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► To cite this version:

Carlos Mazo, Marta Alcolea. New data concerning Neanderthal occupation in the Iberian System: First results from the late Pleistocene (MIS 3) Aguilón P5 cave site (NE Iberia). *Quaternary International*, 2020, 551, pp.105 - 122. 10.1016/j.quaint.2019.07.025 . hal-03492511

HAL Id: hal-03492511

<https://hal.science/hal-03492511>

Submitted on 7 Sep 2022

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1 **NEW DATA CONCERNING NEANDERTHAL OCCUPATION IN THE**
2 **IBERIAN SYSTEM: FIRST RESULTS FROM THE LATE PLEISTOCENE**
3 **(MIS 3) AGUILÓN P5 CAVE SITE (NE IBERIA).**

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13 *Keywords: Middle Palaeolithic, Mousterian, south of the Ebro River, lithic industry,*
14 *palaeoenvironmental conditions.*

15 **Abstract**

16 *This work presents the first results from the Aguilón P5 (Zaragoza) cave site on the*
17 *northern slope of the Iberian System (NE Iberia). The fieldwork carried out since 2010*
18 *on several archaeological layers containing remnants of human occupations has*
19 *revealed lithic remains, processed faunal bones and charred plant remains from*
20 *combustion events. Due to the lithic tool assemblage and radiocarbon dating (>50.0-*
21 *41.9 kyr BP), the attribution of this human occupation to the Mousterian techno-*
22 *complex is clear, contemporary with other important Late Mousterian sites in the Ebro*
23 *Basin (NE Iberia) and Mediterranean region. Preliminary results concerning*
24 *stratigraphic, chronometric, techno-typological and palaeoenvironmental data from the*
25 *last human occupations of the cave (archaeological layers “cnc”, “mcp” and “e”) are*
26 *provided in this paper.*

27 *To contextualize the Neanderthal occupation of the Aguilón P5 cave, a timeline of*
28 *Middle Palaeolithic in the Iberian System is proposed. A total of 45 dates from 19*
29 *stratigraphic units (including speleothems) are available from 10 sites. Chronometric*
30 *dating series allow us to establish the temporary framework of Mousterian industries in*
31 *the Iberian System coinciding with the abrupt climate changes related to Heinrich*
32 *Events which characterize MIS 3. In summary, this paper provides new chronometric*
33 *and archaeological information about Neanderthal settlement and subsistence in an*
34 *under-investigated region.*

35 **1. INTRODUCTION**

36 The disappearance of the last Neanderthals in Europe is an important current issue in
37 archaeological research. The Iberian Peninsula, on a corner of the Eurasian continent,
38 has been revealed as a key territory in this scientific discussion (D’Errico et al., 1998;
39 Villaverde et al., 1998; Pettitt and Bailey, 2000; Straus, 2005; Hublin and Bailey, 2006;
40 Zilhao, 2006; Finlayson et al., 2006; Jennings et al., 2011; Wood et al., 2013; Higham et
41 al., 2014; Benazzi et al., 2011 and 2015). However, vast Iberian territories, such as the

42 Iberian System located immediately to the south of the Ebro River, continue to be
43 under-investigated. The Iberian System extends throughout approximately 35000 km²
44 where the number of known Middle Palaeolithic sites, including stratigraphic sequences
45 in caves, rock shelters and open-air sites, barely exceeds twenty. Most of these sites,
46 distributed in a dispersed pattern, are located on the northern slope, towards the central
47 Ebro Basin, where archaeological surveys have been more intense.

48 In this work we focus on the first results from the Aguilón P5 (AGP5) cave, a new Late
49 Pleistocene (MIS 3) site located on the northern slope of the Iberian System, where
50 successive Mousterian occupations have been documented through flint-knapping
51 evidence as well as in the recognition of numerous examples of combustion evidence.
52 Archaeological fieldwork, started in 2010, as well as specialized studies are still in
53 progress. However, preliminary results enable us to advance some interpretations which
54 will be verified during the progress of the archaeological research. The well-known
55 human occupations correspond so far to archaeological levels “cnc”, “mcp” and “e”.
56 Unpublished stratigraphic and radiometric data are presented in this paper as well as
57 some preliminary results from lithic typology, archaeopetrology, anthracology and
58 archaeozoology. Some aspects of the research, especially concerning
59 palaeoenvironmental aspects during MIS 3, are based on the neighbouring
60 paleontological site of Aguilón P7 (AGP7) (Cuenca et al., 2010), located in the same
61 karst complex (Cerro del Pezón), where some evidence of Neanderthal visits has also
62 been documented. To contextualize this site, a timeline of Middle Paleolithic in the
63 Iberian System is proposed based on available radiometric, stratigraphic and
64 archaeological information, from first Neanderthal manifestations (MIS 9/5) to the last
65 Mousterian occupations that disappeared from this territory around 42-40 ka ago.

66 **2. GEOGRAPHICAL SETTING**

67 **2.1. The Iberian System: regional setting**

68 The Iberian System is a medium high mountain system that rises between the morpho-
69 structural units of the Ebro Basin and Central Plateau. It extends almost 400 km from
70 the Bureba corridor and Demanda Range in the Northwest to the Tortosa-Beceite
71 mountain passes and Mira Range in the Southeast (Figure 1). The higher elevations are
72 concentrated in the northeastern part (Moncayo massif, 2300 masl).

73 The Iberian System is a compartmentalized mountain system composed of a complex
74 group of mountain ranges, massifs and depressions of diverse lithic and structural
75 composition, often geologically isolated, which are linked by intermountain plateaus.
76 The Jalón, Huerva and other rivers cross the system perpendicularly and have served as
77 obligatory transit routes between the Ebro basin and the inner Iberia. From the
78 Mediterranean (Southeastern sector) to the Jalón basin the mountain system is divided
79 into two mountain ranges. The interior is parallel to the Central Plateau, and the exterior
80 to the Ebro River, both separated by the Iberian Depression (or Daroca corridor).
81 Pleistocene glacial phenomena in the Iberian System are infrequent. In the Aragonese
82 sector, cold periods are represented by periglacial forms, with accumulative and erosive

83 processes of cold genesis, such as nivation hollows, block slopes, etc. (Peña and
84 Lozano, 2004).

85 This region is currently characterised by a warm continental Mediterranean climate with
86 long, dry summers, an average annual temperature between 12 and 14 °C, and between
87 350 and 500 mm of annual precipitation, while Atlantic climatic influences are
88 restricted to the highest and most exposed mountain areas of the north-western Iberian
89 System. By contrast, during the MIS 3 cold and arid conditions prevailed in northern
90 Iberia, punctuated by abrupt climate changes related to Heinrich Events (HE) (Moreno
91 et al., 2012).

92

93 **2.2. The Cerro del Pezón: local setting.**

94 Located between the Huerva River and the Valdeaguilón ravine, the Cerro del Pezón
95 massif reaches above 772 masl. The AGP5 and other six cavities are in the contact area
96 between two lithostratigraphic units composed of Upper Jurassic (Malm) marine
97 limestone: Loriguilla Fm. (Kimmeridgian), formed by the regular alternation of
98 mudstone limestone and loamy limestone, and Higuieruelas Fm. (Tithonian), formed by
99 massive oncolithic limestone (Ipas et al., 2004). Only three of these caves, AGP3,
100 AGP5 and AGP7, have offered evidence of human presence, and only two, AGP5 and
101 AGP7, which contains an Upper Pleistocene (MIS 3) paleontological site (Cuenca et al.,
102 2010), were visited by people during the Pleistocene.

103 The Cerro del Pezón is situated in an optimal biogeographical location (Figure 2).
104 Following the course of the Huerva River, the Daroca corridor is easily reached. From
105 there the Mediterranean Levantine area is accessible through the course of the Turia
106 River and the Central Plateau through the Jiloca River (tributary of Jalón). Otherwise,
107 its location in a contact area between the Iberian System and the central Ebro Basin
108 places it in an ecotone between the mountains and valley lowlands.

109 The present-day flora is highly influenced by orography, lithology and also the
110 anthropic impact. Although the Holm oak (*Quercus ilex* subsp. *ballota*) characterizes
111 the climax plant community of the meso-Mediterranean bioclimatic belt in the
112 Mediterranean vegetation region (Rivas-Martínez, 1983), it has been greatly affected by
113 the successive clearings and felling oriented to the creation of crop lands (Longares,
114 2004). Extensive plantations of Aleppo pine (*Pinus halepensis*), a native meso-
115 Mediterranean species that has been re-introduced for wood production, are dominant in
116 the immediate surroundings of the cave.

117

118 **3. ARCHAEOLOGICAL FRAMEWORK**

119 Excluding isolated findings, the number of known Middle Palaeolithic sites in the
120 Iberian Range barely exceeds twenty, including stratigraphic sequences in caves and
121 rock shelters and open-air sites, which cover a chronological range of at least 300 ka
122 (Figure 1). The available archaeological information from each site is truly variable,
123 from very little data to exhaustive multi-disciplinary publications. Settlement patterns

124 suggest that the location criteria depend on the functionality of each site. Thus, the
125 existence of campsites, raw material quarries with knapping activities, and
126 killing/butchering stations has been suggested.

127

128 Regarding open-air sites, the locational criteria probably depends on the immediate
129 access to high quality flint outcrops or certain favourable conditions for hunting.
130 Flintknapping sites are located between 360 masl and 840 masl. This is the case of the
131 Najerilla Basin sites (Utrilla et al, 1988), as well as Miedes and Montón (Galindo,
132 1986), La Bardalera (Utrilla and Aguilera, 1983), Las Paretillas and Paridera de la
133 Condesa (Montes, 1988) and Cabezo de Marañán (Utrilla and Tilo, 2001). The Paridera
134 de la Condesa and Najerilla Basin sites have also been interpreted as open-air campsites
135 dedicated to the exploitation of a broader range of palaeoeconomic resources, based on
136 the abundant presence of retouched blanks apparently used and subsequently discarded
137 or lost (Montes, 1988). Hunting or killing practices have been identified in sites located
138 at higher altitudes such as Cuesta de la Bajada (920 masl) (Santonja et al., 2014) in a
139 fluvial terrace, and Las Callejuelas (1400 masl), the highest Mousterian site of
140 Southwest Europe, in an endorheic plain (Domingo et al., 2017).

141 Archaeological sites in caves or rock shelters are located from 700 to 1280 masl over
142 riverbeds or ravines, passages between valleys and plateaus or places where there is a
143 broad visual domain or that form a sort of natural trap. Some of them have been
144 interpreted as being sites of extended or repeated stays, such as La Ermita and Cueva
145 Millán (Moure and García-Soto, 1983; Díez et al., 2008), Peña Miel (Utrilla et al.,
146 1987), Los Casares (Barandiarán, 1973; Alcaraz-Castaño et al., 2017) and La Quebrada
147 (Villaverde et al., 2017). They reveal more or less structured hearths and anthropic
148 fractures in bones that accompany the recovered lithic assemblages. In other cases these
149 are messy deposits, without recognizable evidence of human spatial organization, such
150 as Ahumado del Pudial (Domingo and Martínez-Bea, 2001-2002), and/or which do not
151 offer chronometric information, such as Eudoviges (Barandiarán, 1975-1976).

152

153 **4. SITE DESCRIPTION AND STRATIGRAPHY**

154 **4.1. Site description**

155 AGP5 is a north-oriented cave opened in the cliff that crowns the Cerro del Pezón
156 massif, close to Aguilón village (Zaragoza), about 740 masl and 110 m above the
157 present running water of the Valdeaguilón ravine. Its geological origin is in the
158 mechanical evolution of two main fractures of the rock, from which occasionally
159 massive collapses have occurred of a limestone bank whose high fracturing degree is
160 multiplied by the presence of stylolitic joints. No karstic processes are observed in its
161 genesis, as opposed to AGP7.

