Goldschmidt 2025 Abstract
https://doi.org/10.7185/gold2025.26954

Capture of carbon by biologically induced precipitation of Ca/Mg carbonates by anoxygenic phototrophic sulfur bacteria

MARAWIT TESFA[1], TODOR RUZIC[1], MORGANE CARRIER[1], SIMON DUBOS[1], MATTHIEU PEYRE-LAVIGNE[1], LIUDMILA SHIROKOVA[2], MATHIEU SPERANDIO[1], OLEG POKROVSKI[2] AND CLAIRE DUMAS[1]

[1]TBI, Université de Toulouse, CNRS, INRAE, INSA Toulouse, France

[2]Géosciences Environnement Toulouse (GET) – Research Institute for Development [IRD]: Toulouse University, CNRS, Toulouse, France

To reduce atmospheric carbon (CO_2) level, the presented study aims to understand the biological processes that entrap CO_2 by calcium/magnesium carbonate precipitation ($Ca/MgCO_3$). Two biological mechanisms precipitating carbonates occur naturally [1]: (i) an active mechanism, where bacteria precipitate carbonates due to their metabolism and (ii) a passive mechanism, where microorganisms increase the pH and/or produce exopolymers, which induce precipitation. Here, the bioprecipitation induced by anoxygenic phototrophic sulfur bacteria (APSB) was studied, taking *Allochromatium Vinosum* as a model microorganism.

To understand bioprecipitation, we attempted to reproduce it in a lab-controlled environment which allowed to characterize the nature of mineral precipitates and quantify their yield and rates of formation. The experiments were conducted in small batch bioreactors, containing *A. Vinosum* with its growth media: vitamins, trace elements, inorganic energy source, sodium carbonates and chloride calcium; without addition of organic substrate to hinder photo-heterotrophy. The concentration of bacteria, some elements from the growth media and the incubation time were modified to pinpoint the variables that drive precipitation. Chemical environment was monitored (pH, COD, inorganic carbon, ions...) and after filtration, precipitates were collected, weighted and analyzed (XRD, SEM).

The incubation variation time displayed two different precipitation phases: rapid, reaching chemical equilibria within one hour, and slow, reaching equilibria within 15 days.

We hypothesize the rapid kinetics was chemically driven and the slow kinetics depended on *A. Vinosum* growth cycle. The presence of phosphate was also shown to induce calcium phosphate precipitation as apatite, competing with $CaCO_3$ precipitation. Previous studies showed that $CaCO_3$ precipitation occurs when bacteria have an organic energy source [2]. Because the aim here is to reduce CO_2, by working in an inorganic growth media to precipitate carbonates with solely inorganic carbon sources, $CaCO_3$ precipitation was challenging and the yields of carbonate precipitation were lower than in traditional experiments with organic-rich media. To overcome this challenge, the work in progress decouples bacterial growth phase from the mineral precipitation phase separating them in different reactors.

[1] Dupraz, C., Visscher, P.T., 2005. Trends Microbiol. 13, 429–438.

[2] Bundeleva, I.A., Shirokova, L.S., Bénézeth, P., Pokrovsky, O.S., Kompantseva, E.I., Balor, S., 2012. Chem. Geol. 291, 116–131.