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Postglacial Development and Geological Structure of the Great Lake Ladoga

Aleksey Amantov and Marina Amantova
VSEGEI, St. Petersburg, Russia

Lake Ladoga is one of the key intriguing regions for constraining the glacial rebound model. It is located close to the margin of expansion of the last glaciation. The majority of data of its post-glacial development, rebound and drainage are disputable in spite of huge amount of data collected by different researchers. The modern basin is located on the slope of the Baltic shield sloping under the Neoproterozoic–Paleozoic cover of the Russian platform, and in spatial links with the shape of Riphean (Mesoproterozoic) basin. Because of this position and contrast topography, several papers report on strong neotectonics with differentiated movements and unclear role of the isostatic rebound.

We want to highlight the following points:
1. Lake Ladoga basin is clearly a product of Cenozoic erosion, with the dominant role in glacial time. Different resistance of Mesoproterozoic formations causes the contrast relief. We consider the deepest northwestern part as the world largest glacial cirque.
2. Sub-Upper Vendian peneplain (base of the “proper” sedimentary cover) and other major Upper Vendian-Cambrian reference horizons show gentle tilt across the area of distribution, as seen in shallow seismic profiling. They continue offshore in the same way, showing clear absence of noticable neotectonic movements that could change the overall rebound pattern.
3. Modeling, which includes sediment redistribution, shows it’s potentially significant role in landscape changes. Widespread thick Ice Lake sediments should be deposited north of the highland of Karelic peninsula, and their later erosion contributed to minor additional uplift.
4. Water level fluctuations are well known for the Ladoga post-glacial history. In hydroisostatic response Ladoga appeared as a circle with the center of additional uplift (or subsidence) migrating southwards. This caused deviations of pure glacial isobases.
5. Peat autocompaction / compaction changed topography over time, especially in oldest sedge-moss peats (i.e. in Neva lowland). Average compaction rate could vary due to type, position of groundwater table and overburden by the transgression. This usual process also contributed to local surface subsidence anomalies instead of tectonics. Possible development of floating peat complicates reconstructions.
6. Presence of massives of both low-dense (i.e. rapakivi) and high-dense (granulites) rocks in the basement causes bending of former water surface, making models using horizontal water table unrealistic.
The modeling shows the possibility of temporary streamflow from the southwestern Ladoga to the Baltic Sea via the local Dunai Lagoon, Lubjya lowland and Okhta river. The raised bogs with up to 10 m of peats mask it in present by topographic inversion. Lubjya strait also existed earlier until cal 11600 BP, slightly longer than Lepsari strait 10-15 km to the north. At this final stage of the Baltic Ice Lake the 5 km long Sady spit separated the Dunai Lagoon.