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3D Integrated geophysical-petrological modelling of the Iranian lithosphere

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The present-day Iranian Plateau is the result of complex tectonic processes associated with the Arabia–Eurasia Plate convergence at a lithospheric scale. In spite of previous mostly 2D geophysical studies, fundamental questions regarding the deep lithospheric and sub-lithospheric structure beneath Iran remain open. A robust 3D model of the thermochemical lithospheric structure in Iran is an important step toward a better understanding of the geological history and tectonic events in the area. Here, we apply a combined geophysical-petrological methodology (LitMod3D) to investigate the present-day thermal and compositional structure in the crust and upper mantle beneath the Arabia–Eurasia collision zone using a comprehensive variety of constraining data: elevation, surface heat flow, gravity potential fields, satellite gravity gradients, xenoliths and seismic tomography. Different mantle compositions were tested in our model based on local xenolith samples and global data base averages for different tectonothermal ages. A uniform mantle composition fails to explain the observed gravity field, gravity gradients and surface topography. A tectonically regionalized lithospheric mantle compositional model is able to explain all data sets including seismic tomography models.

Our preliminary thermochemical lithospheric study constrains the depth to Moho discontinuity and intra crustal geometries including depth to sediments. We also determine the depth to Curie isotherm which is known as the base of magnetized crustal/uppermost mantle bodies. Discrepancies with respect to previous studies include mantle composition and the geometry of Moho and Lithosphere-Asthenosphere Boundary (LAB). Synthetic seismic Vs and Vp velocities match existing seismic tomography models in the area. In this study, depleted mantle compositions are modelled beneath cold and thick lithosphere in Arabian and Turan platforms. A more fertile mantle composition is found in collision zones. Based on our 3D thermochemical model we propose a new scenario to interpret the geodynamical history of area. In this context the present-day central Iran block would be as remain of the older and larger Iranian block present before the onset of Turan platform subduction beneath the Iranian Plateau. Further analysis of sub-lithospheric density anomalies (e.g., subducted slabs) is required to fully understand the geodynamics of the area.