

Pore structure analysis of Eau Claire Formation (Cambrian) and its potential for CO₂ storage seal

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Among the petrologic and petrophysical elements of siliciclastic reservoirs, pore system characterization is critical for CO₂ storage because it influences gas capacity, as well as the flow behaviors of all other fluids in the rock. Since the Eau Claire Formation is considered to be the primary seal for the potential CO₂ storage reservoir above the Mount Simon Sandstone, the mesopore (2-50 nm) and micropore (<2 nm) geometry (size, shape, and surface area) characteristics of 9 samples from the Eau Claire Formation in Indiana were analyzed to: 1) study the storage mechanisms (pore filling vs. adsorption) of gases in pores; 2) determine the relationship between capillary entry pressure and the different pore size distribution; 3) identify the link between pore-size distribution related volume (meso- and microporosity) and bulk porosity; and 4) evaluate the pore structure of these particular rocks relative to their ability to transmit fluid.

The N₂ BET surface area, CO₂ D-R surface area, and micropore volume were measured by low pressure (<10.13 kPa) adsorption analyses using a Micromeritics ASAP 2020 apparatus. Our initial results show that there are no direct relationships between the meso-, micro-porosity, and bulk porosity, which suggest that macro pores (not accounted for in mesopore and micropore analysis) contribute the most to the bulk porosity. Low-pressure D-R CO₂ isotherms yield micropore volumes that positively correlate with TOC. Nitrogen surface areas are covariant with CO₂ micropore volume suggesting that high-sorbing samples are both micro- and mesoporous. Since clay might also be a contributor for porosity, especially for microporosity, the mineral matter content and composition will be subsequently evaluated. The clay-rich shale sample shows the largest BET surface area and micropore volume, indicating its high potential of adsorbing/holding CO₂ gas in the rock, suggesting that these rocks are good candidates to act as the seal for CO₂ storage.