Recent Advances to Take Borehole-based Hydraulic Fracture Monitoring Further and Improve Reservoir Understanding and Performance

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Most predictive models used by reservoir and production engineers to estimate recovery in stimulated wells are based on assumptions that naturally lead to oversimplified fracture geometry. Borehole-based real-time hydraulic fracture monitoring using induced microseismicity is a well established technique. This technique is used to map developing hydraulically-induced fracture networks during stimulation campaigns and allows engineers to calibrate, with improved accuracy, various production models. Following a basic review of the microseismic monitoring technology and the need for high-quality geophysics when acquiring and processing data, we highlight the pros and cons of one vs. several monitoring arrays and discuss the notions of sensitivity and vector fidelity as well as accelerometers vs. geophones. We present the results of a few microseismic monitoring campaigns performed in various environments highlighting the variability of the induced fracture systems to be expected during a stimulation or a re-stimulation program. We document how local stress field can vary along a lateral and how perforation strategies can be developed to maximize production. We also illustrate that it is critical to integrate surface seismic data and microseismic data to detect potential geo-hazards unresolved by surface seismic data.

This technique is also used to verify interpreted fault geometries and allow on-the-fly changes in fracture stimulation design to maximize the reservoir volume effectively contacted by the stimulation treatment. We document how surface seismic-derived information may perhaps be used as a predictive tool when it comes to the potential development of a hydraulically induced fracture network. Finally, we will reveal leading-edge approaches that we have applied to analyze fracture network development and proppant placement.