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Fabrics of the upper mantle and LAB model beneath the Northern Apennines

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

Evolution of the Northern Apennines has been controlled by processes of syn-convergent extension related to a roll-back of the Adriatic slab and to an extension of the Tyrrhenian back-arc basin, all driven by the slow collision of the African and European plates. We image anisotropic structure of the upper mantle beneath the Northern Apennines by analyzing teleseismic body-wave anisotropy evaluated from data collected during experiment RETREAT (2003-2006). Joint analysis of anisotropic parameters evaluated from two independent data sets – teleseismic P-wave travel times and shear-wave splitting – allows us to identify regions of different fabrics. We recognize three main regions – the Tyrrhenian, Adriatic and Transition in between. Each of these regions is characterized by its own anisotropic pattern resulting from oriented fabrics both in the mantle lithosphere and in the sub-lithospheric mantle. Beneath the thin Tyrrhenian plate, a slab-parallel flow prevails in the sub-lithospheric mantle, while nearly slab-perpendicular high velocities dominate on the other side of the region, beneath the thicker Adriatic plate. This asthenospheric-flow pattern excludes a simple corner-flow model that would fit the fabric of the upper mantle in the syn-convergent extensional tectonics and thus suggests the end of the subduction roll-back. Two domains of the continental Adriatic lithosphere are characterized by their own fossil fabric with inclined symmetry axes. We also present a model of the lithosphere-asthenosphere boundary (LAB) in the Northern Apennine region derived from careful azimuthal analysis of the static terms of the relative P-wave travel-time residuals. We estimate the lithosphere thickness of the Tyrrhenian and Adriatic plates at $\sim$50 km and $\sim$80 km, respectively, the latter being subducted down to no more than $\sim$200 km with indications of inherited frozen-in anisotropic fabric. The overall upper mantle fabric in the region indicates that if a potential detachment at the Northern Apennine slab exists then it would have to be narrow and in its initial stage.