Organic Compounds in Produced-Brine from Tuscaloosa Formation Following CO2 Injection in the Cranfield Oil Field, Mississippi

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We are participating in SECARB Phase III, a multi-laboratory field experiment conducted by the Denbury Resources International (DRI) and Texas Bureau of Economic Geology (TBEG) for the National Energy Technology Laboratory (NETL), to investigate the potential for the geologic storage of CO2 in deep saline aquifers under high CO2 volume conditions. Denbury's concurrent goal is injection of CO2 into the Lower Tuscaloosa sandstones in the Cranfield oil field, Mississippi, for enhanced oil recovery (EOR). This field, discovered in 1943, is a simple anticlinal four-way closure that produced ~62 MMbbl of oil and ~670 MMSCF of gas before its abandonment in 1966. Injection of CO2 by Denbury began in mid-July 2008 on the north side of the field, with rates of ~500,000 tons per year. Brine, oil and gas samples were collected from the seven wells that were producing fluids during sampling in March, 2009; samples were subjected to detailed field and laboratory organic and inorganic chemical and isotope analyses to investigate changes following CO2 injection.

In this presentation, we discuss the concentration of organic compounds in high-salinity brine (TDS = 147,000±6,000 mg/L total dissolved solids) obtained from seven wells following the injection of CO2 into the Cranfield oil field; the CO2 content of the co-produced gas ranged from 6.1 to 87% by volume. Organic compounds examined for this study include phenols, BTEX (benzene, toluene, ethyl benzene, and xylenes), n-alkanes, organic acid anions and polycyclic aromatic hydrocarbons (PAHs). In addition, oil samples from the site were also analyzed. Results show that the n-alkanes increased in concentration as the percentage of CO2 in the gas phase increased. Similar general trends were observed in the concentrations of organic acid anions and the parent PAHs and their alkylated homologs with the methyl, dimethyl, and trimethyl PAHs exhibiting the greatest increases in concentration with increases in the percentage of CO2. The BTEX compounds along with the phenols showed increases in the mid-range (37-49%) of the percent CO2 with concentrations tapering off as the percent CO2 increased to 87%. Additional sampling will be carried out at this site, but our preliminary results indicate the probability of mobilization and solubility enhancement of organic compounds, in particular the alkylated PAHs and other high molecular weight organics, following CO2 injection at the Cranfield test site.