New data concerning Neanderthal occupation in the Iberian System: First results from the late Pleistocene (MIS 3) Aguilón P5 cave site (NE Iberia)

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Abstract

This work presents the first results from the Aguilón P5 (Zaragoza) cave site on the northern slope of the Iberian System (NE Iberia). The fieldwork carried out since 2010 on several archaeological layers containing remnants of human occupations has revealed lithic remains, processed faunal bones and charred plant remains from combustion events. Due to the lithic tool assemblage and radiocarbon dating (> 50.0–41.9 kyr BP), the attribution of this human occupation to the Mousterian techno-complex is clear, contemporary with other important Late Mousterian sites in the Ebro Basin (NE Iberia) and Mediterranean region. Preliminary results concerning stratigraphic, chronometric, techno-tipological and palaeoenvironmental data from the last human occupations of the cave (archaeological layers "cnc", "mcp" and "e") are provided in this paper. To contextualize the Neanderthal occupation of the Aguilón P5 cave, a timeline of Middle Paleolithic in the Iberian System is proposed. A total of 45 dates from 19 stratigraphic units (including speleothems) are available from 10 sites. Chronometric dating series allow us to establish the temporary framework of Mousterian industries in the Iberian System coinciding with the abrupt climate changes related to Heinrich Events which characterize MIS 3. In summary, this paper provides new chronometric and archaeological information about Neanderthal settlement and subsistence in an under-investigated region.

1. Introduction

The disappearance of the last Neanderthals in Europe is an important current issue in archaeological research. The Iberian Peninsula, on a corner of the Eurasian continent, has been revealed as a key territory in this scientific discussion (D'Errico et al., 1998; Villaverde et al., 1998; Pettitt and Bailey, 2000; Straus, 2005; Hublin and Bailey, 2006; Zilhão, 2006; Finlayson et al., 2006; Jennings et al., 2011; Wood et al., 2013; Higham et al., 2014: Benazzi et al., 2011, 2015). However, vast Iberian territories, such as the Iberian System, located immediately to the south of the Ebro River, continue to be under-investigated. The Iberian System extends throughout approximately 35,000 km2 where the number of known Middle Palaeolithic sites, including stratigraphic sequences in caves, rock shelters and open-air sites, barely exceeds twenty. Most of these sites, distributed in a dispersed pattern, are located on the northern slope, towards the central Ebro Basin, where archaeological surveys have been more intense.

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

2. Geographical setting

2.1. The Iberian System: regional setting

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

It is a compartmentalized system composed of a complex group of mountain ranges, massifs and depressions of diverse lithic and structural composition, often geologically isolated, which are linked by intermountain plateaus. The Jalón, Huerva and other rivers cross the system perpendicularly and have served as obligatory transit routes between the Ebro basin and the inner Iberia. From the Mediterranean (Southeastern sector) to the Jalón basin the mountain system is divided into two mountain ranges. The interior is parallel to the Central Plateau, and the exterior to the Ebro River, both separated by the Iberian Depression (or Daroca corridor). Pleistocene glacial phenomena in the Iberian System are infrequent. In the Aragonese sector, cold periods are represented by periglacial forms, with accumulative and erosive processes of cold genesis, such as nivation hollows, block slopes, etc. (Peña and Lozano, 2004).

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

2.2. The Cerro del Pezón: local setting

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

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

The present-day flora is highly influenced by orography, lithology and also the anthropic impact. Although the Holm oak (Quercus ilex subsp. ballota) characterizes the climax plant community of the meso- Mediterranean bioclimatic belt in the Mediterranean vegetation region (Rivas-Martínez, 1982), it has been greatly affected by the successive clearings and felling oriented to the creation of crop lands (Longares, 2004). Extensive plantations of Aleppo pine (Pinus halepensis), a native meso-Mediterranean species that has been re-introduced for wood production, are dominant in the immediate surroundings of the cave.

3. Archaeological framework

Excluding isolated findings, the number of known Middle Paleolithic sites in the Iberian System barely exceeds twenty, including stratigraphic sequences in caves and rock shelters and open-air sites, which cover a chronological range of at least 300 ka (Fig. 1). The available archaeological information from each site is truly variable, from very little data to exhaustive multi-disciplinary publications. Settlement patterns suggest that the location criteria depend on the functionality of each site. Thus, the existence of campsites, raw material quarries with knapping activities, and killing/butchering stations has been suggested.

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

Archaeological sites in caves or rock shelters are located from 700 to 1280 masl over riverbeds or ravines, passages between valleys and plateaus or places where there is a broad visual domain or that form a sort of natural trap. Some of them have been interpreted as being sites of extended or repeated stays, such as La Ermita and Cueva Millán (Moure and García-Soto, 1982; Díez et al., 2008), Peña Miel (Utrilla et al., 1987), Los Casares (Barandiarán, 1973; Alcaraz-Castaño et al., 2017) and La Quebrada (Villaverde et al., 2017). They reveal more or less structured hearths and anthropic fractures in bones that accompany the recovered lithic assemblages. In other cases these are messy deposits, without recognizable evidence of human spatial organization, such as Ahumado del Pudial (Domingo and Martínez-Bea, 2001–2002), and/or which do not offer chronometric information, such as Eudoviges (Barandiarán, 1975–1976).

4. Site description and stratigraphy

4.1. Site description

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

The site consists of a north-south direction cavity, about 20m long, 8m wide and up to 7.80m high (2.30m in the mouth). It does not receive direct sunlight, but is remarkably sheltered from the prevailing wind in the Ebro basin. The present surface of the cave is approximately 100m2. Two different areas can be distinguished: a hall, vestibule or entrance area in the outermost part, covered but exposed to environmental conditions, and an inner chamber that offers greater protection. During the Pleistocene occupation of the cave this surface would have been larger because of the widening of the walls. The big stone blocks fallen from the roof substantially affect the inner chamber (Fig. 3).

4.2. Stratigraphy description

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

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

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

4.2.1. Southern stratigraphic profile

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

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

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

4.2.2. Northern and western stratigraphic profiles

The northern and western stratigraphic profiles, located towards the outside of the excavated area, shows a succession of seven archaeological levels. The stratigraphic sequence also starts in this case with levels "a" and "b", the only ones present in both zones of the excavated area.

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

This level corresponds to an accumulation of debris generated in severe cold climatic conditions from stone blocks detached from the mouth of the cave due to periglacial processes associated with stratified slope deposits. From the highest point of this accumulation, located in the entrance of the cave, the small and homometric stone debris would have slid towards both sides, the external slope and the interior of the cave. Towards the interior of the cave the debris was stopped by the large stone block in the 4/6 A squares. Ice and ice-melting conditions would have favoured this process and also would have washed the fine fraction load by sediment transport. This fine fraction from level "cnc" would have become part of the underlying level "bl" due to percolation and/or would have been deposited in the southern part of the excavated area which would have been topographically lower at the time of the level "cnc" formation process (where level "e" is found). This part of the cave, next to a hidden corner of the wall, could have acted as a drain in which there has been some subsidence phenomena as shown by level "b" (Fig. 4). In any case, level "cnc" has offered an archaeological assemblage composed of flint products, faunal bones and some charcoal.

