16 THE MEGALOPOLIS PALEOENVIRONMENTAL PROJECT (MEGAPAL)

Panagiotis Karkanas[1]*, Vangelis Tourloukis[2,3], Nicholas Thompson[2], Domenico Giusti[2], Georgia Tsartsidou[4], Athanassios Athanassiou[4], George E. Konidaris[2], Effrosyni Roditi[2], Eleni Panagopoulou[4], Katerina Harvati[2,5]

[1]*M.H. Wiener Laboratory for Archaeological Science, American School of Classical Studies at Athens, Greece*
[2]*Paleoanthropology, Institute for Archaeological Sciences and Senckenberg Center for Human Evolution and Palaeoenvironment, Department of Geosciences, Eberhard Karls Universität Tübingen, Germany*
[3]*Department of History and Archaeology, School of Philosophy, University of Ioannina, Ioannina, Greece*
[4]*Hellenic Ministry of Culture, Ephorate of Palaeoanthropology–Speleology, Athens, Greece*
[5]*DFG Centre of Advanced Studies 'Words, Bones, Genes, Tools' ,Eberhard Karls University of Tübingen, Tübingen, Germany*
**tkarkanas@ascsa.edu.gr*

http://dx.doi.org/10.15496/publikation-97646

Keywords: Lower Palaeolithic; Pleistocene; Megalopolis Basin; survey

16.1 INTRODUCTION

The Lower Paleolithic record of Greece remains poorly known, even though the Greek Peninsula lies on one of the likeliest dispersal roots between Africa, Western Asia and Europe (Harvati et al., 2009; Tourloukis and Karkanas, 2012). Furthermore, the Balkans is one of the three major southern European refugia for fauna, flora, and possibly human populations during glacial periods, and therefore should have been among those parts of the continent that were relatively continuously occupied (e.g., Tzedakis et al., 2002; Harvati, 2016, 2022). Notwithstanding its importance, paleoanthropological research in the region has until recently been sparse, mainly owing to research priorities focused on later periods. The scanty evidence at hand chiefly consists of sites and findspots lacking a paleoenvironmental and chronological context (Tourloukis and Karkanas, 2012; Harvati, 2016, 2022; Tourloukis and Harvati, 2018). This type of evidence is therefore difficult to interpret and offers a fragmentary and ambiguous, yet highly intriguing, picture.

The recently discovered Lower Paleolithic site of Marathousa 1 (Panagopoulou et al., 2018; Harvati et al., 2018, and references therein) highlights the potential importance of the broader region in human evolution research. Located in the Megalopolis Basin, Marathousa 1 dates to ca. 400–500 ka and as such, it is one of the oldest archaeological sites in Greece and the only known elephant-butchering open-air site in the Balkans. The open-cast lignite mines in the basin have exposed the geological sequence of a paleo-lake, which was active from ca. 900–300 ka (though frequently interrupt-

P. Karkanas: https://orcid.org/0000-0002-7156-671X
V. Tourloukis: https://orcid.org/0000-0002-9527-2708
N. Thompson: https://orcid.org/0009-0003-4770-1744
D. Giusti: https://orcid.org/0000-0003-1438-4036
G. Tsartsidou: https://orcid.org/0000-0003-3379-1681
A. Athanassiou: https://orcid.org/0000-0002-9140-7011
G. E. Konidaris: https://orcid.org/0000-0002-7041-233X
E. Roditi: https://orcid.org/0000-0002-1917-7645
E. Panagopoulou: https://orcid.org/0000-0002-4268-6157
K. Harvati: https://orcid.org/0000-0001-5998-4794

ed by fluvial sedimentary regimes) (van Vugt et al., 2000), hosting a rich fauna and serving as an ideal habitat for hominin populations (see, e.g., Konidaris et al., 2018; Athanassiou et al., 2018; Michailidis et al., 2018; Doukas et al., 2018). In addition to a long and continuous geological sequence, the near-shore and lacustrine conditions under which the Megalopolis sediments were deposited (Karkanas et al., 2018) enabled the excellent preservation of organic materials: these include not only mammalian fauna, but also paleobotanical and microfaunal material (Field et al., 2018), and even minuscule and fragile remains such as wood, seeds, molluscs, rodents, birds, reptiles, eggshells, fish and insects (Panagopoulou et al., 2018). Therefore, the Megalopolis Basin offers an ideal setting to locate evidence of human presence during the earliest phases of human dispersal to Europe, as well as to pursue a detailed understanding of the paleoenvironmental conditions and their impact on human habitation and adaptation over time.