162 The site consists of a north-south direction cavity, about 20 m long, 8 m wide and up to
163 7.80 m high (2.30 m in the mouth). It does not receive direct sunlight, but is remarkably
164 sheltered from the prevailing wind in the Ebro basin. The present surface of the cave is
165 approximately 100 m². Two different areas can be distinguished: a hall, vestibule or

166 entrance area in the outermost part, covered but exposed to environmental conditions,
167 and an inner chamber that offers greater protection. During the Pleistocene occupation
168 of the cave this surface would have been larger because of the widening of the walls.
169 The big stone blocks fallen from the roof substantially affect the inner chamber (Figure
170 3).

171 **4.2. Stratigraphy description**

172 Sedimentary levels have been differentiated based on lithological criteria (composition
173 and consistency) and coloration. The fall of big blocks from the cave roof generated
174 stone barriers that probably conditioned the formation of some levels, their extension
175 along the surface inside the cave, and their sedimentological characteristics. Some of
176 these stone blocks were exposed for a long time until they were totally covered by
177 sediment, as evidenced by the important development of vermiculations on the external
178 surface, evidence of their exposure including wet periods.

179 The sedimentary deposit is entirely Pleistocene with the exception of a disturbed area
180 and the superficial level called “a”: (loose and powdery texture, grey -7.5YR 5/3; 10YR
181 5/3; 10YR 4.3-, contains some small pebbles, plant residues and faecal matter, loam
182 texture and 7.9, 8.2 pH). Level “a” is present along the whole excavated area, 22 m²,
183 with variable thickness. The material assemblage recovered is composed of pottery,
184 lithic and faunal remains assigned to sporadic human presence in the Chalcolithic or
185 Bronze Age.

186 The excavated Pleistocene sediments have been organized in nine sedimentary levels,
187 some of them subsequently subdivided in different sections or sub-levels in some zones
188 (Figure 4). The aforementioned discontinuities in the stratigraphic deposit lead us to
189 distinguish for the moment two stratigraphic profiles even though the excavated surface
190 is not excessively large. The southern stratigraphic profile belongs to 8/10/12/14 A/B
191 squares and the northern and western stratigraphic profile to the rest of the excavated
192 area.

193 *4.2.1. Southern stratigraphic profile.*

194 The southern stratigraphic profile, the innermost part of the excavated area, shows a
195 succession of four archaeological levels. The level “b” (clay-loam and sandy-clay
196 texture, reddish-orange 7.5YR 5/6 and 4/6 and 7.9, 8.0, 8.3 pH) appears immediately
197 below the superficial level “a”. It coincides with continuous rock-falls of big stone
198 blocks from the roof of the cave. The abundant presence of heterometrical limestone
199 pebbles is explained by weathering processes on the rock walls and the roof of the cave
200 along the level formation. It seems to have been even more intense in its intermediate
201 section (“b2” or “c”). This level, which appears over the whole excavated area, offers a
202 very variable thickness. Its ceiling dips towards the north—towards the entrance of the
203 cave—, but its sedimentary basin dips towards the south. It is wedge-shaped, being
204 narrow towards the entrance of the cave, barely 20 cm in the northern stratigraphic
205 profile, and very thick towards the interior (in the southern stratigraphic profile that
206 coincides with A squares, it reaches almost 2 m thickness).

207 Below “b2” or “c” appears level “d” (clay-loam and sandy-clay texture, reddish-orange
208 7.5YR 5/6, 7.5YR 4/6 and 10YR 5/4, 7.9, 8.0, 8.3 pH and presence of limestone, some
209 up to 20 cm). From the sedimentary point of view there were no reasons to distinguish
210 “b” and “d”. The only difference was the decrease in the presence of small mammal
211 dens at level “d”. From the archaeological point of view, both levels are considered
212 archaeologically sterile, although they have offered an important assemblage of
213 microfaunal remains and well preserved macrofaunal bones of paleontological interest.
214 Since 2012, “b”, “c” and “d” have been considered as sections (lower, middle and
215 upper) of the same sedimentary unit: “b”.

216 The level “e” (clay-loam texture, grey-reddish-orange 10YR 3/3 and 8.5 pH) appears
217 below the superimposed unit “b”. It is a less compact level where the size of the stone
218 blocks decreases considerably. The microfaunal remains are less abundant and
219 macrofaunal bones appear very fragmented and some are burned. The archaeological
220 assemblage offers flint tools as well as flint-knapping evidence. Contained inside the
221 level is a discontinuous black sediment with greater concentrations of ashes and wood
222 charcoal, interpreted as combustion events, already found in the initial test pit in 10 A/B
223 squares (Mazo and Alcolea, 2016).

224

225 *4.2.2. Northern and western stratigraphic profile.*

226 The northern and western stratigraphic profile, located towards the outside of the
227 excavated area, shows a succession of seven archaeological levels. The stratigraphic
228 sequence also starts in this case with levels “a” and “b”, the only ones present in both
229 zones of the excavated area.

230 In this zone of the cave, level “b” overlaps level “cnc” (ash-grey 7.5YR 5/4, 10YR 5/4,
231 10YR 4/4 and 8.0, 8.6 pH). It is not a compact level, consisting of a structure of
232 homometric, small (until ~5 cm) and subangular stones. The fine fraction, less than 2
233 mm, decreases drastically (less than 15% of the volume against 50% in level “b”) while
234 the fraction between 2 mm and 5 cm fraction increases. Pebble stones larger than 10 cm
235 are also lacking in level “cnc”. Its sedimentary basin seems to present a subhorizontal
236 arrangement, while its ceiling dips from the E and F rows in the west part of the cave
237 (the thickest point) towards the east and also inwards. This level is not present in the
238 whole excavated area. Its sedimentary features allow it to be distinguished from the
239 overlapping stratigraphic unit.

240

241 This level corresponds to an accumulation of debris generated in severe cold climatic
242 conditions from stone blocks detached from the mouth of the cave due to periglacial
243 processes associated with stratified slope deposits. From the highest point of this
244 accumulation, located in the entrance of the cave, the small and homometric stone
245 debris would have slid towards both sides, the external slope and the interior of the
246 cave. Towards the interior of the cave the debris was stopped by the large stone block in
247 the 4/6 A squares. Ice and ice-melting conditions would have favoured this process and
248 also would have washed the fine fraction load by sediment transport. This fine fraction

249 from level “cnc” would have become part of the underlying level “bl” due to percolation
250 and/or would have been deposited in the southern part of the excavated area which
251 would have been topographically lower at the time of the level “cnc” formation process
252 (where level “e” is found). This part of the cave, next to a hidden corner of the wall,
253 could have acted as a drain in which there has been some subsidence phenomena as
254 shown by level “b” (Figure 4). In any case, level “cnc” has offered an archaeological
255 assemblage composed of flint products, faunal bones and some charcoal.

256 Below “cnc” appear two successive thick levels, both archaeologically sterile (“mr” and
257 “nrj”), that do not extend over the whole excavated area. Then there is the level “bl”
258 (sandy-loam texture, whitish-coloured, 7.5YR 7/4 and 8.7 pH), practically constituted
259 only by fine fraction. Restricted in its development to the northwest area of the
260 excavated area, it has also offered an archaeological assemblage composed of flint
261 products, faunal remains and some charcoal.

262 Finally, level “mcp” (loam-clay-sandy texture, light brown 7.5YR 5/4, 7.5YR 6/4,
263 7.5YR 6/3 and 8.5, 8.7, 8.8 pH) appears below “bl” or “cnc”, depending on the part of
264 the excavated area. From the sedimentological point of view, it is homometric,
265 consistent and offers a balance between the fine fraction and small stone pebbles. This
266 level is of practically horizontal development and reaches the widest and most
267 homogeneous extension along the excavated area. Currently, only 8 m² belonging to
268 6/8/10 rows of the excavation grid have been excavated. It has offered abundant
269 evidence of flint-knapping, flint tools, faunal bones and wood charcoal fragments.

270

271 **5. MATERIALS AND METHODS**

272 Archaeological fieldwork in the AGP5 cave began in 2010 within the framework of
273 a field survey project in the Muel-Mezalocha-Aguilón karst complex. To date there
274 have been 9 archaeological fieldwork seasons (2010-2018). At this time the
275 archaeological excavation process has covered 22 m² (Figure 3).

276 As regards the fieldwork methodology, the space has been organized on the basis of a
277 geo-referenced grid oriented to the north where the basic unit is the square meter
278 divided into 9 sectors. The excavation of sediment has been carried out on levels
279 defined and differentiated using lithological criteria. All the archaeological remains
280 have been stratigraphically and, in most cases, topographically positioned.

281 The three-dimensional position (x, y, z) of every archaeological object larger than 1 cm
282 has been recorded (lithic remains, wood charcoal fragments and macro and microfaunal
283 bones and splinters). This grid has also served as a reference for the collection of
284 sediment samples destined for specific processing (phytoliths, archaeobotany,
285 microfauna, etc.). The sediment has been processed during the fieldwork by dry-
286 screening with 2 and 1 mm mesh sieves. Further samples from each excavated
287 stratigraphic unit have been transferred to the Laboratory of Prehistory the University of
288 Zaragoza for specific processing. Water flotation and wet-screening have not shown any
289 significant influence in the acquisition of archaeobotanical remains and lithic debris

290 with respect to dry-screening. Stratigraphic profiles and excavation plans have been
291 drawn during fieldwork and the excavation process has been digitally photographed.

292 **6. RESULTS AND DISCUSSION**

293 **6.1. Chronological framework of Neanderthal occupation in Cerro del Pezón**

294 Four radiocarbon accelerator mass spectrometry (AMS) dating results are available for
295 the AGP5 cave-site, three from wood charcoal samples and one from a bone sample,
296 which correspond to human occupation in archaeological levels “cnc” and “e” (Table
297 1). The first was obtained from one charcoal fragment selected from the combustion
298 event in level “e” found during the archaeological test pit excavated in 2010. This
299 sample was first identified by anthracoanalysis as a Scots pine type (*Pinus* sp.
300 *sylvestris*). It yielded an age of $41,510 \pm 510$ ^{14}C BP (Beta-313364 ABA-pretreated)
301 (Mazo and Alcolea, 2016). A second pack of four samples, two charcoal and two bone
302 fragments, was sent recently to Curt-Engelhorn-Zentrum Archaeometrie. The sample
303 from level “e” was a bone fragment from a hemimandible of a Fallow deer (*Dama*
304 *dama*). It yielded a date of $44,560 \pm 480$ ^{14}C BP (MAMS-28122 UF-pretreated). Two
305 charcoal samples from the “cnc” level were also identified by anthracoanalysis as being
306 from a Scots pine type (*Pinus* sp. *sylvestris*). The date yielded was $>50,000$ ^{14}C BP in
307 both cases (MAMS-28123 and MAMS-28124 ABA-pretreated). The fourth sample, a
308 bone fragment from the “mcp” level, did not contain enough collagen (MAMS-29829).

309 At the current stage of the research, radiocarbon ages are available for the human
310 occupation in level “cnc” ($>50,000$ BP) in the western part of the excavated area and in
311 level “e” ($44,560 \pm 480$ and $41,510 \pm 510$ ^{14}C BP) in the southern part. Both levels are
312 very different in terms of their lithological composition and are physically separated by
313 the large stone blocks in the A/B rows, so that the stratigraphic relationship between
314 them has not yet been established. The slightly higher topographic position of level
315 “cnc” with respect to level “e” in the excavated area led us at first to think that the
316 former would represent a more recent occupation, probably even the last human
317 occupation of the cave. However, radiocarbon data available to date suggest that this
318 human occupation is older than that in level “e”. In spite of the lack of a stratigraphic
319 correlation between these archaeological levels, it is undeniable that they both lie below
320 level “b” with which both are in contact. Pending new radiocarbon data for the entire
321 sequence, at the current stage of the research all available radiocarbon dates from AGP5
322 are considered valid. In any case, they are around the limits to the age range of the
323 method. It is mandatory to explore other dating methods (OSL).

