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The Zagros fold-thrust belt : constraints on timing and mountain building

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The Zagros Mountains form a broad orogenic domain, approximately 2000 km long, in front of the Turkish-Iranian plateau. Its position at the crossroad between Tibet, Africa and the Mediterranean region and its development at times of Tertiary climatic changes make the Zagros fold-belt an exceptional site to study the drivers of global climate changes associated with Africa-Arabia/Eurasia plate convergence. The Zagros fold belt is also particularly well-known for its remarkable large fold train. In this study, we review the recent findings on the Zagros geology as well as the timing and mechanical model constraints on the Zagros mountain building.

According to recent magnetostratigraphic dating of the Zagros foreland-basin deposits, collision-related folding of the Arabian margin started ca. 13.9 Ma. U-Th(He) thermochronological data provided consistent age for thrusting in the High Zagros. Because facies/sedimentological studies reveal that the first conglomeratic formation of this age (Bakhtyari Formation) were deposited below sea level, the onset of Zagros uplift together with the southern Iranian Plateau uplift now at $\sim$2000 m asl should necessarily be younger than 13.9 Ma. The latest major erosional-depositional event, roughly dated between 3 Ma to 0.8-0.5 Ma, is outlined by the deposition of conglomerates overlying unconformably the folded cover. In the Fars region river network is characterized by a lack of evidence for transverse rivers cutting through folds. This particular drainage pattern suggests that rivers are strongly controlled by the folds growth.

The present-day shortening rates of $\sim$7 mm/Myr across the Zagros, with the minimum age constraints of 13.9 Ma predict $\sim$97 km of total shortening. However, less than half, i.e. 17-45 km can be reconstructed from balanced cross-sections. This could be explained by assuming that shortening was accommodated, for instance, by underplating beneath the Iranian plate or the Iranian plateau. Cover folding appears superimposed on a larger wavelength of $\sim$200 km, which outlined the Zagros wedge topography. The low mean topographic slope of 0.5° was proposed to be the result of the fast propagation of a thin-skinned wedge sliding over a weak basal décollement. But recent modeling, supported by seismotectonic studies, suggested that it can be alternatively reproduced by a thick-skinned brittle-ductile wedge involving the whole crust. Lack of thrust fault associated with Zagros folding suggested that buckling might be dominant mechanisms of folding. Numerical models demonstrate that the multi-layered character of the sedimentary cover has a fundamental importance.

To understand better the timing of the different wavelengths of the topography, further dating of foreland-basin deposits, exhumation history of the hinterland and additional dating of Pleistocene and holocene terraces are necessary.