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

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

5. Materials and methods

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

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

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

6. Results and discussion

6.1. Chronological framework of Neanderthal occupation in Cerro del Pezón

Four radiocarbon accelerator mass spectrometry (AMS) dating results are available for the AGP5 cave-site, three from wood charcoal samples and one from a bone sample, which correspond to human occupation in archaeological levels "cnc" and "e" (Table 1). The first was obtained from one charcoal fragment selected from the combustion event in level "e" found during the archaeological test pit excavated in 2010. This sample was first identified by anthracoanalysis as a Scots pine type (Pinus tp. sylvestris). It yielded an age of 41,510 ± 510 14C BP (Beta-313,364 ABA-pretreated) (Mazo and Alcolea, 2016). A second pack of four samples, two charcoal and two bone fragments, was sent recently to Curt-Engelhorn-Zentrum Archaeometrie. The sample from level "e" was a bone fragment from a hemimandible of a Fallow deer (Dama dama). It yielded a date of 44,560 ± 480 14C BP (MAMS-28122 UF-pretreated). Two charcoal samples from the "cnc" level were also identified by anthracoanalysis as being from a Scots pine type (Pinus tp. sylvestris). The date yielded was>50,000 14C BP in both cases (MAMS-28123 and MAMS-28124 ABA-pretreated). The fourth sample, a bone fragment from the "mcp" level, did not contain enough collagen (MAMS-29829).

At the current stage of the research, radiocarbon ages are available for the human occupation in level "cnc" (> 50,000 BP) in the western part of the excavated area and in level "e" (44,560 ± 480 and 41,510 ± 510 14C BP) in the southern part. Both levels are very different in terms of their lithological composition and are physically separated by the large stone blocks in the A/B rows, so that the stratigraphic relationship between them has not yet been established. The slightly higher topographic position of level "cnc" with respect to level "e" in the excavated area led us at first to think that the former would represent a more recent occupation, probably even the last human occupation of the cave. However, radiocarbon data available to date suggest that this human occupation is older than that in level "e". In spite of the lack of a stratigraphic correlation between these archaeological levels, it is undeniable that they both lie below level "b" with which both are in contact. Pending new radiocarbon data for the entire sequence, at the current stage of the research all available radiocarbon dates from AGP5 are considered valid. In any case, they are around the limits to the age range of the method. It is mandatory to explore other dating methods (OSL). Two radiocarbon dates are available for the neighbouring AGP7 (Table 1). This cave-site contains a paleontological deposit that has been excavated by a research group from the University of Zaragoza led by the geologist G. Cuenca. The fieldwork was mainly focused on a single sedimentary level of 85 cm thickness, which "probably corresponds to a single deposition event" (Galán et al., 2016, pp. 502) from which both dated samples were taken. The first was obtained from an unidentified bone fragment sample that came "from the top of the section" (Galán et al., 2016, pp. 502). It yielded an age of 34,860 ± 360 14C BP (Beta-222732). The second was obtained from a bone fragment sample of a Roe deer (Capreolus capreolus) recovered in the base of the excavated section. Its age was determined as>46,300 14C BP (OxA-27902). Based on these radiocarbon data and the results obtained from the paleontological studies carried out in the site, the researchers have ascribed this deposit to MIS 3 (Núñez-Lahuerta et al., 2016).

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

6.2. Neanderthal occupation in Cerro del Pezón during Late Pleistocene

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

6.2.1. Human occupation in AGP5 level "cnc"

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

The main documented groups of the typologically counted items(Bordes, 1961) from this level are varia (N=31), scrapers (N=17) and notches and denticulates (N=10) (Fig. 5). Non-retouched types considered as tools in Bordes' Middle Paleolithic typological list have not been computed, with the exception of the naturally-backed knives (N=3). The retouched blanks are flakes and laminar flakes mainly produced by Levallois and discoid methods. The 62 retouched items offer 87 units of retouch, 39 on the left edge, 30 on the right edge and 18 on the distal end. The position of retouching is almost exclusively direct and the morphology is mostly scalar, followed by stepped retouch. Almost 95% of the retouched blanks display an elongation index equal to or less than 2 and 65% have a thickness index between 2.01 and 4.50. Average values for their length, width and thickness (including those fractured) are 3.9×3.0×0.9 cm. In the case of flakes with marginal retouching, the average values drop to 3.3×2.1×0.5 cm. All blanks have been made of local flint.

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

6.2.2. Human occupation in AGP5 level “mcp”

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

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

Faunal remains, mainly from herbivores, appear very fragmented and some are burned. Wood charcoal remains are also numerous and appear associated with combustion events.

6.2.3. Human occupation in AGP5 level “e”

Level “e” was the first archaeological level recognized in the initial test-pit in squares 10 A/B (Mazo and Alcolea, 2016). However, given its depth with respect to the current surface of the cave, at present it constitutes the least excavated of the three levels presented in this work, with an excavated surface of 4m2. The lithic assemblage is currentlycomposed of 125 remains representing a density of approximately 31.5 units per m2. Two cores have been recovered to obtain flakes, one of them Levallois (Fig. 5). The rest are blanks and remains of knapping and retouching (Table 2). 42% of this assemblage is smaller than 2 cm in length. Among those larger than 2 cm, 13 (8.3%) are typologically classifiable retouched blanks and three other flakes show marginal retouching.

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

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

6.2.4. Sporadic human visits in AGP7

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

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

The above evidence suggests that AGP7 was visited by Neanderthal people. Human agents have been considered one of the main actors of the faunal bone accumulation in the AGP7 cave-site, due to the predominance of herbivores and evidence of human manipulation of thebones, which would reveal butchery practices on this site (Galan et al., 2016). On the other hand, combustion structures and other combustion evidence such as wood charcoal or ashes have not been found in AGP7, and the faunal remains do not show evidence of burning. While the AGP5 site provides signs of various human occupations with an apparently more stable habitation pattern, probably related with their better living conditions, the archaeopalaeontological record of AGP7 suggests sporadic human visits with very specific purposes such as theprocessing of animal prey, which might or might not be contemporaneous with the use of the nearby AGP5.

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

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

6.3.1. Raw materials procurement

The proximity of a high-quality flint-quarry would have conditioned the use of lithic raw materials in AGP5. The use of flint as a raw material was almost exclusive at the 3 human occupations studied in this paper. It reaches 95.5% in "cnc", 92.9% in "e" and the 100% in level "mcp", considering the blanks of more than 2 cm length. In the first two levels the presence of limestone and silicified limestone has also been documented, and tabular flint in level "e". In any case, none of these raw materials was used in the configuration of retouched products norin the marginally retouched blanks. The quality of flint has been estimated according to the surface texture, 83.6% in level "cnc", 74.03% in "e" and 96.5% in "mcp", corresponding to the fine and very fine categories.

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

The "Botorrita-type" flint usually conserves a calcareous cortex in nodular samples. Microscopically they are mainly composed of microcryptocrystalline quartz, with the presence of macro-crystalline quartz and calcedonite restricted to the filling of porosities. Bioclastic inclusions are frequent, abundant in some cases. Metallic oxides, carbonates and terrigenous relicts are the more frequent non-siliceous components. The grain measure of the siliceous mass varies between fine and medium/fine, the surface ruggedness varies between smooth and smooth/rough, and the texture type between wackestone and packstone (García-Simón and Domingo, 2016). Its knappability is good, or excellent in some cases. The colour appearance is wide ranging, althoughthe nodular morphologies tend to have darker colorations than the stratified ones. Liesegang rings are frequently recognized (Cuchí and Mazo, 1992; García-Simón, 2018).

6.3.2. Plant resource management and paleoenvironment

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

Preliminary results of the wood charcoal analysis (N=113) reveal that Scots pine (Pinus tp. sylvestris) wood is used as the main fuel (Table 5). These trees dominate the anthracological spectra at the 3human occupations studied in this paper and represent the only taxon documented in the "mcp" and "e" levels. These cryophilous pines currentlygrow in the supra-Mediterranean bioclimatic belt in the Mediterranean vegetation region (Rivas-Martínez, 1982) above 1000–1200 masl. In level "cnc" (N=45), these pines appear accompanied byshrubby taxa characteristic of the forest edges (Prunus sp.) suggesting the existence of a probably more open landscape during the cold period that accompanies the formation process of this level. These pines required more humid conditions than the current pines in the surroundings of the cave, although they well-support the long periods of drought that characterize the Mediterranean-type precipitation regime. The pines were adapted to the cold climate that prevailed in the Mediterranean Iberia during the Last Glacial period from the coast to the mountains (Allué et al., 2018; Carrión et al., 2019). In any case, the presence of cryophilous pinewoods in the immediate surroundings of the site between 41 and > 50 ka 14C BP reveals colder and wetter climatic conditions than the current ones, probably of a subhumid or dry supramediterranean type.

