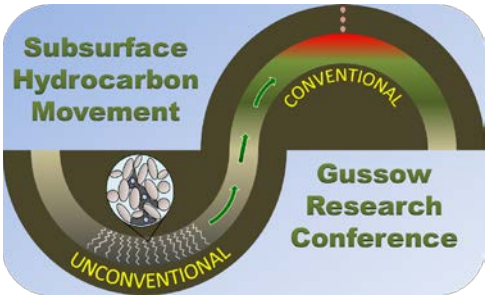

Integrated Fracture and Drainage Modeling For Unconventional Reservoirs

Srimoyee Bhattacharya, Ed Lake, Zongyu Zhai, Robert Dombrowski, Raymond Jones and Gwen Anson

Summary

Unconventional reservoirs rely on horizontal drilling along with hydraulic fracturing to open up vast resources in low permeability reservoirs. However, most models rely on the simplistic assumption of rectangular fractures with uniform fracture properties. Whereas, a variety of geomechanical software is routinely used to populate models with rugose fracture geometry having varying aperture and proppant placement. Currently, commercial reservoir simulators do not have specialized interfaces to import irregular fractures with variable fracture properties such as fracture conductivity and width from our commonly used fracture modeling tools. Hence, effects of fracture geometry distributions and permeability variations are not taken into consideration during simulations, as shown in Figure 1. These oversimplified fracture models fail to represent the reality required to optimize fracture design and well placement.

In this work, we have developed an approach to directly import spatially variable fracture properties along with non-rectangular fracture shape generated by 3D fracture simulator into the reservoir simulator. This automated process enables a comparison of many more combinations of parameters than an engineer could conceivably accomplish by manual effort. Examples of such parameters are well spacing, well orientation, landing depth, landing zone, stage spacing, perforation cluster spacing, fluid volume, fluid viscosity, pumping rate, and proppant size. Pairing fracture simulation and reservoir simulation enables directly predicting the impact of fracture design decisions on production and net present value. Furthermore, the interaction of the stress effect of previous fracturing from neighboring wells may be modeled. When the process is carried through optimization, we can decide well placement from an NPV perspective. This approach also can be extended to optimize several well and completion parameters. This work demonstrates exporting the fracture properties to reservoir engineering space and determining the best well completion design and well spacing.

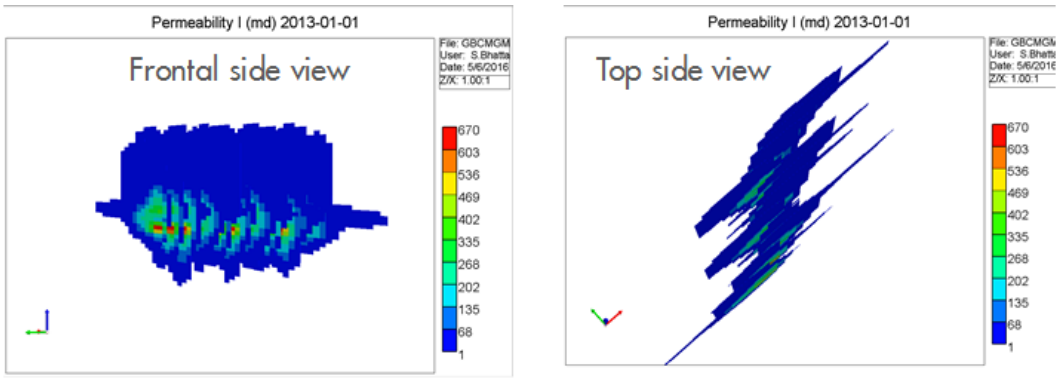

Figure 1. Realistic fracture model that can be imported into the reservoir simulator