A NEW LATE ORLEANIAN/EARLY ASTARACIAN MAMMALIAN FAUNA FROM KULTAK (MILAS-MUGLA), SOUTHWESTERN TURKEY

TANJU KAYA, VAHDET TUNA, DENIS GERAADS


ABSTRACT - In the Mugla area, southwestern Turkey, where the earliest known mammalian fauna is of late Orleanian age, a new late Orleanian/early Astaracian mammalian fauna is recognised in Kultak (Milas-Mugla). The fauna occurs at the top of a marine to continental succession known to be Aquitanian and Burdigalian in age, on the basis of marine faunal evidence. The fauna includes Anchitherium aurelianense hippoides (Lartet, 1851), Ancylotherium (Metaschizotherium) fraasi (Koenigswald, 1932), Tethytragus koehlerae Azanza & Morales, 1994 and Gomphotherium sp. These genera are known in Europe. Anchitherium and Tethytragus are common constituents of the Middle Miocene faunas of Turkey. Anchitherium (Metaschizotherium), which is known in central Europe, is the first record in Turkey. © 2001 Éditions scientifiques et médicales Elsevier SAS.

KEYWORDS: MIDDLE MIocene, MAMMALIAN FAUNA, TURKEY.

RÉSUMÉ - En Anatolie SW, où les plus anciennes faunes mammaliennes connues dataient de la fin de l’Astaracien, nous avons reconnu une nouvelle faune datant de la fin de l’Orléanien/début de l’Astaracien à Kultak (Milas-Mugla). La faune provient de dépôts gréseux au sommet d’une série marine supposée être d’âge Aquitanien. Elle comprend Anchitherium aurelianense hippoides (Lartet, 1851), Ancylotherium (Metaschizotherium) fraasi (Koenigswald, 1932), Tethytragus koehlerae Azanza & Morales, 1994 et Gomphotherium sp. Tous ces genres sont connus en Europe; Anchitherium et Tethytragus sont des constituants habituels des faunes du Miocène moyen de Turquie, mais Anchitherium (Metaschizotherium), surtout connu en Europe centrale, est signalé pour la première fois en Turquie. © 2001 Éditions scientifiques et médicales Elsevier SAS.

MOTS-CLES: MIOCÈNE MOYEN, FAUNE DE MAMMIFÈRES, TURQUIE.

INTRODUCTION

The known ages for the mammal faunas in the Mugla area range from Astaracian to Pliocene (Becker-Platen 1970; Atalay 1980) (Tab. 1). The oldest age produced by the Mugla-Sarçay fauna of the 'Turgut member' is the late Astaracian (late Middle Miocene) (13.5-11.1 Ma) (De Bruin et al. 1992; Steininger et al. 1996; Steininger 1999). The fauna includes Pliospalax primitivus Unay, Anomalomys gaudryi Gillard, Keramidomys sp., Anomalonyx sp. Anchitherium sp., Tethytragus koehlerae Azanza & Morales, Liatradiodon splendens Meyer et Gomphotherium angustidens (Kaup) (Becker-Platen et al. 1975; Unay 1978; Köhler 1987; van der Made 1993). The oldest mammalian age known outside the Mugla area is the Middle Orleanian, on the basis of Rodentia in Aydn-Soké (Unay & Goktas 1999).

This paper describes a still older mammalian fauna in the Mugla area, including Anchitherium aurelianense hippoides (Lartet, 1851), Ancylotherium (Metaschizotherium) fraasi (Koenigswald, 1932), Tethytragus koehlerae Azanza & Morales, 1994 and Gomphotherium sp. The fossil locality lies to the north of the Gokova Gulf, east of Ören, 4 km east of Alatepe (Alakilise), and 1.5 km northeast of Kultak (N 37° 02' 41.8"; E 28° 03' 14.6''), on the road cutting (Fig. 1).

