SEARCHING FOR SEISMIC DISLOCATIONS IN LAKES SEDIMENTS WITH GROUND PENETRATING RADAR

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Introduction. The study of Quaternary sediments is an important and quite difficult task for geological disciplines. Analysis of the structure of glacial landforms, as well as water bodies formed during interglacial periods, can play an important role in the restoring process of the climatic conditions of the environment formation, as well as in the allocation of catastrophic events that occurred in the Quaternary period (Nikolaeva et., all 2016).

The study of glacial deposits is usually carried out by direct sampling methods, by digging exploration pits on ground investigations and drilling wells in the process of studying water bodies. However, it is worth noting that as a complement to existing techniques often include methods of near-surface Geophysics, particularly ground penetrating radar. Literature provides multiple examples of GPR usage for shallow water areas research. Thus, for example, one publication Gomez & Miller (2017) demonstrates GPR utilization in surveying lake slopes deposits and lake sediments. The GPR enabled the authors to detect the ways in which layers with different genesis are reflected in the GPR wave field. There is an example of obtaining bathymetric maps based on GPR (Bava and Sambuelli, 2012). Researchers emphasize the high efficiency of the GPR method in such activities and point out the importance of recording the value of electric conductivity of water while detecting the marginal depth of relevant signal distribution.

Investigated object and used GPR. Our paper describes the experience of the GPR research on a shallow lake located on the Kola Peninsula, in the watershed area of the largest lake in the region – lake Imandra. At this object in the period from 2013 to 2015, researchers from the Kola research Center were drilled several wells and detailed drilling column with a step dimension of 5-10 cm. During the survey, in the thickness of the bottom sediments was allocated horizon containing an increased amount of wood residue, as well as sand and silt. According to researchers, this horizon marks a catastrophic event that occurred in the region about 6500 years ago (Nikolaeva et., all 2017).

The GPR recording was conducted by the GPR OKO-2, a 150M antenna unit with the signal penetration depth up to 12 m and the resolution ability of 30 cm. Data processing was carried out by the program GeoScan 32. The surveys were conducted from ice surface in the winter period.

Example of radar profile. As an example of the wave pictures obtained at the object, figure 1 show one of the radar profiles obtained during the study. On radar profiles, the value ε was not taken into account and as a consequence, a deep incision was not obtained. The thickness of the ice on the lake was up to 0.7 m. Increased amount of noise in the upper part of the section due to the water layer in the ice and is localized at times up to 100 ns and does not interfere with the interpretation of the underlying layers. Further interpretation of ice has the value ε is formed of 3 and 81 for water. Horizon 2 corresponds to the roof of the deposits of lake sediments (sapropel) and is clearly correlated with drilling data. The magnitude ε for horizon 2 was established in the analysis of hyperbolic diffracted waves and amounted to 64. Layer 3 was interpreted as a horizon marking the change of sedimentation regime. Layer 3 has dissimilar petrophysical property's than containing it sapropel layer which causes the formation of clearly visible correlation lines on the borders. This fact allows us to confidently allocate layer 3 in the areas of its localization. The boundary 4 localizes the boundary between sapropel layer and the mineral (sand) base of the lake The boundary 5 is interpreted as a noise – fold reflection from the boundary between organic and mineral sediments.

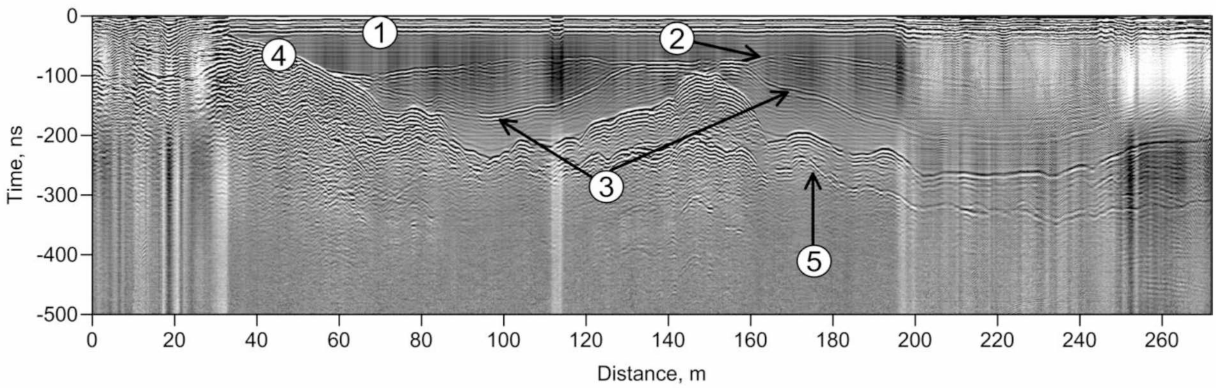

Fig. 1. Radar profile and some interpreted layers.

In addition, on the radar profile has been allocated a region interpreted as fault formed after a catastrophic event, as indicated by the violation of the horizon 3 border form. The area is localized in the range of 100-180 m at times of 100-300 ns.

Summary. GPR made it possible to quickly and thoroughly explore the shallow lake. Drilling data greatly facilitated the process of interpretation of radar profiles, as well as allowed to correlate geological layers and areas of the wave field. In addition to the marking horizon selected during drilling, the use of GPR allowed to localize areas which possibly exposed to tectonic effects. This experience makes it possible to recommend GPR method in other shallow lakes in Kola and Karelian region.

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References:

C Gomez, J Miller. Ground Penetrating Radar Analysis of Slope and Lake Sediments Interplay: A Survey of Lake Pearson // [Research Report] Kobe University. 2017.

A. Neal. Ground-penetrating radar and its use in sedimentology: principles, problems and progress // *Earth-Science Reviews,* 2004. 66 (3-4), p. 261-330.

S. Bava, L. Sambuelli. Case study: A GPR survey on a morainic lake in northern Italy for bathymetry, water volume and sediment characterization // Journal of Applied Geophysics, 2012, vol. 81, p. 48-56.

S.B. Nikolaeva, A.A. Nikonov, S.V. Shvarev, M.V. Rodkin. Comprehensive paleoseismic geological studies in a key site in southwestern Kola Peninsula (Northeast of the Fennoscandian Shield) // Doklady Earth Sciences. 2016. T. 469. № 1. P. 656-660.

S.B. Nikolaeva, N.B. Lavrova, D.B. Denisov. A catastrophic Holocene event in the lake bottom sediments of the Kola region (northeastern Fennoscandian shield) // Doklady Earth Sciences 2017. T. 473. № 1. P. 308-312.

THE HISTORY OF SOIL MAPPING IN LENINGRAD REGION

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The modern soilscape of the area is very diverse due to landscape variability and anthropogenic impact. In 1905 R.V. Rispolozhenskiy conducted the first soil survey and presented schematic soil map at a scale 1:840.000 with 50 soil taxa (Rispolozhenskiy, 1908).

In 1932 - 1936 a team of soil scientists under the leadership of Academician L.I. Prasolov made detailed soil survey of the region. Soil map at a scale 1:500.000 based on 25.000 soil pits was published in the three-volume monograph, describing landscapes and soils, their classification and land use features (Soils of the Leningrad region, 1937).