Seismic imaging of the newly discovered Sub-Lithospheric Discontinuity (SLD) in the larger Alpine region

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The goal of our project is the imaging of the Lithosphere-Asthenosphere Boundary (LAB) below the entire Alpine region and surroundings using the widely applied S-receiver function method which has a high potential for imaging seismic discontinuities within the upper mantle.

The S-receiver function method is one of the most used methods to study the structure of the mantle lithosphere. In a preparatory study we also used this method to study the lithosphere-asthenosphere system in the greater Alpine region using data of permanent seismic stations existing at that time (Kind et al. 2017). However, during preparation of the processing of the Alparray data we discovered that the S-receiver function method is heavily suffering from sidelobes. We found a solution for this problem by avoiding deconvolution and using the picked onset time of the SV signal as reference time. To check the new method we applied it to data sets from two large networks, the USArray and the National Chinese Network (Kind et al. 2019 and Shen et al. 2019). A result of these studies is that we could not confirm the existence of the in many papers discussed Mid-Lithospheric discontinuity (MLD, indicating a low velocity zone) neat 100 km depth in the cratonic North America. We found instead indications of a possible large scale fossil subduction below the Superior Craton which was overwhelmed by the apparent MLD observation in earlier studies. We also confirmed the so far disputed seismic observations of the cratonic Lithosphere-Asthenosphere Boundary near 200 km depth below the cratonic North America. In China we confirmed the unusual shallow location of the LAB in the North China Craton near 100 km depth and extended the same observation also to the South China Craton, which was unknown so far.

We applied the new technique already to the available data of the international Alparray project. First results indicate good observations of the Lithosphere-Asthenosphere Boundary below the eastern Alps (see attached figure). The European LAB seems to deepen from about 90 km depth below southern Germany into south-east direction to about 150 km depth below Slovenia. This is a preliminary result, we will continue working on all data in greater detail when the data collection of all temporary networks will be finished.

References

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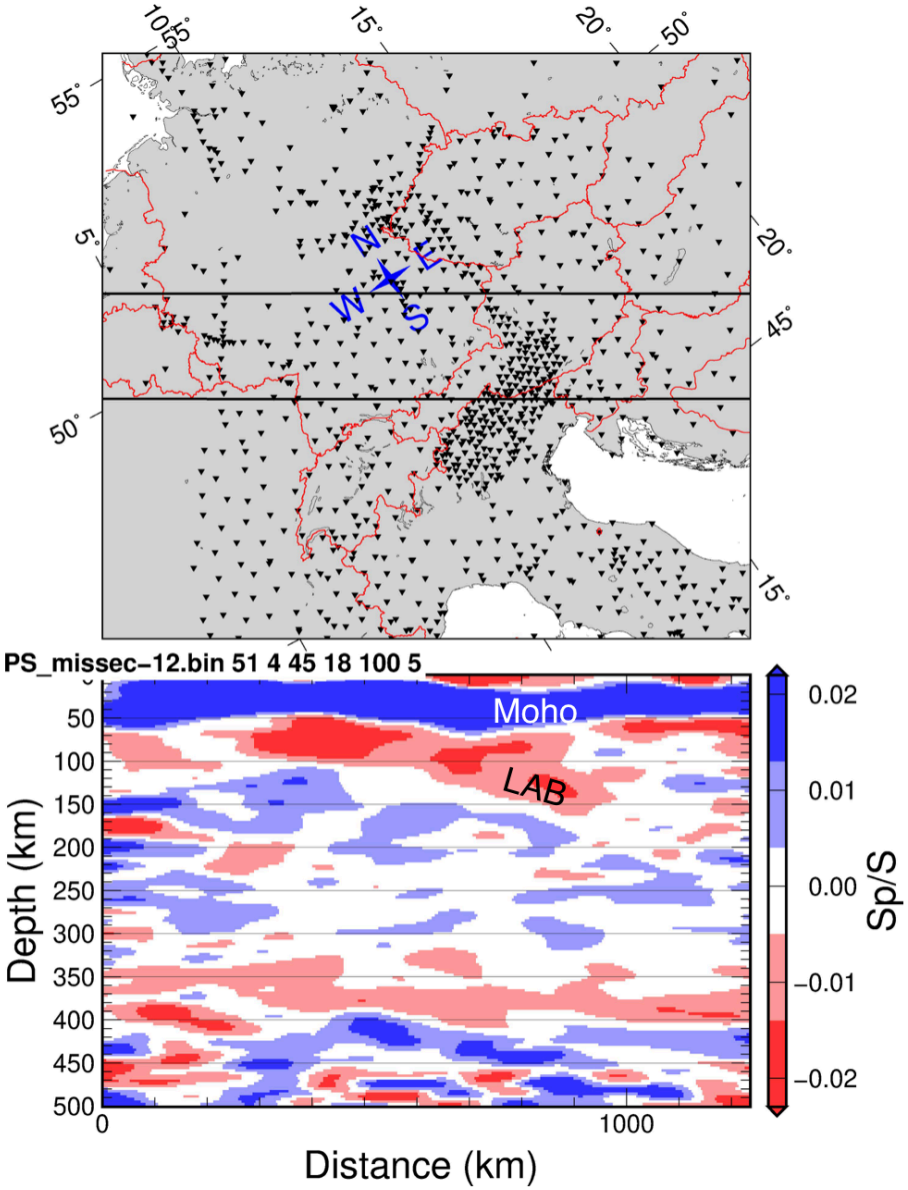

Figure Caption, Lower part: Preliminary S-receiver function data of the Alparray Project. Blue signals indicate velocity increase with depth and red signals velocity decrease with depth. The depth should be read at the lower end of the blue or red signals, not at the center. South-east dipping European lithosphere below the eastern Alps seems to be observed.
Upper part of figure: Black triangles are seismic stations used in this study. All rays travelling between the two black lines are summed to produce the profile in the lower part of the figure.