Anchitherium and Tethytragus are commonly known in the Middle Miocene faunas of Turkey, such as Bursa-Pasalar, Ankara-Çandır, İnönü-I and Mugla-Sarçay (Becker-Platen et al. 1975; Atalay

![Figure 1 - Location map. Carte de localisation.](image-url)
<table>
<thead>
<tr>
<th>MIOCENE</th>
<th>European Land Mammal</th>
<th>Mammalian locality</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mega-Zones</td>
<td>MN-Zones</td>
</tr>
<tr>
<td>LATE</td>
<td>Vallesian</td>
<td>11.1 Ma</td>
</tr>
<tr>
<td></td>
<td>7 + 8</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Astaracian</td>
<td>15.0 Ma</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Orleanian</td>
<td>20.5 Ma</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1981; Köhler 1987; Kaya 1989; Forsten 1990; Fortelius 1990). There is no previous record of Anchitherium (Metaschizotherium) in Turkey.

The terminology and systematics used herein for Anchitherium, Anchilotherium (Metaschizotherium) and Tethytragus follow those of Abusch-Siewert (1983), Butler (1965), Coombs (1978) and Köhler (1987), respectively. Measurements are given in mm. Material is stored in the Natural History Museum (Ege University-Izmir/Turkey). Abbreviations used in this study are: NHM, Natural History Museum-Izmir/Turkey; MMK, Mugla-Milas-Kultak.

**STRATIGRAPHY**

The generalised stratigraphic succession is modified after Görür et al. (1995) (Fig. 2). The 'Cambeleini formation' is made up of interbedded limestone and shale, and rests unconformably on the basement. The limestones are rich in marine molluscan fragments. The composite stratigraphic succession of the 'Akkaya formation' consists, in ascending order, of limy shale, coaly mudstone, Turritella-mudrocks, thinly bedded lithic sandstone, limy Ostrea-biotro- me, mudrocks, poorly bioclastic limestone, in places limy and texturally immature lithic sandstone, and poorly to moderately indurated, lithic conglomerate-sandstone which yielded the mammalian fauna. The mammal-bearing horizon is separated by a covered interval from the underlying sandstone horizon. The lithic conglomerates and sandstones are light brownish gray, poorly to moderately indu-

---

rated, medium to thick-bedded, texturally submature, and interfinger laterally.

The succession of the Çambeleni and Akkaya formations is Aquitanian and Burdigalian in age, on the basis of marine microfossil elements (Nebert 1957; Gürür et al. 1995). The mammalian fauna recovered from the conglomerate-sandstone horizon of the Akkaya formation indicates an Orléanian/Astarian boundary interval age, which correlates approximately with the Burdigalian/Langhian boundary interval age, in terms of marine chronological classification. This horizon may represent the last fluvial ingress in the primarily marine environment of the Akkaya formation.

The ‘Eskihisar Formation’ (Gürür et al. 1995) consists uniformly of poorly to moderately indurated, medium to massive-bedded, brownish gray lithic conglomerates and yellowish gray sandstones. It rests unconformably on the basement rocks, and is separated from the Akkaya formation by extensional faults. Clasts of marine limestones and limy sandstones of the Çambeleni formation occur sporadically in the Eskihisar Formation. The unconformable setting on the basement, and the diagenetic difference between the marine limestone clasts and the matrix of the conglomerates suggest an unconformity between the Eskihisar and Akkaya formations.

SYSTEMATIC PALEONTOLOGY

Order PERISSODACTYLA Owen, 1848
Family EQUIDAE Gray, 1821
Subfamily ANCHITHERINAE Leidy, 1869
Genus Anchitherium H. v. MEYER, 1844

Anchitherium aurelianense hippoides (Lartet, 1851)  
Fig. 3.1a, b

1983 Anchitherium aurelianense hippoides (Lartet) - Abusch-Siewert, p. 156.
1990 Anchitherium aurelianense hippoides (Lartet) - Forsten, p. 476.

Material - Right lower jaw, with m1-m3 in situ (1999-MMK2).

