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El Barranc de la Boella (La Canonja, Tarragona, Catalonia, Spain)

1. Location and Researchs History

The el Barranc de la Boella (literally Boella Creek) site (la Canonja, Tarragona, Catalonia, Spain) is situated in the Northeast of the Iberian Peninsula, 3 kilometres inland from the Mediterranean coast close to the city of Tarragona. The site lies on the terrace system of the Francolí River, which is, in turn, related with the Neogene Gavarres – Constantí interfluve and the Pleistocene *bajada* (merging of several alluvial fans) of the Reus depression. In the second series of the geological map produced by the Spanish Geological and Mining Institute (IGME), the Constantí – Gavarres interfluve is described as a Quaternary calcrete in reference to the Pliocene-Pleistocene limit. With respect to Gavarres – Constantí interfluve, the memoir of this map describes one terrace of the Francolí River above + 60 metres of the Francolí River.

The terrace system within which the Barranc de la Boella site is located was partially buried by the bajada deposits from Reus Depression origin. This area abounds in quarries for the extraction of gravels which have exposed a number of significant outcrops that have enabled us to confirm the existence of the Early Pleistocene terraces of the Francolí River in this area delimited between Constantí – Gavarres interfluve and the Pineda Beach (near the Cape of Salou). The terraces system of Middle and Late Pleistocene age at the lower Francolí River valley is located between the Gavarres – Constantí interfluve and the city of Tarragona where it joins the Mediterranean (Fig. 1).

The first reports on oldest prehistoric artefacts discovered within the geographical area involved the finds made on Early Pleistocene terraces at the foot of Constantí – Gavarres interfluve and Pineda Beach. Many of the sediments that make up the deposits of the terraces of the Francolí River were transported from the Ebro Depression with rocks rich in chert (Bartonian and Lutetian), which lend themsel-

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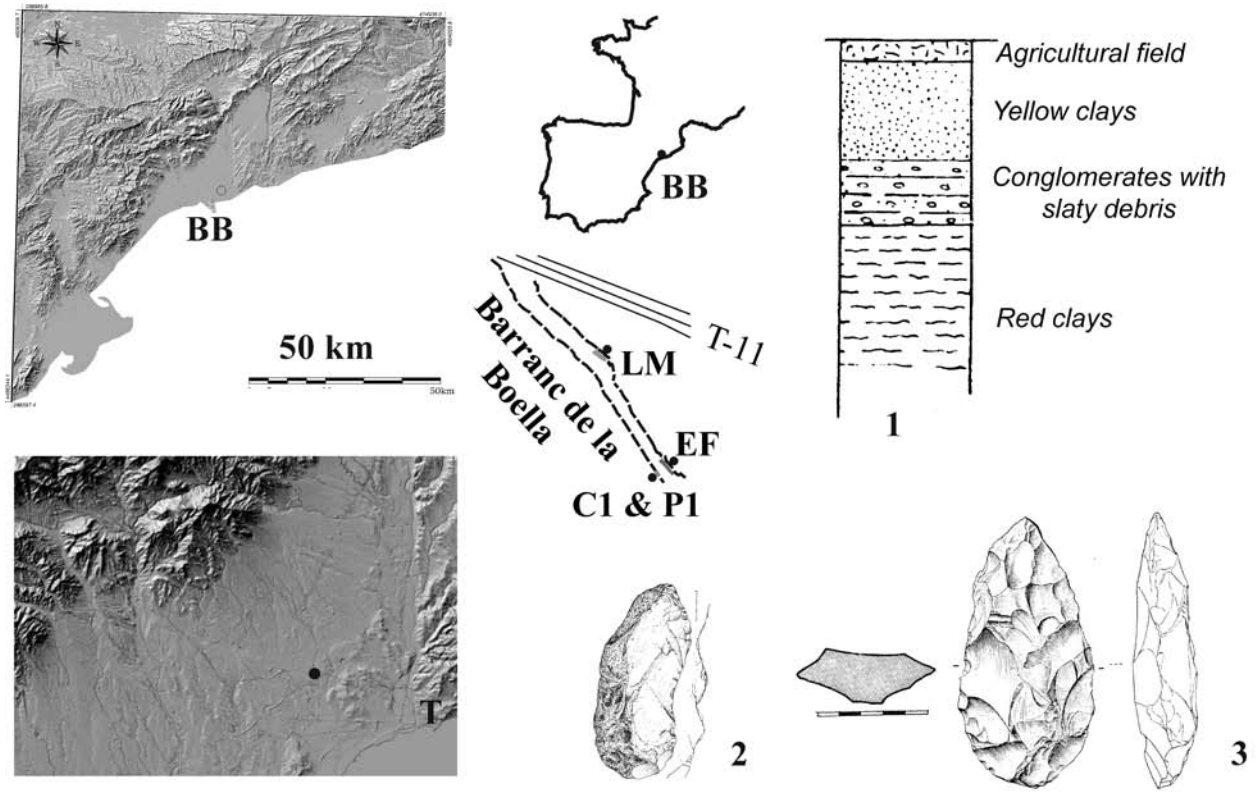

