700)
(Northwest Africa)
Purchased: 2019

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Classification: HED achondrite (Eucrite, monomict)

History: The meteorite was purchased from a local meteorite dealer in Guelmin, Morocco.

Physical characteristics: Flat shaped single stone partly covered by fusion crust.

Petrography: The meteorite is a breccia with fine- and coarse-grained basaltic and black melt clasts set into a clastic mineral matrix. Dominant minerals are exsolved pyroxene and calcic plagioclase of highly variable grain sizes between 80 µm and 1 mm. Minor phases include silica, chromite, FeS, and ilmenite. No metallic Fe has been found.

Geochemistry: low-Ca pyroxene: $Fs_{59.8\pm0.5}Wo_{2.2\pm0.2}$ ($Fs_{58.9-60.6}Wo_{1.8-2.8}$, n=11, FeO/MnO=29-31); Ca-pyroxene: $Fs_{25.4\pm0.9}Wo_{43.5\pm1.0}$ ($Fs_{24.1-27.0}Wo_{41.8-45.0}$, n=15, FeO/MnO=26-35); calcic plagioclase: $An_{91.7\pm0.6}$ ($An_{90.7-92.8}$, n=16)

Northwest Africa 12701 (NWA 12701)

(Northwest Africa)

Purchased: 2019

Classification: HED achondrite (Eucrite, monomict)

History: The meteorite was purchased from a local meteorite dealer in Zagora, Morocco.

Physical characteristics: Single stone lacking any fusion crust.

Petrography: The meteorite is a breccia with up tp 7 mm sized basaltic and black melt clasts set into a clastic mineral matrix. Dominant minerals are exsolved pyroxene and calcic plagioclase of highly variable grain sizes between 30 µm and 1 mm. Minor phases include silica, chromite, FeS, ilmenite, and metallic Fe.

Geochemistry: pyroxene host to augite lamellae: $Fs_{66.1.0\pm1.9}Wo_{3.3\pm0.6}$ ($Fs_{60.4-67.5}Wo_{3.0-4.7}$, n=12, FeO/MnO=31-34); Ca-pyroxene: $Fs_{27.1\pm1.1}Wo_{41.1\pm0.6}$ ($Fs_{25.3-28.7}Wo_{40.0-42.5}$, n=9, FeO/MnO=29-32); diogenitic pyroxene: $Fs_{31.4\pm3.5}Wo_{3.2\pm0.4}$ ($Fs_{28.8-38.1}Wo_{2.4-4.0}$, n=12, FeO/MnO=27-33); calcic plagioclase: $An_{92.1\pm0.9}$ ($An_{90.4-93.6}$, n=13)

Northwest Africa 12702 (NWA 12702)

(Northwest Africa)

Purchased: 2019

Classification: Ureilite

History: The meteorite was purchased from a local meteorite dealer in Essouira, Morocco.

Physical characteristics: Two brownish stones 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: $Fa_{1.9-6.7}$; olivine contains 0.78±0.03 wt% Cr_2O_3 and 0.38±0.02 wt% CaO

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Northwest Africa 12703 (NWA 12703)
(Northwest Africa)
Purchased: 2019
Classification: HED achondrite (Eucrite, monomict)
History: The meteorite was purchased from a local meteorite dealer in Zagora, Morocco.
Physical characteristics: Single stone with some fusion crust.
Petrography: The meteorite is a breccia composed of rare black impact melt clasts set into a basaltic matrix dominated by exsolved pyroxene and often lath shaped calcic plagioclase with grain sizes of about 300 µm. Minor phases include silica, chromite, FeS, ilmenite, fayalite, and metallic Fe.
Geochemistry: low-Ca pyroxene: $Fs_{64.5\pm0.7}Wo_{2.1\pm0.6}$ ($Fs_{63.4-65.6}Wo_{1.5-3.5}$, n=13, FeO/MnO=29-32); Ca-pyroxene: $Fs_{36.7\pm1.3}Wo_{36.5\pm1.4}$ ($Fs_{34.3-39.1}Wo_{34.2-38.6}$, n=13, FeO/MnO=29-35); calcic plagioclase: $An_{83.6\pm2.4}$ ($An_{78.9-87.3}$, n=16)

Northwest Africa 12704 (NWA 12704)
(Northwest Africa)
Purchased: 2019
Classification: HED achondrite (Eucrite)
History: The meteorite was purchased from a local meteorite dealer in Zagora, Morocco.
Physical characteristics: Single stone partly covered by fusion crust.
Petrography: The meteorite is an unbrecciated coarse-grained basaltic rock predominantly composed of exsolved pyroxene and more blocky calcic plagioclase with average grain sizes of about 2 mm. Minor phases include silica, chromite, and troilite. No metallic iron has been found.
Geochemistry: low-Ca pyroxene: $Fs_{45.9\pm0.4}Wo_{2.1\pm0.3}$ ($Fs_{45.0-46.4}Wo_{1.7-2.5}$, n=18, FeO/MnO=29-32); Ca-pyroxene: $Fs_{19.2\pm0.6}Wo_{42.3\pm1.2}$ ($Fs_{18.3-21.0}Wo_{39.3-44.5}$, n=18, FeO/MnO=24-27); calcic plagioclase: $An_{91.6\pm0.4}$ ($An_{90.9-92.3}$, n=14)

Northwest Africa 12705 (NWA 12705)
(Northwest Africa)
Purchased: 2019
Classification: Ureilite
History: The meteorite was purchased from a local meteorite dealer in Zagora, Morocco.
Physical characteristics: Single light brownish stone without fusion crust.
Petrography: The meteorite displays a characteristic cumulate texture of up to 1.5 mm sized olivine and pigeonite crystals. Grains are often elongated and show a preferred orientation. Reduced rims in olivine are abundant. The meteorite contains flaky graphite.
Geochemistry: reduced rims in olivine: $Fa_{2.0-10.6}$; olivine contains 0.50±0.03 wt% Cr_2O_3 and 0.30±0.02 wt% CaO

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Northwest Africa 12706 (NWA 12706)
(Northwest Africa)
Purchased: 2019
Classification: HED achondrite (Eucrite, monomict)

History: The meteorite was purchased from a local meteorite dealer in Zagora, Morocco.

Physical characteristics: Several small fragments ranging from 2.53 g to less than 0.1 g.

Petrography: The meteorite is a breccia with small up to 700 µm sized basaltic and black melt clasts set into a clastic mineral matrix. Dominant minerals are exsolved pyroxene and calcic plagioclase of highly variable grain sizes between 10 and 400 µm. Minor phases include silica, chromite, FeS, and fayalite. No metallic Fe has been found.

Geochemistry: low-Ca pyroxene: $Fs_{56.0\pm2.8}Wo_{3.2\pm0.8}$ ($Fs_{52.9-59.4}Wo_{2.3-4.2}$, n=11, FeO/MnO=30-35); Ca-pyroxene: $Fs_{28.9\pm1.0}Wo_{41.0\pm2.0}$ ($Fs_{27.4-31.0}Wo_{36.7-42.5}$, n=15, FeO/MnO=26-36); calcic plagioclase: $An_{90.8\pm1.0}$ ($An_{89.1-92.2}$, n=14)

Northwest Africa 12707 (NWA 12707)
(Northwest Africa)
Purchased: 2019
Classification: Ureilite

History: The meteorite was purchased from a local meteorite dealer in Zagora, Morocco.

Physical characteristics: Single dark brownish stone without fusion crust.

Petrography: The meteorite shows a cumulate texture composed of up to 1.5 mm sized olivine and pigeonite grains. Olivine shows strong compositional zoning and displays characteristic reduced rims; the meteorite contains flaky graphite.

Geochemistry: reduced rims in olivine: $Fa_{2.4-7.3}$; olivine contains 0.75±0.03 wt% Cr_2O_3 and 0.34±0.02 wt% CaO

Northwest Africa 12708 (NWA 12708)
(Northwest Africa)
Purchased: 2019
Classification: HED achondrite (Eucrite)

History: The meteorite was purchased from a local meteorite dealer in Zagora, Morocco.

Physical characteristics: Single stone with some fusion crust.

Petrography: The meteorite is an unbrecciated coarse-grained basaltic rock predominantly composed of typically 200 µm sized exsolved pyroxene and up to 1 mm sized blocky calcic plagioclase. Minor phases include silica, chromite, troilite, ilmenite, and zircon. No metallic iron has been found.

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Geochemistry: low-Ca pyroxene: $Fs_{60.3\pm0.6}Wo_{2.4\pm0.5}$ ($Fs_{59.4-62.1}Wo_{1.9-3.6}$, n=13, FeO/MnO=31-33); Ca-pyroxene: $Fs_{27.1\pm0.4}Wo_{42.5\pm0.4}$ ($Fs_{26.5-27.7}Wo_{41.9-43.2}$, n=14, FeO/MnO=30-34); calcic plagioclase: $An_{89.2\pm2.6}$ ($An_{80.6-91.8}$, n=16)

Northwest Africa 12709 (NWA 12709)
(Northwest Africa)
Purchased: 2019
Classification: Ordinary chondrite (H6, melt breccia)
History: The meteorite was purchased from a local meteorite dealer in Nouakchott, Mauritania.
Physical characteristics: Six stones lacking any fusion crust.
Petrography: The meteorite is a metal-rich impact melt rock consisting of abundant and partly recrystallized shock melt regions with characteristic FeNi metal and sufide spherules. It contains few chondritic regions with relictic chondrules and mineral fragments of H6 type (plagioclase grain size about 70 µm); no metal or sulfide veins are observed.

Northwest Africa 12710 (NWA 12710)
(Northwest Africa)
Purchased: 2019
Classification: Ureilite
History: The meteorite was purchased from a local meteorite dealer in Zagora, Morocco.
Physical characteristics: Flat shaped single brownish stone.
Petrography: The meteorite displays a characteristic cumulate texture of about 1 mm sized equigranular olivine and pigeonite crystals. Reduced rims in olivine are abundant. The meteorite contains flaky graphite.
Geochemistry: reduced rims in olivine: $Fa_{0.9-7.3}$; olivine contains 0.76±0.03 wt% Cr_2O_3 and 0.34±0.03 wt% CaO

Northwest Africa 12711 (NWA 12711)
(Northwest Africa)
Purchased: 2018
Classification: HED achondrite (Eucrite)
History: The meteorite was purchased from a local meteorite dealer in Morocco.
Physical characteristics: Two fragments partly covered with fusion crust.
Petrography: The meteorite is a coarse-grained monomict basaltic breccia predominantly composed of esxolved pyroxene and calcic plagioclase grains up to 2.5 mm in size. Minor phases include silica, chromite, ilmenite, and metallic iron. The meteorite contains several shock melt veins.

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Geochemistry: low-Ca pyroxene: $Fs_{59.7\pm0.6}Wo_{2.1\pm0.4}$ ($Fs_{558.4-60.9}Wo_{1.6-3.0}$, n=18, FeO/MnO=29-33); Ca-pyroxene: $Fs_{25.8\pm0.4}Wo_{43.3\pm0.6}$ ($Fs_{25.1-26.6}Wo_{42.0-44.2}$, n=15, FeO/MnO=27-33); calcic plagioclase: $An_{88.9\pm0.5}$ ($An_{88.2-90.2}$, n=15)

Northwest Africa 12712 (NWA 12712)
(Northwest Africa)
Find: 2018
Classification: Carbonaceous chondrite (CV3)

Petrography: (K. Metzler, *IfP*) Chondrules, chondrule fragments, CAIs, and AOAs are embedded in a fine-grained dark matrix (about 30 vol% matrix). The matrix is Allende-like, mainly consisting of tiny (<5-20 µm) elongated olivine grains. Many chondrules have apparent diameters between 0.5 and 1 mm, some up to 2.5 mm. CAIs with sizes up to 2 mm are present. Small amounts of sulfides and traces of metal have been found.

Geochemistry: Mineral compositions and geochemistry: The mean olivine composition is $Fa_{7.3\pm4.6}$ ($Fa_{0.5-20.8}$; n=25). The mean low-Ca pyroxene composition is $Fs_{1.5\pm0.6}Wo_{1.0\pm0.4}$ ($Fs_{0.7-2.9}Wo_{0.5-1.7}$; n=14). The composition of matrix olivine (not included in Fa statistics) is $Fa_{49.3\pm1.4}$ ($Fa_{46.8-50.1}$; n=5).

Classification: CV chondrite based on CAI and AOA occurrence, size of chondrules and CAIs, chondrule-matrix ratio, and mineral chemistry. Petrologic type 3 based on the chemical variation of olivine and pyroxene

Northwest Africa 12713 (NWA 12713)
(Northwest Africa)
Find: 2018
Classification: Carbonaceous chondrite (CV3)

Petrography: (K. Metzler, *IfP*) Chondrules, chondrule fragments, CAIs, and AOAs are embedded in a fine-grained dark matrix (about 30 vol% matrix). Many chondrules have apparent diameters between 0.5 and 1 mm, some up to 2.5 mm. CAIs with sizes up to 2 mm are present. Accessories are Fe, Ni metal and sulfides.

Geochemistry: Mineral compositions and geochemistry: The mean olivine composition is $Fa_{8.6\pm10.3}$ ($Fa_{0.6-39.5}$; n=25). The mean low-Ca pyroxene composition is $Fs_{1.5\pm0.9}Wo_{1.0\pm0.3}$ ($Fs_{0.4-3.8}Wo_{0.5-1.8}$; n=19).

Classification: CV chondrite based on CAI and AOA occurrence, size of chondrules and CAIs, chondrule-matrix ratio, and mineral chemistry. Petrologic type 3 based on the chemical variation of olivine and pyroxene

Northwest Africa 12721 (NWA 12721)
Northwest Africa
Purchased: March 2018
Classification: Carbonaceous chondrite (CV3)

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History: Collected by nomads in Western Sahara and purchased by Hichame Mimaghador at Erfoud from a Moroccan dealer.
Physical characteristics: A single piece weighing 105 g without fusion crust. CAIs are visible on the hand specimen cut surface.
Petrography: (V. Moggi Cecchi, G. Pratesi, *UniFi*); The thin section displays a chondritic texture, with GO, BO, PO and POP chondrules ranging from 800 to 1200 µm prevailing over matrix; a chondrule-matrix ratio of 1.2 can be estimated; no CAIs are visible in a small thin section; olivine in PO chondrules is Fa-poor and displays a core-rim zoning; olivine in BO chondrules is Fa-rich; orthopyroxene in POP chondrules is Mg-rich; an Al-rich pigeonite and rare augite is present in BO chondrules; matrix is fine-grained and consists of Fa-rich olivine and orthopyroxene with diffuse altered opaque phases (iron-oxides) and magnetite.
Geochemistry: EMP (V. Moggi Cecchi, G. Pratesi, *UniFi*); Olivine in PO chondrules ($Fa_{1.7\pm0.2}Fo_{98.3\pm0.7}$; Fe/Mn = 12.9, n=10); Olivine in BO chondrules ($Fa_{29.9\pm4.2}Fo_{70.1\pm0.9}$; Fe/Mn = 94.5, n=6); Orthopyroxene in POP chondrules ($Fs_{3.0\pm0.8}En_{96.1\pm0.7}Wo_{0.8\pm0.1}$, Fe/Mn = 67.6, n=8); Pigeonite in BO chondrules ($Fs_{2.2\pm0.2}En_{91.8\pm2.1}Wo_{6.0\pm2.1}$, Fe/Mn = 6.9, n=9), High-Ca pyroxene ($Fs_{25.7\pm0.2}En_{30.4\pm0.3}Wo_{43.9\pm0.4}$, Fe/Mn = 60.6, n=6); plagioclase in POP chondrules ($An_{97.7}Or_{0.1}$).
Classification: Carbonaceous Chondrite (CV3)
Specimens: A total of 25 g specimen is on deposit at *MSN-FI*. Mimaghador holds the main mass.

Northwest Africa 12726 (NWA 12726)
(Northwest Africa)
Purchased: 2010 Feb
Classification: Ordinary chondrite (LL4)
History: Purchased in Tucson by Bob Falls in February 2010. A piece was brought to *Cascadia* by Fred *Olsen*.
Physical characteristics: Sample has black, patchy remnant fusion crust and a weathering patina. Already cut faces have chondritic texture with abundant sulfide and metal and rust haloes.
Petrography: (M. Ream, M. Hutson, A. Ruzicka, *Cascadia*) In thin section, matrix is black and fine-grained, with well-defined chondrules. Minor clinoenstatite is present. A 2.5 mm × 2.3 mm clast is present, which is cut off on its long axis by the edge of the thin section. The clast has well-defined chondrules, matrix that is darker than the host, and contains abundant oriented troilite, including a ~0.17 mm thick vein. Pyroxenes in the clast are zoned in BSE images.
Geochemistry: Mineral compositions and geochemistry: Olivine and pyroxene grains in the host lithology are relatively equilibrated ($Fa_{27.9\pm0.3}$, N=14; $Fs_{21.6\pm2.8}Wo_{1.0\pm0.5}$, N=33). Clast olivine ($Fa_{28.0\pm0.4}$, N=9) is essentially identical with host olivine. Clast pyroxene ($Fs_{21.7\pm7.7}Wo_{1.9\pm1.1}$, N=11) has the same mean Fs content, but a much greater range of compositions than host pyroxene.
Classification: Ordinary chondrite (LL4) based on chemistry and texture.

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Specimens: *Cascadia* holds 30.1 g in three pieces, a polished thin section, and a mounted butt. The main mass is held by Bob Falls (no address given).

Northwest Africa 12730 (NWA 12730)
Algeria
Find: 2017
Classification: Mesosiderite
History: Bought by Zaid Sbiti in 2017, then bought from Mohamed Elguirah in October 2018
Physical characteristics: Full stone with remants of fusion crust
Petrography: (J. Gattacceca, *CEREGE*) Stony-iron meteorite with silicate grain size 500 µm (pyroxene plagioclase) and abundant metal with grain size several mm. Accessory minerals include chromite, silica polymorph (to 50 µm), troilite.
Geochemistry: Low-Ca pyroxene $Fs_{32.5\pm0.3}Wo_{3.7\pm0.8}$, FeO/MnO 23.4±1.8 (n=3). Plagioclase $An_{92.5\pm1.2}Ab_{7.4\pm1.1}Or_{0.1\pm0.1}$ (n=3).
Classification: Mesosiderite.
Specimens: Type specimen at *CEREGE*. Main mass with Jean Redelsperger.

Northwest Africa 12731 (NWA 12731)
Algeria
Purchased: 2018 Oct
Classification: Rumuruti chondrite (R5)
History: Bought from Mohamed Elguirah in October 2018
Physical characteristics: Full stone covered by dull and fractured fusion crust
Petrography: (J. Gattacceca, *CEREGE*) Chondrite with recrystallized texture and average plagioclase size below 50 µm. Olivine is the ultra dominant silicate. Abundant sulfides to 200 µm, including pentlandite and pyrrhotite.
Geochemistry: Olivine $Fa_{39.9\pm0.5}$, NiO=0.25±0.05 wt% (n=4). Plagioclase $An_{7.5}Ab_{86.5}Or_{6.0}$ (n=2). Ca-pyroxene $Fs_{11.8}Wo_{44.4}$ (n=1).
Classification: Rumuruti chondrite (R5).
Specimens: Type specimen at *CEREGE*. Main mass with Jean Redelsperger.

Northwest Africa 12732 (NWA 12732)
Algeria
Purchased: 2018 Oct
Classification: HED achondrite (Eucrite, unbrecciated)
History: Bought from Mohamed Elguirah in October 2018
Physical characteristics: Dark green stone with no fusion crust.
Petrography: (J. Gattacceca, *CEREGE*) Unbrecciated igenous rock with subophitic texture. Silicates are fractured and have typical grain size of 300 µm. Main minerals are pyroxene and plagioclase. Silica polymorph is present. Opaques are troilite, ilmenite (to 50 µm), metal.

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Geochemistry: Low-Ca pyroxene $Fs_{56.2\pm2.4}Wo_{6.4\pm3.8}$, FeO/MnO34.1±2.0 (n=5). Plagioclase $An_{77.5\pm2.5}Ab_{21.5\pm2.2}Or_{1.0\pm0.3}$ (n=3).
Classification: Achondrite (Eucrite, unbrecciated).
Specimens: Type specimen at *CEREGE*. Main mass with Jean Redelsperger.

Northwest Africa 12733 (NWA 12733)
Morocco
Purchased: 2019 Mar
Classification: Primitive achondrite (Brachinite)
Physical characteristics: Brown stone without fusion crust.
Petrography: (J. Gattacceca, *CEREGE*) Igneous rock with equigranular texture and typical grain size 400 µm. Olivine is ultradominant over Ca-pyroxene. No plagioclase was observed. Metal and sulfides are present as euhedral grains (to 200 µm), veins along silicate rims, and µm-sized blebs within silcates. Chromite is present.
Geochemistry: Olivine $Fa_{29.9\pm0.5}$, FeO/MnO 55.2±2.1 (n=3). Ca-Pyroxene $Fs_{9.6\pm0.1}Wo_{43.5\pm0.1}$, FeO/MnO 26.4±0.7 (n=2). Chromite Cr# 0.82.
Classification: Brachinite
Specimens: Type specimen at *CEREGE*. Main mass with *Kuntz*.

Northwest Africa 12734 (NWA 12734)
(Northwest Africa)
Purchased: May 2015
Classification: Ordinary chondrite (L6)
Petrography: (J. Gattacceca, *CEREGE*) Ordinary chondrite with shock veins. Troilite is polycristalline.
Classification: Ordinary chondrite (L6). The olivine Fa content and orthopyroxene Fs content are in the high range for L chondrites, and the metal content (as indicated by magnetic susceptibility) is in the low range.

Northwest Africa 12737 (NWA 12737)
(Northwest Africa)
Purchased: 2019 Mar
Classification: Carbonaceous chondrite (CK5)
History: Purchased in Temara, Morocco, by Adam *Aaronson* in March 2019.
Petrography: (A. Irving, *UWS* and P. Carpenter, *WUSL*) Very fresh specimen composed of some separated, well-formed chondrules in a recrystallized matrix containing Cr-magnetite (with rare inclusions of chlorapatite and ilmenite), intermediate plagioclase, pentlandite and troilite.
Geochemistry: Olivine ($Fa_{29.6\pm0.4}$ (range $Fa_{29.0\text{-}29.9}$), N = 4), low-Ca pyroxene ($Fs_{25.8\pm0.2}Wo_{0.9\pm0.3}$ (range $Fs_{25.6\text{-}25.9}Wo_{1.1\text{-}0.7}$), N = 2), pigeonite ($Fs_{22.0}Wo_{13.0}$), augite ($Fs_{11.3}Wo_{41.6}$), plagioclase ($An_{63.8}Or_{0.7}$). Oxygen isotopes (K. Ziegler, *UNM*):

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analyses of acid-washed subsamples by laser fluorination gave, respectively, $\delta^{17}O$ -3.772, -4.218, -4.061; $\delta^{18}O$ 0.935, 0.273, 0.431; $\Delta^{17}O$ -4.266, -4.362, -4.289 per mil.
Classification: Carbonaceous chondrite (CK5).
Specimens: 21.6 g including one polished thin section at *UWB*; remainder with *Aaronson*.

Northwest Africa 12739 (NWA 12739)
(Northwest Africa)
Purchased: 2019
Classification: HED achondrite (Diogenite)
History: The meteorite was purchased from a local meteorite dealer in Zagora, Morocco.
Physical characteristics: Single stone partly covered by fusion crust.
Petrography: The meteorite is an achondritic breccia composed of two types of low-Ca pyroxene, olivine, and less abundant calcic feldspar. Minerals are up to 4 mm in size and embedded in fine-grained clastic matrix. Minor phases include silica, chromite, FeS, and metallic Fe.
Geochemistry: pyroxene: $Fs_{22.3.0\pm0.2}Wo_{1.4\pm0.1}$ ($Fs_{22.0-22.6}Wo_{1.2-1.5}$, n=13, FeO/MnO=25-28); pyroxene: $Fs_{29.7\pm1.8}Wo_{2.8\pm0.3}$ ($Fs_{28.1-33.9}Wo_{2.6-3.6}$, n=12, FeO/MnO=30-33); olivine: $Fa_{28.2\pm0.7}$ ($Fa_{27.1-29.2}$, n=17, FeO/MnO=48±2); calcic plagioclase: $An_{90.7\pm0.4}$ ($An_{90.0-91.1}$, n=16)

Northwest Africa 12740 (NWA 12740)
(Northwest Africa)
Purchased: 2019
Classification: HED achondrite (Eucrite)
History: The meteorite was purchased from a local meteorite dealer in Zagora, Morocco.
Physical characteristics: Single stone with fusion crust.
Petrography: The meteorite is a fragmental breccia composed of fine- and coarse-grained basaltic fragments set into a clastic mineral matrix dominated by exsolved pyroxene and calcic plagioclase with grain sizes ranging from about 30 to 500 µm. Some pyroxenes show a weak compositional zoning. Minor phases include silica, chromite, FeS, ilmenite, fayalite, and metallic Fe.
Geochemistry: low-Ca pyroxene: $Fs_{59.2\pm1.1}Wo_{4.0\pm0.7}$ ($Fs_{57.7-61.0}Wo_{3.0-4.9}$, n=11, FeO/MnO=30-36); Ca-pyroxene: $Fs_{32.4\pm3.8}Wo_{37.4\pm4.3}$ ($Fs_{29.1-41.2}Wo_{27.1-41.1}$, n=13, FeO/MnO=31-35); calcic plagioclase: $An_{88.4\pm2.3}$ ($An_{84.5-92.5}$, n=10)

Northwest Africa 12741 (NWA 12741)
(Northwest Africa)
Purchased: 2019
Classification: Diogenite-pmict

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History: The meteorite was purchased from a local meteorite dealer in Zagora, Morocco.
Physical characteristics: Single stone with some fusion crust.
Petrography: The meteorite is a polymict breccia predominantly composed of up to 2 mm sized low-Ca pyroxene and plagioclase grains set into fine-grained related matrix. Diogenetic pyroxene shows some augite exsolution lamellae. Very rarely eucritic regions are encountered. Minor phases include silica, chromite, FeS, and metallic Fe.
Geochemistry: diogenetic pyroxene: $Fs_{35.0\pm0.4}Wo_{2.0\pm0.1}$ ($Fs_{34.3-35.6}Wo_{1.8-2.1}$, n=13, FeO/MnO=27-31); augite exsolutions: $Fs_{13.4\pm0.4}Wo_{44.2\pm0.5}$ ($Fs_{13.0-14.3}Wo_{43.0-44.8}$, n=14, FeO/MnO=22-27); eucritic low-Ca pyroxene: $Fs_{57.6\pm0.7}Wo_{1.8\pm0.5}$ ($Fs_{56.5-58.8}Wo_{1.3-3.2}$, n=11, FeO/MnO=32-35); eucritic Ca-pyroxene: $Fs_{26.4\pm1.2}Wo_{40.8\pm1.3}$ ($Fs_{24.3-28.8}Wo_{37.0-42.3}$, n=15, FeO/MnO=30-36); calcic plagioclase: $An_{92.9\pm0.3}$ ($An_{92.3-93.6}$, n=15)

Northwest Africa 12742 (NWA 12742)
(Northwest Africa)
Purchased: 2018
Classification: Carbonaceous chondrite (CM2)
History: The meteorite was purchased from a local meteorite dealer in Morocco.
Physical characteristics: Many black fragments partly covered with fusion crust.
Petrography: The meteorite is a chondritic breccia dominated by fine-grained almost opaque matrix composed of phyllosilicates, Fe-sulfides, Ca-carbonates and rare FeNi metal. Embedded in this matrix are chondrules (mean diameter about 300 µm), chondrule pseudomorphs, mineral fragments, and rare CAIs most of which are surrounded by fine-grained dust rims.

Northwest Africa 12743 (NWA 12743)
(Northwest Africa)
Purchased: 2019
Classification: Ordinary chondrite (H5, melt breccia)
History: The meteorite was purchased from a local meteorite dealer in Erfoud, Morocco.
Physical characteristics: Dark brownish rock with some fusion crust.
Petrography: The meteorite is a melt rock composed of abundant and partly recrystallized melt rock regions with characteristic FeNi metal and sufide spherules. Few chondritic regions of type H5 (plagioclase grain size about 40 µm) with relictic chondrules and mineral fragments are present; no metal or sulfide veins are observed.

Northwest Africa 12744 (NWA 12744)
(Northwest Africa)
Purchased: 2019
Classification: Ordinary chondrite (L4)

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History: The meteorite was purchased from a local meteorite dealer in Erfoud, Morocco.
Physical characteristics: Dark brownish rock with some fusion crust.
Petrography: The meteorite displays a chondritic texture with well defined and often slightly flattened chondrules (mean diameter about 0.6 mm) and fine-grained matrix containing sulfides and FeNi metal. Olivine is compositionally equilibrated; low-Ca pyroxene is highly unequilibrated. The meteorite contains shock melt veins.

Northwest Africa 12745 (NWA 12745)
(Northwest Africa)
Purchased: 2019
Classification: Ordinary chondrite (H6, melt breccia)
History: The meteorite was purchased from a local meteorite dealer in Erfoud, Morocco.
Physical characteristics: Four Dark brownish fragments without fusion crust.
Petrography: Chondritic melt rock with few chondritic regions of type H6 (plagioclase grain size about 60 µm) and abundant melt rock. No metal or sulfide veins are observed.

Northwest Africa 12746 (NWA 12746)
(Northwest Africa)
Purchased: 2019
Classification: Carbonaceous chondrite (CR2)
History: The meteorite was purchased from a local meteorite dealer in Erfoud, Morocco.
Physical characteristics: Dark brownish fragment with some fusion crust.
Petrography: Carbonaceous chondrite composed of abundant mostly slightly flattened chondrules with an apparent mean diameter of about 900 µm and 30-40% almost black matrix. Some chondrules are metal-decorated. Olivine and low-Ca pyroxene are the most abundant silicates and olivine is predominantly very Fe-poor (Fo around 98 mol%); few compositionally zoned olivines with more Fe-rich rims are present.
Geochemistry: Matrix analyses yield an average total of 89.4 wt% (5 µm defocused beam, N=10) suggesting the presence of hydrous minerals.

Northwest Africa 12747 (NWA 12747)
(Northwest Africa)
Purchased: 2006 June
Classification: Carbonaceous chondrite (CV3)
History: Purchased from a Moroccan mineral dealer at the meteorite show in Ensisheim, France

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Petrography: (K. Metzler, *IfP*) Chondrules, CAIs and AOAs are embedded in a fine-grained dark matrix (about 30 vol% matrix). Most chondrules have apparent diameters between 0.3 and 1.5 mm, some up to 3 mm. No type II chondrules were found. Several chondrules show reddish staining due to terrestrial weathering. CAIs with sizes up to 9 mm.
Geochemistry: Mineral compositions and geochemistry: Random measurements of olivine grains revealed $Fa_{4.9\pm4.0}$ (0.6-18; n=x); n=23. Random measurements of low-Ca pyroxene grains revealed $Fs_{1.3\pm0.5}$ $Wo_{1.1\pm0.5}$ ($Fs_{0.5-2.8}Wo_{0.6-3.0}$; n=22).
Classification: CV chondrite based on CAI and AOA occurrence, size of chondrules and CAIs, chondrule-matrix ratio, and mineral chemistry. Petrologic type 3 based on the chemical variation of olivine and pyroxene.

Northwest Africa 12748 (NWA 12748)
(Northwest Africa)
Purchased: 2019
Classification: Carbonaceous chondrite (CM2)
History: Two stones weighing 36 g were found in Morocco prior to 2019 and were purchased by John Sinclair and J. Donald Cline at the 2019 Tucson Gem and Mineral Show.
Physical characteristics: Sample is dark black in color, irregularly shaped, and has ~25% crust coating one side. Cut face of the sample shows small chondrules and CAIs set within a dark-colored matrix.
Petrography: Description and classification (A. Love, *App*): Sample is shows chondritic texture composed of chondrules, fragments, and CAIs (~42 vol %) distributed throughout a black fine-grained matrix (~58 vol%). Porphyritic chondrules have an average diameter of 330 µm with chemical zonation. Additional minerals are: pentlandite, calcite, tochilinite, pyrrhotite, kamacite.
Geochemistry: (A. Love, *App*) Olivine: Type I chondrules $Fa_{0.9\pm0.7}$ ($Fa_{0.3-2.2}$), N=6; Type II chondrules $Fa_{39.9\pm15.2}$ ($Fa_{16.7-63.4}$), N=14 Low Ca-pyroxene: $Fs_{2.3\pm1.7}Wo_{1.4\pm1.1}$($Fs_{1.1-5.4}Wo_{0.2-3.5}$, N=10).
Classification: Carbonaceous chondrite (CM2)/ Based on matrix abundance, chondrule size and mineralogy this is a CM2.
Specimens: *PARI* holds the main mass. One endcut weighing 9.3 g and a polished thin section are on deposit at *App*.

Northwest Africa 12749 (NWA 12749)
(Northwest Africa)
Purchased: 2019
Classification: HED achondrite (Howardite)
History: Two stones weighing 497.29 g were found in Western Sahara prior to 2019. John Sinclair and J. Donald Cline purchased the samples from a meteorite dealer while at the 2019 Tucson Gem and Mineral Show.

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Physical characteristics: The sample has a light orangish-brown exterior with a distinctive brecciated texture. The samples lack fusion crust. Dark brown to dark-greenish clasts up to 4 cm are visible on the exterior of the stone.
Petrography: Description and classification (A. Love, *App*): Sample is a breccia composed of rounded to angular dominant mineral and subordinate lithic fragments with an average diameter of 2.7 mm and some as large as 4 cm. Diogenite (~60 vol%) occurs primarily as zoned crystals and fragments of Opx, although a rare lithic fragment shows interlocking crystals that share 120º grain boundaries. Eucrites (~40 vol%) occur as basaltic and cumulate lithic fragments as well as individual twinned plagioclase and exsolved Cpx crystals. Other phases include pyroxene rimmed silica objects, FeNi metal, FeS, and chromite.
Geochemistry: (A. Love, *App*) Diogenite clasts: low Ca pyroxene $Fs_{31.0\pm2.4}Wo_{1.9\pm0.4}$ ($Fs_{26.5-34.0}Wo_{1.2-2.9}$), Fe/Mn=31.1±1.5, N=20. Eucrite clasts: low Ca pyroxene $Fs_{34.8\pm3.4}Wo_{2.1\pm0.4}$ ($Fs_{28.0-41.5}Wo_{1.5-2.7}$), Fe/Mn=29.7±4.9, Mg#57.5-71.4, n=18; high Ca pyroxene exsolution lamellae $Fs_{15.8\pm1.4}Wo_{42.1\pm0.7}$ ($Fs_{13.0-17.6}Wo_{41.4-43.6}$), Fe/Mn=23.0±3.9, N=10; plagioclase $An_{92.5\pm2.0}Or_{0.3\pm0.1}$, N=8.
Classification: HED (Howardite). Textures, FeO/MnO and Fs compositions of pyroxenes indicate this sample belongs to the HED meteorites. Sample is a howardite with a subequal mixture of eucrite and diogenite.
Specimens: *PARI* holds the main mass. One endcut weighing 21.59 g and a polished mount are on deposit at *App*.

Northwest Africa 12750 (NWA 12750)
(Northwest Africa)
Purchased: 2019
Classification: Carbonaceous chondrite (CO3)
History: A 46 g stone, comprising 3 pieces that fit together, was found in the Western Sahara prior to 2018. The sample was sold to a meteorite dealer and subsequently purchased during the 2019 Tucson Gem and Mineral Show.
Physical characteristics: The sample lacks fusion crust, is dark brown in color and irregularly shaped. Small chondrules are visible on the surface. Small chondrules and CAIs are visible on the cut face.
Petrography: (A. Love, *App*): Sample has a chondritic texture composed of chondrules with an average diameter of 150 µm (N=57), abundant amoeboid olivine aggregates and CAIs set within a fine-grained opaque matrix (~36 vol%).
Geochemistry: (A. Love, *App*) Olivine: $Fa_{19.4\pm20.4}$($Fa_{0.4-64.4}$), Fe/Mn=60.1±43.3), N=32 chondrules (14 Type I chondrules with $Fa_{0.92\pm0.40}$, and 18 Type II chondrules with $Fa_{33.8\pm16.0}$). Cr_2O_3 in ferroan olivine = 0.3±0.1, N=18. Low Ca pyroxene: $Fs_{4.1\pm3.3}Wo_{1.0\pm0.7}$ ($Fs_{1.3-12.5}Wo_{0.3-2.8}$), N=15.
Classification: Carbonaceous Chondrite (CO3). Based on chondrule size and unequilibrated compositions of olivine and pyroxene, sample is a type 3 CO chondrite. Mean and standard deviation of Cr_2O_3 in ferroan olivine plots next to Acfer 094 designated by Grossman and Brearley (2005) as CO3.0

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Specimens: The main mass is held at *PARI*. An $_{9.3}$ g fragment and a polished thin section are on deposit at *App*.

Northwest Africa 12751 (NWA 12751)
(Northwest Africa)
Purchased: 2018
Classification: LL3.10/3.15

History: Marc Jost purchased the stone from a Moroccan dealer at the 2018 Ensisheim show June 16, 2018.

Physical characteristics: The 223 g sample has a brown, weathered exterior with an irregular, tabular shape containing some broad, shallow regmaglypts. The fusion crust appears to be weathered. The cut face shows the interior is a breccia composed of clasts of various lithologies set within a host of flattened chondrules that define a foliation.

Petrography: Description and Classification (A. Love, *App*) Sample is a breccia composed of sparse rounded clasts set within a host of densely-packed, unequilibrated, elongated chondrules (avg. dia. 741 µm, N=66; aspect ratio = 1.48) that define a foliation. Chondrule mesostasis contains devitrified glass. Isotropic glass is rare. Chondrules commonly contain mesostasis that displays yellow CL (43%) and blue CL (57%) N=103. Clinoenstatite is the dominant pyroxene. The sample contains a matrix-rich (84 vol%) chondritic xenolith dominated by poikolitic clinoenstatite chondrules (avg. dia. 451 µm, N=13) with bluish green mesostasis.

Geochemistry: (A. Love, *App*) Host: Olivine $Fa_{16.0\pm8.8}$ ($Fa_{0.5\text{-}33.8}$), Fe/Mn=39.7±15.2, mean Cr_2O_3 in ferroan olivine=0.3±0.2 (0.0-0.6), N=30; low Ca pyroxene $Fs_{16.0\pm8.2}Wo_{0.9\pm1.0}$ ($Fs_{2.8\text{-}29.6}Wo_{0.2\text{-}3.9}$), N=10. Clast 1: Olivine $Fa_{4.8\pm1.4}$ ($Fa_{3.1\text{-}6.5}$), Fe/Mn=12.1±4.7, N=4; low Ca pyroxene $Fs_{7.7\pm4.7}Wo_{1.3\pm2.3}$ ($Fs_{2.9\text{-}14.6}Wo_{0.2\text{-}5.5}$), Fe/Mn=37.4, N=5.

Classification: Ordinary Chondrite (LL3.10/3.15, xenolithic breccia) Based on chondrule size and magnetic susceptibility this sample is an LL ordinary chondrite. CL observations indicate type 3.1 (Huss et al., 2006) and mean and standard deviation of Cr_2O_3 in ferroan Ol is at the limit between 3.10 and 3.15 (Grossmann and Brearley, 2005). Sample contains a xenolithic chondritic clast of unknown affinity.

Specimens: Marc Jost (*SJS*) holds the main mass. 3 slices weighing 26.7 g and a polished thin section and mount are on deposit at *App*.

Northwest Africa 12752 (NWA 12752)
(Northwest Africa)
Purchased: 2015
Classification: Ureilite

History: Marc Jost purchased this 550 g sample in Rissani, Morocco, in 2015.

Physical characteristics: The exterior is dark brown in color and the sample has a rounded shape with a flattened side. The sample is partially coated in a weathered

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patina of caliche. Underneath the caliche is a flow-lined fusion crust. The fusion crust shows the sample was originally oriented. The cut face shows a crystalline interior.
Petrography: Description and Classification (A. Love, *App*) Sample shows protogranular texture composed of 28 vol% twinned, poikilitic pigeonite (avg. length 3.4 mm) containing rounded olivine chadacrysts and 1.4 mm irregularly shaped olivine. Olivine contains reduction rims (~26.7 µm thick) showing magnesian compositions and Fe metal along grain boundaries and fractures. Up to 200 µm graphite laths present.
Geochemistry: (A. Love, *App*) Olivine: cores $Fa_{12.9\pm0.2}$, Fe/Mn=26.6±2.0, Cr_2O_3=0.7±0.0; Reduced Rims $Fa_{9.6\pm1.9}$, Fe/Mn=18.7, Cr_2O_3=0.7±0.0 N=12; Pigeonite $Fs_{11.8\pm0.1}Wo_{9.6\pm0.0}$, Fe/Mn=15.4±0.4, N=10.
Classification: Achondrite (Ureilite) Based on textures and mineralogy, this is a ureilite. The thickness of the reduction rims on olivine and medium hardness indicate this sample has experienced a reduction level R2. U-S3 based upon undulatory extinction and planar fractures in olivine. W3.
Specimens: Marc Jost (*SJS*) holds the main mass. One endcut and a sliced chunk weighing 39.3 g, a polished thin section and mount are on deposit at *App*.

Northwest Africa 12753 (NWA 12753)
(Northwest Africa)
Purchased: 2017
Classification: Carbonaceous chondrite (CM2)
History: The meteorite was purchased from a local meteorite dealer in Morocco.
Physical characteristics: Dark brownish rock with some fusion crust.
Petrography: The meteorite displays a brecciated brownish to black interior and is 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.

Northwest Africa 12754 (NWA 12754)
(Northwest Africa)
Purchased: 2017
Classification: Carbonaceous chondrite (CM2)
History: The meteorite was purchased from a local meteorite dealer in Morocco.
Physical characteristics: Brownish rock with some fusion crust.
Petrography: The meteorite displays a dark brownish interior and is a brecciated carbonaceous chondrite composed of chondrules (mean diameter about 300 µm), chondrule pseudomorphs, CAIs, and mineral fragments set into abundant Fe-rich matrix. Many of the components are heavily corroded and often surrounded by fine-grained dust rims. The meteorite matrix consists of carbonates, few sulfides and fibrous phyllosilicates.

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Northwest Africa 12755 (NWA 12755)
(Northwest Africa)
Purchased: 2019
Classification: HED achondrite (Eucrite, monomict)
History: The meteorite was purchased from a local meteorite dealer in Morocco.
Physical characteristics: Grayish rock partly covered with fusion crust. Saw cut shows a light-grayish interior speckled with up to 2 mm sized feldspar grains.
Petrography: The meteorite is a monomict achondritic breccia predominantly composed of low-Ca-pyroxene and calcic plagioclase. Pyroxene often contains augite exsolutions either ellipsiodale shaped or as fine lamellae. Minor phases include silica, FeS, chromite, and metallic Fe. The meteorite is highly shocked, i.e., plagioclase is partly recrystallized, and contains shock melt pockets.
Geochemistry: low-Ca pyroxene: $Fs_{34.2\pm0.6}Wo_{2.8\pm0.4}$ ($Fs_{33.0-35.1}Wo_{2.4-4.0}$, n=13, FeO/MnO=29-31); Ca-pyroxene: $Fs_{15.1\pm0.2}Wo_{42.9\pm0.4}$ ($Fs_{14.4-15.4}Wo_{42.3-43.7}$, n=12, FeO/MnO=21-27); calcic plagioclase: $An_{93.7\pm0.5}$ ($An_{92.8-94.7}$, n=17)

Northwest Africa 12756 (NWA 12756)
(Northwest Africa)
Purchased: 2019
Classification: HED achondrite (Diogenite)
History: The meteorite was purchased from a local meteorite dealer in Morocco.
Physical characteristics: Grayish, slightly greenish rock with some fusion crust.
Petrography: Fragmental breccia predominantly composed of up to 5 mm sized orthopyroxene crystals set into fine-grained related matrix. Some of the pyroxenes display magmatic zoning. Minor phases include calcic plagioclase, silica, chromite, FeS, and FeNi-sulfides. No metallic Fe has been detected.
Geochemistry: unzoned blocky pyroxene: $Fs_{28.5.0\pm0.2}Wo_{1.3\pm0.1}$ ($Fs_{28.1-28.7}Wo_{1.2-1.4}$, n=15, FeO/MnO=26-29); magmatically zoned pyroxene: $Fs_{24.3\pm1.1}Wo_{2.0\pm0.6}$ ($Fs_{23.2-26.4}Wo_{1.3-2.8}$, n=16, FeO/MnO=26-32); olivine: $Fa_{36.1\pm0.4}$ ($Fa_{35.4-36.5}$, n=13, FeO/MnO=47±2); calcic plagioclase: $An_{91.9\pm3.0}$ ($An_{85.7-94.7}$, n=15)

Northwest Africa 12757 (NWA 12757)
(Northwest Africa)
Purchased: 2015
Classification: HED achondrite (Eucrite)
History: The meteorite was purchased from a local meteorite dealer in Morocco.
Physical characteristics: Grayish rock with some fusion crust.
Petrography: Monomict breccia composed of up to 6 mm sized mineral fragments which are predominantly exsolved pyroxene and calcic plagioclase. Pyroxene is either augite with low-Ca exsolution lamellae or vice versa. Plagioclase shows signs

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of recrystallization. Minor phases include Fe-rich olivine, silica, FeS, chromite, and barite; no metallic Fe has been found. Contains shock melt.
Geochemistry: low-Ca pyroxene: $Fs_{65.7\pm2.4}Wo_{2.9\pm0.8}$ ($Fs_{60.3-67.6}Wo_{2.2-4.9}$, n=12, FeO/MnO=25-34); Ca-pyroxene: $Fs_{29.3\pm2.5}Wo_{42.5\pm0.7}$ ($Fs_{26.4-32.6}Wo_{40.6-43.0}$, n=11, FeO/MnO=29-35); olivine: $Fa_{81.6\pm3.2}$ ($Fa_{75.6-84.8}$, n=19, FeO/MnO=37±7); calcic plagioclase: $An_{90.7\pm1.1}$ ($An_{88.2-92.0}$, n=12)

Northwest Africa 12758 (NWA 12758)
Mali
Purchased: 2019 Jan
Classification: Ungrouped achondrite
History: Purportedly found in Mali and purchased in Agadir, Morocco, by Aziz Habibi in January 2019.
Petrography: (A. Irving, *UWS* and P. Carpenter, *WUSL*) Protogranular aggregate (mean grainsize 0.8 mm) of predominantly low-Ca pyroxene (~70 vol.%) and magnesian olivine (~30 vol.%) with accessory Si-bearing kamacite and Cr-bearing troilite. Plagioclase is absent. Minor secondary Fe hydroxides coat grain boundaries.
Geochemistry: Low-Ca pyroxene ($Fs_{5.9-6.0}Wo_{4.7-4.9}$, FeO/MnO = 20-22, N = 3), olivine ($Fa_{6.5-6.9}$, FeO/MnO = 29-39, N = 4), metal (Ni = 6.5 wt.%, Si = 1.1 wt.%). Oxygen isotopes (K. Ziegler, *UNM*); analyses of acid-washed subsamples by laser fluorination gave, respectively, $\delta^{17}O$ -1.168, -1.115, -1.099; $\delta^{18}O$ 1.422, 1.429, 1.557; $\Delta^{17}O$ -1.918, -1.869, -1.921 per mil.
Classification: Achondrite (ungrouped, ultramafic).
Specimens: 22.7 g including one polished thin section at *UWB*; remainder with A. Habibi.

Northwest Africa 12759 (NWA 12759)
(Northwest Africa)
Purchased: 2019 Feb
Classification: Ordinary chondrite (L5)
History: Three similar, large stones (50 kg, 30 kg and 18.3 kg) were found together at an undisclosed location and purchased in Temara, Morocco by Adam *Aaronson* in February 2019.
Petrography: (A. Irving, *UWS* and P. Carpenter, *WUSL*) Sparse chondrules are present in a recrystallized matrix containing stained metal, chromite, troilite and taenite.
Geochemistry: Olivine ($Fa_{25.2\pm0.9}$ (range $Fa_{24.4-26.1}$), N = 3), low-Ca pyroxene ($Fs_{21.0\pm0.3}Wo_{1.3\pm0.2}$ (range $Fs_{20.7-21.2}Wo_{1.5-1.1}$), N = 3), high-Ca pyroxene ($Fs_{9.6\pm2.6}Wo_{41.7\pm4.8}$ ($Fs_{6.7-11.8}Wo_{45.9-36.4}$), N = 3).
Classification: Ordinary chondrite (L5).
Specimens: 57 g including one polished thin section at *UWB*; remainder with *Aaronson*.

