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Geometry of foreland structures in the Himalayas and the Zagros

Ishtiaq A. K. Jadoon
Department of Environmental Sciences, COMSATS Institute of Information Technology, Abbottabad

Foreland structures are sites of the world's most prolific oil and gas fields in compressional structural settings. The structures, however, may have variable geometry with the presence and absence of a thrust fault at the mountain front. Understanding the geometry of these structures through balanced cross-sections provide solutions to many of the questions related to their evolution and hydrocarbon exploration. Regional balanced sections across the Himalayan foreland in the northern and western part of Pakistan suggest thin-skinned deformation with a mechanically weak decollement immediately above the basement. The cross-section across the central Salt Range/Potwar Plateau in northern part of Pakistan shows presence of a thrust fault, exceeding displacement of about 20 km. The thrust sheet has a flat-ramp-flat geometry extending over about 90 km and riding over a cushion of EoCambrian evaporites. The trailing edge of the thrust sheet is imbricated to form oil-field structures comprising fault-related folds, triangle zones, and pop-up structures. A section across the eastern Salt Range/Potwar Plateau exhibits a set of fault-related anticlines with relatively distributed shortening.

The Sulaiman fold belt along the western margin of the Indian plate does not show the presence of any exposed thrust at the mountain front. It exhibits folds-and-thrust structures in the form of broad detachment anticlines at the mountain front that are transformed into a passive-roof duplex geometry further north. Active seismicity along two linear belts and tectonic geomorphology in the Sulaiman fold belt is indicative of active mountain front and the out-of-sequence thrusting. Similarly, selected structures from the Zagros and its foreland are recognized to represent fold-and-thrust and duplex structures. Variation in structural geometries is influenced by the stratigraphy and mechanics of thrusting. Balanced cross-sections serve as a tool to resolve geometry of foreland structures for hydrocarbon exploration.