Figure 1. El Barranc de la Boella (BB) is situated in the Northeast of the Iberian Peninsula in the basin of the Francolí River. In the digital model of the terrain, courtesy of Miquel Vilà of the Geological Institute of Catalonia, the elevation of the surface area of the upper terraces can be observed to the northeast of the black spot (which is where the el Barranc de la Boella sites are located), with the elevations of the miopliocene between the black spot and the city of Tarragona (T) also being shown. The Barranc de la Boella sites are pit 1 (C1) alongside profile 1 (P1), pit 2 (LM, la Mina) and pit 3 (EF, el Forn). The stratigraphic column represented in 1 shows the stratigraphy reproduced by Marin (1933). The lithic industry shown in 2 is a reproduction of an atypical artefact found next to the remains of proboscideans (Vilaseca, 1973) in which Dr Vilaseca observes artificial, not natural fractures. The lithic industry shown in illustration 3 is the Constantí black flint hand axe documented in 1909 (Gibert, 1909).

ves extremely well to lithic industry, were frequently brought down with them. The provenance of a cordiform hand axe (Gibert, 1909) is attributed to the Constantí area, and for many years it was considered as the oldest proof of the presence of human beings in Catalonia, although the exact location of the find has never been known (Fig. 1: 3). Another piece reported from the past, which is worth mentioning only because it occurred close to Tarragona, is the identification, by Harlé, of a molar of *Elephas meridionalis*, details of which were also published by Marià Faura i Sans (1920). Once again, the exact location of the find is not known, and it is only described here due to its having been found in some gravel quarries administered by the Tarragona Port Authority.

The first paleontological and archaeological finds made in the area around la Canonja and in el Barranc de la Boella are mentioned in the explanatory note of the first series of 1:50000 IGME maps directed by Agustí Marín (1933). In this map, and in the accompanying explanatory note, the outcrop of el Barranc de la Boella was considered to be a paleontological Pliocene site due to the presence of *Rhinoceros* sp., *Cervus* sp. and *Equus caballus* Lin., which were found within a stratum composed of red clays (Fig. 1: 1). This note also describes the discovery of *Helix* sp. in the sand and clay deposits of el Mas Boella on top of the stratum of red clays, which were dated as Upper Pliocene. In the section dedicated to prehistory of the memoir of this map, it is noted that prehistoric lithic implements had been found in la Canonja. Years later, Dr Salvador Vilaseca published details of the discovery of abundant lithic industry remains at la Boella within a stratigraphic context. The remains of the lithic industries were found in a number of large gullies close to Reus Airport (Vilaseca, 1954). These

archaeological remains were discovered in clayey strata that had settled on top of some conglomerates that had, in turn, settled on top of the red clays described above. Dr Vilaseca named this prehistoric site close to Reus Airport la Boella and proceeded to describe it archaeologically based on the prehistoric pottery and archaic lithic industry he found there at a depth of approximately 1.5 metres. On the other hand, this area, at the foot of the Constantí – Gavarres interfluve, contains numerous surface archaeological sites, with many of these considered as Middle Palaeolithic on the archaeological inventories of the Generalitat de Catalunya. However, only one publication exists that is dedicated to these surface sites and in it les Gavarres and their industries are classified as "*campiñoides*" (Vilaseca and Capdevila, 1968).

