

Accelerated Silicate Dissolution Using Small Organic Molecules

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CO₂ accounts for approximately 80% of all greenhouse gas emissions, making it a critical target for reduction. Rock weathering is a natural process that captures about 1 Gt of CO₂ annually. Enhanced weathering is a process where alkaline material is reacted with CO₂, which is then trapped as secondary phases, converting the gas to solid form. This natural process could be replicated on an industrial scale and has the potential to be highly effective. However, despite its promise, one of its major limitations is the slow rate of dissolution of silicate materials. If we could accelerate the dissolution rate, it would be a potential breakthrough in carbon dioxide removal (CDR) technology.

In nature, some organisms (such as fungi and mosses) produce organic molecules that break the bonds in minerals, to release nutrients for their growth [1]. Other organisms sequester elements from water to create hard parts, such as the amorphous silica coverings of diatoms, the calcite shells of oysters and the bones and teeth that our bodies make. Until now, there is a great deal that is not known about the molecular level reaction mechanisms of such processes. We are investigating the behaviour of small biogenic molecules and their role in controlling weathering processes. In particular for this study, we have investigated silica-water-organic molecule interactions to understand the mechanisms they use to speed dissolution of silicate bearing materials. This information will be useful for controlling secondary phase formation and increasing CO₂ uptake.

[1] Chen J., Blume H.P., Lothar B. (2000) Weathering of rocks induced by lichen colonization - A review. *Catena* 39, 121-146.