How would Fennoscandia look like without glacial isostatic deformation?

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Glacial isostatic deformation has considerably affected the Fennoscandian geomorphology. Since the end of the Weichselian glaciation at about 10 ka ago the land uplift has amounted to several hundred meters in the area of maximum uplift. The estimates of remaining uplift are in the range of 100-200 m depending on applied data and methods. We have investigated how the Fennoscandian land surface (based on present topography and bathymetry) would look like if the remaining glacial isostatic uplift would be included in the present geomorphology, and to see whether the role of other possible processes can be recognized.

We made a correction to the Fennoscandian topographic data assuming that the remaining glacial isostatic uplift follows the present uplift anomaly regionally, and that the uplift can be scaled according to the present rates of uplift. The resulting images calculated for two assumed values of remaining maximum uplift (120 and 240 m) reveal an interesting image on the Fennoscandian geomorphology. The Bothnian Sea and the Gulf of Bothnia are much smaller or completely vanished. In the present sea basins, the bathymetric data also reveals distinct paleo erosion channels. A meandering river system has extended from the Gulf of Bothnia to the Baltic Sea Proper. Correlating geological maps with topography indicates that in the areas of the erosion channel sedimentary rocks of Vendian, Lower Cambrian or even Mesoproterozoic age are known under the thin Quaternary (glacial and post-glacial) sediments. In the Bothnian Sea younger Middle Cambrian to Permian rocks border the erosion channel from the west.

The age of the erosion channel is not accurately known, but it probably represents Plio-Pleistocene erosion when considerable sedimentation took place in the North Sea Basin. The available literature suggests that the provenance of the sediments was Fennoscandia. To develop erosion structures the land surface must have been well above sea level, unless the erosion has been purely glacial. The glacial erosion is usually very small in topographically flat peneplane areas, and the estimates for Fennoscandia are of the order of few metres/glaciation cycle. The deepest parts of the paleo erosion channel are presently at depths of 150 – 460 m b.s.l. This would be the minimum amount of remaining uplift, and it is higher than the estimates based on glacial isostatic compensation models. The result may also suggest that the contemporaneous Fennoscandian land uplift is not purely of glacial origin, but includes a tectonic component, maybe in relation to current uplift of the Norwegian mountains. Alternatively, the mechanisms of glacial isostatic deformation over several glaciation cycles may be more complicated than anticipated so far.