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The palaeoecological model of the Upper Palaeolithic site Kamenka (Buryatia-Siberia)

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Abstract: A complex analysis of buried cultural remains at the Kamenka site has provided a significant amount of data on local environment and on past human activity. Multidisciplinary investigations of this open-air Palaeolithic site in Western Zabaikalye indicate a specific form of palaeoadaptation of the Upper Palaeolithic people to particular natural conditions in the Baikal region. Faunal remains suggest that the Kamenka site functioned as a seasonal camp site occupied during late summer-autumn and early winter.

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INTRODUCTION

The study of fossil mammalian assemblages and complexes of lithic artefacts in a palaeoclimatic context based on geological and palaeopedological data creates a chance for palaeoecological interpretations at particular sites in local, regional as well as broader territorial scales. A special interest surrounds natural changes during the Middle/Upper Palaeolithic transition in Eurasia and possible links with the cultural development of early human communities.

The results of the Kamenka site research carried out between 1989 and 1995 under the leadership of the author allow the reconstruction of the local environment of the Palaeolithic Man occupation in the initial phase of the Upper Palaeolithic time in the Baikal region. The stratigraphic description of the site sections was made by S. M. TSEITLIN (1990-1991), the palaeopedological analysis by M. I. DERGACHEVA (1993) and the palaeontology by M. GERMONPRE (1993-1994) with resulting publications including L. LBOVA (1991, 1994, 1996), L. LBOVA - P. VOLKOV (1993), M. I. DERGACHEVA et al. (1995) and M. GERMONPRE - L. LBOVA (1996).

The complex A of the Kamenka site is considered as an experimental study model.

PALAEOGEOGRAPHICAL CONDITIONS

Site geomorphology

A characteristic of the topographical relief in Western Zabaikalye is alternation of wing-shaped ranges reaching altitudes of 800 to 1300 m a.s.l. with smooth watersheds and intermountain depressions. Plain sites are located in river valleys at altitudes of 450–600 m a.s.l. in the central and northern parts of the Selenga District and at 700–850 m a.s.l. in the eastern and western parts.

The principal research area located in the southwest foothills of the Vitim Plateau which belongs to the northern branch of the Borgoi-Uda circuit of the Bryansk neotectonic depression (Fig. 1A). This depression is rimmed in the north by the Thagan-Daban and Muhor-Tala Ridges and in the south by the Barsky Ridge. Relics of mountain terraces are preserved along the 2-4 km long slopes above a flat fluvial plain which is up to 0.5–0.8 km wide. Below the absolute altitude of 1200 m, the aeolian deposits (sands and silts) are widely distributed. The mountain taiga is typical of the area, while the steppe is characteritic on south-facing slopes. A marshy taiga and open meadows are distributed in the river valley (ERMAKOV et al. 1978).

The Bryansk Depression, oriented south-north along the Bryanka River is connected with the basins of the Ilka and Bryanka Rivers (Fig. 1A).

Local river terraces are not well developed. The recent floodplain lies 1.0–1.5 m above the river. The first terrace forms a 3–5 m high level and the second reaches 7–8 m above the floodplain. An open steppe with bushy meadows is typical of this region (Fig. 1B).

The Kamenka site is located in the Transbaikal region some 60 km southeast Ulan-Ude, the capital of the Republic of Buryatia. The site lies in the central part of the Bryanka River valley (the Selenga River basin). The valley, flanked by 100 to 150 m high hills, has a width of 3–5 km and its bottom lies at an altitude of 580 to 590 m a.s.l. This situation is typical for the entire Transbaikal mountain system. In the Transbaikal region, the early Upper Palaeolithic sites are generally associated with a higher topographical relief. The Kamenka site itself is located on

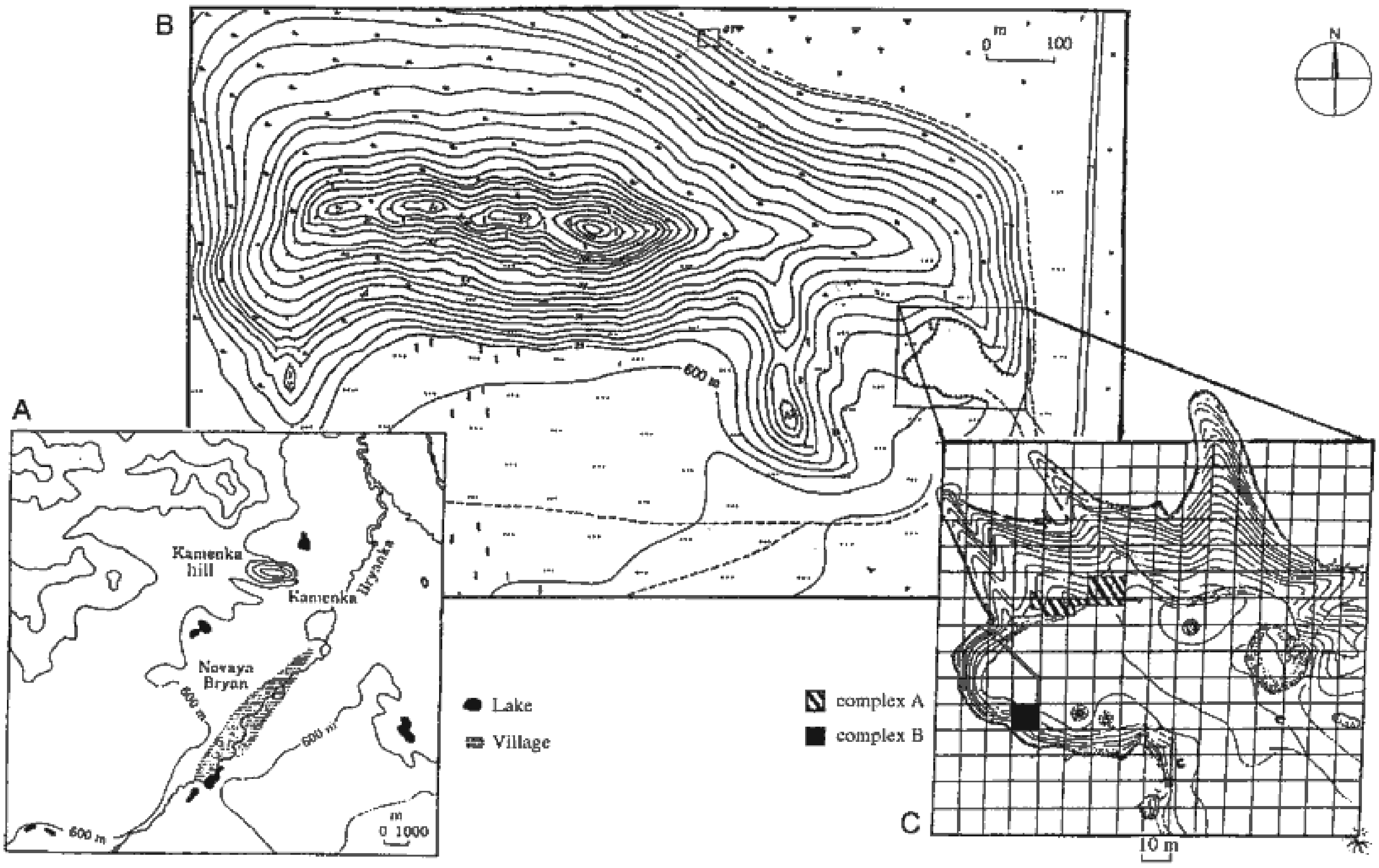

Fig. 1. Location of investigated sites.

the southeastern slope of the Kamenka hill, about 2 km from the present day river channel (Fig. 1B, C).

