Structural Modeling in the Kirthar Fold Belt of Pakistan: From Seismic to Regional Scale

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ABSTRACT

The Kirthar Fold Belt is part of the lateral mountain belts in Pakistan linking the Himalaya orogeny with the Makran accretionary wedge. This region is deforming very obliquely, nearly parallel to the regional plate motion vector. Neither the deep structural architecture nor many aspects of the complex deformation are well understood. In order to support exploration lead maturation and lower risk elements, structural cross-sections have been constructed that take into account as many constraints as possible. The workflow is comprised of: 1) early structural modelling of newly acquired 2D Pre-stack depth migrated seismic, including velocity modelling, 2) surface geological constraints from maps and remote sensing, 3) constraints from the regional to local setting (tectonostratigraphic evolution, mechanical stratigraphy, etc.). The frontal part of the central Kirthar Fold Belt is dominated by folding. Large thrusts with major stratigraphic repetitions are not observed. The regional structural elevation rises from the foreland across the frontal Kirthar Fold Belt towards the hinterland (Khuzdar area), indicating basement involvement in deformation. The large surface anticlines are best described as detachment folds that have been uplifted slightly by transpressive basement deformation underneath. Towards the foreland, deformation is apparently more hard-linked and involves fault-propagation folding and a small triangle zone in Cretaceous sediments. Shortening from section balancing is on the order of 21-24% for the frontal structures. Several weak stratigraphic horizons act as intermediate decollement levels and are responsible for partly disharmonic folding and smaller scale structures like secondary (parasitic) folds. Overall, the N-S structural trend of the frontal folds of the central Kirthar Fold belt is sub-parallel to north-directed plate motion and can best be explained by effective strain partitioning towards the hinterland. A new consistent structural model for the central Kirthar Fold Belt has been defined and can now been tested in future exploration. Early cross-discipline integration of constraints in the workflow substantially improved understanding of the structural architecture and helped to de-risk the large anticlinal trap prospect.