Mamontovaya Kurya: an enigmatic, nearly 40 000 years old Paleolithic site in the Russian Arctic

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ABSTRACT This article presents updated documentation of results from geoarcheological investigations at Mamontovaya Kurya, a Paleolithic site situated in the European part of the Russian Arctic. At this site artifacts and animal bones have been uncovered from strata covered by more than 12 m of alluvial and aeolian sediments. The most important find is a mammoth tusk that is decorated with a large number of human-made marks that presumably were made with an artistic or symbolic meaning. Radiocarbon and optically stimulated luminescence (OSL) dates indicate that the human occupation took place 35-40 000 years ago when the artifacts and bones slumped into the former Usa river and were permanently incorporated in channel alluvium. This is the oldest documented evidence for human presence at this high latitude and raises the question whether the first pioneers who lived in these northern landscapes were Neandertals or fully developed modern humans.

Introduction

There is a need to fill in the gap in the archeological record from high latitudes to increase our understanding of early human colonization and adaptation to the arctic environment. Until recently it was a common opinion that the Eurasian Arctic was not occupied by humans until the final stage of the last Ice Age some 13-14 000 years ago (Hoffecker et al., 1993; Powers, 1996). However, the discovery of the Paleolithic site Mamontovaya Kurya in the Russian Arctic implies that this view should be reconsidered (Pavlov et al., 2001). This site, radiocarbon dated to 35-40 000 years BP, is believed to represent the oldest reported evidence of human occupation in the Arctic. In addition to a handful of stone artifacts, an important find was a mammoth tusk with a series of regular marks which were inscribed by humans. In this paper we present an updated documentation of the

FIG. 1 – Map showing the location of the Paleolithic sites Mamontovaya Kurya and Byzovaya in the Russian Arctic. The area within which Neandertal remains have been found is indicated with a dotted line (Ovchinnikov et al., 2000). Notice that most of the Russian Arctic remained ice free during the Last Glacial Maximum (LGM) around 20-18 000 BP (Svendsen et al., 1999). The location of a few radiocarbon-dated European sites with skeletal remains of late Neandertals and early modern humans are plotted (Bar-Yosef, 1998; Smith et al., 1999; Sinitsyn and Praslov, 1997). Young sites with Neandertal remains: Zafarraya (33 000 BP), Spain; Arcy-sur-Cure (34 000 BP), France; Mezmaiskaya (29 000 BP), Russia; Vindija (28 000 BP), Croatia. Sites with remains of modern humans: Kent's Cavern (31 000 BP), U.K; Vogelherd (32 000 BP), Germany; Kostenki (30 000 BP), Russia; Qafzeh (90 000 BP), Israel.

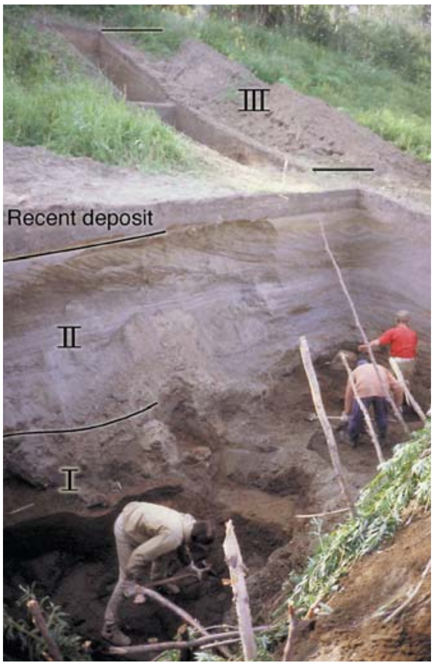

FIG. 2 – Photograph showing the find-bearing strata (I) near the base of the exposed sediments at Mamontovaya Kurya. The brownish layers with bones and artifacts are covered by younger alluvial (II and III) and aeolian deposits (IV and V).

geoarcheological investigations at Mamontovaya Kurya.

Mamontovaya Kurya, which translated into English means "the mammoth curve", is located on the southern bank of the Usa river (66°34'N; 62°25'E), close to the western foothills of the Polar Urals (Fig. 1). The riverbed at this site has long been known as a place for finding mammoth tusks and bones. The finds were made along the outer bend of the river, which cuts more than 10 m into Quaternary sediments. In order to clarify the context of the reported bones and to find out if they could be related to human activities, archeological and geological field investigations were carried out during the course of four summer seasons in 1992, 1994, 1996, and 1997. We also revisited the site during the summer of the year 2000 to collect additional samples from the exposed section. The excavated field, which covers an area of 48 m^2, is located on the narrow erosional slope of the river bank (Fig. 2). In addition to some profile sections along the river bluff several pits were dug on the adjacent terrace in order to study the covering sediments.