324 Two radiocarbon dates are available for the neighbouring AGP7 (Table 1). This cave-
325 site contains a paleontological deposit that has been excavated by a research group from
326 the University of Zaragoza led by the geologist G. Cuenca. The fieldwork was mainly
327 focused on a single sedimentary level of 85 cm thickness, which “probably corresponds
328 to a single deposition event” (Galán et al., 2016, pp. 502) from which both dated
329 samples were taken. The first was obtained from an unidentified bone fragment sample
330 that came “from the top of the section” (Galán et al., 2016, pp. 502). It yielded an age of

331 34,860 ± 360 ¹⁴C BP (Beta-222732). The second was obtained from a bone fragment
332 sample of a Roe deer (*Capreolus capreolus*) recovered in the base of the excavated
333 section. Its age was determined as >46,300 ¹⁴C BP (OxA-27902). Based on these
334 radiocarbon data and the results obtained from the paleontological studies carried out in
335 the site, the researchers have ascribed this deposit to MIS 3 (Núñez-Lahuerta et al.,
336 2015).

337 Radiometric data available so far from AGP5 and AGP7 suggest the existence of some
338 periods of human occupation in Cerro del Pezón by Neanderthal populations during the
339 Late Pleistocene (MIS 3). Although it is not proven in the current stage of the research,
340 the hypothesis that both caves could have been used at some time by the same human
341 group with complementary functions cannot be discarded.

342 **6.2. Neanderthal occupation in Cerro del Pezón during Late Pleistocene**

343 Until the 2017 fieldwork season, archaeological works had been carried out on 22 of the
344 100 m² inside area of the AGP5 cave. The excavated area is located in the entrance area
345 or hall (Figure 3), which coincides with the less weather-protected area. The excavation
346 of the inner chamber involves the hard task of removing the large stone blocks
347 concentrated in this area. The presence of animal bone remains, combustion events and
348 structures, and lithic artefacts resulting from different human occupation of the cave by
349 Neanderthal populations has been documented in the excavated area. Studies of the
350 archaeological materials are still in progress and the fieldwork will continue for years.
351 At the current stage of the research, this paper focused on the assessment of levels
352 “cnc”, “mcp” and “e”.

353 *6.2.1. Human occupation in AGP5 level “cnc”*

354 The excavated surface of level “cnc” is approximately 12 m². The density of
355 archaeological remains by surface unit is low, even more so if the excavated volume of
356 sediment is taken into account (Table 2). The lithic assemblage is constituted by
357 knapping and knapping waste products (N=367). Chips, less than 2 cm length, represent
358 50.9% of the remains and they are related with the retouching and transformation of
359 blanks. Cores are absent as well as lithic remains related to their knapping and
360 preparation. Neither have cortical flakes been recovered. The *chaîne opératoire* stages
361 corresponding to lithic reduction are absent. 180 blanks larger than 2 cm have been
362 recovered, of which 65 (36.1%) are retouched blanks while another 27 show marginal
363 retouching which may be considered as macroscopic traces of use.

364 The main documented groups of the typologically counted items (Bordes, 1961) from
365 this level are varia (N=31), scrapers (N=17) and notches and denticulates (N=10)
366 (Figure 5). Non-retouched types considered as tools in Bordes’ Middle Palaeolithic
367 typological list have not been computed, with the exception of the naturally-backed
368 knives (N=3). The retouched blanks are flakes and laminar flakes mainly produced by
369 Levallois and discoid methods. The 62 retouched items offer 87 units of retouch, 39 on
370 the left edge, 30 on the right edge and 18 on the distal end. The position of retouching is

371 almost exclusively direct and the morphology is mostly scalar, followed by stepped
372 retouch. Almost 95% of the retouched blanks display an elongation index equal to or
373 less than 2 and 65% have a thickness index between 2.01 and 4.50. Average values for
374 their length, width and thickness (including those fractured) are 3.9 x 3.0 x 0.9 cm. In
375 the case of flakes with marginal retouching, the average values drop to 3.3 x 2.1 x 0.5
376 cm. All blanks have been made of local flint.

377 Faunal remains, mainly from herbivores, appear well conserved and scarcely
378 fragmented. Some hyena coprolites have been recovered as well as some wood charcoal
379 from the scant combustion evidence in this level. The sedimentological composition
380 features of level “cnc” suggest their formation during a cold period, which would be
381 consistent with a short-term human occupation suggested by the low density of
382 archaeological remains as well as the lack of evidence of processing activities and a
383 structured occupation.

384 *6.2.2. Human occupation in AGP5 level “mcp”*

385 The excavated area of level “mcp” is approximately 5 m². The density of lithic remains
386 by surface unit is 339.4 per m². Although the excavated area is smaller, the density of
387 remains is clearly higher than that of “cnc”. The lithic assemblage is composed of 1700
388 remains, of which 78.1% are less than 2 cm in length. The presence of some cores, one
389 of them configured by the centripetal Levallois method, and the high number of
390 retouching removals reveals that activities of core reduction and modification of blanks
391 were carried out in the cave during this occupation period (Table 2).

392 370 blanks larger than 2 cm have been recovered, of which 36 (9.7%) are retouched
393 blanks and another 31 show marginal retouching. The main documented groups of the
394 typologically counted items are scrapers (N=13), followed by notches and denticulates
395 (N=9) and varia (N=7). Retouched products are configured on flakes and laminar flakes,
396 some of them produced by the Levallois method (18.7%) (Figure 5). The retouched
397 items offer 42 units of retouch, 22 on the left edge, 14 on the right edge and 6 on the
398 distal end. The morphology of the retouching is exclusively scalar and stepped, the
399 former (73.8%) clearly predominating over the latter. 86% of the tools display an
400 elongation index less than 2 and 71% have a thickness index between 2.51 and 5.0.
401 Average values for their length, width and thickness (including those fractured) are 4.3
402 x 3.5 x 0.9 cm. In the case of flakes with marginal retouching, the average values drop
403 to 3.4 x 2.4 x 0.6 cm.

404 Faunal remains, mainly from herbivores, appear very fragmented and some are burned.
405 Finally, wood charcoal remains are also numerous and appear to be associated with
406 combustion events.

407 *6.2.3. Human occupation in AGP5 level “e”*

408 Level “e” was the first archaeological level recognized in the initial test-pit in squares
409 10 A/B (Mazo and Alcolea, 2016). However, given its depth with respect to the current

410 surface of the cave, at present it constitutes the least excavated of the three levels
411 presented in this work, with an excavated surface of 4 m². The lithic assemblage is
412 currently composed of 125 remains representing a density of approximately 31.5 units
413 per m². Two cores have been recovered to obtain flakes, one of them Levallois (Figure
414 5). The rest are blanks and remains of knapping and retouching (Table 2). 42% of this
415 assemblage is smaller than 2 cm in length. Among those larger than 2 cm, 13 (8.3%) are
416 typologically classifiable retouched blanks and three other flakes show marginal
417 retouching.

418 Once again scrapers (N=8) are the most represented type, followed by notches and
419 denticulates and points, one of them Levallois. There are 16 retouched units, with an
420 almost total predominance of the scalar retouch morphology. There is no substantial
421 difference with the other levels in terms of average tipometric values (4.5 x 4.0 x 0.9) if
422 we compare the same categories. All the pieces have an elongation index of less than
423 2.5 while the thickness offers greater dispersion values: 7 between 3.01 and 4.5 and 3
424 above 5.51.

425 As in the “mcp” level, faunal remains, mainly of herbivores, appear very fragmented
426 and some are burned. Wood charcoal and other charred remains appear, associated with
427 more or less structured combustion events.

428 *6.2.4. Sporadic human visits in AGP7.*

429 Located less than 200 m from AGP5, human evidence on this site is scarce. It is
430 restricted to a single lithic remain, a simple convex scraper with Quina retouch, which
431 appeared in the lower third of the excavated section, and some traces of human
432 manipulation in bone remains (Sauqué et al., 2014).

433 The macrofaunal study is much more advanced in AGP7. 1475 remains have been
434 analysed, of which 1102 (75%) are splinters. Among the remains that have been
435 identified taxonomically (NISP = 373), a high taxonomic diversity of herbivores and
436 carnivores has been documented (Table 3), the former being the most abundant in the
437 record (85.9% of NISP). Anthropogenic marks (cutting and fragmentation of bones) have
438 been identified in herbivorous bones even though this affects only 3.5% of the bone
439 remains (NR = 52/1475). Impact markings of fresh bone fractures caused to access the
440 bone marrow, the fact that 94% of the diaphyses are open, and the values of the fracture
441 patterns of the bones have been cited as further signs of the anthropic character of this
442 bone accumulation. The documented evidence of carnivore activity is lower. Bite marks
443 only affect 1.42% of the total remains (Sauqué et al., 2014).

444 The above evidence suggests that AGP7 was visited by Neanderthal people. Human
445 agents have been considered one of the main actors of the faunal bone accumulation in
446 the AGP7 cave-site, due to the predominance of herbivores and evidence of human
447 manipulation of the bones, which would reveal butchery practices on this site (Galán et
448 al., 2016). On the other hand, combustion structures and other combustion evidence
449 such as wood charcoal or ashes have not been found in AGP7, and the faunal remains

450 do not show evidence of burning. While the AGP5 site provides signs of various human
451 occupations with an apparently more stable habitation pattern, probably related with
452 their better living conditions, the archaeopalaeontological record of AGP7 suggests
453 sporadic human visits with very specific purposes such as the processing of animal
454 prey, which might or might not be contemporaneous with the use of the nearby AGP5.

455 **6.3. Landscape, behaviour and climate in Cerro del Pezón during Late Pleistocene**

456 The main reason for the occupation of a cave is the search for refuge. But this cannot
457 always be the only locational criterion. The suitability of AGP5 as a habitat could be
458 conditioned by other factors, such as visual control of the valley, the proximity of a
459 high-quality flint-quarry, and its location in an ecotone position that allows a more
460 diversified exploitation of the environmental resources. Visibility analyses have been
461 conducted from four observation points using a Digital Elevation Model (DEM) with a
462 5 m grid size and for an observer of 1.50 m height (Table 4) (Figure 2). Visibility is
463 clearly conditioned by its location in the cliff, which generates a kind of "tunnel effect",
464 so that as the area of analysis is enlarged, the percentage of visible surface decreases.
465 The data suggest that from the entrance of the AGP5 cave there is clear visual control
466 for a short distance (up to about 3 km) of the Valdeaguilón ravine and of animal and
467 human populations crossing the valley or mountain.

468 *6.3.1. Raw materials procurement*

469 The proximity of a high-quality flint-quarry would have conditioned the use of lithic
470 raw materials in AGP5. The use of flint as a raw material was almost exclusive at the 3
471 human occupations studied in this paper. It reaches 95.5% in "cnc", 92.9% in "e" and
472 the 100% in level "mcp", considering the blanks of more than 2 cm length. In the first
473 two levels the presence of limestone and silicified limestone has also been documented,
474 and tabular flint exclusively in level "e". In any case, none of these raw materials was
475 used in the configuration of retouched products nor in the marginally retouched blanks.
476 The quality of flint has been estimated according to the surface texture, 83.6% in level
477 "cnc", 74.03% in "e" and 96.5% in "mcp", corresponding to the fine and very fine
478 categories.

479
480 Preliminary results of the petro-archaeological analysis in AGP5 point to an exclusive
481 use of "Monegros-type" flint, in particular the so-called "Botorrita-type" flint (Cuchí
482 and Mazo, 1992). It appears in the limestone sediments that crown the La Muela and
483 Muel-Jaulín structural platforms (south of Zaragoza), close to Cerro del Pezón (Figure
484 6) revealing local procurement. However, the use of evaporitic flint available in the
485 immediate surroundings of the cave, which is of inferior quality, has not so far been
486 recorded.

