ISSN 0012-4966, Doklady Biological Sciences, 2015, Vol. 460, pp. 23–26. © Pleiades Publishing, Ltd., 2015.
Original Russian Text © A.S. Tesakov, A.V. Lopatin, 2015, published in Doklady Akademii Nauk, 2015, Vol. 460, No. 1, pp. 118–121.

First Record of Mylagaulid Rodents (Rodentia, Mammalia) from the Miocene of Eastern Siberia (Olkhon Island, Baikal Lake, Irkutsk Region, Russia)[1]

A. S. Tesakov[a] and Corresponding Member of the RAS A. V. Lopatin[b]

Received July 10, 2014

Abstract—A new genus and species of rodent, Lamugaulus olkhonensis, belonging to the subfamily Promylagaulinae of the family Mylagaulidae, is described on the basis of isolated teeth from the Khalagay Formation of the Lower Miocene Tagay locality (Olkhon island, Lake Baikal, Irkutsk Region). This is the first record of mylagaulids in Eastern Siberia, significantly expanding the data on the distribution of this mainly North American group of rodents in Asia and showing its presence outside the Central Asian arid zone.

DOI: 10.1134/S0012496615010032

Fossil rodents of the family Mylagaulidae were widespread in the Oligocene and Miocene of North America [1]. The general trend of dental structure changes in this family was the progressive hypsodonty, the increasing crown height of the molars as an adaptation to the fossorial life mode and feeding on plant roots. The advanced forms show diminution and loss of some molars and formation of horn-like processes on nasal bones [2]. In the 1970s, the first remains of mylagaulids were identified outside North America, in the Middle Miocene of the Zaysan Depression in Eastern Kazakhstan [3]. Later remains of mylagaulids were found in the Middle Miocene in the nearby area of North China [4, 5]. These two geographically and stratigraphically close records represented the only evidence of the spread of this group of American rodents into Eurasia. Recently, mylagaulids were found at the Tagay locality, in the Khalagay Formation of the Late Cenozoic continental sequence of Olkhon Island (Lake Baikal, Irkutsk Region).

The vertebrate fauna of Tagay, studied by Russian researchers since the 1960s [6], includes numerous large and small mammals. The small mammals are dominated by Cricetodontidae, Cricetidae, Aplodontidae, Sciuridae, Gliridae, and Eomyidae. The age of the Tagay fauna is estimated from the Early Miocene (MN3–MN4 biochrons of the continental scale) [7–9] to the end of the Middle Miocene (MN7-8) [10]. The set of biostratigraphic data (composition of artiodactyls, primitive evolutionary stage of the genus Cricetodon, presence of aplodontid and primitive mylagaulid) indicates the Early Miocene age of the fauna. Below, we describe the third and the oldest record of mylagaulids in the Old World. The material was collected in 2012 by the joint field party of the Zoological Institute, the Institute of the Earth Crust and the Krasnoyarsk regional museum. It is stored in the Geological Institute of the Russian Academy of Sciences (GIN), Moscow.

Order Rodentia Bowdich, 1821

Family Mylagaulidae Cope, 1881

Subfamily Promylagaulinae Rensberger, 1980

Genus *Lamugaulus* Tesakov et Lopatin, gen. nov.

Etymology. After Lamu (Evenkian, Baikal) and gaulus (Greek, bowl), the suffix of generic taxa in the family.

Type species. *L. olkhonensis* Tesakov et Lopatin, sp. nov.

Diagnosis. Small member of subfamily with mesodont prismatic single-rooted cheek teeth. Aplodontoid cuspate structure in occlusal surface of cheek teeth preserved in early and middle wear stages. Wear forms five major fossettes on upper and three fossetids on lower teeth. Premolars slightly enlarged, first and second molars approximately equal in length. Upper cheek teeth show well developed mesofossete and distinct but small mesostyle. Lower cheek teeth with poorly expressed mesoconid, and usually well developed ectostylid, and metastylid crest. Mesostylid crest absent.

Species composition. Type species.

Comparison. From *Tschalimys* Shevyreva, 1971, including Sinomylagaulus Wu, 1988 and *Simpligaulus* Wu et al., 2013, differs in less developed hypsodonty

[1] The article was translated by the authors.

