A Novel Approach Combining Machine Learning & Classical Modeling Techniques to Characterize The Clastic Reservoirs In the Northern Area of Greater Burgan Field

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Abstract

Generating geological models by using different methods where machine learning is combined with classical modelling techniques, has already been established as a common technique in integrated reservoir characterization studies. This approach is also considered in a joint Kuwait Oil Company and Schlumberger study, to generate an integrated 3D model for the Northern part of the Greater Burgan Field. The main hydrocarbon bearing reservoirs in the study area are confined to the Cretaceous reservoirs which include the Wara sandstones; Mauddud limestones and Burgan sandstones. The Mauddud reservoir is typically restricted to the inner ramp carbonate deposition emplace between clastic deposits of Burgan and Wara reservoirs. The Wara Formation is characterised by three distinct incision events leading to the generation and infilling of incised valleys. In addition, the clastic Burgan and Wara reservoirs in the study area deposited within a depositional framework of fluvial to tidally influenced channel-fill, shallow water bay and deltaic to marine-dominated shoreline set-up. This paper presents an integrated approach used to build the 3D static model using data from multiple sources, at different scales and with different degrees of uncertainty. The paper will discuss the key steps used in the modeling process, namely the 1)- simultaneous seismic inversion process, 2)- lithology-classification and analysis, 3)- structural modeling, 4)- facies modeling, 5)- petrophysical modeling, 6)- water saturation modeling. The use and validation of different seismic attributes, and trend properties is also addressed. The integrated modeling approach allowed a very good mapping and modeling of all five lithology codes inferred using the Neural Net process and Quantitative Inversion Techniques and processes. Within the 3D model the litho-facies distribution is easily captured and analyzed to determine potential good reservoirs In-place hydrocarbon estimates using different approaches for Water Saturation modeling is also performed, considering all the available well, core and production data. The novelty approach of this workflow consists in using a unified approach for assessing the data quality, the relationship between different variables and identification of key geophysical and geological and parameters. Due to the model inherent integrated nature, investigating in detail the uncertainty analysis involving all the data used for modelling allowed using multiple scenarios and realizations to improve the understanding of in-place hydrocarbon estimates within the study area.