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Spatial Correlation between Intraplate Volcanism and Thin Lithosphere in the Circum-Mediterranean: New Evidences from Surface Wave Tomography and Thermomechanical Modelling

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During the Cenozoic, the Circum-Mediterranean and its periphery have experienced extensive and widespread anorogenic igneous magmatism that reflects the response of the upper mantle to the geodynamic evolution of this area. The exact origin of the volcanic activities and its relation to the underlying thin lithosphere especially in the continental areas have been long-lasting debated. We investigate the structure of the Mediterranean lithosphere and the sub-lithospheric mantle by surface waves that are mainly sensitive to the 3-D S-wave velocity structure at those depths. A high-resolution tomographic study based on automated broad-band measurements of inter-station Rayleigh wave phase velocities down to about 300 km depth is presented. We identify shallow asthenospheric volumes, characterized by low S-wave velocities between about 70 km and 250 km depth, and distinguish between five major shallow asthenospheric volumes in the Circum-Mediterranean: the Middle East, the Anatolian-Aegean, the Pannonian, the Central European, and the Western Mediterranean Asthenosphere volumes. Remarkably, they form an almost continuous circular belt of asthenospheric areas interrupted only by the thick Permo-Carboniferous oceanic lithosphere in the eastern Mediterranean.

Integrated thermochemical modelling using surface wave phase velocities, topography, and heat flow as constraints indicates a remarkable variability of the lithospheric thickness across the area. Thick lithosphere is found in the Paris Basin, the East European Craton, and the eastern Mediterranean whereas thin lithosphere is found in areas of pronounced negative shear-wave anomalies at depth between 70 km and 200 km. Cenozoic intraplate volcanic fields are located in areas with thin lithosphere underlain by shallow asthenosphere. Thus, anorogenic intraplate volcanism in the Circum-Mediterranean appears to be associated with thin and hot lithospheric regions and low S-wave sublithospheric velocities. The distribution and properties of the shallow asthenosphere volumes in the region are discussed and related to the spatial-temporal occurrence of intraplate as well as subduction related volcanism in the western Mediterranean,

central Europe, the Pannonian Basin, the Anatolian region and the Middle East.