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Stratigraphy and palaeoecology of the Upper Palaeolithic sites near the Maina village (Upper Yenisey valley, Siberia)

SERGEI A. VASILEV[1] - ANATOLY F. YAMSKIKH[2] - GALINA Y. YAMSKIKH[2] - YURI S. SVEZHENTSEV[1] - ANATOLY K. KASPAROV[1]

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Abstract: During a rescue archaeology campaign in the Upper Yenisey region, three key multicomponent early prehistoric sites (Maininskaia, Ui I and Ui II) were discovered and investigated in the area to be flooded by the Krasnoyarsk reservoir. A unique succession of assemblages represents a complete sequence of prehistoric cultures from the middle phase of the Upper Palaeolithic to the Iron Ag The field work included a detailed palaeoecological study of the site-settings, providing evidence on a long-term cultural evolution in t context of changing environments and allowing the reconstruction of the economy and lifeways of the palaeolithic people. The oldest assemblage (layer 2 of Ui I) was associated with periglacial fluvial deposits of the 23–25 m terrace, dated to the beginning of the Sartan Glaciation (22–17 ka BP). Faunal remains include Asiatic wild ass, Siberian wild goat and bison among other species. The majority of more recent Upper Palaeolithic horizons (Maininskaia, Ui II) were embedded in alluvial deposits and the overlying strata of the second (14–18 m) terrace of the Yenisey River. Their geological setting and radiocarbon dates indicate a Late Sartan age (18–10 ka BP). Red deer, wild sheep and bison predominated in the fossil fauna. Palynological data indicate the alternation of steppe grasslands with mixed forests (pine, Siberian pine and birch). Forests invaded periglacial steppes during the Late Sartanian interstadials, indicated by the presence of buried soils in the upper part of the stratigraphic sequence.

[1] *Institute for the Material Culture History, Russian Academy of Sciences, 18 Dvortsovaia emb., 191186 St. Petersburg, Russia*
[2] *Krasnoyarsk State Pedagogical University, 89 Lebedeva st., 660049 Krasnoyarsk, Russia*

INTRODUCTION

In the course of intensive fieldwork over the last few decades in the upper and middle reaches of the Yenisey River, one of the largest concentrations of the Upper Palaeolithic sites in Siberia has been found. The main stratified sites are clustered in three areas, namely near the Krasnoyarsk, on the left bank of Yenisey in the Northern Minusinsk Basin, and at the junction of the river and the West Sayan Mountains (VASILEV 1992). In this paper we consider the stratigraphy of some key sites belonging to the third concentration located near the Maina village.

Palaeolithic research in this region was initially conducted by ASTAKHOV (1986), starting in 1971 by investigations in the area adjacent to the West Sayan Mountains. The first archaeological survey revealed the Oznachennoe I site on the northern slope of Sayan and several other localities in the valley of Golubaia. In 1980, S. N. ASTAKHOV and S. A. VASILEV located other Upper Palaeolithic sites in the Golubaia and Sizaia River valleys. At present, more than twenty palaeolithic localities are known in the vicinity of the Maina village within a small portion of the Upper Yenisey valley, representing a major concentration of stratified multicomponent sites.

In 1980, A. F. YAMSKIKH began to explore the area to be flooded by reservoir of the Maininskaia hydroelectric power station; this resulted in the discovery of several sites near the dam, in the valley of a small left tributary of the Yenisey – the Ui River.

The sites are located in the northernmost portion of the so-called Sayan Canyon of Yenisey, a picturesque gorge, formed by a giant stream crossing the mountain ranges. The West Sayans extend from southwest to northeast and separate the Tuva Basin in the south (the area of Yenisey sources) from the Minusinsk Basin in the north. The valley of Yenisey near Maina becomes wider and receives a number of tributaries, including the Ui, Sizaia, Golubaia and Bolshoi Karak. Near their mouths, Late Quaternary terraces with palaeolithic sites are located. Ten kilometres downstream from Maina, Yenisey leaves the mountain country and enters the Minusinsk steppe lowlands.

The physiographic feature of this area, lying directly on the frontier between two markedly different environmental zones, provided favourable conditions for the subsistence of prehistoric hunter-gatherers, explaining the enormous density of multicomponent habitat occurrences near Maina.