In 1970 Ramón Capdevila accidentally discovered the remains of large herbivores at Barranc de la Boella. J. F. de Villalta i Comellas identified them as *Elephas (Archidiskodon) meridionalis* and in 1973 Dr S. Vilaseca published this as Barranc de la Boella site. Together with the discovery of these remains of proboscides, Dr. S. Vilaseca described the finding of flint fragments, which he classified as atypical artefacts (Vilaseca, 1973). In the paragraph that precedes this classification of the atypical flint artefacts Dr. S. Vilaseca insists on admitting that "…, no site or discovery whatever is known that may be attributed to the Lower Palaeolithic which can provide the necessary scientific guarantees" within Southern Catalonia Archaeology. Dr. S. Vilaseca describes this lithic industry in minute detail and arrives at the conclusion that it includes dubious pieces of flint, meaning that the flakes they bear may well be natural, and mentions one flake is clearly artificial (Fig. 1: 2). In this respect he points out that the existence of the Lower Palaeolithic in Tarragona is suggested by the aforementioned Constantí hand axe, details of which were published in 1909 (Gibert, 1909), although he does express his doubts as to its provenance. However, he then goes on to suggest that more evidence exists regarding the Lower Palaeolithic by pointing out other discoveries, made in Reus, of ancient stone axes, or the Middle Palaeolithic industries found at el Forn d'en Sugranyes (Reus), details of which he himself published (Vilaseca, 1952).

Living, as he did, in the town of Reus meant that Dr. S. Vilaseca had known about Barranc de la Boella for many years. In his summary of 1973 he distinguishes the discoveries made at the site of la Boella (Vilaseca, 1954) from those of the Barranc de la Boella. He also used this study to highlight the contribution made by his friend, the palaeontologist Josep Ramón Bataller, to the explanatory note of the geological map of 1933 (Marín, 1933; Bataller, 1935). Much of the information provided by this mapping of the 1933 received the backing of the Geological Institute of Catalonia, created by the Junta de Ciencias de la Mancomunitat de Catalunya in 1914, under the direction of M. Faura i Sans. Josep Ramón Bataller and Salvador Vilaseca worked as assistants to M. Faura i Sans and had to leave this geological mapping project unfinished in 1924.

Dr S. Vilaseca describes the Barranc de la Boella finds in a chapter dedicated to Quaternary fauna and not to the Palaeolithic in his 1973 publication. The finds are situated on both margins of the creek close to the buildings (Mas Boella) that gives its name to this municipal district of la Canonja. The fossils are described as coming from the clays, but the illustrations show that the finds are located in the conglomerates and the sands above the reddish clays. The stratigraphy of the Barranc de la Boella is described as having a total thickness of almost 7 metres.

The current archaeological project began with a preventive survey dig in 2007. A torrential flow caused the banks of the creek to collapse at the same point where Dr S. Vilaseca and R. Capdevila discovered the bone remains published in 1973. During this survey a significant number of faunal remains and lithic industry made from chert and other rocks (schist, sandstone, etc.) was documented (Vallverdú *et al.*, 2009; Saladié *et al.*, 2009). The discovery of lithic industries at Barranc de la Boella associated with the proboscide confirmed the evidence of lithic industries that had been so prudently presented by Dr S. Vilaseca 35 years earlier. During those 35 years the concept of Spanish Prehistory went from doubting the existence of the Lower Palaeolithic on the Iberian Peninsula to providing direct proof of the first human inhabitants of Europe dating back to 1 Ma. The investigations carried out in Barranc de la Boella as of 2008 were included in the archaeological excavations project called "*Evolució paleoambiental i poblament prehistòric a les conques dels rius Francolí, Gaià, Siurana i rieres del camp de Tarragona*". To date the fieldwork have been concentrated on 3 pit excavations. Pit 1 (C1) contains the 9 m^2 dig of 2007 and stratigraphic profile 1 (P1) on the right-hand bank of the creek. Pit 2, or la Mina (The Mine) (LM), is situated 180 metres upstream from Pit 1 locality and covers an area of 25 m^2. Pit3, also known as el Forn (EF), is situated on the opposite bank to Pit 1 locality and also covers a surface area of 25 m^2. During the 2013 excavation fieldwork the actions planned to be carried out in Pit 3 were totally completed, with the dig reaching the clays (Neogene) making up the basal layer. On the

other hand, with respect to LM we have carried out an extremely partial exploration with only 4 m^2 having been excavated without reaching the clays.

