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Microseismic Monitoring Provides Insight on Hydraulic Fracture Development in Clustered Horizontal Well Completed in Tight Gas Reservoir, Sultanate of Oman

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ABSTRACT

Since 2012, Petroleum Development Oman (PDO) has attempted several hydraulic fracture monitoring (HFM) evaluations in deep high-temperature tight gas wells in the Amin formation of the Fahud salt basin. The first successful job was executed in late 2014 for treatments placed in a horizontal wellbore.

Following this job, in-depth HFM analyses were conducted that led to recommendations on well completion and fracturing treatment improvements. The purpose of the HFM trial in this challenging tight gas Amin reservoir of the Fahud salt basin was evaluating hydraulic fracture geometries, fracture propagation, and orientation. The horizontal well had been purposely drilled in the vicinity of earlier completed vertical well to enable execution of the HFM job. Microseismic monitoring provided a direct measurement of the rock-failure coordinates and helped in gauging the effectiveness of the hydraulic fracture treatments placed in two clusters of the same fracturing stage.

A large set of raw data representing 52,000 events was recorded and processed through different filtering methods including noise processing from gas flow in the monitoring well behind the casing. The evaluation suggested that the fractures were vertically contained. It also revealed fracture length dimensions and stimulated reservoir volume along with the previously unmeasured fracture azimuthal orientation. The HFM job provided insight on how the hydraulic fractures propagate when two perforation clusters are placed in the different stress zones, and if it is possible to place comparable hydraulic fractures in both. HFM results were coupled with geomechanics work and post-fracturing production logging to develop recommendations of the further well completion improvements are also provided.

The HFM evaluation in a well completed with a cemented horizontal lateral section in a challenging high- pressure/high-temperature (HP/HT) and high-stress environment provides insight into probably the first successful unconventional gas exploration project in the Middle East to date, which could be of interest to both local and international operating companies.