ISSN 1028-334X, Doklady Earth Sciences, 2010, Vol. 432, Part 1, pp. 622–625. © Pleiades Publishing, Ltd., 2010.
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GEOGRAPHY

The First Radiocarbon Data of Bone Remains of Mammoth Faunal Forms in Northwestern Russia

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Presented by Academician V.M. Kotlyakov November 26, 2009

Received November 27, 2009

Abstract—Unlike in the neighboring territories, the distribution and the period of habitation of late Pleistocene mammoth complex animals in the northwestern area of Russia had not been studied until recently. This article fills in this gap using the bone material from the Zoological Institute of the Russian Academy of Sciences and the collections of one of the authors. The samples of 14 bones and teeth of big mammals uncovered in different places of the region were dated. The data obtained by conventional ^{14}C method and AMS method agree with each other and make it possible to determine two periods of habitation of mammoth complex animals in the region: 39 000–23 000 years ago and 13 000–9800 years ago, which confirms that ice–free landscapes existed here at these time intervals.

DOI: 10.1134/S1028334X10050168

The question about the habitation of mammoth fauna, which is specific for Russia, has a long history of investigation and serious results in several aspects. For obvious reasons most of them were obtained when the material from Siberia was collected and processed, while the European part of Russia has been studied much less. This particularly concerns the northwestern part of the country, which was practically a blank spot in this respect. This assertion can easily be proved in the summarizing works [1–3]. Comparison with the level of research into the mammoth fauna complex residues in the neighboring western countries makes it especially vivid [4, 5].

During the last ten years, one of the authors has tried to collect the available information about faunal findings in the Leningrad region and the neighboring territories. To do this, the author studied the published literature, including old publications, looked through the journals of receipts in the major museums of Saint Petersburg and several cities of the region, questioned currently employed specialists, and collected bone remains during systematic field work in the region (estimations by E.A. Vangengeim, G.F. Baryshnikov). At present, the list of found fossil bone remains includes several tens of items and consists of about one hundred units of bone material. Mostly they are fortuitous (incidental) findings of fragments and separate bones; there are few found skulls or parts of skeletons of one animal unit; integral skeletons have not been found at all. A considerable part of the findings kept in the museums does not have the necessary geological or geographical documentation.

When selecting the samples for radiocarbon dating at the first stage, our goal was to present the useful bone remains of different animal species from several parts of the region that are more known in geological terms in order to describe the distribution of main faunal forms in the first approximation, as well as the main stratigraphic components of the sections of late Quaternary deposits. This was done using the information about regional geology, paleogeography, and chronostratigraphy that was known from the published data and our own investigations, in order to consider all materials in the paleogeographical aspect. The attention was focused on two open pits in the southern parts of the Leningrad region, where the bone remains were unearthed and were taken to the collections over several years and even tens of years. The first one is the Shapkinskii sand-and-gravel open pit in the Tosnenskii region at 60 km to the southeast of Saint Petersburg. This open pit has been systematically worked out since the 1930s and is still exploited (in a different section). The second one is the Kelkolovskii sand-and-gravel open pit in the Kirovskii district of the Leningrad region 30 km to the east-southeast of Saint Petersburg; it has been under operation since the 1950s.

The residues of the late Pleistocene animals in the region are dated by 14 samples (Table 1), among them four estimations were made in the Russian laboratories using an ordinary radiocarbon method, and eight samples were examined in the Groningen laboratory by

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A list of dated bone fragments of the mammoth complex in the northwest of Russia

