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A preliminary report on the Late Oligocene vertebrate fauna from Máriahalom, Hungary

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(with 2 plates)

Relatively sparsely found fossil vertebrate remains have been collected with variable intensity from the Upper Oligocene sand beds of Máriahalom during the last twenty-five years. Recent fieldworks and the obtaining of a private collection have provided good opportunity for a preliminary study of this diverse fauna for the first time. Currently hundreds of isolated specimens are housed at the Natural History Museum of the Eötvös University and so far 26 different taxa have been determined. The Máriahalom fauna consists of both shallow marine and terrestrial elements as demonstrated by the remains of various shark genera, myliobatoid rays, bony fishes, turtles, an anguid squamate, crocodylians, birds, anthracotheriid and ruminant artiodactyls and primitive ursid and mustelid carnivorans. The various habitat preferences of these forms and the accumulation of their remains in the same beds might reflect a transportation process by intense sea currents which is consistent with the sedimentological interpretation of the strata. Apparently Máriahalom is a significant vertebrate site, as Late Oligocene reptiles, birds and large terrestrial mammals have been extremely poorly known from eastern Europe. Concerning the mammals, Máriahalom shows considerable affinities with Late Oligocene faunas in Western Europe.

Introduction

The Máriahalom sand pit is a reputed site in Hungarian palaeontology and is rated to be well-known for its remarkably abundant mollusc remains. If not the most diverse fauna has been reported from here, at least it is likely that Máriahalom is one of the richest mollusc localities of Hungary.

Conversely, it is much less known that a relatively large amount of isolated, shallow marine – continental vertebrate remains have been also collected during the last twenty years. The intense study of the vertebrate fauna has only begun recently and the preliminary results already indicate that Máriahalom is simultaneously an exceptionally significant fossil vertebrate site. The importance is given by the particular age and the high diversity of the fauna as also by the presence of large terrestrial mammals which have not been reported from the Oligocene of Hungary before. In addition, Late Oligocene coastal vertebrate faunas are rather sparsely known all over Europe and this is especially the case with continental elements. Máriahalom has produced isolated remains of at least 26 different vertebrate taxa, which, to our knowledge, make it the richest fauna of the Hungarian Paleogene. The only other Late Oligocene fauna from Hungary was discovered near Bodajk in the Bakony Mts. in clay fillings of karst fissures. This material is currently under study and yet unpublished in detail (L. KORDOS personal communication).

The first recognition of the Máriahalom mollusc lens was made by a geology student in the 1960's and soon attracted the attention of Professor Tamás BÁLDI, a leading expert in Oligocene marine geology. He ranged the outcropping strata into the Upper Oligocene Mány Formation. A comprehensive analysis of the mollusc fauna and the geology of the Mány Formation, including the Máriahalom sand pit is given in BÁLDI (1973), BÁLDI & CSÁGOLY (1975), and JANSSEN (1982).

Vertebrates remained undiscovered until the 1980's when private collectors began to visit the pit and when paleontologists first became aware of the fossils. The earliest mention of vertebrates was made by JÁNOSSY (1986) as he reported a single anthracotheriid molar from Máriahalom. This material was treated as sparse finding and was not figured. It

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was housed in the Natural History Museum of Hungary but presently it is not available.

The largest private collection belongs to Zoltán EVANICS who made frequent field trips to the locality in the 1980's and 90's. This material, consisted of hundreds of isolated specimens, has been kindly offered by him to the Natural History Museum of Eötvös University.

Further collecting and minor excavations have been organized by the authors from 1999 using 1 m x 0,5 m sieves and basic sedimentological examination has also been done in the field.

Location and geological setting

The village of Máriahalom is located in the north-eastern boarder of the Mány-Zsámbék basin, 47 km north-west from Budapest. The sand pit is situated on the south-western side of the road between the townships of Úny and Máriahalom.

The Máriahalom strata are part of the Mány Formation, a statement primarily supported by the study of the mollusc fauna by BÁLDI (1973). The Mány Formation is widely accepted to be Egerian (Chattian, Upper Oligocene) in age according to the mollusc biostratigraphical analyses of BÁLDI & CSÁGOLY (1975). It is predominately built up of sand, sandstone and locally of clayey sand with coal strings. The mollusc fauna have been recognized as a typical *Tympanotonus-Pirenella* community and thus the environment is interpreted as an extensive shallow-water, brackish lagoon with an average depth of 2-5 m (BÁLDI & CSÁGOLY 1975).

