Discrete Fracture/Fault Network Models and Structural Uncertainty SubTitle

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Discrete Fracture/Fault Network (DFN) models are powerful tools for generating secondary permeability values for use in single-, dual-, or triple-media reservoir simulations. However, until recently, the full power of the DFN approach has not been employed to address the impact of structural uncertainty.

Subsurface data available for building a DFN are often sparse, incomplete, or unusable. It is possible to generate multiple DFNs based on the subsurface data before calibration to dynamic data can be considered. Fracture density and length information are highly uncertain parameters used to generate a DFN. However, uncertainty in fracture length may be irrelevant depending on the number of fracture sets present, their relative orientations, dispersion within the orientation data, facies associations, and matrix permeability. Similarly, subseismic fault and fracture swarm modeling often suffers from a dearth of input data along with multiple options for extrapolating below the seismic detection limit. Important considerations include (1) Over what range of sizes does the fragmentation (fractal) dimension make a difference? (2) When do rules-of-thumb such as length-displacement scaling break down?

In this paper, we take an experimental approach to develop guidelines for assigning a degree of uncertainty to secondary permeability. These will aid the modeler in assessing which variables are the most important for a given reservoir. The modeler can then use the DFN to interrogate the reservoir and assess uncertainty associated with the structural interpretation. Multiple scenarios may be appropriate, depending on the business case. An important step is a feedback loop from the simulator back to the DFN for further model refinement.