The Lower Palaeolithic site of Marathousa 1, Megalopolis, Greece: overview of the evidence

Eleni Panagopoulou¹, Vangellis Tourloukis², Nicholas Thompson², George Konidaris², Athanassios Athanassiou¹, Domenico Giusti², Georgia Tsartsidou ¹, Panagiotis Karkanas³
Katerina Harvati²

1. Ministry of Culture, Ephoreia of Palaeoanthropology–Speleology, Ardittou 34B, Athens, Greece

2. Eberhard Karls University of Tübingen, Palaeoanthropology, Senckenberg Centre for Human Evolution and Palaeoenvironment, Rümelinstraße 23, 72070 Tübingen, Germany

3. Malcolm H. Wiener Laboratory, American School of Classical Studies at Athens, Souidias 54, Athens, 10676, Greece

Corresponding author; elenipanagopoulou@yahoo.com (Eleni Panagopoulou)
Abstract

Marathousa 1 is a Lower Palaeolithic open-air site located in the Megalopolis basin, an area in Southern Greece known for its fossiliferous sediments. Mining activities in the basin uncovered a thick sequence of Middle Pleistocene lacustrine deposits representing the environment of a palaeolake. Marathousa 1 was discovered in 2013 during a targeted palaeoanthropological survey and excavated subsequently by an interdisciplinary team from the Ephoreia of Palaeoanthropology–Speleology of Greece and the University of Tübingen, Germany. This article presents results from the ongoing investigation and reviews the state of knowledge about the site.

Systematic excavations during five field seasons have exposed a total of 72 m² and revealed a partial skeleton of the elephant *Palaeoloxodon antiquus* and remains of other large mammals in spatial and stratigraphic association with a “small tool” lithic assemblage. Faunal and taphonomic studies indicate the presence of cut-marks and percussion damage on elephant and other large mammal bones. The study of site formation processes, together with taphonomic and geostatistic spatial analyses confirm the association of fossil and hominin activity remains and the stratigraphic integrity of the site. Radiometric dating, geological and biostratigraphical evidence suggest that hominin activity at the site occurred between 0.5–0.4 Ma.

Marathousa 1 is the oldest currently known archaeological site in Greece and the only Lower Palaeolithic butchering site in the Southern Balkans. It is also a key site for documenting high resolution palaeoclimatic, palaeoenvironmental and cultural records of a wider geographical area that potentially acted as a refugium during the successive waves of hominin colonization of Europe.

Keywords: Lower Palaeolithic; Middle Pleistocene; Greece; Elephant butchering site; “small tool” assemblage
1. Introduction

In the last decades, evidence of the earliest occupation history of Eurasia has changed significantly (Bar-Yosef and Belfer-Cohen, 2001; 2013; Dennell, 2003; Dennell and Roebroeks, 2005; Moncel, 2010; Moncel et al., 2018) with the presence of hominins attested at 1.8 Ma at Dmanisi in Georgia (Agustí and Lordkipanidze, 2011 and references therein) and 1.4 Ma at ‘Ubeidiya (Bar-Yosef, 1989; Bar-Yosef and Goren-Inbar, 1993), 0.78 Ma at Gesher Benot Ya’aqov in Israel (Goren-Inbar et al., 2000) and at around 1 Ma in Turkey (see Dinçer, 2016 for a summary of the recent evidence). In Europe, the earliest traces of hominins come from the Mediterranean area which probably hosted a first dispersal event and served as a core area for a range of expansions of hominin populations northwards (Dennell et al., 2011) and are dated to over a million years ago (Carbonell et al., 2008; Arzarello and Peretto, 2010, but see Roebroeks, 2001; Muttoni et al., 2010; 2013). Early dates around 1.6–1 Ma that need to be verified have been recently suggested for Eastern Europe (Ivanova, 2016), although secure and dated Lower Palaeolithic contexts are rare in this area (cf. Doboș and Iovita, 2016). Despite the fact that Greece lies at the crossroads of Europe, Africa and Asia and, therefore, possibly at the most direct pathway in the movements of hominins between Africa and Eurasia, there is a scarcity of evidence for hominin presence in the Early and Middle Pleistocene, due to preservation biases and the dearth of systematic archaeological research (Harvati et al., 2009; Tourloukis, 2010; Harvati, 2016; Tourloukis and Harvati, 2018). This paper presents recently obtained Lower Palaeolithic evidence from the excavation of Marathousa 1, an open-air site in southern Greece. It provides an account of the discovery, excavation and preliminary analysis of remains from a sequence of archaeological horizons dating to approximately 0.5–0.4 Ma.

First, a synoptic overview of the geological setting, the excavation and stratigraphic framework, the dating and the palaeoenvironmental and cultural records, discussed in detail in other articles in this issue, is presented. Drawing on it, a preliminary interpretation of palaeolithic activity in the long-vanished palaeogeographical context of the site is attempted. Finally, comparisons with relevant sites from Greece and neighbouring regions are initiated in order to contextualize the data from Marathousa 1 into the wider framework of the Middle Pleistocene of the Mediterranean.
2. The site

2.1 Geographic and geological background

Marathousa 1 is situated in the basin of Megalopolis (Fig. 1), an area in southern Greece long-known for its fossiliferous sediments (e.g. Melentis, 1961). The Megalopolis basin is an inter-mountainous depression that was formed during the Late Miocene – Pliocene as a result of extensional tectonic movements. During parts of the Pleistocene the basin hosted a large shallow lake. The sedimentary sequence of the basin includes lacustrine and fluvial deposits that reach a thickness of more than 250 m and are divided stratigraphically into six formations (Fm). The formation of interest is the "Choremi Fm" (Fig.1), which dates to the Early and Middle Pleistocene (Vinken, 1965; van Vugt et al., 2000) and is subdivided into the Marathousa and Megalopolis Members (Mb). These members include lacustrine and fluvial sediments, respectively, and represent glacial–interglacial alternations (Nickel et al. 1996; van Vugt et al., 2000; Okuda et al., 2002).

