

For Submission to the 2015 American Geophysical Union Fall Meeting

Multiscale Multiphase Caprock Seal Analysis: A Case Study of the Farnsworth Unit, Texas, USA

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Caprock sealing behavior depends on coupled processes that operate over a variety of length and time scales. Capillary sealing behavior depends on nanoscale pore throats and interfacial fluid properties. Larger-scale sedimentary architecture, fractures, and faults may govern properties of potential “seal-bypass” systems. We present the multiscale multiphysics investigation of sealing integrity of the caprock system that overlies the Morrow Sandstone reservoir, Farnsworth Unit, Texas. The Morrow Sandstone is the target injection unit for an on-going combined enhanced oil recovery-CO₂ storage project by the Southwest Regional Partnership on Carbon Sequestration (SWP). Methods include small-to-large scale measurement techniques, including: focused ion beam–scanning electron microscopy; laser scanning confocal microscopy; electron and optical petrography; core examinations of sedimentary architecture and fractures; geomechanical testing; and a noble gas profile through sealing lithologies into the reservoir, as preserved from fresh core. The combined data set is used as part of a performance assessment methodology. The authors gratefully acknowledge the U.S. Department of Energy's (DOE) National Energy Technology Laboratory for sponsoring this project through the SWP under Award No. DE-FC26-05NT42591. 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.