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El Mirador cave (Sierra de Atapuerca, Burgos, Spain): A whole perspective

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ABSTRACT

The archaeological site of El Mirador is located in the southern slope of the Sierra de Atapuerca. The work developed at the site is providing a substantial set of data from the Upper Palaeolithic and Early Neolithic to the Middle Bronze Age. Throughout at least about 4000 years of occupation, the cave was used for various activities, among which, burial, habitation and animal stalling. The practices related with this last use is, at the moment, the main origin of the archaeological deposits, which are mainly composed by burnt animal dung with vegetal residues, potsherds, lithics and faunal remains. In addition, it is characterized by high sedimentation rates that have enabled an individual and clear record of different episodes, providing high resolution chronological data. Due to these particularities, specific excavation methodology and interdisciplinary studies of the archaeological data have been developed in order to understand the genesis of this archaeological sequence and, at the same time, to provide information about the introduction and development of the production economy in the Submeseta Norte region.

1. El Mirador cave

The El Mirador cave (Ibeas de Juarros, Burgos) overlooks the southernmost flank of Sierra de Atapuerca at an altitude of 1.033 m asl, with commanding southerly views across the Arlanzón River valley (Fig. 1). Presently, the mouth of this karst cavity is approximately 23 m wide and 4 high, penetrating some 15 m inwards. Its current shelter-like form is due to the collapse of part of the roof. It is part of the Sierra de Atapuerca karst system, although a possible connection to the Cueva Mayor cavitiy system along the Trinchera del Ferrocarril is yet to be confirmed.

Edelweiss Caving Group dug a small test pit in 1970 (Ortega and Martín, 2012) locating Bronze Age remains. This work was not continued, and poachers looted the site in the following years. In 1999, the Atapuerca Research Team began the archaeological excavation at the site and it is still continuing.

2. Archaeological fieldwork and stratigraphic succession

In the first 10 years, the archaeological work was focused in the excavation of 6 m^2 area test pit in the centre of the zone now sheltered by the roof, in order to ascertain the archaeological potential. In the 20 m deep profile explored during these years are documented 14 m of Pleistocene deposits and 6 m of Holocene sediment. In 2009, fieldwork began in two new sectors, named 100 and 200, at the NW and NE ends of the cave, respectively, in contact with the current wall. These sectors are not being dug vertically but

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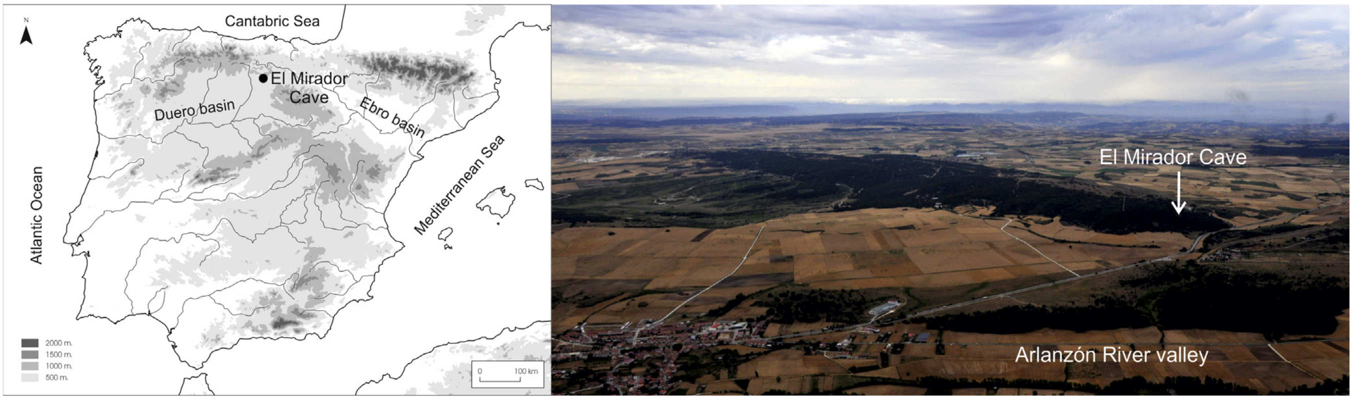

Fig. 1. Location of El Mirador cave.

in steps, following the line of the cave roof in order to document the inward retreat of the cave and also the stratigraphic variations between its different areas (Fig. 2, left).

