10 AN UPDATED SPATIAL TAPHONOMIC STUDY OF THE MIDDLE PLEISTOCENE OPEN-AIR SITE OF MARATHOUSA 1 (MEGALOPOLIS BASIN, GREECE): PRELIMINARY RESULTS

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http://dx.doi.org/10.15496/publikation-97659

Keywords: site formation processes; spatial analysis; Middle Pleistocene; open-air site; Greece

10.1 INTRODUCTION

In recent years, a growing number of Middle Pleistocene sites in Europe yielding evidence of elephant exploitation has further fed the long-lasting debate over past human-elephant interactions (Konidaris et al., 2021). Viewed in the broader context of past human-carnivore-megafauna interactions, evidence of elephant exploitation provides further insights into past human behaviors, diet and subsistence strategies. However, modeling past human behaviors is not straightforward: direct types of evidence for repetitive elephant exploitation (i.e., cut-marks, bone tools or breakages for brain/marrow extraction, embedded lithic tools) are rather rare, whereas indirect types of evidence—such as spatial association, or tool use-wear and residues patterns—are significantly more common, although often questionable (Giusti, 2021; Konidaris and Tourloukis, 2021). Spatial association, for instance, does not necessarily imply causation: spatial associations of lithics and modified fauna are not direct evidence of a cultural accumulation, because syn- and post-depositional processes may equally produce spatial associations. Therefore, in spite of the growing archaeological record, the mode of acquisition and processing of the elephant carcass, the degree of exploitation of the carcass, its timing relative to, eventually, carnivore scavenging and to the carcass decomposition are, more often than not, inadequately understood.

The open-air site of Marathousa 1 (MAR-1), Megalopolis Basin, Greece, offers important insights into the understanding of the Middle Pleistocene mega-fauna exploitation in Europe. The site, dated to ca. 400–500 ka (Marine Isotope Stage 12; Blackwell et al., 2018; Doukas et al., 2018; Jacobs

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et al., 2018; Tourloukis et al., 2018a; Konidaris et al., 2018), yielded strong evidence (cut-marks) of elephant exploitation by Middle Pleistocene hominins. Since the site's discovery in 2013, two excavation areas were systematically investigated until 2019: Area A (Fig. 1a) where a partial skeleton of a single individual of *Palaeoloxodon antiquus* was unearthed, together with a relatively small number of lithic artifacts and other faunal remains; and Area B (Fig. 1b), about 60 m to the south of Area A, where the lithic assemblage is significantly richer and occurs in association with elephant remains of another individual, as well as remains of other mammal taxa. As yet, evidence of butchering (cut-marks) has been identified on two of the elephant bones from Area A, as well as on one elephant bone (accompanied by peeling) and other mammal bones from Area B (Konidaris et al., 2018). Additionally, a bone diaphysis fragment that most likely also belongs to an elephant, has been provisionally identified as a percussor, as it preserves percussion marks, as well as a flake scar and cut-marks (Tourloukis et al., 2018b). However, despite multiple types of evidence pointing to a multi-carcass butchering site, it is of primary importance to evaluate the taphonomy and degree of site integrity, before reliably deducing behavioral inferences from the material record.

The site occurs at the margin of a paleolake of the Megalopolis Basin. The sedimentary sequences of both areas include lacustrine and fluviolacustrine clastic deposits sandwiched between two lignite seams. A clear and well-documented hiatus divides both sequences in two parts: a lower subaqueous sequence of bedded sands and silts and an organic rich upper sequence partially subaerial. The hiatus is attributed to the exposure of a lake shore surface and subsequent erosion by a gravity flow process, such as a mud- or hyperconcentrated-flow (Karkanas et al., 2018). Indeed, the sequence above the hiatus is characterized by a series of erosional-bounded depositional units, attributed to mudflows (i.e., UA3–UA2, UB5–UB2; Fig. 2). The hiatus correlates the main find-bearing units of both areas, namely UA3c and UB4c (Fig. 2). Specifically, in Area A the elephant remains lie at the contact of UA3c/4 and are covered by UA3c (Fig. 2a); while in Area B, most of the remains were collected

