EARTH MODELING AND NATURAL FRACTURE NETWORK USING A PRESALT SYNTHETIC MODEL

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ABSTRACT: Three dimensional (3D) natural fracture modeling requires computational tools capable of simulating these processes nearby and between wells. As the stochastic simulation of natural fractures approaches, honoring well information and extrapolation equiprobable scenarios can contribute to the evaluation of multiscale heterogeneities in geocellular models. When building stochastic models of fracture with the conventional approach, one can use the discrete fault network (DFN) approach, also known as the “FracMan,” consisting of dropping flat discs with randomly located centers and orientations drawn from user-specified distributions of dip and strike. Although this method honors fracture density, aperture, and orientation, it frequently misses significant amounts of other data, including locations of known and observed fractures on wells as well as fracture hierarchy. New methods for stochastic fracture network modeling have been under development in last the 15 years, primarily for disposal of nuclear waste in a deep geologic repository in fractured crystalline rock. This requires robust characterization of fractures and modeling alternative approaches surged considering the fracture continuum model (FCM) to characterize. The applicability for use in the simulation flow and transport of generic nuclear waste is not restricted to the nuclear industry, but also can be applied to the petroleum industry. The FCM approach maps the permeability of discrete fractures onto a regular grid, and then extends it for a 3D representation and spatial correlation. This FCM [or equivalent continuum model (ECM)] approach is referred to in this work as natural fracture modeling (NFM). This paper discusses earth modeling (EM) in addition to the natural fracture network modeling (EM + NFM approach) using a synthetic example that mimics presalt. A modeling workflow is presented combining EM with fracture modeling applied to four synthetic wells, including data preparation, seismic horizons, stratigraphic modeling, structural modeling, facies and petrophysical modeling, fracture orientation, dips, intensities, simulation of interval densities, conditional simulation, and extrapolation to the geocellular grid. With this process of synthetic corridors of high permeability being simulated, a more realistic representation of the variability can lead to improved production predictions if tested in the flow simulators. After fracture simulation, an upscale with grid refinement closer faults could be generated, thus completing the static modeling process.

KEYWORDS: EARTH MODELING, NATURAL FRACTURE MODELING, CARBONATES