6.3.3. Faunal assemblage and palaeoenvironment

Regarding faunal assemblages in AGP5 and AGP7, a high taxonomidiversity of herbivores and carnivores has been documented (Table 3). Herbivores are more abundant (85.7% of NISP in AGP7) and among them predominate ungulates of medium and small size such as Red deer (Cervus elaphus) (30.4 of NMI in AGP7) and Wild goat (Capra pyrenaica) (25% of NMI in AGP7) (Sauqué et al., 2014).

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

7. Timeline of Middle Paleolithic in the Iberian System

To establish the temporary framework of the Middle Paleolithic in the Iberian System, available chronometric information includes 49 samples dating 20 stratigraphic units from 11 archaeological sites (Table 1 and 6) (Fig. 8). The geographical spread of this sites extends along the Iberian System from the northwestern (Arlanza Basin) to the southeastern part (upper Turia Basin). This dataset has been obtained by means of 6 different dating methods and some intra-series discrepancies are not lacking. Furthermore, some dates are not useable for different reasons: i) the high values of deviation (UGRA-128 of Peña Miel), ii) the fact that the exact archaeological context is unknown (LEB 8530 and 8531 of Las Callejuelas), iii) the disagreement with other results (OxA-4603 of La Ermita) or iv) the unclear relationship between the date and the archaeological phenomenon (GrA- 27613 of Los Toros).

7.1. The early Middle Paleolithic in the Iberian System (MIS 9/5)

A set of dates place the first Middle Paleolithic industries in the Iberian System around MIS 10/8. Previous techno-complexes, corresponding to the Acheulean (Mode 2), have been clearly identified in Gran Dolina, Galería and Ambrona. Some of these sites have also revealed lithic industries with transitional tendencies. This is the case of the base of the stratigraphic subunit TD10.1 in Gran Dolina (Burgos), dated by ESR/U-series at 379 ± 57 ky with a mean of 337 ± 57 ky for its top (Falgueres et al., 1999; Berger et al., 2008), which “could represent the local evolution of Mode 2 (Acheulean) to Mode 3 (Mousterian) in Sierra de Atapuerca" (Carbonell et al., 2014, pp. 544).

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

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

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

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

Cueva Millán is located in the Arlanza basin. Its proximity to La Ermita cave, as well as the strong formal similarity of both lithic assemblages (raw materials and technology), led to the suggestion that both sites could have been contemporarily occupied by the same human population. Radiocarbon dates places the human occupations of Cueva Millán in 41,972 ± 527 (level 1a) and 41,856 ± 495 cal BP (level 1b) (Moure and García-Soto, 1982). The use of varied local raw materials (flint, quartzite, quartz, limestone and sandstone) influences the lithic industry characterized by the presence of small flakes with low representation of Levallois technology and high representation of Quina type scrapers. Palaeoenvironmental conditions inferred from faunalstudies suggest a similar but higher water supply climate than the current one (Pérez and Cerdeño, 1992).

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

Los Casares cave, located in the Upper Tajo basin, has also been ascribed to Quina Charentian facies although it could also be consistent with a typical Mousterian characterized by a high presence of scrapers (Barandiaran, 1973). Palaeoenvironmental data inferred from pollen, small mammals, wood charcoal and phytoliths point to a relatively temperate and humid interval within MIS 3, probably GIS 11, during the human occupation in level "c" (43,456 □} 703 cal BP) (Alcaraz-Castano et al., 2015, 2017). In the overlying level "b" scarce evidence of human activity has been documented, indicating a deterioration of the local environment and the abandonment of the site.

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

Finally, La Quebrada rock shelter, located in the Upper Turia basin, contains seven archaeological levels ascribed to Mousterian (Villaverde et al., 2008, 2017). The sedimentary sequence is divided in two sections separated by a sterile level 1m thick (VI) dated by OSL at 80.0 } 4.7 and 83.2 } 5.4 ka, placing its deposition in MIS 5a or MIS 5b (Carrion et al., 2019). At the top of the sequence are concentrated the richest levels (III to V) accumulated in an interval between MIS 5b and early MIS 3. These levels have been described as palimpsests which would be the result of short recurrent human occupations related to hunting, fishing and animal food processing. Small thin blanks produced by Levallois technology and characterized by quadrangular morphology constitute a specific production in the site probably related to the processing of animal carcases (Eixea et al., 2015). The lower levels (VII to IX) differ from the previous ones in settlement patterns as well as in lithic technology and raw material management. Inferred palaeoenvironmental conditions based on plant macroremains and micromammals suggest a dry or subhumid supramediterranean climate. Wood charcoal analysis reveals that the Scots pine type (*Pinus* tp. *sylvestris*)dominated the vegetation cover in the surroundings of the site, this being the preferred fuel during the whole sequence (Badal et al., 2012; Carrion et al., 2019).

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

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

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

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

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

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

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

8. Final remarks

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

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

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

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Figure captions

Fig. 1. Middle Paleolithic sites in the Iberian System (black dots). 1. La Ermita; 2. Cueva Millán; 3. Gran Dolina; 4. Najerilla; 5. Peña Miel; 6. Perdiguero and La Marcú; 7. La Bardalera; 8. Las Paretillas; 9. Paridera de la Condesa; 10. Miedes; 11. Montón; 12. AGP5 and AGP7; 13. Eudoviges; 14; Cabezo Marañán; 15. Ahumado del Pudial; 16. Los Toros; 17. Las Callejuelas; 18. La Quebrada; 19. Cuesta de la Bajada; 20. Los Casares; 21. Ambrona. Sites of Middle Paleolithic in immediate geographical context (blue dots). 22. Peña Cabra; 23. Los Torrejones; 24. Jarama VI; 25. La Roñuela; 26. Rambla de los Morenos; 27. Barranc de Carcalín; 28. San Luis; 29. El Pinar; 30. Tossal de la Font.

Fig. 2. View of Cerro del Pezon with location of AGP5, AGP7 and AGP3 caves. Visual field estimation from AGP5 (1) and the highest point of the cliff (4), (ArcGIS 10.4). Below: views from point 2, with visual domain of Valdeaguilon ravine.

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

Fig. 4. Above: Stratigraphic sequence in western profile. Below on the left: Detail of subsidence phenomena in level "b" in southern stratigraphic profile. Below on the right: Detail of contact between levels "b" and "cnc".

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

Fig. 6. Location of AGP5 and AGP7 caves with access routes to the Central Plateau, Levant, and Ebro Basin. In the surroundings of the flint outcrops, isolated findings appear with typologies ascribable to Middle Paleolithic. The use of quartzite has not been registered in AGP5 cave to date.

Fig. 7. Above: Data summary from paleontological studies in AGP7 and AGP5 and palaeoenvironmental implications. Below: hyena coprolite, distal humerus fragment of *Cervus elaphus* and hemimandible of *Dama dama* dated 44,560 } 480 14C BP.

Fig. 8. Calibrated radiocarbon dates from Mousterian occupations (MIS 3) in the Iberian Range against the NGRIP climatic curve (Rasmussen et al., 2014). (a) SST and (b) pollen percentage of Mediterranean forest from drilling core MD95-2042 and SU81-1833 (Sanchez-Goni et al., 2008). Timing of Heinrich events, blue bars, Rasmussen et al. (2014); loess deposition period in the Alto Tajo Bassin, ochre bar, Wolf et al. (2018); Campanian ignimbrite (Giaccio et al., 2017). Red dots, radiocarbon date > to. The dating of layer "d" from Los Toros represents the most recent Mousterian occupation in the Iberian System. Note, however, that the dating of the overlying level "c" has provided an age>45,000 14C BP.

