General Session G02
Stratigraphy and Palaeontology

Scientific Annals, School of Geology, Aristotle University of Thessaloniki Proceedings of the XIX CBGA Congress, Thessaloniki, Greece	Special volume 99	57-62	Thessaloniki 2010

NEW HIPPOPOTAMID FINDS IN EUROTAS VALLEY (LACONIA, GREECE)

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Abstract: A new locality tracked down in the Eurotas Valley (Laconia, Greece) yielded mammalian dental remains of a young individual referred to as *Hippopotamus antiquus*. The findings are of very large size compared to already known specimens from Greece and W. Europe. The new locality is biochronologically dated at the Early–Middle Pleistocene.

Keywords: *Hippopotamus* Laconia, Peloponnesus, Greece, Pleistocene

1. Introduction

During a geological survey in Eurotas valley (Laconia, Peloponnesus) in October 2006, a new mammal locality was discovered. The site, dubbed "Myrtiá" (MYP), is located in the area among the small town of Vlachiótis and the villages of Myrtiá and Peristéri, near the road that leads from Myrtiá to the main road of Skála–Vlachiótis (Fig. 1). It is a small remnant of an old terrace of the river Eurotas, which outcrops above the present floodplain, forming a low hill (highest altitude: 38 m). It consists of gravels and loose conglomerates deposited in a fluvial environment. Part of the gravels has been quarried several years ago.

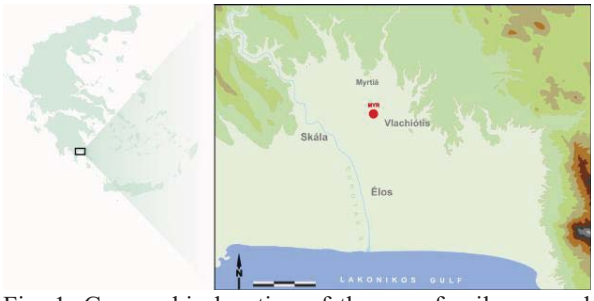

Fig. 1. Geographic location of the new fossil mammal locality Myrtiá (MYP). Graphical scale in km. Contour interval: 100 m.

The new locality yielded two *Hippopotamus* molars that plausibly belong to the same individual, as they were found in association and exhibit similar degree of wear.

Fossil mammal localities of Pliocene to Early Pleistocene age are already known in the broader area of the Eurotas Valley: Georgalas (1941) describes a proboscidean molar from Skoúra, SE of Sparta, which he refers to the Pliocene species *Anancus arvernensis*. Sidiropoulou (1972) refers an equid maxillary fragment from Vrontamás, preserving cheek teeth in both sides, to *Equus caballus* forma *primitiva*; however, its dental characters, as the short protocones and the narrow styles, indicate that the specimen belongs to a stenonid horse of Late Pliocene or Early Pleistocene age. In a ravine of the same region Symeonidis (1970) mentions the presence of a (proboscidean?) tusk fragment. The broader area of Vrontamás has recently yielded some new mammal remains (Skourtsos pers. com. and personal field data). Symeonidis & Theodorou (1986a) describe proboscidean skeletal and dental material from Vlachiótis, in the vicinity of Myrtiá, which they refer to *Mammuthus meridionalis*. Other Laconian localities, outside the Eurotas Valley, include the cave of Dyrós, which is particularly rich in *Hippopotamus* (Giannopoulos 2000; Symeonidis & Giannopoulos 2001), as well as the important anthropological sites of Apídima (Pitsios 1999; Tsoukala 1999) and Lakonís (Harvati et al. 2003).

2. Systematics

Order: Artiodactyla OWEN, 1848
Family: Hippopotamidae GRAY, 1821
Genus: *Hippopotamus* LINNAEUS, 1758
Hippopotamus antiquus DESMAREST, 1822
Material: MYP-1: upper left second molar (M2); MYP-2: upper left third molar (M3) (Fig. 2). The material is currently stored in the Museum of Pa-

laeontology and Geology of the National and Kapodistrian University of Athens.