Sediment stratigraphy

A vertical sequence of about 12 m was exposed along the frontal escarpment of the river terrace (Fig. 3). The studied sediment section was divided into five major stratigraphic formations, labeled I toV from oldest to the youngest. These include a sequence of alluvial sediments (I-III) covered by mostly aeolian sediments (IV and V). The lowermost sediment that was exposed at Mamontovaya Kurya is a laminated sand that was reached only during the 1994 season when the water level in the river was exceptionally low (Fig. 4). However, only some 10-20 cm of the laminated sand was exposed and it is unclear whether this sand forms part of the find-bearing strata above (unit I) or if it belongs to an older stratigraphic unit. It should also be

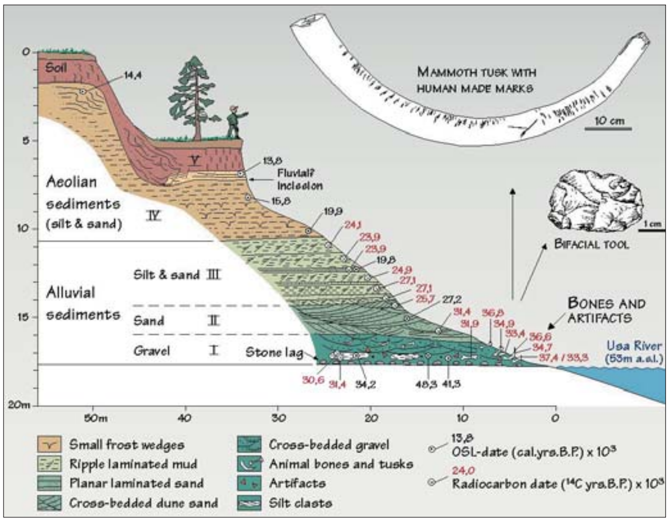

FIG. 3 – The excavated sediment section at Mamontovaya Kurya. The artifacts and bones were uncovered from the river channel deposits near the base of the exposure. Radiocarbon and optically stimulated luminescence (OSL) dates from the various layers are indicated (Table 1). Note that the radiocarbon dates are given in ^{14}C years BP whereas the OSL dates are in principal calendar years before the present.

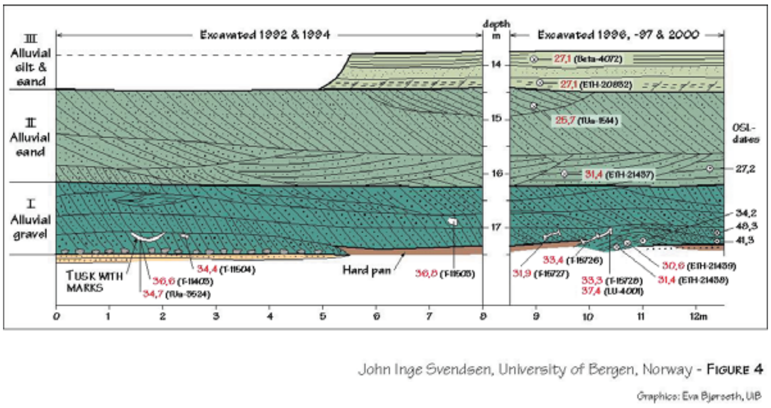

FIG. 4 – Sediment profile showing the basal layers at Mamontovaya Kurya. The profile is parallel (N-S) with the river. Same legend as in Fig. 3. Radiocarbon dates (in red) and optically stimulated luminescence (OSL) dates (in black) from the various layers are indicated (Table 1). See legend to Fig. 3.

mentioned that the profile sections along the erosional slope are relatively small and for this reason the inferred lateral extension and geometry of the various layers are subject to some uncertainty. A description of each formation is given below starting with the basal layers.

Alluvial sediments (units I-III)

Unit I

This is an up to 1.4 m thick sediment sequence that mainly consists of trough cross-bedded sand and gravel (Figs. 2-4). The base of this unit is marked by a thin band of pebbles forming a nearly horizontal boundary interpreted as an erosional lag. The individual trough-shaped sets are typically 0.2-0.4 m thick, 2-5 m wide and generally they are more than 7-8 m long. We interpret this unit as a river channel deposit. The cross-bedded strata reflect a consistent paleo-current direction towards due west, i.e. in approximately the same direction of flow as the present river. In the lower part of unit I there is a distinct band of reddish brown, ferruginous concretions (hard pan) which could be traced as a nearly horizontal boundary along the section. Below this level there are places with silty and gravelly lenses and clasts which seem to be inter-bedded with the cross-bedded strata above. The size of the inter-fingering lenses is highly variable, but typically they are less than a meter long and up to a few decimeters thick. Palynological investigations revealed that the silt, which contains plenty of terrestrial plant macro fossils, is a water-laid sediment. Probably they are lumps of redeposited alluvial silt that slumped into the river channel and were subsequently incorporated in the crossbedded strata. The artifacts as well as the bones were found throughout unit I, but with a clear concentration near the lower boundary. Some of the bones were encapsulated with silt and were found in association with the sediment lenses described above. Others were recovered from within the cross-bedded gravel and sand troughs.