A similar position is typical of other archaeological sites in Zabaikalye (e.g. Varvarina Gora, Tolbaga, Bain, Hutac or Sapun Gora – cf. Bazarov et al. 1982).

Site geology

The cultural complexes at Kamenka occur in polygenetic slope sediments 9 to 11 m below the original surface. The stratigraphic profile is summarized in Fig. 2. Layer 1 represents the top soil. Layers 2 and 3 are composed of grey sand and include four buried palaeosols in layer 2. Layer 4 is formed by a light yellow, fine grained sand with an apparent horizontal stratification. Layer 5 is characterized by horizontal banding of a fine grained yellow, brown and dark grey sand with some clay lenses; at the base of this layer ice wedge casts occur. Layer 6 consists of three parts. The upper part is composed of a brown sand mixed with clay and gravel, the middle part represents a zone of calcification in a brown clayey sand and the lower part is formed by a brown sand more clayey than the previous layers. It contains lenses of a yellow sand and dark bands of a redeposited palaeosol. Layer 7 consists of a brown grevally sand with interbeds of bluish grey clay and calcified horizons (Lbova 1996).

Layers 1–3 are colluvial deposits, layers 4 and 5 are fluvial in origin, layers 6 and 7 are again colluvial. Stratigraphically layers 1–3 belong to the Holocene, layers 4–7 are assigned to the Pleistocene. It is assumed that layers 4 and 5 were deposited during the Sartan Glacial stage, which is part of the Zyriansk Glacial (Last Glacial), and lasted from 24 000–22 000 yr. BP to 11 000–10 000 yr. BP. Based on palaeopedological features, layers 6 and 7 are thought to have been formed during the Karginsk non-glacial interval (50 000–45 000 yr. BP to 24 000–22 000 yr. BP) under a warmer interstadial climate (Vorob'jeva et al. 1990).

The assemblages of cultural remains (complex A and B) are bound to layer 6; complex B in its upper part and complex A in the lower part. The vertical distance of these two cultural horizons is 1.0 to 1.5 m and includes a sterile beds of clay and sand, secondarily altered by strong calcification. The complex A occupation level is distinguished by a dark grey subhorizontal and continuous band inclined 2–3° in respect to present day river level.

The complex B (upper level) produced two radiocarbon dates on two bone samples: 28 815 ± 150 yr. BP (SD RAS-3032) and 28 060 ± 475 yr. BP (SD RAS-2903). Complex A was radiocarbon dated to 31 060 ± 530 yr. BP (SD RAS-3133), 31 060 ± 2 000 yr. BP (SD RAS-3134), 30 220 ± 270 yr. BP (SD RAS-3353), 30 460 ± 430 yr BP (SD RAS-3354) and 35 845 ± 695 yr. BP (SD RAS-2903), respectively (Orlova 1995, Lbova 1996).

The three palaeosol horizons (section 6) of the Karginsk age indicate a past surface stability and a favourable environment for soil formation. The archaeological level of the complex A is associated with a continuous dark grey to black humus horizon 5 to 30 cm thick. Geochemical analysis has shown that the soil was generated in warm dry conditions with a mean annual temperature of 8–10 °C, thus exceeding present day temperature values (DERGACHEVA et al. 1995).

Site palaeogeography

The large study area is situated in the Hangay-Daurian Mountain forest-steppe province, which is influenced by a highly continental climate, with maximum precipitation in July and August (mean annual precipitation averages 250 mm); winter temperatures are low (January –20 °C and mean July +23 °C (GALAZII 1969).

Sediments from the deep drilling in the bottom deposits of lake Baikal (the Academic Ridge) and analyses of diatoms and sponges as well as granulometrical and chemical analyses convincingly demonstrate that the Karginsk interstadial is defined by an interval from 24–25 to 55–60 ka BP, with the thermal optimum around 30 ka BP (GRACHEV 1996). The warmest phase corresponds to the Complex A at Kamenka, with the majority of radiocarbon dates being around 30 ka BP. The climate in Zabaikalye was warm and dry, with a marked aridisation phase towards the end of this non--glacial interval. At that time, the precipitation is believed to have been lower that at any other time during the entire Pleistocene (DEREVIANKO 1990). During the climatic optimum of the Karginsk stage, a steppe-parkland, dominated by birch (24–75 %) and coniferous boreal forest with larch and pine (14–66 %), existed there (REZANOV 1988).

The type section at Thagan-Morin shows a relative balance of AP (arboreal pollen 32–53 %) and the NAP (non-arboreal i.e. herbaceous pollen 47–68 %). Birch (*Betula*), pine (*Pinus*) and sometimes larch (*Larix*), willow (*Salix*), alder (*Alnus*) dominate the first group, whereas herbs are represented by *Artemisia, Graminae* and occasionally *Ranunculaceae*, *Spergulaceae* and *Compositae* (ANTOSHENKO - OLENEV 1982).

The late Pleistocene fauna of W. Zabaikalye is characterized by the presence of species with specific environmental adaptations. The fossil fauna spectrum includes rhinoceros (*Coelodonta antiquitatis*), bison (*Bison priscus*), horse (*Equus calabus*), kulan [*Equus* (*Hemionus*) *hemionus*], giant deer (*Megaloceros giganteus*), Kiakhta antelope (*Spirocerus kiakthensis*), the Baikalyak (*Poephagus baikalensis*), dzeren [*Procapra* (*Gazelle*) *gutturosa*] and argali (*Ovis ammon*). Among others, rodents are represented by field-vole of Brandt, hare-tolai, steppe lemming and suslik (KALMIKOV 1990). The association of a specific fauna of the steppe as well as of the taiga environment is explained by a mosaic type palaeolandscape of the Zabaikalye, which exists in the region even at the present time.

The materials from the Palaeolithic horizons of the Bryansk complex at Kamenka, and geological cuts near the site, provide significant data for reconstruction of local palaeogeographical conditions of the Karginsk stage (mid-Last Glacial).

Faunal analysis

Analysis of the fossil fauna includes calculation of the number of bone fragments (NF), calculation of the minimum of individuals (MNI), description of preservation, weathering, naturally induced traces and human utilization patterns (as bone breakage and cut marks). These data help to distinguish the game animals from the background fauna and suggest some ways by which the carcasses of the game were transported, butchered, processed and utilized. MNI were established by matching left and right elements. The elements of the NISP and MNI are indicated only for species that are represented with more than 25 specimens in each complex (GERMONPRE - LBOVA 1996).