Built upon the targeted systematic survey for stratified remains in 2012-13 (Thompson et al., 2018); and the subsequent discovery (2013) and excavation (2013-19) of Marathousa 1 (Panagopoulou et al., 2018) by our joint team in the context of the ERC projects PaGE and CROSSROADS, a new five-year project was initiated in 2018: the Megalopolis Paleoenvironmental Project (MegaPal). MegaPal is a collaboration between the Hellenic Ministry of Culture and the American School of Classical Studies at Athens (ASCSA). Dr. P. Karkanas from ASCSA in collaboration with Prof. Katerina Harvati from Tübingen University and Dr. Eleni Panagopoulou from the Ministry of Culture are leading the project, in the framework of the ERC grant CROSSROADS awarded to Prof. Harvati. MegaPal is a multifaceted interdisciplinary project with many other institutes participating in its implementation.

The project has three main objectives largely overlapping with the broader research goals of CROSSROADS:

1. to survey exposed section profiles throughout the Megalopolis Basin, focusing on the lowest components of the geological sequence to locate archaeological evidence older than, or contemporary with, the chronology of Marathousa 1 (ca. 450 ka: Jacobs et al., 2018). This goal addresses the question of whether southeast Europe was occupied already in the Early or early Middle Pleistocene, as is the case in the southwestern and northern parts of the continent;
2. to help develop for the first time a regional chronological framework of the Lower Paleolithic in Greece and the Balkans in general. This goal will assess whether a gap existed between the earliest arrival of humans and the subsequent human activity in the Megalopolis Basin, or instead to determine whether hominin habitation was relatively continuous, as expected for areas with a refugium status;
3. to provide a palaeoecological framework within which to interpret the archaeological record of existing (Marathousa 1) and future sites with human activity in the Megalopolis Basin. This aim addresses the question of how behavioral and biological changes are related to environmental conditions, climatic fluctuations and landscape use.

16.2 METHODOLOGY

Field investigations were conducted by a small team of specialists (geologists, Palaeolithic archaeologists, paleontologists) who systematically examined the longitudinal profiles of sedimentary exposures. The project tests in the field a predictive model for locating early hominin sites, which has been conceptualized based on the sedimentological and stratigraphic study of the Marathousa

1 site (Karkanas et al., 2018). According to the model, the high probability areas of the geological sequence are those that confirm sedimentary evidence of shallow lake levels, terrestrial erosional surfaces and subaerial exposures. This type of sedimentary facies occurs mainly as relatively thin horizons or erosional contacts within sedimentary units, which directly underlie or overlie lignite seams thereby denoting also depositional environments that indicate transitional conditions from colder to warmer climatic stages and vice versa.

The survey focused on examining the part of the sequence between Lignite Units I and III. Survey areas were designated as "Survey Units" (SUs), which are arbitrary units of observation delineated by stratigraphic or artificial boundaries, such as the start/end of a tier inside the mine (Thompson et al., 2018). A large number of survey units were investigated, which were located inside the mines of Kyparissia, Marathousa and Choremi.

In addition to field survey, an extensive sampling program is in progress including a plethora of techniques. Several dating methods are employed including cosmogenic nuclides, paleomagnetism, electron spin resonance, U-Th series, and luminescence. An extensive micromorphological and sedimentological analysis of strata is conducted, as well as novel soil biochemistry analyses also including several palaeoenvironmental proxies (e.g., diatoms, sponge spicules, pollen, phytoliths, charcoal, wood, and seed).