Unit II

This unit consists of a 1,5-2,0 m thick sequence of long, cross-bedded dunes of medium-coarse grained sand (Figs. 2-4). The trough sets, that have a maximum thickness of about 1.0-1.2 m, are typically a few meters wide and more than 10 m long. The foresets, which dip up to 34 degrees towards due west, are slightly concave upwards with tangential lower contacts. No bones and artifacts were found within this unit, which is interpreted as sand bars that were deposited in a relatively deep (6-7 m) river.

Unit III

This is a 3.7 m thick sequence that consists predominantly of cross-laminated mud inter-bedded with a few horizontally laminated silt and sand layers. Ten separate layers have been recognized, ranging in thickness from 5 cm to more than a meter. Most of the layers reveal climbing ripple cross-lamination. The thickness of the individual sets is typically 5-6 cm. The angle of climb is typically 20-30 degrees and the cross-lamination reflects a consistent depositional direction towards the west, i.e. in the same direction as the underlying units. The mud, which has a bluish gray color when freshly exposed, contains a lot of organic material, including the remains of terrestrial herbs and mosses. Like the underlying sediments, we interpret this unit as an alluvial deposit. Possibly it forms part of a point bar sequence together with the crossbedded sand below.

Aeolian sediments (units IV-V)

Unit IV

Resting on the alluvial sediments is a flat bedded formation dominated by silt and fine sands (Fig. 3). The lower 4 m of the formation were exposed along the frontal cliff, but from lateral correlation it is assumed that the maximum thickness is as much as 10 m. However, the upper 5 m have only been studied by digging small test pits and therefore have not been described in detail. There is no sharp boundary between units III and IV and, apparently, the latter unit is conformably overlying the alluvial sediments described above. Along the lower boundary there are frequent soft sediment deformation structures attributed to water escape mechanisms. The lower 40 cm consists of a brownish, horizontally laminated fine sand. Upwards the fine sand grades into a brownish gray, sandy silt. A vague, wavy stratification was recognized from the occurrence of some rusty laminae. The strata are gently sloping towards the NW, i.e. oblique towards the present river bank. Inter-bedded in the silt sequence are three horizons with small desiccation cracks and/or small frost cracks. Some of the sand lenses are heavily deformed, probably as a result of cryoturbation. Higher up along the frontal cliff, the horizontal bedding disappears and the sediments become distinctly mottled. It is believed that these changes are a result of soil forming processes. We interpret this unit as an aeolian deposit that blankets the underlying alluvial deposits.

Unit V

This formation, which is 1.5-2.0 m thick, is the uppermost unit along the exposed section. The lower part (0.5 m) consists of banded/laminated silt interbedded with some thin (1-3 cm) and distinct layers of sand. We believe this stratification is due to running water and that the terrace along the escarpment formed as a result of fluvial incision. Above the stratified sequence follows a brownish grey, nearly massive sandy silt. The sediment cover, which is capped by a thin peat, is most likely of aeolian origin and subsequently affected by soil formation processes.

The archeological and paleontological finds

As described above, all finds were uncovered from the cross-bedded gravel and sand of unit I. The finds were scattered all over the 48 m^2 excavated area without any conspicuous concentrations. However, most of the finds were made near the base of the excavation.

Note that the sediment masses were not sifted through sieves during the excavations and it is therefore possible that small bones and artifacts escaped our attention.

Mammoth tusk with incision marks

The most important find was a mammoth tusk that exhibits a series of distinct incision marks (Fig. 5). The marks, which are 1-2 mm deep, appear as rows with densely spaced, 0.5-1 cm long indentations crosswise along the tusk. Microscope analysis reveals that the indentations are chopping marks that were caused by a sharp stone edge, evidently the work of humans. Our impression is that the marks were not inflicted by chance while using the tusk as support for chopping meat or some other processing work. Instead, the marks seem to be organized in rows along all sides of the tusk following a regular and repeatable pattern. We believe they were made intentionally with an artistic or symbolic meaning.

FIG. 5 – Photograph of the mammoth tusk from Mamontovaya Kurya. The marks appear to have been inflicted by a sharp stone tool. Note that few marks cross each other.

Stone artifacts

In addition to the tusk with engravings, several stone artifacts were uncovered from unit I. Most of the artifacts are unmodified flakes, but the assemblage also includes a scraper and a well-defined bifacial tool (Fig. 3). The latter artifact, which is made of slate, is interpreted as a knife. The artifacts resemble Middle Paleolithic (Mousterian) as well as early Upper Paleolithic assemblages in Eastern Europe. Considering that so few artifacts were uncovered, it is difficult to undertake a correlation with Paleolithic cultures on the basis of typological criteria.

Animal remains

One hundred and twenty three mammalian bones, primarily mammoth, but also horse (2), reindeer (5), and wolf (2) were collected (Table 1). Some of the mammoth bones may belong to one single animal, but several individuals were identified. Most of the bones are well preserved. It is likely that at least some of the animals were utilized by contemporaneous humans, but unambiguous human made cut marks were not recognized.

