Reconstruction of mammoth environments at different stages of the Pleistocene in the West-Siberian Plain

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SUMMARY: The data obtained by spores-pollen, carpological, entomological and microteriological analyses from 5 sites in the West-Siberian Plain, where the remains of fossil proboscideans were also found, are discussed within the paper. The results were used for the reconstruction of the environment of proboscideans in this territory for the Early (Chembakchino 94 A), Middle (Chembackhino 94 B) and Late Pleistocene (Nikitino, Ugansky Uval 1290/2, 430th km). The materials obtained allow one to get more specific information about the environment of fossil proboscideans in different regions of the West Siberian Plain and during different stages of the Quaternary period. The environment of the region was mainly a boggy floodplain with a mosaic landscape including tundra, forest and sometimes steppe elements.

1. Introduction

One of the important aspects in the study of fossil proboscideans from Northern Eurasia is the reconstruction of their environment. In this term the findings of complete mammoth carcasses from permafrost, with excellently preserved food remains in their stomach (Vereshchagin & Mikhelson 1981; Sokolov 1982), are most informative. But they are very rare even in the north of East Siberia. The findings of Quaternary fossil bones of proboscideans are very common in the West Siberian Plain. A comparison of the results of spore-pollen, carpological and palaeoentomological analyses with the evidence of the associated vertebrate fauna allows a detailed and objective reconstruction of the Pleistocene ecosystems where proboscideans lived. Plants, insects, large and small mammals characterize the various energy levels in the structure of ecosystems, and, therefore their distribution is limited by different ecological factors. In taphonomic terms these organisms characterize different processes in the formation of deposits (Borodin *et al.* 1998).

Numerous sites with paleobotanical, entomological (more then 80) and small mammal (about 70) fossil remains are known from the Quaternary deposits of the West Siberian Plain (Borodin 1996). However complex sites with both mammoth and other vertebrates, insects and plants are rare. The present study deals with the results of the investigation of fossil flora and fauna from 5 complex sites in West Siberia.

2. Geographical position and the Age of sites

2.1 Chembakchino-94 A

This site is situated on the right bank of the Irtysh River, at 60°N latitude. The section is about 10 km long - the cliff being over 40 m high. An almost complete skeleton of *Archidiskodon trogonterii* Pohlig, 1885 was found in the deposits of the lower part of section, at a point 7 km from Chembakchino. It was found in a sand-silt lens within a thick bed of grey clay and was accompanied by the remains of small mammals, fossil insects and plant fragments (Borodin *et al.* 1998). These deposits (Semeikian Suite Formation) have been dated by the thermoluminescence (TL) method to 650,000±110,000 years BP in the regional stratigraphical scheme for West

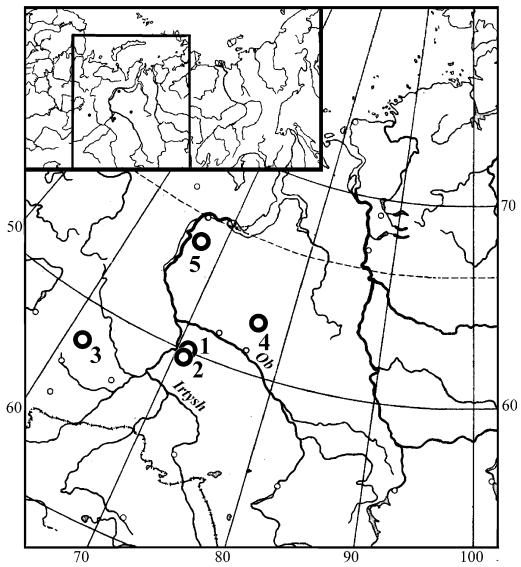

Fig.1 - The geographical position of the sites: 1 - Chembakchino-94 A; 2 - Chembakchino-94 B; 3 - Nikitino; 4 - Agansky Uval 1290/2; 5 - 430th km.

Siberia (Arkhipov 1987). The morphological analysis of the molar teeth of vole fossils implies that the fauna is at least older than the Okian Stage (i.e. older than the Elsterian).

2.2 Chembakchino-94 B

The lower jaw of *Mammuthus* cf. *chosaricus* Dubrovo, 1966 (determination of P.A. Kosintsev, oral report) was found down-stream from the site Chembakchino-94 A in a sand layer located in the deposits of Semeikian suite at a height of 18-25 m. It was accompanied by the remains of small mammals, insects and plants and was incorporated in a sand lens with clayish gravel and formed a lenticular stratified body of fine light-grey sand and plant detritus.

The morphological characteristics of the molars of *Dicrostonyx* (late stages of *D. simplicior* Fejfar,1966) allow one to date this material to the Elsterian. Small mammal fauna of this site are more ancient and essentially poor in species diversity, as compared to the formerly described Chembakchino small mammal fauna deposits, that have been dated by thermoluminescence (TL) method to 313,000±80,000 years BP in the regional stratigraphical scheme for the quaternary deposits of West Siberian Plain (Smirnov *et al*, 1984; Borodin 1996).

