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Cut marks on the Middle Pleistocene elephant carcass of Áridos 2 (Madrid, Spain)

J. Yravedra [a], M. Domínguez-Rodrigo [a,b,*], M. Santonja [c], A. Pérez-González [c], J. Panera [d], S. Rubio-Jara [d], E. Baquedano [b,e]

[a] Department of Prehistory, Complutense University of Madrid, Ciudad Universitaria s/n, 28040 Madrid, Spain
[b] IDEA (Instituto de Evolución en África), Museo de los Orígenes, Plaza de San Andrés 2, 28005 Madrid, Spain
[c] CENIEH (Centro Nacional de Investigación sobre la Evolución Humana), Paseo Sierra de Atapuerca s/n, 9002 Burgos, Spain
[d] Department of Prehistory, UNED, Senda del Rey s/n, 28040 Madrid, Spain
[e] Museo Arqueológico Regional de Madrid, Plaza de las Bernardas, Alcalá de Henares, Madrid, Spain

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A B S T R A C T

Áridos 1 and Áridos 2 (Madrid, Spain) are two Middle Pleistocene sites belonging to the isotopic stages 9–11. Both places contain partial carcasses of *Elephas* (*Paleoxodon) antiquus* associated to Acheulian stone tools. In this work, the taphonomic study of the elephant remains of Áridos 2 is presented. This study has documented several cut marks on different bones, which indicate bulk flesh and viscerae extraction by Middle Pleistocene hominins. Several arguments are provided to support that at least some of the cut marks were made with handaxes, further suggesting that some of these artifacts were butchering tools in this stage of human evolution. Although cut marks on elephant carcasses have been documented at some Middle Pleistocene sites, very few have been published in detail to allow consideration of their status as hominin-imparted marks. By doing so, the present study provides more evidence of large carcass exploitation by hominins during this period.

1. Introduction

One of the recurrent phenomena in Paleolithic archaeology is the spatial association of stone tools and elephant bones in various sites both in Europe and Africa (Villa et al., 2005; Domínguez-Rodrigo, 2008). From the earliest discoveries during the nineteenth century until the present, several interpretations have been produced to account for this association. Some researchers argued that they were the result of some sites having acted as hunting grounds where hominins were actively engaged in preying on proboscideae (Cerralbo, 1913; Howell, 1966; Butzer, 1972; Freeman, 1994; Howell et al., 1995; Radmilli and Boschian, 1996), butchery places where carcass obtainment strategies were not identifiable (Leakey, 1971), scavenging spots (Shipman, 1986; Binford, 1987; Martos, 1998; Fosse, 1998; Mussi, 2005), or natural traps (Anconetani et al., 1996). Others, more marginally, have argued that several of these spatial associations of stone tools and elephant bones were accidental in nature and not functionally related (Mussi, 2005; Villa et al., 2005; Domínguez-Rodrigo et al., 2007).

A hypothesis that has been gaining credibility in the past few years is that regular exploitation of resources from elephant carcasses cannot be documented prior to the European Upper Paleolithic (Frison and Todd, 1986; Frison, 1989; Martos, 1998; Fosse, 1998; Villa et al., 2005; Gaudzinski et al., 2005; Surovell and Waguespack, 2008). Only, exceptionally, at some earlier sites can this activity be documented, probably corresponding to a marginal strategy in hominin subsistence. Middle Pleistocene sites such as La Cotte de Saint Brelade (Channel Island of Jersey) or Lehringen (Germany) are defended by some as places where elephant hunting may have taken place (Scott, 1986; Thieme and Veil, 1985). It has also been argued that if the exploitation of elephant meat were a marginal activity, the exploitation of elephant bones might still have been more frequent for the purpose of manufacturing tools (Gaudzinski et al., 2005; Mussi and Villa, 2008).