TABLE 1
List of bones from Mamontovaya Kurya.

***Mammuthus primigenius* Blum (wholly mammoth)**	***Rangifer tarandus* L. (reindeer)**	***Canis Lupus* L (wolf)**	***Equus caballus* (horse)**
7 ribs	1 antler	1 metacarpal	2 teeth
1 pelvis	1 pelvis	1 unspecified	
2 tusks	1 shoulder		
1 lower jaw			
1 skull fragment			
3 teeth, upper jaw			
2 vertebrae			
70 unspecified mammoth	2 unspecified		

The table includes animal remains collected from the excavated site and that could be identified to species (from Pavlov et al., 2001). Additional 27 bone fragments could not be identified, but most of them are probably of mammoth.

Dating results

Twenty one samples from the Mamontovaya Kurya site have been radiocarbon dated (Table 2). Several laboratories were used: Trondheim Radiocarbon Laboratory (T), Norway; St. Petersburg University (LU), Russia; Beta Analytic (Beta); and the Swiss Federation Institute of Technology (ETH). Ten conventional radiocarbon dates of various animal remains, mostly mammoth, were conducted. Additional 11 dates of terrestrial plant remains were analyzed by using accelerator mass spectroscopy (AMS). The tusk with incision marks was dated by using conventional as well as AMS technique. In addition to the radiocarbon dates of plant and animal remains the chronostratigraphy is based on a series of nine optically stimulated luminescence (OSL) dates from the various stratigraphic units (Table 3). The OSL dates were processed at the Nordic Laboratory for Luminescence Dating, Denmark. All dates used the Single Aliquot Regenerative (SAR) dose protocol applied to quartz grains in the sand size fraction to estimate the equivalent radiation dose (Murray and Wintle, 2000). It should be noted that the OSL dates are reported in calendar years whereas the radiocarbon ages may deviate from the real age by several thousand years for this age interval due to fluctuating ^{14}C content in the atmosphere.

TABLE 2
Radiocarbon dates.

Depth (m)	Lab no.	Age	Dating method	δ13C (‰)	Material dated and stratigraphic context
11.0	ETH-20830	24 080±220	AMS	-25.9	Terrestrial moss, unit III
12.0	Beta-119501	23 860±120	AMS	-25.8	Terrestrial moss, unit III
12.4	Beta-119502	23 890±140	AMS	-26.0	Terrestrial moss, unit III
12.8	ETH-20831	24 890±210	AMS	-25.1	Terrestrial moss,unit III
13.4	Beta-4072	27 130±180	AMS	-26.4	Terrestrial moss, unit III
13.9	ETH-20832	27 090±240	AMS	-24.4	Terrestrial moss, unit III
14.5	TUa-1514	25 650±535	AMS	-28.2	Terrestrial plants, unit II

TABLE 2 [Cont.]
Radiocarbon dates.

Depth (m)	Lab no.	Age	Dating method	δ13C (‰)	Material dated and stratigraphic context
16.0	ETH-1437	31 420±370	AMS	-21.0	Terrestrial moss, unit II
16.6	T-11503	36 770/+2620/-1980	Conv.	—	Horse tooth, unit I
17.1	ETH-21439	30 610±350	AMS	-18.9	Terrestrial moss, unit I
17.1	ETH-21438	31 380±380	AMS	-22.2	Terrestrial moss, unit I
17.1	T-11403	36 630/+1310/-1130	Conv	-22.3	Mammoth tusk with marks, unit I
17.1	TUa-3524	34 655±570	AMS	-22.3	Mammoth tusk with marks, unit I
17.1	T-15726	33 440±710	Conv.	-22.3	Mammoth bone, unit I
17.0	T-15727	31 880±390	Conv.	-22.4	Mammoth bone, unit I
17.0	T-15728	33 340±460	Conv.	-22.0	Mammoth bone, unit I
17.0	LU-4001	37 360±630	Conv.	-22.3	Mammoth bone, unit I (same bone as T-15728)
	LU-3994	34 920±1040	Conv.	-22.4	Mammoth tusk, uncertain context
	LU-4008	12 380±60	Conv.	-22.0	Mammoth bone, uncertain context
	TUa-3525	40 035/+ 825/-1485	AMS	-25.0	Wolf bone, uncertain context

The radiocarbon dates (^{14}C yr BP) were carried out at various laboratories. Abbreviations: Beta, Beta Analytic; ETH, the Swiss Federal Institute of Technology AMS Facility; T, Trondheim Radiocarbon Laboratory; Tua, prepared at Trondheim and measured at the accelerator in the Svedberg Laboratory, Uppsala; LU, St. Petersburg University.

