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Lithosphere – asthenosphere boundary (LAB) around the Trans-European Suture Zone (TESZ)

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Exploiting the long memory of the deep continental lithosphere fabric, we present the LAB as a transition between a fossil anisotropy in the lithospheric mantle and an underlying seismic anisotropy related to the present-day flow in the asthenosphere. A uniform updated model of the European LAB, recalculated from data collected during several regional studies of seismic anisotropy and other tomographic experiments (Plomerova and Babuska, 2010) is complemented by LAB depth estimates from the PASSEQ (2006-2008) field measurements, involving about 17 countries (Wilde-Piorko et al., SGG 2008).

Analysis of static terms of teleseismic P-wave travel time deviations shows that the LAB topography is more distinct beneath the Phanerozoic part of Europe than beneath its Precambrian part and deepens down to ∼220 km beneath the two Alpine roots, the South Carpathians and eastward of the Trans-European Suture Zone (TESZ), being shallowest beneath basins. The TESZ represents a distinct tectonic feature, which can be traced from north-western to south-eastern Europe in various seismic velocity tomography as well as in seismic anisotropy (Babuska et al., PAGEOPH 1998).

Modelling seismic anisotropy around the western part of TESZ (Plomerova et al., Tectonophysics 2002; Babuska and Plomerova, Terra Nova 2004) delimited there three lithospheric domains of different thickness and fabrics: (1) thick Fennoscandian lithosphere north of the TESZ, (2) the sharply bounded fragment of a thinner lithosphere between the northern (Sorgenfrei-Tornquist Zone) and southern branch (Thor Suture) of the TESZ; (3) south of the TESZ, a domain belonging to a very thin lithosphere of Avalonia. Structure of the mantle around the Teisseyere-Tornquist Zone (TT), i.e. in the central part of the TESZ, is one of the main targets of the PASSEQ seismic experiment. The suture appears there as a broad transition zone on the surface and in the mantle it separates the thick lithosphere domains of the Paleozoic platform in the west and the East European Craton in the east. Lateral variations of anisotropic parameters across the zone indicate differences in mantle lithosphere fabrics on both sides. Distinct deepening of the LAB towards the east across the TESZ is detected by different approaches of the LAB modelling, but on the other hand, it is the region where European LAB models differ substantially (Jones et al., Lithos 2010). This finding re-opens a question to which extent different methods identify the same discontinuity, though discrepancies may also reflect differences in resolution and accuracy of individual methods. On the other hand, if there are differences in a nature of the LAB, we should try to understand which physical parameters are relevant to the most important interface in the upper mantle from the plate-tectonic point of view.