The Pleistocene deposit is composed by 14 m of metric and decimetric limestone blocks with no sedimentary matrix in between. It is the result of the collapsed roof (MIR51/4 and MIR51/1) and contains two intercalated levels: MIR51/3, a shallow archaeological sterile level composed of wind-borne sediment, dated on 12.520 ± 40 BP (15.110–14.470 cal. BP) and MIR51/2, with the same sedimentary characteristics but with evidence of human activity: remains of a hearth, lithic and faunal materials. Charcoal samples extracted from material burned in the hearth have yielded two dates: 11.450 40 BP (13.420–13.180 cal. BP) and 11.670 40 BP (13.580–13.420 cal. BP).

The 6 m Holocene sedimentary layers rest directly on top of MIR51/. Four meters are attributed to Neolithic occupations (levels MIR24 to MIR6) occurring between the last third of the 6th millennium and the first half of the 4th cal BC (Vergès et al., 2008), while the remaining 2 m are from the Middle Bronze Age (MIR4 and MIR3A), between the 2nd and 4th quarter of the 2nd millennium cal BC (Vergès et al., 2002) (Table 1).

These levels were essentially formed as a result of the use of the cave as a livestock pen. The activities related to animal husbandry left sedimentary layers, dung, which was piled together and burned at regular intervals in order to reduce the volume and to eliminate parasites (Angelucci et al., 2009). These burned layers alternate with partially burnt and unburned layers of manure and nodules of ash from burned dung. An artefact record related to domestic

Table 1
1. Archaeological level; 2. Material; 3. Identification; 4. Laboratory number; 5 y 6. Measured Radiocarbon Age (5) and conventional (6), in years ^{14}C BP; 7 and 8. 2σ calibrated results, in cal BP years (7) and in cal BC years (8); 9. ^{13}C/^{12}C ratio. Calibrated using Intcal'13 curve (Reimer et al, 2013) in CalPal 2013.

1	2	3	4	5	6	7	8	9
MIR 4 (roof)	Charcoal	*Quercus* sp. evergreen	Beta-154894	3020 ± 40	3040 ± 40	1440–1120	3390–3070	−23.9‰
MIR 4 (base)	Charcoal	*Quercus* sp. deciduous	Beta-153366	3380 ± 40	3400 ± 40	1780–1580	3730–3530	−23.8‰
MIR 4 (pit)	Human bone	*Homo sapiens*	Beta-153366	3580 ± 40	3670 ± 40	2060–1820	4010–3770	−19.3‰
MIR 4 (pit)	Human bone	*Homo sapiens*	Beta-182041	3800 ± 40	3900 ± 40	2380–2100	4330–4050	−19.2‰
MIR 4 (pit)	Human bone	*Homo sapiens*	Beta-182042	3730 ± 40	3830 ± 40	2270–1990	4220–3940	−18.8‰
MIR 6	Charcoal	*Quercus* sp. evergreen	Beta-153367	4760 ± 40	4780 ± 40	3680–3400	5630–5350	−23.5‰
MIR 8	Charcoal	*Quercus* sp. evergreen	Beta-181086	4950 ± 40	4970 ± 40	3820–3620	5770–5570	−23.6‰
MIR 9	Charcoal	*Triticum aestivum/durum*	Beta-220912	5050 ± 40	5090 ± 40	3990–3710	5940–5660	−22.6‰
MIR 11	Charcoal	*Quercus* sp. evergreen	Beta-181087	5340 ± 50	5360 ± 50	4350–3990	6300–5940	−23.9‰
MIR 13	Charcoal	*Triticum dicoccum*	Beta-208131	5420 ± 40	5470 ± 40	4360–4200	6310–6150	−21.8‰
MIR 14	Charcoal	*Triticum aestivum/durum*	Beta-220913	5470 ± 40	5480 ± 40	4390–4230	6340–6180	−24.3‰
MIR 16	Charcoal	*Quercus* sp.	Beta-181088	5700 ± 70	5700 ± 70	4730–4370	6680–6320	−25.0‰
MIR 18	Charcoal	*Triticum dicoccum*	Beta-208132	6090 ± 40	6120 ± 40	5130–4890	7080–6840	−23.0‰
MIR 19	Charcoal	*Quercus* sp. deciduous	Beta-182040	6130 ± 50	6130 ± 50	5260–4900	7210–6850	−24.7‰
MIR 20	Charcoal	*Triticum dicoccum*	Beta-197384	6070 ± 50	6100 ± 50	5120–4840	7070–6790	−22.9‰
MIR 21	Charcoal	*Quercus* sp.	Beta-197385	6350 ± 40	6380 ± 40	5440–5240	7390–7190	−22.9‰
MIR 22	Charcoal	*Triticum aestivum/durum*	Beta-208133	6110 ± 40	6150 ± 40	5250–4890	7200–6840	−22.3‰
MIR 23	Charcoal	*Triticum dicoccum*	Beta-208134	6300 ± 50	6320 ± 50	5380–5180	7330–7130	−23.8‰
MIR 24	Charcoal	*Triticum dicoccum*	Beta-220914	6080 ± 40	6110 ± 40	5110–4870	7060–6820	−23.4‰
	Charcoal	*Pinus* type *sylvestris*	Beta-197386	7030 ± 40	7060 ± 40	6020–5820	7970–7770	−22.9‰
MIR 51/2	Charcoal	*Pinus* type *sylvestris*	Beta-208135	11450 ± 40	11470 ± 40	11470–11230	13420–13180	−24.0‰
	Charcoal	*Pinus* type *sylvestris*	Beta-208136	11670 ± 40	11610 ± 40	11630–11470	13580–13420	−25.0‰
MIR51/3	Pollen		Beta-220915	12520 ± 40	12480 ± 40	13160–12520	15110–14470	−27.2‰
MIR103	Charcoal	*Pinus* type *sylvestris*	Beta-339094	3150 ± 30	3190 ± 30	1500–1340	3450–3290	−22.8‰
MIR104	Charcoal	*Pinus* type *sylvestris*	Beta-339095	3330 ± 30	3350 ± 30	1710–1510	3660–3460	−22.4‰
MIR 106	Human bone	*Homo sapiens*	Beta-296226	3340 ± 30	3430 ± 30	1720–1520	3670–3470	−19.4‰
MIR203	Human bone	*Homo sapiens*	Beta-296225	4000 ± 30	4100 ± 30	2600–2440	4550–4390	−18.9‰
	Human bone	*Homo sapiens*	Beta-296227	4120 ± 30	4220 ± 30	2930–2530	4880–4480	−18.7‰