Two boreholes from the Marathousa mine are also studied. The first one took place at the western part of the Marathousa mine and close to the Paleolithic site of Marathousa 1, reaching a total depth of 103 m. The other drill site was located at the northeastern part of the same mine next to the site of Marathousa 2 and reached a depth of 123 m. The goal of this ongoing study, currently underway at the University of Tübingen (see Bludau

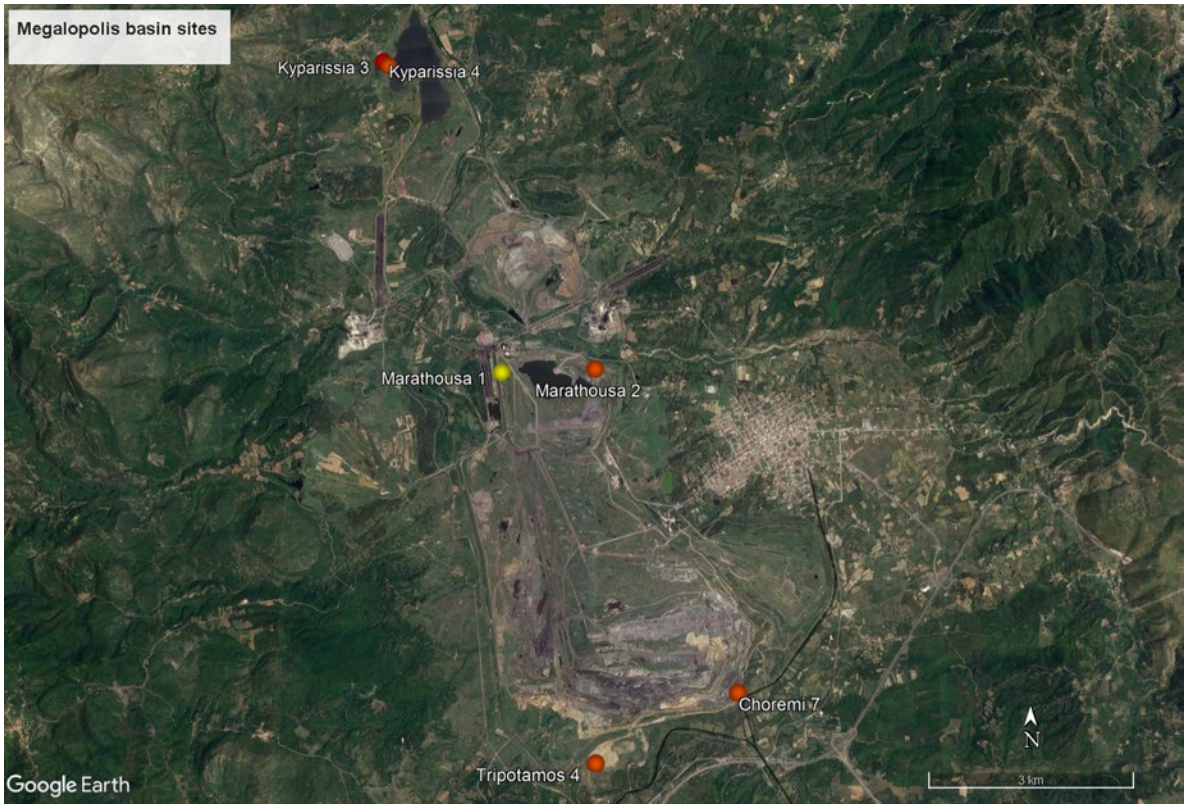

Figure 1: Location of the archaeological and paleontological sites mentioned in the text.

et al., this volume), is to retrieve and analyze environmental and biological proxies, such as micro-faunal and micro-fossil remains (e.g., insects, molluscs, ostracods, diatoms), plant micro- and macro-remains (pollen, phytoliths, gyrogonites, oospores, wood, fruit, seeds, spores, stamens, buds, scales), as well as geochemical and mineralogical data, which will altogether allow us to pursue a paleoenvironmental reconstruction of the paleo-lake system and its evolution through time.

Finally, a tectonosedimentary analysis of the basin is in progress with the aim to synthesize and analyze the geometry and sedimentary architecture of the entire basin and produce a complete history of the sedimentary fill (Kranis et al., 2020; this volume). The analysis of these diverse proxies, in combination with a well-constrained age model, will lead to a sophisticated, high-resolution reconstruction of the evolution of the paleoenvironment of the Megalopolis Basin. This reconstruction will put in context the highly significant archaeological findings already recovered. Importantly, however, it will also provide a detailed framework for understanding the interaction between early humans and their environment, with the ultimate goal of elucidating human adaptation in the Pleistocene, as well as of establishing a predictive model for identifying new Lower Palaeolithic sites in the area and in wetland environments in general.