Table captions

Table 1. Radiocarbon accelerator dates of Mousterian occupations (MIS 3) in the Iberian System. Dates calibrated with OxCal v4.3.2 (Bronk Ramsey, 2017) and atmospheric curve IntCal13 (Reimer et al., 2013). Wrong or unusable dates in italics.

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

Table 3. Taxonomical representation of AGP5 and AGP7 faunal assemblages. AGP5 values expressed in terms of presence/absence (p/a) (G. Cuenca and V. Sauqué pers. com.). AGP7 modified from Sauqué et al. (2014). (*) Presence of hyena coprolites, no bones identified so far.

Table 4. Data from visual field for areas of 3, 5 and 10 km radius. See Fig. 2.

Table 5. Preliminary results of wood charcoal analysis of AGP5 (n=113).

Table 6. Radiometric data. Stratigraphic units of the Middle Palaeolithic in the Iberian System (MIS 9–MIS 5). 1. Depending on the signal chosen. Ages obtained based on the combination of centres Ti–Li and Ti–H (1) or only in the centre Ti–H (2). 2. Sample taken from the laminar calcite flowstone overlying the Pleistocene sedimentary deposit. Invalidates OxA-4603.

Table 1

Site Level Reference Method Date C14 1 σ Calibrated Date BP

(68,2% probability)

2 σ Calibrated Date

BP (95,4% probability)

Reference

La Ermita *5a OxA-4603 C14 31,100* ± *550 35,606*‐*34,531 36,189–34,084* Moure et al. (1997)

Cueva Millan 1a GrN-11021 C14 37,600 □} 700 42,483‐41,486 43,031‐40,872 Moure and Garcia-Soto, 1982

1b GrN-1161 C14 37,450 □} 650 42,353‐41,408 42,841‐40,818

Pena Miel c OxA-5518 C14 37,700 □} 1300 43,127‐40,958 44,656‐39,862 Utrilla et al. (1987)

c UGRA-128 C14 39,900 ± *10,000*

e OxA-5519 C14 40,300 □} 1600 45,471‐42,710 47,977‐41,907

e GrN-12123 C14 45,500 □} 1400

g CSIC-546 C14 >40,000

AGP5 e Beta-313,364 C14 ABA 41,510 □} 510 45,406‐44,510 45,907‐44,055 Mazo and Alcolea (2016)

e MAMS-28122 C14 UF 44,560 □} 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-222,732 C14 34,860 □} 480 39,905‐38,845 40,524‐38,461 Galan et al. (2016)

base OxA-27902 C14 >46,300

Los Casares c COL4208.1.1 C14 39,494 □} 850 44,015‐42,640 44,899‐42,175 Alcaraz-Castano et al., 2017

Los Toros d GrA-24789 C14 35,250 □} 490 40,384‐39,235 40,970‐38,766 Montes et al. (2006)

c GrA-27613 C14 >45,000

La Quebrada III Beta-244,003 C14 ABA 40,500 □} 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-244,002 C14 ABA 43,930 □} 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 Carrion et al., 2019

Table 2

Archaeological level cnc mcp e

Excavated surface ±12m2 ±5m2 ±6m2

Total surface of level Unknow Unknow Unknow

Lithic assemblage 367 1700 125

Density m2 30.5 340 20.8

Dominant raw material Flint Flint Flint

Cores – 3 2

Knapping products Flakes Flakes Flakes

Lenght/Width/Thickness

(Weight) µ

– 4.5/4.5/1.7

(34.6)

5.4/4.4/2.5

(61.9)

Levallois – 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 < 2 cm (%) 187 (50.9) 1327 (78.0) 52 (41.6)

Blanks > 2 cm (%) 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

Table 3
AGP7 AGP5
NISP NMI
n % n % p/a
Canis lupus 13 3,5 2 3,6 -
Capra pyrenaica 92 24,7 14 25,0 *
Capreolus capreolus 51 13,7 8 14,3 -

Cervus elaphus 139 37,3 17 30,4 *

Crocuta crocuta 1 0,3 1 1,8 *(*)

Cuon alpinus 1 0,3 1 1,8 -

Dama dama - - - - *

Equus ferus 16 4,3 2 3,6 -

Felis silvestris 2 0,5 1 1,8 -

Lynx pardinus 8 2,1 1 1,8 -

Meles meles 1 0,3 1 1,8 -

Oryctolagus cuniculus - - - - *

Panthera pardus 8 2,1 1 1,8 *

Rupicapra pyrenaica 22 5,9 4 7,1 -

Ursus arctos 12 3,2 2 3,6 -

Vulpes vulpes 7 1,9 1 1,8 *

Total 373 100 56 100 -

Splinters 1102 74,7 - - -

Total NR 1475 100 - - -

Table 4

Pixels (5×5 m) Surface (km2) Percentage

Not visible Visible Total Not visible Visible Total Not visible Visible

Angular vision from 1

3 km *369,148 66,558 435,706* 9,2 1,7 10,9 84,7 15,3

5 km *1090745 106,154 11,968* 27,3 2,7 29,9 91,1 8,9

10 km *4340267 407,251 4747518* 108,5 10,2 118,7 91,4 8,6

Vision from 2 (360)

3 km *1004309 126,580 1130889* 25,1 3,2 28,3 88,8 11,2

5 km *2962851 178,581 3141432* 74,1 4,5 78,5 94,3 5,7

10 km *11882287 683,860 12566147* 297,1 17,1 314,2 94,6 5,4

Vision from 3 (369)

3 km *1007479 123,428 1130907* 25,2 3,1 28,3 89,1 10,9

5 km *2945926 195,554 3141480* 73,6 4,9 78,5 93,8 6,2

10 km *11785836 780,312 12566148* 294,6 19,5 314,2 93,8 6,2

Vision from 4 (360)

3 km *950,538 180,352 1130890* 23,8 4,5 28,3 84,1 15,9

5 km *2825735 315,701 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

Table 5

Layer cnc mcp e

Taxa n % n % n %

Pinus tp. *sylvestris* 42 95,5 39 100 28 100

Prunus 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

Table 6

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

La Ermita Calcite flowstone ‐ U/Th 95.1 } 5.7 2 Sanchez and Diez (2015)

Calcite flowstone ‐ U/Th 101.8 } 4.0 2

5a ‐ AAR 128.8 } 39.1 Diez et al. (2008)