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occupations is often present in these levels. This kind of deposit is known as "*fumier*".

Between the second quarter of the 3rd millennium and the second quarter of the 2nd millennium cal BC, El Mirador was used as a burial cave. A group burial laid in a small natural chamber (sector 200, MIR203), cannibalised remains deposited in a hole at MIR4 and a single burial placed on one of the rock ledges inside the cave, have all been documented. Extensive excavations will allow us to discover whether the differential treatment of the corpses and the different types of burial reflect distinct funeral traditions, or whether they evolved together.

3. Methodological remarks on the excavation and study of the *fumier* deposits: the *facies*

At El Mirador cave, the Holocene stratigraphic succession identified as a *fumier* presents a high complexity because of its remarkable lateral and vertical variability, in addition to a notable sedimentary discontinuity (Fig. 2, right). This aspect, along with the logistics of the excavation process, have forced us to refute the use of major litostratigraphic units and to redefine the techniques and criteria employed during their excavation, sampling and analysis of the sediments.

In the field, it was decided to subdivide the succession into stratigraphic units in order to document; not single events, but rather complex events that occurred in a relatively limited time-frame. The criteria used for their identification include the existence of homogeneous and continuous surfaces over the whole excavation area. On the contrary, naming every single level implied a "divisionist" approach that would have been confusing when the stratigraphic matrix was compiled, since it would contain thousands of units scattered within only a few square metres (Angelucci et al., 2009). Likewise, it was important to document the internal variability of every stratigraphic ensemble. To cope with the complexity of the *fumiers* structure and lithology, we decided to use the concept of sedimentary *facies*. Therefore, each stratigraphic unit was subdivided into lithofacies according to its sedimentary characteristics that were recognizable in the field. Additionally, all the lithofacies were individually excavated and sampled, and three of them were dimensionally mapped (Angelucci et al., 2009). In this way, an open reference list of the lithofacies was created (specified with a small letter) and used to deal with the excavation, description and interpretation of *fumiers* (Table 2).

Table 2
Sedimentary characteristics of the different lithofacies identified in the Holocene series (Angelucci et al., 2009).