16.3 RESULTS

During the five field campaigns of the project, MegaPal has identified five archaeological sites, one every field season, an exceptional rate of discovery (Fig. 1). In addition, numerous paleontological sites have been identified. The most important to be mentioned here is the oldest one, Choremi 6 (CHO-6), which is located under lignite seam Ia and therefore predates the Brunhes/Matuyama boundary (Tourloukis et al., 2018a). CHO-6 includes dental and post-cranial remains of hippopotamus, most likely belonging to a single individual. The fossils were found stratified at the contact between a lignite seam and the underlying deposit of grey clays, at an elevation of 291 m above sea level (masl). Oxidation features and rhizoliths indicate the presence of a paleo-surface that was subaerially exposed and was later covered by a swamp.

The first site discovered, Marathousa 2 (MAR-2), was found during the first year of the project, in 2018, and is located in a stratigraphic position similar to that of Marathousa 1, but on the eastern side of the mine (Fig. 1). MAR-2 is located above lignite seam IIb and below lignite seam IIIa, at an elevation of 355 masl (Fig. 2a). The site produced mainly paleontological findings, but with clear evidence of human modification of the fauna in the form of cut marks, which indicate butchering activities in the area (Konidaris et al., 2019, 2023). A lithic artifact was discovered during the last field season in the same stratigraphic unit as the hippopotamus bones with cut marks, thereby confirming the presence of human activities in the eastern part of the Marathousa mine (Konidaris et al., 2023).

The second site identified is Kyparissia 4 (KYP-4; Fig. 1). This was an already well-known paleontological locality found and studied by Athanassiou (2018) and Athanassiou et al., (2018). During a subsequent inspection of the area, lithic remains were discovered that could represent the earliest currently known evidence of human presence in Greece. The site lies on top of a weathered limestone protrusion of the Alpine basement in the north-westernmost edge of the former Pleistocene lake at Megalopolis. The sedimentary sequence comprises mainly silts and organic-rich muds occasionally rich in mollusc shells (Fig. 2b) that suggest a shoreline environment in the proximity of a carbonate spring (Boni et al., this volume; Papadopoulou et al., this volume). Based on the lignite