The fossil remains of the Complex A – assemblage are in an excellent state of preservation. The colour varies from dark grey-brown to light brown. In terms of the weathering stages defined by BEHRENSMEYER (1978), the bones mostly belong to the weathering stages 0 and 1. According to LYMAN and FOX (1989), the interpretation of a set of weathering stages of an assemblage is a complex matter, because weathering not only depends on the number of years since the death of the animal, but also on the skeletal structure, the taxon, environment of deposition, accumulation history and the time of exposure. About 79 % of bones from the Kamenka site are less than 6 cm long. The preponderance of small fragments is generally typical for an assemblage modified by humans. For example according to DAVIS and FISHER (1989) the large number of broken bones of the 1000 year-old Los Terrace Site, Montana, attests to a bone breakage for marrow extraction by prehistoric proghorn hunters. Also at Denisova Cave, Altai, the high percentage of small skeletal fragments is thought to partly reflect an intensive human utilization of the long animal bones (GERMONPRE 1993). Similarly, it may be assumed that the fragmentary condition of the bones at Kamenka Complex A reflects a marrow extraction activity. Recent bone fractures were not detected in the material. The percentage of the bones with some cultural modification traces of the Kamenka-A assemblage is given in Table 1.

The fossil fauna at Kamenka is basically represented by animals associated with a steppe and parkland environment with a prevailance of horse (*Equus caballus*), dzeren-Mongolian gazelle (*Procapra gutturosa*), followed by woolly rhinoceros (*Coelodonta antiquitatis*),

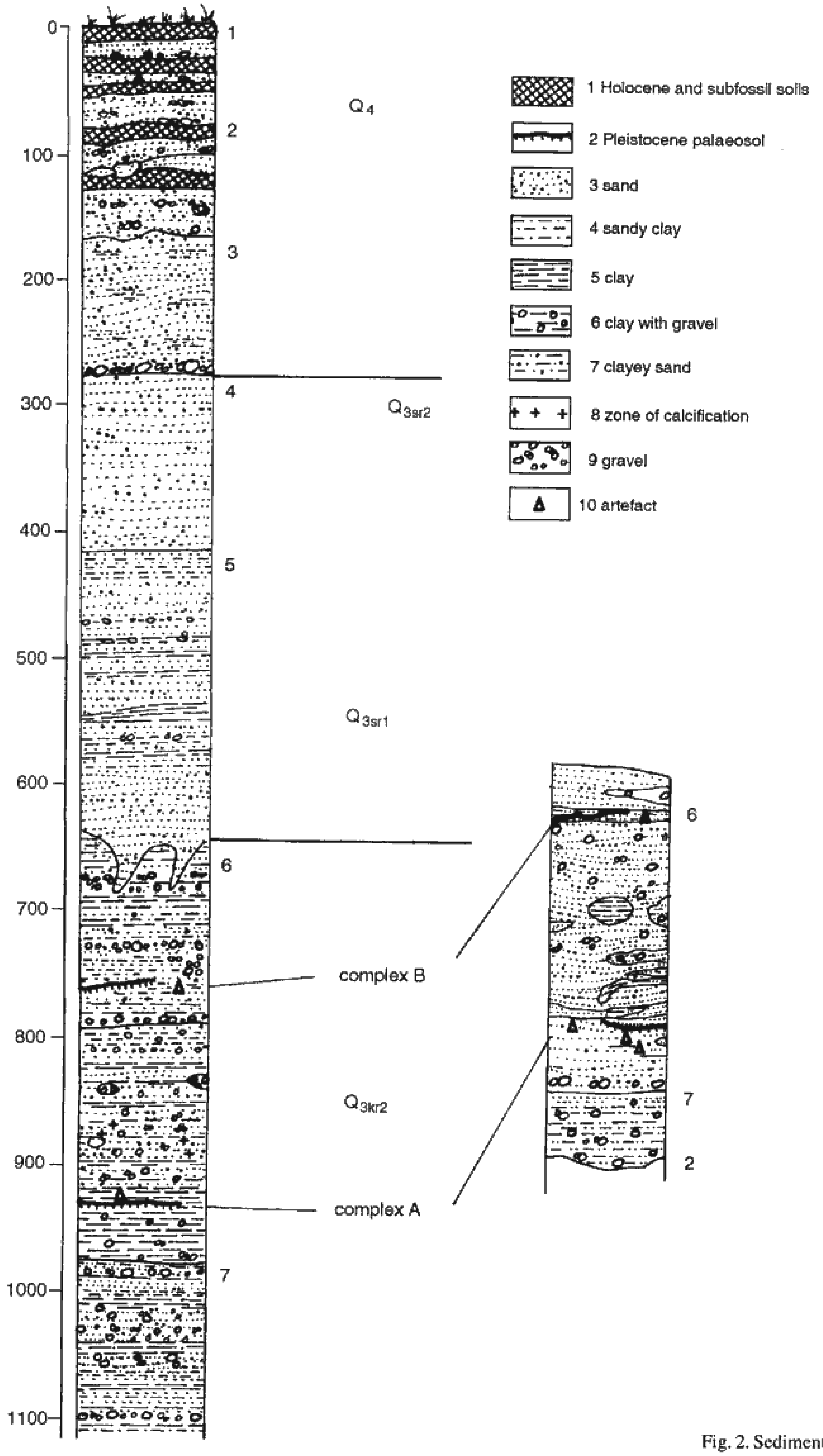

Fig. 2. Sedimentary sequence in Kamenka.

Table 1. Frequency distribution of modified bones of the Kamenka Complex A

Modifications	Total %
Naturally induced	
carnivore gnaving	1.9
plant root traces	11.3
burnt fragments	1.3
Traces of human activities	
cut marks	1.0
percussion marks	1.1
cancellous blocks	3.3
bone splinter	10.5
bone tools	2.7

Table 2. List of mammals from Kamenka Complex A and B (Minimum number of individuals)

Species	A	B
Mammuthus primigenius	0	1
Equus caballus	12	0
Equus hemionus	1	0
Coelodonta antiquitatis	3	1
Camelus sp.	1	0
Megaloceros giganteus	1	0
Bison priscus	3	1
Spiroceros kiakhtensis	1	0
Procapra gutturosa	8	1
Ovis ammon	3	0
Bovidae	0	0
Panthera leo	1	0
Total	33	4

The mammalian fauna was determined by Dr. Mietje Germonpre

bison (*Bison priscus*), sheep-argali (*Ovis ammon*) and rare mammoth (*Mammuthus primigenius*), kulan (*Equus hemionus*), giant deer (*Megaloceros giganteus*), antelope (*Spiroceros kiakhtensis*) and camel (*Camelus* sp. – see Tab. 2), i.e. predominantly steppe species.

Procapra gutturosa

Remains of the Mongolian gazelle account for 55.3 % of the NISP and of 33.3 % of the estimated MNI of the Complex A bone assemblage. Since no important skeletal parts are missing, it is evident that more or less whole carcasses were brought to the site for processing and consumption.

