THREE-DIMENSIONAL PRINTING POROSITY MODELS OF RESERVOIR ROCKS FROM MULTISCALE PETROPHYSICAL DATA

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Abstract

Pore-scale imaging and modeling are becoming routine geoscience techniques of reservoir analysis in the petroleum industry. Enhanced hydrocarbon recovery depends on the multiscale reservoir rock characterization including accurate modeling of the rock microstructure and physical characteristics of fluids occupying the pore space. Three-dimensional (3-D) printing may facilitate the transformation of pore-space imagery into artificial rock models, which can be lab-tested and compared with natural rock samples. This study uses 3D printing as a novel way of interacting with tomography and SEM image data from reservoir core plugs based on modeling of pore space and grain matrix in coarse-grained sandstones. Pore radii of the reservoir sandstones used in this study (e.g., Berea Sandstone of Ohio) range from one to 100s of microns. While the resolution of computed tomography imaging (~2 microns) allows macropores to be captured and the resolution of SEM imaging (nanometer-scale) yields information on micropores, 3D printing is capable of only manufacturing pores 30 to 300 microns in diameter. The most significant challenge in the application of 3D printing to pore space analysis is to reproduce the smallest elements of reservoir rock's pore system—the pore throats. While current resolution of 3D printers is insufficient to build micron-scale porosity, mercury injection analysis will be used on upscaled models of sandstones to measure the accuracy of the 3D printed copies. The ongoing development of 3D printing technology and materials will make it possible to produce reservoir rock models at original scale in the future.

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