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Holocene paleoclimate history of Lake Bannoe (South Ural), from magnetic, geochemical investigation, and grain□size characteristics

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In this work, the methods and results of sedimentary and palaeoclimatological analyses of the modern lake sediment of Lake Bannoe are presented. The methods include coercive spectrometry, differential thermomagnetic analysis, particle-size analysis, δ C_{org}. The results are used to characterize the sediments and to study the changing climatological and environmental settings during the Holocene.

Lake Bannoe (53°35'48.13"N 58°37'47.28"E) is in the Southern Urals. The lake's age model was constructed based on the radiocarbon dating of 9 samples. According to the model, the lake is ~12.5 thousand years of age. For a detailed complex analysis, core No. 3 was selected according of the primary lithological description and the results of seismoacoustic studies.

Hysteresis parameters were obtained using the J_meter coercitive spectrometer, and it allows separate measurements of the remanent and induced magnetizations in magnetic fields up to 1.5 T at room temperature, induced magnetization versus temperature. For 254 samples taken every 2 cm from core column #3, normal-magnetization coercive spectra were obtained.

Differential thermomagnetic analysis was carried out for tracing magnetic minerals according their Curie temperature.Measurements were carried out on Curie express balance. The temperature dependence of induced magnetization in air at a heating rate of 100 °C/min up to a maximum temperature of 800°C were measured in a constant magnetic field - 400 mT.

Particle size analysis was carried out on 15 samples using Microtrac Bluewave Particle Size Analyzer(Microtrac, USA). Previously, about 2 g of each sediment sample was used for the analysis. The organic matter and carbonate contents were removed by treating the samples with 30% H_2O_2 and 10% acetic acid. The three fractions (sand, silt and clay) are presented in sediments . Organic geochemistry ($\delta^{13}C_{org}$) was determined for 51 samples using Delta V Plus isotope mass spectrometer (ThermoFisher Scientific, Germany) with Flash HT prefix.

Normal-magnetization curves were used to determine the hysteresis parameters, the domain structure and ferrimagnetic grain sizes, as well as the contribution of k_para, k_ferro and k_super components to the total magnetic susceptibility. Variations in the paramagnetic content reflect the inflow of allothigenic clastic material into the sedimentation basin. The k_ferro component is

represented by single-domain grains (presumably of biogenic origin) and multi-domain clastic grains. According to differential thermomagnetic analysis magnetic minerals in sediments mostly presented by iron sulfides and magnetite. The result of particle size analysis is showing, that the content of clay fraction in the sediment varies in the range (0.11-2.74) %, silt fraction from 71.51% to 94.5, sand - (2.76-26.71) %.The values of δC_{org} vary from -27.65 ‰ to -24.22 ‰. The periods of high and low humidity in the Southern Urals identified during the study are consistent with the Blytt–Sernander classification.

The present study of magnetic properties, grain size and organic geochemistry of core sediments from Lake Bannoe provides paleoclimatological record for South Ural for the Holocene Period.

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