The Mongolian gazelle lives today in dry grassland steppes and semideserts in Eastern Altai, Mongolia and Inner Mongolia. It prefers plains and gently rolling landscapes and avoids steep slopes and regions with a heavy snowfall. Its shoulder height varies between 54 and 84 cm, and the body weight between 20 and 39 kg. The meat of this gazelle is said to be good and its winter pelt is used for fur coats.

The Mongolian gazelle occurs in several Late Pleistocene sites of the Transbaikal region (Imetchenov - Kalmikov 1988). At the early Upper Palaeolithic site of Varvarina Gora, situated some 17 km southeast of Kamenka along the Bryanka River, Mongolian gazelle is the most frequent species present both in the NISP (29 %) and MNI (28 %). On the contrary at the Tolbaga site, situated some 90 km southeast of Kamenka and dated to the early Upper Palaeolithic, the Mongolian gazelle is rare (Ovodov 1987).

Equus caballus

Taxonomy of the Pleistocene horses, abundant in Eurasia (Vereshagin - Baryshnikov 1982), is a very complicated matter. For now, the caballine horse of Kamenka is determined as a small form (128–142 cm) of *Equus caballus*. This subspecies is better known from the Late Pleistocene in North Siberia (cf. Sher 1974).

The remains of this horse account for of 39.9 % of the NISP and of 33.3 % of the MNI. The faunal assemblage distribution of the elements is more uneven than that for *Procapra*. As not all elements that include ribs, vertebrae, sternum and ulna occur, it is possible the corresponding body parts of animals were not brought to the site (Germonpre - Lbova 1996).

Horses preferred open grasslands. The stomach content of the frozen remains from permafrost in Siberia revealed that these animals subsisted on a diet consisting mainly of grasses, and to a lesser extent, of willow and birch twigs.

Equus hemionus

Several sites in the Transbaikal region contain remains of kulan (Imetchenov - Kalmikov 1988). This species prefers hilly steppes and semi-deserts where it lives on grasses and sedges. It can cover great distance during the summer and winter migrations. At Tolbaga, Varvarina Gora and Shikhotino 4, only a few specimens are present (Ovodov 1987).

Coelodonta antiquitatis

The wooly rhinoceros was an inhabitant of the tundra--steppe in Eurasia. It is only a minor component of the faunal assemblages of the Palaeolithic sites of the Russian Plains (Vereshagin - Baryshnikov 1982), whereas fossil remains of this animal are commonly found in the Late Pleistocene deposits of the Transbaikal region (Imetchenov - Kalmikov 1988). All skeletal elements are well represented.

Camelus sp.

One specimen of the Pleistocene camel was found in Complex A, although in a rather weathered form, showing a columnar long bone fracture. Historically, wild camels ranged in the deserts and steppes of Kazakhstan, Mongolia and China. However, their numbers have steadily declined during this century. Only two Pleistocene sites in the Transbaikal yielded *Camelus knoblochi* remains (IMETCHENOV - KALMIKOV 1988).

Megaloceros giganteus

Only two remains from Complex A belong to the giant deer, which lived in the forest-steppes, steppes and steppe-tundra of Eurasia (GROMOVA - BARANOVOI 1981). The Transbaikal region is the eastern limit of the distribution of this species, with only two sites known. In Siberia, the latest finds date from the beginning of the Upper Palaeolithic (VERSHAGIN - BARYSHNIKOV 1984).

Bison priscus

Some bone fragments belong to a large bovid of the size of either *Bison priscus, Bos primigenius* or *Poephagus baikalensis*. The material is too fragmented to allow more detailed identification. However, the yak and archar are rare in Transbaikal region and a skull fragment points to the presence of the steppe bison (*Bison priscus*).

Bison priscus inhabited the steppes and steppe-tundra of Northern Eurasia. As with the living bison, it probably did not tolerate thick snow cover. Many Pleistocene sites in the Transbaikal region contain remains of this large bovid (IMETCHENOV - KALMIKOV 1988).

Spirocerus kiakhtensis

Ther prehistoric hunter-gatherers of Kamenka undoubtedly hunted *Spirocerus kiakhtensis*, an extinct antelope which, however, must not have been an important game animal. It has been found in the Pleistocene deposits of the Altai, the Baikal region, Mongolia and North China (GROMOVA - BARANOVOI 1981). At the Upper Palaeolithic sites of Tolbaga, Varvarina Gora and Sukhotino–4, it occurs only in low quantities as is the case of Kamenka (OVODOV 1987).

Ovis ammon

This species displays a remarkable geographical variability in size and horn morphology. The largest subspecies, living in Southern Siberia today, is *Ovis ammon ammon* the Altai sheep called archar or argali. It can reach a shoulder height of 125 cm and a body weight up to 200 kg. Outside Altai, it is distributed in North Mongolia and in the Transbaikal region (IMETCHENOV - KALMIKOV 1988). It prefers steppes of high plateaus and foothills and avoids steep slopes.

Panthera leo

The Complex A (1993) assemblage contains one ulna fragment of the Pleistocene lion, which is a typical component of the mammoth fauna. This felid, however, is not frequently found in the Late Pleistocene sites of Southern Siberia.

Overall the fossil fauna of Complex A suggests a dry steppe environment. The two most common mammals found are the Mongolian gazelle and horse. Other inhabitants of the steppe zone include steppe bison, kulan, rhinoceros and camel. Also, the presence of Brandt's vole (*Lasiopodomys brandti*) in the small fauna indicates an open arid steppe (KHENZYKHENOVA 1996). Cold climate-adapted species such as reindeer (*Rangifer tarandus*) are virtually absent. All species present avoid thick snow cover.

