

Proxy data of various paleoclimatic archives in Altai Mountains

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Introduction

The Altai Mountains are located on the boundary between contrasting climatic and vegetation zones, i.e. the boreal forest zone in the north and the vast steppe belt of Kazakhstan to the west and south-west, and Mongolia to the south and south-east. A variety of environmental conditions determines the presence of various natural objects that can be used as paleoindicators for reconstruction and prognosis of climate changes, i.e. diatom algae and chrysophycean cysts, pollen grains, tree rings.

Materials and Methods

Objects: bottom sediments in deep (Lake Teletskoye) and shallow (Lake Manzherokskoye), ice cores from glaciers in Russian (Belukha) and Mongolian (Tsambagarav) Altai, speleotherms in caves, peats, etc.



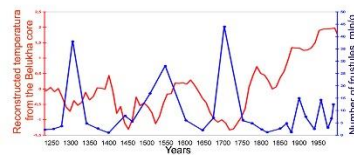
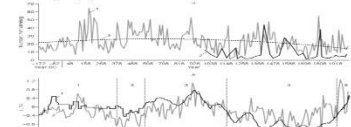
Results and discussion

Lake Teletskoye

Diatoms in bottom sediments

(A) Number of diatom frustules with a trend line in the bottom sediments from the underwater Sophia Lepneva Ridge (1) and in the deepest part of the lake (near Korbu River mouth) (2, by Skabitchevskaya, 2000),

(B) Reconstructed average 100-year temperatures for the region of Lake Teletskoye (a) and ten-day temperatures for North-Eastern Europe (b)



The temperature change according to the ice core data of the Belukha saddle (red line) and the distribution of diatom valves (blue line) in the bottom sediments of Lake Teletskoye over the period 1250-2000.



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A variety of environmental conditions in Altai Mountains determines the presence of various objects that can be used as paleoindicators for reconstruction and prognosis of climate changes



Institute for Water and Environmental Problems of the Siberian Branch of the Russian Academy of Science (Barnaul, Altai krai)



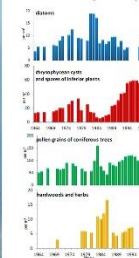
Lake Manzherokskoye

Compilation of spore-pollen, diatom and biochemical analyses of samples from the top 80-cm sediments of Manzherok Lake, located on the western foothills of the Altai Mountains (51.49015.500N, 85.48035.700E, 400 m a.s.l.), revealed influence of regional climate changes during the past 1350 years on the hydrological budget of the lake and the dynamics of the surrounding vegetation. Sharp maxima of non pollen palynomorphs Anabaena and Bryales/Algae at the 43-46 cm depth (~900 a BP) possibly mark ecological crises in lake's biotope. Our study indicates that, as a small and shallow lake located in the forest-steppe western foothills of the Altai Mountains, Manzherok Lake is more sensitive to high-resolution (less than centennial scale) climatic and environmental variations, in comparison with the large and deep Teletskoye Lake located in the mountain taiga zone of the northern Altai.

Glacier ice cores

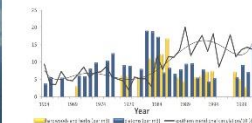
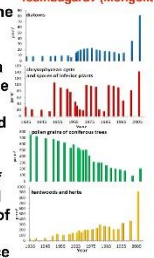
The Altai glaciers located at the most continental northern periphery of Central Asia are the most typical inland glaciers.

Belukha (Russia)

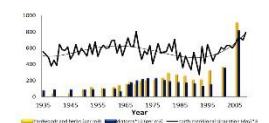


Analysis of the ice core from Belukha glacier reveals that the modern Altai glaciers were formed during the Younger Dryas (...10 950 to ...7500 cal a BC), and that they survived the Holocene Climate Optimum (...6500 to ...3600 cal a BC) and the Medieval Warm Period (...640 to ...1100 AD) (Aizen et al., 2016) while the analysis of the biological proxies allowed identifying the main sources of them deposited onto the incoming to the glacier surface (Papina et al., 2013).

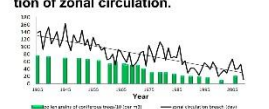
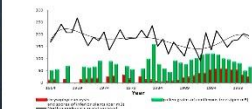
Tsambagarav (Mongolia)



Changes in the amount of diatoms and pollen of hardwoods and herbs are similar to fluctuations in the southern meridional circulation while for cysts and pollen of coniferous trees - northern one.



Synchronous changes in the concentration of pollen hardwoods and herbs and the phase of the change in the number of days with northern meridional circulation. Coniferous pollen concentration is significantly reduced in parallel with a decrease in the number of days with a violation of zonal circulation.



Conclusions

Bottom sediments in deep lakes are very informative paleoarchives due to their thickness, long accumulation period and the presence of a large number of stored biological proxies. The spatial and temporal variations in temperature and in aridity that occurred during the Holocene in the Altai Mountains and the surrounding areas were reconstructed based on pollen and diatom data from shallow lake and peats. The tree rings, ice core from glaciers, speleotherms in caves are indicative archives for a year or even a season reconstruction.