

Original Research Paper

# The Quaternary Mammals from Kozhamzhar Locality (Pavlodar Region, Kazakhstan)

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**Abstract:** A new locality of fossil mammals near Kozhamzhar in Pavlodar Priirtysh Region has been described. The article provides the description of the quaternary sediments section found in the outcrop near Kozhamzhar. In the Karginian Age (MIS 3) alluvial deposits of the described locality we found the remains of *Elasmotherium sibiricum*, *Mammuthus* ex gr. *trogotherii-chosaricus*, *Mammuthus primigenius*, *Bison* sp. AMS Radiocarbon dating of the Elasmotherium skull gave a young age-26038±356 BP (UBA-30522). The skull of *Elasmotherium sibiricum* exceeds in size the skull of the mammals from Eastern Europe. The lower jaw of the elephant, considering the size and the morphology of the last dentition teeth, is very close to that of *Mammuthus trogotherii chosaricus*.

**Keywords:** Pavlodar Region, Middle and Late Pleistocene, *Mammuthus* ex gr. *Trogotherii-chosaricus*, *Mammuthus primigenius*, *Elasmotherium sibiricum*, Morphology, Biostratigraphy

## Introduction

The remains of fossil mammals from Late Cenozoic are found very often but irregularly on the territory of Pavlodar region. Mostly, they are found on the sandbanks or in the outcroppings of river terraces. The age period of the known localities covers the time from late Miocene to Holocene. The most numerous are the localities of mammals from Middle and Late Pleistocene. In Pavlodar Priirtysh area the Pyateryzhskoye and Grigoryevka localities are confined to the Middle Pleistocene. Presumably, the remains of large-sized mammals discovered in sections near Yamyshevo settlement and the one in between Moiseyevka and Zhelezinka originate from the sediments of middle-pleistocene; the species composition and the position within the sections should be verified for those localities.

The remnant diggings of the Quaternary mammals in the Irtysh floodplain terrace sediments were performed extensively in the 1950-70 s by the staff of paleozoology laboratory from the Institute of Zoology (Almaty) and by several geologic organizations, which used to send the collected materials for identification to Geological Institute of Academy of Science of Russia (Moscow). Considerable and often unique materials are presented in Pavlodar Regional Museum of Local Lore, History and Economy (Pavlodar) (Shpansky, 2014). New materials are collected by the staff of Pavlodar State Pedagogical

Institute (PSPI), Pavlodar House of Geography (Pavlodar, Kazakhstan) and Tomsk State University (Tomsk, Russia). Presently, the collection of the PSPI Nature Museum is the most numerous one (among the museums of Pavlodar) and has in its possession the osteological materials from several localities, including the fragment of the skeleton belonging to *Mammuthus trogotherii* (Pohlig) from Pyateryzhsk settlement (Shpansky *et al.*, 2008), as well as the important materials from Grigoryevka (Shpansky *et al.*, 2007).

This article is dedicated to analyzing the new facts of discovering the remains of large-sized mammals in Kozhamzhar locality.

The following abbreviations have been used in the article: Geological Institute of Russian Academy of Sciences (GINRAS) (Moscow, Russia), Institute of Zoology (IZ) (Almaty, the Republic of Kazakhstan); Museum of Nature at Pavlodar State Pedagogical Institute (MN PSPI) (Pavlodar, the Republic of Kazakhstan); Paleontology Institute of Russian Academy of Sciences (PINRAS) (Russia, Moscow); Saratov Museum of Local Lore (SLLM), History and Economy (Saratov, Russia); Zoology Institute of Russian Academy of Sciences (ZINRAS) (Russia, Saint-Petersburg); Institute of Archaeology and Ethnography (IAE) of Siberian Branch, Russian Academy of Sciences (Russia, Novosibirsk); sign "C" before a numeric value in the tables means the incomplete measurement of the bone.

### Geographical and Geological Position of the Kozhamzhar Locality

The study of fossil mammals from paleontological locality near Kozhamzhar in Pavlodar Priirtysh and their species identification allow undertaking a comparison of the obtained set with already known localities of Pavlodar Priirtysh Region and evaluating the stratigraphic position of the studied taphocoenosis.

The Quaternary sediments section is situated on the left bank of the Irtysh River, 120 km to the North-West of Pavlodar, directly downstream from Aktogay settlement (till 1995 it was named Krasnokutsk) to Kozhamzhar in Aktogay District (Fig. 1). The section length is about 8 km. While investigating the section in 2011 and 2015, it was noted that the bank of the Irtysh River was being extensively washed away downstream Aktogay and near Kozhamzhar village and the plinth terrace of the Irtysh River was becoming cropped out. The most outcropped parts of the section have the coordinates near Aktogay as follows: 53°01'02" north latitude, 75°57'40" east longitude, near Kozhamzhar: 53°01'59" north latitude, 75°52'18" east longitude. The middle part of the section, with the length about 4 km is not being washed out currently (it is represented by sodded taluses) and is distanced from the bed part of the Irtysh by up to 300-500 m. The structure of the section in both outcrops is identical.

Local residents admit finding bone fragments in the downstream outcrop (near Kozhamzhar village), the most part of which have been lost. Earlier, this section was described by Zinova (1982) in the study named "Dawn" (after the name of a state farm which was located here), in the geologic sources the mammal locality was also known under the name of Krasnokutsk, based on the part of the bone materials collected here. Zhylkibayev (1975) notes the discovery of the lower left tooth of Khozar elephant, made by M.B. Kuyanets in 1964 near Zhdanovo settlement (now Leningradskoye village) 1 km downstream Aktogay. Kozamkulova (1969) notes finding several bones of bison in Krasnokutsk.