However, this is in slight contrast with the low clay content and perceptible cross-bedded sand bodies at Máriahalom with bunch thickness reflecting a minimum of 15-20 m. JANSSEN (1982) also noted that a number of mollusc species also imply relatively open marine circumstances.

The outcropping deposits at the Máriahalom locality are principally formed by medium grain-sized sand, clayey sand and interbedding sandstone bodies. Based on the distribution of clay, the sediments on surface can be divided to two sections. The lower one contains 10-12% clay, while in the upper it is decreased to 2-4% and thus a change of the accumulation process from lower to higher energy is likely. The upper section might reflect an environment notably exposed to sea currents and may be interpreted as an outer side of a barrier island. This would be consistent with the fact that the shells of the lagoonal molluscs are found in the same layers together with the fossils of terrestrial mammals and shallow-water sharks. The most acceptable explanation of this mixed accumulation is given by intense currents which transported the invertebrate and vertebrate remains from different environments to the same depositional scene.

All vertebrate fossils are found isolated and they have been collected from almost the entire area of the sand pit but according to our experience they are more frequent where the molluscs are accumulated in greater number. In the eastern wall of the sand pit the mollusc shells form interbedding, 2-5 m wide lens of uncertain origin. The extreme abundance of the molluscs is coupled with the relatively more frequent occurrence of vertebrate fossils in these structures.

Represented faunal groups

Selachians

Among 250 collected specimens of shark teeth 102 proved to be sufficient for identification on genus level. Dominantly the teeth belong to shallow-water genera with only two exceptional hemipelagic forms, hardly represented by two specimens. Systematics was adopted from PURDY et al. (2001) and REINECKE et al. (2005).

The most commonly found shark teeth belong to members of the Carcharinidae. This family is almost exclusively represented by one taxon: *Carcharhinus*. These small teeth with serrated cutting edge running along the root and posterolaterals with hooked distal curvature are typical of the species *Carcharhinus elongatus* LERICHE, 1910. (Plate I. A, Fig. 1). A single labiolingually compressed, distinctly distally curved lateral tooth with flat triangular accessory cusps is most similar to the carcharhinid *Carcharoides catticus* PHILIPPI, 1846 (Plate I. A, Fig 3).

Two members of the family Odontaspidae can be recognized which could be also common elements of the fauna. The teeth with slender, lingually curved crowns and with elongated, straight accessory cusps are regarded as *Odontaspis,* while the teeth with wide and flat crowns and with hooked accessory cusps are considered to be *Carcharias*. Our preliminary analyses allow the identification of the species *Odontaspis acutissima* AGASSIZ, 1843 and *Carcharias cuspidata* AGASSIZ, 1843 (Plate I. B, Fig 5.)

Teeth belonging to other families are found infrequently or even exceptionally. Squatinids are represented by four teeth with flat root more or less

perpendicular to the crown and are very similar to the genus *Squatina*. The Lamnidae are questionably present based on a small, single, smooth-crowned tooth with flat and triangular shape, close to *Isurus* in appearance (Plate I. B, Fig. 2). However, it possibly belonged to a juvenile as it has an undeveloped accessory cusp, retained only by young individuals of *Isurus*. Another single tooth may belong to *Mitsukurina lineata* PROBST, 1879 (Mitsukurinidae). It has a lingually striated crown with the root labiolingually flattened (Plate I. B, Fig. 4). Both *Isurus* and *Mitsukurina* are considered to be hemipelagic forms which is consistent with the exceptional occurrence of their remains in a shallow marine environment. Their presence in Máriahalom might be related to transportation or even to stray individuals but the preference of shallow water environments among juveniles of *Isurus* can also not be ruled out.

Myliobatoids

Remains of myliobatoid rays are often found at the locality including median tooth plates and spines. Some tooth plates are preserved with two or three plates fused. We considered CAPETTA (1987) for the basics of taxonomy.

Two genera have been identified but they may be rather recognized as morphotypes as the generally insufficient preservation of this group leads to uncertainties in the identification of single tooth plates.

Some tooth plates have curved lateral edges and thus this taxon probably lacked the lateral tooth rows which is a feature found in *Aetobatus* (Plate I. B, Fig. 7). The other morphotype is hexagonal and the crown bears an anteriorly extended ridge ventrally which is interlocking with the groove on the following tooth (Plate I. B, Fig. 6). According to CAPETTA (1987) and BOURDON (2002) these characters are linked to the genus *Rhinoptera*.

