Thetys subduction and continental collision imaged by magnetic and gravity modelling

Vahid Teknik [1,2], Abdolreza Ghods [1], Hans Thybo[3,4], Irina M. Artemieva [2]

[1]Institute for Advanced Studies in Basic Sciences, Department of Earth Sciences, Zanjan, Iran.

[2]University of Copenhagen, Department of Geosciences and Natural Resource Management, Copenhagen, Denmark.

[3]Eurasia Institute of Earth Sciences, Istanbul Technical University, Istanbul, Turkey, h.thybo@gmail.com

[4]Centre for Earth Evolution and Dynamics, University of Oslo, Oslo, Norway.

Subduction of the Paleo-Thetys and Neo-Thetys oceans and related collisions led to the formation of several magmatic arcs and sedimentary basins within the Himalayan-Alpine belt. The related structures are mostly separated by thrust faults that correspond to ancient suture zones and they are highlighted by ophiolites. Identification of Thetys-related magmatic arcs and ophiolite belts is impeded by sediment cover and overprint of a different magmatic phase from the Late Triassic to recent Quaternary.

We identified in the Iranian Plateau the known magmatic arcs, such as the Urmia Dokhtar Magmatic Arc (UDMA), and unknown sediment-covered magmatic arcs by aeromagnetic data. Our new map of average susceptibility calculated by the radially averaged power spectrum method displays a high average susceptibility at known Magmatic-Ophiolite Arcs and a low average susceptibility at known sedimentary basins such as Zagros, Makran, Kopeh dagh, Tabas. We identified hitherto unknown sedimentary basins based on a low average susceptibility We also identified unknown parallel Magmatic-Ophiolite Arcs in eastern Iran and the SE part of UDMA which both indicate steeply dipping (>60º dip) paleo-subduction zones. In contrast, we interpret shallow subduction (<20º dip) of the Neo-Tethys in the NW part of UDMA and the Sabzevar-Kavir MOA.

We present a new 2D crustal-scale model of the NW Iranian plateau based on gravity-magnetic modelling constrained by receiver functions along the 500 km long CIGSIP (China-Iran Geological and Geophysical Survey in the Iranian plateau) seismic profile across major tectonic provinces of Iran from the Arabian plate to the South Caspian Basin (SCB). Our 2D crustal model shows significant variations in sedimentary thickness, Moho depth and the depth and extent of intracrustal interfaces. The Main Recent Fault (crustal suture) between the Arabian crust and the overriding Central Iran crust dips at ~13° towards the NE to a depth of ~40 km, and its geometry suggests ~150 km of underthrusting of the Arabian plate beneath Central Iran. Our model indicates the presence of a high-density lower-crustal layer beneath Zagros.

We identified a new crustal-scale suture beneath the Tarom valley between the South Caspian Basin crust and Central Iran and the Alborz. This suture is associated with sharp variations in Moho depth, topography and magnetic anomalies and the presence of a 20 km thick high-density crustal root at 35-55 km depth to the north of the suture. The high density lower crust in Alborz and Zagros may be related to partial eclogitization of a crustal root. Our 2D crustal density model does not support Airy isostasy along the profile, in particular around the Tarom valley. Our model does not support an oceanic origin of the southern South Caspian Basin (SCB) but rather suggests a highly extended continental crust along our

profile.