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Inversion controlled deformation in a highly oblique collision zone: Linked thick-skinned - thin-skinned deformation in the Central Kirthar Fold Belt, Pakistan

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The Kirthar Fold Belt is part of the lateral collision zone in Pakistan linking the Makran accretionary wedge with the Himalaya orogeny. The region is deforming very obliquely, nearly parallel to the regional S-N plate motion vector, indicating strong strain partitioning. In the Central Kirthar Fold Belt, folds trend roughly N-S and their structural control is poorly understood. We use newly acquired 2D seismic data with pre-stack depth migration, published focal mechanisms and structural modelling with restoration and balancing to constrain the structural architecture and kinematics.

The Central Kirthar Fold Belt is controlled by Pliocene to recent inversion of Mesozoic rift related normal faults. Focal mechanisms indicate dip-slip faulting on roughly N-S trending faults with angles in the order of 45°, too steep for newly initiated faults. Strike-slip faults dominate towards the hinterland. The inverting faults do not break straight through the thick sedimentary column of the post-rift and flexural foreland. Instead, the inversion movements links with a series of detachment in the sedimentary cover, progressively imbricating the former footwall of the normal fault. Due to the presence of a thick incompetent upper unit (Eocene Ghazij shales) these imbricates develop as passive roof duplexes. Finally, the youngest footwall shortcut links with a major decollement and the deformation propagates to the deformation front, forming a large fault-propagation fold. Calculated shortening is in the order of 20% for most of the sections worked on.

The structural evolution of the recent Central Kirthar fold belt is a genuine example of paleogeographic control on deformation: The complex tectonostratigraphy (rift, post rift, flexural foreland) with strong E-W gradients defines the mechanical stratigraphy, which in turn controls the complex thin-skinned deformation. The locations and sizes of the former rift faults controls the location and orientation of the major folds.