Since 1969 mining operations at the open-cast lignite mine of Megalopolis have exposed thick sequences of deposits, enhancing the visibility of fossiliferous horizons. Previous work indicated that the area is potentially important for palaeoanthropological/palaeolithic research (Lénormant, 1867; Sickenberg, 1976; Darlas, 2003; Harvati et al., 2009). However, systematic research targeting Pleistocene sites had never been conducted. In 2012 a systematic interdisciplinary surface survey was initiated by a joint team of the Ephoreia of Palaeoanthropology–Speleology of Greece and the University of Tübingen (Germany) in the framework of the ERC project "Palaeoanthropology at the Gates of Europe" (PaGE), with the aim to discover primary context Pleistocene archaeological sites (Harvati and Tourloukis, 2013; Panagopoulou et al., 2015; Harvati, 2016). The survey discovered numerous palaeontological (Athanassiou et al., this issue) and palaeolithic findspots, the latter attributed mainly to the Middle Palaeolithic (Thompson et al., this issue). Since the focus of research has been the in situ recovery of secure, stratified and datable contexts, the survey concentrated on the examination of the sections exposed by mining activities. Marathousa 1 was discovered in 2013 when members of the research team identified the first Palaeolithic artefacts in association with large mammal remains in an exposed profile (Panagopoulou et al., 2015).

Marathousa 1 is located in sediments of the Marathousa Mb, which consists of lacustrine clay, silt and sand beds with freshwater bivalves and ostracods, and thick lignite seams. The site is located at 350 m above mean sea level (masl), inside the Marathousa lignite mine at
the center-west part of the basin (Panagopoulou et al., 2015). The cultural and fossil material was found in the detrital unit, which is sandwiched between two lignite seams (Fig. 2, and see below, Stratigraphy section).

2.2 Excavation: goals, methodology and results

During the Marathousa mining activities, the area was formed into artificial terraces. When the site was located, the find-bearing horizon was covered by ca. 4 m. of sediments, which were removed mechanically before the start of the archaeological investigation. In the same year a salvage excavation was initiated which developed into a long term systematic research project (Panagopoulou et al., 2015). Here, we report the first results of the ongoing excavation.

Fossiliferous and cultural deposits were observed throughout ca. 100 m along the exposed section of the lignite mine (Thompson et al., this issue). Results of the rescue excavation suggested that an in situ Middle Pleistocene horizon was preserved along the western bank of the palaeolake. A grid system of 1×1 m units was set up and trenches were opened in two Excavation Areas, A and B (Fig. 2) to investigate the spatial distribution and main concentrations of finds and to locate the extent of the site. Due to the nature of the finds, excavation was conducted in 1×1 m squares and 10 cm spits in Area A, where excavation focused on recovery of the elephant remains; and in sub-square quadrants of 50×50 cm and 5 cm spits in Area B, where a denser lithic assemblage associated with faunal remains was found. Due to the compaction of the sediment and the high organic content, sediments were excavated with leaf trowels and small knifes, by stratigraphic unit, following the geological layers and/or the presence of archaeological features. In close proximity to the fossil finds wooden tools were used, in order to avoid damaging the surfaces of the bones or imitating the effects of cut-mark on the fossils. A total station was employed to document three-dimensional coordinates of finds including all lithic artefacts, teeth, bone and organic material ≥ 2 cm), as well as micromammal and other micro-faunal and palaeobotanical remains of special interest, such as eggshells or seed/fruits, sediment samples and sedimentary features. Dense clouds of surface points of the elephant remains were recorded using both a total station and a close range photogrammetric technique (for a detailed account of the recording system, see Giusti et al., this issue). The dimensions, dip/orientation of finds were also recorded for fabric analysis (Giusti et al., this issue). The Total Station data were transferred to a GIS data base to three-dimensionally reconstruct
find distributions and occupational surfaces. Systematic water-screening of all excavated sediments through a 1 mm mesh was initiated from the beginning of the project to ensure the recovery of numerous small finds, including lithics, faunal (mammals, reptiles, fish, mollusks, ostracods, insects etc.) and botanical (fruits, seeds, wood, charcoal etc.) remains. Flotation of selected samples for the recovery of macronutritional remains was also implemented. Furthermore, samples were collected for micromorphological, microfaunal, microbotanical (including phytoliths) remains and radiometric dating analyses. Sampling procedures involved both a site-specific and an off-site approach (selected profiles of the open-cast mine were also sampled). The find-bearing stratigraphic units (see stratigraphy section below and Karkanas et al., this issue) were recovered in both excavation Areas, and were investigated over a total of 72 m², accounting for 55 m³ of excavated sediment.

In Area A, excavations were initially devoted to the collection and protection with plaster-jackets of the fossil material that was in danger of eroding out of the artificial section profile. The work focused on the cranium of an elephantid, as well as on a number of the axial skeleton elements, presumably of the same individual, that were exposed in the section. Taxonomic identification based on the craniodental morphology attributed the cranium to the species *Palaeoloxodon antiquus* (Konidaris et al., this issue). The expansion of excavation units in subsequent seasons revealed numerous well-preserved elephant skeletal elements in close association in the same layer, including a humerus, an ulna, a femur, a tibia, ribs, vertebrae, the pelvis, autopodial elements and tusk fragments (Fig. 3). Their stratigraphic and close spatial association with the cranium and the subsequent study (Konidaris et al., this issue) indicated that they indeed belong to the same individual. The elephant remains were found in direct spatial and stratigraphic association with lithic tools and rich macro- and microfaunal and floral records, including seed micro-remains, wood and charcoal fragments, birds, reptiles, ostracods and coleopters. As suggested by the distribution patterns (Giusti et al., this issue), the lithics found in Area A are mostly spread around the elephant skeletal remains (Fig. 4).

