Comparison of Single and Multiphase Tracer Test Results from the Frio CO_2 Pilot Study, Dayton, Texas

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Injection of CO_2 into deep-brine reservoirs is one of several solutions under consideration to mitigate the effect of global warming caused by the release of man-made greenhouse gases to the atmosphere. An important issue related to subsurface CO_2 storage is whether the target reservoirs will have adequate volume to economically store large volumes of CO_2 gases sequestered from fossil-fuel-burning power plants, and how effective gas injection will be in sweeping or displacing native reservoir fluids.

We performed a series of tracer tests to study miscible and immiscible fluid displacement through the Frio sandstone, a deep saline reservoir located beneath the Gulf Coast Region of Texas. To study miscible displacement and help characterize the reservoir, we pumped brine from the reservoir and then injected it back into the reservoir to produce a steady-state flow field, referred to as a dipole test. A tracer, added to the injected water and monitored at the pumping well, allowed us to evaluate interwell travel times and tracer-breakthrough curves. These results are compared to CO_2 travel times and gas-tracer-breakthough curves resulting from multiphase immiscible displacement of brine by CO_2, observed during subsequent CO_2 injection. CO_2 breakthrough occurred within 51 hours of the start of injection compared to 8.9 days for the liquid tracer. CO_2 breakthrough was also faster than model predictions, suggesting that gas movement occurred along preferential pathways. The tracer-test data are evaluated using a combination of methods including a three-dimensional numerical model developed to predict the performance of CO_2 injection during geologic sequestration.

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