Fig. 1. Geographical situation of Kozhamzhar locality (Pavlodar region)

The remains of the mammals described below were delivered to the Museum of Nature at Pavlodar State Pedagogical Institute in autumn of 2010. In fact, the collecting was done by a local resident of Kozhamzhar K.S. Khayrulin in 1988-1989 in the "downstream" outcropping. The remains were deposited at the depth of 5 meters from the upper layer of the terrace, in the upper part the overlapping horizontal-oblique layered sands of layer 6 (Fig. 2). Below is given the description of the section of quaternary sediments in outcropping near Kozhamzhar, this part of the section has more steep outcropping and less taluses; the layers are cropped out from the top down as follows:

Lithologic section and the specific features of the layer occurrence	Depth, m
1 Soil layer, humus, dense, dark-brown	0.4
2 Loess loam, light-brown, dense, non-laminated, porous, with vertical cleavage (holds the wall well), lightly carbonized, in some places has thin inlayers of fine-grained sand. Lower boundary is sharp, even	0.8
3 Grey-brown sandy loams, in lower part changing into horizontally layered sands with diverse grain sizes from fine to mid-coarse grains and the coloring changes from light-brown to reddish-brown, iron bearing. Lower boundary is sharp, but not even	1.0-1.5
4 Grey coarse-grained sands with small pebble inclusions (up to 5 mm), with horizontal and oblique layering, irregular in spreading, blowing out and with bulges	0.1-0.6
5 Different size grain sands, light-brown with thin slightly inclined layering	1.0-1.5
6 Horizontal and oblique layered sands, fine grained with overlapping layers with coarse-grained sands and pebbles (up to 1.5-2 cm). Oblique layered series have the depth up to 10-15 cm. The coloring of the sands often changes from grey to reddish. The lower boundary is sharp and even. At the bordering of the layer the remains of large-sized mammals were found	2.8
7 Coarse-grained sands with small pebbles rich in iron oxides and of rust-brown color. The lower boundary is sharp, even	0.1-0.2
8 Massive, dense, bluish, bluish-grey clays with clear thin horizontal ribbon-like layering, soft, cut easily with an instrument, viscous, in some places mixing with siltstones. Upper 8-10 cm of clays contacting with sands are saturated with Fe oxides, are of brown color, becoming brittle, crumble easily. When the clay gets dry it becomes light-grey, almost white and very hard. In the lower part of the layer at the plane of stratification there are thin layers of light-grey sand and the developments of thin packing of iron hydroxides. Pancake-shaped siderite inclusions occur. Those go down under water edge.	9.5

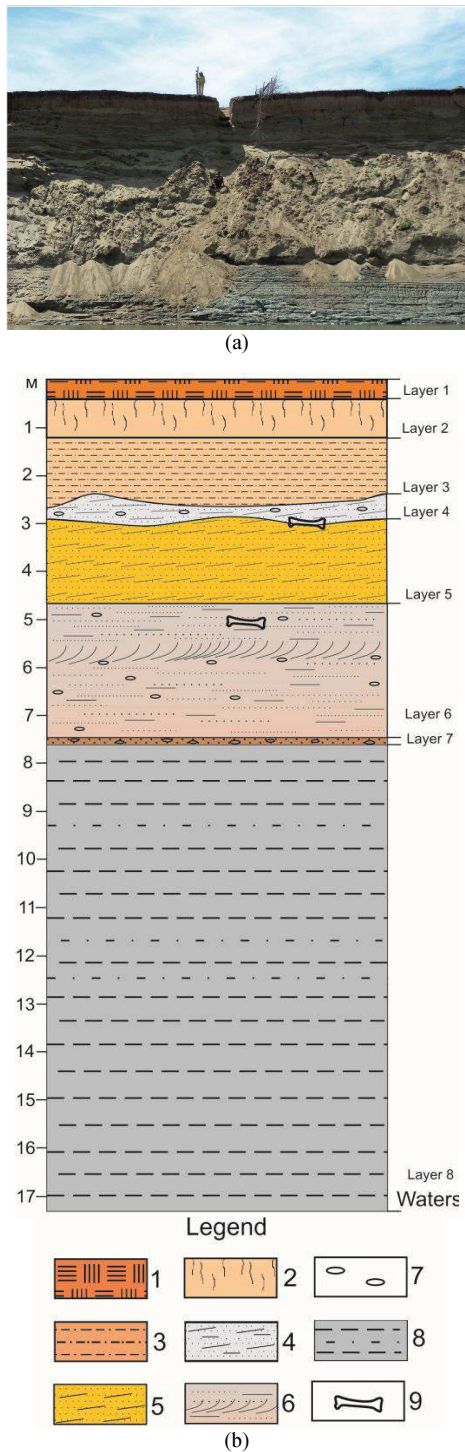


Fig. 2. (a) General view of the quaternary deposits of Irtysh River near Kozhamzhar (Pavlodar region), (b) Section plan of the quaternary deposits of Irtysh River near Kozhamzhar (Pavlodar region): 1-soil-vegetable bed; 2-loess loam; 3-loams and loamy sands 4-sands with horizontal and slant bedding; 5-oblique bedding sands; 6-anisomerous, interstratifying sands; 7-pebble; 8-blue-gray clays with siltstone inclusions; 9-remains of mammals