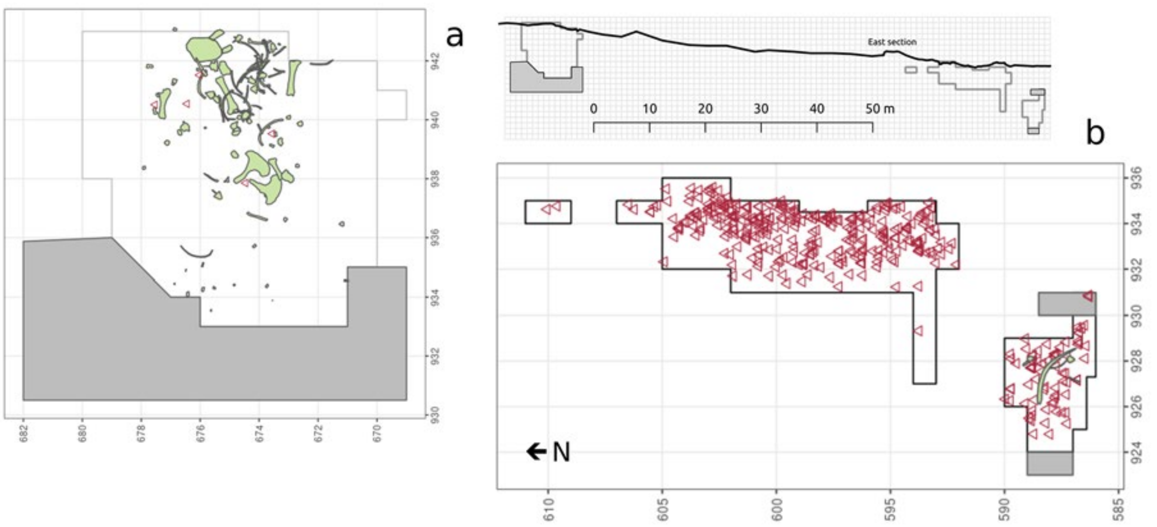

Figure 1: Distribution maps of the plotted remains from a) areas A (units UA3c and UA4) and b) B (units UB4c and UB5a), collected until 2019. Due to their high number, lithic debris/chips are not plotted. Grey zones mark the 2019 trench extensions. Area B is located 60 m to the South.

from unit UB4c and mostly close to the contact with the underlying unit (Fig. 2b).

In order to decipher the depositional nature of the main find horizons, an initial spatial taphonomic study was conducted in order to evaluate the degree and reliability of the spatial association of the lithic artifacts with the elephant and the other faunal remains from both areas (Giusti et al., 2018). From different spatial perspectives, and in agreement with preliminary taphonomic observations of the archaeological and paleontological material (Konidaris et al., 2018; Tourloukis et al., 2018b), the results all supported an autochthonous origin of the lithic and faunal assemblages, subject to minor post-depositional reworking. Thus, the results of Giusti et al. (2018) were in agreement with the current interpretation of MAR-1 as a butchering site. Giusti et al. (2018) analyzed material collected from 2013 to 2016, during systematic excavations of the site. Systematic investigation of the site continued until 2019, allowing us to significantly extend the excavation areas and collect more data.

The present study builds upon the previous preliminary results and incorporates new data, allowing us to test our former conclusions and refine our initial inferences. Specifically, as regards the spatial taphonomy of the site, the main research question is whether we are still looking at an autochthonous assemblage (subject to minor post-depositional reworking), or not.

