Short communication

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Environment of bottom sediments formation from the Lake Dedovo in the Voronya River valley (Kola Peninsula), according to diatom analysis (preliminary data)

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ABSTRACT. The study presents preliminary results of the species composition and distribution of diatoms in the core of bottom sediments of the Lake Dedovo located in the Voronya River valley (Kola Peninsula). It was determined that sedimentation occurred in the periglacial basin during Late glacial. After there was a large basin that connected with the sea, but this basin was freshwater due to the large influx of melt water. The level of this basin was at the same elevation for a long time at the beginning of the Holocene. According to preliminary radiocarbon dating, the isolation of the lake depression from a large freshwater basin occurred at the end of the Early–beginning of Middle Holocene. Lake Dedovo develops as an independent basin with a diverse freshwater diatom flora after the isolation.

Keywords: diatoms, bottom lake sediments, Voronya River valley, Kola Peninsula

1. Introduction

As is known, the analysis of diatoms in cores of bottom sediments of lakes makes it possible to reconstruct the environment sedimentation. Previously, diatom analysis of bottom lake sediments was carried out in order to determine their genesis for sea-level change researches. Such works were carried out on the Barents Sea coast of the Kola region in the areas of the Dalnie Zelentsy (Snyder et al., 1997), Nikel (Corner et al., 1999), Polyarny (Corner et al., 2001), and in the inner part of the Kola region in the Tuloma River (Tolstobrov et al., 2015), Lotta River valleys (Tolstobrov, 2018), and etc. This study presents a new data on the diatom analysis of bottom sediments of Lake Dedovo, located at an altitude of 23.5 m above sea level (a.s.l.) in the Voronya River valley, the Kola Peninsula (Fig. 1A).

The purpose of this article is to reconstruct the environment of bottom sediments formation from the Lake Dedovo in the Voronya River valley according to diatom analysis data in the late and postglacial period.

2. Materials and methods

The materials were obtained during field research in 2018. The core of sediments of different facies was taken in summer from a catamaran, using a piston corer with 54-mm diameter. The thickness of the exposed bottom sediments was 360 cm. Lithological description, photographic documentation and sampling of bottom lake sediment cores were carried out in the field. The preparation of slides for diatom analysis was carried out according to standard methods (Diatomovyye.., 1974). The main attention is focused on the characteristics of diatom species in relation to their salinity. The taxonomic identification of diatoms was refined according to the Algaebase database (Guiry and Guiry, 2022). Geochronological control was carried out using preliminary radiocarbon data.

3. Results and discussion

3.1. Lithology of bottom sediments

Sediments were described from the bottom to top. Depths are given from the surface of the water in the lake (Fig. 1B):

780–660 cm– gray clay with a bluish tint, with layers of silt and fine-grained sand. A lens of gray sand occur at a depth 752–754 cm.

660–607 cm — thinly laminated silt and organic matter (gyttia). A layer of gray sand occur at the 654–652 cm. Amount of organic material increases at the 630–607 cm. Mottled textures occur at the 607–612 cm.

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607–592 cm — laminated silt and organic matter, the amount of silt increases. Lamination gradually disappears, and the amount of organic matter increases up the section. The transition to the overlying gyttia is gradual.

592–438 cm — gyttia with interlayers 5–7 cm thick, expressed by color change. The color of gyttja is brown to greenish brown.

438–420 cm — gyttia dark brown, structureless.

Legend: 1–gyttja; 2–clay; 3–silt; 4–sand; 5–lamination; 6–weak lamination; 7–sharp boundary; 8–gradual boundary; 9–radiocarbon dating.

3.2. Diatom analysis

Diatom analysis was carried out for 12 samples. A total of 205 taxa of diatoms were found.

According to the data of diatom analysis, no diatoms were found in clay from the basal part of the section (780–660 cm). Previously, we assumed that clays accumulated in the sea basin according to lithological data (Tolstobrova et al., 2019), however, diatom analysis did not confirm this. The absence of diatom valves probably indicates the accumulation of this interval under severe conditions of a periglacial basin.

In contrast to clay, a rich and diverse freshwater diatom flora was found in the thinly laminated silt and gyttia (660–607 cm). Indifferent species predominate (80–92%), the subordinate position belongs to halophobes and halophiles, which account for 5–18% and 0.2–3.5%, respectively. Species with unclear position belonging to salinity range from 2 to 7%. The dominant species is the planktonic species *Aulacoseira subarctica* (O. Müll.) Haworth. Planktonic species *A. ambigua* (Grun.) Simons. and fouling species *Stauroforma exiguiformis* (Lange-Bert.) Flower, Jones et Round, *Staurosira venter* (Ehrb.) Kobayasi, *Tabellaria flocculosa* (Roth) Kütz were identified as subdominants. Other species are represented in smaller numbers and are very diverse. The similar composition of the diatom flora was identified at the 607–592 cm. This composition of the diatom flora corresponds to the freshwater environment of sedimentation. We assume that there was large basin connected with the sea after the glacier retreat. However, this basin was freshwater due to the large influx of meltwaters and small width and depth of the valley. According to the thickness of the laminated silt and gyttia and preliminary data of radiocarbon dating, the level of this basin was approximately at the same elevation for a long time (Fig. 1B). Later, as a result of the fall in the relative sea level, the level of this large basin also fell, and the studied lake was isolated. According to radiocarbon dating, the isolation of the Lake Dedovo was at the end of the Early – beginning of the Middle Holocene.