Maininskaia

This multicomponent site located on the left bank of the Yenisey, near the mouth of the Ui River, was the main focus of the excavations in 1980–1984 and 1990–1991. The site includes two investigated areas, the western (A) and the eastern (B).

A. The western (upper) area is associated with deposits of the 25–27 m terrace. The excavation 10 in the southwestern part of this area revealed the following section (Fig. 1):

	Stratum	depth in m
1	Surface cover (dump)	0.00–0.05
2	Present chernozem	0.05–0.40
3	Brownish grey sandy loam (B horizon with a Neolithic layer at a depth of 0.4 m)	0.40–0.70
4	Grey fine grained sand with vertical cracks and carbonatized horizon Layer A1 occurs at the depth of 0.6 m Layer A2 occurs at the depth of 0.7 m Layer A3 occurs at the depth of 1.15 m At the level of layer A2, there is a paleosol with signs of disturbance by solifluction	0.70–1.50
5	Grey laminated sand, less carbonized Layer B occurs at the depth of 1.6 m Layer V occurs at the depth of 1.7 m Layer 6 occurs at the depth of 2.2 m At the level of layers B and V, traces of buried soils are identified	1.50–2.50
6	Interstratification of grey fine grained and coarse grained sand with gravel lenses	2.50–2.80
7	Grey cross-bedded sand	2.80–3.70
8	Bedrock	

Radiocarbon dates (Table 1) indicate a late Sartan age for layers A1–A3 (ca. 12 ka BP). The palaeosol at layer A2 could be attributed to the Taimyr Interstadial; this corresponds to the Alleröd on the European scale. Buried soils identified at the levels of layers B and V could be correlated with the Early Sartan interstadial (ca. 15–16 ka BP), corresponding to the radiocarbon date obtained for the layer B.

The Siberian wild goat, red deer and argali (wild sheep) predominated among the fauna, accompanied by bison, Asiatic wild ass, wolf and birds; roe deer is a permanent component of the fauna from layer B onwards.

Granulometric analysis indicates a fluvial origin for the lower portion of the deposits, which accumulated during higher water stands. Palynological analysis