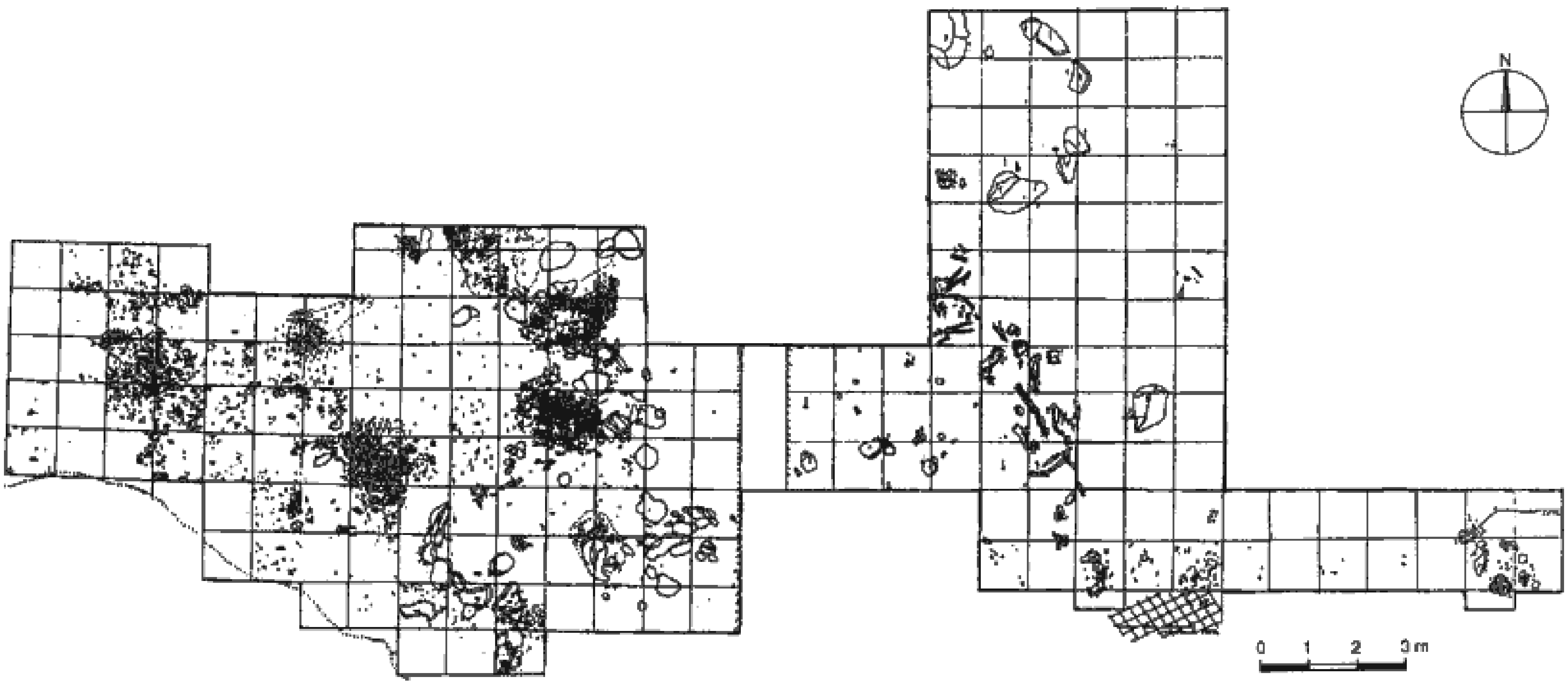

Fig. 3. Plan of excavations (in 1993–1995).

Planigraphy situation

The planigraphy analysis is still preliminary, the purpose of it is to reveal possible structural zones of the Kamenka site (Complex A) in terms of space arrangement of various objects in the archaeological layers, including lithic raw materials, stone tool products and mammalian remains within the excavated area of 207 m^2 (Fig. 3).

As mentioned above, the cultural material is associated with middle part of a horizontally bedded, 3–30 cm thick layer comprising a brown alluvial clay sand with inclusions of gravel, light grey sandy lenses and strong secondary carbonization. The latter is likely due to pedogenetic processes that are related to the dark-grey band of humus-rich sandy clay (paleosol) dipping 2–3° towards the river.

In the excavation area, there were two household complexes recorded 7–8 m from each other. They are evidenced by large stone arrangements surrounding an area of 40 m^2 and 70 m^2, respectively. A zone of bone concentration, up to 2 m wide, was located in the southeast-nordwest direction and adjacent to a central fire place. Some 1.5 m east of the fire place, a unique cluster of 36 finished tools was found. Approximately 6 m farther east, another stone ring construction with a central area for fire was fixed. Overall, this eastern household complex may represent a central occupation area, where processing of killed animals and possibly some related rituals took place. The western household complex is characterized by a rather specific structural feature with artefact concentrations in which broken fragmented bones of horse and gazelle (dzeren) prevail. Five concentration zones of 2–3 m^2 (with density of artefacts up to 100 pcs per m^2) are marked; and two zones with more than 150 artefacts per m^2 (Fig. 3).

Besides the two structural complexes, several working places (up to 1 m in diameter) were located. They indicate wood and stone processing activities, manufacture of mineral paints and preparation and consumption of food. An affinity of working places on wood and bone processing (prevalence of chisel instruments) and a place for manufacturing of mineral paints is apparent. A specific feature of the Kamenka (A) site is the absence of stone flaking. Among the stone tool inventories, the knives on blades and blunted blades prevail, followed by denticulate tool forms, scrapers, notched pieces and burins. Core and pre-core forms with a differential degree of extraction were found at all habitation areas. Bone artefacts are associated, as a rule, with zones of artefact concentration, explicitly defined by two working sites of bone tool production, manifested by a concentration of detached bone flakes (Fig. 5).

In the southern part of the site, a cluster of intentionally combined large stones and broken bones including those of camel, giant deer and panther, are documented in association with a series of fire places.

A final reconstruction and interprertation of specific cultural behavioral activities of the local palaeolithic people will be the subject of future studies.

Typology of artefacts

The lithic artefact assemblage is characterized by an advanced blade technology, encompassing 27 % of the total flaked stone material. The mean dimensions of blades, produced from prismatic cores, are 8–12 cm in length, 2 cm in width and 0.5 cm in thickness. The industry of Complexes A, characterized by facetted striking platforms (index of faceting is 34–29 %), contains a series of knives (50 %) with one or two subparallel and converging working edges and predominance of dorsal flaking. The tool inventory further includes scrapers (10 %) with a lateral and offset position of the working edge, notched and denticulate pieces (15.5 %) and a few burins (Fig. 4).

In general, the industry of the Complexes A is attributed to the early Upper Palaeolithic in respect to the dominant blade flaking technological characteristics and the presence of end scrapers of the Aurignacian type, and a few typical burins, although it is also clearly reminiscent of the Mousterian facies of the Levallois tradition. The presence of bone and horn tools of standard forms corroborate the general chronological assignment.

Siliceous tuff was the main raw material used for the lithic industry production at sites of the Bryansky complex. In the Complex A Kamenka site, it comprises 70 %, particularly by a light grey variant. The probable source of this raw material is the Mukhor-Tala deposit which is located 60 km east of Kamenka in the Ilka valley, the right tributary of Bryanka. Other rock materials include mountain crystal, quartz, chalcedony, slate and jasper, all present in minor (1–6 %) proportions. The origin of these rocks and minerals is in the Mukhor-Tala and Tugnui regions (30 km to the south).

Bone modification evidence

The fossil bone record from the 1995 investigation includes more than 3 000 specimens, 656 specimens (21.9 %) of which show some cultural modification traces.

The latter are further classified as:

1. burned bone fragments – 1.3 %
2. splitted bones (parameter 2–11 cm) – 12.0 %
3. specially modified cubic bone specimens – 4.5 %
4. bones with traces of impact – 0.3 %
5. unfinished bone tools – 0.2 %
6. finished bone tools – 2.7 %
7. other bone artefacts – 1.1 %.