The most recent fieldwork has managed to test the value of the cultural and paleontological succession of the Barranc de la Boella record. The available existing fossil record and the results of the stratigraphic research might be considered sufficient for establishing the patrimonial and scientific value of the site. The team participating in this project are those represented in this text as authors. The next research challenges involve the exploration of the deposits laid down prior to the Jaramillo Subchron (< 1Ma) and also of those deposits in which we hope to find archaeo-paleontological remains dating back to the beginning of the Middle Pleistocene (0.5-0.78 Ma). Therefore, at Barranc de la Boella it is our intention to investigate the temporal continuity of the first human occupations of Europe prior to and during the transition from Early Pleistocene to Middle Pleistocene (1.5 to 0.5 Ma). Within the Eurasian context, the first human occupations have, to date, been seen as biological dispersions fed by different migratory currents, rather than a colonisation based on the adaptation of the human settlements on the Eurasian continent (Dennell, 2003). Finally, the industries of El Barranc de la Boella confirms the existence Acheulean technocomplex during the Early Pleistocene in Europe.

2. Geological Context and Stratigraphy

The geology and stratigraphy of El Barranc de la Boella can be described as an incised valley fill encaised in the +60-metres terrace of the Francolí River system. The basal lithostratigraphic units of this incised valley fill is interbedded with the + 50-metre terrace deposits.

The incised valley fill of the Barranc de la Boella has been characterised in 4 principal outcrops with a thick of 9 metres and 6 lithostratigraphic units have been determined (Fig. 2). In units I to III negative polarity has been determined in a high number of samples. The change of polarity has been measured in the samples of the base of unit IV of profile 1 (Fig. 2). The magnetostratigraphy of the top section from unit IV to unit VI shows a normal polarity. The determination of *Mammuthus meridionalis*, *Hippopotamus antiquus*, *Mimomys savini* in the biostratigraphy of unit II indicates that the inverse polarity determined in units I, II, III and in the basal part of IV corresponds to the Matuyama chron (> 0.78 Ma) and to late Early Pleistocene (1 –0.78 Ma) of the temporal geological scale.

The botton of the unnit I consists in an erosive unconformity that covers miopliocene clays (unit 0) and has a variable thickness to 1.5 metres of beds with well stratified, imbricated and clast supported schistt gravels set in azoic reddish muds. Unit I also contains, albeit less frequently, greenish grey massive sandy beds with fine graded gravels within lenticular scours. On occasion, and on top of unit 0, there are discontinuous lag deposits which contain limestones and flint as well as the schists and other lithologies in which igneous rocks predominate. Unit II overlay unit I in erosive unconformity and has a variable thickness of up to 2 metres. Unit II contains poorly stratified beds made from medium gravel-sized schist matrix supported by green-grey sands. The top of unit II is dominated by poorly stratified beds of massive greenish-grey sand and granules and fine graded gravels in scours. In addition to the schists, in the lithology of the gravels found in unit II sandstones, weathered limestones, rounded flints and other igneous rocks (granitoids) are also less frequently found. The sand and gravel beds of the top layer of unit II are impregnated with yellowish bands of cryptocrystalline segregations and also by carbonaceous laminated muds , especially in the Forn outcrop. Unit II contains fossils in different layers: in C1 and LM 2 levels have been determined; and up to 6 levels have been determined in El Forn. Unit III contains massive greenish muds and has a regular thickness of 2 metres. This unit is extremely mottled by brown and reddish cryptocrystalline segregations, and it is also the unit in which 1 archaeo-paleontological level has been determined in C1 and in EF. Unit IV consist in tabular green sandy muds and scours and channels filled with imbricated schist gravels, and lenticular bodies of matrix supported carbonated nodules by green muds. Its thickness is quite regular and reaches a maximum of 2 metres. The top of unit IV contains calcium carbonate rhizomes at la Mina outcrop. Unit V has a thickness of up to 3 metres in pit 2, which rapidly thins out towards EF and desapears in pit 1. Unit VI merges with unit V in EF in a conglomeratic petrocalcic horizon that has continuity with the petrocalcic horizons which exist on top of the deposits of the alluvial fans of the Reus Depression. These deposits of the Reus Depression have been dated from the second half of the Middle Pleistocene using the Uranium series technique.