Overall height of the terrace from the water edge amounts to 16.5-17.3 m in the low-water season. The described outcropping has clearly expressed two-level structure: The lower part is made of layer 8, represented by lacustrine layered clay sediments, predominantly of dove and blue-grey color. According to Zinova (1973), the clays form sediments from Krasnokutsk (= Katchiry) suites of the very end of Upper Pliocene. The clays with erosion are overlapped by different-age Quaternary sediments, making up the third terrace above the flood plain. The section between Aktogay and Kozhamzhar is identified as a stratotype of the Krasnokutsk suite (Zinova, 1973). Svaritchevskaya and Ten (1966) estimate the age of Krasnokutsk suite as Middle Pliocene. According to Zinova (1982), the age of these sediments, based on malacofauna and sporo-pollen spectrum, is estimated now as Early Pleistocene (= Calabrian?) and is associated with the upper bed of the Kotchkovski level (Unified..., 2000) and Apsheon regional layer.

The upper part of the section is made of Middle and Upper Pleistocene alluvial deposits bedded with erosion (layers 2-7). The age of bone-bearing layers 6 and 7 (according to the description of the section, submitted by (Zinova, 1973), these were layers 9-11 in point of observation 42) is associated with the sediments of Tobolsk level. From these layers the remains of *Elasmotherium sibiricum*, *Mammuthus* ex gr. *trogotherii-chosaricus*, *Bison* sp., were obtained which will be described below. In her studies R.A. Zinova accentuated the sporo-pollen data and the remains of the mammals were just mentioned, pointing out the general species composition from several localities, presumably, of the same age—"Equus sp., very large form with primitive attributes, associating the same with *Equus steinheimensis* Reich, as well as the remains of *Cervus* ex gr. *elaphus* L., *Capreolus* sp., *Megaloceros* sp., Cervidae (cf. Rangifer), *Mammuthus* cf. *trogotherii* Pohl., *Palaeoloxodon* cf. *antiquus* (Falc.)" (Zinova, 1982), with references to definitions given by E.A. Vangengeim. At the same time, on the schematic section near Krasnokutsk she marked the confinement of these remains to the sediments of Middle Pleistocene, collected at the depth of 5-7 m, but, for the most part, in the middle of the sand layer (layer 9, according to R.A. Zinova, 1982; Fig. 32). In the collections at GINRAS the remains of bison and the teeth of the elephants are stored, found by R.A. Zinova and All Union Hydrogeological Trust. The degrees of their mineralization and preservation are the same as those of the bones, obtained by us from this layer. The mollusk shells are presented by *Corbicula fluminalis* (Müll.). The seed flora, obtained by R.A. Zinova from the diagonal sands, is represented by *Azolla interglacialica* Nikit., *Potamogeton vaginatus* Turcz., *P. filiformis* Pers., *Carex*

sp., *Chenopodium album* L., *C. rubrum* L., *Heleocharis palustris* (L.), *Limnanthemum hymphoides* (L.) and is associated with Tobolsk interglacial period (MIS 9-11). In sporo-pollen spectrum the arborous plants prevail (*Pinus* more than 70%, *Betula* about 20%), the herbaceous plants are represented by chenopodiaceous plants, absinthium and, to a lesser degree, by Compositae.

At the border of layers 3 and 4 two teeth of "typical" *Mammuthus primigenius* Blum. Table 3 were found, those having lesser mineralization degree and slightly differing in color from the bones from layer 6. Layers 3 and 4 are deposited with erosion, are irregular in spreading, which, taking into account the teeth of "typical mammoths", makes it possible to determine the time of their formation as Late Pleistocene.

## Materials and Methods

The measurements of the lower jaw of steppe elephant are assumed according to Shpansky *et al.* (2015). The measurements of *Elasmotherium sibiricum* are assumed according to Khromov (1999) as supplemented by Shpansky (2013). For describing and measuring the teeth of the elephants the methodology, presented in the study by Dubrovo (1960), was used; for the dentition identifications the methodology of Sher and Garutt (1985) was applied.

The skull of *Elasmotherium sibiricum* was subjected to AMS radiocarbon dating analysis in the laboratory of <sup>14</sup>CHRONO Centre for Climate, the Environment and Chronology (School of Geography, Archaeology and Paleoecology; Queen's University Belfast; Belfast, UK).

Osteological materials are represented by specimens as follows:

- Lower jaw (MN PSPI 1523/2011-HYa) of the elephant of transient type from *Mammuthus ex gr. trogontherii-chosaricus* with two teeth of the last dentition M3 (MN PSPI No. 1519-1/2011 and No. 1519-2/2011)
- Skull (MN PSPI 1521/2011-HYA) of *Elasmotherium sibiricum* Fischer 1808
- Two upper teeth of the mammoth: The last but one dentition M2 (MN PSPI No. 1520-1/2011) and the last dentition M3 (No. 1520-2/2011) of *Mammuthus primigenius* (Blumenbach 1799)
- Fragments of horn stem (MN PSPI 1522/2011-HYa) of *Bison* sp.
- To determine the general species composition of the locality and to analyze its stratigraphic position the collections GINRAS: Nos. 305, 895 were used

For the purpose of comparison the published materials on steppe elephant and *Elasmotherium sibiricum* were studied.