<table>
<thead>
<tr>
<th></th>
<th>MMK-2</th>
<th>Pasalar 1</th>
<th>Çandır 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>m1</td>
<td>m2</td>
<td>m3</td>
</tr>
<tr>
<td>L</td>
<td>21.5</td>
<td>20.3</td>
<td>22.2</td>
</tr>
<tr>
<td>MB</td>
<td>15.3</td>
<td>13.2</td>
<td>11.1</td>
</tr>
<tr>
<td>DB</td>
<td>13.8</td>
<td>12.2</td>
<td>10.5</td>
</tr>
<tr>
<td>Me H</td>
<td>9.7</td>
<td>10.2</td>
<td>9.8</td>
</tr>
<tr>
<td>Prd H</td>
<td></td>
<td>11.4</td>
<td>11.0</td>
</tr>
<tr>
<td>L,m1-m3</td>
<td>60.3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


Description - The teeth are medium-sized and little worn (Tab. 2). The m1 is larger than the other molars. The m3 is long and narrow. The protoconid is larger than the hypoconid. Both occur as V-shaped buccal cusps separated by a deep and transverse valley. The paralophid curves posteriorly. The metaconid and metastylid are separated. Their tips are distinct on m1. The metastylid is lower in m2 and m3 than in m1. The lingual groove between the metaconid and metastylid is not distinct. The metaflexid is a shallow valley, and does not reach the base. The entoconid is V-shaped, forms a deep valley, and lacks enamel fold. The anterior cingulum is strong, and surrounds the anterior side. The labial cingulum is well developed and continuous in m1 and discontinuous between cusps in m2. It is weak in m3. A small crest is located between the hypolophid and hypoconulid. There is no lingual cingulum. The heel of m3 is low and vertical.

Comparison - The taxon resembles morphologically Anchitherium aurelianense hippoides from Sansan and La Grive in France (Abusch-Siewert 1983, Pl. 15, Fig. 2; Pl. 7, Fig. 4) and from Pasalar (Forsten 1990). They share the continuous labial cingulum and the separated metaconid and metastylid. However, the teeth from Pasalar are smaller, and the labial cingulum is generally continuous (Forsten 1990). The labial cingulum in the teeth from Sansan is stronger than in the specimen from Kultak. The teeth from La Grive are somewhat smaller, with a continuous and strongly developed labial cingulum and a weak lingual cingulum (Abusch-Siewert 1983). The lower teeth from Kultak resemble those from Çandır. However, there are some differences. In the material from Çandır, the labial cingulum is strongly developed, and the teeth are slightly larger. The specimens from İnönü-1 are clearly smaller, and the heel of m3 is absent in one specimen (Geraeds & Güleç in press).

The teeth from Kultak differ from those of A. aurelianense aurelianense from Sandelzhausen (Abusch-Siewert 1983, Pl. 2, Fig. 1). The Sandelzhausen material is smaller, and has a stronger labial cingulum, a lingual groove between the metaconid and metastylid and a higher heel in the m3. The lower teeth from Kultak are also different from A. a. aure-
**Tethytragus koehleri** Azanza & Morales, 1994

**Description** - The tooth is mesodont and its enamel is fairly rugose. Although broken, the basal pillar exhibits a strong development. The outer lobes of the tooth between the stylids are slightly rounded. The outer lobes of the tooth are angular. The parastylid, metastylid and entostylid are developed. In terms of Köhler's (1993) classification, *Tethytragus (Caprotragoides)* teeth are of the 'squasher type'.

The tip of the horn core, which is inserted above the orbit, is broken. The present length of the horn core is 8.5 cm. The horn core is curved slightly and regularly backwards. The surface of the horn core is irregularly ridged and grooved. The lateral surface is slightly flattened while the medium surface is more convex. The front of the pedicle is higher than the back. The cross-section of the horn core is oval. The supraorbital canal is short. The supraorbital foramina is small and anterointernal to the base of the pedicle. The orbital fossa is fairly deep. According to Köhler's (1993) classification, *Tethytragus (Caprotragoides)* horn represents the 'pusher type'.

---

**Table 3 - Measurements of proximal phalanx of *A. (M.) fraasi*. Dimensions de la phalange proximale de *A. (M.) fraasi***

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MMK.2</strong></td>
<td></td>
</tr>
<tr>
<td>Length</td>
<td>72.4</td>
</tr>
<tr>
<td>Length of metapodial articulation</td>
<td>25.0</td>
</tr>
<tr>
<td>Proximal width</td>
<td>48.4</td>
</tr>
<tr>
<td>Distal width</td>
<td>28.5</td>
</tr>
<tr>
<td>Index I = prox.width x 100/length</td>
<td>68</td>
</tr>
<tr>
<td>index II = distal.width x 100/prox. width</td>
<td>58</td>
</tr>
</tbody>
</table>

---

**Order ARTIODACTYLA Owen, 1848**

**Family BOVIDAE Gray, 1821**

**Genus Tethytragus** Azanza & Morales, 1994

**Tethytragus koehleri** Azanza & Morales, 1994

**Fig. 3.3-4**

---

**References**

1983: Abush-Siewert, Pl. 8, Fig. a) which are smaller, and have a higher and two-pointed heel in the m3.

