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Upper mantle structure of the Alpine and Adriatic regions unraveled by high-resolution P-wave tomography

Liang Zhao (1), Anne Paul (2), Marco G. Malusà (3), Xiaobing Xu (1), Tianyu Zheng (1), Stefano Solarino (4), Stéphane Guillot (2), Stéphane Schwartz (2), Thierry Dumont (2), Simone Salimbeni (5), Coralie Aubert (2), Silvia Pondrelli (5), Qingchen Wang (1), and Rixiang Zhu (1)

(1) State Key Laboratory of Lithospheric Evolution, Institute of Geology and Geophysics, Chinese Academy of Sciences, Beijing, China, (2) Université Grenoble Alpes, CNRS, ISTerre, Grenoble, France, (3) Department of Earth and Environmental Sciences, University of Milano-Bicocca, Milan, Italy, (4) Istituto Nazionale di Geofisica e Vulcanologia, CNT, Genova, Italy., (5) Istituto Nazionale di Geofisica e Vulcanologia, Bologna, Italy

The upper mantle structure beneath the Alpine and Adriatic regions is only partly resolved by available geophysical data, leaving many geological and geodynamical issues widely open. Here, we present a new high-resolution tomography model based on P-wave data from 527 broadband seismic stations, which provides much denser and more evenly distributed coverage than any previous work. The new model provides an improved image of the upper mantle structure in the Alpine and Adriatic region, and fundamental pin-points for the analysis of Cenozoic magmatism, (U)HP metamorphism and Alpine topography. Our results document the lateral continuity of the European slab from the Western to the Central Alps, and the down-dip slab continuity beneath the Central Alps, ruling out the hypothesis of slab breakoff. The steep European slab gets flatter at ∼400 km beneath the Po Plain, where it lays below a low-velocity anomaly at mid-upper mantle depth. Another low velocity anomaly extending down to the mantle transition zone is observed beneath the highest peaks of the Western Alps, pointing to dynamic topography effects. A NE-dipping Adriatic slab, consistent with Dinaric subduction, is observed beneath the Eastern Alps, whereas the laterally continuous Adriatic slab of the Northern Apennines shows major gaps at the boundary with the Southern Apennines, and becomes near vertical in the Alps-Apennines transition zone. Tear faults accommodating opposite-dipping subductions during Alpine convergence may represent reactivated lithospheric faults inherited from Tethyan extension.