POSTGLACIAL PALEOSEISMODISLOCATION ON MOUNT VOTTOVAARA

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Mount Vottovaara (abs.alt.417.2 m), the highest top of the West Karelian Upland, is a ridge elongated approximately north – south for about 7 km, composed of Jatulian quartzite and quartzitic sandstone and broken by numerous faults probably rejuvenated in Postglacial time. The denudation surface displays a highly rugged topography, the top surfaces are subdued by exaration, and the relative altitude above the surrounding terrain is up to 157 m. Mount Vottovaara bear traces of disastrous geological events that took place here at the Pleistocene-Holocene boundary (Demidov, 1997; Demidov et al., 1998; Lavrova & Demidov,1997; Lukashov, 2004; Shelekhova, 1999). The crystalline rock surface has been considerably transformed by multiple glaciations during the Quaternary Period. Exaration forms, roche moutonee, glacial grooves, ruts and scars are common to the area. Holocene tectonics has been confirmed by the lithologo-stratigraphic and micropaleontological study of bottom sediments from a small lake located in a seismogenic basin near the mountain top (63o 04' 20" N, 32 o37 '15"E). The lithological composition of the sediments, spore-and-pollen spectra (SPS) and the diatom complex changed markedly at the Preboreal-Boreal boundary, suggesting a break in sedimentation. The SPS display a rapid succession of dominant components and the increasing contribution of hygro- and hydrophytes. Diatom flora evolved gradually up to the Preboreal-Boreal boundary, but the diatom complex changed rapidly after the break (Shelekhova, 1999). Radiocarbon analysis of sapropel, which accumulated in the lake after the break, has shown that their deposition began in Boreal time (8920∟60 years ago, SU-2824) y.a. A break in sedimentation in the lake and numerous traces of seismodislocations suggest that they were produced by a violent earthquake. It could have been provoked by the degradation of the Late Valdai glaciations and the rapid removal of the glacial load which contributed to the rejuvenation of old faults of varying rank. Paleoseismodislocations were undoubtedly derived in Postglacial time, as indicated by extensive evidence for dislocations in the form of steep walls with fresh irregular surfaces, traces of rock breaking and the detachment of individual massive rock blocks; numerous dismembered blocks shifted relative to each other; thrown away and shifted blocks; seismogravitational collapses, the distinctive feature of which are blocks similar in the degree of weathering or overgrowing with lichens, rock blocks thrown away from the carp wall so that a niche is formed, clefts; gaping extension joints in the basement; broken roche moutonee, on which the glacially affected surface displays fresh fractures; «fresh» fault scarps; fractures extending along the mire bottom; and a seismogenic pit with a lake in the centre.

Seismodislocations within Vottovaara Ridge could have taken place at the Preboreal-Boreal boundary. This assumption is supported by the occurrence of similar forms in the same seismogenic structure in Lake Pizanetz, 26 km north-east of Mount Vottovaara. (Lukashov, 2004). Mount Vottovaara undoubtedly attracts tourists and scientists who study local paleoseismodislocations of postglacial age.

References

Demidov I.N. 1997. Mount Vottovaara relief formation in Postglacial time // Archaeology of the North, issue 1, KarRC. Petrozavodsk. P. 200-203.

Demidov I.N., Lukashov A.D., Lavrova N.B., Shelekhova T.S., Vyakhirev S.A. 1998. Paleoecology and paleoseismology of the Mount Vottovaara area, Western Karelia, I Late and Postglacial time. Abstracts of presentations at the International Symposium “Paleoclimates and evolution of paleogeographic settings in the Earth’s geologic evolution”. 27-31 August, 1998. Petrozavodsk, P.28-30.

Lavrova N.B., Demidov I.N. 1997. Paleoecological conditions of sedimentation and evolution of vegetation on top of Mount Vottovaara. // Problems in Karelia’s geoecology. Petrozavodsk. IG KarRC, RAS. P.13-20.

Lukashov A.D. 2004. Neo-geodynamics // Deep structure and seismicity of the Karelian Region and its surroundings. Petrozavodsk: Karelian Research Centre, RAS, P. 150 – 191.
Shelekhova T.S. 1999. Postglacial and Holocene evolution of Vottovaara Landscape Preserve's nature.//Problems in Karelia's geology and ecology. Petrozavodsk, KarRC, RAS, P.39-44.

DEFORMATIONS OF SEDIMENTS AND TOPOGRAPHY OF THE ESKER, AS EFFECTS OF STRONG SEISMIC EVENTS IN LATE GLACIAL (KARELIAN ISTHMUS, SOUTH EASTERN PART OF FENNOSCANDIAN SHIELD)

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The research area is located in the Northern part of the Karelian Isthmus between Lake Ladoga and the Gulf of Finland of the Baltic sea. Glaciofluvial landforms of the last glaciation - esker ridges, spatially associated with faults in the cristalline basement, which were activated in late- and post-glacial time. The esker under study is located in the central part of Karelian Isthmus and has length about 40 km. The esker elongated to North-West and in the south part located along the valley of the Vuoksi River. Three cross-sections show different types of deformations in the esker sediments.

The first cross-section (southern) shows complex of opposite oriented normal faults forming a graben-like structure, oriented to NW and coinciding with orientation of the esker ridge and main morphologically expressed lineaments. Vertical amplitude of the graben is about 1 m, and amplitudes of faults reach to first decimeters. Important properties of this deformational structure is that some thrust-faults located in the central (axial) part of graben and asymmetry of graben with steep (mainly quazi vertical) NE side and gentle SW side. Therefore, the structure forming process consisted of two stages, the first is stretching and the second is compression. These stages coincide to process of tectonic movement. Upper layers are horizontally bedded sands and gravel lightly lowered above graben and dissected near bottom by thrust faults from lower deformed part. It is evidence that first stage of stretching was accompanied by flow with coarse depositions (gravel). Second stage of compression occurred when the gravel deposition was not finished.

The second cross-section (middle) includes two main parts as previously. The upper part is horizontally bedded sands, gravel and pebbles. The lower part is sands and partly silt dissected by normal faults oriented orthogonally the esker ridge, but coincides to morphologically expressed lineaments, crossed the ridge. Amplitudes of faults reach to first decimeters usually, but the master fault amplitude is about 1.9 m. Some layers in this depositional complex include soft-sediment deformational structures. Some species of the upper layers of deformed part represent fragments of varved clays which are considered as depositions of Baltic Ice Lake (BIL) which was here between 13.0-11.6 cal. kyr. BP. Therefore we can state that traces of several seismic events was found here. Horizontal upper layers and abrasion surface we can connect with the activity of the BIL on the last stage. This feature of cross-sections are characteristic as for this location, so for the first site of investigation. Thus observed traces of seismic events we can connect with the early stage of BIL.

The third cross-section (northern) is most interesting and intricate. First of all, the surface of the esker in orthogonal (NE-SW) cross-section represents two lengthwise ridges and shallow hollow between them. Left (NE) part is binomial. Lower layers are deformed sands and silt with large boulders which "swimming" in liquefied matrix. Upper layers are horizontally bedded sands, gravel, pebbles and very good rounded boulders near the surface. Central part represents gentle inclined to central axis parallel bedded sands and gravel. The border between left and central parts consist of several (mainly three) parallel normal faults. The master fault amplitude is more