This diversity of interpretations is due to the scarcity of taphonomic evidence and absence of arguments that could be used to interpret the association of stone tools and elephant bones properly. Only exceptionally have cut marks and percussion marks on prehistoric elephant bones been documented (e.g., Shipman and Rose, 1983; Villa et al., 2005). Several authors argue that finding this type of evidence is highly unlikely for various reasons. Bone preservation in a large portion of sites is too poor, weathering also deletes part of these traces, the periostium on several bones is too thick to allow stone tools modify bone surfaces, and cartilage,

* Corresponding author. Department of Prehistory, Complutense University of Madrid, Ciudad Universitaria s/n, 28040 Madrid, Spain. Tel.: +34 91 394 60 08; fax: +34 91 394 6008.
E-mail address: manueldr@ghis.ucm.es (M. Domínguez-Rodrigo).

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tendons, ligaments and the large muscle masses also do not enable frequent contact between stone tool edges and bone surfaces (Villa, 1990; Martos, 1998; Fosse, 1998; Mussi, 2005; Villa et al., 2005; Gaudzinski et al., 2005; Schreve, 2006; Mussi and Villa, 2008). Actualistic butchery observations also show that elephant butchery can be performed leaving very few traces on bones (Crader, 1983; Haynes, 1991). In sum, cut marks on elephant bones are a very uncommon type of taphonomic evidence. For this reason, several researchers have turned their attention to indirect types of evidence such as isotopic analyses, use wear analyses of associated stone tools or the taphonomic study of the context where the elephant bones are found to discuss the possibility of elephant consumption by hominins (Weber, 2000; Schreve, 2006; Mussi and Villa, 2008).

However, the presence of cut marks still remains the most straightforward evidence in support of hominin exploitation of carcasses. This is why the identification of cut marks has to be carried out with utmost care. For instance, the earliest evidence reported for cut-marked elephant bones comes from FLK North 6 (Olduvai Gorge, Tanzania), which was interpreted as a butchery spot (Leakey, 1971; Bunn, 1982). However, the taphonomic re-analysis of the remains has shown these marks to be the result of trampling. No taphonomic arguments can be provided to defend that hominins exploited the elephant remains at the site (Domínguez-Rodrigo et al., 2007). This cautions against the reporting of cut-marked elephant bones without publishing enough information (e.g., detailed magnified binocular or S.E.M. photographs) to show the features necessary to identify such marks as hominin-imparted.

The oldest examples of elephant bones bearing cut marks have been documented in Middle Pleistocene sites such as Ambrona (Spain), La Polledrara and Castel di Guido (Italy), Bilzingsleben (Germany) and La Cotte de Saint Brelade (Channel Island of Jersey). At Ambrona, very few cut-marked bones have been discovered despite the number of elephants, suggesting a marginal but repeated role for hominins sporadically exploiting carcass remains (Shipman and Rose, 1983; Villa et al., 2005). Polledrara and Castel di Guido are known for the artifacts made on elephant bone (Pitti and Radmilli, 1984; Anzidei and Cerilli, 2001), but some of them also bear cut marks suggesting some exploitation of carcasses (Mussi, 2005). La Cotte de Saint Brelade also includes several elephant bones with cut marks (Scott, 1986). Bilzingsleben has yielded several cut-marked elephant bones, among which a foot bone bearing some cut marks on its articular surface is probably the most widely known (Mania, 1990). At Gesher Benot Ya'akov an elephant skull was discovered lying on an anvil, surrounded by stone artifacts, and with some marks above the nasal bone and the occipital suggestive of human exploitation (Goren-Imbar et al., 1994).

Use wear analyses on artifacts from sites where stone tools appear spatially associated to elephant bones have also produced several artifacts suggesting the processing of meat at Gröbern (Germany) and Áridos 2 (Spain), which enables conjecture about the exploitation of elephant meat by hominins (Weber, 2000; Ollé Canellas, 2005).

