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Regional models of the upper mantle structure in the greater Alpine area

J. Plomerova, V. Babuska, L. Vecsey, H. Munzarova, and H. Karousova
Institute of Geophysics, Academy of Sciences, Prague, Czech Republic (jpl@ig.cas.cz)

Large-scale international passive seismic experiments proved their essential role in acquiring digital waveform data for studies of deep structure of the Earth, particularly of the upper mantle or specifically, of the lithosphere-asthenosphere system. The Alps developed at a collision zone of the Eurasian and African plates and their fragments, however an extensive passive seismic experiment similar to those in other European provinces has not been carried out yet. Interactions of European lithosphere with plates colliding from the south were not simple and resulted in complicated geometry of subductions in the Western and Eastern Alps, where two separated Alpine roots developed (Babuska et al., Tectonophysics 1990; Lippitsch et al., JGR 2003, Kissling et al., ELD 2006). Standard tomographic images of the velocity or velocity perturbations detect predominantly isotropic structure of the upper mantle. By evaluating large-scale seismic anisotropy of the upper mantle we can model its fabric and map in detail structure of the lithosphere-asthenosphere system. Studies of the mantle fabrics in 3D, exploiting body-wave anisotropic parameters, shed more light on development of the complex Alpine region and its surroundings.

We present isotropic and anisotropic models of the upper mantle in tectonically different provinces of the greater Alpine area, retrieved from joint inversion/interpretation of both directional terms of relative travel-time deviations of longitudinal waves and shear-wave splitting. The 3D self-consistent anisotropic models of the continental mantle lithosphere exhibit often sharply bounded domains of uniform fossil fabrics. We interpret the domain-like structure of the mantle lithosphere as representing individual continental fragments, which are able to retain their original anisotropy, which was created a long time before their assembly (Babuska and Plomerova, PEPI 2006; Plomerova and Babuska, Lithos 2010). Deciphering the structure of paleo-plates in the Alpine area requires to install sufficiently dense and uniformly spaced network of broad-band stations, which will record teleseismic earthquakes whose rays will as evenly as possible illuminate the upper mantle. We support the general consensus on combing the national efforts in imaging the Alpine crust and upper mantle, and plan to contribute to the AlpArray studies by retrieving 3D anisotropic models of the upper mantle aiming at better understanding tectonics and evolution of the region.