

Near-surface monitoring of large-volume CO₂ injection at Cranfield: Early field test of SECARB Phase III

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Abstract:

An early field project of the Southeast Regional Carbon Sequestration Partnership (SECARB) was conducted in Cranfield oil field, western Mississippi. Carbon dioxide (CO₂) was injected into coarse-grained fluvial deposits of the Cretaceous lower Tuscaloosa formation, forming a gentle anticline at depths of 3300 m. CO₂ injection started in July 2008, increasing to 23 wells (as of May 2011), with total injection rates greater than 1 million tons/yr. Focused monitoring programs of the deep subsurface and near surface have been implemented in different study areas. Here we present results of the near-surface monitoring program over a 3-year period, including shallow groundwater monitoring and soil-gas monitoring. A general methodology of detecting CO₂ leakage into shallow groundwater chemistry is proposed. A set of geochemical indicator parameters was identified on the basis of the characterization of groundwater geochemistry, and these were further tested and validated using numerical modeling approaches, laboratory experiments, and field experiments. For soil-gas monitoring, a site (P-site) containing a plugged and abandoned well, a nearby open pit, and an engineered pad (representing a typical industrial near-surface environment for soil-gas monitoring) was selected for detailed study. The site was heavily instrumented with various sensors for measuring soil-gas concentrations at different depths, soil-water content, matric potential, and weather information. Three monitoring technologies were assessed: soil CO₂ concentration measurements, CO₂ flux measurements on the land surface, and multiple soil-gas component measurements. Results indicate that soil-gas-component measurements provide reliable information for gas-leakage detection. Methodologies of nearsurface monitoring developed in this study can be used to improve CO₂-leakage monitoring at other CO₂ sequestration projects. This early field project was funded by the US Department of Energy, National Energy Technology Laboratory, as part of the Regional Carbon Sequestration Partnerships (RCSP) program. SECARB is led by the Southern States Energy Board (SSEB).

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