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Microseismic Technology Applications: A Case Study for Hydraulic Fracture Monitoring in the Jafurah Basin of Saudi Arabia

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ABSTRACT

An optimized field development plan in any unconventional reservoir requires understanding several parameters such as lateral well spacing, effective drainage area, hydraulic fracture half-length, and stage contribution. The Jurassic Tuwaiq Mountain (TQMN) formation in the Jafurah Basin of Saudi Arabia has been actively appraised. Today, Saudi Aramco's unconventional program in Jafurah Basin is progressing firmly towards pilot/development. One of the challenges is estimation of the resultant hydraulic fracturing stimulation geometries, and fracture propagation behavior. To address this challenge, a multi-well pad was planned and drilled with three 5,000ft horizontal wells in the Tuwaiq Mountain were placed at varying lateral spacing and targeted different stratigraphic interest zones within the TQMN. All wells underwent multi-stage plug-n-perf hydraulically fracturing with different frack designs mainly driven by slurry volumes and proppant concentrations. As a result, different frack design parameters were validated through the microseismic (MS) monitoring, where a clear correlation between the frack job size and fracture geometry was established. While microseismic fracture mapping is still the primary focus of this study, other diagnostic/surveillance techniques were utilized to assess the hydraulic fracturing jobs such as chemical fluid tracers, downhole pressure gauge measurements and production logs. The integration of different and independent surveillances technologies allowed for a more comprehensive understanding of fracture propagation and geometry in this complex environment. Chemicals tracers were used to provide a measure of stage contribution and also inter-well hydraulic fluid communication to validate micro seismicity; while the recorded pressure interference was used to provide possible fracture communication and validate microseismic geometries. This study will show how microseismic monitoring indicated effective stage isolation, upper ends of hydraulic fracture geometries, and how the targeted reservoir was accessed during stimulation operation. These results have proven valuable to aid in completion design optimization, while providing the necessary insights for field development planning for maximized hydrocarbon recovery.