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Importance of Conceptual Geological Models in 3D Reservoir Modelling

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SUMMARY

This paper briefly describes a methodology which covers different components of Conceptual Geologic model building and its importance in terms of improved understanding of reservoir depositional environments (from basin to reservoir scale), geometry, connectivity and diagenetic history. The importance of integrating the 3D conceptual geologic model with the 3D reservoir models (static and dynamic) has been demonstrated through an example of silici-clastic reservoirs. This example has limited geoscientifc and engineering data with high subsurface uncertainties. The study shows that different possible geologic scenarios incorporated in digital representation of 3D reservoir models lead to significantly different Hydrocarbon-In-Place, recoverable resources and production forecasts.

Several benefits derived from this integration such as better 3D reservoir characterization, quantifying the impact of key reservoir uncertainties on fluid-flow characteristics and associated risks, providing essential information to the management in terms of more reliable production forecasts for informed decision makings are highlighted.

Effective interpretation of reservoirs is a challenging and often difficult goal to achieve for oil and gas companies. The effective interpretation process involves gathering and integrating multi-disciplinary subsurface data which, along with appropriate software and workflows, enable domain-experts to communicate and collaborate for a consistent and systematic subsurface description and understanding. Over the last few years, the predictive power of effective interpretation has escalated due to significant advances made in all core disciplines, and their related subjects. Today, 3D reservoir models are routinely used to predict reservoir performance which supports oil and gas fields development and depletion planning. Based on the lessons learned from 3D reservoir modelling studies performed in-house in different projects, available public domain literature, authors' and industry experiences, lack of integration of geological knowledge in the 3D reservoir modelling studies has been identified as a major missing element in the current simulation practices.

Conceptual geological models are an expression of geological knowledge used as a predictive tool in constructing the 3D reservoir models. Construction of conceptual geological models is in fact a non-linear and complex process which involves the application of geological rules and mainly the experience. Building of a fully integrated conceptual geological model involves at least four stages of the processes including: Construction of structural model, identification of depositional model, construction of sedimentary facies models and finally building of diagenetic facies models. Uses of conceptual geological model in the 3D reservoir modeling workflow allow bridging the gap between reservoir geology and numerical simulation techniques used for facies and property distribution. The major challenges in building the Conceptual Geological Models lie on the availability of the input data/information (e.g. core, logs, seismic, analogues, etc.) from different disciplines with the variable scale of resolution (micro to mega) and associated uncertainties, lack of enough geological knowledge, proper data integration, geologic interpretation for the quantification of vertical and lateral reservoir heterogeneities.

This paper briefly describes a methodology which covers different components of Conceptual Geologic model building and its importance in terms of improved understanding of reservoir depositional environments (from basin to reservoir scale), geometry, connectivity and diagenetic history. The importance of integrating the 3D conceptual geologic model with the 3D reservoir models (static and dynamic) has been demonstrated through an example of silici-clastic reservoirs. This example has limited geoscientifc and engineering data with high subsurface uncertainties. The study shows that different possible geologic scenarios incorporated in digital representation of 3D reservoir models lead to significantly different Hydrocarbon-In-Place, recoverable resources and production forecasts.

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