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News and Views

Earliest evidence for human consumption of tortoises in the European Early Pleistocene from Sima del Elefante, Sierra de Atapuerca, Spain

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Introduction

The scientific community currently accepts that the presence of human groups in Western Europe dates as far back as the Early Pleistocene (Carbonell et al., 1995, 2008; Bermúdez de Castro et al., 1997, 2004). However, knowledge of human subsistence strategies relies on few data, given the shortage of study sites and the sparse anthropic evidence that has been recovered (Fosse and Bonifay, 1991; Fosse, 1994; Bermúdez de Castro et al., 1999; Guleç et al., 1999; Tappen et al., 2002; Echassoux, 2004; Gaudzinski, 2004; Huguet, 2007; Carbonell et al., 2008; Rabinovich et al., 2008; Espigares et al., 2010). The majority of these studies have dealt with the relation between the lithic industry and faunal record, and have focused on large game. Nevertheless, small animal remains (rabbits, hares, birds, tortoises, turtles, etc.) are also found frequently at many of these sites. Although studies that focus on small game are rare for Early Pleistocene sites, the accumulations of these small animal remains tend to be interpreted as the result of natural deaths and/or the activities of raptors and carnivores.

Chelonian presence is documented in several European archaeological sites of this period. However, anthropogenic damage of their remains has not been described. This is the case with the Vallparadís site (Martínez et al., 2010), the TD4 and TD6 level at Gran Dolina (Huguet, 2007), Barranco León and Fuente Nueva-3 in Spain (Huguet, 2007; Espigares et al., 2010), Grotte du Vallonet (Hervet, 2000) and Lézignan-le-Cèbe in France (Crochet et al., 2009), and Pirro Nord in Italy (Arzarello et al., 2011). Similar examples can be found in archaeological sites of the Near East, such as at 'Ubeidiya (Gaudzinski, 2004) or Dmanisi (Lordkipanidze et al., 2007). Nevertheless, it is important to bear in mind that many of these remains have not been studied in detail. A small sample of freshwater turtles (*Mauremys caspica*) was also recovered at Gesher Benot Ya'aqov in Israel (Hartman, 2004). Although direct evidence of hominin consumption has not been identified, the turtles' distribution patterns are similar to the distributions observed for other vertebrates (Alperson-Afil et al., 2009).

Examples of sites that demonstrate the occasional human consumption of chelonian in the Early Pleistocene are located in Africa, specifically at the Oldowan site of FwJJ20 in the East Turkana Basin of northern Kenya (Braun et al., 2010). From an ecological point of view, Joordens et al. (2009) suggest the exploitation of aquatic resources between 1.5 and 0.9 Ma at Trinil-Hauptknochenschicht in Java (Indonesia). For these authors, hominins living in coastal habitats could have consumed aquatic fauna among an array of available resources.

In more recent chronologies, the consumption of chelonian appears more frequently. This is evidenced in some localities in the Middle and Upper Pleistocene of Israel (Speth and Tchernov, 2002; Stiner, 2005; Stiner et al., 2009), Italy (Stiner, 1994; Stiner et al., 2000) and Spain (Arribas et al., 1997; Blasco, 2008; Blasco and

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Fernández Peris, 2011; Morales Pérez and Sanchís Serra, 2009), and in the Middle and Later Stone Age of South Africa (Klein and Cruz-Uribe, 1983, 1987, 2000; Parkington et al., 1992; Sampson, 1998; Henshilwood et al., 2001; Halkett et al., 2003; Avery et al., 2004; Thompson, 2010). However, until now, diagnostic evidence for human consumption of tortoises in the European Early Pleistocene has not been documented. In this sense, the Sima del Elefante site (TE) is an important exception. The TE locality has been dated by palaeomagnetism, cosmogenic nuclides and biostratigraphy as Early Pleistocene, and lithic industries are recorded from Levels TE9, TE11, TE13 and TE14. These findings suggest that early hominins continuously occupied the cave (Bermúdez de Castro et al., 1997, 2011; Carbonell et al., 2008). In this context, we explore the earliest evidence of anthropogenic consumption of tortoises and suggest ways to improve the data on the subsistence strategies of the first European hominins based on small game.