## Characteristics of an Object

The obtained materials have different degree of preservation: The skull of the elasmotherium and the upper teeth of the mammoth are less mineralized and differ in color, they are gray and brown, fractured, but do not carry any traces of rolling, gnawing marks and exfoliation. The lower jaw of the steppe elephant is of red-brown color, its surface is exfoliating. The horn of the bison has some traces of being rolling and is mineralized considerably; there are developed spots of manganese oxide or of iron oxide in many places.

### *Mammuthus ex gr. trogontherii-chosaricus*

The remains of steppe elephant are represented by the lower jaw MN PSPI instance 1523/2011-HYa with two teeth of the last dentition M3 (MN PSPI No.1519-1/2011 and No.1519-2/2011) (Fig. 3). The lower jaw is of average degree of preservation; both ascending ramification pieces are missing, the lingual alveolar walls and the mental protuberance of mandible are broken off. The jaw is not large in size (Table 1), the horizontal ramifications are thick, swollen and the ventral surfaces of the horizontal ramifications are comparatively smooth with a slight upward flexure in the middle (Fig. 3b). Symphysis is relatively high. The frontal ends of *cr. mentalis* are sharp and cylinder-shaped. The horizontal ramification along the frontal edge of the alveolus is considerably higher than that along the rear edge. At the buccal side of the horizontal ramification there is one mental foramen, situated in front of the fang root. The angle of divergence of horizontal ramifications is about 75°.

In the lower jaw the teeth of the last dentition m3 with average degree of erosion used to function: The front plates were worn down to the roots and the rear ones were only slightly worn, the talon has not started eroding. The tritons are slightly concaved in the cross-section plane. The plates are wide with bulges in the middle. The type of the plate attrition is as follows: (– . –). The dental enamel is moderately thick with buckled ruffles. The dimensions of the teeth are given in Table 2. The same degree of preservation and the enamel thickness (2-2.2 mm) are characteristic of the teeth (GIRAS 305/64 and 895/44a), collected by R.A. Zinova and by the geologists of All-Union Hydrogeological Trust. One more tooth m3 (IZ 3515/64-P) is noted by Zhylkibayev (1975). Its morphometric data are included in general dimensional sequence of the teeth *M. chosaricus* (Zhylkibayev, 1975). The extreme values for the plates occurrence rate per 10 cm (7-8.5 pcs) and the enamel thickness (2-2.5 mm) are quite comparable with the parameters of the teeth of the lower jaw described in this study earlier.

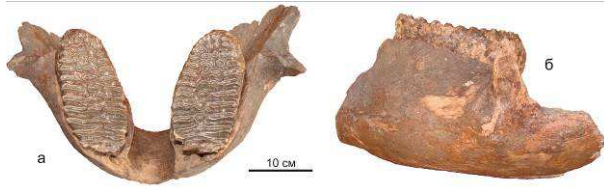


Fig. 3. Lower jaw of an elephant *Mammuthus* ex gr. *trogontherii-chosaricus* from Kozhamzhar locality MN PSPI sp. 1523/2011-HYA: A-plane view; b-side view

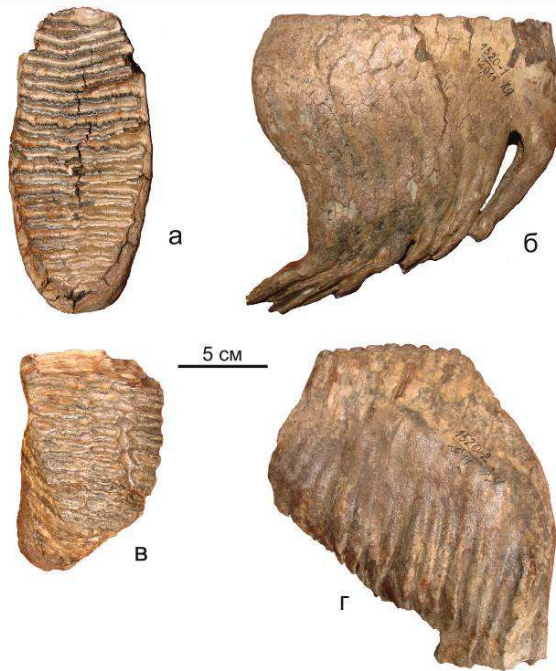


Fig. 4. Upper teeth of *Mammuthus primigenius* from Kozhamzhar locality: a-M2 (MN PSPI sp. 1520-1/2011) from the occlusive surface; b-side view of the same; c-M3 (MN PSPI 1520-2/2011) from the occlusive surface; d-side view of the same

Comparison of the teeth of the Kozhamzhar elephant with those of the elephants from other localities showed that as regards the indicative characteristics (plate occurrence rate per 10 cm and the enamel thickness), the teeth of the Kozhamzhar elephant are more progressive than those of the typical *Mammuthus trogontherii trogontherii* from Western Siberia and Europe and are closer to the characteristics of *M. trogontherii chosaricus* Dubrovo (1966).

#### *Mammuthus Primigenius Blum*

The remains of the mammoth are represented by two upper teeth M2 and M3 MN PSPI instance 1520-1/2011 (Fig. 4) and instance 1520-2/2011 (Table 3). The dimensions and the key morphological parameters of the teeth are typical of *Mammuthus primigenius* from Kazakhstan localities.

