



A late Eocene eomyid rodent from the Zaysan Basin of Kazakhstan

Robert J. Emry , Banyue Wang , Ljubov A. Tjutkova & Spencer G. Lucas

To cite this article: Robert J. Emry , Banyue Wang , Ljubov A. Tjutkova & Spencer G. Lucas (1997) A late Eocene eomyid rodent from the Zaysan Basin of Kazakhstan, Journal of Vertebrate Paleontology, 17:1, 229-234, DOI: [10.1080/02724634.1997.10010966](https://doi.org/10.1080/02724634.1997.10010966)

To link to this article: <http://dx.doi.org/10.1080/02724634.1997.10010966>



Published online: 24 Aug 2010.



Submit your article to this journal [↗](#)



Article views: 32



View related articles [↗](#)



Citing articles: 6 View citing articles [↗](#)

A LATE EOCENE EOMYID RODENT FROM THE ZAYSAN BASIN OF KAZAKHSTAN

ROBERT J. EMRY¹, BANYUE WANG², LJUBOV A. TJUTKOVA³, and SPENCER G. LUCAS⁴

¹Department of Paleobiology, National Museum of Natural History, Smithsonian Institution, Washington, DC 20560;

²Institute of Vertebrate Paleontology and Paleoanthropology, Academia Sinica, P.O. Box 643, Beijing 100044, China;

³Institute of Zoology, National Academy of Sciences of the Republic of Kazakhstan, Almaty 480032, Kazakhstan;

⁴New Mexico Museum of Natural History, 1801 Mountain Road NW, Albuquerque, New Mexico 87104

ABSTRACT—*Symplokeomys zaysanicus* is a new genus and species of eomyid rodent from the upper part of the Aksyr Formation of the Zaysan Basin, eastern Kazakhstan. The new taxon differs from other eomyids in having a complex pattern of interconnecting lophules within the central basin of its cheek teeth. Other mammals from the Aksyr Formation indicate an Ergilian (late Eocene) age.

ПОЗДНЕ-ЭОЦЕНОВЫЕ ЭОМИИДНЫЕ ГРЫЗУНЫ ИЗ ЗАЙСАНСКОГО БАСЕЙНА КАЗАХСТАНА

РЕЗЮМЕ

Symplokeomys zaysanicus новый род и вид эомиидного грызуна из верхней части Аксырской формации Зайсанского бассейна восточного Казахстана. Новый таксон отличается от других эомиид по усложненному соединению лофулей с центральным углублением на их щечных зубах. Возраст Аксырской формации по другим млекопитающим определяется как Эргилиан (поздний Эоцен).

INTRODUCTION

During the summers of 1993 and 1994, the Kazakh-American-Georgian Paleontological Expedition spent a total of about 10 weeks engaged in field work in the Zaysan Basin of eastern Kazakhstan (Fig. 1). Much of this work was devoted to screen-washing large volumes of sediment in an effort to obtain samples of small mammals; more than 40 sites were so sampled within the Paleogene sequence exposed there. Several of these sites are within the upper part of the Aksyr Formation (Fig. 1), where it is exposed on the south flank of an anticline on the east side of the Koksaly River. The most productive of these sites has yielded thousands of teeth of small rodents and insectivores, among which were found the teeth of the new genus and species of Eomyidae described herein. This specific site is designated number K10 of the Kazakh-American-Georgian Expedition, but has been called Zertsalo by Russian and Kazakh collectors who have worked there previously (V. Chkhikvadze, pers. comm.). The K10 locality is in thin lenses of coarse, gravelly sandstone at the top of a yellowish gray, muddy siltstone approximately 4 m below the contact of the Aksyr Formation with the overlying Kusto Formation.

Definitions and Abbreviations—The dental terminology used herein is shown in Figure 2, a corrected version of that adopted by Wang and Emry (1991:fig. 2). “IZ NAS RK,” as a prefix to specimen numbers, indicates the Institute of Zoology, National Academy of Sciences, Republic of Kazakhstan; the specimen repository is the Laboratory of Paleozoology of the Institute of Zoology, Almaty.

SYSTEMATIC PALEONTOLOGY

Order RODENTIA Bowdich, 1821

Family EOMYIDAE Deperet and Douxami, 1902

Genus *SYMPLOKEOMYS*, gen. nov.

Etymology—*Symplokos*, Greek, complex, interwoven; *eomys*, common ending for genera of the family Eomyidae.

Type and Only Species—*Symplokeomys zaysanicus*, sp. nov.

Known Distribution—Late Eocene of Eastern Kazakhstan.

Diagnosis—Medium-sized eomyid (Table 1); dental formula: 1/1, 0/0, 2/1, 3/3; cheek teeth brachyodont with distinct main cusps, lophes well developed but lower than main cusps. Differs from all other eomyids in having branching mesoloph and mesolophid contributing to complex pattern of interconnecting lophules in middle syncline and synclinid, P4 with long anteroloph and syncline I.

SYMPLOKEOMYS ZAYSANICUS, sp. nov.
(Fig. 3)

Etymology—“*Zaysanicus*” refers to the type locality in the Zaysan Basin of Kazakhstan.

