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# Reservoir Fluid-Rock Interactions During a CO2EOR/CCS Pilot Test at Citronelle Oil Field, Alabama

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Citronelle Oil Field, located in Mobile County, Alabama, was chosen as a pilot site for enhanced oil recovery (EOR) and simultaneous carbon capture and storage (CCS) by the US Department of Energy. The planned installation of a carbon capture unit at nearby Plant Barry further improved the suitability of Citronelle Field as the study location because large quantities of CO2 would eventually need to be piped to the site for full-scale commercially viable EOR. The production unit targeted for the injection of supercritical CO2 was the Upper Donovan Sand, located at the top of the Rodessa Formation, at a depth of nearly 3500 meters. Four production wells located around a central injection well were selected for sampling. After an initial period of waterflood, injection of CO2 began on 12/1/2009 and continued until 9/25/2010. Aqueous samples were taken from each producing well beginning 6/25/2010 and ending 2/13/2012. The samples were analyzed for cation concentrations by ICP-OES and for anion concentrations by ion chromatography. The chemical data were modeled using PHREEQC to interpret fluid-rock interactions induced by the supercritical CO2.

Water samples collected from wells 1908 and 1911 showed significantly lower solute concentrations than those collected from wells 1907 and 1909. This observation can be explained by accidental over-pressuring of the reservoir that occurred during initial CO2 injection attempts that caused wells 1908 and 1911 to be hydraulically connected by NE-SW trending fractures. Wells 1908 and 1909 demonstrated similar temporal patterns, with lower solute concentrations during CO2 injection, but sharply increasing solute concentrations after injection ended and waterflood resumed. In contrast, solute concentrations in wells 1907 and 1911 were elevated during CO2 injection, but decreased slightly after resumption of waterflood. Calculated saturation indices indicate dissolution of feldspars and carbonate minerals during CO2 injection and precipitation of these minerals upon resumption of waterflood. Water samples were supersaturated with respect to a number of clay minerals and iron oxide throughout the observation period. The results of this study improve understanding of the impact of fluid-rock interactions induced by the injection of supercritical CO2 and waterflood on heterogeneous sandstone reservoirs.