EGU21-8911
https://doi.org/10.5194/egusphere-egu21-8911
EGU General Assembly 2021

Living and fossil microbialites in Laguna de Los Cisnes (Southernmost Chile): A duel between biotic and abiotic processes

Clément Pollier[1], Daniel Ariztegui[1], Alejandro Nuñez Guerrero[2], and Jorge Rabassa[3]
[1]Department of Earth Sciences, University of Geneva, Geneva, Switzerland (clement.pollier@etu.unige.ch)
[2]Universidad de Magallanes, Porvenir, Chile (alejandro.nunez@umag.cl)
[3]CADIC-CONICET, Ushuaia, Argentina (jrabassa@gmail.com)

Appeared more than 3.5 billion years ago, microbialites represent one of the oldest ecosystems on Earth. These architects of oxygenic photosynthesis dominate the fossil record for nearly 80% of Earth's history, having influenced the evolution of the planet notably by changing the properties of the atmosphere. Despite a dramatic decline in their abundance from the start of the Phanerozoic, they still develop today in a wide spectrum of depositional environments (The Bahamas, Australia, Brazil, etc.). The spatio-temporal distribution of microbialites therefore make them a valuable archive of both life and Earth evolution. However, after nearly 100 years of research, their origin as well as their environmental significance is still a matter of debate. Little is known about microbialite formation, in particular the relative roles of microbial versus environmental factors ruling their growth. Laguna de Los Cisnes located at 53 ° 25' S and 70 ° 40' W in Chilean Tierra del Fuego, Patagonia, provides us with a unique site to fill this gap. This basin was formed during the retreat of the ice following the last glaciation about 10,000 years ago. Subsequently, the lake was densely colonized by microbial mats that developed the presently living and fossil carbonate microbialites. We have explored the relative contribution of environmental versus biological factors controlling microbialite morphogenesis across various scales.

Macroscopically, these organo-sedimentary deposits have an extension of almost 8 km^2 encompassing several morphologies exceptionally large with maximum heights and widths of 1.5 m and 5.0 m respectively. Crater-like shapes are dominant, displaying a spherical to elongated character most frequently unfilled. Both spatial distribution and temporal succession of morphotypes indicate that the dominant physico-chemical character of the water is critical in the localization as well as in the style of the microbial carbonate factory, which in turn is reflected in the morphological character of the subsequent deposit. The microbialite meso-structure reveals a pattern of three lithological distinctive stacked layers. This fabric reflects a multiphase history of formation, linked with the ecological succession of specific bacterial communities throughout time that are still strongly influenced by the prevailing environmental conditions. Interestingly, the simultaneous occurrence of various living bacterial mats provides insights regarding the

microscale interactions between the different compounds of the bacterial ecosystem (cyanobacteria, sulfate-reducing bacteria, green algae and diatoms) and their relative roles in the calcification processes.

Finally, the presence of extraordinary well-preserved fossil outcrops along with living microbialites gives a temporal dimension to this study, laying the foundation for the development of a new formation model. By applying the latter to other microbialites outcropping at different geographical and temporal scales, the microbial carbonates of Laguna de Los Cisnes can provide critical information to better reconstruct the dominant environmental conditions during the early evolution of life on Earth.