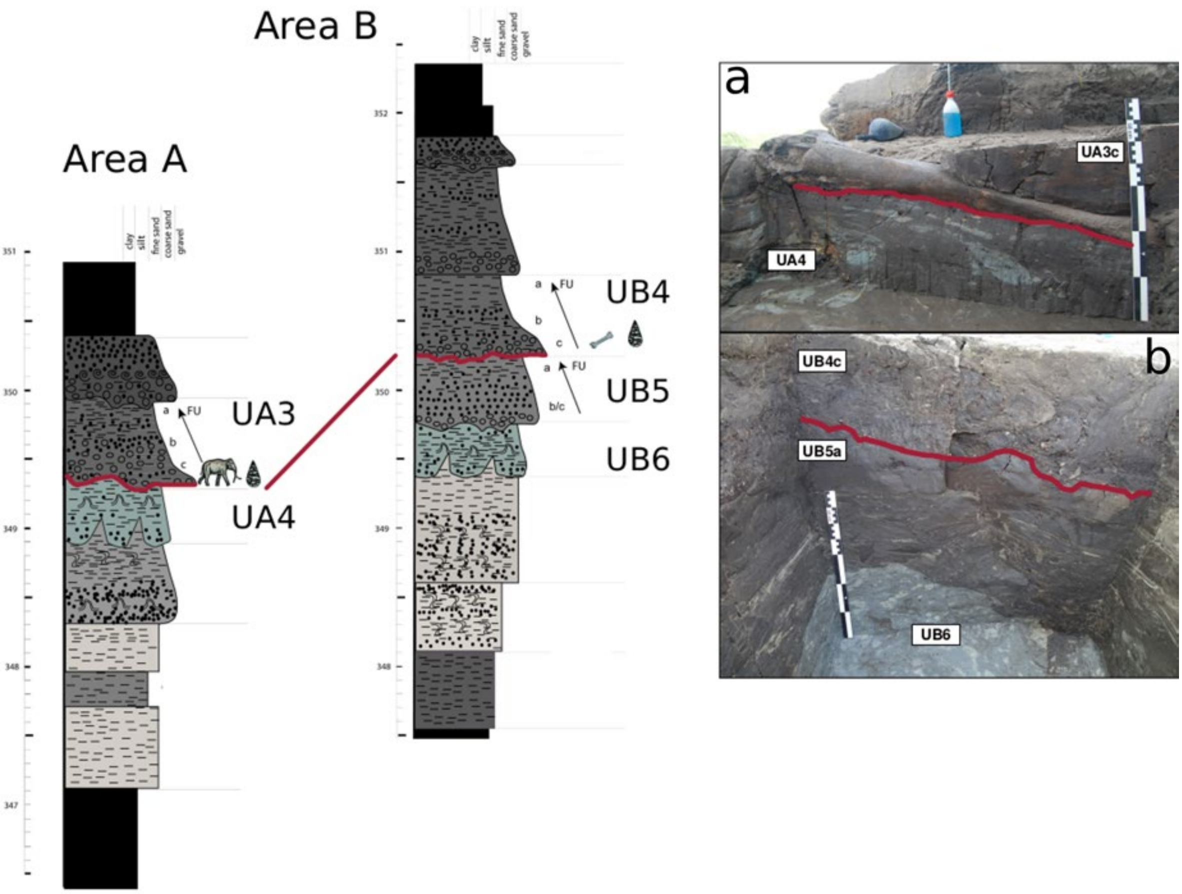

Figure 2: Stratigraphic setting of the Marathousa 1 site, modified after Karkanas et al. (2018). Absolute elevations in m a.s.l. Photograph (2017) of the left femur of the *Palaeoloxodon antiquus* skeleton, lying at the UA3c/4 contact and covered by unit UA3c (a). West profile (2014) of the excavation Area B (square 932/603), exposing the UB4c/5a (black solid line) and the UB5/6 erosional contacts (b).

10.2 MATERIALS AND METHODS

From 2013 to 2019, systematic investigation of the Marathousa 1 site were carried out by a joint team from the Ephorate of Palaeoanthropology-Speleology (Hellenic Ministry of Culture) and the University of Tübingen. High-resolution techniques were used to document the archaeological process as completely as possible, allowing us to acquire a large dataset. A total station was used to record the three-dimensional position of finds (i.e., all the lithic artifacts, teeth and diagnostic bones; bones and organic material with length equal to and greater than 20 mm), samples, collected spits of sediment (of 5 and 10 cm thickness, in Area B and A respectively) and geological features, such as exposed erosional surfaces. The dimensions (length, width and thickness) of plotted finds were measured on-site with a millimeter accuracy. The orientation (plunge and bearing) of elongated finds was recorded with a compass and inclinometer with a 1-degree accuracy.

The present study analyzes material recovered from the more extensively excavated stratigraphic units, namely UA3c and UA4 in Area A, UB4c and UB5a in Area B (Table 1). In order to consistently use the same sampling strategy as in the first study, the regions of investigation are limited in Areas A and B to the square units excavated respectively until 2016 (28 m^2) and 2019 (74 m^2). In contrast to Area B, many sediment bags from the last excavation campaigns in Area A are yet to be screened or sorted. Including sieved material is especially important in Area A, since the number of lithics (mostly debris, but also tool-resharpening chips) collected over the years from sieved sediment substantially exceeded the number of finds plotted in the field. Nevertheless, whilst the Area A sample is only slightly bigger (×1.2), the Area B sample is definitely larger (×1.9) with respect to our previous dataset.

