

## **Analysis of Mineral Trapping for CO<sub>2</sub> Disposal in Deep Aquifers**

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CO<sub>2</sub> disposal into deep aquifers has been suggested as a potential means whereby atmospheric emissions of greenhouse gases may be reduced. However, our knowledge of the geohydrology, geochemistry, geophysics, and geomechanics of CO<sub>2</sub> disposal must be refined if this technology is to be implemented safely, efficiently, and predictably. As a prelude to a fully coupled treatment of physical and chemical effects of CO<sub>2</sub> injection, we have analyzed the impact of CO<sub>2</sub> immobilization through carbonate precipitation. A survey of all major classes of rock-forming minerals, whose alteration would lead to carbonate precipitation, indicated that very few minerals are present in sufficient quantities in aquifer host rocks to permit significant sequestration of CO<sub>2</sub>. We performed batch reaction modeling of the geochemical evolution of three different aquifer mineralogies in the presence of CO<sub>2</sub> at high pressure. Our modeling considered (1) redox processes that could be important in deep subsurface environments, (2) the presence of organic matter, (3) the kinetics of chemical interactions between the host rock minerals and the aqueous phase, and (4) CO<sub>2</sub> solubility dependence on pressure, temperature and salinity of the system. The geochemical evolution under both natural background and CO<sub>2</sub> injection conditions was evaluated. In addition, changes in porosity were monitored during the simulations. Results indicate that CO<sub>2</sub> sequestration by matrix minerals varies considerably with rock type. Under favorable conditions the amount of CO<sub>2</sub> that may be sequestered by precipitation of secondary carbonates is comparable with and can be larger than the effect of CO<sub>2</sub> dissolution in pore waters. The precipitation of ankerite and siderite is sensitive to the rate of reduction of ferric mineral precursors such as glauconite, which in turn is dependent on the reactivity of associated organic material. The accumulation of carbonates in the rock matrix and induced rock mineral alteration due to the presence of dissolved CO<sub>2</sub> lead to a considerable decrease in porosity. The numerical experiments described here provide useful insight into sequestration mechanisms, and their controlling conditions and parameters.

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