Short communication

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Sediments of Lake Malye Chany as a Late Holocene paleoecological archive in the south of West Siberia (Russia)

Zhilich S.[1]*, Krivonogov S.[2], Nazarova L.[3,4], Palagushkina O.[4], Cao X.[1,5,6], Rudaya N.[1,3,4,7,8]

[1] PaleoData Lab, Institute of Archaeology and Ethnography SB RAS, 17 Akademika Lavrentyeva ave., Novosibirsk, 630090, Russia
[2] Institute of Geology and Mineralogy SB RAS, 3 Akademika Koptyuga ave., Novosibirsk, 630090, Russia
[3] Alfred Wegener Institute Helmholtz Center for Polar and Marine Research, Telegrafenberg Gebäude A43, Potsdam, 14473, Germany
[4] Kazan Federal University, 18 Kremlevskaya str., Kazan, 420008, Russia
[5] CAS Center for Excellence in Tibetan Plateau Earth Sciences, Chinese Academy of Sciences (CAS), 3 Lincui Road, Chaoyang District, Beijing, 100101, China
[6] Key Laboratory of Alpine Ecology, Institute of Tibetan Plateau Research, Chinese Academy of Sciences, 3 Lincui Road, Chaoyang District, Beijing, 100101, China
[7] Biological Institute, Tomsk State University, 36 Lenina str., Tomsk, 634050, Russia
[8] Novosibirsk State University, 1 Pirogova str., Novosibirsk, 630090, Russia

ABSTRACT. The paper presents the first results of multiproxy study of the sediment core from Lake Malye Chany. This lake is a part of the biggest drainless lake in Russian Lake Chany. The Kargat and Chulym Rivers flow into Malye Chany. The lake locates in the forest-steppe near the southern border of taiga zone which makes it a promising object for reconstructions of the vegetation shifts and other ecological changes of the past periods. The sediment core was investigated by sedimentological, pollen, chironomid, diatom, ostracod analyses. Based on pollen and chironomid data were maid quantitative reconstructins of climate, vegetation cover and biodiversity. According to radiocarbon dates the upper 200 cm of the core covers the last ca. 3900 years. It was established that reconstructed time boundaries of climate, vegetation and ecological changes coincide according to various reconstruction approaches. At the beginning of its existence, Lake Malye Chany was a shallow saline lake with warm water; only after 2.4 thousand years BP the water level rose and the lake became fresh and the water colder. Then the water level and salinity changed, and only 1 thousand years BP the lake became deep again. The last 200 years recorded a slight warming of the water. Landscapes developed from very dry steppe to modern forest-steppe, about 2 thousand years ago there was a short-term cooling and spread of taiga elements. Last 200-300 years, there has been a steppification.

Keywords: Lake Malye Chany, south of West Siberia, multiproxy study, reconstructions

1. Introduction

Despite a number of lakes and peat-bogs studied in the south of West Siberia palaeoclimatological and palaeoecological tendencies are underivestigated. Small lakes in Siberia are the most promising for climate and environmental reconstructions because their sediments record mostly local signals of the climate, vegetation and ecological changes. The lakes accumulate different kinds of organic matter formed inside them and transported from their catchment, including pollen, diatoms, chironomids etc which allow realization of multiproxy approach and complex reconstructions. Our research team includes scientists from Novosibirsk and several other national and foreign institutions studying lakes in Siberia and Central Asia. Here we present first results of multiproxy study of Llakes Malye Chany.

2. Materials and methods

Objects and the study area. Malye Chany (54.55220° N, 77.99580°E) is a freshwater lake located in Novosibirsk region, with a surface area about 200 km^2, mean water depth of 1.4 m and salinity of 0.8 g/L. Lake Malye Chany lies at 106 m a.s.l. and is a part of the saline Lake Chany system, the biggest drainless lake in Russian. The Kargat and Chulym Rivers flow into Malye Chany. The lake locates near the southern border of the Baraba forest-steppe which is a temperate-

*Corresponding author.
E-mail address: snezhy@yandex.ru (S.V. Zhilich)

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climate ecotone and habitat type, where birch groves are inter- spersed with swamps and meadow steppes. In the north, the forest-steppe borders the southern taiga. Modern vegetation around Lake Malye Chany is presented by typical forest-steppe, steppe meadows and grasslands communities. Along the lake's shores grow aquatic plants such as *Typha* sp., *Potamogeton* sp., *Scirpus* sp. The climate of Baraba is continental; the annual temperature amplitudes are around 38 ˚C. Mean July temperatures are 18.3 ˚C, mean January temperatures -19.7 ˚C, annual precipitation level is about 400 mm.

The 3.6-meter-long sediment core of Malye Chany was investigated by sedimentological, pollen (99 samples), chironomid (17 samples), diatom (35 samples), ostracod, an petromagnetic analyses. Pollen and chironomid analyses data were used to reconstruct quantitative characteristics of climate (annual precipitation and temperature), vegetation cover (biomization) and biodiversity. Three radiocarbon dates were used to create the age-depth model according to that the upper 200 cm of the core covers the last *ca.* 3900 years.

3. Results and discussion

According to the sedimentological data, the lake sediments have thickness of 290 cm and there are two distinct lacustrine layers: one (290–190 cm) consisting of terrigenous material (sands) and another one (190–0 cm) considerably organic and authigenic (carbonates). As rivers Chulym and Kargat flow into Malye Chany we assume that the lower layer of terrigenous material (290-190 cm, border is about 3.8 ka BP) was formed under conditions of a low water level in the lake, when the river delta moved deeper and the sand brought by the rivers was deposited in the center of the rlake. In the organic (sapropel) layer we can distinguish two stages of sedimentation: the shallow stage (3.8-2.6 ka BP) and the deep stage (2.6-0 ka BP). Salinization of the lake began at the end of the sand accumulation stage (after 3.7 ka BP), which may be related to a decrease in freshwater inflow due to decreased precipitation and/or river runoff. Gradual desalinization and eutrophication of the lake began after 3.3 ka BP, which suggests a constant inflow of river water during this period.

The ostracod analysis data indicate that up to 3.5 ka BP the water in the lake was brackish and well heated. Then, up to 2.4 ka BP, the water was colder and salinity decreased. At the beginning of the deep water stage there was a drop in water level, the water became warmer, and the salinity of the water varied. After 1.1 ka BP, the water level rose again and the water became colder. Last 200 years are characterized by a slight warming of the water (Khazin et al., 2016).

The pollen data and the results of biomization were used to reconstruct plant communities development in the Lake Malye Chany area. In the period between 4.2 and 3.2 ka BP steppe communities with a large proportion of desert components dominated around the lake, the climate was warm and dry, there were probably intensive soil erosion processes and frequent fires, as evidenced by very high concentrations of chlamydospores *Glomus* and charcoal particles. After 3.2 ka BP, steppe also dominated, but desert components decreased, and macrophytes (water plants) began to grow along the lake shores. The climate was probably warm and humid. After 2 ka BP the area was covered by forest-steppe and the climate remained quite humid, but became colder. According to biomization data, in the period of 1.8-1.5 ka BP there was a short spread of taiga and a probable cooling. In the last 200 years, there is a slight increase in the role of steppe elements and a decrease in taiga elements, which may indicate the process of steppification associated with increased anthropogenic pressure.

The time boundaries of changes in reconstructed by different methods sedimentation conditions and environmental changes are well correlated or coincide.

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Conflict of interest

The authors declare no conflict of interest.

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