Combining Microseismic Hydraulic Fracture Monitoring, Petrophysical Evaluation and New Analytical Techniques to Improve Reservoir Management

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Abstract

Proper characterization of the created fracture geometry is essential to the effectiveness of any stimulation program. We present the results of a multistage microseismic hydraulic fracture monitoring campaigns performed during 2004 on a Dominion Exploration and Production, Inc.'s producing well in a mature, tight gas field in south Texas.

The objective of the initial microseismic monitoring surveys was to determine the overall geometry of the hydraulically-induced fractures in a six-stage completion interval as part of a completion optimization program. Newly developed techniques (e.g., full-waveform moment tensor inversion and multiplet analysis) help describe geological relationships between induced microseismic events.

All available geological and petrophysical data pertaining to both the monitor and treatment wells are integrated with a vertical seismic profile to develop a robust calibrated velocity model, which leads to the accurate processing of the microseismic data acquired during the hydraulic fracturing operation. Interpretation of the microseismic data illustrates unique geometries in each of the fracture stages. These include larger-than-anticipated fracture heights generated in some stages while others demonstrate good vertical containment, as well as a situation in which all stages are oriented along the same azimuth. While no stage achieved the designed length, several stages exhibit asymmetric wing propagation. We show how these techniques, in addition to traditional petrophysical evaluation, fracture models and prorated production-rate transient analyses, improve our understanding of natural and hydraulic fracture systems. These observations led to suggest changes in (a) drilling pattern and (b) completion methodology (e.g., fracturing fluids, injection rate, etc.).