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An Early Miocene microtoid cricetid rodent from the Junggar Basin of Xinjiang, China

OLIVIER MARIDET, WENYU WU, JIE YE, JIN MENG, SHUNDONG BI, and XIJUN NI


Microtoid cricetids are widely considered to be the ancestral form of arvicoline rodents, a successful rodent group including voles, lemmings, and muskrats. The oldest previously known microtoid cricetid is Microtocricetus molassicus from the Late Miocene (MN9, ca. 10–11 Ma) of Europe. Here, we report a new microtoid cricetid, Primoprismus fejferi gen. et sp. nov., from the Junggar Basin of Xinjiang, northwestern China. The rodent assemblage found in association with this specimen indicates a late Early Miocene age, roughly estimated at 18–17 Ma, and thus more than 6 million years older than M. molassicus. While morphological comparisons suggest that the new taxon is most closely related to M. molassicus, it differs from the latter in a striking combination of primitive characters, including a lower crown, smaller size, a differentiated posterolophid and hypolophid, a faint anterolophid, the absence of an ectolophid, and the presence of a stylid on the labial border of the tooth. Arid conditions prevailing across the mid-latitude interior of Eurasia during the Early Miocene, enhanced by the combined effects of the Tibetan uplift and the gradual retreat of the Tethys Ocean, likely played a role in the appearance of grasslands, which in turn triggered the evolution of microtoid cricetids and, ultimately, the origin of arvicoline rodents.

Key words: Mammalia, Rodentia, Cricetidae, Arvicolinae, Miocene, Junggar, China, Central Asia.

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Introduction

Arvicolines, which include voles, lemmings, and muskrats, represent one of the most successful groups of rodents, having colonized all continents except Antarctica and Australia (McKenna and Bell 1997; Musser and Carleton 2005; Fejfar 1999; Fejfar et al. 2011). The group is characterized by hypsodont and prismatic check teeth adapted to hard plant foods (Fejfar 1999; Fejfar et al. 2011). The earliest undoubted arvicoline rodents appeared in northern Eurasia during the Early Pliocene, before rapidly dispersing into North America and southern Asia (Chaline et al. 1999; Fejfar et al. 2011; Musser and Carleton 2005). It is widely accepted that arvicoline rodents are derived from cricetid ancestors (Kretzoi 1955; Zheng and Li 1990; Michaux et al. 2001), with some Late Miocene cricetids from Eurasia and North America showing arvicoline-style cheek teeth with various degrees of hypsodonty and prismatic morphology. The latter are also known as microtoid cricetids, and are believed to have preceded the appearance of true arvicoline rodents (Schaub 1934; Fejfar 1999; Fejfar et al. 2011). Here, we describe a new microtoid cricetid from the Early Miocene deposits of the Junggar Basin in Xinjiang, China. This new record is about 6 million years older that the earliest previously-known microtoid cricetid, Microtocricetus molassicus Fahldusbus and Mayr, 1975 from the Late Miocene (MN9) of Europe (Fejfar 1999), thus indicating a much deeper origin of microtoid rodents than previously assumed.

Geological and paleontological investigations in the Junggar Basin have been going on for more than 50 years. Since the 1980s, the Institute of Vertebrate Paleontology and Paleoanthropology of the Chinese Academy of Sciences, Beijing (IVPP) has been excavating and screen-washing samples from this region every year in order to collect mammalian fossils. During the field season of 2006, a new fossiliferous locality (XJ200604) was discovered about 35 km northwest of Burqin Town (47°58.780’N 86°38.266’E; Fig. 1), northwest of other, previously known Early Miocene localities of the Junggar Ba-
The sediments exposed at this locality belong to an unnamed rock unit consisting of grayish- to blackish-yellow fluvial sandstone and sandy mudstone. Mammalian fossils were discovered in a lens of pebbly coarse sandstone in the basal layer of these fluvial sediments, which overlies the brightly-coloured Irtysh River Formation (Ye et al. 2005), and is separated from the latter by a disconformity. Owing to its central position within Asia (Fig. 1A), this locality plays a crucial role in the dispersion and diversification of mammalian faunas.