Phyllodontid and sphyraenid fishes

The most common vertebrate fossils are dentaries of phyllodontid-like fishes with pebble-like teeth in numerous parallel lines. An enlarged tooth is situated posteriorly in each dentary. A well-preserved left dentary with almost intact symphysis has considerably larger size and different tooth row arrangement, and probably represents a distinct taxon (Plate I. B, Fig. 8). Single pebble-like teeth are also found quite often and numerous vertebrae of different size and shape have been unearthed as well. Large carnivorous fish teeth are also frequently come to surface. They are flattened, pointed, tent-shaped and very similar to that of recent sphyraenids (barracudas). Yet unreported, identical teeth have been also collected from the lower Oligocene of Hungary (Kiscell Clay Formation) which were identified as *Sphyraena* by an unknown person. A freshwater gar, *Atractosteus* maybe also present based on a single tooth with characteristic pike shaped apex (P. GULYÁS, personal communication).

Dozens of otolits have also been collected and the preliminary analyses reveal that at least four taxa can be separated and thus the ichthyofauna based only on dental remains would be incomplete (M. BOSNAKOFF personal communication).

Chelonians

Turtles are represented by numerous isolated plates, several plate fragments, a coracoid and a single vertebra. Trionychoid turtles are easily recognized by the typical soft-shell turtle ornamentation, consisted of distinct ridges and pits. Among the dozens of fragments several complete costals and neurals belong to this group (Plate I. C, Fig. 10).

Another turtle, possibly a testudinoid is also present based on a few hyo- and hypoplastra, neurals, peripherals and costal fragments (Plate I. C, Fig 9). An adequate identification of this taxon as Testudonioidea is yet poorly acceptable as the presence of strong inguinal buttresses diagnostic for the group is unknown at the moment.

Squamata

Two tiny trunk vertebrae with flared condyle lacking the precondylar constriction of varanids and with ventrally flat centrum indicate the presence of a possible, indeterminate anguid.

Crocodylians

Occasionally remains of crocodiles came to surface at Máriahalom. The material includes a fragmentary dentary without teeth, a posteriorly incomplete angular, some isolated teeth, a distally incomplete femur and a few osteoderms. The presence of two taxa is obvious as shown by the significantly different size of the teeth. A few teeth have the size of *Asiatosuchus*, from 1.5 to 3.5 cm while the rest vary from 0.3 cm to 1 cm (Plate I. C, Fig. 11). The only evidence for this large crocodylian is given by dental remains and according to their relative size, the mandibular elements, the femur and the osteoderms probably belong to the smaller taxon (Plate I. C, Fig 12). The dentary shows U-shaped symphysis, typical of alligatoroids.

Aves

A few, temporarily undetermined bird limb bones have turned up, among others an almost intact osprey-like claw and a distal epiphysis of a tibiotarsus showing affinities with Anseriformes. Further studies can reveal the importance of these bird remains which may be hypothesized due to their exceptionally sparse occurrence in the European Oligocene.

Sirenians

Some thick, compact, more or less complete rib fragments of Sirenians have been unearthed. Further study of the material is needed for supportable identification as Sirenians in the case of some different, potential specimens.

Artiodactyls

The terrestrial mammal remains from Máriahalom are of particular interest as from Hungary these are the only fossils of large terrestrial mammals from the Oligocene. The locality of Bodajk in the Eastern Bakony Mts. produced a diverse small mammal fauna while the large mammals are missing (L. KORDOS personal communication). Despite the extremely rare preservation of their remains at the locality it appears that the mammalian diversity was quite high, which gives further significance for Máriahalom.

A number of brachyodont, bunoselenodont molars and premolars belong to medium-sized anthracotheriids. This material consists of upper M2 and M3 and lower m3 teeth (Plate II. Figs. 3, 4). The M3 is square-shaped with five cones and well-developed complete cingulum and the postprotocrista is buccolingually oriented. Therefore it appears to be a very close form or even identical to *Microbunodon minimum* Cuvier, 1822 which is a common element of Late Oligocene faunas in southern France (LIHOREAU et al. 2004).

A yet undetermined, medium-size primitive ruminant is also present with lower m3 and m2 molars and possibly belong to Gelocidae. Similar forms have been reported from the Oligocene phosphorites of Quercy in Provence, Southern France (see Blondel 1997).

