

Modeling of CO₂-Water-Rock Interactions in Mississippian Sandstone Reservoirs of Kentucky

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The chemistry of formation waters directly influences the potential for dissolution of CO₂ into fluids, and mineral-forming reactions. Pilot tests are underway in Kentucky to further understand the processes involved with sequestering carbon into geologic reservoirs including: oil and gas fields, and deep saline aquifers. This study focuses on modeling the water-rock-CO₂ interactions occurring during injection into two Mississippian oil reservoirs of Kentucky.

New samples (n= 71) and archived data collected from oil wells were used to characterize the chemistry waters from the Jackson sandstone reservoir in Sugar Creek field (Hopkins County) and the Cypress sandstone reservoir in Euterpe field (Henderson County). Core and cuttings samples (n= 41) from the reservoir and overlying cap-rocks in or near these fields were analyzed for bulk and clay mineralogy using X-ray diffraction.

With water chemistry and mineralogical data as inputs, speciation and reaction path models were created using Geochemist Workbench (GWB) to predict the saturation states of minerals at equilibrium, the evolution of fluid chemistry, and mineral saturation states as CO₂ is injected into the reservoir. Default settings in GWB database, such as ionic strength, were altered to account for reactions with higher salinity brines in the reservoir. Field measurements at Sugar Creek show pH is a sensitive indicator of CO₂ migration and so a sliding pH scale was used to model the shift in pH due to increased CO₂ fugacity. Continued efforts will model the changes in CO₂ fugacity away from the injection well and the effects on mineral saturation states.