High-Density Surveillance in a Supergiant Field: Integrating Clastic Sedimentology With Dynamic Data in a Mature Waterflood

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ABSTRACT

The Main Pay reservoir of the supergiant Rumaila field has been on production since 1953, and is now in a mature waterflood phase. An onshore field of this scale and longevity is in a rare position to benefit from large volumes of high density dynamic data, including repeat cased hole saturation logs, formation pressure data and production logging tool runs. In mature field life these data are beginning to highlight complex reservoir behaviour, not fully captured in previous subsurface descriptions. The Main Pay represents the maximum regression of the Early Cretaceous Zubair Formation; a paralic reservoir deposited in a delta-front setting. The Main Pay is divided into reservoir units, in terms of both stratigraphic expression and dynamic performance, based on major shale-prone flooding surfaces. The reservoir units vary in heterogeneity and net-to-gross based on their stratigraphic position in higher order regressive-transgressive cycles. The existing static description of the LN reservoir unit was observed to be inconsistent with recent dynamic data and well performance. These include examples of early water breakthrough, multiple moved oil water contacts and bypassed oil. Re-evaluation of core sedimentology, biostratigraphy, image logs, together with openhole and surveillance data from over 600 wells led to the interpretation of alternative stratigraphic correlations. Alternative scenarios were tested against known type wells and instances of anomalous well performance to update the reference case subsurface description. The resulting preferred subsurface description differs from the previous model principally in the identification of a number of extensive coal-prone surfaces. These are capable of holding back pressure and fluids, but are locally removed by subsequent lowstand incisions imparting a complex but predictable reservoir architecture. As net-to-gross changes across the field, so too do observed reservoir management challenges consistent with the model, ranging from unexplained produced water, to water cusping over coal-prone surfaces and oil trapped below. This model has generated significant business value, including prolonging well life through bypassed oil zones and identifying future high angle well targets.