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Fractures and In-Situ Stresses in the Upper Jurassic Arab-D and Hanifa Formations, Khurais, Eastern Saudi Arabia

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ABSTRACT

The nature of the fractures and the present day in-situ stresses have been investigated in the main carbonate reservoir sections of the Upper Jurassic Arab-D and Hanifa Formations in Khurais area, Eastern Saudi Arabia, to characterize their influence on fluid flow and borehole stability. A total of 317,713 ft (96.83 KM) of borehole images (BHI), from 92 wells (averaging approximately 3,450 ft per well), were interpreted. The BHI interpretations were integrated with 360° DMT core scans (~1,552 feet) from seven vertical wells and with further core details included from two additional core sections.

The natural fractures were characterized on the BHI on the basis of their micro-resistivity. Two main types were recognized; electrically resistive or conductive, with further subdivision, particularly of the conductive fractures based upon their image character, e.g., continuous trace, discontinuous trace, mega (wide aperture), layer-bound, etc. Quantified details of the orientation and inclination of the natural fractures were extracted. Borehole breakouts and drilling induced fractures were also identified.

Results show that there are several fracture trends. The main conductive continuous fracture set striking predominantly ENE-WSW, whereas the resistive fractures strike more E-W. These tangential relationships can also be seen from core, where examples of mineralized (resistive) fractures are cross-cut by open fractures. The wider aperture (mega) conductive fractures strike ENE-WSW and NNE-SSW and many, though not exclusively, are associated with mud losses recorded while drilling. Preliminary interpretation of these fractures with in-situ stress analysis, indicate that some may be critically stressed. The layer bound conductive fractures show two dominant strikes NNE-SSW and NW-SE. This quality controlled and core verified fracture dataset provides robust well-based control for incorporation in the geological model and as a basis for integration in future geomechanical analysis.