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Northwest Africa 12760 (NWA 12760)
(Northwest Africa)
Find: 2017 Apr
Classification: Lunar meteorite (feldspathic breccia)
History: A single very large, uncrusted stone (58.090 kg) was found in April 2017 in Western Sahara or the Western Sahara/Algeria border region, and purchased by Darryl Pitt in June 2017 from a Mauritanian dealer
Petrography: (A. Irving, *UWS* and P. Carpenter, *WUSL*) Breccia composed of mineral clasts of anorthite, olivine, orthopyroxene, exsolved pigeonite, unexsolved pigeonite and augite within a sparsely vesicular and partly glassy matrix containing troilite, magnesian ilmenite, chromite and minor secondary barite.
Geochemistry: Olivine ($Fa_{19.1-35.9}$, FeO/MnO = 88-97, N = 4), low-Ca pyroxene ($Fs_{31.1-45.4}Wo_{4.6-6.1}$, FeO/MnO = 50-56, N = 3), augite ($Fs_{14.8}Wo_{40.8}$, FeO/MnO = 38), pigeonite host in exsolved pyroxene ($Fs_{38.4}Wo_{12.7}$, FeO/MnO = 58), low-Ca pyroxene lamellae in exsolved pyroxene ($Fs_{46.9-52.6}Wo_{4.3-5.3}$, FeO/MnO = 57, N = 2), plagioclase ($An_{96.4-97.2}Or_{0.1}$, N = 2).
Classification: Lunar (feldspathic breccia).
Specimens: 20.1 g including a polished endcut at *UWB*; remainder with *DPitt*.

Northwest Africa 12761 (NWA 12761)
(Northwest Africa)
Purchased: 2011 Dec
Classification: Ordinary chondrite (L6)
History: Purchased by Beat Booz in December 2011 from a Moroccan dealer.
Petrography: (A. Irving, *UWS* and P. Carpenter, *WUSL*) Breccia composed of lithic clasts consisting of rare chondrules in a recrystallized metal-bearing matrix plus disaggregated related crystalline debris.
Geochemistry: Olivine ($Fa_{25.2\pm0.3}$ (range $Fa_{25.0-25.5}$), N = 3), low-Ca pyroxene ($Fs_{21.1\pm0.8}Wo_{2.0\pm0.3}$ (range $Fs_{20.7-22.3}Wo_{1.6-2.2}$), N = 4), augite ($Fs_{7.4}Wo_{47.2}$; $Fs_{9.5}Wo_{39.8}$).
Classification: Ordinary chondrite (L6 breccia).
Specimens: 21.7 g including one polished thin section at *UWB*; remainder with Mr. B. Booz.

Northwest Africa 12762 (NWA 12762)
(Northwest Africa)
Purchased: 2012 Oct
Classification: Carbonaceous chondrite (CV3)
History: Purchased by Beat Booz in October 2012 from a Moroccan dealer.
Petrography: (A. Irving, *UWS* and P. Carpenter, *WUSL*) Well-formed PO and granular chondrules (apparent diameter 800 ± 240 µm, N = 22) together with very

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fine grained, irregularly-shaped CAI are set in a fine grained matrix (~30 vol.%, sepia-brown in thin section).
Geochemistry: Olivine ($Fa_{3.6\pm3.8}$ (range $Fa_{0.3-8.0}$), N = 4), low-Ca pyroxene ($Fs_{1.1\pm0.4}Wo_{2.0\pm2.1}$ (range $Fs_{0.9-1.6}Wo_{0.7-4.5}$), N = 3), diopside ($Fs_{1.2\pm0.1}Wo_{38.1\pm0.2}$ (range $Fs_{1.-1.3}Wo_{38.4-37.7}$), N = 2).
Classification: Carbonaceous chondrite (CV3).
Specimens: 21.0 g including one polished thin section at *UWB*; remainder with Mr. B. Booz.

Northwest Africa 12763 (NWA 12763)
(Northwest Africa)
Purchased: 2016 Dec
Classification: HED achondrite (Eucrite, monomict)
History: Purchased by Beat Booz in December 2016 from a Moroccan dealer.
Petrography: (A. Irving, *UWS* and P. Carpenter, *WUSL*) Breccia composed of microgabbroic eucrite clasts plus mineral clasts of related crystalline debris, both exhibiting some preferred dimensional orientation. Minerals are exsolved pigeonite (pale orange in thin section), calcic plagioclase (polycrystalline) together with accessory ilmenite, Ti-chromite, troilite and zircon. Minor secondary calcite is present.
Geochemistry: Low-Ca pyroxene ($Fs_{59.7-63.4}Wo_{3.8-5.6}$, FeO/MnO = 28-33, N = 3), high-Ca pyroxene ($Fs_{25.1-27.8}Wo_{43.0-42.5}$, FeO/MnO = 30-34, N = 3), plagioclase ($An_{92.1}Or_{0.2}$).
Classification: Eucrite (monomict breccia, microgabbroic, shocked)
Specimens: 21.9 g including one polished thin section at *UWB*; remainder with Mr. B. Booz.

Northwest Africa 12764 (NWA 12764)
(Northwest Africa)
Purchased: 2018 Apr
Classification: Carbonaceous chondrite (CO3)
History: Purchased by Beat Booz in April 2018 from a Moroccan dealer.
Petrography: (A. Irving, *UWS* and P. Carpenter, *WUSL*) Small chondrules (apparent diameter 170±80 µm, N = 21), mineral fragments and fine grained CAI are set in a fine grained matrix (~40 vol.%, deep reddish-brown in thin section). Opaque phases are kamacite, taenite, troilite and chromite.
Geochemistry: Olivine, $Fa_{24.2\pm21.3}$ (range $Fa_{0.6-45.8}$, N = 5); low-Ca pyroxene, $Fs_{0.9}Wo_{3.3}$, $Fs_{42.3}Wo_{4.2}$; anorthite, $An_{96.4}Or_{0.1.}$
Classification: Carbonaceous chondrite (CO3).
Specimens: 20.5 g including one polished thin section at *UWB*; remainder with Mr. B. Booz.

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Northwest Africa 12765 (NWA 12765)
(Northwest Africa)
Purchased: 2019 Mar
Classification: Lunar meteorite (feldspathic breccia)
History: Purchased in March 2019 by Darryl Pitt from a Mauritanian dealer.
Petrography: (A. Irving, *UWS* and P. Carpenter, *WUSL*) Breccia composed of mineral clasts of anorthite, olivine (some of which is forsterite), low-Ca pyroxene, unexsolved pigeonite, subcalcic augite, chromite and ilmenite within a fine grained, sparsely microvesicular matrix containing minor secondary barite.
Geochemistry: Olivine ($Fa_{1.8-77.2}$, FeO/MnO = 85-104, N = 4), low-Ca pyroxene ($Fs_{28.2}Wo_{4.0}$, FeO/MnO = 64), pigeonite (F30.2-45.1$Wo_{11.8-11.9}$, FeO/MnO = 60-65, N = 2), subcalcic augite ($Fs_{35.7}Wo_{29.9}$, FeO/MnO = 59), anorthite ($An_{96.8}Or_{0.2}$).
Classification: Lunar (feldspathic breccia).
Specimens: 20.1 g in the form of a polished endcut at *UWB*; remainder with *DPitt*.

Northwest Africa 12766 (NWA 12766)
(Northwest Africa)
Purchased: 2015 Sep
Classification: Ordinary chondrite (L6, melt breccia)
History: Purchased by Darryl Pitt in September 2015 from a Moroccan dealer at the Denver Show.
Petrography: (A. Irving, *UWS* and J. Boesenberg, Brown) Breccia composed of rounded Type 6 clasts (W1) in a black, very fine grained matrix (W0/1) containing abundant tiny spherical grains of metal and troilite. The clasts consist of rare chondrules within a recrystallized matrix containing stained metal, troilite, merrillite and chlorapatite.
Geochemistry: Olivine ($Fa_{24.5\pm0.3}$ (range $Fa_{24.1-25.0}$), N = 6), low-Ca pyroxene ($Fs_{20.7\pm0.3}Wo_{1.8\pm0.2}$ (range $Fs_{20.5-21.1}Wo_{1.4-2.1}$), N = 7), augite ($Fs_{7.8\pm0.2}Wo_{44.5\pm0.3}$ (range $Fs_{7.6-7.9}Wo_{44.7-44.3}$), N = 2).
Classification: Ordinary chondrite (L6 melt breccia).
Specimens: 28.1 g including one polished thin section at *UWB*; remainder with *DPitt*.

Northwest Africa 12767 (NWA 12767)
Mali
Find: April 2018
Classification: Iron meteorite (ungrouped)
History: A single 6.3 kg mass was found in Mali in April 2018
Physical characteristics: The main mass is an irregularly shaped rock with a dark-brown exterior and no obvious regmaglypts.
Petrography: (C. Herd and L. Tunney, *UAb*) Optical and SEM examination of a 3.5 × 4 cm polished and etched slice, as well as images of etched surfaces provided by the owner, show kamacite spindles up to a few mm long and approximately 100 µm

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wide, often in clusters. Schreibersite grains are typically enclosed by kamacite; the matrix consists of taenite exsolved on a sub-µm scale. Also visible are trains of elongate kamacite crystals up to several cm long and 1-2 mm wide. These crystals are also cored by scheibersite. No inclusions were observed on any cut surfaces, and no weathering veins are evident.
Geochemistry: (C. Herd and L. Tunney, *UAb*) ICP-MS data, using sample of North Chile (Filomena) as standard: Ni = 12.3, Co = 0.80 (both wt%); Ir = 5.0, Ga = 28, Ge = 139, As = 22.8, W = 1.0, Re = 0.35, Pd = 5.9, Pt = 20.9, Cu = 179, Au = 2.5 (all µg/g).
Classification: Iron, ungrouped. Although the composition suggests a relationship to the IAB-sHL subgroup, Co, Ir and Pt are all too high. The lack of silicate inclusions is also inconsistent with the IAB group.
Specimens: Type specimen of 61.9 g at *UAb*. Main mass with A. Habibi.

Northwest Africa 12768 (NWA 12768)
Morocco
Purchased: September 2017
Classification: Iron meteorite (IIE)
History: A single 55 g stone purchased from a dealer in Alnif in September 2017.
Physical characteristics: The main mass is irregularly shaped, approximately 2.5 × 5 × 3 cm, with a mottled dark and light brown exterior.
Petrography: (C. Herd, L. Tunney, and R. Bukatiuk, *UAb*) Optical and SEM examination of a 1 × 2.5 cm polished and etched slice, as well as images of etched surfaces provided by the owner, show a well-developed micro-Widmanstatten pattern. Kamacite lamellae average 26±10 µm in width (n=89), but are individually comprised of equant subgrains with 120 degree junctions, suggesting recrystallization. Larger crystal boundaries are apparent at the cm scale, bounded by ~30 µm-wide kamacite lamellae. Inclusions were sought but not found.
Geochemistry: (C. Herd and L. Tunney, *UAb*) ICP-MS data, using sample of North Chile (Filomena) as standard: Ni = 8.8, Co = 0.47 (both wt%); Ir = 4.5, Ga = 25, Ge = 76, As = 14, W = 1.2, Re = 0.47, Pd = 3.9, Pt = 10, Cu = 316, Au = 1.2 (all µg/g).
Classification: Iron, IIE, finest octahedrite.
Specimens: Type specimen of 11.6 g at *UAb*. Main mass with *Kuntz*.

Northwest Africa 12769 (NWA 12769)
Morocco
Purchased: January 2019
Classification: Iron meteorite (IVB)
History: A single 349 g stone purchased from a dealer in Zagora in January 2019.
Physical characteristics: The main mass is roughly shield-shaped, 7.5 × 3 cm across and 2 cm thick. The exterior surface is mottled red-brown to dark brown, with rusty red spots.

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Petrography: (C. Herd, L. Tunney, and R. Bukatiuk, *UAb*) Optical and SEM examination of a 1.5 × 2.5 cm polished and etched slice, show extremely fine (~5 µm) intergrowths of kamacite and taenite, with ~20 × 50 µm lozenge-shaped inclusions of kamacite and schreibersite. Some areas of taenite are also present, ~50 µm across and up to a few hundred µm long.
Geochemistry: (C. Herd and L. Tunney, *UAb*) ICP-MS data, using sample of North Chile (Filomena) as standard: Ni = 17.5, Co = 0.79 (both wt%); Ir = 15.1, Ga <0.5, Ge <2.6, As = 1.6, W = 3.0, Re = 1.4, Os = 1.9, Pd = 9.6, Pt = 30.2, Cu = 7.5, Au <0.8 (all µg/g).
Classification: Iron, IVB, ataxite
Specimens: Type specimen of 21.7 g at *UAb*. Main mass with *Kuntz*.

Northwest Africa 12770 (NWA 12770)
Morocco
Purchased: January 2019
Classification: Iron meteorite (IIIAB)
History: Six stones ranging from 53 g to 327 g, purchased from a dealer in Essaouria in January 2019.
Physical characteristics: The six stones range in size from ~3 to 10 cm in longest dimension, and consist of a suite of irregularly shaoed masses with mottled brown and rusty red exterior surfaces.
Petrography: (C. Herd, L. Tunney, and R. Bukatiuk, *UAb*) A 2 × 3 cm polished and etched slice shows a well-developed Widmanstatten pattern with average kamacite bandwidth of 0.9 ± 0.3 mm (n=11). No inclusions were observed.
Geochemistry: (C. Herd and L. Tunney, *UAb*) ICP-MS data, using sample of North Chile (Filomena) as standard: Ni = 7.3, Co = 0.47 (both wt%); Ir = 12.2, Ga = 16.7, Ge = 27.2, As = 3.8, W = 1.0, Re = 1.2, Os = 2.6, Pt = 15.5, Cu = 169, Au <1.0 (all µg/g).
Classification: Iron, IIIAB, medium octahedrite
Specimens: Type specimen of 26.2 g at *UAb*. Main mass with *Kuntz*.

Northwest Africa 12771 (NWA 12771)
Morocco
Purchased: Feb 2016
Classification: Ordinary chondrite (L6)
History: Purchased from a Moroccan dealer in 2016.
Physical characteristics: Physical Characteristics: Single rectangular stone, 4.2 kg, with blocky, iceberg style, orange-brown weathering and black fusion crust with shallow regmaglypts. Saw cut reveals patchy light and dark areas with sparse deformed chondrules. Darker areas cut by 1 mm shock veins and patches, iron oxide staining.
Petrography: (K. Domanik and J. Satkoski, *UAz*) The meteorite is highly recrystallized, especially in light-colored areas. A few remnant, deformed chondrules

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were observed. Secondary plagioclase grains range up to 200 µm in size. Maskelynite is present in pockets near opaque shock veins. Olivine has well-defined mosaic extinction. No ringwoodite was found in shock veins or pockets. Kamacite, troilite, and chromite are also present.
Geochemistry: Mineral compositions and geochemistry: Olivine $Fa_{25.2 \pm 1.0}$, Fe/Mn=48.0 ± 3.4, n=20; low-Ca pyroxene $Fs_{20.9\pm0.8}Wo_{1.7\pm0.7}$, Fe/Mn=30.0 ± 2.5, n=15.
Classification: Ordinary Chondrite (L6), Weathering grade W2
Specimens: 20 g including polished thin section on deposit at *UAz*, J. Satkoski holds the main mass.

Northwest Africa 12772 (NWA 12772)
(Northwest Africa)
Purchased: 2015 Sep
Classification: Carbonaceous chondrite (CV3)
History: Purchased by Michael Farmer from a meteorite dealer at the Denver Gem and Mineral Show, September 2015.
Physical characteristics: Whole stone mostly covered with black fusion crust.
Petrography: Dominated by abundant large (0.1 to 4 mm, mean 0.8 mm; N=165 chondrules; 54.8 vol.%) FeO-poor and FeO-rich chondrules (FeO-poor chondrules are dominant) with unequilibrated silicates ($Fa_{0.4\text{-}43.5}$) set in an FeO-rich fine-grained matrix (40.9 vol.%). Chondrule types include C, POP, PO, and BO. The meteorite contains abundant CAIs (4.3 vol.%), and contains a large type B CAI (3.5±1.6 mm in apparent dimensions). Similar to the reduced CV3 chondrite RBT 04133 (Davidson et al., 2014), Ni is not positively correlated with Co (e.g., Ni-poor Fe,Ni metal with 4.84 wt.% Ni and 1.93 wt.% Co, and Ni-rich Fe,Ni metal with 46.49 wt.% Ni and 0.65 wt.% Co).
Geochemistry: Olivine: overall $Fa_{11.4\pm15.5}$, $Fa_{0.4\text{-}43.5}$; N=25; FeO-poor chondrules ($Fa_{0.7\pm0.3}$, $Fa_{0.4\text{-}1.1}$; N=15); FeO-rich chondrules ($Fa_{27.4\pm12.8}$, $Fa_{3.2\text{-}43.5}$; N=10).
Classification: Carbonaceous chondrite (CV3)
Specimens: 198.75 g at *ASU*.

Northwest Africa 12773 (NWA 12773)
Morocco
Find: 2019 Jan
Classification: HED achondrite (Eucrite)
Physical characteristics: In hand specimen, the cut surface shows cm-scale, pale-gray clasts surrounded and cross-cut by abundant dark melt veins.
Petrography: The polished block investigated (P23721), displays a fine to medium-grained texture dominated by sub-rounded basaltic clasts with ophitic and sub-ophitic texture. Prominent melt clasts and veins also observed, which contain abundant vesicles up to a few hundred µm in size. Some smaller clasts display a fine grained, more granoblastic texture.

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Geochemistry: Mineral compositions and geochemistry: All analyses by EPMA. Ca-Pyroxene: $Fs_{27.6\pm1.8}Wo_{42.2\pm2.0}$, FeO/MnO = 31.2±1.8 (n=32) Low Ca-Pyroxene: $Fs_{61.2\pm1.1}Wo_{2.6\pm0.9}$, FeO/MnO = 30.3±1.1 (n=31) Plagioclase: $Ab_{10.3\pm1.4}An_{89.4\pm1.6}Or_{0.4\pm0.2}$ (n=29) Silica: 0.3-0.56 wt% FeO, 0.16-1.69 wt% Al_2O_3, 0.07-0.76 wt% CaO (n=2). Clast A (granoblastic): Pyroxene: $Fs_{27.2\pm0.7}Wo_{43.1\pm0.9}$, FeO/MnO = 31.5±1.0 (n=5) Silica: 0.3-0.56 wt% FeO, 0.16-1.69 wt% Al_2O_3, 0.07-0.76 wt% CaO (n=2). Clast B (coarse-grained basaltic): Low Ca-Pyroxene: $Fs_{61.0\pm1.0}Wo_{3.4\pm1.6}$, FeO/MnO = 30.5±1.0 (n=3) Ca-Pyroxene: $Fs_{27.0\pm1.5}Wo_{43.1\pm1.0}$, FeO/MnO = 31.0±1.4 (n=4) Plagioclase: $Ab_{9.6\pm0.5}An_{73.8\pm0.5}Or_{0.4\pm0.3}$ (n=4) Ilmenite: 0.91-0.93 wt% MnO, 0.35 to 0.44 wt% Cr_2O_3 (n=2) Silica: 0.34 wt% FeO, 0.03 wt% CaO (n=2) Clast C (granoblastic): Low Ca-Pyroxene: $Fs_{61.7\pm0.4}Wo_{2.2\pm0.3}$, FeO/MnO = 32.6±0.8 (n=3) Ca-Pyroxene: $Fs_{27.6\ \pm0.9}Wo_{42.4\pm1.2}$, FeO/MnO = 31.8±0.3 (n=4) Silica: 0.18 - 0.28 wt% FeO, 0.17 wt % Al_2O_3, 0.07-0.1 wt% CaO (n=2) Ilmenite: 0.85-0.88 wt% MnO, 0.25-0.43 wt% Cr_2O_3 (n=3) Clast D (basaltic): Low Ca-Pyroxene: $Fs_{60.9}Wo_{3.2}$, FeO/MnO = 30.7 (n=1) Ca-Pyroxene: $Fs_{30.8\pm0.7}Wo_{37.9\pm0.9}$, FeO/MnO = 30.3±0.8 (n=6) Silica: 0.15-0.39 wt% FeO, 0.08-0.43 wt % Al_2O_3, 0.05-0.16 wt% CaO (n=2) Plagioclase: $Ab_{10.3\pm1.9}An_{89.3\pm1.8}Or_{0.4\pm0.0}$ (n=3)
Classification: HED achondrite (eucrite, breccia)
Specimens: 40.18 g on deposit at the *NHM* London (BM.2019,M64), including polished block (P23721). M. Goff holds the main mass.

Northwest Africa 12774 (NWA 12774)
(Northwest Africa)
Purchased: 2019 Jun
Classification: Angrite
History: The stone was purchased by Rachid and Jaouad Chaoui in March 2019 from a Mauritanian dealer, and in June 2019 the main mass was acquired from them at the Ensisheim Show by Marc Jost and Karl Wimmer.
Physical characteristics: A single dark, dense ellipsoidal stone (454 g) lacking fusion crust. The fresh interior exhibits small green crystals within a black matrix.
Petrography: (A. Irving, *UWS* and P. Carpenter, *WUSL*) Porphyritic texture. Euhedral, skeletal compositionally-zoned phenocrysts of olivine and subhedral phenocrysts of Al-Ti augite are set within a much finer grained, rapidly-cooled groundmass composed of parallel-grown anorthite, olivine, kirschsteinite and Al-Ti augite together with minor troilite, ulvöspinel and rare spherical grains of kamacite.
Geochemistry: Olivine (cores $Fa_{16.5\text{-}18.9}$Ln0.7, FeO/MnO = 88-111, N = 3; mantles $Fa_{34.1\text{-}44.7}$Ln1.1-1.5, FeO/MnO = 89-100, N = 5; rim $Fa_{69.5}$Ln4.3, FeO/MnO = 76), olivine in groundmass ($Fa_{76.2}$Ln4.8, FeO/MnO = 76), Al-Ti augite phenocrysts ($Fs_{17.9\text{-}19.5}Wo_{56.4\text{-}52.9}$, FeO/MnO = 64-77, Al_2O_3 = 17.0-17.7 wt.%, TiO_2 = 1.1-1.5 wt.%, N = 3), Al-Ti augite in groundmass ($Fs_{30.3\text{-}42.1}Wo_{50.8\text{-}53.6}$, FeO/MnO = 75-120, Al_2O_3 = 6.3-7.8 wt.%, TiO_2 = 2.2-5.3 wt.%, N = 2), anorthite ($An_{99.4\text{-}99.7}Or_{0.6\text{-}0.3}$, N = 2), kirschsteinite ($Fa_{61.5\text{-}61.7}$Ln35.5-35.8, FeO/MnO = 68-71, N = 2). Bulk composition (J. Tepper, UPugetSound): analysis of a representative whole rock

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powder by ICP-OES gave (in wt.%) SiO_2 39.4, Al_2O_3 10.9, CaO 10.9, Na_2O 0.32, Mg/(Mg+Fe) = 0.0598.
Classification: Angrite (olivine-phyric). Although texturally similar to NWA 7812, this specimen has different mineral and whole rock compositions, and thus pairing between these stones is ruled out.
Specimens: 22.1 g including one polished thin section and a polished endcut at *UWB*; the main mass is held jointly by M. Jost and K. Wimmer.

Northwest Africa 12775 (NWA 12775)
(Northwest Africa)
Purchased: 2011
Classification: HED achondrite (Eucrite)
History: Cataloged in the *ROM* collection as LM55993.
Physical characteristics: The meteorite has a well-preserved, dark fusion crust, with no evident weathering. Interior of the meteorite intact, uniform and pale gray, with visible thin, black veins and very-fine grained texture.
Petrography: Fine-grained basalt, with equilibrated texture, slightly brecciated. A small vein that appears to be of impact origin. The sample contains a small clast that shows thermal disequilibration. Very fine grained plagioclase and pyroxene in the matrix, with seldom large laths of plagioclase and subordinate large pyroxene grains. Matrix plagioclase needle-shaped.
Geochemistry: Mineral composition and geochemistry: Plagioclase, $An_{89.5\pm2.2}$ (n=18). Low-Ca pyroxene composition: $Fs_{42.7\pm1.6}Wo_{4.6\pm1.9}$ and Mg# 34.5-36.7 (n=8); high-Ca pyroxene composition: $Fs_{24.1\pm8.6}Wo_{38.1\pm15.3}$, Mg# 38.2-52.2 (n=10)
Classification: (A. Cernok, *ROM*) Sample is an equilibrated basaltic eucrite. Texture and compositions suggest the sample has experienced thermal equilibration.

Northwest Africa 12776 (NWA 12776)
(Northwest Africa)
Purchased: 2015
Classification: HED achondrite (Eucrite)
History: Catalogued in *ROM* as sample LM57789.
Physical characteristics: Visible fusion crust showing low to moderate weathering, evident by a light orange coloring. Cracks in the fusion crust filled in with caliche or oxides. Interior of the sample fresh, showing coarse grained cummulate texture. Only slight weathering in the sample's inside.
Petrography: Cumulate rock with equilibrated texture, not brecciated, no clasts, containing Opx, Cpx and plagioclase laths; equilibrated texture. No clasts noted. Low shock deformation.
Geochemistry: Mineral composition and geochemistry: Plagioclase $An_{89.8\pm0.4}$ (n=16). Low-Ca pyroxene composition: $Fs_{39.0\pm2.0}Wo_{7.4\pm3.5}$ and Mg# 37.1-

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39.6 (n=11); high-Ca pyroxene composition: $Fs_{20.5\pm6.4}Wo_{40.5\pm11.9}$, Mg# 40.8-50.9 (n=18)
Classification: (A. Cernok, *ROM*) Texture and compositions suggest the sample is a cummulate, gabbroic eucrite.

Northwest Africa 12777 (NWA 12777)
(Northwest Africa)
Purchased: 2015
Classification: HED achondrite (Eucrite)
History: Catalogued at the *ROM* as sample LM57448.
Physical characteristics: Visible fusion crust showing minimal weathering. Interior of the sample shows a pale orange color possibly due to caliche formation. Different clasts visible inside the sample.
Petrography: Polymict eucrite breccia containing several clasts, all of which have Opx, Cpx and plagioclase. Matrix is comprised of phenocrysts of pyroxene and plagioclase laths surrounded by fine-graind material of the same composition. Clasts can be described as 1) a very fine grained clast of disequilibrated texture, containing Plag, Opx and Cpx; 2) a lighter clast containing larger plagioclase and pyroxene grains, showing annealed or thermally-metamorphosed texture; 3) several basaltic clasts with needle-shaped plagioclase laths. Whole rock shows severe brecciation and crushing, some clast show more thermal and shock deformation.
Geochemistry: Mineral composition and geochemistry: Plagioclase $An_{92.4\pm3.8}$ (n=10). Low-Ca pyroxene composition: $Fs_{23.3\pm9.3}Wo_{4.3\pm1.2}$ and Mg# 39.0-70.8 (n=19); High-Ca pyroxene composition: $Fs_{24.9\pm11.9}Wo_{24.1\pm17.7}$, Mg# 38.5-70.2 (n=9)
Classification: (A. Cernok, *ROM*) Texture and compositions suggest the sample is a polymict eucrite breccia. Lack of clear Opx-dominated clasts excludes the possibility of this meteorite being a howardite.

Northwest Africa 12778 (NWA 12778)
(Northwest Africa)
Purchased: 2018
Classification: Carbonaceous chondrite (CM2)
History: Purchased by Matthew Stream from Mike Bandli in 2018, who purchased it from Aziz Habibi at the 2018 Tucson Gem and Mineral Show.
Physical characteristics: Four dark-gray stones. A slice reveals a dark fine-grained interior.
Petrography: (D. Sheikh, *FSU*) Small chondrules present (mean diameter ~260 µm), isolated mineral fragments (Olivine, low-Ca pyroxene, high Ca-Pyroxene) and small CAIs with fine-grained dust rims set in a dark, abundant matrix. In many chondrules the mesostasis has been aqueously altered to phyllosilicates. The matrix also contains phyllosyllicates as indicated by low microprobe totals.

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Geochemistry: (D. Sheikh, *FSU*) Olivine ($Fa_{11.9\pm17.0}$, range $Fa_{0.7-41.4}$, Cr_2O_3=0.40±0.13, n=12); low-Ca Pyroxene ($Fs_{3.5\pm3.3}$ $Wo_{0.8\pm0.3}$, range $Fs_{1.1-5.9}Wo_{0.6-1.0}$, n=10). Isolated mineral grains of low-Ca Pyroxene ($Fs_{27.8\pm1.1}$ $Wo_{0.5\pm0.1}$, range $Fs_{26.9-29.0}Wo_{0.4-0.6}$, n=3) and high-Ca Pyroxene ($Fs_{9.9}$ $Wo_{9.2}$, n=1) found in matrix.
Classification: Carbonaceous Chondrite (CM2)
Specimens: 7.22 grams at *UCLA*; main mass with Matthew Stream.

Northwest Africa 12779 (NWA 12779)
Morocco
Purchased: 20 Apr. 2017
Classification: Carbonaceous chondrite (CK5)
History: the meteorite was purchased in Morocco from Moroccan dealer, Aziz Habibi
Petrography: (M. A. Ivanova, *Vernad*). The meteorite consists of coarse-grained matrix (~60%) and chondrules, their fragments and plagioclase-rich aggregates. POP, BO, PP chondrules are not well delineated. The meteorite contains olivine, pyroxene, plagioclase, Cr-magnetite, ilmenite, spinel and sulfides (pentlandite, pyrrhotite); Fe,Ni-metal is absent.
Geochemistry: Feldspar composition: $Ab_{20.7-81.1}$, $An_{78.9-14.0}$; NiO in olivine - 0.77 wt%; magnetite (3.7 wt% Cr_2O_3, 1.9 wt% Al_2O_3)
Classification: CK5 chondrite, S2, W4, based on minerals compositions and texture
Specimens: 1 thin section and two pieces of meteorite (13.8 g and 2 g), 15.8 g in total are located at *Vernad*, the main mass is located at *DMUH*

Northwest Africa 12796 (NWA 12796)
Morocco
Purchased: 2013 Sep
Classification: Carbonaceous chondrite (CK3)
History: Catalogued in the Royal Ontario Museum Collections as LM57472.
Physical characteristics: Fusion crust visible on portions of hand sample. Millimeter-sized chondrules and CAIs visible set in a greenish-yellow matrix.
Petrography: Sample contains 70% fine grained matrix (<10 µm) with some grains in the 100 µm range. The sample contains 15-20% chondrules and CAIs 10%. Average chondrule size is 1 mm in diameter. Chondrules, CAIs and matrix contain plagioclase (plagioclase abundance >10 vol%). Matrix has greenish-yellow colour. Magnetite has an average of 2.2 wt% Cr_2O_3.
Geochemistry: Olivine is somewhat heterogeneous in the sample (Fa coefficient of variation = 60.8%, Fa PMD = 54.45%). Olivine in the matrix is more fayalitic ($Fa_{34.5}$) than in chondrules ($Fa_{16.8}$). Orthopyroxene in the sample is enstatitic in composition, and clinopyroxene ranged from augite to diopside, with the average composition being augite. Plagioclase $An_{42.4\pm25.6}$ (N = 28).
Classification: Carbonaceous chondrite (CK3) with minimal weathering and shock.

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Northwest Africa 12798 (NWA 12798)
(Northwest Africa)
Purchased: 2018
Classification: Ordinary chondrite (H6, melt breccia)
History: The meteorite was purchased from a local meteorite dealer in Morocco.
Physical characteristics: Forty-three brownish fragments without fusion crust.
Petrography: The meteorite is a chondritic melt breccia composed of abundant melt rock and very few H6 chondritic regions (plagioclase grain size about 60 µm) containing some relict chondrule fragments. No metal or sulfide veins are observed.

Northwest Africa 12799 (NWA 12799)
(Northwest Africa)
Purchased: 2018
Classification: Ordinary chondrite (LL5-6)
History: The meteorite was purchased from a local meteorite dealer in Morocco.
Physical characteristics: Three grayish fragments with some fusion crust.
Petrography: The meteorite is a chondritic breccia composed of L6-type fragments (plagioclase grain size about 60 µm) set into L5-type matrix (plagioclase grain size about 30 µm).

Northwest Africa 12800 (NWA 12800)
(Northwest Africa)
Purchased: 2018
Classification: Carbonaceous chondrite (CV3)
History: The meteorite was purchased from a local meteorite dealer in Guelmim, Morocco.
Physical characteristics: Fifteen dark-grayish fragments with some fusion crust.
Petrography: Carbonaceous chondrite composed of chondrules (mean diameter about 0.8 mm; up to 3 mm sized), CAIs, and olivine amoeboids all set into a fine-grained almost black matrix. Type II chondrules are absent.

Northwest Africa 12801 (NWA 12801)
(Northwest Africa)
Purchased: 2018
Classification: Carbonaceous chondrite (CK3)
History: The meteorite was purchased from a local meteorite dealer in Guelmim, Morocco.
Physical characteristics: Two dark-grayish fragments without fusion crust.
Petrography: The meteorite displays a brownish interior and is composed of several well defined chondrules (mean diameter about 700 µm) set into abundant

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recrystallized matrix. Compositionally equilibrated Fe-rich olivine is the dominant mineral phase in the matrix. Olivine and low-Ca pyroxene are compositionally zoned in most chondrules. Minor phases include intermediate plagioclase, Ca-pyroxene, and troilite. Cr-rich magnetite is abundant; metal was not detected. The meteorite appears brecciated.

Geochemistry: unequilibrated olivine: $Fa_{20.9\pm4.4}$ ($Fa_{15.0-25.5}$, n=11); unequilibrated low-Ca pyroxene: $Fs_{14.9\pm7.8}Wo_{0.4\pm0.1}$ ($Fs_{3.8-23.3}Wo_{0.3-0.5}$, n=14); Fe-rich matrix olivine: $Fa_{29.5\pm0.9}$, FeO/MnO=115±13, n=13; low-Ca matrix pyroxene: $Fs_{24.3\pm0.7}Wo_{1.0\pm0.2}$, n=18; matrix Ca-pyroxene: $Fs_{10.0\pm1.4}Wo_{43.6\pm4.6}$, n=5; matrix feldspar: $An_{25.7\pm7.5}Ab_{69.3\pm6.3}Or_{5.1\pm1.4}$, n=6

Northwest Africa 12802 (NWA 12802)
(Northwest Africa)
Purchased: 2017
Classification: Mesosiderite

History: The meteorite was purchased from a local meteorite dealer in Ouarzazate, Morocco.

Physical characteristics: Brownish fragment without fusion crust.

Petrography: The meteorite displays a light brownish interior and is composed of silicate (about 60 vol%) and metallic (about 40 vol%) portions. The metallic lithology consists of most abundant kamacite and some taenite. The silica fraction is dominated by up to 0.5 µm sized low-Ca pyroxene, less abundant olivine, calcic plagioclase, and minor silica and merrillite.

Geochemistry: olivine: $Fa_{31.7\pm0.3}$, FeO/MnO=46±2, n=15; low-Ca pyroxene: $Fs_{28.4\pm0.3}Wo_{3.1\pm0.3}$, FeO/MnO=27±1, n=16; Ca-pyroxene: $Fs_{12.2\pm0.3}Wo_{43.0\pm0.2}$, n=10; plagioclase: $An_{90.9\pm1.4}Ab_{8.7\pm1.2}Or_{0.4\pm0.1}$, n=16

Northwest Africa 12803 (NWA 12803)
(Northwest Africa)
Purchased: 2017
Classification: Ordinary chondrite (H4)

History: The meteorite was purchased from a local meteorite dealer in Zagora, Morocco.

Physical characteristics: Brownish fragment without fusion crust.

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

Northwest Africa 12804 (NWA 12804)
(Northwest Africa)
Purchased: 2018

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Classification: Ordinary chondrite (LL7)
History: The meteorite was purchased from a local meteorite dealer in Algeria.
Physical characteristics: Dark-grayish rock with some fusion crust.
Petrography: The meteorite displays a thoroughly recrystallized texture of dominantly olivine and orthopyroxene grains with relativey high Wo-contents. Plagioclase grains are up to 150 µm in size. One relict chondrule fragment has been found in the 1 × 1.5 cm section.
Classification: Petrologic type 7 based on the equilibrated state of olivine and pyroxene, the large grain size of secondary plagioclase, and the high CaO concentration in low-Ca pyroxene.

Northwest Africa 12804 (NWA 12804)
(Northwest Africa)
Purchased: 2018
Classification: Ordinary chondrite (LL7)
History: The meteorite was purchased from a local meteorite dealer in Algeria.
Physical characteristics: Dark-grayish rock with some fusion crust.
Petrography: The meteorite displays a thoroughly recrystallized texture of dominantly olivine and orthopyroxene grains with relativey high Wo-contents. Plagioclase grains are up to 150 µm in size. One relict chondrule fragment has been found in the 1 × 1.5 cm section.
Classification: Petrologic type 7 based on the equilibrated state of olivine and pyroxene, the large grain size of secondary plagioclase, and the high CaO concentration in low-Ca pyroxene.

Northwest Africa 12804 (NWA 12804)
(Northwest Africa)
Purchased: 2018
Classification: Ordinary chondrite (LL7)
History: The meteorite was purchased from a local meteorite dealer in Algeria.
Physical characteristics: Dark-grayish rock with some fusion crust.
Petrography: The meteorite displays a thoroughly recrystallized texture of dominantly olivine and orthopyroxene grains with relativey high Wo-contents. Plagioclase grains are up to 150 µm in size. One relict chondrule fragment has been found in the 1 × 1.5 cm section.
Classification: Petrologic type 7 based on the equilibrated state of olivine and pyroxene, the large grain size of secondary plagioclase, and the high CaO concentration in low-Ca pyroxene.

Northwest Africa 12805 (NWA 12805)
(Northwest Africa)
Purchased: 2019

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Classification: Ureilite
History: The meteorite was purchased from a local meteorite dealer in Morocco.
Physical characteristics: Brownish fragment without fusion crust.
Petrography: The meteorite shows a cumulate texture of olivine and pigeonite grains with highly variable grain sizes. Coarse-grained regions have grain sizes of up to 2 mm, more fine-grained regions of about 0.5 mm. The meteorite contains flaky graphite; olivine displays characteristic reduced rims.
Geochemistry: reduced rims in olivine: $Fa_{1.2-4.7}$; olivine contains 0.76±0.03 wt% Cr_2O_3 and 0.39±0.01 wt% CaO

Northwest Africa 12806 (NWA 12806)
(Northwest Africa)
Purchased: 2019
Classification: Ureilite
History: The meteorite was purchased from a local meteorite dealer in Agadir, Morocco.
Physical characteristics: Brownish fragment without fusion crust.
Petrography: The meteorite shows a cumulate texture of up to 1.5 mm sized and mostly elongated olivine and pigeonite grains. It contains flaky graphite; olivine displays characteristic reduced rims.
Geochemistry: reduced rims in olivine: $Fa_{2.1-6.1}$; olivine contains 0.73±0.04 wt% Cr_2O_3 and 0.40±0.01 wt% CaO

Northwest Africa 12807 (NWA 12807)
(Northwest Africa)
Purchased: 2011 Feb 12
Classification: Ordinary chondrite (L4)
Geochemistry: kamacite Co 0.59±0.09 wt% (0.54-0.67 wt%), Ni 10.6 wt% (7.4-14.3 wt%.
Classification: L4, "black chondrite"
Specimens: The 1263 g TKW includes a main mass of 915 g. There are 7 sawn slices and ends in addition to the main mass, and 3 polished thin sections (PTS), a total of 1263 g remaining after cutting and sample prep. Dealer sold small additional amounts (some tens of grams (?), unknown, not included in TKW) prior to GCW purchasing all the remainder on 2011 Feb 12.

Northwest Africa 12808 (NWA 12808)
(Northwest Africa)
Purchased: 2001
Classification: Ordinary chondrite (L3)
History: The meteorite was purchased from a local meteorite dealer in Erfoud, Morocco.

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Physical characteristics: Greyish fragment with some fusion crust.
Petrography: The meteorite shows a chondritic texture with nicely defined, mostly flattened and loosely packed chondrules (mean diameter about 0.7 mm) in a more fine-grained matrix that contains sulfides and FeNi metal.

Northwest Africa 12812 (NWA 12812)
(Northwest Africa)
Purchased: 2001
Classification: HED achondrite (Diogenite)
History: The meteorite was purchased from a local meteorite dealer in Erfoud, Morocco.
Physical characteristics: Many greyish fragments without fusion crust.
Petrography: The meteorite displays a grayish interior and is predominantly composed of blocky up to 7 mm sized orthoproxene grains. Minor phases include calcic plagioclase, silica, chromite, FeS, and metallic iron. It appears unbrecciated in the section studied.
Geochemistry: low-Ca pyroxene: $Fs_{27.7\pm0.6}Wo_{2.9\pm0.6}$ ($Fs_{26.4-28.3}Wo_{2.5-4.7}$, n=12, FeO/MnO=26-32); calcic plagioclase: $An_{93.0\pm0.7}$ ($An_{92.2-94.5}$, n=12)

Northwest Africa 12814 (NWA 12814)
(Northwest Africa)
Purchased: 2019
Classification: Carbonaceous chondrite (CK4)
History: The meteorite was purchased from a local meteorite dealer in Morocco.
Physical characteristics: Grayish rock partly covered with fusion crust.
Petrography: The meteorite displays a greyish to slightly greenish interior and is predominantly consists of fine-grained recrystallized matrix dominated by ferrous olivine. Few chondrules with a mean diameter of about 700 µm are present. While olivine is equilibrated throughout the meteorite, low-Ca pyroxene shows compositional zoning in matrix and chondrules. Minor phases include intermediate plagioclase, Ca-pyroxene, and troilite. Cr-rich magnetite is abundant; metal is virtually absent.
Geochemistry: olivine: $Fa_{26.9\pm0.4}$ (FeO/MnO=97±10, n=15); low-Ca pyroxene: $Fs_{15.1\pm6.5}Wo_{1.8\pm1.2}$ ($Fs_{3.4-22.5}Wo_{0.8-4.2}$, n=19); Ca-pyroxene: $Fs_{1.4\pm0.1}Wo_{42.3\pm1.6}$, n=10; feldspar: $An_{38.0\pm7.3}Ab_{59.5\pm6.6}Or_{2.5\pm0.7}$, n=11

Northwest Africa 12815 (NWA 12815)
(Northwest Africa)
Purchased: 2019
Classification: Carbonaceous chondrite (CM2)
History: The meteorite was purchased from a local meteorite dealer in Morocco.

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Physical characteristics: Many small black fragments some of which partly covered with fusion crust.
Petrography: The meteorite is a chondritic breccia dominated by fine-grained almost opaque matrix composed of flaky phyllosilicates, sulfides, Ca-carbonates and rare FeNi metal, the latter mostly enclosed within olivine. Embedded in this matrix are chondrules (mean diameter about 250 µm), chondrule pseudomorphs, mineral fragments, and rare CAIs most of which are surrounded by fine-grained dust rims. Chondrule mesostasis has completely been replaced by alteration products.
Geochemistry: FeO in carbonate about 1 wt%

Northwest Africa 12816 (NWA 12816)
(Northwest Africa)
Purchased: 2019
Classification: Carbonaceous chondrite (CO3)
History: The meteorite was purchased from a local meteorite dealer in Algeria.
Physical characteristics: Brownish fragment without fusion crust.
Petrography: The meteorite shows a dark brownish to black interior and is composed of abundant small chondrules, CAIs, and mineral fragments set into a fine-grained matrix. Chondrules are dominantly porphyritic type I with a mean diameter of about 0.2 mm. Some sulfides and FeNi metal are present in matrix and chondrules.

Northwest Africa 12817 (NWA 12817)
(Northwest Africa)
Purchased: 2018
Classification: HED achondrite (Eucrite, unbrecciated)
History: Marc Jost acquired the 12 7g sample from Giorgio Tomelleri at the St Marie aux Mines show in 2018.
Physical characteristics: The exterior is covered by a ~1mm thick, dark brown, bumpy fusion crust. Pyroxenes protrude through the surface of the crust as blocky, brown crystals. The cut face shows the interior is composed of light orange and white interlocking crystals with an igneous texture.
Petrography: Description and classification (A. Love, *App*): Sample is a coarse-grained, unbrecciated, ophitic-textured basalt with 990 µm euhedral to subhedral plagioclase laths enclosed by 4 mm exsolved pigeonites. Some margins of pyroxenes show they have been recrystallized into smaller sub grains with 120º grain boundaries. Additional minerals are: ilmenite, chromite, zircon, phosphate and a silica polymorph.
Geochemistry: (A. Love, *App*) Low Ca pyroxene $Fs_{61.9\pm0.9}Wo_{5.3\pm1.0}$ ($Fs_{60.2-63.1}Wo_{4.1-7.2}$), Fe/Mn=30.4±0.4, Mg#=34.8, N=22; high Ca pyroxene $Fs_{32.7\pm0.5}$ $Wo_{39.9\pm0.6}$ ($Fs_{31.7-33.7}Wo_{38.9-41.2}$), Fe/Mn=32.3±0.9, N=15; plagioclase $An_{89.1\pm2.1}Or_{0.4\pm0.1}$ ($An_{86.3-91.4}Or_{0.2-0.7}$), N=8.
Classification: Achondrite (gabbroic eucrite, unbrecciated). Based on ophitic texture, equilibrated compositions, Fe/Mn and Mg# of pigeonites, this sample is a

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coarse-grained, unbrecciated, equilibrated gabbroic eucrite. This sample corresponds to a type 6 eucrite of Takeda and Graham (1991) based upon inversion of original pigeonite and equilibrated compositions of pyroxenes.
Specimens: Marc Jost (*SJS*) holds the main mass. 2 slices weighing 20.5 g, a mount and polished thin section are on deposit at *App*.

Northwest Africa 12818 (NWA 12818)
(Northwest Africa)
Purchased: 2018
Classification: Ordinary chondrite (LL3-5)
History: Marc Jost purchased from a Moroccan dealer at the 2018 Ensisheim meteorite show.
Physical characteristics: The 241g sample has a brown weathered exterior with an irregular shape and a weathered fusion crust. The cut face shows the interior is a breccia composed of clasts of equilibrated lithologies set within a host of flattened chondrules that define a foliation.
Petrography: Description and Classification (A. Love, *App*) Sample is a breccia composed of sparse, angular-rounded clasts of recrystallized equilibrated chondrite set within a host of densely-packed, unequilibrated chondrules and fragments (avg. dia. 917 µm, N=58) with fine-grained rims and rare matrix lumps.
Geochemistry: (A. Love, *App*) Host: Olivine $Fa_{18.6\pm11.1}$ ($Fa_{0.5\text{-}37.6}$), Fe/Mn=53.5±17.0, mean Cr_2O_3 in ferroan olivine=0.1±0.1 (0.0-0.4), PMD=51% N=16; low Ca pyroxene $Fs_{12.3\pm7.4}Wo_{0.8\pm0.8}$ ($Fs_{1.4\text{-}29.5}Wo_{0.2\text{-}3.5}$), PMD=47%, N=14. Clast 1: Olivine $Fa_{28.2\pm2.5}$ ($Fa_{22.9\text{-}30.1}$), Fe/Mn=55.0, N=6; low Ca pyroxene $Fs_{25.1\pm0.1}Wo_{1.7\pm0.4}$, N=3. Clast 2: Olivine $Fa_{30.4\pm0.2}$, Fe/Mn=56.5, N=6; low Ca Pyroxene $Fs_{25.2\pm0.2}Wo_{1.4\pm0.5}$, N=3.
Classification: Ordinary Chondrite (LL3, 5C-S3, W3) Based on chondrule size and magnetic susceptibility and mineral compositions, this sample is an LL ordinary chondrite. Based on textures and mineral compositions, this sample is an LL3-5 breccia. Host is ≥3.2 based on PMD of Ol and Opx, CL observations indicate ≥3.3 following Huss et al. (2006), and mean and standard deviation of Cr_2O_3 in ferroan Ol ≥3.2.
Specimens: Marc Jost (*SJS*) holds the main mass. 2 slices weighing 33.2 g and a polished mount and thin section and mount are on deposit at *App*.

Northwest Africa 12819 (NWA 12819)
(Northwest Africa)
Purchased: 2018
Classification: Carbonaceous chondrite (CK3)
History: Marc Jost purchased this 1022g sample from Mokhtar Aithiba at Munich show 2018.
Physical characteristics: The sample has a rounded shape, with numerous chondrules and inclusion are visible on the exterior. The cut face shows the interior

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has a chondritic texture composed of dispersed chondrules and CAIs, set within a greenish-gray, fine-grained matrix.
Petrography: Description and Classification (A. Love, *App*) Sample is composed of ~39 vol%, 1364 im (avg. dia.) chondrules and CAIs in a matrix composed of olivine, pyroxene, zoned plagioclase and magnetite. BO and POP chondrules are dominant and many contain concentric clastic and igneous rims.
Geochemistry: (A. Love, *App*) Olivine chondrules $Fa_{24.7\pm9.7}$ ($Fa_{9.2-33.5}$), Fe/Mn=121.1±26.2, mean NiO in chondrule rims = 0.3 wt%, N=10; Matrix olivine $Fa_{33.3\pm0.2}$, mean NiO =0.4wt%, N=8; low Ca pyroxene $Fs_{10.1\pm8.3}Wo_{2.0\pm1.8}$ ($Fs_{1.8-24.6}Wo_{0.6-4.0}$), N=7; high-Ca pyroxene $Fs_{8.1\pm8.3}Wo_{25.3\pm18.3}$ ($Fs_{1.5-22.6}Wo_{6.0-51.6}$), N=5 Plagioclase cores: $An_{87.8\pm2.3}Or_{0.1\pm0.1}$; rims: $An_{30.7\pm5.3}Or_{2.7\pm0.6}$, N=5.
Classification: Carbonaceous chondrite (CK3). Based upon chondrule size, oxidized composition of chondrule olivines, and presence Cr-bearing magnetite and NiO content of olivine, this sample is a CK. Based on unequilibrated compositions of olivine and pyroxenes, this sample is a type 3 CK chondrite. CK3 wi-3 C-S3
Specimens: Marc Jost (*SJS*) holds the main mass. A polished thin section and mount and 3 slices totaling 29.4 g comprise the type specimen which is on deposit at *App*.