487 The "Botorrita-type" flint usually conserves a calcareous cortex in nodular samples.
488 Microscopically they are mainly composed of micro-cryptocrystalline quartz, with the
489 presence of macro-crystalline quartz and calcedonite restricted to the filling of
490 porosities. Bioclastic inclusions are frequent, abundant in some cases. Metallic oxide

491 inclusions, being carbonates and terrigenous relicts are the more frequent non-siliceous
492 components. The grain measure of the siliceous mass varies between fine and
493 medium/fine, the surface ruggedness varies between smooth and smooth/rough, and the
494 texture type between wackestone and packstone (García-Simón and Domingo, 2016).
495 Its knappability is good, or excellent in some case. The colour appearance is wide
496 ranging, although the nodular morphologies tend to have darker colorations than the
497 stratified ones. Liesegang rings are frequently recognized (Cuchí and Mazo, 1992,
498 García-Simón, 2018).

499

500 6.3.2. *Plant resource management and palaeoenvironment*

501

502 The availability of forest resources is also an important factor in the locational choices
503 of human groups. This has not traditionally been given much consideration due to the
504 perishability of woody plant remains which are not always well-preserved in
505 archaeological records. However, the vegetation present in the site environment
506 provides raw material, food and fuel. Wood charcoal studied in level “e” of AGP5
507 belongs to the combustion event documented in 10 A/B of the test-pit and dated $41,5 \pm$
508 $0,5 \text{ ka } ^{14}\text{C BP}$, while in the “mcp” and “cnc” levels the results come from scattered
509 charcoal.

510

511 Preliminary results of the wood charcoal analysis (N=113) reveal that Scots pine (*Pinus*
512 *tp. sylvestris*) wood is used as the main fuel (Table 5). These trees dominate the
513 anthracological spectra at the 3 human occupations studied in this paper and represent
514 the only taxon documented in the “mcp” and “e” levels. These cryophilous pines
515 currently grow in the supra-Mediterranean bioclimatic belt in the Mediterranean
516 vegetation region (Rivas-Martínez, 1983) above 1000-1200 masl. In level “cnc” (N =
517 45), these pines appear accompanied by shrubby taxa characteristic of the forest edges
518 (*Prunus* sp.) suggesting the existence of a probably more open landscape during the
519 cold period that accompanies the formation process of this level. These pines required
520 more humid conditions than the current pines in the surroundings of the cave, although
521 they well-support the long periods of drought that characterize the Mediterranean-type
522 precipitation regime. The pines were adapted to the cold climate that prevailed in the
523 Mediterranean Iberia during the Last Glacial period from the coast to the mountains
524 (Allué et al. 2018; Carrión et al., 2019). In any case, the presence of cryophilous
525 pinewoods in the immediate surroundings of the site between 41 and $>50 \text{ ka } ^{14}\text{C BP}$
526 reveals colder and wetter climatic conditions than the current ones, probably of a
527 subhumid or dry supramediterranean type.

528

529 6.3.3. *Faunal assemblage and palaeoenvironment*

530

531 Regarding faunal assemblages in AGP5 and AGP7, a high taxonomic diversity of
532 herbivores and carnivores has been documented (Table 3). Herbivores are more
533 abundant (85.7% of NISP in AGP7) and among them predominate ungulates of medium

534 and small size such as Red deer (*Cervus elaphus*) (30.4 of NMI in AGP7) and Wild goat
535 (*Capra pyrenaica*) (25% of NMI in AGP7) (Sauqué et al., 2014).

536 Palaeoenvironmental inferences related to micro and macrofaunal studies must be made
537 based on the AGP7 assemblage which is much more advanced. This faunal assemblage
538 shows highly diverse habitat preferences (Figure 7). As regards macromammals, taxa
539 associated with forest habitats are mainly herbivorous (*Cervus elaphus* and *Capreolus*
540 *capreolus*) which represent 59% of the NISP (Sauqué et al., 2014). In the case of
541 micromammals, those that show preferences for forest areas (*Apodemus* sp.) or rocky
542 areas (*Chionomys nivalis*) have a lower presence. In contrast, *Iberomys cabreræ*, an
543 endemic Iberian species adapted to live in humid meadows and Mediterranean climate,
544 is dominant among rodents (López-García and Cuenca, 2012). In contrast, species that
545 need to inhabit specific cold climate conditions have also been recorded, such as the
546 ptarmigan (*Lagopus* sp.), currently mainly limited to circumpolar areas (Núñez-
547 Lahuerta et al., 2015), among birds; the Snow vole (*Chionomys nivalis*) among rodents;
548 and two species of bats not registered before in the Iberian Peninsula Pleistocene but
549 well-recorded in Europe during cold periods: *Rhinolophus hipposideros* and *Myotis*
550 *daubentoni* (Galán et al., 2016). Their presence suggests a more oceanic-influenced
551 climate in contrast to the dry Mediterranean continental climate that now prevails in the
552 region. Interpreted as a single moment of accumulation, arguing that rapid climate
553 changes that took place during MIS 3 (D'Errico and Sánchez-Goñi, 2003) which
554 conditioned the existence of communities without present-day equivalent (as proposed
555 by López-García et al., 2010 and Sauqué et al., 2014), other authors suggest the
556 existence of a patched landscape composed of woodland environments with rocky areas
557 and meadowlands, where the greater water supply would have enabled significant
558 vegetation coverage (Galán et al., 2016).

559 **7. TIMELINE OF MIDDLE PALAEOLITHIC IN THE IBERIAN SYSTEM**

560 To establish the temporary framework of the Middle Palaeolithic in the Iberian System,
561 available chronometric information includes 49 samples dating 20 stratigraphic units
562 from 11 archaeological sites (Tables 5 and 6) (Figure 8). The geographical spread of
563 this sites extends along the Iberian System from the northwestern (Arlanza Basin) to the
564 southeastern part (upper Turia Basin). This dataset has been obtained by means of 6
565 different dating methods and some intra-series discrepancies are not lacking.
566 Furthermore, some dates are not usable for different reasons: i) the high values of
567 deviation (UGRA-128 of Peña Miel), ii) the fact that the exact archaeological context is
568 unknown (LEB 8530 and 8531 of Las Callejuelas), iii) the disagreement with other
569 results (OxA 4603 of La Ermita) or iv) the unclear relationship between the date and the
570 archaeological phenomenon (GrA- 27613 of Los Toros).

571 **7.1. The Early Middle Palaeolithic in the Iberian System (MIS 9/5)**

572 A set of dates place the first Middle Palaeolithic industries in the Iberian System around
573 MIS 10/8. Previous techno-complexes, corresponding to the Acheulean (Mode 2), have
574 been clearly identified in Gran Dolina, Galería and Ambrona. Some of these sites have

575 also revealed lithic industries with transitional tendencies. This is the case of the base of
576 the stratigraphic subunit TD10.1 in Gran Dolina (Burgos), dated by ESR/U-series at 379
577 ± 57 ky with a mean of 337 ± 57 ky for its top (Falgueres et al., 1999; Berger et al.
578 2008), which "could represent the local evolution of Mode 2 (Acheulean) to Mode 3
579 (Mousterian) in Sierra de Atapuerca" (Carbonell et al., 2014, pp. 544).

580 In Ambrona, the level AS6, dated by the ESR/U-series at about 350 ky (Falgueres et al.,
581 2006) and characterized by the development of flake tools, scrapers and denticulates, is
582 ascribed to the European Early Middle Palaeolithic (Rubio-Jara, 1996; Santonja et al.,
583 2014). The list also contains Cuesta de la Bajada level CB3, interpreted as a killing-site
584 in a terrace of the Alfambra River, where the volumetric concepts of bifacial
585 conformation and the production of large support flakes are also replaced by a lithic
586 technology focused on flaking with small products retouched following Mousterian
587 patterns, with a high percentage of scrapers and denticulates. Although direct dating
588 places this human occupation in a wide range between 250 ky and 450 ky, according to
589 numerical ages derived from the combination of ESR, OSL and AAR dating methods in
590 nearby fluvial terraces "the most likely age of the site would be MIS 8 or 9 rather than
591 MIS 11 or 12" (Santonja et al., 2014, pp. 566).

592 A gap in the chronometric data extends until the transition between the Middle and
593 Upper Pleistocene (MIS 6/5). The combined AAR age estimated for three samples of
594 horse teeth at 124 ± 9.7 ka places the human occupation of Las Callejuelas at the onset
595 of MIS 5. This open-air site located at high altitude (1400 masl) has provided a scanty
596 lithic assemblage based on branched production sequences with small flakes and
597 exhausted cores (Domingo et al., 2017). Human occupations in levels VII to IX from La
598 Quebrada (Villaverde et al., 2017) and La Ermita, one at each end of the Iberian
599 System, are also ascribed to MIS 5. According to two dates obtained by U-series
600 (Sánchez and Díez, 2015) of the calcite concretion that cover the sedimentary sequence
601 of La Ermita, its minimum age is around 100 ka., in agreement with the dates obtained
602 by AAR on horse teeth from levels 5a and 5b (Díez et al., 2008), and invalidating the
603 radiocarbon date from level 5a (OxA-4603) that suggested their attribution to MIS 3
604 (Moure et al., 1997).

605

606 **7.2. The last Neanderthals in the Iberian System (MIS 3)**

607 The last Neanderthal occupations in the Iberian System occur during MIS 3 coinciding
608 with the development of Mousterian techno-complexes. The chronometric data
609 available for this period include the occupations of Cueva Millán, Peña Miel, Los
610 Casares, Los Toros and La Quebrada, as well as the AGP5 site.

611 Cueva Millán is located in the Arlanza basin. Its proximity to La Ermita cave, as well as
612 the strong formal similarity of both lithic assemblages (raw materials and technology),
613 led to the suggestion that both sites could have been contemporarily occupied by the
614 same human population. Radiocarbon dates places the human occupations of Cueva
615 Millán in $41,972 \pm 527$ (level 1a) and $41,856 \pm 495$ cal BP (level 1b) (Moure and

616 García-Soto, 1983). The use of varied local raw materials (flint, quartzite, quartz,
617 limestone and sandstone) influences the lithic industry characterized by the presence of
618 small flakes with low representation of Levallois technology and high representation of
619 Quina type scrapers. Palaeoenvironmental conditions inferred from faunal studies
620 suggest a similar but higher water supply climate than the current one (Pérez and
621 Cerdeño, 1992).

622 In the Peña Miel cave the presence of well-structured hearths suggests the existence of
623 prolonged human occupations in levels “e” ($44,544 \pm 1543$ cal BP) and “g” ($> 40,000$
624 ^{14}C BP). Mousterian lithic assemblages, mainly made of quartzite, have been ascribed to
625 Quina Charentian facies based on the abundance of scrapers produced by non-Levallois
626 technology and the presence of carenated types. Bone industry has also been
627 significantly documented in this site. The inferred palaeoenvironmental conditions
628 suggest a patched landscape, with a combination of dry meadows and open mixed
629 forests, coinciding with the human occupation of archaeological level “g” (Utrilla et al.,
630 1987).

631 The Los Casares cave, located in the Upper Tajo basin, has also been ascribed to Quina
632 Charentian facies although it could also be consistent with a typical Mousterian
633 characterized by a high presence of scrapers (Barandiarán, 1973). Palaeoenvironmental
634 data inferred from pollen, small mammals, wood charcoal and phytoliths point to a
635 relatively temperate and humid interval within MIS 3, probably GIS 11, during the
636 human occupation in level “c” ($43,456 \pm 703$ cal BP) (Alcaraz-Castaño et al., 2015;
637 2017). In the overlying level “b” scarce evidence of human activity has been
638 documented, indicating a deterioration of the local environment and the abandonment of
639 the site.

640 The scant data from the Los Toros (Teruel) site—reveals a stratigraphic sequence
641 composed of three archaeological levels ascribed to Mousterian: “c” ($>45,000$ BP), “d”
642 ($39,853 \pm 561$ cal BP) and “e”, from the top to the base. The whole lithic assemblage
643 was mainly made of flint as raw material, although a testimonial presence of quartzite
644 has also been documented (Utrilla and Álvarez, 1985; Montes et al., 2006).

