Short communication

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Northern Eurasian large lakes level changes in the context of late Quaternary climatic and glacial history

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ABSTRACT. During the last years major progress in the reconstruction of the climatic and environmental history of Northern Eurasia has been made within the scope of the Russian-German project PLOT. The project aimed at investigating the regional responses of the quaternary climate and environment on external forcing and feedback mechanisms along a more than 6000 km long longitudinal transect crossing Northern Eurasia. The well-dated record from Lake El´gygytgyn used as reference site for comparison the local climatic and environmental histories. Seismic surveys and sediment coring up to 54 m below lake floor performed on Ladoga Lake (North-West of Russia), Lake Bolshoye Shchuchye (Polar Ural), Lake Levinson-Lessing and Lake Taymyr (Taymyr Peninsula), Lake Emanda (Yana Highlands). Here, we present the major results of the project with a special focus on lake-level fluctuations and forcing mechanisms.

Keywords: Northern Eurasian large lakes, Late Quaternary environments, lake-level changes

1. Introduction

Much progress has been made recently in the reconstruction of the climatic and environmental history of Northern Eurasia based on exploring and retrieving long sediment records from lakes. The most prominent example is Lake El´gygytgyn that was the subject of an international ICDP drilling project that resulted in the recovery of the longest continuous palaeoclimatic and palaeoenvironmental record for the terrestrial Arctic covering the last 3.6 million years (Melles et al., 2012; Brigham-Grette et al., 2013).

Russian-German project PLOT (Paleolimnological Transect) aimed at investigating the regional responses of the quaternary climate and environment on external forcing and feedback mechanisms along a more than 6000 km long longitudinal transect crossing Northern Eurasia using the well-dated record from Lake El´gygytgyn as reference site for comparison the local climatic and environmental histories.

2. Materials and methods

In order to reconstruct the climatic and environmental history during Late Quaternary times seismic surveys and sediment coring performed on five lakes, which together with Lake El´gygytgyn form a more than 6000 km long longitudinal transect across northern Eurasia.

A multi-channel, high-resolution seismic reflection survey using a Micro-GI airgun and Innomar sediment echo sounding system were used for obtaining large-scale information on the depositional and post-depositional histories, and for selecting the most appropriate locations for coring.

Sediment coring performed by using an improved UWITEC percussion piston corer.

For the reconstruction of the sedimentary processes a range of bulk analyses carried out on the sediment cores, including whole-core MSCL logging (physical properties, 1 cm spacing), half-core XRF

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scanning (chemical composition, 0.2 to 5 mm spacing), thin section microscopy (microstructures, irregularly) as well as water contents, grain-size distributions, organic and inorganic geochemistry (regular, every 4 to 16 cm). The basic chronologies established by means of ^{14}C AMS and optically stimulated luminescence (OSL).

The paleoclimatological reconstructions particularly rely on palynological and diatom analyses.

3. Results

Major results recently published in special issues of journals Boreas (Melles et al., 2019 and references therein) and Journal of Quaternary Science (Melles et al., 2022 and references therein).

During the pilot stage of the project in 2013 about 1500 km of seismic profiles were performed and two long (18 m and 22 m) sediment cores were retrieved in northern part of Lake Ladoga that is largest European lake located in North-West of Russia. In summer 2016 54 m-long sediment core was obtained in the central part of 130 m deep Lake Bolshoye Shchuchye located in Polar Ural. During 2016 and 2017 seismic surveys and sediment coring performed in Taymyr Peninsula on lakes Levinson-Lessing (47 m-long sediment core) and Taymyr (14 m and 16 m-long sediment cores). In summer 2017 sediment echo sounding and coring (6 m-long sediment core) were performed on Lake Emanda (Yana Highlands).

4. Discussion and conclusions

New results concerning Late Quaternary lake-level fluctuations obtained for lakes Ladoga (Gromig et al., 2019; Lebas et al., 2021), Bolshoye Shchuchye (Lenz et al., 2022a), Levinson-Lessing (Lebas et al., 2019; Lenz et al., 2022b), Taymyr (Gromig et al., 2022), Emanda (Baumer et al., 2021) and El´gygytgyn (Fedorov et al., 2019) in addition to partly available information in the literature allow to make following main conclusions:

1. In the western and central sectors of Northern Eurasia strongly affected by Late Quaternary Ice Sheets large lakes level changes do not directly correlate with climatic history but more controlled by ice margin position.
2. In the eastern sector of Northern Eurasia large lakes level changes shows prominent correlation with climatic history.
3. The longest lake-level history is reconstructed for Lake El´gygytgyn (since MIS 7). Reconstruction shows that long-term lake-level history during the Middle and Late Pleistocene is the mean summer temperature but short-term lake-level changes at the transition from the last glacial to the Holocene and within the Holocene, in contrast, are controlled not only by the temperature but also by the local precipitation.

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Conflict of interest

The authors declare no conflict of interest.

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