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The lithosphere-asthenosphere system of the Periadriatic region: a geophysical perspective

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We present a multiscale 3D model of the crust and upper mantle of the Periadriatic region showing how the Adriatic plate, the Northern indent of the African promontory, is involved in the Apennines, Alpine, and Dinarides subduction zones, respectively surrounding its western, northern, and eastern margins.
The model is obtained through the ensemble of cellular models expressed in terms of shear waves velocity (Vs), thickness and density of the layers, to a depth of 350 km. These physical properties are obtained by means of advanced non-linear inversion techniques, such as the "hedgehog" inversion method of group and phase velocity dispersion curves for the determination of Vs and the non-linear inversion of gravity data by means of the method GRAV3D.
The model obtained at the scale of 1°x1° is analysed along selected sections perpendicular to the orogenic complexes of the study area (Apennines, Alps, Dinarides) and it confirms the existence of deep structural asymmetries between E- and W-directed subduction zones. The asymmetry found between the almost vertical Apenninic subduction and the Alpine-Dinaric subduction, which is in turn characterized by a low dip angle, can be ascribed to an eastward mantle flow taking place in the low velocity zone (LVZ) that characterizes the top of the very shallow asthenosphere beneath the Tyrrhenian basin. The high-resolution model obtained for the Alpine region at a scale of 0.5°x0.5° enlightens the extreme variability of the crustal thickness as well the small scale heterogeneities in the upper mantle beneath the study area. The density model clearly shows that the subducting lithosphere turns out to be less dense than the surrounding mantle. A temperature model of the mantle layers is obtained by means of an advanced conversion technique of Vs to temperature that takes in account variable chemical composition and bulk water content.
The superposition of different geodynamic mechanisms in the mentioned areas is coherent with the global asymmetry of plate tectonics, evidence of polarized plate tectonics, and supports a passive origin of plate boundaries, contrary to what is usually assumed.