645 Finally, the La Quebrada rock shelter, located in the Upper Turia basin, contains seven
646 archaeological levels ascribed to Mousterian (Villaverde et al., 2008; 2017). The
647 sedimentary sequence is divided in two sections separated by a sterile level one meter
648 thick (VI) dated by OSL at 80.0 ± 4.7 and 83.2 ± 5.4 ka, placing its deposition in MIS
649 5a or MIS 5b (Carrión et al., 2019). At the top of the sequence are concentrated the
650 richest levels (III to V) accumulated in an interval between MIS 5b and early MIS 3.
651 These levels have been described as palimpsests which would be the result of short
652 recurrent human occupations related to hunting, fishing and animal food processing.
653 Small thin blanks produced by Levallois technology and characterized by quadrangular
654 morphology constitute a specific production in the site probably related to the
655 processing of animal carcasses (Eixea et al., 2015). The lower levels (VII to IX) differ
656 from the previous ones in settlement patterns as well as in lithic technology and raw

657 material management. Inferred palaeoenvironmental conditions based on plant
658 macroremains and micromammals suggest a dry or subhumid supramediterranean
659 climate. Wood charcoal analysis reveals that the Scots pine type (*Pinus* sp. *sylvestris*)
660 dominated the vegetation cover in the surroundings of the site, this being the preferred
661 fuel during the whole sequence (Badal et al., 2012; Carrión et al., 2019).

662

663 In summary, Mousterian sites which have provided reliable chronometric information
664 are scarce and scattered throughout the Iberian Range. Scrapers, produced by Llevallous
665 and non-Llevallous technology, predominate in almost all the lithic assemblages, of
666 which only Los Toros would be excluded. Quina Charentian facies is the most
667 represented techno-complex appearing in Cueva Millán, Los Casares and Peña Miel. A
668 varied use of raw materials is observed. The use of local varieties of flint predominates
669 in these assemblages, mainly in AGP5 and La Quebrada. The use of quartzite is also
670 relevant in Los Casares and Peña Miel. Montane cryophilous pines (*Pinus* sp. *sylvestris*)
671 dominate the vegetation cover in the immediate surroundings of the sites on both slopes
672 of the Iberian System as revealed by AGP5, La Quebrada and Los Casares, being the
673 preferred fuelwood of the Neanderthal populations. Medium and small-sized ungulates
674 would have been the preferred prey. Faunal assemblages are dominated by Red deer
675 (*Cervus elaphus*) and Wild goat (*Capra pyrenaica*). Regarding the palaeoenvironmental
676 conditions under which these human occupations occurred, different proxies suggest
677 from dry to humid and from warm to cold climatic conditions, probably depending on
678 the rapid climate changes that took place during MIS 3 (D'Errico and Sánchez-Goñi,
679 2003).

680 **7.3. The end of the Neanderthal occupations in the Iberian System**

681 The end of lithic assemblages of cores and flake-tools, associated with Neanderthal
682 populations in Europe since the last third of Middle Pleistocene, is not unconnected
683 with the debate about the timing of the biocultural turnover that brought about the
684 replacement of Neanderthal populations by anatomically modern humans in this part of
685 western Europe.

686 Based on biostratigraphical (Barroso and Medina, 1989) and geoarchaeological
687 evidence (Vega, 1990; Villaverde and Fumanal, 1990), the "Ebro frontier" model was
688 formulated in the 1990's (Zilhão, 1993). It was supported on the basis of the late ages of
689 Mousterian sites in the south of the Iberian Peninsula and the Central Plateau (Hublin,
690 1995; Finlayson, 2008; Walker et al., 2012) as well as palaeoenvironmental studies
691 revealing important ecological differences during the MIS 3 between the south of the
692 Ebro River and the rest of Europe (Sepulcher et al., 2007). According to this model, the
693 Ebro River would have functioned as a biogeographical barrier delaying the
694 Aurignacian expansion by almost 5000 years (Zilhão et al., 2017) and allowing
695 Neanderthal survival in the Iberian Peninsula until much more recent times than in the
696 rest of Europe. The Levant and south of the Iberian Peninsula would have been the final
697 stronghold of the last Neanderthals with ages such as ~ 32.5 ka cal BP (Finlaysson,
698 2006).

699 Many of the old arguments defending the late presence of the Neanderthals south of the
700 Ebro River are highly questioned nowadays. Re-dating and critical examination of key
701 sites, such as Jarama VI or Zafarraya (Kehl et al., 2013; Wood et al., 2013; Barroso et
702 al., 2014), and new interpretations of the sedimentological information and its climatic
703 transfer to the chronological interpretation, as in Cova Negra (Villaverde et al., 2014),
704 are revealing that Neanderthal occupations are older than previously thought. Recently,
705 a Proto-Aurignacian or Early Aurignacian technocomplex has been found in the
706 Bajondillo cave (Málaga) level Bj/13 and dated ~43.0 – 40.8 cal ka BP (Cortés-
707 Sanchez et al., 2019). The presence of modern humans in the south of the Iberian
708 Peninsula synchronously with the rest of Europe also suggests a faster spread maybe
709 “only possible over essentially ‘empty’ territories” (Cortés-Sanchez et al., 2019, pp.
710 210).

711

712 The Iberian System could have been that kind of scenario: an ‘empty’ territory, a
713 completely depopulated area, or severely depleted of human populations. The recent
714 archaeological work in the Los Casares cave (Alcaraz-Castaño et al., 2017) and the
715 paleoenvironmental study of four sections of the high-resolution loess record from the
716 Upper Tajo basin (Guadalajara) (Wolf et al., 2018) indicate that the latest Neanderthal
717 occupations in the interior Iberia occurred towards ~ 42 ka cal BP. Los Casares level
718 “c” dated 44,9 - 42,2 ka cal BP during a warm and humid interval of MIS 3, probably
719 correlated with Greenland Interstadial 11, constitutes one of the last Neanderthal
720 occupations in the southern slope of the Iberian System. The overlying level “b” records
721 a deterioration of local environments. The abandonment of these territories, apparently
722 independent of the arrival of first modern humans, is linked with the onset of hostile
723 climatic conditions characterized by the driest conditions of the last glacial period
724 (except an even drier period linked to H3) that precedes the onset of H4. No
725 archaeological or palaeoanthropological evidence attests to a Neanderthal presence in
726 the whole interior of Iberia since 42 ka ago (Alcaraz-Castaño et al., 2017; Wolf et al.,
727 2018).

728

729 The lack of high-resolution palaeoenvironmental reconstructions for MIS 3 and further
730 chronometric information about the northern slope of the Iberian System makes it
731 difficult to produce hypotheses about the timing of the Neanderthals’ disappearance in
732 this region. These are the objectives of the research project presented in this paper,
733 which includes archaeological works in new sequences, such as AGP5 or the Los
734 Rincones cave (on the southern slope of Moncayo massif), as well as revisiting old
735 archaeological excavations such as Peña Miel, where level c, that has offered the only
736 acceptable date despite the wide deviation, would contain the last Neanderthal or the
737 first modern human presence in this region. In any case, the current available data do
738 not testify to the Neanderthal occupation on the northern slope of the Iberian Range
739 since 42-40 ka ago (Figure 8).

740 **8. FINAL REMARKS**

741 The Iberian System was occupied by Neanderthals over a long period between MIS 9
742 and MIS 3. Mousterian techno-complexes signify the end of Middle Palaeolithic in the
743 region. Evidence discussed in this paper supports the view that it was no longer
744 occupied by this people around 42-40 ka ago, according to the available chronometric
745 information and the current state of the research. The northern slope of the Iberian
746 System and the south of the Ebro basin emerges as a key region in the understanding of
747 population dynamics in southwest Europe during Late Pleistocene, which still remains
748 under-investigated.

749 The new finding of the Aguilón P5 site increases the number of classic Mousterian sites
750 known in the Iberian System. The stratigraphic, chronometric, tipotechnological and
751 paleoenvironmental data provided in this paper illustrate local Neanderthal subsistence
752 and settlement. Archaeological levels “cnc”, “mcp” and “e” contain the last Neanderthal
753 occupations in Cerro del Pezón and also probably one of the last of the Iberian System.

754 Although the evidence presented and discussed in this paper represents a significant
755 advance in the archaeological research, the fieldwork should continue, the studies in
756 progress should advance, and further studies are needed. Classic Mousterian sites with
757 stratified sedimentary deposits, such as Los Toros and Peña Miel, need to be revisited
758 and ongoing excavations in new sites as well as high-resolution palaeoenvironmental
759 reconstructions for MIS 3 will provide more scientific answers contributing to the
760 debate about the timing of the Neanderthals’ disappearance in this region.

761 **Acknowledgements**

762 This study agrees with the objectives of the Spanish R+D Project HAR 2017-85023-P
763 *Gaps and sites. Vacíos y ocupaciones en la Prehistoria de la Cuenca del Ebro* funded
764 by the Ministry of Economy and Competitiveness. Fieldwork is funded by the local
765 government of Aguilón (Zaragoza) and Comarca del Campo de Cariñena. Research
766 group H14_17R PPVE and IUCA funded by the Government of Aragón and European
767 Social Funding have also contributed. M. Alcolea work is funded by a Post-Doc Grant
768 Plan Xunta de Galicia mod. A (Ref. ED481B 2018/016). The authors thank J.L. Peña-
769 Monné his helpful comments and J. Chancellor for English editing. Finally, the author
770 expresses his appreciation to two anonymous reviewers and guest editor whose
771 constructive comments helped to improve the original manuscript.

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1070 **TABLE AND FIGURE CAPTIONS**

1071 Fig. 1.

1072 Middle Palaeolithic sites in the Iberian System. 1. La Ermita; 2. Cueva Millán; 3. Gran
1073 Dolina; 4. Najerilla; 5. Peña Miel; 6. Perdiguero and La Marcú; 7. La Bardalera; 8. Las
1074 Paretillas; 9. Paridera de la Condesa; 10. Miedes; 11. Montón; 12. AGP5 and AGP7; 13.

1075 Eudoviges; 14; Cabezo Marañán; 15. Ahumado del Pudial; 16. Los Toros; 17. Las
1076 Callejuelas; 18. La Quebrada; 19. Cuesta de la Bajada; 20. Los Casares; 21. Ambrona.
1077 Blue dots: Sites of Middle Palaeolithic in immediate geographical context. 22. Peña
1078 Cabra; 23. Los Torrejones; 24. Jarama VI; 25. La Roñuela; 26. Rambla de los Morenos;
1079 27. Barranc de Carcalín; 28. San Luis; 29. El Pinar; 30. Tossal de la Font.

1080 Fig. 2.

1081 View of Cerro del Pezón with location of AGP5, AGP7 and AGP3 caves. Visual field
1082 estimation from AGP5 (1) and the highest point of the cliff (4), (ArcGIS 10.4). Above:
1083 views from point 2, with visual domain of Valdeaguilón ravine.

1084 Fig. 3.

1085 Site section, plan and excavation grid. Topography made by Mario Gisbert, Centre of
1086 Speleology of Aragón. 1. Mouth of the AGP5 before the excavation. 2. Fissure in the
1087 bank of limestone, next to the cave. 3. Evidence of rockfall.

1088 Fig 4.

1089 Above: Stratigraphic sequence in western profile. Below on the left: Detail of
1090 subsidence phenomena in level “b” in southern stratigraphic profile. Below on the right:
1091 Detail of contact between levels “b” and “cnc”; note the sedimentological composition
1092 differences.

1093 Fig 5.

1094 Lithics from AGP5: 1 and 10-15 (cnc), 2 and 16-23 (mcp), 3-9 (e), 25 (disturbed area).
1095 Recurrent-centripetal Levallois core (1). Preferential Levallois core (2). Scrapers (3-5,
1096 7, 10-14, 16, 18 and 20). Points (6, 9, 13, 21). Denticulates (15 and 17). Retouched
1097 blade Aurignacian? (25). Lithic from AGP7: 24, Quina scraper.