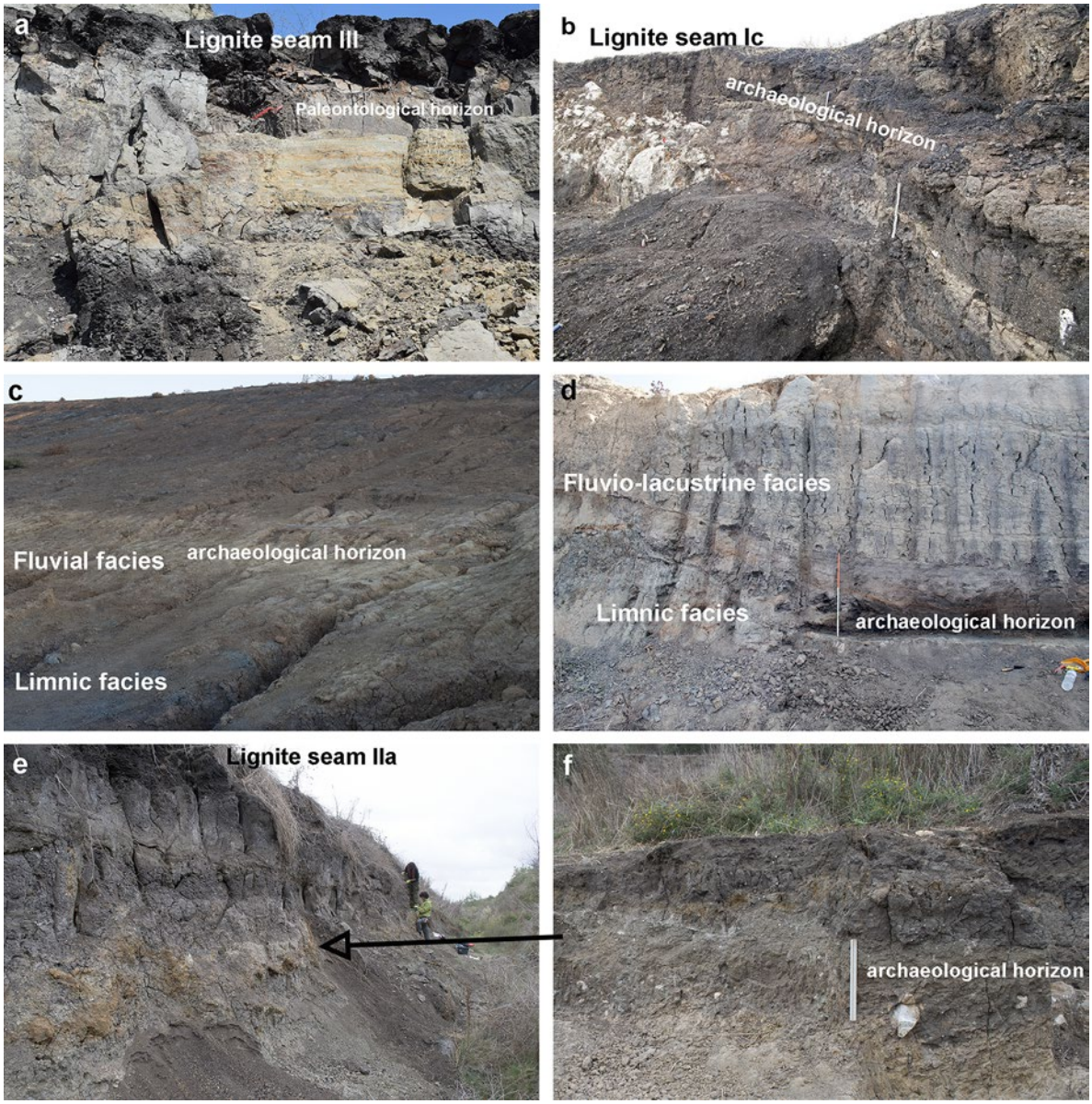

Figure 2: a) Marathousa 2 site; b) Kyparissia 4 site; c) Tripotamos 4 site; d) Choremi 7 site; e) and f) Kyparissia 3 site.

stratigraphy of the area, KYP-4 should be located close to the top of lignite seam I, at an elevation of 330 masl and therefore is stratigraphically much older than Marathousa 1.

KYP-4 is characterized by a typical Galerian fauna of an early Middle Pleistocene age (Athanassiou et al., this volume; van Kolfschoten et al., this volume). It comprises mainly artiodactyls (cervids, hippopotamids, bovids, suids), followed by rhinoceroses, few carnivorans, rodents, birds and turtles. Additionally, a primate tooth belongs to the macaque *Macaca sylvanus* documenting the second evidence for the presence of monkeys in the basin (Konidaris et al., this volume). Whereas the faunal remains suggest an older age than that of Marathousa 1, the lithic assemblage (N=53) is similar to the one of Marathousa 1 (Tourloukis et al., 2018b) with predominately small-sized debitage products and few retouched tools.

The site of Tripotamos 4 (TRP-4) was found in 2020 and it is located at the southwestern edge of the basin (Fig. 1). Archaeological and faunal re-

mains are concentrated along a light-colored silty-sand layer. The findings are found at the contact between bluish lacustrine muds and coarser clastic sediments deposited in a terrestrial environment with clear evidence of exposure in the form of iron-rich crusts (Fig. 2c). These sediments probably represent the first evidence of the transition of the limnic Marathousa Member to the fluvial Megalopolis Member at the western margin of the basin. In the lignite stratigraphy, TPR4 is most likely located stratigraphically above lignite seam IIIa at an elevation of about 390 masl. Therefore, the site is stratigraphically younger than Marathousa 1.

TRP-4 is very rich in archaeological finds, particularly lithics. The lithic assemblage (N=206) consists of flakes and flake fragments, cores, debris and retouched tools, and there is no evidence of bifacial knapping. Overall, when compared to the assemblages from Marathousa 1 and Kyparissia 4, the lithic toolkit from TRP-4 shows affinities with the older material from MAR-1 and KYP-4, but it also presents potentially noteworthy differences in aspects of core management and core exploitation. Due to the more terrestrial environment of deposition, the faunal material is less well preserved, comprising mostly long-bone fragments, but also a cervid antler and elephantid lamellar fragments.