Name	Short description
a	Yellowish brown clayey silt, with few to common unsorted calcareous stones, common organic matter, high porosity; it contains common ash and scarce microcharcoal fragments dispersed in the matrix
b	Accumulations of ash, almost pure; sometimes contains charcoal fragments or yellowish small mottles; occasionally shows fine parallel lamination
bg	Ash accumulations with intermediate characteristics between facies b and facies g
c	Accumulations of mm- to cm-sized vegetal charcoal fragments
d	Very dark grey, granular, organic sediment formed of scarcely or moderately decomposed animal excrements, sometimes welded together
f	Fine layers of white to light gray ash with preserved fibres with horizontal, parallel or perpendicular, orientation pattern
g	Light gray silt, massive, with abundant ash dispersed in the matrix
i	Greenish silt, with abundant dispersed ash
m	Light brown, massive (sometimes granular) accumulations of ash, containing mm-sized fragments of charcoal and reddened sediment
o	Accumulation of organic matter, very dark grey to black, with massive structure and absence of recognizable excrements at the naked eye
P	Bioturbated parts
q	Clayey silt, reddish brown burnt sediment, with granular structure
s	Strongly deformed or broken ashy sediment, with heterogeneous characteristics
t	Dark greyish brown clay, with parallel or weakly wavy lamination and pseudomorphs of vegetal fibres preserved in between the laminae
tf	Silt with abundant ash and varied colour, sometimes with platy structure and moderate cementation
v/vl	3 to 5 cm-thick layers of clayey loam, massive (facies v) or with parallel lamination, with intercalations of orange layers with fibrous or granular structure containing recognizable digested bones and coprolites (facies vl)
-l	Suffix used for presence of lamination
-r	Suffix used for presence of reddening

Attending the complex formation and composition of the *fumiers*, as regards their study and interpretation, we applied two methodologies. On the one hand, taking in account that *fumiers* usually contain poor assemblages of cultural remains but are very rich in products derived from stabling (coprolites and associated spherulites) and botanical remains (charcoals, seeds, pollen, phytoliths, etc.), all units and facies were floated, as well as, systematically sampled. On the other hand, soil micromorphology was applied as a basic technique for explaining their formation processes. Accordingly, some works on pastoral cave contexts have highlighted the importance of the integration of archaeobotanical (Dehlon et al., 2008; Cabanes et al., 2009) and archaeozoological data (Boschian and Miracle, 2008) in the interpretation of *fumiers* as indicators of cave and landscape use by prehistoric shepherds (Angelucci et al., 2009).

At the same time, to rigourously deal with the complexity of studying these deposits, it has been considered necessary to develop experimental programs. These allow for current reference data to provide more accurate interpretations the prehistoric archaeological records documented in these livestock areas. So far, we have developed experimental work aimed at studying the processes of dung combustion (Vergès, 2011) and how these processes can affect archaeological remains buried within the deposits, especially archaeobotanical and faunal remains (Vergès et al., in this volume; Martín et al., this volume b).

4. Archaeobotanical studies

The burnt dung accumulation of the uppermost layers from El Mirador cave during the Neolithic and Bronze Age produced an exceptional accumulation of archeobotanical micro and macro