1987: Caprotragoides potwaricus Pilgrim - Köhler, p. 160-168, text-fig. 34-39, pl. 2.3.

1990: Caprotragoides stehlini Thienius - Gentry, p. 540-542, figs 4 b-c, 5 a-c.


---

**Material** - Left proximal phalanx of digit IV (1999/MMK.1).

**Description** - The proximal part of the phalanx is much broader than the distal part (Tab. 3). The proximal border forms two lobes of which the ulnar (lateral) one is more prominent. There is a pronounced notch between the lobes. The proximal facet is heart-shaped and strongly concave. It faces proximo-dorsally, and occupies less than half the dorsal surface of the phalanx. The distal part consists of the trochlea with median groove and lateral keels. The keels are parallel in the distal part. On the palmar side there is a longitudinal concavity between the keels. The median groove is deep and straight in the volar side. The lateral surfaces of the phalanx are roughened for ligaments. The intermediate volar tubercle is weak.

**Comparison** - The size and morphology of the material from Kultak is similar to *Ancylotherium (Metaschizotherium) fraasi* from Steinheim in Germany (Koenigswald 1932). Both have a heart-shaped proximal facet which faces proximo-cranially, and a large proximal part compared to the distal part.

**The Kultak material resembles Ancylotherium (Ancylotherium) pentelicum (Gaudry & Lartet) from Pikermi and Samos (Gaudry 1862; Schaub 1943) with respect to the proximo-cranial orientation of the proximal facet. The difference comes from the larger-sized, and narrower proximal part in A. (A.) pentelicum. The material from Kultak is also close to *Moropus elatus* Marsh from Nebraska (Holland & Peterson 1914, p. 43) in having the dorsal orientation of the proximal facet, a slightly asymmetrical distal facet, and a narrowing distal part.

A. (M.) fraasi is distinguished from 'Chalicothere' grande Blainville from Devinská Nová Ves in Slovakia (Zapfe 1979). In 'C. grande the proximal facet is flat, almost parallel to the long axis of the bone, and occupies more than half the dorsal surface. A. (M.) fraasi differs from *C. rusingense* Butler (Butleria rusingensis; Bonis et al. 1995) from Rusinga (Kenya) (Butler 1965, Fig. 16C). The latter is a small-sized form, possesses a proximal facet less oblique to the long axis of the bone and has a narrower and smaller proximal facet.
Comparison - Morphologically the tooth from Kultak is close to T. koehlerae from Pasalar (Köhler 1987) and Çandır (Geraads in press). The material from Çandır is the smallest form compared to T. koehlerae in Pasalar, Sarçay (van der Made 1993) and Kultak (Tab. 4). The tooth of T. koehlerae from Kultak is similar to that of T. langai (Azanza & Morales 1994) and Sarçay. Both are characterised by the presence of the strong basal pillar. However, in T. langai the mesostyloid and the entostyloid are weak, the anterior lobes are slightly angular, and the cingulum is well developed (Azanza & Morales 1994).

T. koehlerae has been described in Çandır (Geraads in press) and Inonü (Geraads et al. 1995). The names of Caprotragoidea potwaricus and C. stehtini are used, respectively in Sarçay (Köhler 1987) and Pasalar (Gentry 1990, 1995). The size and morphology of the material from Kultak are close to those of Çandır and Pasalar (Tab. 4).

T. koehlerae differs from T. langai from Arroyo de Val-Barranca and Paracuellos-3 in Spain (Azanza & Morales 1994). The horn core of T. koehlerae is large, with homonym(e) torsion and long pedicel. The frontal sinuses are weak or absent. The cross-sections vary from round to oval (Köhler 1987; Gentry 1990). In T. langai the horn cores are small and narrow, the torsion is heteronym, the pedicel is very short, the frontal sinuses which begin at the base of the pedicle are strong, the ornamentation is continuous, and the cross-section of the horn core is oval. With respect to general shape, Tethytragus 2 stehtini (Thenius) differs from T. koehlerae by having strong frontal sinuses without torsion, and the presence of strong ornamentation (Thenius 1951).