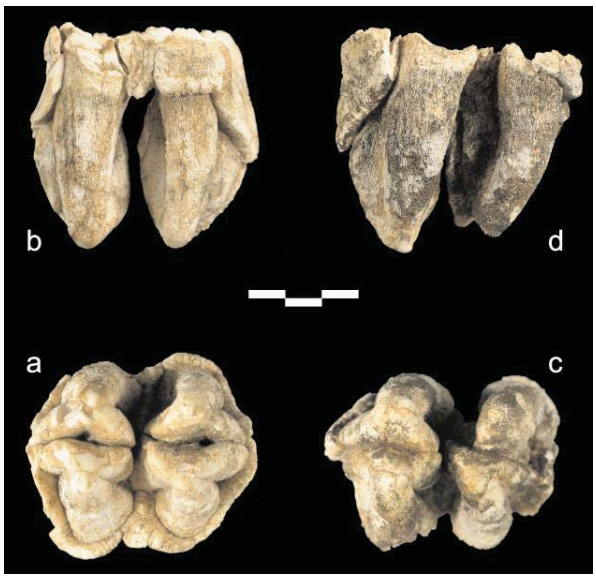

Fig. 2. *Hippotamus antiquus* from Myrtiá. Left upper second molar (MYP-1): a, occlusal view; b, labial view. Left upper third molar (MYP-2): c, occlusal view; d, labial view. Mesial side is on the left. Graphical scale in cm.

Description: The two molars were found in anatomical association; however no maxillary bone not even the roots are preserved. Both teeth are in pristine condition: the enamel is wrinkled and only the mesial cusps (protocone and paracone) of M2 show some signs of polishing due to very early enamel wear. The M3 must not have been erupted at the time of death. In occlusal view the teeth exhibit the typical trefoil-shaped crown morphology, which is characteristic for the Hippopotamidae. The M2 has trapezoid shape, the mesial cusps being considerably wider than the distal ones. In M3 the cusp pairs are placed rather oblique in relation to the sagittal plane. All cusps are conical and converge towards their apices. In labial or lingual view the mesial cusps appear almost straight, or bend slightly backwards, while the distal cusps are clearly bent toward the centre of the crown. The mesial and distal cusp pairs are separated by very deep transverse valleys that open lingually and labially. The styles situated mesially and distally of each cusp are very strong in M2, particularly the hypostyles. In M3 they are considerably weaker; the distal metastyle is practically lacking, being only visible near the base of the crown. Both molars have a cingulum. In M2 it is very strong in all sides of the tooth: mesially and distally it reaches the middle of the crown, while it forms a cuspid in the lingual and labial openings of the transverse valleys (the lingual one being more robust). In M3 the cingulum is preserved only mesially and distally. The distal one is weaker than the corresponding structure of M2. The dimensions of M2 are (63.0) × (58.5) × 60.0 (mesiodistal diameter × labiolingual diameter × height, in mm), while those of M3 are (61.0) × (54.0) × 56.8 respectively (the dimensions in parentheses indicate inaccurate measurements, due to incomplete preservation).

The degree of dental wear can provide information on the ontogenetic age of the Myrtiá individual. According to Laws (1968), who described the age groups of extant African hippos based on the eruption sequence of lower teeth, the first signs of wear on lower second molar appear at the age groups VII-VIII. The same author, based though on limited observations, states that the same criteria approximately apply on the upper teeth too. Thus the individual of Myrtiá can be aged into these groups, which correspond to an ontogenetic age of 11±2 to 15±2 years in the extant populations (Laws, 1968).

3. Discussion

An exclusively African genus during the Holocene, *Hippopotamus* was common in Europe during most of the Pleistocene (especially in the western part), where it is present in hundreds of palaeontological localities (Faure, 1981). The genus occurred in South, Central and Western Europe during the Early and early Middle Pleistocene, but subsequently retreated to the South (Iberian, Italian and Balkan peninsulas) till the end of the Middle Pleistocene. In the Late Pleistocene the hippos were again widespread in Western Europe, reaching as far north as N. England. In general their biogeographic range extended north during the interglacials and contracted to southern refugia during the glacials. The European population diminished and eventually became extinct during the last glacial.