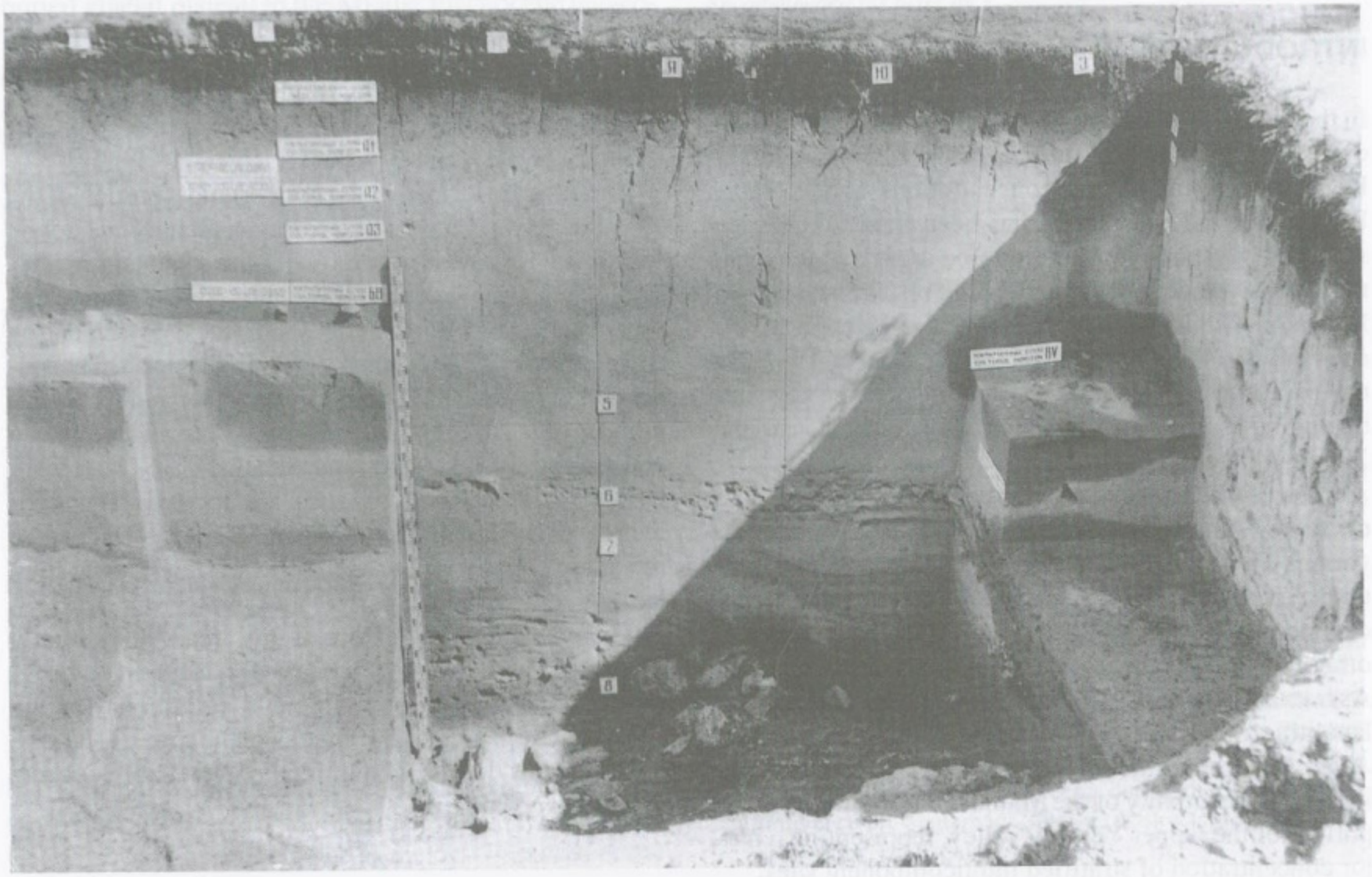

Fig. 1. Maininskaia. Stratigraphy of the upper section of the site. The northern wall of the excavation area 10.

Table 1. Radiocarbon dates of the sites

no.	Site, Layer	Assay	Lab. no.	Material
1	Maininskaia, Layer A-1	12110±220	LE-4255	bone
2	Maininskaia, Layer A-1-3	11700±100	LE-3019	bone
3	Maininskaia, Layer B	15200±150	LE-2383	charcoal
4	Maininskaia, Layer 1	15500±150	LE-2299	bone
5	Maininskaia, Layer 2-1	12120±120	LE-2300	bone
6	Maininskaia, Layer 2-1	12280±150	LE-2300	bone
7	Maininskaia, Layer 2-2	10800±200	LE-2378	charcoal
8	Maininskaia, Layer 3	12120±650	LE-4252	bone
9	Maininskaia, Layer 3	12330±150	LE-2149	bone
10	Maininskaia, Layer 3	13900±150	LE-2149	bone
11	Maininskaia, Layer 3	14070±150	LE-2149	bone
12	Maininskaia, Layer 4	12910±100	LE-2133	bone
13	Maininskaia, Layer 4	13690±390	LE-4251	bone
14	Maininskaia, Layer 5	16176±180	LE-2135	bone
15	Maininskaia, Layer 5	16540±170	LE-2135	bone
16	Ui II, Layer 4	10760±420	LE-3713	charcoal
17	Ui II, Layer 4	11970±230	LE-3609	charcoal
18	Ui II, Layer 6	14310±3600	LE-3713	charcoal
19	Ui II, Layer 2	16760±120	LE-3358	bone
20	Ui II, Layer 2	17520±130	LE-3359	bone
21	Ui II, Layer 2	19280±200	LE-4257	bone
22	Ui II, Layer 2	22830±530	LE-4189	charcoal

Table 2. Palaeomagnetic dates of Maininskaia

	Level	Assay
1	Up to the Layer 0	8900
2	Below the Layer 3a	14100
3	Layer 9	19000

reveals the dominance of birch, Chenopods and mosses during formation of layer B. Layers A1–A3 are characterized by a pine-birch forest with admixture of fir, larch and silver fir. Among herbs, *Poaceae* and *Artemisia* prevail.