The mammoth tusk with incision marks is of special importance. Preliminary microscope analysis suggests that the marks were inflicted when the ivory was still fresh and that they were most likely made shortly after the mammoth died. A conventional radiocarbon age of 36 630/+1310/-1130 BP (T-11403) was initially obtained at the Trondheim Laboratory. The same tusk was recently redated by the AMS technique at the Uppsala Laboratory and two measurements gave a weighted mean age of 34 655±570 BP (Tua-3524) which is within two standard deviations of the previous dating result. A conventional radiocarbon date of another tusk conducted by the St. Petersburg Laboratory yielded a similar age of 34 920±1040 BP (LU-3994). Additional five dates of various mammoth bones and one horse tooth from the same strata have yielded ages in the range 32-37 000 BP. An AMS date of a wolf bone gave a somewhat higher age of 40 035/+1825/-1485 (Tua-3525). The mean value of all nine dates conducted on animal remains from this stratigraphic unit (I) is around 35 000 ^{14}C years BP.

Two AMS dates of plant macrofossils that were collected from a clast of silt within the find-bearing strata yielded the somewhat younger ages of 31 380±380 BP (ETH-21438) and 30 610±350 BP (ETH-21437). Taken at face values, these two dates may suggest that the find-bearing alluvial sediments are slightly younger than the bones. However, we suspect that the age differences may be artifacts of dating uncertainties. The OSL dates can be used to estimate the time elapsed since buried sediment grains were last exposed to daylight (Murray and Olley, 2002). A sediment sample that was collected from the above-mentioned silt clast produced an age of 34 000±2000 BP (Ri-012595) that is in good agreement with the AMS dates of the terrestrial plant material. On the other hand, two other OSL samples that were collected from crossbedded sand within the same stratigraphic unit (I) yielded somewhat higher ages of 41 000±3000 BP (Ri-012574) and 48 000±3000 BP (Ri-012575) which are more consistent with the above-mentioned mammoth dates (Table 3). Even though the dating results are not fully conclusive they suggest that the sediments accumulated nearly at the same time as the animals were living. It should be noted that the radiocarbon ages for this time interval probably should be calibrated by the addition of 1000 to 2000 years, based on Kitagawa and van der Plicht (1988) and Voelker et al. (1998).

A series of eight AMS dates of plant remains from the overlying alluvial deposits have yielded consistent ages in the range 31 400-23 800 BP. Two OSL dates from units II and III gave the ages of 27 000±2000 BP (Ri-012576) and 19 800±2100 BP (Ri-99253-0), respectively. The dating results suggest that this part of the sediment sequence is significantly younger than the find-bearing sediments below and that the sediments are getting younger upwards in succession.

There are no radiocarbon dates from the aeolian sediments above, but the OSL dates suggest that this part of the sequence dates from the Late Weichselian period between 20 000 and 14 000 calendar years ago. It is noteworthy that one radiocarbon date on a mammoth bone collected from the surface sediment on the riverbank yielded a deviating age of 12 380±60 BP (LU-4008). Most likely, this bone originates from the upper part of the aeolian sequence.

TABLE 3

Optically stimulated luminescence (OSL) dates.

Depth (m)	Lab no.	Age	Dose rate (Gy/ka)	Stratigraphic context
7.0	99253-1	13 800±1100	2,37	Aeolian/fluvial sand, unit V
2.0	99253-2	14 400±900	2,29	Aeolian sand, unit IV
8.0	99253-3	15 800±1000	2,52	Aeolian silt, unit IV
10.0	99253-4	19 900±1300	2,46	Aeolian silt, unit IV
12.4	99253-0	19 800±2100	2,09	Alluvial silt, unit III
15.5	01257-6	27 200±2000	1,28	Alluvial sand, unit II
17.0	01257-5	48 300±3000	0,83	Alluvial sand, unit I
17.4	01257-4	41 300±3000	1,29	Alluvial sand, unit I
17.4	012595-5	34 200±2000	1,61	Alluvial silt, unit I

The OSL dates (calendar years), measured on quartz grains in the sand grain fraction, were produced at the Nordic Laboratory for Luminescence Dating, Risø National Laboratory, Denmark.

Interpretation of the geological history

We have previously interpreted the entire sequence of alluvial sediments (units I-III) at Mamontovaya Kurya as a point bar deposit that accumulated as a result of lateral migration of a meandering river (Pavlov et al., 2001). According to this interpretation the former Usa river was undercutting the strata with bones and artifacts which slumped into the river and were concentrated in the channel lag deposit a few thousand years after they were left on the former river bank. The slumped blocks from the cut side were preserved as discontinuous lenticular patches on the deepest part of the channel. According to the classical point bar model, bed load particles, sand and gravel accumulate on the lower part of the bar while finer particles are being swept further up towards the surface, giving a systematic reduction of grain size upslope. Point bars also show an upslope diminution in size of bedforms reflecting diminishing water depth and shear stress. The new dating results substantiate our previous conclusion concerning the age of the bones and artifacts. However, the OSL dates cast doubt about our previous assumption that all three stratigraphic units within the alluvial sequence accumulated during one single depositional event at around 27 000 ^{14}C years ago. In the light of the new dating results we now think that the find-bearing sediments are significantly older than 27 000 BP and that the alluvial sequence represents at least two separate depositional events with a time break in between.