In favor of the argument that a scarcity of cut-marked elephant bones does not necessarily imply marginal use of elephant carcass resources, it should be stressed that cut-marked elephant bones are also scarce during the Upper Pleistocene (Nývltová Fišáková, 2005). At Mousterian sites such as Kulna (Moravia) or Santo Antao do Tojal (Portugal), there is taphonomic evidence supporting hominin exploitation of elephant carcasses. At Kulna, some possible cut marks were identified (Moncel, 2001) and at Santo Antao do Tojal, two small flint flakes were located embedded in one of the femur fragments (Zbyszewski, 1943), although they could be located in such a position by post-depositional sedimentary processes, given the fluvial context of the site (Sousa and Figueiredo, 2001). In the Gravettian sites of Krakow Spadzista Street b and Milovice G (Poland), a few cut-marked bones were found (Svoboda et al., 2005). Late Pleistocene sites such as Algar de Joao Ramos (Portugal), Gontsy (Ucraine) and Lugovkaye (Russia) have also yielded few cut-marked bones (Zbyszewski, 1943; Sousa and Figueiredo, 2001; Maschenko et al., 2003; Zenin et al., 2003; Iakovlevaa and Djindjian, 2005).

This work expands previous evidence of elephant cut-marked bones by reporting newly found cut marks on bones from the Middle Pleistocene site of Áridos 2 (Spain) (Santonja et al., 1980a,b, 2001; Villa, 1990). Our study shows the presence of cut marks on some bones from the articulated partial carcass of an *Elephas antiquus* uncovered at the site. This increases the number of Middle Pleistocene sites where elephant butchery is reported and well documented.

2. Location and characteristics of Áridos (Arganda, Madrid, Spain)

Áridos 1 and 2 are situated to the left margin of the Jarama river to the southeast of Madrid (Fig. 1). The micromammal study suggests that the sites can be placed within the isotopic stages 9–11 (López Martínez, 1980; Santonja et al., 2001; Sesé and Soto, 2002). Both sites are located in a floodplain (overbank facies) (Pérez-González, 1980; Pérez-González and Uribelarrea, 2002) and both bear lithic artifacts spatially associated with partial elephant carcasses.

In Áridos 1 a surface of 112 m^2 was excavated exposing two paleosurfaces (Santonja and Querol, 1980a). The articulated carcass remains of an *E. antiquus* was found on the oldest paleosurface, concentrated in an area of 50 m^2 (Soto, 1980; Santonja and Querol, 1980b). A total of 331 lithic pieces and mandibular fragments of two bovids were also found (Santonja and Querol, 1980a). Bone surfaces are mostly moderately well preserved. The lithic assemblage is characterized by the abundance of flakes and some refitting was successfully carried out (Santonja et al., 1980a,b). The discrete association of stone tools and bones, despite the absence of cut marks, has been interpreted as functional, despite the differences with the overlying paleosurface (e.g., where only two flakes were recovered) (Mourer-Chauviré, 1980; López Martínez, 1980; Díez, 1992).

Áridos 2 was situated about 200 m away from Áridos 1 (Santonja and Querol, 1980c; Santonja and Pérez-González, 2002). The site is located at the top of the stratigraphic unit of Arganda I (Pérez-González, 1980). This unit is the top of a fluvial sequence including the units Arganda II, III and IV, spanning a thickness of 40–50 m in the mid- and lower valley of the Jarama river. These overlying sequences were created by the sinking of the underlying karst system composed of Miocene evaporitic rocks, which are the substrate of the Tertiary basin of Madrid in this region. Dates obtained through AAR (amino acid racemization) (379.7 $\pm$ 45 ka) and ESR (electron spin resonance) (384 $\pm$ 77 ka) for the Arganda I unit containing the site indicate that Áridos 2 could be assigned to the end of MIS 11 (Moreno et al., in press; Panera et al., in press). Áridos 2 correlates with the units B, C and D of the stratigraphic column documented in Áridos 1 (Fig. 1). These units are muddy overbank deposits and secondary pebble and sandy low-energy channels that existed in the wide alluvial plain of the meandriform Jarama river.