Holotype—IZ NAS RK (Institute of Zoology, National Academy of Sciences, Republic of Kazakhstan) 35(10)/1843, left m1, Figure 3N.

Paratype—IZ NAS RK 35(10)/1833, right M1 or M2, Figure 3F.

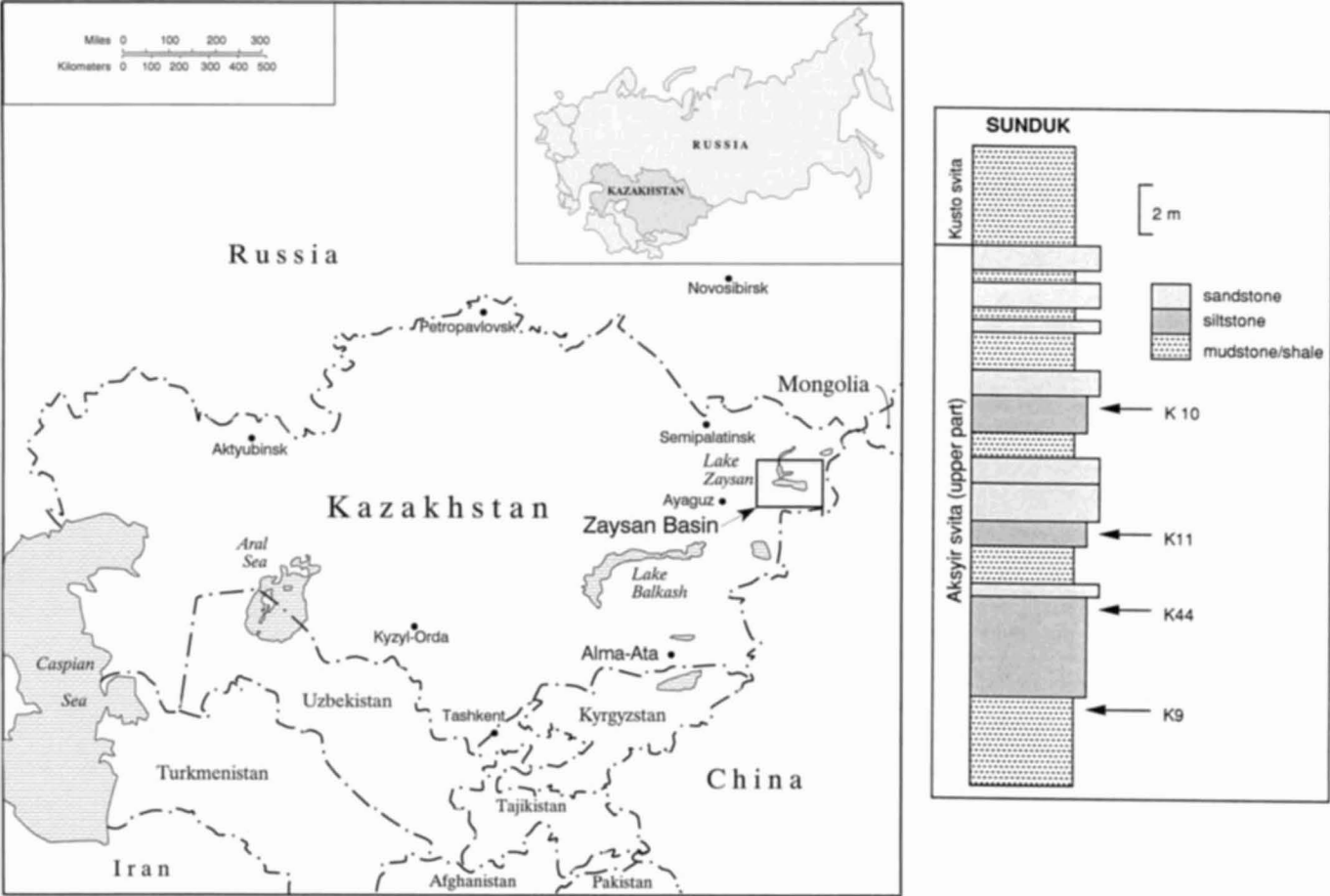


FIGURE 1. Locator map indicating the Zaysan Basin in Eastern Kazakhstan, and schematic stratigraphic section of the upper part of the Aksyir svita at Sunduk. Sunduk is an east-west trending anticline just east of the point where the Chakpaktas and Koksaldy rivers merge to form the Sarybulak River (Russell and Zhai, 1987:fig. 89). The Sunduk anticline exposes at least 20 m of upper Aksyir svita (Formation), including mudstone, shale, siltstone, and very fine-grained sandstone variegated yellowish gray, grayish yellow, and orange. Brown, reddish brown, and gray smectitic shale of the Kusto svita conformably overlie the Aksyir here. Four fossil vertebrate localities occur on the south limb of the anticline: K9, Krassnyy lishanyk (red lichen), at UTM 390055E, 5259733N, zone 45; K44, new unnamed locality at UTM 390098E, 5259564N, zone 45; K11, Rozovyy valun (pink boulder), at UTM 390098E, 5259564N, zone 45; K10, Zertsalo (looking glass), at UTM 390026E, 5259640N, zone 45.