2.3 Nikitino

A mammoth (*Mammuthus primigenius* Blumenbach 1799) vertebra was found on an 8-meter cliff on the left bank of the river Kirga (river Tura tributary) in Nikitino (57°N latitude). The remains of plants, insects and small mammals were taken from the sand-silt layers at the depth 5.0-5.8 m. The suggested age is compared to Zyrianian (= Weichselian) time, which can be proved by the morphology of rodent molars.

2.4 Agansky Uval- 1290/2

Bones (2 tusks and ascapula) from woolly mammoth were found in the south-west part of the pit wall, located 8.5 km from the river Kattoyyogan between the rivers Agan and Vakh (right tributaries of the river Ob) at 61°N latitude. From the same layer (1.0-3.0 m of depth), formed by sand-silk with plant remains we collected the remains of insects and small mam mals. The radiocarbon date for this material is

23,300±500 (IERiZh-176). The evolutionary level of vole molars are related to the beginning of Sartanian (=late Weichselian).

2.5 430th km

Some mammoth bones of a late type are known from the deposits of the site 430th km. It is situated on the right bank of the river Ob 430 km from the river mouth, 5 km downstream from Hashgort (66°N). The height of the cliff is approximately 8-12 m. Bone remains of small mammals and insects were found in the deposits of light-grey sand with clayish gravel. This layer is located on the moraine-like deposits. The radiocarbon date for this material is 24,000±1500 (IERiZh-63). According to the morphological characteristics of the vole molars (late stages of *D. guilielmi* Sanford, 1870) the fauna of this site relates to the end of Karginian - beginning of Sartanian time (=late Weichselian).

3. Paleontological data

3.1 Chembakchino-94 A

The data of spores-pollen analyses testify to the distribution of forest-tundra vegetation formed by pine-birch forests, dwarf birch, shrubs of the taiga zone and *Artemisia*-Chenopodiaceae complexes (determination of L.A. Pyankova). The results of a carpological study have shown that the plant assemblages recovered from the Chembakchino site contained the fruits of tree birches *Betula* sect. *Albae*, and of willows *Salix* spp., and also some needles of the spruce *Picea obovata* Ldb. Other shrubs were represented by occasional finds of dwarf birch fruits *Betula nana* L. and seeds of crowberry *Empetrum nigrum* L. Among the herbs identified the remains of marsh, aquatic and riverside species dominated. The plant macrofossil assemblages indicate that the vegetation of the region was a boggy floodplain within an area of birch-spruce forest.

On the evidence provided by the insect fauna, it is possible to conclude that during the formation of the layer studied there were plant communities similar to modern floodplain vegetation with some solitary trees. The sites lay close to the open shore with a clay substrate. This is deduced from the modern habitat distribution of the dominant beetle species (the ground beetles *Pelophila borealis* Pk., *Amara interstitialis* Chd., *A. erratica* Chd. and *Elaphrus angus-ticollis* Sahlb.). The remains of cryophilous insects (the ground beetle *Curtonotus alpinus* Pk. and the road beetles *Tachinus* sp. and *T.* cf. *arcticus* Maekl) suggest a colder climate in this region at that time in comparison to that of today.

Paleoteriological material including collared lemming *Dicrostonyx* ex gr. *renidens-simplicior* (5%), brown lemming *Lemmus sibiricus* Kerr. (18%) and tundra vole *Microtus* ex gr. *oeconomus* Pallas (77%) allows one to suggest tundra-forest environment (Borodin *et at.*, 1998).

The results of the analyses presented allow the reconstruction of a riverside ecosystem; a boggy floodplain with meadow vegetation, scrub and a fringe of birch-spruce woodland. The edge of the river was bordered by a zone of bare clay up to several meters wide and lacking vegetation. The type of ecosystem described was probably also typical of sites away from the river. The data suggest the predominance of open landscapes with boggy-meadow vegetation or open woodlands. The list of animal species present suggests that the environment cannot be equated precisely either with modern periglacial or boreal types. The species content of both the insect and the small mammal faunas suggests more rigorous climatic conditions in this region at that time than today.

3.2 Chembakchino-94 B

The carpology data from the lower part of the deposits reconstruct the floodplain spruce-birch forests (close to the type of Chembakchino-94 a) with such elements as *Pinus sylvestris* L., *Pinus sibirica* Rupr., *Betula nana* and some taiga shrubs. According to carpological analyses in the samples of sand-silt deposits the forest type of vegetation is chang-

ing by tundra type. The same tendency is proven by entomocomplexies. Among small mammals predominate *Lemmus sibiricus* and *Dicrostonyx simplicior*, about 20% of fossil remains belong to voles (*Microtus*) in which we specify *M. middendorffii* Polyakov 1881. Though all these species are considered to be ancestral to modern tundra species this fact can not exclude the forest type vegetation in the floodplain.