Sima del Elefante

The Sima del Elefante site is located in the Sierra de Atapuerca at approximately 980 m above sea level, 14 km east of the city of Burgos (Spain) (Fig. 1). The TE stratigraphic section comprises 16 stratigraphic levels from TE7 to TE21 that are grouped into three sedimentary phases. The lower phase (lower TE or TE-LRU) ranges from the bottom of the sequence up to the unit TE14 (TE7–TE14). The middle phase is composed of the TE15 to TE19 units. Finally, the upper phase comprises the TE20 and TE21 stratigraphic units. The lower phase (i.e., the Lower Red Unit) is extremely rich in faunal remains, including amphibians, reptiles, birds and mammals (bats, rodents, insectivores, lagomorphs, in addition to large herbivores and carnivores). A detailed description of the exposed stratigraphic succession and the Lower Red Unit sediment composition can be found in Rosas et al. (2006).

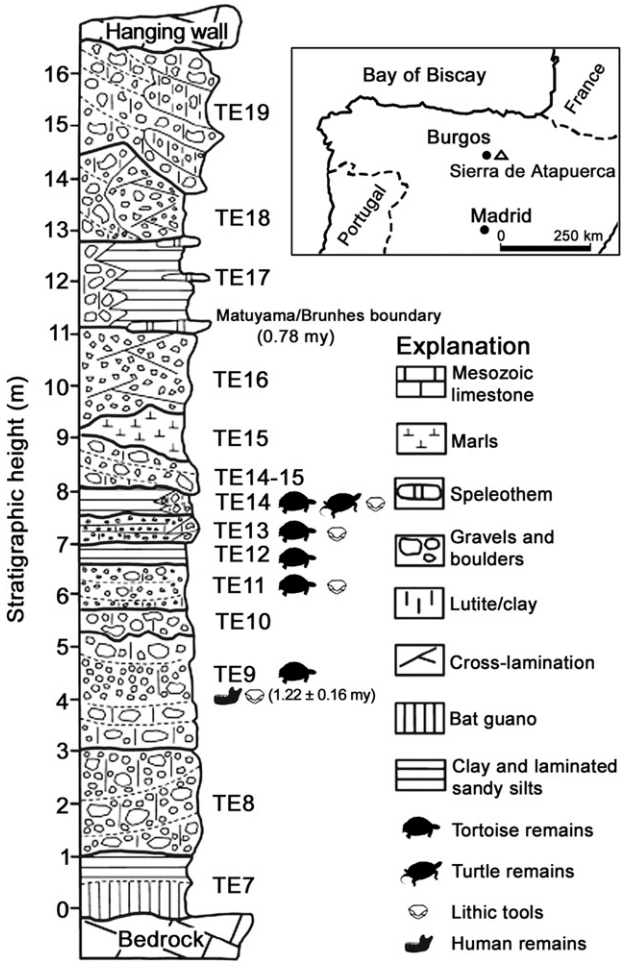

Figure 1. Geographic location of the Atapuerca archaeological sites in the Iberian Peninsula with indications of the presence of chelonian and/or human presence in levels. Lithostratigraphy and chronology of the Sima del Elefante locality adapted from Carbonell et al. (2008).

Small mammal remains are crucial in dating the TE-LRU as the oldest occupation in Atapuerca, i.e., pre-Jaramillo faunas (Cuenca-Bescós et al., 2010a). In particular, the arvicoline and insectivore associations suggest that TE-LRU is from the Early Pleistocene age and is at least as old as the localities of Fuente Nueva-3 and Barranco León in the Guadix–Baza basin (Granada, ca. 1.2–1.5 million years ago, Ma). This is consistent with the presence of the large-sized mustelid, *Pannonictis nestii*, which dates from the Early Pleistocene (García et al., 2008). Recent cosmogenic nuclide analysis dated the TE9 level to ~1.2 Ma (Carbonell et al., 2008), and palaeomagnetism analysis show that the levels of TE-LRU have a reversed polarity (Parés et al., 2006), thus confirming the biostratigraphically inferred chronology.