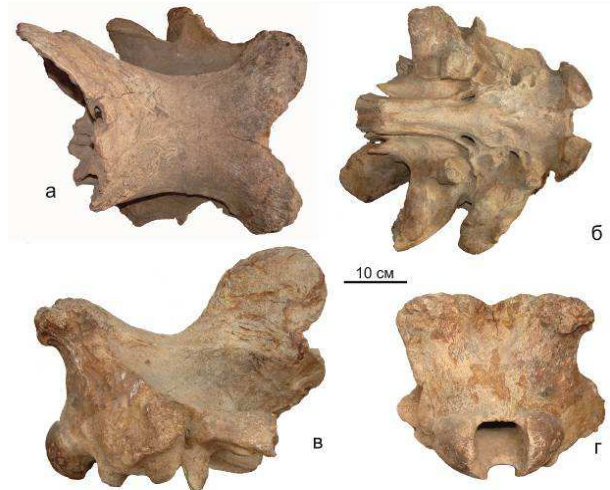


Fig. 5. Skull fragment (1521/2011 HYA) *Elasmotherium sibiricum* from Kozhamzhar: A-plane view; b-bottom view; c-right-side view; d-rear view

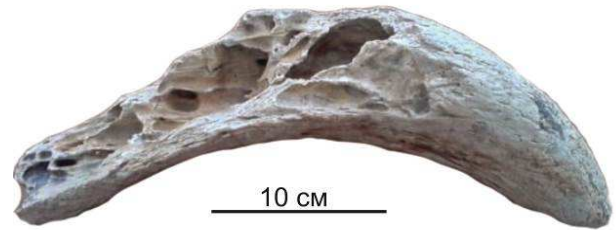


Fig. 6. Horn stem MN PSPI 1522/2011-HYA *Bison* sp.

#### *Elasmotherium Sibiricum Fisch*

Fragment of the skull MN PSPI inst. 1521/2011-HYA is represented by fronto-occipital part (Fig. 5), the front part of the skull was broken off at the level of the midline of the cupola-shaped eminence. Zygomatic arches are broken off at the basis; the left occipital eminence is also broken off. The post-glenoid ramifications are cone-shaped and are situated 220 mm away from the occipital condyles. The occipital condyles are big, oval-shaped. The cupola-shaped eminence, exposed after being broken, shows that its integral part is represented by the coarse granular bone tissue and is considerably pneumatized. The thickness of the bone in the upper part of the eminence ranges from 5 to 10 mm and from 10 to 15 mm in the lateral parts. The external surface of the cupola-shaped eminence is very rough and has multiple fissures and grooves, indicating the considerable individual age of the mammal. The occipital ridge is well developed and is of forked, dovetail shape. Angular parts of the occipital ridge are diverged at a right angle; they are massive, tuberos, overhanging extensively over the occipital condyles. The plane of the occipital bone is much flexed (concave) in the lower part (over occipital orifice) and spreads smoothly in very hypertrophied, long and widely spaced lateral occipital prominences. The extreme points of

occipital prominences project outside the width of zygomatic arches and represent the largest width dimension of the skull. Rear surfaces of the prominences are uneven with multiple sharp cristae and eminences. The lingual part of occipital prominences is directed laterally and to the front, in parallel to the rear part of the malar arch. Such structure makes the mammal's ear channels deep-seated. The upper part of occipital plane (between the angular parts of the occipital ridge) is occupied by a large circular-shaped indentation (with horizontal diameter of 63 mm).

Table 4 gives the measurements of the skulls of *Elasmotherium sibiricum* from Kozhamzhar locality and from East European localities. Notwithstanding the fragmentariness of the skull, in many respects: The length

of medullar compartment, the width in the occipital ridges, the width of the cupola-shaped eminence, the distance from the edge of occipital condyles to the tip of the post-glenoid appendix-this specimen is well comparable with the skulls of *Elasmotherium sibiricum*. At the same time, the dimensions of the Kozhamzhar specimen exceed considerably the dimensions of East European elasmotheriums.

*Bison* sp.

The fragment of the horn stem (MN PSPI 1522/2011-HYa) of bison is represented by a distal half, broken off along an oblique line. The horn belonged to a big mammal; the preserved fragment is 337 mm long in the chord (Fig. 6).

Table 1. The dimensions of the lower jaws of *Mammuthus trogontherii*

Measurements, mm	Kozhamzhar MN PSPI 1523/2011	Pyateryzhsk P2002.1149 (Shpansky <i>et al.</i> , 2008)	Ust-Tarka IAE 18 (Shpansky <i>et al.</i> , 2015)	Azov 1 (Baigusheva and Garutt, 1987)
Horizontal ramification length	C425	480	472	
Horizontal ramification height along the alveolus front edge	190	235	240	
The same along the rear edge	160	171	169	187
Horizontal ramification thickness (max.)	C155	180	194	174
Distance between horizontal ramifications along the front edge of alveolus (inside)	60?	70	85	
Maximum distance between outer walls of horizontal ramifications (along rear edge)	C513	640	577	620
Distance between the teeth (in front, min.)	70	67	68	
Distance between the teeth in the rear (by mid-axes)	230	185	200	
The same maximum at the buccal sides of the teeth	298	275	282	
Symphysis height	96	93	112	
Symphysis front-rear diameter, incl. mental protuberance	C101	160	150	

