A NEW APPROACH TO SCREEN AND INVESTIGATE POSTGLACIAL FAULTS IN FINLAND

by

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Finland is located within Proterozoic/Archean part of the Fennoscandian Shield implying that volcanism is absent and seismic activity is low. From this point of view the Finnish bedrock conditions are favorable for a spent nuclear fuel repository. However, as Finland is situated in high latitudes, future glaciations may pose potential risks for the long-term safety. Slow loading of horizontal stresses during the advance of ice sheet and rapid unloading of the vertical stresses during the melting stage forces the bedrock to readjust to the changing conditions. The recorded present-day uplift rates in Finland are up to 9-10 mm/a. Faults disturbing the overlying Quaternary deposits or offsetting glacially polished bedrock surfaces are taken as evidences of glacio-isostatic compensation of the bedrock to the stresses induced by the ice sheet. Such recently activated faults are called postglacial faults (PGF) regardless of their exact date, whether being late-glacial or truly postglacial. PGF's have been described from Finland, Norway and Sweden since 1960's. Conventionally they have been identified from aerial photographs or by map interpretations and field observations. The reported surface traces of the faults are up to 160 km long and the largest observed vertical displacement is about 30 m. The faults are thrust faults striking SW-NE and coincide with ancient deformation zones. If the observed displacements have formed in a single seismic event, the earthquakes may have reached the magnitudes up to 7 – 8. So far, all the reported major PGF's are located in the northern part of Fennoscandia.

During the past couple of decades, the mapping of PGFs has achieved what has been possible by the available tools. With the advent of airborne LiDAR-based digital elevation models, a new and accurate remote sensing mapping methodology has become available. It allows fast and low-cost detection of postglacial features, not only fault scarps, but also other morphological features within the fault's impact area, thus increasing significantly the probability to find and identify seismic zones. Such features include, for example, paleolandslides. The high-resolution elevation data is also capable to reveal features, which are basically unnoticeable in field.

Geological Survey of Finland and Posiva have jointly launched a country-wide LiDAR based search for PGFs, paleolandslides and other morphological features of Quaternary deposits possibly related to post- and late-glacial seismic activity. The project has two main goals: 1) to reassess the existence of PGF's in the southern part of the country and 2) to improve the understanding of the reactivation mechanisms, internal geometry and other properties of the faults. All observations made during the project are collected and classified into a common geodatabase, using the ArcGis (© ESRI) -software. The outcome of the project will contribute in assessing the seismic risk and the stability of fracture network in Olkiluoto during the future glacial cycles. A longer term aim is to combine the PGF observations from Nordic countries into a single database in order to facilitate regional interpretations.