Similar to what was presented in Giusti et al. (2018), two contrasting hypotheses of depositional scenarios are here tested. The allochthonous model implies significant transport of the material by the mud-flow from the original locus of deposition to the site; in this scenario, the lithics and fauna cannot be shown to belong to the same depositional event. In contrast, the autochthonous model assumes that the flow event eroded an exposed surface where the elephant and the archaeological material were already lying. The latter model implies the loss of any original, pristine spatial relations between remains, but minor transport from the primary depositional locus. We are here interested in investigating the vertical distribution of the finds from both areas, with respect to the erosional surfaces between UA3c/4 and UB4c/5. Our assumption is that a statistically significant concentration of unsorted finds in the proximity of the erosional surfaces would suggest an autochthonous origin of the assemblage, whereas a homogeneous vertical distribution of finds in UA3c or UB4c would support the allochthonous hypothesis. Indeed, gravity flow processes such as hyperconcentrated flows are highly erosive and show rather chaotic structures,

		Lithic				Bone tool	Fauna	
Sample	n	Debris	Flake	Tool	Core		Mammalia	AAPR
UA3c (2013-2016)	343	56	2	1			86	198
UA4 (2013-2016)	72	7	2				22	41
UB4c (2013-2019)	2324	1391	296	72	23	2	396	144
UB5a (2013-2019)	181	101	23	5	3		37	12

Table 1: List of sampled observations for the vertical distribution analysis. The Mammalia sample includes large and small mammals. However, it does not include specimens of the order Proboscidea, to be sampled for further specific analysis. AAPR: Amphibia, Aves, Pisces, Reptilia.

which might result in normal or inverse grading (Benvenuti and Martini, 2002; Pierson, 2005).

By applying an IDW (Inverse Distance Weighting) interpolation of recorded random three-dimensional points of the UA3c/4 and UB4c/5 stratigraphic hiatus, we were able to build geostatistical models of the erosional surfaces. Thus, we measured the minimum orthogonal distance (*d*) of each find to the interpolated erosional surface of the respective area (Giusti et al. 2018). The distribution of the distances *d* is finally estimated by means of histograms and density functions.

10.3 PRELIMINARY RESULTS AND DISCUSSION

Fig. 3 shows the distribution of the minimum orthogonal distances (*d*) of the UA3c and UA4 finds to the UA3c/4 surface; and the distribution of the distance *d* of the UB4c and UB5a finds to the UB-4c/5a surface. With regards to the units above the erosional surfaces (i.e., UA3c and UB4c), both distributions clearly skew to the right, with mean values between 0.1 and 0.2 m from the stratigraphic contact with the underlying units UA4 and UB5a. The density functions show that different classes of lithic artifacts and faunal remains have similar distributions, thus suggesting the absence of any sort of grading. Hence, most of the material from units UA3c and UB4c indistinctly occurs in proximity to the erosional surfaces, within the first 10-20 cm, whereas the rest is gradually dispersed towards the upper part of the units, up to about 50 cm. Such a distribution is consistent with the hypothesis of an autochthonous assemblage. Conversely, we would expect a normal distribution in the case of a homogeneous vertical distribution, and eventually inverse grading, or a continuously aggrading bed (Benvenuti and Martini, 2002).

As for the units below the erosional surfaces (i.e., UA4 and UB5a), both distributions skew to the left with much shorter tails. Indeed, both distributions are compressed within 20-30 cm below surface, with mean values around 10 cm. The density functions of the UB5a sample show similar distributions for different classes of lithic artifacts and faunal remains, thus suggesting no size sorting.

The occurrence of material very close to, or at the contact with the erosional surfaces, supports

