Analog Studies: Groundwater

Project Description

One concern with geologic carbon sequestration is unintended CO_2 leakage from the storage formations into overlying potable aquifers through faults, fractures, and active or abandoned wells. Such leakage has the potential for impacting underground sources of drinking water (USDW). Safeguarding USDW during geologic sequestration is of fundamental interest to both regulators and stakeholders.

Monitoring a push-pull test at the Brackenridge Field Laboratory

Methodology

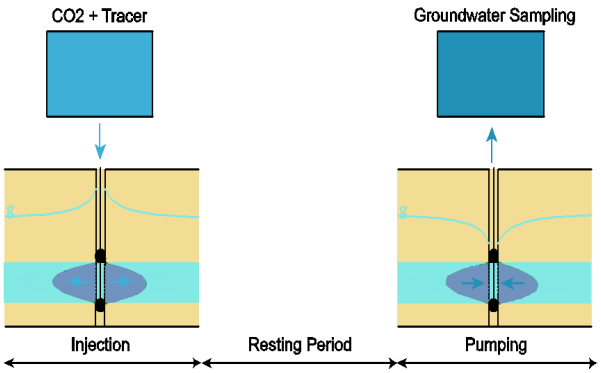
We used an integrated approach combining numerical simulations, laboratory experiments, and single-well push-pull tests to assess potential impacts of CO_2 leakage on groundwater quality and to validate groundwater geochemical measurements as indicators of CO_2 leakage.

- **Laboratory experiments.** Sedimentary and groundwater samples collected from the target aquifer are placed into beakers. Groundwater chemistry is monitored after CO_2 gas is introduced.

- **Single-well push-pull testing.** Groundwater is pumped from the target aquifer into containers, equilibrated with CO_2, then injected back into the aquifer. The injected groundwater is charged with CO_2, reacted with aquifer sediments, and then pumped back underground so that changes in groundwater chemistry can be studied.

- **Numerical simulations.** Calibrated with parameters from laboratory and field results, reactive transport models are used to predict and assess potential impacts to USDW overlying geologic storage formations.

Laboratory batch experiments



Schematic of single-well push-pull test

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Monitoring Strategy

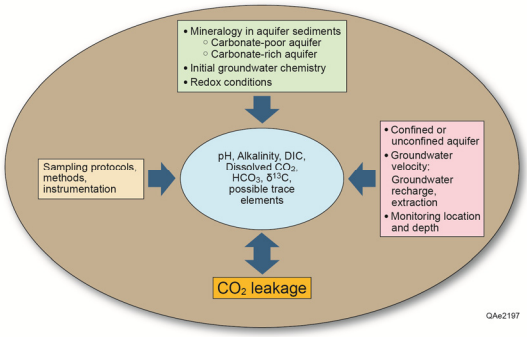
A step-wise monitoring strategy for monitoring groundwater at a geologic sequestration site was tested at the Southeast Regional Carbon Sequestration Partnership (SECARB) Phase III.

Step 1: Characterize groundwater chemistry and mineralogy in potable aquifers of concern.

Step 2: Select preliminary groundwater chemical indicators of CO_2 leakage.

Step 3: Assess sensitivity of groundwater chemical parameters to CO_2 leakage with laboratory experiments, single-well push-pull tests, and numerical simulations.

Step 4: Determine groundwater chemical parameters and monitoring tools that are the most robust indicators of CO_2 leakage.



Environmental and technical factors for monitoring CO_2

Major Findings

- Single-well push-pull tests provide reliable assessment of potential impacts of CO_2 leakage on groundwater quality.
- No significant damage to groundwater quality was found in our laboratory experiments or field tests.
- Dissolved CO_2 and dissolved inorganic carbon (DIC) detect CO_2 leakage better than groundwater pH or alkalinity.

Selected Citations

Mickler, P. J., Yang, C., Scanlon, B. R., Reedy, R., Lu, J., 2013, Potential impacts of CO_2 leakage on groundwater chemistry from laboratory batch experiments and field push–pull tests: Environmental Science and Technology, v. 47, no. 18, p. 10694–10702.

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