Mapping Reservoir Stress Conditions using Hydraulic Fracturing Microseismicity

Orlando J. Teran[1]

[1]MicroSeismic Inc.

ABSTRACT

Focal mechanisms, when computed for an entire microseismic catalogue, permit a rapid assessment of the stress states throughout the stimulated reservoir. The premise for this is that the fracturing potential depends on the frictional resistance to slip and ratio of shear to normal stress on the plane (determined by fracture orientation within the stress field). Previous studies using borehole images and laboratory techniques have demonstrated that the most hydraulically conductive fractures have the highest failure potentials.

In this talk we present a geomechanical analysis workflow using microseismic focal mechanisms to investigate the dynamic response of the reservoir during and after stimulation. Focal mechanisms are derived using full waveform fitting techniques, and the ambiguity in identifying the true fracture plane is resolved by simply choosing the nodal plane that aligns with the developing hydraulic fractures. A global stress inversion of the fracture plane solutions is done to estimate the orientations and relative magnitudes of the principle stresses. Friction laws are then used to constrain for each event a suite of geomechanical parameters (failure potential, dilation tendency, and excess pore pressure) in order to identify fracture populations likely to control fluid flow, those that required different stimulation pressures in order to contribute to flow, and the mechanical conditions that favored out-of-zone growth and reactivation of geohazards. The method is applied and discussed in the case of a microseismic event catalogue obtained during the stimulation of two horizontal wells landed in the Eagle Ford, where large variations in event densities as well as geohazards were observed. We will also show examples from other plays to demonstrate that this workflow is applicable to all plays.