Geophysical Research Abstracts
Vol. 14, EGU2012-7736-1, 2012
EGU General Assembly 2012

Upper mantle and crustal structure of southwestern Scandinavia: Results of the TopoScandiaDeep project

A. Köhler (1), N. Balling (2), J. Ebbing (3), R. England (4), A. Frassetto (10), S. Gradmann (3), B.H. Jacobsen (2), T. Kvarven (6), V. Maupin (1), A. Bondo Medhus (2), R. Mjelde (6), J. Ritter (7), J. Schweizer (8), W. Stratford (5), H. Thybo (5), B. Wawerzinek (7), and C. Weidle (9)

(1) Dept. of Geosciences, University of Oslo, Norway (andreas.kohler@geo.uio.no), (2) Dept. of Earth Sciences, University Aarhus, Denmark, (3) NGU, Trondheim, Norway, (4) Dept. of Geology, University of Leicester, UK, (5) Dept. of Geography and Geology, University of Copenhagen, Denmark, (6) Dept. of Earth Science, University of Bergen, Norway, (7) Geophysical Institute, Karlsruhe Institute of Technology, Germany, (8) NORSAR, Kjeller, Norway, (9) Institute of Geosciences, Christian-Albrechts-Universität zu Kiel, Germany, (10) Incorporated Research Institutions for Seismology, Washington, USA

The origin of the Scandinavian mountains, located far away from any presently active plate margin, is still not well understood. In particular, it is not clear if the mountains are sustained isostatically either by crustal thickening or by light upper mantle material. Within the TopoScandiaDeep project (a collaborative research project within the ESF TOPO-EUROPE programme), we therefore analyse recently collected passive seismological and active seismic data in the southern Scandes and surrounding regions. We infer crustal and upper mantle (velocity) structures and relate them to results of gravity and temperature-composition modelling.

The Moho under the high topography of southern Norway appears from controlled source seismic refraction and Receiver Functions as relatively shallow (<= 45 km) compared to the deeper conversion (>55 km) imaged beneath the low topography in Sweden and elsewhere in the Baltic Shield area outside Norway. The Receiver Function modeling as well as the active seismic results suggest that the differences in the observed Moho response may represent the transition between tectonically reworked Moho under southern Norway and an intact, cratonic crust-mantle boundary beneath the Baltic Shield. Furthermore, the 410km-discontinuity and the LAB is imaged, the latter one suggesting a lithospheric thickening in NE direction.

Upper mantle P-wave and S-wave velocities in southern Sweden and southern Norway east of the Oslo Graben are correspondingly relatively high while lower velocities are observed in the southwestern part of Norway and northern Denmark. The lateral velocity gradient, interpreted as the southwestern boundary of thick Baltic Shield lithosphere, is remarkably sharp. Differences in upper mantle velocities are found at depths of 100-400 km and amount to $\pm$ 2-3%. S-to-P wave conversions, interpreted to originate from the lithosphere-asthenosphere boundary, are preliminary estimated to 90-120 km depth.

Inversion of Rayleigh and Love surface wave phase velocity dispersion curves from observations of ambient noise and earthquakes yield another independent model of the crust and upper mantle structure below southern Norway. Inverted crustal velocities and Moho depths are consistent with the results of seismic refraction and receiver functions. Additionally, indications for radial crustal anisotropy of up to about 3% are found. The inferred upper mantle S-wave velocities show that the lithosphere under southern Norway has characteristics usually found under continental platforms and changes towards a cratonic-like velocity structure in the East, in agreement with the body wave tomography.

All in all, these separate investigations give a very consistent and stable picture of the crust and upper mantle configuration. Integrated geophysical modeling of the results shows that a lateral transition from thinner, warmer lithosphere under southern Norway towards thicker, colder lithosphere under Sweden results in a density distribution that significantly adds to the isostatic support of Norway's high topography.