tions of the external environment. * Analysis of trends and climate cyclicity of different orders allows to predict climatic parameters for 50 years and beyond.

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MECHANISM OF VARVES FORMATION IN THE OBDEKH RIVER PALEOVALLEY (PSKOV REGION, RUSSIA)

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Varves are a unique paleogeographic archive allowing to reconstruct the paleohydrology regime of lakes, the nature of sedimentation and changes of the environments and climate in the catchment area with an annual resolution. Classic varves accumulated in the extensive proglacial lakes on the North-West of the Russia in the Late Valday (Late Weichselian) are found in the lower parts of lowlands and ancient buried paleo-incigions. The varves in depressions on the lowlands are studied by a number of researchers. They have been known better than those into the paleo-incisions.

The series of varved clays are found in the Obdekh R. paleovalley during our investigations. The valley is located at the base of the eastern slopes of the Haanja Upland. Specific features of varve formation are predetermined by the morphology of the paleovalley and its deglaciation character. The cross profile of the valley has the shape of a trapezium. The width of the valley is 400-1000 m and the width of the bottom - 100-200 m. The depth of the modern river valley is 40-50 m, while that of the buried paleovalley is about 100 m. The thickness of the Late Pleistocene glacial deposits filling the paleovalley reaches 50 m. There are two structural terraces on the right slope. The left slope is steep and with landslide processes widely spread on it. Both slopes are cut by gullies (small erosion landforms). The bottom is complicated by hummocky moraine, some kame terrases, depressions and meltwater channels to the north of the Lake Malskoye only. The difference in relative heights does not exceed 10 m. South from the marked border the most part of the bottom is flat and occupied lakes (Malskoye, Gorodishchenskoye) and swamps (Sukhoe and the Nizhniy Krupsk bogs). The studied area is situated in 4 km to the north-east of the Luga stage boundary of the Late Valdai (Late Weichselian) glaciation.

During the field investigations it was established that varves occur on the bottom of the paleovalley and the depth of their top varies from 6,40 to 8,20 (probably more). There is a decrease in the depth of the top of varved clays towards the lakes. The southern boundary of the varves is presumably at the beginning of valley, the northern one is to the north-west from the Lake Malskoye. It can be assumed that the hummock moraine and other landforms originated under condition of melting dead ice which dammed the runoff from the proglacial lake. The varved clays were deposited in this lake.

The discovered varved clays are clastic. The chemical composition of varved clays is characterized by high proportion of the mineral constituent, high content of Si and other elements typical of the mineral class of silicates – Al, Na, K, Mg, Ti, and Fe. There are two series of clays characterised by a rhythmical seasonal lamination. These series are separated with the layer of sandy-silt material. The individual varves in the lower part of clays are from 10 to 77 mm thick, those in the upper part are from 3 to 52 mm thick. The main part of the varve thickness falls on the summer layer. The granulometric composition of both layers of varved clay is also different. The varves of the lower layer are predominantly clayey and silty. The proportion of clay decreases, but silt and sand increases significantly in the upper of varves. The amount of sand in the summer layers of the upper horizon of varves increases from the bottom to top of the series. The seasonal rhythmicity of microlayers is emphasized by the granulometric composition in the varved clays of the upper series, while it is poorly expressed for the lower varves. Seasonal layers within individual varves contain finer microlayers and disturbances visible in the photographs of thin sections at large magnification. The lower series microlayers are more abundant and better pronounced disturbances of the layered microstructure are also observed in the microlayers, which could be the impact of bottom currents transporting material from the melting dead ice nearby. The upper series of varved clay has mainly undisturbed seasonal laminations.

The results obtained suggest that the key borehole penetrated both and proximal and distal varved clays. The formation of proximal varves (those in the lower varved clay series) took place under conditions of close location of melting dead ice, abundant supply of fine-grained clastic material, turbid flows taking an active part in the deposition. Accumulation of distal varves (those in the upper varved clay series) took place in the remote part of the basin in calm water with predominance of gravitational sedimentation processes. The results obtained, that are in good agreement with early works (Kolka, 1996; Bakhmutov et al., 2006, and others), established that for the purposes of the varvochronology only distal varved clays are suitable. In our main core, 217 distal varves are counted within the upper varved clay series. Similar distal-type varved clays were found in other boreholes drilled farther south of the main one. By now, the results of varvometric measurements are difficult to correlate with chronological scale accurately because of the lack of 14C dates available.