B. In the eastern (lower) area of the site, the cultural material is associated with deposits forming the lower (16–18 m) terrace, adjacent to the cliffs of outer banks. The section of the excavation 6 revealed the following stratigraphic sequence:

	Stratum	depth in m
1	Present chernozem	0.00–0.80
2	Loss-like sandy loam with occasional gravel. In this part in other excavation area, two buried soils were identified; remains of the cultural horizon 0 were associated with the lowermost soil. Layer 1 is below the depth of 2.40 m	0.80–2.85
3	Greyish brown fine-grained sand with horizontal and wave bedding. Between 3.00 and 7.10 m, a series of cultural layers (2–1, 2–2, 2–3, 2–4, 2–5, 3a, 4, 5, 6, 7, 8, 9) was identified. Frost wedge casts were discerned between layers 3b and 4 (Fig. 2)	2.85–7.10

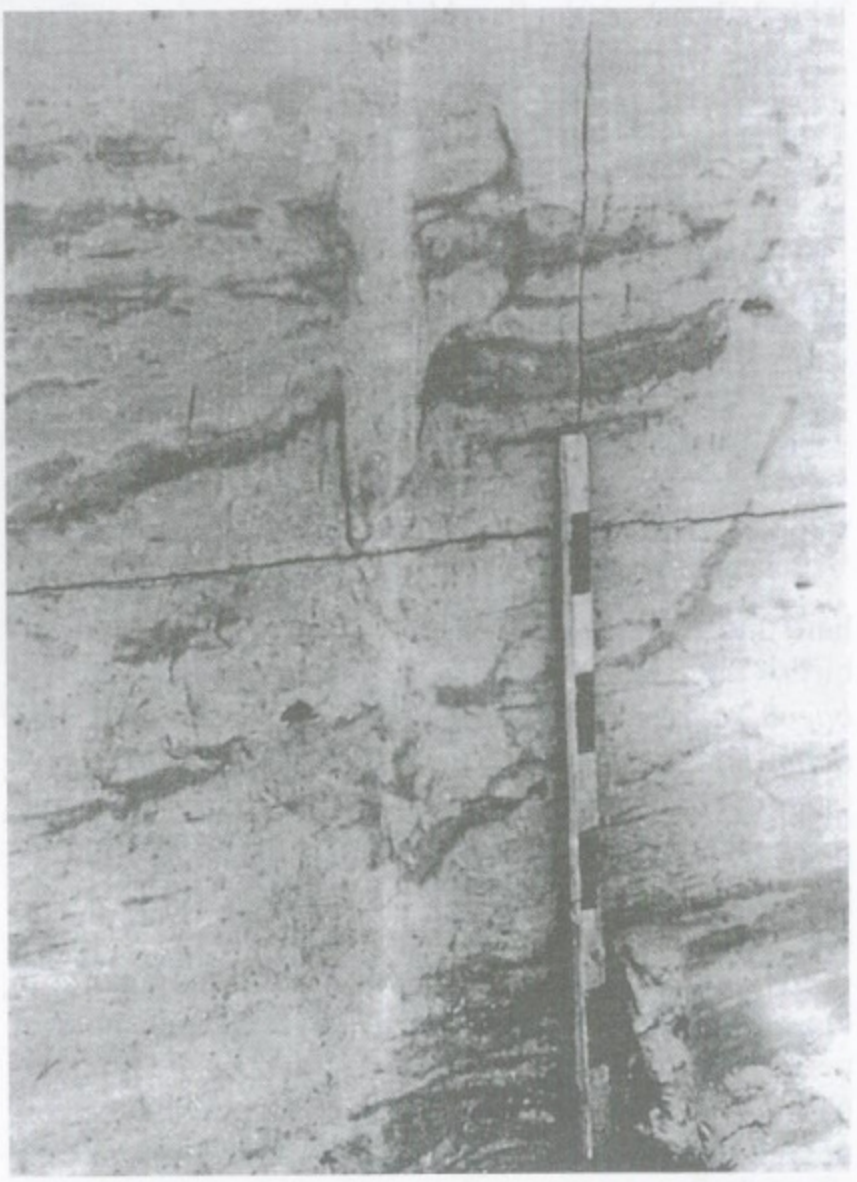

Fig. 2. Maininskaia. Cryogenic disturbances of laminated fluvial sediments (excavation area 6).

