Environmental vs. biological factors ruling the development of fossil and living microbialites in Laguna de los Cisnes, southernmost Chile

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Microbialites are organo-sedimentary deposits resulting from the activity of a microbial consortia. The prevailing environmental conditions during their formation can also have major implications in their development. The lack of detailed studies of modern examples, however, prevent a complete understanding of the different factors ruling microbialite formation.

Laguna de los Cisnes in southernmost Patagonia (Chile) is part of a set of lakes formed during the retreat of the ice following the last glaciation. Subsequently, the lake was densely colonized by microbial mats that developed the presently living and fossil microbialites. We present here the first detailed geomorphological, geochemical and geomicrobiological study. These organo-sedimentary deposits have an extension of almost 8 km² encompassing four principal macro-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. This particular macro-morphology seems clearly controlled by the prevailing environmental conditions as shown by a systematic orientation of their elongated shapes perpendicular to the coastline. In addition, there is also a relational increase in the height of the microbialites with water depth most probably to adapt to reducing light conditions during increasing lake water levels. Microscopic observations of the fossil microbialites as well as of the living microbial communities show that they both are quite uniform. A dense lamellar carbonate in the bottom appears associated with sulfate-reducing bacteria on top of which microbialites further develop with a shrub-like fabric. The latter is most probably due to the escape of bubbles resulting from cyanobacteria photosynthetic activity.
The occurrence of extraordinary well-preserved fossil outcrops along with living microbialites allows to develop a model of formation. This model can be further applied not only to this exceptional site but also to other microbialites outcropping at different geographical and temporal scales. It can also provide innovative data that can be used in the search of the cradle of life in both early Earth as well as another planets.

Mots-Clés : microbialites, living, fossil, southernmost Chile

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