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3D Numerical Modeling of Fracture Propagation in Complex Reservoirs Rocks at Microscale

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There are many applied technical and research tasks such as optimization of hydraulic fracture stimulation of tight reservoirs, validation of elastic-plastic models using results of laboratory geomechanical rock testing, maximization of voids connectivity in near wellbore zone. The solution of these tasks requires knowledge of condition of fracture propagation at microscale taking into account rock heterogeneity. The main goal of this work is to investigate of fracture propagation at microscale in hydrocarbon reservoir rocks to maximize production of oil and gas from non-connected voids. The authors developed comprehensive approach which consists of 4 steps. The first step was conducting of laboratory experiments for determination of mechanical parameters of rock samples, computed tomography (CT) before and after loading tests and quantitative evaluation of minerals by scanning electron microscopy (QEMSCAN). Next step was the registration of 2D QEMSCAN and 3D micro-CT to build 3D digital mineral rock model. The third step was building the mesh on this model and assigning the mechanical properties to the grains. To provide numerical calculations the authors use Abaqus Standard/Explicit commercial software. Final step, the verification would be performed with results of experimental geomechanical tests and calculations of analytical models based on Cahn-Hillard equation.