

CO₂ INJECTION AND RESERVOIR CHARACTERIZATION: AN INTEGRATED PETROGRAPHIC AND GEOCHEMICAL STUDY OF THE FRIO FORMATION, TEXAS.

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The Gulf Coast Carbon Center (GCCC), a branch of the Bureau of Economic Geology of the University of Texas at Austin, conducted a pilot CO₂ sequestration experiment in the Oligocene, Frio Formation at the South Liberty Oil Field, Dayton, Texas. Petrographic examination of core samples from the Frio "C" sandstone, ranging in depth from 1500m-1657m, classifies the sandstone as a poorly cemented, subangular to subrounded, subarkose with mean composition of Q₇₀F₂₄L₆. Detrital grains are dominated by quartz, plagioclase, K-feldspar, and volcanic rock fragments. Matrix increases with depth. Measured core plug mean porosity is 32% (±3) and mean permeability is 1513md (±872). Point count porosity, dominated by primary intergranular porosity, is 24% (±10). Formation waters, sampled during the sequestration experiment, exhibited a rapid decrease in pH and increases in alkalinity and dissolved metals (Ca, Fe, Mn, Zn, Pb, & Mo). In an effort to identify the source of ions in solution, XRD and SEM analyses were completed. XRD and SEM analyses identify illite/smectite clay coats with rare amounts of kaolinite. SEM with EDAX analyses identified authigenic pyrite, occurring as framboids and euhedral crystals, and lesser amounts of quartz and feldspar overgrowths, and barite. Secondary porosity, through the dissolution of feldspar, is also observed (1% ±1). EDAX analysis of clay grain coats identifies Fe, Si, O, Al, K, Na, and Mg and BSE identifies pyrites (≤ 1µm) intergrown with the clays. Electron microprobe analyses of euhedral and framboidal pyrite were conducted to quantify trace element concentrations. Microprobe analyses identified Mn as the dominant trace element associated with these upper Frio Formation pyrites, indicating that pyrite serves as the source for Fe and Mn ions identified in the formation waters. Alteration mechanisms of the pyrite, allowing the release of Fe and Mn into solution, are still unknown though may result from surface complexes created when the pyrite is exposed to increasing HCO₃⁻ concentrations- a by-product of CO₂ injection. These data are essential in understanding the chemical changes occurring in the formation and assisting in a model simulation of the Frio sandstone's chemical reactive properties, all in response to increased CO₂ concentrations. This research supports the GCCC's CO₂ sequestration efforts, assessing the Frio Formation as a repository for anthropogenic CO₂, and ultimately, atmospheric CO₂ reduction.