The earlier forms (Early to Middle Pleistocene), usually referred to as *Hippopotamus antiquus*, were very large. Later forms (generally after the mid-Pleistocene) were smaller, comparable in size to the recent African species *H. amphibius* and usually referred to as such. A number of other species were also proposed, as *H. incognitus* FAURE, 1984 and *H. tiberinus* MAZZA, 1991, based on anatomical peculiarities of the skull or postcranial skeleton, though they are not generally accepted with-

out reservation (Mazza 1995; Petronio 1995). Other authors consider all European Pleistocene hippopotamuses as belonging to the gradually evolving extant species *H. amphibius*, in which they recognize two subspecies (*H. amphibius antiquus* and *H. amphibius amphibius*) (e.g. Kahlke, 1990; Kahlke, 2001). Since the taxonomy of the genus at the species/subspecies level is still debated, the two species (*antiquus–amphibius*) taxonomic scheme is provisionally accepted in the present study, following Petronio (1995).

Non-endemic *Hippopotamus* is already known from several sites in Greece (Fig. 3), but it is mostly represented by few fragmentary finds in each site. The richest sites are located in the Megalópolis Basin —sites Megalópolis (Melentis, 1966a) and Kyparíssia (personal data)—, as well as in Dyrós Cave (Petrochilos, 1958; Giannopoulos, 2000; Symeonidis and Giannopoulos, 2001). The presence of *Hippopotamus* sp. is also mentioned by Deprat (1904) at Panagia Heria, Euboea, together with a Late Miocene assemblage, which makes this determination rather doubtful. In a later publication on the Miocene faunas of the island (Mitzopoulos, 1947) the genus is not included in the faunal lists. Endemic *Hippopotamus* (*H. creutzburgi* BOEKSCHOTEN & SONDAAR, 1966) is currently known from twenty localities in Crete (Lax, 1996; Iliopoulos et al., 2010), the most important of which is in the mountain basin of Katharó (Eastern Crete) (Boekschoten and Sondaar, 1966; Dermitzakis et al., 2005).

The *Hippopotamus* molars have only minimally changed during the genus' evolution and, consequently, their morphology is not taxonomically diagnostic. Nevertheless, the trapezoid outline of M2 in occlusal view has been considered as a specific character of *H. antiquus* (Thenius, 1955). In a metrical comparison to other dental samples of European *Hippopotamus* (Fig 4), the molars from Myrtiá plot near the maxima of *H. antiquus* ranges according to Faure (1985) and appear to be among the largest specimens of the same species according to Mazza (1995). *Hippopotamus* upper molars from Greece, which can be metrically compared to the Myrtiá material, are known from the following localities: Manzavináta (Psarianos, 1954), Elis (Thenius, 1955), Haliákmon Valley (Melentis 1966b), Káto Salmeníko (Symeonidis and Theodorou, 1986b), Ravin Voulgarákis (Kostopoulos, 1996) and Dyrós Cave (Giannopoulos, 2000). The molars from Manzavináta and Haliákmon Valley,

Fig. 3. Distribution of non-endemic *Hippopotamus*-bearing localities in Greece: 1, Ravin Voulgárakis, 2, Haliákmon Valley (unknown exact location), 3, Perdíkkas, 4, Libákos, 5, Kapetánios, 6, Q-Profil, 7, Piniós Valley, 8, Toíchos, 9, Manzavináta, 10, Elis, 11, Ag. Dimítrios, 12, Káto Salmeníko, 13, Limnón Cave, 14, Kyparíssia, 15, Megalópolis, 16, Marathoúsa, 17, Apídima Caves, 18, Dirós Cave, 19, Myrtiá, 20, Kos. Data according to Desio (1931), Psarianos (1954), Thenius (1955), Milójčić et al. (1965), Melentis (1966a, 1966b, 1969), Sickenberg (1976), Stratigopoulos (1986), Symeonidis and Theodorou 1986b) Steensma (1988), Koufos et al. (1989), Tsoukala (1999), Symeonidis and Giannopoulos (2001), Reimann and Strauch (2008) and personal observations.

as well as those from Dyrós, are much smaller than Myrtiá, which is also consistent with their specific determination by the above authors as *H. amphibius*. The two M2s from Dyrós (specimens N.84 and N.86; Museum of Palaeontology and Geology, University of Athens) are, however, close to the maximum values of the species' range, as given by Faure (1985). The M2 from Elis is similar in size to MYP-1, while the M2 from Káto Salmeníko is slightly smaller. The locality of Ravin Voulgarákis has yielded an almost complete juvenile skull that preserves the M2s. With a mesiodistal dimension of about 55 mm (Kostopoulos, 1996, Table 146) the M2s of this skull are smaller than the ones from Myrtiá.