Based on the available evidence we now interpret the sediment succession at Mamontovaya Kurya as follows (Fig. 6):

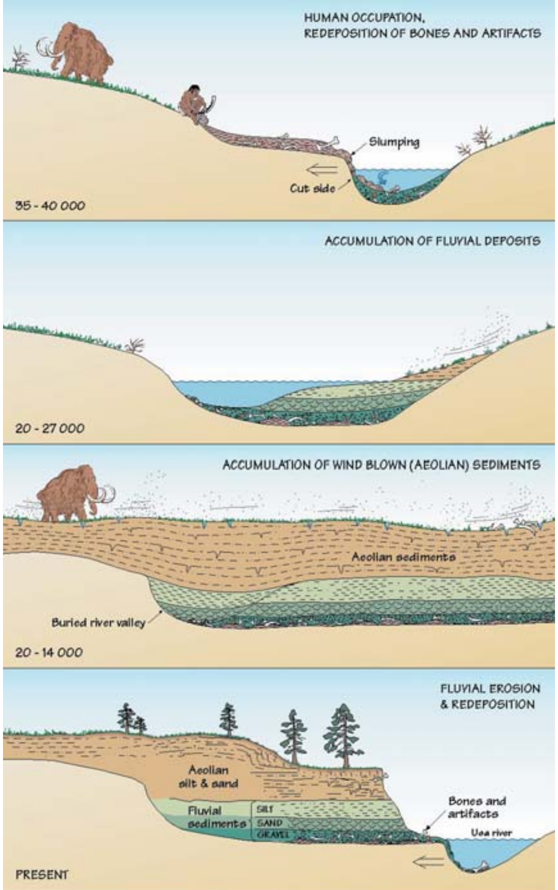

FIG. 6 – Reconstructed geological history at Mamontovaya Kurya. According to our interpretation the bones and artifacts slumped into the former Usa river soon after they were left on the riverbank 35-40 000 years ago. The find-bearing strata were subsequently covered by younger alluvial and aeolian sediments. The present river started to incise into the sediment sequence around 14 000 years ago and exposed the layers with bones and artifacts along the present river bank.

1) The refuse from human occupation, including bones and artifacts, was left on the river bank of Usa not later than 34-35 000 ^{14}C years BP and was soon after permanently incorporated in alluvial deposits. The fact that neither the bones nor the stone artifacts show any sign of wearing substantiates the assumption that they were swiftly buried.

2) The overlying alluvial sediments (units II and III) accumulated during one or more depositional events around 27-24 000 ^{14}C years BP. Judging from the size of the alluvial dunes that cover the find-bearing strata the Usa River was at least 6-7 m deep during flooding when these sediments accumulated.

3) Aeolian loess-like sediments (unit IV) accumulated on top of the alluvial deposits during the final stage of the Ice Age from around 20 000 to around 14 000 calendar years ago. Similar blankets of aeolian sand are widespread in the Pechora Basin and probably reflect a very dry period (Astakhov et al., 1999). It is noteworthy that mammoths seem to reappear in the area at the end of this period.

4) Finally the Usa River incised into the entire sequence and exposed the basal layers with bones and artifacts. Judging from the uppermost OSL sample, collected from fluvially reworked sediments of aeolian origin, the downcutting seems to have started shortly after 14 000 calendar years before the present.

The paleoenvironment

The last shelf-centered ice sheet that inundated the northern rim of the Russian mainland seems to have reached its maximum position some 50-60 000 years ago (Mangerud et al., 2001). At this time the southern margin of the Barents-Kara Ice Sheet terminated near the mouth of the Pechora river some 300 km to the NW of Mamontovaya Kurya (Astakhov et al., 1999). This ice sheet probably vanished long before humans took up residence in the area around 35-40 000 years ago. A regrowth of the ice sheet occurred at a much later time, but even during the Last Glacial Maximum, some 20-18 000 years ago, most of the Russian Arctic remained ice free. At this time the southern margin of the Barents-Kara Ice Sheet terminated on the continental shelf in the Pechora Sea (Svendsen et al., 1999).

