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Seismological and gravity evidence for a buoyant crustal root beneath the highlands of Southern Norway and tectonic implications

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The origin of high topography along the western part of the Scandinavian Peninsula (the Scandes) including the highlands of Southern Norway is a matter of debate. Significant Cenozoic including Neogene tectonic uplift has been suggested but a convincing uplift mechanism remains undiscovered. Successful explanatory models must satisfy information on deep structures and be consistent with gravity data and information on the state of isostasy.

We present new determinations of depth to Moho from the analysis of teleseismic receiver functions across Southern Norway and a new crustal thickness map for this area. Crustal thickness variations in the range of 29 - 44 km are found. Marked regional Bouguer gravity anomalies are observed, between 30 and -100 mgal, and we observe a close correlation between thick crust and low Bouguer gravity and high surface elevation. High topography in Southern Norway seems isostatically maintained mainly by the buoyancy of a crustal root.

The various models suggested for the formation of the Scandes (asthenospheric plume, crustal underplating, lihospheric delamination, rift shoulder uplift, remnants of the Caledonian mountains etc.) are briefly discussed in the light of the above observations and considering other important geological and geophysical constraints. Our observations are very hard to reconcile with the suggestions of the Scandes being formed entirely or mainly by Cenozoic tectonic uplift. The most simple explanation for the Scandinavian mountains consistent with our observations of a buoyant crustal root is that they are mainly topographic remnants from the Caledonian (and perhaps older)

collision orogeny and that the present morphology is the result of several dynamic processes following orogeny.