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The Oligocene rodent record of Anatolia: a review

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The succession of rodent faunas of Anatolia from the Eo/Oligecene to the Oligo/Miocene boundary interval is reviewed. Three faunistic phases are distinguished: (A) The Early Oligocene assemblage contains a balanced mainland fauna with genera of Iranian and central Asiatic provenance. Ctenodactylids and murids are dominant, glirids and sciurids are absent. (B) The 'middle' Oligocene assemblages contain impoverished endemic faunas suggesting insulation. Ctenodactylids and murids continue to be dominant, but are now represented by highly specialised local genera and species that have, at least potentially, their ancestry in the fauna of phase A. The presence of the first glirids in the phase B assemblages suggests fauna exchange with Europe, while the dipodids and aff. *Sayimys* show affinities with central Asia. Sciuridae are absent. (C) The Late Oligocene assemblages testify a complete turn-over in the Anatolian rodent fauna and the installment of a new balanced mainland fauna. The establishment of this community was initiated by the immigration (from Iran ?) of the murids *Meteamys*, *Muhsinia*, *Cricetodon* and *Spanocricetodon* who were soon joined by newcomers from Europe (*Melissiodon*, *Paraglirululus*, *Glis* and cf. *Palaeosciurus*) and from central Asia (*Heterosminthus*). The first record of the genus *Enginia*, a murid genus of unknown provenance (Iran?), is from this level also. The endemic Anatolian ctenodactylids and murids became extinct early during phase C, while the first record of ochotonid lagomorphs is from late during this phase.

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INTRODUCTION

The record of the Oligocene rodents of Anatolia has sufficiently improved since our preleminary report on this subject (Ünay & de Bruijn 1987) to allow up-dating and correcting our earlier conclusions. New information shows that fauna exchange between present day Anatolia and the adjacent parts of Europe and central Asia was limited during most of the Oligocene: The Pseudosciuridae, present in European Turkey, do not seem to have reached Anatolia, while another typical European family, the Gliridae, do not show up in Anatolia until the Late Oligocene. The same semi-barrier effect is shown by the near-absence of the Ctenodactylidae, an important component in all early Oligocene Anatolian rodent assemblages, from Thrace

(Ünay 1989). The two areas obviously were parts of different fauna provinces throughout the Oligocene (Saraç, in press), so we shall restrict this analyses to the Oligocene rodents from Anatolia proper. The marked endemism that characterises the Oligocene Anatolian rodent faunas hampers the biostratigraphical correlation of our assemblages with the MP scheme (Schmidt-Kittler, 1987) and the informal biochronology developed for the continental Oligocene of Mongolia by Höck *et al.* (1999).

THE RODENT ASSEMBLAGES

The content of the assemblages from six localities in Anatolia (Fig. 1) is summarised in Figure 2. For the identifications of the genera and species from Süngülü and Inkonak we refer to de Bruijn *et al.* (2003) and de Bruijn *et al.* (1992) respectively, while the data for Yeniköy are revised after Ünay & de Bruijn (1987) and Sümengen *et al.* (1990). The unpublished rodent assemblages from Gözükızıllı and Kargı 1+2 will be briefly discussed below. Age estimates, other than those based on the fossil content of a locality, are available through correlation to the GPTS for Inkonak (best fit 25-26 Ma) and for Yeniköy (29.2 Ma; Krijgsman *et al.* 1996). The other localities have been arranged in stratigraphical order on the basis of their fauna. The older locality Süngülü (samples A, B and C come from the same horizon) is considered to represent the Eocene/Oligocene boundary interval (de Bruijn *et al.* 2003) and the younger locality Kargı 2 the Oligo/Miocene boundary interval.

The assemblage of Süngülü with two species of Ctenodactylidae (Fig. 3 H, I), one Dipodidae and eight Muridae is considered to represent a balanced mainland fauna, yet it contains three genera that are neither known from Europe nor from central Asia. Among the others *Edirnella* and *Lignitella* are known from Thrace only, while two others (*Heosminthus* and *Zhungaromys*) are so far restricted to central Asia. The presence in the Süngülü assemblage of the oldest species of *Paracricetodon* is of special interest because the origin of this genus that appears as an immigrant in Europe during MP 23 was not known. The two remaining murid genera

Figure 1 Map of Turkey showing the approximate position of the localities from which the rodent assemblages discussed were collected. The GPS coordinates of the Oligocene mammal localities in Anatolia: Süngülü N 41 29 35.7, E 42 52 35.8. Yeniköy N 39 06 58.3, E 36 23 00,7. Gözükızıllı N 40 01 10.0, E 34 01 02.3. Inkonak N 39 19 39.2, E 37 08 51.7. Kargı N 40 50 53.2, E 34 52 13.7.

