A Multidisciplinary Approach for Rock Typing Characterization in a Highly Heterogeneous Carbonate Reservoir in Abu Dhabi UAE*

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Abstract

Nowadays, there is a significant number of reservoir models that are purely constrained to numerical reservoir perception. Moreover, such models neglect the influence of geological events which are essential in characterizing and modeling carbonate reservoirs. This mentioned approach leads to conceptual errors because ideally, a reservoir model would enable heterogeneities predictability and mitigate reservoir-modeling uncertainty. The objective of this paper is to show the results obtained from an integrated reservoir rock-typing characterization process for its subsequent implementation into reservoir models.

This multi-disciplinary study emerged as the fundamental pillar to model the Lower Cretaceous Thamama Group in a major Oil Field in the Arabian Plate. This rock-typing approach intends to define rock types (referred as Static Rock Types (SRTs) in this paper) which result from the combination of two sub-processes, the Petrophysical Synthesis and the Geologic Synthesis. The latter aims to define Facies groups by relating depositional facies and their associated diagenetic processes. On the other hand, the Petrophysical Synthesis proposes to define petrophysical groups based on a combination of similar petrophysical characteristics. Ultimately, this rock-typing approach enables generating Static Rock Types defined by the reconciliation of related geologic and petrophysical patterns. The data inventory for this study includes detailed Core Description, RCA, SCAL, and Log data. Applying consistent data quality validation, which allows implementing a robust workflow combining deterministic methods and machine learning supported algorithms for data analysis.

Static Rock Types (SRT) were classified through distinctive sets of geologic and petrophysical groups. This classification resulted in four SRTs. SRT1 exhibiting enhanced reservoir properties product of early diagenesis, SRT2 is dominated by neutral diagenetic processes that preserve reservoir properties, SRT3 and SRT4 are both associated to late diagenetic property reducing processes that distort arrangement of minerals and pore structure. The major achievement of this rock-typing approach resumed in the integration of the Geology and Petrophysics. This integration enable finding significant evidence to understand reservoir properties at depositional stage, properties alteration product of diagenetic processes and reservoir dynamic behavior links to a geologic concept. This rock-typing approach changes the traditional practice,
formerly used to model this particular reservoir, which was limited only to the classification of petrophysical patterns; instead, this approach allows associating a particular petrophysical pattern to a singular geologic facies, feature or event.

Ultimately, via the integration of dynamic and static data, reservoir models become more predictive. Similarly, the basis of the rock-typing approach presented herein brings together a solid static understanding in order to delineate the origin of particular reservoir dynamic behaviors. This fit-for-purpose approach built from the premise of integration provides a complete basis for reservoir simulation, management, and forecasting; and at the same time contributes reducing reservoir uncertainties by means of enhancing heterogeneities predictability, dynamic flow understanding, which all combined yields organically into optimized field development strategies.
Abstract: Nowadays, there is a significant number of reservoir models that are purely constrained to numerical reservoir perception. Moreover, such models neglect the influence of geological events which are essential in characterizing and modeling carbonate reservoirs. This mentioned approach leads to conceptual errors because ideally, a reservoir model applies to heterogeneous predictability and mitigate reservoir-modelling uncertainty. The objective of this study is to approach the results obtained from an integrated reservoir rock-typing characterization process for its subsequent implementation into reservoir models. This multi-disciplinary study emerged as the fundamental pillar to model the Lower Cretaceous Thamama Group in a major Oil Field in the Arabian Plate.

Ultimately, via the integration of dynamic and static data, reservoir models become more predictable. Similarly, the basis of the rock-typing approach presented herein brings together a solid static understanding in order to delineate the origin of particular rock types dynamically. This approach allows associating a particular petrophysical pattern to a depositional stage, properties alteration product of diagenetic processes and reservoir dynamic behavior links to a geologic singularity present. The major achievement of this rock-typing approach resulted in the integration of Geology and Petrophysics. This integration enables finding significant evidence to understand reservoir properties affected by depositional stage, properties alteration product of diagenetic processes and reservoir dynamic behavior links to a geologic concept. This rock-typing approach changes the traditional practice, formerly used to model this particular reservoir, which was limited to the classification of petrophysical patterns; instead, this approach allows associating a particular petrophysical pattern to a depositional facies, feature or event.