PALAEOCLIMATIC EVENTS AND HUMAN PALAEOENVIRONMENT OF WESTERN SIBERIA IN THE LATE PLEISTOCENE

ABSTRACT: The paper illustrates the application of the combined use of a palaeoenvironmental Database and GIS technology for analysis of the environmental components and ancient sites in Western Siberia for the time interval from 50,000 to 10,000 radiocarbon years ago. Both geological and archaeological information were used to generate the palaeolandscape maps and to establish the features of the spatial-temporal distribution of Palaeolithic sites.

KEY WORDS: Geoarchaeology – Late Pleistocene palaeoenvironment – Mousterian – Upper Palaeolithic – Western Siberia

INTRODUCTION

The aim of the paper is to examine inter-relations between the natural environment and ancient people on the territory of Western Siberia over the time interval from 50,000 to 10,000 radiocarbon years ago (BP), a period of rapid and severe environmental changes throughout the Northern hemisphere (e.g., Velichko 1984, 1993). Because Late Pleistocene and Early Holocene humans were hunters-gatherers, environmental conditions affected very strongly the people's lifestyle, economy and cultural development. Western Siberia, which incorporates the territory between the Ural Mountains and the Yenisei River including the West Siberian Lowland and the Altai and Sayany Mountains, is a promising area for the study of human-environment interaction because a large body of data is available for both Quaternary geology and archaeology. The palaeoenvironmental Database and Geographic Information System (GIS) technology for data processing and maps generation have been used in order to establish the computer-based approach for geoarchaeological research in Siberia. Also the possible impact of rapid and catastrophic environmental phenomena on human existence has been studied, particularly the settlement distribution patterns.

MATERIAL AND METHODS


To analyze the Late Pleistocene biotic and non-biotic environmental components and their influences on the spatial and temporal distribution of ancient sites, a Regional
GIS Atlas has been compiled. This Atlas is supported by several software packages, including the GIS "ARC/INFO-ARC/VIEW", the GIS "SOCRAT-GEO" (created at the Novosibirsk Regional Center for GIS Technologies, Siberian Branch of the Russian Academy of Sciences), and the "PARADOX" Database Management System (DBMS). The analytical functions of the GIS Atlas were executed through different types of requests to the "PARADOX" DBMS, and the data processing results are output on worksheets (Zabadeeva, Zolotnikov 1996). The maps created (Figures 1-5) have been used as a basic source for data analysis and interpretation.

RESULTS

Climat stratigraphic periodization of the environmental conditions in the Late Pleistocene of Western Siberia, ca 50,000–10,000 BP

To understand the peculiar features of both climatic and environmental changes in the Late Pleistocene, ca 50,000–10,000 BP, it is necessary to increase the time scale up to the Middle Holocene (ca 5000 BP). This allows us to use some palaeoenvironmental situations as analogues. According to the modern conception (Arkhipov, Volkova 1994), the second half of the Late Pleistocene in Western Siberia comprises two main climatic stages, the Karginian Interglacial (ca 50,000–23,000 BP) and the Sartan Glaciation (ca 23,000–10,000 BP).

The Karginian Interglacial, ca 50,000 – 23,000 BP
For the Early Karginian warming, ca 50,000–45,000 BP, palaeoenvironmental conditions are not completely clear. A provisional palaeolandscape reconstruction is presented in Figure 1. According to pollen data (e.g. Arkhipov, Volkova 1994), the climate was warmer than now or close to modern, and this may be confirmed by the existence of taiga-like forests in the modern tundra area of the Ob River mouth and Taymyr Peninsula (Arkhipov et al. 1977, Kind, Leonov 1982). At ca 50,000–45,000 BP, several significant environmental changes had been taking place. They included such phenomena as the degradation of continental glaciers and the exposure of land; the cut-off of glacial lakes; and the formation of fluvial systems. Thus, this period was characterised by rapid geomorphic processes which caused changes of the surface in the northern and central parts of Western Siberia. Evidently, during the only 5000 years it is unlikely to expect the formation of vegetation zones in the northern Western Siberia under such unstable environmental conditions. More probably, the landscapes were quite mosaic-like at that time, and they reflected the dissimilar geological, geomorphic, and climatological features.

The Early Karginian cooling, ca 45,000–43,000 BP, was characterised by active solifluction processes, the burying of the remains of continental glaciers by colluvial and solifluction deposits, and the conservation of glacier remains in underground position under permafrost conditions. The activity of erosional and other geomorphic processes was comparatively low. Because of quite stable conditions of the earth surface in the northern part of Western Siberia, the formation of soils and vegetation cover of tundra and forest tundra had been taking place during ca 45,000–43,000 BP.

