

Gypsum solubility in CO₂ rich aqueous solutions

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Background and methods

Injection into the deep subsurface is a viable approach for the long-term sequestration of CO₂. Supercritical CO₂ in saline aquifers dissolves into water and reacts with solutions and reservoir rocks. We investigated specifically gypsum solubility because of the prevalence of gypsum cap rock in natural CO₂ reservoirs. Gypsum saturated solutions in quartz lined reactors were exposed to stepwise increasing CO₂ pressure. Sample aliquots were withdrawn and Ca concentration determined. At the end of each experiment the solid phase was characterized.

Results and discussion

Our initial hypothesis was that solubility would increase due to sulfate protonation to bisulfate as pH decreases, allowing more gypsum to dissolve. We found however that solubility actually decreases with increasing CO₂ pressure from 25-60°C. The effect was greatest in pure water (almost 50%), decreasing with increasing ionic strength.

When plotted against total dissolved CO₂, instead of pressure, the decrease is linear up to 1.5M dissolved CO₂.

Discussion

These results are opposite our prediction and that of the standard geochemical models. Models using the Pitzer equations however more closely approximate the results even in distilled water. We are investigating the role of hydration number, and water activity on solution complexes. These results suggest that sequestration in Ca:SO₄ type waters may precipitate gypsum, decrease porosity or seal the reservoir.