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Ferric Iron-Bearing Minerals as Geologic Traps for CO₂ Sequestration: Iron Reduction Using SO₂ or H₂S Waste Gas

Most studies of *in situ* mineral trapping of CO₂ discuss the use of glauconitic or plagioclase-bearing sediments to precipitate CO₂ in siderite or calcite. Glauconitic beds, which contain the desired ferrous iron, are generally of limited thickness and geographical occurrence. However, ferric iron-bearing sediments, including redbeds, have the advantages of widespread geographic distribution, generally greater thickness, and higher porosity and permeability. Iron, however, must be in its ferrous oxidation state in order for it to precipitate as siderite. Ferric iron in sediments requires a reductant to be reduced to the ferrous oxidation state; possible reductants include organic matter, SO₂, or H₂S. Equilibrium and kinetically controlled geochemical simulations with SO₂ or H₂S, which may be a component of the injected, CO₂-dominated waste gas, show that iron in minerals can be converted almost entirely to siderite, and simultaneously, that sulfur can be converted almost entirely to dissolved sulfate. For quartz arenite containing 1.0 wt. % Fe₂O₃, results at 105°C show that approximately 5.0 g. of CO₂ can be sequestered per kg. of rock. In order to maximize CO₂ sequestration and minimize iron sulfide precipitation, the CO₂-dominated gas must contain approximately 20.0 wt. % SO₂, or 5.0 wt. % H₂S. The resultant porosity decrease is small, on the order of 0.2%, relative to the initial porosity of 21%. Disposal of CO₂ in red beds has the added advantages of disposing of SO₂ that may already be present in the combustion gas, and of making use of a mineral trap with potentially great capacity.