5b ‐ AAR 114.3 } 41.9

Figure 1

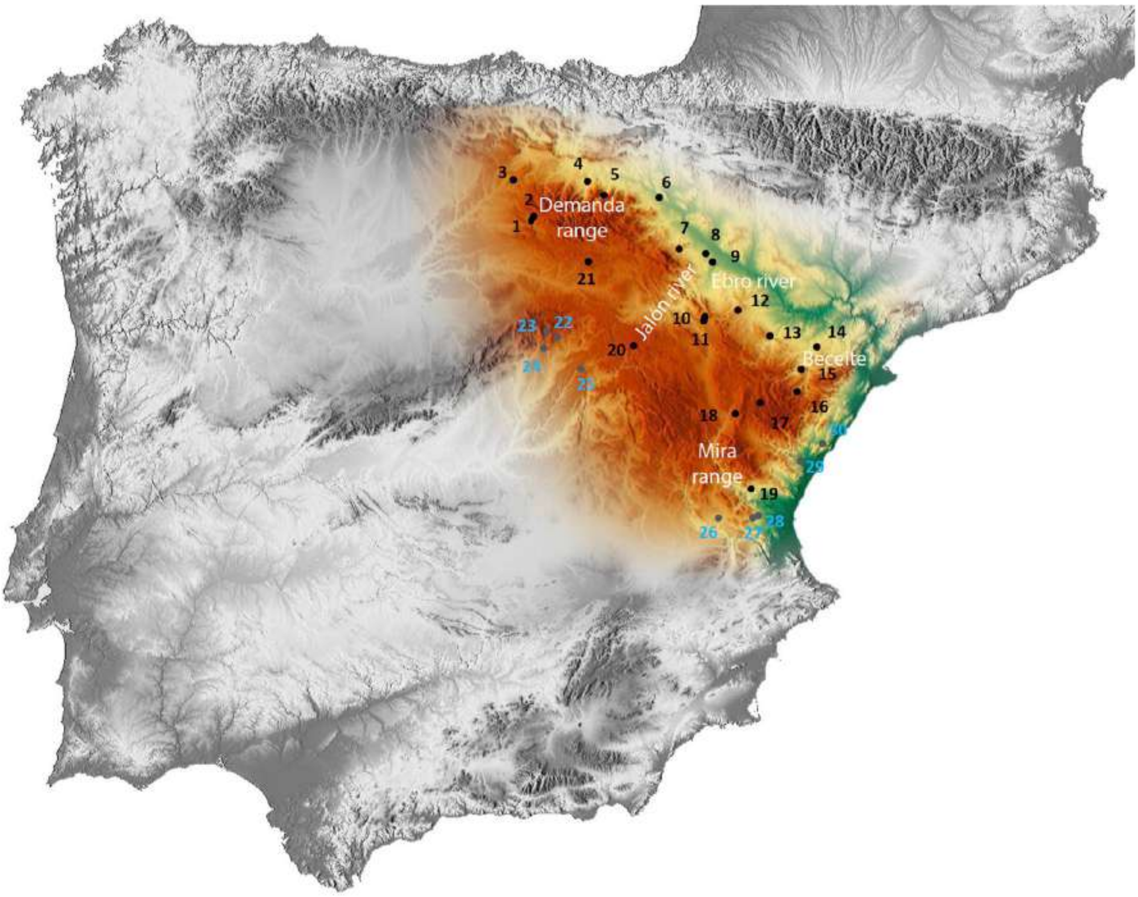


Figure 2.

