ECOLE LEMANIQUE DES SCIENCES DE LA TERRE
DES UNIVERSITES DE GENEVE ET DE LAUSANNE

Master ès Sciences in Earth sciences

Tracking Mg-silicates in microbialites from the geological record

Contact persons

Nina Zeyen (nina.zeyen@unige.ch)
Johanna Marin Carbonne (johanna.marincarbonne@unil.ch)

Context

Microbialites are organo-sedimentary structures that formed under the influence of microbial ecosystems. These structures span the entire geological record from the Archean to today and are among the oldest traces of Life on Earth. Understanding the mineralization process driven by the biological activity is challenging as microenvironments can also induce chemical variations responsible for mineral formation. However, it is now established in modern environments that authigenic poorly crystalline Mg-silicates are likely to be one of the precursors of the mineralization.

Aims and Methods

The aim of this master project is to investigate ancient microbialites, mostly from the Archean to characterize the Mg and Fe silicate phases present. Potential target samples include Isua stromatolite (3.7 Ga, Greenland), Strelley Pool stromatolite (3.47 Ga, Australia), Tumbiana stromatolite (2.7 Ga, Australia), and Malmani Campbellrand stromatolite (2.5 Ga, South Africa). Comparison with modern microbialites from Sardinia (marine environment) and Mexican lakes will also be performed.
The mineralogy of these samples will be investigated by microscopy (optical and SEM), Raman spectroscopy, and XRD. FTIR will also be performed to better understand the association between organic matter and these silicates. Quantitative chemical analyses by EPMA will also be implemented on selected samples. For these samples, in situ isotopic Fe analyses can be performed at the SwissSIMS as standards are currently under development for a NASA exobiology project.

References

Zeyen, Nina, et al. "Formation of low-T hydrated silicates in modern microbialites from Mexico and implications for microbial fossilization." *Frontiers in Earth Science* 3 (2015): 64.
Burne, Robert V., et al. "Stevensite in the modern thrombolites of Lake Clifton, Western Australia: A missing link in microbialite mineralization?." *Geology* 42.7 (2014): 575-578
Zeyen, Nina, Benzerara, Karim, Menguy, Nicolas, *et al.* Fe-bearing phases in modern lacustrine microbialites from Mexico. *Geochimica et Cosmochimica Acta*, 2019, vol. 253, p. 201-230.
Tosca, Nicholas J., Stephen Guggenheim, and Peir K. Pufahl. "An authigenic origin for Precambrian greenalite: Implications for iron formation and the chemistry of ancient seawater." *Bulletin* 128.3-4 (2016): 511-530.

Stromatolite from The Malmani Formation (2.5 Ga, South Africa)

Website

Prerequiste

Chemical analyses and imaging techniques for major and trace elements
Isotope analyses