Geophysical Research Abstracts
Vol. 16, EGU2014-10528, 2014
EGU General Assembly 2014

Seismic images of the upper mantle velocities and structure of European mantle lithosphere

Jaroslava Plomerova, Helena Munzarova, Ludek Vecsey, and Vladislav Babuska
Institute of Geophysics, Academy of Sciences, Prague, Czech Republic (jpl@ig.cas.cz)

Tomography images of seismic velocities in the Earth mantle represent significant tool for recovering first order structural features. Regional studies, based on dense networks of temporary stations allow us to focus on structure of the continental upper mantle and to study variations of body-wave velocities in greater detail. However, the standard tomography exhibits only isotropic view of the Earth, whose structure is anisotropic in general, as shown by results of various studies exploiting a broad range of methods, types of waves and scales.

We present results of our studies of seismic anisotropy in tectonically different provinces that clearly demonstrate the continental mantle lithosphere consists of domains with different fossil fabrics. We detect anisotropic signal both in teleseismic P-wave travel-time deviations and shear-wave splitting and show changes of the anisotropic parameters across seismic arrays, in which stations with similar characteristics form groups. The geographical variations of seismic-wave anisotropy delimit individual, often sharply bounded domains of the mantle lithosphere, each of them having a consistent fabric. The domains can be modelled in 3D by peridotite aggregates with dipping lineation a or foliation (a,c). These findings allow us to interpret the domains as micro-plate fragments retaining fossil fabrics in the mantle lithosphere, reflecting thus an olivine LPO created before the micro-plates assembled. Modelling anisotropic structure of individual domains of the continental mantle lithosphere helps to decipher boundaries of individual blocks building the continental lithosphere and hypothesize on processes of its formation (Plomerova and Babuska, Lithos 2010).

Exploiting the long memory of the deep continental lithosphere fabric, we present the lithosphere-asthenosphere boundary (LAB) as a transition between a fossil anisotropy in the mantle lithosphere and an underlying seismic anisotropy related to the present-day flow in the asthenosphere. A uniform updated model of the European LAB is recalculated from data collected during several regional studies of seismic anisotropy and other tomographic experiments. Depth of this first order discontinuity from the plate tectonic point of view varies from $\sim$220 km beneath a large portion of the Precambrian Fennoscadia and the two Alpine roots in Phanerozoic part of Europe, to $\sim$60 km beneath the Pannonian Basin or Po Plain in the south, or, the North German Platform and the Southern Scandes (southern Norway) in the north.

Integrating seismic anisotropy into tomographic approaches of imaging Earth velocity structures appears as an inevitable further step for improved modelling structure and development of the mantle lithosphere, as well as the LAB relief.