1098 Fig. 6.

1099 Location of AGP5 and AGP7 caves with access routes to the Central Plateau, Levant,
1100 and Ebro Basin. In the surroundings of the flint outcrops, isolated findings appear with
1101 typologies ascribable to Middle Palaeolithic. The use of quartzite has not been
1102 registered in AGP5 cave to date.

1103 Fig. 7.

1104 Above: Data summary from paleontological studies in AGP7 and AGP5 and
1105 palaeoenvironmental implications. Below: hyena coprolite, distal humerus fragment of
1106 *Cervus elaphus* and hemimandible of *Dama dama* dated 44560±480 ¹⁴C BP.

1107 Fig. 8

1108 Calibrated radiocarbon dates from Mousterian occupations (MIS 3) in the Iberian Range
1109 against the NGRIP climatic curve (Rasmussen et al., 2014). (a) SST and (b) pollen

1110 percentage of Mediterranean forest from drilling core MD95-2042 and SU81-1833
1111 (Sánchez-Goñi et al., 2008). Timing of Heinrich events, blue bars, Rasmussen et al.,
1112 2014; loess deposition period in the Alto Tajo Bassin, ochre bar, Wolf et al., 2018;
1113 Campanian ignimbrite (Giaccio et al. 2017). Red dots, radiocarbon date > to. The dating
1114 of layer “d” from Los Toros represents the most recent Mousterian occupation in the
1115 Iberian System. Note, however, that the dating of the overlying level “c” has provided
1116 an age > 45,000 ¹⁴C BP.

1117 Table 1.

1118 Radiocarbon accelerator dates of Mousterian occupations (MIS 3) in the Iberian System.
1119 Dates calibrated with OxCal v4.3.2 (Bronk Ramsey, 2017) and atmospheric curve
1120 IntCal13 (Reimer et al. 2013). Wrong or unusable dates in italics.

1121 Table 2.

1122 Retouched pieces including naturally-backed knife. Measures in centimeters, weight in
1123 grams. Knapping order: First order (1), more than 95% of cortical surface; second order
1124 (2), as much as 95% of cortical surface and third order (3), free of cortex. The location
1125 of laterality of cortex (left, right, other) and retouched edges (left, right, distal) is
1126 described relative to the flake conventionally oriented, in dorsal view and butt
1127 downwards. Retouched edges: 1, 2 or 3 edges retouched. Retouch: Simple (S),
1128 Scaled/Stepped (Sc) and Abrupt (A).

1129 Table 3.

1130 Taxonomical representation of AGP5 and AGP7 faunal assemblages. AGP5 values
1131 expressed in terms of presence/absence (p/a) (G. Cuenca and V. Sauqué pers. com.).
1132 AGP7 modified from Sauqué et al., 2014. (*) Presence of hyena coprolites, no bones
1133 identified so far.

1134 Table 4.

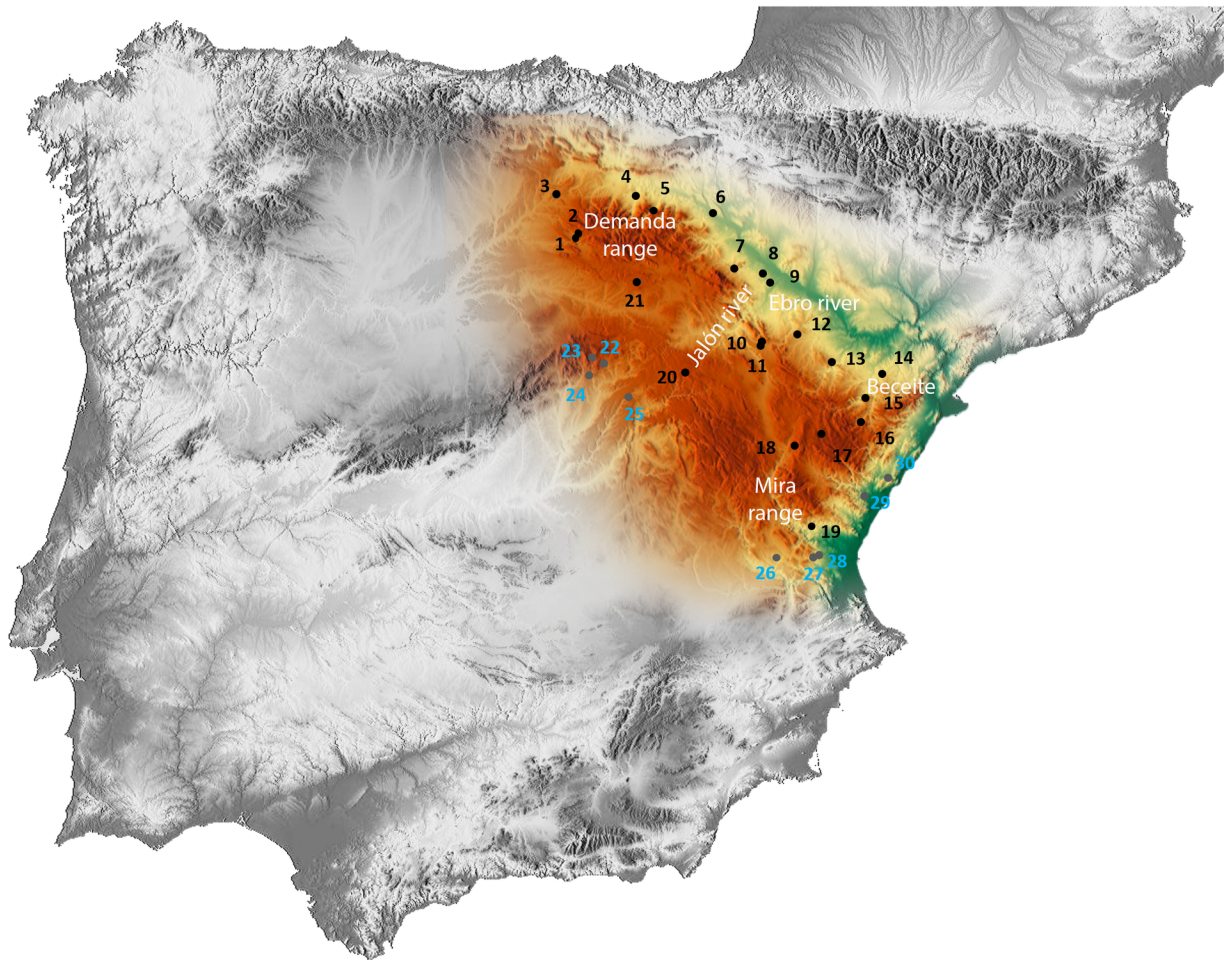
1135 Data from visual field for areas of 3, 5 and 10 km radius. See Figure 2.

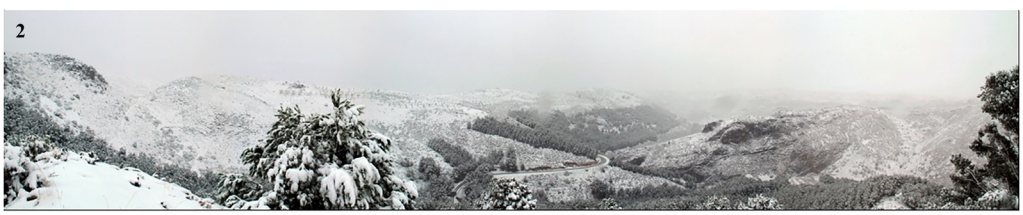
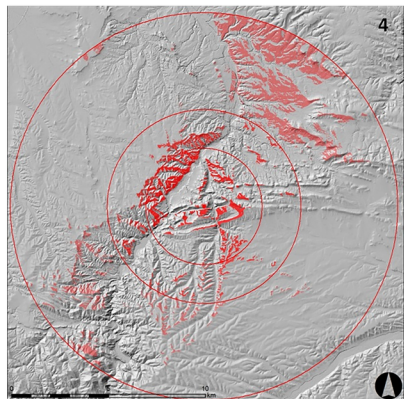
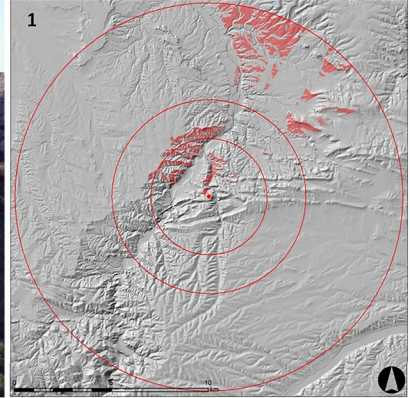
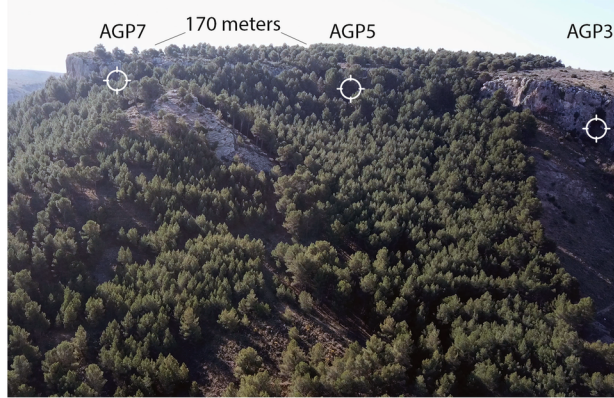
1136 Table 5.

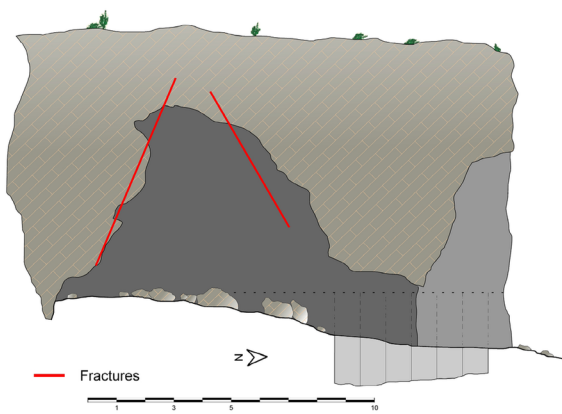
1137 Preliminary results of wood charcoal analysis of AGP5 (n=113).

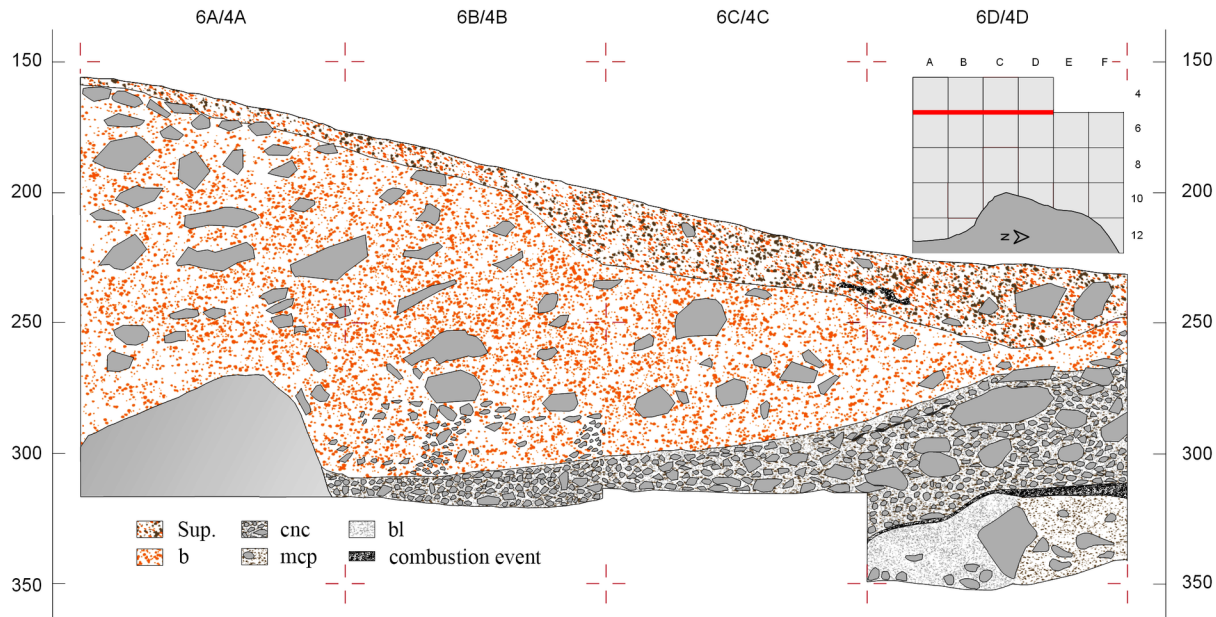
1138 Table 6.