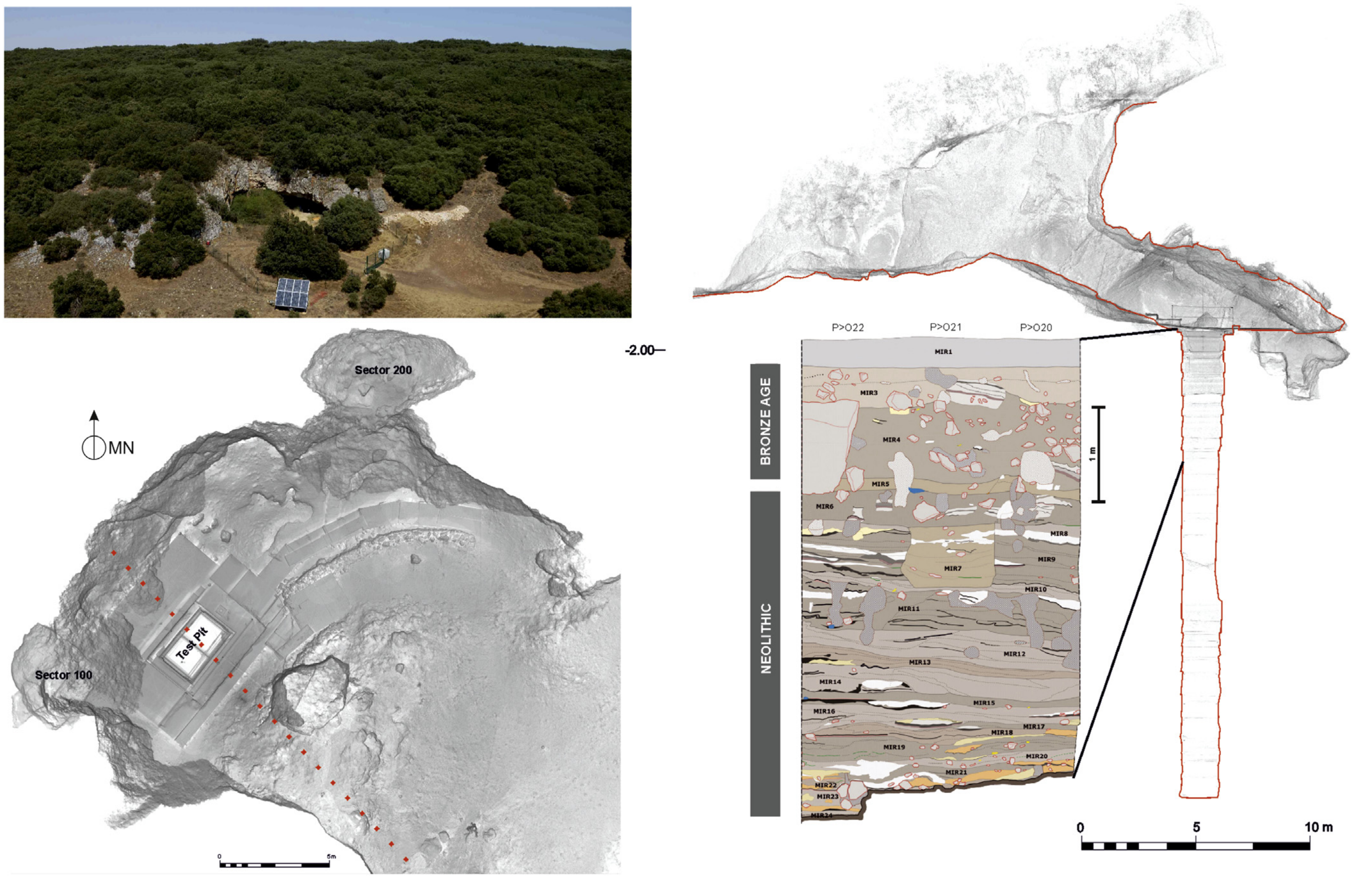

Fig. 2. Upper left: aerial view of El Mirador cave (J. Mestre/IPHES). Lower left: Plant of the cave of El Mirador where were indicated the three archaeological areas and the direction of the section. Right: N–S section of the cave and stratigraphical profile from the Holocene south section of the test pit.

remains, including pollen, no pollen palynomorphs (NPP), phytoliths, charcoal and charred fruits and seeds. Specific methodological and technical approaches have been developed for each material that depend on accurate sampling and extraction methods. For the macro-remains, all sediment has been water sieved using a flotation machine or bucket flotation. Concerning the micro-remains, systematic sampling has been carried out and pollen, NPP and phytoliths have been recovered in the laboratory using specific chemical and physical procedures. The evidence allows to explain the evolution of the vegetal cover and its transformation throughout the period that the cave was used at different intensities. At the moment, the data indicates a mosaic landscape formed by crop fields, pastures, and forested areas, locally represented by deciduous and evergreen oaks. On a regional scale, other types of vegetation, such as pine groves or beech forests, are also recorded (mainly during the Bronze Age). The sequence (from the base to the top) shows landscape transformations due to the intensification of human activity in the area and the influence of climatic changes that occurred during the mid-Holocene (4.2 cal BP event). Plant evidence is also important to understand human activities regarding crop plantations, crop processing, plant food, fuel and fodder (Euba et al., in this volume; Rodríguez et al., in this volume).

At El Mirador, different archaeobotanical evidence shows that crop fields were probably very close to the cave. In fact, the abundance of cereal pollen grains and the presence of spikelet forks in some samples are clear evidence for the development of crop processing activities (Expósito et al., in this volume; Rodríguez et al., in this volume). The existence of agricultural and livestock practices along the entire sequence and their clear antropozoogenic origin also implies the proliferation of coprophilous and carbonicola fungi. In addition, the important values of deciduous and evergreen oaks and their dendrological characterization are indicating the significance of these species that were probably used as wood fodder (Euba et al., in this volume).