The climate and vegetation during the Malayai Kheta warming, 43,000–33,000 BP, were similar to the Early Karginian warming (Figure 1). According to the pollen data, it was slightly cooler than now, and the boundaries between principal vegetation zones were little more northwards than today.

The climate during the Konoscheye cooling, 33,000–30,000 BP, was quite severe, of arctic type (Kind 1974).

On the whole territory of Western Siberia, vegetation was represented by two types, 1) tundra – north of 58° northern latitude (N), and 2) forest tundra – south of 58° N (Arkhipov et al. 1980) (Figure 2). According to S. A. Arkhipov et al. (1977), that period corresponds to the formation of mountain-and-valley glaciers in the northern Ural Mountains, with several bigger glaciers of piedmont type which dammed the Ob River valley near the latitude of Arctic Circle (ca 65–66° N).

The vegetation and climate of the Lipovka-Novozelovo warming, ca 30,000–23,000 BP (Figure 3), were very close to the Holocene Climatic Optimum.

The Sartan Glaciation, ca 23,000–10,000 BP
The vegetation during that period was represented by three zones, very different from both the interglacial and recent ones (Figure 4). The first type, the periglacial vegetation, occupied the territory south of the continental ice sheet down to the 63° N, and covered almost all the modern forest (taiga) zone. The most typical plants for that zone were wormwood (Artemisia sp.) and dwarf birch, along with different cereals (Poaeeae), Lycopodium alpinum, and Selaginella selaginoides. The second type of vegetation represented different kinds of arctic tundra. The southern boundary of the tundra zone has been located south of 56° N, ca 1100 km more southwards than it is today. The third type of vegetation, forest tundra, has been located south of 58° N, on the modern territory of the forest steppe and steppe. Spruce and larch forest occupied the river valleys which drain into the glacial lakes. The southern boundary of the forest tundra zone had been located beyond the Western Siberian Lowland. The climate was cold and dry. The annual mean temperature was approximately 10° C lower than it is today (Arkhipov, Volkova 1994, Velichko 1993).
The Early and Middle Holocene, ca 10,000–5000 BP

During the Preboreal time in the Early Holocene, ca 10,000–9000 BP, the vegetation (Figure 5) was quite different from the modern one. It was represented by two major types, tundra and forest tundra. Numerous pollen and radiocarbon data reflect the vegetation of the light birch-larch forests on the territory of the modern forest and forest steppe zones (Levina, Orlova et al. 1995). The tundra belt occupied the area down to 64° N. South of that point, the forest tundra zone had been located. The expansion of the forest tundra zone was estimated to ca 400 km toward the south. The climate was mild and cold. The average January and July temperatures were lower than today by 7° C and 13° C, respectively (Levina, Orlova 1993).

The Holocene Climatic Optimum, ca 8000–5000 BP, was characterised by the expansion of forest vegetation toward the north by 300–400 km when compared with the Early Holocene. In the western part of the territory, forests consisted mostly of pine and fir. In the southwestern part of Western Siberia, the main vegetation type was pine-birch forests with considerable amount of broad-leaved species such as oak, linden, and elm. Today, boundaries of the habitat of both elm and oak lie beyond Western Siberia, and the linden habitat is restricted to the extreme south-western part of the territory. Both linden and elm were represented in the modern forest steppe zone between ca 6650 BP and 5400 BP (Levina, Orlova 1993). The mean annual temperature in the Holocene Climatic Optimum on the latitude of Omsk (55° N) was higher than today by 1°C; on the latitude of northern taiga area (ca 65° N) it was higher by 3°C; and in the tundra area (ca 70° N) it was higher by 9°C (Arkhipov, Volkova 1994, Arkhipov et al. 1994).
CONCLUSION

This paper illustrates the application of a paleoenvironmental database and GIS technology for the analysis of both natural environments and ancient site distributions. The use of a GIS Atlas has allowed to create maps of paleoenvironment for different time intervals. Data on the spatial-temporal distribution of Palaeolithic sites could then be superimposed on the paleoenvironmental maps. The simultaneous analysis of both kinds of information helps to reveal the peculiarities of human existence in the natural environments of Pleistocene Western Siberia. Also information about the natural environmental hazards has been used to show the influence of rapid environmental events on the existence of ancient people in the Palaeolithic.

ACKNOWLEDGEMENTS

We are grateful to Dr Jiří Chlachula for the invitation to submit the paper to this volume. We also thank Drs. Vyacheslav N. Dementiev, Nikolai N. Dobretsov, and Igor S. Zabadaev for their help. Novosibirsk Regional Centre for GIS Technologies, Siberian Branch of the Russian Academy of Sciences, Novosibirsk, Russia, for assistance with using the GIS software developed in the Center. This research was funded by grants from the Russian Foundation for Fundamental Investigations (RFPI) (89-05-04837), and the Fulbright Program (# 21230, 1997).

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