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

PI: Rainer Kind, FU Berlin, GFZ Potsdam

In a recent study (Kind et al. 2017) we examined the seismic structure of the upper mantle between the Moho and the 410-km discontinuity beneath a large part of central Europe with the S-receiver function method. We found below the north German and Polish Basin, below the Bohemian Massif and below the Pannonian Basin a negative discontinuity (velocity reduction downward, called SLD in our paper) with strong topography varying between about 150 and 300 km depth (see Figure). Such a discontinuity could perhaps be expected below a craton as lithosphere-asthenosphere boundary (LAB), but not below a phanerozoic continental region. The geological interpretation of such a structure is very difficult.

Şengör (2017) combines Hans Stille's definition of germanotype tectonics with modern plate tectonics. In this combined model, the regions of germanotype tectonics are extended plate boundary zones, with Central Europe and the western United States given as examples. The crustal structure of these zones is well known as consisting of uplifts and depressions. However, the structure of the mantle lithosphere beneath is still much less known. Our observations of a SLD in eastern central Europe indicate that the lower part of the lithosphere of the East European Craton may have penetrated during continental collision far west beyond the Tornquist-Teisseyre Zone and been strongly deformed in that process.

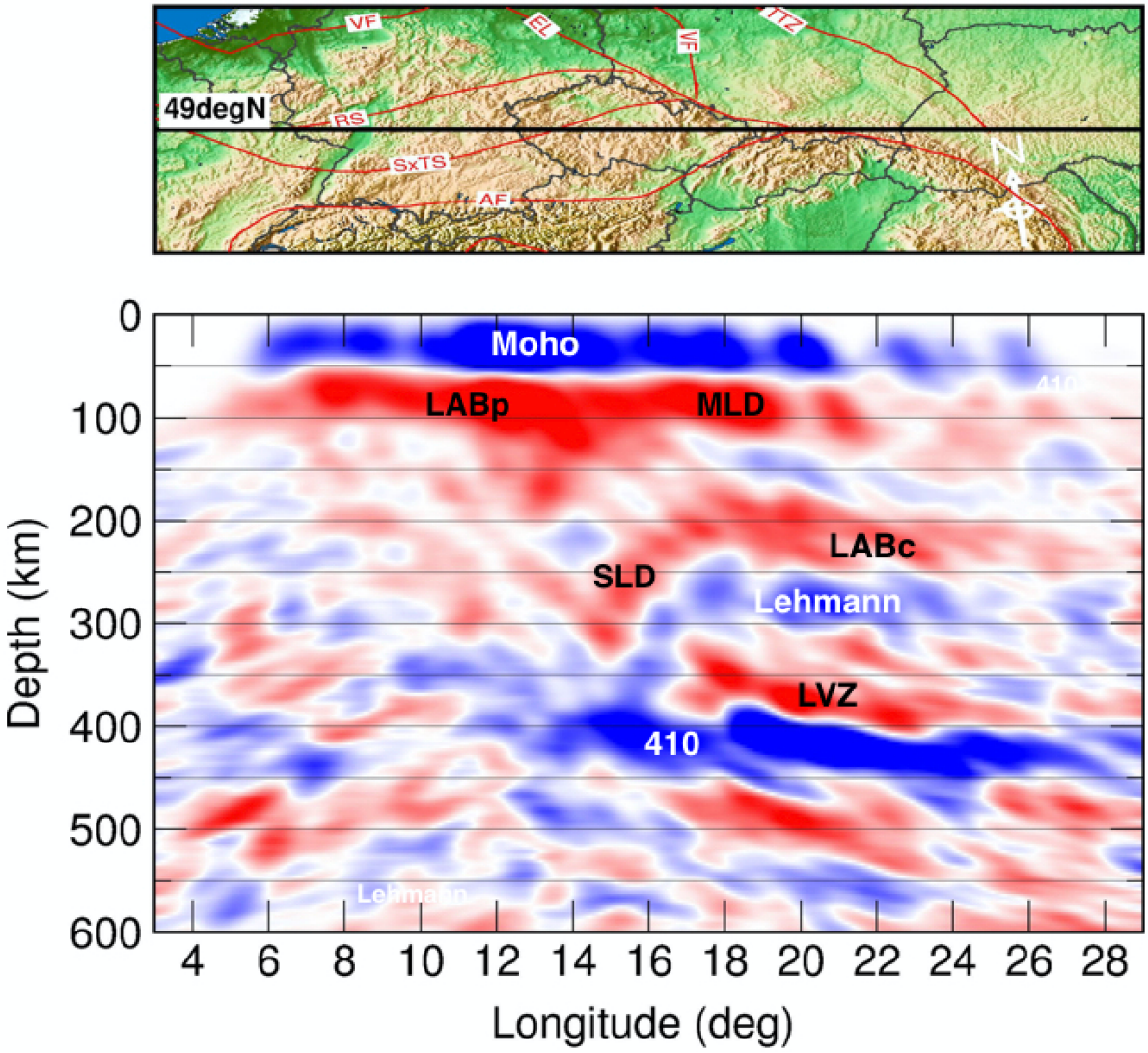
In our preparatory paper (Kind et al. 2017), we used only permanent seismic stations in the Alpine region and surroundings. We obtained very interesting images north and north-east of the Alps. The images directly below the Alps, however, remain still unclear. Therefore, our intention is to repeat this study with data from all the temporary stations operating in the present international AlpArray project.

I am cooperating with international colleagues within the Receiver Function Working Group of the AlpArray Project and am linked with Research Themes 1, 3 and 4 in the SPP.

References

Kind, R., Handy, M.R., Yuan, X., Meier, T., Kämpf, H., Soomro, R. (2017): Detection of a new sub-lithospheric discontinuity in central Europe with S-receiver functions, Tectonophysics, 700, 19-31.

Şengör, A.M.C. (2017): What has remained of Hans Stille's tectonics? Global Tectonics and Metallogeny, in press.



Caption: This figure shows an east-west S-receiver function profile through Bohemia. Blue signals are discontinuities with increasing velocity downward and red areas indicate velocity reductions downward. LABp is interpreted as the Phanerozoic lithosphere-asthenosphere boundary (LAB) in the western part of Europe, MLD is mid-lithospheric discontinuity usually observed beneath cratons and SLD (sub-lithospheric discontinuity) is the newly discovered north-west dipping discontinuity below the Bohemian Massif. LABc is the LAB of the east European craton. “Lehmann” stands for the Lehmann discontinuity, “LVZ” for a low-velocity zone on top of the discontinuity at 410 km depth, and “410” is the known discontinuity at that depth.