Excavation Area B, located 60 m to the south of the elephant fossil accumulation along the exposed west section of the lignite quarry (Fig. 2), revealed an assortment of lithic and faunal materials distributed across well-defined archaeological layers. Additional elephant elements, including the proximal end of a tibia, vertebra, rib and tusk fragments, were found. Subsequent study of the material indicated that at least the tibia represents a different individual from the one found in Area A. A higher density of lithics and the remains of other large mammals (e.g. cervids, bovids, hippos, carnivores) were also recovered from
Area B, along with fragments of rotted organic material and a range of organic remains, including mollusks, ostracods and microvertebrates. As in Area A, the distribution of the faunal remains correlates closely with the distribution of stone tools (Fig. 4, Giusti et al., this issue).

2.3 Stratigraphy, chronology, palaeoenvironment

2.3.1. Stratigraphy and site formation

According to the research design, from the beginning of the project formation processes were addressed at both the site-scale (Marathousa 1), and the palaeolandscape (Megalopolis basin) level. This approach provided the critical data necessary for the clarification of the geological processes at the basin and contributed to the chronological and palaeoenvironmental assessment of the site. The stratigraphic sequence of the site and the correlations between the two excavation areas and their respective stratigraphic columns are shown in Fig. 5 and summarized in the following paragraphs. A full account of the sedimentological and micromorphological analyses of the deposits and the interpretation of site formation processes is presented in Karkanas et al. (this issue).

The sedimentary sequence of Marathousa 1 is located between Lignite Seams IIb and IIIa (Tourloukis et al., this issue a) and comprises 4 m of lacustrine and fluvialacustrine clastic deposits (Fig. 2). Previous chronostratigraphic and palaeoenvironmental analyses of the Megalopolis basin have interpreted the cyclical nature of the lignite layers as representing interglacial periods, while detrital intervals likely correspond to glacial periods (Nickel et al. 1996; van Vugt et al., 2000; Okuda et al., 2002; Siavalas et al., 2009).

The clastic sedimentary sequence is thicker in Area B and more compressed in Area A (Fig. 5), indicating that the latter was probably located closer to the lake shore. Correlation between the two excavation areas was accomplished on the basis of stratigraphic, sedimentological and geochemical evidence (Karkanas et al., this issue). Both excavated areas A and B are characterized by a lower clastic sedimentary sequence, devoid of cultural remains (UA4 to UA7 and UB6 to UB10 respectively). These in turn overlie lignite unit II (UA7 and UB10 respectively). Sedimentation in this part of the sequence consists of bluish organic-poor muds and sands and appears to be relatively continuous and deposited mostly under water. According to the sedimentological and micromorphological analysis the sediments were deposited in a shallow to very shallow water lake environment. Eroded
remnants of a bluish mud layer are capping the sequence in both areas. This mud layer is thicker in Area B (UB6) and is found as thin remnants in Area A (UA4).

The overlying sedimentary sequence (UA3-2 and UB5-2) follows a major depositional hiatus (UA3/4, UB5/6), which is attributed to exposure and erosional processes. The erosional contacts UA3c/4 and UB4c/5a separate the cultural units in both areas and are overlain by a series of mudflows and hyperconcentrated flows deposited at the fringes of the palaeolake. Frequent fluctuation in the lake level resulted in the formation of extensive mudflats also characterized by repeated exposure and erosion. The fossiliferous and cultural layers are found close to the base of the upper part of the sequence and are associated with this major erosional and exposure surface. The units start with dark brown, organic and mudclast-rich muds and are followed by organic-rich massive muds, often interrupted by finely laminated sands. Finally, Lignite Unit III (UA1 and UB1) is capping the sedimentary sequence of Marathousa 1.

In summary, the context of Marathousa 1 represents a depositional environment close to the shore of the lake, punctuated by higher energy events, such as mudflows and periodic subaerial exposure with dry, terrestrial depositional conditions (Karkanas et al., this issue). The cultural deposits are embedded in such a mudflow formed close to the shores of the palaeolake. Several unconformities in the sequence indicate temporal gaps of unknown duration in the sedimentation and are related to fluctuating lake levels caused by short-term climatic variability.

2.3.2 Chronology

As already discussed, the find-bearing layers occur between Lignite Units II and III; therefore, according to the chronostratigraphic model of van Vugt et al., (2000), Marathousa 1 dates to Marine Isotope Stage (MIS) 16, or to MIS 14, according to Okuda et al. (2002). While relative age information is sufficient as a first approximation, radiometric, fine resolution chronology is necessary for placing the cultural evidence from the site in the wider discussion of behavioural evolution processes in this time range. Thus, in order to refine the chronology we initiated dating of the deposits by Electron Spin Resonance (ESR) and post-infrared Infrared Stimulated Luminescence (post-IR IRSL) dating. Samples for cosmogenic nuclides analysis were collected and results are pending.
Preliminary Electron Spin Resonance (ESR) age determinations indicate that the age of Marathousa 1 should fall around 450–500 ka BP (Blackwell et al., 2016), although these results should be confirmed by the dating of more samples, currently underway. On the other hand, sediment samples from the two excavation areas were dated by post-infrared Infrared Stimulated Luminescence (post-IR IRSL) and provided age determinations between 400 and 450 ka (Fig. 5), consistent with deposition of sediments during MIS 12. (Jacobs et al., this issue). In order to place constraints on the age of the site, the magnetostratigraphy of the Megalopolis basin was investigated and correlated to a standard isotope record of Pleistocene climatic variability. According to the preferred interpretation put forth by Tourtoukis et al. (this issue a), the archaeological horizon of Marathousa 1 is chronologically placed in MIS 12. This chronological bracketing is in broad agreement with the radiometric assays provided by ESR and OSL dating. Relative dating provided by the biochronological data from the small mammal assemblages (Doukas et al., this issue) is in good agreement with the Luminescence dating and the results of the palaeobotanical (Field et al., this issue) and sedimentological (Karkanas et al, this issue) analyses (see below, palaeoenvironment section), suggesting that the archaeological horizon dates to the end of glacial MIS 12 and the gradual transition to the interglacial MIS 11. The above results currently make Marathousa 1 the oldest archaeological site in Greece and one of the oldest open-air sites in South-Eastern Europe.