The section is typical of the lower Yenisey terrace, including gravelly and bouldery channel deposits at the base dated to 25–30 ka BP and overlain by flood-plain (overbank) sediments (Ravsky - Tseitlin 1968). The main part of the section is represented by periglacial alluvium, that accumulated during the Sartan Glaciation. Traces of frost cracks in the middle of the bed are attributed to the later cold stage of the Sartan, i.e. between 13–16 ka BP. Alluvial deposits are overlain by the upper strata, belonging to the Final Pleistocene (Late Glacial) and dated to 10–13 ka BP. It contains two buried soils, correlated to the Kokorevo (Bölling 12 250–12 750 yr. BP) and the Taimyr (Alleröd 10 800–12 000 yr. BP) interstadials.

The correlation of this scheme with our section shows that the lower cultural layers (embedded in the periglacial alluvium) can be placed between 13 and 18 ka BP. The first layer at the base of the upper strata can be dated to sometime after 13 ka BP; layer 0 (in the second buried soil) to about 12.5 ka BP. The radiocarbon dates (Table 1) indicate the Late Sartan age of the layers. The palaeomagnetic dates (Table 2) also provide a chronological framework.

Faunal remains include red deer, Siberian wild goat (the dominant species), bison, argali (wild sheep), elk,

Table 3. Faunal remains from Maininskaia

CULTURAL LAYERS	A-1	A-2	A-3	B	V	0	I	2-1	2-2	2-3	3	3a	3b	4	5	6	7	8	9
Horse (*Equus caballus*)																			1
Asiatic wild ass (*Equus hemionus*)				6															
Bison (*Bison priscus*)	5	1	5				3	6			4			10	35	2			
Argali (*Ovis ammon*)		1	2				5	1			7						5	2	
Siberian wild goat (*Capra sibirica*)	22	5	15	10	2	1	19	12			17	7		47	26	3		2	1
Red deer (*Cervus elaphus*)	14	24	17	3	1		11	16	4	2	23		2	1	23	5	1	2	1
Elk (*Alces alces*)								5			3	4		3					
Roe deer (*Capreolus capreolus pygargus*)	4	4	2	4															
Wolf (*Canis lupus*)	37*																		
Red fox (*Vulpes vulpes*)								8										1	
Glutton (*Gulo gulo*)												1							
Hare (*Lepus* sp.)								1							16			30**	
Birds (*Aves*)				1											2				8

* Bones of skeleton of the same individual
** Bones of the same hind extremity

hare and more rarely bones of horse, glutton, fox and birds (Tab. 3). The molluscan fauna, in which *Bradybaena schrencki* dominates (also the shells of *B. fruticum* and *Corbicula fluminalis* were identified), provides the basis for reconstruction of the immediate environment around the site. Accordingly the occupation appears to have concentrated in open places close to water with abundant grasses and some bush.

Palynological analysis shows a dominance of herbs in the basal part of the section. In layer 5, indicators of periglacial cold steppes and forest-steppes are replaced by those of a boreal forest. These changes could be correlated with the late Sartan interstadial (15–16 ka BP). Overlying strata are characterized mostly by forest-steppes (Siberian pine, pine, dwarf birch, *Poaceae*, *Artemisia*). In the upper bed, containing two buried soils, fir, pine, birch and alder dominate in addition to *Poaceae*, *Chenopodiaceae*, *Artemisia*, sedges, ferns and moses. The economy of the prehistoric inhabitants was based on hunting and gathering. There is no evidence for the latest activity, except for the discovery of shells of bird eggs near the hearth in layer 5. Hunting activities were carried out in forested valleys (red deer, roe deer and elk were the main game) and in the highlands as well (the Siberian wild goat). Scarce bones of steppe species (Asiatic wild ass, horse) witness that hunting occasionally expanded into the Minusinsk steppes, i.e. at least 15–20 km from the principal habitation area. The prey was brought to the sites as larger parts of butchered carcasses as evidenced by finds of vertebrae and leg bones in anatomic position. The analysis of faunal remains suggests that the site was inhabited predominantly during summer (spring-autumn) seasons.

Ui II locality

This site is situated on the other side of the mouth of the Ui River, opposite to Maininskaia. The cultural layers are buried in sediments of the second (lower) terrace and can be correlated with the eastern part of Maininskaia. The stratigraphy indicates that Ui II was actually a part of Maininskaia, but was then cut off by the river.