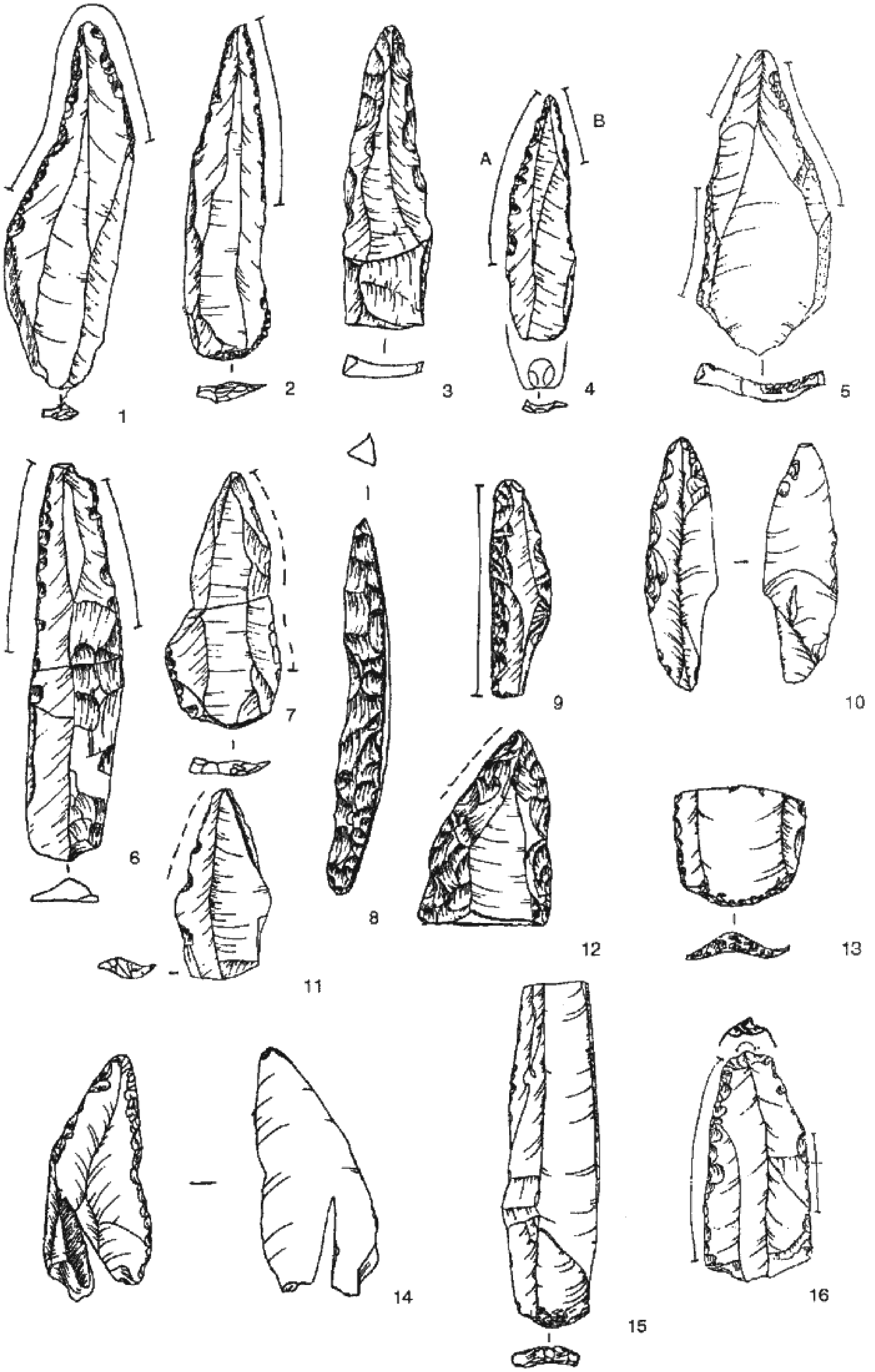

Fig. 4. Lithic artefacts: knives for cutting meat (1, 2, 3, 4A, 6, 12), and for sawing wood (9), scraper (4B, 13, 16), polyfunctional tools (5, 10, 14, 16) and technical blade (9, 15).

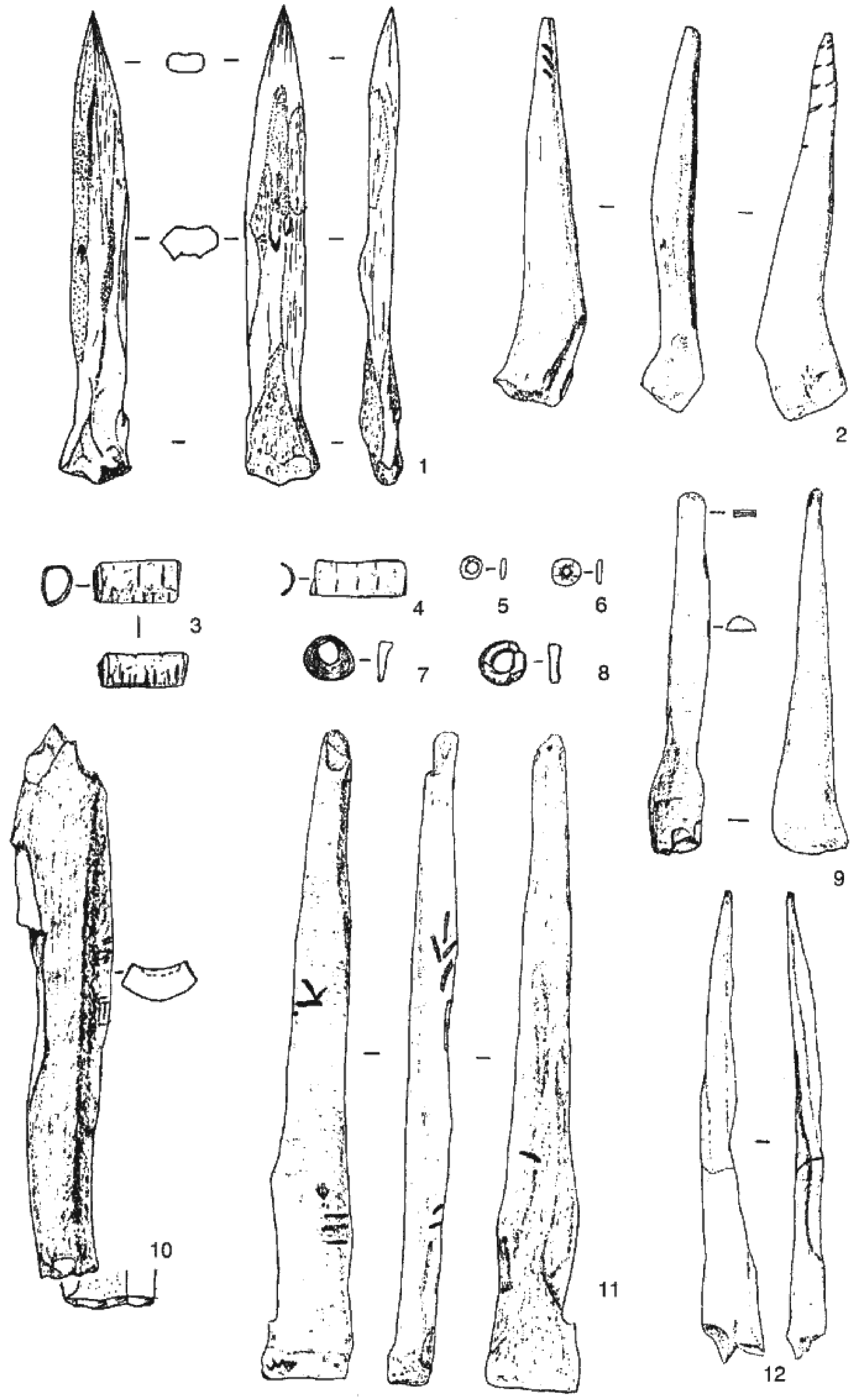

Fig. 5. Bone implements: perforates (1, 2, 12), chisel (9), decorations (beads 3, 7) and polyfunctional tools (10, 11).

