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Composition of the upper mantle beneath the Lapland-Kola orogen (northern Fennoscandian shield) obtained by 3-D modeling of Bouguer anomaly

E. Kozlovskaya (1), H. Silvennoinen (1), T. Janik (2)

(1) Sodankyla Geophysical Observatory, University of Oulu, Finland (elena.kozlovskaya@oulu.fi), (2) Institute of Geophysics, Polish Academy of Sciences

To estimate response of the lithosphere of the Fennoscandian shield to glacial isostatic adjustement, it is important to know differences in density and mechanical properties of rocks in the upper mantle. These properties are usually estimated using seismic velocity models that are interpreted in terms of rock composition and temperature. However, the same velocity anomalies can be explained also by variation of seismic anisotropy, as the upper mantle beneath the shield is generally seismically anisotropic. The anisotropy is caused by large-scale fabric in the upper mantle due to preferred orientation of olivine. As the gravity data is not sensitive to seismic anisotropy, gravity modeling can be applied in order to distinguish between velocity anomalies caused by seismic anisotropy and anomalies caused by variation in rock composition and temperature. As an example, we present a 3-D density model of the crust and upper mantle in the area of Proterozoic Lapland-Kola orogen, where seismic modeling revealed a high velocity anomaly in the upper mantle and where a regional maximum of the Bouguer anomaly is observed. We used results of controlled-source wide-angle and near vertical reflection seismic studies to constrain the density in the crust and made a 3-D forward modeling and inversion of the Bouguer anomaly in the area of the orogen. Our study showed that the major source of the regional Bouguer maximum and high velocity anomaly is a well-preserved dense eclogitic root beneath the orogen that continues to a depth of more than 70 km.