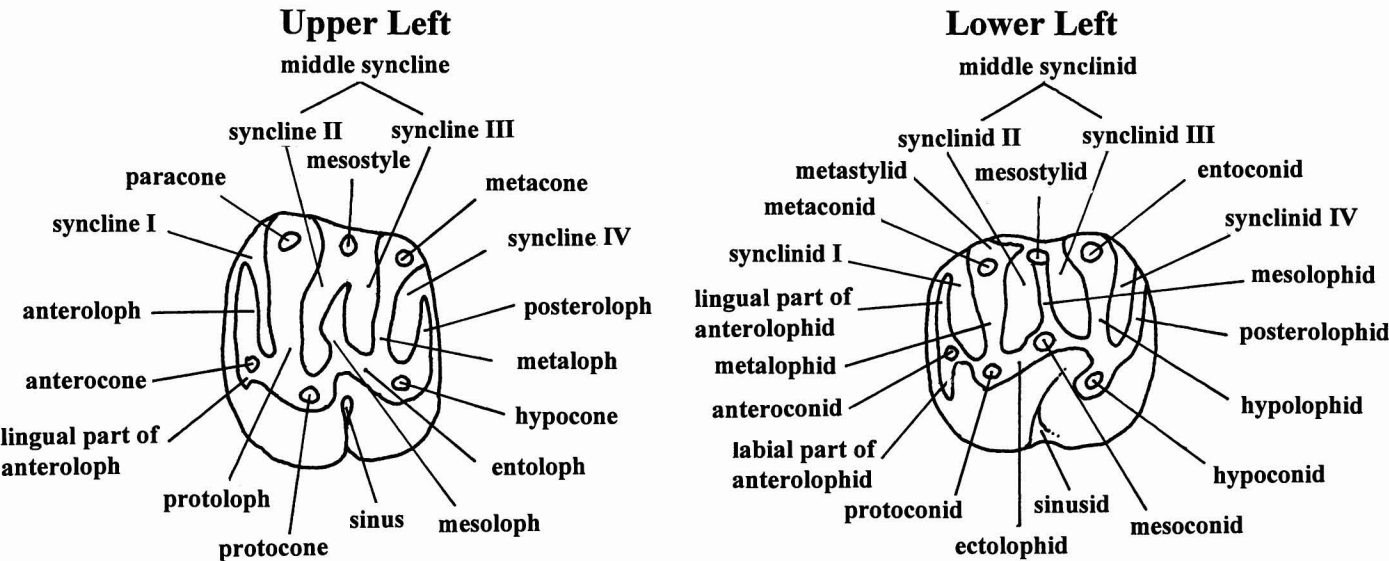


FIGURE 2. Terminology used for the cheek teeth of Eomyidae.

TABLE 1. Measurements in mm of teeth of *Symplokeomys zaysanicus*.

IZ NAS RK 35(10)	Specimens	Length	Width
1828	LDP4	1.44	1.34
1829	LP4	1.63	1.69
1830	LP4	1.51	1.75
1831	LM1 or 2	1.71	1.92
1832	LM1 or 2	1.54	
1833 (paratype)	RM1 or 2	1.64	1.87
1834	RM1 or 2	1.60	1.89
1835	LM3	1.26	1.54
1836	LM3	1.02	1.58
1839	Rp4	1.54	1.41
1840	Rp4	1.44	1.25
1841	Rp4	1.40	1.35
1842	Rp4	1.55	1.52
1943 (holotype)	Lm1	1.86	1.75
1844	Rm1	1.79	1.74
1845	Lm2	1.83	1.71
1846	Lm2	1.81	1.61
1847	Lm2	1.79	1.63
1849	Lm3	1.78	1.49
1850	Lm3	1.65	1.62
1851	Rm3	1.75	1.55
1852	Rm3	1.76	1.54
1853	Rm3	1.76	1.50
1854	Rm3	1.66	1.54

Referred Specimens—All specimen numbers preceded by IZ NAS RK 35(10); “35(10)” indicates region and locality. 1828, left DP4; 1829–1830, left P4s; 1831–1832, left M1 or M2s; 1834, right M1 or M2 (incomplete); 1835–1836, left M3s; 1839–1842, right p4s; 1844, right m1; 1845–1847, left m2s; 1848, left m2 (incomplete); 1849–1850, left m3s; 1851–1854, right m3s.

Horizon and Locality—Aksyir Formation, late Eocene, from Koksaldy River, Zaysan Basin, Kazakhstan (locality no. K10).

Diagnosis—The genus is presently monotypic and the generic diagnosis serves for the species.

Description—The types and all referred specimens consist of isolated teeth, but there is little doubt that a single species is represented: all teeth are from a single site, the upper teeth match the lower ones in size, and all teeth have an unusual, complicated pattern of accessory crests in the central basin. The teeth are brachyodont and lophate, with the primary cusps distinct and the connecting crests well defined but lower.