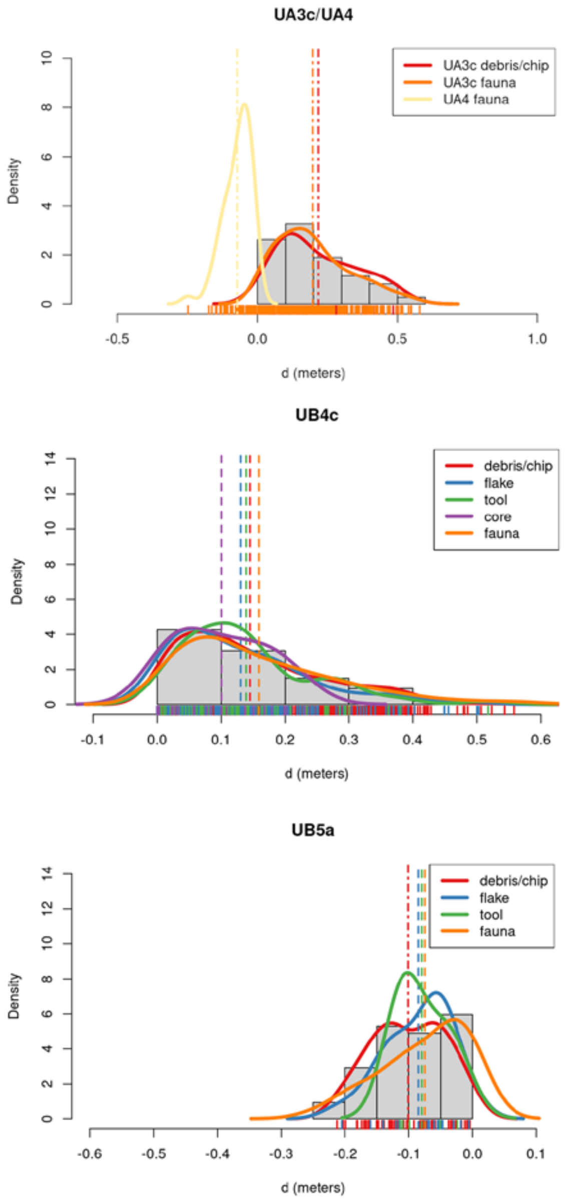

Figure 3: Distribution of minimum orthogonal distances (*d*) to the UA3c/4 and UB4c/5a surfaces. The histogram represents the total distribution; the curves express density functions for each class of find (UA3c fauna plots on the x-axis with negative *d* values); dashed lines indicate mean values.

again our working hypothesis that the primary deposition of the archaeological assemblage occurred *in situ*, and a subsequent gravity flow event eroded it. Thus, according to our autochthonous hypothesis, the material would have been only locally reworked in both areas. The exceptional preservation and number of mint-to-sharp lithic artifacts, as well as the rather good state of the bone preservation would support this hypothesis, suggesting limited, if any, transport over a short distance and/or for a short time span, and a common taphonomic history for both lithics and fauna. A further indication that the lithic and fauna assemblages have not undergone substantial reworking would come from the currently in progress refitting analyses. To date, 5 bone refits have been found from unit UB4c, and 1 between two mammal bone fragments from units UB4c and UB5a. Similarly, a limestone flake from unit UB4c has been found to refit a core from the same unit, and a radiolarite flake from UB4b has been found to refit a core from UB4c. Nonetheless, the original, pristine spatial extension and relationship between items would have been lost, precluding any further high-resolution investigation of the spatial dimension of past human behaviors. Whereas the erosional event represents a snapshot of a relatively short time-frame, little is known about the duration and intensity of the human activities before the depositional event that capped and preserved the archaeological record. We might argue that, considering the high rate of bone fragmentation and the density of lithic debris/chips, it is likely that the assemblage represents a palimpsest of repeated events of hunting/scavenging and exploitation of lake shore resources, similar to what Schlanger (1992) refers to as a persistent place. However, little is known about the intensity of human activities preserved after the UA3/UB4 mud-flow. The sedimentary sequence above the main hiatus is characterized by a series of erosional-bounded depositional units all attributed to mud- or hyperconcentrated-flows (i.e., UA3–UA2, UB5–UB2; Fig. 2) and a relatively small number of lithic artifacts and faunal remains were recovered from most of those units; nevertheless, the small amount of scattered finds from those units does not allow for hypothesis testing – it only indicates human presence, with an intensity that at the present cannot be assessed.

Therefore, although we can reliably conclude that hominin exploitation of elephant carcasses and other mammals occurred at MAR-1, inferences about the mode of acquisition and processing of the carcasses (hunting or active/passive scavenging), as well as the degree of exploitation (partial or complete) are speculative in light of the current information. Furthermore, despite the relatively high rate of cut-marks (2 out of 2 elephant individuals with cut-marks), the temporal resolution of the archaeological record is too low to allow for testable assumptions about the intensity of occupation and degree of exploitation (systematic or occasional) of elephants by humans. A better understanding of the frequency of past human-elephant interactions has major implications for the broader debate about the role of meat consumption in the biological and cultural evolution of hominins.

ACKNOWLEDGMENTS

Excavation at Marathousa 1 was conducted under a permit granted to the Ephorate of Palaeoanthropology-Speleology, Hellenic Ministry of Culture. It was supported by the ERC Consolidator Grant ERC-CoG-24703 (“CROSSROADS”) and the ERC Starting Grant ERC-StG-83503 (“PaGE”), both awarded to K.H. V.T., G.E.K. and K.H. are also supported by the Deutsche Forschungsgemeinschaft (DFG Project no. 463225251, “MEGALOPOLIS”). K.H. is also supported by the ERC Advanced Grant ERC-AdG-101019659 (“FIRSTSTEPS”). We are grateful to all the participants in the excavation campaigns in Marathousa

1 for their essential collaboration. We would also like to thank E. Discamps and the anonymous reviewer for their comments and suggestions.

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