[a] *Geological Institute, Russian Academy of Sciences, Pyzhevsky per. 7, Moscow, 119017 Russia*
[b] *Paleontological Institute, Russian Academy of Sciences, Profsoyuznaya ul. 123, Moscow, 117997 Russia*

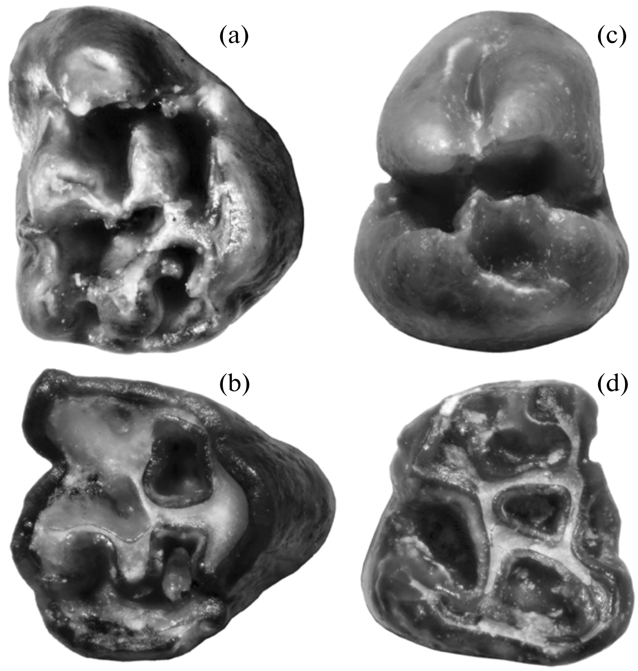

Fig. 1. *Lamugaulus olkhonensis* sp. nov., isolated teeth in occlusal view: (a) holotype GIN, no. 1138/02, right P4; (b) specimen GIN, no. 1138/15, right M1/2; (c) specimen GIN, no. 1138/11, left p4; (d) specimen GIN, no. 1138/07, left m1/2.

and better developed mesoconid. From *Promylagaulus* McGrew, 1941, in well developed mesofossete in the upper cheek teeth, and in well developed ectostylid in the lower cheek teeth. From *Crucimys* Rensberger, 1980, in lack of mesostylid crest, and in a well developed metastylid crest; from *Trilaccogaulus* Korth, 1992, in lower hypsodonty, presence of ectostylid, and in stronger reduction of mesoconid; from *Mylagaulodon* Sinclair, 1903, in lower hypsodonty, less developed mesostyle, reduction of root numbers in P4 to one; from *Mesogaulus* Riggs, 1899 and *Galbreathia* Korth, 1999, in considerably lower hypsodonty, stronger mesoconid reduction, in slight enlargement of premolars, and unreduced length of first molars.

Lamugaulus olkhonensis Tesakov et Lopatin, sp. nov.

Etymology. From the island of Olkhon.

Holotype. GIN, no. 1138/02, right upper premolar, P4; Irkutsk region, Olkhon district, 10 km west of the Khuzhir settlement, Tagay Bay, Tagay locality; Lower Miocene, Khalagay Formation.

Description (Fig. 1). P4 is the largest of the upper cheek teeth. It has an elongated oval shape with straight labial and convex lingual edges. Nearly unworn specimen (Fig. 1a) has cuspate structure. Anterocone is large, mediolaterally elongated, sickle-shaped. Anterocone connects to protocone by a lingual branch of anteroloph with developed anterostyle. Labially from strong protocone runs the protoloph with protoconule and paracone, and metaloph with metaconule and metacon. Mesostyle is well expressed slightly distally off the midpoint of the labial edge of the tooth. The valleys (flexi) are deep. The anterior valley uniting connected paraflexus and protoflexus is bounded by anterocone and protoloph. Central mesoflexus is bordered by protoloph and metaloph. The posterior part of the tooth bears connected deep hypoflexus and very shallow metaflexus, that are bounded by metaloph from the anterior, and by poorly developed posteroloph from the rear. Most heavily worn specimens show only two lingual enamel islands, protofossette and hypofossette. Enamel-dentin boundary is irregular, forming smooth dentine tracts. The most significant tract is at the rear side of the crown. The root has a rounded triangular shape in cross-section, with a well defined labial concavity.