The rich and diverse small mammal fauna discovered at this locality includes isolated teeth belonging to Gliridae, Eomyidae, Cricetidae, Aplodontidae, Sciuridae, Mylagaulidae, Erinaecidae and Soricidae, and Lagomorpha. A preliminary study of the small mammals identified two lagomorphs, three glirids (*Miodyromys asiamediae*, *Microdyromys* *aff.* *orientalis*, and one unidentified species of *Eliomys*), four eomyids (*Asia−neomys aff. engesseri*, *Asianeomys* sp., *Keramidomys* sp., and an unidentified eomyid), three cricetids (*Demo−cricetodon* sp., *Cricetodon* sp., and the new microtoid cricetid reported here), and a new species of *Ansomys*. Eight of these taxa are also present or are represented by close relatives in the middle Shanwangian (about 17–18 Ma) Sihong, Gashun−yin'adege, and Suosuoquan S−u faunas (Fig. 2). The association of *Democricetodon* and *Cricetodon* is so far only known from the Early Miocene and early Middle Miocene of China (Wu et al. 2009; Qiu 2010; Maridet et al. 2011b), with *Cricetodon* being replaced by more hypsodont forms such as *Gobicricetodon* and *Plesiodipus* from the late Middle Miocene onwards (e.g., Qiu 1996). The discovery of *Asianeomys* aff. *engesseri* and *Microdyromys aff. orientalis* confirms an Early Miocene age for the locality. However, while *Asia−neomys engesseri* is known from the Suosuoquan Formation Zone II, dated to between 21.7 and 21.9 Ma based on paleomagnetostratigraphic data (Meng et al. 2006), *Microdyromys orientalis* is known from the late Early Miocene Shanwangian locality of Sihong, thus possibly suggesting a younger age for XJ200604. Paleomagnetostratigraphic and isotopic dating suggest that the Shanwang and Sihong localities are about the same age (Deng 2006), with basalts underlying the Shanwang Formation having been dated to 18.05 ± 0.55 Ma (Cheng and Peng 1985). *Keramidomys* sp. and the new species of *Ansomys* from XJ200604 also resemble specimens from Sihong (Qiu 1987) and Gashunyin’adege in Inner Mongolia (Qiu Zhuding, personal communication 2011), thus corroborating a middle Shanwangian age for XJ200604 (Fig. 2).

**Systematic paleontology**

**Order Rodentia Bowdich, 1821**

**Superfamily Muroidea Illiger, 1811**

**Family Cricetidae Fischer de Waldheim, 1817**
Genus *Primoprismus* nov.

**Type species:** *Primoprismus fejfari* sp. nov.; monotypic, see below.

**Etymology:** From the Latin *primo*, first, and *prismus*, prism; in reference to the early trend toward a prismatic morphology displayed by the specimen.

**Diagnosis:** Small-sized cricetid rodent with incomplete lophodonty; low crown with prismatic pattern; metaconid and entoconid located anterior to protoconid and hypoconid, respectively; mesolophid and ectomesolophid developed into...
cuspids; lingual anterolophid absent, and labial one faintly de
developed.

Differs from Microtocricetus Fahlbusch and Mayr, 1975 in its smaller size, lower crown, smaller posterolophid differen
tiated from the hypoconid, the presence of a cingulum on the labial border, and a weakly developed labial anterolophid. Differs from Rotundomys Mein, 1966 in having a well-developed mesolophid and ectomesolophid. Differs from Microto-
scoptes Schaub, 1934, Gomiodontomys Wilson, 1937, Para-
microscoptes Martin, 1975, and Pannonicola Kretzoi, 1965 in its much lower crown and less advanced prismatic morphology. Differs from Ceradentia Mein, Moissenet, and Adrover, 1983, Anatolomys Schaub, 1934, Trilophomys Deperet, 1892, Bjornkurenia Kowalski, 1992, and Baranomys Kormos, 1933 in the absence of a mesodont tooth morphology. Differs from all other cricetids in its anteriorly shifted lingual cuspids and sub-lophodont morphology, and in having the mesolophid and ectomesolophid developed into cuspids. Differs from un-
doubted arvicolines in having roots, the absence of cementum in the re-entrants, and the lack of a true association of pris-
matic and hyposodont morphology.

Primoprismus fejfari sp. nov.

Fig. 3A–C.

Etymology: Named after Oldrich Fejfar, in honor of his work on “microtoid cricetids”.

Holotype: IVPP V18128, one left lower m2, L = 1.25 mm, W = 0.92 mm.

Type locality: Locality XJ 200604, northwestern Junggar Basin, Xinjiang, China.

Type horizon: Early Miocene, about 17–18 Ma.