The stratigraphy of northern part is as follows (Fig. 3):

	Stratum	Depth in m
1	Present soil, layer A (Iron Age)	0.00–0.17
2	Yellowish grey sand, layer B (Neolithic-Bronze Age)	0.17–0.37
3	Buried soil represented by two horizons of a dark grey sand with lenses of a yellowish grey sand, layers V and G (Neolithic-Bronze Age)	0.37–0.57
4	Yellowish grey sand	0.57–0.67
5	Brownish grey sand (a cryoturbated paleosol)	0.67–0.87
6	Yellowish brown sand, B horizon of the paleosol. At 0.85 m depth – layer I (Early Neolithic)	0.87–1.07
7	Yellowish grey cryoturbated sand. Layer 2 at 0.90 m depth, layer 3 at 1.20 m. In other excavated areas, there is a buried soil between layers 2 and 3	1.07–1.37
8	Lenses of a colluviated soil with traces of frost wedge casts	1.37–1.40
9	Greyish yellow carbonized sand with several generations of cryoturbation traces. At 1.45 m depth – layer 5, occasionally accompanied by remnants of a buried soil	1.40–1.75
10	Grey heavily carbonised sand with frost wedge casts. At 1.75 m depth – layer 6	1.75–2.10
11	Interstratification of laminated horizontal and wave-like bedded light grey and brownish grey sand transected by frozen ground wedges at several levels (Fig. 3). At 1.90 m depth – layer, 7	2.10–3.10
12	Boulders and pebbles with sandy matrix (layer 8 on top of the stratum)	3.10–3.20

According to YAMSKIKH (1993), all sediments are of fluvial origin. The age of layer 8 above the gravel could be early Sartan (ca. 18–21 ka BP). The overlying alluvial cryoturbated sand with cultural horizons 6 and 7, is assigned to the subsequent phase of the last glacial

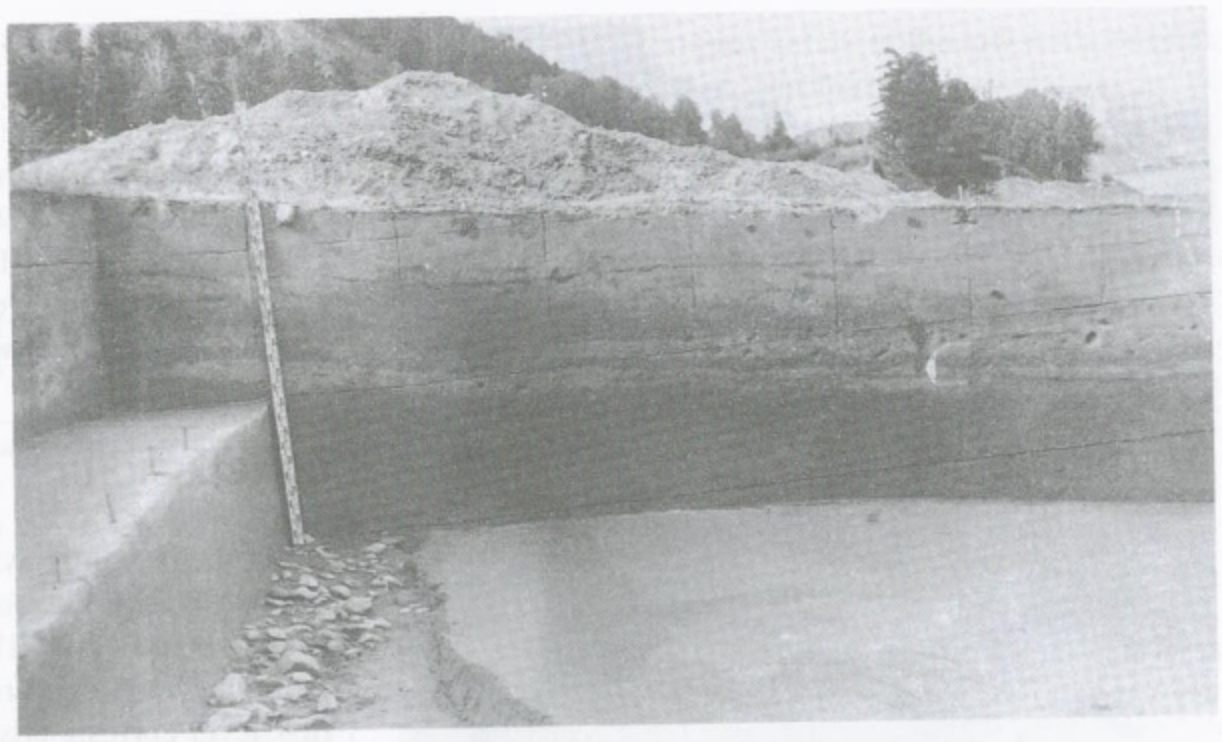

Fig. 3. Ui II. The northern wall of the excavation area 5.