P4 is trapezoidal in occlusal outline (Fig. 3B–C), with slightly longer anterior and buccal sides. The four main cusps are almost equal in size. The protocone has a well-developed anterior arm extending buccally but has no posterior arm. The transverse lophs are developed. The paracone is elongated into a transversely oriented protoloph, which may be connected with the anterior arm of the protocone forming a continuous loph (no. 1829), or may fail to contact the protocone, being separated from it by a very narrow fissure. The metacone is transversely elongate, parallel to the protoloph and forming a metaloph that connects with the anterior arm of the hypocone. The anterior arm of the hypocone (=entoloph) is very long and extends anterobuccally toward the paracone; its anterobuccal end may be free (no. 1829) or may join with the protoloph (no. 1830). The mesocone varies from distinct to indistinct. The mesostyle is small but distinct, and is unusual in that it divides lingually into two branches, the anterior one reaching the anterior end of the entoloph, and the posterior one meeting the metaloph; the anterior branch probably represents the true mesoloph. The two lingual branches are uneven and sometimes have additional branches or small spurs. Therefore, the middle syncline is full of interconnecting, thin crests. The anteroloph and syncline I are longer than half the width of the tooth. The lingual end of

the anteroloph connects to the anterior arm of the protocone, i.e., there is no free lingual part of the anteroloph. Synclines I, II, and III are open buccally. The posteroloph is retreated buccally, and syncline IV may be open or closed buccally. In either case, the posteroloph and syncline IV are longer than their anterior counterparts, and syncline IV may be equal to or longer than the middle syncline (nos. 1829–1830). The sinus is long transversely, curved, oblique anterobuccally, and may be continuous with either syncline I (no. 1830) or II (no. 1829). One of the P4s (no. 1830) has a distinct, small wear facet near the center of its anterior surface, indicating that a small P3 was present during life.

DP4 (Fig. 3A) is smaller and proportionally narrower than the P4. Protoloph and metaloph are both complete, convex anteriorly, and parallel to each other. As on P4, the anteroloph is longer than half the width of the tooth, but it differs from that of P4 in its connection to the protoloph; at its buccal end is an accessory cuspule that partially dams the buccal exit of the first syncline. The latter opens both buccally and lingually, but is separated into two parts by a thick spur from the protoloph. The mesostyle is also distinct and extends lingually forming a mesoloph, which is single, does not reach the entoloph, and lacks the distinct fork and other complications seen in P4. The mesocone is distinct and has an anterobuccal projection that fails to meet the protoloph. The protocone has a weak posterior arm that almost reaches the mesocone to close an isolated basin between them. The sinus is transverse and symmetrical; at its buccal end is an accessory cusp. The posteroloph is not complete; it terminates at a slightly swollen lingual end, which is separated from the hypocone by a distinct groove. All four synclines are open buccally.

DP4 has a small wear facet on its anterior surface, indicating the presence of either DP3 or P3, probably the former.

In this sample, consisting only of isolated teeth, M1 cannot be distinguished with certainty from M2; both are probably represented and are so similar that one description can apply. In occlusal outline, these teeth are rounded rectangles, slightly wider than long (Fig. 3D–G). The protoloph is complete, oriented nearly directly transversely, but slightly convex anteriorly. The metaloph is also complete, and usually somewhat more convex anteriorly than the protoloph. The entoloph, connecting protocone with hypocone, is complete and is concave lingually. As on P4, the middle syncline has a complex pattern of crests, but the pattern differs in details from that on P4. The mesoloph is long and complete, extending from the entoloph to a distinct mesostyle; on some specimens, it is slightly oblique, less straight, and develops several small branches. Between the protoloph and mesoloph, an accessory spur extends anterobuccally from the entoloph, dividing into several branches before terminating. The anteroloph and syncline I are relatively longer than on P4, extending much beyond half the width of the tooth before connecting to the anterior arm of the protocone. No lingual part of the anteroloph is present. The posteroloph is longer than the anteroloph. Some specimens have small cusps or spurs on the anteroloph and posteroloph. Synclines II and IV are about equal in length and longer than syncline I; syncline III is the shortest, about half the width of the tooth. All four synclines are open buccally. The sinus is long transversely and oblique anteriorly.

In occlusal outline, M3 is a broad, rounded triangle (Fig. 3H–I). The anterior part is similar to the comparable part of M1 or M2: the protoloph is complete, and the anteroloph and syncline I are long (much greater than half of the tooth width). The posterior part of M3 is much reduced but complexly filled with thin, interconnecting crests. The metacone and hypocone are both much smaller and are connected to each other by short posteroloph and metaloph. The latter is irregular and concave posteriorly. Syncline VI is a closed basin, which is separated