5. Archaeomagnetism studies

Another innovative line of research that we are carrying out at El Mirador cave is archaeomagnetism. The numerous burning episodes (ash–carbonaceous couplets) documented along the Holocene stratigraphy, radiometrically well-dated (C^{14}), and in a very good state of preservation, provide a suitable context with which to reconstruct the directional variations of the Earth's magnetic field in the past. This information has interest both from the geophysical and archaeological point of views. From the geophysical perspective, 15 isolated directions of the Earth's magnetic field were obtained from 15 different burning features ranging from 5500 to 4000 yr cal BC (Carrancho et al., 2013). Sampling was performed using a cylindrical non-magnetic device, which incorporates a built-in orientating system to allow a precise geographical orientation of the samples. Although this device is not the standard sampling tool, we adapted it due to the non-consolidated nature of these sediments. Certainly, the difficulties involved in collecting oriented samples with precision have prevented archaeomagnetic research in this type of contexts before.

A comprehensive rock-magnetic study demonstrated that these fires are mostly dominated by low-Ti titanomagnetite as the main magnetic mineral carrying a thermoremanence reading (TRM) (Carrancho et al., 2009). Thus, these burnt sediments prove to be suitable directional geomagnetic field recorders fulfilling the necessary requirements for archaeomagnetic analyses. The data obtained represents the oldest archaeomagnetic directions currently existing in Western Europe. The directions obtained here, combined with data from other mid-Holocene sites in Eastern Europe, allowed us to design the first directional European Palaeosecular Variation (PSV) curve of the geomagnetic field (6000–1000 yr BC) which can already be used as a dating method (Carrancho et al., 2013). This new curve has a dating resolution similar to radiocarbon (±30 to ± 200 yr). More importantly, it shows the potential of this type of sediment to extend back in time archaeomagnetism as a dating method.

Also, the versatility of archaeomagnetism and mineral magnetism applied to the study of burnt anthropogenic cave sediments has yielded useful archaeological information such as, the determination of palaeo-temperatures or the evaluation of post-depositional mechanical alterations, among others. The magnetic results obtained at the site indicate that the ashes reached heating temperatures of >700 °C and the subjacent carbonaceous facies underwent heating temperatures of up to 350–450 °C. Likewise, magnetic analyses (i.e., anisotropy of magnetic susceptibility) successfully determined the absence of flowing fluids (i.e., water currents) that might disturb the preservation of the ashes in these burning events (Carrancho et al., 2012; Carrancho et al., in this volume). Certainly, this information has important implications in the cultural interpretation of the sequence. Nowadays, research is focused on obtaining additional archaeomagnetic (directional) determinations from new survey pits recently opened at the site, as well as absolute palaeo-intensity data from well-dated pottery fragments. All of this data will contribute to elaborate a full vector (directional and intensity) master PSV record, which will be used as reference for archaeomagnetic dating in Western Europe until Mid-Holocene times.

6. Lithic assemblage studies

A total of 3072 of lithic remains have been recovered along the entire sequence of the test-pit (3 × 2 m): 112 come from the Palaeolithic level (MIR51), 2779 from the Neolithic level, and 181 from Bronze Age levels (MIR3A and MIR4). Livestock and dung burning episodes strongly affected the lithic assemblage by way of thermal fissures, fractures, cupules and mechanical retouching. Before burning, lithic items display an oily, blackish patina, that permits to clearly identify the recycling events that are common along the entire archaeological sequence. Keeping that in mind, the representative lithic tools and the general tendencies of the assemblage have been described for each of the cultural phases.

In the lithic industry of the Palaeolithic level, the typical identifiable typological items have not been found. Flakes are recognized (more than 50% of total items), 10 of which were retouched (1 scraper and 1 notch). In contrast, a considerable number of cores were recovered (n = 13; 11.6%), many of which are blades cores.

The Neolithic layers have yielded a major part of lithic repertory, especially concentrated in the earlier part of the sequence (from MIR24 to MIR16). Siliceous rocks were managed in a similar way along the entire Holocene sequence (Bronze Age included): the production of blades and flakes and intensively used cores. The latter were deduced by their later phase of small-flake production and by anvil-flaking marks (very common for high-quality raw materials). Typologically, apart from simple retouched flakes and some denticulates and notches, the most significant element is circle-segments. We have recovered a total of 12 complete segments, 11 of them coming from the early Neolithic levels (MIR24-MIR17). All of these display diversity in retouching techniques that seem to have been freely applied, combining techniques (bifacial and abrupt retouch), blank faces (direct and inverse retouch) and pressure angles (flat or single retouching). A large number of pebble-tool fragments have been also been recovered. These include mill fragments, mill-grinders, sharpeners, hammers, and possibly boil-stones or pan-stones. These are especially abundant in the levels of last 3rd of VI millennia (MIR24–MIR17). Some of them accumulate diverse functional marks. Three fragments of polished tools made up on silimanite were also founded in these levels.