no.	Location, year	Finding conditions	Animal species, part of skeleton	Date	Laboratory no.
1	Leningrad region, the Neva River valley, Kelkolovo open pit	Dredged from the depth of 15 m	Proboscidea, upper end of ulnar bone	33160 + 220 − 210	GrA-39117
2	same place, 2002	Dredged from the depth of 15 m	Mammuthus sp., fragment of tusk plate	31420 ± 400	GIN-12097
3	same place, 2003	Dredged from sands, depth 17 m	Mammuthus sp., fragment of jaw	33300 ± 700	LU-5092
4	same place, 2005	In sands, depth 15 m	Elephantidae, shoulder-blade, fragment	24000 ± 700	GIN-13310
5	Leningrad region, Shapkinskii open pit, 1936	In sand-and-gravel layers, funds of the Zoological Institute, RAS, no. 19773	Mammuthus sp., two broken and strongly rounded fragments of the lower jaw	38450 + 400 − 340	(GIN-12092) GrA 39116
6	Leningrad region, Shapkinskii open pit, 1949	Funds of the Zoological Institute, RAS, no. 23942	Mammuthus sp., fragment of thigh bone	35140 + 280 − 260	GrA-41235
7	Saint Peterburg, Volkova village, 1965	Without a number	Mammuthus primigenius, dorsal vertebra, weakly rounded	No collagen	GIN-12094
8	Karelia, coast of Lake Ladoga, Uuksu River, 1943		Mammuthus sp., right upper tooth	>40000	Hela-366
9	Leningrad region, Kelkolovo open pit, 2003	Dredged from the depth of 17 m	Rhinocerotidae, shaft of shoulder bone	>45000	GrA-38903
10	same place, 2003	Dredged from depths 17 m	Rhinocerotidae, radial bone	38360 + 300 − 270	GrA-38819
11	same place, 2003	Dredged from the depth of 17 m	Bison sp., shoulder blade	35520 + 230 − 210	GrA-38820
12	Leningrad region, Northern coast of the Gulf of Finland near Komarovo settlement, 1923	Funds of the Zoological Institute, RAS, no. 11167, in dunes of coastal zone	Bison priscus longicornis, skull with horn piths	31080 + 200 − 180	GrA-41239
13	Leningrad region, Podporozhye, the left bank of the Svir' River, 7 km from the village of Yandeba, 1940	Excavated from sand, depth 6 m. Funds of the Zoological Institute, RAS, no. 21658	Bison priscus Boj., skull with horn piths, three ribs were also found there	10390 ± 50	GrA-41241
14	Leningrad region, Neva River lowland, Kelkolovo open pit, 2004	Dredged from the depth of 28–30 m	Equus sp., small form, limb bone	30650 + 140 − 120	GrA-41236
15	Leningrad region, Karelian Isthmus, left bank of the Burnaya River, 2003	In the outcrop, near the river level, late glacial basin	Rangifer tarandus, limb bone, rounded	11400 ± 670	LU-5091

Note: The data are not calibrated.

the AMS–method. Eight estimations were obtained from the collections of the first author; five, by bone remains from the funds of the Zoological Institute, Russian Academy of Sciences. Seven of the dated samples were the bone remains of mammoths; two, rhinoceros; three, bison; and one, horse; i.e., in general they belong to the main forms of the mammoth complex.

The obtained data with respect to age can be classified into three groups: (1) limbless, >40 000 and >45 000 years ago (mammoth and rhinoceros), (2) 38 500–24 500 years ago (mammoth, rhinoceros, bison, and horse, totally 8 estimations, five of them were obtained in the Kelkolovo open pit), (3) 11 400–10 400 years ago ^{14}C (reindeer and bison). It is very important that all the data conform to the geological age of the enclosing deposits and the data of these deposits by plant residues (where they occur).

In the Kelkovo open pit, a rhinoceros bone found from under moraine sands was dated >45 000 years ago (table, no. 9), and a wooden fragment from moraine loams was dated 45 000 years ago [GrA–41641]. For the same moraine sands in the Kelkolovo open pit, the obtained data are 33 300 and 33 100 years ago for the

mammoth bones (table, nos. 3, 1); 38 300 years ago for rhinoceros; 35 500 years ago for bison (table, nos. 10, 11); and 30 600 years ago for the horse, (table, no. 14) and range within the same limits as the data for the same under moraine sands 33 200 years ago (LU–5485) for the wood and plant residues and 40 700 and 37 200 years ago (GIN–12571n) for peat interlayers.

In the Shapki open pit in the south of the Leningrad region, special attention should be paid to two pieces of data calculated by mammoth bones that were found in different years from thick sandy (under moraine!) strata (table, nos. 5, 6). The mammal bone remains were found in this open pit as early as before the 1940s; among them were bones of mammoth, woolly rhinoceros, and horse [6, 7]. A great many features observed by geologists [6, 8], as well as the separateness and rounded state of bone fragments, indicate that the bone-containing strata were deposited by water flows, including by those able to transfer coarse pebble, single rubble, and, certainly, bone remains. The earlier conclusion about a "glacial, 'würm' period in the broad sense" of the stratum formation [7] is valid in contrast to the assumption of the same author "about their [deposits] synchronism to the Mginsk intermoraine strata" [7]. At present, a significant amount of geological data is in favor of referring them to the Leningrad megainterstadial, whose age is estimated as the late Valdai by the radiocarbon data [9, 10]. This estimate is confirmed by the data of 38 500 and 35 100 years ago which we obtained for the mammoth bones uncovered from the sand strata in this open pit at a different time (table, no. 5, 6).

