Preliminary Reactive Geochemical Transport Modeling Study on Changes in Water Chemistry Induced by CO_2 Injection at Frio Pilot Test Site

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A total of 1600 tons of CO_2 were injected into the Frio "C" sandstone layer at a depth of 1500 m over a period of 10 days. The pilot, located near Dayton, Texas, employed one injection well and one observation well, separated laterally by about 30 m. Each well was perforated over 6 m in the upper portion of the 23-m thick sandstone. Fluid samples were taken from both wells before, during, and after the injection. Following CO_2 breakthrough, observations indicate drops in pH (6.5 to 5.7), pronounced increases in concentrations of HCO_3^- (100 to 3000 mg/L), in Fe (30 to 1100), and dissolved organic carbon. Numerical modeling was used in this study to understand changes of aqueous HCO_3^- and Fe caused by CO_2 injection. The general multiphase reactive geochemical transport simulator TOUGHREACT was used, which includes new fluid property module ECO2N with an accurate description of the thermophysical properties of mixtures of water, brine, and CO_2 at conditions of interest for CO_2 storage. A calibrated 1-D radial well flow model was employed for the present reactive geochemical transport simulations. Mineral composition used was taken from literatures relevant to Frio sandstone. Increases in HCO_3^- concentration were well reproduced by an initial simulation. Several scenarios were used to capture increases in Fe concentration including (1) dissolution of carbonate minerals, (2) dissolution of iron oxyhydroxides, (3) de-sorption of previously coated Fe. Future modeling, laboratory and field investigations are proposed to better understand the CO_2-brine-mineral interactions at the Frio site. Results from this study could have broad implication for subsurface storage of CO_2 and potential water quality impacts.