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Seismic study of the crust beneath the Northern Mountains from Receiver Function analysis

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The analysis of P receiver functions is rapidly becoming a classical technique for study of the crust beneath seismic stations from seismic arrays. This approach is based on the simple assumption of 1D horizontal layers. If the resolution depends on the inter-station distance and the noise level, we can extract easily the Ps conversion from the Moho beneath the station by picking the spike around +/-5 s after the direct P wave. Knowing the delay between the Ps conversion and the direct P wave and assuming a relative Vp we can quantify the Moho depth and the Vp/Vs ratio. We have applied this approach in a noisy environment (Scandinavia) using 2 temporary broadband (SCANLIPS2 and SCANLIPS3D) arrays in order to have a better idea of the Moho geometry across the Scandinavian Mountains. This mountain range is a topographic anomaly (peaks above 1 km) close to the flat region of the Baltic shield (maximum height 500 m above sea level). The classical techniques such as H-k stacking and the CCP depth migration have been used to image the crustal structure. Our results show a crustal thickening from West to East (40 km to 50 km) without an associated change in surface or Moho topography. These results suggest that the Scandinavia Mountains will not be supported by a crustal root like that seen beneath young mountain ranges such as the Alps or Himalaya. Our inverse modelling cannot confirm the presence of a low velocity zone in the upper crust suggested previous works in the area using P receiver functions and controlled souce seismology. We suggest a new 2D crustal model (H, Vs) across the range. Nevertheless, the uncertainty on the Vp/Vs ratio under the some stations due to very weak PpS phase is an issue for the interpretation of our results. Indeed without extra information we have used a Vp/Vs ratio for the crust of 1.73 in the modelling of receiver functions. From the H-K stacking we have a variability of Vp/Vs ratio from 1.74 to 2.0–which is not consistent with the geology and the geodynamic context. We chose to use stations showing stable values (ie H between 36 and 50 km and Vp/Vs between 1.70 and 1.90) for better constraints on this ratio.