Diagnosis.—As for the genus.

Description.—The only available tooth has just two roots. The tooth crown is mesiodistally elongated and has a roughly rectangular outline in occlusal view, with the mesial and distal sides of the tooth bearing flat contact facets. Together, these features suggest the tooth to be an m2. The crown is low and marked by a flat occlusal surface. The cuspids are elongated and form an incomplete lophodont pattern. The prismatic morphology, though evident, is not fully developed. The metaconid and entoconid are located anterior to the protoconid and hypoconid, respectively. The lingual anterolophid is absent, while the labial anterolophid is short and weakly developed. The mesolophid and ectomesolophid are developed into elongated cuspids, with the mesolophid forming a transverse crest together with the protoconid, while the ectomesolophid forms an oblique crest with the entoconid. There ectolophid is ab-
sent. A stylid is present on the labial border at the extremity of the ectomesolophid, along with a faint cingulum closing the two labial posterior sinusids. Although both the hypolophid and the posterolophid are elongate and form a nearly trans-
verse posterior crest, they remain clearly differentiuated.

Remarks.—No other murid rodent resembling Primoprismus fejfari has ever been reported from the Late Oligocene–Middle Miocene of Central Asia. Previously reported Early Miocene cricetids from the Junggar Basin, such as Cricetodon

Fig. 3. Left lower m2 of cricetid rodent Primoprismus fejfari gen. et sp. nov. from Junggar Basin, China. IVPP V18128 in occlusal (A), ventral (B), and labial (C) views.
cene locality of Sala in Inner Mongolia likely also belongs to this taxon (Qiu and Li 2003). *Microtocricetus* and *P. fejfari* may be closely related, and share a flat occlusal surface, the development of the ectomesolophid and mesolophid into elongated cuspsids, an incomplete prismatic morphology, and the presence of transverse crests formed by the protoconid-mesolophid and entoconid-ectomesolophid (“external transversal ridge” or “äußerer Quersporn” sensu Fejfar 1999), respectively.

Other Late Miocene microtoid cricetids, such as *Rotundomys* Mein, 1966, *Celadensia* Mein, Moissenet, and Adrover, 1983, and *Blancomys* van de Weerd, Adrover, Mein and Soria, 1977 lack the ectomesolophid. Finally, microtoscopine cricetids, such as *Microtoscopes* Schaub, 1934, *Goniodontomys* Wilson, 1937, *Paramicrotoscopes* Martin, 1975, and *Pannonicola* Kretzoi, 1965, display much more advanced hyposodont and prismatic morphologies.

**Discussion**

Previous authors proposed some general morphological trends for microtoid cricetids and true arvicoline rodents (Fejfar 1999; Fejfar et al. 2011; Chaline et al. 1999). For Late Miocene “microtoid cricetids”, these include an increase in the degree of hypsodonty; reinforcement of the lophodont and prismatic morphologies; the disappearance of cingula and the opening of sinuses/sinusids; and the transformation of anterolophs/anterolophids and posterolophs/posterolophids into transverse crests (Fejfar 1999). By contrast, later arvicoline evolution is characterized by the convergent development of cement in the re-entrant angles of the molars, the gradual disappearance of roots, and the appearance of an enamel tract (Chaline et al. 1999). With regard to these trends, our specimen displays a striking combination of primitive characters compared with Late Miocene microtoid cricetids, include its small size, the retention of roots, a low crown, a differentiated posterolophid and hypolophid, a faint labial anterolophid not developed into a crest, the absence of an ectolophid, and the presence of a stylid on the labial border, with a faint cingulum closing the two labial posterior sinusids. These primitive features suggest that *P. fejfari* is much more archaic than all previously described microtoid cricetids, including *Microtocrisetus molassicus*.

Fejfar et al. (2011) concluded that the morphological peculiarities of *Microtocrisetus* exclude any affinities with other microtoid cricetids, and suggested that *Microtocrisetus* could be an isolated lineage which went extinct before the end of the Miocene. However, the resemblance of *Microtocrisetus* and *Primoprismus* suggests that these two taxa may be related, with *Primoprismus* probably representing a relatively early stage. It should be noted that the labial synclines of *Primoprismus* are not exactly opposite to its lingual antclines, a feature present in some Microtoscopinae (such as *Microtoscopes*, *Paramicrotoscopes* and *Goniodontomys*), but absent in *Microtocrisetus*. However, given its age and retention of many generalized features, it is possible that *Pri-

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References


Fejfar, O. 2011b. Early Miocene cricetids from the Junggar basin (Xinjiang, China) and their biochronological implications. Geobios 44: 445–459.