Table 2. Dimensions (mm) of molars m3 *Mammuthus trogontherii* from localities in West-Siberian plain and Europe

Measurements	Kozhamzhar MN PSPI		<i>Mammuthus trogontherii trogontherii</i>			<i>Mammuthus trogontherii chosaricus</i>		
	m3 sin 1519-1/2011	m3 dex 1519-2/2011	Pyateryzhsk MN PSPI (Shpansky <i>et al.</i> , 2008)	West Runtun (Lister and Stuart, 2010)	Azov 1 (Baigusheva and Garutt, 1987)	(Dubovo, 1966)	(Garutt, 1972)	Tchembaktchino (Kosintsev <i>et al.</i> , 2004)
			m3 dex sin P2002.1149	m3 dex sin 1992.36	m3 dex sin AM3 No. KP-21081	m3 dex; sin KP 4874	m3 dex; sin OF-909	m3 dex sin KhM-10398
Tooth crown length	200	210	215; 225	430	418	258; 252	c190; c195	315
Maximum crown width	100	93	85.5; 91.2	104	91	98; 97	c84; c75	80
Maximum crown height	115	110	-	167	168			145
Total amount of plates	12+талон	12+талон	12, 13	21	22	18	13+?	22
Plate occurrence rate at each 10 cm	6.5-7	6-6.5	6	5.25	5.9	6; 5.5	6.5-8	5.75
Enamel thickness	2.0-2.3	2	1.8-2.5-3.1	2.0-2.3-2.7	2.2-2.4	1.8-2.1	1.8-2.1	1.9

Table 3. Dimensions (mm) of the upper molars of *Mammuthus primigenius* from some localities in Kazakhstan

Measurements	Pavlodar region Kozhamzhar MN PSPI		Alma-Ata, Corner of Lenina/Kirova streets (Zhylykibayev, 1975)	Ust-Kamenogorsk (Zhylykibayev, 1975)	Pavlodar (while meet packing plant construction) (Zhylykibayev, 1975)
	M2 1520-1/2011	M3 1520-2/2011	M3 3519/52-A1	M2 or M3 w/o/No. coll.	M2 3490/53-P
Tooth crown length	180	-	122	140	135
Max. crown width	79	80	68	78	75
Max. crown height	130	150	40	95	60
Total amount of plates	13+талон	>17	-	12	11
Plate rate at each 10 cm	8-9	12	10	9	8
Enamel thickness	1.8	1.5-2.0	1.5	1.1-1.5	1.5

Table 4. Measurements of the skulls of *Elasmotherium sibiricum* from Kozhamzhar locality and from Eastern Europe

Measurements (mm)	Krasnokutsk (1521/2011 HYA)	PINRAS (Titov, 2008) n = 2	Sarepta SLLM 8470 (Khromov, 1999)	Sarepta GINRAS ASR (Khromov, 1999)
1 Length of medullary compartment (from lower edge of occipital orifice to orbital line)	310 (340)	-		
2 Width in the occipital ridges	324	322.0; 237,0	251	310
3 Distance between mastoid ramifications	-(inside 120)	-		
4 Width in pre-orbital apophysis	-	457.0; 328.0		
5 Width in zygomatic arches	-(c 415)	423.0; 270.0		
6 Minimal width of frontal bone behind the cupola-shaped eminence	188	142.0; 140.0	167	163
7 Width of cupola-shaped eminence at the basis	260 (c295 estimated 340)	262	248	260
8 Height of occipital orifice	76 (68)	70.0; 58,0	57	63
9 Width of occipital orifice	65 (70-72)	62.0; 58.0	54	65
10 Length of occipital condyles (height)	103.98	107.0; 85.0	72	96
11 Width of occipital condyles	240	182.0; 155.0	~230	~240
12 Distance from the edge of occipital condyles to the tip of the postglenoid appendix	220 (260)	-		
13 The width of basisphenoideum	60	-		
14 The width of parasphenoideum	-	-		
Minimum width of occiput	298		225	267
Maximum width of occiput in occipital prominences (exuberances)	470		376	447
Minimum height of occiput (from the upper ridge of occipital orifice)	200		130	180
Maximum height of occiput	(258)/272			
Width in the external edges of the articular surfaces for the lower jaws	382			

## Discussion

Kozhamzhar locality includes relatively small amount of remains of the mammals (about 20 bones, including the materials submitted by R.A. Zinova and K.Zh. Zhylkibayev), however, their species belonging and good correlation allow undertaking a comparison of the obtained complex with already known localities in Pavlodar Priirtysh Region and evaluating the stratigraphic position of the taphocoenosis under study. The lower jaw with teeth of *Mammuthus* ex gr. *trogontherii-chosaricus* and the fragment of skull of *Elasmotherium sibiricum* were obtained from the sand formation (layer 6). These species have considerable stratigraphic meaning: *M. trogontherii* belongs to orthostratigraphic line of mammothoid elephants and *E. sibiricum* belongs to parastratigraphic group of rhinoceroses, being important for the south of Western Siberia, Kazakhstan and the south of Eastern Europe. The biochronological comparison of the mammothoid elephants (*Archidiskodon-Mammuthus*) and species *Elasmotherium* for the south of Eastern Europe was undertaken by Shvyreva (2015). According to her, *E. sibiricum* existed in Early-Middle Pleistocene and was included in Tiraspol, Singil and Khazar Faunal Complexes of Eastern Europe (Fig. 7). During this time it co-existed with *M. trogontherii trogontherii* in the end of the Early Pleistocene (Tiraspol Complex) and *M. trogontherii chosaricus* in Middle Pleistocene (Singil and Khazar Complexes).