The preserved surface of this site is very small (10 m^2) because erosion caused by two channels destroyed most of the site. In addition, modern human exploitation of the quarry altered an important part of the site (for example, half of the rib cage of the elephant was removed by the bulldozer). A partial elephant skeleton associated with 34 lithic artifacts was found on the paleo-

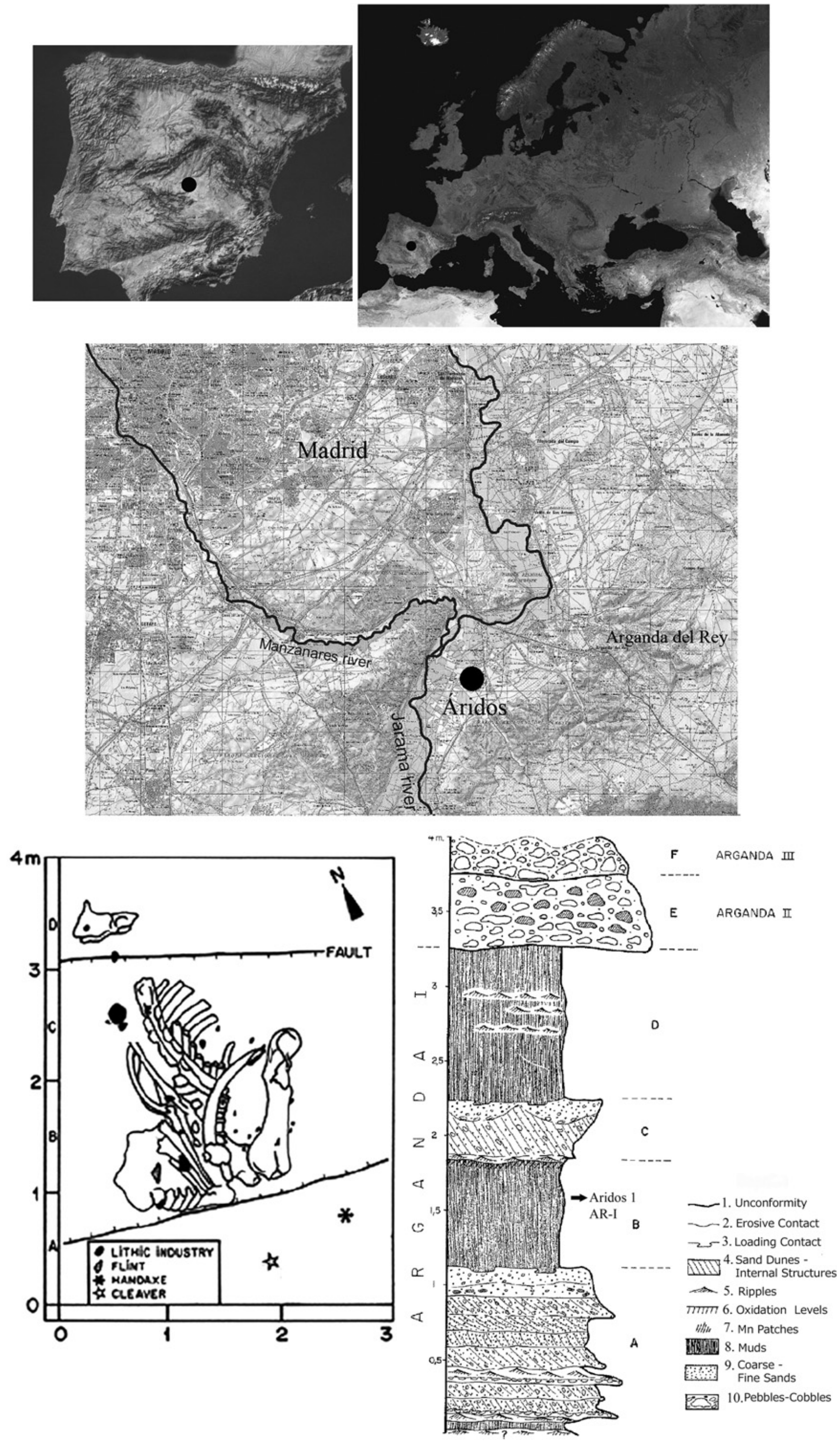

Fig. 1. Geographic situation, stratigraphic position of Áridos 2 and excavated area. The stratigraphic column shows the sequence at Áridos 1, where the Arganda I, II and III units are differentiated. The sandy and muddy facies (A, B, C and D) at the top of Arganda I can also be observed.

