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Crustal structure and evolution of the NW Zagros Mountains (Iran): Insights from numerical modeling of the interplay between surface and tectonic processes

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Protracted Arabia-Eurasia convergence resulted in the closure of the >2000 km wide Neo-Tethys Ocean from early Late Cretaceous to Recent. This process was controlled by the structure of the NE margin of the Arabian plate, the NE-dipping oceanic subduction beneath Eurasia, the obduction of oceanic lithosphere and the collision of small continental and volcanic arc domains of the SW margin of Eurasia. The evolution of the Zagros Amiran and Mesopotamian foreland basins is studied in this work along a ∼700 km long transect in NW Zagros constrained by field, seismic and published data. We use the well-defined geometries and ages of the Amiran and Mesopotamian foreland basins to estimate the elastic thickness of the lithosphere and model the evolution of the deformation to quantitatively link the topographic, tectonic and sedimentary evolution of the system. Modelling results show two major stages of emplacement. The obduction (pre-collision) stage involves the thin thrust sheets of the Kermanshah complex together with the Bisotun basement. The collision stage corresponds to the emplacement of the basement duplex and associated crustal thickening, coeval to the out of sequence emplacement of Gaveh Rud and Imbricated Zone in the hinterland. The geodynamic model is consistent with the history of the foreland basins, with the regional isostasy model, and with a simple scenario for the surface process efficiency. The emplacement of Bisotun basement during obduction tectonically loaded and flexed the Arabian plate triggering deposition in the Amiran foreland basin. The basement units emplaced during the last 10 My, flexed the Arabian plate below the Mesopotamian basin. During this stage, material eroded from the Simply Folded belt and the Imbricated zone was not enough to fill the Mesopotamian basin, which, according to our numerical model results, required a maximum additional sediment supply of 80 m/Myr. This additional supply had to be provided by an axial drainage system, which can be correlated by the income of paleo-Tigris and paleo-Eufrates rivers transporting sediments from north-westernmost areas.