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GEOGRAPHY

The Age of Mammoth Fauna on the Lower Ob

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This paper discusses the results of absolute dating of fossil organics on the Ob River along the Arctic Circle (Fig. 1) in order to shed more light on the problem of the last arctic glaciation. The dated samples were collected by Astakhov and his associates during field seasons 2000 and 2001. Radiocarbon measurements have been performed by Arslanov in the Geochronological Laboratory of St. Petersburg University by the liquid-scintillation method [1]. The bones have been based on collagen that has been purified of contaminants (humic acids, saprophytes, and others) using an improved technique [2]. Radiocarbon content has been measured with a higher statistical reliability (Table 2). OSL ages in Fig. 2b have been obtained by optically stimulated luminescence on quartz grains of sand samples [3] by A. Murray in the Nordic Laboratory for Luminescence Dating, University of Aarhus (Denmark). A comprehensive description of OSL results in the Russian Arctic is presented in the special issue of *Quaternary Science Reviews 2004* containing the final report of the Quaternary Environment of the Eurasian North program.

Dating mammoth fauna is directly related to the problem of the last glaciation. In the north of Europe, remains of large mammals are either older than 25 ka or younger than 15 ka. This gap is attributed to the low productivity of glacial deserts during the Last Glacial Maximum (LGM) 25–15 ka ago. However, far beyond the Urals and east of the 75th meridian, bones of large animals dated within this interval are not rare in the glaciated terrains of Gydan, Taimyr, and even Severnaya Zemlya [4–6]. On the other hand, glacial features of that age are totally absent over the flat mainland of the Russian Arctic, which has been amply proven by recent efforts by Russian, Western European, and American geologists in the Pechora Basin, Yamal, and Taimyr [7–10]. One of the most convincing arguments for an older age of the last glaciation is provided by numerous remains of the mammoth fauna not covered by till.

The well-exposed Quaternary sections of the Lower Ob area have always been considered crucial for the Pleistocene stratigraphy and paleogeography of West Siberia. Many researchers have concluded that the last glaciation either did not reach this area at all [11] or covered it partly in the very beginning of the last glacial cycle, i.e., earlier than 50 ka [12]. However, according to the official viewpoint, adopted in the Regional Stratigraphic Scheme, the last glacier invaded this area some 20–18 ka ago [13]. This idea was based on several finite radiocarbon dates obtained by scientists of the Siberian Division of Russian Academy of Sciences in the Salekhard area from the lenses of diamicton interpreted as tills of an ice sheet [14].

We have not found bona fide surficial tills anywhere in this area (Fig. 1). Sparse lenses of thin diamicton are spatially interspersed—not with glacial formations, but with the mantle of loess-like silt. At the base, they show only permafrost disturbances. Therefore, these diamicts should be attributed to solifluction processes.

Plant remains *in situ* have been collected in a deep sand pit of Aksarka village (Fig. 1, section 18) and in fresh headwalls of triangular ravines cutting the southern bank of the Ob River along the former ice wedges close to the Pyak-Yaha and Pichuguy-Yaha creeks. The bones were mainly picked at the foot of the north-facing bluff of the Nadym Ob at 3–4 km downstream of the Pichuguy-Yaha creek and near the mouth of the Pyak-Yaha creek (Figs. 1, 2; sections 25, 26). The subvertical bluff, rising up to 40 m above the shallow wave-cut platform, is persistently undercut by storm floods and spring ice floes. Local fishermen commonly find fresh, unrounded bone fragments of mammoth fauna along the aforesaid stretch of the river bank. It was not too difficult for us to collect many large bone fragments of mammoth, muskox, horse, woolly rhinoceros and reindeer in 3–4 h (Table 1). The frequency of bone finds grows towards creek valleys concurrently with descent of the bluff and loess cover.

