

Algae in bottom sediments of deep Lake Teletskoye as indicators of climate change in Altai Mountains

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Introduction

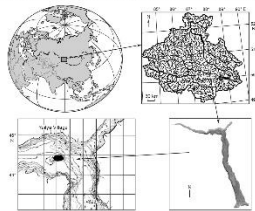
Stratigraphic analysis of diatom in different layers of bottom sediments permits reconstruction of the environmental conditions in the particular geologic period.

In the mid 1990s, Lake Teletskoye (and its diatom algae) became the study object of the International Program for the Comparative Study of the Latest Tectonics and Sedimentation in the Large Rift Lakes of the World (CASIMIR).

The composition and abundance of diatom algae hosted by the sediments are good indicators of climate, therefore time series of temperature, pH, etc. can be reconstructed.

Materials and Methods

Lake Teletskoye is a unique water body due to its location at the center of large mountain region in Eurasia. It is the deepest (maximum depth is 323.3 m) lake in Altai Mountains of tectonic origin with low trophicity. The surface area is 223 km², the catchment with 70 permanent and 150 ephemeral tributaries – 227 th.km². The lake of 41.1 km³ volume lies in a narrow mountain valley and has thick bottom sediments. The average sedimentation rate is 1.45 mm yr⁻¹, the underwater Sofia Lepneva Ridge – 0.3 mm yr⁻¹ (Selegei et al., 2001; Kalugin et al., 2009).



Results and discussion

More than 300 species of diatoms in bottom sediments were revealed.

Number of species per layer - 16-63, an average - 38±4. Analysis of diatom composition in bottom sediments suggests that the following species prevail:

- inhabitants of the bottom and fouling (70%),
- widespread (43%) by geographical location,
- indifferent to salinity (64%),
- alkaliphilous (34%) and indifferent (30%) to pH,
- beta-mesosaprobic (37%) among species-indicators of organic pollution.



International Mountain Conference, Innsbruck, 08–12 September 2019

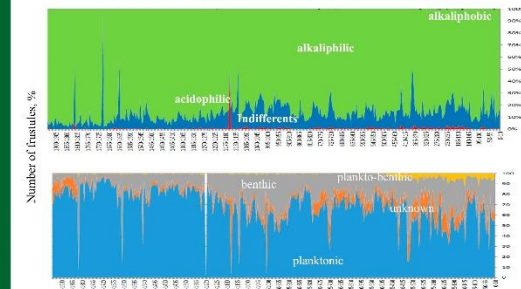
Composition and abundance of diatom algae in bottom sediments of the deep lake in Altai Mountains indicate climate changes and ecosystem stability during the last 4000 years



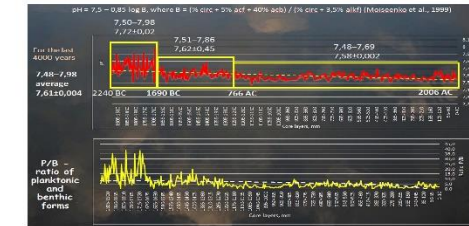
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Diatoms - indicators of pH and habitats



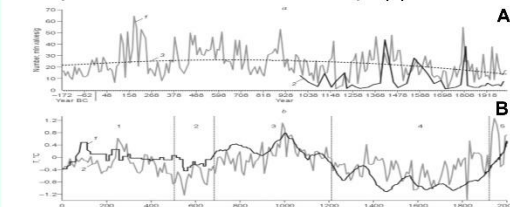
Reconstruction of pH and water level



Distribution of diatoms and reconstructed temperatures

(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 correlation coefficient of diatom number with temperature and precipitation for the period of 1965-2006 was -0.89 and 0.83, respectively.

Conclusions

The reconstructed pH value for the period from 2240 BC to 2006 AD varied insignificantly, corresponding to a weakly alkaline environment (7.0–8.5). The temperature varied widely and there were serious climatic changes over the last 2000 years. The predicted pH value indicates the stability of the lake environment both in the past periods and in the nearest future. Environmental changes in the lake are not so dramatically over the past 4000 years due to, perhaps, some inertia of all processes in the deep reservoir.