The Impact of Detailed Fault Characterization on Field Development Planning

Ufuoma A. Akpomeyoma[1], Yahya Al Shereiqi[2], John Solum[3], Kachi Onyeagoro[3], Leytzher Muro Del Mar[1], Mutsam Al Ghammari[1], Yaqoob Al Rashdi[1], Salim Al-Amri[1]

[1]Shell Development Oman
[2]Shell Development Oman
[3]Shell US

Abstract

Production in deformed fields is strongly influenced by faulting, which means that valid fault interpretation is particularly important. The field in question is an onshore field in North Oman. It occurs in an extensional setting, with deep-seated, tight clastic Cambro-Ordovician reservoirs.

The field has recently come into production and the initial water gas ratio was higher than predicted in the field development plan. Updating the field development plan requires understanding the root cause for this elevated water production; hence we investigated the possibility of water moving through fault damage zones. Further, observations from production and pressure data suggested the presence of compartments in certain areas of the field, suggesting that faults may simultaneously act as vertical conduits and lateral seals. With the next phase of field development in mind; improving the understanding of the fault spatial distribution, the resulting compartmentalization and water production would also be important to optimize further well placement in the subsurface.

The integrated study began with a review of the existing structural interpretation, models, reservoir properties and production information. Deep learning fault highlighting volumes; discontinuity attributes; fault juxtaposition sections and geologically realistic fault transmissibility multipliers were integrated to provide a robust updated understanding of reservoir fault distribution. Faults were also analyzed per reservoir with focus on intra reservoir fault patterns.

Results from the study highlighted the impact of hitherto designated ‘subtle’ faults on reservoir compartmentalization in certain areas of the field. Generated AI fault volumes and attributes enabled the delineation of fault damage zone polygons which would later be applied to well planning, drilling and hydraulic fraction stimulation optimization for wells located in the vicinity of faults. The study also allowed the team to document specific water production trends which could be directly attributable to fault proximity. Integration of the results of the study will be applied to update the field development plan.