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Lithospheric structure beneath Fennoscandia based on P- and S-wave receiver functions

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Fennoscandia consists of geologically distinct domains of Archaean, early and late Proterozoic and Phanerozoic age at the surface. Such heterogeneous structure is a result of a long and complex tectonic history and little is known about the interrelation of these domains at depth. Controlled-source experiments show potential expression of suture zones extending down to ∼100 km depth. Furthermore, regional studies based on receiver functions and active experiments show lithospheric interfaces, interpreted as the mid-lithospheric discontinuity (MLD), 8-degree discontinuity or the lithosphere–asthenosphere boundary (LAB), that are markers of continent formation and evolution. But each study samples a small portion of Fennoscandia and does not provide a comprehensive model for the whole system.

We use teleseismic P- and S-wave receiver functions (PRF and SRF) recorded at 398 stations from 13 temporary and permanent arrays to constrain the lithospheric structure over whole Fennoscandia. We aim at providing detailed maps of the Moho, MLD, LAB and 410-km discontinuity, test the sharpness of the LAB, and locate potential suture zones at depth. We build 2D long-range seismic images from common conversion point (CCP) stacking and apply H-K stacking on the PRF dataset to recover the crustal thickness and Vp/Vs ratio. We use a multi-mode CCP technique to avoid problems of contamination of PRF by crustal multiples. SRFs are free from crustal reverberations in the target window for studying the MLD and LAB.

By mapping the upper mantle discontinuities, we are able to: 1) understand the longevity of Caledonian orogenic signatures in the western part of Fennoscandia, 2) estimate how significantly they were affected by the lithospheric stretching related to the opening of the Atlantic Ocean and 3) capture the preexisting structure of the Proterozoic and Archaean blocks of Fennoscandia and suture zones between them.