Basin Analysis and Reservoir Characterization for Subsurface Geologic Carbon (CO_2) Sequestration Associated with a Direct Reduced Iron Plant, Iron County, Utah

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Abstract

The Iron Springs district in southwest Utah is one of the largest iron producing regions in the western United States. A local mine recently proposed building a direct reduced iron plant to optimize their operations and increase the domestic supply of steel. Funded by the U.S. Department of Energy (Award DE-FE0031837), we are conducting rigorous site characterization to assesses the CO_2 sequestration potential of subsurface geologic strata near the proposed plant to accommodate carbon-rich byproducts on a commercial scale. The region possesses world-class reservoir/seal packages at depths suitable for CO_2 storage and lacks evidence of an active petroleum system which lowers the risk of occluded pore space and overpressure, but considerable geologic uncertainty remains due to complex and poorly constrained subsurface conditions. Our characterization leverages geological and geophysical data to assess CO_2 reservoir and seal quality and drilling hazards. Primary injection targets lie within eolian sequences of the Jurassic Navajo Sandstone (porosity 15%; permeability 156 mD), overlain by stacked confining units that include anhydrite-carbonate beds in the Temple Cap Fm. (Manganese Wash Mbr.) and gypsiferous shale and limestone of the Carmel Fm. (Co-Op Creek Mbr.), which itself was intruded by the Three Peaks quartz monzonite. Locally, the Navajo Sandstone lies entirely in the subsurface and preliminary thin section petrography work on cuttings samples from the ARCO Three Peaks #1 well reveals a range of lithofacies and fabrics that appear promising for CO_2 storage. Reservoir analog data from nearby outcrop exhibit a range of structural and depositional realms rock mechanics and petrographic data from these locations provide potential end-member values for reservoir quality. Attribute analysis of reprocessed 2D seismic data indicates laterally continuous subsurface reflectors and viable structural, stratigraphic, and volcano-stratigraphic trap styles, suggesting favorable reservoir / seal presence and continuity. A new gravity survey reveals an intrusive sealing unit with greater volume and more complex geometry than previously identified. Each of these data inputs will be combined into a geomodel to simulate flow and CO_2 storage potential. This study highlights how integrated basin analysis and reservoir characterization can provide key inputs for site selection and facility design, a first step on the path toward onsite CO_2 sequestration for industrial projects.