The available morphological and —especially— metrical characters of the molars from Myrtiá support the attribution of the finds to the species *Hippopotamus antiquus*.

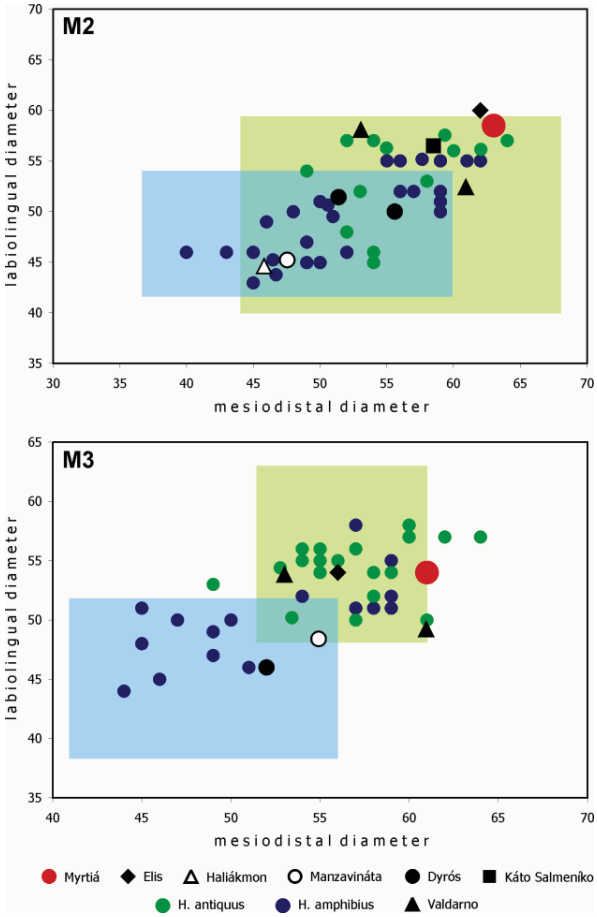

Fig. 4. Scatter plots comparing the mesiodistal (DAP) to labiolingual (DT) dimensions in mm of *Hippopotamus* M2 and M3 samples. The blue and green squares represent the range given by (Faure 1985) for *H. amphibius* and *H. antiquus* respectively. The blue and green points correspond to *H. amphibius* and *H. antiquus* measurements respectively, according to Mazza (1995). Measurements of Valdarno, Manzavináta, Elis, Haliákmon Valley and Káto Salmeníko according to Leonardi (1948), Psarianos (1954), Thenius (1955), Melentis (1966b) and Symeonidis and Theodorou (1986b). The plots depict clearly the great metrical overlapping of samples referred to as *H. amphibius* and *H. antiquus*, which leads to confusion regarding the taxonomy of the European representatives of the genus.

4. Biochronology–Palaeoecology

Azzaroli et al. (1982) place the first appearance of *Hippopotamus* in Europe at the Early Pleistocene (Tasso Faunal Unit, at about 1.8–1.7 Ma), as it is known during this time interval from localities in Italy and other Mediterranean regions. However, scanty specimens from sites of rather earlier, Late Pliocene age make probable an even earlier dispersal from Africa to Europe (Kahlke, 1987). Thenius (1955) dates his *H. antiquus* findings from Elis to the Astian (Late Pliocene), based on correlations with mollusk faunas, and this age has been recently corroborated by Reimann and Strauch (2008), who studied a partially preserved skull from the same area. This places the finds from Elis among the earliest *Hippopotamus* of Europe. The other hippo-yielding localities of Greece are of later or not well definable age. Steensma (1988) dates the localities of Libákos and Kapetánios to the biozone MNQ19 (Early Pleistocene). Slightly younger, Ravin Voulgarákis is dated by Koufos (2001) in MNQ20. The findings of the Megalópolis Basin (sites Megalópolis, Marathousa and Kyparíssia) are of Middle Pleistocene age, as the lacustrine sediments of the basin are dated from ~900 ka to ~350 ka (van Vugt et al., 2000). Of the three faunas, Marathousa is probably the older, about at the Early/Middle Pleistocene boundary, while Kyparíssia is possibly closer to the top of the stratigraphic sequence.

