Addressing the Impact of Structural Complexity in Formation Evaluation of Tight Carbonate Reservoirs: A New Workflow from Kurdistan, Northern Iraq

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Abstract

Intense folding and faulting in the Tight Carbonate Reservoirs of Kurdistan, Northern Iraq affects not only the distribution of reservoirs, but also the formation evaluation for reservoir properties. Fractures define the reservoir quality and production behavior of these reservoirs and their morphology and attributes govern the economic viability of the plays as well. This work tries to understand the subsurface geological complexity rendered by structural complexity creating near-well structural model, while establishing the role of these events in the development of reservoir properties.

The studied formations are mostly dolomites, with intercalation of anhydrite beds exhibiting overturned folds, sharp faults, and numerous fractures of different generation. A near-well structural model was built with the dip-data from borehole images; and advanced interpretation of shear dispersion and stoneley analysis was performed against the fractures seen on borehole images. Fracture attributes for orientation, intensity, porosity, aperture, and permeability were computed to model the flow behavior.

The porosity from conventional logs and nuclear magnetic resonance (NMR) methods are found to be < 10% in many intervals; where fracture porosity contributes to the reservoir potential. For reservoirs with more than one set of fractures in different orientations, contribution from each fracture-set was studied separately in conjunction with the prevalent stress-regime. Most of the open fractures were found to be predominantly striking toward NE-SW direction, parallel to the in-situ maximum horizontal stress and exhibit higher aperture values than other sets, therefore contributing to the permeability. Another set of fracture were found to strike toward NW-SE direction, however, it tends to have very small aperture values and intensity.

The near-well structural model prepared in this study, serves as a guide not only to understand the distribution of reservoirs affected by structural complexity; but also helps in characterizing the porosity and permeability of the fractured reservoirs. This workflow, first of its kind in Iraq also can be used as a robust methodology to decipher and address the impact of structural complexity in other oilfields of Kurdistan in Northern Iraq.