2.3.4. Palaeoenvironment

Due to the excellent preservation of all sorts of organic remains, Marathousa 1 represents an important archive for reconstructing past environment and past floral and mammalian resources in the Lower Palaeolithic of Greece. From the beginning of the excavation the systematic sampling for wood, macro- and micro-plant remains, macro- and micro-vertebrate remains was initiated (Fig. 6). Plant macrofossils (seeds/fruit, wood and wood charcoal), phytoliths and diatoms were analyzed and were used as proxies for the reconstruction of the vegetation and climate during the deposition of the sedimentary sequence at Marathousa 1 (Field et al., this issue).

The combined evidence from the palaeobotanical study suggests that the sedimentary sequence was deposited during a time of climatic amelioration. More specifically, the presence of the thermophilous Palmae in the charcoal and phytolith records and of carpological remains such as *Euryale ferox* and *Salvinia natans* (currently extinct in southern
Europe) indicate that the prevailing climate during the time of hominin activity was warm. This is corroborated by the sedimentological analysis (Karkanas et al., this issue) which indicates that the upper part of the stratigraphic sequence represents a gradual transition from colder conditions represented by clastic sediments to the overlying organic-rich transitional units below Lignite Seam III, deposited during warmer climatic conditions. Additional palaeoecological evidence is provided by the composition of the faunal assemblages (Konidaris et al., this issue; Doukas et al., this issue; Michailidis et al., this issue), which indicates a landscape with substantial woodland component and more open areas in the wider palaeolake system and a temperate climatic zone.

The excellent preservation and variability of the floral archive raise the possibility of investigating the question of plant use in the diet of the Marathousa 1 hominins. The local environment would have produced rich botanical food resources potentially edible for hominins, that probably attracted them to the locality and contributed to their diet. The confirmation of plant use for dietary purposes or as raw material source, however, is notoriously difficult to determine in Palaeolithic contexts, since it leaves few recognizable traces in the archaeological record. Nevertheless, recent research (Bigga et al., 2015; Melamed et al., 2016; Hardy et al., 2017; Pérez-Pérez et al., 2017) provides some, albeit circumstantial, evidence for the use of plants as food in Lower Palaeolithic contexts. At this early stage of research there is no direct evidence for the use of plants in the diet of the Marathousa hominins (Field et al., this issue) but it is a research question that we plan to pursue further in the following years, through the implementation of use-wear and residue analysis on the lithic artefacts for possible traces of vegetal processing.

3. The faunal and cultural assemblages

Large mammals include a castorid, two mustelids, a felid, two canids, an elephantid, a hippopotamid, a large bovid and two cervids (Konidaris et al., this issue), while small mammals (e.g. the water vole *Arvicola*, Doukas et al., this issue), birds (Michailidis et al., this issue), reptiles, amphibians and fishes are well represented in the assemblage. As already discussed, of particular interest is the partial skeleton of the straight-tusked elephant *Palaeoloxodon antiquus* found in close spatial association in the same layer of Area A (Fig 3), which also contained several other faunal remains referred to beaver, otter, hippopotamus
and deer. Additional isolated elephant elements were found c. 60 m south of the main elephant fossil accumulation, in Area B, along with partial remains of other herbivores (hippopotamus, bison, at least two species of deer; Fig. 7) and carnivores (wild cat, fox, wolf). The large mammal fauna can be correlated with the Galerian Land Mammal Age (~0.9–0.4 Ma, Konidaris et al., this issue). The direct contextual association of lithic artefacts and fossils and the excellent state of skeletal element preservation encouraged further investigation on hominin modifications related to the exploitation of animal carcasses. The results of the taphonomic analysis indicate a clear anthropogenic signal. Evidence of hominin involvement is recorded on two elephant skeletal remains from Area A and on elephant and other mammal bones from Area B (e.g. a cut-marked epiphysis of a fallow deer and a diaphysis fragment of a small/medium mammal) and indicates filleting, disarticulation and marrow extraction (Konidaris et al., this issue). Carnivore damage is testified on some bones from Area B (Fig. 7), indicating possible competition with hominins for early access to the animal carcasses.

Lithic artefacts were recovered from two main areas (Fig. 4): firstly, from the deposits surrounding the elephant in Area A (approximately 70 lithics), and secondly from the same stratigraphic horizon in Area B (at least 1200 lithics). Several varieties of raw materials (radiolarite, flint, limestone, quartz), mostly originating in the vicinity of the site, were used for the manufacture of the assemblage, with the emphasis on the exploitation of small radiolarite pebbles. Preliminary reconnaissance identified primary sources of radiolarite in the fringes of the Megalopolis basin (Thompson et al., this issue). On the other hand, black flint might have been introduced to the site in the form of finished artefacts. Preliminary analysis of the main features of the assemblage (Tourloukis et al., this issue b), documents the presence of a “small tools” (sensu Burdukievicz and Ronen, 2003) lithic industry (Fig. 8). The employed technological approach aimed at the production of blanks from minimally prepared cores (evidence for core preparation is lacking) and then the selection of flakes for use, either without secondary modification or with retouch to produce a notched or pointed edge. Secondary modification is also systematically used for the manufacture of backed edges, probably to facilitate manual prehension or hafting. The assemblage composition (rarity of cores and cortical blanks and dominance of small debitage and blank shaping by-products, such as retouch/resharpening flakes, chips, and spalls) indicates that the later phases of the reduction sequence are dominant and that lithic activity at the site was mainly geared towards tool manufacture, use, maintenance and discard. Bifacial technology is not recorded so far and the assemblage is clearly not related to the Acheulean. Nevertheless,
the absence of bifacial technology from the Marathousa 1 lithic assemblage is not conclusive evidence of its absence in the region (cf. Lénormant 1867, for a handaxe collected in the Megalopolis area in association with elephant remains), especially in the light of recent discoveries of Acheulean related assemblages on Aegean islands (see below, Discussion section).

