Microseismic Geomechanics: The Critical Link be-tween Geophysics and Completions in Discrete Fracture Networks

Mark Mack

IMaGE

Abstract

In many unconventional reservoirs, economic success de-pends on the activation or stimulation of pre-existing fractures, not the creation of simple planar hydraulic fractures. Simulating the evolution of the activated fracture network is challenging, because often the geometry and properties of the pre-existing fractures are not well-characterized. Even if they are well-characterized, they vary across the reservoir. In addition, few fracture simulators can truly predict the ultimate fracture network geometry created during a stimulation treatment.
For many years, microseismic data has been used to visualize hydraulic fracture networks. It has been assumed that the cloud of microseismic events represents the hydraulic fracture network geometry. However, fractures can occur aseismically (i.e., without microseismic events), and micro-seismic events can occur away from the hydraulic fractures (i.e., dry events which do not contribute to fracture network geometry or production).

This presentation introduces a relatively new workflow in which the evolution of both the hydraulic fracture network geometry and the microseismic event cloud is predicted using an advanced geomechanical simulator. The “synthetic” event cloud is compared with the field micro-seismic data. This unique method of calibrating a simulation with microseismic data transforms microseismic measurement from a visualization tool to a true interpretation tool.

Case studies from North America demonstrate the application of this methodology to answer typical questions related to well and completion geometry, including well spacing and landing point optimization, stage spacing and cluster spacing.