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Mantle dynamics in the Mediterranean

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The Mediterranean offers a unique avenue to study the driving forces of tectonic deformation within a complex mobile belt. Lithospheric dynamics are affected by slab rollback and collision of two large, slowly moving plates, forcing fragments of continental and oceanic lithosphere to interact. Here, we review the rich and growing set of constraints from geological reconstructions, geodetic data, and crustal and upper mantle heterogeneity imaged by structural seismology. We discuss a conceptual and quantitative framework for the causes of surface deformations. Exploring existing and newly developed tectonic and numerical geodynamic models, we illustrate the role of mantle convection on surface geology. A coherent picture emerges which can be outlined by two, almost symmetric, upper mantle convection cells. The down-wellings are found in the centre of the Mediterranean, and are associated with the descent of the Tyrrhenian and the Hellenic slabs. During plate convergence, these slabs migrated, driving return flow of the asthenosphere from the backarc regions. These currents can be found at large distance from the subduction zones, and are at present expressed in two upwellings beneath Anatolia and eastern Iberia. This convection system provides an explanation for the general pattern of seismic anisotropy in the Mediterranean, the first-order Anatolia and Adria microplate kinematics, and the positive dynamic topography of Anatolia and Eastern Iberia. More generally, it is an illustration of upper mantle, small-scale convection leading to intraplate deformation and complex plate boundary reconfiguration at the westernmost terminus of the Tethyan collision.