Northwest Africa 12820 (NWA 12820)
(Northwest Africa)
Purchased: 2019
Classification: Carbonaceous chondrite (CV3)
History: A single stone weighing 2350 g was purchased in Agadir, Morocco, in March of 2019.
Physical characteristics: Sample is dark-colored, has a rounded tabular and is very friable. 60% of sample is covered by an ablated fusion crust with chondrules and CAIs visible on the uncrusted surface. The cut face shows the interior is composed of reddish-orange chondrules and light-colored CAIs in a dark-grey - black matrix.
Petrography: Description and Classification (A. Love, *App*) Sample has a chondritic texture composed of ~658 µm (avg. dia., N=38) chondrules, chondrule fragments, abundant CAIs and forsteritic amoeboid olivine aggregates, set within a fine-grained opaque matrix. Additional minerals are spinel, diopside, troilite, magnetite, rare FeNi metal and chromite.
Geochemistry: (A. Love, *App*) Olivine: $Fa_{3.0\pm2.4}$ ($Fa_{0.6-9.5}$), N=12; low Ca pyroxene: $Fs_{1.6\pm1.3}Wo_{0.7\pm0.2}$ ($Fs_{0.9-4.9}Wo_{0.3-0.9}$), N=8.
Classification: Carbonaceous chondrite (CV3). Carbonaceous chondrite, based abundance of CAIs and size of chondrules. CV3 based on unequilibrated compositions of chondrules. CV3 C-S3, moderate weathering.
Specimens: Thierry Simard holds the main mass. An endcut weighing 21.22 g and a polished thin section are on deposit at *App*.

Northwest Africa 12821 (NWA 12821)
(Northwest Africa)

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Purchased: 2019
Classification: Enstatite chondrite (EL3)

History: Purchased by Habib Naji, Morocco, 6 Jan 2019, from a nomad who reportedly found the meteorite.

Physical characteristics: Single stone with fusion crust, outlines of small chondrules are visible on the surface. Saw-cut surface reveals abundant bright metal/sulfide grains making up 15-20% of this meteorite. Numerous small chondrules are present in a dark gray matrix.

Petrography: (C. Agee, *UNM*) Microprobe examination of a polished mount shows many distinct, well formed chondrules with dominant enstatite and lesser forsterite, apparent mean diameter 375±200 µm (n=18). Some chondrules are mantled with metal or contain many fine-grained metal/sulfide inclusions. Very fine-grained metal is dispersed throughout the matrix, numerous larger metal grains up to 500 µm are ubiquitous. No feldspar was detected.

Geochemistry: : (C. Agee, *UNM*) Forsterite $Fa_{0.3\pm0.2}$, n=20; enstatite $Fs_{1.6\pm1.8}Wo_{0.7\pm0.9}$, Fe/Mn=9±3 n=12; oldhamite Ca=52.9, Mn=1.12, S=43.2 (all wt%), n=3; Cr-bearing troilite Cr=2.7±1. (wt%), n=5; kamacite Ni=6.6±0.2, Si=1.32±0.02, n=10. Oxygen isotopes (K. Ziegler, *UNM*): 8 acid-washed fragments analyzed by laser fluorination gave, respectively $\delta^{18}O$= 5.892, 5.846, 6.049, 6.023, 6.068, 6.091, 6.402, 6.081; $\delta^{17}O$= 3.045, 3.119, 3.359, 3.212, 3.216, 3.168, 3.367, 3.254; $\Delta^{17}O$= -0.065, 0.032, 0.166, 0.032, 0.012, -0.048, -0.013, 0.043 (linearized, all per mil, TFL slope=0.528).

Classification: Enstatite chondrite (EL3), type 3 based on presence of numerous, well-formed type I chondrules. EL based on Si content of kamacite.

Specimens: 20.5 g including a probe mount on deposit at *UNM*, Habib Naji holds the main mass.

Northwest Africa 12822 (NWA 12822)
Northwest Africa
Purchased: 2019
Classification: Angrite

History: Purchased by Habib Naji from a Moroccan meteorite hunter in Morocco, March 2019.

Physical characteristics: Single stone of several fragments that fit together. Irregular shaped exterior, dark brown, lacking fusion crust. Broken surface reveals coarse grains, dark brown and light brown in color, many cleavage faces are visible.

Petrography: (C. Agee, *UNM*) Microprobe examination of a polished mount shows a protogranular texture of calcium-bearing olivine, titanoan aluminian augite, anorthite, and spinel. Approximately half of the kamacite in this meteorite has been altered to iron-oxide. Many fine veinlets of iron-oxide crosscut the primary minerals. Iron sulfide was also detected.

Geochemistry: (C. Agee, *UNM*) Olivine $Fa_{40.6\pm0.2}$, CaO=1.2±0.2 (wt%), Fe/Mn=84±22, n=7; titanoan aluminian augite $Fs_{10.3\pm1.8}Wo_{53.6\pm0.6}$, Al_2O_3=7.5±0.7, TiO_2=1.3±0.1 (both wt%). Fe/Mn=84±2 n=7; anorthtite $An_{99\text{-}96}$, n=3.

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Classification: Plutonic angrite, likely paired with NWA 2999 and NWA 3164.
Specimens: 23 g plus a probe mount on deposit at *UNM*, Habib Naji holds the main mass.

Northwest Africa 12823 (NWA 12823)
Algeria
Purchased: 2018
Classification: Pallasite
History: (Ziyao Wang) Purchased by Ziyao Wang from Adnane Sami during the China Mineral & Gem Show in *Beijing* City in Nov. 2018.
Physical characteristics: (Ziyao Wang) 3 brown stones totaling 36.8 g, without fusion crust.
Petrography: (R. Bartoschewitz, *Bart*) Metal phase is weathered completely to Fe-hydroxides and bear olivine grains up to 5 mm.
Geochemistry: (R. Bartoschewitz, *Bart*, P. Appel and B. Mader, *Kiel*) Olivine $Fa_{13.3\pm0.1}$ (n=5). Oxidized metal: ~57 % Fe, ~3 % Ni. Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 5.13
Classification: Pallasite
Specimens: 7.6 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 2.2 g with *Bart*.

Northwest Africa 12824 (NWA 12824)
(Northwest Africa)
Purchased: 2019
Classification: Ordinary chondrite (H~6)
History: Purchased at the Chenzhou Mineral Show in 2019 by Ziyao Wang and was donated to R. Bartoschewitz
Physical characteristics: One brown globular stone of 38 g
Petrography: (R. Bartoschewitz, *Bart*) Gray, metal-rich, recrystallized matrix, with recognizable chondrules and vugs (av. 0.2 mm) that bear silicates with well developed crystal faces.
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 5.41
Classification: Ordinary chondrite (H~6, W0)
Specimens: 7.7 g on deposit at *Kiel*, *Bart*. holds the main mass

Northwest Africa 12825 (NWA 12825)
(Northwest Africa)
Purchased: 2019
Classification: HED achondrite (Diogenite, polymict)
History: The meteorite was purchased from a local meteorite dealer in Morocco.
Physical characteristics: Many dark brownish fragments with some fusion crust.

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Petrography: The meteorite is a fragmental breccia composed of a large diversity of mostly angular mineral fragments and some impact melt clasts set into a fine-grained clastic matrix. Minerals include diogenitic orthopyroxene of two different compositions, Fe-rich eucritic low-Ca pyroxene with augite exsolution lamellae, two compositionally different types of olivine, and calcic plagioclase. Minor phases are silica, chromite, FeS, and barite. No metallic Fe was detected. Contains some calcite-filled veins due to terrestrial alteration.
Geochemistry: diogenetic pyroxene: $Fs_{24.4\pm0.2}Wo_{2.5\pm0.1}$ ($Fs_{24.1-24.8}Wo_{2.3-2.6}$, FeO/MnO=31-35, n=11); diogenetic pyroxene: $Fs_{20.7\pm0.2}Wo_{1.1\pm0.1}$ ($Fs_{20.4-21.2}Wo_{1.0-1.1}$, FeO/MnO=30-35, n=11); eucritic low-Ca pyroxene host crystals to augite lamellae: $Fs_{63.3\pm0.6}Wo_{2.0\pm0.2}$ ($Fs_{62.3-64.0}Wo_{1.8-2.2}$, FeO/MnO=35-37, n=11); augite exsolution lamellae: $Fs_{28.7\pm0.3}Wo_{41.5\pm0.6}$ ($Fs_{28.2-29.2}Wo_{40.7-42.5}$, FeO/MnO=30-37, n=12); olivine: $Fa_{22.6\pm0.2}$ ($Fa_{22.3-22.8}$, FeO/MnO=48±2, n=10); olivine: $Fa_{12.7\pm0.3}$ ($Fa_{12.3-13.0}$, FeO/MnO=43±4, n=10); calcic plagioclase: $An_{91.8\pm1.0}$ ($An_{89.8-93.6}$, n=14)
Classification: Diogenite due to high abundance of orthopyroxene and presence of olivine.

Northwest Africa 12826 (NWA 12826)
(Northwest Africa)
Purchased: 2019
Classification: Lunar meteorite
History: The meteorite was purchased from a local meteorite dealer in Algeria.
Physical characteristics: Many brownish fragments with some fusion crust.
Petrography: The meteorite is a feldspathic breccia composed of mineral fragments, basaltic clasts, and impact melt clasts set into a fine-grained partly shock-melted groundmass. Most abundant minerals are calcic plagioclase and pigeonite; less abundant are augite and olivine. Accessories include FeS, ilmenite, and FeNi-metal. The meteorite contains shock melt veins.
Geochemistry: olivine: $Fa_{28.3\pm6.7}$ ($Fa_{19.7-35.1}$, FeO/MnO=97±10, n=15); pigeonite: $Fs_{30.9\pm6.4}Wo_{11.2\pm4.9}$ ($Fs_{21.9-40.1}Wo_{6.4-18.9}$, FeO/MnO=57±6, n=27); Ca-pyroxene: $Fs_{12.5\pm0.8}Wo_{39.8\pm2.3}$ ($Fs_{11.7-14.6}Wo_{33.2-41.3}$, FeO/MnO=40±4, n=11); calcic plagioclase: $An_{96.9\pm0.6}$ ($An_{95.2-97.7}$, n=17)
Classification: Lunar (feldspathic breccia)

Northwest Africa 12828 (NWA 12828)
(Northwest Africa)
Purchased: 2019
Classification: HED achondrite (Diogenite)
History: The meteorite was purchased from a local meteorite dealer in Morocco.
Physical characteristics: Brownish rock with some fusion crust.
Petrography: The meteorite is a coarse-grained fragmental breccia predominantly composed of up to 3 mm sized orthopyroxene crystals set into fine-grained related matrix. Minor phases include chromite and FeS. Neither feldspar, nor olivine, nor

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metallic Fe have been detected in the section studied. The meteorite shows some orange staining due to terrestrial weathering.
Geochemistry: low-Ca pyroxene: $Fs_{24.5.0\pm0.2}Wo_{1.8\pm0.1}$ ($Fs_{24.1-25.0}Wo_{1.7-1.8}$, FeO/MnO=27-30, n=15)

Northwest Africa 12829 (NWA 12829)
(Northwest Africa)
Purchased: 2019
Classification: Carbonaceous chondrite (CK3)
History: The meteorite was purchased from a local meteorite dealer in Morocco.
Physical characteristics: Several black fragments with some fusion crust.
Petrography: The meteorite displays a dark brownish interior and is composed of several sharply defined chondrules (mean diameter about 900 µm) set into abundant recrystallized matrix. Olivine and low-Ca pyroxene are compositionally zoned in most chondrules and also in some matrix grains. Minor phases include intermediate plagioclase, Ca-pyroxene, and Fe,Ni-sulfides. Cr-rich magnetite is abundant; metal was not detected.
Geochemistry: olivine: $Fa_{24.6\pm11.9}$ ($Fa_{1.1-33.6}$, FeO/MnO= 139±17, n=25); low-Ca pyroxene: $Fs_{12.9\pm10.2}Wo_{1.5\pm1.2}$ ($Fs_{1.4-26.5}Wo_{0.9-4.4}$, n=20); Ca-pyroxene: $Fs_{1.7\pm0.1}Wo_{33.4\pm1.2}$, n=5; feldspar: $An_{61.1\pm1.3}Ab_{37.7\pm1.2}Or_{1.3\pm0.1}$, n=6

Northwest Africa 12830 (NWA 12830)
(Northwest Africa)
Purchased: 2019
Classification: Lunar meteorite
History: The meteorite was purchased from a local meteorite dealer in Morocco.
Physical characteristics: Greyish rock partly covered with fusion crust.
Petrography: The meteorite is a recrystallized melt breccia displaying a poikilitic texture of olivine, pigeonite, and augite up to 50 µm in size enclosing calcic plagioclase. Some plagioclase grains exhibit mechanical twinning, show strongly undulating extinction, and contain planar deformation features. Maskelynite has not been observed. Minor phases include silica, FeS and FeNi-metal. The meteorite is fractured and contains abundant shock melt veins and pockets.
Geochemistry: olivine: $Fa_{31.8\pm1.6}$ ($Fa_{30.3-34.0}$, FeO/MnO=100±5, n=11); pigeonite: $Fs_{28.6\pm0.4}Wo_{7.6\pm0.5}$ ($Fs_{28.2-29.1}Wo_{7.1-8.5}$, FeO/MnO=58±2, n=10); Ca-pyroxene: $Fs_{17.9\pm0.9}Wo_{36.8\pm1.4}$ ($Fs_{16.7-19.6}Wo_{35.1-39.0}$, FeO/MnO=46±6, n=11); calcic plagioclase: $An_{95.4\pm1.3}$ ($An_{92.9-97.1}$, n=11)
Classification: Lunar (anorthositic melt breccia)

Northwest Africa 12831 (NWA 12831)
Niger
Purchased: 2019 May

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Classification: Lunar meteorite (feldspathic breccia)

History: Purportedly found in Niger by nomads and purchased by Alexandre Debienne in May 2019 from a dealer in Agadir, Morocco.

Petrography: (A. Irving, *UWS* and P. Carpenter, *WUSL*) Breccia composed of mineral clasts of high-Ca pyroxene (some exsolved), low-Ca pyroxene (some exsolved), anorthite and sparse olivine in a finer grained matrix containing silica polymorph, Cr- ilmenite, Ti-chromite, fayalite, hedenbergite, baddeleyite, troilite and merrillite.

Geochemistry: Olivine ($Fa_{19.3-46.7}$, FeO/MnO = 85-93, N = 4), low-Ca pyroxene ($Fs_{17.2}Wo_{3.3}$; $Fs_{26.2}Wo_{4.7}$; FeO/MnO = 50-58; N = 2), pigeonite ($Fs_{31.9}Wo_{13.4}$, FeO/MnO = 56), augite ($Fs_{14.4}Wo_{36.4}$, FeO/MnO = 44; $Fs_{5.9}Wo_{47.2}$; FeO/MnO =34; N = 2), pigeonite exsolution lamella ($Fs_{52.4}Wo_{6.9}$, FeO/MnO = 68), augite exsolution lamella ($Fs_{24.8}Wo_{42.2}$, FeO/MnO = 61), anorthite ($An_{96.9-97.0}Or_{0.1}$, N = 2).

Classification: Lunar (feldspathic breccia).

Specimens: 20.02 g including a polished endcut at *UWB*; remainder with Mr. A. Debienne.

Northwest Africa 12832 (NWA 12832)

(Northwest Africa)

Purchased: 2018

Classification: Carbonaceous chondrite (CO3)

History: Purchased in 2018 by Mbark Arjdal from a dealer in Zouerat, Mauritania.

Petrography: (A. Irving, *UWS* and P. Carpenter, *WUSL*) Small well-formed chondrules (apparent diameter 170 ± 100 µm, N = 20), mineral fragments and fine grained CAI are set in a much finer grained matrix (red-brown in thin section, ~40 vol.%).

Geochemistry: Olivine ($Fa_{24.0\pm24.6}$ (range $Fa_{0.7-52.3}$), N = 4; Cr_2O_3 in ferroan examples 0.13-0.33 wt.%, mean 0.23 wt.%, N = 2), low-Ca pyroxene ($Fs_{6.0\pm5.5}Wo_{1.1\pm0.4}$ (range $Fs_{5.1-11.8}Wo_{0.8-1.6}$), N = 3), augite ($Fs_{7.3\pm2.7}Wo_{36.4\pm0.3}$ (range $Fs_{5.4-9.2}Wo_{36.2-36.6}$), N = 2), diopside ($Fs_{1.1}Wo_{38.3}$), anorthite ($An_{99.0}Or_{0.0}$).

Classification: Carbonaceous chondrite (CO3).

Specimens: 23.8 g including one polished thin section at *UWB*; remainder with Mr. M. Arjdal.

Northwest Africa 12833 (NWA 12833)

(Northwest Africa)

Purchased: 2019 Mar

Classification: HED achondrite (Eucrite, monomict)

History: Purchased by Darryl Pitt in March 2019 from a dealer in Agadir, Morocco.

Petrography: (A. Irving, *UWS* and P. Carpenter, *WUSL*) Breccia consisting of subophitic eucrite clasts plus related crystalline debris. Minerals are exsolved pigeonite, low-Ca pyroxene, calcic plagioclase, silica polymorph, ilmenite,

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baddeleyite, troilite and rare Ni-free metal. Minor secondary calcite veinlets and barite are present.
Geochemistry: Orthopyroxene ($Fs_{61.5-62.4}Wo_{1.7-2.2}$, FeO/MnO = 32-33, N = 2), clinopyroxene ($Fs_{27.1-29.2}Wo_{42.5-40.1}$, FeO/MnO = 30-32, N = 3), low-Ca pyroxene ($Fs_{58.2-50.2}Wo_{6.0-5.1}$, FeO/MnO = 32, N = 2), plagioclase ($An_{82.2}Or_{1.0}$; $An_{91.1-92.7}Or_{0.2}$; N = 3).
Classification: Eucrite (monomict breccia).
Specimens: 22.7 g including one polished thin section at *UWB*; remainder with *DPitt*.

Northwest Africa 12834 (NWA 12834)
(Northwest Africa)
Purchased: 2019 Feb
Classification: Ordinary chondrite (H5)
History: Purchased by Beat Booz in February 2019 from a Moroccan dealer.
Petrography: (A. Irving, *UWS* and P. Carpenter, *WUSL*) Moderately shocked breccia composed of closely packed clasts containing sparse, well-formed chondrules and relatively abundant stained metal. Silicates are noticeably shock darkened.
Geochemistry: Olivine ($Fa_{20.0\pm0.3}$ (range $Fa_{19.7-20.3}$), N = 3), low-Ca pyroxene ($Fs_{17.1\pm0.2}Wo_{1.3\pm0.1}$ (range $Fs_{16.9-17.3}Wo_{1.4-1.2}$), N = 3), high-Ca pyroxene ($Fs_{5.2}Wo_{47.0}$).
Classification: Ordinary chondrite (H5 breccia, shock-darkened).
Specimens: 21.0 g including one polished thin section at *UWB*; remainder with Mr. B. Booz.

Northwest Africa 12835 (NWA 12835)
(Northwest Africa)
Purchased: 2019 Feb
Classification: HED achondrite (Eucrite, monomict)
History: Purchased by Jason Bliss in February 2019 from a Moroccan dealer.
Petrography: (A. Irving, *UWS* and P. Carpenter, *WUSL*) Breccia consisting of eucrite clasts with intersertal to subophitic texture plus related crystalline debris. Minerals are exsolved pigeonite, calcic plagioclase, silica polymorph, ilmenite, Ti chromite, troilite and rare zircon plus minor secondary calcite and gypsum.
Geochemistry: Orthopyroxene ($Fs_{62.0-62.3}Wo_{1.8-1.9}$, FeO/MnO = 31-32, N = 3), clinopyroxene ($Fs_{26.7-28.3}Wo_{44.2-42.8}$, FeO/MnO = 28-30, N = 3), plagioclase ($An_{79.8-82.5}Or_{1.1-0.7}$, N = 2).
Classification: Eucrite (monomict breccia).
Specimens: 20.5 g including one polished thin section at *UWB*; remainder with Mr. J. Bliss.

Northwest Africa 12836 (NWA 12836)

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(Northwest Africa)
Purchased: 2019 May
Classification: CK4-6

History: Purchased by Beat Booz in May 2019 from a Moroccan dealer.

Petrography: (A. Irving, *UWS* and P. Carpenter, *WUSL*) Breccia composed of angular clasts and isolated equilibrated chondrules set within a finer grained stained matrix containing Cr-magnetite and pyrrhotite. Clasts are devoid of recognizable chondrules and are metamorphic-textured aggregates composed primarily of olivine, augite, intermediate plagioclase, Cr-magnetite, pentlandite and chlorapatite.

Geochemistry: Discrete chondrules: olivine ($Fa_{32.5\pm0.7}$ (range $Fa_{31.5-33.3}$), N = 7; one magnesian core $Fa_{21.0}$), pigeonite ($Fs_{21.2}Wo_{11.2}$), subcalcic augite ($Fs_{12.3}Wo_{30.4}$). Type 6 clasts: olivine ($Fa_{33.4\pm0.2}$ (range $Fa_{33.2-33.6}$), N = 2), augite ($Fs_{15.3}Wo_{45.3}$), plagioclase ($An_{69.3}Or_{0.5}$).

Classification: Carbonaceous chondrite (CK4-6 breccia).

Specimens: 20.1 g including one polished thin section and one polished mount at *UWB*; remainder with Mr. B. Booz.

Northwest Africa 12837 (NWA 12837)
Mali
Purchased: 2019 June
Classification: Martian meteorite (Shergottite)

History: Found in Mali and purchased by Darryl Pitt in June 2019 from a Mauritanian dealer.

Petrography: (A. Irving, *UWS* and P. Carpenter, *WUSL*) Cumulate texture. Grains (mean grainsize 0.7 mm) of olivine (some exhibiting undulose extinction) and clinopyroxene (pigeonite and subcalcic augite; some as oikocrysts enclosing small olivine chadacrysts) occur with intercumulus briefringent, twinned plagioclase (~15 vol.%) and accessory Mg-bearing ilmenite, Ti-chromite, pyrrhotite and merrillite. Both olivine and pyroxenes have limited compositional zoning.

Geochemistry: Olivine ($Fa_{34.7-36.8}$, FeO/MnO = 50-52, N = 4), pigeonite ($Fs_{24.7-30.4}Wo_{4.8-8.6}$; $Fs_{28.2}Wo_{16.6}$; FeO/MnO = 28-30, N = 5), subcalcic augite ($Fs_{20.7}Wo_{24.1}$; $Fs_{17.4-17.8}Wo_{33.7-34.3}$; FeO/MnO = 24-26, N = 3), plagioclase ($An_{56.9-58.1}Or_{0.8-0.9}$, N = 2).

Classification: Martian (shergottite, olivine gabbroic, orthocumulate, low shock). Texture, mineralogy and degree of shock are essentially identical to those observed in NWA 12241, with which this material is almost certainly paired. Although the broken pieces of NWA 12241 were purchased in far southern Algeria (close to the border with Mali), there is no assurance that they were found in Algeria, whereas the find location for these newly-studied pieces is reliably established as Mali.

Specimens: 20.4 g including one polished thin section at *UWB*; remainder with *DPitt*.

Northwest Africa 12838 (NWA 12838)

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(Northwest Africa)
Purchased: 2018
Classification: HED achondrite (Eucrite, monomict)

History: Purchased by Mbark Arjdal from an Algerian dealer in 2018.

Petrography: (A. Irving, *UWS* and P. Carpenter, *WUSL*) Breccia consisting of closely-packed eucrite clasts (exhibiting partly recrystallized subophitic texture) plus sparse related crystalline debris. Minerals are exsolved pigeonite, calcic plagioclase, silica polymorph, ilmenite, Ti chromite, troilite, rare zircon and minor secondary calcite.

Geochemistry: Orthopyroxene ($Fs_{59.9-60.2}Wo_{3.7-3.0}$, FeO/MnO = 33-34, N = 2), clinopyroxene ($Fs_{28.8-31.9}Wo_{42.1-38.5}$, FeO/MnO = 31-32, N = 2), plagioclase ($An_{83.6-84.2}Or_{0.6}$, N = 2).

Classification: Eucrite (monomict breccia).

Specimens: 12.6 g including one polished thin section at *UWB*; remainder with Mr. M. Arjdal.

Northwest Africa 12839 (NWA 12839)
(Northwest Africa)
Purchased: 2019 June
Classification: Lunar (diabase)

History: Purchased by Ben Hoefnagels in June 2019 from a dealer in Agadir, Morocco.

Petrography: (A. Irving, *UWS* and P. Carpenter, *WUSL*) Diabasic texture (mean grainsize 0.5 mm). Composed primarily of zoned clinopyroxene and maskelynite with accessory blade-like ilmenite, very sparse zoned olivine (~3 vol.%), Cr-Ti oxides, baddeleyite, probable zirconolite, troilite, merrillite, silica polymorph, fayalite and hedenbergite. Dark shock glass is present in pockets (vesicular) and as cross-cutting veinlets.

Geochemistry: Subcalcic augite (core $Fs_{28.8}Wo_{26.3}$, FeO/MnO = 50; rim $Fs_{72.4}Wo_{23.6}$, FeO/MnO = 77), augite (core $Fs_{21.2}Wo_{38.7}$, FeO/MnO = 47; rim $Fs_{81.5}Wo_{17.7}$, FeO/MnO =81), pigeonite (core $Fs_{41.8}Wo_{12.9}$,FeO/MnO = 65; rim $Fs_{69.8}Wo_{22.4}$, FeO/MnO = 77), olivine cores ($Fa_{37.6-39.5}$, FeO/MnO = 92-94, N = 3), olivine rims ($Fa_{54.1-68.2}$, FeO/MnO = 93-110, N = 3), fayalite ($Fa_{99.2}$, FeO/MnO = 95), maskelynite ($An_{87.5-88.2}Or_{0.3}$, N = 2).

Classification: Lunar (mare diabase, clinopyroxene-rich, olivine-poor).

Specimens: 14.1 g including one polished thin section at *UWB*; remainder with Mr. B. Hoefnagels.

Northwest Africa 12840 (NWA 12840)
Morocco
Purchased: 2005
Classification: Ordinary chondrite (H5)

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History: Originally found in the Sahara in 2004 and purchased from a meteorite dealer in Erfound in 2005.
Physical characteristics: The single, 46.75 kg stone has dark brown to reddish surface on one side; the other side is covered with caliche.
Petrography: (C. Herd and M. Holt, *UAb*) Optical and microprobe examination of a polished thin section shows a brecciated texture with well-delineated chondrules. Minor iron staining is present. Shock effects include minor veining, and undulatory extinction with >2° angular variation in olivine. Weathering grade according to Zurfluh et al. (2016); shock stage according to Fritz et al. (2017).
Geochemistry: (C. Herd and M. Holt, *UAb*) Data obtained by EMP examination of carbon-coated thin section: Olivine $Fa_{17.3\pm0.5}$ (n=46); Low-Ca Pyroxene $Fs_{15.5\pm0.9}Wo_{1.1\pm0.6}$ (n=31).
Classification: Ordinary chondrite, H5
Specimens: Type specimen of 25.64 g, including one thin section, is at *UAb*. Main mass at *JTESM*.

Northwest Africa 12841 (NWA 12841)
(Northwest Africa)
Purchased: 2010
Classification: Ordinary chondrite (L6)
History: Acquired by *NHMV* from Abdelaziz Mouadine (meteorite dealer in Austria) as part of a batch of unclassified Northwest Africa meteorites. The acquired stone was 267.8 g (6 × 5 × 4.5 cm).
Physical characteristics: Physical Characteristics: Brownish-black (no fusion crust; desert varnish) stone with a few open fractures (containing some remnants of soil). On the cut surface, a dense network of shock veins are visible, up to 1 mm in thickness, along with few metal grains.
Petrography: (L. Ferrière and S. Rajpriye, *NHMV*). This meteorite is moderately shocked, thermally metamorphosed, and altered. Chondrule boundaries are poorly defined. Most of the chondrules (fragments) are fractured and either of barred olivine or porphyritic olivine-pyroxene types. Minor opaque minerals and mostly recrystallized, fine-grained matrix surrounds chondrule fragments. Kamacite, taenite, tetrataenite, and troilite are present, along with few grains of merrillite and chlorapatite (up to 140 µm). Sparse chromite grains, up to 400 µm, are anhedral with rounded outlines and fractured. Minor oxide rims are present around a number of metal and troilite grains. A network of shock veins is present (up to 1 mm thick). Large ringwoodite grains (up to few 100 µm) are visible within some of the veins. Melt pockets also occur.
Geochemistry: (L. Ferrière, S. Rajpriye, and D. Topa, *NHMV*). Olivine in the matrix is $Fa_{24.3\pm0.3}$ (23.8-25.0), Fe/Mn: 50.2±2.6 (N=19) and in chondrule fragments is $Fa_{24.0\pm0.3}$ ($Fa_{23.6-24.5}$), Fe/Mn: 50.7±3.8 (N=6). Low Ca-Pyroxene: in matrix $Fs_{20.1\pm0.3}Wo_{1.5\pm0.1}$ ($Fs_{19.8-21.0}Wo_{1.3-1.8}$), Fe/Mn: 29.3±1.8 (N=21) and in chondrules is $Fs_{20.0\pm0.2}Wo_{1.3\pm0.1}$ ($Fs_{19.7-20.3}Wo_{1.2-1.4}$), Fe/Mn: 26.6±1.6 (N=5). High Ca-Pyroxene: $Fs_{7.2\pm0.7}Wo_{44.1\pm0.5}$ ($Fs_{6.7-7.6}Wo_{43.7-44.4}$) and Fe/Mn: 21.3 (N=2). Plagioclase: $An_{10.1\pm}$

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$_{0.37}$Ab $_{83.4\pm0.7}$Or$_{6.6\pm0.5}$ (An$_{9.7\text{-}11.5}$Ab$_{81.3\text{-}84.0}$Or$_{6.0\text{-}8.0}$) (N=22). Kamacite: Ni 6.1±0.3 (5.4-6.6), Co 0.85±0.16 (N=17); Taenite: Ni 29.0±2.7 (25.1-34.7), Co 0.25±0.06 (N=16). Tetrataenite: Ni49.9±2.1 (46.9-52.0), Co 0.12±0.04 (N=5). Chromite: Cr# 0.88 and Fe# 0.88.
Classification: Ordinary Chondrite (L6), S4, W2
Specimens: The entire specimen (*NHMV*-N8623; 262.83 g) as well as one polished thin section (*NHMV*-O1154) are at *NHMV*.

Northwest Africa 12842 (NWA 12842)
Morocco
Purchased: 2018 Feb
Classification: Ordinary chondrite (L4)
Classification: Ten olivine grains were analyzed with compositions ranging from Fo$_{72.0}$ to 76.2, a mean of Fo$_{73.9}$ and a standard deviation of 1.2. Several large chondrules are present (up to ~7 mm), some retaining initial crystallization textures (barred olivine). However, chondrules have undergone some deformation, are mostly no longer spherical, and no glass is present in chondrule matrix. This sample is L4 chondrite.

Northwest Africa 12843 (NWA 12843)
Morocco
Purchased: 2018 Feb
Classification: Ordinary chondrite (L6)
Classification: Ten olivine grains were analyzed with compositions ranging from Fo$_{72.7}$ to 75.4, a mean of Fo$_{74.1}$ and a standard deviation of 1.0. Chondrules are small (up to 2 mm) and rarely observed due to metamorphism. Only one primary chondrule texture was observed. This sample is L6 chondrite

Northwest Africa 12844 (NWA 12844)
Algeria
Purchased: 2019 Apr
Classification: Ordinary chondrite (H5)
History: Bought from Zaid Oualguirah in April 2019.
Physical characteristics: Stone with fusion crust. Interior is brown, with visible chondrules.
Petrography: (J. Gattacceca, *CEREGE*) Equilibrated ordinary chondrite with average plagioclase size below 50 µm. Matrix is scarce and inter-chondrule porosity is high, making chondrules well-delineated.

Northwest Africa 12847 (NWA 12847)
(Northwest Africa)

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Purchased: Mar 2017
Classification: Carbonaceous chondrite (CV3)

History: Collected by nomads in Western Sahara and purchased by Romano Serra at the Bologna Mineral Show in 2017 from a Moroccan dealer.

Physical characteristics: A single small piece without fusion crust. CAIs are visible on the cut surface.

Petrography: (V. Moggi Cecchi, G. Pratesi, *UniFi*); The thin section displays a chondritic texture, with PO, POP and BO chondrules ranging from 750 to 1300 µm in a fine grained matrix. PO and POP chondrules display zoned, Mg-rich olivine crystals and elongated pyroxene grains. Orthopyroxene in chondrules is rather homogeneous. Iron oxides are prevailing among opaque phases; Fe-Ni alloys and troilite can alse be observed as individual grains in the matrix or rimming chondrules.

Geochemistry: EMP (V. Moggi Cecchi, G. Pratesi, *UniFi*); Olivine in PO chondrules cores ($Fa_{1.1\pm1.0}Fo_{98.9\pm1.0}$; Fe/Mn = 6.8, n=12); Olivine in matrix ($Fa_{32.5\pm3.4}Fo_{68.5\pm3.4}$; Fe/Mn = 63.5, n=11); Orthopyroxene in chondrules and in matrix ($Fs_{1.1\pm0.1}En_{97.5\pm0.6}Wo_{1.4\pm0.2}$, Fe/Mn = 18.6, n=11).

Classification: Carbonaceous Chondrite (CV3); S1; W2

Specimens: A total of 3.2 g specimen is on deposit at *MSN-FI*. *OAM* holds the main mass.

Northwest Africa 12850 (NWA 12850)
(Northwest Africa)
Purchased: Oct 2017
Classification: Carbonaceous chondrite (CV3)

History: Collected by nomads in Western Sahara and purchased by Mario Di Martino at the Torino Mineral Show in 2017 from a Moroccan dealer.

Physical characteristics: A single piece weighing 42 g displaying chondrules and without fusion crust. The cut surface displays scattered CAIs.

Petrography: (V. Moggi Cecchi, G. Pratesi, *UniFi*); In thin section a chondritic texture consisting of PO and POP chondrules ranging from 600 to 1500 µm in a fine-grained matrix is visible. PO chondrules display zoned olivine crystals. Olivine in PO and POP chondrules is markedly inhomogenesous with Mg-rich cores, while is more Fe-rich in the matrix. Orthopyroxene in chondrules is homogeneous. Iron oxides, Fe-Ni alloys and troilite are the most common opaque pohases, present as individual grains scattared in the matrix or rimming chondrules. Rounded metal aggregates are visible in some chondrules.

Geochemistry: EMP (V. Moggi Cecchi, G. Pratesi, *UniFi*); Olivine in cores of chondrule grains ($Fa_{1.6\pm0.3}Fo_{98.4\pm0.3}$; Fe/Mn = 13.4, n=11); Olivine in matrix ($Fa_{34.9\pm3.6}Fo_{65.1\pm3.4}$; Fe/Mn = 66.6, n=15); Orthopyroxene in chondrule grains and matrix ($Fs_{4.3\pm1.5}En_{94.9\pm1.2}Wo_{0.8\pm0.1}$, Fe/Mn = 6.5, n=10).

Classification: Carbonaceous Chondrite (CV3); S1; W3

Specimens: A total of 8.6 g specimen is on deposit at *MSN-FI*. Di Martino holds the main mass.

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Northwest Africa 12852 (NWA 12852)
(Northwest Africa)
Purchased: May 2018
Classification: Ordinary chondrite (L3)

History: Collected by nomads in Western Sahara and purchased by Nicola Castellano at the Genova Mineral Show in 2018 from a Moroccan dealer.

Physical characteristics: A black crust-covered single piece weighing 504 g. A cut surface displays several well formed chondrules.

Petrography: (V. Moggi Cecchi, G. Pratesi, *UniFi*); The thin section displays a marked chondritic texture, with PO, PP and POP chondrules ranging from 200 to 800 µm in a fine grained matrix. PO and POP chondrules display inhomogenesous olivine and orthopyroxene crystals, with a slight core-rim variability. Olivine is Fe-rich in the matrix while orthopyroxene is Mg-rich. Plagioclase is Na-rich. Opaque phases are consisting of iron oxides, Fe-Ni alloys and troilite as individual grains scattared in the matrix or rimming chondrules.

Geochemistry: EMP (V. Moggi Cecchi, G. Pratesi, *UniFi*); Olivine in chondrules and in matrix ($Fa_{22.3\pm4.7}Fo_{77.8\pm4.6}$; Fe/Mn = 58.6, n=23); Orthopyroxene in chondrules grains and in matrix ($Fs_{17.8\pm6.3}En_{81.3\pm3.3}Wo_{0.9\pm0.1}$, Fe/Mn = 23.5, n=15); plagioclase ($An_{6.0}Or_{2.2}$);

Classification: Ordinary Chondrite (L3); S3; W3

Specimens: A total of 22.8 g specimen is on deposit at Museo di Storia Naturale dell'Università di Firenze (MSN-Fi). Castellano holds the main mass.

Northwest Africa 12855 (NWA 12855)
(Northwest Africa)
Purchased: 2014
Classification: Ordinary chondrite (H3)

History: Collected by nomads in Western Sahara and purchased by Parco Astronomico delle Madonie from Giorgio Tomelleri in 2018.

Physical characteristics: A black crust-covered single piece weighing 224 g. Several well-formed chondrules are visible on the cut surface

Petrography: (V. Moggi Cecchi, G. Pratesi, *UniFi*); A marked chondritic texture is visible in the thin section displays, with PO, PP and POP chondrules ranging from 300 to 1200 µm in a fine grained matrix. Olivine and orthopyroxene crystals PO and POP chondrules are inhomogenesous, with a slight core-rim variability. Olivine is more Fe-rich in the matrix. Opaque phases are diffuse and mainly represented by iron oxides, Fe-Ni alloys and troilite as individual grains scattared in the matrix or rimming chondrules.

Geochemistry: EMP (V. Moggi Cecchi, G. Pratesi, *UniFi*); Olivine ($Fa_{12.4\pm9.5}Fo_{87.6\pm5.5}$; Fe/Mn = 42.0, n=24); Orthopyroxene in chondrules' grains and in matrix ($Fs_{10.4\pm6.9}En_{88.5\pm3.3}Wo_{0.9\pm0.1}$, Fe/Mn = 25.2, n=15);

Classification: Ordinary Chondrite (H3); S1; W3

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Specimens: A total of 20.1 g specimen is on deposit at *MSN-FI*. Parco Astronomico delle Madonie holds the main mass.

Northwest Africa 12856 (NWA 12856)
(Northwest Africa)
Purchased: 2014
Classification: HED achondrite (Eucrite)
History: Collected by nomads in Western Sahara and purchased by Parco Astronomico delle Madonie from Giorgio Tomelleri in 2018.
Physical characteristics: A single piece weighing 468 g partialy covered with a black fusion crust. The cut surface displays scattered CAIs.
Petrography: (V. Moggi Cecchi, G. Pratesi, *UniFi*); The thin section analyzed displays a basaltic texture. Orthopyroxene is the major phase, with crystals 100-160 µm in width; minor clinopyroxene and anorthitic plagioclase are visible. Exsolved low-Ca pyroxene crystals with fine (5-7 µm) pigeonite exsolution lamellae can be observed. Minor phases are ilmenite, troilite, chromite, and FeNi metal.
Geochemistry: EMP (V. Moggi Cecchi, G. Pratesi, *UniFi*); Calcic plagioclase ($An_{87.0\pm1.2}Or_{0.4\pm0.2}$, n=4); low-Ca pyroxene ($Fs_{58.0\pm1.3}En_{34.3\pm0.3}Wo_{7.7\pm0.1}$; n=6; Fe/Mn=49.9±0.5); diopside exsolution lamellae in orthopyroxene ($Fs_{44.3\pm3.0}En_{33.1\pm0.1}Wo_{22.6\pm1.4}$; n=6; Fe/Mn = 39.1±0.5).;
Classification: Eucrite with medium degree of shock and medium degree of weathering.
Specimens: A total of 20.2 g specimen is on deposit at *MSN-FI*. Parco Astronomico delle Madonie holds the main mass.

Northwest Africa 12858 (NWA 12858)
(Northwest Africa)
Purchased: 2019 May
Classification: Rumuruti chondrite (R3)
Petrography: (K. Metzler, *IfP*) Unequilibrated chondrite, consisting of well-preserved chondrules and chondrule fragments set in a fine-grained matrix which is dominated by equilibrated olivine.
Geochemistry: Mineral compositions and geochemistry: Mean olivine composition $Fa_{19.6\pm8.9}$ ($Fa_{4.7-36.6}$); n=22. Mean low-Ca pyroxene composition $Fs_{5.9\pm2.8}$ $Wo_{0.8\pm0.5}$ ($Fs_{1.8-11.8}$ $Wo_{0.3-2.3}$); n=19. Mean olivine composition in fine-grained matrix (not included in olivine statistics) $Fa_{47.5\pm0.8}$ ($Fa_{46.7-49.0}$); n=7. Accessories are troilite and pentlandite; no metal was found.
Classification: R chondrite based on mineral chemistry. Petrologic type 3 based on unequilibrated olivine and pyroxene.

Northwest Africa 12859 (NWA 12859)
(Northwest Africa)

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Purchased: 2018
Classification: Ordinary chondrite (H3)

History: Marc Jost purchased the sample from Abdelaziz Mouadine at the 2018 Munich Mineral show on October 24th, 2018.

Physical characteristics: The 498 g sample has a rounded, flattened shape with some broad shallow regmaglypts on one side. The exterior is completely covered by a weathered, brown fusion crust. The cut face shows the interior is compose of densely packed, well-formed chondrules.

Petrography: Description and classification (A. Love, *App*) Sample has a chondritic texture composed of distinct 634 µm (avg. dia.) chondrules and fragments set in a matrix of FeNi metal and FeS. Porphyritic chondrules contain turbid mesostasis and many chondrules display rims composed of FeS. Clinoenstatite is the dominant pyroxene. Sample has ~8 % FeNi metal. Additional minerals are chromite and merrillite.

Geochemistry: (A.Love-*App*) Olivine ($Fa_{10.5\pm4.4}$ ($Fa_{4.9-18.2}$), Fe/Mn=37.5±9.9, mean Cr_2O_3 in ferroan olivine=0.1±0.0, N=8), low Ca pyroxene $Fs_{16.2\pm11.9}Wo_{1.3\pm1.3}$ ($Fs_{2.4-31.9}Wo_{0.3-4.5}$), Fe/Mn=26.2±13.2, N=13.

Classification: Ordinary chondrite (H3, C-S3, W1 estimated subtype 3.6). H chondrite based on magnetic susceptibility metal abundance and mineral compositions. Sample is >3.5 based on lack of red CL in chondrules (Huss et al., 2006). Mesostasis glass was not observed, indicating sample is 3.6-3.7.

Specimens: Marc Jost (*SJS*) holds the main mass. 2 slices weighing 25.1 g, a polished mount and polished thin section and mount are on deposit at *App*.

Northwest Africa 12860 (NWA 12860)
(Northwest Africa)
Purchased: 2019
Classification: Mesosiderite

History: Eleven stones weighing 321 g were found in Western Sahara prior to 2019. John Sinclair and J. Donald Cline purchased the samples from a meteorite dealer while at the 2019 Tucson Gem and Mineral Show.

Physical characteristics: Eleven fragments, some of which fit together, comprise a single flight-oriented stone. The largest fragment has a black fusion crust coating 70% of its surface area, shows rollover lipping, and has an irregular pyramidal shape. The interior shows an obvious brecciated texture with coarse clasts up to 1 cm.

Petrography: Description and classification (A. Love, *App*): Sample is a breccia composed of 26 vol% FeNi metal, ~58 vol% Opx (up to 1 cm), 4 vol% plagioclase and 1 vol% olivine. Opx and plag comprise 93 vol% and 6 vol% of the silicates respectively. Pyroxenes poikolitically enclose olivine. Recrystallization is present in fine-grained regions and within some of the clasts. Average grainsize in fine-grained regions is 51µm. Additional minerals are apatite, troilite, kamacite, taenite and chromite.

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Geochemistry: (A. Love, *App*) Olivine ($Fa_{23.8\pm1.0}$ ($Fa_{23.0-25.7}$), Fe/Mn=41.7±1.9, N=5), low Ca pyroxene $Fs_{23.4\pm0.8}Wo_{2.0\pm0.3}$ ($Fs_{22.0-24.4}Wo_{1.7-2.8}$), Fe/Mn=27.0±0.5, N=14), plagioclase $An_{93.4\pm1.5}Or_{0.2\pm0.1}$ ($An_{90.9-95.6}Or_{0.1-0.4}$, N=10).
Classification: Mesosiderite (estimated class C3). Mesosiderite based on texture, modal abundance of metal and magnetic susceptibility. Class C based on modal abundance of plagioclase (6 vol%) and orthopyroxene (93 vol%) of one thin section. Metamorphic grade 3 based on recrystallized nature of fine-grained regions.
Specimens: *PARI* holds the main masses. A polished thin section and a 20.98 g fragment are on deposit at *App*.

Northwest Africa 12861 (NWA 12861)
(Northwest Africa)
Purchased: 2014
Classification: Carbonaceous chondrite (CM2)
History: Marc Jost purchased the 28.97 g sample from sellers in Sidi Ifni, Morocco, March, 2014.
Physical characteristics: The sample has an irregular rounded shape and is coated in a flow-lined, black contraction-cracked fusion crust. The cut face shows the interior has a chondritic texture composed of a mostly small chondrules and CAIs set within a black fine-grained matrix.
Petrography: Description and classification (A. Love, *App*) Sample has a brecciated chondritic texture composed of chondrules, fragments, and CAIs distributed throughout a black fine-grained matrix (~60 vol%). Chondrules have an average apparent diameter of 226 µm (N=33) and are primarily porphyritic chondrules with altered mesostasis. All components are surrounded by fine-grained, dust mantles. Additional minerals are: pentlandite, calcite, chromite, tochilinite, pyrrhotite, kamacite.
Geochemistry: Olivine (Type I Chondrules $Fa_{0.7\pm0.2}$ ($Fa_{0.6-1.0}$), N=5, Type II chondrules $Fa_{29.0\pm9.9}$ ($Fa_{13.7-44.6}$), Cr_2O_3 in ferroan olivines=0.4±0.1, N=11), low Ca pyroxene $Fs_{6.1\pm10.4}Wo_{1.1\pm0.9}$ ($Fs_{0.7-39.0}Wo_{0.3-4.0}$, N=14).
Classification: Carbonaceous chondrite (CM2) Based on matrix abundance, chondrule size, mineralogy and magnetic susceptibility, this is a CM carbonaceous chondrite. Based on the abundance of unaltered silicates this is a CM2.
Specimens: Marc Jost (*SJS*) holds the main mass. An end cut weighing 7.48 g and a polished mount are on deposit at *App*.

Northwest Africa 12862 (NWA 12862)
Algeria
Purchased: 13 Aug 2018
Classification: Pallasite
History: Purchased on 13 August 2018 by Chalom Malka from Naji C. in Boujdour, Morocco.
Physical characteristics: Dark-brown stones with a weathered rind.

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Petrography: (D. Sheikh, *FSU*) 4-5 mm fractured olivine grains set in a heavily weathered matrix of iron oxides and near absent FeNi metal.
Geochemistry: (D. Sheikh, *FSU*) Olivine ($Fa_{13.1\pm0.3}$, range $Fa_{12.4\text{-}13.8}$, n=14).
Classification: Pallasite
Specimens: 20.67 grams at *UCLA*; main mass with Chalom Malka.