The fauna of Piniós Valley is dated by Milójčić et al. (1965) to the last interglacial or the beginning of the last glacial period. However, radiometric dates cited by Runnels & van Andel (1999) place the fossiliferous sediments well into the late glacial. If these late dates (~ 45–30 ka) are corroborated, then the taxonomic attribution of the finds, referred by Milójčić et al. (1965) to as *H. amphibius* cf. *antiquus*, might need revision. New material collected recently at the locality may yield additional data on this problem (Athanassiou in preparation). A late date would also raise the upper biochronological limit of the genus in Europe, which is currently placed at Oxygen Isotope Stage 5 or 4 (Petronio, 1995; Palombo and Mussi, 2001). A late radiometric date of at least 32 ka is also cited by Symeonidis and Giannopoulos (2001) for the *H. amphibius*-bearing fauna of Dyrós Cave.

The specimens from Manzavináta and Haliákmon Valley are attributed by Melentis (1966b) and Psarianos (1953) to *H. amphibius*, on the base of their rather smaller dimensions, so a Middle–Late Pleistocene age is more probable for these localities. A stratigraphic correlation of several European *Hippopotamus*-bearing localities is given in the chart of figure 5.

The stratigraphic range of *H. antiquus* is usually given as Early–Middle Pleistocene (Faure, 1981; Mazza, 1995; Petronio, 1995) and this is a plausible age for the locality of Myrtiá. Given the very large dimensions of the studied specimens and the suggested Late Pliocene age of the Elis finds, a similar age could also be supposed as possible for Myrtiá. However, since *Hippopotamus* remains

have not yet been found in any well-dated Pliocene mammal assemblage in Greece, we reserve a Late Pliocene date, until the early presence of the genus in Greece is supported with more biostratigraphic data from more sites. The presence of *Mammuthus meridionalis* in the nearby locality of Vlachiótis (Symeonidis and Theodorou 1986a) also indicates a wide chronological range of Late Pliocene – Early Pleistocene. A direct stratigraphic correlation between the two localities is, though, not possible.

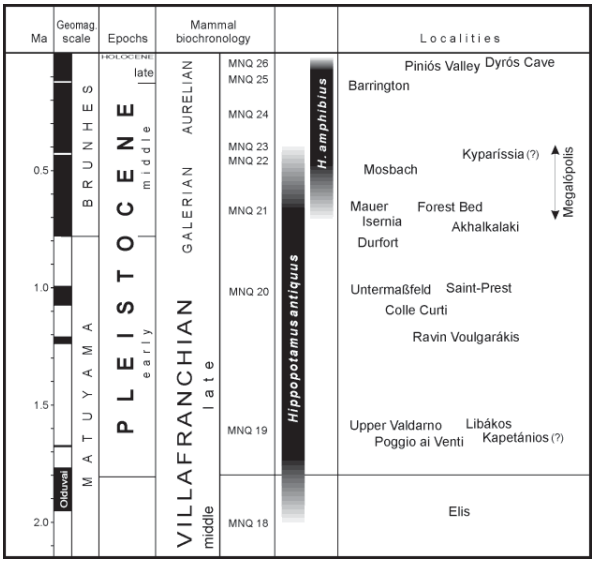

Fig. 5. Stratigraphic chart of selected European *Hippopotamus*-bearing localities, including well-dated Greek sites. Chronostratigraphic and magnetostratigraphic subdivisions according to Gibbard and van Kolfschoten (2005). Mammal biozonation according to Guérin (1990) Faunal data references are given in text.

Hippos are adapted to a semi-aquatic way of life and depend on the presence of fresh water bodies throughout the year. Their presence has also been interpreted as an indication of warm climate. This is, though, not true, at least for southern Europe, as already pointed out by Faure (1981) and as indicated by recently available radiometric dates for Piniós Valley and Dyrós Cave, which place these faunas into the last glacial. The presence of *H. antiquus* in Myrtiá, in combination to the coarse-grained lithology of the site, indicates a fluvial environment.

5. Conclusion

The dental findings (upper M2 and M3) from the new locality Myrtiá are referred to a young individual of *Hippopotamus antiquus*. The specific determination is mainly based on the specimens' very large size, compared to recent material, as well as to fossils already known from several European localities. The presence of *Hippopotamus* in Myrtiá suggests a fluvial environment. The new locality is biochronologically dated at the Early–Middle Pleistocene.

Acknowledgements

The authors wish to thank Paris Pavlakis and an anonymous reviewer, whose suggestions improved the paper.

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