(14–16 ka BP; cf. radiocarbon dates in Table 1). Buried soils in the upper part of the section can be correlated with the late Sartan interstadials (10–12 ka BP). Faunal remains from the Palaeolithic layers (Tab. 4) include red deer (dominant), bison, Asiatic wild ass, wild sheep or goat. *Bradybaena schrencki* was identified within the molluscan fauna.

Palynological analysis shows that the bottom part of the alluvial deposits, containing layer 7, was formed under forest (birch, pine, larch, rare fir), with a considerable distribution of *Chenopodiaceae*. Overlying alluvial bands, including layer 6, were characterized by dominance of herbs (*Chenopodiaceae, Poaceae*, ferns). The upper beds (layers 2 to 5) evidence birch and larch forest with herbs.

Table 4. Faunal remains from Ui II

CULTURAL LAYERS	2	3	4	6	7	Excavation area N1, low level
Asiatic wild ass (*Equus hemionus*)	1/1					
Bison (*Bison priscus*)	6/1	3/1				
Argali or Ibex (*Ovis at Capra*)	18/2	2/1		1/1	1/1	
Red deer (*Cervus elaphus*)	4/1	3/1	3/1	6/2		1/1
Hare (*Lepus* sp.)						1/1
Arctic ground squirrel (*Citellus undulatus*)						+
Common hamster (*Cricetus cricetus*)						+

the numerator – quantity of bones, the denominator – of individuals

Ui I locality

The site is located in remnants of a largely destroyed 23–25 m terrace, some 500 m upstream from the Ui River mouth. Excavations carried out in 1981, 1985 and 1986 revealed the following stratigraphy (Fig. 4).

The rock terrace is built by slates overlain by colluvial deposits, channel alluvium (bed 14), flood plain and cut-off channel facies (bed 13). In the upper part of the section, there is a complex interstratification of channel and overbank fluvial facies, containing the buried occu-

	Stratum	depth in m
1	Modern surface deposits	0.00–0.25
2	Present soil	0.25–0.40
3	Light grey silty sand, heavily carbonised	0.40–0.75
4	Light grey coarse grained sand with a fine grained gravel	0.75–0.80
5	Grey medium and fine grained laminated sand; layer 1 in the upper part	0.80–1.00
6	Yellow grey, fine grained sand tapering into greenish sandy loam near the slope of the terrace	1.00–1.18
7	Grey, fine grained laminated sand	1.18–1.63
8	Interstratification of grey sandy loam with gravel sand. Artefacts attributed to the "intermediate" cultural horizon	1.63–2.13
9	Light grey fine grained sand with traces of frost cracks. This bed contains two levels of ferruginous concretions	2.13–2.28
10	Yellowish grey ferruginous sandy loam. First and second horizons of layer 2 at the bottom. A number of frost wedge casts forming a polygonal network extends from the top of this bed	2.28–2.63
11	Grey small grained sand with gravel bands. Third horizon of layer 2 at the upper boundary. Below the artefact horizon, there is a level of frost wedge casts	2.63–3.03
12	Grey laminated sand	3.03–3.93
13	Grey dove coloured and green sandy loam	3.93–4.63

Fig. 4. Ui I. The western wall of the excavation area I.

pation surfaces. Radiocarbon dates (Table 1) date the assemblage of the main (second) cultural layer to the early Sartan; the cryogenic disturbances may be correlated with the initial phase of this glaciation.

The faunal assemblage of layer 2 (Tab. 5) is dominated by Asiatic wild ass, bison, Siberian wild goat and sheep; there are also horse, red deer, toloai hare, fox and marmot, while yak was identified in the overlying deposits. The assemblage differs from the megafauna of the Final Pleistocene (Late Glacial) occurrences mentioned, particularly with the absence of elk and roe deer and the scarcity of red deer.

Sediments containing this assemblage are characterized by pollen of birch, pine, Siberian pine, *Artemisia*, *Chenopodiaceae*, different ferns and mosses, corresponding to a mosaic environment of mixed coniferous and deciduous forest with open steppes.