Northwest Africa 12863 (NWA 12863)
(Northwest Africa)
Purchased: 2016
Classification: HED achondrite (Eucrite)
History: Catalogued in the *ROM* collection as LM58157
Physical characteristics: Heavily weathered fusion crust present, beige to brown in color. Cracks in the fusion crust filled in with caliche or oxides. Interior of sample is intact, but weathered as well, with caliche covering 50% of the surface. Where visible the interior of the meteorite is light grey, with some larger grey to black clasts visible.
Petrography: (K.Tait, I. Nicklin, *ROM*) Breccia composed of basaltic to gabbroic clasts with mineral fragments and shards of dark melt-glass set in a very finely grained comminuted matrix. The largest clast is 4 × 3 mm. Mineral fragments show variable shock stages ranging from undulous extinction to mild mosaicism.
Geochemistry: Mineral composition and geochemistry: Plagioclase $An_{87.8\pm3.4}$ (n = 30). Low-Ca pyroxene composition: $Fs_{39.5\pm3.4}Wo_{9.5\pm4.7}$ (n=27). Mg#33.4-49.6 (n=27).

Northwest Africa 12864 (NWA 12864)
(Northwest Africa)
Purchased: 2011
Classification: HED achondrite (Eucrite)
History: Catalogued in the *ROM* collection as LM57449
Physical characteristics: Visible fusion crust present exhibiting low-moderate weathering, evident with minor light orange caliche. Fusion crust quite fractured. Interior of the sample is moderately weathered, showing a coarse grained cumulate texture.
Petrography: (K. Tait, I. Nicklin, *ROM*) Breccia containing basaltic and gabbroic clasts with abundant mineral fragments set in a finer grained, comminuted matrix. Dark shock-melt clasts are also present as well as clasts composed of finer-grained, brecciated material. The largest clast is 4 × 2 mm. Mineral fragments show a range of shock states from mild undulose extinction to mosaicism.
Geochemistry: Mineral composition and geochemistry: Plagioclase $An_{85.1\pm6.1}$ (n = 29). Low-Ca pyroxene composition: $Fs_{51.3\pm15.8}Wo_{6.3\pm5.7}$ (n=25) and Mg#38.7-76.1 (n=25). High-Ca pyroxene composition: $Fs_{36.3\pm0.6}Wo_{28.9\pm4.6}$ (n=2). Mg# 50.3-54.6 (n=2).

Northwest Africa 12865 (NWA 12865)

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(Northwest Africa)
Purchased: 2011
Classification: HED achondrite (Eucrite)
History: Catalogued in the *ROM* collection as LM57451
Physical characteristics: Visible fusion crust with low weathering, evident with minor light orange caliche in fractures. Interior of the sample is fresh, showing a coarse-grained cumulate texture. Only slight weathering on the inside of the sample.
Petrography: (K. Tait, I. Nicklin, *ROM*) Breccia composed of basaltic and gabbroic clasts and mineral grain fragments set in a finely comminuted matrix. The largest clast is 5 × 3 mm. One thin shock vein (0.5 mm maximum width) runs discontinuously across the thin section. Mineral grains in the clasts and matrix show undulose extinction.
Geochemistry: Mineral composition and geochemistry: Plagioclase $An_{87.9\pm1.4}$ (n = 28). Low-Ca pyroxene composition: $Fs_{34.7\pm2.3}Wo_{5.1\pm4.9}$ and Mg#32.6-41.8 (n=14). High-Ca pyroxene composition: $Fs_{30.0\pm0.8}Wo_{42.5\pm1.2}$, Mg#49.6-53.9 (n=10).

Northwest Africa 12866 (NWA 12866)
Morocco
Purchased: September 2013
Classification: HED achondrite (Eucrite)
History: Sample number (LM58159) in the Royal Ontario Museum collection.
Physical characteristics: A single angular stone partially covered with a black shiny fusion crust. The cut stone shows a fresh grey surface.
Petrography: The thin section shows a complex polymict breccia, consisting of mineral clasts and large rock fragments of up to 2 cm long, embedded within a fine-grained clastic matrix. Rock fragments are composed of fine- and medium-grained pyroxene and plagioclase of granular and gabbroic texture. Both high-Ca exsolved augite and pigeonite is present; both show little to no mosaicism; augite lamellae are locally displaced by low shock. Plagioclase is relatively fresh and no maskelynite is present. Minor minerals are ilmenite, chromite, tridymite, quartz, apatite, merrillite, zircon and FeNi metal.
Geochemistry: Mineral compositions and geochemistry: Ferrosilite ($Wo_{1.2-4.5}En_{32.1-42.7}Fs_{55.9-66.5}$; FeO/MnO=29.9-32.5) with Pigeonite lamellae ($Wo_{5.2-18.2}En_{32.3-41.5}Fs_{48.3-61.3}$; FeO/MnO=30.9-32.2), pigeonite ($Wo_{6.1-10}En_{27.1-32.4}Fs_{57.5-63.9}$; FeO/MnO=29.9-32.5) with augite lamellae ($Wo_{22.4-32.6}En_{27.8-37.3}Fs_{31.5-49.6}$;FeO/MnO=29.4-32.2). Plagioclase ranges from An_{72-90} with an average of $An_{81.}$
Classification: Eucrite (polymict breccia)

Northwest Africa 12867 (NWA 12867)
Morocco
Purchased: Febuary 2011
Classification: HED achondrite (Eucrite)
History: Sample number (LM57450) in the *ROM* collection.

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Physical characteristics: A single small and rounded stone covered with a black shiny fusion crust. The cut stone shows a fresh grey surface.
Petrography: The thin section shows one distinct lithological clast (60 mm in diameter) and a mixture of mineral and basaltic clasts embedded within a fine-grained clastic matrix. The lithological clast is a medium-grained enstatite-plagioclase rock of granular texture with a large chromite situated within. Both high-Ca exsolved augite and pigeonite is present as mineral clasts; both show little to no mosaicism. Plagioclase is relatively fresh both within the lithological clast and as mineral clasts with no maskelynite present. Minor minerals are olivine, ilmenite, chromite, tridymite, quartz, apatite, merrillite, zircon and FeNi metal.
Geochemistry: Mineral compositions and geochemistry: Enstatite ($Wo_{1.7-4.9}En_{50.9-57.5}Fs_{40.7-46.6}$;FeO/MnO=29-35.4), pigeonite ($Wo_{5.1-17.1}En_{32.2-37.8}Fs_{45-59.4}$; FeO/MnO=27.5-32) with augite lamellae ($Wo_{36.2-37.7}En_{26.9-34.5}Fs_{29.1-44.9}$; FeO/MnO=27.8-32.6), Ferrosilite ($Wo_{2.4-3.6}En_{40.2-43.7}Fs_{52.6-57.1}$; FeO/MnO=29.7-31.7) with high-Ca pyroxene ($Wo_{19-20}En_{35.9-39.5}Fs_{40.4-44.9}$; FeO/MnO=28.1-29.2). Plagioclase ranges from An_{59-97} with an average of $An_{87.}$ Olivine ranges from $Fo_{40.2-71.9}$ with an average of $Fo_{64.4.}$
Classification: Eucrite (polymict breccia)

Northwest Africa 12869 (NWA 12869)
Mali
Purchased: 2019
Classification: Primitive achondrite
History: Single stone purchased by Abdelhadi Aithiba in Taoudenni, Mali, 2019.
Physical characteristics: Dark brown, weathered, irregular shaped exterior. Broken surfaces show dark brown, green, and honey-colored grains.
Petrography: (C. Agee, *UNM*) This meteorite contains approximately 70% olivine, 20% low-Ca pyroxene, 5% plagioclase, and 10% kamacite+troilite. The texture is poikiolitic to equigranular with typical grain sizes 100-500 µm. Many triple junctions are present. Fine crosscutting Fe-oxide veinlets were seen throughout. No chondrules observed.
Geochemistry: (C. Agee, *UNM*) Olivine $Fa_{34.7\pm0.2}$, Fe/Mn=86±5, n=10; low-Ca pyroxene $Fs_{26.2\pm1.3}Wo_{3.6\pm0.4}$, Fe/Mn=58±8, n=6; plagioclase $An_{47.4\pm0.5}Ab_{51.5\pm0.5}Or_{1.2\pm0.1}$, n=4. Oxygen isotopes (K. Ziegler, *UNM*): 3 acid-washed fragments analyzed by laser fluorination gave $\delta^{18}O$= 3.668, 3.584, 3.181; $\delta^{17}O$= 0.225, 0.170, -0.072; $\Delta^{17}O$= -1.712, -1.722, -1.752 (linearized, per mil, TFL slope=0.528).
Classification: Primitive achondrite. This a plagioclase-bearing harzburgite with oxygen isotopes similar to CR/CH chondrites, however the high Fa-content and Fe/Mn of olivine is inconsistent with a direct genetic link to CR/CH. Possibly paired with or related to NWA 3250 and NWA 6901, and broadly similar in geochemistry to other primitive achondrites that have olivine compositions ~Fa_{30-35} and oxygen isotopes in the vicinity of the CR/CH field such as NWA 3100 and Tafassasset.

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Specimens: 22 g including a probe mount on deposit at *UNM*, Abdelhadi Aithiba holds the main mass.

Northwest Africa 12870 (NWA 12870)
Algeria
Purchased: 2017
Classification: Lunar meteorite (feldspathic breccia)
History: Purchased in 2017 by Daoud Wabich from a seller in Laayoune, Morocco.
Physical characteristics: Single stone lacking fusion crust; composed of white and gray angular clasts set in a dark-gray matrix.
Petrography: (D. Sheikh, *FSU*) Sample is a feldspathic fragmental breccia composed of olivine, anorthite, augite (some exsolved), pigeonite, orthopyroxene, ilmenite, and Ti-Al-chromite grains (10-80 µm) set in a fine-grained feldspathic matrix. One high-fayalite olivine grain was also observed.
Geochemistry: (D. Sheikh, *FSU*) Olivine ($Fa_{30.4\pm9.6}$, range $Fa_{17.3-46.7}$, Fe/Mn=95.6, n=30), Fayalite ($Fa_{91.3}$, Fe/Mn=93, n=1), Augite ($Fs_{17.5\pm4.8}Wo_{35.3\pm4.8}$, range $Fs_{6.8-21.5}Wo_{26.8-44.2}$, Fe/Mn=50.8, n=15), Pigeonite ($Fs_{33.3\pm10.7}Wo_{8.0\pm2.4}$, range $Fs_{16.9-54.4}Wo_{5.2-15.0}$, Fe/Mn=58.7, n=20), Orthopyroxene ($Fs_{25.5\pm8.0}Wo_{3.5\pm0.7}$, range $Fs_{16.4-42.1}Wo_{2.6-4.8}$, Fe/Mn=55.5, n=14), Anorthite ($An_{96.1\pm0.8}$, range $An_{93.7-97.9}$, n=35).
Classification: Lunar (feldspathic fragmental breccia).
Specimens: 6.06 grams at *UCLA*; main mass with Daoud Wabich.

Northwest Africa 12871 (NWA 12871)
(Northwest Africa)
Purchased: 2018
Classification: Ordinary chondrite (LL3)
History: Purchased in 2018 by Matthew Stream from Habib Naji Naji in Morocco.
Physical characteristics: Dark-brown stone containing weathering cracks throughout the fusion crust into the interior.
Petrography: (D. Sheikh, *FSU*) Sample contains abundant well-formed, closely packed chondrules (up to 2.5 mm, av. diameter 950 µm) in a dark matrix of fine-grained silicates, troilite, iron oxides, and rare iron-nickel metal.
Geochemistry: (D. Sheikh, *FSU*) Olivine ($Fa_{16.6\pm10.5}$, range $Fa_{0.8-33.2}$, n=25), Cr_2O_3 in ferroan olivine (0.07-0.35 wt%, mean 0.21±0.10, n=12), Orthopyroxene ($Fs_{9.5\pm6.2}Wo_{1.9\pm1.7}$, range $Fs_{2.4-21.0}Wo_{0.2-4.3}$, n=20).
Classification: Ordinary Chondrite (LL3)
Specimens: 20.08 grams at *UCLA*; main mass with Matthew Stream.

Northwest Africa 12872 (NWA 12872)
(Northwest Africa)
Purchased: 2019
Classification: Ordinary chondrite (L5, melt breccia)

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History: The meteorite was purchased from a Morrocan meteorite dealer on the meteorite fair in Ensisheim, France.
Physical characteristics: Two brownish rocks with some fusion crust.
Petrography: The meteorite is a melt breccia and largely consists of partly recrystallized shock melt regions with characteristic FeNi metal and sufide spherules. Unmelted chondritic regions are of type L5 (plagioclase grain size about 30 µm) and contain few relictic chondrules; no metal or sulfide veins are observed.

Northwest Africa 12873 (NWA 12873)
(Northwest Africa)
Purchased: 2019
Classification: Ordinary chondrite (L3)
History: The meteorite was purchased from a Moroccan meteorite dealer at the meteorite fair in Ensisheim, France.
Physical characteristics: Dark-grayish rock partly covered with fusion crust.
Petrography: The meteorite shows a chondritic texture with well defined, mostly flattened and densely packed chondrules (mean diameter about 0.7 mm) in a more fine-grained matrix that contains sulfides and FeNi metal.

Northwest Africa 12874 (NWA 12874)
(Northwest Africa)
Purchased: 2019
Classification: Primitive achondrite (Winonaite)
History: The meteorite was purchased from a Morrocan meteorite dealer on the meteorite fair in Ensisheim, France.
Physical characteristics: Three dark brownish fragments with some fusion crust.
Petrography: The meteorite displays a recrystallized texture dominantly composed of typically 100 to 200 µm sized enstatite, forsteritic olivine, and augite grains, with enstatite being the most abundant mineral phase. Augite often contains low-Ca pyroxene exsolutions. 120 degree triple junctions are abundant. Minor phases include kamacite, schreibersite, and troilite. Contains veinlets of metal or Fe-oxide throughout. Neither feldspar nor chondrules were observed.
Geochemistry: olivine: $Fa_{3.3\pm0.1}$ ($Fa_{3.2-3.4}$ FeO/MnO=15±1, n=13); low-Ca pyroxene: $Fs_{3.6\pm0.4}Wo_{1.4\pm0.2}$ ($Fs_{3.3-4.5}Wo_{1.2-1.7}$, FeO/MnO=10±1, n=13); Ca-pyroxene: $Fs_{1.7\pm0.4}Wo_{45.4\pm0.4}$ ($Fs_{1.2-2.3}Wo_{44.6-46.3}$, FeO/MnO=8±3, n=13); feldspar: $An_{11.5\pm0.3}Ab_{83.5\pm0.6}Or_{5.0\pm0.7}$, n=17

Northwest Africa 12876 (NWA 12876)
(Northwest Africa)
Purchased: 2019
Classification: Ordinary chondrite (L5, melt breccia)

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History: The meteorite was purchased from a Morrocan meteorite dealer on the meteorite fair in Ensisheim, France.
Physical characteristics: Seven brownish rocks with some fusion crust.
Petrography: The meteorite is a melt breccia composed of L5 chondritic regions with several recognizable chondrules (plagioclase grain size about 40 µm) and abundant up to 1 cm wide recrystallized shock melt veins and pockets with characteristic FeNi metal and sufide spherules.

Northwest Africa 12877 (NWA 12877)
(Northwest Africa)
Purchased: 2018
Classification: Carbonaceous chondrite (CV3)
History: The meteorite was purchased from a Morrocan meteorite dealer on the meteorite fair in Ensisheim, France.
Physical characteristics: Two brownish fragments without fusion crust.
Petrography: Carbonaceous chondrite composed of chondrules (mean diameter about 0.9 mm; up to 3 mm sized), abundant olivine amoeboids, and less abundant CAIs all set into a fine-grained dark brownish matrix. Several type II chondrules are present. Most chondrules show reddish staining due to terrestrial weathering.

Northwest Africa 12878 (NWA 12878)
(Northwest Africa)
Purchased: 2019
Classification: HED achondrite (Eucrite)
History: The meteorite was purchased from a meteorite dealer in Errachidia, Morocco.
Physical characteristics: Small dark greyish fragment with some fusion crust.
Petrography: The meteorite is a polymict breccia with fine- and coarse-grained basaltic clasts set into a clastic matrix predominantly composed of exsolved pyroxene and calcic plagioclase of highly variable grain sizes. Minor phases include silica, chromite, FeS, ilmenite, zircon, and some kamacite. The meteorite contains shock melt veins.
Geochemistry: low-Ca pyroxene: $Fs_{61.8\pm0.4}Wo_{2.2\pm0.5}$ ($Fs_{60.8-62.2}Wo_{1.8-3.4}$, FeO/MnO=32-37, n=12); Ca-pyroxene: $Fs_{27.3\pm0.4}Wo_{43.6\pm0.4}$ ($Fs_{26.5-28.2}Wo_{42.9-44.4}$, FeO/MnO=31-36, n=14); calcic plagioclase: $An_{87.8\pm4.0}$ ($An_{79.5-91.0}$, n=15)

Northwest Africa 12879 (NWA 12879)
(Northwest Africa)
Purchased: 2019
Classification: Angrite
History: The meteorite was purchased from a meteorite dealer in Morocco.
Physical characteristics: Many small dark brownish fragments without fusion crust.

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Petrography: The meteorite exhibits a subophitic texture of lath-shaped up to 200 µm sized anorthite, Al-Ti-augite, and Ca-rich olivine. Pyroxene and olivine show strong compositional zoning, which in case of olivine can be reverse. Several olivine grains are overgrown by kirschsteinite. Minor phases include titanomagnetite, troilite, kuratite, and silicoapatite.
Geochemistry: olivine: $Fa_{65.1\pm20.9}Ln9.5\pm6.8$ ($Fa_{15.6\text{-}84.9}Ln0.4\text{-}21.2$, FeO/MnO=86±12, n=36); clinopyroxene: $Fs_{33.2\pm12.1}Wo_{51.9\pm0.9}$ ($Fs_{19.9\text{-}49.5}Wo_{49.9\text{-}53.1}$, FeO/MnO=110±26, TiO_2 = 2.2±0.9 wt%, Al_2O_3 = 7.6±1.1 wt%, n=22); kirschsteinite: $Fa_{60.1\pm1.8}Ln36.1\pm1.4$ ($Fa_{57.7\text{-}63.4}Ln33.1\text{-}38.0$, FeO/MnO=70±4, n=11); anorthite: $An_{99.6\pm0.2}$ ($An_{99.1\text{-}99.8}$, n=11)

Northwest Africa 12880 (NWA 12880)
(Northwest Africa)
Purchased: 2019
Classification: Carbonaceous chondrite (CV3)
History: The meteorite was purchased from a meteorite dealer in Algeria.
Physical characteristics: Many brownish fragments without fusion crust.
Petrography: The carbonaceous chondrite displays a dark brownish interior and is composed of chondrules (mean diameter about 1 mm; up to 2 mm sized), CAIs (up to 5 mm), and olivine amoeboids all set into a fine-grained matrix. Type II chondrules are absent. Several chondrules show reddish staining due to terrestrial weathering.

Northwest Africa 12881 (NWA 12881)
Morocco
Purchased: 2017 Nov
Classification: Iron meteorite (IIAB)
History: The meteorite was purchased in Morocco from a dealer.
Petrography: (Y. Shen, *UWO*) Fresh interior, hexahedrite texture with kamacite, plessite, and phosphides found by BSE imaging in the polished mount.
Geochemistry: (Y. Shen, *UWO*) Elemental composition in %: Co=0.51 and Ni= 7.1; and in ppm: Cr=56, Ga=60, As=5.6, Ru=19, Pt 26, Ir=3.5 and Au=1.2. EMPA: taenite Ni 23-36 wt% and kamacite Ni 2-7 wt% in plessite.
Classification: Iron, IIAB
Specimens: 22.0g at *UWO* including a polished mount.

Northwest Africa 12882 (NWA 12882)
(Northwest Africa)
Purchased: 2017
Classification: Carbonaceous chondrite (CK6)
History: Marc Jost (*SJS*) acquired a 1214 g stone from Aziz Habibi at the Munich Mineral show in 2017.

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Physical characteristics: The sample has an irregular, tabular shape and appears to show flight-orientation with a broad flow-lined leading edge. The cut face shows the interior has a chondritic texture of dispersed, dark-colored chondrules in a dark brownish green matrix.

Petrography: (Description and Classification A. Love, *App*) Sample has a chondritic texture showing chondrules and CAIs (up to ~3 mm) set within a recrystallized matrix. Chondrules have an average apparent diameter of 796 µm (n=32) and barred and granular olivine chondrules with igneous rims are dominant. Plagioclase with intermediate composition occurs throughout matrix and has an average long dimension of 64 µm (n=40). Additional minerals are plagioclase, Ca-phosphates and Cr-magnetite containing ilmenite exsolution lamellae and apatite inclusions.

Geochemistry: (A. Love, *App*) Olivine ($Fa_{30.5\pm0.2}$, Fe/Mn=115.7±3.1, mean NiO=0.5, N=12), low Ca pyroxene $Fs_{26.3\pm0.2}Wo_{0.9\pm0.1}$, Fe/Mn=26.2±13.2, N=10), high Ca pyroxene ($Fs_{9.4\pm0.5}Wo_{48.2\pm0.3}$, N=5).

Classification: Carbonaceous chondrite (CK6) wi-3 C-S2. Based on chondrule size, composition and abundance (~36%) and presence of ubiqiutous CAIs and Cr-magnetite, this is a CK chondrite. Sample is a petrologic type 6 based on equilibrated compositions of chondrules and size of secondary plagioclase.

Specimens: Marc Jost (*SJS*) hold the main mass. A polished mount, a polished thin section and two slices comprise the 25.7 g type specimen.

Northwest Africa 12883 (NWA 12883)

(Northwest Africa)

Purchased: 2015

Classification: Ordinary chondrite (H5-6)

History: A sculpted, oriented 148 g stone was given to Marc Jost (*SJS*) by Aziz Mouadine at the Munich Mineral Show 2015 as a gift.

Physical characteristics: The sample has a pronounced nosecone with radial flow lines emanating from the point and a rollover lip covering a rim around the trailing edge. The cut face shows the interior has a brecciated texture composed of chondritic clasts set within a host of chondrules suspended in a dark-colored matrix.

Petrography: Description and Classification: (A. Love, *App*) Sample has a brecciated texture composed of up to 2.5 cm rounded, recrystallized, chondritic clasts set in a shock-darkened host of chondrule fragments. Host in between clasts is composed of distinct chondrules and fragments set within a metal-sulfide-rich shock-melted matrix. All textural types of chondrules are represented and they show an average apparent diameter 430 µm. Sample contains ~7 vol% FeNi metal.

Geochemistry: (A. Love, *App*) Olivine ($Fa_{17.9\pm0.2}$, Fe/Mn=37.2±0.7, N=12), low Ca pyroxene ($Fs_{15.9\pm0.1}Wo_{1.1\pm0.1}$, Fe/Mn=20.8±0.6, N=8).

Classification: Ordinary chondrite (H5-6 breccia, C-S3, W1). Sample is an H chondrite based upon mineral compositions, magnetic susceptibility and chondrule diameters. Host is type 5 based upon distinct chondrules with equilibrated

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compositions. Clasts are type 6 based upon recrystallized texture and equilibrated compositions.
Specimens: Marc Jost (*SJS*) holds the main mass. A polished thin section and a 24.4 g slice are on deposit at *App*.

Northwest Africa 12884 (NWA 12884)
(Northwest Africa)
Purchased: 2015
Classification: HED achondrite (Eucrite, brecciated)
History: Marc Jost (*SJS*) purchased the 2850 g sample in Rissani in January of 2015.
Physical characteristics: The sample has an irregular shape and the exterior is light brown-tan in color. Clasts are visible on the exterior surface. The cut face shows the interior is a breccia composed of rounded to angular clasts with basaltic textures.
Petrography: Sample is a cataclastic breccia composed of cm-sized, rounded, basaltic and rare cumulate-textured clasts set within a host of related mineral fragments. Clast show ophitic texture. Pyroxenes show exsolution textures and clouding. Additional minerals are: chromite, troilite, ilmenite, an Si polymorph and Ca phosphate minerals.
Geochemistry: (A. Love, *App*) Low Ca pyroxene ($Fs_{56.2\pm0.4}Wo_{1.9\pm0.1}$ Fe/Mn=33.0±0.3, Mg#=42.7±0.4, N=12), high-Ca pyroxene ($Fs_{23.1\pm0.5}Wo_{44.6\pm0.4}$, Fe/Mn=30.9±0.9, N=12), plagioclase ($An_{82.7\pm2.}Or_{0.9\pm0.5}$, N=6).
Classification: HED achondrite (Eucrite breccia). Based on ophitic texture and mineral compositions (Fe/Mn and Mg#) of pyroxenes, this sample is an equilibrated basaltic eucrite breccia M-S2 low weathering.
Specimens: Marc Jost holds the main mass. A polished thin section and 2 slices totaling 25.5 g are on deposit at *App*.

Northwest Africa 12885 (NWA 12885)
(Northwest Africa)
Purchased: 2014 Feb
Classification: Ordinary chondrite (H5)
History: Purchased in February 2014 in Tuscon, AZ, by Fred *Olsen* from a Moroccan dealer. Acquired by Daniel Sheikh in 2018.
Physical characteristics: Single stone with dark-brown fusion crust.
Petrography: (DE. Sheikh, *FSU*) Low chondrule abundance (400±50 µm, n=3). Sample composed of olivine, low-Ca pyroxene, high-Ca pyroxene, recrystallized plagioclase (Av. 5 µm), troilite, Fe-Ni metal, Fe-oxides, and chromite.
Geochemistry: Olivine ($Fa_{18.3\pm0.8}$, n=30), Low-Ca Pyroxene ($Fs_{16.7\pm0.9}Wo_{1.1\pm0.1}$, n=35), High-Ca Pyroxene ($Fs_{6.0\pm0.3}Wo_{43.1\pm0.6}$, n=2).
Classification: Ordinary Chondrite (H5) Sample is classified as type 5 due to the homogeneity of the olivine and pyroxene grains as well as due to the presence of 5 µm recrystallized plagioclase.
Specimens: 28.4 grams at *UCLA*; main mass with Sheikh.

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Northwest Africa 12886 (NWA 12886)
(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 *PSF*, then sold in 2019 to the Harkness Collection.
Petrography: (A. Irving, *UWS* and J. Boesenberg, *BrownU*; T. Bunch and J. Wittke, *NAU*) Some well-formed, relatively small chondrules are set in a relatively coarse grained matrix containing abundant altered metal.
Geochemistry: Olivine ($Fa_{19.3\pm0.3}$ (range $Fa_{119.1-19.7}$, N = 4), low-Ca pyroxene ($Fs_{116.8\pm0.2}Wo_{1.5\pm0.2}$ (range $Fs_{16.6-17.0}Wo_{1.7-1.4}$, N = 3).
Classification: Ordinary chondrite (H4/5).
Specimens: 88.55 g including one polished thin section at *PSF*; remainder in Harkness Collection.

Northwest Africa 12887 (NWA 12887)
(Northwest Africa)
Purchased: 2005
Classification: Ordinary chondrite (L5)
History: Purchased by an anonymous collector from a dealer at the Munich Show in 2005, subsequently acquired by *PSF*, then sold in 2019 to the Harkness Collection.
Petrography: (A. Irving, *UWS* and J. Boesenberg, *BrownU*) Sparse chondrules occur within a recrystallized matrix containing altered metal.
Geochemistry: Olivine ($Fa_{24.6\pm0.4}$ (range $Fa_{24.0-25.0}$, N = 5), low-Ca pyroxene ($Fs_{21.1\pm0.2}Wo_{1.2\pm0.2}$ (range $Fs_{20.9-21.3}Wo_{1.0-1.4}$, N = 3).
Classification: Ordinary chondrite (L5).
Specimens: 25.04 g including one polished thin section at *PSF*; remainder in Harkness Collection.

Northwest Africa 12888 (NWA 12888)
(Northwest Africa)
Purchased: 2005
Classification: Ordinary chondrite (L5)
History: Purchased by an anonymous collector from a dealer at the Munich Show in 2005, subsequently acquired by *PSF*, then sold in 2019 to the Harkness Collection.
Petrography: (A. Irving, *UWS* and J. Boesenberg, *BrownU*) Monomict breccia composed of clasts and related mineral debris. The clasts contain sparse chondrules set in a recrystallized matrix containing altered metal.
Geochemistry: Olivine ($Fa_{25.1\pm0.5}$ (range $Fa_{24.5-25.4}$, N = 3), low-Ca pyroxene ($Fs_{22.2\pm2.1}Wo_{2.1\pm0.3}$ (range $Fs_{21.0-25.3}Wo_{1.8-2.6}$, N = 4).
Classification: Ordinary chondrite (L5 breccia).

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Specimens: 24.2 g including one polished thin section at *PSF*; remainder in Harkness Collection.

Northwest Africa 12889 (NWA 12889)
(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 *PSF*, then sold in 2019 to the Harkness Collection.
Petrography: (A. Irving, *UWS* and J. Boesenberg, *BrownU*) Rare chondrules occur within a recrystallized matrix containing altered metal.
Geochemistry: Olivine ($Fa_{25.5\pm0.5}$ (range $Fa_{25.0-26.1}$, N = 4), low-Ca pyroxene ($Fs_{21.3\pm0.3}Wo_{1.7\pm0.3}$ (range $Fs_{21.1-21.7}Wo_{2.0-1.4}$, N = 3), augite ($Fs_{7.4}Wo_{45.6}$).
Classification: Ordinary chondrite (L6).
Specimens: 56.32 g including one polished thin section at *PSF*; remainder in Harkness Collection.

Northwest Africa 12890 (NWA 12890)
(Northwest Africa)
Purchased: 2005
Classification: Ordinary chondrite (H4)
History: Purchased by an anonymous collector from a dealer at the Munich Show in 2005, subsequently acquired by *PSF*, then sold in 2019 to the Harkness Collection.
Petrography: (A. Irving, *UWS* and J. Boesenberg, *BrownU*; T. Bunch and J. Wittke, *NAU*) Well-formed, relatively small chondrules are set in a relatively coarse grained matrix containing abundant altered metal.
Geochemistry: Olivine ($Fa_{18.6\pm0.7}$ (range $Fa_{18.1-19.5}$, N = 4), low-Ca pyroxene ($Fs_{16.5\pm0.2}Wo_{0.5\pm0.3}$ (range $Fs_{16.2-16.6}Wo_{0.7-0.2}$, N = 3).
Classification: Ordinary chondrite (H4).
Specimens: 47.02 g including one polished thin section at *PSF*; remainder in Harkness Collection.

Northwest Africa 12891 (NWA 12891)
(Northwest Africa)
Purchased: 2005
Classification: Ordinary chondrite (L3)
History: Purchased by an anonymous collector from a dealer at the Munich Show in 2005, subsequently acquired by *PSF*, then sold in 2019 to the Harkness Collection.
Petrography: (A. Irving, *UWS* and J. Boesenberg, *BrownU*) Well-formed chondrules (apparent diameter 830±420 µm, N = 23) are set in a sparse, finer grained matrix containing stained metal.

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Geochemistry: Olivine ($Fa_{24.1\pm2.8}$ (range $Fa_{19.0-27.5}$, N = 6); Cr_2O_3 in ferroan examples <0.04 wt.%), low-Ca pyroxene ($Fs_{20.8}Wo_{0.7}$; $Fs_{12.9}Wo_{5.0}$), subcalcic augite ($Fs_{9.6}Wo_{33.3}$). Magnetic susceptibility log χ ($\times 10^{-9}$ m^3/kg) = 4.92.
Classification: Ordinary chondrite (L3).
Specimens: 33.72 g including one polished thin section at *PSF*; remainder in Harkness Collection.

Northwest Africa 12892 (NWA 12892)
(Northwest Africa)
Purchased: 2016
Classification: Primitive achondrite (Acapulcoite)
History: Purchased online in 2016 by George Penneff from Mohamed Salem el Wali el Alaoui in Morocco.
Physical characteristics: Single dark-brown stone with minor fusion crust.
Petrography: (D. Sheikh, *FSU*) Sample is highly recrystallized and contains abundant 120° triple junctions. Silicate major phases include angular to sub-rounded grains (Av. 180 µm) of olivine, low-ca pyroxene, high-ca pyroxene, and plagioclase. Fe-Ni metal grains (mostly kamacite, Av. 500 µm) occupy ~10% volume of the sample. Other phases include troilite, chromite, fluorapatite, and merrillite.
Geochemistry: (D. Sheikh, *FSU*) Olivine ($Fa_{8.9\pm0.3}$, range $Fa_{8.3-9.7}$, Fe/Mn=17±4, n=32), low-Ca Pyroxene ($Fs_{9.8\pm0.3}Wo_{2.5\pm0.4}$, range $Fs_{9.3-10.4}Wo_{1.7-3.1}$, Fe/Mn=11±2, n=26), high-Ca Pyroxene ($Fs_{4.1\pm0.2}Wo_{42.5\pm2.6}$, range $Fs_{3.8-4.3}Wo_{38.7-44.3}$, Cr_2O_3 1.4 wt%, Fe/Mn=6±1, n=4), plagioclase ($An_{19.5\pm0.8}Or_{2.5\pm0.4}$, range $An_{18.7-20.4}Or_{2.0-3.0}$, n=5), Chromite (Cr/(Cr+Al)=86.9, n=2), Kamacite (Ni wt%=6.6, n=11).
Classification: Acapulcoite
Specimens: 5.07 grams at *UCLA*; main mass with George Penneff.

Northwest Africa 12893 (NWA 12893)
Mauritania
Purchased: 2018
Classification: Ordinary chondrite (L6, melt breccia)
History: Purchased online in 2018 by Daniel Sheikh from Matthew Stream, who had purchased it in 2017 from a seller in Mauritania.
Physical characteristics: Single stone with dark-brown fusion crust. Interior slice reveals brecciated texture.
Petrography: (Daniel Sheikh, *FSU*) Sample is a breccia composed of angular clasts (up to 2.5 cm) set in a shock melted matrix. Major phases present include olivine, low-ca pyroxene, high-ca pyroxene, sodic plagioclase (Av. 60 µm), kamacite, taenite, and troilite. Accessory chromite is present as well. A few of the clasts contain relict chondrule (BO and RP) fragments.
Geochemistry: (Daniel Sheikh, *FSU*) Olivine ($Fa_{24.8\pm0.6}$, n=87), low-Ca Pyroxene ($Fs_{21.1\pm0.6}Wo_{1.4\pm0.2}$, n=48), high-Ca Pyroxene ($Fs_{8.5\pm0.7}Wo_{43.7\pm0.7}$, n=11), Sodic Plagioclase ($An_{11.3\pm0.6}$, n=43), Chromite (Cr/(Cr+Al)=85.5±0.2, n=4).

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Classification: Ordinary chondrite (L6-melt breccia)
Specimens: 16.83 grams at *UCLA*; main mass with Daniel Sheikh.

Northwest Africa 12902 (NWA 12902)
(Northwest Africa)
Purchased: 2019
Classification: Ordinary chondrite (L~6)
History: (Ziyao Wang) Purchased by Ziyao Wang from Sbai Mohamed at the Chenzhou show in 2019.
Physical characteristics: 271 g leather brown stone with heavily pitted surface.
Petrography: (R. Bartoschewitz, *Bart*) Light gray and brown mottled recrystallized matrix with chonrules (av. 0.7 mm), metal and sulfide particles.
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.65
Classification: Ordinary chondrite (L~6, W3)
Specimens: 21.1 g on deposit at *Kiel*, *Bart* holds the main mass

Northwest Africa 12903 (NWA 12903)
Morocco
Purchased: 2019
Classification: Ordinary chondrite (LL~5)
History: (Ziyao Wang) Purchased by Wei Jiang from a Moroccan dealer at the mineral show in Chenzhou in May, 2019?; sold to Ziyao Wang in Jun 2019.
Physical characteristics: (Ziyao Wang) Reddish brown stone of 133 g with little fusion crust.
Petrography: (R. Bartoschewitz, *Bart*) brown recrystallized matrix with chondrules (av. 0.9 mm). Metal is completely and sulfide mostly oxidized.
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.28
Classification: Ordinary chondrite (LL~5, W4)
Specimens: 20.8 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 45 g with *Bart*.

Northwest Africa 12904 (NWA 12904)
Morocco
Purchased: 2018
Classification: Ordinary chondrite (LL4-5)
History: Purchased by Matthew Stream at the 2018 Tucson Gem Show in Tucson, AZ.
Physical characteristics: Single stone with dark-brown fusion crust.
Petrography: (Daniel Sheikh, *FSU*) Low chondrule abundance (900±100 µm, n=4). Sample composed of both type 4 and type 5 clasts present in a dark, fine-grained

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matrix. Major phases present include olivine, low-ca pyroxene, high-ca pyroxene, recrystallized sodic plagioclase (only in type 5 clasts, average size 5 µm), troilite, Fe-Ni metal, and chromite.
Geochemistry: Olivine ($Fa_{30.6\pm0.8}$, n=40), Low-Ca Pyroxene ($Fs_{25.5\pm0.6}Wo_{1.8\pm0.5}$, n=5), High-Ca Pyroxene ($Fs_{10.5\pm0.5}Wo_{43.2\pm0.3}$, n=4), Sodic Plagioclase ($An_{12.4\pm0.3}$, n=4).
Classification: Ordinary Chondrite (LL4-5) Sample is classified as type 4-5 due to the homogeneity of the olivine and pyroxene grains and the absence of recrystallized plagioclase in the type 4 clasts as well as the homogeneity of the olivine and pyroxene grains and the presence of 5 µm recrystallized plagioclase in the type 5 clasts.
Specimens: 14.94 grams at *UCLA*; main mass with Matthew Stream.

Northwest Africa 12905 (NWA 12905)
Algeria
Purchased: 2019
Classification: HED achondrite (Howardite)
History: Purchased by Matthew Stream in 2019 from a seller in Algeria.
Physical characteristics: Minor fusion crust; a slice of the interior reveals a variety of light and dark clasts set in a fine-grained matrix.
Petrography: (D. Sheikh, *FSU*) Fine-grained polymict breccia, <7 mm clast size for basaltic eucrite clasts, <3 mm for diogenite clasts, <2 mm for cumulate eucrite clasts. Modal content of howardite (in vol.%): diogenites, 30%; cumulate eucrites, 25%; basaltic eucrites, 40%; anorthosite clasts, 4%; opaques, 1%.
Geochemistry: Eucrite pyroxene: pigeonite ($Fs_{46.6}Wo_{12.2}$), n=19; augite ($Fs_{36.5}Wo_{31.8}$), n=4; Fe/Mn=28. Diogenite pyroxene: orthopyroxene ($Fs_{30.1}Wo_{2.7}$), n=35; Fe/Mn=30. Calcic plagioclase (An_{90}), N=13. Chromite and SiO_2-rich glass present.
Classification: Achondrite (Howardite). Likely paired with NWA 12227 due to both originating from the same source in Algeria.
Specimens: 20.08 grams at *UCLA*; main mass with Matthew Stream.

Northwest Africa 12906 (NWA 12906)
(Northwest Africa)
Purchased: 2018
Classification: Ordinary chondrite (LL6)
History: Purchased by Fred *Olsen* in 2018 from a seller in Northwest Africa. Acquired by Daniel Sheikh in 2018.
Physical characteristics: Single stone with dark-brown fusion crust.
Petrography: (D. Sheikh, *FSU*) Low chondrule abundance (900±100 µm, n=2). Sample composed of olivine, low-ca pyroxene, recrystallized plagioclase (average size 55 µm), troilite, Fe-Ni metal, Fe-oxides, and chromite.

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Geochemistry: Olivine ($Fa_{31.3\pm0.7}$, n=25), Low-Ca Pyroxene ($Fs_{25.4\pm0.6}Wo_{2.1\pm0.2}$, n=11), Sodic Plagioclase ($An_{12.5\pm0.3}$, n=10).
Classification: Ordinary Chondrite (LL6) Sample is classified as type 6 due to the homogeneity of the olivine and pyroxene grains as well as due to the presence of 55 µm recrystallized plagioclase.
Specimens: 17.14 grams at *UCLA*; main mass with Daniel Sheikh.

Northwest Africa 12908 (NWA 12908)
(Northwest Africa)
Purchased: 2019
Classification: Martian meteorite (Shergottite)
History: Purchased by Zuokai Ke from a Moroccan dealer in Chenzhou, China, in May 2019.
Physical characteristics: Single stone, brownish sand blasted exterior with no fusion crust. Cut surface reveals greenish-yellow grains and dark gray grains or domains.
Petrography: (C. Agee, *UNM*; X. Gu, *CSU*-China) The two major phases in this meteorite are clinopyroxene and maskelynite. Ubiquitous minor phases are merrillite, apatite, titanomagnetite, ilmenite and troilite. Trace amounts of baddelyite, taenite, chalcopyrite, and molybdenite were detected. The clinopyroxene has a modal abundance of approximately 60%, with significant core to rim zoning observed in backscatter electron images indicating an igneous crystallization trend with Mg-rich pigeonite cores, mantled by augite, and rimmed with ferropigeonite. Clinopyroxene average grain size is approximately 300-500 µm. Maskelynite has modal abundance of approximately 30%, most grains are thin and elongate with maximum length ~1 mm. Merrilite is more abundant than apatite in this sample.
Geochemistry: (C. Agee, *UNM*; X. Gu, *CSU*-China: (C. Agee, *UNM*) Clinopyroxene $Fs_{45.6\pm17.2}Wo_{22.6\pm7.2}$, core to rim range $Fs_{31.1}Wo_{14.0}$ (Mg-pigeonite) $Fs_{22.6}Wo_{37.0}$ (augite) - $Fs_{73.3}Wo_{17.6}$ (ferropigeonite), Fe/Mn=38±5, n=24; maskelynite $An_{47.4\pm4.8}Ab_{48.9\pm3.9}Or_{3.7\pm1.4}$, n=13. Oxygen isotopes (K. Ziegler, *UNM*): 3 acid-washed fragments analyzed by laser fluorination gave $\delta^{18}O$= 4.728, 4.967,4.670; $\delta^{17}O$= 2.780, 2.896, 2.738; $\Delta^{17}O$= 0.284, 0.273, 0.272 (linearized, all per mil, TFL slope=0.528).
Classification: Geochemically evolved pyroxene-phyric basalt, clinopyroxene compositional zoning trends are similar to QUE 94201. Likely paired with NWA 12522.
Specimens: 18.7 g including a probe mount on deposit at *UNM*, Zuokai Ke holds the main mass.

Northwest Africa 12909 (NWA 12909)
(Northwest Africa)
Purchased: 2019
Classification: Lunar meteorite (feldspathic breccia)

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History: Purchased by Zuokai Ke in Chenzhou, China, in May 2019 from Moroccan meteorite dealer.
Physical characteristics: Single stone, desert weathered exterior, sawcuts reveal a fragmental breccia with many white, feldspathic clasts set in a dark-gray groundmass.
Petrography: (X. Gu, *CSU*-China; C. Agee, *UNM*) This meteorite is composed of anorthite (55%), olivine (23%), augite (15%), orthopyroxene (6%), with ubiquitous minor kamacite, troilite, ulvospinel, ilmenite, Cr-spinel, silica, schreibersite and pentlandite. Brecciated clasts sizes range from several micrometers to 1 mm.
Geochemistry: (X. Gu, *CSU*-China) Olivine $Fa_{30.4\pm12.5}$, n=26; low-Ca pyroxene $Fs_{22.1\pm10.3}Wo_{3.5\pm0.8}$, Fe/Mn=63±8, n=8); augite $Fs_{26.9\pm11.0}Wo_{22.6\pm14.1}$, n=17, plagioclase $An_{97.3\pm1.9}Or_{0.2\pm0.3}Ab_{2.6\pm1.9}$, n=11. (C. Agee, *UNM*) Olivine $Fa_{30.0\pm10.9}$, Fe/Mn=88±8, n=6; pigeonite $Fs_{28.9\pm6.0}Wo_{13.2\pm5.8}$, Fe/Mn=53±9, n=3; augite $Fs_{20.0\pm14.9}Wo_{39.2\pm7.3}$, Fe/Mn=42±2, n=3, plagioclase $An_{96.3\pm0.6}Or_{0.2\pm0.1}Ab_{3.5\pm0.6}$, n=3.
Classification: Lunar feldspathic breccia
Specimens: 23.2 g including a probe mount on deposit at *UNM*, Zuokai Ke holds the main mass.

Northwest Africa 12910 (NWA 12910)
(Northwest Africa)
Purchased: 2019
Classification: HED achondrite (Diogenite)
History: Purchased by Zuokai Ke from a Moroccan dealer in March 2019.
Physical characteristics: Single stone, ~80% of the surface is covered with fresh black fusion crust. Exposed interior shows pale greenish pyroxene grains and a distinct, very planar, dark colored shock melt vein with numerous small parallel shock melt veins adjacent to it.
Petrography: (C. Agee, *UNM*; X. Gu, *CSU*-China) This meteorite is an orthopyroxenite, containing ~98% orthopyroxene that is extremely homogeneous in composition. There is minor, ubiquitous troilite, chromite, silica, and augite. This meteorite has been subjected to high shock levels as many grains are fragmented, and some zones have cataclastic textures. A strikingly prominent shock melt vein crosscuts the entire sample, the composition of which is nearly identical to the host orthopyroxene indicating in-situ melting rather than injection from an exotic external source.
Geochemistry: (C. Agee, *UNM*; X. Gu, *CSU*-China): Orthopyroxene $Fs_{23.8\pm0.1}Wo_{2.2\pm0.0}$, Fe/Mn=29±1, n=6; shock melt vein SiO_2=55.2±0.4, TiO_2=0.07±0.01, Al_2O_3=0.8±0.5, Cr_2O_3=0.5±0.2, MgO=26.2±0.4, FeO=15.5±0.5, MnO=0.51±0.01, CaO=1.2±0.3, all wt%, n=6.
Classification: HED (diogenite)
Specimens: 22.7 g including a probe mount on deposit at *UNM*, Zuokai Ke holds the main mass.

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Northwest Africa 12911 (NWA 12911)
(Northwest Africa)
Purchased: 2003
Classification: Ordinary chondrite (L6)

History: Baird purchased at a meteorite auction in Tucson in 2003, and donated an end piece to *Cascadia* in 2013.

Physical characteristics: The exterior of the end piece is covered by a dark brown/black fusion crust and is faceted. The cut face is polished; most of the face is dark brown, lacks readily defined chondrules, and contains almost no visible metal/sulfide grains. One side of the cut face is light gray and contains moderately abundant metal/sulfide grains.

Petrography: (M. Hutson, A. Ruzicka, W. Fish, *Cascadia*): The texture of the silicates in thin section are relatively well-integrated; indistinct chondrules are visible. Plagioclase feldspar grains up to 70 microns across are present. Approximately 60-70% of metal and sulfide grains have been replaced.

Geochemistry: Mineral compositions and geochemistry: Olivine and pyroxene grains are equilibrated: $Fa_{25.7\pm0.5}$, N=14; $Fs_{21.4\pm0.1}Wo_{1.6\pm0.2}$, N=13.

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

Specimens: *Cascadia* holds 22.2 g in two pieces, in addition to two polished thin sections and a mounted butt. The main mass is held by Baird: Jerry Baird, Lake Havasu City, AZ.

Northwest Africa 12912 (NWA 12912)
(Northwest Africa)
Purchased: 12 Dec 2016
Classification: Ordinary chondrite (LL3)

History: BBaecker purchased an NWA meteorite on Ebay on December 12, 2016, and donated seven pieces to *Cascadia* on February 4, 2017.

Physical characteristics: *Cascadia* received seven small pieces that are medium- to dark-brown with patches of tan caliche on surfaces.

Petrography: (M. Hutson, A. Ruzicka, R. Kostynick, *Cascadia*): Distinct chondrules set in an opaque background are visible in thin section. Metal and sulfide have been replaced by iron hydroxides, and plucked, leaving holes in the poorly-polished thin section. No shock veins were visible using the optical microscope. Strong zoning of silicates is evident in BSE images. Chondrules are partly surrounded by a melt matrix. Small (?50 µm across) chromite-plagioclase patches are visible, mainly inside larger pyroxene grains. Chondrules average apparent diameter 0.89 mm (N=18).

Geochemistry: Mineral compositions and geochemistry: Olivine and pyroxene grains are highly unequilibrated: $Fa_{28.6\pm8.1}$, N=32; $Fs_{13.5\pm9.5}Wo_{1.7\pm1.6}$, N=17.

Classification: Ordinary chondrite (LL3) based on olivine fayalite content and average chondrule diameter.

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Specimens: *Cascadia* holds 6.6 g in eight pieces, in addition to a polished thin section and a mounted butt. The main mass is held by BBaecker: Bastien Baecker, Huntsville, AL

Northwest Africa 12913 (NWA 12913)
(Northwest Africa)
Purchased: 20 Nov 2016
Classification: Ordinary chondrite (L6)
History: BBaecker purchased an NWA meteorite on Ebay on November 20, 2016, and donated 11 pieces to *Cascadia* on February 4, 2017.
Petrography: (M. Hutson, A. Ruzicka, R. Kostynick, *Cascadia*): The texture of the silicates in thin section is fairly integrated, with numerous readily distinguished chondrules. Plagioclase feldspar textures suggest fluidization. Chromite-plagioclase regions and maskelynite are present. A few crystalline grains exceed 50 microns in length. Thin veins caused by shock are present, many with droplets of metal/sulfide surrounding angular silicate clasts. Replacement of metal and sulfide is concentrated along veins filled with iron hydroxide, with alteration of metal and sulfide across the thin section being roughly 25-30%.
Geochemistry: Mineral compositions and geochemistry: Olivine and pyroxene grains are equilibrated: $Fa_{24.9\pm0.5}$, N=12; $Fs_{21.6\pm0.9}Wo_{1.6\pm0.2}$, N=10.
Classification: Ordinary chondrite (L6) based on chemistry and texture.
Specimens: *Cascadia* holds 36.3 g in ten pieces, in addition to a polished thin section and a mounted butt. The main mass is held by BBaecker: Bastien Baecker, Huntsville, AL.

