09/28/2016; 1:55PM

The Interplay of Bedding Plane Failures and Vertical Fractures in Controlling Flow During Stimulations

Adam Baig
ESG Solutions

Hydraulic fracturing in the Permian Basin is used to liberate hydrocarbons to capitalize these resources. However, the heterogeneity in formations and the dynamics of the stress fields during multiwell completions leads to complexities in the process of estimating reserves that may be produced. Advanced processing of microseismic data offers an opportunity to understand the variations in growth as related to geological and completion -related factors, especially through integration of other datasets such as chemical tracer data. Spatial microseismic event distributions by themselves tend to yield significant overestimates of stimulated volume, but when advanced processing such as seismic moment tensor inversion (SMTI) is used, the connectivity of the fracture network and the openings and closures of the fracture network can be established.

We examine in detail a multiwell dataset from the Permian Basin where the seismicity was recorded from three vertical borehole-deployed arrays of geophones that facilitates SMTI and other modes of analyses. Careful interpretation of the mechanisms associated with the microseismicity, including clustering data to resolve dynamics of the stress field, reveals that two general families of fractures are activated during the stimulation: one sub-vertical and the other sub-horizontal. Over the monitored completion, the two fractures occur in roughly equal proportions, the dominance of the vertical over the horizontal fracturing, or *vice versa*, however varies over the reservoir. In terms of understanding the effectiveness of the fracturing, we correlate the proportion of our the orientations of the individual fractures with chemical tracer data and observe that where the horizontal ruptures are domi-

nant, there the ability to transport water- and oil-based tracers across to wells adjacent to the stimulated well. These observations suggest that ruptures along bedding planes are more effective at carrying fluids and proppants into the formation.