The palaeontological record shows that the lower phase was deposited during a warm-temperate climate. Small vertebrate assemblages from the lower levels are characterised by the dominance of species that suggest open dry and moist habitats, such as *Allophaiomys*, *Pelobates cultripes*, *Bufo calamita*, *Crocidura kornfeldi*, *Erinaceus praeglacialis*, *Talpa* cf., *T. europea* and aquatic environments, such as *Galemys* cf. *G. kormosi*, *Arvicola jacobaeus*, *Asoriculus gibberodon* and *Castor fiber* (Blain et al., 2010; Cuenca-Bescós et al., 2010b; Rodríguez et al., 2011). The interpretation of a landscape with water courses and/or lagoon environments is reinforced by the presence of *Pelophylax* sp., *Anas* sp. and *Haliaetus albicilla* (Rosas et al., 2006; Rodríguez et al., 2011).

The low concentration of pollen and spores in the samples from the lower levels of TE is insufficient for detailed environmental interpretation. Conifers and *Quercus* are present as tree species, and Asteraceae and Poaceae as herbaceous taxa, together with the presence of Mediterranean taxa, such as *Olea-Phillyrea*. *Acer* and *Quercus* charcoals have also been identified at TE9 (Rodríguez et al., 2011).

The lower levels have yielded an assemblage of Mode 1 lithic tools, which include cores, simple flakes and waste flakes (debris) made of Neogene and Cretaceous flint, as well as Cretaceous limestone. These raw materials are available within 2 km of the site. The reduction sequence produced simple flakes detached from medium-size cores by direct hard hammer percussion (Carbonell et al., 2008).

A fragment of hominin mandible and an isolated lower LP_4 of the same individual were recovered at the TE9c level (Carbonell et al., 2008). These fossils are not complete enough to make a taxonomic assignment and have been recently referenced as *Homo* sp. (Bermúdez de Castro et al., 2011).

Methods

The TE faunal analysis was performed following a zooarchaeological methodology and includes the study of all of the fossil chelonian remains recovered. The data were obtained from anatomical and taxonomic analysis, and from the structural modifications of the bones. Osteological comparisons were made with specimens without scutes from the collections of amphibians and reptiles of the Museo de Ciencias Naturales de Madrid (Spain) and the collections of the Institut de Paleoecologia Humana i Evolució Social (Tarragona, Spain). The tortoise remains were

anatomically classified. The NISP (Number of Identified Specimens), MNE (Minimum Number of Elements) and MNI (Minimum Number of Individuals) were calculated. The MNE was calculated taking into account age, portion and size. Surface alterations generated by the hominins were treated at both the macroscopic and microscopic levels. For microscopic study, an Olympus Europe SZ11 (magnification up to 110) and ESEM (FEI QUANTA 600) were used. Cut-marks were identified according to the criteria established by Binford (1981), Potts and Shipman (1981), Shipman (1983), Shipman and Rose (1983), Bromage and Boyde (1984), Shipman et al. (1984) and Noe-Nygaard (1989). These cut-marks were categorised as either incisions or scrapes. Incisions included striations with a linear outline of variable length, width, and depth. Incisions have a V-shaped section and display internal microstriation. In some cases, Hertzian, shoulder effects and barbs were found. The scrape marks were shallow, sub-parallel cut-marks caused when a stone tool was dragged transversally along the length of the bone. The analysis of cut-marks took into account the number of striations, the location on the anatomical element, the orientation regarding the longitudinal axis of the bone (oblique, longitudinal or transverse) and their distribution over the surface (isolated, clustered or crossed). The criteria used to distinguish between stone tool-caused butchery marks and random striae (including trampling damage) were based on the results obtained by Domínguez–Rodrigo et al. (2009). Striae generated by trampling are usually characterised by a U-shaped cross-section, a sinuous and discontinuous trajectory and the presence of microstriations of irregular trend. The ends of these striae usually appear to be abruptly cut off, and they do not show any kind of narrowing that indicates directionality. Their distribution across the bone surface is often random.

Table 1
NISP, MNE and MNI from the Sima del Elefante chelonians assemblage by archaeostratigraphical levels.