3. The Archaeo-Paleontological Record

The most abundant bone remains found in the prehistoric localities are those of the large herbivores located in the lithostratigraphic units II and III (Tab. 1). The species identified at the different locations excavated are *Mammuthus meridionalis*, *Hippopotamus antiquus*, *Stephanorhinus* cf. *hundsheimensis*, *Equus*

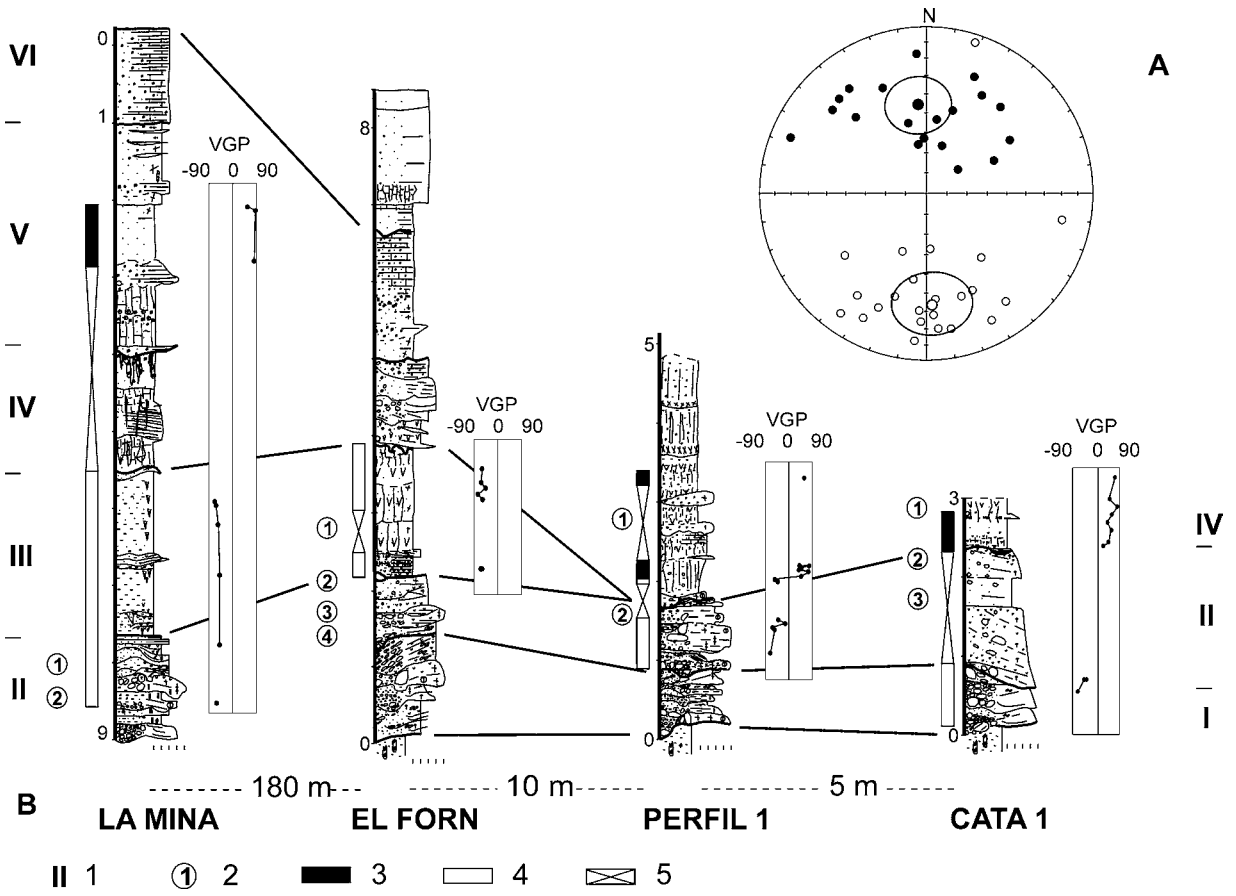

Figure 2. Paleomagnetic samples and stratigraphic correlation between the Barranc de la Boella localities.
A. The number of samples with a characteristic component for projecting the paleomagnetic direction within an equal area. The solid circles are projections within the normal polarity in the lower hemisphere and the blank circles are the projection within the reverse polarity in the upper hemisphere.
B. Correlations between stratigraphic units based on lithostratigraphic and magnetostratigraphic measurements and observations. Key: 1, lithostratigraphic unit; 2, archaeo-palaeontological level; 3, normal polarity; 4 reverse polarity; 5, undetermined polarity.

sp., Cervidae, *Ursus* sp., *Panthera* cf. *gonbaszoegensis*, *Hyaenidae*, *Macaca sylvanus*, *Mimomys savini* and *Victoriamys chalinei*. Found alongside the bones were the abundant remains of the coprolites of a large bone crushing carnivore, possibly a type of hyena.

