

Fractures evaluation of Samana Suk Formation and Sakessar Limestone on Mala Khel Anticline: Implications for hydrocarbon reservoir potential of central Surghar Range, Trans-Indus Ranges, Northwest Pakistan

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Abstract

Mala Khel overturned Anticline is prominently exposed and preeminent structural feature located towards frontal flank as a décollement related detachment fold in the central Surghar Range, Trans-Indus Ranges, north Pakistan. The Mala Khel Anticline is laterally extended for several kilometers along strike and nearly five kilometers along widthwise and comprised of strata ranging in age from Jurassic to Siwaliks. Eocene strata of the overturned forelimb of the anticline are thrust along the frontal ramp over the Chinji Formation of Siwaliks. The Jurassic sequence is constructing the centre of the fold where the oldest rocks of Datta Formation are exposed in the core of this anticline. Tectonically induced secondary and diagenetically formed primary fractures are well developed in the Samana Suk Formation of Jurassic and Sakessar Limestone of Eocene throughout this anticlinal cluster. The tectonically induced compressional, tensional and occasionally trans-tensional fractures are mostly regular in their orientations while diagenetic fractures are irregular in the form of semi-spherical to spherical burrows, elongated, rough and beds parallel to oblique openings. The Samana Suk Formation is dominantly comprised of the compressional and tensional fractures whereas the Sakessar Limestone is additionally comprised of circular, irregular openings of diverse orientations. Most of the transverse and longitudinal fractures in the Samana Suk Formation are formed at high angles to bedding and reveals two to three discrete preferred orientation sets. In the outcrop exposure some of the fractures are subsequently filled by the combination of calcite, clay and quartz cements in the form of veins in Samana Suk horizon conversely, most of the fractures in the Sakessar Limestone are closely spaced, unfilled and of wide apertures mounting probability of hydrocarbon flow and reservoir potential of the area. Variation in fractures orientations, their structural position on anticline of both formations reflects the progression of fold growth history related to ramp-flat trajectory from the basal detachment horizon. Structural geometry of anticline and frontal thrust fault of the central Surghar Range reveals south verging structural style protrudes southward upon the Punjab Foredeep in the south.