EGU23-9427
EGU General Assembly 2023

How did tectonics shape the Zagros Collisional Zone? Insights from data observations and numerical models

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The Zagros Mountains were formed in the Late Paleogene by the collision of the northern margin of the Arabian platform with the microplates of central Iran, after the closure of the Neotethys ocean. This fold-and-thrust belt extends in a NW-SE direction from eastern Turkey to the Makran subduction zone in southeastern Iran. The complex deformation of this collisional zone resulted in several parallel tectonic structures. From SW to NE, the Zagros belt can be divided into three elongated zones: the Zagros Fold and Thrust Belt (ZFTB), the Sanandaj–Sirjan Metamorphic Zone (SSZ), and the Urumieh–Dokhtar Magmatic Arc (UDMA). At NE, the ZFTB is bounded by an active thrust fault, the Main Zagros Thrust (MZT), which is considered a suture zone between the Arabian and Iranian plates.

In this study, conducted as part of the PRIN 2017 project, we analyze several types of recently acquired data, such as seismic tomography models of the crust and upper mantle, Moho depth, obtained from the inversion processes for *Vs* models [1], Curie point depth [2], derived from magnetic anomaly inversion, seismiciy distribution from the most updated seismic databse [3], and surface topography. Sharp lateral changes in velocities/temperatures occur at depths of ~100 km along the SSZ, where the crust reaches its greatest thickness (~60 km). These changes in deep structures are accompanied by a transition from high-frequency to smoother surface topography and an abrupt decrease in seismicity along the MZT. Velocity/temperature anomalies also allow identification of along-strike variations in the inclination of the subducting plate in the different sectors of the Zagros Collisional Zone: shallower in the northwest and steeper with possible slab detachment in the central part of the orogen. Looking at the transects perpendicular to the Zagros belt, the differences between the northwestern and central segments are also evident in the profiles of the surface topography and the distributions of the seismic events. We attribute these observations to the relamination process (i.e., the detachment of the Arabian crust from the subducting lithospheric mantle and its underthrusting beneath the crust of the overriding plate), which evolves to varying degrees along the Zagros belt, as it is controlled by the variable geometry of the subducting slab. To test this hypothesis, we use the numerical code I2VIS [4] to perform a series of numerical experiments that simulate the relamination process that occurs during the collisional phase, following subduction of an oceanic slab between two continents. We explore the influence of different convergence rates and slab dip angles on the final shape, viscosity structure, and topography of the orogen and compare the modelling outcomes with the available observations in the Zagros Collisional Zone. Finally, in order to verify the consistency of the results, the static gravity field of the modelled structures was forward modelled and compared with the present-day observed gravity.

References

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