3.3 Nikitino

The study of carpology indicates spruce-birch (probably floodplain) forests with dwarf birch, taiga shrubs and some cryophyte species: *Dryas* sp., *Selaginella selaginoides* (L.) Link. Entomofauna is presented by arctic and subarctic species including dendrophyls *Otiorhynchus politus* Gyll., *Phtorophloeus spinulosus* Rey. associated with conifers (spruce and larch) and also cryophil steppe species - *Poecilus ravus* Lutschn. The remains of *Notaris bimaculatus* F. allow one to suggest carex communities quite close to this place. Small mammal fauna could be characterized as non-analogous with steppe (*Lagurus lagurus* Pallas 1773, *M.gregalis* Pallas 1778, *Eolagurus* sp.) and tundra (*Dicrostonys* sp., *Lemmus* sp.) elements. This component of tundra species does not exceed 5% of the remains.

3.4 Agansky Uval 1290/2

In spores-pollen spectra the high portion of trees (birch, spruce, pine), some chenopodiaceae pollen, fern and moss spores were found, whereas in plant macroremains trees were not found. The carpological data allow one to reconstruct the vegetation of a humid tundra or probably forest-tundra with dwarf birch and carex.

The examined entomocomplex is of a tundra-like type with predominating hemi- and euarctic species (*Tachinus arcticus* Maekl., *Pterostichus costatus* Men.) and with polyzonal insects and xerophyl *Morychus viridis* Kuzm et Kor. The main part of small mammal remains belongs to *M. gregalis* (76.8 %). *Dicrostonyx* cf. *henseli* Hinton, 1910 (5.03 %), *Lemmus sibiricus* (11.17 %) and *M. middendorffii* (7 %) were also found. All these species are considered to be ancestral to the modern tundra voles of West Siberia.

3.5 430th km

Spore-pollen data indicate open tundra-like landscapes with xerophyte places and spruce-birch forests in river valleys (Panova *et al.* 1988). The entomocomplex is of also tundra-like type with prevailing arctic insects. Some cryophil species of steppe landscapes were also found (*Chrysolina perforata* Gebl. and others). Small mammals are represented by *M.gregalis* (32,32%), *Dicrostonyx cf. henseli* (35.39 %), *Lemmus sibiricus* (30.27 %) and *M. middendorffii* (2.02 %) and thus are analogous to Agansky Uval-site small mammals fauna.

4. Conclusion

This study enable us to reconstruct the local natural environment at the moment of proboscideas burial in the West Siberian Plain. The data obtained by spore-pollen analyses indicate a zonal vegetation type, whereas other methods allow detailed landscape-climatic conditions of the investigated localities.

The analyses of Chembakchino-94 A and B sites revealed the same environments for mammoths of different evolutionary levels in the Early and Middle Pleistocene at one geographical point. It was shown, that the fossil assemblages indicate that the environment of the region was a boggy floodplain within an area of birch-spruce forest and tundra-like communities. The materials from the site Nikitino have shown that in the Late Pleistocene there was a mosaic landscape including forest, tundra and steppe elements.

Comparison of the data from Agansky Uval 1290/2 and 430th km sites (sites of the same age late Karginian - early Sartanian), revealed that there were different landscapes at different latitudes: tundra-like type including significant participation of xerophyte herb communities in northern sites (430th km) and forest-tundra in southern site (Agansky Uval 1290/2).

The results obtained to detail the environments of proboscideans of the West Siberian Plain and to compare them to the environments of other regions.

5. Acknowledgements

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6. References

Arkhipov, S.A. 1987. *Stratigraphy of Quaternary deposits of the Tyumen oil-gas region. Specified stratigraphy basis*. Novosibirsk: IG and G Publishers (in Russian).

Borodin, A.V. 1996. Quaternary small mammal faunas from the west Siberian plain. *Acta zoologica cracoviensia*, 39: 75-81.

Borodin, A.V., Kosintsev, P.A., Zinoviev, E.V., Trofimova, S.S., Nekrasov, A.E. 1998. Palaeoecological investigations of the landscape inhabited by the early Middle Pleistocene mammoth *Archidiskodon trogontherii from* Chembakchino, Western Siberia. *Mededelingen Nederlands Instituut voor Toege-paste Geowetenschappen TNO*, 60: 343-352.

Smirnov, N.G., Bolshakov, V.N., Borodin, A.V. 1986. *Pleistocenovye grysuny cevera Zapadnoy Sibiri [Pleistocene rodents of the North of West Siberia]*. Moscow: Nauka (in Russian).

Sokolov, V.E. (ed.) 1982. *Yuribeisky mamont [The Yuribei mammoth]*. Moscow: Nauka (in Russian).

Panova, N.K., Smirnov, N.G., Bykova, G.V. 1988. Iskopayemy pomyet polyovok kak istochnikpaleoecologicheskoy informatsii [Caprolytes as a source of paleoecological information]. In A. Borodin (ed.), *Sovremennoe sostoyanie i istoriya zhivotnogo mira Zapadno-Sibirskoy nizmennosti*: 65-80. Sverdlovsk: Ural Branch of Academy of Science, USSR (in Russian).

Vereshchagin, N.K. & Mikhelson, V.M. (eds.), 1981. *Magadanskii mamontyonok [Magadan baby mammoth]*. Leningrad: Nauka (in Russian).