In Central and Northern Kazakhstan and south of West Siberian Plain the remains of elasmotherium are quite numerous. Kozamkulova (1981a) notes 30 localities of Middle Pleistocene. At the territory of Pavlodar Priirtysh Region the remains of elasmotherium are known from 4 localities: Podpusk, Moiseyevka-Zhelezinka, Grigoryevka and Kozhamzhar. The finding of the vertebra and the radial bone of a very big specimen of elasmotherium near Chernoyarka village, noted by Belyayeva (1935), up to now has neither description of geological position nor of the bone materials, thus using it for an analysis is rather complicated.

Kozamkulova (1981a; 1981b) correlates the remains of elasmotherium in Kazakhstan with the Koshkurgan (= Vyatka) Faunal Complex of Middle Pleistocene, which included *Equus mosbachensis*, *E. (Asinus) hydruntinus*, *Stephanorhinus kirchbergensis*, *Paracamelus gigas*, *Cervalces latifrons*, *Bison schoetensacki*, *Soergelia* sp. (Kozamkulova, 1981b). The findings of elasmotherium: Lower jaws and teeth in Grigoryevka are confined as belonging to the sediments of Tobolsk Horizon of Middle Pleistocene. In this locality the remains of elasmotherium were found together with the remains of the elephant, similar to Khazar *M. ex gr. trogontherii chosaricus*. These data are in good agreement with those of (Shvyreva, 2015) for Middle Pleistocene in Eastern Europe. In Grigoryevka *E. sibiricum* and *M. trogontherii chosaricus* were found as a part of

Priirtysh Faunal Complex (Shpansky *et al.*, 2007)-*Bison priscus*, *Megaloceros giganteus ruffi*, *Camelus knoblochi*, *Saiga borealis*, etc. The species composition of Grigoryevka matches very well compared with Singil Faunal Complex in Eastern Europe (Shpansky, 2009; Ilyina and Shpansky, 2014).

The situation with the remains of elasmotherium in sediments of Paleopleistocene (= Gelasian) in the section between Podpusk and Lybyazhie (Orlov, 1930; Vislobokova, 1996) is more complicated. The most numerous findings of postcranial remains and teeth fragments were made near Lebyazhie village. Here they occur together with the remains of *Homotherium* sp. *Eucyon minor*, *Archidiskodon meridionalis gromovi*, *Equus livenzovensis*,

*Paracamelus* cf. *gigas*, *Eucladoceros* sp., etc., which are included in Podpusk-Lebyazhie Complex and are associated with MN 17 Mammalian Zones. The species belonging of these remains has not been identified up to now (Fig. 7). However, I.A. Vislobokova (1996) notes the similarity of the remains to those typical of *E. sibiricus*. Shvyreva (2004) identified *E. chaprovicum* with Paleopleistocene (= Gelasian) in Eastern Europe, to which a part of the found elasmotheriums have been ascribed, though earlier they had been related to *E. caucasicum* (Titov 2008). For Eastern Europe the time of existence of *E. chaprovicum* is correlated with the spread of *Archidiskodon meridionalis gromovi*. For Lebyazhie locality similar correlation is observed.

