LITHOSPHERIC STRUCTURE BENEATH FENNOSCANDIA BASED ON P- AND S-WAVE RECEIVER FUNCTIONS

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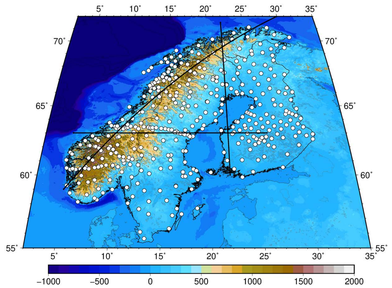
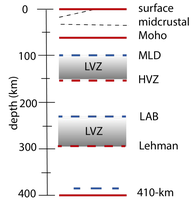
INTRODUCTION



Topography map (m); white circles are stations used in this study

Fennoscandia consists of geologically **distinct domains of Archaean,** early and late **Proterozoic** and **Phanerozoic age** at the surface. A 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. Regional studies show evidence for the mid-lithospheric (**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 [e.g. 2,3,4].



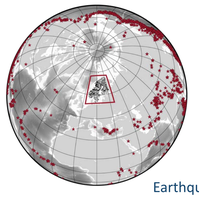
Sketch of the expected discontinuities. Red color indicates discontinuity with increase of velocity with depth, blue – decrease. MLD – mid-lithospheric discontinuity; HVZ – high velocity zone; LVZ – low velocity zone; LAB – lithosphere-asthenosphere boundary.

Our goal is to image structural differences of the upper mantle in 3 geological domains create a unified model of Fennoscandia.

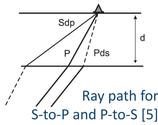
DATA & METHODS

- We use teleseismic **~14,800 P- and ~5,100 S-wave receiver functions** (PRF and SRF).
- Unlike PRFs, SRFs are free from crustal
- reverberations in the target window for studying the MLD and LAB.
- We build 2D seismic images by picking maximum and minimum amplitudes on common conversion point (CCP) stacking images
- To build maps we picked the discontinuities on 1x0.5° grid of CCP profiles, each of them was bootstrap resampled 100 times
- We locate potential expression of the suture zones at depth and show maps of:

1. **the Moho** based on SRF and PRF at 20-55 km depth,
2. **mid-lithospheric** or 8° discontinuity **(MLD)** at ~80-100 km depth – top of the low-velocity zone **(LVZ)**
3. **high-velocity zone** (HVZ) at ~150 km depth - bottom of the **LVZ**

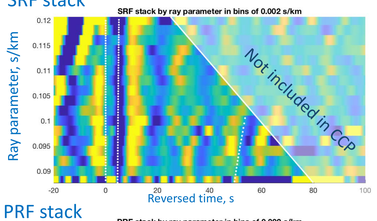


Earthquake locations used for PRF

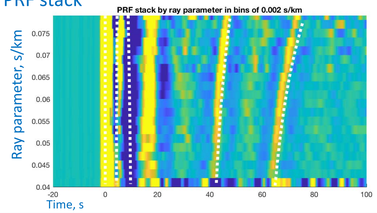


Ray path for S-to-P and P-to-S [5]

SRF stack



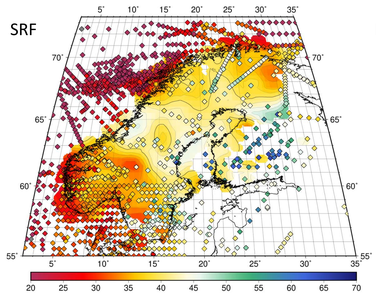
PRF stack

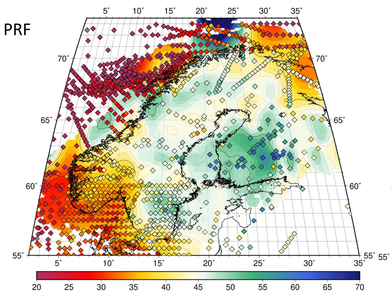


RESULTS: MAPS

Moho

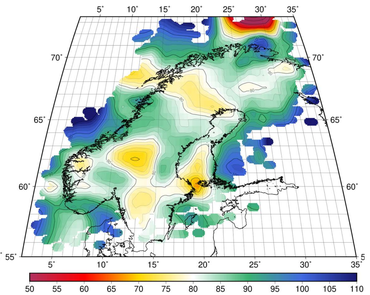
Moho depth obtained by picking (left) SRF CCP images (background color) and (right) PRF CCP images with Moho depth (background) measurements from EUNAseis [1] (diamonds)