The Bronze Age levels (MIR4 and MIR3A) contain few lithic items. Some retouched flakes and 3 sickle teeth are the most significant typological elements. Despite the paucity of the flint sample, the cores show flaking techniques associated to raw material exhaustion: a final phase of small-flake production and evidence of anvil-marks.

Several studies are ongoing, including raw material provenance determination, traceology and studies of the effects of thermal alteration.

7. Zooarcheological studies

Macromammal remains are very abundant in El Mirador cave. The Neolithic and Bronze Age levels have yielded 9372 remains recovered from the central test trench and sector 100. Faunal assemblage conservation is very good, but the anthropic index of bone breakage is high, which causes difficulties for the taxonomical identifications. The number of identified specimens (NISP) is 3643.

The faunal study consisted in taxonomical, anatomical and taphonomic analysis. The age of death was calculated for the domestic animals and experimental work has been carried out in order to study faunal assemblage formation processes and taphonomic modifications.

Macromammals management in El Mirador cave was based on complementary livestock breeding and hunting practices (Martín et al., in this volume; Martín and Vergès, in this volume). Mixed goat (*Capra hircus*) and sheep (*Ovis aries*) flocks breeding was the most important practice during the Neolithic and Bronze Age. Immature sheep and goat were very abundant, especially fetal and neonatal individuals. El Mirador was employed as a breeding cave for pregnant ewes (Martín et al., in this volume).

Cattle (*Bos taurus*) breeding was complementary, but its importance increased towards the Bronze Age in parallel with an increase in the representation of wild taxa. This could be linked with the diversification of faunal source exploitation and with the intensification of human activity (documented by the archaeobotanical analysis).

Dogs (*Canis familiaris*) and pigs (*Sus domesticus*) were also part of the domestic repertory. However, determination of domestic horses (*Equus caballus*) is difficult. The horse NMI was higher during the Bronze Age: these could be domestic horses or wild horses monitored by the human community (Martín et al., 2014b).

Wild consumed animals were: deer (*Cervus elaphus*), roe deer (*Capreolus capreolus*), several small carnivores (*Meles meles*, *Felis silvestris*, *Vulpes vulpes*), lagomorphs and birds. Wild carnivore consumption was punctual and could be linked with protecting the flocks or with accidental hunting (Martín et al., 2014a).

Most of the taphonomic modifications identified are anthropic (cut marks, tooth marks, fractures, culinary alterations). Domestic dogs and suid modifications (tooth marks and fracturing) were also observed. Fossil diagenetic alterations are scarce, identifying trampling, manganese and root etching. Finally, bone tools are scarce: 10 remains with anthropic abrasion were identified.

8. Human remains and DNA studies

At the start of the Bronze Age, in the final third of the 3rd millennium cal BC (i.e., in MIR4 level), skeletal remains of six individuals deposited in a small hole were documented. They bear evidence of having been defleshed, fractured, cooked and eaten (Cáceres et al., 2007). They were certainly collected and buried hundreds of years after their death by the farmers that occupied the cave. Experimental work (Saladié et al., 2015) supports the evidence for cannibalism on these human remains.

At test pit 200, we have identified at least 23 individuals (MIR203) deposited in a small natural chamber (Fig. 3). Two of them were dated in 4000 ± 30 BP (4.550–4.390 cal. BP) and 4120 ± 30 BP (4.880–4.480 cal. BP), locating the burial episode in the Chalcolithic period. The final stage of this site's use as a burial cave is documented at test pit 100 and is marked by a single burial (MIR106) of a young male who was placed on one of the rock ledges inside the cave. The radiocarbon age is 3.340 ± 30 BP (3.670–3.470 cal. BP), corresponding with the Middle Bronze Age. The analysis of these human remains is still ongoing, however, work carried out so far has contributed results relating to dental morphology, pathology and DNA analyses.

Dental analyses show some bucco-dental pathologies and abnormalities associated with one of the buried individuals. This is the case of Individual 4, who suffered several oral pathologies and shows an ancient case of super-numerary molars in her mandible (Ceperuelo et al., 2015). The analysis of the morphological characterization of the inner anatomy of the root canals of the permanent molars of these human fossils using cone-beam computed tomography determined that the shape and disposition of the root canals show the same diversity from the Chalcolithic populations until nowadays (Ceperuelo et al., 2014). Recently, the presence of dental wear related to cultural uses of teeth on the occlusal surfaces of two of the 23 individuals has been determined (Lozano et al., 2015).