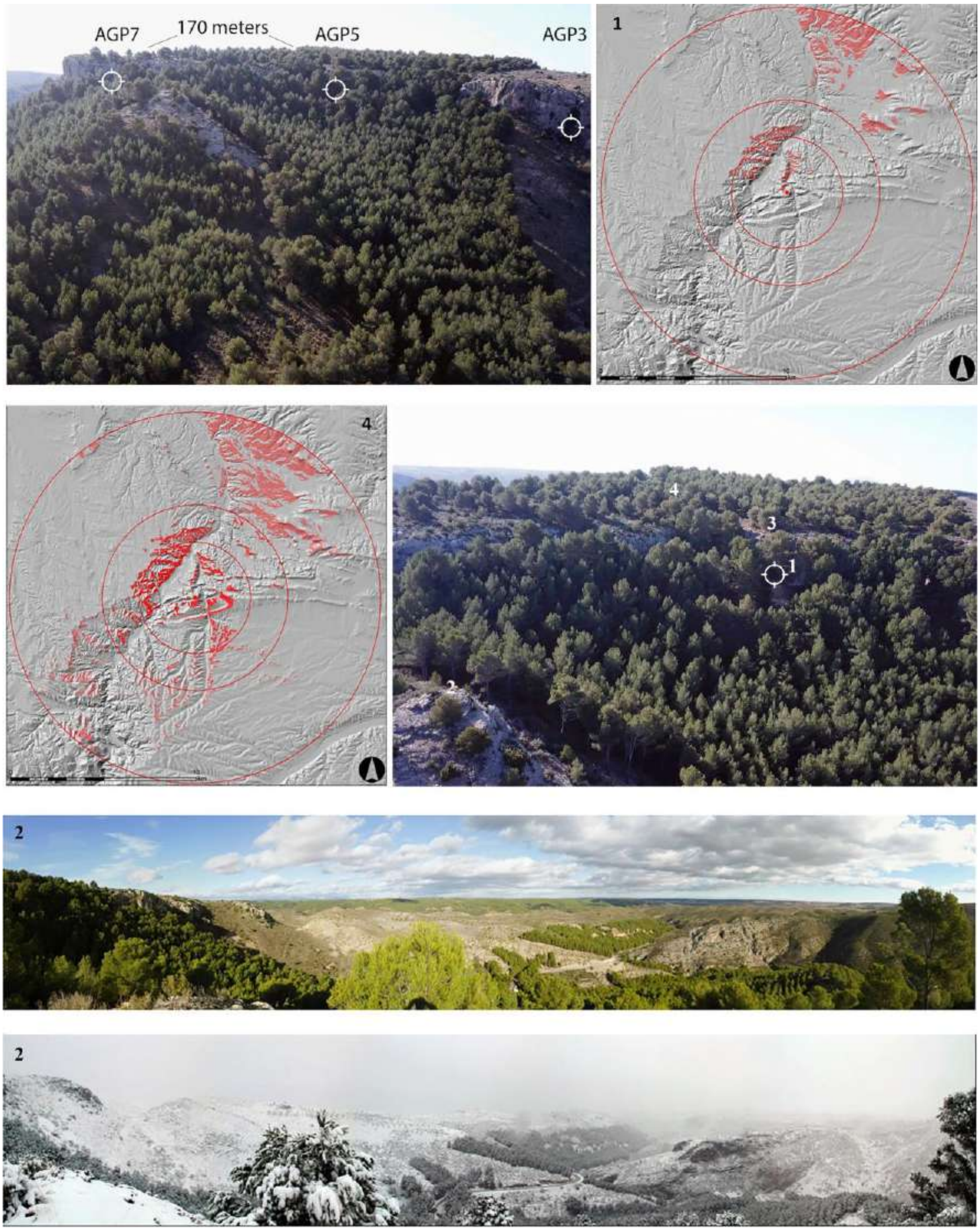


Figure 3

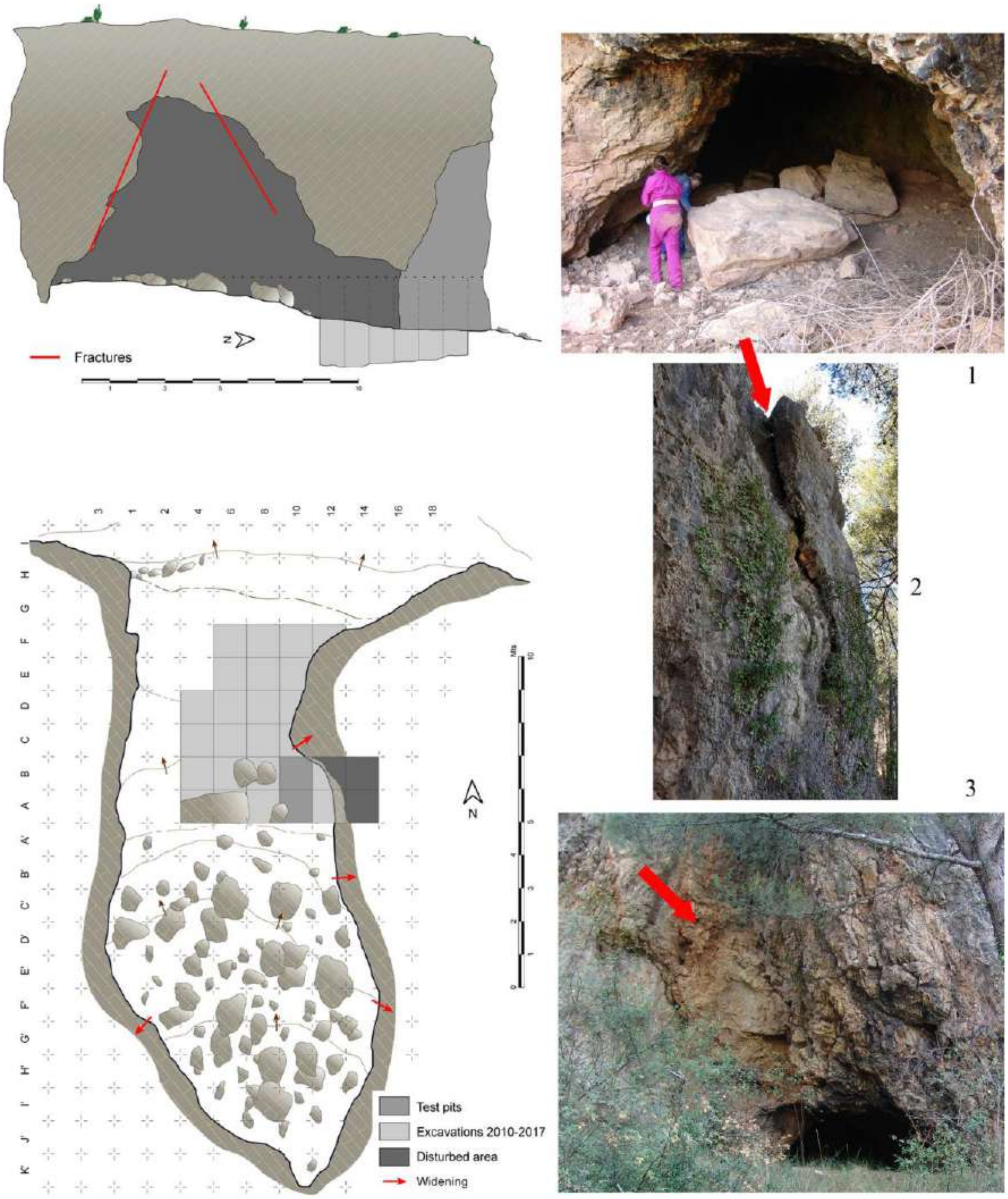
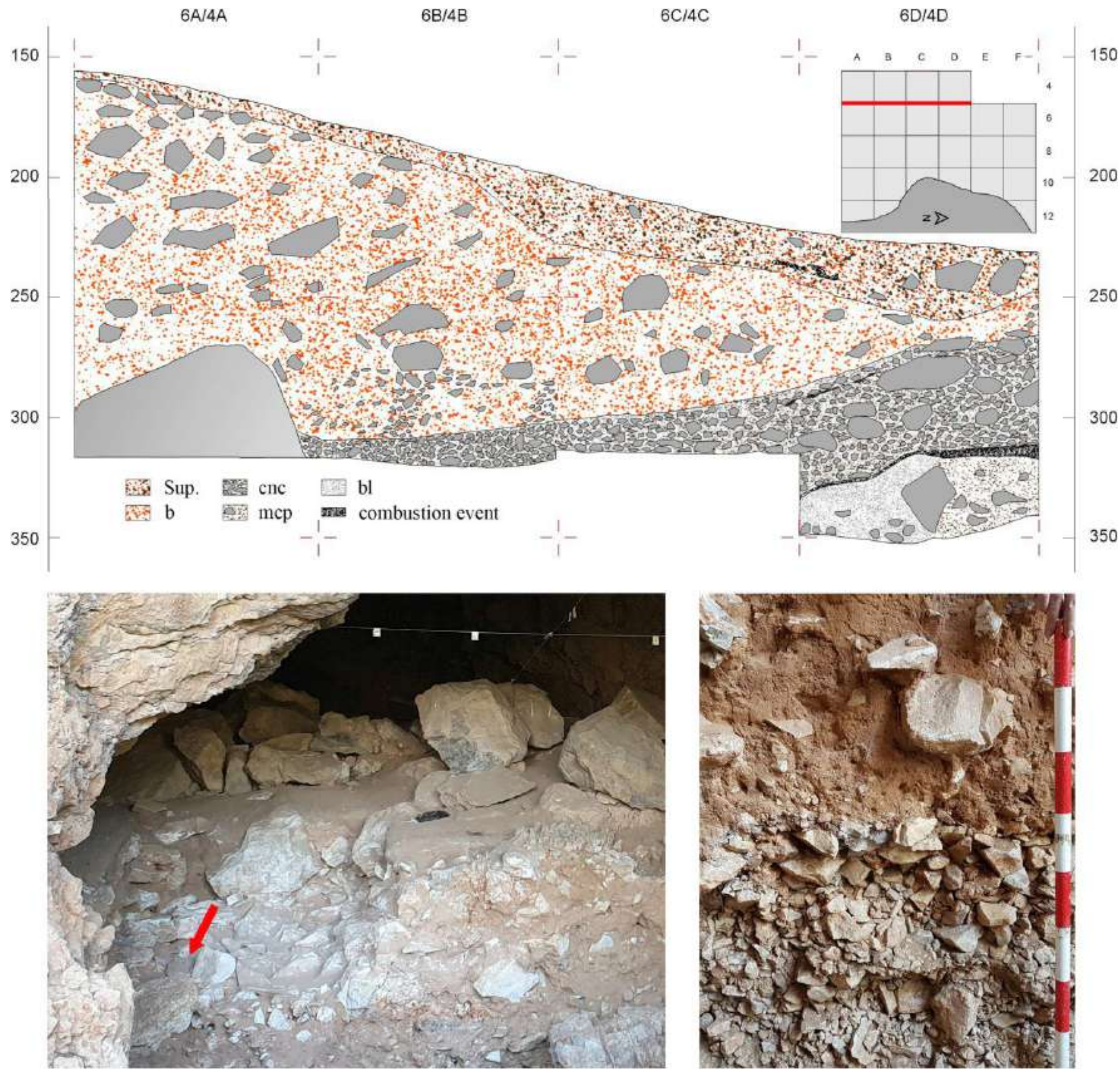

Fractures
1
2
3
N
Test pits
Excavations 2010-2017
Disturbed area
Widening

Figure 4



6A/4A
6B/4B
6C/4C
6D/4D
150
200
250
300
350
A B C D E F
4
6
8
10
12
Sup.
b
cnc
mcp
bl
combustion event