Northwest Africa 12914 (NWA 12914)
(Northwest Africa)
Purchased: 22 Jan 2017
Classification: Ordinary chondrite (L6)
History: BBaecker purchased an NWA meteorite on Ebay on January 22, 2017, and donated pieces to *Cascadia* two weeks later.
Physical characteristics: *Cascadia* received two somewhat crumbly pieces lacking fusion crust. Samples are light gray with metal/sulfide bumps protruding from the silicates, with rust patches near opaques. One end of one piece is heavily weathered, and represents the stone's exterior.
Petrography: (M. Hutson, A. Ruzicka, R. Kostynick, *Cascadia*): The texture of the silicates in thin section is well-integrated; indistinct chondrules are barely visible. Plagioclase feldspar grains up to 120 microns across are present. Almost all of the metal in the section is concentrated in one long roughly ovoid patch (~1.3 × 0.7 mm). Abundant sulfide grains in section are all smaller (<= 0.6 mm) than the metal grain.
Geochemistry: Mineral compositions and geochemistry: Olivine and pyroxene grains are equilibrated: $Fa_{25.2\pm0.6}$, N=11; $Fs_{21.0\pm0.1}Wo_{1.5\pm0.3}$, N=12.
Classification: Ordinary chondrite (L6) based on chemistry and texture.

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Specimens: *Cascadia* holds 12.2 g in multiple fragments, in addition to a polished thin section. The main mass is held by BBaecker: Bastien Baecker, Huntsville, AL.

Northwest Africa 12915 (NWA 12915)
(Northwest Africa)
Purchased: 2019
Classification: Iron meteorite (ungrouped)
Physical characteristics: A single brownish mass. Cut surface reveals fresh metallic interior.
Petrography: Etching of a polished section reveals a plessitic octahedrite structure with finger plessite. One 100 µm × 1 mm polycristalline troilite grain is visible on the studied 1.5 cm2 section.
Geochemistry: (J.T. Wasson, *UCLA*): INAA data, Ni = 203, Co = 4.72 (both mg/g), Cu = 1090, Ga = 1.2, As = 15.8, W= 0.12, Re <28, Ir = 0.26, Pt = 2.07, Au = 2.91 (all µg/g). The Cu content is unusually high.
Classification: Iron, ungrouped. Ungrouped designation based on composition; no close compositional relatives among 105 other ungrouped irons.
Specimens: Type specimen (33.7 g) at *CEREGE*. Main mass with Albert Jambon.

Northwest Africa 12916 (NWA 12916)
(Northwest Africa)
Purchased: 2019 Mar
Classification: Iron meteorite (ungrouped)
Physical characteristics: A single brownish mass. Cut surface reveals fresh metallic interior.
Petrography: Etching of a polished section reveals a finely recrystalized coarse octahedrite structure with grain size about 10 µm. Remnants of swathing kamacite bands are visible.
Geochemistry: (J.T. Wasson, *UCLA*): INAA data, Ni = 108, Co = 5.19 (both mg/g), Cu = 45, Ga = 4.8, As = 2.57, W= 1.63, Re = 844, Ir = 6.95, Pt = 13.55, Au = 0.48 (all µg/g).
Classification: Iron, ungrouped. Ungrouped designation based on composition; no close compositional relatives among 105 other ungrouped irons.
Specimens: Type specimen (55 g) at *CEREGE*. Main mass with Albert Jambon.

Northwest Africa 12917 (NWA 12917)
(Northwest Africa)
Purchased: 19 mar 2019
Classification: Carbonaceous chondrite (CM2)
History: Purchased by Carlos Muñecas in 19 mar 2019 from a nomad in Guelmin, Morocco

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Physical characteristics: Almost black individuals partly covered with fusion crust. Friable.
Petrography: Porous aggregate of chondrules with an apparent diameter of 0.2-2 mm (N=11) and often surrounded by fine-grained accretionary rims plus tiny mafic silicate grains (olivine and pyroxene) occur in an extremely fine-grained black matrix containing magnetite, sulfides and phyllosilicates (75-80 vol% by point counting).
Geochemistry: Mineral compositions and geochemistry: Mean values of defocused matrix analyses (all wt%; N=10): SiO_2: 28.1, TiO_2: 0.12; Na_2O: 0.09; Cr_2O_3: 0.63, MgO: 18.2, MnO: 0.16, CaO: 0.15, FeO: 22.6, Al_2O_3: 1.98, NiO: 0.82, P_2O_5: 0.02, S: 0.65, Total: 73.5. Olivine $Fa_{1.2-45.4}$, Cr_2O_3=0.22-0.49 (N=8). Low-Ca pyroxene $Fs_{0.9-6.7}Wo_{3.0-4.3}$ (N=4).
Classification: Carbonaceous chondrite (CM2)

Northwest Africa 12918 (NWA 12918)
(Northwest Africa)
Purchased: 19 mar 2019
Classification: HED achondrite (Diogenite)
History: Purchased by Carlos Muñecas and Adrian Contreras on 19 Mar 2019 from a dealer in Guelmin, Morocco.
Physical characteristics: Partially covered by a black fusion crust.
Petrography: The specimen shows a cataclastic texture with large crystal fragments in a matrix of finer grains of the same minerals. Predominantly orthopyroxene accompanied by accessory olivine, clinopyroxene, anorthite, chromite, Ni-poor metal and troilite.
Geochemistry: Mineral compositions and geochemistry: Orthopyroxene $Fs_{24.6-25.7}Wo_{3.1-4.0}$, FeO/MnO=28-34; clinopyroxene $Fs_{10.2-11.1}Wo_{42.9-43.8}$, FeO/MnO=20-22; olivine $Fa_{25.8-27.6}$, FeO/MnO=49-50; plagioclase $An_{77.7-90.9}$.
Classification: Diogenite

Northwest Africa 12919 (NWA 12919)
Morocco
Purchased: June 2019
Classification: Martian meteorite (Shergottite)
History: Purchased in July 2019 from Abdellah Afiniss via the internet.
Physical characteristics: The main mass is a 7.5 g irregular, ellipsoidal, green-gray stone with no fusion crust.
Petrography: (C. Herd and A. Sheen, *UAb*) Medium-grained basaltic assemblage of pyroxene (~60 vol.%) and maskelynite (~30 vol.%), plus minor titanomagnetite, ilmenite, merrillite, chlorapatite, and Fe-sulfides, and trace olivine, glassy mesostasis, and baddeleyite. Pyroxene grains range between 200 µm to 800 µm in length and consist of augite cores with pigeonite rims. Maskelynite grains are up to 1.2 mm in length.

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Geochemistry: (C. Herd and A. Sheen, *UAb*) Pyroxene displays two distinct compositional trends: pigeonite ($Fs_{45}En_{41}Wo_{13}$-$Fs_{72}En_{15}Wo_{13}$, average $Fs_{63}En_{23}Wo_{14}$, FeO/MnO=37; n=85) and augite ($Fs_{26}En_{33}Wo_{40}$-$Fs_{54}En_{17}Wo_{29}$, average $Fs_{38}En_{29}Wo_{33}$, FeO/MnO=32; n=83). Pigeonite adjacent to late-stage melt pockets has Fe-rich compositions reaching $Fs_{76}En_{10}Wo_{14}$. Maskelynite is $Ab_{43-57}An_{40-56}Or_{1-4}$ (n=21). Olivine grains (n=3) are highly fayalitic (Fa_{88-93}; FeO/MnO=58-65) and associated with mesostasis.
Classification: Martian (shergottite)
Specimens: Entire specimen of 7.5 g, including one thin section, at *UAb*.

Northwest Africa 12920 (NWA 12920)
(Northwest Africa)
Purchased: 2018
Classification: Ordinary chondrite (L6)
History: Thierry Simard purchased a 10 kg stone in November of 2018 from a meteorite dealer in Rissani, Morocco.
Physical characteristics: The sample is coated in a dark-brown fusion crust that contains broad shallow regmaglypts, contraction cracks, and some weak flow lines. The cut face shows a mottled orangish-brown interior with a single, large, sulfide-rimmed chondrule set within a recrystallized matrix of silicates, metal, and sulfide.
Petrography: Description and classification (A. Love, *App*) Sample is a recrystallized chondrite containing a 9 mm diameter olivine macro-chondrule and several other indistinct chondrules. Additional minerals are troilite, chromite merrillite, kamacite and taenite.
Geochemistry: (A. Love, *App*): Olivine ($Fa_{24.1\pm0.2}$, Fe/Mn=44.1±0.7, n=10); low Ca pyroxene ($Fs_{21.0\pm0.1}Wo_{1.8\pm0.1}$, Fe/Mn=27.2±0.4, n=10).
Classification: Ordinary chondrite (L6, C-S3, W1). L chondrite based on olivine and pyroxene compositions and magnetic susceptibility. Type 6 based on texture and equilibrated compositions of silicates.
Specimens: Thierry Simard holds the main mass. A slice and fragments weighing 27.34 g, a polished thin section and mount are on deposit at *App*.

Northwest Africa 12921 (NWA 12921)
(Northwest Africa)
Purchased: 2018
Classification: Ordinary chondrite (LL7)
History: Marc Jost purchased the 566 g stone from Giorgio Tomellieri at the St. Marie aux Mines show in 2018.
Physical characteristics: The rounded sample has a weathered brown exterior. A cut face shows the interior is light green in color and has a crystalline texture with visible flakes of metal and sulfide.
Petrography: Description and classification (A. Love, *App*): Sample has a fine-grained, poikiloblastic texture composed of: 60 vol% Ol; 25 vol% Ca-poor and Ca-

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rich pyroxene and 14 vol% albitic plagioclase (avg length 112µm, n=53). Additional minerals are: troilite; pentlandite; chromite (average length 79µm, n=31); merrillite; kamacite and taenite. Recrystallization has overprinted and erased primary chondritic texture.

Geochemistry: (A. Love, *App*): Olivine ($Fa_{31.6\pm0.1}$, Fe/Mn=57.2±1.1, n=12); low Ca pyroxene ($Fs_{26.1\pm0.2}Wo_{2.7\pm0.4}$, CaO=1.1-1.7, n=6); high Ca pyroxene ($Fs_{12.1\pm0.3}Wo_{41.7\pm0.7}$, n=6); plagioclase ($An_{10.9\pm0.1}Or_{5.9\pm0.2}$, n=2).Oxygen isotopes (K. Ziegler, *UNM*): analyses of 3 acid-washed mineral separates by laser fluorination gave, respectively, $\delta^{17}O$ = 4.373, 4.214, 4.199; $\delta^{18}O$ = 5.787, 5.526, 5.472; $\Delta^{17}O$ = 1.318, 1.297, 1.310 (data are linearized all per mil).

Classification: Ordinary Chondrite (LL7 C-S2 W1). LL based on oxygen isotopic composition, olivine and pyroxene compositions and magnetic susceptibility. Type 7 based on recrystallized poikiloblastic texture, equilibrated compositions, CaO content of low and high-Ca pyroxenes and size of plagioclase.

Specimens: Marc Jost (*SJS*) holds the main mass. 2 slices weighing 35.4 g, a polished mount and a polished thin section are on deposit at *App*.

Northwest Africa 12922 (NWA 12922)

(Northwest Africa)

Purchased: 2019

Classification: Carbonaceous chondrite (CK6)

History: A single stone weighing 20.3 g was found in Western Sahara prior to 2019. The sample was purchased by John Sinclair and J. Donald Cline at the Tucson Gem and Mineral show in 2019.

Physical characteristics: Sample is dark grayish-black in color, and has a weakly tabular shape. The sample is partially covered in a weathered black fusion crust with contraction cracks. A cut face shows the interior is composed of a dark brownish assemblage of rounded chondrules set within a dark matrix.

Petrography: Description and classification (A. Love, *App*): Sample shows a recrystallized chondritic texture composed of indistinct chondrules set within a recrystallized, olivine-dominated, opaque-rich matrix. Porphyritic and granular olivine chondrules have an average diameter of 672 µm Additional minerals are: low-Ca pyroxene, pigeonite, Ca-pyroxene, Cr-bearing magnetite, zoned plagioclase feldspar, rare troilite and rare alkali feldspar.

Geochemistry: (A. Love, *App*): Olivine ($Fa_{30.5\pm0.3}$, Fe/Mn=93.1±2.6, NiO=0.4±0.0, n=10); low Ca pyroxene ($Fs_{26.7\pm1.4}Wo_{1.7\pm1.6}$ ($Fs_{24.5-3.2}Wo_{0.5-4.8}$), Fe/Mn=61.9±4.2, n=6); pigeonite ($Fs_{22.1\pm0.7}Wo_{12.9\pm2.7}$ ($Fs_{21.3-22.7}Wo_{9.8-14.8}$), Fe/Mn=58.2±2.2, n=3); Ca pyroxene ($Fs_{10.6}Wo_{42.1}$, n=1); plagioclase: ($An_{43.9\pm10.4}Or_{3.2\pm2.2}$, n=5); Cr-Magnetite contains 4.2Wt% Cr_2O_3.

Classification: Carbonaceous Chondrite (CK6 C-S2 W3). Chondrule size, magnetic susceptibility, Cr-bearing magnetite and Fe/Mn of olivine and pyroxene are consistent with CK. Equilibrated compositions of olivine, indistinct, yet visible chondrules and size of plagioclase grains (>100µm) characterize this sample as CK6.

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Specimens: *PARI* holds the main mass. A polished thin section and endcut weighing 4.1 g are on deposit at *App*.

Northwest Africa 12923 (NWA 12923)
Niger
Purchased: 2017
Classification: Ordinary chondrite (H5, melt breccia)
History: Wang Chen and Ziyao Wang purchased many individual specimens totaling 3.4 kg and 2 kg respectively from a Moroccan meteorite dealer during the 2017 *Beijing* International Mineral, Gem & Fossil Show.
Petrography: (C. Herd, *UAb*) Examination of two ~2 × 4 cm sequential slices and a ~1.5 × 2.5 cm slice (later used to make the thin section) shows dark-gray rounded clasts containing metal and silicates with some microporosity, surrounded by lighter-gray microcrystalline domains which often have vein-like morphology relative to the clasts. Metal grains in the clasts are mostly <0.5 mm, but locally up to 5 mm in longest dimension. At thin section scale, the clasts consist of poorly-delineated chondrules, metal and sulfides in a typical equilibrated ordinary chondrite texture. Microcrystalline domains are glassy in places under optical microscopy. Under the electron microprobe, these domains consist of ~150 µm scale rounded sulfide blebs, and clasts of olivine and low-Ca pyroxene set in a fine-grained matrix of olivine and feldspathic glass; these are likely shock melt veins. Other shock effects include strong mosaicism in olivine.
Geochemistry: (C. Herd and L. Tunney, *UAb*) Data obtained by EMP examination of carbon-coated thin section: Clast Olivine $Fa_{18.7 \pm 0.3}$ (n=10); vein olivine $Fa_{18.3\pm0.1}$ (n=3). Low-Ca Pyroxene in clasts $Fs_{16.4\pm0.4}$, $Wo_{1.7\pm0.1}$ (n=9); vein pyroxene $Fs_{16.1}$, $Wo_{1.7}$ (n=1). Clast Feldspar $Or_{3.1}Ab_{75}$ (n=1).
Classification: Ordinary chondrite, H5-melt breccia. Likely paired with Tassedet 004.
Specimens: Type specimen of 21.1 g, including one thin section, at *UAb*. Many stones totaling 3.4 kg with Wang Chen, 2 kg with Ziyao Wang.

Northwest Africa 12924 (NWA 12924)
Niger
Purchased: January 2018
Classification: Ordinary chondrite (H5, melt breccia)
History: Mendy Ouzillou and Dustin Dickens purchased a single 5.7 kg stone directly from a dealer in Laayoune, Morocco in January 2018.
Petrography: (C. Herd, *UAb*) Examination of a ~3 × 4.5 cm slice and a ~1 × 2 cm slice (later used to make the thin section) shows dark-gray rounded clasts containing metal and silicates with some microporosity, surrounded by lighter-gray microcrystalline domains which often have vein-like morphology relative to the clasts. Metal grains in the clasts are mostly <0.5 mm, but locally up to 8 mm in longest dimension. At thin section scale, the clasts consist of poorly delineated

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chondrules, metal and sulfides in a typical equilibrated ordinary chondrite texture. Microcrystalline domains are glassy in places, and contain fragments of the larger clasts; these are likely shock melt veins. Other shock effects include strong mosaicism in olivine.
Geochemistry: (C. Herd and L. Tunney, *UAb*) Data obtained by EMP examination of carbon-coated thin section, grey clasts only: Olivine $Fa_{18.8\pm0.4}$ (n=8); Low-Ca Pyroxene $Fs_{16.3\pm0.2}$, $Wo_{1.3\pm0.2}$ (n=5); Feldspar $Or_{2.5}Ab_{81}$ (n=1).
Classification: Ordinary chondrite, H5-melt breccia. Likely paired with Tassedet 004.
Specimens: Type specimen of 20.1 g, including one thin section, at *UAb*. Mendy Ouzillou 2.85 kg, Dustin Dickens 2.85 kg.

Northwest Africa 12925 (NWA 12925)
(Northwest Africa)
Purchased: 2018
Classification: Carbonaceous chondrite (CK5)
History: Purchased Dec. 2018 by Dustin Dickens in Morocco from anonymous dealer.
Physical characteristics: Dark, fusion crusted exterior, saw cut and broken surfaces reveal a very dark gray interior, some scattered CAIs visible, a few large (>1mm) chondrules are present. Friable.
Petrography: (C. Agee, *UNM*) This meteorite consists numerous texturally equilibrated chondrules, ubiquitous Cr-bearing magnetite and pentlandite. Olivine is nickel-bearing. Matrix appears to be recrystallized with some fine-grained plagioclase.
Geochemistry: (C. Agee, *UNM*) Olivine $Fa_{30\pm0.8}$, Fe/Mn=102±8, NiO=0.48±0.05 (wt%), n=20; low-Ca pyroxene $Fs_{26.8\pm0.9}Wo_{1.2\pm1.3}$, Fe/Mn=68±7, n=6; clinopyroxene $Fs_{13.8\pm4.4}Wo_{34.9\pm11.9}$, Fe/Mn=58±7, n=6. Oxygen isotopes (K. Ziegler, *UNM*): 3 acid-washed fragments analyzed by laser fluorination gave $\delta^{18}O$= 1.584, 1.005, 1.067; $\delta^{17}O$= -3.141,-3.415, -3.581; $\Delta^{17}O$= 3.242, 2.808, 2.958 (linearized, all per mil, TFL slope=0.528).
Classification: Carbonaceous chondrite CK5.
Specimens: 20.5 g including a probe mount on deposit at *UNM*, Dustin Dickens holds the main mass.

Northwest Africa 12926 (NWA 12926)
(Northwest Africa)
Purchased: 2018
Classification: Ordinary chondrite (H7)
History: Purchased by Mustapha Oulkouch in Morocco from anonymous dealer and sent to Dustin Dickens for classification.

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Physical characteristics: Single stone with brown, desert weathered, exterior. Saw cut reveals polygonal texture of dark colored silicates and opaques, significant oxidation present.
Petrography: (C. Agee, *UNM*) This meteorite has an intergranular texture of olivine and pyroxene, with grain size 50-500 µm, plagioclase grain size up to 100 µm. Oxidized metal and sulfide, numerous oxide veinlets present. No chondrules observed.
Geochemistry: (C. Agee, *UNM*) Olivine $Fa_{18.5\pm0.2}$, Fe/Mn=38±2, n=6; low-Ca pyroxene $Fs_{16.6\pm0.1}Wo_{3.6\pm0.3}$, Fe/Mn=23±1, n=6; plagioclase $Ab_{82.6\pm1.4}$, n=4.
Classification: Ordinary chondrite H7. Type 7 based on absence of chondrules, presence of plagioclase, relatively high wollastonite content of orthopyroxene.
Specimens: 8 g including a probe mount on deposit at *UNM*, Dustin Dickens holds the main mass.

Northwest Africa 12927 (NWA 12927)
(Northwest Africa)
Purchased: 2016
Classification: HED achondrite (Diogenite)
History: Purchased Nov 2016 by Dustin Dickens in Mauritania from anonymous dealer.
Physical characteristics: Single stone with desert weathered exterior. Saw cut and broken surfaces reveal relatively coarse grained texture of dark brown grains set in a yellow-brown groundmass.
Petrography: (C. Agee, *UNM*) This meteorite is an equilibrated orthopyroxenite with ~95% pyroxene, and minor amounts of augite, chromite and iron-oxide. No olivine or plagioclase were detected.
Geochemistry: (C. Agee, *UNM*) Low-Ca pyroxene $Fs_{27.3\pm0.6}Wo_{3.6\pm1.0}$, Fe/Mn=27±0, n=5.
Classification: Diogenite
Specimens: 22 g including a probe mount on deposit at *UNM*, Dustin Dickens holds the main mass.

Northwest Africa 12928 (NWA 12928)
(Northwest Africa)
Purchased: 2016
Classification: HED achondrite (Eucrite, monomict)
History: Purchased Nov 2016 by Dustin Dickens in Mauritania from anonymous dealer.
Physical characteristics: Single stone, fusion crusted exterior, saw cut reveals a fragmental breccia of lithic clasts set in a light colored, fine-grained groundmass.
Petrography: (C. Agee, *UNM*) Microprobe examination of a polished mount shows approximately 60% pyroxene and 35% plagioclase. Many pyroxenes have exsolution lamellae. Minor silica and troilite observed.

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Geochemistry: (C. Agee, *UNM*) Low-Ca pyroxene $Fs_{53.4\pm4.6}Wo_{2.5\pm1.1}$, Fe/Mn=33±1, n=10; high-Ca pyroxene $Fs_{37.6\pm17.0}Wo_{28.8\pm21.7}$, Fe/Mn=31±2, n=2; plagioclase $An_{80.5\pm12.3}$, n=6.
Classification: Monomict basaltic eucrite, equilibrated.
Specimens: 20.9 g including a probe mount on deposit at *UNM*, Dustin Dickens holds the main mass.

Northwest Africa 12929 (NWA 12929)
(Northwest Africa)
Purchased: 2016
Classification: HED achondrite (Eucrite, monomict)
History: Purchased Dec. 2018 by Dustin Dickens in Morocco from anonymous dealer.
Physical characteristics: Many identically appearing pieces, desert weathered exterior, broken surface reveals a dark, fine grained interior.
Petrography: (C. Agee, *UNM*) Microprobe examination of a polished mount shows mild brecciation with approximately 60% pyroxene and 35% plagioclase. Many pyroxenes have exsolution lamellae. Minor silica and troilite observed. Shock melt veins are present.
Geochemistry: (C. Agee, *UNM*) Low-Ca pyroxene $Fs_{61.6\pm1.8}Wo_{3.3\pm2.4}$, Fe/Mn=32±0, n=9; high-Ca pyroxene $Fs_{36.7\pm9.5}Wo_{33.4\pm10.9}$, Fe/Mn=31±0, n=4; plagioclase $An_{89.4\pm3.1}$, n=7.
Classification: Monomict basaltic eucrite, equilibrated.

Northwest Africa 12930 (NWA 12930)
(Northwest Africa)
Purchased: 2018
Classification: Carbonaceous chondrite (CO3.0)
History: Purchased Dec. 2018 by Dustin Dickens in Morocco from anonymous dealer.
Physical characteristics: Many small, identically appearing pieces. Most pieces are fragmented with partial fresh fusion crust. Broken surfaces are very dark colored with many small chondrules. Scattered, small CAIs are visible throughout.
Petrography: (C. Agee, *UNM*) Microprobe examination of a polished mount shows numerous small chondrules, opaque matrix makes up approximately 40% of this meteorite. Mean apparent chondrule diameter 150±75 µm, n=27.
Geochemistry: (C. Agee, *UNM*) Olivine $Fa_{8.0\pm14.4}$, Cr_2O_3=0.36±0.13 (wt%), n=22; low-Ca pyroxene $Fs_{2.3\pm1.2}Wo_{3.4\pm0.5}$, n=9.
Classification: Carbonaceous chondrite (CO3.0), 3.0 based on the Cr_2O_3 content and 1-sigma in olivine (Grossman and Brearley, 2005).
Specimens: 8.5 g including a probe mount on deposit at *UNM*, Dustin Dickens holds the main mass.

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Northwest Africa 12931 (NWA 12931)
(Northwest Africa)
Purchased: 2016
Classification: HED achondrite (Diogenite)
History: Purchased Nov 2016 by Dustin Dickens in Mauritania from anonymous dealer.
Physical characteristics: Single stone with desert weathered exterior. Saw cut and broken surfaces reveal a light-colored interior. Friable.
Petrography: (C. Agee, *UNM*) This meteorite is an equilibrated orthopyroxenite with ~95% pyroxene, and minor amounts of silica, chromite and troilite. No olivine or plagioclase were detected.
Geochemistry: (C. Agee, *UNM*) Low-Ca pyroxene $Fs_{27.5\pm0.3}Wo_{3.6\pm0.3}$, Fe/Mn=26±1, n=12.
Classification: Diogenite
Specimens: 21.6 g including a probe mount on deposit at *UNM*, Dustin Dickens holds the main mass.

Northwest Africa 12932 (NWA 12932)
(Northwest Africa)
Purchased: 2016
Classification: HED achondrite (Eucrite, unbrecciated)
History: Purchased Nov 2016 by Dustin Dickens in Mauritania from anonymous dealer.
Physical characteristics: Single stone, fusion-crusted exterior, broken surface and saw cut reveals a light colored, fine-grained mix of plagioclase and pyroxene grains.
Petrography: (C. Agee, *UNM*) Microprobe examination of a polished mount shows an ophitic texture with approximately 60% pyroxene and 35% plagioclase. Many pyroxenes have exsolution lamellae. Minor silica and troilite observed.
Geochemistry: (C. Agee, *UNM*) Low-Ca pyroxene $Fs_{61.9\pm0.6}Wo_{2.8\pm1.1}$, Fe/Mn=31±1, n=8; high-Ca pyroxene $Fs_{28.2\pm2.1}Wo_{43.2\pm2.3}$, Fe/Mn=31±1, n=4; plagioclase $An_{86.7\pm4.1}$, n=6.
Classification: Basaltic eucrite, equilibrated, unbrecciated.
Specimens: 20.6 g including a probe mount on deposit at *UNM*, Dustin Dickens holds the main mass.

Northwest Africa 12933 (NWA 12933)
(Northwest Africa)
Purchased: May 2017
Classification: HED achondrite (Eucrite)
Petrography: The meteorite belongs to a breccia with a doleritic texture.The dominant mineral of the meteorite is plagioclase and pyroxene (up to 2.2 mm).

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Accessory ilmenite and troilite can be observed. Exsolution of the high calcium pyroxene from the low calcium proxene can be also observed.
Geochemistry: Low-Ca pyroxene $Fs_{59.5\pm1.4}$, $Wo_{3.5\pm1.1}$, n=7, FeO/MnO=34.4±3.2, n=8; High-Ca pyroxene $Fs_{26.2\pm2.2}$, $Wo_{45.0\pm2.2}$, n=7; Plagioclase $An_{88.8\pm3.3}$, n=9 (EDAX).

Northwest Africa 12934 (NWA 12934)
(Northwest Africa)
Purchased: Oct 2018
Classification: Angrite
Petrography: The meteorite mainly consists of irregular plagioclase (28 vol%, grain size 0.24 mm), olivine (31 vol%, grain size 0.96 mm) and pyroxene (41vol%, grain size 0.54 mm) and show a diabasic texture. Accessory troilite and ilmenite can be observed.
Geochemistry: Olivine $Fa_{40.1-42.7}$, CaO content is 1.09 wt% , FeO/MnO=73.4-98.7, N=18; Pyroxene $Fs_{7.7-11.7}$, $Wo_{52.8-56.4}$, Al_2O_3 content is 7.08 wt%; TiO_2 content is 1.34 wt%, FeO/MnO=55.1-193.2, N=8; Plagioclase $An_{99.2-99.8}$ (EPMA).

Northwest Africa 12935 (NWA 12935)
(Northwest Africa)
Purchased: Aug 2013
Classification: Ordinary chondrite (L6)
History: John Shea purchased an NWA sample from meteorite dealer Mirko Graul in August 2013.
Physical characteristics: An end piece of the meteorite has a dark brown fusion crust on external surfaces. The cut face is medium brown and crossed by darker veins.
Petrography: (M. Hutson, A. Ruzicka, B. Rapozo, *Cascadia*): In transmitted light, the sample is broken into clasts separated by opaque veins. The texture of the silicates in thin section is well-integrated; indistinct chondrules are barely visible. Plagioclase feldspar has been converted to maskylenite. Shock veins containing droplets of metal and sulfide cross the section. Approximately 40-50% of the metal and sulfide have been replaced by iron hydroxide weathering product.
Geochemistry: Mineral compositions and geochemistry: Olivine and pyroxene grains are equilibrated: $Fa_{24.7\pm0.4}$, N=23; $Fs_{20.8\pm0.1}$ $Wo_{1.2\pm0.1}$, N=9.
Classification: Ordinary chondrite (L6) based on chemistry and texture.
Specimens: *Cascadia* holds 31.3 g in two pieces, in addition to a polished thin section and a mounted butt. The main mass is held by Shea: John A. Shea, Wallingford PA.

Northwest Africa 12936 (NWA 12936)
(Northwest Africa)

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Purchased: Nov 2013
Classification: Ordinary chondrite (L6)

History: John Shea purchased an NWA sample from meteorite dealer Greg Catterton in November 2013.

Physical characteristics: An end piece of the meteorite has a dark brown fusion crust on most external surfaces; one side is orange due to weathering. Most of the cut face is medium brown, with a light-colored clast 2.5 × 0.5 cm in exposed area.

Petrography: (M. Hutson, A. Ruzicka, B. Rapozo, *Cascadia*): In transmitted light, the sample is broken into clasts separated by thin opaque veins. The texture of the silicates in thin section is well-integrated; indistinct chondrules are barely visible. Plagioclase feldspar has been converted to maskylenite. Thin web-like shock veins composed of sulfide cross the section. Approximately 20-30% of the metal and sulfide have been replaced by iron hydroxide weathering product.

Geochemistry: Mineral compositions and geochemistry: Olivine and pyroxene grains are equilibrated: $Fa_{24.8\pm0.3}$, N=14; $Fs_{21.0\pm0.2}$ $Wo_{1.4\pm0.1}$, N=15.

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

Specimens: *Cascadia* holds 131.4 g in five pieces, in addition to a polished thin section and a mounted butt. The main mass is held by Shea: John A. Shea, Wallingford PA

Northwest Africa 12937 (NWA 12937)
(Northwest Africa)
Purchased: 3 Feb 2019
Classification: HED achondrite (Eucrite)

History: *Cascadia* purchased an NWA sample from Sidi Mohamed Ismaily at the Tucson GEM show on February 3, 2019

Physical characteristics: No remnant fusion crust is visible on the exterior. Most of the exterior is covered by a dark brown weathering rind; one surface has a lighter rusty brown matte surface. A few dark ridges stick up from the background, and one waxy grain of feldspar (5 mm × 7 mm) is visible on the weathered surface. Most of the cut faces appear dark gray, fine-grained, and featureless in hand specimen, with the exception of a thin (1-5 mm) rim of coarser-grained material (white and brown grains) near the surface.

Petrography: (M. Hutson, A. Ruzicka, *Cascadia*): In thin section, sample is a breccia with clast textures ranging from hypidiomorphic to subophitic. Most clasts are fine-grained, with a coarse-grained clast visible on the edge of the section. Clasts are separated by a dark fine-grained matrix. Both pyroxene and plagioclase grains appear partially recrystallized in cross-polarized light, with patches of remnant twinning in many pyroxene grains and only a few of the largest feldspar grains. Feldspar is crystalline. The sample is moderately weathered with small calcite veins cutting across the section. In BSE imaging, feldspar grains contain numerous inclusions, which are concentrated on the outer margins of the larger grains. Pyroxene grains are heavily fractured. Remnant areas of twinned augite and low-Ca pyroxene, are offset by microfaults, and grade into mottled regions defined by a

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subtle core-rim structure. In some areas pigeonite rims surround low-Ca pyroxene cores, in other areas rims of low-Ca pyroxene surround pigeonite cores. The mottled regions are roughly 5-25 microns across, the same size as the fine-scale recrystallization seen in optical microscopy. Areas between clasts contain melt veins that cut across silicates. Phases present include pyroxene, feldspar, chromite, ilmenite, and silica polymorph

Geochemistry: Mineral compositions and geochemistry: (M. Hutson, A. Ruzicka, *Cascadia*; K. Ziegler, *UNM*). Despite textural variation, the low-Ca pyroxene ($Fs_{63.3\pm1.0}Wo_{2.5\pm0.5}$, N=14), augite ($Fs_{27.8\pm0.7}Wo_{43.6\pm0.7}$, N=14), and feldspar ($An_{89.9\pm0.9}Or_{0.5\pm0.2}$, N=13) grains are equilibrated. Intermediate composition pyroxenes form a mixing line between augite and low-Ca pyroxene, with a well-defined cluster in the pigeonite field ($Fs_{59.6\pm1.4}Wo_{6.1\pm1.8}$, N=12). Oxygen data (mean and standard deviation, all in per mil and linearized): $\delta^{17}O$=1.770±0.077, $\delta^{18}O$=3.855±0.140, and $\Delta^{17}O$=-0.266±0.012 (N=3).

Classification: Achondrite (eucrite) based on chemistry, texture, and oxygen isotope composition.

Specimens: *Cascadia* holds the main mass in one large piece (463.2 g) and several fragments, with a total mass of 471.9 g, in addition to a polished thin section and a mounted butt.

Northwest Africa 12938 (NWA 12938)

(Northwest Africa)

Purchased: 12 Mar 2019

Classification: HED achondrite (Eucrite)

History: Dr. Richard Palin of the Colorado School of Mines purchased a single stone in March 2019 from a dealer on ebay (identified as matt992011). On the ebay listing, the seller says that he purchased a NWA, unclassified, probable HED from a Moroccan dealer, three years before the 2019 listing. Dr. Palin sent images of the hand specimen, a type specimen, and preliminary EMP data to *Cascadia* asking for confirmation that the sample was an HED, and for aid in classification.

Physical characteristics: *Cascadia* received an end piece covered with a dark brown desert varnish. The cut face shows intermingled lighter and darker gray patches with small crystals visible in the lighter patches. Photographs of the entire specimen shows patches of remnant fusion crust surrounding uncoated euhedral to subhedral feldspar grains of varying size and abundance.

Petrography: (M. Hutson, A. Ruzicka, *Cascadia*; R. Palin, CSM): The thin section shows two lithologies, with a sharp (breccia) contact between. One is coarser-grained with a cumulate texture, and the other finer-grained with a subophitic to intergranular texture. Phases present include pyroxene, feldspar, chromite, ilmenite, zircon, a calcium phosphate, and silica polymorph, and terrestrial calcite fills fractures. The cumulate clast contains inclusion-filled feldspars up to 1 mm in length. Feldspar grains in the finer-grained clast are always less than 400 microns long, with most less than 200 microns in length. In both clasts, in cross-polarized light, many of the smaller feldspar grains are isotropic; the larger grains contain remnant twins, with

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patches that are isotropic. Pyroxene grains are heavily fractured and stained brown, with darker staining near the edge of the sample. In BSE, pyroxene grains show remnant twinning grading into untwinned regions. Twins are often offset by one to several microfaults. A small melt region occurs at the contact between the two clasts and is rich in a silica polymorph. A vein dominated by silica polymorph originates in this melt region and cuts across the finer-grained clast; small areas of whole-rock melt occur along this vein.

Geochemistry: Mineral compositions and geochemistry: (M. Hutson, A. Ruzicka, *Cascadia*; K. Ziegler, *UNM*). Despite textural variation, the low-Ca pyroxene ($Fs_{60.3\pm0.8}Wo_{2.3\pm0.4}$, N=27), augite ($Fs_{25.7\pm0.5}Wo_{43.7\pm0.3}$, N=13) and feldspar ($An_{84.9\pm1.}Or<1$, N=49) grains are equilibrated. Chromite Cr# = 84.1±1.7 (N=5). Oxygen data (mean and standard deviation, all in per mil and linearized): $\delta^{17}O$=1.745±0.128, $\delta^{18}O$=3.795±0.209, and $\Delta^{17}O$=-0.259±0.019 (N=3).

Classification: Achondrite (eucrite) based on chemistry, texture, and oxygen isotope composition. The sample is brecciated, but the minerals have the same chemical composition, so this appears to be a genomict breccia.

Specimens: *Cascadia* holds 14.4 g in two pieces, in addition to a polished thin section and a mounted butt. Dr. Richard Palin of the Colorado School of Mines holds the main mass.

Northwest Africa 12939 (NWA 12939)

Morocco

Purchased: 2013

Classification: Ureilite

History: Purchased from A. *Aaronson* by D. *DGregory* in Tuscon, Arizona, who provided origin as Morocco. Type specimen is catalogued at the *ROM* as M58175.

Physical characteristics: The sample is covered by a weathered fusion crust, with one face particularly rusted.

Petrography: The sample is composed of medium to coarse-grained silicates meeting at triple junction boundaries. Modal abundances are approximately 70% olivine, 26% low-Ca pyroxene, and 4% interstitial material, including carbon. Raman analysis confirms the presence of both graphite and diamond. Olivine grains range up to 1.9 mm and exhibit little to no reduction textures and have planar fractures, undulatory extinction, and moderate mosaicism. Low-Ca pyroxene grains range up to 1.1 mm and exhibit twinning and undulatory extinction. Weathering products are common within fractures and along grain boundaries

Geochemistry: Mineral compositions and geochemistry: EPMA quantitative WDS: Olivine cores: $Fa_{13.4\pm0.3}$ (N=14), 0.28±0.02 wt% CaO, 0.51±0.03 wt% Cr_2O_3, and 0.54±0.02 wt% MnO. Pyroxene cores: $Fs_{12.3\pm0.4}Wo_{4.8\pm0.4}$ (N = 13), 2.46 ± 0.14 wt% CaO, 1.02 ± 0.05 wt% Cr_2O_3, 0.52 ± 0.03 wt% MnO. Oxygen isotopes (K. Ziegler, *UNM*): analyses of three acid-washed subsamples by laser flourination gave $\delta^{17}O$ = 3.191, 3.257, 3.504; $\delta^{18}O$ = 8.023, 8.185, 8.666; and $\Delta^{17}O$ = -1.045, -1.065, -1.072 (per mil).

Classification: Ureilite

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Northwest Africa 12945 (NWA 12945)
(Northwest Africa)
Purchased: 2019 Sep
Classification: Enstatite chondrite (EH6)

History: Purchased by Fabien *Kuntz* in September 2019 from a dealer in Zagora, Morocco.

Petrography: (A. Irving, *UWS* and P. Carpenter, *WUSL*) Recrystallized aggregate of enstatite and subordinate sodic feldspar with accessory altered kamacite, troilite (some Cr- and Mn-bearing), niningerite and schreibersite. No chondrules are apparent.

Geochemistry: Enstatite ($Fs_{1.3\pm0.8}Wo_{1.5\pm0.1}$ (range $Fs_{0.4\text{-}2.4}Wo_{1.4\text{-}1.6}$, N = 3), plagioclase ($Ab_{80.6\text{-}82.2}An_{14.0\text{-}14.6}Or_{3.8\text{-}4.7}$, N = 3), kamacite (Si = 2.6-3.3 wt.%).

Classification: Enstatite chondrite (EH6).

Specimens: 22.54 g including one polished thin section at *UWB*; remainder with *Kuntz*.

Northwest Africa 12946 (NWA 12946)
(Northwest Africa)
Purchased: 2019 Feb
Classification: HED achondrite (Eucrite, monomict)

History: Purchased by Darryl Pitt in February 2019 from a Mauritanian dealer.

Petrography: (A. Irving, *UWS* and P. Carpenter, *WUSL*) Breccia consisting of eucrite clasts with intersertal texture plus related crystalline debris in a sparse matrix. Minerals are exsolved pigeonite and calcic plagioclase together with accessory silica polymorph, ilmenite, Ti-chromite, troilite and rare Ca phosphate.

Geochemistry: Low-Ca pyroxene ($Fs_{61.2\text{-}62.2}Wo_{2.4\text{-}2.2}$, FeO/MnO = 31-33, N = 4), high-Ca pyroxene ($Fs_{26.8\text{-}28.1}Wo_{44.1\text{-}42.5}$, FeO/MnO = 31-34, N = 4), plagioclase ($An_{89.3\text{-}89.7}Or_{0.4}$, N = 2).

Classification: Eucrite (monomict breccia).

Specimens: 20.5 g including one polished thin section at *UWB*; remainder with *DPitt*.

Northwest Africa 12947 (NWA 12947)
(Northwest Africa)
Purchased: 2018 Oct
Classification: Ordinary chondrite (L3)

History: Purchased by Darryl Pitt in February 2019 from a Mauritanian dealer.

Petrography: (A. Irving, *UWS* and P. Carpenter, *WUSL*) Well-formed, closely packed chondrules (apparent diameter 780±340 µm, N = 24) are set in a sparse finer-grained matrix containing stained metal.

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Geochemistry: Olivine, $Fa_{25.3\pm4.3}$ (range $Fa_{20.1-31.5}$, N = 5); low-Ca pyroxene, $Fs_{13.6\pm12.6}Wo_{0.5\pm0.2}$ (range $Fs_{3.7-21.7}Wo_{0.2-0.8}$, N = 4). Magnetic susceptibility log χ ($\times 10^{-9}$ m^3/kg) = 4.67.
Classification: Ordinary chondrite (L3).
Specimens: 25.7 g including one polished thin section at *UWB*; remainder with *DPitt*.

Northwest Africa 12948 (NWA 12948)
(Northwest Africa)
Purchased: 2019 Feb
Classification: Carbonaceous chondrite (CV3)
History: Purchased by Darryl Pitt in February 2019 from a dealer in Tindouf, Algeria.
Petrography: (A. Irving, *UWS* and P. Carpenter, *WUSL*) Well-formed granular and PO chondrules (apparent diameter 1100±460 µm, N = 23) plus irregularly-shaped, very fine grained CAI are set in a fine grained matrix (~30 vol.%, orange-brown in thin section).
Geochemistry: Olivine in chondrules ($Fa_{11.0\pm12.4}$ (range $Fa_{0.4-41.9}$, N = 11), olivine in matrix ($Fa_{60.9\pm1.8}$, N = 2), low-Ca pyroxene ($Fs_{0.8\pm0.1}Wo_{4.4\pm4.2}$ (range $Fs_{0.7-0.9}Wo_{1.0-9.9}$, N = 4), Al-Ti diopside ($Fs_{1.6}Wo_{46.4}$, Al_2O_3 = 5.5 wt.%, TiO_2 = 5.1 wt.%), plagioclase ($An_{83.4-88.3}Or_{0.1}$, N = 2).
Classification: Carbonaceous chondrite (CV3).
Specimens: 20.2 g including one polished thin section at *UWB*; remainder with *DPitt*.

Northwest Africa 12949 (NWA 12949)
(Northwest Africa)
Purchased: 2019 May
Classification: Mesosiderite
History: Purchased in May 2019 by Craig Zlimen, Thomas Thiegs and Dr. Peter March from a dealer in Goulmima, Morocco.
Petrography: (A. Irving, *UWS* and P. Carpenter, *WUSL*) Aggregate (mean grainsize ~0.4 mm) of orthopyroxene, pigeonite, anorthite and ~ 40 vol.% metal (kamacite+taenite) with accessory augite, silica polymorph, Ti-chromite and troilite.
Geochemistry: Orthopyroxene (F18.0-23.5$Wo_{1.2-3.2}$, FeO/MnO = 28-33, N = 3), pigeonite ($Fs_{38.3-57.5}Wo_{4.4-7.0}$, FeO/MnO = 24-30, N = 4), augite ($Fs_{31.9-50.6}Wo_{39.0-42.1}$, FeO/MnO = 33-36, N = 2), plagioclase ($An_{90.5}Or_{0.3}$), kamacite (Ni = 4.9 wt.%), taenite (Ni = 26.5 wt.%).
Classification: Mesosiderite.
Specimens: 60.2 g in the form of a polished endcut at *UWB*; remainder held jointly by C. Zlimen, T. Thiegs and Dr. P. March.

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Northwest Africa 12950 (NWA 12950)
(Northwest Africa)
Purchased: 2016 Sep
Classification: Ordinary chondrite (LL4)

History: Purchased by Darryl Pitt in September 2016 from a Moroccan dealer at the Denver Show.

Petrography: (A. Irving, *UWS* and P. Carpenter, *WUSL*) Well-formed, closely packed equilibrated chondrules (apparent diameter 1100±550 µm, N = 22) are set in a sparse finer-grained matrix containing stained metal.

Geochemistry: Olivine, $Fa_{27.1\pm0.1}$ (range $Fa_{26.9\text{-}27.2}$, N = 5); low-Ca pyroxene, $Fs_{22.4\pm0.2}Wo_{1.7\pm0.2}$ (range $Fs_{22.2\text{-}22.8}Wo_{1.4\text{-}2.0}$, N = 5). Magnetic susceptibility log χ (× 10^{-9} m^3/kg) = 4.35.

Classification: Ordinary chondrite (LL4).

Specimens: 20.8 g including one polished thin section at *UWB*; remainder with *DPitt*.

Northwest Africa 12951 (NWA 12951)
(Northwest Africa)
Purchased: 2019 Aug
Classification: Primitive achondrite (Winonaite)

History: Three stones of similar size were purchased by Dr. Albert Jambon in August 2019 from a dealer in Nouakchott, Mauritania.

Physical characteristics: About 80% of the surface of each stone is wind ablated with prominent metal veins and wedges separating depressed silicate regions, but remnant regmaglypts can be discerned. Large exposed metal areas exhibit a visible Widmanstätten pattern as thin, shiny taenite bands separating millimetric kamacite with a greenish oxidized surface. The bottom (formerly buried) sides of the stones are covered with remnants of weathered fusion crust. Fine grained olivine and green pyroxene are observed in places where the crust is missing.

Petrography: (A. Irving, *UWS* and P. Carpenter, *WUSL*) Silicate-rich regions of the specimen have a metamorphic, triple grain junction texture (mean grainsize ~150 µm) and are composed of olivine, orthopyroxene, sodic plagioclase, kamacite, taenite and troilite. Cross-cutting metal-rich veins and patches are composed predominantly of kamacite and taenite.

Geochemistry: Olivine ($Fa_{1.1\text{-}1.3}$, FeO/MnO = 3-5, N = 5), orthopyroxene ($Fs_{6.5\text{-}6.9}Wo_{1.8\text{-}2.1}$, FeO/MnO = 9-10, N = 4), plagioclase ($An_{14.8\text{-}15.4}Or_{3.1\text{-}3.4}$, N = 2). Oxygen isotopes (K. Ziegler, *UNM*): analyses of acid-washed subsamples by laser fluorination gave, respectively, $\delta^{17}O$ 1.969, 2.049, 2.119; $\delta^{18}O$ 4.730, 4.887, 5.035; $\Delta^{17}O$ -0.528, -0.531, -0.540 per mil.

Classification: Winonaite (metal-veined).

Specimens: 33.3 g including one polished thin section at *UWB*; remainder with Dr. A. Jambon.

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Northwest Africa 12952 (NWA 12952)
(Northwest Africa)
Find: 2011
Classification: Lunar meteorite (feldspathic breccia)

History: Found in 2011 at an undisclosed desert location and purchased in 2018 by Luc *Labenne* from a dealer in Erfoud, Morocco. Subsequently the stone was acquired by Hermès, Paris.

Physical characteristics: Very fresh specimen with a glassy exterior coating. The interior exhibits numerous small clasts in a black matrix.

Petrography: (A. Irving, *UWS* and P. Carpenter, *WUSL*) Breccia composed of a variety of mineral clasts and rare fayalite-hedenbergite-silica symplectite clasts in a much finer grained crystalline matrix. Minerals are anorthitic plagioclase, subcalcic augite (zoned to ferropigeonite), olivine, chromite, augite with pigeonite exsolution lamellae, fayalite, hedenbergite, silica polymorph, ilmenite, troilite, zircon and baddeleyite.

