

## Evaluating Carbon Sequestration Potential by Modeling Mineral Carbonation of Mafic Rocks from Nevada Using Both Pure CO<sub>2</sub>(g) and Flue Gas

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Mineral carbonation is a process whereby carbon-bearing gases are reacted with rocks to sequester the carbon into synthetic minerals. Carbon sequestration potential increases with Fe and Mg content, therefore mineral carbonation studies have focused on reacting mafic and ultramafic rocks with carbon dioxide captured from point sources (coal-fired power plants, cement manufacturers). However, point source flue gases generally contain other greenhouse gases including CO, CH<sub>4</sub>, SO<sub>2</sub>, and NO<sub>x</sub>, albeit at much lower partial pressure than CO<sub>2</sub>(g). Thus, the purpose of this study is to compare models at various temperatures of rock-CO<sub>2</sub>(g) and rock-flue gas reactions for mafic rocks from Nevada using the EQ3/6 reaction path code. These models help to predict the likely waste and useful reaction products that would be generated from reacting flue gas with mafic rocks.

Input parameters are modeled after experimental conditions for ex-situ wet mineral carbonation of forsterite (O'Connor et al., 2002). The experimental procedure from that study used a solution of 1.0 molar NaCl and 0.64 molar NaHCO<sub>3</sub>, and reacted it with forsterite at 185°C in the presence of 15 MPa CO<sub>2</sub>(g). In the modeled system, a similar solution containing sodium, chloride, and bicarbonate ions was reacted with a basalt with CO<sub>2</sub> fugacity fixed at 150 bars. CIPW norms calculated for several Nevada basalts served as preliminary input basalt compositions. Various concentrations of CO, CH<sub>4</sub>, and SO<sub>2</sub> gases were added as reactants for the rock-flue gas models. NO<sub>x</sub>(g) was ignored in most models as N does not participate in mineral-forming reactions. Models were run from 0 to 200°C at 25°C intervals for each basalt, using both arbitrary and true kinetics.

In mafic rock-CO<sub>2</sub>(g) reactions carbon was sequestered in up to five mineral phases: calcite, dawsonite, dolomite, magnesite, and siderite. In the rock-flue gas models carbon was also sequestered as graphite. Non carbon-sequestering product minerals included albite, diaspore, hematite, muscovite, nontronite, and quartz. Reactions paths that involved SO<sub>2</sub>(g) resulted in the precipitation of pyrite under highly anoxic conditions. In the modeled system, iron is removed by precipitation of pyrite instead of siderite. Alternatively, SO<sub>2</sub> in a flue gas is inversely proportional to carbon sequestration in the siderite phase.