The human occupation most likely occurred during a relatively mild interlude of the last Ice Age, possibly corresponding to the Hengelo interstadial (39-36 000 BP) in western Europe (van Andel and Tzedakis, 1996). The environmental conditions 35-40 000 years ago were probably favorable for human colonization, although probably colder and more continental than today. This means that the winter temperatures in this region were lingering between -30 and -50°C for several months, whereas the average temperatures during July-August may have been as high as 10-15°C. At any rate, the landscape evidently hosted a rich and varied mammalian fauna that could be hunted. The bone material from the Mamontovaya Kurya site indicates that humans preyed on large herbivorous animals, including mammoths, horse and bison. A pollen diagram covering the alluvial sequence at the site has been constructed (Halvorsen, 2000). This includes several spectra from the dated clast of alluvial silt found within the gravel unit with bones. The pollen composition reflects a treeless tundra-steppe environment dominated by herbs and grasses, presumably with local stands of willow scrubs (*Salix* spp) along the river banks. This implies that the landscape was treeless, but humid enough to support fertile river valleys with almost normal water discharge. We believe that such riverine environments were the natural pathways for northbound human migrations. It is noteworthy that the scrub elements seem to be absent during deposition of the overlying alluvial deposits (unit III) when the local vegetation became dominated by *Artemisia* and *Poacea*, resembling a cold steppe environment. The changing vegetation is reflecting a climatic cooling around 27-25 000 yrs BP. During the widespread deposition of aeolian sediments between 20 and 14 000 years ago the vegetation cover was probably more discontinuous and the landscape could sustain fewer animals.

Neandertals or modern humans?

The finds from Mamontovaya Kurya indicate that humans crossed the Polar Circle in the European part of the Russian Arctic as early as 35-40 000 years ago, much earlier than previously thought. A pressing question is whether the pioneers who lived in these northern landscapes were Neandertals (*Homo sapiens neanderthalensis*) or fully developed modern humans (*Homo sapiens sapiens*). If they were Neandertals then this human type expanded much further north than hitherto assumed, implying that their cultural development was not a hindrance for colonization of the Arctic habitat. Based on our current knowledge about the Neandertals and their distribution on the Eurasian continent during the last Ice Age we doubt that they were living this far north. However, we cannot exclude this possibility and/or that they evolved into modern humans. In this connection, it remains an unsolved puzzle that the early Upper Paleolithic Szeletian industry in Eastern Europe resembles artifacts related to the foregoing Mousterian complex, including the bifacial stone technology (Allsworth-Jones, 1986).

Alternatively, if the residents at Mamontovaya Kurya were not Neandertals but fully developed modern humans, then this human race colonized the Russian Arctic shortly after the first newcomers entered Europe some 40 000 years ago (Bocquet-Appel and Demars, 2000; Straus et al., 2000). Unfortunately, no human bones were found at

Mamontovaya Kurya that can throw light on this question and the few stone artifacts that were found are not diagnostic. However, the tusk with incision marks may possibly hold some clues. Similar "decorations" on mammoth tusks are known from some other sites in Russia, but from much younger strata. All known parallels to the tusk from Mamontovaya Kurya are found in contexts that are confidently related to fully developed modern humans. One example is the late Upper Paleolithic site Avdeevo on the Russian Plain that has been radiocarbon dated to between 21 000 and 20 000 BP (Gvozdover, 1995). Most scholars consider the widespread use of decorations as a distinguishing feature for the appearance of modern humans. Even though the tusk from Mamontovaya Kurya can hardly be categorized as an advanced "work of art", it fits into the same tradition, suggesting that these people mastered the power of abstraction, perhaps a qualification necessary for surviving on an annual basis at these high latitudes. We therefore tend to believe that the person who inflicted the characteristic marks on this tusk was a modern human.

There are also other finds in northern Russia that provide us with reason to believe that modern humans colonized this region at a relatively early stage. Some 300 km SW of Mamontovaya Kurya is a slightly younger Upper Paleolithic site that is located close to the Byzovaya village along the Pechora River (Fig. 1). More than 300 finds and 4000 bones have been unearthed during several excavations (Pavlov et al., 2001 and references therein). Recently, we carried out more field investigations at this important site and established a better chronology. A series of radiocarbon analyses conducted on well-preserved mammoth bones from the find-bearing strata have yielded radiocarbon ages in the range 28-29 000 ^{14}C years BP. The lithic industry at Byzovaya shows clear similarities with the artifacts from the famous Sungir site near Moscow where skeletons of modern humans have been dated to approximately the same period (Sinitsyn and Praslov, 1997). In all likelihood, fully developed modern humans were present in the Pechora basin not later than 28 000 ^{14}C years BP, which is considered as a minimum age for their first appearance in this region.

Whoever the persons who lived at Mamontovaya Kurya were, the finds from this site open new perspectives on the earliest colonization of the Arctic and Europe in general. We find it remarkable that humans were living in the Arctic this early and it raises the question whether they recently emigrated from temperate areas much further to the south or if their origin should be sought in other areas. Perhaps the first immigrants of modern humans in northern Europe were "Asians" spreading westwards from Siberia?

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REFERENCES

ALLSWORTH-JONES, P. (1986) - *The Szeletian*. Oxford: Clarendon.

ASTAKHOV, V. I.; SVENDSEN, J. I.; MATIOUCHKOV, A.; MANGERUD, J.; MASLENIKOVA, O.; TVERANGER, J. (1999) - Marginal formations of the last Kara and Barents ice shelves in northern European Russia. *Boreas*. Oslo. 28, p. 23-45.