Geochemistry: Olivine ($Fa_{34.1-49.9}$, FeO/MnO = 85-103, N = 7), subcalcic augite ($Fs_{24.0-39.8}Wo_{28.9-28.1}$, FeO/MnO = 48-65, N = 2), ferropigeonite ($Fs_{54.7-67.2}Wo_{20.9-23.0}$, FeO/MnO = 70-87, N = 2), pigeonite ($Fs_{31.6}Wo_{13.2}$, FeO/MnO = 57), augite ($Fs_{16.6}Wo_{36.3}$, FeO/MnO = 40), fayalite ($Fa_{83.8}$, FeO/MnO = 105), plagioclase ($An_{89.2-90.8}Or_{0.2-0.3}$, N = 2).

Classification: Lunar (feldspathic breccia).

Specimens: 20.2 g including a polished endcut at *UWB*; remainder with Hermès, 24 rue du Faubourg Saint-Honoré, 75 008 Paris.

Northwest Africa 12953 (NWA 12953)
Algeria
Purchased: 2019 Jun
Classification: HED achondrite (Diogenite)

History: The majority of this material was purchased by Jason Bliss in June 2019 from a dealer in Oregon, who had acquired it from an Algerian source. Later in September 2019 additional amounts of the same material were purchased jointly by Jason Bliss and Topher Spinnato from a Moroccan dealer. Samples form both batches were examined and analyzed.

Physical characteristics: The material (total weight 1939 g) comprises muliple relatively coarse-grained, friable stones (locally stained dull orange-brown with black chromite grains visible).

Petrography: (A. Irving, *UWS* and P. Carpenter, *WUSL*) Breccia composed predominantly of angular grains of orthopyroxene (exhibiting undulose extinction) plus some polygranular diogenite clasts in a sparse finer-grained matrix. Accessory phases include olivine, clinopyroxene, V-bearing chromite, troilite and iron hydroxides (evidently produced by pervasive terrestrial weathering of primary Ni-free metal).

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Geochemistry: Orthopyroxene ($Fs_{23.8-23.9}Wo_{1.7-1.9}$, FeO/MnO = 25-26, N = 4), olivine ($Fa_{27.1-27.7}$, FeO/MnO = 43-45, N = 4), clinopyroxene ($Fs_{8.0}Wo_{46.2}$, FeO/MnO = 20), chromite (V_2O_3 = 0.5 wt.%).
Classification: Diogenite (breccia, stained by terrestrial weathering).
Specimens: 41.7 g including one polished thin section and one polished mount at *UWB*; remainder held jointly by Mr. J. Bliss and Mr. T. Spinnato.

Northwest Africa 12954 (NWA 12954)
Morocco
Purchased: February 2014
Classification: Ordinary chondrite (L4)
History: Purchased in February 2014 in Tuscon by Fred *Olsen* from a moroccan dealer. Acquired by Daniel Sheikh in 2018.
Physical characteristics: Single stone with dark-brown fusion crust.
Petrography: (D. Sheikh, *FSU*) Low chondrule abundance (700±100 ?m, n=3). Sample composed of olivine, low-Ca pyroxene, high-Ca pyroxene, troilite, Fe-Ni metal, and Fe-oxides.
Geochemistry: Olivine ($Fa_{22.1\pm1.7}$, n=17), low-Ca Pyroxene ($Fs_{20.2\pm2.2}Wo_{1.7\pm0.3}$, n=6), high-Ca Pyroxene ($Fs_{8.4\pm0.4}Wo_{41.2\pm0.8}$, n=2).
Classification: Ordinary Chondrite (L4)
Specimens: 20.2 grams at *UCLA*; main mass with Sheikh.

Northwest Africa 12955 (NWA 12955)
Algeria
Find: 2016
Classification: HED achondrite (Eucrite, polymict)
History: Purchased in 2016 in Morocco by Matthew Stream from Daoud Wabich.
Physical characteristics: Single stone with minor fusion crust. A slice of the interior reveals an assortment of light and dark clasts.
Petrography: (D. Sheikh, *FSU*) Sample is a breccia composed predominantly of cumulate and basaltic eucritic clasts (>5mm) set in a dark fine-grained matrix containing isolated mineral fragments (>3mm). Some diogenitic clasts are present as well (<10% volume). Minerals present include orthopyroxene, pigeonite, augite, calcic plagioclase, chromite (some containing Ti), iron-rich olivine, ilmenite, silica polymorph, troilite, FeNi metal, and barite. Some of the pyroxenes exhibit exsolution textures. Some carbonate weathering veins are present.
Geochemistry: Low-Ca pyroxene ($Fs_{39.3\pm2.4}Wo_{3.5\pm1.4}$, Fe/Mn=29, n=12; $Fs_{57.6\pm3.2}Wo_{4.2\pm1.1}$, Fe/Mn=30, n=30), diogenitic orthopyroxene ($Fs_{26.7\pm1.9}Wo_{2.6\pm0.7}$, Fe/Mn=30, n=22), pigeonite ($Fs_{51.6\pm6.8}Wo_{9.7\pm3.1}$, Fe/Mn=31, n=27), augite ($Fs_{28.5\pm3.2}Wo_{41.1\pm1.2}$, Fe/Mn=30, n=18), low-Ca pyroxene host ($Fs_{57.0\pm0.4}Wo_{5.3\pm0.4}$, Fe/Mn=31, n=12), high-Ca pyroxene exsolution lamellae ($Fs_{36.7\pm2.1}Wo_{28.8\pm2.5}$, Fe/Mn=28, n=9), calcic plagioclase ($An_{90.5\pm2.0}Or_{0.3\pm0.1}$, n=19), olivine ($Fa_{64.7\pm1.6}$, Fe/Mn=46,n=3), chromite (Cr/(Cr+Al)=82, n=2), ilmenite (Fe/(Fe+Mg)=92, n=2).

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Classification: Eucrite (polymict breccia)
Specimens: 9.06 grams at *UCLA*; main mass with Matthew Stream.

Northwest Africa 12956 (NWA 12956)
Mauritania
Find: 2017
Classification: HED achondrite (Eucrite, polymict)
History: Purchased in 2017 by V. Oullet from a seller in Mauritania.
Physical characteristics: Single stone with almost absent fusion crust. A slice of the interior reveals an assortment of light and dark clasts.
Petrography: (D. Sheikh, *FSU*) Sample is a breccia composed predominantly of cumulate and basaltic eucritic clasts (>4 mm) set in a dark fine-grained matrix. Some diogenitic clasts are present as well (<10% volume). Minerals present include orthopyroxene, pigeonite, augite, calcic plagioclase, ilmenite, and troilite.
Geochemistry: Low-Ca pyroxene ($Fs_{41.4\pm9.6}Wo_{4.1\pm2.4}$, Fe/Mn=32, n=63), diogenitic orthopyroxene ($Fs_{25.7\pm2.4}Wo_{1.8\pm0.7}$, Fe/Mn=28, n=14), high-Ca pyroxene ($Fs_{25.8\pm2.4}Wo_{40.5\pm3.5}$, Fe/Mn=29, n=7), calcic plagioclase ($An_{90.5\pm1.9}Or_{0.3\pm0.1}$, n=15), ilmenite (Fe/(Fe+Mg)=95, n=2).
Classification: Eucrite (polymict breccia)
Specimens: 20.03 grams at *UCLA*; main mass with V. Oullet.

Northwest Africa 12958 (NWA 12958)
Morocco
Purchased: 2019
Classification: HED achondrite (Eucrite, melt breccia)
History: Purchased in Morocco in 2019.
Physical characteristics: Dark brecciated stone. Cut surface reveals a dark-gray interior with light, cm sized clasts.
Petrography: (J. Gattacceca, *CEREGE*) Brecciated fine-grained igneous rock with lithic clasts set in a melt rock matrix. Main minerals are plagioclase and pyroxene (some with augite exsolutions). Other minerals: rare metal (up to 50 µm), troilite, ilmenite, silica polymorph, chromite.
Geochemistry: Low-Ca pyroxene $Fs_{64.1\pm1.5}Wo_{2.5\pm1.0}$, FeO/MnO 33.6±3.0 (n=5). Augite exsolution $Fs_{293}Wo_{42.6}$ (n=1). Plagioclase $An_{89.6\pm0.6}Ab_{9.9\pm0.7}Or_{0.5\pm0.4}$ (n=3). Chromite Cr# 0.84 (n=1).
Classification: Achondrite (eucrite melt breccia).
Specimens: Type specimen at *CEREGE*. Main mass with Isabelle Pothier.

Northwest Africa 12959 (NWA 12959)
Algeria
Purchased: 2019
Classification: Carbonaceous chondrite (CV3)

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History: Purchased in Morocco in 2019.
Physical characteristics: Dark stone. Cut face reveals a dark interior with chondrules and CAIs.
Petrography: (J. Gattacceca, *CEREGE*) Chondrules (average apparent diameter 890±270 µm, n=15) and CAIs set in a iron-rich fine-grained matrix. Opaques are sulfides and magnetite.
Geochemistry: Olivine $Fa_{9.2\pm4.2}$ (n=4). Low-Ca pyroxene $Fs_{3.4\pm1.8}Wo_{2.4\pm1.0}$ (n=4). Matrix microprobe over an area of 30 × 30 µm: total 100.0%, FeO 39.9 wt% (n=1).
Classification: Carbonaceous chondrite (CV3).
Specimens: Type specimen at *CEREGE*. Main mass with Isabelle Pothier.

Northwest Africa 12960 (NWA 12960)
(Northwest Africa)
Purchased: 2019
Classification: Martian meteorite (Shergottite)
History: Found in Ageria in the Ouargla area. Purchased in Morocco in 2019.
Physical characteristics: Crusted stones. Cut surface reveals a greenish fine-grained interior.
Petrography: (J. Gattacceca, *CEREGE*) Igneous rock with doleritic texture. Mains minerals are pyroxene (typical size 500 µm, strongly zoned) and maskelynite, Fe oxides (to 150 µm), and sulfides (to 50 µm).
Geochemistry: Pyroxene $Fs_{51.2\pm21.3}Wo_{21.4\pm6.2}$, range $Fs_{23.1-78.3}$, Fe/Mn=35.8±5.8 (n=12). Maskelynite $An_{50.2\pm3.1}Ab_{47.1\pm2.1}Or_{2.7\pm1.3}$ (n=5). Magnetic susceptibiilty log χ ($\times 10^{-9}$ m^3/kg) = 3.50.
Classification: Martian meteorite (shergottite). Possibly paired with NWA 12550.
Specimens: Type specimen at *CEREGE*. Main mass with Isabelle Pothier.

Northwest Africa 12961 (NWA 12961)
Morocco
Purchased: 2019 Mar
Classification: Ordinary chondrite (L7)
Physical characteristics: Single stone without fusion crust
Petrography: (J. Gattacceca, *CEREGE*) Highly recrystallized rock with no relict chondrules visible in the studied section. Plagioclase has K-rich rims. Opaque minerals are metal and troilite. Abundant vesicles with typical size 250 µm.
Geochemistry: Olivine $Fa_{23.0\pm0.1}$ (n=3). Low-Ca pyroxene $Fs_{18.8\pm0.3}Wo_{4.4\pm0.0}$ (n=3). Plagioclase $An_{2.8\pm1.3}Ab_{86.6\pm4.8}Or_{10.6\pm6.0}$ (n=2) with K-rich rims $An_{2.3}Ab_{52.8}Or_{44.9}$ (n=1).
Classification: Ordinary chondrite (L7). Type 7 from texture, Wo content of low-Ca pyroxene, and presence of K-rich rims in plagioclase.
Specimens: Type specimen and a polished section at *CEREGE*. Main mass with *Kuntz*.

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Northwest Africa 12962 (NWA 12962)
(Northwest Africa)
Purchased: 2019 May
Classification: Enstatite chondrite (EL melt rock)
Physical characteristics: Three gray "porous" stones lacking fusion crust
Petrography: (J. Gattacceca, *CEREGE*) Highly recrystallized rock. No relict chondrules were observed. Main minerals are enstatite with typical size 100 µm and plagioclase to 150 µm. Metal and sulfides (including daubréelite) are found as µm sized spherical grains. Abundant vesicles with typical size 50 µm. Abundant terrestrial weathering products.
Geochemistry: Enstatite $Fs_{0.2\pm0.0}Wo_{0.5\pm0.1}$ (n=3).
Classification: Enstatite-melt rock. Likely paired with Al Haggounia 001.
Specimens: Type specimen and a polished section at *CEREGE*. Main mass with *Kuntz*.

Northwest Africa 12963 (NWA 12963)
(Northwest Africa)
Purchased: 2019 May
Classification: HED achondrite (Eucrite, cumulate)
Petrography: (J. Gattaccecan, *CEREGE*) Brecciated igneous rock. Main minerals are mm-sized pyroxene and plagioclase. Other minerals include Fe,Ni metal, troilite, chromite (to 100 µm).
Geochemistry: Low-Ca pyroxene $Fs_{33.3\pm0.4}Wo_{3.4\pm0.5}$, FeO/MnO=30.5 (n=3). Plagioclase $An_{93}Ab_{6.7}Or_{0.2}$ (n=2). Chromite Cr# 0.81.
Classification: achondrite, eucrite
Specimens: Type specimen and a polished section at *CEREGE*. Main mass with *Kuntz*.

Northwest Africa 12964 (NWA 12964)
Morocco
Purchased: 2018
Classification: Ureilite
Petrography: (J. Gattaceca, *CEREGE*) Blocky silicate assemblage. Grain size about 1 mm. Olivine dominates strongly over pyroxene. Olivine shows reduced rims. Carbon material is present at grain boundaries.
Geochemistry: Olivine cores $Fa_{22.8\pm0.2}$ (n=3), rim $Fa_{18.2}$ (n=1), CaO 0.27 wt%, Cr_2O_3 0.54 wt%. Pigeonite $Fs_{18.9}Wo_{10.2}$, FeO/MnO=32.9 (n=2).
Classification: Ureilite
Specimens: Type specimen at *CEREGE*. Main mass with George Peneff.

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Northwest Africa 12965 (NWA 12965)
Morocco
Purchased: 2019 May
Classification: Martian meteorite (Shergottite)
Physical characteristics: Single stone without fusion crust
Petrography: (J. Gattacceca, *CEREGE*) Igneous rock with sub-ophitic texture. Typical grain size 800 µm. Main minerals are strongly zoned pyroxene and maskelynite. Pyroxene has lobate contacts with plagioclase. Opaque minerals are iron oxides and pyrrhotite to 200 µm.
Geochemistry: Pyroxene $Fs_{37.9\pm5.6}Wo_{31.0\pm2.0}$, range $Fs_{27.0-45.3}Wo_{32.5-27.6}$, FeO/MnO=36.6±2.7 (n=12). Maskelynite $An_{54.8\pm1.1}Ab_{43.3\pm1.4}Or_{1.9\pm0.4}$ (n=7).
Classification: Martian (Shergottite)
Specimens: Type specimen at *CEREGE*. Main mass with *Kuntz*.

Northwest Africa 12966 (NWA 12966)
Morocco
Purchased: 2019
Classification: Lunar meteorite (feldspathic breccia)
Petrography: (J. Gattacceca, *CEREGE*) Sparse mineral clasts (anorthite, olivine, pyroxene) in a melt rock matrix. Melt rock has abundant vesicles with typical sizes 50 µm. Toilite and rare metal are found in the melt rock fraction.
Geochemistry: Anorthite $An_{96.00}Ab_{3.6}Or_{0.4}$ (n=3). Pyroxene $Fs_{30.8}Wo_{8.9}$, FeO/MnO = 52 (n=2). Olivine $Fa_{36.4}$, FeO/MnO=118 (n=2).
Classification: Lunar (feldspathic melt breccia).
Specimens: Type specimen at *CEREGE*. Main mass with Pierre-Marie Pelé.

Northwest Africa 12967 (NWA 12967)
Mauritania
Purchased: 2019 May
Classification: Mesosiderite
History: Found in Mauritania and purchased by Rachid Chaoui in May 2019 from a dealer in Nouakchott, Mauritania.
Petrography: (A. Irving, *UWS* and P. Carpenter, *WUSL*) Aggregate of predominantly orthopyroxene, anorthite and metal (~30 vol.%, kamacite with minor taenite) plus subordinate olivine (as fractured unzoned grains with a range of compositions), augite, silica polymorph (as acicular grains), chromite, troilite, pentlandite, ilmenite and merrillite. Orthopyroxene is compositionally-zoned (with symplectitic chromite in the ferroan rims) and some orthopyroxene contains irregular included blebs of augite.
Geochemistry: Zoned orthopyroxene (cores: $Fs_{17.8-22.6}Wo_{1.0-2.1}$, FeO/MnO = 30-33, N = 4; rims: $Fs_{30.1-34.1}Wo_{3.8-1.9}$, FeO/MnO = 22-24, N = 4), olivine ($Fa_{17.6-26.7}$, FeO/MnO = 36-41, N = 5), ferroan orthopyroxene hosts ($Fs_{36.0-38.4}Wo_{2.3-3.0}$,

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FeO/MnO = 21-23, N = 2), clinopyroxene blebs in orthopyroxene ($Fs_{16.3-16.8}Wo_{42.9-41.9}$, FeO/MnO = 17-18, N = 2), anorthite ($An_{90.2-90.3}Or_{0.3}$, N = 2).
Classification: Mesosiderite.
Specimens: 49 g polished slice at *UWB*; remainder with Mr. R. Chaoui.

Northwest Africa 12968 (NWA 12968)
Mauritania
Purchased: 2019 Jul
Classification: HED achondrite (Eucrite, brecciated)
History: Purportedly found in Mauritania and purchased by Jason Phillips in July 2019 from a dealer in Zagora, Morocco.
Petrography: (A. Irving, *UWS* and P. Carpenter, *WUSL*) Breccia composed of mineral clasts of exsolved pigeonite, calcic plagioclase, pigeonite and subcalcic augite together with accessory silica polymorph in a finer grained matrix containing ilmenite (with marginal zircon blebs), troilite and secondary barite.
Geochemistry: Low-Ca pyroxene host ($Fs_{59.4-61.1}Wo_{2.3-1.6}$, FeO/MnO = 33-36, N = 3), pigeonite ($Fs_{35.6-44.1}Wo_{9.0-10.1}$, FeO/MnO = 29-34, N = 2), orthopyroxene rim on pigeonite ($Fs_{59.5}Wo_{1.9}$, FeO/MnO = 33), subcalcic augite ($Fs_{39.7-44.2}Wo_{27.7-22.3}$, FeO/MnO =33, N = 2), plagioclase ($An_{85.1}Or_{0.5}$).
Classification: Eucrite (breccia).
Specimens: 20.2 g including one thin section and one polished endcut at *UWB*; remainder held Mr. J. Phillips.

Northwest Africa 12970 (NWA 12970)
(Northwest Africa)
Purchased: 2019 May
Classification: Ordinary chondrite (L3)
History: Purchased in Agadir, Morocco by Aziz Habibi in May 2019.
Petrography: (A. Irving, *UWS* and P. Carpenter, *WUSL*) Well-formed, closely-packed chondrules (apparent diameter 890±490 µm, N = 25) are set in a sparse finer-grained matrix containing stained metal.
Geochemistry: Olivine ($Fa_{18.6\pm11.7}$ (range $Fa_{3.0-30.3}$, Cr_2O_3 <0.05 wt.%, N = 7), low-Ca pyroxene ($Fs_{12.0\pm11.8}Wo_{1.1\pm0.6}$ (range $Fs_{1.5-24.9}Wo_{0.6-1.7}$, N = 2), high-Ca pyroxene ($Fs_{3.6}Wo_{38.8}$). Magnetic susceptibility log χ ($\times 10^{-9}$ m^3/kg) = 4.70.
Classification: Ordinary chondrite (L3).
Specimens: 33.6 g including one polished thin section at *UWB*; remainder with Mr. A. Habibi.

Northwest Africa 12971 (NWA 12971)
(Northwest Africa)
Purchased: 2019 Apr
Classification: Lunar (troctolitic melt rock)

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History: Purchased jointly by Craig Zlimen, Mark Lyon and Matthew Stream in April 2019 from a Moroccan dealer.
Physical characteristics: A single light gray stone (280 g) with visible vesicles and light brown weathering products on one side. The fresh interior is composed predominantly of vesicular melt rock which contains some clast-like regions of coarser grained melt rock.
Petrography: (A. Irving, *UWS* and P. Carpenter, *WUSL*) Very fine-grained (grainsize up to 5 µm), microvesicular melt-textured specimen composed predominantly of anorthite plus subordinate olivine and accessory pigeonite, augite, chromite (exhibiting zoning from Ti-bearing cores to Ti-free rims), troilite and pyrrhotite. No intact clasts were observed anywhere in the entire 5 cm diameter slice examined by microprobe imaging, but there are sporadic coarser-grained (up to 40 µm) melt-textured regions.
Geochemistry: Anorthite ($An_{97.2-97.7}Or_{0.0}$, N = 2), olivine ($Fa_{24.9-35.5}$, FeO/MnO = 77-99, N = 6), magnesian olivine core ($Fa_{19.0}$, FeO/MnO = 98), ferroan olivine rim ($Fa_{38.3}$, FeO/MnO = 80), pigeonite ($Fs_{26.2}Wo_{19.4}$, FeO/MnO = 44), augite ($Fs_{19.8-35.1}Wo_{35.5\pm0.0}$, FeO/MnO = 43-55, N =2).
Classification: Lunar (troctolitic melt rock). The predominance of anorthite and olivine indicates a troctolitic bulk composition. The texture and apparent absence of clasts are consistent with crystallization from a totally molten state.
Specimens: 22.3 g in the form of a large polished slice at *UWB*; remainder with Mr. C. Zlimen, Mr. M. Lyon and Mr. M. Stream.

Northwest Africa 12972 (NWA 12972)
(Northwest Africa)
Purchased: 2017 Mar
Classification: Ordinary chondrite (LL5)
History: Purchased by Adam *Aaronson* in March 2017 from a dealer in Zagora, Morocco.
Petrography: (A. Irving, *UWS* and P. Carpenter, *WUSL*) Sparse chondrules occur within a recrystallized matrix containing lightly-stained metal.
Geochemistry: Olivine ($Fa_{33.3\pm0.1}$ (range $Fa_{33.2-33.5}$, N = 6), low-Ca pyroxene ($Fs_{26.8\pm0.2}Wo_{2.5\pm0.1}$ (range $Fs_{26.4-27.1}Wo_{2.3-2.6}$, N = 6), high-Ca pyroxene ($Fs_{11.0}Wo_{43.9}$).
Classification: Ordinary chondrite (LL5).
Specimens: 24 g including one polished thin section at *UWB*; remainder with *Aaronson*.

Northwest Africa 12973 (NWA 12973)
Tunisia
Purchased: 2019 Mar
Classification: HED achondrite (Diogenite, anomalous)
History: Found in Tunisia in January 2019 and purchased in Agadir, Morocco by Aziz Habibi in March 2019.

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Petrography: (A. Irving, *UWS* and P. Carpenter, *WUSL*) Protogranular texture with prominent triple grain junctions. The major constituent is orthopyroxene, but there are domains of polycrystalline olivine (~5 vol.% overall). Spherical vesicles (empty, up to 3 mm in diameter) are present. Accessory phases include clinopyroxene, V-bearing chromite and troilite, plus minor secondary calcium sulfate and barite.
Geochemistry: Orthopyroxene ($Fs_{23.6-23.8}Wo_{3.9-3.5}$, FeO/MnO = 28-31, N = 4), olivine ($Fa_{28.6-29.0}$, FeO/MnO = 48-53, N = 3), clinopyroxene ($Fs_{11.2}Wo_{42.9}$, FeO/MnO = 22).
Classification: Diogenite (anomalous, vesicular, olivine-bearing). The prominent vesicles in this specimen are an anomalous feature.
Specimens: 21.9 g including one polished thin section and one polished mount at *UWB*; remainder with Mr. A. Habibi.

Northwest Africa 12974 (NWA 12974)
(Northwest Africa)
Purchased: 2019 Sep
Classification: Ureilite-mmict
History: Purchased by Adam *Aaronson* in Temara, Morocco, in September 2019.
Petrography: (A. Irving, *UWS* and P. Carpenter, *WUSL*) Breccia composed predominantly of angular grains of zoned olivine and pigeonite with accessory augite, schreibersite, troilite and altered kamacite (as abundant cross-cutting veinlets). No carbon phases were observed. Olivine grains have more ferroan cores and reduced, more magnesian rims. Minor secondary iron chloride and calcium sulfate are associated with altered kamacite.
Geochemistry: Olivine (cores $Fa_{11.7-12.7}$, N = 4; rims $Fa_{6.5-9.1}$, N = 4), pigeonite ($Fs_{11.2-11.3}Wo_{9.8-9.6}$, N = 2), augite ($Fs_{6.8-7.5}Wo_{36.4-35.4}$, N = 3).
Classification: Ureilite (monomict breccia).
Specimens: 6.2 g including one polished thin section and one polished mount at *UWB*; remainder with *Aaronson*.

Northwest Africa 12975 (NWA 12975)
(Northwest Africa)
Purchased: 2019 Jul
Classification: Ordinary chondrite (LL3)
Petrography: (K. Metzler, *IfP*) Brecciated ordinary chondrite of low petrologic type. It consists of chondrules (up to 3.5 mm), chondrule fragments, mineral fragments, and mm-sized unequilibrated chondrite clasts, embedded in a fine-grained clastic matrix. The mean apparent chondrule size is 680 µm (n=53). Small amounts of Fe,Ni metal and troilite, mostly residing outside of chondrules.
Geochemistry: Mineral compositions and geochemistry: The mean olivine composition is $Fa_{19.1\pm8.7}$ ($Fa_{3.9-33.5}$; n=26); the mean low-Ca pyroxene composition is $Fs_{14.0\pm6.8}Wo_{0.8\pm0.8}$ ($Fs_{5.6-24.3}Wo_{0.1-2.8}$; n=11).

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Classification: LL chondrite based on metal content and apparent chondrule size. Petrologic type based on the chemical variation of olivine (PMD of Fa values: 46), estimated LL3.5.

Northwest Africa 12976 (NWA 12976)
(Northwest Africa)
Purchased: 2019 Jul
Classification: Ordinary chondrite (L3)
Petrography: (K. Metzler, *IfP*) Ordinary chondrite of low petrologic type consisting of chondrules (up to 3.9 mm), chondrule fragments, Fe,Ni metal grains and troilite, with small amounts of fine-grained interchondrule matrix. The mean apparent chondrule size is 480 µm (n=59).
Geochemistry: Mineral compositions and geochemistry: The mean olivine composition is $Fa_{20.3\pm6.9}$ ($Fa_{2.3-31.1}$; n=24); the mean low-Ca pyroxene composition is $Fs_{13.8\pm6.3}Wo_{0.9\pm0.9}$ ($Fs_{2.5-19.7}Wo_{0.1-3.8}$); n=15.
Classification: L chondrite based on metal content and apparent chondrule size. Petrologic type based on the chemical variation of olivine (PMD of Fa values: 34), estimated L3.6.

Northwest Africa 12977 (NWA 12977)
(Northwest Africa)
Purchased: 2019 Aug
Classification: Ordinary chondrite (LL3)
Petrography: (K. Metzler, *IfP*) Ordinary chondrite of low petrologic type, consisting of closely packed chondrules (up to 2.2 mm) and chondrule fragments with low amounts of interchondrule matrix. The mean apparent chondrule size is 560 µm (n=68). Metal is almost completely oxidized by terrestrial weathering.
Geochemistry: Mineral compositions and geochemistry: The mean olivine composition is $Fa_{21.1\pm10.1}$ (5.1-44.4; n=26); the mean low-Ca pyroxene composition is $Fs_{13.0\pm6.7}$ $Wo_{1.4\pm1.2}$ ($Fs_{1.7-31.7}$ $Wo_{0.3-4.4}$; n=32).
Classification: LL chondrite based on the mean chondrule size. Petrologic subtype estimated as 3.5 due to the chemical variation of olivine (PMD of Fa values: 48).

Northwest Africa 12978 (NWA 12978)
Northwest Africa
Purchased: 2018
Classification: Eucrite melt breccia
History: Thierry Simard purchased the 1022 g sample in Rissani, Morocco, in 2018 November.
Physical characteristics: Sample is rounded-irregular in shape, coated with a dark-brown weathered patina containing numerous pits that show the surface expression

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of lithic fragments. The cut face shows a brecciated structure composed of light-colored igneous-textured clasts set in a finer-grained dark matrix.

Petrography: Description and classification: (A. Love, *App*): Sample is a melt rock-supported breccia composed of 1.2 mm - 2.5 cm rounded-irregular-shaped brecciated, rare cumulate and basaltic-textured clasts and related mineral debris set in within a quenched melt matrix. Basaltic clasts have subophitic textures and contain exsolved pyroxenes. Additional minerals are: fayalite, a silica polymorph, ilmenite, rare zircon and phosphate.

Geochemistry: (A. Love, *App*): Low Ca pyroxene ($Fs_{61.9\pm2.0}Wo_{2.9\pm1.7}$, Fe/Mn=31.2±1.3, Mg#36.2±2.0, n=14); high Ca pyroxene ($Fs_{28.5\pm2.4}Wo_{42.6\pm0.8}$, Fe/Mn=30.9±0.9, n=8); plagioclase ($An_{89.2\pm6.2}Or_{0.5\pm0.6}$, n=10).

Classification: HED Achondrite (eucrite melt breccia). Textures and mineral compositions (Fe/Mn ratios and Mg# of pyroxenes) indicate this sample is a basaltic eucrite melt breccia.

Specimens: Thierry Simard holds the main mass. Several fragments and a polished thin section comprise 22 g type specimen which is on deposit at *App*.

Northwest Africa 12980 (NWA 12980)

Mauritania

Find: 2018 Nov

Classification: Lunar impact melt breccia

History: A single weathered stone lacking a fusion crust was found by nomads in Mauritania in November 2018 and purchased by Graham Ensor in Morocco in June 2019.

Physical characteristics: Dark gray/brown sandblasted exterior, with many irregularly shaped fragments set in a glassy impact melt groundmass. No fusion crust.

Petrography: (T. S. Hayden, M. Anand, *OU*). The meteorite is a clast rich impact melt breccia containing numerous mineral and lithic fragments embedded in a glassy partially recrystallised impact melt matrix. The lithic clast populations consists primarily of highlands clasts, dominated by anorthitic plagioclase and Ca-rich pyroxene, with olivine components. The size range of the lithic clasts is 0.11-1.73 mm. Mineral clasts are mainly pyroxene, olivine, plagioclase and spinel group phases.

Geochemistry: Mineral Composition and Geochemistry: (T. S. Hayden, M. Anand, *OU*) Feldspar ($An_{96.8\pm0.6}Ab_{3.0\pm0.59}$, N = 93), Pigeonite ($Fs_{31.0\pm7.4}Wo_{9.4\pm2.9}$, Fe/Mn = 54.5±5.2, N=29), Augite ($Fs_{18.9\pm9.3}Wo_{36.5\pm6.3}$, Fe/Mn = 48.1±6.6, N=27), Clinoenstatite ($Fs_{22.3\pm6.7}Wo_{4.3\pm0.5}$, Fe/Mn = 56.6±3.3, N=8), Olivine ($Fa_{34.8\pm10.2}$, Fe/Mn = 95.7±13.6, N=120). O isotopes (measured at OU): δ17O = 3.294‰, δ18O = 6.289‰, Δ17O = -0.001‰ (linearized using a slope of 0.5247 [Miller 2002 GCA 66(11)]).

Classification: Lunar impact melt breccia

Specimens: Specimen: 20.3g held at *OU*. Graham Ensor holds the main mass (1.3 kg).

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Northwest Africa 12981 (NWA 12981)
(Northwest Africa)
Purchased: 2019 Aug
Classification: Ordinary chondrite (LL3)

Petrography: (K. Metzler, *IfP*) Ordinary chondrite of low petrologic type consisting of closely packed chondrules (up to 2.9 mm) and some chondrule fragments with low amounts of Fe,Ni metal, troilite, and interchondrule matrix. The mean apparent chondrule size is 670 µm (n=87).

Geochemistry: Mineral compositions and geochemistry: (K. Metzler, *IfP*; A.Greshake, *MNB*) The mean olivine composition is $Fa_{12.9\pm7.1}$ (1.0-27.8; n=28); the mean low-Ca pyroxene composition is $Fs_{9.6\pm8.3}Wo_{1.0\pm0.9}$ ($Fs_{2-32.8}Wo_{0.1-3.5}$); n=19. The mean concentration of Cr_2O_3 in ferroan olivine is 0.070±0.042 (n=52), similar to that in St. Mary's County (LL3.3; Grossman and Brearley 2005).

Classification: LL chondrite based on metal content and apparent chondrule size. Estimated petrologic subtype is 3.3, based on PMD of Fa values and on mean concentration and variability of Cr_2O_3 in ferroan olivine.

Northwest Africa 12982 (NWA 12982)
(Northwest Africa)
Purchased: 2018
Classification: Ordinary chondrite (L6)

History: Purchased by Dave Gheesling from Erfoud, Morocco, 2018.

Physical characteristics: Single stone, flight oriented with front-facing shield shape and prominent trailing fluted regmaglypts. Surface has smooth, lightly weathered fusion crust with dark brown color.

Petrography: (C. Agee, *UNM*) Microprobe examination of a polished mount shows textually equilibrated chondrules and recrystallized matrix. Plagioclase grain size is up to ~150 µm.

Geochemistry: (C. Agee, *UNM*) Olivine $Fa_{25.6\pm0.8}$, Fe/Mn=51±3, n=10; low-Ca pyroxene $Fs_{21.2\pm0.1}Wo_{1.6\pm0.3}$, Fe/Mn=29±1, n=4.

Classification: Ordinary chondrite (L6)

Specimens: 20.5 g including a probe mount on deposit at *UNM*, Dave Gheesling holds the main mass.

Northwest Africa 12983 (NWA 12983)
(Northwest Africa)
Purchased: 2012
Classification: Ordinary chondrite (H5)

History: Purchased by Dave Gheesling from Erfoud, Morocco, 2012.

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Physical characteristics: Single stone, conical shape, and prominent regmaglypts. Surface has lightly weathered fusion crust with dark brown color. Small chondrules are visible in the surface.
Petrography: (C. Agee, *UNM*) Microprobe examination of a polished mount shows numerous small chondrules and abundant Fe-Ni metal. Plagioclase grain size is up to ~25 µm.
Geochemistry: (C. Agee, *UNM*) Olivine $Fa_{18.0\pm0.5}$, Fe/Mn=37±1, n=8; one olivine grain had an anomalous composition $Fa_{26.9}$, Fe/Mn=63; low-Ca pyroxene $Fs_{17.8\pm2.0}Wo_{1.1\pm0.3}$, Fe/Mn=24±3, n=4.
Classification: Ordinary chondrite (H5)
Specimens: 36.2 g including a probe mount on deposit at *UNM*, Dave Gheesling holds the main mass.

Northwest Africa 12985 (NWA 12985)
Algeria
Find: 2016
Classification: Lunar meteorite (feldspathic breccia)
History: Purchased in 2019 by Matthew Stream from a seller in Algeria.
Physical characteristics: Single stone with absent fusion crust. A slice of the interior reveals an assortment of light and dark-colored clasts.
Petrography: (Daniel Sheikh, *FSU*) Sample is a feldspathic fragmental breccia composed predominantly of angular anorthitic clasts (<2mm) containing minor amounts of olivine, pigeonite, augite, ilmenite, and chromite.
Geochemistry: (Daniel Sheikh, *FSU*) Olivine ($Fa_{29.4\pm10.4}$, range $Fa_{18.7\text{-}44.6}$, Fe/Mn=89±10, n=3), pigeonite ($Fs_{36.5\pm7.6}Wo_{14.1\pm4.0}$, range $Fs_{31.8\text{-}50.2}Wo_{10.7\text{-}20.9}$, Fe/Mn=51±7, n=5), wugite ($Fs_{11.7}Wo_{42.0}$, Fe/Mn=38, n=1), anorthite ($An_{96.4\pm1.1}$, range $An_{93.8\text{-}98.4}$, n=33).
Classification: Lunar (feldspathic fragmental breccia).
Specimens: 6.7 grams at *UCLA*; main mass with Matthew Stream.

Northwest Africa 12986 (NWA 12986)
Morocco
Find: 2016
Classification: HED achondrite (Eucrite, monomict)
History: Purchased in 2017 by Matthew Stream from a seller in Morocco.
Physical characteristics: Single stone with minor fusion crust.
Petrography: (Daniel Sheikh, *FSU*) Sample is a fine-grained monomict breccia composed of subophitic eucrite clasts containing orthopyroxene, pigeonite, augite, calcic plagioclase, SiO_2-rich glass, and troilite. Minor secondary calcite veins present.
Geochemistry: (Daniel Sheikh, *FSU*) Orthopyroxene ($Fs_{64.0\pm1.4}Wo_{4.2\pm0.7}$, range $Fs_{62.0\text{-}65.9}Wo_{3.2\text{-}5.3}$, Fe/Mn=27±2, n=10), pigeonite ($Fs_{54.9\pm4.1}Wo_{14.4\pm5.1}$, range $Fs_{47.2\text{-}}$

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$_{61.0}Wo_{6.2\text{-}24.3}$, Fe/Mn=29±3, n=35), augite ($Fs_{42.0\pm4.1}Wo_{30.4\pm5.0}$, range $Fs_{33.5\text{-}48.1}Wo_{25.7\text{-}41.2}$, Fe/Mn=29±3, n=17), calcic plagioclase ($An_{84.1\pm2.1}$, range $An_{80.1\text{-}89.1}$, n=44).
Classification: Eucrite (monomict breccia).
Specimens: 22 grams at *UCLA*; main mass with Matthew Stream.

Northwest Africa 12990 (NWA 12990)
(Northwest Africa)
Purchased: 2019 Apr
Classification: Ordinary chondrite (L6, melt breccia)
Physical characteristics: Single stone with remnants of fusion crust.
Petrography: (J. Gattacceca, *CEREGE*) Melt rock suported breccia. Ordinary chondritic clasts are petrologic type 6.

Northwest Africa 12991 (NWA 12991)
Morocco
Purchased: 2017 Mar 08
Classification: Ordinary chondrite (L5)
Physical characteristics: Hand specimen shows weathered fusion crust. Cut surface indicates pervasive weathering with oxidised metal and rust staining throughout.
Petrography: Chondrules are dominantly porphyritic with typical size of 800-1000 µm, with one notably large chondrule observed at > 4 mm. Few exhibit discernible edges but most are poorly delineated and chondrule fragments blend in with the recrystallized matrix. Metal grains average at 200 µm in length with modal abundance of ~4 vol%. Both metals and sulphide grains are heavily weathered, and alteration veins are pervasive. Plagioclase grains are dominantly <50 µm in length.
Geochemistry: Mineral composition and geochemistry: All analyses by EPMA. Olivine: $Fa_{25.4\pm0.6}$ (N=49). Pyroxene: $Fs_{21.6\pm0.6}En_{77.0\pm0.7}Wo_{1.4\pm0.3}$ (N=43). Plagioclase: $Ab_{84.1\pm1.6}An_{10.2\pm0.6}Or_{5.7\pm1.8}$ (N=27). Metal and sulphide analyses had low totals due to weathering.

Northwest Africa 12992 (NWA 12992)
(Northwest Africa)
Find: 2016
Classification: Ordinary chondrite (LL6)
Physical characteristics: Hand specimen is considerably weathered and pitted, with partial fusion crust.
Petrography: Chondrules are dominantly porphyritic with typical size of 600-700 µm. Few exhibit discernible edges but most are poorly delineated and chondrule fragments blend in with the recrystallized matrix. Metal grains average at 100-200 µm in length with modal abundance of ~2 %. Olivines are mostly 200-400 µm, pyroxenes 300-400 µm and plagioclase 100-200 µm in length. Minor chromite and apatite are observed.

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Geochemistry: Mineral composition and geochemistry: All analyses by EPMA. Metal: predominantly kamacite with 5.4±0.3 wt% Ni and 2.4±0.3 wt% Co, taenite with 32.6-51.7 wt% Ni and 0.5±0.1 wt% Co. All troilite and chromite analyses had low totals due to weathering. Olivine: $Fa_{28.8\pm0.3}$ (N=42). Pyroxene: $Fs_{24.4\pm0.5}En_{73.9\pm1.0}Wo_{1.8\pm0.8}$ (N=29). Plagioclase: $Ab_{86.5\pm2.7}An_{11.2\pm2.9}Or_{2.2\pm0.7}$ (N=23)

Northwest Africa 12993 (NWA 12993)
(Northwest Africa)
Find: 2016
Classification: Ordinary chondrite (L6)
Petrography: Chondrules are dominantly porphyritic with typical size of 250-400 µm, with one notable large chondrule observed at >2 mm. Few exhibit discernible edges but most are poorly delineated and chondrule fragments blend in with the recrystallized matrix. Metal grains (~ 4 vol%) have lengths up to 1.2 mm. Sulfides have a ~4 vol% abundance. Plagioclase is mostly 50-200 µm in length.
Geochemistry: Mineral composition and geochemistry: Metal: predominantly kamacite with 6.1±1.2 wt% Ni and 0.8 ±0.1 wt% Co, taenite with 16.3-46.5 wt% Ni and 0.5±0.2 wt% Co. Troilite and chromite analyses had low totals due to weathering. Olivine: $Fa_{25.1\pm1.2}$ (N=28). Pyroxene: $Fs_{20.7\pm1.2}En_{77.6\pm1.4}Wo_{1.7\pm0.4}$ (N=24). Plagioclase: $Ab_{83.9\pm0.4}An_{10.3\pm0.3}Or_{5.8\pm0.5}$ (N=15)

Northwest Africa 12996 (NWA 12996)
Western Sahara
Find: 2019
Classification: HED achondrite (Eucrite, monomict)
History: Found in Western Sahara in spring 2019. Purchased in Mauritania in the summer of 2019.
Physical characteristics: Dozens of specimens mostly broken pieces, fresh black fusion crust, saw cut reveals a mildly brecciated texture with basaltic clasts set in dark-gray groundmass.
Petrography: (C. Agee, *UNM*) Microprobe examination shows a mix of pyroxene and plagioclase grains most in the range 200-500 µm. Many pyroxene grains have exsolution lamellae. Ubiquitous minor FeTi-oxide, troilite, and silica observed.
Geochemistry: (C. Agee, *UNM*) Low-Ca pyroxene $Fs_{54.8\pm3.1}Wo_{4.5\pm4.5}$, Fe/Mn=36±1, n=9; high-Ca pyroxene $Fs_{34.7}Wo_{30.9}$, Fe/Mn=34, n=1; plagioclase $An_{80.1\pm6.1}$, n=2.
Classification: Monomict eucrite
Specimens: 22.6 g on deposit at *UNM*, *DPitt* holds the main mass.

Northwest Africa 12997 (NWA 12997)
(Northwest Africa)
Purchased: 2015
Classification: Lunar (troct)

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History: Found by unknown nomads (date and location unconfirmed). Purchased in 2015 in Morocco by Graham Ensor.
Physical characteristics: Light grey sandblasted exterior, with visible dark melt veins visible on exterior and interior of rock. No fusion crust. Cumulus olivine and plagioclase.
Petrography: (T. S. Hayden, M. Anand, T. J. Barrett, *OU*). The meteorite is a cumulate troctolite mainly comprising olivine and plagioclase crystals, with minor pyroxene. Accessory phases include ilmenite, spinel, merrillite and chromite.
Geochemistry: Mineral Composition and Geochemistry: (T. S. Hayden, M. Anand, T. J. Barrett, *OU*) Feldspar ($An_{96.6\pm1.0}Ab_{3.4\pm1.0}$, N = 13), Pigeonite ($Fs_{22.3\pm8.2}Wo_{9.7\pm5.4}$, Fe/Mn = 46.7±8.7, N=6), Augite ($Fs_{11.3\pm1.2}Wo_{37.0\pm1.7}$, Fe/Mn = 28.0±3.5, N=3), Clinoenstatite ($Fs_{19.3\pm1.3}Wo_{3.5\pm0.8}$, Fe/Mn = 47.4±4.2, N=8), Olivine ($Fa_{22.9\pm1.2}$, Fe/Mn = 88.1±5.9, N=21). O isotopes (measured at *OU*): Repetition 1: $\delta^{17}O$ = 3.092‰, $\delta^{18}O$ = 5.916‰, $\Delta^{17}O$ = -0.008‰, Repetition 2: $\delta^{17}O$ = 3.057‰, $\delta^{18}O$ = 5.844‰, $\Delta^{17}O$ = -0.005‰. Mean: $\delta^{17}O$ = 3.0745±0.025‰ (1-sigma), $\delta^{18}O$ = 5.880±0.051‰ (1-sigma), $\Delta^{17}O$ = -0.006±0.002‰ (1-sigma) (linearized using a slope of 0.5247 (of Miller (2002)).
Classification: Lunar troctolite. Thought to be paired with NWA 5744 clan based on textural and mineralogical similarities.
Specimens: Specimen: 16.8 g specimen held at *OU*. Graham Ensor holds the main mass (two stones weighing 60 g).

Northwest Africa 12998 (NWA 12998)
Northwest Africa
Purchased: 2017
Classification: Primitive achondrite (Winonaite)
History: Purchased by Matthew Stream from a meteorite dealer in 2017 at the Tucson Gem and Mineral Show.
Physical characteristics: Single stone with dark-brown fusion crust.
Petrography: (D. Sheikh, *FSU*) No chondrules present. 120° triple junctions present at mineral grain boundaries. Sample contains forsterite, enstatite, augite, troilite, Fe-Ni metal (~10-15 vol%, with grain size 100-30 µm), and Fe-oxides. Silicate grain size is 100-200 µm.
Geochemistry: Olivine ($Fa_{0.7\pm0.2}$, FeO/MnO=7±1, n=25), Low-Ca Pyroxene ($Fs_{3.2\pm0.2}Wo_{1.4\pm0.1}$, FeO/MnO=8±1, n=22), High-Ca Pyroxene ($Fs_{1.4\pm0.3}Wo_{45.2\pm0.5}$, FeO/MnO=7±1, n=12).
Classification: Primitive achondrite (winonaite) based on the presence of near endmember forsterite and enstatite.
Specimens: 6.01 grams at *UCLA*; main mass with Matthew Stream.

Northwest Africa 12999 (NWA 12999)
Morocco
Purchased: 2009

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Classification: Ordinary chondrite (LL5)
History: Purchased in 2009 at the Denver Mineral Show from a Moroccan meteorite and mineral dealer.
Petrography: (C. Herd and R. Bukatiuk, *UAb*) Optical and microprobe examination of a polished thin section shows a brecciated texture with well-delineated chondrules. Shock effects include undulatory extinction with > 2° angular variation in olivine. Weathering grade according to Zurfluh et al. (2016); shock stage according to Fritz et al. (2017).
Geochemistry: (C. Herd and R. Bukatiuk, *UAb*) Data obtained by EMP examination of carbon-coated thin section: Olivine $Fa_{33.5\pm0.3}$ (n=54); Low-Ca Pyroxene $Fs_{26.3\pm0.2}Wo_{1.5\pm0.2}$ (n=15).
Classification: Ordinary chondrite, LL5
Specimens: Type specimen of 5.0 g, including one thin section, is at *UAb*. Main mass at *JTESM*.

Northwest Africa 13000 (NWA 13000)
(Northwest Africa)
Purchased: 2019 Jul
Classification: Iron meteorite (IIAB)
Petrography: Etching of a polished section reveals a hexaedrite texture. Rhabdites are present.
Geochemistry: (J.T. Wasson, *UCLA*): INAA data, Ni = 67.9, Co = 4.62 (both mg/g), Cu = 120, Ga = 87.1, As = 13.2, W= 1.17, Re = 0.194, Ir = 2.20, Pt = 6.9, Au = 1.576 (all µg/g).
Classification: Iron, IIAB
Specimens: Type specimen at *CEREGE*. Main mass with *Kuntz*

Northwest Africa 13001 (NWA 13001)
Morocco
Purchased: 2017
Classification: Iron meteorite (IAB-MG)
Petrography: Etching of a polished section reveals a recrystalllized coarse octahedrite texture. Kamacite bandwidth is about 3 mm. Rhabdite (typical size 40 µm) and Neumann bands are present
Geochemistry: (J.T. Wasson, *UCLA*): INAA data, Ni = 67.4, Co = 4.65 (both mg/g), Cu = 119, Ga = 83.2, As = 12.7, W= 1.02, Re = 0.254, Ir = 2.74, Pt = 57, Au = 1.593, Cr=22 (all µg/g).
Classification: Iron, IAB-MG
Specimens: Type specimen (21 g) at *CEREGE*. Main mass with George Penneff.

