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Integrated Petrographical, Petrophysical and Geomechanical Assessment of Fault-Seal in an Onshore Carbonate Reservoir in Abu Dhabi, UAE

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ABSTRACT

In the carbonate reservoirs of Onshore Abu Dhabi, fault seals can be developed by diagenesis, and deciphering whether these faults are sealed or opened is one of the key challenges in petroleum industry. A dedicated well was drilled and specifically cored at the vicinity of few seismic faults oriented N45W to N75W that are considered to be sealed to characterize the rock mechanical and petrological properties. Sub-seismic fractures naturally developed in association with these faults under different stress regimes. The objectives are to understand and quantify the Geomechanical rock properties' variation at the vicinity of one of the fault seals; to evaluate the fault seal with its associated Hydrocarbon Column (HC) height in a three way closure trap and to evaluate the potential reactivation of these natural fractures including the major seismic fault, and their effects on charging, migration and entrapment, as well as production and depletion.

Seismic semblance, core data and image log analyses, CT-scans and core description across the fault together with Rock Mechanics Testing (RMT) were integrated to build several 1D-Geomechanical models, which include in-situ stress profiles, pore pressure and rock strength and elastic properties for offset wells. These calibrated 1D- Geomechanical models were used to build a 3D-Geomechanical model that estimated the 3D stress-strain state, and is further used for fault seal assessment under 96 scenarios of different constraints. Four major parameters that control these scenarios are: stress regimes, faults dip-magnitudes, maximum stress directions and oil to gas ratio. Results indicate higher fracture intensity and micro-porosity loss clearly seen on thin sections as a result of cementation and digenesis closer to the seismic fault zone. The seismic semblance, core data and image log analyses across the fault suggests that there is a significant uncertainty with dip magnitude of faults and this dip may range from 60° to 90°. The strike of these faults varies from N45W to N75W, typical fault orientations in Cretaceous formations of Abu Dhabi. The strain distribution along the fault seal varies depending on the above mentioned constraints indicating possible leakage particularly along few fault bends.

These results helped better understanding the dynamic behavior of these faults and their associated sub-seismic fractures, and provided detailed geomechanics characterization along them that help field development.