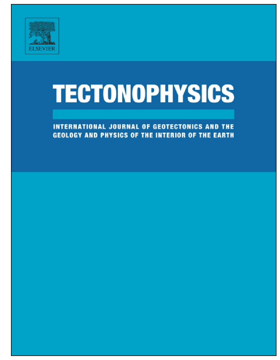

Active and fossil mantle flows in the western Alpine region unravelled by seismic anisotropy analysis and high-resolution P wave tomography

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Active and fossil mantle flows in the western Alpine region unravelled by seismic anisotropy analysis and high-resolution *P* wave tomography

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Abstract.

The anisotropy of seismic velocities in the mantle, when integrated with high-resolution tomographic models and geologic information, can be used to detect active mantle flows in complex plate boundary areas, providing new insights on the impact of mantle processes on the topography of mountain belts. Here we use a densely spaced array of temporary broadband seismic stations to analyze the seismic anisotropy pattern of the western Alpine region, at the boundary between the Alpine and Apenninic slabs. Our results are supportive of a polyphase development of anisotropic mantle fabrics, possibly starting from the Jurassic to present. Geophysical data presented in this work, and geologic evidence taken from the literature, indicate that: (i) fossil fabrics formed during Tethyan rifting may be still preserved within the Alpine and Apenninic slabs; (ii) mantle deformation during Apenninic slab rollback is not compensated by a complete toroidal flow around the northern tip of the retreating slab; (iii) the previously observed continuous trend of anisotropy fast axes near-parallel to the western Alpine arc is confirmed. We observe that this arc-parallel trend of fast axes is located in correspondence to a low velocity anomaly in the European upper mantle, beneath regions of the Western and Ligurian Alps showing the highest uplift rates. We propose that the progressive rollback of the Apenninic slab, in the absence of a counterclockwise toroidal flow at its northern tip, induced a suction effect at the scale of the supraslab mantle. The resulting mantle flow pattern was characterized by an asthenospheric counterflow at the rear of the unbroken Western Alps slab and around its southern tip, and by