Northwest Africa 13003 (NWA 13003)
Morocco

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Purchased: 2014
Classification: Ordinary chondrite (L5)
History: Purchased by Fred *Olsen* from a moroccan dealer in Tucson, AZ, in 2014. Acquired by Daniel Sheikh in 2018.
Physical characteristics: Single stone with dark-brown fusion crust.
Petrography: (Daniel Sheikh, *FSU*) Low chondrule abundance (average 700±50 µm, n=5). Sample is composed of olivine, low-ca pyroxene, recystallized plagioclase (~10 µm), Fe-Ni metal, troilite, and Fe-oxides.
Geochemistry: Olivine ($Fa_{23.7\pm0.6}$, n=10), Low-Ca Pyroxene ($Fs_{21.3\pm0.8}Wo_{1.4\pm0.3}$, n=10).
Classification: Ordinary Chondrite (L5)
Specimens: 33.4 grams at *UCLA*; main mass with Daniel Sheikh.

Notice: this meteorite was originally published here as "Rusalka." After review, the name has been changed to Northwest Africa13004.

Northwest Africa 13004
Find: 2016 Mar
Classification: Ordinary chondrite (L4)
History: A fresh meteorite sample of 816 g.
Physical characteristics: The meteorite has a dark appearance with a well-preserved fusion crust.
Petrography: (A. Bischoff, *IfP*). The rock is an ordinary chondrite. It has a chondritic texture, with well-defined chondrules with a size of about 500 µm. The metal is well-preserved, but partly shows thin rims of typical terrestrial alteration products. The weathering degree is W1. The rock is weakly shocked with olivines having planar fractures (S3).
Geochemistry: Mineral compositions and geochemistry: (K. Klemm and A. Bischoff, *IfP*). The rock has equilibrated olivine (average: $Fa_{22.6\pm0.7}$; n = 10). Low-Ca pyroxene (average: $Fs_{17.9\pm2.2}$; (n = 9)) shows some variation in composition (range: $Fs_{13.9\text{-}19.7}$) typical for type 4 ordinary chondrites. The analysis of the oxygen isotopes (A. Pack, *UGött*) indicates an L chondrite heritage ($\delta^{18}O$=5.32‰, $\delta^{17}O$=3.51‰; $\Delta^{17}O$=0.74‰). The composition has been affected by terrestrial alteration. Cosmogenic radionuclide concentrations have been analyzed (M. Laubenstein, *LNGS*) by means of nondestructive high purity germanium (HPGe) gamma spectroscopy in spring 2019. Of the medium and long-lived cosmogenic radionuclides only ^{22}Na and ^{26}Al were positively identified. From the data, it was calculated that the meteorite probably fell about 12 (±2) years ago.
Classification: Ordinary chondrite (L4, S3, W1)
Specimens: 20.5 g and polished thin section

Northwest Africa 13005 (NWA 13005)
Morocco

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Purchased: 2019 Jan
Classification: Iron meteorite (IIIAB)

History: Purchased in January 2019 via the internet from Moroccan dealer Lahcen ait Ha, who found the meteorite in Morocco.

Physical characteristics: The meteorite is irregularly shaped, and measures approximately 8 cm × 10 cm × 5 cm. It has a dark brown outer surface, with minor rust spots.

Petrography: (C. Herd, *UAb*) Optical investigation of a ~3.5 × 2.5 cm polished and etched slice reveals a well-developed Widmanstatten pattern consistent with a medium octahedrite (1.01 ± 0.25 mm; n=21). Several mm-scale lath-shaped schreibersite inclusions are present. Terrestrial alteration appears to have only affected the exterior surface.

Geochemistry: ICP-MS data, using sample of North Chile (Filomena) as standard (C. Herd and G. Chen *UAb*): Ni = 8.5, Co = 0.49 (both wt%); Ir = 0.13, Ga = 22, As = 12.7, W = 0.4, Ru = 2.7, Rh = 1.1, Pd = 4.0, Os = 0.34, Pt = 4.7, Cu = 127, Au = 1.5 (all μg/g).

Classification: (C. Herd, *UAb*): IIIAB iron, medium octahedrite.

Specimens: Type specimen consisting of a 22.2 g representative slice at *UAb*. Main mass with Craig Zlimen.

Northwest Africa 13006 (NWA 13006)
Niger
Purchased: 2019 Mar
Classification: Iron meteorite (IIIAB)

History: Reportedly found in Niger in December 2018. Purchased in March 2019 via the internet from Moroccan dealer Mustapha Oulkouch.

Petrography: (C. Herd and J. Victor, *UAb*) Optical investigation of a ~3 × 5 cm polished and etched slice, as well as photos provided by the owner, reveals a well-developed Widmanstatten pattern consistent with a medium octahedrite (1.05 ± 0.13 mm; n=23). No inclusions were observed. Terrestrial alteration appears to have only affected the exterior surface.

Geochemistry: ICP-MS data, using sample of North Chile (Filomena) as standard (C. Herd and G. Chen *UAb*): Ni = 7.1, Co = 0.46 (both wt%); Ir = 11.7, Ga = 20, Cr = 63, As = 4.6, W = 1.2, Ru = 11.3, Rh = 1.6, Pd = 2.0, Re = 1.2, Os = 3.2, Pt = 15.0, Cu = 160, Au = 0.6 (all μg/g).

Classification: (C. Herd, *UAb*): IIIAB iron, medium octahedrite.

Specimens: Type specimen consisting of a 49.2 g representative slice at *UAb*. Main mass owned in equal parts by Craig Zlimen, Mark Lyon and Peter March.

Northwest Africa 13007 (NWA 13007)
(Northwest Africa)
Purchased: 2019
Classification: Ordinary chondrite (LL4)

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History: The meteorite was purchased from a meteorite dealer in Zagora, Morocco.
Physical characteristics: Many brownish fragments without fusion crust.
Petrography: The meteorite displays a chondritic texture with slightly flattened chondrules (mean diameter about 0.8 mm) in a fine-grained greyish to brownish matrix that contains sulfides and rare FeNi metal. The meteorite is brecciated and contains black impact melt clasts.

Northwest Africa 13008 (NWA 13008)
(Northwest Africa)
Purchased: 2019
Classification: Rumuruti chondrite (R3-4)
History: The meteorite was purchased from a meteorite dealer in Zagora, Morocco.
Physical characteristics: Dark greyish rock partly covered with fusion crust.
Petrography: The meteorite displays a dark greyish interior and is composed of up to 6 mm sized angular type 4 clasts set into type 3 matrix. Olivine and low-Ca pyroxene are compositionally unequilibrated in the matrix; equilibrated Fe-rich olivine is the most dominant mineral phase in the clasts. Low-Ca pyroxene is also compositionally unequilibrated in the matrix. More minor phases include Ca-pyroxene, sodic plagioclase, sulfides, and Ti-bearing chromite; no metal has been detected.
Geochemistry: type 3 lithology: olivine: $Fa_{28.0\pm13.7}$ ($Fa_{5.3-39.2}$, n= 17); pyroxene: $Fs_{14.4\pm6.5}Wo_{1.6\pm0.9}$ ($Fs_{5.4-23.8}Wo_{0.4-3.3}$, n=10); type 4 lithology: olivine: $Fa_{38.9\pm0.2}$, n=1; pyroxene: $Fs_{24.3\pm4.1}Wo_{0.9\pm0.5}$ ($Fs_{16.6-29.6}Wo_{0.4-1.9}$, n=17)

Northwest Africa 13009 (NWA 13009)
(Northwest Africa)
Purchased: 2019
Classification: Carbonaceous chondrite (CV3)
History: The meteorite was purchased from a meteorite dealer in Erfoud, Morocco.
Physical characteristics: Dark brownish rock without fusion crust.
Petrography: Carbonaceous chondrite composed of well-defined chondrules (mean diameter about 1 mm), CAIs (up to 3 mm), and olivine amoeboids all set into a fine-grained almost black matrix. Type II chondrules are absent. Most chondrules show reddish staining due to terrestrial weathering.

Northwest Africa 13012 (NWA 13012)
(Northwest Africa)
Purchased: 2019
Classification: Ordinary chondrite (LL3-6)
History: The meteorite was purchased from a meteorite dealer in Erfoud, Morocco.
Physical characteristics: Grayish rock without fusion crust.

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Petrography: The meteorite is a chondritic breccia consisting of angular to subrounded LL6 clasts set into LL3 type matrix showing a chondritic texture with well defined chondrules. Chondrules are mostly flattened and well packed and have a mean diameter of about 0.9 mm. Plagioclase grain size in LL6 clasts is about 60 µm.
Geochemistry: type 3 lithology: olivine: $Fa_{16.4\pm9.6}$ ($Fa_{2.7\text{-}30.1}$, n= 17); pyroxene: $Fs_{12.5\pm7.8}Wo_{1.2\pm0.8}$ ($Fs_{2.3\text{-}23.8}Wo_{0.3\text{-}2.4}$, n= 22); type 6 lithology: olivine: $Fa_{30.6\pm0.4}$, n=10; pyroxene: $Fs_{25.1\pm0.2}Wo_{1.5\pm0.1}$, n=9

Northwest Africa 13013 (NWA 13013)
(Northwest Africa)
Purchased: 2019
Classification: Ordinary chondrite (LL3)
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 chondritic texture with sharply defined, partly flattened and loosely packed chondrules (mean diameter about 0.9 mm) in a more fine-grained brownish matrix that contains sulfides and rare FeNi metal.

Northwest Africa 13014 (NWA 13014)
(Northwest Africa)
Purchased: 2019
Classification: Carbonaceous chondrite (CV3)
History: The meteorite was purchased from a meteorite dealer in Erfoud, Morocco.
Physical characteristics: Dark brownish rock without fusion crust.
Petrography: Carbonaceous chondrite composed of chondrules (mean diameter about 1 mm; up to 2.5 mm sized), CAIs (up to 5 mm sized), and olivine amoeboids all set into a fine-grained dark brownish to almost black matrix. Type II chondrules are absent.

Northwest Africa 13016 (NWA 13016)
(Northwest Africa)
Purchased: 2019
Classification: Carbonaceous chondrite (CO3)
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 dark brownish interior and is composed of abundant small chondrules, CAIs, and mineral fragments some of which surrounded by fine-grained dust rims set into a fine-grained matrix. Chondrules have a mean diameter of about 0.2 mm; few regions show brownish staining due to terrestrial weathering.

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Northwest Africa 13022 (NWA 13022)
(Northwest Africa)
Purchased: 2017
Classification: Ordinary chondrite (L3)
History: The meteorite was purchased from a meteorite dealer in Zagora, Morocco.
Physical characteristics: Brownish rock without fusion crust.
Petrography: The meteorite displays a chondritic texture with mostly flattened and well packed chondrules (mean diameter about 0.6 mm) in a more fine-grained matrix that contains sulfides and FeNi metal.

Northwest Africa 13023 (NWA 13023)
(Northwest Africa)
Purchased: 2017
Classification: Ordinary chondrite (H3)
History: The meteorite was purchased from a meteorite dealer in Zagora, Morocco.
Physical characteristics: Brownish rock without fusion crust.
Petrography: The meteorite shows a fragmented texture with mostly flattened and loosely packed chondrules (mean diameter about 0.4 mm) in a more fine-grained matrix that contains sulfides and abundant FeNi metal.

Northwest Africa 13024 (NWA 13024)
(Northwest Africa)
Purchased: 2017
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 shows a chondritic texture with densely packed and mostly flattened chondrules (apparent mean diameter about 0.9 mm). While olivine is compositionally equilibrated, low-Ca pyroxene show compositional zoning.

Northwest Africa 13033 (NWA 13033)
(Northwest Africa)
Purchased: 2019 Sep
Classification: Ordinary chondrite (L3)
History: Purchased in Temara, Morocco, by Adam *Aaronson* in September 2019.
Petrography: (A. Irving, *UWS* and P. Carpenter, *WUSL*) Closely packed, well-formed chondrules (apparent diameter 610±200 µm, N = 20) are set in a sparse matrix containing stained metal.
Geochemistry: Olivine ($Fa_{23.6\pm11.2}$ (range $Fa_{0.9\text{-}33.2}$, N = 10; Cr_2O_3 in ferroan examples 0.03-0.17 wt.%, mean 0.06±0.04 wt.%, N = 13), low-Ca pyroxene

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($Fs_{14.6\pm11.3}Wo_{1.0\pm0.6}$ (range $Fs_{4.7-24.5}Wo_{0.4-1.7}$, N = 4), high-Ca pyroxene ($Fs_{4.7\pm2.5}Wo_{38.8\pm2.7}$ (range $Fs_{2.9-6.4}Wo_{34.7-30.9}$, N = 2).
Classification: Ordinary chondrite (L3).
Specimens: 30.2 g including one polished thin section and one polished mount at *UWB*; remainder with *Aaronson*.

Northwest Africa 13037 (NWA 13037)
Algeria
Purchased: 2018 Dec
Classification: Ordinary chondrite (L3)
History: Purportedly found near Djelfa, Algeria, and purchased from the finder by Naji Ben Faraji and Mohamed Brahim Sueilem in December 2018 in Adrar, Algeria.
Physical characteristics: Very fresh specimen (465 g) coated by black fusion crust.
Petrography: (A. Irving, *UWS* and P. Carpenter, *WUSL*) Closely packed, well-formed chondrules (apparent diameter 780±350 µm, N = 22) are set in a sparse matrix containing stained metal.
Geochemistry: Olivine ($Fa_{22.0\pm6.5}$ (range $Fa_{13.2-33.6}$, N = 18; Cr_2O_3 in ferroan examples 0.01-0.07 wt.%, mean 0.02±0.02 wt.%, N = 15), low-Ca pyroxene ($Fs_{17.9\pm5.3}Wo_{1.7\pm1.7}$ (range $Fs_{9.9-23.0}Wo_{0.9-4.3}$, N = 6), subcalcic augite ($Fs_{11.7}Wo_{22.8}$), augite ($Fs_{14.6\pm7.4}Wo_{37.6\pm3.0}$ (range $Fs_{9.4-19.8}Wo_{39.7-35.5}$, N = 2). Magnetic susceptibility log χ = 4.77.
Classification: Ordinary chondrite (L3).
Specimens: 27.6 g including one polished thin section at *UWB*; remainder held jointly by N. Ben Faraji and M. Brahim Sueilem.

Nova 056
(unknown)
Find: unknown
Classification: Iron meteorite (IAB-sLM)
History: Reportedly found in Shandong, China, and purchased by *HMG* from a dealer in China.
Physical characteristics: Specimen has patchy relict fusion crust. The specimen is half of a larger object. The etched surface clearly shows a Widmanstaetten pattern.
Petrography: The meteorite is a coarsest octahedrite (Ogg) containing kamacite, teanite and few plessite fields. Kamacite bandwidth is within 1-5 mm, but chiefly is larger than 3.3 mm. Schreibersite is present as veins with swathing kamacite.
Geochemistry:ICP-MS data, Ni = 102, Co = 5.1, P = 0.8(all mg/g), Cu = 139, Ga = 20.3, Ge = 53.2, As = 17.3, Sn = 0.48, Ir = 0.59, Au = 1.88 (all µg/g).
Classification: iron meteorite IAB-sLM
Specimens: 5320 g is at *HMG*.

Nova 057

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Baja, Mexico
Find: 1984
Classification: Iron meteorite (IIAB)

History: Purportedly found in Baja California, Mexico, in 1984

Physical characteristics: The 26.5 kg meteorite is oblong, with a red-brown exterior, regmaglypts of varying size, and measures approximately 40 cm × 18 cm × 15 cm.

Petrography: (C. Herd, *UAb*) Optical investigation of a small (~1.5 × 2.0 cm) polished and etched slice reveals a Widmanstaetten pattern consistent with a coarsest octahedrite (6-7 mm). No obvious inclusions were noted. Terrestrial alteration appears to have only affected the exterior surface.

Geochemistry: ICP-MS data, using sample of North Chile (Filomena) as standard (C. Herd and G. Chen *UAb*): Ni = 5.9, Co = 0.47 (both wt%); Ir = 9.6, Ga = 48, As = 6.4, W = 2.4, Re = 0.8, Os = 1.0, Pt = 17.9, Cu = 101, Au = 0.9 (all µg/g).

Classification: IIAB iron, through comparison of bulk composition with data from Wasson et al. (2007), coarsest octahedrite. Composition is distinct from other known IIAB irons from Mexico, and this is the first known IIAB iron from Baja California.

Specimens: Type specimen consisting of 23 g in four slices at *UAb*. Main mass with the anonymous owner.

Nova 058

Minas Gerais, Brazil
Find: before 1968
Classification: Iron meteorite (IAB-sLL)

History: The meteorite was given before 1968 to Djalma Guimarães (now deceased) from Industrial Technology Institute (ITI, Minas Gerais) while he was working in João Pinheiro (Minas Gerais). The meteorite was then kept by Prof. Cláudio Vieira Dutra until the inauguration of the Djalma Guimarães Museum in 2000.

Physical characteristics: Semi prismatic shape.

Petrography: (F. N. Puchetta, UFOP and M. E. Zucolotto MN/UFRJ) - Etched sections display a coarse widmanstätten structure with bandwidth of 1.80±0.50 mm. Neumann lines are common. Plessite occurs in minor amounts as degenerated comb, pearlitic and spheroidized plessite. Some acicular and martensitic plessite is also observed. Cohenite is very common on most sections. Troilite and schreibersite are also present. Rhabdites are very common and tetragonal prisms in some kamacite lamellae.

Geochemistry: 7.9 wt% Ni; 0.47 wt% Co; 80.0 ppm Ga; 335 ppm Ge; 1.66 ppm Au (INAA, J.T. Wasson, *UCLA*)

Classification: Iron, IAB-sLL

Specimens: type specimen *MNRJ*. Main mass at Museu Djalma Guimarães (Belo Horizonte, Minas Gerais, Brazil)

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Nova 059

(unknown)

Find: 2016

Classification: Iron meteorite (IAB-MG)

History: This meteorite was reportedly discovered by Ingo Klümper, Brandlecht, while he was searching with metal detector in 5 cm depth beside a forest path SW of Nordhorn/Lower Saxony (52°22.696'N, 7°05.919'E) on Feb. 27, 2016. However, a find in eolian sand is neither consistent with very high accumulation of U (see below), which requires a much higher terrestrial age than the embedding sediment, nor with crack fillings of carbonates. Noble gas isotopes and radionuclides require a very large crater-forming object. Therefore this report is in doubt.

Physical characteristics: (R. Bartoschewitz *Bart*) One iron piece of about 7.5 × 4 × 3 cm and 370 g.

Petrography: (R. Bartoschewitz *Bart*) The meteorite shows a bulky coarse Widmannstätten pattern with bandwidth of 2-5 mm with Neumann lines and rhabdite. Graphite, troilite and schreibersite occur on kamacite boundaries. Corrosion cracks filled with Fe-hydroxides and carbonates.

Geochemistry: (R. Bartoschewitz *Bart*) Chemistry (M. Humayun, Univ. of Florida Tallahassee by laser ablation ICP-MS, standards Odessa, Toluca, Staunton, Dungannon) Co = 0.47, Ni = 5.99 (both in wt.%); Cu = 104, Ga = 88, Ge = 398, As = 13, Sb = 0.33, Ir = 3.38, Au = 1.52 (all in ppm). Radionuclides (M. Laubenstein, INFN Gran Sasso) ^{26}Al (<0.10 dpm/kg) reflects a preatmospheric radius of >85 cm and sample depth of >40 cm. ^{238}U (2.1±0.2 ng/g) likely due to terrestrial contamination. Noble gas isotopes (K. Nagao, *KOPRI* Incheon) cosmogenic ^{3}He/^{21}Ne = 94.

Classification: (R. Bartoschewitz, *Bart*): Iron (IAB MG, coarse octahedrite), possibly a piece of Campo del Cielo.

Specimens: 21.5 g on deposit at *Kiel*, main mass with Ingo Klümper and 122 g with *Bart*.

Nova 060

(unknown)

Find: 2016

Classification: Ordinary chondrite (H5)

History: (I. Klümper, Brandlecht) Discovered by R. Bartoschewitz in a scrap-box of metal detector finds of Ingo Klümper from Brandlech. Mr. Klümper explained that he discovered it on a Holocene inland dune in the Tillenberge natural reserve in Nordhorn/Lower Saxony (52°24.190'N, 7°07.420'E) on Feb. 20, 2016.

Physical characteristics: (I. Klümper, R. Bartoschewitz) Red-brown 5 × 4 × 2.5 cm fragment of 56 g. After cleaning the color was green-brown.

Petrography: (R. Bartoschewitz, *Bart*) Brown-stained strongly recrystallized matrix, with chondrules (0.1-0.7 mm, av. 0.4 mm), metal and troilite patches. Fractures filled with Fe-hydroxides.

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Geochemistry: (R. Bartoschewitz, *Bart*) Olivine $Fa_{18.8\pm0.4}$ (n=136); pyroxene (low-Ca) $Fs_{16.7\pm0.7}Wo_{1.3\pm0.2}$ (n=82); kamacite Co 0.64 % (n=15) Magnetic susceptibility log χ ($\times 10^{-9}$ m^3/kg) = 4.86 and bulk density of 3.40 g/cm³. Terrestrial Ar-, Kr-, Xe-isotope contamination (K. Nagao, R. Bartoschewitz) is much higher than known from European finds, but are consistent with the contamination trend in hot deserts. Sr (B. Hofmann, handheld XRF) of 79 ppm is not consistent with lower Saxony preglacial inland dune content, but is consistent with weathering in hot desert environment.
Classification: Ordinary chondrite (H5, S2/3, W2-4)
Specimens: 11.6 g on deposit at *Kiel*, I. Klümper holds the main mass, and 14 g with *Bart*.

Nova 061
(unknown)
Find: 2017
Classification: Ordinary chondrite (H~6)
History: (I. Klümper, Brandlecht) R. Batoschewitz was informed by Ingo Klümper that he discovered a further meteorite on a medow 825 m SW of his first find (52°23.933'N, 7°06.828'E) by metal detector on March 26, 2017.
Physical characteristics: (I. Klümper, R. Bartoschewitz) 5 red-brown fragments totaling 21.5 g that fit together to one nearly complete fragment.
Petrography: (R. Bartoschewitz, *Bart*) Brown stained strong recrystallized matrix with poor recognizable chondrules (av. 0.4 mm), metal and sulfide is completely oxidized. Fractures filled with carbonate and Fe-hydroxides.
Geochemistry: (R. Bartoschewitz, *Bart*) Magnetic susceptibility log χ ($\times 10^{-9}$ m^3/kg) = 4.70 and bulk density of 3.35 g/cm³. Sr (B. Hofmann, handhold XRF) of 41 ppm is not consistent with lower Saxony inland dune content, but weathering in desert environment. Zr 11 ppm is about 25% of Nova 060 (B. Hofmann, handhold XRF). Carbonate in fractures, Zr and Sr indicate non-pairing to Nova 060.
Classification: Ordinary chondrite (H~6, W5)
Specimens: 5.6 g on deposit at *Kiel*, I. Klümper holds the main mass, and 7 g with *Bart*.

O'Donnell (b) 32°57.733'N, 101°50.300'W
Texas, United States
Find: 2018
Classification: Ordinary chondrite (H5)
History: ~8 kg found by Michelle Rios working in her garden in O'Donnell, Texas, in March 2018. Sample was initially screened and passed on for classification by New England Meteoritical Services (NEMS).
Physical characteristics: Physical Characteristics: Single stone, iron oxide stained black and dark brown exterior with occasional patches of weathered fusion crust.

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Saw cut reveals dark interior with a few scattered chondrules, small grains of oxidized metal and bright troilite.
Petrography: (K. Domanik and F. Stephan, *UAz*) Microprobe examination of a polished mount shows numerous, recognizable, partly re-crystalized chondrules 500-1500 µm in size set in a re-crystalized matrix. Sparse plagioclase grains in matrix mostly 20-50 µm in size. Kamacite and troilite almost completely oxidized. Sample cut by many small iron-oxide weathering veins.
Geochemistry: Mineral compositions and geochemistry: (K. Domanik and F. Stephan, *UAz*) Olivine $Fa_{19.3\pm0.3}$, Fe/Mn=36.5±1.7, n=37; low-Ca pyroxene $Fs_{17.2\pm0.4}Wo_{1.3\pm0.2}$, Fe/Mn=21.8±1.6, n=25.
Classification: Ordinary Chondrite (H5), Weathering grade W3. Found 9.25 km NE of O'Donnell and maybe potentially paired with it given the proximity. However olivine Fa differs slightly from that recorded for O'Donnell ($Fa_{18.6}$).
Specimens: 20 g and a thin section on deposit at *UAz*. Michelle Rios holds the main mass.

O'Malley 022 30°37'53.4"S, 131°29'53.5"E
South Australia, Australia
Find: 17 May 2012
Classification: Ordinary chondrite (L6)
History: Found by A. Tait on desert caliche between claypans.
Physical characteristics: Half-fist sized dark red-brown sample with 95% smooth fusion crust, a small amount of lichen attached.
Petrography: (L. Bowlt) Chondrules range in size up to 1.2 mm diameter, have diffuse boundaries and sit in a highly recrystallised matrix. Mineralogy includes olivine, pyroxene, plagioclase (many plagioclase grains exceed 50 µm), Fe-Ni metal and troilite. Chondrule types include BO, RP, PO, PP, POP. Metal and troilite grains are large, both ranging up to 1 mm in size. Plagioclase is abundant (20-30%) and some has been converted to maskelynite. Olivine grains show undulose extinction, mosaicism and contain distinct perpendicular sets of shock lamellae. Moderate oxidation of metal and troilite has occurred with 20-25% of the grains affected. Given that most oxidation occurs as rims on the metals/sulfides and there are no oxide veins, estimates of original percentages of metal and troilite are approximately 1-3% and 5-15% respectively.
Geochemistry: (L. Bowlt, *Monash*) Microprobe analyses show that olivine and pyroxene compositions are uniform: olivine $Fa_{23.1-24.3}$, mean= $Fa_{23.4}$, std=0.65, n=6; Low-Ca pyroxene $Fs_{18.4-19.9}$, mean= $Fs_{19.3}$, std=0.64 , n=6.
Classification: Ordinary Chondrite (L6, S4, W3)

O'Malley 023 30°38'57.7"S, 131°28'20.2"E
South Australia, Australia
Find: 17 May 2012
Classification: Ordinary chondrite (L6)

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History: Two adjacent pieces found by A. Tomkins amongst limestone gravel
Physical characteristics: Two fragments with smooth brown-black fusion crust, covering 70% of the larger sample.
Petrography: (L. Bowlt) Poorly defined fragmented chondrules, ranging in size up to 2 mm, sit in a strongly recrystallized matrix. Mineralogy includes olivine, pyroxene, plagioclase, troilite, Fe-Ni metal and chromite. Chondrule types include BO, GOP and PO. Plagioclase is very coarse grained with sizes commonly in the range of 80 µm. Olivine grains show mosaicism and shock lamellae. Plagioclase is partly converted to maskelynite and there are shock melt veins. Incomplete transformation of plagioclase to maskelynite suggests shock classification of S4. 20-30% of FeNi metal and troilite are weathered with thin oxide rims.
Geochemistry: (L. Bowlt, *Monash*) Microprobe analyses show that olivine and pyroxene compositions are uniform: olivine $Fa_{22.2-22.9}$, mean= $Fa_{22.5}$, std=0.31, n=5; Low-Ca pyroxene $Fs_{18.6-19.7}$, mean= $Fa_{19.3}$, std=0.55 , n=5.
Classification: Ordinary Chondrite (L6, S4, W3)

O'Malley 024 30°41'28.7"S, 131°03'38.2"E
South Australia, Australia
Find: 8 Apr 2015
Classification: Ordinary chondrite (H6)
History: Two jig-saw fitting pieces found by A. Tait
Physical characteristics: Two fragments representing 60% of the total stone.
Petrography: (S. Alkemade, *Monash*) Chondrules (0.2 - 1.0 mm diameter) have indistinct edges, in a strongly recrystallized matrix. Relict chondrules types include BO, RP, POP, cryptocrystalline and poikilitic. Mineralogy includes olivine, pyroxene, plagioclase, abundant Fe-Ni metal and troilite. Undulatory extinction and irregular fractures are exhibited in the majority of olivine grains with minor planar fractures in few grains. Approx 40-50% Fe-Ni metal and troilite is oxidised.
Geochemistry: (S. Alkemade) FEG-SEM analysis shows that olivine and pyroxene compositions are uniform: Olivine $Fa_{18.3-19.2}$, mean = $Fa_{18.8}$, std = 0.33, n = 5; Low-Ca pyroxene $Fs_{16.0-17.2}$, mean = $Fa_{16.6}$, std = 0.45, n = 5.
Classification: Ordinary Chondrite (H6, S2, W2)

Ooldea 004 30°33'17.30"S, 131°49'9.20"E
South Australia, Australia
Find: 2013 Apr 9
Classification: Enstatite chondrite (EL3)
History: Many fragments (individual masses are up to 1044 g) possibly representing four individual stones, each extensively broken up and dispersed through desert weathering over about 500 m2, from a newly defined strewn field identified in 2013, and further recovered in 2014 and 2017. The current dimensions of the strewn field is about 200 m by 50 m. These stones were found 15 km from Watson 007, which is

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an EL3 of the same weathering extent; given the rarity of EL3 chondrites, they are likely to be from the same fall, thus representing a much larger strewn field.

Physical characteristics: Numerous broken fragments up to 10 cm, blocky or flat, weathered to dark brown.

Petrography: (A. Tait, A. Tomkins, *Monash*) This sample is dominated by orthopyroxene (>95%), although a small proportion of chondrules (~10%) contain olivine. Chondrules are well defined and are mainly RP and PP; they range in size up to 5 mm, with many in the range 1-4 mm. The matrix is opaque and chondrule mesostases typically extremely fine grained (crystals <1 µm). Olivine has straight extinction, and there are no indicators of higher shock. Greater than 95% of the metal has been oxidized, but remaining metal contains exsolved acicular pyroxene crystals, and these can also easily be seen in iron oxide pseudomorphs of metal. Petrographically this meteorite has the same silicate petrography, shock characteristics and extent of weathering as Watson 007, which was found 15 km to the west. Given the rarity of EL3 chondrites, it is highly likely that these are from the same fall, and represent part of a relatively large strewn field.

Geochemistry: (A. Tait, *Monash*) Low-Ca pyroxene has $Fs_{0.12-1.93}$, mean = $Fs_{0.74\pm1.03}$, n=3, olivine has $Fa_{0.13-2.09}$, mean = $Fa_{0.46\pm0.72}$, n = 7; metal has 0.55 wt.% Si.

Classification: The sparse olivine and very fine grained chondrule mesostases are consistent with Type 3 classification. Low Si in metal indicates EL. Enstatite Chondrite (EL3, S1, W4).

Ooldea 011 30°30’9.30"S, 131°51’23.50"E
South Australia, Australia
Find: 2015 Apr 15
Classification: Ordinary chondrite (LL6)

History: One fragment found by A. Tait, embedded in a cryptogamic soil horizon. Found during the *Monash* University meteorite recovery expedition.

Physical characteristics: One oval fragment 18 mm long, no fusion crust. Contains crosscutting calcite/gypsum weathering veins.

Petrography: (A. Tait, *Monash*) Chondrule edges are poorly defined, marked by extensive recrystallization of the matrix. BO and POP relict chondrules are rare, with equilibrated edges. Large (>100 µm) skeletal plagioclase grains exist across most the sample, with blebs of FeNi-alloy melt. Fe-oxide weathering is extensive with <5 wt% FeNi and/or sulfides remaining. Olivine show undulose extinction, but there are no indicators of higher shock.

Geochemistry: (A. Tait, *Monash*) EDS analyses show that olivine and pyroxene compositions are uniform: olivine $Fa_{25.7-28.5}$, mean= $Fa_{26.9\pm1.0}$ (N=11). Low-Ca pyroxene $Fs_{20.4-23.8}Wo_{1.8-1.2}$, mean $Fs_{21.3\pm1.0}Wo_{1.5\pm0.2}$ (N=13).

Classification: Ordinary Chondrite (LL6, S2, W4)

Specimens: The main mass and a thin section are held at *Monash* Under the curation of A. Tomkins.

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Ooldea 012 30°34’16.4"S, 131°46’18.1"E
South Australia, Australia
Find: 9 Apr 2013
Classification: Ordinary chondrite (L5)
History: Twelve fragments spread over ~20 m^2 found by A Tomkins
Physical characteristics: Several flatish blocky fragments up to 4 cm, several with partial fusion crust, weathered to brown-red.
Petrography: (J. Savage, *Monash*) Porphyritic chondrules >1 mm are recognisable amongst well recrystallized matrix. Two porphyritic chondrules <1 mm have troilite rims. Chondrule mesostasis is completely recrystallized. Minerals present are olivine, pyroxene, plagioclase, Fe-Ni metal and troilite. Chondrule types include PO, C, BO, POP, PP, and RP. The majority of olivine, pyroxene and plagioclase grains exhibit undulose extinction. 85% of Fe-Ni metal is weathered, 50-60% of Sulfides.
Geochemistry: (J. Savage, *Monash*) Microprobe analyses show that olivine and pyroxene compositions are uniform: olivine $Fa_{23.0-26.4}$, mean=$Fa_{24.2}$, std=1.6, n=5; Low-Ca pyroxene $Fs_{20.3-23.1}$, mean=$Fa_{21.4}$, std=1.09, n=5.
Classification: Ordinary chondrite (L5, S2, W3)

Ooldea 013 30°30’21.89"S, 131°48’29.78"E
South Australia, Australia
Find: 10 Apr 2013
Classification: Ordinary chondrite (L5)
History: Two broken fragments specimen found by J Kuyken
Physical characteristics: Partial fusion crust with rubbly looking broken interior, weathered brown with some lichen attached.
Petrography: (J. Savage, *Monash*) This meteorite is a genomict breccia consisting of two fragments. Nonporphyritic chondrules >1 mm are identifiable in one fragment amongst fine-grained matrix of plagioclase/maskelynite, pyroxene and olivine (chondrule types: PP, POP, RP, BO, PO, C). The other breccia fragment has lost all chondrule texture, with the exception of one 1.2 mm POP chondrule with a thick troilite rim. The contact between the two fragment types is gradational. All olivine, pyroxene and plagioclase show undulose extinction; some pyroxene and olivine grains have shock lamellae, and multiple olivine grains exhibit mosaicism. Fe-Ni metal shows<10% weathering, troilite <5%.
Geochemistry: (J. Savage, *Monash*) Microprobe analyses show that olivine and pyroxene compositions are uniform: olivine $Fa_{23.1-24.4}$, mean $Fa_{23.8}$, std=0.5, n=4; Low-Ca pyroxene $Fs_{19.6-20.5}$, mean $Fs_{20.13}$, std=0.47, n=5.
Classification: Ordinary Chondrite (L5-6, S4, W1).

Ooldea 015 30°31’53.5"S, 131°50’15.7"E
South Australia, Australia

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Find: 23 Apr 2013
Classification: HED achondrite (Howardite)

History: Single non-magnetic stone found by A. Tomkins

Physical characteristics: A brown flatish stone with sparse patches (5%) of black fusion crust.

Petrography: (S. Alkemade) This meteorite is an achondrite polymict breccia, containing clasts of eucrite and diogenite with sizes ranging from 0.2-5 mm in a clastic matrix. Mineralogy consists of orthopyroxene (>10%), clinopyroxene, plagioclase and minor olivine. A few dark angular clasts (0.5-2 mm) are fragments of carbonaceous chondrite material with mineralogy including amphibole, mg-spinel, and clinopyroxene. Accessory minerals are troilite, FeNi metal, chromite, ilmenite and olivine. The sample is highly shocked with most clasts exhibiting mosaic extinction and planar deformation features. Oxidation of metal and troilite is slight.

Geochemistry: (S. Alkemade) Orthopyroxene ($Fs_{42.1\pm11.9}$, n=10), pigeonite ($Fs_{22.1}Wo_{11.0}$), augite ($Fs_{25.8}Wo_{47.1}$), plagioclase (An_{87}, n=4), and rare olivine ($Fa_{6.65}$, n=1). Oxygen isotope analysis completed at *UNM* by Karen Ziegler, samples acid treated. $\delta^{17}O'$=1.586 (per mil, ±0.190) , $\delta^{18}O'$=3.644 (per mil, ±0.387), $\Delta^{17}O'$=-0.338 (per mil, ±0.043).

Classification: Howardite. Oxygen isotopes plot slightly below the eucrite/diogenite fractionation line, suggesting material from the carbonaceous chondrite clasts was included in the analyses.

Ooldea 017 30°31’40.9"S, 131°50’48.2"E
South Australia, Australia
Find: 19 Apr 2017
Classification: Ordinary chondrite (L5)

History: Three broken fragments found over an area of ~30 m^2 by R. Hine

Physical characteristics: Three red-brown fragments, probably about 50% of a single stone given the amount of fusion crust.

Petrography: (D. Steele) Chondrules are readily discernable in a recrystallized matrix. Chondrule types include BO, RP, POP, GOP. Mineralogy consists of olivine, plagioclase, pyroxene, Fe-Ni metal and troilite. Olivine displays straight extinction and weak mosiac extinction, planar and irregular fractures. The examined thin section contains one basalt clast. Fe-Ni metal and troilite have minor oxide rims

Geochemistry: (D. Steele) Microprobe analysis shows olivine and pyroxene compositions are uniform: olivine $Fa_{24.9\text{-}26.3}$, mean = $Fa_{25.5}$, std = 0.52, n = 5; Orthopyroxene $Fs_{20.9\text{-}21.0}$, std = 1.95, n = 3.

Classification: Ordinary Chondrite (L5, S4, W1)

Ooldea 018 30°35’27.5"S, 131°46’18.9"E
South Australia, Australia
Find: 21 Apr 2017

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Classification: Ordinary chondrite (L6)
History: 20 fragments were found in a small weathering dispersion elipse
Physical characteristics: A collection of broken fragments.
Petrography: (D. Steele) Chondrules are poorly defined in a stongly recrystallized matrix. Chondrule types include BO, GOP, RP, PP. Mineralogy consists of olivine, plagioclase, pyroxene, minor Fe-Ni metal, and troilite. Olivine displays undulose extinction and planar fractures. Opaque shock veins and melt pockets are present. Fe-Ni metal and troilite are ~95% replaced by Fe oxides.
Geochemistry: (D. Steele) Microprobe analysis shows olivine composition is moderately variable and pyroxene composition is uniform: Olivine $Fa_{24.9-25.3}$, mean $Fa_{25.0}$ mol%, std = 0.2, n =5; Orthopyroxene $Fs_{21.63-23.58}$, mean = 22.55 mol%, std = 0.91, n = 4.
Classification: Ordinary Chondrite (L6, S3, W3)

Ooldea 020 30°37'23.3"S, 131°53'43.2"E
South Australia, Australia
Find: 26 Apr 2017
Classification: Ordinary chondrite (H5)
History: Single stone found by j. Mitchell
Physical characteristics: Single piece with ~50% fusion crust.
Petrography: (D. Steele) Chondrules are well-defined in a transparent microcrystalline matrix. Chondrule types include BO, GOP, GP, RP, POP, PP, and cryptocrystalline. Mineralogy consists of olivine, pyroxene, plagioclase, Fe-Ni metal and troilite. Olivine and pyroxene display straight extinction. Fe-Ni metal and troilite are ~10% replaced by Fe oxides.
Geochemistry: (D. Steele) Microprobe analysis shows olivine and pyroxene compostion is uniform: Olivine $Fa_{18.3-19.2}$, mean = $Fa_{18.8}$, std = 0.32, n = 5; Orthopyroxene $Fs_{16.52-16.9}$, mean = 16.7, std = 0.16, n = 5.
Classification: Ordinary Chondrite (H5, S1, W1)

Ooldea 021 30°38'31.0"S, 131°54'58.5"E
South Australia, Australia
Find: 26 Apr 2017
Classification: Ordinary chondrite (LL3)
History: A single black specimen found amongst other black terrestrial rocks and limestone gibber by A. Tait
Physical characteristics: Black weakly magnetic sample, ~60% fusion crust.
Petrography: (D. Steele) Chondrules are sharply defined in an opaque matrix. Large chondrules between 1 and 1.5 mm are common. Chondrule types include BO, RP, GOP, GP, PO, POP, PP, cryptocyrstalline and poikilitic. Mineralogy consists of olivine, pyroxene, minor Fe-Ni metal and troilite. Olivine displays straight extinction. Fe-Ni metal and troilite is 30%-60% oxidised.

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Geochemistry: (D. Steele) Microprobe analysis shows olivine and pyroxene composition is widely variable: olivine $Fa_{17.1-49.5}$, mean = $Fa_{28.3}$, std = 12.83, n = 5; orthopyroxene $Fs_{8.35-38.1}$, mean = $Fa_{22.6}$, std = 11.86, n = 5.
Classification: Ordinary Chondrite (LL3, S1, W2)

Ouargla 003 31.466237°N, 5.325944°E
Ouargla, Algeria
Find: 2018
Classification: Martian meteorite (Shergottite)
History: Five matching fragments were purchased from the Moroccan dealer in 2019 totaling 68.40 g.
Physical characteristics: The meteorite has a greyish appearance without fusion crust.
Petrography: (A. Bischoff, *IfP*). The rock is coarse-grained and consists of up to mm-sized grains of pyroxene (intergrowth of low-Ca- and Ca-pyroxene; approximately 60 vol%) and interstitial maskelynite grains (~40 vol%). Plagioclase is completely transformed into maskelynite. Pyroxene is strongly fractured and has shock-induced mosaic extinction.
Geochemistry: Mineral compositions and geochemistry: (K. Klemm and S. Lentfort, *IfP*). Zoned low-Ca pyroxene is $Fs_{39-62}En_{22-44}Wo_{11-17}$ (average: $Fs_{52.1\pm7.0}En_{33.8\pm7.2}Wo_{14.1\pm1.5}$; n= 11). Ca-pyroxene is $Fs_{26.0\pm5.0}En_{42.3\pm4.8}Wo_{31.7\pm1.3}$, on average (n=14). The pyroxenes have mean Fe/Mn = 35.0. Plagioclase is $An_{51.2\pm4.7}Ab_{47.1\pm4.8}Or_{1.7\pm0.4}$ on average (n=9) and varies ($An_{42-57}Ab_{41-56}Or_{0.4-2.3}$).
Classification: Martian (Shergottite)
Specimens: 13.5 g and polished thin section at *IfP*

Oued Sfayat 26°42.433'N, 6°9.766'W
Tindouf, Algeria
Confirmed fall: 16 May 2019
Classification: Ordinary chondrite (H5)
History: On May 16, 2019, a meteor was seen by a group of shepherds at 9:00 pm (local time) at the Dakhla camp in Tindouf, Algeria. The meteor came in at a low angle (about 30 °) from the west and was moving east at a relatively low velocity. A shockwave was felt as the meteor exploded, and a booming sound was heard near the camp. Hibballah, one of the shepherds present at the camp, went in search alone the following morning (May 17, 2019) for pieces of potential meteorites that may have fallen, by following the direction of the observed meteor trail and booming sound. That same day, Hibbballah recovered the first fragment, an 80 g freshly crusted individual in the area of Oued Sfayat, a river valley about 70 km to the east of the Dakhla camp. After finding this piece, Hibballah returned to the camp to tell his father Oueld Ennajm the location where he had found the first piece. Several days later, Oueld Ennajm and a some shepherds traveled to Oued Sfayat and over the next few of months went searching for more fragments. After searching between the end

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of May through the middle July in a 1-2 km area at Oued Sfayat, about 8 kg of freshly crusted individual fragments (mostly small stones of varying sizes between 10-60 g, with the exception of a few larger-sized individuals ~600 g) were recovered by Oueld Ennajm and the shepherds. Some of these recovered fragments were then later sold to Ahmed Chacha and Otman Sidi Ahmed. Later on, some of the purchased fragments (2.6 kg) were subsequently purchased by Youssef Bennani, who later sent some small stones in for analysis.
Physical characteristics: Stones are covered by a black, fresh fusion crust. A cut of the interior reveals a light-gray surface.
Petrography: (Daniel Sheikh, *FSU*) Chondrules nearly absent(400 µm, N=1). Recrystallized matrix with plagioclase (10 µm). FeNi metal and troilite present.
Geochemistry: Olivine, $Fa_{18.1\pm0.3}$ (N=35); orthopyroxene, $Fs_{16.8\pm0.5}Wo_{1.1\pm0.1}$ (N=11).
Classification: Ordinary Chondrite (H5)
Specimens: 23.4 grams at *UCLA*; main mass with Youssef Bennani.

Paposo 055 24°59.727'S, 70°06.004'W
Antofagasta, Chile
Find: 2017 Feb 17
Classification: Ordinary chondrite (H5)
History: Found on coarse stony pediment. There were several fragments up to 10 m distance.
Physical characteristics: The main fargment is 30.5 kg.
Petrography: (J. Gattacceca, *CEREGE*) Equilibrated ordinary chondrite with plagioclase average size below 50 µm. Shock veins.
Classification: Ordinary chondrite (H5)

Paposo 059 24°56.894'S, 070°00.578'W
Antofagasta, Chile
Find: 2017 Feb 19
Classification: Carbonaceous chondrite (CO3)
Physical characteristics: Sawn surface shows a dark interior with many small chondrules. Stone low weathered.
Petrography: Abundant chondrules (predominantly of type I) and small CAIs set in a fine-grained matrix. The average chondrule apparent size is 180±60 µm (N=50).
Geochemistry: Olivine in the range $Fa_{4.0\text{-}43.1}$ (mean $Fa_{22.9\pm18.1}$, N=34). Cr_2O_3 in ferroan olivine 0.2±0.1 wt.% (N=12). Orthopyroxene in the range $Fs_{1.7\text{-}23.6}$ (mean $Fs_{12.1\pm9.2}$, $Wo_{1.9\pm1.3}$, N=14).

Rabt Sbayta 012 24°4.2917'N, 14°46.1147'W
Rio de Oro, Western Sahara
Find: 2016
Classification: Martian meteorite (polymict breccia)

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History: Found by Zaid Oualguirah and his group in 2016 near Bir Anzarane. Purchased by George Penneff in 2017 from Daoud Wabich in Zagora, Morocco.
Physical characteristics: Three stones, black fusion crust. A slice of the interior reveals a dark-gray surface containing light and dark clasts.
Petrography: (D. Sheikh, *FSU*) Polymict breccia composed of light and dark lithic clasts and mineral fragments set in a fine-grained matrix. Mineral compositions and textures throughout the specimen are highly variable.Mineral phases identified include orthopyroxene, pigeonite, augite, plagioclase, apatite, and magnetite.
Geochemistry: Orthopyroxene: $Fs_{26.6\pm5.5}Wo_{2.8\pm0.6}$ ($Fs_{21.3-38.2}Wo_{1.9-4.0}$, N=11, Fe/Mn=43.4±6.5); Pigeonite: $Fs_{34.2\pm7.9}Wo_{9.0\pm0.1}$ ($Fs_{28.6-39.8}Wo_{8.9-9.1}$, N=2, Fe/Mn=46.2±7.6); Augite: $Fs_{23.9\pm8.0}Wo_{38.5\pm3.7}$ ($Fs_{18.4-33.1}Wo_{36.1-42.8}$, N=3, Fe/Mn=47.4±9.4); Plagioclase: $An_{38.9\pm8.1}Ab_{58.8\pm7.0}Or_{2.3\pm1.3}$ ($An_{20.9-46.7}Ab_{51.7-73.1}Or_{1.5-6.0}$, N=11). Oxygen isotopes (K. Ziegler, *UNM*): analyses of acid-washed subsamples by laser fluorination gave, respectively, $\delta^{17}O$ 4.064, 3.943, 3.904; $\delta^{18}O$ 6.525, 6.337, 6.332; $\Delta^{17}O$ 0.619, 0.597, 0.561 per mil.
Classification: Martian (Polymict Breccia). Likely paired with NWA 7034 and pairings.
Specimens: 2.37 grams at *UCLA*; main mass with George Penneff.

Ramlat as Sahmah 531 (RaS 531) 20°10.568'N, 56°29.191'E
Al Wusta, Oman
Find: 2014 Nov
Classification: CV3.4
History: A fractured single stone was found as numerous specimens on an about 4 m^2 area by an anonymous finder.
Petrography: Chondrite with well defined chondrules and CAIs set in an abundant fine grained iron-rich matrix (48 vol% by point counting, n=266). Chondrule average apparent diameter 690±360 µm (n=39). Opaques are mostly magnetite and sulfides. Based on the structural order of the polyaromatic matter assessed by Raman spectroscopy (L. Bonal, *IPAG*), this meteorite appears to be slightly less metamorphosed than Chainpur (type 3.4). The Raman spectroscopy parameters of interest are FWHM-D (cm^{-1})=158.0±23.9, ID/IG=1.02±0.05, N=6 (see Bonal et al. 2016, figure 6).
Geochemistry: Olivine $Fa_{9.9\pm6.6}$, range $Fa_{3.9-22.4}$, Fa PMD 52% (n=5). Cr_2O_3 in ferroan olivine 0.14±0.09 wt% (n=5). Orthopyroxene $Fs_{2.2\pm0.2}Wo_{2.4\pm1.7}$ (n=3). Defocused matrix analyses: FeO 28.1 wt%, total 100.0 wt%.
Classification: Carbonaceous chondrite (CV3.4). Oxidized subgroup. Subtype from Raman spectroscopy.
Specimens: Type specimen at *CEREGE*. Main mass with *Kuntz*.

