Precipitation of low-T hydrated talc by microorganisms in modern microbialites from Mexico

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Microbialites are organo-sedimentary structures found in abundance throughout the geological record back to 3.5 Ga. Although they are considered as among the oldest life remains on Earth, the search for fossils of microbial cells remains a challenge due to the difficulty to distinguish biogenic traces from abiotic artefacts.

In order to improve our knowledge on these questions, we studied modern microbialites from four Mexican crater lakes: Alchichica, Quechulac, La Preciosa and Atexcac. Characterization of water solutions was systematically coupled with a mineralogical analysis of microbialites.

X-Ray Diffraction (XRD) and Fourier Transform Infrared Spectroscopy (FTIR) analyses revealed a diversity of mineral phases including aragonite and sometimes calcite, hydromagnesite ($Mg_5(CO_3)_4(OH)_2{\cdot}4(H_2O)$), and more interestingly, a poorly crystalline hydrated silicate phase. Coupling of scanning electron microscopy with energy dispersive x-ray spectrometry microanalyses on polished sections showed that this latter phase is abundant, authigenic, rich in silicon and magnesium and sometimes associated with iron and manganese. The Mg/Si atomic ratio is estimated to 3/4 by electron microprobe analyses, suggesting that this mineral phase is similar to an hydrated poorly crystalline talc phase ($Mg_3Si_40_{10}(OH)_2$, nH_2O).

A diversity of morphologically well preserved microfossils was observed in this mineral phase. The structural and chemical features of these potential fossils were further studied down to the nanometer scale using a combination of Focused Ion Beam (FIB) milling, Transmission Electron Microscopy (TEM) and Scanning Transmission X-ray Microscopy (STXM) at the carbon and magnesium K-edges and iron $L_{2,3}$-edges. These results suggest that the poorly-crystalline hydrated magnesium-rich silicate may result from a biomineralization process. Implications for microbial fossilization in ancient rocks will be discussed.