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Unravelling the role of microbial biofilms in freshwater lacustrine ooid formation - Field and laboratory experiments

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Previous investigations in the western portion of Lake Geneva, Switzerland, have shown that shallow water sediments are mainly composed of ooids. SEM observations pointed towards microbial biofilms infilling depressions on the surface of the nucleus of these coated grains. This activity suggests that these biofilms may represent starting points triggering the development of low-Mg carbonate cortex. These new observations, hence, indicate that microbial biofilms may play a significant role in the formation of ooids.

A special device was designed for harvesting microbial biofilms in order to better understand and constrain their role in ooid formation. The device was placed at 2.50 meter water depth, and it contained 12 vertical glass slides on a horizontal plastic arm in order to avoid particle setting on their surfaces. These glass slides were previously frosted so as to offer attractive depressions in which microbial biofilms developed as in the surface of the coated grains. SEM observations of these frosted glass slides showed that, as in the natural ooids, low-Mg calcite precipitates are always found in close association with microbial biofilms. The inspection of dehydrated samples using a critical point shows that microbial biofilms are mainly composed of coccoid (Synechoccus, Anacystis) and filamentous (Tolipothrix, Oscillatoria) cyanobacteria, heterotrophic bacteria and different species of diatoms.

Ultra high-resolution geochemical analysis using X-ray microfluorescence allowed mapping elemental distribution within the microbial biofilms confirming their close relation with low-Mg calcite formation.

Microbial biofilms were further isolated from the frosted glass slides and successfully grown in BG11 solid and liquid cultures. Several experiences have been conducted in the laboratory and identical mineral phases were precipitated under controlled conditions. Ongoing laboratory experiments include DNA extraction for precise identification of biofilms communities. The latter will be critical to design more specific experiments in order to define the exact role of these microbes in the precipitation of low-Mg calcite in freshwater environments.