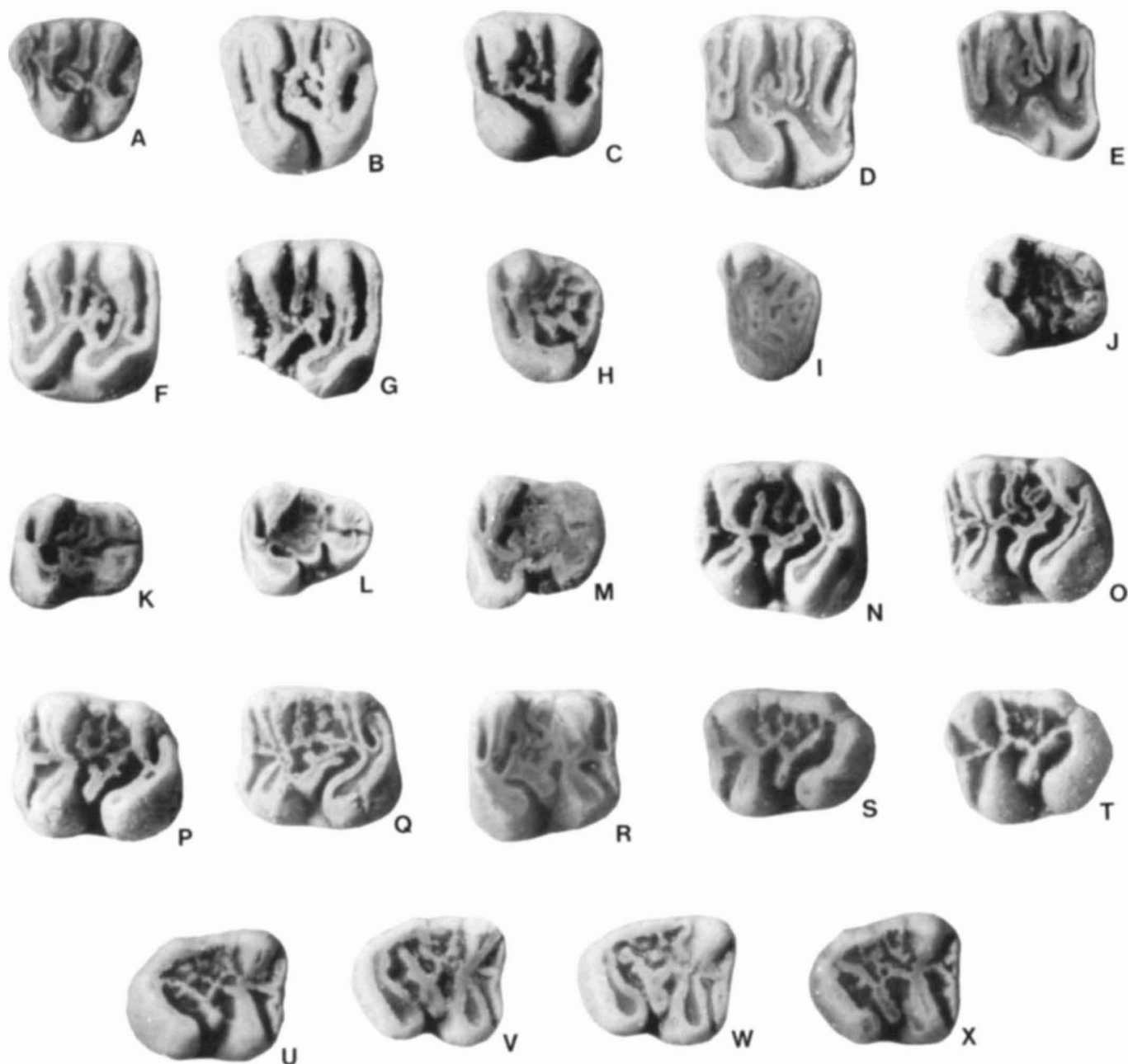


FIGURE 3. Cheek teeth of *Symplokeomys zaysanicus*, gen. et sp. nov. All specimen numbers are preceded by IZ NAS RK 35 (10). A, 1828, left dP4; B, 1829, left P4; C, 1830, left P4; D, 1831, left M1 or M2; E, 1832, incomplete left M1 or M2; F, 1833, right M1 or M2, paratype; G, 1834, incomplete right M1 or M2; H, 1835, left M3; I, 1836, left M3; J, 1839, right p4; K, 1840, right p4; L, 1841, right p4; M, 1842, right p4; N, 1843, left m1, holotype; O, 1845, right m2; P, 1846, right m2; Q, 1847, right m2; R, 1844, left m1; S, 1849, right m3; T, 1850, right m3; U, 1851, left m3; V, 1852, left m3; W, 1853, left m3; X, 1854, left m3. All approximately $\times 15$, scale bar = 1 mm.

into two parts by a lower longitudinal crest. On the buccal margin of the tooth, a crest (= ectoloph?) connects the metacone and mesostyle, and nearly reaches the base of the paracone to close the buccal exit of the middle syncline. The entoloph is also curved. An accessory spur from the entoloph projects anterobuccally and has a branch reaching the protoloph. Between the protoloph and metaloph are two rough transverse lophules: the anterior one extends obliquely from the mesostyle to the base of the protoloph; the posterior one extends inward from

the ectoloph, gives off several short branches, and ultimately meets or nearly meets the accessory spur from the entoloph. The sinus is divided by a crest from the hypocone to the protocone, resulting in a small, closed basin and a shallow, lingual groove.

