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Spatial persistence of macropores and authigenic clays in a reservoir sandstone: Implications for Enhanced Oil Recovery and CO2 Storage

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Multiphase flow in clay-rich sandstone reservoirs is important to enhanced oil recovery (EOR) and the geologic storage of CO_2. Understanding geologic controls on pore structure allows for better identification of lithofacies that can contain, storage, and/or transmit hydrocarbons and CO_2, and may result in better designs for EOR-CO_2 storage. We examine three-dimensional pore structure and connectivity of sandstone samples from the Farnsworth Unit, Texas, the site of a combined EOR-CO_2 storage project by the Southwest Regional Partnership on Carbon Sequestration. We employ a unique set of methods, including: robotic serial polishing and reflected-light imaging for digital pore-structure reconstruction; electron microscopy; laser scanning confocal microscopy; mercury intrusion-extrusion porosimetry; and relative permeability and capillary pressure measurements using CO_2 and synthetic formation fluid. Our results link pore size distributions, topology of porosity and clay-rich phases, and spatial persistence of connected flow paths to multiphase flow behavior. The authors gratefully acknowledge the U.S. Department of Energy's National Energy Technology Laboratory for sponsoring this project. Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy’s National Nuclear Security Administration under contract DE-AC04-94AL85000.