Slightly worn M1/2 is nearly rectangular. Cusps are well developed. The structure of this molar is similar to P4 but distinct in poorly developed anterocone (Fig. 1b). The deepest valleys are the protoflexus, hypoflexus, and the lingual part of mesoflexus. The labial edge is wavy, with a pronounced mesostyle, and valleys between paracone and mesostyle, and mesostyle and metacone. The anteroloph is straight, the posteroloph slightly convex. The root cross-section is rounded-triangular with convex lingual and straightened labial sides. Progressively worn specimens of M1/2 show a consistent simplification of the occlusal structure. The deepest enamel islands, protofossette and hypofossette, persist longer during the wear. The depth of the other islands and their expression under wear are variable.

M3 is strongly reduced molar with rounded occlusal surface, with slightly rounded lingual edge (protocone) and a straight posterior side. The presence of at least three fossettes at earlier wear stages is indicated by their weak dentine traces in the center of the occlusal surface. Dentine tracts are low, somewhat higher on the rear and front sides of the crown. The root is slightly curved labially and rounded in the cross-section.

Lower premolar p4 is the largest among the lower cheek teeth. The occlusal surface has an elongated rounded triangle shape, the ratio of basal width and length is ca. 0.8. A nearly unworn specimen (Fig. 1c) has four main cusps. These are protoconid separated from the opposing, but slightly anteriorly placed, metaconid by the anterior valley (anteroflexid), hypoconid, and entoconid. The anteroconid is not developed. The anterior cusps are posteriorly connected by a short protolophid. The strong hypoconid and entoconid are connected by posterolophid and hypolophid that bounds the metaflexid. The wear converts the postero-external valley into a moderately deep metafossetid. Wear connects the posterior branch of metaconid (metastylid crest) with hypolophid and divides the deep inner reentrant valley (mesoflexid) into the isolated mesofossetid and a shallow residual lingual valley. A well-defined ectostylid occurs labially at the bottom part of the deep labial valley (hypoflexid). A small rounded depression in the enamel is present on the posterior side of the hypoconid.

A heavily worn p4 shows only a dentin trace of completely worn postero-internal enamel island (metafossetid), mesofossetid, small rounded anterofossetid, and open hypoflexid. The postero-external edge of the latter valley bears a well-defined fused ectostylid. The inner margin of the valley bears a poorly defined mesoconid. The highest dentine tracts are on the anterior and postero-internal crown sides. The cross-section of the root has a shape of elongated oval, stretched anteroposteriorly.

Lower molars m1/2 are slightly elongated anteroposteriorly (the basal width/length ratio is ca. 0.9). Four main cusps are typically present. The hypoconid and entoconid oppose each other, and the metaconid is slightly anteriorly shifted relative to the protoconid (Fig. 1d). The anterofossetid is bounded by anterolophid in the front and by protolophid in the rear. This fossetid may be single or be subdivided by a transverse or longitudinal additional ridge running from the metaconid in two islands. The protolophid runs transversely and connects the protoconid with the metaconid or with the metastylid crest. A deep hypoflexid remains open until late wear stages. The lingual edge of this valley may bear a weak undulation of the mesoconid ($n = 2$). The ectostylid is expressed as a circular or transversely elongated cuspule ($n = 2$), may be variably fused with the hypoconid ($n = 2$), or absent ($n = 2$). The metafossetid, limited by the hypolophid and posterolophid, is always closed. The mesofossetid is bounded anteriorly by the protolophid and lingually by a metastylid crest ($n = 5$). This crest in most specimens deviates labially from the longitudinal direction and connects with the hypolophid slightly medially to the entoconid. In one specimen the metastylid crest is not developed and mesoflexid remains unlocked. A shallow inner valley is preserved anteriorly to the entoconid.

Relatively larger molars are questionably interpreted as m1, whereas the smaller molars with less developed ectostylid may represent m2. Dentine tracts are well defined on the anterior and posterolingual sides of the crown. The root shows an oval or rounded rectangular shape in cross-section with the long axis running from the posterolabial to anterolingual sides of the molars.

