MR13B-3202 Micrometer- to Nanometer-scale Characterization of Shale Caprocks, Implications for Hydrogen-brine-mineral Interactions

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13:40 - 17:30
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Abstract

Depleted oil and gas reservoirs offer promising potential for large-scale geologic storage of hydrogen since they have proven space for fluids-injection and favorable geomechanical conditions. However, the feasibility of large-scale storage projects in depleted reservoirs depends on the ability of caprock to block injected gas from leakage. As a reducing agent, hydrogen can induce a state of geochemical disequilibrium, triggering redox reactions with iron-bearing and/or sulfur-bearing minerals commonly seen in caprocks, which may affect the integrity of the caprock and the purity of the storage gas. This study aims to investigate the three-dimensional distribution of reactive minerals and their vicinity to reaction interfaces. Caprock samples used in this study were collected from Miocene Monterey Shale at the Elk Hills Oil Field. Using scanning electron microscopy energy dispersive X-ray spectroscopy (SEM EDS), x-ray diffraction (XRD), and synchrotron X-ray nanotomography (nanoCT), three-dimensional characterization of the pores and minerals were carried out at micrometer to nanometer-scale. Petrophysical properties for the caprock including porosity, pore morphology, and permeability were quantified using nanotomography data. The results highlight the complex pore structures and pore connectivity. More importantly, connected pores adjacent to pyrite crystals provide interface for hydrogen-brine-mineral interactions.

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