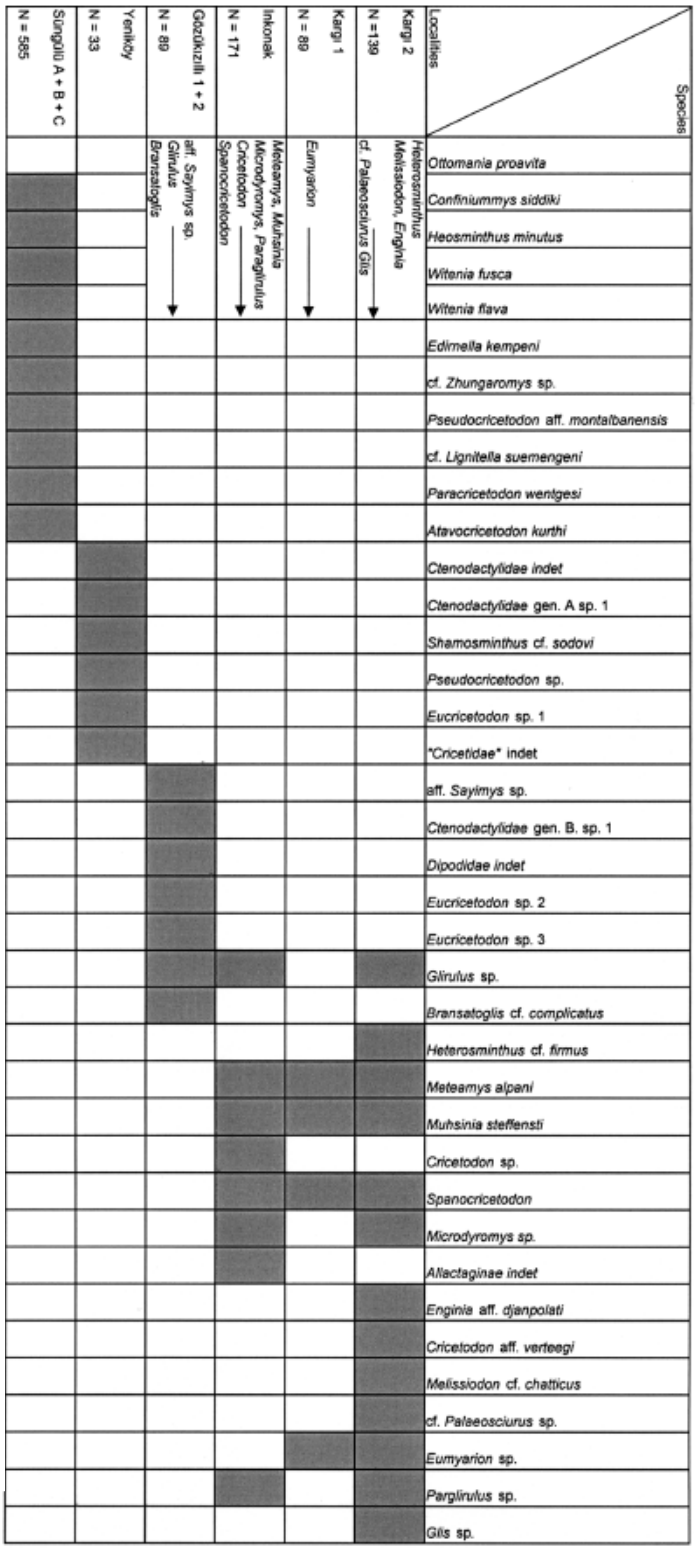

Figure 2 Diagram giving the identifications of the rodents per locality. First occurrences of immigrating genera are indicated by an arrow.

(*Atavocricetodon* (Fig. 3 J) and *Pseudocricetodon*) seem to have had a pan-Eurasian range during the Early Oligocene and do therefore not help in the reconstruction of migration routes. The assemblage from Süngülü thus shows a high degree of endemism. Unambiguous European influence is missing, but there seems to have been limited fauna exchange with central Asia. This conclusion is in perfect agreement with the paleogeographical map of the Paratethys during the Early Oligocene presented by Popov (2001).

The small assemblage from Yeniköy contains exclusively fauna elements that have potentially ancestors in the Süngülü fauna. The small number of species (six) represented may either be due to the small size of the sample, or to endemic isolation. The very unorthodox ctenodactylid genus A, species 1 (Fig. 3 E,F) with its low-crowned lophodont cheek teeth that have thin enamel and lack a longitudinal crest resemble those of theridomyids and glirids in many respects. These features show that it is a highly derived aberrant endemic member of the Ctenodactylidae indicating insulation. This conclusion is supported by the presence of two size groups among the morphologically similar *Eucricetodon* cheek teeth (Fig. 3, G) of the Yeniköy assemblage.

