CP01

Integrated Core and Log-based Approach to Enhancing the Understanding of Reservoir Distribution within the Arab Formation, Abu Dhabi: Constraining the Future Reservoir Model Build

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Correlation and prediction of reservoir quality variability / heterogeneity within shallow carbonate ramp deposits of the Arab Formation in an Abu Dhabi offshore field has previously proved challenging. This study, commissioned by ADMA-OPCO, presents the results of integrated sedimentology and reservoir quality assessment of the A to D members of the Arab Formation.

A consistent set of Dunham-based lithofacies have been used to characterise ca. 6,800 ft of the Arab Formation in 30 partially cored wells. These sub-bed / bed-scale lithofacies are up-scaled and grouped into a series of lithofacies associations based on genetically related sedimentary structures, textures and allochem assemblages to provide an understanding on the depositional evolution of the Arabian Platform. These lithofacies associations, coupled with the broad lithological characterisation (anhydrite, dolomite and limestone), also provide fundamental descriptors for subsequent reservoir quality analysis.

Calibration of lithofacies associations with the open-hole logs enabled extension of the sedimentological framework into the uncored intervals / wells. However, this process demonstrated that there is considerable uncertainty in recognising facies associations using wireline logs alone, and this reduced confidence has implications for the field-scale sedimentological model. The facies population of the uncored intervals was assisted by the generation of a revised sequence-stratigraphic framework, derived mainly from the recognition of key surfaces and vertical facies stacking patterns derived from core measurements. The sequence-stratigraphic framework captures a hierarchical scale of eleven fourth-order cycles over three third-order cycles each marking a transgressive (flooding) and regressive event developed over the formation-scale shallowing-upwards trend.

This sedimentological database enabled production of facies trend maps for each of the fourth-order cycles, that provide an understanding of the lateral facies variability across the field. These GIS trend maps are generated from the interrogation of thickness data of lithofacies associations from both cored and uncored intervals. Through the application of percentage 'cut-off' values to the thickness data, the lateral facies trends are plotted using sedimentological principles and the understanding gained from the sequence-stratigraphic and depositional models. The resulting GIS shape data provides important constraints on geobody geometry and lateral facies development for the update of the static geological model.

Reservoir quality analysis, based on conventional core analyses data coded to lithofacies and lithofacies associations, provides an assessment on the influence of primary pore fabrics and subsequent diagenetic modifications, such as dolomitisation, on pore system development. Furthermore, the lateral distribution of reservoir quality within the limits of the third- and fourth-order sequence-stratigraphic cycles is investigated and mapped to provide a better understanding of the impact of the sedimentological and diagenetic influences on reservoir behaviour and distribution. Recent proprietary diagenetic studies provided by ADMA-OPCO have been considered, although a full diagenetic study is beyond the remit of this project.

In addition, previously established rock types supplied by ADMA-OPCO have been tested against lithofacies associations and lithological descriptors generated by this study. The tests evaluated the robustness and relationship to the sedimentological model so as to help constrain the distribution and predictability of the reservoir rocks on a field-wide basis for future static reservoir models. Neutron / density log responses are coded to core-based lithofacies associations to test the relationship between porosity, cementation and facies with the aim of producing a diagnostic method for identifying intervals of improved reservoir quality in uncored intervals elsewhere in this field. However, a full and detailed petrophysical evaluation does not form part of the remit of this study and would be required to confirm initial observations.