floodplain surface and overlain by sands and gravels (Santonja and Querol, 1980c). No significant sedimentary disturbance of the assemblage has been identified due to the small size of the lithic pieces and the lack of abrasion or polishing. Although two small channels were located to the east and north of the assemblage, and they contributed with sands to the local sedimentary matrix, no taphonomic indicator shows that the carcass may have been transported by any hydraulic jumble, although some rearrangement of the smaller components (e.g., lithics) and some *in situ* reorientation or tilting of some bones could be hypothesized. Furthermore, the identification of meat use wear polishing on the edges of several of the artifacts indicates they probably were used to butcher the elephant (Ollé Canellas, 2005). The elephant was an adult male of about 40 years, 4.6 m tall and almost 5000 kg (Soto, 1980). The stone tool assemblage is composed of 26 flakes, four cores, one burin, one backed knive, one handaxe and one cleaver.

At the end of the excavation (October, 1976), the elephant remains were covered in polyurethane to be transported in a block

Fig. 2. Remains of the elephant carcass from Áridos 2 as are currently exhibited.

to the National Museum of Archaeology in Madrid. They were not removed from the polyurethane cast until 2002 when the Regional Archaeological Museum of Madrid restored them and the elephant was exposed at the exhibit "Handaxes and Elephants: the first inhabitants of Madrid" (Panera and Rubio-Jara, 2002a,b) (Fig. 2). This enabled its detailed taphonomic study reported here.

3. Sample characteristics and method of analysis

The elephant carcass is composed of a right scapula and humerus, a cranial fragment, 24 vertebrae and almost all the ribs of the right side and three of the left side. The entire assemblage is almost articulated (Figs. 1–3).

The anatomical articulation of the elephant bones in the block extracted first for transport to the museum and later, for permanent exhibit at the museum, conditioned that bone inspection could only be performed visually, without moving them from the block. Therefore, the analysis of bone surfaces was restricted to those surfaces exposed in their current position (Fig. 2). Bones were screened with hand lenses using a magnification of 10×, 15× and 20×. Then, marks identified were molded using a fluid water-compatible high-resolution silicone (ISP 4823). The negatives were turned into positive casts with high-resolution resin (Esaflex Feropur PR 55 E-01 and Feropur E 55 E+01). The entire process was carried out under the supervision of the museum's restoration expert, since bone surfaces had been previously consolidated and the consolidating product had to be removed from the identified cut marks prior to molding them with silicone.

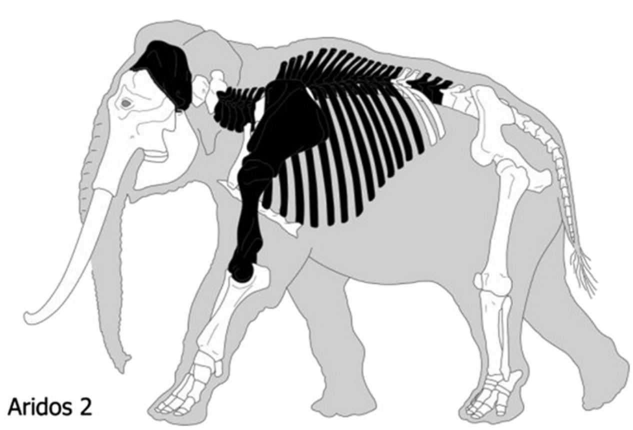

Fig. 3. Skeletal representation of the elephant carcass at Áridos 2.

Fig. 4. Sets of cut marks on the elephant scapular surface. Arrows indicate the location of the clusters 1 & 3. Cluster 2 location is indicated, although it cannot be seen in this photograph.