The assemblage from Gözükızıllı contains seven rodent species. Four of these: The ctenodactylid genus B species 1 (Fig. 3 A,B), the dipodid, and the two species of *Eucricetodon* (Fig. 3 C,D) have potentially ancestors in the Süngülü assemblage, but aff. *Sayimys* and the glirids *Glirulus* and *Bransatoglis* represent immigrants. The ctenodactylid genus B species 1 has five-crested upper molars, four-crested lower molars and thin enamel again.The longitudinal crest is weak, but complete. The cheek teeth show a special kind of partial hypsodonty in having a much higher anterior part than posterior part, a configuration that must have inhibited chewing in the longitudinal direction (at right angles to the dominant direction of the lophs). The unusual combination of dental characteristics in this rodent such as high-crowned cheek teeth that lack cement, but have very strong roots shows that we are dealing with a highly specialised aberrant ctenodactylid again. However, the direction of specialisation seen in the dentition of genus A species 1 from Yeniköy is completely different from that in genus B species 1 from Gözükızıllı. We interprete this difference between, what seem to be roughly contemporary ctenodactylids, as indicative for insulation. *Eucricetodon* is represented in the assemblage of Gözükızıllı by isolated cheek teeth in two size groups that show only minor morphological differences (Fig. 3 C,D). In this case there seems no doubt that these size groups represent different, but closely related, species. Associated with these endemic taxa the assemblage from Gözükızıllı contains three newcomers: The ctenodactylid listed as aff. *Sayimys* sp. has, the for members of the family, normal thick enamel and the first Anatolian glirids *Glirulus* and *Bransatoglis*.

The assemblage thus contains a mixture of highly endemic species, a species of presumably central Asiatic origin (aff. *Sayimys*) and two species of European origin (*Glirulus* and *Bransatoglis*). This remarkable mixture is nevertheless interpreted as an island fauna because it is impossible to visualise the Yeniköy and Gözükızıllı assemblages as representing contemporaneous faunas that coexcisted on the same continental block. The paleogeographical map of the Paratethys during the Late Oligocene presented by Popov (2001) does not help to explain the observed faunistic chracteristics, although it suggests that Anatolia and Europe were more closely connected during the Late Oligocene than during the Early Oligocene. Possibly this change in geographical configuration allowed the Gliridae to reach Anatolia

The assemblages from Inkonak (Sivas basin) and Kargı 1 (Dodurga basin) are quite similar (Fig. 2). This similarity is even more striking if it is taken into account that they come from different basins and lithologies. These Late Oligocene assemblages do not