During the fourth field season the new site of Choremi 7 (CHO-7) was discovered. The site is found at the eastern margin of the mine at an elevation of 384 masl, at a similar elevation to TRP-4 (Fig. 1). Archaeological remains were identified at an erosional contact between bluish lacustrine muds of the Marathousa Member and an overlying underwater channel of silts and sands of the Megalopolis fluvial member (Fig. 2d). In contrast to what was observed in the case of TRP-4, CHO-7 is located above the entire lignite sequence of seam III, and specifically above the last lignite seam IIIc. Therefore, although both sites are located in a similar depositional environment at the contact of Marathousa limnic with Megalopolis fluvial sediment, CHO-7 appears to be stratigraphically much younger than TRP-4. This is also confirmed by the rich lithic assemblage that was discovered (N=116), which shows evidence of Middle Palaeolithic affinities and includes tools shaped by bifacial knapping and preferential treatment of raw materials that differs from the other sites. The fauna is relatively rich, consisting mainly of shaft fragments of cervids, a few remains of birds, and several bones with cut-marks. Several wood fragments and well-preserved pinecones were also found. CHO-7 is the youngest site of the sequence, and it demarcates the end of the lacustrine phase of the Megalopolis Basin at the eastern margin of the basin and the beginning of the establishment of the modern drainage system of the Alpheios River.

Finally, the fifth site identified is Kyparissia 3 (KYP-3) (Fig. 1). This was also an already known paleontological locality found and studied by Athanassiou (2018) and Athanassiou et al., (2018). KYP-3 is located above KYP-4 site at an elevation of 346 masl. Stratigraphically, it is placed in the upper parts of the clastic unit underlying Lignitic Seam II (Fig. 2e and f), and is therefore younger than Kyparissia 4, but older than Marathousa 1. During a reinvestigation of the area, skeletal remains of elephant and other large mammals were found in direct spatial and stratigraphic association with lithic artifacts (N=19). The newly collected faunal material of the site is dominated by elephant skeletal elements (a molar and several bones, mainly ribs), but also includes artiodactyls (Hippopotamidae, Cervidae, Suidae), as well as turtles and birds. The lithic artifacts consist of simple flakes, flake fragments and debris from core reduction, as well as a few possible tools or tool fragments with evidence of retouch, all of which are made of radiolarite.

16.4 CONCLUDING REMARKS

The five-year program of surface and geoarchaeological investigations resulted in the identification of five new and important Palaeolithic sites in the Megalopolis Basin, all dating to the Middle Pleistocene. The sites preserve cultural and faunal remains in stratigraphic contexts and offer a unique opportunity to investigate human behavior over time, for an important period in the history of human evolution and in an area that had been thus far little investigated. There are a lot of studies to be conducted, but the preliminary palaeoenvironmental indications obtained through the Megalopolis geological sequence demonstrate the presence of humans in the basin during multiple periods within the Middle Pleistocene and a likely refugium status of the area.

ACKNOWLEDGMENTS

The 2018-2021 Field survey in the Megalopolis Basin was conducted in the framework of the Megalopolis Paleoenvironmental Project (MegaPal) under a permit granted to the Ephorate of Paleoanthropology–Speleology, Hellenic Ministry of Culture, and the American School of Classical Studies at Athens. Fieldwork was supported by the ERC Consolidator Grant ERC-CoG-724703 ("CROSSROADS"), awarded to K.H. G.E.K., V.T. 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 would like to thank our reviewers G. Syrides and P. Elefanti for their constructive comments and suggestions.

REFERENCES

Athanassiou, A., 2018. Pleistocene vertebrates from the Kyparíssia lignite mine, Megalopolis Basin, S. Greece: Rodentia, Carnivora, Proboscidea, Perissodactyla, Ruminantia. Quaternary International, 497, pp. 198–221.

Athanassiou, A., Konidaris, G.E., Tourloukis, V., Thompson, N., Giusti, D., Karkanas, P. and Harvati, K., this volume. The Middle Pleistocene large mammal fauna from Kyparissia (Peloponnese, S. Greece): New collected material.