Measurements, in mm (L, length, W, width). P4: holotype: L—2.47, W—2.2; specimen GIN, no. 1138/05: L—2.35, W—2.1; M1/2: specimen GIN, no. 1138/01: L—1.87, W—1.79; specimen GIN, no. 1138/15: L—2.02, W—1.93; specimen GIN, no. 1138/03: L—1.96, W—2.01; specimen GIN, no. 1138/04: L—1.78, W—2.07; M3: ind. GIN, no. 1138/19: L—1.58, W—1.62; p4: ind. GIN, no. 1138/11: L—2.41, W—1.95; specimen GIN, no. 1138/16: L—2.51, W—1.96; m1/2: ind. GIN, no. 1138/13: L—2.12, W—1.66; specimen GIN, no. 1138/14: L—2.1, W—1.92; specimen GIN, no. 1138/06: L—2.01, W—1.79; specimen GIN, no. 1138/07: L—1.73, W—1.45; specimen GIN, no. 1138/12: L—1.79, W—1.54.

Materials. In addition to the holotype, 13 specimens from the type locality, in collection of GIN: no. 1138/05, left P4; nos. 1138/01, 03, 04, 15, right M1/2; no. 1138/19, left M3; nos. 1138/11, 16, left and right p4; nos. 1138/06, 07, 12, 13, 14, right (nos. 1138/06, 12, 13, 14) and left (no. 1138/07) m1/2.

The first record of mylagaulids in Eastern Siberia (and only the third one in Eurasia) significantly extends the knowledge of the Asian range of this mainly North American group of rodents. It also demonstrates its presence outside the Central Asian arid zone. In North America, the stratigraphic range of the subfamily Promylagaulinae, to which the Baikal form belongs, covers the Late Oligocene (Arikareen) to the beginning of the Middle Miocene (Barsotovian) [1]. The Early Miocene fauna of Tagay demonstrates the existence of a direct faunal contact between the East Siberian and North American regions of the Holarctic via the Bering Bridge. The primitive morphological traits of the Baikal mylagaulid compared with forms of the Middle Miocene (Tunggurian) of the Zaysan Basin (Sarybulak Formation, Eastern Kazakhstan) and Xinjiang (Halamagay Formation, Northwest China) prompts a hypothesis of a phyletic continuity of *Tschalimys* and *Lamugaulus*. In turn, this may indicate an autochthonous evolution of one of the family groups after the penetration into Asia from North America during the Early Miocene.

ACKNOWLEDGMENTS

This work was supported by Russian Foundation for Basic Research project 14-04-00575-a.

REFERENCES

1. Flynn, L. and Jacobs, L.L., in *Evolution of Tertiary Mammals of North America*, Cambridge: Cambridge Univ. Press, 2008, pp. 377–390.

2. Korth, W., *The Tertiary Record of Rodents in North America*, New York: Springer Sci.+Business Media, 1994.

3. Shevyreva, N.S., *Soobshch. Akad. Nauk Gruz. SSR*, 1971, vol. 62, no. 2, pp. 481–484.
4. Wu, W.-Y., *Vertebr. PalAsiat.,* 1988, vol. 26, no. 4, pp. 250–264.
5. Wu, W.-Y., Ni, X., Ye, J., et al., *Vertebr. PalAsiat.*, 2013, no. 1, pp. 55–70.
6. Logachev, I.A., Lomonosova, T.K., and Klimanova, V.M., *Kainozoiskie otlozheniya Irkutskogo amfiteatra* (Cenozoic Deposits of the Irkutsk Amphitheater), Moscow: Nauka, 1964.
7. Vislobokova, I.A., *Paleontol. Zh.*, 1990, no. 2, pp. 134–138.
8. Vislobokova, I., *Palaeovertebrata*, 1994, vol. 23, nos. 1–4, pp. 177–197.
9. Vislobokova, I., *Ann. Naturhistor. Mus. Wien A,* 2004, vol. 106, pp. 371–385.
10. Daxner-Höck, G., Böhme, M., and Kossler, A., in *Fossil Mammals of Asia: Neogene Biostratigraphy and Chronology*, New York: Columbia Univ. Press, 2013, pp. 508–519.