

Geomechanical and Reservoir Engineering Evaluation of Tight Oil Formation for Hydraulic Fracture Stimulation

Petro Babak¹, Seyyed Ghaderi¹, and Suzy Chen¹

¹Penn West, Calgary, AB, Canada

Abstract

Hydrocarbon recovery from tight formations relies heavily on multi-stage hydraulic fracture stimulation of horizontal wells. Success of fracture stimulation depends on many factors including good understanding of geomechanical properties of formation rocks, and, specifically, in situ stress distribution in the reservoir. However, the in situ stress distribution is a dynamic property that constantly changes throughout production/injection operation, and during the implementation of the fracture job itself. It is not straightforward to quantify these changes due to the limitations in data availability and current analysis tools.

The objective of this study is to develop and apply a coupled fluid flow and geomechanics simulation technique to evaluate fracture stimulation performance and fracture behavior from an actual case study in one of our tight oil reservoirs. This will help us improve future fracture design and field development. This technique involves two steps. Firstly, initial production history match of vertical wells in the project area before the hydraulic fracture stimulation is performed without invoking geomechanical features of the simulator, thus helping to expedite the history matching process. Then, the geomechanical features are activated to quantify the changes of in situ stress and its impact on fracture orientations around the multi-stage fractured horizontal wells. Quality check is conducted by comparing the results to microseismic measurements. The technique is useful for development planning and optimization of multi-stage fractured horizontal well locations, which avoids potential problematic areas for fracture stimulation, and forecasts fracture orientations more accurately.