Athanassiou, A., Michailidis, D., Vlachos, E., Tourloukis, V., Thompson, N. and Harvati, K., 2018. Pleistocene vertebrates from the Kyparíssia lignite mine, Megalopolis Basin, S. Greece: Testudines, Aves, Suiformes. Quaternary International, 497, pp. 178–197.

Bludau, I.J.E., Junginger, A., Wagner, B., Kirscher, U., Zachow, C., Schindler, M., Tourloukis, V., Kyrikou, S., Karkanas, P., Panagopoulou, E. and Harvati, K., this volume. Overview of MAR-1A and MAR-2A drill core analysis and chronological framework.

Boni, G., Syrides, G., Konidaris, G.E., Athanassiou, A., Tourloukis, V., Koukousioura, O., Panagopoulou, E., Karkanas, P. and Harvati, K., this volume. Preliminary results on the taxonomy and paleoenvironmental analysis of the mollusc fauna from Marathousa 1, Marathousa 2 and Kyparissia 4 (Middle Pleistocene, Megalopolis Basin, Greece).

Doukas, C., van Kolfschoten, T., Papayianni, K., Panagopoulou, E. and Harvati, K., 2018. The small mammal fauna from the palaeolithic site Marathousa 1 (Greece). Quaternary International, 497, pp. 95–107.

Field, M.H., Ntinou, M., Tsartsidou, G., van Berge Henegouwen, D., Tourloukis, V., Thompson, N., Karkanas, P., Panagopoulou, E. and Harvati, K., 2018. A palaeoenvironmental recon-

struction (based on palaeobotanical data and diatoms) of the Middle Pleistocene elephant (*Palaeoloxodon antiquus*) butchery site at Marathousa, Megalopolis, Greece. Quaternary International, 497, pp. 108–122.

Harvati, K., 2016. Paleoanthropology in Greece: recent findings and interpretations, in Harvati, K. and Roksandic, M. (Eds.), Paleoanthropology of the Balkans and Anatolia: Human Evolution and its Context. Vertebrate Paleobiology and Paleoanthropology Series, pp. 3–14. Springer, Dordrecht.

Harvati, K., 2022. The hominin fossil record from Greece, in: Vlachos, E. (Ed.), Fossil Vertebrates of Greece Vol. 1 – Basal vertebrates, amphibians, reptiles, afrotherians, glires, and primates. Springer – Nature Publishing Group, Cham, pp. 669–688.

Harvati, K., Panagopoulou, E. and Runnels, C., 2009. The paleoanthropology of Greece. Evolutionary Anthropology, 18, pp. 31–43.

Harvati, K., Konidaris, G. and Tourloukis, E. (Eds.), 2018. Human Evolution at the Gates of Europe. Quaternary International, 497.

Jacobs, Z., Li, B., Karkanas, P., Tourloukis, ppV., Thompson, N., Panagopoulou, E. and Harvati, K., 2018. Beyond maps: Optical dating of K-feldspar grains from Middle Pleistocene lacustrine sediment at Marathousa 1 (Greece). Quaternary International, 497, pp. 170–177.

Karkanas, P., Tourloukis, V., Thompson, N., Giusti, D., Panagopoulou, E. and Harvati, K., 2018. Sedimentology and micromorphology of the Lower Palaeolithic lakeshore site Marathousa 1, Megalopolis Basin, Greece. Quaternary International, 497, pp. 123–136.

Konidaris, G.E., Athanassiou, A., Panagopoulou, E., Karkanas, P. and Harvati, K., this volume. Fossil macaques (Cercopithecidae, Primates) from the Middle Pleistocene of the Megalopolis Basin (Greece) with description of a new specimen from Kyparissia 4.

Konidaris, G.E., Athanassiou, A., Tourloukis, V., Thompson, N., Giusti, D., Panagopoulou, E. and Harvati, K., 2018. The skeleton of a straight-tusked elephant (*Palaeoloxodon antiquus*) and other large mammals from the Middle Pleistocene butchering locality Marathousa 1 (Megalopolis Basin, Greece): preliminary results. Quaternary International, 497, pp. 65–84.

Konidaris, G., Tourloukis, V., Athanassiou, A., Giusti, D., Thompson, N., Panagopoulou, E., Karkanas, P. and Harvati, K., 2019. Marathousa 2: A new Middle Pleistocene locality in Megalopolis Basin (Greece) with evidence of human modifications on faunal remains. Proceedings of the European Society for the study of Human Evolution, 8, 82.