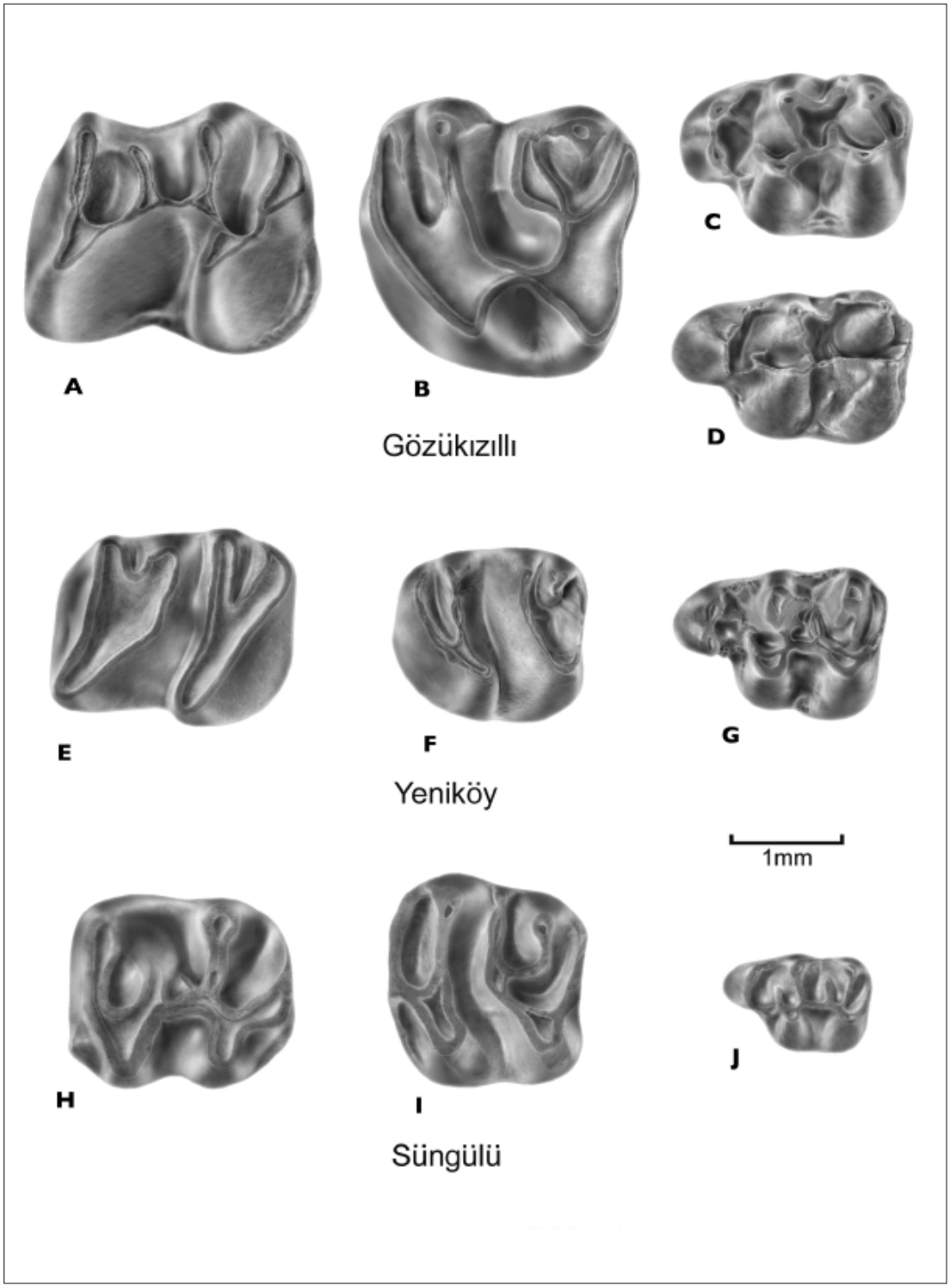

Figure 3 **A** m1 and **B** M2 of Ctenodactylidae gen. B sp. 1 from Gözükızılı. **C** M1 *Eucricetodon* sp. 1. **D** M1 *Eucricetodon* sp. 2 from Gözükızılı. **E** m1 and **F** M1 of Ctenodactylidae gen. B sp. 1 from Yeniköy. **G** M1 of *Eucricetodon* sp. from Yeniköy. **H** m1 and **I** M1 of *Ottomania proavita* from Süngülü. **J** m1 of *Atavocricetodon kurthi* from Süngülü.

share a single genus with those of Gözükızıllı and Yeniköy, which shows that there has been a complete turnover of the Anatolian rodent fauna during the Late Oligocene (between 29.2 and 25-26 Ma). In this process the endemic insular characteristics of the earlier faunas were eraded and a balanced pan-Anatolian mainland fauna settled. The murid genera that are characteristic for this new assemblage of Miocene aspect have no potential ancestors in Anatolia and are obviously immigrants. The origin of these immigrants is uncertain because there is no older record for any of them from anywhere else. It seems clear, however, that they came neither from central Asia, nor from Europe because the endemic Late Oligocene rodent assemblages from these areas are relatively well known. We therefore assume that the murid genera *Meteamys*, *Muhsinia*, *Cricetodon* and *Spanocricetodon* came from Iran over an Elbours-Kopetdagh corridor. This hypothesis matches the paleogeographical reconstruction of the Paratethys during the Late Oligocene presented by Popov (2001) well.

The assemblage from Kargı 2, a locality that is situated some 25 m. above Kargı 1 in the same section (KYB abandoned lignite quarry) is of special interest because it shows that the renewal of the Anatolian rodent fauna discussed above was a process that continued into the Oligo/Miocene boundary interval. The first occurrence of a species of *Enginia* (from Iran?), of *Heterosminthus* (from central Asia), of *Melissiodon* (from Europe?) and of cf. *Palaeosciurus* (from ?) at this level shows that the isolation of Anatolia came to an end during the Early Miocene. The observation that the Oligo/Miocene boundary interval shows a peak in fauna exchange in Anatolia does not match the paleogeographical reconstruction for that period presented by Rögl (2001) because that shows the Anatolian block as an island.

CONCLUSIONS

Analysis of rodent assemblages suggests that the Anatolian block was part of, or connected to, the Iranian block during the Early Oligocene, but isolated from Europe. Fauna exchange with central Asia is restricted to the family Dipodidae during that period. The 'middle' Oligocene assemblages are impoverished, show a high degree of endemism and differ very markedly from each other. This suggests fragmentation of the Anatolian block into a number of islands. The Late Oligocene assemblages show the re-instalment of a pan-Anatolian mainland fauna containing immigrants from Europe, central Asia and probably Iran, suggesting that the isolation of the Anatolian block came to an end.

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