This mammoth fauna site is not unique. Well-preserved bone remnants in a similar position are reported by local hunters also in the upstream of the left-bank area. Right-bank finds of mammoth remains, unfortu-

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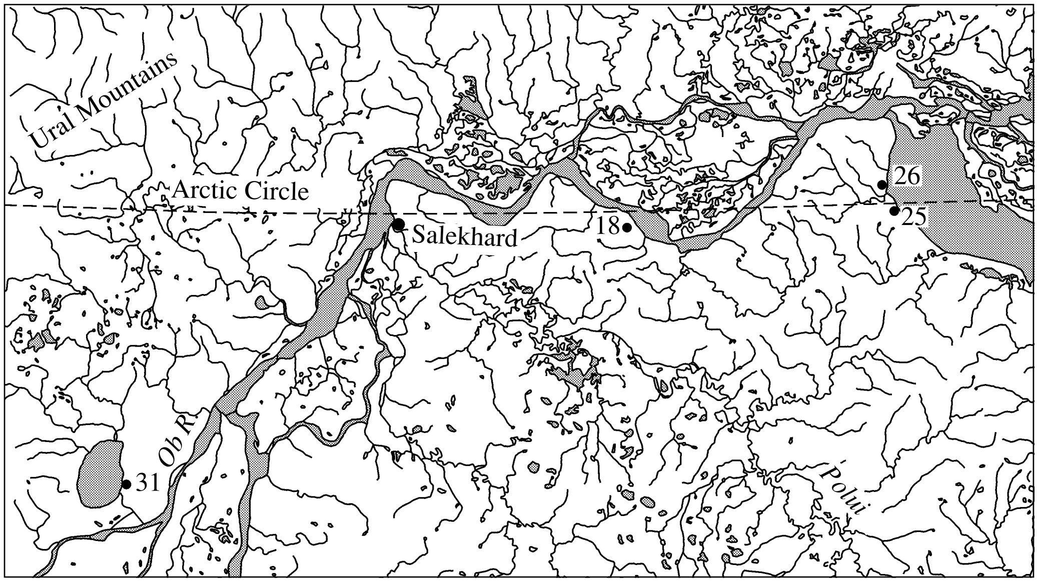

Fig. 1. Location of dated Quaternary sequences on the Lower Ob.

nately undated, have been described in the upper part of the right-bank terrace 2 [15]. We also found splinters of bones and teeth on the eastern shore of Shuryshkary Sor, just north of the village (Fig. 1, section 31), where an outcrop of thick autochthonous peat is known [14].

The base of the Nadym Ob bluffs is built of compact matrix-supported diamicton with characteristic structures of basal till (Fig. 2a). OSL dates of ~200 ka have been obtained from beneath the till. The ancient till is overlain by inorganic silt rhythmite grading into varved clay. This glacilacustrine formation of the high southern bank of the Ob River is older than 140 ka, which follows from the luminescence dates obtained in the sand-filled channel incised into the rhythmite (Fig. 2b).

The rhythmite is in many places truncated by cross-bedded fluvial sand with fine gravels and peat interlay-

Table 1. Pleistocene mammal remains found on the Lower Ob (identified by I.Ye. Kuz'mina)

Sample no.	Locality	Identification
112	Pichuguy-Yaha, downstream part of sect. 25	1. Two tubular bones and rib of mammoth 2. Lower part of right humerus of adult horse 3. Lower part of radius bone of muskox 4. Antler of large reindeer and a bone of short-legged reindeer
122	Pichuguy-Yaha, upstream part of sect. 25	1. Upper part of muskox cranium with horn roots 2. Shinbone, humerus, ribs of mammoth 3. Three bones of reindeer – caxal bones and cannon-bone 4. Five muskox bones– vertebrae, fragment of scapula, a cannon-bone and a cannon-bone of another individual
123	Pyak-Yaha, downstream part of sect. 26	1. Rib and fragment of mammoth tusk 2. Caxal bone of horse
126	Pyak-Yaha, downstream part of sect. 26	1. Ribs of adult mammoth 2. Calcaneum of woolly rhinoceros 3. Right humerus of mammoth 4. Right radius bone of horse 5. Caxal bone and fragment of humerus of reindeer
135	Pyak-Yaha, upstream part of sect. 26	1. Fragment of mammoth thigh-bone
176	Shuryshkarsky Sor, sect. 31	1. Fragment of mammoth bone 2. Horse diaphysis
183	Shuryshkarsky Sor, sect. 31	1. Fragment of mammoth tooth

Table 2. Radiocarbon dates from Quaternary sediments of the Lower Ob area obtained in geochronological laboratories of St. Petersburg University (index LU) and the Karpinsky All-Russia Research Institute of Geology (index LG)