Level	Anatomical element		NISP	MNE	MNI
TE18	Carapace	Nuchal	1	1	1
		Pleural	3		
		Peripheral	1		
TE14	Carapace	Pleural	2	1	1
		Suprapygal	1		
TE14a	Carapace	Neural	1	1	1
		Pleural	2		
TE14b	Plastron	Hyoplastron	1	1	1
TE14c	Carapace	Nuchal	1	1	2
		Neural	2		
		Pleural	9		
		Peripheral	4		
	Plastron	Epiplastron	2	2	
		Entoplastron	2		
		Hyoplastron	3		
		Hypoplastron	7		
		Xiphiplastron	2		
TE13	Carapace	Pleural	3	1	1
		Peripheral	1		
	Plastron	Hypoplastron	1	1	
TE12a	Carapace	Pleural	1	1	1
TE11	Carapace	Neural	8	1	1
		Pleural	5		
		Peripheral	1		
	Plastron	Hyoplastron	1	1	
TE9	Carapace	Neural	3	1	1
		Pleural	3		
		Peripheral	1		
		Suprapygal	1		
	Plastron	Hyoplastron	1	1	
		Hypoplastron	1		
Total			75	14	10

Results

The chelonian presence in the Atapuerca archaeological localities is generally discrete, and there are few plate elements from the Early to Middle Pleistocene of the Sima del Elefante, Gran Dolina and Galería sites. Most of the fossils may be classified as the Hermann's tortoise (*Testudo hermanni*), with the exception of Level TE14 where a hyoplastron of a probable European pond turtle (*Emys* cf. *E. orbicularis*) is recorded. In the TE site, several levels have provided chelonian remains (Fig. 1, Table 1): TE18, TE14, TE13, TE12, TE11 and TE9, although they are more abundant at the sublevel TE14c. In total, 75 tortoise and turtle remains have been recovered: 74 belong to *T. hermanni* and one belongs to the genus *Emys* in sublevel TE14b. The MNE is 14 and is mostly represented by neural and pleural bones of the carapace. The MNI is 10, as established from the most common skeletal element according to the location of the tortoise skeleton and its size.

Taxonomic identification is based on the overall morphology of the shell elements and on the pattern resulting from the impression of the epidermal shields, according to the criteria given by Gmira (1995) and Hervet (2000, 2004). The shell bones are characterised by their relative thickness and the presence of well-developed growth-striae on the external side. This set of characteristics allows us to relate the fossils to the terrestrial tortoises (Testudinidae) and to distinguish them from the pond turtles group present in Europe (Emydidae and Geoemydidae). Attribution to *T. hermanni* principally relies on the morphology of the humerus-pectoral sulcus and the pectoro-abdominal sulcus, both located more anteriorly in *T. hermanni* than in *Testudo graeca*. They show a laterally pronounced curvature where they respectively reach the axillary and inguinal notches. As in *T. hermanni*, the entoplastron is of a triangular shape in our fossils, whereas in *T. graeca*, it is more rounded (Fig. 2).

No anthropic evidence has been documented on the hyoplastron of *Emys*. However, the majority of the alterations observed on the tortoise remains are anthropic in origin at levels TE14c and TE11. Cut-marks are identified on the ventral surface of carapaces, with a predominance of incisions and scrapes on the pleural and neural shield. In total, eight tortoise remains show anthropogenic marks: two at level TE14c and six at level TE11 (Table 2). These striae show all of the diagnostic elements used to define butchery marks, and they can be clearly distinguished from the natural marks caused by sediment abrasion on bone surfaces through various processes, such as trampling (Fig. 3).

There was no evidence of carnivore damage on the tortoise remains, and none of the bones showed signs of having passed through the gut of a predator. Neither polished nor rounded bones by water action or other agents were observed.

Discussion and conclusions

Several tortoise remains identified in the Sima del Elefante site present sufficient evidence to attribute their presence to human activity. Although the cut-marks identified on *T. hermanni* indicate the clear association between hominins and tortoises in levels TE14c and TE11, the confined excavation area does not allow us to construct the complete bone assemblage. Consequently, the skeletal representation of tortoises obtained at these levels is not comparable with the representation described by Sampson (2000) for Bushmen in the semi-arid Karoo of South Africa. However, the abundance of shells in the anthropic assemblages documented by Sampson (2000) coincides with the assemblage from the TE site.