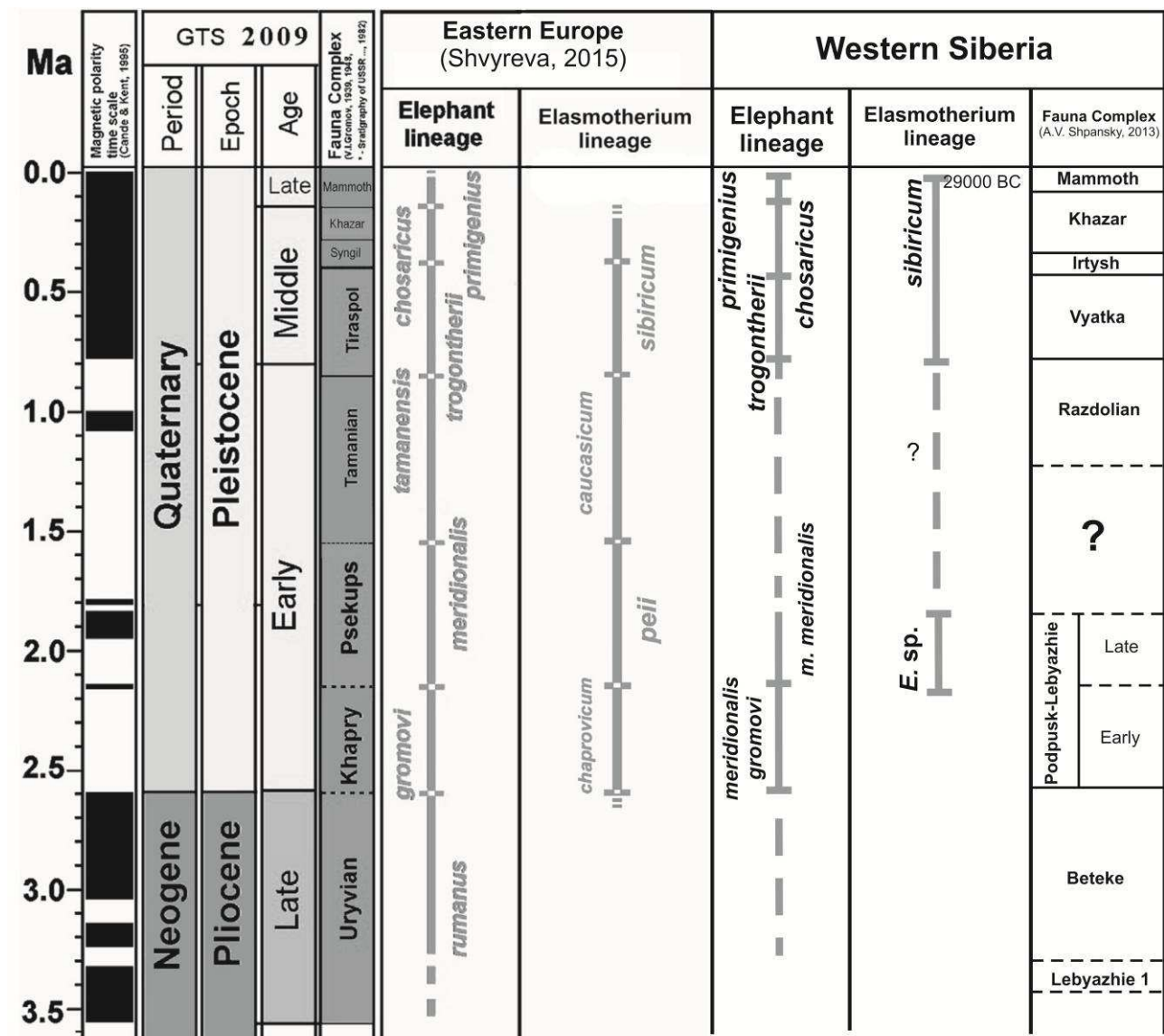


Fig. 7. Stratigraphic position of the representative of genus *Elasmotherium* in Eastern Europe and Western Siberia



From the insufficiently investigated sediments, cropped out between Moiseevka and Zhelezinka, the remains of large-sized mammals of very different geological ages are known. The remains of elasmotherium are represented by the bones of the distal parts of extremities, which makes it very difficult to identify their species belonging. The bones are highly mineralized and bear some resemblance to the materials from Lebyazhie. The issue of the taxonomic ranking of the rhinoceros from Lebyazhie and Moiseevka is very important for biostratigraphy and paleozoogeography. This is made even more complicated by the fact of finding in Moiseevka the remains of rhinoceros of species *Stephanorhinus*; a fragment of highly mineralized lower jaw and two teeth are stored in Pavlodar Regional Museum of Local Lore, History and Economy (according to the unpublished information).

In Kozhamzhar we identified a combination of mammalian species similar to Grigorievka locality, but with less variety of species. Our preliminary opinion was that according to biostratigraphic data both occurrences have the same geological age-Middle Pleistocene (Ilyina and Shpansky, 2014). The presence of teeth of the “typical mammoth” in the locality and small traces of rolling on the lower jaw of *M. ex gr. trogontherii-chosaricus* caused our doubts. Therefore, we selected a sample from the elasmotherium skull for the radiocarbon dating analysis. The obtained date was 26038±356 years (UBA-30522), calibration age ranges from 28985 to 27490 BC. The obtained results completely change our preliminary opinion. Now we can say that the alluvial deposits of Kozhamzhar were formed at the end of the Karginy Thermochron of Late Pleistocene. The lower jaw of the steppe elephant found together with the elasmotherium skull was probably redeposited from more ancient deposits, though its younger age is not excluded. This requires its radiocarbon dating research. Earlier, a series of the same young radiocarbon dates was obtained by our colleagues from Ekaterinburg (Kosintsev, 2014) on the bones of elasmotheriums from localities southwest of the West Siberian Plain.

## Conclusion

Survey of the found remains of Elasmotherium in Pavlodar Priirtysh Region revealed quite a long existence of these rhinos in the southeast of the West Siberian Plain. Our investigations into the Kozhamzhar occurrence showed that biostratigraphic interpretation of the geological age of the alluvial Quaternary deposits is highly complicated.

The use of radiocarbon bone dating methods allows solving some problems of biostratigraphy and specify the time of the existence and extinction of certain species of mammals. Our study following the

data by Kosintsev (2014) confirmed the longer existence of *Elasmotherium sibiricum* within the territory of the West Siberian Plain.

The time of its extinction can now be compared with the boundary between Karginy Thermochron and Sartan Cryochron of Late Pleistocene (boundary of MIS 3 and 2) in Western Siberia. These data significantly complicate the solution of stratigraphic and geochronological issues based on the remains of fossil mammals in the Quaternary sediments. New data are also pushing for mass radiocarbon studies of mammalian remains that were previously considered admittedly ancient and extinct more than 50-100 thousand years ago.

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## Author's Contributions

**Andrei Valerievich Shpansky:** The field research and a description of the material.

**Valentina Nurmagambetovna Aliyassova:** Autor designed the research plan and organized the study.

**Svetlana Anatolievna Ilyina:** Measurements of the samples.

## Ethics

This article is original and contains unpublished material. The corresponding author confirms that all of the other authors have read and approved the manuscript and no ethical issues involved.

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