Short communication

Reconstruction of the relative sea-level (RSL) of the Gulf of Dvina (White Sea) based on the study of lake sediments on the Onega Peninsula

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ABSTRACT. We present the preliminary results of the granulometric and geochemical analyses of lake-bottom sediments obtained from the Murmanskoe and Maloe Murmanskoe lakes. Based on the collected data, we reconstructed changes of relative sea-level (RSL) in the Gulf of Dvina (White Sea) during the Holocene. The conditions and maximum levels of two transgressions (Late Glacial and Tapes) and one Early Holocene regression were identified.

Keywords: lake sediments, Holocene, White Sea, sea-level change, grain-size, geochemistry

1. Introduction

The reconstruction of the relative sea-levels of the White Sea requires to identification glacioisostatic and eustatic components that determined the asynchronous formation of the coast during the Holocene. Therefore, different areas of the White Sea region need to be investigated, including the coast of the Gulf of Dvina. In addition to the previous stratigraphic (Peretrukhina et al., 2019), geochronological and diatom (Repkina et al., 2019) studies, we performed granulometric and geochemical analyses for sediment cores taken from the Murakanskoe and Maloe Murakanskoe lakes.

2. Methods

Fieldworks, lithological descriptions, and the radiocarbon and diatom data of the study area have been reported by Peretrukhina et al., (2019) and Repkina et al., (2019). In Lake Maloe Murakanskoe, a core was sampled in the western part of the lake with a maximum water depth 4 meters (core ID MM), at the foot of the moraine ridge (Peretrukhina et al., 2019). In Lake Murakanskoe, three drilling cores were sampled: two in the western and eastern parts of the lake (core ID MT2 and MT3, respectively) and one in the central part (not used for this study).

Grain-size and bulk geochemical analyses were conducted at the Korea Polar Research Institute (KOPRI) for reconstructing sedimentary environments (freshwater or marine). The grain-size measurements of in total 107 samples (cores MM ($n = 40$), cores MT2 ($n = 36$), and MT3 ($n = 31$)) were carried out for the range of 0.02 to 3000 μm using a Malvern Mastersize laser particle sizer (Mastersizer 3000). The interpretation and the classification were based on Blott and Pye (2012).

The content of total organic carbon (TOC) and total nitrogen (TN) and their isotopes ($\delta^{13}C_{TOC}$ and $\delta^{15}N_{TN}$) of in total 84 samples (cores MM ($n = 30$), cores MT2 ($n = 24$) and MT3 ($n = 30$)) were determined with a Flash 2000 organic elemental analyzer connected to a Delta V Plus isotope ratio mass spectrometer (Thermo Fisher Scientific).

3. Results and Discussion

Two investigated lakes are located near the coastal line of the White Sea in different hypsometrical levels. There are no salinity indicators in bottom sediments of Lake Maloe Murakanskoye (10.9 m above sea level), also diatoms were not found in the MM core (Repkina et al., 2019). The existence of the straits between Lake Maloe Murmanskoe and the Gulf of Dvina can be tentatively associated with Late Glacial transgression ~13.5 to 11.5 cal. kyr BP (Kolka and Korsakova, 2017).

The first and rapid lithological changes in the core MM occurred at 10.4-10.1 cal. kyr BP (Repkina et al., 2019). This time interval corresponds to the

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beginning of the peat horizon formation above sands, that evidence about complete drainage of the basin. Characteristics of the early Holocene regression were also found in the core MT2 – age of the peat was 9.46-9.09 cal. kyr BP. It is most likely the RSL was below 7 m above sea-level at that time. The peat formation continued in the eastern basin of Lake Murakanskoe up to 8.55-8.39 cal. kyr BP (Repkina et al., 2019). Then, during the Tapes transgression, the RSL rose again.

Clayish gyttja began to accumulate above the peat; the interval of 525-507 cm in the core MT2 indicates an increase of salinity, $\delta^{13}C_{TOC}$ of $> -24‰$, and C/N ratio of < 9.5. The intervals of 507-485 cm were probably related to the meromictic stage of the lake since there was a weak salinity signal along with the absence of freshwater indicators. Above 485 cm, the sediments were represented by typical lake deposits with $\delta^{13}C_{TOC}$ of $< -24‰$ and C/N ratio of > 10, which indicates the freshwater condition in the lake. Accordingly, our results provide valuable information for clarifying the history of RSL changes in the White Sea.

4. Conclusions

Late Glacial transgression in the Eastern part of Onega Peninsula was higher than 11 m above present sea level. The Early Holocene regression occurred earlier than 10.4-10.1 cal. kyr BP with the elevation 10.9 m above sea level and earlier than 9.46-9.09 cal. kyr BP with the elevation 7 m above sea level. In the beginning, the regression would have been rapid, but gradual at the final stage. The Mid Holocene transgression began to ca. 8.55-8.39 cal. kyr BP and its highest level did not exceed 10.9 m in the investigated area. In near future, we will provide new radiocarbon data for better estimating the RSL degreasing.

Acknowledgments

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