Integration of well-based subsurface monitoring technologies: Lessons learned at SECARB study, Cranfield, MS

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Abstract:

An array of closely spaced wells at Cranfield, Mississippi, USA provided a field laboratory to test wireline-based techniques for measurement of substitution of carbon dioxide (CO2) for brine. Characterization of this moderate porosity–moderate permeability sandstone reservoir in the lower Tuscaloosa Formation was conducted using openhole logs. Cased hole monitoring was conducted over the first year of injection using wireline tools including crosswell seismic, sonic, pulsed neutron, and resistivity logs. The wells were also instrumented with casing- and tubing-deployed instruments.

The most quantitative wireline measurements were made using time-lapse pulsed neutron and crosswell seismic which documented evolution of the CO2 plume. Theoretically, interpretation of fluid flow would be optimized by collection of as many types of data as possible, realistically in this setting interference among different measurements limited the amount of data collection possible. Complex well completions interfered with resistivity and sonic log quality. Changes in well bore fluids from brine to CO2 can affect measurements of the pulsed neutron tool and additional processing may be required. Data collection with large diameter tools required displacing near well CO2 with heavy brine, which perturbed the near well saturation and geochemistry.

These observations provide pragmatic information for future tests to suggest (1) the need to optimize tools to maximize value and avoid interference and (2) suggest avenues of new tool development to avoid interference in CO2 injection settings.