Mineral carbonation in a low energy system

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Mineral carbonation is a safe and long term method for CO_2 sequestration, but it is difficult to increase the slow reaction rate with minimal energy input. It is imperative to develop a more energy efficient approach. A lab-scale study of forsterite dissolution is examined to test a passive design, which will ultimately use a feedstock of 5% CO_2 captured from air. CO_2 enriched air was equilibrated with deionized water using a liquid-air exchange membrane. San Carlos olivine powder and the aqueous solution were reacted at approximately 25°C and 1 bar lab conditions in a batch reactor. Reaction products of forsterite dissolution were quantified by elemental analysis of the solution and dissolved solids. Reaction progress was continuously monitored by infrared gas analysis of P_{CO2} of a fixed recirculating gas volume as well as pH measurements of the solution. Forsterite dissolution at ambient lab conditions resulted in increased concentrations of Mg in solution, as desired. Based on Ni as an indicator of olivine dissolution, approximately 0.03% of the olivine was dissolved over the initial nine-day experiment. While the pace is leisurely, the results indicate that it is feasible to dissolve olivine with a low P_{CO2} and minimal energy input. The initial experiment provides a starting point for numerous ways to improve the process. It suggests a path to passive mineral carbonation.