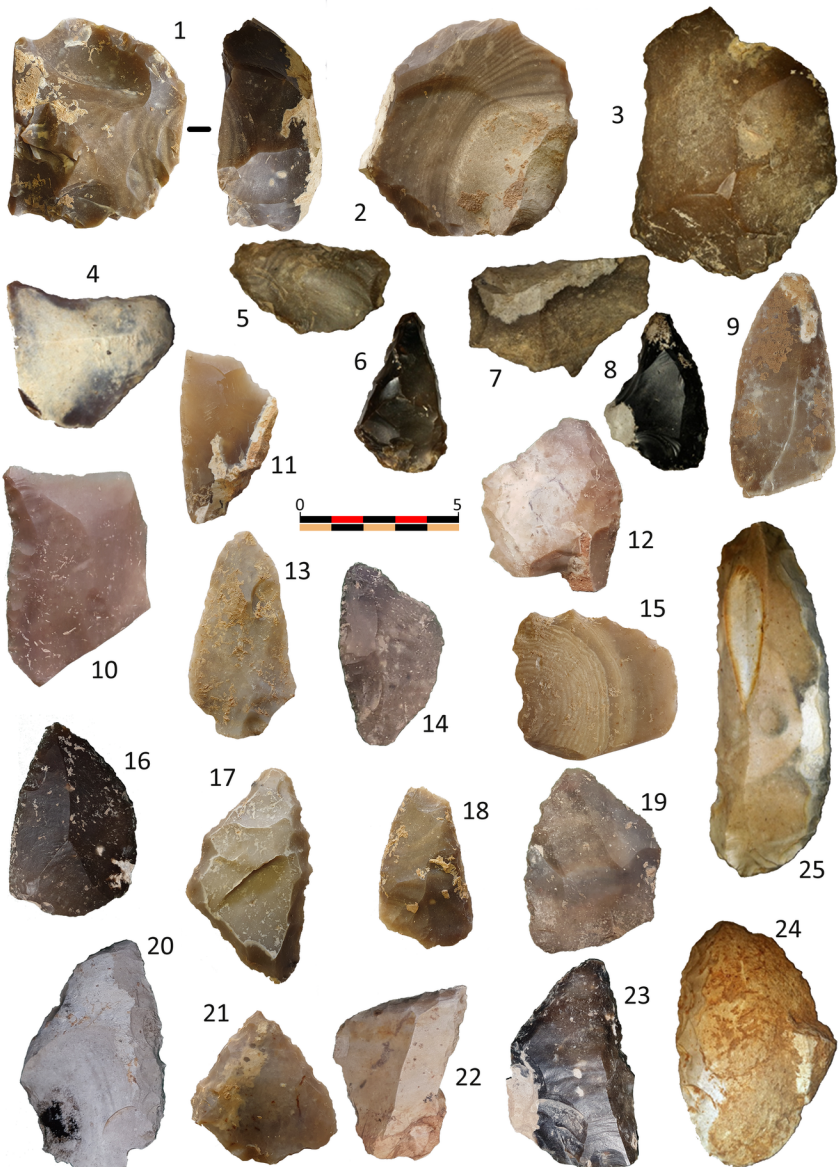
1139 Radiometric data. Stratigraphic units of the Middle Palaeolithic in the Iberian System
1140 (MIS 9–MIS 5). 1. Depending on the signal chosen. Ages obtained based on the
1141 combination of centres Ti-Li and Ti-H (1) or only in the centre Ti-H (2). 2. Sample
1142 taken from the laminar calcite flowstone overlying the Pleistocene sedimentary deposit.
1143 Invalidates OxA-4603.

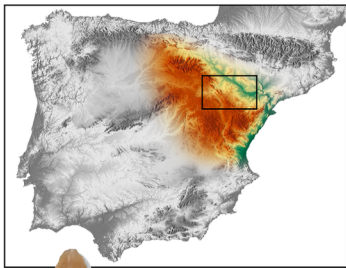






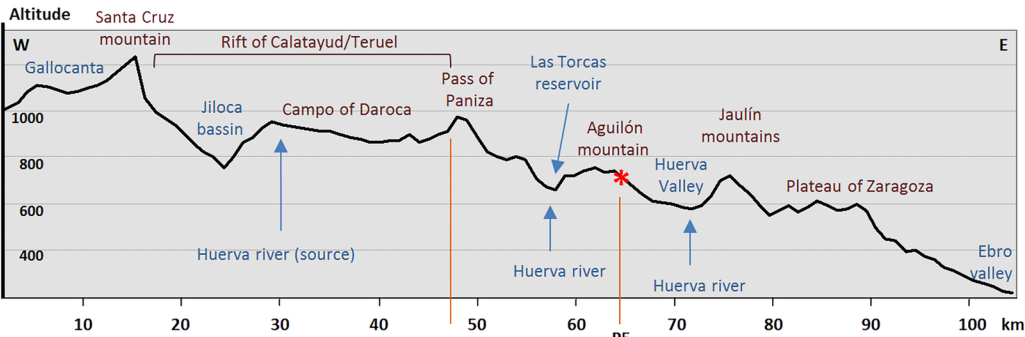
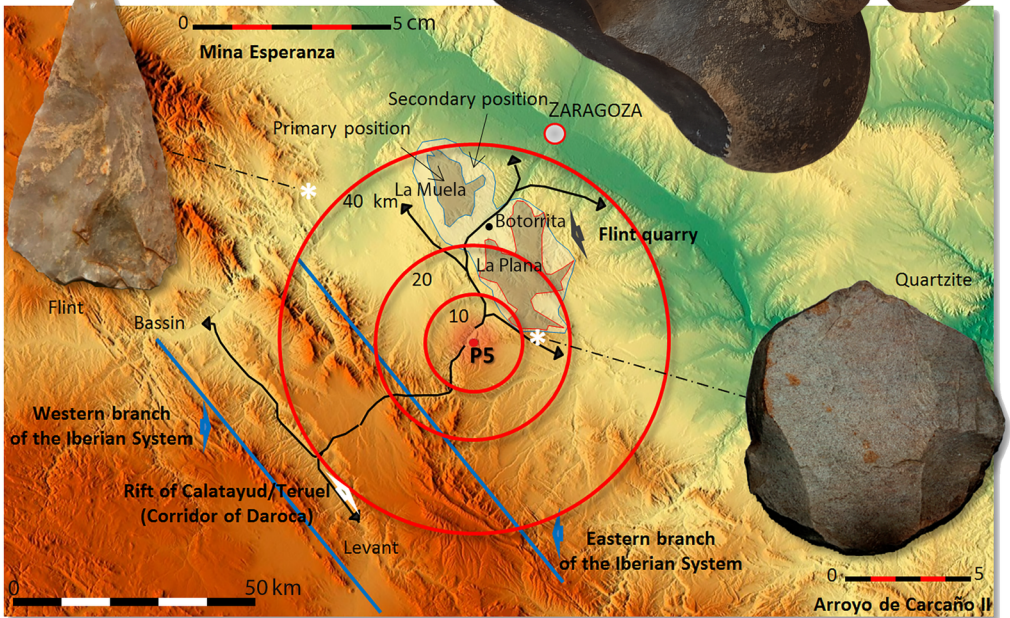






Flint: "Monegros"
Quarry: "Botorrita"

Flint nodules





AGP7

Forest (NISP 59%)

Cervus elaphus, Capreolus capreolus

High or medium mountain (NISP 35%)

Capra pyrenaica, Rupicapra pyrenaica

Open spaces (low proportion)

Equus ferus

**Weet meadows and
Mediterranean climate**

Iberomys cabreræ, Crocidura sp.

Forest

Apodemus sp.

Rocky

Chionomys nivalis

**Mountain areas with forest
and presence of open space**

Aquilachrysaetos

Anthus trivialis

Prunella modularis



**Taxa adapted to hunting in forest
(most)**

Myotis gr. myotis/blythii

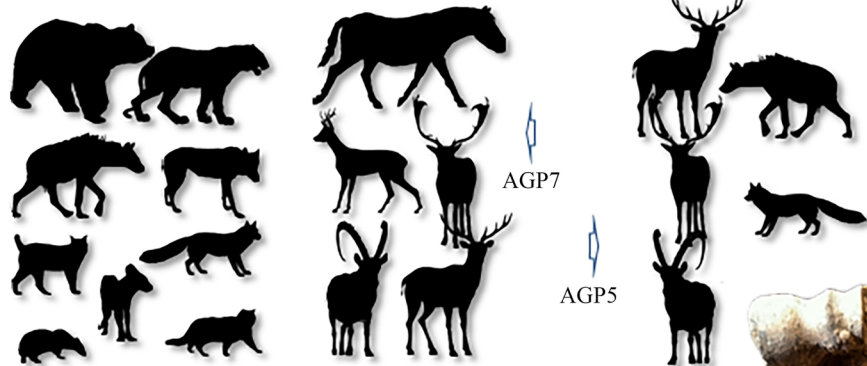
Rhinolopus ferrumequinum

Myotis bechsteinii

Most generalist taxa (minority)