CONCLUSIONS

Using the presently available data, evolution of the late Upper Palaeolithic culture in the Yenisey Basin between 10 and 22 ka BP can be reconstructed. The sites are bound to two different geomorphological levels. The first level corresponds to the 23/25–27 m terrace. The section Ui I revealed two cultural layers embedded within the periglacial alluvium. The lowermost layer is dated to the beginning of the Sartan Glaciation (17–22 ka BP). In the upper part of Maininskaia, the cultural material was associated with alluvial deposits (layers B, V, and G may be of 15–18 ka BP) and the overlying strata, containing a series of cultural horizons (A1, A2 and A3) of a Late Glacial age. The second level corresponds to the lower (14/16–18) terrace of the Yenisey, associated with the site Ui II and the lower portion of Maininskaia. The section of Ui II revealed the lowermost (8th) cultural layer, lying directly on the surface of river cobbles. Its geological setting indicates an early Sartan age (about 18–21 ka BP). In the overlying sandy alluvial beds of the late Sartan age, layers 2–7 of Ui II and layers 2–9 of Maininskaia were identified. The overlying strata with buried soils contained layers 0 and 1 in the Maininskaia stratigraphic column (Table 6).

The assemblage of the lower layer of Ui I seems to be the earliest in this area. The lithic industry shares some features with the early Sartan industries in the Middle Yenisey area, as well as with other Middle Upper Palaeolithic cultures of Northern Asia. The more

Table 5. Faunal remains from Ui I

CULTURAL LAYERS	Intermediate horizon	2			
		horizon 1	horizon 2	horizon 3	mixed horizons
Horse (*Equus* sp.)				1/1	1/1
Asiatic wild ass (*Equus hemionus*)			18/2	16/3	28/3
Bison (*Bison priscus*)	2/1		22/2	21/2	9/1
Yak (*Bos*. sp.)	1/1				
Argali (*Ovis ammon*)				9/2	8/1
Siberian wild goat (*Capra sibirica*)			10/3	16/2	
Argali or Ibex (*Capra* et Ovis)		4/1	28/3	23/3	31/1
Red deer (*Cervus elaphus*)			4/1(?)		
Red fox (*Vulpes vulpes*)					1/1
Tolai hare (*Lepus tolai*)				1/1	
Marmot (*Marmota* sp.)					2/1

Table 6. A provisional correlation scheme of the Upper Palaeolithic of the area

Years B. P.	Maininskaia East	Maininskaia West	UI II	UI I	Other sites
10,000					Maininskaia, Lesozavod
		A–1	2		Golubaia IV
			3		Sizaia VIII, Layers 1–2
11,000		A–2	3a		Kantegir, Layer 1
	0	A–3	4		
	1		5		
12,000					
	2–1				Golubaia I, Layers 1–3
	2–2				Kantegir, Layer 2
13,000	2–3			1	
	2–4				Dzhoi
	2–5				Kantegir, Layer 3–5
14,000	3		6		Oznachennoe I
	3a				
	3b				
15,000	4	B			
16,000					Nizhnii Idzhir I
	5		7		
		V			
17,000	6				
	7				
	8				
18,000	9	G			
19,000					
20,000					
			8	2	
21,000					

recent assemblages of Maininskaia and Ui II belong to the Afontova Gora culture, dominating in Yenisey basin in the Final Pleistocene (Late Glacial, VASIL'EV 1993). The uppermost layer of Maininskaia and layer 1 of Ui II, belonging to the Early Aceramic Neolithic, may be dated to 4–5th millennium BC (VASIL'EV - SEMENOV 1993).

Despite the significant research progress in the area, many problems relevant to the Upper Palaeolithic palaeoecology still need to be solved. The present data suggest a more complex nature of the low terraces of the Yenisey River, which can hardly be explained by the traditional concept of "terrace stairs". Due to the scarcity of pollen in the culture-bearing strata, it was impossible to obtain coherent diagrams reflecting all vegetation changes that occurred during the Final Pleistocene (Late Glacial). The buried soils have not been studied by micromorphological methods. Finally, the limited radiocarbon dates provide only a very rough idea of the age of sediments. Thus, the continuation of this interdisciplinary study is necessary.

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