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CO_2 Solutions - Driven by enzyme-enabled carbon capture

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One approach for mitigating excessive carbon dioxide (CO_2) in the atmosphere, a factor that contributes to extreme weather and wildfires, is to reduce excessive CO_2 levels by capture and storage. However, storage runs the risk that CO_2 injected underground as fluid can migrate and escape. Fortunately, nature has provided a solution through carbonate mineralization in deep rock, which stores the carbon in the rock as part of the rock itself. Since biology accelerates carbon mineralization in basalts, therefore, in this talk, I will discuss the systems available to increase the sequestration of CO_2 via carbonate mineralization from either bioaugmentation or bio stimulation in deep rock. One amongst this system is the use of microbial carbonic anhydrase that catalyzes reversible CO_2 hydration and forms metal carbonates that mimic the natural phenomenon of weathering/carbonation. However, little is known if this process could be made more effective with the assistance of extremophiles. This work aims to collect the pilot data needed to begin developing an extremophile mediated carbon mineralization sequestration system that can be deployed at industrial to community scales. For this purpose, we are using microbes isolated from on the 4100 feet level and sediments from the 4850 feet level of Sanford underground research facility (SURF), Lead, SD and other locations, 65% of which are unique and can grow in conditions as varied as at high temperatures (thermophiles), low pH (acidophiles) or salinity (halophiles). Further, work is in progress to understand life rules in the rocks of core samples drilled from the 4100 feet level of SURF at high temperatures and pressures.