The correct radiocarbon age of sediments was obtained only for the upper – organogenic - part of the key borehole. The difference in 14 C dates noticed from varved clays is connected with the insufficient carbon content in the samples of varves, and the uncertainty in the origin of dated organic matter. The content of organic matter in the samples was about 3%, the dating was carried out in terms of total carbon. The plant detritus was found in the upper series of the varves (the results of dating are not ready yet). In addition, the results of pollen analysis of lake sediments near the studied area indicate the first peak of carbonate accumulation to correspond to Preboreal (materials of geological survey). Accordingly, varved clays occurring 0,5 to 1,5 m lower in the section could be formed in the Allerød.

Initially the varved clays were deposited in the water-filled cracks in the dead ice. In the upper part of the paleovalley the dead ice melting proceeded unevenly, the ice blocks in place of the modern lakes (Malskoye, Gorodizhchenskoye) persisted the longest. The difference in the time of the ice melting is confirmed by increasing depth of the varve position from the periphery towards the Lake

Gorodizhchenskoye. As the ice melted, a single proglacial lake developed in the upper part of the paleovalley, northwest of the Lake Malskoye, its level not exceeding 75 m abs. (the elevation of the terrace II surface). Then the proglacial lake was rapidly drained, the spillway traces are recognizable by preserved meltwater channel (now occupied by the Obdekh R.) and structures of sediments studied in cores.

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FIRST RADIOCARBON RESULTS OF ONEGA LAKE BOTTOM SEDIMENTS BASED ON CONVENTIONAL AND AMS METHODS

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The Lake Onega is a huge important polygon for palaeoreconstruction due to its location, history development and specific features. The most particular studies are belonged to Pleistocene-Holocene transition when Fennoscandia deglaciation was occurred [Saarnisto, Saarinen, 2001] Huge amount of data was obtained in 20th century during Finnish-Russian collaboration when geological, biostratigraphical, neotectonical, glaciological and geomorphological studies were conducted [Saarnisto, 1995; Saarnisto, 2016]. Most part of palaeoevent reconstructions for Onega Lake are based on stratigraphic approach using varve clay consequence, pink horizon [Demidov, 2006] and other markers, while absolute ages are almost absent [Filimonova, Lavrova, 2017]. Such situation can be explained by specifics of Onega Lake sediments. Big and especially postglacial lakes tend to form the sediments with extremely low organic carbon content that makes such objects a quite complicated for radiocarbon dating. According to published data there are no absolute ages for bottom sediments of Onega Lake. Samples for radiocarbon measurements were taken mostly from surrounding lakes and bogs.

Current work represents the first radiocarbon results of Onega Lake bottom sediments obtained by measurements with applying of liquid scintillation spectrometer (conventional method) and Accelerator mass spectrometer (AMS). Pollen analysis was also carried out to establish stratigraphy of bottom sediments and verify absolute age by non-absolute dating approach.

Classic radiometric measurements were conducted in “Geomorphology and Palaeogeography of Polar Regions and the World Ocean” Laboratory (Köppen-Lab) in Saint Petersburg State University, Russia. AMS measurements were carried out by CologneAMS laboratory in University of Cologne, Germany.

During the expedition that was headed by Prof. Aleksandr Rybalko in 2016 the seismoacoistic profiling was conducted and 7 sediment cores were collected. The different core location is supposed to represent the complete record of Onega Lake bottom sediments deposition in case of complicated morphology of lake basin and different rate of sedimentation. Two sediment cores ONG-2 and ONG-5 were chosen for complex studies, that also includes radiocarbon and pollen analysis, due to its maximum thickness of deposits. Sampling intervals for radiocarbon dating were chosen according