

Evolution of the Middle Triassic-Middle Jurassic Tight Reservoirs in Abu Dhabi, UAE

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Abstract

The Middle-Triassic to the Middle-Jurassic formations, namely Gulailah (also known as Jilh), Minjur, Marrat, Hamlah and Izhara in an ascending order, are potential play fairways of tight hydrocarbon resource in Abu Dhabi. However, due to lack of systematic data integration, these tight formations were poorly mapped without a clear definition of inner reservoirs. Recent study integrating available exploration data shows the development of tight carbonate reservoirs associated with the intra-shelf basin sequences in the Middle-Triassic to Middle-Jurassic formations.

A consistent Middle-Triassic to Middle-Jurassic stratigraphic framework across Abu Dhabi was updated based on regional 3D seismic interpretation and well correlation. Subsequently, reservoirs and non-reservoirs were mapped in the framework by integration of paleoenvironment maps based on lithology interpretation using sedimentary samples and ANN model, and reservoir property analysis based on well logs, stacking geometry, seismic-derived depositional features, and geochemical measurement of cutting samples.

The Middle-Triassic to the Middle-Jurassic formations in Abu Dhabi are composed of a series of west-east dip carbonate ramps with the Gulailah and Hamlah intra-shelf basin prograding sequences thickening towards southern and eastern onshore Abu Dhabi related with Qatar Arch activities.

Because of the restricted condition and frequent clastic influx, large-scale reefal units of high reservoir qualities were not developed. The primary tight carbonate reservoirs are dolomitic pack-/grain-stone facies in a shallow-water shoal environment. Shoal reservoirs of Gulailah, Hamlah and Izhara in the west are laterally replaced by the peritidal pack-/wacke-stone facies towards the east as the secondary reservoir. Two dolomitization stages recognized based on isotope measurement and outcrop studies formed dolomitization corridors in the early-stage and pervasive dolomite cements in the late-stage, which is the major control of tight reservoir properties. Except the Minjur Clastics as a labyrinth reservoir with discontinuous sand bodies on a fluvial plain, reservoirs of the other carbonate formations are framed in the carbonate ramp and intra-shelf basin sequences as a mixture of layer-cake model in the gentle ramps and high frequency lateral pinch-out geometry in the prograding sequences of intra-shelf basin.