New bacterium forms intracellular minerals

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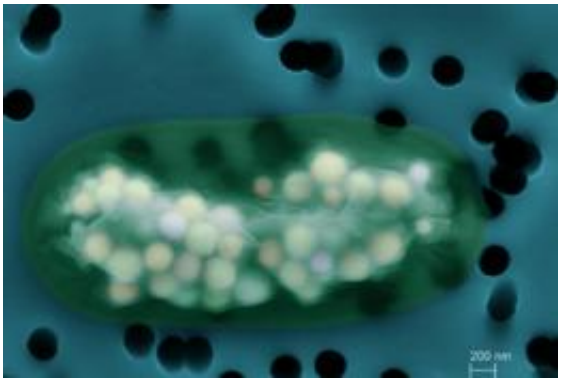

Image of Candidatus Gloeomargarita lithophora. Inclusions of calcium, magnesium, barium and strontium carbonates can be seen Inside the cyanobacterium. © Karim Benzerara & Stefan Borensztajn

A new species of photosynthetic bacterium has come to light: it is able to control the formation of minerals (calcium, magnesium, barium and strontium carbonates) within its own organism. Published in *Science* on April 27, 2012, a study by French researchers reveals the existence of this new type of biomineralization, whose mechanism is still unknown. This finding has important implications for the interpretation of the ancient fossil record.

Cyanobacteria have long attracted scientists' attention. Capable of photosynthesis, these microorganisms have played a major role in Earth's history, in particular by contributing to the oxygenation of the atmosphere. Some cyanobacteria are able to form calcium carbonate

outside their cell, especially those associated with stromatolites, carbonate rocks that date back some 3.5 billion years and are among the earliest traces of life on Earth. Fossil cyanobacteria should therefore be present within this type of formation. However, the first fossil cyanobacteria go back a mere 700 million years, well after oxygen levels in the Earth's atmosphere started to rise some 2.3 billion years ago.

A French team may have found the reason for this long time lapse. In stromatolites collected in a crater lake in Mexico and cultured in the laboratory, the scientists discovered a new species of cyanobacterium, called Candidatus Gloeomargarita lithophora. This microorganism descends from a lineage that diverged early on in cyanobacteria. Thanks to an as yet unknown biomineralization mechanism, this cyanobacterium forms intracellular calcium carbonate nanoparticles of around 270 nanometers (270 billionths of a meter). While some cyanobacteria were known to form extracellular calcium carbonate within stromatolites, their formation within the cell had never been observed. Another distinctive feature of the new species is that it accumulates strontium and barium and incorporates them into the carbonate.

This finding is significant for the interpretation of the ancient fossil record. If the cyanobacteria associated with stromatolites formed carbonates inside their cells rather than outside, they would not have been preserved in the fossil record. This would explain the time lapse between their earliest appearance (at least 2.3 billion years ago) and the oldest fossils discovered (700 million years ago). The next step is to find out why and how this cyanobacterium produces the calcium carbonate.

More information: An Early-Branching Microbialite Cyanobacterium Forms Intracellular Carbonates, Estelle Couradeau, Karim Benzerara, Emmanuelle Gérard, David Moreira, Sylvain Bernard, Gordon E. Brown Jr., Purificación López-García – *Science*, 27 April 2012

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