Figure 5

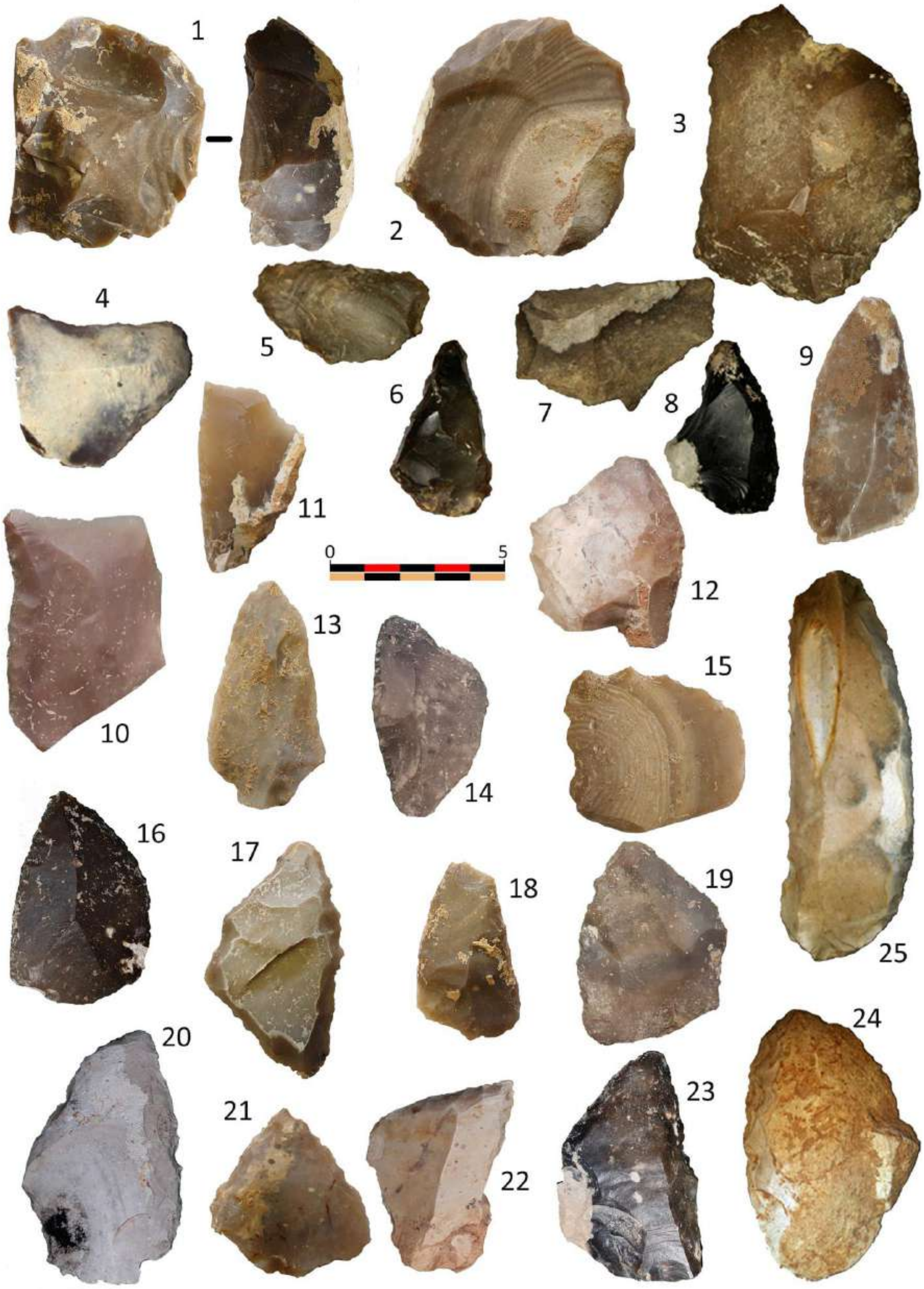
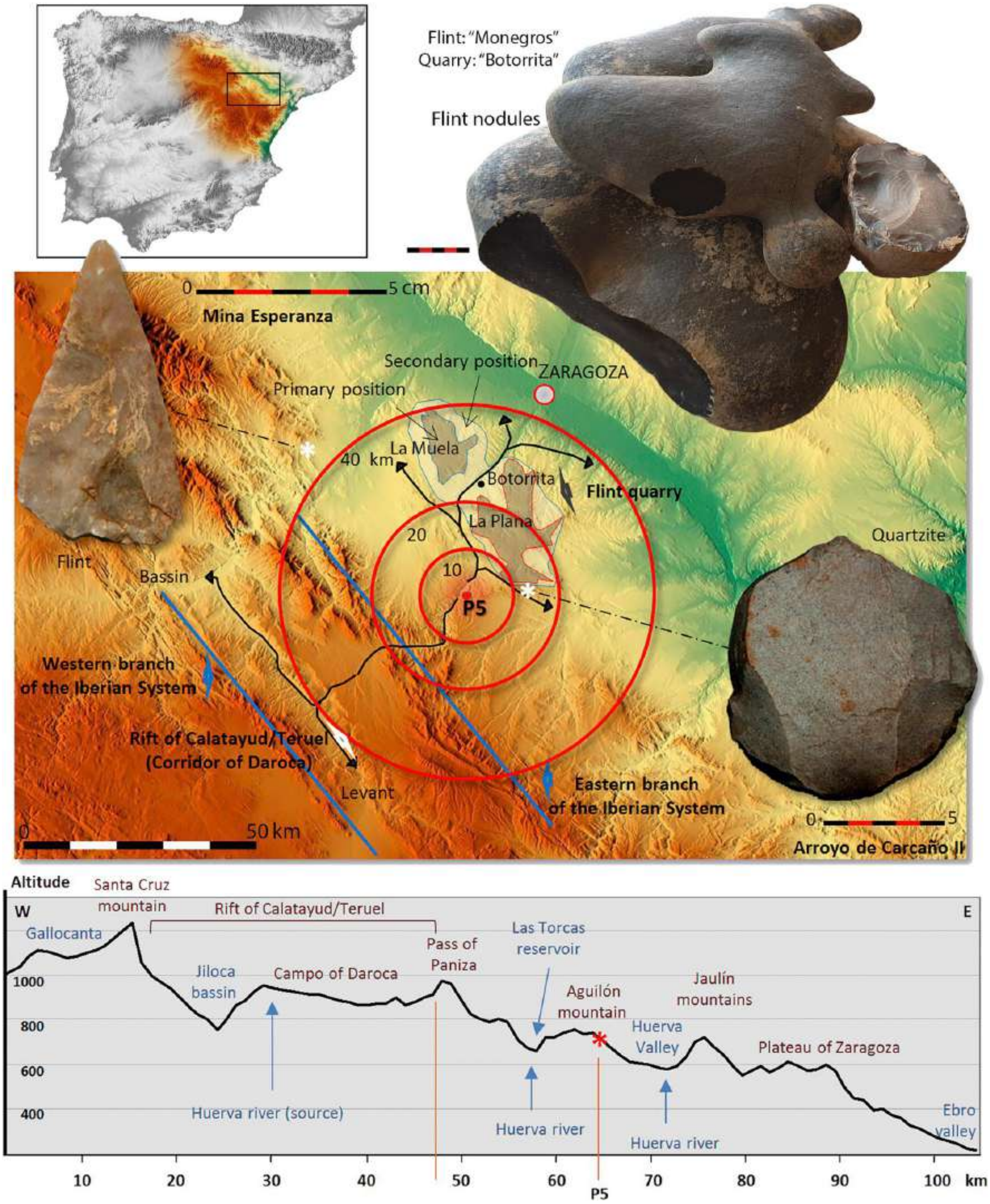
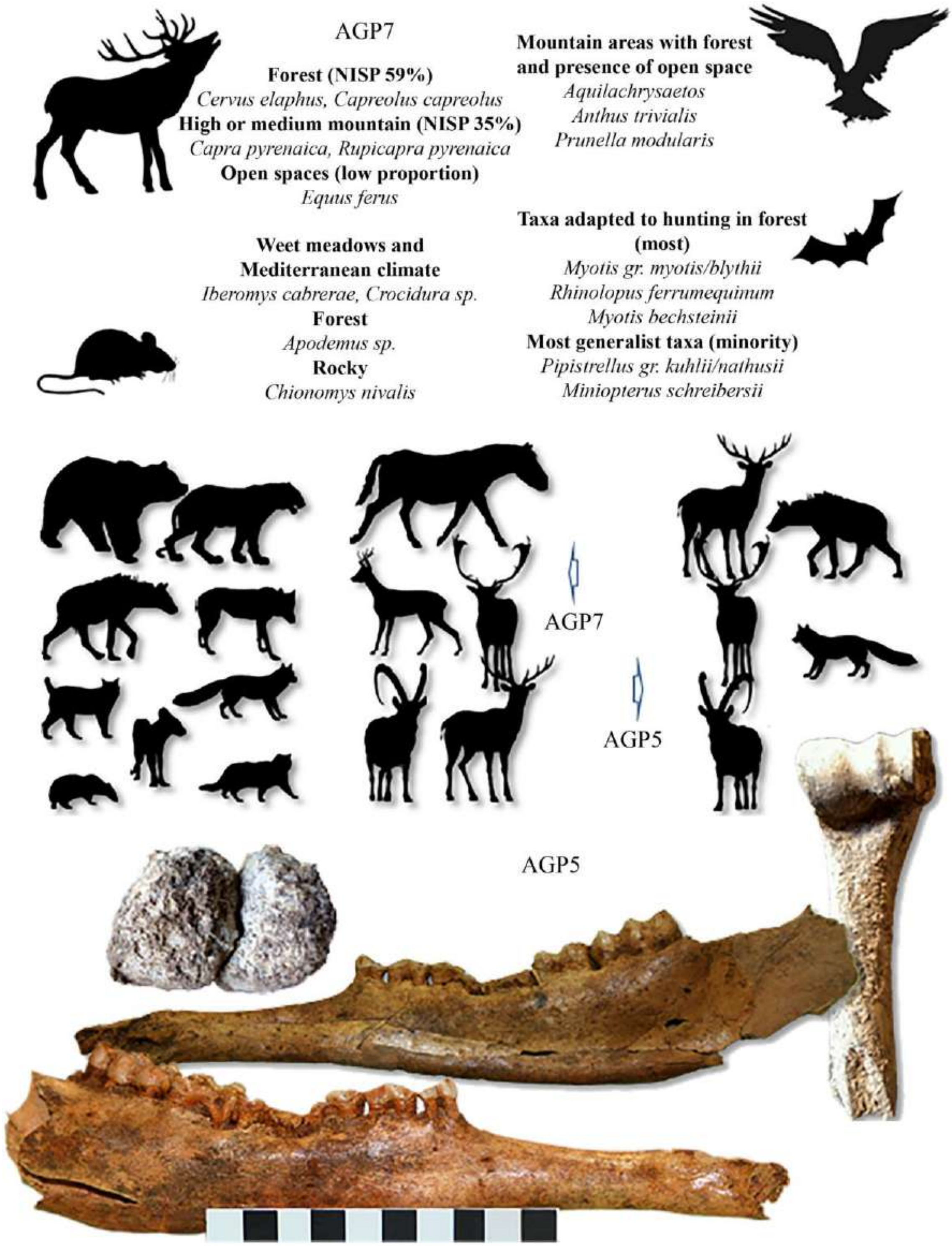