Carnivorans

Paleogene carnivorans remained unknown from the area of Hungary until their recent discovery at Máriahalom. Three genera can be determined on the bases of lower m1 teeth and an almost complete tibia. A few premolars, an upper molar, possibly a canine, a fragmentary occipital are also considered to belong to yet indeterminate carnivorans. Two m1 teeth with anteriorly projecting paraconid, moderately well-developed metaconid, low hypoconid and a talonid being less than two times smaller than the trigonid are most similar to the Hemicyoninae genus *Cephalogale* (Plate II. Fig. 2). *Cephalogale* is a dog-sized, primitive ursid spread during the Late Oligocene-Early Miocene of western Europe and is again best known from the Quercy phosphorites, southern France (BEAUMONT 1965).

A hardly and a more strongly worn m1 have a paraconid being directed anterodorsally, a less developed metaconid and a talonid with well-developed hypoconid and entoconid (Plate II. Fig. 1). These teeth seem to be identical with that of *Potamotherium*, an otter-sized basal, aquatic mustelid. An excellently preserved left tibia with both the proximal and distal halves of the diaphysis curving caudally and with strong crista tibiae is also ascribed to *Potamotherium* (Plate II. Fig. 5). *Potamotherium* was a very frequent carnivoran of different aquatic environments during the Late Oligocene of Europe and thousands of their skeletal remains have been unearthed from French and Swiss localities (SAVAGE 1957).

A smaller m1 belongs to a different weasel-sized mustelid. It is very similar to *Amphictis* concerning the anteriorly projecting paraconid, the tall metaconid, low hypoconid and the tiny lingual notch between the talonid and the metaconid. *Amphictis* is recognized as a basal mustelid by WOLSAN (1993), while BASKIN (1998) supports the procyonid affinity.

Summary

So far 26 taxa have been identified from the sand pit of Máriahalom and this number may grow with further analyses. This diverse coastal fauna makes this site significant particularly in eastern Europe where Late Oligocene reptiles, birds and mammals are very poorly known. Probably no such diverse fauna have been discovered in the Paleogene of Hungary either, bearing in mind that the supposedly contemporary Egerian fauna from Bodajk is presently under study and yet unpublished in detail. The vertebrate fauna from Máriahalom is dominated by aquatic and semi-aquatic forms. The presence of vertebrates with considerably different habitat preferences imply various paleoenvironments. This is most evidently demonstrated if the lifestyles of the presumably semi-aquatic anthracotheriids, the terrestrial Hemicyoninae

bears, the Sirenians and members of the diverse ichthyofauna are compared. A reasonable explanation of the accumulation of these remains at the same depositional scene can be transportation by sea currents. This process is yet unknown in detail but it may be hypothesized that the remains of terrestrial mammals, lagoonal molluscs and shallow-water sharks were all removed by the currents and where transportation intensity decreased they were then deposited. This is supported by sedimentological observations (i.e. low clay content and cross-bedded sand) which presume energetically higher depositional circumstances than that of a lagoon which would be unless regarded as the paleoenvironment solely on the basis of the mollusc fauna.

As already been demonstrated, the mammal fauna of Máriahalom has similar elements, even on species level to contemporary southern French faunas reported from the Quercy phosphorites. However, probably due to the incompleteness of the Máriahalom fauna for evident preservational reasons, a number of contemporary families, such as felids, viverrids and amphicyonids are missing.

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Plate 1

A.

Figure 1. *Carcharhinus elongatus* (LERRICHE, 1910). Lingual view of upper anterior tooth. V.280

Figure 2. *Isurus* sp. Lingual view of upper anterior tooth. V.277

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Figure 3. *Carcharoides catticus* (PHILIPPI, 1851). Lingual view of lower left lateral tooth. V.275

Figure 4. *Mitsukurina* cf. *lineata* (PROBST, 1879). Lingual view of upper left lateral tooth. V.276

Figure 5. *Carcharias cuspidata* (AGASSIZ, 1843). Lingual view of upper anterior tooth. V.274

Figure 6. *Rhinoptera* sp. Lingual view of medial tooth plate. V.350

Figure 7. *Aetobatus* sp. Occlusal view of medial tooth plate. V.351

Figure 8. Phyllodontidae indet. Occlusal view of left lower jaw. V.352

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Figure 9. ?Testudinoidea indet. Visceral view of right hypoplastron. V.353