Munich.


Kormos, T. 1933. Baranomys lóczyi n. g. n. sp. modern arvicorgygos wallar of the magyarország felső pliocénenből (Baranomys lóczyi n. g. n. sp. ein neues Nagetier aus dem Oberpliocän Ungarns). Állattani Közlönyek 30: 45–54.


Kretzoi, M. 1965. Panunomica brevidens n.g. n.sp. ein echter Arvicole aus dem ungarischen Unterpliozän, Vertebrata Hungarica Musei historico-naturals Hungarici 7: 131–139.


basin: implications to related bio-chronostratigraphy and environmental changes. 


Michaux, J. and Catzeflis, F. 2000. The bushlike radiation of muroid rodents 
is exemplified by the molecular phylogeny of the LCAT nuclear gene. 
Molecular Phylogenetics Evolution 17: 280–293.

most speciose mammals: molecular phylogeny of muroid rodents. 


Johns Hopkins University Press, Baltimore.

Prieto, J., van den Hoek Ostende, L.W., and Böhme, M. 2011. Reappear-
ance of Galerita (Erinaceomorpha, Mammalia) at the Middle to Late Miocene transition in South Germany: biostratigraphic and palaeoecologic implications. Contributions to Zoology 80: 179–189.

Qiu, Z.-D. 2010. Cricetid rodents from the early Miocene Xiacaowan, Jiangsu; 

Qiu, Z.-D. 1996. Middle Miocene Micromammalian Fauna from Tunggur, 

Qiu, Z.-D. 2010. Cricetid rodents from the early Miocene Xiacaowan For-

Qiu, Z.-D. and Li, C.-K. 2003. Rodents from the Chinese Neogene: Bio-

Qiu, Z.-D., Wang, X.-M., and Li, Q. 2006. Faunal succession and bio-


Sun, J., Ye, J., Wu, W.-Y., Ni, X., Bi, S.-D., Zhang, Z., Liu, W., and Meng, J. 2010. Late Oligocene–Miocene mid-latitude aridification and wind pat-


and species of the Cricetidae (Mammalia, Rodentia) from the Pliocene of South-Western Europe. Proceedings of the Koninklijke Nederlandse 

noveau Pliopithecus (Primates, Mammalia) associé à des rongeurs 
dans les sables du Miocène supérieur de Priay (Ain, France) et rémar-
qués sur la paléogéographie de la Bresse au Vallesian. Comptes Rendus 

Wilson, R.W. 1937. New Middle Pliocene rodent and lagomorph faunas 
from Oregon and California. Carnegie Institution of Washington Public-
ation 487: 1–19.

Wu, W.-Y. 1988. The first discovery of Middle Miocene rodents from the 

Wu, W.-Y. 1986. The aragonian vertebrate fauna of Xiaocaowan, Jiangsu – 
4. Gliridae (Rodentia, Mammalia) [in Chinese with English summary]. 

Wu, W.-Y., Meng, J., and Ye, J. 2003. The discovery of Pliopithecus from 
northern Junggar basin, Xinjiang [in Chinese with English summary]. 
Vertebrata PalAsiatica 41: 76–86.

Wu, W.-Y., Meng, J., Ye, J., Ni, X.-J., Bi, S.-D., and Wei, Y.-P. 2009. The 
Miocene mammals from Dingshanyanchi Formation of North Junggar 

Wu, W.-Y., Ye, J., Bi, S.-D., and Meng, J. 2000. The discovery of late 
Oligocene Dormice from China [in Chinese with English summary]. 
Vertebrata PalAsiatica 38: 36–42.

Ye, J. 1989. Middle Miocene Artiodactyla from the Northern Junggar Basin 

lithological and biological stratigraphy in the Burqin region of Xinjiang 

Turcocerus from the middle Miocene of the northern Junggar Basin. 
In: Y.Q. Wang and T. Deng (eds.). Proceeding of the Seventh Annual 
Meeting of the Chinese Society of Vertebrate Paleontology, 149–156.

Ocean Press, Beijing.

Fejfar and W.D. Heinrich (eds.), International Symposium: Evolution, 
Phylogeny and Biostratigraphy of Arvicolids (Rodentia, Mammalia), 