Freshwater diatom flora found in gyttia (592–438 cm). There is a change in the dominant species, while no significant changes in salinity have been identified. The ratio of species changes according to the pH of the environment towards oxidation. The planktonic species

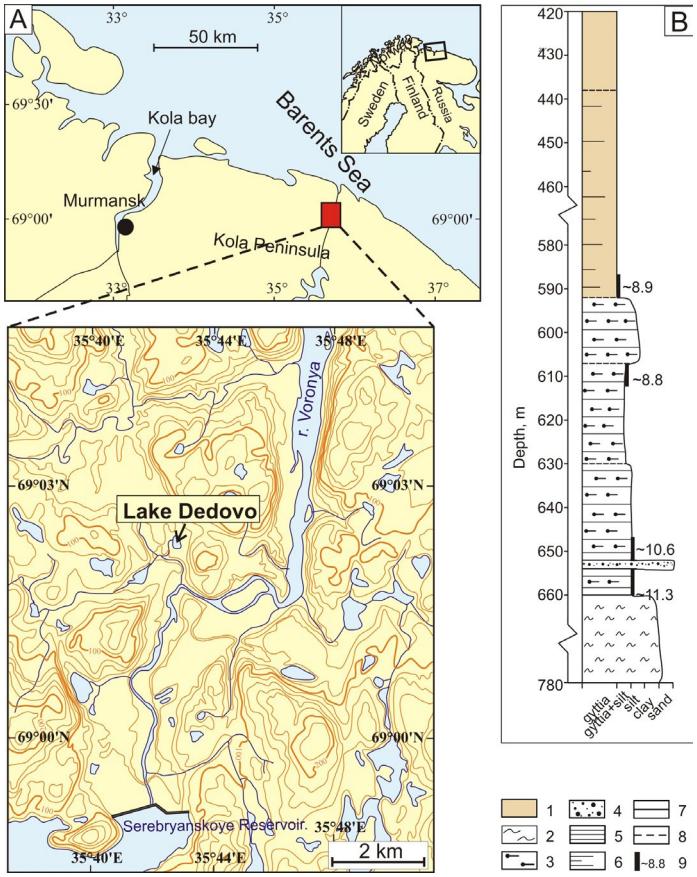

Fig.1. The location of the study area and section of bottom sediments of Lake Dedovo.

A. lirata (Ehrb.) R.Ross and the fouler *S. exiguiformis* were identified as dominants here, the subdominant is *Pseudostaurosira brevistriata* (Grun.) Williams et Round.

4. Conclusions

(1) The absence of diatoms at the initial stages of sedimentation in the bottom sediments of Lake Dedovo indicates the existence of a periglacial basin in this part of the valley in the late glacial period. (2) After the retreat of the glacier a basin was formed here, which was connected to the sea, but was freshwater due to the large influx of melted glacial waters. (3) The isolation of the Lake Dedovo depression from this large basin took place at the end of the Early – beginning of the Middle Holocene. After isolation the Lake Dedovo develops as an independent basin.

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Conflict of interest

The authors declare no conflicts of interest.

References

Diatomovyye vodorosli SSSR. Iskopayemyye i sovremennyye. Tom I [Diatoms of the USSR. Fossil and modern]. Vol. I. 1974. In: Proshkina-Lavrenko A.I. (Ed.). Leningrad: Nauka. (in Russian)

Corner G.D., Yevzerov V. Ya., Kolka V.V. et al. 1999. Isolation basin stratigraphy and Holocene relative sea-level change at the Norwegian-Russian border north of Nikel, northwest Russia. Boreas 28(1): 146-166. DOI: 10.1111/j.1502-3885.1999.tb00211.x

Corner G.D., Kolka V.V., Yevzerov V.Ya. et al. 2001. Postglacial relative sea-level change and stratigraphy of raised coastal basins on Kola Peninsula, northwest Russia. Global and Planetary Change 31: 153-175. DOI: 10.1016/S0921-8181(01)00118-7

Guiry MD, Guiry GM. 2022. AlgaeBase. World-wide electronic publication, National University of Ireland, Galway. URL: http://www.algaebase.org

Snyder J.A., Forman S.L., Mode W.N. et al. 1997. Postglacial relative sea-level history: sediment and diatom records of emerged coastal lakes, north-central Kola Peninsula, Russia. Boreas 26: 329-346. DOI: 10.1111/j.1502-3885.1997.tb00859.x

Tolstobrova A.N., Tolstobrov D.S., Kolka V.V. 2019. Records of the tapes sea transgression in bottom sediments of lakes in the Voronia valley, Kola Peninsula. Trudy Karel'skogo Nauchnogo Tsentra RAN [Proceedings of the Karelian Research Center of the Russian Academy of Sciences] *10: 267-273*. DOI: 10.25702/KSC.2307-5252.2019.6.039 (in Russian)

Tolstobrov D.S. 2018. Holocene tectonics of the northwestern part of the Kola region. Cand. Sc. Dissertation, Geological Institute RAS, Moscow, Russia. (in Russian)

Tolstobrov D.S., Tolstobrova A.N., Kolka V.V. et al. 2015. Postglacial uplift of the Earth crust in the north-western part of the Kola region. Vestnik MGTU [Vestnik of MSTU] 18(2): 295-306. (in Russian)