Particularly long bones and, in lesser amounts, shoulder blades were used for tool production. The artefacts from horn in the Complex A are rare and limited to two pieces only. The most widespread working functions of bone instruments at the site are assumed to be connected with point perforation and cutting-scraping activities (Philipov 1983 – see Fig. 5).

Category of bone products for non-utilitarian purposes – 34 samples (5.2 %) of the bone artefact collection--includes decoration specimens (necklaces, 6 pieces), zoomorphology sculptures (6 samples), subjects of unknown purpose (10 samples) and various fragments (10 samples). An additional 22 pieces have some decoration in the form of parallel cutting traces; 3 artefacts show ochre painting (Fig. 5). Overall the artefactually modified bone collection demonstrates a variety of technological methods in the processing of bone material and a variety of finished products suggesting a wide spectrum of use.

SITE FUNCTION

The archaeological structural features, artefacts and fossil skeletal material found at the different loci represent the remains of repeated episodes of human occupation during which the subsidence-related activities were carried out. The presumed nearby watering place, with a high concentration of game animals, probably also attracted the Palaeolithic hunters as this spot with its suitable topography and vegetation of the surrounding hills may have offered good opportunities for ambushing prey. The Mongolian gazelle and horse were the primary game. The frequency distribution of the skeletal remains of gazelle suggests that mostly complete and unprocessed animals were brought to the camp. The carcasses were basically dismembered at joints by cutting (Germonpre - Lbova 1996).

The frequency distribution of the remains of horses is different. The evidence from Complex A 1993 suggests that the horses were partially butchered elsewhere. The missing elements of the axial skeletons might have been abandoned or consumed at the kill site, although it is also possible that these body parts were heavily fragmented at the camp for grease and marrow extraction and therefore could not be identified.

The archaeological features (hearths, stone structure, pits etc.), the modified bone remains, the large quantity of shaft pieces and cancellous blocks indicate that people spent some time at the site to process the killed animals and by-products such as bones and horns.

DISCUSSION AND CONCLUSIONS

1. The archaeological, geological and palaeoenvironmental contextual evidence at the Kamenka site is a basis for the local palaeogeographical reconstruction and understanding of adaptive patterns of the early Upper Palaeolithic people about 30 ka ago.
2. The geomorphological, geological, palynological, palaeontological, palaeopedological and archaeological data from the cultural layers Kamenka A reflect a seasonal (late summer–early winter) occupation and hunting camp (Germonpre - Lbova 1996). The Mongolian gazelle and horse were the main hunted animals.
3. The local environment was characterized by a mosaic landscape with an open parkland-steppe in a warm and dry climate of the Karginsk interstadial. The variety of faunal species brought back to the site from different ecotomes suggests that the Kamenka people travelled up to 60–100 km into the mountain zone.
4. The variety of lithic raw materials manifests a wide exploitation territory of more than 2000 km^2.

In summary, the Kamenka site shows a rather advanced development stage of the early Upper Palaeolithic culture in Zabaikalye about 30 000 yr. BP.

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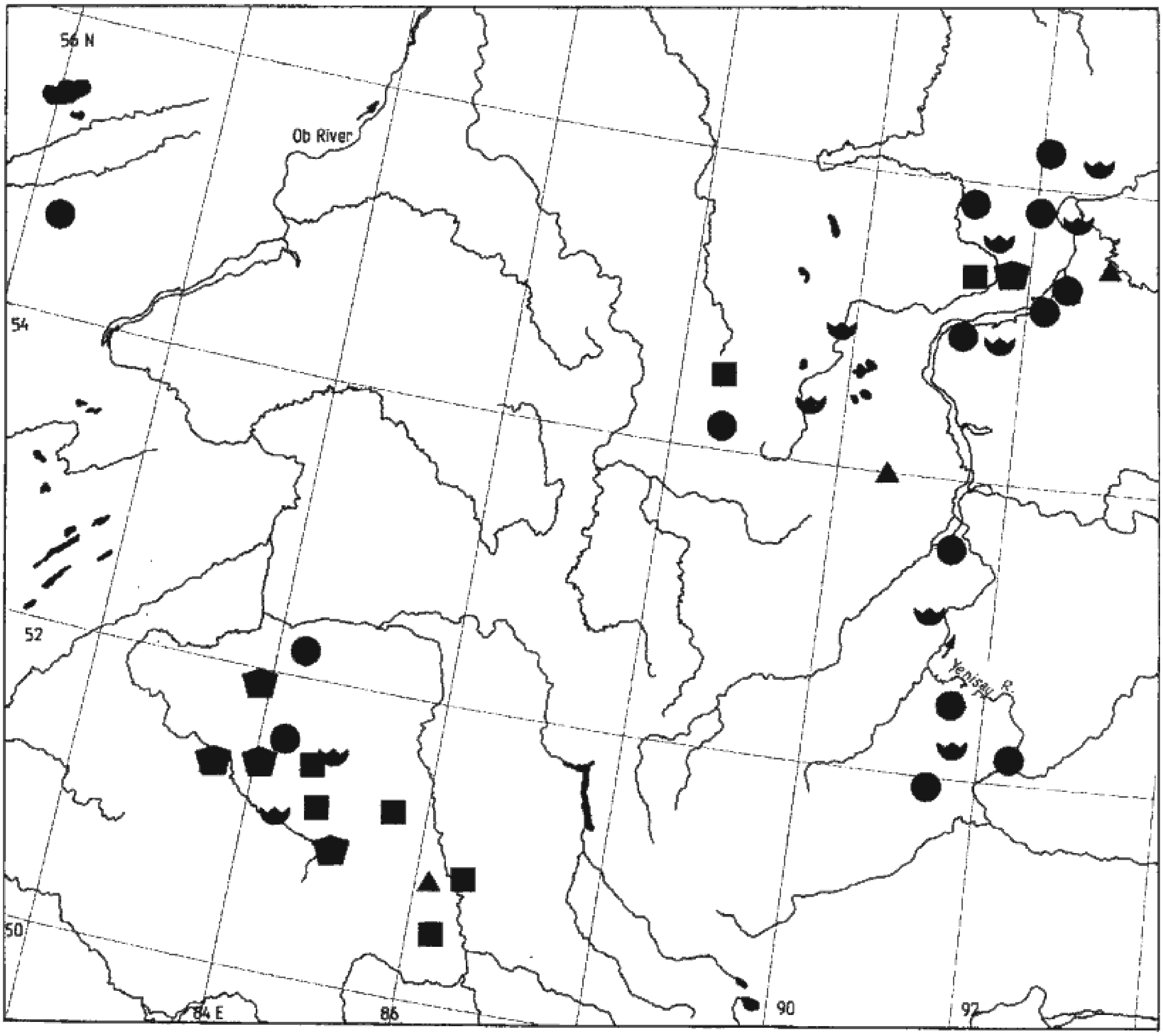

Fig. 2. Distribution of the Upper Paleolithic sites in Western Siberia.

several software products such as the GIS "ARC/ INFO-ARC/VIEW", GIS "SOCRAT-GEO" (made in Novosibirsk Regional Centre for GIS technologies, Siberian Branch of the Russian Academy of Sciences) and the "PARADOX" Database Management System (DBMS). The core of the GIS Atlas are the metrical and semantical databases. The metrical database contains the morphological description and geographic position of the reference points; this information may be further processed by both the "ARC/INFO-ARC/VIEW" and the "SOCRAT-GEO" software. The semantical database contains the information about chronological, palaeoenvironmental and archaeological characteristics of particular reference points, through the "PARADOX" DBMS programme.