Morphologically the horn-cores of Tethytragus are similar to those of Gentrytragus from the Middle Miocene of Africa and Arabia, but some differences are recognisable. G. gentryi (Thomas) from Ngorora (Kenya) remains poorly known, however G. thomasi (Azanza & Morales) from Fort Ternan (Kenya)
(Aznaga & Morales 1994) has horn-cores with upwards increasing divergence. In Gentytragus there are no frontal sinuses, and the torsion and the ornamentation are strong. T. koehlerae is also different from 'Caprotragoides' potwaricus from Potwar-Nagri and Ramnagar (Pakistan).

PALEOECOLOGY

The small number of fossils permits some restricted indications for a paleoenvironmental reconstruction. Anchitherium has low-crowned teeth, and represents a forest biotope. The lophodont teeth of A. (Metaschwizotherium), with the deeply split ungual phalanx and the elongated arms, indicate the involvement of leafy trees, but Anchylottherium was certainly less restricted to forest environments than the Chalicotheriinae. According to Kühler (1993), Tethyragus (= Caprotragoides) is a very ubiquitous bovid. The morphological characteristics of this species, such as high teeth, orbits, foot type and horn cores indicate an open country.

CHRONOLOGY AND CONCLUSIONS


The size of European Anchitherium increased from the Early Miocene to early Late Miocene (Mayet 1908; Wehrli 1938). It is noted that this occurred irregularly and into differential trends in various parts of Europe (Abusch-Siewert 1983). The Turkish Anchitherium material supports the idea of increase in size from early Middle Miocene to early Late Miocene. However, the dental size cannot be used definitely for stratigraphic purposes (Forsten 1990).

Association of a large Anchitherium with Hipparion occurs in the Vallesian localities, e.g. Esme-Akçaköy, Nombrevilla in Spain, Gaiselberg in Austria and Soblau in France (Becker-Platen et al. 1975; Sondaar 1971). The apparent absence of Hipparion in Kütahya indicates that medium-sized Anchitherium may be confined to the Middle Miocene. The material resembles more the form from the Middle Miocene (Pasalar and Çandır) than that from the Upper Miocene (Esm-Akçaköy).

A. (M.) fraasi is an European element and a rare constituent of the Middle Miocene faunas. A. (M.) fraasi is known from Hader, Sandelzhausen, Steinheim, Viehhausen in Germany, La Grive St.-Alban in France, Krems and Kaisersteinbruch in Austria (Koenigswald 1932; Zapfe 1967, 1974; Coombs 1974, 1989). The chronological range of this species is Middle Miocene-early Vallesian (Coombs 1989). There is no earlier record of A. (M.) fraasi in Turkey.

Tethyragus is a mainly Middle Miocene bovid (Aznaga & Morales 1994). It is known from Pasalar, Çandır, Inönü-1, and Sarçayı, and it has also been reported from the Late Miocene site of Kavakkere (Ankara) (Loc. 34), as 'Caprotragoideis steihlini' (Kappelman et al. 1996). If this identification is correct, Tethyragus might have survived into the Late Miocene in Turkey, but the species Tethyragus koehlerae is only known in the Astaracian.

The chronological age of the above species and the stratigraphic succession of the study area indicate that the Kultak fauna is early Middle Miocene (late Orleanian/early Astaracian) in age.

Acknowledgements - We thank M.C. Coombs (Massachusetts) and A. Forsten (Helsinki) for paleontological data, G. Saraq, F. Goktas and S. Sun (General Directory of Mineral Research and Exploration Institute, Ankara) for stratigraphic data, H. De
Mittmann, H.W. (Eds.), The Evolution of Western Eurasian Neogene Mammal Faunas, Columbia University Press, 7-46.

T. KAYA & V. TUNA
Ege University, Natural History Museum
35100 Bornova/Izmir, Turkey

D. GERAADS
UPR 2147 CNRS, 44 rue de l'Amiral Mouchez
F-75014 Paris