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Vertical movements and Cenozoic propagation of the deformation in the Zagros belt: insights from sections balancing and detritial low temperature thermochronology (AHe and ZHe)

Jean-Christophe Wrobel-Daveau (1,2), Jean-Claude Ringenbach (2), Geoffrey M. H. Ruiz (3), Finlay M. Stuart (4), and Dominique Frizon de Lamotte (1)

(1) Université de Cergy-Pontoise, Géosciences et Environnement, F95 000 Cergy-Pontoise, France., (2) TOTAL, Département d'interprétation structurale et sédimentaire, CSTJF,, (3) IMG, University of Lausanne, Switzerland., (4) Isotope Geosciences Unit, SUERC, East Kilbride G750QF, UK

The Zagros collision Belt, located at the Arabian-Eurasian plates boundary, has been widely studied during the last 15 years. In the Zagros collision Belt, the first deformation in the Arabian sedimentary pile is recorded in the late Cretaceous and related to the emplacement of the Neotethyan oceanic units over the northeastern rim of the plate. The main shortening stage takes place after the onset of collision around 35 Ma. However, the calendar of the propagation of the deformation and its magnitude through time since 35 Ma are still ill-constrained by quantitative methods.

This study combines structural analysis (crustal-scale sections from the back-stop to the foreland) and low temperature thermochronology (AHe and ZHe) in the Lurestan and Izeh-Dezful domains, in order to constrain the timing of vertical movements (burial depths and exhumation ages). Samples come from Paleogene flysch and Mio-Pliocene molasse in the Arabian platform domain, but also from Tertiary flysch in the crush zone (Lurestan) and from a diorite massif in the Sanandaj-Sirjan Zone (SSZ).

To the north of the Dezful-Izeh section, a combination of AHe and ZHe allows constraining a rapid exhumation rate (∼0,42mm/y) of the upper plate (SSZ) during the Eocene. In the High Zagros, south of the Main Zagros Thrust, the structural style is dominated by the activation of the Hormuz salt basal décollement. Southward the tectonic style is more complex due to the presence of multiple décollements. AHe ages in the outer part of the simply folded belt (SFB) show the activation of the frontal basement thrust (Main Frontal Fault, MFF after 2-3 Ma.

In the Lurestan, the structure of the Kermanshah Crush Zone (KCZ) illustrates the stacking of nappes during the late Cretaceous "obduction" and by 35 Ma (collision phase). AHe ages in the KCZ suggest its underthrusting beneath the SSZ between 16 and 12 Ma and subsequent exhumation caused by imbrications of lower crust sheets at depth that occurs after 12 Ma.
In the Paleocene flysch, reset AHe ages to the north of the SFB, partially reset AHe ages in the central SFB and partially reset AHe ages in the Mio-Pliocene molasse south of the MFF indicate a differential sedimentary load of the syn-orogenic sequences so as partial unroofing. In the north of the SFB, the progressive southward decrease of the fold wavelength and AHe ages permit to propose a southward "up-section" propagation of the deformation in the sedimentary pile by 12 Ma, followed by the activation of the frontal basement thrust after 6 Ma. The propagation of this thick-skined event in the sedimentary cover allows the development of longer wavelengths folds at the front of the Lurestan. Finally, south of the MFF, AHe ages in the Mio-Pliocene molasse suggest a reactivation of former Cretaceous graben after 2-3 Ma, forming the current deformation front.

We propose a geodynamic step by step forward reconstruction of the Cenozoic deformation, based on the new elements partly exposed above and on existing studies.