No.	Sample no.	Locality	Stratigraphic position	Material	^{14}C age, yr BP (lab. no.)
1	117	Pichuguy-Yaha, sect. 25, downstream part	sand with current ripples between loess-like silt and glacilacustrine rhythmite, 35.5 masl	plant detritus	≥52400 (LU–4769)
2	118	The same	The same, 37.5 masl	The same	≥45900 (LU–4767)
3	112	The same	picked up under the bluff	mammoth bone	25050 ± 220 (LU–4787)
4	122a	Pichuguy-Yaha, sect. 25, upstream part	The same	The same	15480 ± 70 (LU–4783)
5	122b	The same	The same	muskox cranium with horns	16380 ± 50 (LU–4992)
6	132	Pyak-Yaha, sect. 26	cross-bedded sand with gravel above glacilacustrine rhythmite, 28.5 masl	plant detritus	≥46200 (LU–4764)
7	129	The same	sand with current ripples, 33 masl	Wood	≥50400 (LU–4759)
8	131	The same	peat between sands and loess-like silt, 33.2 masl	Peat	≥44700 (LU–4765)
9	135	Pyak-Yaha, sect. 26, upstream part	picked up under the bluff	mammoth bone	≥43900 (LU–4784)
10	126	Pyak-Yaha, sect. 26, downstream part	The same	The same	35200 ± 210 (LU–4785)
11	123	The same	The same	bones of mammoth and horse	9530 ± 120 (LU–4788)
12	170	Shuryshkarsky Sor, sect. 31	autochthonous peat, 10 masl	twigs	≥39700 (LU–4761)
13	185	The same	The same	birch in bark	≥47200 (LU–4768)
14	178	The same	upper part of loess-like silt 20. 0 masl	twigs	12800 ± 150 (LU–4763)
15	183	The same	picked up under the bluff	mammoth tooth	≥30700 (LU–4757)
16	176	The same	The same	bones of mammoth	17340 ± 230 (LU–4786)
17	485	Pit at Aksarka, sect. 18	ice wedge cast in sand, 17 masl	Peat	≥45000 (LU–4553)
18	502	The same	base of loess-like silt, 40 masl	peaty silt with twigs	27840 ± 310 (LU–4555)
19	LG-13	Pyak-Yaha, sect. 26 [11]	bed of silty clay in gravelly sand	Wood	≥57000 (LG–13) [11]

ers. The sand, most probably, relates to the last interglacial, which is indicated by southern taiga pollen spectra [11] and non-finite radiocarbon dates (Table 2, samples 117, 118, 129, 131, 132, 485 and LG-13). The top of the interglacial formation is blown out, cryoturbated, and everywhere covered by loess-like (flowable if wet) silt that mantles the bluff highs and descends over the terraces and slopes of small tributary valleys (Fig. 2).

The cover silt is the most natural source of bones, because their ages are mostly less than 40 ka, whereas the fluvial sand is obviously much older (Table 2). One bone fragment has yielded an age of more than 43 900 yr, and therefore, in principle, might have originated from the fluvial sand (Fig. 2b). However, the majority of the bones have no traces of aqueous transportation. On the contrary, cavities of the well-preserved muskox skull contained remains of loess-like silt. Fallen blocks of similar silt are often observable where the bluff is lower.

The described chronological relations persist in other Ob sections. Thus, fluvial sand has yielded several radiocarbon values greater than 45 ka in the