The most noteworthy faunal remains found in level 2 of C1 are those of *M. meridionalis* (n=549), which pertain to a single individual of around 30 years of age. Both of the animal's tusks were recovered together with its upper and lower molars (Fig. 3). The remains of ribs, vertebrae and skull fragments were found scattered around the tusks and teeth and the two scapulas, one of them totally fragmented, possibly as a result of being trodden on by other mammoths. Found together with these dental and bone remains was the most significant collection of lithic industry discovered at the site complex to date (n=125).

The composition of the faunal materials and of the lithic industry can, in accordance with the classification of site types established by Leakey (1971), to be related with those of a "butchering site" where the carcass of a large herbivore was processed. Although there is no doubt that the Hominidae ate meat, it has not been possible to establish how they accessed carcasses. In the level immediately below (level 3) more remains of *M. meridionalis* were found; these mainly comprised dental elements (2 tusks, 4 molars) and skull fragments. No lithic industry associated with this animal was found in this level. However, this discovery confirms that this is an area that was habitually frequented by these animals, which possibly came to the channels and pools to drink.

In pit 3, el Forn locality, taxonomic diversity is high and similar in all the archaeo-paleontological

	Centre de Convencions		EL Forn							La Mina		
Archaelogical Level	**2**	**3**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**1**	**2**	**3**
Cervus sp.			x	x	x	x		x			x	
Dama cf. *vallonetensis*	x	x	x	x	x	x	x			x	x	x
Megaloceros savini			x	x	x	x					x	
Equus cf. *stenonis*		x	x	x	x	x	x			x	x	
Bovini indet.				x	x	x				x		
Hippopotamus antiquus			x	x	x	x	x			x	x	x
Stephanorhinus hundsheimiensis			x	x	x	x			x			
Mammuthus meridionalis	x	x		x	x	x					x	
Sus scrofa			x									
cf. Pachycrocuta brevirostris					x							
Ursus sp.						x				x	x	
Canis sp.											x	
cf *Panthera gombaszoegensis*											x	
Macaca silvana											x	
Castor sp.						x						

Table 1. The table shows the species present in the different archaeological levels of the three locations excavated in El Barranc de la Boella. All of the levels pertain to lithostratigraphic unit II, except for level I of El Forn, which forms part of unit I.

Figure 3. Image of the tusks of *Mammuthus meridionalis* and other skeletal elements found in level 2 of the pit 1 (P. Saladié/IPHES).

