

Regional Geological Sequestration Potential of the Middle Devonian Sylvania Sandstone, Michigan Basin, USA

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The Sylvania Sandstone is a prospective, saline reservoir geological sequestration target in the central Michigan Basin. Reservoir quality in the Sylvania Sandstone is well documented by extensive brine mining since the late 19th century. The Sylvania Sandstone is overlain by confining layers of the Amherstburg and Lucas formations and is present adjacent to several large coal fired power plants, making it a prime target for geological storage feasibility investigation.

Previous regional geological storage capacity investigations have substantial uncertainty due to stratigraphic, lithologic, and diagenetic complexity in this formation. In order to reduce this uncertainty, a detailed stratigraphic and petrophysical study of 3 cored wells, 50 conventional core analyses, and 115 modern well logs was undertaken.

Core analyses data indicate that sandstone lithofacies have moderate to good porosity and high permeability and are excellent injection targets. Tripolitic chert lithofacies have high porosity and low to moderate permeability and questionable injection potential. All other lithofacies have low porosity and permeability. Core to modern wire-line log calibration provides confident discrimination amongst reservoir sandstone, and non-reservoir tripolitic chert and carbonate lithofacies. By assuming 4% efficiency and plugging in effective net porosity into DOE's storage capacity formula, regional geological sequestration capacity of 732 Mmt of CO₂ was calculated.

Three shoaling upward parasequences and facies changes down depositional dip direction compartmentalize the reservoir in both vertical and lateral directions. Reservoir compartmentalization, limited spatial distribution and spatial variability in reservoir performance require sophisticated reservoir characterization for site specific deployment of geological sequestration in the Sylvania Sandstone.