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Biomineralization of hydrous Mg carbonates and silicates

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The biomineralization of CO_2 in the form of carbonate minerals is considered as one of the efficient solutions of atmospheric CO_2 removal, allowing stable and sustainable storage of this greenhouse gas. The weathering of (ultra)mafic rocks such as olivine, first step of CO_2 storage, releases small amounts of Si in the environment, which could impact the formation of secondary Mg carbonates and allow the formation of silicate minerals. Although the formation of carbonate rocks by cyanobacteria in the form of stromatolites has been well documented (e.g., [1], [2], [3]), the effect of dissolved Si on kinetics of precipitation and the nature of formed solid phases have not been yet studied.

In this work, we studied, via laboratory experiments, the biologically-induced precipitation of hydrous Mg carbonates and silicates from carbonate-bearing medium enriched in Mg and in presence of a small amount of Si (~0.3 mM) in the presence of cyanobacteria *Synechococcus* sp., in order to characterize the rates, stoichiometry and mineralogical nature of precipitates.

Our results demonstrated the formation of Mg carbonates and silicates via the increase of pH induced by the photosynthetic activity of cyanobacteria. Transmission electron microscopy observations and associated chemical and crystallographic analyzes identified magnesium carbonates around the cells which could be nesquehonite ($MgCO_3 \cdot 3H_2O$) and/or hydromagnesite ($Mg_5(CO_3)_4(OH)_2 \cdot 4(H_2O)$), as well as an amorphous Mg silicate, sepiolite ($Mg_4Si_6O_{15}(OH)_2 \cdot 6H_2O$). Overall, the presence of Si allowed the formation of sepiolite but did not prevent the formation of Mg carbonates.

[1] Mavromatis *et al.* (2012), *Geochim. Cosmochim. Acta* **76**, 161-174. [2] Shirokova *et al.* (2013), *Aquat. Geochem.* **19**, 1-24. [3] Martinez *et al.* (2016), *Appl. Geochem.* **75**, 76-89.