Non-cyanobacterial lineages likely contribute to carbonate precipitation in modern microbialites

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Microbialites are organosedimentary structures whose formation is influenced by the metabolic activity of phylogenetically diverse microbial communities. Microbialites are today found in a restricted number of environments where the conditions (*e.g.* high alkalinity, saturation in specific elements) are favourable to the precipitation of minerals, notably carbonate. Cyanobacteria are thought to play a key role in carbonate precipitation due to their metabolic activity, but other organisms carrying out oxygenic photosynthesis (photosynthetic eukaryotes) or other metabolisms (*e.g.* anoxygenic photosynthesis, sulfate reduction), may also contribute to carbonate formation.

We studied the microbial diversity of microbialites from the Alchichica crater lake (Mexico) by mining for 16S/18S rRNA genes in metagenomes obtained by direct sequencing of environmental DNA. We studied samples collected at the Western (AL-W) and Northern (AL-N) shores of the lake and, at the latter site, along a depth gradient (1, 5, 10 and 15 m depth).

The associated microbial communities were mainly composed of bacteria, whereas archaea were negligible. Eukaryotes composed a relatively minor fraction dominated by photosynthetic lineages. Although cyanobacteria were the most important bacterial group contributing to the carbonate precipitation potential, photosynthetic eukaryotes, anoxygenic photosynthesizers and sulfate reducers were also very abundant. Multivariate statistical analyses showed a strong positive correlation of two cyanobacterial groups (Pleurocapsales and Chroococcales) with aragonite formation at macroscale, suggesting a potential causal link. Despite the previous identification of intracellularly calcifying cyanobacteria in Alchichica microbialites, most carbonate precipitation seems extracellular in this system.

[1] Saghaï et al. (submitted to Frontiers in Microbiology): Metagenome-based diversity analyses suggest a significant contribution of non-cyanobacterial lineages to carbonate precipitation in modern microbialites.