The resin molds of cut marks were then analyzed under a binocular microscope and a SEM (Scanning Electron Microscope) at the Complutense University of Madrid.

4. Results

The partial elephant carcass is mainly represented by axial and cranial elements (Fig. 3). The only long bone present is a humerus. The absence of the remaining long bones cannot be explained because of the partial destruction of the site.

Several cut marks were identified on the scapular blade (Figs. 4–7) and one the ventral side of one rib (Fig. 8). Cut marks on the scapula occur in groups in three different places (Fig. 4). The first set of marks shows several deep grooves larger than 30 mm with an open V-shaped section. The clayish matrix of the soil filled part of the grooves (Fig. 5). The second set of marks is comprised of two straight V-shaped long grooves with a substantial amount of flaking on the shoulders (Fig. 6). A gap linked to a crack fracture intersects the cut mark. The third set of marks (Fig. 7a) is somewhat different since these are broader than the previous ones and at least two examples of fork-shaped marks, like those documented experimentally in cut marks created with a retouched edge, can be observed (Domínguez-Rodrigo et al., 2009a). Fig. 7b and c are experimentally-created cut marks made with handaxes (de Juana et al., in press). Fig. 7b shows the bifurcation of the groove causing a "fork-shaped" mark similar to the longest curvy groove located on the elephant scapula (Fig. 7a). Fig. 7c shows another

Fig. 5. Cluster 1 of cut marks on the elephant scapula.

Fig. 6. Cluster 2 of cut marks on the elephant scapula.

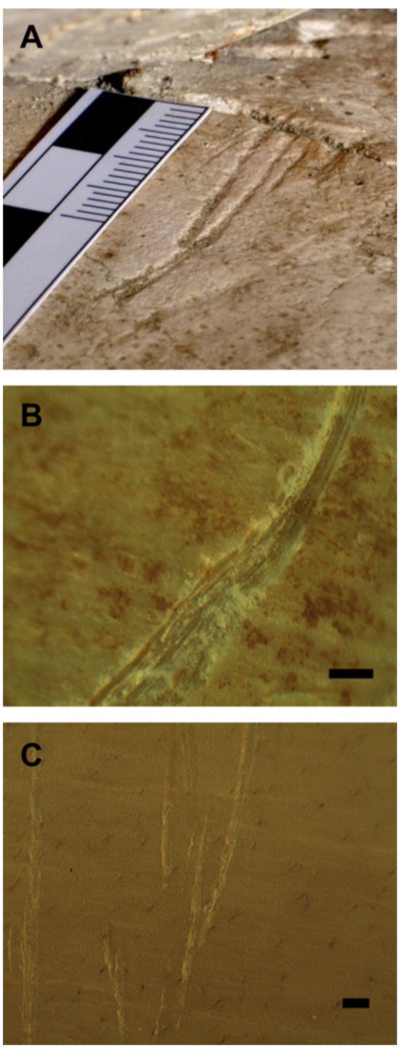

Fig. 7. A, Cluster 3 of cut marks on the Áridos 2 elephant scapula. B, experimental "fork-shaped" cut mark made with a handaxe consisting of a bifurcating groove. C, experimental "fork-shaped" cut mark made with a handaxe consisting of two joining grooves. The pattern is observed on the main long grooves to the right and also on the lower smaller grooves located to the left of the first "fork-shaped" mark. The experimental marks shown in B and C are from a single stroke. Experimental data are from de Juana et al. (in press). Scale for 7b and 7c is 1 mm.