The p4 is trapezoidal in occlusal outline (Fig. 3J–M). The trigonid is narrower and slightly higher than the talonid. The protoconid and hypoconid are directly opposite the metaconid and entoconid, respectively. The bulbous protoconid and meta-

conid are about equal in size and close to each other in position. The trigonid basin is a very narrow groove open anteriorly and posteriorly. The posterior arm of the protoconid is usually present (three of four specimens), but may or may not reach the posterior base of the metaconid. A posterior crest from the metaconid extends toward the entoconid to close or almost close the middle synclinid. The entoconid and hypoconid are also distinct and about equal in size, but are more widely separated than the anterior cusps. The hypoconid sweeps anteriorly. The hypolophid is oblique posteriorly and meets the posterolophid. The lingual part of the posterolophid is short transversely and retreated from the lingual side. The synclinid IV is also short transversely and may be open (two of four specimens) or closed at the lingual exit (two of four specimens). The ectolophid is usually a straight connection from the protoconid to the hypoconid (four of five specimens); on one specimen (no. 1839) it is curved and crossed by a well-developed, transverse, "S-shaped" crest composed of a long mesolophid, the mesoconid, and a short ectomesolophid. On this particular p4, the sinusid is separated into two parts, and there are accessory crests from the ectolophid anterior to the mesolophid and ectomesolophid, respectively. Each of the other p4s has a distinct mesoconid, a short oblique crest extending from the ectolophid behind the mesoconid, and a broad shallow sinusid. In the middle syncline is a complex pattern of folded and interconnected thin crests. One p4 (no. 1842) has a small ectomesostylid in the sinusid.

In occlusal outline, m1 is nearly rectangular (Fig. 3N, R); it is distinguished from m2 by being slightly narrower anteriorly than posteriorly, whereas m2 is slightly narrower posteriorly. Of the four main cusps, the metaconid and hypoconid are larger than the other two. The distinct anterolophid is isolated, with both ends free, so that synclinid I opens both lingually and buccally. A short ridge extends backward from the middle of the anterolophid to meet or nearly meet the metalophid. The metalophid is complete, widely V-shaped anteriorly, and composed of arms of protoconid and metaconid. The hypolophid is a slightly narrower "V," composed of obliquely oriented entoconid and hypoconid. The posterolophid originates at the apex of this "V" and continues to the posterolingual edge of the entoconid, enclosing a narrow synclinid IV. A distinct mesostylid is present, more closely associated with the metaconid than with the entoconid; it restricts, but does not dam, the exit of the middle synclinid. From a well-developed mesoconid, crests extend anterolingually and posterolingually (together these form a variant of the ectolophid). The anterolingual branch of this ectolophid curves forward and meets at a triple junction two other crests, a short one that connects to the protoconid part of the metalophid, and a longer one, the "mesolophid" (quotation marks indicate uncertain homology), directed lingually toward, but not quite to, the mesostylid. The posterolingual branch of the ectolophid parallels the oblique hypoconid, and on the holotype (no. 1843), connects to the entoconid part of the hypolophid; on no. 1844, it hooks backward at its posterolingual end to connect to the hypoconid part of the hypolophid. The sinusid is Y-shaped about the buccal, free end of the mesoconid, which basally is more closely associated with the protoconid than with the hypoconid. A horse-shoe-shaped accessory crest is present in the middle syncline. The ectomesostylid may be distinct or indistinct.

The m2 is distinguished from m1 by being slightly narrower posteriorly than anteriorly (Fig. 3O–Q). It is otherwise generally similar to m1, but differs in several details: the posterolophid and synclinid IV are relatively shorter; the mesostylid is situated at the lowest part of the entolophid, more nearly blocking the exit of the middle synclinid; in some specimens the "mesolophid" reaches the lingual margin between the metaconid and mesostylid; the posterolingual branch of the ectolophid connects with the entoconid part of the hypolophid in all

cases; in some specimens the anterolingual branch of the ectolophid is short with a free end, not connected to the "mesolophid." The buccal end of the mesoconid may merge basally with the protoconid to partially close the anterior branch of the Y-shaped sinusid. Small accessory crests, variable in shape, are present in the middle synclinid.

The occlusal outline of m3 approximates an oval with a convex posterior side (Fig. 3S–X). The anterior part is similar to that of the two anterior molars. The mesoconid is also well developed, with anterobuccal and posterolingual projections forming the ectolophid. The anterolingual one is usually long and reaches the "mesolophid" (two of six teeth) or metalophid (three of six teeth), as on the anterior molars, but the posterior one continues directly to the posterolophid. No indication of the hypolophid is present. The hypoconid is as well developed as on the more anterior molars, but the entoconid is much smaller and less distinct. The hypoconid, posterolophid, and entoconid form a continuous curved crest. The middle synclinid is closed. In the middle syncline, there are also irregular crests. The sinusid is usually Y-shaped (four of six teeth), but in two examples, the anterior part of the Y-shaped sinusid is closed or nearly closed by the approximation of the mesoconid and the protoconid.