Except for the lithic assemblage, Marathousa 1 has produced evidence of organic technology, rare so far in Greece, in the form of occasional bone flakes and tools and a bone percussor (Fig. 9), indicating both the understanding of the particular properties of bone and the intimate knowledge of knapping techniques on the part of the Marathousa hominins. The bone percussor is made on a diaphysis fragment of a large mammal (probably an elephant limb bone (Fig. 9: 1) and bears impact scars and percussion marks concurrent with its interpretation as a soft hammer. With the exception of Boxgrove (Smith, 2013) bone percussors and/or retouchers are rare in European Lower Palaeolithic contexts and are usually associated with Neanderthal toolkits from MIS 9 onwards. Given the rarity of the specimen and its importance for human evolutionary studies, a comprehensive set of analyses is planned, including technological and microwear investigations.

4. Discussion

The preceding sections have presented evidence on the different aspects of the site: excavation, stratigraphy, fauna, palaeoenvironment and archaeology. In this section, the data generated by the preliminary results of the various specialist analyses are integrated to (a) provide an overview of the formation and preservation of the site, (b) attempt a coherent synthesis of the archaeological record within this framework and (c) contextualize the data into the wider framework of the evidence for the Middle Pleistocene archaeology of Greece and the Mediterranean.

4.1 The archaeological context of Marathousa 1
After five years of systematic excavation, geoarchaeological assessment of the site’s formation processes and analyses of the faunal, palaeoenvironmental and cultural material, we have a working hypothesis of the site’s character and the hominin activities reflected in the assemblages. In the archaeological horizon uncovered in Area A, a partial skeleton of a *Palaeoloxodon antiquus* spatially and stratigraphically associated with remains of hominin activity has been located, representing manufacture, use and maintenance of lithic tools. Hominin presence is also testified by bones with cut-marks. Well-preserved botanical remains (including plant macro-fossils, wood, charcoal and phytoliths) and a wide range of macro-and micro vertebrates (bovids, cervids, carnivores, micromammals, turtles and birds) from the same stratigraphic context provide excellent proxies for the reconstruction of the vegetation and climate. They suggest that hominin activity took place at a time of mild climatic conditions, when Marathousa 1 was a swampy plain at the edge of a fluctuating lakeshore. Multiple lines of evidence (Vlachos and Delfino, 2016; Field et al., this issue; Michailidis et al., this issue) suggest a rich lakeshore microenvironment that attracted animals and hominins to the water and the plant resources. Magnetostratigraphy, ESR and luminescence dating, as well as micromammal biostratigraphy support the timing of the episode to around 0.5–0.4 Ma.

With the evidence so far available, it is difficult to ascertain whether the exploitation of the elephant carcass was the result of hunting or scavenging (Konidaris et al., this issue). Since Marathousa 1 was on a lakeshore, it is likely that some individuals entered the faunal assemblage as a result of natural deaths or carnivore predation and were subsequently exploited by hominins. Nevertheless, the Marathousa 1 elephant carcass was exploited, presumably by a group of early hominins co-operating effectively over a restricted time period when the meat retained freshness. This evidence provides a high resolution signature of hominin activity and subsistence behaviour, one of the oldest so far discovered in South-East Europe.

In the same stratigraphic unit, 60 m to the south of Area A, in excavation Area B faunal remains of elephant and other taxa with evidence of hominin intervention, associated with a much denser lithic assemblage and exhibiting higher rates of bone fragmentation are also found, suggesting a wider range of animal exploitation for the procurement of meat, marrow and, as indicated by the presence of bone artefacts, bone as raw material at the site. Carnivore involvement in the bone accumulation is also indicated by gnawing marks on some bones from this area (Konidaris et al., this issue). The correlation of the two Areas has been established on stratigraphic, lithological, sedimentological, geochemical and
micromorphological evidence (Karkanas et al., this issue) and corroborated by the consistency in the lithic raw materials utilized and the technological signature of the assemblages (Tourloukis et al., this issue b). Overall, the currently available stratigraphic, site formation, faunal and lithic evidence from both excavated areas indicates a special purpose site related to the exploitation of faunal and other resources available at a lakeshore environment.

The position of Marathousa 1 along the shores of the palaeolake reflects both hominin preference for this environment and the preferential preservation in a waterlogged, low energy depositional environment. The lake was apparently the focus of elephant activity and the site highlights the importance of water-bodies and, more specifically, lakes for food procurement in a rather open and seasonal landscape.

At a deeper level, the investigation and analysis raise a series of questions regarding site formation processes and the integrity of the archaeological record. For instance, what is the nature of the depositional contexts associated with the assemblages? To what degree are the cultural layers in primary context? How many activity events are represented in the archaeological deposits? It should be reminded in this context that, according to the interpretation of the sedimentary processes (Karkanas et al., this issue), the find bearing layers, i.e. units UA3c and UB4c in Areas A and B respectively, are characterized as a mudflow event, i.e. a depositional context associated with some transport of the finds and indicating movement of the sediment together with the remains it contained. On the other hand, the positional arrangement of the elephant bones found in approximate anatomical association (Konidaris et al., this issue), the sedimentology of the cultural layers, as well as those immediately overlying and underlying them, indicate relatively low-energy site formation processes. This assumption is also supported by the mint condition of the stone-tools (Tourloukis et al., this issue b), the bone surface preservation, which indicates rapid burial (Konidaris et al., this issue), the general scarcity and small size of any present gravels, the excellent preservation and rich variety of organic remains (spores, wood fragments, etc.) and fauna (including fish, reptiles, amphibians, micro-mammals, micro-fossils, coleopters) and the occasional bone refits (Konidaris et al., this issue). All the above data clearly indicate a minimally disturbed context.