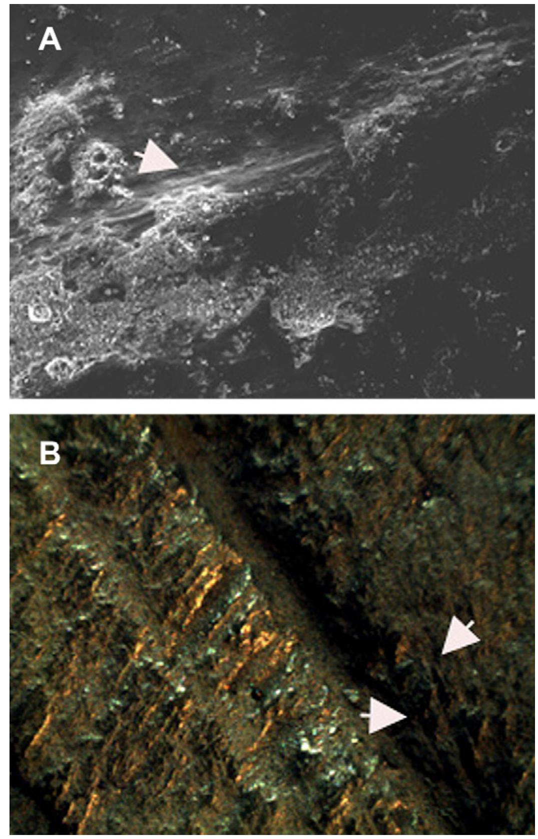

Fig. 8. A, S.E.M. image (100×) showing a portion of one of the cut marks displaying some microstriations (arrow) at the base on the groove, close to the wall of the mark where some hertzian cones can also be documented. B, another cut mark showing a V-shaped section with accompanying shoulder effect (broader shallower groove to the left) where some microstriations (arrows) are documented both on the internal side of the wall and the edge of the mark. This image has been obtained by using a binocular microscope (20×) on the high-resolution positive mold of the mark prepared for S.E.M. inspection.

pattern of "fork-shaped" marks created by the junction of two independent grooves created by a single stroke, as documented in the two longest grooves from the set of marks on the elephant scapula. In addition, the absolute widths of several grooves (see scale in Figs. 4–7) exceed the dimensions of marks made with simple or retouched flakes (Domínguez-Rodrigo et al., 2009a) and are similar to those reported for cut marks made with handaxes (de Juana et al., in press). This interpretation is further supported by the discovery of meat use wear polish on the spatially associated handaxe that was found near the elephant remains (Ollé Canellas, 2005). Mark section shape, the intensity of flaking on the shoulder of some of the marks, and the straight trajectory of the marks are criteria that clearly identify these marks as cut marks instead of trampling marks. This is further supported by the absence of oblique intersecting striations and the micro-abrasion marks which occur in almost 100% of cases where bones are trampled (Domínguez-Rodrigo et al., 2009a). Furthermore, although bone preservation is very poor (Fig. 8) and a lot of microflaking caused by bone modification has removed most of the original microstriations, high magnification is useful to spot some remnants of the original striated groove. Fig. 8 captures some of the microstriations that have survived in only a portion of the main body of the groove, showing that an abrasive agent (e.g., stone tool edge) created the wide mark.

Cut marks on the rib form two sets. The left set is composed of few and widely spaced marks with V-shaped straight trajectories

Fig. 9. Cut marks on the ventral side of the elephant rib.

and the right set has several parallel marks, all of them V-shaped, some with intensive flaking on the edge (Fig. 9). These characteristics as well as the presence of the bulk of the axial skeleton above this rib prevents them from having been caused by trampling. The presence of these cut marks on the ventral side of the ribs suggest that they were caused during evisceration. This is important since evisceration, even in a carcass this size, occurs in the earliest stages of its consumption by carnivores. Therefore, this may be suggestive of hominins having had access to this carcasses either before carnivores did or at the very early stages of carcass consumption (Fig. 10).

Most of the cut marks show all the characteristics of cut marks made with simple flakes or with tools whose edges have not been retouched. Only the third set of marks on the scapula seems to have been made with a retouched tool, given its broad section shape and the intersecting fork-shaped pattern. This feature, together with the absolute width of the grooves, supports the hypothesis that these marks may have been created with handaxes or large retouched tools (Domínguez-Rodrigo et al., 2009a,b). This functional interpretation of the lithic tools and the taphonomic data reported here is also supported by the use–wear analysis of part of the lithic assemblage assemblage (Ollé Canellas, 2005, 419–441).