Figure 6



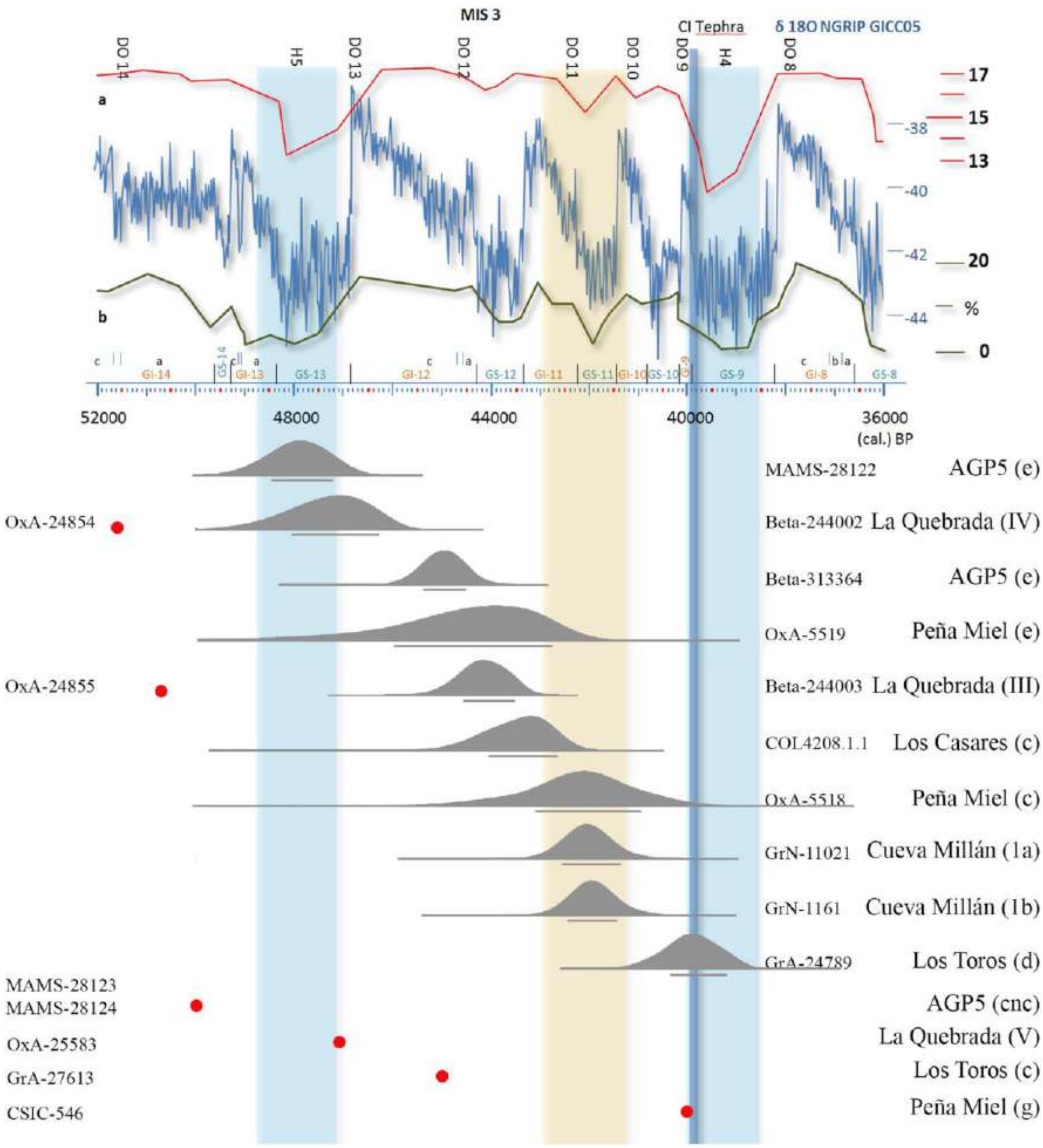
Flint: "Monegros"
Quarry: "Botorrita"
Flint nodules
0
5 cm
Mina Esperanza
Secondary position
ZARAGOZA
Primary position
La Muela
40 km
Botorrita
Flint quarry
La Plana
20
10
P5
Quartzite
Flint
Bassin
Western branch
of the Iberian System
Rift of Calatayud/Teruel
(Corridor of Daroca)
Levant
Eastern branch
of the Iberian System
0
50 km
0
5
Arroyo de Carcaño II
Altitude
W
E
Santa Cruz
mountain
Rift of Calatayud/Teruel
Gallocanta
Pass of
Paniza
Las Torcas
reservoir
Jiloca
bassin
Campo of Daroca
Aguilón
mountain
Jaulín
mountains
Huerva
Valley
Plateau of Zaragoza
1000
800
600
400
Huerva river (source)
Huerva river
Huerva river
Ebro
valley
10
20
30
40
50
60
70
80
90
100
km
P5

Figure 7



AGP7
Forest (NISP 59%)
Cervus elaphus, Capreolus capreolus
High or medium mountain (NISP 35%)
Capra pyrenaica, Rupicapra pyrenaica
Open spaces (low proportion)
Equus ferus
Mountain areas with forest
and presence of open space
Aquilachrysaetos
Anthus trivialis
Prunella modularis
Weet meadows and
Mediterranean climate
Iberomys cabrerae, Crocidura sp.
Forest
Apodemus sp.
Rocky
Chionomys nivalis
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
AGP7
AGP5
AGP5

1250 Figure 8



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