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Petrophysical Properties Estimation Based on Digital Rock Modeling for Sandstone

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Permeability and capillary pressure curve are important to characterize hydrocarbon-bearing formations. There are several laboratory approaches to estimate such petrophysical properties. Nevertheless, one faces with the range of complications such as uncertainties during laboratory measurements, treating micro- and nano-pore permeability and multi-scale geometry of the pore space, complex mineral composition.
Within this work, to provide petrophysical properties prediction we combined laboratory investigation and one- and two-phase fluid flow simulations using digital rock models. The workflow was applied for low permeable samples from sandstone reservoir with measured complex mineral composition. We utilized the combination of high-contrast μCT scanning technique and Focused Ion Beam milling with Scanning Electron Microscopy (FIB-SEM) to construct high quality 3D multiclass digital rock models of sandstone samples. The constructed 3D multiclass digital rock models were used as an input for simulations of one- and two immiscible fluid flow through such 3D multiclass porous media and further analysis. Numerical approaches include the direct Navier-Stokes, the Lattice Boltzmann methods. Permeability and drainage capillary pressure curves were experimentally determined from laboratory measurements on core samples and compared to the simulation results. Both predicted permeability and drainage capillary pressure curves were in a good agreement with experimental values.

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