In addition to the anthropogenic exploitation of the elephant, carnivore intervention has also been detected. Several tooth marks

Fig. 10. Elephant carcass at the initial stage of being scavenged by lions. Eventration has already taken place at this early stage where meat has not been targeted yet. Obtained at Tarangire National Park (photo: Agness Gidna).

Fig. 11. Distal humerus epiphyseal end and metadiaphysis showing gnawing. Lower image shows a close-up detail of the distal epiphysis.

have been identified together with intense furrowing on the distal epiphysis of the humerus (Fig. 11). The size of the tooth pits as well as the degree of furrowing clearly identify hyenids as the carnivores responsible for these modifications. Some chewing on one rib end has also been observed.

5. Conclusions

Cut marks have been found on the scapula and one rib of the elephant at Áridos 2, indicative of butchery and involving both defleshing and evisceration. This is suggestive of early access to the carcass by hominins. Haynes (2005) shows that viscerae disappear fast in the consumption of elephant carcasses by carnivores. This is also indicative of large carcass consumption during the Middle Pleistocene by hominins, not solely restricted to the Upper Pleistocene (Gaudzinski et al., 2005; Surovell and Waguespack, 2008). The evidence from Áridos 2 can be added to similarly documented elephant butchery behaviors taphonomically reported in sites such as Ambrona (Villa et al., 2005), Gesher Benot Ya'akov (Goren-Inbar et al., 1994), La Cotte de St Brelade (Scott, 1986) and other sites where, even if cut-marked bone is absent, such as at Lerhingen (Thieme and Veil, 1985) and Gröbern (Weber, 2000), the tight spatial association of elephant carcass remains and stone tools, as well as the presence of a fragment of a wooden spear, are suggestive of exploitation of these carcass remains by hominins. It is obviously difficult to assess whether these resources were acquired through hunting or scavenging (Fosse, 1998; Mussi, 2005). Arguments supporting both options are available (Villa and Lenoir, 2009). The natural deposition of carcasses at Ambrona with their occasional exploitation by hominins has been defended by Villa et al. (2005). The much more spatially discreet accumulation found in La Cotte de St Brelade with better taphonomically-supported evidence of repeated butchery of most of the individuals represented in the accumulation, as well as the location of the site at the foot of a cliff, are better understood as the result of an intentionally active acquisition strategy displayed by hominins (Scott, 1986).

One way or another, what is becoming relevant is that the exploitation of elephant and other large carcasses during the Middle Pleistocene (e.g., woolly rhinoceros at La Cotte de St Brelade (Scott, 1986) and Boxgrove (Parfitt and Roberts, 1998)) was more than a marginal strategy of protein obtainment by hominins. This is documented not only at European sites but also at African sites, such as several Middle Pleistocene sites in Middle Awash, where remains of hippopotamus occur in association with stone tools, several of them bearing cut marks (de Heinzelin et al., 2000). Exploitation of resources from these large animals has also been documented earlier in Africa, during the Lower Pleistocene. For example, several cut-marked hippopotamus bones have been documented at Buia (Fiore et al., 2004) and even earlier at Koobi Fora (Bunn, 1994). However, the evidence of consumption of these animals prior to 1 Ma is so scanty that there are no arguments supporting anything but a marginal and irregular exploitation of these carcasses at that time. Exploitation of animals larger than 1000 kg has also been documented at BK (Upper Bed II, Olduvai Gorge, Tanzania) at around 1.2 Ma (Domínguez-Rodrigo et al., 2009b). Beyond documenting the inclusion of faunal taxa larger than 1000 kg in the diet of hominins, archaeologists are faced now with the need to explain why consuming resources from such large animals becomes more visible after the end of the Lower Pleistocene in the archaeological record.

The discovery of a butchered elephant at Áridos 2 reported in the present work is relevant because it shows one of the earliest pieces of evidence of this type of behavior associated with an Acheulian site and where a convincing case can be made for handaxe use for butchery of a proboscidean carcass.

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