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Geomechanics: A Key to Understanding the Underperformance of Fracture Treatments

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Abstract

In many cases, the production prediction at the fracture design stage and later from the post-fracture pressure matching exercise is never realized. The underperformance of fracture treatments is often attributed to either formation damage, proppant crushing and embedment, or to the poor reservoir quality despite a reasonably good reservoir property indicator from all sources including minifrac pressure decline. Based on several case studies from fields in the Asia Pacific region, this paper will highlight a number of issues that were found responsible for underperformance of fracture treatments. The understanding and mitigation of these issues required the application of comprehensive geomechanics.

For each case, a comprehensive geomechanical model was built for the field characterizing the depth profiles of all three stresses, rock mechanical properties and the direction of the horizontal stresses integrating data from various sources including drilling and logging data, laboratory rock test data and mini-fracture test data. The contrasts in stress and rock mechanical properties among various lithologies along the well path were created based on fundamental geomechanical principles. The hydraulic fracture growth was simulated as per the pressure matching practice for each treatment carried out. The production condition was applied to the simulated propped fracture to predict production and compare with the actual production data where available.

Issues that were found responsible for lower than expected production include (1) out of zone fracture growth which could not be predicted using the oversimplified geomechanics in earlier modelling works; (2) poor connection between wellbores and fractures for unfavorably oriented wells; (3) non-optimum perforation intervals that caused non-optimum fracture growth and near-perforation low conductivity; (4) malpractices in treatment execution that resulted in disconnected fractures with the perforations; and (5) suboptimal treatments for the reservoirs. Appropriate mitigation strategies were recommended for wells in production, and increased productions were reported where the recommendations were implemented.

Fig. 1(a) is an example of a predicted fracture using oversimplified geomechanics in the pressure matching simulation that raised an expectation of high post-fracture production, which was not realized. **Fig. 1(b)** is the pressure matching simulation for the same case with comprehensive geomechanics which was able to explain the reason of significantly lower than expected production due to mostly out of zone short fracture with low conductivity in the zone. Other cases will also be presented in the paper with such simulation results to explain the reasons for lower than expected productions. The paper will also demonstrate what malpractices exist in the industry in creating and calibrating the stress contrast, which is primarily responsible for unrealistic fracture growth and production prediction

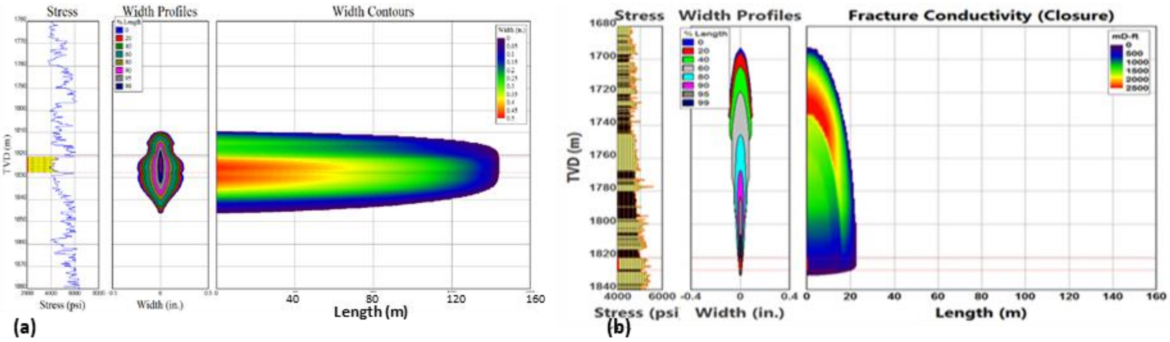

Fig. 1. Post-treatment fracture predictions: (a) oversimplified geomechanics, (b) comprehensive geomechanics.