3D Stress Modelling of a Neotectonically Active Area in Northwestern Norway

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The Nordland area in NW Norway is one of the tectonically most active areas in Fennoscandia. It exhibits patterns of extension, which are in contradiction to the first-order regional stress pattern which reflects compression from ridge-push. The regional stress field stems from the interaction of ridge push and GIA (glacial isostatic adjustment); the local stress field mainly results from gravitational stresses as well as the flexural effects of sediment erosion and re-deposition. Whereas the first three effects are fairly well constrained, the latter is only poorly known and is the focus of this study.

A number of data sets are collected within the project: Seismicity is monitored by a 2-year local seismic network. Surface deformation is recorded by a dense GPS network and DInSAR satellites. In-situ stresses are measured in a couple of relevant boreholes.

We develop 3D finite element numerical models of crustal scale, using existing geometric constraints from previous geophysical studies. Internal body forces (e.g. variations in topography) already yield significant deviatoric stresses, which are often omitted in stress models. We apply the far-field stress fields (GIA, ridge-push, sediment redistribution) as effective force boundary conditions to the sides or base of the model. This way, we can account for all stress sources at once, but can also vary them separately in order to examine their relative contributions to the observed stress and strain rate fields.

We develop a best-fit model using the different seismological and geodetic data sets collected and compiled within the project. Effects of lateral density changes and pre-existing weakness zones on stress localization are studied in connection to observed clusters of enhanced seismic activity.