Comparisons and Discussion—All known specimens of *Symplokeomys zaysanicus* are isolated teeth, making it difficult to assess the position of this taxon within the Eomyidae. However, the teeth do have some information bearing on phylogeny.

A small wear facet on the anterior surface of dP4, and on at least one of the P4s, indicates the presence of dP3 in the deciduous dentition, and in at least some individuals, either P3 or retained dP3 in the permanent dentition. The resulting dental formula, 1/1, 0/0, 2/1, 3/3, is otherwise seen in Eomyidae only in the Subfamily Yoderimyinae (Emry and Korth, 1993). However, *Symplokeomys* differs greatly from yoderimyines in other details of tooth morphology: occlusal pattern more complex, no lingual part of anterior cingulum, no anteroconid on p4, hypolophid joins posterolophid, and smaller synclinid IV. The apparent presence of P3 is a primitive character shared by Yoderimyinae and *Symplokeomys*; instead of indicating close relationship, it simply indicates retention of a primitive character in two independent lineages of Eomyidae.

Symplokeomys differs from other known eomyids in having a complex of interconnecting lophules in the middle syncline and synclinid. This complexity invites comparison to several taxa from the middle to late Eocene of North America that have been referred to the family Eutypomyidae. The most similar of these, superficially, is *Microeutypomys karenae* Walton, 1993 from the middle Eocene of Texas. Somewhat less similar is *M. tilliei* (Storer, 1988), from the late Eocene of Saskatchewan. When one looks beyond this superficial complexity to the underlying, basic tooth structure on which it is imposed, the comparisons between *Symplokeomys* and *Microeutypomys* begin to break down. In the upper cheek teeth of *Symplokeomys*, the typical eomyid five-crested pattern clearly underlies the secondary complexity (Fig. 3A–G), and the connections between the primary crests follow the pattern typical of eomyids. In *Microeutypomys*, the central basin of the upper cheek teeth is filled with a complicated pattern of secondary ridges and cusps (Walton, 1993:fig. 1A–G), but it is not apparent that these mask a mesoloph, or even that they might have been derived from a mesoloph. In addition, the crest connections of *Microeutypomys* differ from the typical eomyid pattern; for example, the protocone seems to be more strongly associated with the anteroloph in *Microeutypomys* (see Walton, 1993:fig. 1A–G), whereas in *Symplokeomys*, it is most strongly connected with the paracone (Fig. 3B–G). Similarly, differences are seen between the lower cheek teeth of the two genera. In *Symplokeomys*, the metaconid and protoconid have a direct connection,

forming a strong transverse loph (Fig. 3N–X); in *Microeutypomys* (Walton, 1993:fig. 1K–O), the metaconid has a direct connection to the buccal part of the anterolophid, and the connection between metaconid and protoconid is secondary and weak. In *Symplokeomys*, the anterolophid of the lower molars (Fig. 3N–X) is a sharp transverse crest with distinct buccal and lingual ends free, and with a short crest connecting backward to the center of the metalophid. In contrast, the anterolophid in the lower molars of *Microeutypomys* has neither end free; its lingual part connects to the anterolingual part of the metaconid, and its buccal part connects via a secondary lophid to the buccal surface of the metaconid. The similarity between *Symplokeomys* and the small, early eutypomyids is in the secondary complexity that overlies a basic structure that has significant differences.

Nothing in the morphology of *Symplokeomys* suggests any special relationship to any of the eomyids from Nei Mongol, China, described by Wang and Emry (1991). *Symplokeomys* may represent an otherwise unknown distinct branch of eomyids, perhaps endemic to Asia.

Shevyreva (1993) described *Zaisaneomys eos* as a new genus and species of Eomyidae from the middle Eocene (late early Eocene of Shevyreva) Obayla Svita of the Zaysan Basin. The species is known only from the holotype, a single, very small tooth that Shevyreva (1993) believed compared most closely to the North American eomyid genus *Namatomys*. Certainly *Zaisaneomys eos* has nothing in common with *Symplokeomys*, and, if Shevyreva's description and figure are accurate, it seems doubtful that *Zaisaneomys eos* is even an eomyid; its morphology is more consistent with that of the small Eocene zapodids and cricetids of Asia (see, for example, Tong, 1992; Wang, 1985; Wang and Dawson, 1994).

AGE

There seems to be little doubt that the age of the upper part of the Aksyr Formation correlates with the Ergilin Dzo Formation of Mongolia, and therefore can be assigned to the Ergilian Asian Land Mammal Age of Russell and Zhai (1987).

In addition to *Symplokeomys zaysanicus*, described above, the rodents from site K-10 are tentatively identified as follows: at least three species of Zapodidae (*Sinosminthus* sp., *Allosminthus* sp., cf. *A. ernos*, *Allosminthus* sp., and *Heosminthus primiveris*), one of Cricetidae (*Eucricetodon* sp.), one of Cylindrodontidae (*Ardynomys* sp.), and at least one of Ctenodactylidae (cf. *Karakoromys*).