Konidaris, G., Tourloukis, V., Boni, G., Athanassiou, A., Giusti, D., Thompson, Syrides, G., N., Panagopoulou, E., Karkanas, P. and Harvati, K., 2023. Marathousa 2: A new Middle Pleistocene locality in Megalopolis Basin (Greece) with evidence of human exploitation and megafauna (*Hippopotamus*). PaleoAnthropology 2023, pp. 34-55.

Kranis, H., Skourtsos, E., Davis, G., Karkanas, P., Tourloukis, V., Panagopoulou, E. and Harvati, K., 2020. Switch-on, switch-off: Plio-Quaternary evolution of the Megalopolis Basin (Southern Greece), through structural overprinting, interaction and fault migration, European Geoscience Union – EGU General Assembly 2020, Online, 4–8 May 2020.

Michailidis, D., Konidaris, G.E., Athanassiou, A., Panagopoulou, E. and Harvati, K., 2018. The ornithological remains from Marathousa 1 (Middle Pleistocene; Megalopolis Basin, Greece). Quaternary International, 497, pp. 85–94.

Panagopoulou, E., Tourloukis, V., Thompson, N., Konidaris, G., Athanassiou, A., Giusti, D., Tsartsidou, G., Karkanas, P. and Harvati,

K., 2018. The Lower Palaeolithic site of Marathousa 1, Megalopolis, Greece: Overview of the evidence. Quaternary International, 497, pp. 33–46.

Papadopoulou, P., Tsoni, M., Konidaris, G.E., Tourloukis, V., Panagopoulou, E., Karkanas, P., Harvati, K. and Iliopoulos, G., this volume. Ostracod contribution to the palaeoenvironmental study of Kyparissia-4 (Megalopolis Basin, Greece).

Thompson, N., Tourloukis, V., Panagopoulou, E. and Harvati, K., 2018. In search of Pleistocene remains at the Gates of Europe: Directed surface survey of the Megalopolis Basin (Greece). Quaternary International, 497, pp. 22–32.

Tourloukis, V., Karkanas, P., 2012. The Middle Pleistocene record of Greece and the role of the Aegean in hominin dispersals: new data and interpretations. Quaternary Science Reviews 43, pp. 1-15.

Tourloukis V., Harvati K. 2018. The Palaeolithic record of Greece: a synthesis of the evidence and a research agenda for the future. Quaternary International, SI Filling the Geographic Gaps in the Human Evolutionary Story, 466, 48–65.

Tourloukis, V., Muttoni, G., Karkanas, P., Mones, E., Scardia, G., Panagopoulou, E. and Harvati, K., 2018a. Magnetostratigraphic and chronostratigraphic constraints on the Marathousa 1 Lower Palaeolithic site and the Middle Pleistocene deposits of the Megalopolis Basin, Greece. Quaternary International, 497, pp. 47–64.

Tourloukis, V., Thompson, N., Panagopoulou, E., Giusti, D., Konidaris, G., E., Karkanas, P. and Harvati, K., 2018b. Lithic artifacts and bone tools from the Lower Palaeolithic site Marathousa 1, Megalopolis, Greece: Preliminary results. Quaternary International, 497, pp. 47–64.

Tzedakis, P.C., Lawson, I.T., Frogley, M.R., Hewitt, G.M. and Preece, R.C., 2002.Buffered tree population changes in a Quaternary refugium: Evolutionary implications. Science, 297, pp. 2044–2047.

van Kolfschoten, T., Konidaris, G.E., Doukas, C., Athanassiou, A., Tourloukis, V., Panagopoulou, E., Karkanas, P. and Harvati, K., this volume. Voles (Rodentia, Mammalia) as a proxy to date the site Kyparissia 4 (Megalopolis Basin, Greece).

van Vugt, N., de Bruijn, H., van Kolfschoten, T. and Langereis, C.G., 2000. Magneto- and cyclostratigraphy and mammal-fauna's of the Pleistocene lacustrine Megalopolis Basin, Peloponnesos, Greece. Geologica Ultrajectina, 189, pp. 69–92.