Labex MATISSE

Axe Biomineralization

« Intracellular biomineralization by cyanobacteria: *in vitro* and *in vivo* study»

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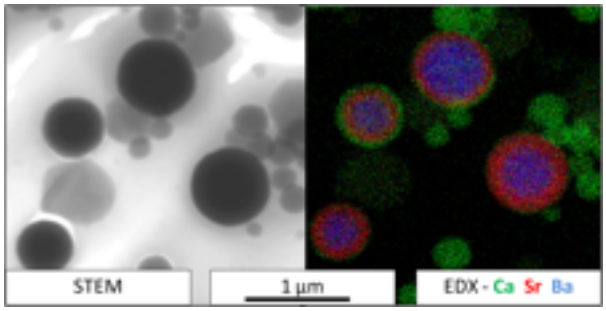

A culture of cyanobacteria is grown in a medium containing Ca, Sr and Ba. We can observe Ca, Sr and Ba carbonates forming inside a cell by scanning transmission electron microscopy in bright field mode and the corresponding EDX mapping. These carbonates have a core-shell structure with successive layers of Ba, Sr and Ca. This spatial distribution illustrates the successive and selective incorporation of Ba then Sr and finally Ca within the cells.

Hosting laboratories, teams and and thesis supervisors names:

LRS, Biointerfaces team, Jean-François Lambert
IMPMC, Geobiologie team, Karim Benzerara

Research project (10 lines)

Cyanobacteria are relatively diverse phylogenetically, abundant and widespread at the surface of the Earth. By their photosynthetic activity they modify significantly their environment and in particular impact the carbon geochemical cycle by formation of organic carbon and precipitation of calcium carbonate. Recently some cyanobacteria able to form intracellular carbonates have been discoved [1, 2]. It has been suggested moreover that calcification might be controlled by these cyanobacterial species. The intracellular carbonates they form have several peculiar characteristics: they are poorly crystalline, relatively small (between 60 and 500 nm) and at least in some cases have much higher Sr/Ca and Ba/Ca ratios than the solution in which the cells grow. Therefore, understanding the formation of these carbonates may open new perspectives on remediation of heavy alkaline earth metals.

[1] Couradeau, Benzerara, Gerard, Moreira, Bernard, Brown, and Lopez-Garcia, *Science* (2012) 336, 459–462.
[2] Benzerara, Skouri-Panet, Li, Férard, Gugger, Laurent, Couradeau, Ragon, Cosmidis, Menguy, Margaret-Oliver, Tavera, López-García, and Moreira, *Proc. Natl. Acad. Sci.* (2014) 111, 10933–10938.

Summerize your scientific results & impacts (5 lines)

I performed *in vitro* abiotic syntheses of Mg-, Ca-, Sr- and Ba-containing carbonates with compositions, crystallinities and sizes close to those observed in cyanobacteria. These syntheses show the cyanobacteria specifically accumulate Sr and Ba. Bacterial growth experiments reveal that the intracellular precipitation of carbonate is fast and only possible thanks to an active biological process. Also a cyanobacterial strain reveals a great ability to select Ba and Sr relative to Ca.

Main key facts

Publication: N. Cam, T. Georgelin, M. Jaber, J-F. Lambert, K. Benzerara: ***"In vitro synthesis of amorphous Mg-, Ca-, Sr- and Ba-carbonates: what do we learn about intracellular calcification by cyanobacteria?"*** *Geochim. Cosmochim. Acta.* (2015) DOI: 10.1016/j.gca.2015.04.003

Oral presentation: 12th International Symposium on Biomineralization. Freiberg, Saxony / Germany. 27-30 August. N. Cam, T. Georgelin, K. Benzerara, M. Jaber, J-F. Lambert: **"Abiotic synthesis of amorphous (Mg, Ca, Sr, Ba)- carbonates: mimicking intracellular controlled calcification by cyanobacteria"**

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