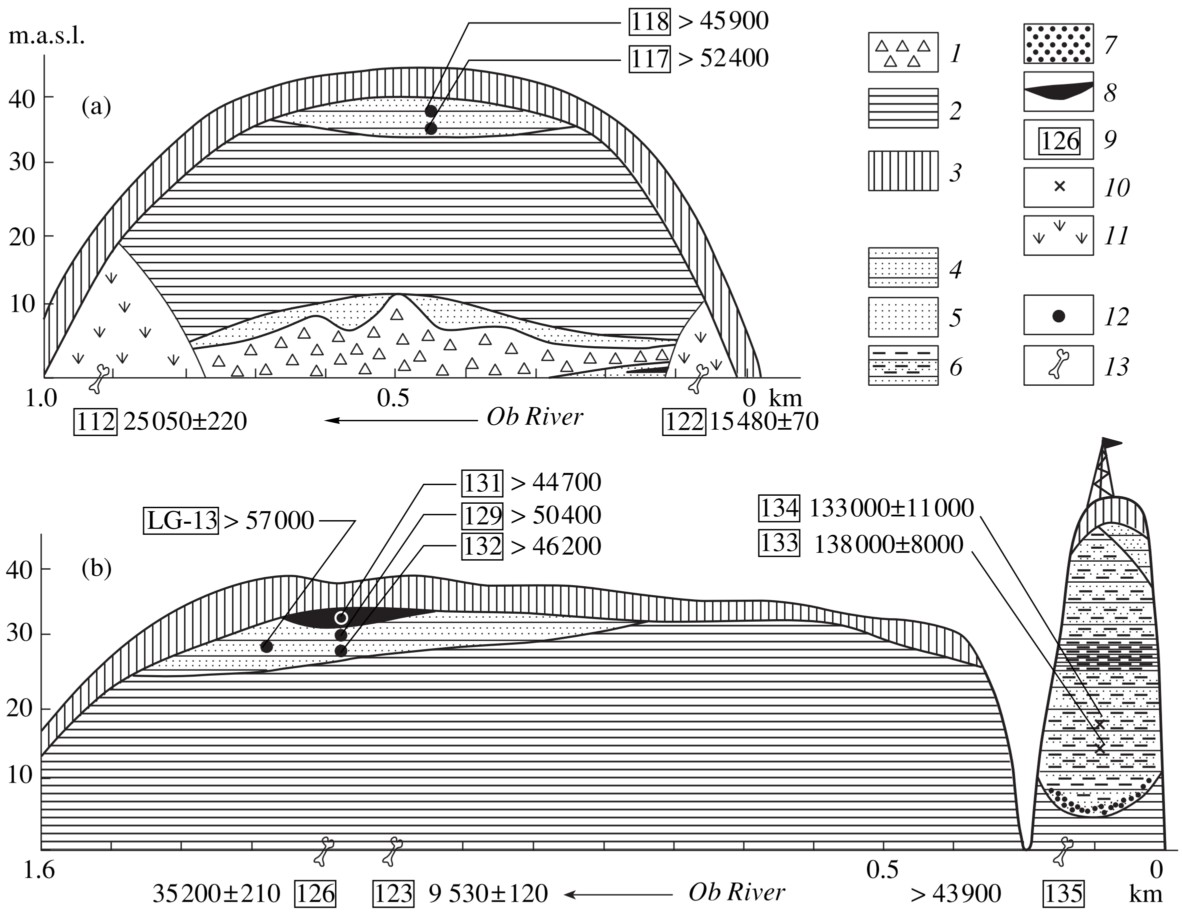

Fig. 2. Location of dated samples in two sections of the southern bank of the Nadym Ob. Zero distance is in 3 km downstream of the Pichuguy-Yaha creek for Fig. 2a (sect. 25) and 0.3 km downstream of the Pyak-Yaha creek for Fig. 2b (sect. 26). (*1*) Basal till (diamicton); (*2*) glacilacustrine rhythmite (clay and silt); (*3*) subaerial mantle (loess-like silt); (*3a*) Fluvial sediments; (*4*) cross-bedded sand with gravels; (*5*) laminated sand; (*6*) sand with silt interlayers; (*7*) gravel; (*8*) peat; (*9*) sample no.; (*10*) OSL date; (*11*) screen; (*11a*) Radiocarbon dates on; (*12*) plant remains; (*13*) mammal bones

Aksarka sand pit, whereas a lens of mire silt, found at the base of a cover silt 6–7 m thick, is ~28 ka old (Table 2, samples 485, 502). A very young age of the bulk of the subaerial cover is also supported by the date of 12 800 yr at 1 m below the top of the loessic mantle of Shuryshkary Sor (Table 2, sample 178) and by the still younger (~9.5 ka) age of bone sample 123.

Occurrence of much older mammoth remains cannot be ruled out on the Ob River. However, for the present discussion, the radiocarbon values within the 25–15.5 ka interval (Table 2, samples 112, 122a, 122b, 176) are of prime interest. They, for the first time, demonstrate that, during the so-called Last Glacial Maximum, the arctic Trans-Uralia was not a glacial desert but a pasture for a characteristic Upper Paleolithic community of large mammals, including not only mammoths, woolly rhinos, muskoxen, and reindeer, but also horses. This fauna, together with the loessic appearance of the synchronous sediments, is evidence of dry, snow-poor, and windy—but habitable—frozen steppe for the second half of the Late Pleistocene. Results obtained for the Lower Ob along with the data by earlier researchers [4–6] give reason to believe that such landscapes dominated over the entire Siberian Arctic.

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