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Fracture Characterization and Modelling workflow for a Jurassic fractured carbonate field (Kurdistan, Iraq) and the importance to incorporate key subsurface uncertainties.

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ABSTRACT

This study summarizes the results of an integrated modelling approach implemented on a carbonate heavy oilfield in the Zagros foreland basin near Erbil (Kurdistan, Northern Iraq). The field of focus is an approximately 600 m thick fractured limestone of Late Jurassic age containing heavy oil of about 7-10 API. The main structure is a low relief NW - SE oriented anticline with bounding faults to the north and south. At least two stages of deformation have been recognized in which the decollement layers appear to have played a primordial role in the style of deformation. The matrix properties of the reservoir are laterally relatively uniform and vertically the reservoir can be subdivided in areas of higher and lower porous zones with a degree of variation in the fracture density.

With just four vertical and deviated wells drilled, combined with the challenges associated with heavy oil fields in fractured carbonates, a reservoir uncertainty study was recommended. A large part of the expected oil recovery will come from the fractures, while the matrix contribution is highly uncertain. At the same time, are largest uncertainties expected in the fracture network in terms of fracture density and distribution, porosity and permeability. Fracture modelling was therefore executed with a range of high and low case scenarios as well as different matrix porosity and permeability, aquifer support and degree of compartmentalization modelling approaches.

We applied the reservoir characterization learnings from the Cretaceous Tawke oil field in Kurdistan where a fully integrated modelling approach resulted in the most optimized reservoir model for this successful oilfield. For the fracture characterization and fracture modelling the full range of the available dataset was utilised: 1) interpretation of the main fault framework from seismic, 2) analysis of the fault kinematics from the regional tectonic history, 3) seismic attribute analysis to identify the smaller scale tectonic features, 4) detailed fracture and fault characterization from borehole imagery, 5) core data, and 6) dynamic data from test results for calibration. An acoustic impedance cube was used to predict matrix porosity away from the wellbore. There are still major uncertainties associated with the reservoir performance. However, a range of models have been history matched, covering the main subsurface realizations with associated forecasts.