The cut-marks identified on tortoise remains are located on the ventral surface of the carapace (principally neural and pleural bones). According to Blasco (2008), these marks are related to

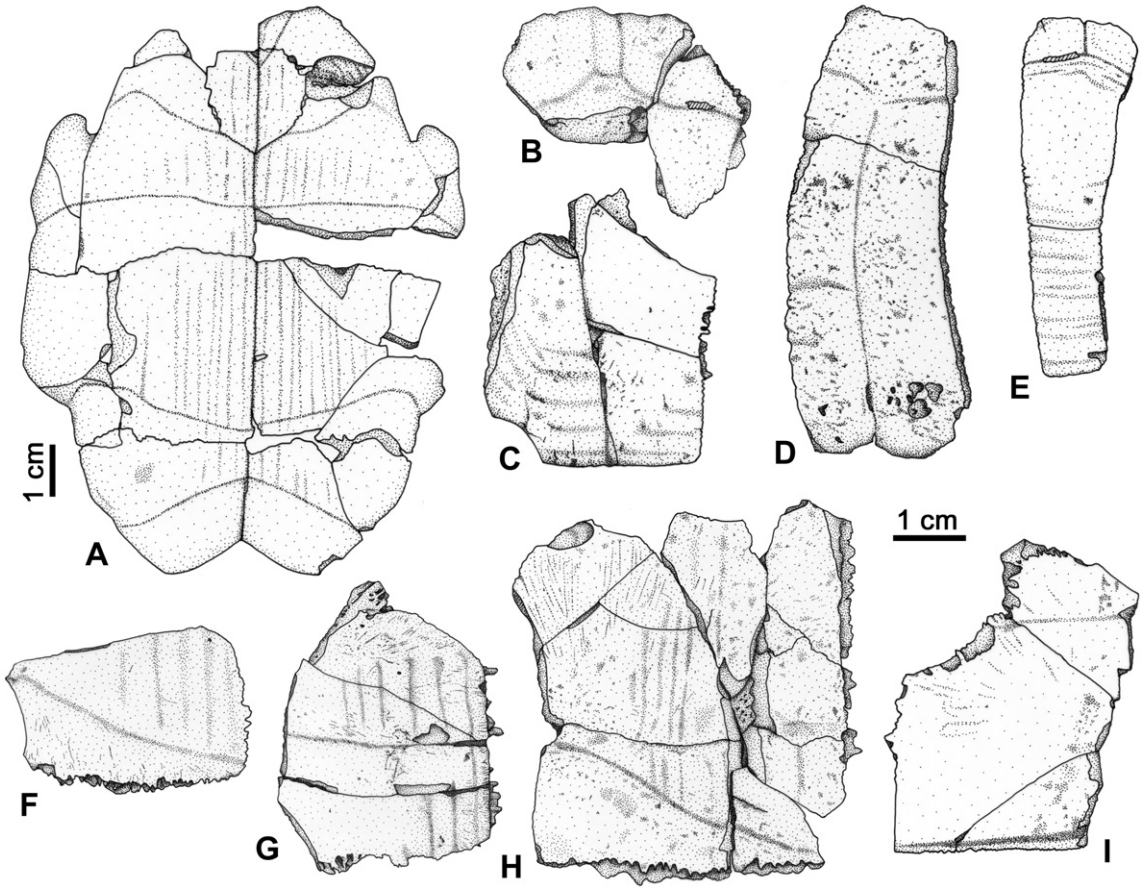

Figure 2. Some chelonian fossil remains from the Sima del Elefante site. A–H, *Testudo hermanni* Gmelin, 1789. A: sub-complete plastron (TE14c), ventral view; B: nuchal (TE14c), dorsal view; C: first left pleural (TE11), dorsal view; D: second right pleural (TE14), dorsal view; E: fifth left pleural (TE14), dorsal view; F: right hypoplastron (TE9), ventral view; G: right hyoplastron (TE9), ventral view; H: right hypoplastron (TE13), ventral view; I, *Emys* cf. *E. orbicularis* Linnaeus, 1758, left hyoplastron, ventral view.