On the other hand, the analysis of DNA of these individuals has provided important information about this human group and its relationships with other contemporary and previous groups (Mathieson et al., 2015). The mitochondrial DNA sequence and the haplogroup composition of 19 individuals from the collective burial has been obtained (Gómez-Sanchez et al., 2014). This work is related to the analysis of the current distribution of haplogroup H that was modeled by the expansion of the Bell Beaker culture out of Iberian Peninsula during the Chalcolithic period. However, little is known about the genetic composition of other contemporary populations lacking of the archaeological traits of the Bell Beaker culture.

Fig. 3. Chalcolithic collective burial (MIR203).

The specific mtDNA composition of the El Mirador group differs from other contemporaneous Bell Beaker populations and from present-day Iberians. El Mirador shares affinities with Near Eastern groups and gathers of the Middle and Late Neolithic populations from Germany (Rössen, Salzmünde and Baalberge archaeological cultures). However, El Mirador is not clustered with contemporaneous Bell Beakers.

The mtDNA of El Mirador is related to the hypothesis of the continuity of the previous Middle Neolithic genetic composition into the Chalcolithic.

9. Ceramic remains studies

The ceramic equipment from the site is studied with a double aim: 1) to determine the type and measurement of ceramic vessels in order to establish functional possibilities and 2) to initiate the decorative-formal study of the remains so as to establish a cultural affiliation for each chronological phase.

The Bronze Age (c. 594 fragments) and Neolithic (c. 2300 fragments) ceramic records obtained from the test pit have been analysed to establish the minimum number of vessels (plain and decorated). We have performed a macroscopic analysis and have studied the type of finish, mineral inclusions and cooking methods. Furthermore, decorative features of the available sample have been analysed.

The analysis of the Bronze Age ceramics shows a lack of the Classic Cogotas I motifs. This characteristic has led us to question the inclusion of El Mirador in the heart of the development of the Cogotas I material horizon, being more appropriate include the area of the Sierra de Atapuerca in the so-called Contact Zone, where the decorated pottery style distance from the Cogotas I (Moral, 2002). In this regard, not only the relationship of these materials with those found at the nearby Valle del Ebro, but the presence of a number of materials that could be described as showing “outside influence”, are noteworthy (Moral et al., 2003–2004).

A greater number of ceramic vessels has been observed in the Early Neolithic and Late Neolithic layers than in the intermediate phase. Also, subtle differences in the volumes between the phases and morphologies have been observed. This would imply the possibility that the occupations were of varying intensities and that, at the same time, their duration was also differential. In addition, the decorations are documented mostly in the earliest levels (Moral and Cebrià, 2006), while they are anecdotal from the Middle Neolithic. This indicates that the same tendency is followed in the peninsular Neolithic as in the centre of the Iberian Peninsula sites (Oms et al., 2014).

10. Final remarks

The study of prehistoric societies requires singular records that take us beyond the outline of processes, providing data that allow to draw details. This degree of definition is achieved by the availability of a continuous stratigraphic succession with a long chronology: it is made possible thanks to finely preserved records obtained from well-distinguished archaeological units that allow to document minor changes and to establish their chronological succession.

When the subject of study is the implementation and expansion of farming societies, this is the case of the records preserved in so-called pen-caves. In the context of the interior of the Iberian Peninsula Los Husos I and II y San Cristobal (Fernández-Eraso, 2008; Polo and Fernández-Eraso, 2010), El Portalón (Galindo-

Pellicena et al., 2014) y El Mirador (Vergès et al., 2002, 2008) are outstanding archaeological sites.

El Mirador cave has over 6 m of Holocene stratigraphic sequence, ranging from the Neolithic to the Middle Bronze Age, with a sedimentation rate corresponding to the Neolithic period of 1 mm/year. It is an extraordinary deposit with which to observe cultural, economic and environmental change. Proof of its potential is provided by the innovative studies on archaeomagnetism that are being carried out (Carrancho et al., 2009, 2012, 2013, in this volume). Likewise, the excellent conditions of the cave's archaeological record, even at the level of genetic material, is testified by the studies carried out to date (Gomez-Sanchez et al., 2014, Mathieson et al., 2015). The El Mirador cave therefore provides an exceptional opportunity it to carry out of all the study methods nowadays made available for archeology.

The results from the studies developed up to now and from those that are currently in progress, some of which are included in the articles of this volume, place El Mirador cave as a reference among archaeological sites for the study of the Neolithisation process in the Iberian Peninsula and in other Mediterranean pen-caves.

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