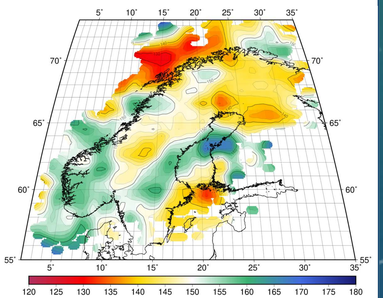
MLD

Map of the Mid-lithospheric discontinuity



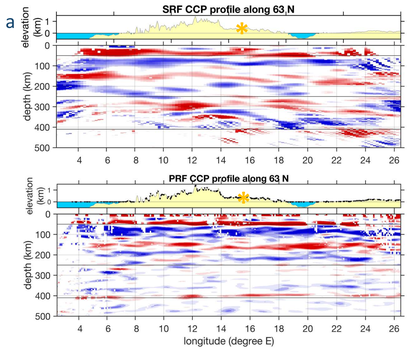
HVZ

Depths of the high-velocity zone



RESULTS: CCP stacks

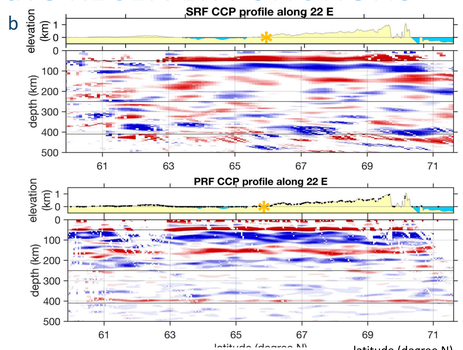
CCP STACKS OF P- & S-wave RECEIVER FUNCTIONS

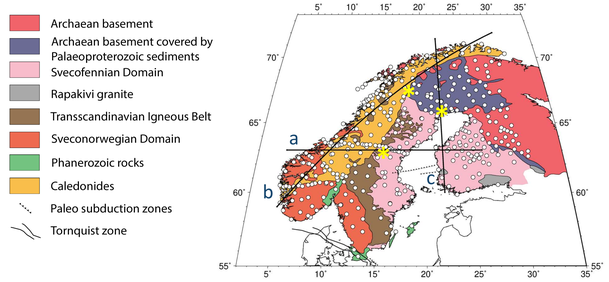


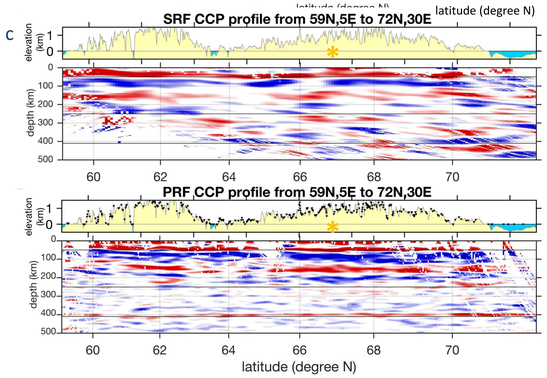
Deep structures observed in CCP stacks of SRF spatially correlate with geological boundaries on the surface:

- Caledonian Nappe over the Proterozoic basement;
- boundary between Archaean and Proterozoic domains

Similarities in SRF and PRF images allow a robust joint structural interpretation.







CONCLUSION

- We obtained S- receiver functions (SRF) for >300 stations across entire Fennoscandia
- Structures at depth imaged on CCP stacks correlate with geological boundaries
- We created maps of Moho, top and bottom of the low-velocity zone (MLD and HVZ) for Scandinavia based on SRF

For additional information about the mantle transition zone in Fennoscandia see:

Makushkina et al. (2019). The Mantle Transition Zone in Fennoscandia: Enigmatic high topography without deep mantle thermal anomaly. ***Geophysical Research Letters.*** https://doi.org/10.1029/2018GL081742

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