To assess the stratigraphic context of the cultural remains and the taphonomic processes that affected their distribution within the excavated sediments and, hence, the integrity of the site and the validity of our behavioural interpretations, a set of spatial statistics,
including fabric, vertical distribution and point pattern analyses, was implemented in a geoarchaeological and taphonomic framework to the recorded distribution of remains in both excavated Areas. Results demonstrate an autochthonous deposition subject to localized minor reworking and a short transport distance in both areas (Giusti et al., this issue). It is suggested that in Area A the elephant skeletal remains laid on an ephemerally exposed surface (at the contact of UA3c/4, Fig. 5) and were relatively rapidly covered and only slightly moved by the mudflow deposit of UA3c (Karkanas et al., this issue). In the same vein, in Area B the fossil and cultural materials were most likely derived from the erosion of exposed mudflat areas and were re-distributed locally and buried by the same depositional event represented by unit UB4c (Karkanas et al., this issue). In this sense, hominin activity at Marathousa took place in the immediate vicinity of the banks of the palaeolake.

As is the case in open-air sites (cf. Hovers et al., 2014) and indeed in every archaeological site, the combined results of the analyses showed that both hominin activity and natural processes contributed to the formation of the archaeological record at Marathousa 1. However, despite the slight local reorientation and displacement of remains, no major depositional processes have affected the cultural record, thus enabling behavioural interpretations.

Of interest is also the question of whether the site preserves a single episode of use for the butchering of animals, a time averaged palimpsest of different activities and durations and/or a palimpsest of natural and anthropogenic episodes, i.e. independent carnivore and hominin-created bone accumulations. In other words, does Marathousa 1 represent a temporally restricted, specific use of a place by hominins? Or a palimpsest of different natural and anthropogenic episodes in the area of the palaeolake at different times?

Different lines of evidence, namely the much higher density lithic cluster, the number of species present and the higher bone fragmentation, as well as the spatial association of the faunal assemblage in Area B, suggest variations in the use of the two excavation areas of the site, that could be due to repeated visits in an area farther from the shore of the palaeolake, more conducive to several activities. In this sense, the assemblages in Area B could have been created over a short but currently unknown time-span (over which animal carcasses were still edible), in fact corresponding to an accumulation of multiple events and indicating partially overlapping but individual activity episodes.

On the other hand, with the information currently available, distinguishing anthropogenic from non-anthropogenic signatures and fine-tuning the nature and sequence of depositional
events is not possible. More data from the continuation of the excavation and the use of different approaches for deciphering between single and multiple accumulation events at different temporal/spatial scales (e.g., detailed taphonomic analysis, lithic and bone refitting studies, tooth isotopic variations), are needed to understand the site biography and the natural and human impacts on bone accumulations.

4.2. Marathousa 1 in context

The data regarding the Lower Palaeolithic in Greece is intermittent and fragmented both chronologically and spatially and, in most cases, the available information is rudimentary at different levels. With the earliest of fossils consisting of one cranium from the cave of Petralona and an isolated tooth from Megalopolis (see Harvati, 2016 for a review of the palaeoanthropological data), most of the evidence consists of lithics from surface scatters or shallow sub-surface concentrations and is, consequently, marred with unresolved problems of taphonomy and chronology (for a summary and critical review of the evidence see Tourloukis, 2010; 2016; Elefanti and Marshall 2015; Papoulia, 2017; Tourloukis and Harvati, 2018 and references therein). Nevertheless, knowledge pertaining to the Greek Lower Palaeolithic has considerably improved in recent years through the implementation of targeted surveys (Strasser et al., 2010; 2011; Runnels et al., 2014), excavations (Panagopoulou et al., 2015; Galanidou et al., 2016) and re-evaluations (Tourloukis et al., 2015) of open-air sites that provided important new evidence.

Lower Palaeolithic sites are scattered on the mainland and on Aegean islands (Fig.10). With the exception of the cave of Petralona, they are all open-air sites and findspots, a pattern well attested in the Eurasian Lower Palaeolithic, where the use of caves is only sporadically recorded (cf. Chazan et al., 2012). In terms of chronology, the Early Pleistocene is absent from the record and, except for Marathousa 1 which dates at 400–500 ka, in the few cases where radiometric dates are available (Strasser et al., 2011; Tourloukis et al., 2015; Galanidou et al., 2016), they indicate a late Middle Pleistocene age. The sites are associated with various depositional settings (marine terraces, tectonic depressions, fluvial and lacustrine deposits) and, as a result, reflect several taphonomic histories and potential for behavioural inferences. Faunal materials are either almost completely absent or not associated with material culture remains. As regards the lithic records, the assemblages
contain both Large Cutting Tools (LCTs, sensu McNabb et al., 2004) with Acheulean affinities (Runnels et al. 1993; Strasser et al., 2010; Tourloukis et al., 2015; Galanidou et al., 2016) and “small tool” assemblages (Panagopoulou et al., 2015), suggesting an important and, as yet, poorly understood variability in the cultural record that could contribute new and important data in the wider discussion of the spatio-temporal distribution of Acheulean versus non-Acheulean assemblages and the Out of Africa 2 hypothesis (cf. Gallotti, 2016; Rocca et al., 2016; Sharon and Barsky, 2016). Except for sporadic remains on the mainland, LCTs sites/findspots have recently been located on the near-shore island of Lesvos (Galanidou et al., 2016), and, most intriguingly, in view of the proposed southern pathway of early hominin migration into Europe (Muttoni et al., 2010) and the new palaeogeographic reconstructions of the Aegean (Lykoussis 2009; Tourloukis and Karkanas, 2012) on the off-shore island of Crete (Strasser et al., 2010), suggesting possible hominin connectivity and interaction in the eastern Mediterranean and a line of research that needs to be pursued in the future.

