Exploration Growth in the Permian Gharif Sandstones: Extending the Creaming Curve with a Novel Stratigraphic Play

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Abstract

Complex stratigraphic plays are a key emerging theme with the focus in Central Oman on unlocking the Permian aged Upper and Middle Gharif combination structural-stratigraphic traps. Current understanding is that facies distribution, reservoir architecture, seal capacity, relief of structural nose, presence of faults and access to vertical migration routes seem to be important petroleum system elements. The play, however, is further characterised by distinctly different systems within the Upper and Middle Gharif reservoir units. The Upper Gharif trapping mechanism relies on fluvial and fluvial-deltaic channels orientated perpendicular or oblique to a structural nose. Reservoir quality is highly variable with better sand development in more proximal fluvial-deltaic facies. However, where the net-to-gross of reservoir cycles and connectivity of the channel system is too high hydrocarbons are not retained. Floodplain and lacustrine shales and paleosols act as important seals in-order to retain hydrocarbons. Hydrocarbon saturations are generally high and multiple contacts can generally be interpreted on logs that seem to be constrained to individual channel belts. The Middle Gharif is more complex and is better defined as a tight oil play where capillary trapping may be more important than the orientation of fluvial and fluvial-tidal channels relative to the structural nose. The lateral proximal floodplain shales and paleosols are the main seals, although these are often leaky systems. Hydrocarbon columns can therefore be connected through the ‘matrix’ and due to the tightness of the reservoir and long transition zones it is often difficult to determine hydrocarbon contacts. Predicting the Upper and Middle Gharif channel geometry and reservoir quality is key to exploring for the play. In Central Oman this is challenging both from a geological and geophysical perspective. High reservoir heterogeneity, varying reservoir quality, reservoir thickness c.a. <12m, poor seismic quality (noise, multiples) and the overlap of sand-shale acoustic properties mean it is difficult to extrapolate well results and image these sands with advanced attribute and CSSI inversion tools. Further evaluation of well results in combination with seismic AvO inversion analysis could help de-risk this challenging play.