Examining How CO_2 Displaces Brine at the Pore Level

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ABSTRACT: Combining micro-computed tomography scanning and computational fluid dynamics this study examined how CO_2 displaces brine in a small volume of pore space. The pore volume (4.41 (10^{-11}) m^3) was obtained from an Xradia Micro XCT-400 scanner with a voxel resolution of 27.1 microns from a sub-core of Mt Simon sandstone, recovered from a depth of ≈1770m. The complex micro-structure was preserved via careful three-dimensional reconstruction of the scanned data into a fully meshed volume, with over 3.5 million hexahedral cells. A series of simulations was performed with the commercial CFD code FLUENT to evaluate the immiscible flow behavior of CO_2 and brine within this volume, under a range of conditions that might be expected at a CO_2 storage site. This was done using the volume-of-fluid method to handle multiphase flow, and solving the full Navier-Stokes equations. Initial results show that an increase in the CO_2 viscosity, which could be obtained by adding a surfactant or by increasing depth of the injection, results in an increase in the residual volume of CO_2 within the pore space.