The analytical functions of the GIS Atlas are realized through different types of request in the "PARADOX" DBMS, and the worksheets are compiled as a result of data processing. They are combined with the metrical database and visualized as computer maps within the GIS. Fig. 1 shows the location of palaeolithic sites subdivided into five groups (see Materials). On Figs. 3 and 4 is displayed a cartographic visualisation of both palaeovegetational and archaeological data with radiocarbon dates made for several chronological intervals. Such a presentations of results is illustrative and convenient for visual perception, and allows the analysis of different kinds of data combinations.

The "SOCRAT-GEO" software programme has the additional potential for data processing in comparison with the "ARC/INFO-ARC/VIEW" system. The information about cartographic objects, both metrical and semantical, may be included in a joint database and in one table. Such contextual data allow the conductance of

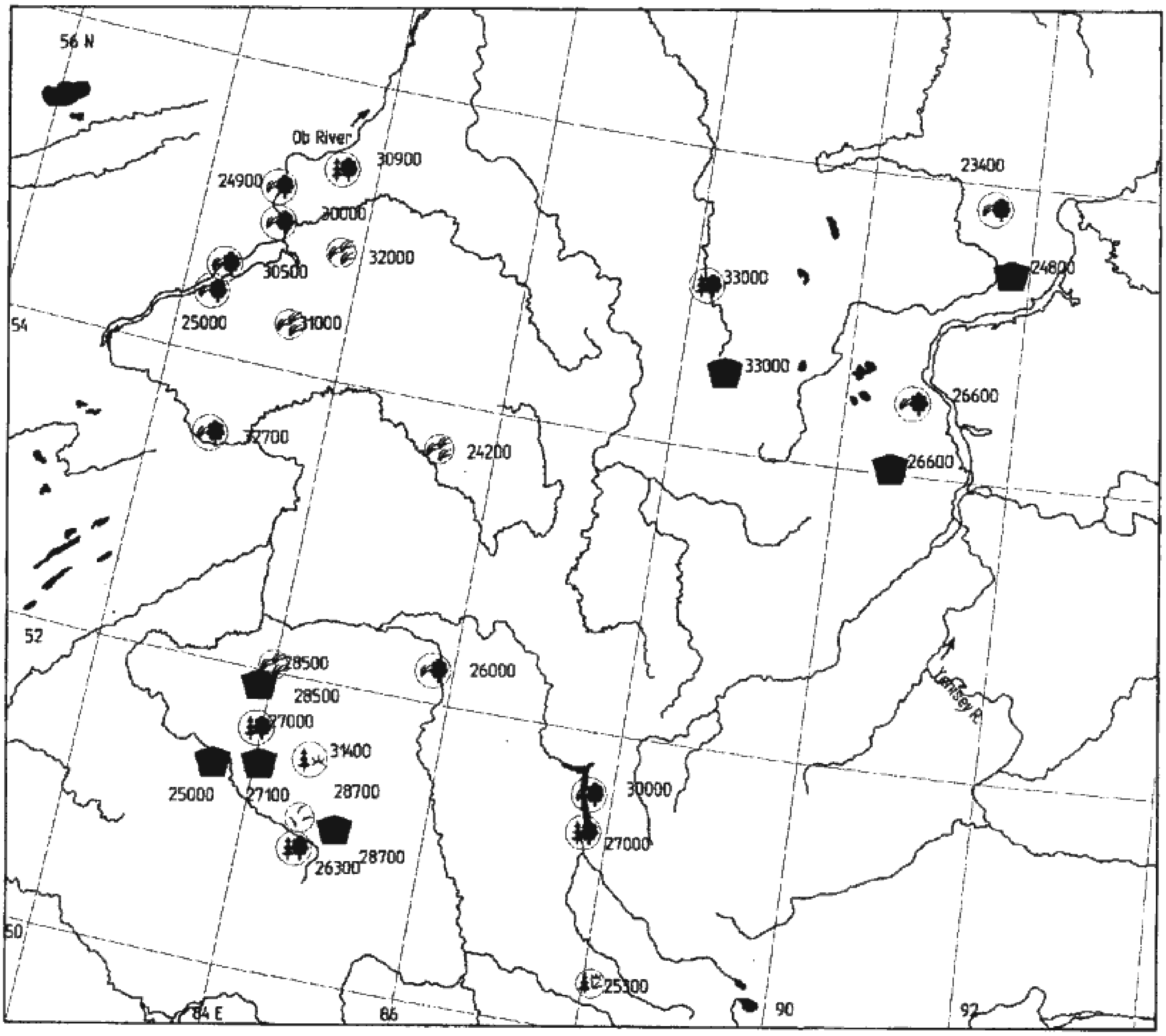

Fig. 3. Late Karginsk (24–32 ka BP) vegetation and occupation sites.

joint analysis of a spatial-temporal distribution of reference points using the DBMS. It is especially important when we have the points with spatial, temporal, and other subdefinities (i.e. an incomplete information – ZABADAEV - ZOLNIKOV 1996). For example, we assigned among such points archaeological sites and palaeovegetational determinations without radiocarbon dates.

RESULTS

Using the GIS technology, maps of palaeovegetation and distribution of palaeolithic sites for several chronological intervals within the Karginsk-Sartan time were generated. We demonstrate here, as an example of our approach, computer-generated maps for the late Karginsk (24 000–32 000 yr. BP) and Sartan (14 000 to 24 000 yr. BP) intervals (Figs. 3–4).

The analysis shows two geographical groups of the late Karginsk sites located far from each other, the first in the Yenisey River basin and the second in the foothills of the Altai Mountains (Fig. 3). In the Yenisey basin, the environment for human existence ca. 33 000–26 600 yr. BP was more favourable. The main vegetational types were forest-steppe (Dvuglazka and Kurtak 4) and taiga (Malaya Syia). In the Altai foothills, the environment ca. 31 400–28 700 yr. BP was more severe, the Ust-Karakol site existed subsequently in a forest- tundra and "cold steppe" (semidesert) setting. About 28 500 to 26 300 yr. BP, the environmental conditions of human habitat became more favourable, and the vegetation during the occupation of the Okladnikov, Strashnaya and Denisova cave sites was represented by an open steppe