A unique wide-angle reflection/refraction survey across the central Fennoscandian Shield, Sweden

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In May-June 2017, we acquired a 600-km-long wide-angle reflection/refraction (WARR) profile in central Sweden with a mix of 580 1C and 3C receivers and 7 shots with charge sizes between 360 and 500 kg. The north-south trending profile extends between south of Linköping and northeast of Sundsvall. Our main goal was to gather information on the nature and structure of the lithosphere in this part of the Fennoscandian Shield using higher-resolution and closer source and receiver spacing than in the only former project in this area, the FENNOLORA WARR profile, recorded about 40 years ago which had larger receiver spacing (~10 km) and large distance between sources (~200 km). Our collaborative data acquisition used equipment and expertise from various institutions. The following recorders were used: Sercel RAUs, Reftek-125 Texan and Data-Cube3, from Sweden, Denmark, Poland and Germany, respectively. Geologically, the profile covers 5 different tectonic domains with the Bergslagen region in the center bounded by broad deformation belts in the north and south. The highly mineralised Bergslagen was formed between 1.91 Ga and 1.87 Ga and was metamorphosed at variable conditions between c. 1.85 and 1.80 Ga.
There are different contrasting models describing the tectonic evolution of the Bergslagen area. Dominant concepts are migratory tectonic switching and microcontinent-continent collision. In this study, we present the results of the simultaneous P- and S-wave traveltime tomography along the entire profile. Over 2800 first breaks and 2300 secondary arrivals were used for this purpose. Reciprocity check shows only minor differences illustrating the quality of the data and picks. The final velocity models show an RMS of 137 ms and 242 ms for P- and S-wave velocity models, respectively. To overcome the extreme crookedness of the profile, receivers and shots were projected to a 2D plane. The final velocity models suggest a deepening of the Moho south-central of the Bergslagen area. In general, the Moho is deepest (ca. 55 km) in the southern part of the profile than in the north. Together with this crustal thickening, we observe lower velocities below Bergslagen than the surrounding regions. In particular, lower crustal velocities range from 6.3 km/s to 7.0 km/s between 30-45 km depth in the Bergslagen domain, whereas lower crustal velocities are 7.0 km/s – 7.5 km/s along most of the profile. The two northernmost shots show sub-Moho reflections that we speculate about their nature and their implications.

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