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**Reservoir geochemistry of CO<sub>2</sub> injection at Cranfield field, Mississippi, USA**

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At Cranfield field, Mississippi, USA, a monitored CO<sub>2</sub>-EOR project provides a unique opportunity to monitor and understand geochemical interactions of injected CO<sub>2</sub> within the reservoir. CO<sub>2</sub> injection by Denbury Resources Inc. began in mid-July 2008 on the north side of the field, with rates of ~500,000 tones per year. In mid-2009 CO<sub>2</sub> will be injected into the downdip, nonproductive Tuscaloosa Formation on the east side of the same field.

Cranfield field, discovered in 1943, is a simple anticlinal four-way closure, which had a large gas cap surrounded by an oil ring (Mississippi Oil and Gas Board, 1966). The field was produced to economic limit, and almost all wells were plugged and abandoned by 1966. The reservoir returned to original reservoir pressure (hydrostatic pressure) by a strong water drive in 2008. In the lower Tuscaloosa Formation at depths of >3,000 m, the reservoir is composed of stacked and incised channel fills and is highly heterogeneous vertically and horizontally. The Tuscaloosa Formation overlies a regional unconformity over the Washita Formation; valley-fill-fluvial conglomerates and sandstones are complexly incised and aggregated, forming a sheetlike basal sandstone unit that is the injection zone. A variable thickness (5–15 m) of terrestrial mudstone directly overlies the basal sandstone, providing the primary seal and isolating the injection interval from a series of fluvial sandbodies occurring in the overlying 30 m of the section. Above these fluvial channels, marine mudstone of the Middle Tuscaloosa forms a continuous secondary confining system of ~75 m.

The sandstones in the injection interval are rich in iron, with abundant diagenetic chamosite (ferroan chlorite), siderite, and pyrite. The reddish mudrock/siltstone layer overlying the injection zone is heavily cemented by hematite and siderite. Improved understanding of CO<sub>2</sub> interactions with this unique assemblage of ferroan minerals is needed.

Formation water chemistry was obtained before CO<sub>2</sub> injection, which provides constraints on the original geochemistry of the system. Preliminary geochemical modeling has been conducted in Geochemist's Workbench (GWB) on the basis of mineralogical and water chemical data. Water and gas samples were recently obtained from seven production wells after 8 months of CO<sub>2</sub> injection. Field determinations of EC yielded relatively constant values of 171±6 mS/cm and an alkalinity of 280 to 580 mg/L as HCO<sub>3</sub>. Higher alkalinities were generally obtained from gas samples that had higher field-measured CO<sub>2</sub> concentrations. Brine and gas samples are being subjected to detailed chemical and isotope analyses. Results of all water analyses, such as

alkalinity, pH, divalent cation concentrations, and O isotopes of water will improve understanding of CO<sub>2</sub>-induced reactions in this unique geochemical system. The modeling will also be calibrated to changes in formation water compositions. C isotopes of the gas, together with original carbonate isotopes of core samples, will enable estimation of the extent of CO<sub>2</sub>-carbonate reactions.