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Tomography images of the Alpine roots and surrounding upper mantle

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Teleseismic body-wave tomography represents powerful tool to study regional velocity structure of the upper mantle and to image velocity anomalies, such as subducted lithosphere plates in collisional zones. In this contribution, we recapitulate 3D models of the upper mantle beneath the Alps, which developed at a collision zone of the Eurasian and African plates. Seismic tomography studies indicate a leading role of the rigid mantle lithosphere that functioned as a major stress guide during the plate collisions. Interactions of the European lithosphere with several micro-plates in the south resulted in an arcuate shape of this mountain range on the surface and in a complicated geometry of the Alpine subductions in the mantle. Early models with one bended lithosphere root have been replaced with more advanced models showing two separate lithosphere roots beneath the Western and Eastern Alps (Babuska et al., Tectonophysics 1990; Lippitsch et al., JGR 2003). The standard isotropic velocity tomography, based on pre-AlpArray data (the currently performed passive seismic experiment in the Alps and surroundings) images the south-eastward dipping curved slab of the Eurasian lithosphere in the Western Alps. On the contrary, beneath the Eastern Alps the results indicate a very steep northward dipping root that resulted from the collision of the European plate with the Adriatic microplate. Dando et al. (2011) interpret high-velocity heterogeneities at the bottom of their regional tomographic model as a graveyard of old subducted lithospheres. High density of stations, large amount of rays and dense ray-coverage of the volume studied are not the only essential pre-requisites for reliable tomography results. A compromise between the amount of pre-processed data and the high-quality of the tomography input (travel-time residuals) is of the high importance as well. For the first time, the existence of two separate roots beneath the Alps has been revealed from carefully pre-processed, mostly the ISC-bulletin data (Babuska et al., Tectonophysics 1990). Calculated relative travel-time residuals have been assigned to source clusters and filtered relative to the residual mean of each cluster of events. We expect that future 3D studies of the mantle velocities and mantle fabrics with the use of body-wave anisotropic parameters from the AlpArray data will shed a new light on tectonic development of the complex Alpine region and its surroundings.