visceral removal. The fact that incision and scrape marks predominate on the carapace could be due to edible tissues remaining on the plates after the extraction of the main visceral mass. As such, the early humans would have scraped the ventral surface of the carapaces. Cut-marks related to the visceral removal were also identified at the Oldowan site of FwJJ20 in the East Turkana Basin of northern Kenya (Braun et al., 2010), in subsequent periods as at Level IV of Bolomor Cave in Spain (Blasco, 2008), and at a modern camp (Site 20) located on the eastern shore of Lake Turkana (Rybczynski et al., 1996).

The percentage of cut-marks on the tortoise remains is high, principally at Level TE11 (40%) (Table 2). However, several factors may explain the absence of incisions in some bones. When viscera or meat is removed, the tool does not always come into contact with the bone. In addition, hands may have also been used to extract the internal organs.

Among small prey, Stiner (2001) proposed a distinction between slow-moving types that were easily collected (mostly tortoises and shellfish), fast-running mammals (mostly lagomorphs) and quick-flying game (birds). The slow-moving small animals could be gatherable with limited technology and would represent the simplest category to catch. Tortoises are immobile or sluggish and, once discovered, are easy to collect. Therefore, obtaining them does not require much effort and involves no risk. For these reasons, slow-moving small game may be considered to be food that is easy to acquire. Likewise, acquiring such food may be associated with a high net return in terms of energetic cost. In contrast, capturing fast-running and quick-flying small prey requires more effort, particularly if a sophisticated technology is not employed. This is especially the case with birds. Tortoises, however, are not the only kind of small prey that were used for food at the TE site. One cut-mark on the proximal metaphysis of a bird radius is documented at Level TE9a, and two cut-marks on the middle diaphysis of a leporid radius are identified at TE12a (Huguet, 2007). In this manner, the use of lower-ranked fast small game is documented

Table 2
Number of tortoise bones with cut-marks from Sima del Elefante according to archaeostratigraphical levels.

	TE14c	TE11	
Anatomical element	Carapace Pleural	Carapace Neural	Pleural
No. bone remains	2	3	3
Bone surface	Ventral	Ventral	Ventral
Type	Incisions-Scrapes	Incisions-Scrapes	Incisions-Scrapes
No. striations by group	1–7	1–5	2–11
Distribution	Clustered-Isolated	Clustered	Clustered
Orientation	Obl-Long(Obl)	Tr-Obl	Obl
Delineation	Straight	Straight	Straight-Curved
Measures (mm)	2.3–4.4	0.6–2.7; 6.2–7.5; 2.8–4.9; 6.5–8.9	9.6–10.5; 3.4–6.7; 4.7–5.2; 3.8–7.1
Action performed	Viscera removal/ Soft tissue removal	Viscera removal/ Soft tissue removal	Viscera removal/ Soft tissue removal

Obl: oblique; long: longitudinal and Tr: transverse.

