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Natural Fracture Trends from Non-oriented Cores: A Case Study from Northwest Saudi Arabia

Adnan S. Alghannam[1], Elizabeth C. Lacsamana[1], Keith A. MacPherson[1]

[1]Exploration Technical Services Department, Saudi Aramco, Dhahran, Eastern, Saudi Arabia

ABSTRACT

Core is essential for the characterization of natural fractures, but conventional non-oriented cores cannot be used directly for measuring the strike of structural features. Typically, core is used in conjunction with borehole images (BHI) to orientate fractures. When BHI are unavailable or natural fractures in core cannot be resolved against the BHI, an indirect approach is required to measure the core fracture strike. In this work, induced petal fractures in conjunction with the direction of the current-day maximum horizontal in-situ stress (S_{Hmax}) are utilized to restore the cores true orientation. This technique utilizes the fact that induced petal fractures develop at a strike parallel to S_{Hmax} which is oriented NNW-SSE in the study area.

A total of 240 ft of conventional non-oriented core from two vertical wells in the Late Ordovician Sarah Formation of Northwest Saudi Arabia were studied; both induced and natural fractures are present. All natural fractures identified in the siltstone and sandstone, included in this study, are completely mineralized. The fractures were classified into calcite-filled and dolomite-filled as confirmed by energy-dispersive spectroscopy analysis (EDS).

The natural fracture strike was calculated based on a two-step approach; firstly, drilling induced and natural fractures were distinguished. Secondly, circumferential (360°) core scan images were oriented by aligning the strike of induced petal fractures to NNW-SSE. Subsequently, the natural fracture true strike was interpreted from the oriented core scan images. Three trends were observed, E-W, WNW-ESW and ENE-WSW, the dominant trend is E-W. The angle between S_{Hmax} and the fracture trends ranges from 30° to 90°. This abstract presents a case study demonstrating the advantage of the applied technique in wells where borehole image logs or oriented cores are not available. It is applicable to natural fractures below the resolution of borehole image logs.