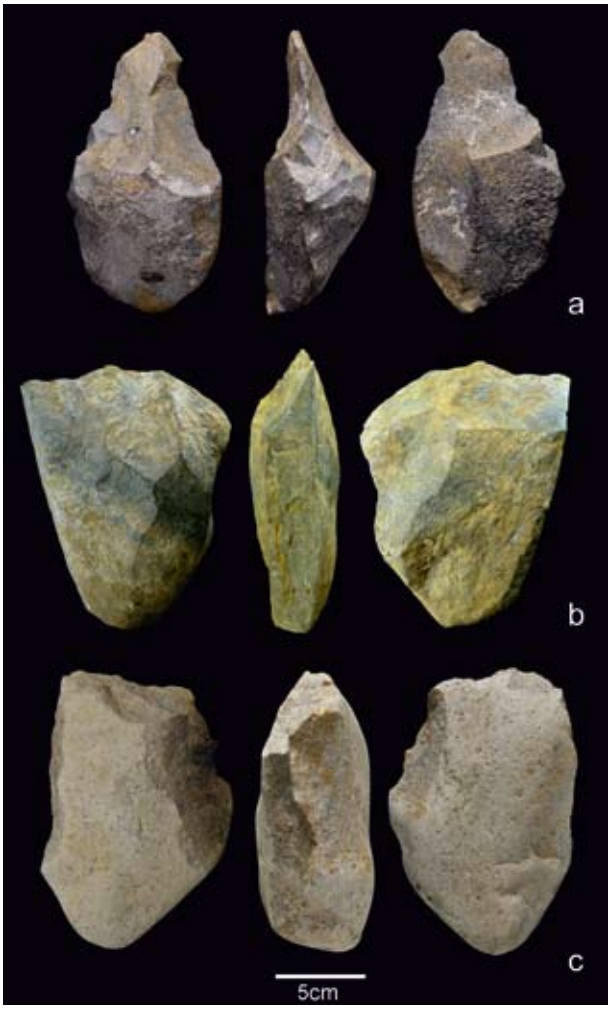

Figure 4. a) Schist pick found in level 2 of the pit 1 locality. b) Cleaver discovered in level 2 of el Forn. c) Chopping tool found in la Mina. (A.Ollé/IPHES).

levels (Tab. 1). The most commonly found skeletal elements are the most robust due to their higher mineral density, such as teeth, horns, antlers and the fragments of the diaphysis of the long bones. In pit 3, la Mina locality, complete bones are less abundant, which seems to be due to the increased activity of Hominidae and carnivores with respect to the bones found throughout the entire sequence known to date. The activity of the carnivores has been identified by way of the bite marks, the consumption of the epiphysis of the long bones and the presence of long splinters of bone showing signs of digestion. These modifications, together with the presence of coprolites (Fig. 5), would appear to indicate the presence of a large type of hyena, perhaps *Pachycrocuta brevirostris*, although so far no skeletal remains of these animals have been found at this site.

Figure 5. Hyena coprolite found in la Mina in spatial association with a flake of chert (P. Saladié/IPHES).

Evidence of Hominidae activity is barely visible. In general, the surfaces of the bones found at the three sites excavated in el Barranc de la Boella are in poor condition. This makes it impossible for us to accurately identify any possible cut marks. Despite this situation, the presence of Hominidae is evident at all three sites due to the presence of lithic industry. At el Forn this is abundant in levels 1 and 2 and disappears in the levels below these.

The lithic industry in the Barranc de la Boella record most of the pieces are made of chert, although schist, quartz, granite and quartzite were also used. All of the raw materials are locally available.

The lithic collection of the level 2 at pit 1 locality contains three hammerstones and seven fractured cobbles, which may suggest they were used either for striking or as striking platforms. The three existing cores show a unipolar and, occasionally, centripetal reduction. The rest of this lithic industry located at level 2 of the pit 1 locality consists of 45 complete flakes, 37 fractured flakes and fragments of flakes. Finally, the lithic assemblage contains only 8 retouched flakes, in the form of notched and denticulate implements. Also associated with this collection was a large-format tool: a pick made from a thick flake of

schist (Fig. 4a). It must be pointed out that 11 refit groups were identified in this lithic collection, thereby proving its integrity.

The EF unit II (levels 2, 3 and 4) assemblage is composed of 104 items, including three hammerstone; 11pebbles and fractured pebbles mainly made from schist and one unipolar quartz core. The group of artefacts made from chert includes seven cores, 46 flakes, 14 broken flakes and six retouched flakes (denticulates). The assemblage also contains one cleaver made from a massive schist flake (split cobble) (Figure 4b).

In the LM assemblage, with 81 pieces found to date, sandstone and granite hammerstone have also been identified, together with several pebbles and cores from different types of rock. A. LM contains pebble and core technology with three schist choppers and two chopping tools, one of quartzite and the other of porphyry (Fig. 4c). The chert artefacts are almost as common (25 flakes, 21 flake fragments and seven retouched denticulate flakes).

4. Conclusions

The fossil associations of the Barranc de la Boella were distributed in a flooded habitat situated at the confluence of a torrential tributary watercourse and the Francolí River. Against this backdrop the hominines accessed the carcasses of large animals that had become trapped or stranded in pools or channels, as documented in recent studies (Haynes, 1981). These animals also being accessed by carnivores have also been documented. A long mammoth bone found in EF shows significant perforations in its epiphyses caused by the consumption thereof by carnivores. These modifications point, almost without doubt, to the presence of *Pachycrocuta brevirostris* in this area during the Early Pleistocene.