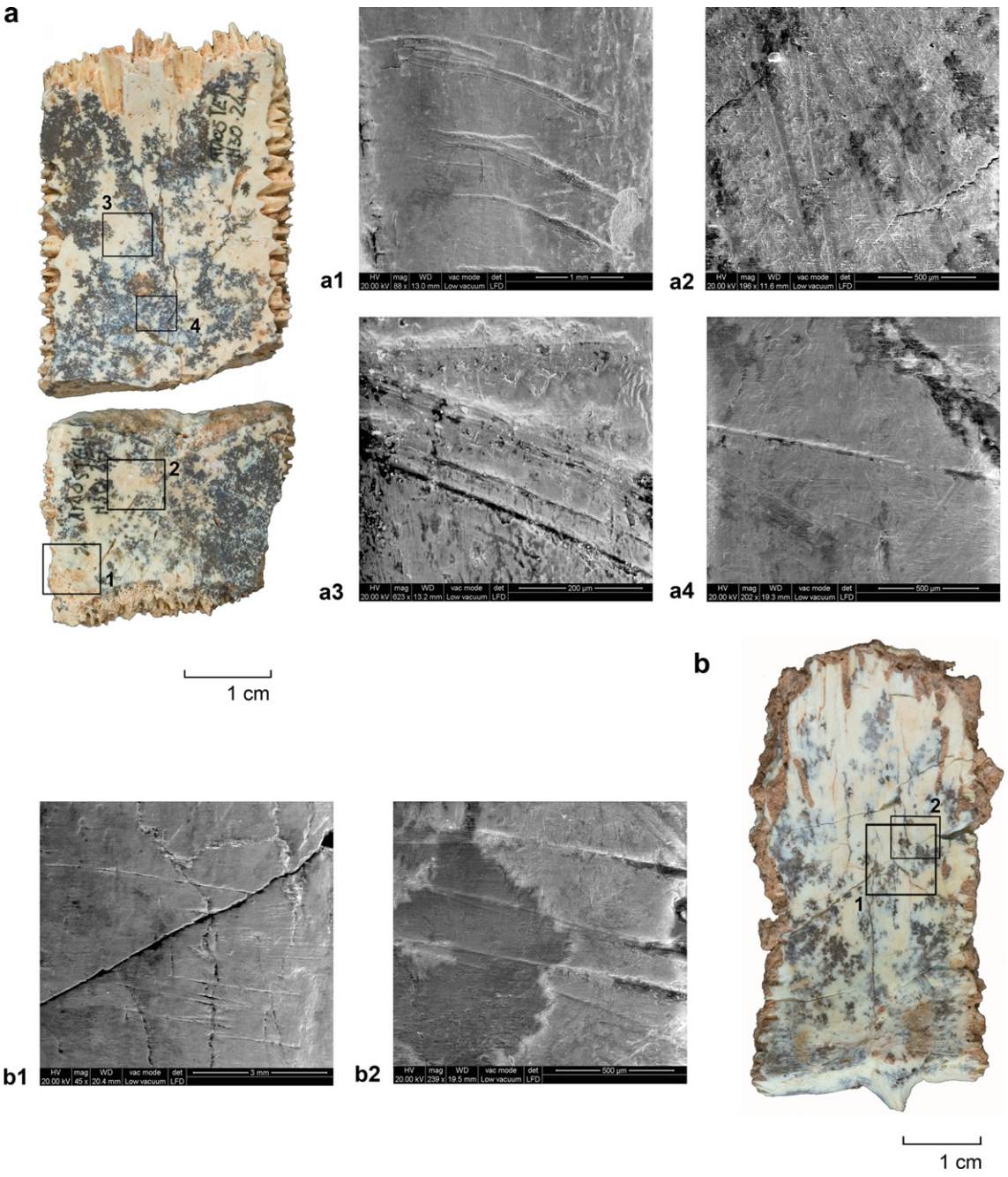

Figure 3. Examples of cut-marks on tortoise remains (pleural bones) from TE11 under environmental scanning electron microscope (ESEM).

during the Early Pleistocene at this site. Evidence of the consumption of quick-flying animals is also preserved in Dursunlu (Turkey), where several incisions on the distal metatarsus of a large bird have been recognised (Güleç et al., 2009).

Although the use of tortoises for food seems to be sporadic in TE, it is repeated in at least two levels of the site's stratigraphic sequence (TE14c and TE11). This fact indicates that tortoises were part of the spectrum of potential resources for the hominins of the Sierra de Atapuerca and that they were present in the human diet from an early period.

The evidence of anthropogenic processing of small animals (slow and fast small prey), along with the large game identified in the site (Huguet, 2007; Carbonell et al., 2008) (Table 3), points to the generalist behaviour of the Early Pleistocene human groups. Such subsistence strategies are also suggested in Africa, specifically in Bed I at Olduvai (Tanzania) where the occasional use of hedgehogs (*Erinaceus broomi*) was documented (Fernández-Jalvo et al., 1999), and in the Turkana Basin of Kenya where the human diet included diverse aquatic small animals (Braun et al., 2010). Similarly, Wood and Strait (2004) have proposed a generalist behaviour based on the exploitation of a broad range of dietary elements ranging from plants (fruits, leaves, tubers, seeds) to invertebrates (insects, molluscs), as well as small and large vertebrates among the first Asian hominins.

