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Growth of the Zagros Fold-Thrust Belt and Foreland Basin, Northern Iraq, Kurdistan

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The Zagros orogenic belt in the Middle Eastern segment of the Alpine-Himalayan system is among the youngest seismically active continental collision zones on Earth. However, due to diachronous and incremental collision, the precise ages and kinematics of shortening and deposition remain poorly understood. The Kurdistan region of the Zagros fold-thrust belt and foreland basin contains well-preserved Neogene wedge-top and foredeep deposits that include clastic nonmarine fill of the Upper Fars, Lower Bakhtiari, and Upper Bakhtiari Formations. These deposits record significant information about orogenic growth, fold-thrust dynamics, and advance of the deformation front. Thermochronologic and geochronologic data from thrust sheets and stratigraphic archives combined with local earthquake data provide a unique opportunity to address the linkages between surface and subsurface geologic relationships. This research seeks to constrain the timing and geometry of exhumation and deformation by addressing two key questions: (1) Did the northwestern Zagros fold-thrust belt evolve from initial thin-skinned shortening to later thick-skinned deformation or vice-versa? (2) Did the fold-thrust belt advance steadily under critical/supercritical wedge conditions involving in-sequence thrusting or propagate intermittently under subcritical conditions with out-of-sequence deformation? From north to south, apatite (U-Th)/He ages from the Main Zagros Thrust, the Mountain Front Flexure (MFF), and additional frontal thrusts suggest rapid exhumation by $\sim$10 Ma, $\sim$5 Ma, and $\sim$8 Ma respectively. Field observations and seismic sections indicate progressive tilting and development of growth strata within the Lower Bakhtiari Formation adjacent to the frontal thrusts and within the Upper Bakhtiari Formation near the MFF. In the Kurdistan region of Iraq, a regional balanced cross section constrained by new thermochronometric results, proprietary seismic reflection profiles, and earthquake hypocenters suggest prolonged thin-skinned shortening in sequence from north to south followed by a thick-skinned out-of-sequence MFF deformation and intermittent hinterland uplift postdating initial collision. Magnetostratigraphic analyses of Dinarta wedge-top deposits and Kifri foredeep deposits constrain accumulation of the Upper Fars-Lower Bakhtiari synorogenic succession to 12.5–5 Ma. These findings suggest that temporal and spatial shifts in upper-crustal modes of deformation in the Kurdistan segment of the Zagros orogenic belt strongly influenced patterns of topographic growth, landscape development, and resulting foreland basin stratigraphy.