ACCUMULATION AND DISTRIBUTION OF RARE EARTH ELEMENTS IN LATE PLEISTOCENE BOTTOM SEDIMENTS OF ICE ONEGA LAKE (DATA FROM THE SMALL LAKE POLEVSKOYE).

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Lake Onega, Europe's second largest lake, is located on the boundary of the Baltic crystalline shield and the Russian Plate. During the Quaternary period, the Lake Onega basin underwent significant changes related to the degradation of the Valday glacier and the development of the glacial water body. The authors obtained data on the stratigraphy of the samples of bottom sediments (BS) of Lake Polevskoye, which may indicate that this core of BS can be considered as representative e.g. Gurbich et. al., (2017). The aim of this research is to investigate of the distribution of the rare earth elements (REE) in recent and the Late Pleistocene bottom sediments (varved clays) of the relict Ice Onega Lake and the analysis of their inherent systematics REE for better visualization of the formation.

The object of research –BS of Lake Polevskoye, which was previously part of a large Ice Onega Lake (IOL). The selection the core of the BS was carried out using the Russian Corer in the winter time with an ice (2017) (the thickness of the recovered sediments is 13 meters).

The core samples were studied layer-by-layer with intervals of 1–2 cm. The sediment was studied using a set of geological, geochemical, petrographical and mineralogical methods at the multi-element isotopic research centre of Siberian Branch of RAS in Novosibirsk (atomic absorption, X-ray diffraction, IR spectroscopy, scanning electron microscope, ICP-MS and others).

The upper part of the sediment core is composed of sapropel layers (Loss on ignition (LOI) is 32%). Below by the core massive homogeneous gray sandy clay silt with interlayers (<1mm) of black (pyrolysis, goethite) and green (vivianite) colors are replaced. Following layers are the varved clays (LOI 98%). It`s coloured by greenish-gray, and in the lower part of the section (from 12.05 m) pink-brown varve with layers (up to 1 cm) of black (shungite), formed in the Late Glacial period. On granulometric structure of the BS are of predominantly by pelit and silt fractions. The mineral composition of these BS (quartz, feldspar, mica. amphibole and chlorite) was determined byX-ray diffraction analysis. Dolomite is added to this set of minerals at the bottom of the core (below 12 m). Usually a black (pyrolusite, shungite and/or goethite) layers, bright green color and honey (vivianite - siderite, rhodochrosite) are abundant across the whole width of varved clays. In the BS accumulated in the IOL emerged "pink" marker horizon can be followed from the cores of the BS of Llake Onega to the lakes of the Zaonezhye e.g. Demidov (2006). In Lake Polevskoye, the "pink" layer in the width of varved clays is also present, with clear, sharp contact at a depth 10,37 m, and the top gradual to a depth of 10.08 m. According to the obtained geochemical data (48 elements) significant differences in contents of "pink" in the horizon relative to higher and lower lying layers have not been identified.

Data of rare earth elements (REE) are actively used for the reconstruction of formation conditions and the evolution of various geological processes. The content of REE in the BS of Lake Polevskoye with different depths (sapropels, homogeneous clay, varved clay layers ("pink horizon", upper, below contact with the "pink horizon" and varve clay with shungite layers) and their distribution pattern are fixed (fig.1). For comparison, the contents REE in the modern BS of

Lake Onega (excluded data from the Petrozavodsk Bay of Lake Onega, as the distribution in it is sharply different from other areas of the lake) and varve clays of the Baltic Ice Lake e.g. Kunzendorf, Valius (2004) are also presented in fig.1.

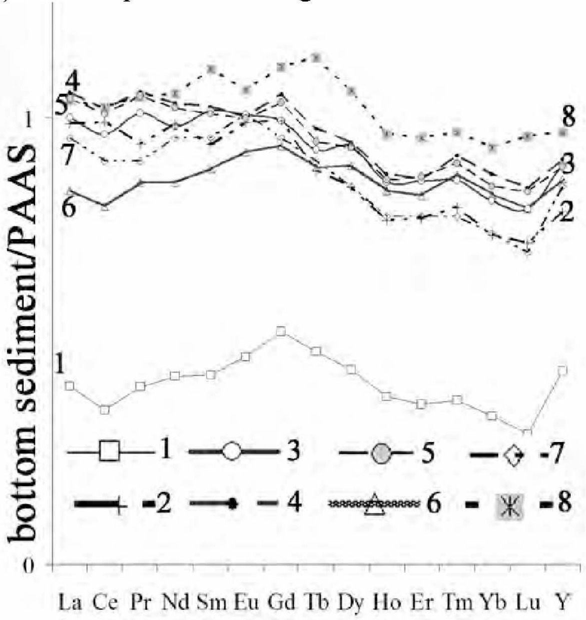

Fig. 1. The PAAS normalized spectra of REE distribution in Holocne (1,2) and Late Pleistocene bottom sediments of Lake Polevskoy (3-6); in recent bottom sediments of Lake Onega (7) and varve clays of the Baltic Ice Lake (8): 1 - sapropel layers, 2 - massive homogeneous gray sand-clay silt, 3 - varved clays upper “pink” layer, 4 - in the varved clays “pink” marker horizon, 5 - 3 - varved clays lower “pink” layer, 6 - pink-brown varve with interlayers of the shungite.

Average REE content in layers of BS of different age does not differ significantly, except for sapropel part of core, in which REE concentration is much lower, due to dilution with organic matter. General character of REE distribution in the BS of Lake Polevskoye is no different from the BS of Lake Onega. In the layers of varve with shungite interlayers ∑REE are ranges from 142 to 148 g/t (∑LREE/HREE from 3.2 to 3.5); in varve, including in the “pink layer” - ∑REE from ~180 to ~256 g/t (4.6-5.2); in homogeneous clays - ∑REE from ~130 to ~176 g/t (4.5-5.1); in sapropel layers - ∑REE from ~51 to ~54 g/t (3,5-3,8); in modern BS of Lake Onega-∑REE from ~ 84 to ~136 g/t (3.6-5.6); in modern BS of the Petrozavodsk Bay ofLake Onega - ∑REE from ~242 to ~439 g / t (15-26), which corresponds to the continental lithogenesis. The PAAS normalized REE distribution in BS of Lakes Polevskoye and Onega characterized by rather low angle slightly MREE oriented shape and the following peculiarities. A weak negative (Ce/Ce*)PAAS (0,89-0,92), except the Petrozavodsk Bay BS ofLake Onega (2,56 -4,33) and varying values (Eu/Eu*)PAAS: a significant negative for the sapropels (0,56), mild negative for all horizons of varved clays (0,92-0,99), and clearly manifested a positive for varvved clays with interlayers of shungite (1,66) and slightly positive for the “pink” layer (1,1). The general feature of BS of all layers indicate the expressed similarity with distribution of REE in crystalline rocks of Archaean and Proterozoic of the Baltic Crystalline Shield. BS of Lake Onega are characterized by the size Nd (t) from -21,98 to -25,9, which also corresponds to the model age of crystalline rocks of Archaea and Proterozoic Baltic shield.

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