Marathousa 1 is the only Lower Palaeolithic site in Greece with faunal remains associated with cultural material and the only known Lower Palaeolithic butchering site in the Southern Balkans. The cultural assemblage (small lithic tools and organic artefacts) has no parallel in the Greek record and challenges the long proposed link between cognitive abilities, elaborate lithic design, as evidenced by handaxes, and successful adaptations in the variable conditions of the Middle Pleistocene. Recent research has established the existence of a complex mosaic of lithic signatures, including LCTs and core-and-flake assemblages, in Europe and Western Asia during this period (Roberts and Parfitt 1999; Dobosi, 2003; Barsky and de Lumley 2010; Ollé et al., 2013; Wenban-Smith, 2013; Aureli et al., 2016; Moncel et al., 2018). It is clear that a set of parameters (e.g. raw material, site function, removal of curated items from the record, social practices in isolated groups) affects lithic assemblage composition and invoking biological and cognitive change or waves of Out of Africa expansion (Sharon and Barsky, 2016; but see Gallotti, 2016) might be misleading in several cases. Middle Pleistocene hominins employed multiple technological solutions in different contexts, and LCTs and “small tool” assemblages probably reflect differential distribution of archaeological signatures within a varied technological repertoire.

We have only started to recognize the complexity of the Greek Lower Palaeolithic record and, given the complex topography and the varied environments of the country, the lack of evidence for site functions and the absence of an established chronostratigraphic framework, further evidence is needed from well-preserved and dated contexts, displaying different environmental adaptations and functional characteristics, to disentangle the
distribution of small vs Large Cutting Tool assemblages and to see if it is related to diverse ecological settings, subsistence strategies, sub-regional traditions and chronologies. With a stratigraphically intact and radiometrically dated context and a gamut of in situ environmental proxies that would help establish correlations between local environment and hominin activities, Marathousa 1 represents such a case. The site will undoubtedly serve as a reference point for building a chronostratigraphic framework for the Lower Palaeolithic of Greece, understand some of the causes of the variability in the material signature and identify more nuanced patterns in the complexities of hominin adaptations in the Middle Pleistocene.

On another level, the evidence from Marathousa 1 reported in the present work constitutes one of the earliest snapshots of hominin activity and subsistence behaviour in this part of Europe and contributes to our wider understanding of the Middle Pleistocene record of Eurasia. The Middle Pleistocene witnessed significant climatic and palaeoenvironmental changes (Almogi-Labin, 2011; Abbate and Sagri, 2012) and was a period of great importance for both biological and cultural aspects of human evolution (e.g. Roebroeks, 2001; Stiner et al., 2009; Barham 2010; Harvati et al., 2010; Arsuaga et al., 2014; Gamble et al., 2014; Stringer 2016; Hublin et al., 2017; Posth et al., 2017). A focal research question is the type of subsistence strategies hominins followed during this time, as they dispersed from Africa across a highly variable Eurasian landscape. In this context, hominin exploitation of megafauna and especially hominin-elephant interaction is a topic that has attracted major attention in recent years (e.g. Ben-Dor et al., 2011). However, the co-occurrence of proboscidean remains and lithics in several sites does not necessarily indicate exploitation of megafauna whether hunted or scavenged (cf. Freeman, 1994; Villa et al., 2005; Domínguez-Rodrigo, 2008). In some of the sites of the period, direct evidence of anthropogenic processing of faunal remains is either non-existent, or is obscured due to the impact of taphonomic and post depositional processes on the distribution of the fossil and cultural remains, thus limiting behavioural inferences. The discussion below focuses on a small but increasing number of Middle Pleistocene sites from the Mediterranean area (Fig. 11) with clear evidence of hominin interference on skeletal material in the form of butchering or other kinds of carcass processing, pointing to important changes in subsistence behaviour.

Among the few Lower Palaeolithic localities which yielded well-preserved fossil material of butchered carcasses are the sites of Gesher Benot Ya’aqov (Goren-Inbar et al., 2000) and Revadim (Marder et al., 2011; Rabinovich et al., 2012) in Israel, La Ficoncella (Aureli et al., 2015; 2016), Isernia la Pineta (Peretto et al., 2015), Notarchirico (Piperno, 1999), La
Polledrara di Cecanibbio (Santucci et al., 2016) and Castel di Guido (Saccà, 2012; Boschian and Saccà, 2015), in Italy, Torralba and Ambrona (Freeman 1994; Villa et al., 2005), Barranc de la Boella (Mosquera et al., 2015) and Áridos 2 (Yravedra et al., 2010) in Spain, where there are hominin modifications on elephant bones, as well as on other herbivore taxa. More importantly, at many of those sites (Galotti and Peretto 2015; Peretto et al., 2015; Aureli et al., 2016; Rocca et al., 2016; Santucci et al., 2016), “small tool” assemblages are associated with the faunal remains (cf. Barkai et al., 2010 for microwear evidence of meat processing on small flakes).

Although the above sites preserve a strong and unquestionable anthropogenic signal, it is still not clear if hominin exploitation is related to hunting and/or scavenging practices. Hunting has been suggested at Gesher Benot Ya’aqov (Goren-Inbar et al., 2000) in the Mediterranean, at the late Lower Palaeolithic sites of Schöningen (Starkovich and Conard, 2015; van Kolfschoten et al., 2015) and Lehringen (Veil and Plisson, 1990) in Germany and hypothesized at the Ebbsfleet site (Wenban-Smith, 2013) in the U.K., while in most other cases it seems that the bone remains represent the result of a systematic or occasional exploitation of already dead animals (cf. Boschian and Saccà, 2015). Be that as it may, it is becoming increasingly obvious that proboscidean exploitation data indicate a more than a marginal strategy of protein and fat obtainment on the part of hominins (Yravedra et al., 2010; Ben-Dor et al., 2011).