Figure 10. Trionychoidea indet. Dorsal view of right costal. V.354

Figure 11. Crocodylia indet. Isolated tooth. V.355

Figure 12. Crocodylia indet. Lateral view of right fragmentary angular. V.356

Plate 1

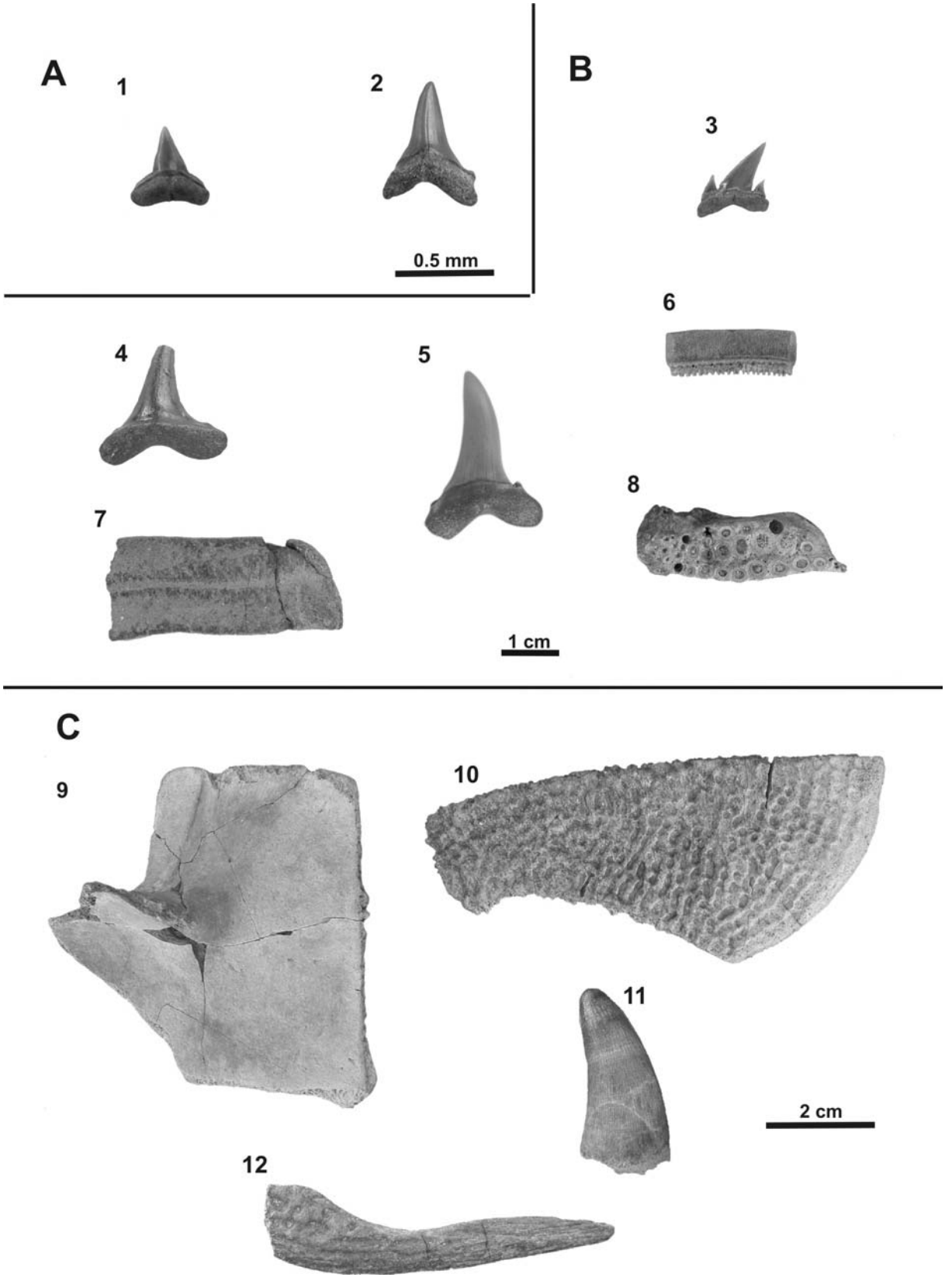

Plate 2

Figure 1. *Potamotherium* sp. Buccal view of left m1 tooth. V.288

Figure 2. *Cephalogale* sp. Buccal view of right m1 tooth. V.286

Figure 3. *Microbunodon minimum* (CUVIER, 1822). Occlusal view of left m3 tooth. V.283

Figure 4. *Microbunodon minimum* (CUVIER, 1822). Buccal view of left m3 tooth. V.283

Figure 5. *Potamotherium* sp. Cranial view of left tibia. V.278

Plate 2