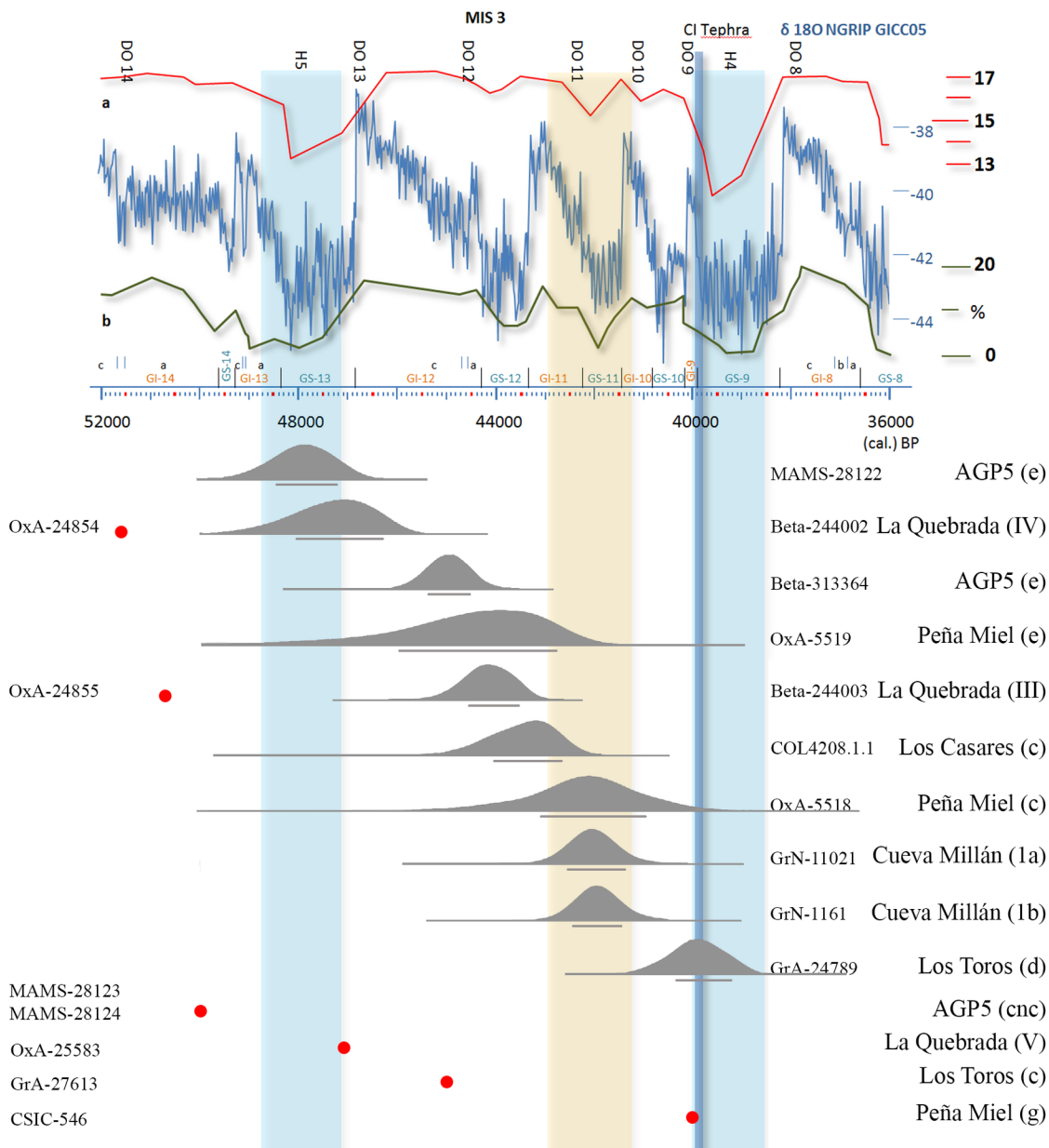
Pipistrellus gr. kuhlii/nathusii

Miniopterus schreibersii



AGP5





Site	Level	Reference	Method	Date C14	1 σ Calibrated Date BP (68,2% probability)	2 σ Calibrated Date BP (95,4% probability)	Reference
Cueva Ermita	5a	OxA-4603	C14	31,100 \pm 550	35,606 – 34,531	36,189 – 34,084	Moure et al. 1997
Cueva Millán	1a	GrN-11021	C14	37,600 \pm 700	42,483 – 41,486	43,031 – 40,872	Moure and García 1982
	1b	GrN-1161	C14	37,450 \pm 650	42,353 – 41,408	42,841 – 40,818	
Peña Miel	c	OxA-5518	C14	37,700 \pm 1,300	43,127 – 40,958	44,656 – 39,862	Utrilla et al. 1987
	c	UGRA-128	C14	39,900 \pm 10,000			
	e	OxA-5519	C14	40,300 \pm 1,600	45,471 – 42,710	47,977 – 41,907	
	e	GrN-12123	C14	45,500 \pm 1,400			
	g	CSIC-546	C14	> 40,000			
AGP5	e	Beta-313364	C14 ABA	41,510 \pm 510	45,406 – 44,510	45,907 – 44,055	Mazo and Alcolea 2016
	e	MAMS-28122	C14 UF	44,560 \pm 480	48,487 – 47,202	49,181 – 46,666	This paper
	cnc	MAMS-28123	C14 ABA	> 50,000			
	cnc	MAMS-28124	C14 ABA	> 50,000			
AGP7	top	Beta-222732	C14	34,860 \pm 480	39,905 – 38,845	40,524 – 38,461	Galán et al. 2016
	base	OxA-27902	C14	> 46,300			
Los Casares	c	COL4208.1.1	C14	39,494 \pm 850	44,015 – 42,640	44,899 – 42,175	Alcaraz et al. 2017
Los Toros	d	GrA-24789	C14	35,250 \pm 490	40,384 – 39,235	40,970 – 38,766	Montes et al. 2006
	c	GrA-27613	C14	> 45,000			
La Quebrada	III	Beta-244003	C14 ABA	40,500 \pm 530	44,557 – 43,550	45,069 – 43,150	Villaverde et al. 2008
	III	OxA-24854	C14 ABOx	> 50,800			Villaverde et al. 2017
	IV	Beta-244002	C14 ABA	43,930 \pm 750	48,034 – 46,317	49,099 – 45,750	Villaverde et al. 2008
	IV	OxA-24855	C14 ABOx	> 51,600			Villaverde et al. 2017
	V	Oxa-25583	C14 ABOx	> 47,100			Carrión et al. 2018

Archaeological level	cnc	mcp	e
Excavated surface	± 12 m ²	± 5 m ²	± 6 m ²
Total surface of level	Unknow	Unknow	Unknow
Lithic assemblage	367	1700	125
Density m ²	30.5	340	20.8
Dominant raw material	Flint		
Cores	-	3	2
Knapping products	Flakes		
Lenght/Width/Thickness (Weight) μ	-	4.5/4.5/1.7 (34.6)	5.4/4.4/2.5 (61.9)
<i>Levallois</i>	-	1 (preferential)	1 (recurrent cent.)
Lenght/Width/Thickness (Weight) μ	-	6.0/6.6/1.4 (55.2)	5.7/4.7/2.6 (86.2)
Blanks < 2cm (%)	187 (50.9)	1327 (78.0)	52 (41.6)
Blanks > 2cm (%)	180 (49.1)	370 (21.7)	71 (56.8)
Retouched pieces (%)	65 (36.1)	36 (9.7)	13 (18.3)
Retouched Levallois point	1	-	1
Pseudo-Levallois point	1	-	-
Elongated mousterian point	-	-	1
Single straight scraper	4	3	4
Single convex scraper	3	1	-
Single concave scraper	-	-	1
Double straight scraper	1	2	-
Double straight-convex scraper	2	1	-
Double convex-concave scraper	1	-	-
Straight convergent scraper	-	1	-
Convex convergent scraper	1	-	-
Déjeté scraper	5	4	-
Straight transverse scraper	-	1	2
Convex transverse scraper	-	-	1
Atypical perçoir	1	-	-
Naturally-backed knife	3	5	-
Notch	6	5	2
Denticulate	4	4	1
Flake with thin abrupt retouch	1	-	-
Rabot	-	1	-
Miscellaneous	31	7	-
Blanks of retouched pieces	Flakes and laminar flakes		
Lenght/Width/Thickness (Weight) μ	3.9/3.0/0.9 (11.8)	4.3/3.5/0.9 (13.2)	4.5/4.0/0.9 (14.2)
Knapping order 1/2/3	0/17/48	2/19/15	0/4/9
Laterality of cortex: left/right/other	4/3/9	8/5/6	1/1/2
Retouched pieces/retouched edges	62/87	31/42	13/16
Retouched edges: 1/2/3	38/23/1	22/7/2	10/3/0
Retouched edges: left/right/distal	39/30/18	22/14/6	5/6/5
Retouch: S/Sc/A	71/10/6	31/11/0	15/1/0
Blanks marginally retouched (%)	27 (15.0)	31 (8.3)	3 (4.22)
Lenght/Width/Thickness (Weight) μ	3.3/2.1/0.5 (4.0)	3.4/2.4/0.6 (6.1)	2.7/3.0/0.5 (4.28)
Laterality of cortex: left/right/other	0/6/21	0/11/20	0/0/3
Not retouched (%)	88 (48.8)	303 (81.8)	55 (77.4)
Alterations: patina/thermic	27/13	63/12	14/7

	AGP7				AGP5
	NISP		NMI		p/a
	n	%	n	%	
<i>Canis lupus</i>	13	3,5	2	3,6	-
<i>Capra pyrenaica</i>	92	24,7	14	25,0	*
<i>Capreolus capreolus</i>	51	13,7	8	14,3	-
<i>Cervus elaphus</i>	139	37,3	17	30,4	*
<i>Crocota crocuta</i>	1	0,3	1	1,8	*(*)
<i>Cuon alpinus</i>	1	0,3	1	1,8	-
<i>Dama dama</i>	-	-	-	-	*
<i>Equus ferus</i>	16	4,3	2	3,6	-
<i>Felis silvestris</i>	2	0,5	1	1,8	-
<i>Lynx pardinus</i>	8	2,1	1	1,8	-
<i>Meles meles</i>	1	0,3	1	1,8	-
<i>Oryctolagus cuniculus</i>	-	-	-	-	*
<i>Panthera pardus</i>	8	2,1	1	1,8	*
<i>Rupicapra pyrenaica</i>	22	5,9	4	7,1	-
<i>Ursus arctos</i>	12	3,2	2	3,6	-
<i>Vulpes vulpes</i>	7	1,9	1	1,8	*
Total	373	100	56	100	-
Splinters	1102	74,7	-	-	-
Total NR	1475	100	-	-	-

	Pixels (5x5 m)			Surface (km2)			Percentage	
	Not visible	Visible	Total	Not visible	Visible	Total	Not visible	Visible
Angular visión from 1								
3 km	369148	66558	435706	9,2	1,7	10,9	84,7	15,3
5 km	1090745	106154	11968	27,3	2,7	29,9	91,1	8,9
10 km	4340267	407251	4747518	108,5	10,2	118,7	91,4	8,6
Vision from 2 (360)								
3 km	1004309	126580	1130889	25,1	3,2	28,3	88,8	11,2
5 km	2962851	178581	3141432	74,1	4,5	78,5	94,3	5,7
10 km	11882287	683860	12566147	297,1	17,1	314,2	94,6	5,4
Vision from 3 (369)								
3 km	1007479	123428	1130907	25,2	3,1	28,3	89,1	10,9
5 km	2945926	195554	3141480	73,6	4,9	78,5	93,8	6,2
10 km	11785836	780312	12566148	294,6	19,5	314,2	93,8	6,2
Vision from 4 (360)								
3 km	950538	180352	1130890	23,8	4,5	28,3	84,1	15,9
5 km	2825735	315701	3141436	70,6	7,9	78,5	90,0	10,0
10 km	11538970	1027168	12566138	288,5	25,7	314,2	91,8	8,2

Layer	cnc		mcp		e	
	n	%	n	%	n	%
Taxa						
<i>Pinus tp. sylvestris</i>	42	95,5	39	100	28	100
<i>Prunus</i> sp.	2	4,5	-	-	-	-
Total identifiable	44	100	39	100	28	100
Unidentifiable	1	2,3	1	2,5	-	-
Total	45	100	40	100	28	100

Site	Level	Reference	Method	Date ka BP	Obs.	Reference
Ambrona	AS6	Am0007	ESR/U-series	366 +55/- 51		Falgueres et al. 2006
	AS6	Am0006	ESR/U-series	314 +48/- 45		
Cuesta de la Bajada	CB3	CB10-1	OSL	293 ± 24		Santonja et al. 2014
	CB3	CB10-2	OSL	264 ± 22		
	CB3	combined	OSL	278 ± 32		
	CB3	CB1	OSL	282 ± 32		
	CB3	CUB1005 (1)	ESR	350 ± 49	1	
	CB3	CUB1005 (2)	ESR	264 ± 42	1	
	CB3	-	AAR	378		
	CB3	-	AAR	413		
	CB3	-	AAR	455		
	CB3	-	AAR	478		
	CB3	combined	AAR	431 ± 44		
Las Callejuelas	-	LEB 8533	AAR	116		Domingo et al. 2017
	-	LEB 8529	AAR	122		
	-	LEB 8532	AAR	135		
	-	combined	AAR	124 ± 9.7		
Cueva Ermita	Calcite flowstone	-	U/Th	95.1 ± 5.7	2	Sánchez and Díez 2015
	Calcite flowstone	-	U/Th	101.8 ± 4.0	2	
	5a	-	AAR	128.8 ± 39.1		Díez et al. 2008
	5b	-	AAR	114.3 ± 41.9		