Site K-10 also produces teeth of a small herpetotheriine didelphid marsupial, tentatively referred to *Asiadidelphis zaisanense* Gabunia, Shevyreva, and Gabunia, 1990, the holotype of which is from a nearby locality at a slightly lower stratigraphic level within the Aksyr Formation.

Very few large mammals have been reported from the upper part of the Aksyr Formation. Gabunia (1977) reported an indeterminate anthracothere, the anthracothere *Brachyodus*, and the leptomerycid *Archaeomeryx*. The presence of *Brachyodus*, otherwise a Miocene taxon, seems unlikely (Russell and Zhai, 1987). Large mammals from stratigraphically lower in the Aksyr Formation, such as the amynodontid *Zaisanamynodon borisovi*, and from the Kusto Formation, which overlies the Aksyr, such as the amynodontid *Cadurcodon ardynensis* (= *Cadurcodon tuskabakensis*) and the entelodontid *Entelodon gobiensis*,

suggest an Ergilian (late Eocene) age (Emry et al., 1995; Lucas et al., 1995).

ACKNOWLEDGMENTS

For their assistance in various aspects of the field work we thank Bolat Bayshashov, Aijan Djamangaraeva, Vladimir Gurov, Elena Kordikova, and Pyruza A. Tleuberdiva (Kazakh Academy of Sciences); Viaceslav Chkhikvadze (Georgian Academy of Sciences); Alexandr Karhu (Russian Academy of Sciences); Brian Stafford and Frederick Szalay (Hunter College, New York); Peter Reser (New Mexico Museum of Natural History); and Frederick Grady (Smithsonian Institution). We thank Nadezhda Kyzjakova, Oksana Pita, and Nasima Nurfeizova for their long hours spent carefully sorting concentrate. For their help with the illustrations, we thank Peter Kroehler and Steven Jabo (Smithsonian). Irina Koretsky provided the Russian language abstract, for which we thank her. The manuscript was improved by two careful, anonymous reviewers.

LITERATURE CITED

- Emry, R. J., L. A. Tjutkova, B.-y. Wang and S. G. Lucas. 1995. The Ergilian-Shandgolian (Eocene-Oligocene) transition in the Zaysan Basin of Kazakhstan. *Journal of Vertebrate Paleontology* 15 (Supplement to no. 3):27A.
- and W. W. Korth. 1993. Evolution in Yoderimyinae (Eomyidae: Rodentia), with new material from the White River Formation (Chadronian) at Flagstaff Rim, Wyoming. *Journal of Paleontology* 67:1047–1057.
- Gabunia, L. K. 1977. Contribution à la connaissance des Mammifères paléogènes du Bassin de Zaïssan (Kazakhstan central); in *Faunes de Mammifères du Paléogène d'Eurasie*. Géobios, Mémoire spécial 1:29–37.
- , N. S. Shevyreva, and V. Dzh. Gabunia. 1990. Novyye oposum (Didelphidae, Marsupialia, Metatheria, Mammalia) iz nizov oligotsena Zaysanskoy vpadiny (Vostochnyy Kazakhstan). *Paleontologicheskii Zhurnal* 1990:101–109 (in Russian).
- Lucas, S. G., R. J. Emry, and B. U. Bayshashov. 1996. *Zaisanamynodon*, a late Eocene amynodontid (Mammalia, Perissodactyla) from Kazakhstan and China. *Tertiary Research* 17:1–8.
- Russell, D. E., and Zhai, R.-j. 1987. The Paleogene of Asia: mammals and stratigraphy. *Mémoires du Muséum National D'Histoire Naturelle*. Sciences de la Terre Tome 52:1–488.
- Shevyreva, N. S. 1993. A new eomyid (Eomyidae, Rodentia, Mammalia) from the Paleogene of Asia (The Zaysan Basin of Eastern Kazakhstan). *Paleontological Journal* 27:134–139.
- Storer, J. E. 1988. The rodents of the Lac Pelletier lower fauna, late Eocene (Duchesnean) of Saskatchewan. *Journal of Vertebrate Paleontology* 8:84–101.
- Tong, Y. 1992. *Pappocricetodon*, a pre-Oligocene cricetid genus (Rodentia) from central China. *Vertebrate Palasiatica* 30:1–16.
- Walton, A. H. 1993. A new genus of eutypomyid (Mammalia: Rodentia) from the middle Eocene of the Texas gulf coast. *Journal of Vertebrate Paleontology* 13:262–266.
- Wang, B.-y., 1985. Zapodidae (Rodentia, Mammalia) from the lower Oligocene of Qujing, Yunnan, China. *Mainzer Geowissenschaftliche Mitteilungen* 14:345–367.
- and M. R. Dawson. 1994. A primitive cricetid (Mammalia: Rodentia) from the middle Eocene of Jiangsu Province, China. *Annals of Carnegie Museum* 63:239–256.
- and R. J. Emry. 1991. Eomyidae (Rodentia: Mammalia) from the Oligocene of Nei Mongol, China. *Journal of Vertebrate Paleontology* 11:370–377.

Received 14 July 1995; accepted 28 April 1996.