

Porosity and CO₂ Storage Capacity of the Maryville Basal Sandstone Section in the Kentucky Geological Survey 1 Hanson Aggregates Stratigraphic Research Well, Carter County, Kentucky

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ABSTRACT

The Kentucky Geological Survey drilled the 1 Hanson Aggregates stratigraphic research well, Carter County, northeast Kentucky, to test in situ rock properties in the subsurface for their potential as CO₂ storage reservoirs and confining intervals (cap rock). The Middle Cambrian Maryville Basal sands interval (4600 - 4720 ft) were evaluated to determine effective porosity, clay volume, and standalone potential CO₂ storage reservoir capacity. The interval is composed of two muddy dolomitic sandstones, each about 30 ft thick, separated by about a 40-ft interval of sandy dolomitic mudstones. The upper unit is the Maryville sandstone, an informal subsurface member of the Maryville Limestone, whereas the lower is the informal Basal sandstone which overlies a thin Granite Wash on Precambrian Grenville basement. Effective porosity and clay volume in the strata were calculated from the density log using a three matrix shaly-sand model. Four formation lithologies were identified from primary lithology and clay volume: muddy sandstone, sandy mudstone, dolomitic mudstone, and dolomitic claystone. Average effective porosity calculated in the Maryville sandstone is 8.9% with clay volume of 35.3%. Average effective porosity in the Basal sandstone is 8.7% with 41.2% clay volume. Effective porosities calculated in this evaluation are a good match with porosity measured in core plugs from the intervals. Porosity and net reservoir thickness for calculating potential CO₂ storage volume were determined using an industry-standard 7% porosity cutoff. In the 664,500-acre study region around the 1 Hanson Aggregates estimated effective porosity greater than the 7% cutoff is 13.7% and average net reservoir thickness is 34 ft. Storage volume was determined using the methodology of the U.S. Department of Energy, Office of Fossil Energy, National Energy Technology Laboratory. Estimated P50 supercritical CO₂ storage volume for the Maryville Basal sandstone interval is 654 metric tons/acre and 434.6 million metric tons in the study region. Thus, about 1530 acres would be required to store 1 million metric tons of supercritical CO₂ in the Maryville Basal sands interval. Thin reservoir sandstones, low permeability (~50 mD), low reservoir volume, and low fracture gradient of 0.581 psi/ft measured in a step-rate test, however, probably makes the Maryville Basal sandstone interval unsuitable for standalone CO₂ storage in the southern Appalachian Basin. More likely is that the interval would be part of a stacked-reservoir CO₂ storage project, although there are no current or future plans to store CO₂ in the region.