Red Dry Lake 079 (RdDL 079) 35°39.05'N, 114°1.66'W
Arizona, USA
Find: 2009

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Classification: Ordinary chondrite (L5)
History: Found in 2009 by meteorite-hunter, John Wolfe, while visually searching the surface of the dry lake.
Physical characteristics: This meteorite is a well-rounded, nearly-whole individual stone. The exterior is dark, grayish-brown and is 90% covered with a 2 mm-thick, relict fusion-crust, which is smooth and has very little in the way of rust-spots. A cut surface shows the interior is half-tan and half-orange in color, with few distinct chondrules in a compact matrix with very low metal-grain content, and few troilite grains.
Petrography: (Daniel Sheikh, *FSU*) Chondrule boundaries blurred (700±100 µm, N=3). Recrystallized matrix with plagioclase (10-25 µm).
Geochemistry: Olivine, $Fa_{22.6\pm0.9}$ (N=25); orthopyroxene, $Fs_{19.4\pm0.9}Wo_{2.5\pm0.7}$ (N=25).
Classification: Ordinary Chondrite (L5)
Specimens: 2.16 grams at *UCLA*; main mass with *Verish*.

Sahara 98112
Sahara
Find: 1998
Classification: Carbonaceous chondrite (CH3)
History: A single piece with a mass of 2.0 g was found in 1998 during the *Labenne* meteorite search in the Sahara.
Physical characteristics: The sample is a small, heavily weathered individual partly covered with fusion crust.
Petrography: (A. Bischoff, *IfP*) The meteorite shows a chondritic texture of small chondrules, abundant mineral and chondrule fragments, metals, sulfides, very rare small Ca,Al-rich inclusions, and small phyllosilicate-rich fragments embedded into a fine-grained matrix rich in terrestrial Fe-rich weathering products. The rock is a breccia. Chondrules are dominantly cryptocrystalline and typically <0.1 mm in diameter. Relicts of sulfides and FeNi metals are present in matrix and chondrule and fragments. Olivine shows undulatory extinction. Most metal is altered to Fe-hydroxides.
Geochemistry: (K. Klemm and A. Bischoff, *IfP*). Olivine Fa_{1-41} (mean $Fa_{16.1\pm11.4}$, n=23); low-Ca pyroxene $Fs_{0.5-21}Wo_{0-6}$ (mean $Fs_{6.2\pm5.3}Wo_{2.3\pm1.7}$, n=26).
Classification: CH3. S2, strong weathering.

San Juan 090 (SJ 090) 25°34.545' S, 069°43.892' W
Antofagasta, Chile
Find: 03-Feb-15
Classification: Iron meteorite (IIE)
Physical characteristics: A single mass partly sand-blasted. Sawn surface shows unweathered metallic interior with dark mm-sized inclusions.
Petrography: Etched section show a polycrystalline texture composed of 0.1 to 3 mm grains of kamacite often showing Neumann bands, troilite, schreibersite, silicate

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(0.2-1 mm) inclussions and plessitic fields. The silicates include olivine (Fa_{17-20}) and pyroxene (Fs_{16-19}).
Geochemistry: ICP-OES data (*UPC*): Ni=79.0, Co=4.6, P=1.3, S=3.2 (all mg/g); ICP-MS data: Cu=155, Cr=1.1, Ge=41.2, Ga=26.9, Pt=9.8, Os=4.4, Ru=5.2, Ir=5.3, Au=0.8 (all µg/g)
Classification: Iron, IIE

San Juan 105 (SJ 105) 25°35'48.0"S, 69°57'33.7"W
Antofagasta, Chile
Find: 2017 Oct
Classification: Ordinary chondrite (H3)
Petrography: (J. Gattacceca, *CEREGE*) Chondrite with well-delineated and packed chondrules. Opaque minerals are Fe,Ni metal and FeS. Olivine is slightly zoned.
Geochemistry: Olivine $Fa_{17.1\pm7.5}$, Fa PMD=32%, range $Fa_{1.7-29.8}$, Cr_2O_3 0.05±0.03 wt%.
Classification: Ordinary chondrite (H3)

Shanshan 002 43°6'18.84"N, 90°21'19.68"E
Xinjiang, China
Find: 2017 May 12
Classification: Carbonaceous chondrite (CO3)
History: The stone was collected by Zijian Wang and Yuxian Zhao during a meteorite seearch campaign in the Kumtag desert south of Shanshan County, Xinjiang, China.
Physical characteristics: One individual sample, 3100 g, spherical shape, covered with brown fusion crust.
Petrography: Meteorite consists of fine-grained matrix material, chondrules of Type I and II, AOAs, and refractory inclusions. Average diameter of chondrules is 0.16 mm. Chondrules consist of olivine, pyroxene, and plagioclase mesostasis. The minor phase are spinel, melilite, sulfides, kamacite, taenite, anorthite, perovskite and hibonite
Geochemistry: Olivine $Fa_{26.9\pm31.6}$ (N=25),CaO 0.36±0.30 wt%, MnO 0.38±0.21 wt%; low-Ca pyroxene $Fs_{52.0\pm5.4}Wo_{2.2\pm2.1}$ (N=14), pyroxene $Fs_{10.6\pm10.7}Wo_{38.3\pm10.4.}$

Shidian 24°42'27.54"N, 99°4'41.92"E
Yunnan, China
Confirmed fall: 2017 Nov 27
Classification: Carbonaceous chondrite (CM2)
History: On November 27, 2017, at about 14:30 local time, the fall of two stones were witnessed by eight local villagers and collected by one of them. The two stones fell in Dapuzhai and Chenjiazhai villages, in Shidian county, Yunan province. The

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two meteorites are 235 g (E 99°4'29.20", N24°41'54.81") and 1574 g (E 99°4'41.92", N24°42'27.54"), separated by about 1 km.
Physical characteristics: Two meteorites partly covered with fusion crust were recovered. The interior of the stones are black with abundant white dots.
Petrography: The meteorite consists of fine-grained matrix material (84.6 vol%) containing phyllosilicates, type I chondrules (15.4 vol%; average apparent diameter 380±120 µm, n=11) and rare CAIs. The dominant mineral of the meteorite is olivine and serpentine. Accessory minerals include troilite and calcite. Most chondrules are altered, but there still exist a few chondrules and forsteritic olivine.
Geochemistry: Forsterite $Fa_{0.51\pm0.16}$, range $Fa_{0.29-0.90}$ (N=11, EPMA).
Classification: Carbonaceous chondrite (CM2).

Sierra Gorda 010 22°30.49'S, 69°07.65'W
Antofagasta, Chile
Find: 2017 Oct 20
Classification: R4-an
History: One individual meteorite (280 g) was found in the desert by T. V. Kryachko.
Physical characteristics: The meteorite has a dark-brown fusion crust and greenish-gray color.
Petrography: M. A. Ivanova (*Vernad*) Meteorite consists of POP, BO and OP chondrules, up to 0.7 mm and matrix; matrix/chondrule ratio is ~1; some chondrule boundaries are not clear; main minerals are olivine, plagioclase, pyroxene, sulfides (pentlandite, pyrrhotite), magnetite; acsessory minerals are ilmenite and spinel; Fe,Ni metal is absent. Magnetic susceptibility (J. Gattacceca, *CEREGE*) log χ ($\times 10^{-9}$ m^3/kg) = 4.28 is an order of magnitude higher than for the usual R chondrites, and indicate a magnetite content of ~4 wt%.
Geochemistry: Mineral compositions and geochemistry: M. A. Ivanova (*Vernad*, *SI*), V. V. Kozlov (Oxford Instruments OM & Gatan Inc., Moscow Office) Olivine: $Fa_{36.9\pm0.3}$ (N=42), NiO - 0.44 wt%, orthopyroxene: $Fs_{20.5\pm6.3}Wo_{0.9\pm0.5}$ (N=35); augite $Fs_{11.7\pm0.5}Wo_{43.4\pm0.8}$; diopside $Fs_{8.4\pm2.5}Wo_{46.5\pm0.5}$; magnetite is highly enriched in Cr_2O_3 (9.0 wt%, n=27), and TiO_2 (1.56 wt%) and Al_2O_3 (1.6 wt%); plagioclase composition is $An_{4.7-12.2}Ab_{83.3-89.0}$; sulfides are pyrrhotite and pentlandite; Oxygen isotopic compositions: (*OU*) after acid washing $\delta^{17}O$ 5.684, 5.594; $\delta^{18}O$ 5.005, 4.932; $\Delta^{17}O$ 3.082, 3.029 (all per mil).
Classification: Chondrite, R4. The anomalous designation comes from the Fa content of olivine that is lower than in other R chondrites, and from the unusual and abundant magnetite enriched in Cr_2O_3 (up to 9.0 wt%) and TiO_2 (up to 1.56 wt%).
Specimens: One sample wheighing 64.9 g and a thin section are deposited in *Vernad*. Main mass with Mr. T. V. Kryachko (bredfield@mail.ru).

Sierra Gorda 012 22°30.198'S, 69°08.703'W
Antofagasta, Chile

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Find: 2018 Apr 6
Classification: Ordinary chondrite (H4)

History: The meteorite was found on 6 April 2018 by Ilya Chaplygin during an expedition organized by Timur Kryachko.

Physical characteristics: The meteorite is covered by a thin film of weathered material. Fusion crust has been totally sand-blasted. The interior of the meteorite is gray to dark brown whereas the surface is dark brown.

Petrography: (Pavel Yu. Plechov, *FMMR*) Petrographic observation of a polished section shows chondrules with clear borders. Chondrules size up to 1200 µm. Porphyric olivine and olivine-pyroxene chondrules as well as nonporphyric pyroxene and barred olivine chondrules are present. POP chondrules consist of large homogeneous Ol crystals whereas Low-Ca Px occupies peripheral parts. Low-Ca Px often has clear zoning from very high-Mg relict parts ($Fs_{1.8}$) to more ferrous rims ($Fs_{14.8}$) in these chondrules. Matrix consists of tiny olivine and low-Ca pyroxene grains (near 1 µm) with Fe-Ni metal and troilite. Metal consists of kamacite and taenite (with 23-34 wt% Ni). Very rare Plagioclase grains ($An_{1.9-3.5}$) are about 1 µm and only few are up to 3-5 µm. These features indicate a petrological type of 4 for the meteorite. Olivine shows no undulatory extinction. No shock veins or melt were found. Weathering products (goethite, "hydrogoethite") occur as veins and in situ alteration of FeNi metal.

Geochemistry: Mineral composition and Geochemistry: EDS-WDS analyses (Pavel Yu. Plechov, *FMMR*). Olivine $Fa_{15.8\pm1.2}$ (N=48), orthopyroxene $Fs_{11.2\pm3.1}Wo_{0.8\pm0.6}$ (N=24), plagioclase $Ab_{91.7}An_{2.6}Or_{5.1}$ (N=5), Cr-bearing clinopyroxene $En_{49.9}Fs_{15.4}Wo_{34.2}$ (N=5), chromite Crt76.8Spl5.5 (N=6). Phosphates are both Cl-apatite and merrillite. Composition of kamacite (in wt%, N=5): Fe 92.4, Ni 7.1, Co 0.56 (measured by WDS). Taenite (N=3): 27.1 wt% Ni, 0.26 wt% Co. Troilite is close to ideal FeS.

Classification: Ordinary chondrite (H4).

Specimens: Ilya Chaplygin holds main mass. 61 g and thin section, *FMMR*.

Sierra Gorda 013 22°30.96'S, 69°07.51'W
Antofagasta, Chile
Find: 2018 Oct 24
Classification: Carbonaceous chondrite (CBa)

History: 8 pieces of one meteorite were found in the the desert by Mr. T. V. Kryachko.

Physical characteristics: all samples of the meteorite have a brown fusion crust.

Petrography: M. A. Ivanova, C. A. Lorenz (*Vernad*) Meteorite contains two lithologies - one lithology consists of Fe,Ni-metal nodules(~80 vol%), up to 0.5 cm, and POP and BO chondrules, and their fragments up to 0.4 cm, matrix is absent; minerals are olivine, pyroxene, anorthite, Fe,Ni-metal, daubreelite, schreibersite and chromite. The second lithology consists of Fe,Ni-metal (~50 %) and silicates (~50%), with relic chondrules; many fractures filled by products of Fe,Ni oxidation are crossing the lithology. In this lithology, sulfides and schreibersite are absent.

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Shock stage is S2, but several fragments have stage S3-4 and contain melt pockets enclosing tiny blebbs of Fe,Ni-metal.
Geochemistry: Mineral compositions and geochemistry: M. A. Ivanova, C. A. Lorenz (*Vernad*) Olivine: $Fa_{2.2\pm0.3}$ (N=53), orthopyroxene: $Fs_{3.4\pm0.3}Wo_{1.6\pm0.3}$ (N=75), clinopyroxene is represented by diopside: $Fs_{1.9\pm0.4}Wo_{45.7\pm0.5}$; plagioclase has a constant composition: $An_{95.8\pm0.2}Ab_{4.0\pm0.3}$; Fe,Ni-metal is not zoned, kamacite contains 6.90 wt% of Ni, 0.39 wt% wt% of Co; daubreelite is enriched in V (up to 2.0 wt%); chromite contains up to 15.0 wt% of Al_2O_3 and 18.0 Wt% of MgO . Oxygen isotopic compositions: (*OU*) $\delta^{17}O$ -1.889, -1.9; $\delta^{18}O$ 0.65, 0.59; $\Delta^{17}O$ -2.226, -2.206 permil.
Classification: bencubbinite. Based on the texture, FeNi metal and chondrule sizes, their abundances, mineral compositions and bulk oxygen isotopic composition, the meteorite belongs to type CBa.
Specimens: a piece of the meteorite (99.3 g), 2 polished thin sections are deposited in *Vernad*. Mt. T. V. Kryachko (bredfild@mail.ru) holds the main mass of the meteorite.

Sierra Gorda 022 22°30.042'S, 69°01.475'W
Antofagasta, Chile
Find: 30 Mar 2018
Classification: Ordinary chondrite (L5)
History: Meteorite (1 piece) was found on March 30 2018 by Ilya Chaplygin during desert meteorite search organized by Timur Kryachko. Date of fall is unknown.
Physical characteristics: Single stone of rounded shape almost completely covered with black fusion crust. Broken part is brown. Fresh cut shows light gray-brown interior. Bottom part is covered with light-colored desert material.Dimentions 10,5x15x8,5 cm.
Geochemistry: Mineral composition and Geochemistry: EDS-WDS analyses (V.I. Taskaev, *IGEM* RAS). The primary chondrite paragenesis includes olivine $Fa_{24.41\pm1.09}$ (N=7), orthopyroxene $Fs_{20.1\pm1.04}Wo_{1.54\pm0.38}$ (N=9), plagioclase $Ab_{78.5}An_{14.8}Or_{6.5}$ (N=8), chromite-spinel Crt72Spl10.9Usp7.72 (n=2). Composition of kamacite (in wt., %, N=5): Fe 91.44, Ni ? 6.27 , Co ? 1.02 and taenite (in wt., %, N=3): Fe 61.1, Ni ? 37.92 , Co ? 0.42. Troilite is close to FeS.
Classification: (Pavel Yu. Plechov, *FMMR*). Ordinary chondrite. L5, S1, W1
Specimens: Mr. I. Chaplygin holds main mass 97.15 g. 20 g and thin section ? *FMMR*.

Sierra Gorda 023 22°30.020'S, 69°10.745'W
Antofagasta, Chile
Find: 31 Mar 2018
Classification: Ordinary chondrite (L6)
History: Meteorite (1 piece) was found on March 31, 2018, by Ilya Chaplygin during a desert meteorite search organized by Timur Kryachko.

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Physical characteristics: Individual stone, 2090 g, with angular shape and rough regmaglypts. Brown stone partly covered with dark-brown fusion crust. Fresh cut of the meteorite shows light-brown weathered interior and grains of metal. Bottom part is covered with light-colored desert material. Dimensions 10 × 10 × 9.5 cm.
Geochemistry: Mineral composition and Geochemistry: EDS-WDS analyses (V.I. Taskaev, *IGEM* RAS). The primary chondrite paragenesis includes olivine $Fa_{24.97\pm1.81}$ (N=15), Low-Ca pyroxene $Fs_{21.0\pm0.4}Wo_{1.74\pm0.25}$ (N=17), plagioclase $Ab_{94.1}An_{10.8}Or_{5.1}$ (N=2), high-Ca pyroxene $En_{47.06}Fs_{9.09}Wo_{43.71}$ (N=2). Composition of kamacite (in wt.%): Fe 93.52, Ni 4.99, Co 0.54 . Taenite contain 37.57 and 0.24 wt.% of Ni and Co respectively. Troilite is close to ideal FeS.
Classification: (Pavel Yu. Plechov, *FMMR*). Ordinary chondrite. L6, S1, W1
Specimens: Mr. I. Chaplygin holds main mass about 1.8 kg. 289 g and thin section, *FMMR*.

Smolenice 48°31.2'N, 17°23.9'E
Zapadoslovensky, Slovakia
Find: 2012 Mar 04
Classification: Iron meteorite (IVA)
History: On March 11, 2012, a meteorite was found in the forest. As the finder was not geologist and could not identify the object as a meteorite, he left it in place. He returned after three weeks and found it again on April 3, 2012.
Physical characteristics: One piece of 13.95 kg was found. The meteorite has a brown-colored surface that represents oxidized iron minerals.
Petrography: M. Gargulák (*SGUDS*) and D. Ozdín (*CUB*). The meteorite is composed of kamacite, taenite, troilite and daubréelite. There is a Widmanstätten pattern present. Troilite forms nodules in metal. Kamacite dominates over taenite. The average bandwidth of kamacite is 0.22 mm.
Geochemistry: Mineral compositions and geochemistry: ICP-MS and ICP-AES (S. Strekopytov, *NHM*): Ni 8.10, Co 0.378, Fe 88.7, P 0.05, S <0.006 (all in wt%); Ge < 0.7, Ir 1.67, Ga 1.80, Cr 87.3, Cu 135, As 4.52, Mo 5.82, Sn 1.53, W 0.565, Re 0.176, Ru 3.56, Rh 0.897, Pd 4.12, Au 1.19, Zn <5, B <0.68, Pb <0.06 (all in ppm).
Classification: Iron, fine octahedrite (Of), IVA group. Weathering of the meteorite is mostly minimal, moderate at the rims.
Specimens: The anonymous finder owns the main piece of the meteorite. The type specimens: 24.5 (*CUB*), 28.6 (*SNM*).

Star Flat N39°21.8717', W118°37.1482'
Nevada, United States
Find: 2013 Oct 18
Classification: Ordinary chondrite (H5)
History: Main mass holder is Robert *Verish*, who witnessed its recovery by the finder, Monika Waiblinger, in the middle of a dry lake on March 31, 2011.

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Physical characteristics: A roughly egg-shaped, dark-brownish black stone with a very weathered exterior that has sparse patches of relict fusion-crust. The interior is uniformly brown. Cut surfaces are sparsely flecked with very small metal-grains, but much troilite and many visible chondrules.
Petrography: (Daniel Sheikh, *FSU*) Chondrule boundaries blurred (500±100 µm, N=7). Recrystallized coarse-grained matrix with plagioclase (20-50 µm). Interconnected iron-oxide veins.
Geochemistry: Olivine, $Fa_{19.7\pm0.2}$ (N=22); orthopyroxene $Fs_{19.4\pm0.2}Wo_{2.4\pm0.1}$ (N=22).
Classification: Ordinary Chondrite (H5)
Specimens: 25.8 g at *UCLA*; main mass with *Verish*.

Sueilila 005 24.658°N, 14.692°W
Rio de Oro, Western Sahara
Find: 2015-Apr
Classification: Lunar meteorite (feldspathic breccia)
History: The stone was found by two Moroccan hunters in April 2015 in a barren region. Further searching in the area led to the recovery of other similar-appearing stones totaling 15.6 kilograms, but this first stone was considered to be possibly different (because of the presence of some larger lithic clasts), and it was excluded from the classification of the other stones as a group under the name NWA 10495. Subsequently the first stone was sold by the finders to a Moroccan dealer, who in turn sold it in February 2018 at the Tucson Gem and Mineral Show to representatives of ArtAncient (a British antiquities dealer).
Physical characteristics: A single, dark brown stone (282 g) lacking fusion crust but exhibiting a glossy weathering patina. Sawcuts reveal a very fine grained interior with diffuse larger whitish to black clasts.
Petrography: (A. Irving and S. Kuehner, *UWS*; P. Carpenter, *WUSL*) Breccia consisting of sporadic gabbroic anorthosite and rare dunite clasts in a fine grained crystalline matrix. Minerals are anorthite, exsolved pigeonite, orthopyroxene, pigeonite, subcalcic augite, olivine, ilmenite, Ti chromite (with variable Ti content) and secondary barite.
Geochemistry: Anorthite ($An_{97.1-97.4}Or_{0.0}$, N = 2), low-Ca pyroxene host ($Fs_{50.1}Wo_{6.0}$, FeO/MnO = 58), augite exsolution lamella ($Fs_{25.1}Wo_{40.9}$, FeO/MnO = 59), augite host ($Fs_{26.6}Wo_{40.2}$, FeO/MnO = 57), orthopyroxene exsolution lamella ($Fs_{56.1}Wo_{1.7}$, FeO/MnO = 55), orthopyroxene ($Fs_{39.6-41.7}Wo_{2.7-3.2}$, FeO/MnO = 59-63), pigeonite ($Fs_{26.7}Wo_{19.4}$, FeO/MnO = 55), subcalcic augite ($Fs_{21.0-39.2}Wo_{26.8-25.1}$, FeO/MnO = 46-59), olivine ($Fa_{41.3-56.8}$, FeO/MnO = 89-99, N = 3), olivine in dunite clast ($Fa_{46.7-48.0}$, FeO/MnO = 93-97, N =2).
Classification: Lunar (feldspathic breccia). This specimen is from the same strewnfield as the NWA 10495 stones and is very likely paired with them.
Specimens: 21.5 g in the form of two slices (one polished) at *UWB*; remainder with ArtAncient, Chelsea Creek, 31 Imperial Road, London SW6 2FR, UK.

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Sunfair 002 34°11.490'N, 116°14.130'W
California, United States
Find: 2013 September 13
Classification: Ordinary chondrite (H5)

History: A single 14.55 g stone was found among the gravels on the margin of a playa by Robert *Verish* on September 13, 2013, while part of a three person recovery team searching for additional meteorites from this locality.

Physical characteristics: This dark brownish-black, 14.55 g, nearly whole stone, with deeply weathered cracks, has a typical dry-lake smooth exterior, that of having a relict fusion-crust that has been devitrified and then sand/silt-polished while exhumed. A cut surface reveals an area of numerous, small metal-grains with visible chondrules, as well as a darker area with no visible metal grains or chondrules.

Petrography: (D. Sheikh, *FSU*) Chondrules blurred. Recrystallized coarse-grained matrix with plagioclase (15-30 µm). Interconnected iron-oxide veins.

Geochemistry: Olivine $Fa_{18.6\pm0.3}$ (N=25); orthopyroxene $Fs_{17.3\pm0.3}Wo_{2.4\pm0.1}$ (N=25).

Classification: Ordinary Chondrite (H5)

Specimens: 3.4 grams at *UCLA*; main mass with *Verish*.

Swayyah 001 26.709°N, 8.851°W
Saguia el Hamra, Western Sahara
Purchased: 2018 Nov
Classification: Lunar meteorite (gabbro)

History: Two large stones (2338 g, 1754 g) and several smaller stones were found together. One stone (177 g) was purchased by Darryl Pitt in November 2018. The 1754 g stone was purchased by Aziz Habibi in January 2019, and subsequently acquired by Darryl Pitt, who independently purchased three additional stones from several Mauritanian dealers in March 2019.

Physical characteristics: All stones lack fusion crust. Fresh interiors have a mottled dark gray appearance with a relatively coarse grained, equigranular texture.

Petrography: (A. Irving and S. Kuehner, *UWS*; P. Carpenter, *WUSL*) Coarse grained, with a gabbroic texture (mean grainsize 1.5 mm). Composed of patchily zoned clinopyroxene, maskelynite, and olivine, with accessory ilmenite, troilite, tranquillityite, Th-free monazite and rare kamacite. Minor secondary calcite and hyalophane were observed on some grain boundaries.

Geochemistry: Olivine ($Fa_{66.6-84.2}$, FeO/MnO = 92-102, N = 3), pigeonite cores ($Fs_{30.1-31.6}Wo_{13.4-10.4}$, FeO/MnO = 53, N = 2), pigeonite rim ($Fs_{44.4}Wo_{12.5}$, FeO/MnO = 59), subcalcic augite rim ($Fs_{46.9}Wo_{32.8}$, FeO/MnO = 71), maskelynite ($An_{85.1-89.1}Or_{0.8-0.3}$, N = 2).

Classification: Lunar (mare gabbro).

Specimens: 46.9 g including one polished thin section and one polished endcut at *UWB*; remainder with *DPitt*.

Swayyah 002 26.707°N, 8.936°W

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Saguia el Hamra, Western Sahara
Purchased: 2019 Feb
Classification: Martian meteorite (Shergottite)

History: Multiple stones (the largest weighing 3092 g) were found in early 2019. The majority of this material was purchased in February 2019 by Darryl Pitt from a Mauritanian dealer. One stone (100.34 g) was also purchased by Eric *Twelker* in February 2019 and two stones (total 98 g) were purchased by Ben Hoefnagels from Aziz Habibi in May 2019.Finally a stone (92.6 g) was acquired in October 2019 by Luc *Labenne* from a dealer in Zagora, Morocco

Physical characteristics: The stones lack fusion crust but in parts exhibit a desert weathering patina coating. Interiors have a mottled greenish-gray appearance.

Petrography: (A. Irving, *UWS* and P. Carpenter, *WUSL*) Diabasic texture (mean grainsize 0.7 mm). Composed mainly of zoned clinopyroxene and maskelynite with accessory Cr-Ti-bearing magnetite, ilmenite, chlorapatite, pyrrhotite and rare baddeleyite. Grains of Fe-Ti oxides and clinopyroxene exhibit minor orange staining, and there are some thin veinlets of secondary calcite. Sparse glassy shock melt pockets are present.

Geochemistry: Subcalcic augite ($Fs_{21.4-22.1}Wo_{35.4-33.6}$, FeO/MnO = 26-28, N = 3), pigeonite ($Fs_{30.8}Wo_{13.1}$, FeO/MnO = 28), ferroan pigeonite ($Fs_{50.8-63.3}Wo_{17.2-12.8}$, FeO/MnO = 35-38, N = 4), maskelynite ($An_{57.8}Or_{1.0}$). Bulk composition (A. Falster, *MMGM*): analyses by X-ray fluorescence spectrometry on cut surfaces of three specimens gave (in wt.%): SiO_2 48.56, TiO_2 1.15, Al_2O_3 12.00, Cr_2O_3 0.11, FeO 15.68, MnO 0.45, MgO 6.47, CaO 12.84, K_2O 0.03, P_2O_5 1.18.

Classification: Shergottite (diabasic).

Specimens: 31.9 g including two polished thin sections at *UWB*; remainder with *DPitt*, E. *Twelker* and B. Hoefnagels.

Tamusubulage 001 40°14’25.39"N, 103° 9’15.10"E
Nei Mongol, China
Find: 2016
Classification: Ordinary chondrite (LL~5)

History: (Ziyao Wang) Discovered by Yongsheng Wang in the desert Badain Jaran Shamo (Inner Mongolia) in 2016

Physical characteristics: 41 g stone with about 50 % black fusion crust

Petrography: (R. Bartoschewitz, *Bart*) light brown, recrystallized matrix with well-developed gray chondrules (0.4-2 mm, av. 1 mm) and small metal and sulfide specks

Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 3.91

Classification: Ordinary chondrite (LL~5, W2)

Specimens: 8.2 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 6.9 g with *Bart*.

Taqtaq-e Rasoul 34° 36' 56"N, 45° 46' 8"E

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Bakhtaran, Iran
Confirmed fall: 2019
Classification: Ordinary chondrite (H5)

History: Around 07h50 local time (GMT+3.5) on 10 August 2019, residents of several villages in Dasht-e Zahab region of Kermanshah province in Iran heard loud explosions like thunder. They were followed by noises similar to flying drones. Moments later, Madam Gohari a resident of Taqtaq-e Rasoul village (next to a hill with a similar name) noticed an object fall in their family yard, producing dust and getting dogs excited, surrounding it. After receiving a call from his mother about the event, Saman Gohari arrived at the site after 20 '. Informed about meteorites, he collected the stone (claiming that the stone was still hot). Because of site's vicinity to Iraq's border (~4 km), police investigated the site and the rock was broken into several pieces (two main pieces). As the area close to the border is covered by land mines, searching for more fragments was not possible. Several search attempts in the farms around the house and the villages failed to find additional fragments. A ~30 g fragment, along with several small fragments (~14 g together) were sent to Hamed Pourkhorsandi for study.

Physical characteristics: Originally a single stone was covered with fusion crust. A layer of soil was visible on the surface, resulting from its impact with the ground. Light-gray interior hosts chondrules. Metal and sulfide grains are visible by naked eye.

Petrography: Chondrite with recrystallized texture. Plagioclase average size is 40 µm. Opaque minerals are Fe,Ni metal and troilite.

Geochemistry: Olivine $Fa_{19.1\pm0.3}$ (n=5), orthopyroxene $Fs_{17.0\pm0.1}Wo_{1.3\pm0.1}$ (n=4), plagioclase $An_{12.2}Ab_{83.4}Or_{4.4}$ (n=1).

Classification: Ordinary chondrite (H5) based on petrography, magnetic susceptibility and mineral chemistry.

Specimens: A piece of ~1050 g is with the finders, ~650 g is with the police, and ~260 g is in Hojat Kamali's private collection. Type specimen (30 g) and a polished section at *CEREGE*. 14 g at *RBINS*.

Tassédet 004 ~18°40'30"N, ~7°23'53"E
Agadez, Niger
Find: 2016
Classification: Ordinary chondrite (H5, melt breccia)

History: A large stone of 405 kg was found around 5 km SE of Akokan. It is probably part of a large strewnfield extending for kilometers. Tassédet 004 is widely traded under the name "Tchifaddine."

Physical characteristics: Interior shows little to no signs of weathering. Exterior largely dark colored with protruding metal clasts, typically cm-sized.

Petrography: Examination of multiple kg of material shows considerable variation in petrography and clast size. This description is based on two representative slices (10 × 8 cm and 18 × 18 cm) and two polished microprobe mounts. The polished slices are dominated by black rounded clasts, surrounded by lighter-colored

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quenched melt and igneous-textured microporphyritic melt domains. The black clasts show an even distribution of metal and sulfide, typically <500 µm across, and significant porosity as vesicles 10 to 200 µm, some with euhedral grains protruding into the voids. Rare melt pockets to 100 µm. In the two sections, the chondrules in the black clasts are largely integrated into the matrix. A few PO and BO chondrules were recognized. The silicates contain an abundance of small, <1 µm, sulfide and metal grains. Clast metal dominated by kamacite, lacks Neumann bands, is anhedral though with curved outlines. It is typically single crystal, though some show a lath-like martensitic texture. Most kamacite grains have a "frothy" coating of troilite. Troilite is single crystal to polycrystalline and lacks shock lamellae. Metal/troilite grains >2 mm in the melt show eutectic textures. Grains smaller than 2 mm consist of Fe-Ni spheres with coatings of troilite. Chromite is a common accessory as anhedral grains to 200 µm. Feldspar, as anhedral grains, have a wide size distribution from <10 to >50 µm.

Geochemistry: (L. Garvie, *ASU*) Black clast: Olivine $Fa_{19.3\pm1.2}$, range $Fa_{18.5\text{-}22.1}$, FeO/MnO=39.9±2.9, CaO to 2.2 wt%, Cr_2O_3=0.1±0.03, range 0.04 to 0.14 wt%, n=9. Low Ca pyroxene, $Fs_{16.7\pm0.9}Wo_{1.8\pm0.5}$, FeO/MnO=23.4±2.5, n=10. Two high-Ca pyroxene grains found, $Fs_{6.8}Wo_{44.4}$ and $Fs_{6.1}Wo_{45.4}$. Feldspar $Or_{2.0\pm0.4}Ab_{76.2\pm0.9}$, n=5.

Classification: H5-melt breccia. Low weathering, W1, and high shock. Mineralogy and petrography are similar to the Gao-Guenie H5 melt breccia (Schmieder et al., 2016). Tassedet 004 is widely traded under the name Tchifaddine.

Specimens: 1237 g at *ASU*.

Tocache 8°11.78'S, 76°28.64'W
San Martin, Peru
Confirmed fall: 1998 Jan 01
Classification: Ordinary chondrite (H5)

History: The meteorite fall was witnessed by Mr. Leodegario Tolentino Laiza and Mrs. Horacia Padilla Herrera in the Tocache District, Tocache Province, San Martín Department, Peru. According to the witnesses, the fall occurred between midnight and two in the morning of January 1, 1998. A fireball was observed in the sky and, within ", it exploded. Soon after, a humming sound, like a small plane, was heard and then two impacts on the ground were felt. In the following week, Mr. Leodegario found the 5140 g fragment on his coffee plantation, in a small crater 1 m deep by 50-80 cm in diameter in the clay soil. According to him, the meteorite had a smell that resembled something burned and with sulfur. The meteorite was kept in a shed of the property, being exposed to the high humidity of the region that is part of the Peruvian Amazon. In 2017, the fragment was acquired from the couple's son, Mr. Willy Tolentino Padilla, by the Quimiosfera Laboratory at the Chemistry Institute of the University of São Paulo (*USP*) for study and classification.

Physical characteristics: The only fragment of the fall was acquired by the laboratory and weighed 5110 g, in addition to 30 g of fragments that were previously broken and sent by the owner. Thus, the final mass added up to 5140 g. The fragment was covered in about 80% of a dark-reddish fusion crust with different ° of oxidation.

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The exposed inner parts also have several rust colored spots of oxidized metal flakes. The fragment measured about 22 × 13 × 13 cm before the cut. One of the sides shows slight signs of orientation and, in one of the exposed inner parts, the meteorite shows a feature positively identified as a shatter cone. The conical and striated structure has 3 × 4 cm and was partially damaged by the action of the former owner during the removal of the 30 g of fragments that were first sent to the laboratory.

Petrography: Chondrule apparent diameter typically between 0.3 and 0.8 mm (mean 0.5 mm). Chondrules are not well defined. The chondrules represent around 60 to 70% of the area of the meteorite thin section. Most of the types seen are PO and POP, with RP appearing in lesser proportion, with no identified CAIs or AOAs. The Ol/Px proportion is around 80%/20%. More than 95% of the pyroxene crystals are orthopyroxenes, while 5% are clinopyroxenes. Olivine show light undulatory extinction, while virtually every pyroxene crystal shows strong undulatory properties. The pyroxene crystals commonly show both irregular and planar fractures. In contrast, the olivine crystals only show irregular fractures, while planar ones are rare. The metorite shows several long and thin melt veins (around 400 µm wide), some of them with small melt pockets and presence of melted metal and troilite flakes or even whole melt metal veins. The opaque phase makes up 11% of the meteorite volume (tomography), of which ~7-8% is kamacite/taenite, 3% is troilite and possibly 0.1 to 0.2% is chromite. The metal flakes have sizes varying between 0.1 and 1 mm (mean 0.3 mm), with some degree of connection between them being moderately common. Neumann lines can be seen on kamacite crystals and around 20 to 30% of the metal has already been oxidized. This generates an orange staining on the silicate phase around the metal flakes, being that areas near the surface show more oxidation than inner areas (F. Falco, *USP*).

Geochemistry: Mineral compositions and geochemistry: Olivine ($Fa_{20.1\pm0.8}$; N=82), low-Ca pyroxene ($Fs_{16.6\pm0.6}Wo_{1.3\pm0.7}$; N=60), high-Ca pyroxene ($Fs_{11.2}Wo_{25.7}$; N=1), feldspar ($Ab_{78.3\pm4.5}An_{15.7\pm6.4}Or_{5.9\pm4.7}$; N=7). MEV/EDS: troilite (Fe = 64.7±0.6 wt%, S = 35.5±0.6 wt%; N=2), kamacite (Ni = 7.2±1.5 wt%; N=2), taenite (Ni = 29.8±3.7 wt%; N=2), tetrataenite (Ni = 46.2±0.6 wt%; N=1), chromite (Cr/(Cr+Al): 0.88±0.06; N=4), zoned Cr-spinel (edge = Cr/(Cr+Al): 0.58±0.05, Mg/(Mg+Fe): 0.22±0.03, Ti: 0.5±0.1 wt%; N=3) (center = Cr/(Cr+Al): 0.29±0.04, Mg/(Mg+Fe): 0.40±0.03; N=3), apatite (Cl: 5.0±0.2 wt%, F: 1.2±0.2 wt%; N=1), ilmenite and merrillite (RAMAN).

Classification: Ordinary Chondrite (H5), S3, W2.

Specimens: Quimiosfera Laboratory - IQ/*USP*: 3320 g (main mass); Museo de Historia Natural - UNMSM: 131.6g; Type specimens: IGc/*USP*: 397.13g and 6 thin sections, *MNRJ*: 145.6 g and *MCM*: 7.4g and 2 thin sections.

Viñales 22°37.17'N, 83°44.57'W
Pinar del Rio, Cuba
Fall: 2019 Feb 01
Classification: Ordinary chondrite (L6)

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History: A bright bolide accompanied by loud sonic booms flew across the province of Pinar Del Rio, Cuba, at 1:17 pm local time (18:17:10 UTC) on 1 February 2019. A long smoke trail was also observed. The residents thought a plane had crashed, as they heard explosions and then ground rumbling lasting 15 to 20 s. A meteorite shower fell on Vinales Valley, a national monument since 1978 and a UNESCO world heritage site. The area is covered by a forest and fields. The first and some of the largest stones were collected near the monument "Mural of Prehistory" by artist Leovigildo Gonzalez Morillo. Others were discovered in and around Viñales and throughout the Viñales Valley. Some of the meteorite individuals penetrated the ground, one of them broke through an asphalt road, and many were recovered from rooftops.

Physical characteristics: Hundreds of individual samples were collected by the local residents. The stones are covered by black fusion crust with reddish smears of a laterite clay. The substance of the meteorite of light gray color can be seen in small areas of the broken crust. The masses of stones are in a range 2 to 1100 g. In total, about 50-100 kg of the meteorite were collected.

Petrography: The interior is light-colored; silicates are transected by dark, pseudotachylite-like shock veins. The rock is highly recrystallized; chondrule margins are difficult to discern. Recognizable chondrule types include POP, PO and BO, ranging up to ~1 mm in diameter. The meteorite samples contain the several vol% of black inclusions of melt rock. Metal grains range in size up to about 700 µm. The rock exhibits moderate silicate darkening. Chromite grains are moderately to extensively fractured. Some troilite grains and some kamacite grains are polycrystalline. A few kamacite grains contain small rounded grains of troilite within them. Metallic Cu was not observed. There are several small chromite-plagioclase assemblages and some olivine grains contain small chromite veinlets. The shock veins range to more than 1 cm in length and are typically 20 µm to 150 µm wide. The veins contain major silicate and small blebs of metallic Fe-Ni, and to a lesser extent, troilite; these opaque blebs are typically 1-3 µm in diameter. Also present in the veins are cellular metal-troilite veinlets 10-30 µm in length. Elongated aggregates of chromite occur alongside portions of some shock veins. Slabs of Viñales show intersecting dark shock veins, anastomosing veins, and a few quasi-circular melt concentrations where veins intersect. Coarse metal grains are heterogeneously distributed in some samples – some regions of these samples have abundant coarse metal; other regions have none. Near the dark fusion crust, numerous thin veinlets of troilite surround and penetrate fractures within silicate grains. Magnetic susceptibility (J. Gattacceca, *CEREGE*): log χ ($\times 10^{-9}$ m^3/kg) = 4.93 measured on a 18 g sample.

Geochemistry: Mineral compositions and geochemistry: (Borisovsky S. E., *IGEM*; A. Rubin, *UCLA* and L. Garvie, *ASU*) Olivine, $Fa_{24.7\pm0.3}$ (N=15, *IGEM*), $Fa_{24.6\pm0.4}$ (n=23, *UCLA*); low-Ca pyroxene, $Fs_{21.0\pm0.4}Wo_{1.5\pm0.3}$ (N=21, *UCLA*), $Fs_{20.2\pm0.3}Wo_{1.6\pm0.2}$ (N=15, *IGEM*); other minerals characterized by *UCLA* and *ASU* include diopside ($Fs_{8.1\pm0.1}Wo_{44.8\pm0.6}$; n=5), plagioclase (which has an average size of ~80 µm; $Ab_{90.0\pm0.5}Or_{1.8\pm1.2}$; n=14), chromite, kamacite (6.6±0.6 wt.% Ni; 0.89±0.12 wt.% Co), troilite (containing 0.7-0.42 wt.% Ni), taenite, and

accessory tetrataenite, merrillite and chlorapatite. Oxygen isotopes (K. Ziegler, *UNM*): $\delta^{18}O$=4.38, 4.55, 4.69; $\delta^{17}O$=3.39, 3.50, 3.57; $\Delta^{17}O$=1.08, 1.09, 1.09 (all ‰).
Classification: (Dr. C. Efrén Jaimez Salgado; IGA, Havana, Cuba; C. A. Lorenz, *Vernad*.) Ordinary chondrite (L6), Weathering grade is W0, Shock stage is S3 (*Vernad*) or S4 (*UCLA*).
Specimens: The individual sample of 148 g and one transparent-polished section are deposited in *Vernad*; 22 g, *UCLA*; 18 g, *CEREGE*; 8 individual samples of total mass 2.31 kg are on deposit in Institute of Geophysics and Astronomy (IGA), Havana, Cuba. Large specimen masses are also held by John Higgins, *MFarmer*, and *DPitt*.

Wadi El Gamal
Egypt
Purchased: 1974
Classification: Iron meteorite (IIIAB)
History: Qarabawi's Camel Charm was acquired from Abdullah Qarabawi of the Ababda tribe of eastern Egypt and donated to the Smithsonian Institution in 1974 by the Geological Society of Egypt. Although the location of the meteorite find is not known, it was found by the Ababda tribe. Wadi El Gamal, translated as the Valley of the Camel, is the name of a 7000 km2 national park, which can be found on the edge of the Red Sea, within the traditional homelands of the Ababda. A heritage center opened in this park in 2006 dedicated to preserving the heritage of the Ababda.
Physical characteristics: The charm consists of an ~6.5 cm flattened disk (thickness 5 mm) with the Arabic inscription "Allahu Akbar", which translates as "God is Greatest." Attached to the charm are four links, also made of meteoritic material.
Petrography: Non-destructive analyses of the disk and metallographic examination of the distal link reveal a deformed medium octahedral pattern, confirming the meteoritic origin of the Camel Charm.
Geochemistry: Major, minor, and trace element compositions are consistent with classification as a IIIAB iron. Fe 91.75 wt %, Ni 7.76 wt %, P 0.09 wt %, Co 0.01; Ir (14.63 ppm, LA-ICP-MS), Ni (7.76 wt%, microprobe analyses), Ga (28.5 ppm LA-ICP-MS), and Ge (38.0 ppm LA-ICP-MS).
Classification: Iron, IIIAB

Watson 021 30°35'53.2"S, 131°35'05.3"E
South Australia, Australia
Find: 12 Apr 2015
Classification: Ordinary chondrite (L6)
History: One fragment found by A. Langendam. Sub-sectioned for biology experiment in the field.

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Physical characteristics: Single stone found with large crack running down the middle, fusion crust remaining (~30%), which appears to have had chipped off in places.
Petrography: (A. Tait, *Monash* U.) Sample has chondrules that are strongly equilibrated with the surrounding matrix, including POP, RP, PO types. Large plagioclase exhibit undulose extinction. Dihedral angles between plagioclase, olivine and pyroxene are consistently ~120 °. About 90% of the FeNi grains are oxidised, with many unoxidised troilite grains, and iron oxide veins transect the sample. Olivine shows undulose extinction and shock lamellae. Pockets exist of troilite-silicate melt emulsion (shock melting).
Geochemistry: (A. Tait, *Monash*) EPMA analysis show olivine and pyroxene compositions are uniform: Olivine $Fa_{24.3-25.2}$, mean = $Fa_{24.6\pm0.3}$, n = 19; Low-Ca pyroxene $Fs_{20.6-23.0}Wo_{1.0-1.9}$, mean = $Fs_{21.2\pm0.7}Wo_{1.5\pm0.2}$, n = 16.
Classification: Ordinary Chondrite (L6, S4, W4)
Specimens: Main mass and one thin section curated at *Monash*.

Watson 024 30° 29’ 07.3"S, 131° 41’ 08.6"E
South Australia, Australia
Find: 2015 Apr 08
Classification: Enstatite chondrite (EL6)
History: Single stone found amongst limestone gibber by H. Brand.
Physical characteristics: Flatish weathered looking stone lacking fusion crust.
Petrography: (D. Steele) Relict ~0.6 mm wide chondrules are poorly defined in a strongly recrystallised matrix. Surviving chondrule type is predominantly RP. Mineralogy consists of ensatite, plagioclase, Fe-Ni metal and graphite. Pyroxene displays undulose extinction and planar fractures. Fe-Ni metal is 70% - 90% replaced by Fe oxides.
Geochemistry: (D. Steele, A. Tomkins) Microprobe analysis shows pyroxene compositions are uniform: Enstatite $Fs_{0.14-1.09}$, mean = $Fs_{0.47\pm0.38}$Ens97.97$Wo_{1.56}$, n = 5. Metal averages 1.10 wt.% Si.
Classification: Enstatite Chondrite (EL6, S2, W4)

Wubao 001 42°05’38.94"N, 92°12’26.68"E
Xinjiang, China
Find: 2017
Classification: Ordinary chondrite (H~4)
History: (Ziyao Wang) Discovered by Wentao Yang (Urumqi) in the desert near Dahaidao (Xinjiang Province) in 2017
Physical characteristics: 905 g nearly square stone with many cracks
Petrography: (R. Bartoschewitz, *Bart*) assemblage of gray to light-brown, rounded rock fragments up to 5 cm, rimmed by gray-black veins. Well recognizable chondrules (0.2-1 mm, av. 0.5 mm) and irregular metal and sulfide inclusions

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Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ (× 10^{-9} m^3/kg) = 5.06
Classification: Ordinary chondrite (H~4, W2)
Specimens: 21.5 g on deposit at *Kiel*, Wentao Yang and Ziyao Wang holds the main mass, and 86 g with *Bart*.

Wubao 003 42°17'37.30"N, 92°00'47.44"E
Xinjiang, China
Find: 2019 Mar
Classification: Ordinary chondrite (L~6)
History: (Ziyao Wang) Discovered by Wentao Yang (Urumqi) in the desert near Dahaidao, Xinjiang Province, in Mar 2019
Physical characteristics: (Ziyao Wang) Gray-brown stone of 78 g without fusion crust
Petrography: (R. Bartoschewitz, *Bart*) yellowish gray-brown recrystallized matrix with indistinct chondrules and shock veins.
Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ (× 10^{-9} m^3/kg) = 4.58
Classification: Ordinary chondrite (L~6, W4)
Specimens: 16.0 g on deposit at *Kiel*, Ziyao Wang holds the main mass, and 9 g with *Bart*.

Yazd 002 31.76697°N, 55.31815°E
Yazd, Iran
Find: 2018
Classification: Ordinary chondrite (LL3)
Petrography: (J. Gattacceca, *CEREGE*) Chondrite with packed chondrules with average apparent diameter 920±450 µm (n=23). Opaque are metal and sulfides.
Geochemistry: Olivine $Fa_{21.0\pm10.4}$, Fa PMD 39%, Cr_2O_3 0.06±0.04 (n=6). Low-Ca pyroxene $Fs_{13.3\pm10.8}Wo_{1.4\pm0.4}$ (n=2).
Classification: Ordinary chondrite (LL3). LL group from chondrule size.

Yu Wei Liang 002 (YWL 002) 41°53'31.40"N, 91°08'58.00"E
Xinjiang, China
Find: 2015
Classification: Ordinary chondrite (H~6)
History: (Ziyao Wang) The meteorite was discovered by the meteorite hunter Jianjiang Xu (Hami/Xinjiang) near Ruoqiang (Xinjing) in 2015
Physical characteristics: brown stone of 22.9 g
Petrography: (R. Bartoschewitz, *Bart*) dark-gray, recrystallized matrix, with poorly recognizable chondrules, and nearly oxidized metal and sulfide

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Geochemistry: Magnetic susceptibility (R. Bartoschewitz, *Bart*) log χ ($\times 10^{-9}$ m^3/kg) = 4.78
Classification: Ordinary chondrite (H~6, W5)
Specimens: 4.6 g on deposit at *Kiel*, Jianming Wang and Ziyao Wang holds the main mass, and 5 g with *Bart*.

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