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Sedimentological Evolution of Upper Shuaiba Reservoir Sequences, Northwest Oman: Controls on Reservoir Trends and Geometries

Christopher Nicholls[1], Abdullah Hamdi[1], and Mohamed Azzazi[1]

[1]Field Development Centre, UDR, Petroleum Developmemt Oman, Muscat, Oman.

ABSTRACT

Across PDO's acreage in NW Oman, the Cretaceous Upper Shuaiba Member forms thin (<15 metres) carbonate reservoir layers separated by argillaceous non-reservoir layers. Light oil is located in 8 fields and 12 separate layers across an area of some 45km by 40km. The Upper Shuaiba is equivalent to the Bab Member in Abu Dhabi and represents the final phase of infill of the Bab intra-shelf basin. This basin infill is expressed by low angle clinoform layers that prograde from basin margin to basin centre. Clinoform dip angle becomes gradually shallower towards the basin centre reflecting a gradual decrease in basin topography and water depth. Marine conditions become more restricted reflected by faunal changes, a decrease in depositional energy and available accommodation space. These factors affect the dominant reservoir facies in succeeding layers, the rock properties and internal body geometries. A full synthesis of core data (44 wells) and log data (> 200 wells) has led to a consistent correlation scheme. Depositional facies distribution can be related to water depth via cumulative thickness maps (base Upper Shuaiba to the layer in question) which act as a proxy for sedimentary slope. Complementary individual layer thickness maps reflect, for carbonate-rich reservoir layers, the progradation and infill of available accommodation space and the productivity of the carbonate factory at the time. Clay-rich layers represent periods when clay influx suppressed or killed off the carbonate factory. There is little evidence that clay influx is related to sea-level fluctuations - climatic cycles may control the supply of clay into the Bab Basin at some distant source. Within this overall motif of carbonate-clay cyclicity and clinoform – water depth facies controls there are local variations such as exposed islands, sheltered lagoons and a possible channel linking two sub-basins. The workflow is linked to the petrophysical evaluation via a rock type scheme. Ten Rock Types are defined in core by their porosity-permeability and capillary properties and geological association. A workflow for predicting rock type from log response was developed calibrated to the core-based scheme. The main rock types are identified by different saturation-height characteristics. Log responses can consequently be used to predict rock type and permeability distribution along horizontal well sections – a powerful tool for mapping rock property variation within individual reservoir layers.