Mature Field Advancement through Core-Based Flow Unit Reservoir Characterization, Sultanate of Oman

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Abstract

Upper Shuaiba carbonates are prolific hydrocarbon reservoirs throughout Oman and the Middle East. The field is a north-dipping low-relief monocline located on the Lekhwair Arch in Block 9 of North Oman. The field produces from the Shuaiba Formation (Lower Cretaceous Aptian-age). The Shuaiba Formation conformably lies atop the Kharaib and semi-conformably under the Nahr Umr. The Nahr Umr acts as an effective fieldwide seal between Shuaiba and the shallower Natih. The field is geologically heterogeneous and contains complex flow architecture. The Shuaiba includes multiple intervals of exposure and tilting that resulted in a strong stratigraphic trapping component, and local four-way and three-way fault-dependent dip closures that led to further compartmentalization within the field. The internal structures of the Shuaiba Formation are segmented by permeability variations within the flow units. We observe an order of magnitude increase in permeability within high (>15%) porosity intervals. This permeability heterogeneity is tied to lithofacies observed from core and thin sections. The Shuaiba flow units are made up of clinoforms that dip towards the Bab Basin and pinch out into argillaceous carbonates to the south-southwest along the Lekhwair Arch.

The fundamental goal of this study is to better understand the three-dimensional oil distribution within each high frequency sequence through the integration of core. Understanding the internal variability and facies geometry of the Shuaiba is key to extending the development of this mature field. This high-resolution reservoir characterization study defines complex internal heterogeneities of the field by tying reservoir quality directly to depositional facies. Integration of outcrop analogs, core descriptions, wireline logs, well tops, and seismic reflections provide the foundation for a more geologically realistic model that properly captures sequence boundaries that control reservoir architecture. This study provides insight into the Shuaiba Formation in North Oman as well as other carbonate reservoirs around the world.