We cannot know for sure whether the animals were obtained actively, perhaps by being pursued and driven into the boggiest places or whether the carcases were accessed following the accidental or natural deaths of the animals. The record of the late Early Pleistocene TD6-2 shows that the hominines of this time actively hunted large and potentially extremely dangerous animals such as rhinoceros or aurochs (Saladié *et al.*, 2011), which is why we can assume that the same strategies were also used in and around the Barranc de la Boella. However, it is possible that other methods were used to obtain the animal resources provided by mega-herbivores such as *M. meridionalis* or *H. antiquus*. The sites used for butchering individual large herbivores have been described as part of the foraging strategies of modern hunter-gatherers. This analogy would suggest that the hominines that occupied the area in and around Barranc de la Boella localities and, by default, the hominines of that time, were towards the top of the food chain, a claim also indicated by the record of level TD6-2 of Gran Dolina (Sierra de Atapuerca) (Saladié *et al.*, 2014) and by all the other Lower Pleistocene collections of the Sierra de Atapuerca (Huguet *et al.*, 2013). The El Barranc de la Boella record also confirms the capacity of these hominines to use and obtain animal resources in the European ecosystems of the late Early Pleistocene by means of different strategies.

Finally, mention must be made of the discovery of elements characteristic of an early Acheulean technology in the pit1 and EF locations, whereas these have not been found yet in LM. These Acheulean components consist of large cutting tools manufactured in schist and represent standardised morphologies such as the pick and the cleaver, and they are accompanied by an assamblage collection of smaller chert instruments, the most noteworthy of which are small– and medium-sized flakes, some of them retouched (denticulate tools). It is important to point out that the large cutting tools from level 2 of the Pit 1and el Forn represents one of the oldest evidences of the early Acheulean in Europe.

The goal of archaeological investigation at Barranc de la Boella site over the next few years will be to develop a research project based on the established documentation. This fieldwork will be one of the key factors in the acquisition of diaphanous and well founded archaeological records in order to participate in the debate regarding the origin, autecology and paleoecology of the first settlers of Eurasia. This oportunity was opened by Dr Salvador Vilaseca at Barranc de la Boella when he produced his daring description of an artificially reduced stone object found there together with the faunal remains of a proboscide. This paradigm has been recognised 40 years later and we must now acknowledge his honest stance with respect to the facts observed regarding the material culture of our most distant predecessors.

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Moli Del Salt (Vimbodí I Poblet, Tarragona)

The Molí del Salt site is located in the village of Vimbodí i Poblet (Conca Barberà Region, province of Tarragona), at 490 meters a.s.l., on the left bank of the Milans, a small tributary of the Francolí river. Its UTM coordinates are X=336532.5 Y=458446.5 (ETRS89 system). It is a rockshelter open in the Upper Oligocene conglomerates and lutites formations, common along the eastern borders of the Ebro basin. The site was first mentioned in the works of Salvador Vilaseca (1953), who cited it as a surface lithic scatter. The existence of a stratified deposit was not determined until the 1990s. The first archaeological excavation was carried out in 1999. This fieldwork consisted of a test pit of 3 m2 that revealed a complete stratigraphic sequence. After positive results, a research project was undertaken in 2001 and is still in progress today. The excavated area has been extended from the first excavations up to 70 m^2 of the current excavation area (Fig. 1).

1. Stratigraphy and chronology

The stratigraphic sequence is 2.5 meters thick (Fig.2). Two main human occupation phases have been distinguished, separated by fallen blocks from the collapsed ceiling. The earliest phase corresponds to the Late Upper Paleolithic (units B and A), and the most recent to the Mesolithic (Sup level). The lowermost section of the sequence corresponds to Upper Paleolithic levels. It is the most relevant from an archaeological point of view and it was deposited in an interior context of the rockshelter. The Mesolithic level was formed outside in an open-air context instead when the rockshelter had disappeared as a consequence of the filling processes and the collapse of the ceiling. It was developed adjusting to the slope topography. These are the main stratigraphic units identified, from bottom to top:

- Unit B. It is 75 cm thick of gravels and brown and dark yellow sand layers and is directly superimposed over the lutites of the substrate. It is a succession of lenticular layers subdivided into two levels (B1 and B2). Sedimentary processes could be related to diffuse surface runoff water. There is an important increase in the thickness of the layers towards the top of the deposit. At the moment, the only data available corresponds to the test pit excavated in 1999, and because of that the information is relatively scarce in comparison with that from upper levels.

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