BAR-YOSEF, O. (1998) - The Chronology of the Middle Paleolithic of the Levante, In AKAZAWA, T.; AOKI, K.; BAR-YOSEF, O., eds. - *Neandertals and modern Humans in Western Asia*. New York: Plenum Press, p. 39-56.

BOCQUET-APPEL, J-P.; DEMARS, P.Y. (2000) - Neanderthal contraction and northern human colonization of Europe. *Antiquity*. Cambridge. 74, p. 544-552.

GVOZDOVER, M. (1995) - *Arts of the Mammoth Hunters: The Finds from Avdeevo*. Oxford: Oxbow Books (Oxbow Monograph; 49).

HALVORSEN, L. S. (2000) - Palaeovegetation and environment during Weichselian stadials and interstadials at Mamontovaya Kurja and Sokolova in the Pechora basin, northern Russia. Unpublished cand. scient. thesis, University of Bergen. 67

HOFFECKER, J. F.; POWERS, W. R.; GOEBEL, T. (1993) - The colonization of the Beringia and the peopling of the New World. *Science*. Washington. 259, p. 46-53.

KITAGAWA, H.; VAN DER PLICHT, J. (1998) - Atmospheric radiocarbon calibration to 45,000 yr B.P.: Late Glacial fluctuations and cosmogenic isotope production. *Science*. Washington. 279, p. 1187-1190.

MANGERUD, J.; ASTAKHOV, V. I.; MURRAY, A.; SVENDSEN, J. I. (2001) - The chronology of a large ice-dammed lake and the Barents-Kara ice sheet advances, northern Russia. *Global and Planetary Change*. Amsterdam. 31, p. 321-336.

MURRAY, A. S.; WINTLE, A. G. (2000) - Luminescence dating of quartz using an improved single-aliquot regenerative-dose protocol. *Radiation Measurements*. Amsterdam. 29, p. 503-515.

MURRAY, A. S.; OLLEY, J. O. (2002) - Precision and accuracy in the optically stimulated luminescence dating of sedimentary Quartz: a status review. *Geochronometria*. Gliwice 21, p. 1-16.

OVCHINNIKOV, I. V.; GÖTTHERSTRÖM, A.; ROMANOVA, G.; KHARITONOV, V. M.; LIDEN, K.; GOODWIN, W. (2000) - Molecular analysis of Neanderthal DNA from the northern Caucasus. *Nature*. London. 404, p. 490-493.

PAVLOV, P.; SVENDSEN, J. I.; INDRELID, S. (2001) - Human presence in the European Arctic nearly 40,000 years ago. *Nature*. London. 413, p. 64-67.

POWERS, W. R. (1996) - In STRAUS, L. G.;. ERIKSEN, B. V; ERLANDSON, J. M.; YESNER, D. R., eds. - *Humans at the end of the Ice Age. The Archaeology of the Pleistocene-Holocene Transition*. New York: Plenum Press, p. 229-253.

SINITSYN, A. A.; PRASLOV, N. D., eds. - *Radiocarbon Chronology of the Paleolithic of Eastern Europe and Northern Asia. Problems and perspectives.* St. Petersburg, p.21-66 (in Russian).

SMITH, F. H.; TRINKAUS, E.; PETTITT, P. B.; KARAVANIC, I.; PAUNOVIC, M. (1999) - Direct radiocarbon dates for Vindija G1 and Velika Pecina Late Pleistocene hominid remains. *Proceedings of the Natural Academy of Sciences*. Washington. 96, p. 12281-12286.

STRAUS, L. G.; BICHO, N.; WINEGARDNER, A. C. (2000) - The Upper Palaeolithic settlement of Iberia: first-generation maps. *Antiquity*. Cambridge. 74, p. 553-566.

SVENDSEN, J. I.; ASTAKHOV, V. I.; BOLSHIYANOV, D.Yu.; DEMIDOV, I.; DOWDESWELL, J. A.; GATAULLIN, V.; HJORT, Ch.; HUBBERTEN, H. W.; LARSEN, E.; MANGERUD, J.; MELLES, M.; MÖLLER, P.; SAARNISTO, M.; SIEGERT, M. J. (1999) - Maximum extent of the Eurasian ice sheet in the Barents and Kara Sea region during the Weichselian. *Boreas*. Oslo. 28, p. 234-242.

VAN ANDEL, T. H.; TZEDAKIS, P. C. (1996) - Paleolithic landscapes of Europe and environs, 150,000-25,000 years ago: An overview. *Quaternary Science Reviews*. London. 15, p. 481-500.

VOELKER, A. H. L.; SARNTHEIM, M.; GROOTS, P. M.; ERLENKEUSER, H.; LAJ, C.; MAZAUD, A.; NADEAU, M.-J.; SCHLEICHER, M. (1998) - Correlation of marine ^{14}C ages from the Nordic Seas with GISP2 isotope record: implications for the ^{14}C calibration beyond 25 ka BP. *Radiocarbon*. Tucson. 40, p. 517-534.