Mapping Facies and Distribution of Lateral Reservoir Properties in the Aptian Lower Shuaiba Formation: A Case Study from an Oil Field in Northern Sultanate of Oman

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Abstract

The Lower Shuaiba Formation, a complex carbonate reservoir in the Middle East, displays significant textural variability, indicating diverse reservoir properties. This heterogeneity stems from distinct depositional conditions during Shuaiba deposition and subsequent diagenesis, resulting in substantial modifications to the original properties. Facies mapping plays a crucial role in addressing uncertainties related to facies distribution and characterization, emphasizing the presence of high-quality facies within the reservoir. The primary goals of this study include outlining the lateral distribution of reservoir properties through the identification and spatial mapping of various facies types.
Our methodology incorporates a specific workflow that integrates multiple datasets to capture reservoir heterogeneity and construct a facies model for the Lower Shuaiba field. Geological, seismic, petrophysical, well, dynamic, drilling data and microfacies analysis contribute to a comprehensive dataset. The study provides a detailed approach for applying reservoir rock typing to predict the characteristics of uncored intervals, integrating petrophysics and sedimentology. The resulting maps and models depict the internal reservoir architecture, highlighting diverse facies types, their trends, and the anticipated reservoir quality.

The field area's reservoir is characterized by an abundance of Algal-rich facies dominating the uppermost 10-20m. The regional depositional setting is identified as a shallow lagoon with limited open marine input due to contemporaneous buildups. Reservoir quality is primarily influenced by diagenesis, with the abundance and arrangement of lithofacies rich in large skeletal allochems, such as Algal-rich and Rudist-rich dominated lithofacies, playing a crucial role. Enhanced dissolution in these lithofacies promotes more effective pore connectivity, surpassing Wackestone-dominated lithofacies. The most connected pores are interpreted as being created by acidic aqueous unsaturated fluids, either preceding or accompanying hydrocarbon charge events. Depositional heterogeneities, subsequent diagenetic modifications, and structural adjustments collectively govern the development and distribution of lateral reservoir properties.