The bison skull unearthed from the northern coast of the Gulf of Finland was dated 31 100 years ago (table, no. 12). Although the skull was uncovered near the present-day coast in the dunes, the ancient date conforms with the interstade deposits which are distributed in this area both in steeps above sea level and in depths well below sea level where their thickness under the late Valdai moraine reaches 24 m and where the date 45 770 ± 1160 years ago ^{14}C was calculated for the wood at a depth of 28 m [11]. The same also refers to the date of the mammoth tooth found on the northeastern coast of Lake Ladoga (table, no. 8), where there is a thick stratum of under moraine layered deposits along the coast.

The late glacial deposits with new data for the bones of reindeer and bison (table, nos. 15, 13) in the section of the Burnaya River on the Karelian Isthmus and in the trough near the Svir' River were dated earlier by plant residues. In the section of the Burnaya river, where the reindeer bone was dated 11 400 ± 670 years ago ^{14}C (LU–5091) in the middle of the section of the basin strata, the data for the wood were 13 070 ± 130 years ago ^{14}C (LU–3525) at the basis of the stratum (above the water level) [12] and 9500 years ago ^{14}C (GIN-12569n) in the roof along the gyttja. The date of the bison skull on the Svir' River (table, no. 13), 10 400 years ago, was very close to the date 10 520 ± 90 years ago ^{14}C (LU–5876) that was obtained by the peat interlayer from the upper part of the late glacial basin deposits in the section of the Chegla near the inflow of the Oyat' River to the Svir' River.

Thus, the most representative data for mammoth complex forms obtained in the region by bone remains first of all indicate that these animals (mammoth, rhinoceros, bison, and horse) inhabited the territory of the present-day Leningrad region and southern Karelia 38 000 (39 000) to 24 000 (23 000) years ago ^{14}C. During the same time about 40 000 years ago, there was a freshwater basin above the rapids at the place of the present-day valley of the Neva River, which is shown by the outcropped thick strata of under moraine sandy loams with plant residues that were dated 40 200 ± 1030 years ago (LU–5705). From this it follows that over this time and earlier up to 45 000 years ago, the territory was ice-free and was characterized by continental conditions on vast areas, and not completely covered by water basins. The conclusion about the ice-free, tundra–steppe landscape in southeastern Russia quite conforms to the previous data, including those based on the radiocarbon data for Fennoscandia [13] and to more representative data obtained for the central part of the last glaciation cover within Finland [4].

Despite the fact that in the area under study among the dated bones there are no mammoth residues of the late glacial period, the mammoth undoubtedly existed in northwestern Russia at that time. This is proved by the radiocarbon data of the findings in eastern Estonia and in the west of the Vologda region at a latitude of ~59°. For example, in 1907, near the city of Cherepovets, mammoth bones were unearthed in the lower stream of the Sheksna River during harbor construction at a depth of 5–6 m in a layer of muddy clay, one of the bones was dated 12 620 ± 500 years ago ^{14}C (GIN-8676) [14]. In 1943, not far from this place, also near Cherepovets, 68 pieces of mammoth bones were taken from the lake sapropel underlying the peatbog pit of the Zhidikhinsk swamp under a 70-cm-layer of peat from the depth of 1.2–3.5 m, including a lower jaw with teeth, vertebrae, and thigh bones [14, 15]. They belonged to one animal unit. L.D. Sulerzhitskii obtained the following data for three fragments of the rib: 9810 ± 100 (GIN–8676a), 9840 ± 50 (GIN-8885b), 9760 ± 40 (GIN-8885c), the average value is 9800 ± 50 years ago ^{14}C. In Estonia, to the west of the northern part of Lake Peipus, two teeth of mammoth taken from different places in fluvioglacial deposits were dated 10 100 ± 100 (Hela–423) and 10 200 ± 100 years ago ^{14}C (Hela–425) [5].

Having generalized the currently available radiocarbon data for the region and taking into account the data for the neighboring areas, we may conclude that in the southeastern periphery of Fennoscandia in the late glacial period, mammoth as well as (in some

places) reindeer and bison inhabited the area of 59°–62° N in the time span of 13 000–9800 years ago ^{14}C.

ACKNOWLEDGMENTS

The authors are grateful to A.K. Markova, G.F. Baryshnikov, M.V. Sablin, Ye.V. Syromyatnikova, E.A. Vangengeim, Kh.A. Arslanov, L.D. Sulerzhitskii, M.M. Pevzner, D.Yu. Bol'shiyanov, and Kh. Deenen for assistance in this research.

This work was supported by the Netherland Organization for Scientific Research (project nos. 47.009.004 and 047.017.2006.014) and the Russian Foundation for Basic Research (project no. 07-05-92312 HBO_a).

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