

## **Mitigating Geologic Risk Uncertainty for Carbon (CO<sub>2</sub>) Sequestration in Multiple Subsurface Targets in the Iron Springs District, Iron County, Utah**

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### **Abstract**

The Iron Springs District in southwest Utah lies at the eastern boundary of the Basin and Range Province as it transitions into the Colorado Plateau. The region comprises north-northeast-trending basement-cored uplifts and grabens that juxtapose thick sequences of Paleozoic and Mesozoic strata and extensive Eocene and younger volcanics, all of which have been heavily faulted. Although this area is potentially suitable for CO<sub>2</sub> sequestration for several reasons—the presence of multiple, world-class reservoir/seal packages at depths suitable for CO<sub>2</sub> storage and the absence of an active petroleum system which lowers the risk of occluded pore space and overpressure—considerable geologic risk is involved due to complex and poorly constrained subsurface conditions. To reduce uncertainty within the ~180-km<sup>2</sup> area, our subsurface characterization approach leverages new and existing geological and geophysical data for analysis of CO<sub>2</sub> storage capacity, reservoir and seal quality, drilling hazards, and economic contingency planning. Favorable injection targets include (1) eolian sequences of the Jurassic Navajo sandstone ( $\phi$ :  $\leq 15\%$ ;  $\mu$ :  $\leq 156$  mD, historically), overlain by gypsiferous shale and limestone of the Carmel Fm. that was intruded by the Three Peaks quartz monzonite, and (2) the intensely fractured Permian Kaibab Limestone, overlain by the mudstone-dominated Triassic Chinle Fm. Control points include reprocessed 2D seismic lines, newly acquired gravity data, on-site outcrop exposures, and geophysical logs, core and cuttings from three nearby petroleum exploration wells. pXRF analysis of core and cuttings from the ARCO Three Peaks #1 well reveals several crosscutting, calcite-filled fracture sets and elevated Ca and S values in the Carmel Fm., providing evidence for paleo-fluid mobilization related to quartz monzonite intrusion ca. 22 Ma. Metasomatic fluids from anhydrite-carbonate beds in the Manganese Wash Mbr. of the overlying Temple Cap Fm. may have precipitated pore-occluding CaCO<sub>3</sub> and CaSO<sub>4</sub> in the uppermost Navajo Fm.—the entire reservoir quality remains under evaluation. Reprocessed 2D seismic data indicate some promising laterally continuous reflectors and several viable structural, stratigraphic, and volcano-stratigraphic trap styles within Sevier thrust belt structural duplexes. Published data from the Covenant oil field in Sevier County (~200 km away) show that max. permeability in upper Navajo lithofacies varies by several orders of magnitude (0.01—41 mD) between interdunal and massive facies. Terrestrial gravity surveys complement seismic time-to-depth conversion and can delineate basin structure and laccolith extent. Preliminary calculations indicate that current reservoir targets can store industrial volumes of CO<sub>2</sub> and saline water geochemical models yield encouraging results to greenlight CO<sub>2</sub> injection. Ongoing petrographic work includes MICP analysis, thin section petrography, and electron microprobe analysis.