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# Geometry And Evolution Of Gravity Collapse Fault Structures In Mangala Field, Barmer Basin

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## ABSTRACT

Mangala field located in the Northern Barmer Basin is one of a series of reactivated tilted fault blocks. Discovered in 2004, it was among one of the significant global discoveries of the decade. The field is bounded to the north and west by intersecting near-perpendicular rift faults and has strong dip closure to the south east. The reservoir dips to the southeast at a consistent 9 degrees. The crest of the field is offset by a series of low angle listric “scoop” faults affecting the top of producing Fathegarh Formation and the overlying Barmer Hill Formation.

The scoop faults are mapped using the Seismic data across the crest of the field. These are interpreted to have developed in response to gravity instability due to the local topography created during the late palaeocene- early Eocene rifting. Gravitational collapse structures from the North Sea Brent and Statfjord Fields are used as analogues. With the development of the field, more than 300 wells have been drilled and a significant number of them pass through the gravity collapse faults. Multiple seismic data including high resolution 3D has also been acquired over the area which allowed detailed mapping of the faults and improved the understanding of the geometry and evolution of the gravity collapse faults in the Mangala field. It also provides an excellent opportunity to compare and contrast the geometry and evolution style with the published models from the North Sea.

Statjford field in the Norwegian North Sea, one of the best studied subsurface gravity collapse datasets (Hesthammer and Fossen., 1999; Welbon et al., 2007), indicates development of gravity collapse complex in response to the middle- late Jurassic rifting, which caused major uplift and tilting creating considerable local topography across the main rift faults. The gravity collapse faults initiated during a period of non-deposition associated with erosion and local reworking of the sediments from the topographic highs. The earlier phases of gravity collapse initiated as shallow listric faults within the youngest sediments. Subsequent movement along the rift fault exposed the deeper sediments to gravitational instabilities initiating new break-away zones deeper in the Stratigraphy. The later faults had steeper geometry and cross-cut the early faults. Rifting ceased at end Jurassic followed by thermal subsidence resulting in a blanket shale deposition over the structures.

In contrast to the North Sea, rifting in Barmer Basin initiated in the Palaeocene and continued till early Eocene with movement recurring in multiple pulses coupled with continuous sedimentation in a lacustrine setting. This resulted in a different geometry of the gravity collapse structures. The initial phase of rifting in Mangala occurred in upper Fatehgarh- lower Barmer Hill time resulting in tilting of the fault block and creation of significant topographic variations at the upthrown block. Gravitational instabilities resulted in rigid block slides along listric fault planes effecting Upper Fatehgarh and lower Barmer Hill formation. Deposition continued in a lacustrine setting before rifting reactivated the main boundary fault again in Upper Barmer-Hill time, during which gravitational instabilities renewed and subsequent phase of gravity collapse faulting occurred. In contrast to the North Sea model, later phase of gravity collapse faults in Mangala initiated from a shallow depth,

parallel to the previous faults and extend to younger stratigraphy deposited after the first phase of gravity collapse. Gravitational slides also created additional accommodation space in the downthrown sides of the slides resulting in deposition of thicker sediments.

This study helped in building a robust structural model for Mangala Field which is being used for field development planning of Mangala Barmer Hill Formation.