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Mineral and microbial community composition of gypsum-based microbialites from the Danakil depression, Ethiopia

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Stromatolites are an emblematic example of the geology-biology synergy that has marked Earth's fossil record and atmospheric evolution. These laminated, organo-sedimentary structures form upon the interplay of phylogenetically highly diverse microorganisms with environmental variables. Stromatolites are usually carbonate-based, but atypical, gypsum-based stromatolites and endoliths have been reported from some extreme geochemical systems around the world, e.g., Egypt, Chile, Antarctica, Mexico or Venezuela. Gypsum stromatolites also formed during the 'Messinian salinity crisis', one of the greatest desiccation events of the Mediterranean and Paratethys Sea [1, 2]. Given the ongoing desertification, such evaporitic, gypsum-based ecosystems are expected to expand once more in the sedimentological record. However, gypsum stromatolites are understudied compared to their carbonate counterparts. Getting information on the microbial ecology, mineralogy and biogeochemistry of gypsum-based microbialites will allow understanding how these structures form and how they will evolve in response to changing environmental variables. At a fine-scale level, identifying mineral-microbial associations in modern and fossil gypsum stromatolites will help to differentiate true biosignatures from biomorphic, chemical precipitates.

Here, we present an ongoing study of the microbial communities, geochemistry and mineralogy of newly-discovered gypsum microbialites from the Lake Bakili and surroundings, Danakil depression (Ethiopia). Lake Bakili is a unique natural laboratory for the study of Ca-sulfate precipitation in presence of microorganisms, as well as for the preservation of fossil remnants in gypsum deposits, because it harbors subaerial mineralized microbial mats, subaqueous living stromatolites and fossil gypsum microbialites. We use a suite of microscopic, spectroscopic and diffraction characterization techniques to study the geochemistry and mineralogy of the living/fossil stromatolites and mineralized mats. We apply a 16S rRNA gene metabarcoding approach to characterize the microbial community structure of the stromatolites. Finally, multivariate statistical analysis including physicochemical parameters will help us to determine the drivers of mineral precipitation and stromatolite formation.

References

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