The Middle Marrat Reservoir Characterization as a Showcase of Best Practice Modeling Workflows and Value Added by Subsurface Data Integration

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ABSTRACT

This contribution aims to give an overview of best practice reservoir characterization workflows to guide the static model study work in the challenging context of complex carbonate reservoirs. The Middle Marrat case study, which is the best producing Toarcian reservoir interval in Kuwait, is taken as example. 3D visualization or correlation capabilities are key to the characterization of reservoirs for which a large amount of well data is available. To this end, an extensive 3D database project was created that included, amongst others, a unified and harmonized set of well logs, completion data, core plug data, core descriptions and pictures, fracture information as well as geochemical fluid fingerprints, petrophysical rock classes (carbonate rock types) and all production and pressure tests. The consideration of a wide range of subsurface data led to significantly different combinations of subsurface flow and storage. In addition to the usual isochronous correlation, a flow dominated correlation (flow zones) was framed, enabling the models to reproduce the actual depletion patterns of the reservoir, which do not always follow stratigraphic boundaries. To avoid incompatibility between geological understanding at fine scale and large scale dynamic modeling realm, a “close the loop” approach between static and dynamic realizations was adopted. By using available dynamic data such as pressure, interference test results and well test results, an optimal grid was constructed, facilitating the dynamic modeling exercise. Specifically, baffles, matrix thief zones and fracture corridors were all implemented in the static model and transferred to the dynamic models. This complete integration and modeling exercise resulted in a significant increase of the in place volume. Moreover, the revised conceptual fluid contact, based on subsurface data and regional analogues, also unlocked significant appraisal opportunities. The key enablers for the success of this integration project can be summarized as: one team, one tool, one common language. People from different companies and across disciplines worked in an integrated manner as a single team. A single modeling platform was utilized to store and analyze all data as well as to model the reservoirs (both in the static and dynamic realm). The introduction of flow zones and rock types provided a best practice for characterizing the reservoir at both field and plug scale.