Like Marathousa 1, most Middle Pleistocene proboscidean butchering sites from the Mediterranean are related to permanent or ephemeral water bodies, where elephants likely gathered during droughts. The repeated occurrence of Lower Paleolithic sites with proboscidean remains in lakeside environments in the Mediterranean and further afield suggests that the hominin groups were well aware of the movements of migrating herds, selected locations in the landscape which provided the best opportunities for accessing them (cf. Devès et al., 2014) and practiced regularly on-site butchery activities for meat procurement. In terms of cognitive and behavioural complexity, this pattern suggests the ability to share information on the environment and the resources available (cf. Coward, 2016) and organize a successful food acquisition strategy through social interactions and strategic planning (Roebroeks, 2001).
5. Conclusions

Five excavation seasons at Marathousa 1 have provided important new cultural, palaeoenvironmental, faunal and chronological evidence on the Middle Pleistocene archaeological record of Greece and have raised a number of major research questions. The project’s results will be supplemented by further work and re-evaluated and re-interpreted over the years. In any case, the evidence currently available has interesting implications for hominin adaptations in the Middle Pleistocene of Eurasia. The project results are important for three main reasons:

(a) They document a rare snapshot of hominin activities at 0.5–0.4 Ma. They show that during the Middle Pleistocene hominins equipped with a simple lithic technology successfully exploited large herbivores in an ecosystem that included other predators. Marathousa 1 is one of the best-preserved archives of Paleolithic archaeology in the Southern Balkans and it has the potential of giving a robust chronology and an environmental framework for studying hominin socialscapes in the Middle Pleistocene record.

(b) They expand considerably the chronology of the Greek Lower Palaeolithic. Marathousa 1 is the oldest stratigraphically intact and radiometrically dated archaeological site in Greece and the only elephant butchering site in the Southern Balkans.

(c) They integrate into the framework of similar contexts from the Middle Pleistocene archaeology of Eurasia, enabling the examination of the evidence in the wider discussion of behavioural evolution processes in this time.

Marathousa 1 is not a single site, but rather part of the archaeological landscape of the Megalopolis basin, now largely destroyed by time and mining activities, but still preserving thick Pleistocene deposits. From the results of our survey (Thompson et al., this issue), it is clear that the basin was a place that hominins used repeatedly, forming a focus of activity for at least 400–500 ka and making it possibly one of the richest Palaeolithic archaeological landscapes in the Southern Balkans. In addition to the continuation of the excavation, future work will concentrate on the reconstruction of the complex trajectory of landscape evolution and on locating more stratified Pleistocene localities. The aim is to examine how hominin populations and their behavioural repertoire adapted to a changing landscape within a single region through deep time.
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Figure Captions

Figure 1
Map of the Megalopolis basin with the location of Marathousa 1. Modified after Giusti et al., this issue.

Figure 2
Panoramic view of the Marathousa 1 site (view towards W/SW); the picture was taken in 2013, when the excavation trenches were first opened.

Figure 3
Panoramic view of Area A showing the distribution of the elephant remains (*Palaeoloxodon antiquus*), as revealed during the excavations of the 2015 field campaign. A plaster jacket (visible in the back) covers the cranium. Note the meter-stick (1 m) in the back and the 50 cm-scale in the front.

Figure 4
Plan views of Area A (left) and Area B (right) showing the distribution of finds at the archaeological horizon (contacts between UA3–UA4 and UB4–UB5, respectively). Lithic artefacts classified as debris and palaeobotanical remains are not plotted.

Figure 5
Stratigraphic columns of Marathousa 1 showing correlations between the two excavated areas (modified from Karkanas et al., this issue). OSL dates are shown with their stratigraphic position marked with stars. Dates represent weighted mean ages of several samples coming from the same stratigraphic unit. For details on the OSL dates see Jacobs et al. (this issue).
Figure 6
Examples of fossil remains from Marathousa 1. a) elephant and wood remains in situ, scale: 10 cm; inset: close-up of an eggshell fragment. b) insect fragment (pronotum of a coleopteran?). c) fruitstone in situ, Area A, d) remains of the *Palaeoloxodon antiquus* and large wood fragment in situ, scale: 50 cm.

Figure 7
Mandibular fragment of a deer (*Dama* sp.) as it was found in situ in Area B (a), and with the refit (b). Note in (b) the notches from carnivore gnawing. Adapted from Konidaris et al., this issue.

Figure 8
Lithic artefacts from Marathousa 1. 1–3, 6, 7, 9, 11–13, 15, 17–19, 21, 24: flakes, 5, 8: chips, 10, 19, 20: composite tools, 4, 14: retouched pieces, 16: backed piece, 18, 21–23: backed knives, 24: core. Numbers 4, 12, 17, 18 are fragments. The lithic material is stored at the Ephoreia of Palaeoanthropology–Speleology in Athens.

Figure 9
Bone artifacts from Marathousa 1: percussor on a diaphysis fragment of probably an elephantid limb bone (upper row); flake (lower left); flake with denticulated edge (lower right). The osseous material is stored at the Ephoreia of Palaeoanthropology–Speleology in Athens.

Figure 10
Map of Greece with Lower Palaeolithic sites and key palaeoanthropological localities. M: Megalopolis, P: Petralona; 1: Marathousa 1, 2: Rodafnidia, 3: Kokkinopilos, 4: Plakias sites.
Figure 11

Map showing the main Lower Palaeolithic sites with proboscidean remains in the Mediterranean.
