Geophysical Research Abstracts, Vol. 9, 02719, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-02719

Accurate depths to Moho beneath the highlands of southern Norway resolved by teleseismic receiver functions

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We present new accurate determinations of depth to Moho along two profiles, 400 km and 500 km long in southern Norway. The profiles extend from the Atlantic coast and cross regions of high topography and the Oslo Rift. We estimate receiver functions from teleseismic recordings at temporary seismograph stations and from the permanent seismograph arrays NORSAR and Hagfors. A total of 1071 teleseismic waveforms recorded by 24 temporary and 8 permanent stations are analyzed. The depth-migrated receiver functions show a well resolved Moho for both profiles. The velocity model used in the migration is based on a high-quality refraction study made for the Sognefjord region between our two profiles. The sensitivity of the obtained Moho depths to the velocity assumptions is not likely to exceed +/- 1 km for realistic deviations from the used velocity model. Including interpretational uncertainty our Moho depths are generally accurate within +/- 2 km.

For the northern profile, which crosses Jotunheimen, Norway's area of maximum topography, we obtain Moho depths between 32 and 43 km (below sea level). For the southern profile, which crosses the major highland of Hardangervidda, the obtained Moho depths range from 29 km at the Atlantic coast to a maximum of 41 km below the highland plateau.

Generally the depth of Moho is close to or above 40 km beneath areas of high mean

topography (>1 km). The eastern part of both profiles crosses the Oslo Rift where the crust is locally thinned down to 32 km. Further east we observe a deep Moho beneath low topography.

Beneath the highlands the obtained Moho depths are 4-5 km deeper than previous estimates based only on interpolation and extrapolation of early refraction studies in adjacent areas. Our results are supported by the fact that west of the Oslo Rift, on both profiles, a deep Moho correlates very well with low Bouguer gravity which also correlates well with high mean topography.

A slight offset of ca. 50 km is observed between the maxima of the mean topography and the observed Moho depths.

Our results reveal a 10-12 km thick crustal root beneath the highlands of southern Norway, and emphasize the contribution to Airy-type isostatic compensation. The observed crustal root leaves little room for additional buoyancy-effects in the lithosphere. Thus, our observations do not seem consistent with the mechanisms of significant additional buoyancy presently suggested to explain a Cenozoic uplift widely believed to be the cause of the high topography in present-day southern Norway.