In conclusion, the TE site provides sufficient proof to document the human consumption of tortoises in the European Early Pleistocene. This fact, together with the cut-marks identified on fast small prey, contributes new data on the subsistence strategies based

Table 3
NISP from the Sima del Elefante site according to Huguet (2007) and Bermúdez de Castro et al. (2011).

Taxon/Level	TE9c	TE9b	TE9a+	TE9a	TE10	TE11	TE12c	TE12b	TE12a	TE12N	TE13	TE14c	TE14b	TE14a
Hominidae	2	–	–	–	–	–	–	–	–	–	–	–	–	–
Cercopithecidae	2	–	–	2	–	–	–	–	–	–	–	–	–	–
Ursidae	–	–	–	–	–	–	–	–	3	1	–	1	–	–
Canidae	1	–	–	3	5	1	–	5	92		9	1	3	6
Felidae	8	1	–	3	–	1	–	–	36	21	1	–	–	–
Mustelidae	–	5	–	27	1	2	–	–	3	–	–	1	–	–
Carnivora indet.	–	3	1	2	–	–	–	1	17	–	1	1	1	–
Rhinocerotidae	–	1	1	–	–	–	–	–	–	–	–	–	2	1
Equidae	–	1	1	2	2	–	–	1	–	–	1	2	–	–
Cervidae	12	23	8	26	20	2	–	1	8 (*)		9	12	4	4
Bovidae	5 (*)	4 (*)	1	3 (*)	1	1	–	–	–	1	–	–	–	1
Hipoppotamidae	–	–	–	–	–	–	–	–	–	–	–	–	–	2
Suidae	–	–	–	4	–	–	–	–	–	–	–	–	–	–
Castoridae	–	–	–	1	46	3	–	–	–	–	1	2	–	–
Leporidae	30	20	40	123	77	9	4	35	75 (*)	–	36	9	7	86
Erinacidae	1	–	1	–	1	–	–	–	–	–	1	–	–	–
Talpidae	–	–	–	36	12	1	–	–	2	–	2	–	–	–
Chelonia	–	–	–	9	–	15 (*)	–	–	1	–	5	32 (*)	1	3
Birds	91	65	62	343 (*)	322	9	17	54	193	–	73	14	45	5
Unident. macromammals	35 (*)	61 (*)	14	75	35	14	–	4	26	–	11 (*)	10	14	3
Unident. microvertebrates	2	4	2	44	37	4	1	7	18	–	12	4	9	3

Hominidae: *Homo* sp.; Cercopithecidae: *Macaca* sp.; Ursidae: *Ursus* cf. *U. dolinensis*; Canidae: *Canis* cf. *C. arnensis/mosbachensis*, *Vulpes* cf. *V. alopecoides*; Felidae: *Panthera gombaszoegensis*, *Lynx* cf. *L. issiodorensis*; Mustelidae: cf. *Barangale antiqua*; *Mustela* cf. *M. palerminea/praenivalis*; cf. *Pannonictis* sp.; Rhinocerotidae: *Stephanorhinus etruscus*; Equidae: *Equus* sp. (Stenonian type); Cervidae: *Eucladoceros giulii/Megaloceros savini*, *Dama vallonetensis*, Cervidae indet.; Bovidae: *Bison* sp.; Castoridae: *Castor fiber*; Leporidae: *Lepus* sp., *Oryctolagus* sp.; Erinacidae: *Erinaceus* sp.; Talpidae: *Talpa* sp.; Chelonia: *Testudo hermanni*, *Emys* cf. *E. orbicularis*. (*): species with anthropogenic damage.

on small game, and demonstrates the generalist behaviour of the first European hominins. Such subsistence strategies, which include both small and large prey consumption, represent yet another argument to demonstrate the adaptation capabilities of these hominins to the environment. This, among other factors, may have been one of the keys to success in the first settlements of Europe.

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