Geophysical Research Abstracts
Vol. 21, EGU2019-18068, 2019
EGU General Assembly 2019

Microbial participation on the production and preservation of gypsum structures from Salar de Pajonales, northern of Chile

Cinthya Tebes (1), Constanza Rodriguez (2), Cecilia Demergasso (3), Guillermo Chong (2), Nancy Hinman (4), and Victor Parro (5)

(1) Ph.D student of doctoral program in Sciences with a mention in Geology, Universidad Católica del Norte (UCN), (2) Department of Geology Universidad Católica del Norte , (3) Centro de Biotecnología Alberto Ruíz, Universidad Católica del Norte , (4) Department of Geosciences, University of Montana, (5) Astrobiology Center (INTA-CSIC), España

Along Tertiary times, aridity and volcanism defined in northern Chile a “saline domain”. Chlorides, sulfates, and borates are sourced from magmatism through volcanism, recycled by hydrothermal circulation or hydrological activity. Gypsum frequently occurs in evaporitic environments and is also known as a habitable architecture for microorganisms. One example is gypsum structures (GS). Recently, Chilean salt flats, like Salar de Pajonales (SP) and Salar de Gorbea, have received global attention as terrestrial analog environments to Mars because of the potential long-term microbial viability within gypsum crystal. Evidence of endolithic communities has been reported in GS associated with volcanic rocks, calcite, quartz, and halite. However, nothing is known about the microbial participation in the formation and preservation of GS.
Our main objective is to characterize the microbial communities in microbial mats with evident gypsum precipitation and in gypsum structures with a distinctive grade of formation and preservation.
In order to distinguish abiotically and biotically gypsum precipitation in the formation process, hydrochemistry and brines evolution were registered. A geological map of SP exhibiting the localization of GS in-formation and in-preservation has been carried out. GS were classified according to morphology, colonization type, relative humidity, texture, macro and fine-scale mineralogy, fluorescence pattern, lipids biomarkers, microfossil composition, microbial abundance, and diversity indexes.
SP is classified as arid region due to its low precipitation (80-150mm/year), low transpiration (1350 mm/year) and other data (397,3 W/m2, 3-10°C, and 0,2%RH). Lagoons with <10% of salinity do not have abiotically gypsum precipitation. Microbial mats with gypsum precipitation and in-formation GS are observed submerged in lagoons with 14 to 44% of salinity in the center of SP, and fossil outcrops are preserved in the southeast part of SP. Endolithic colonization is found in the last two cases. Thermal springs, carbonate terraces, and ulexite horizons associated with silica and halite are also present in SP. SEM and micro-XRF analysis revealed the occurrence of a millimeter-scale laminated structure at the bottom of the preserved GS and centimeter-scale vertical selenitic crystals at the top of formed and preserved GS. Diatom frustules and biofilm remains were observed mainly in the laminated structure where Fe-SiO4-rich interplayed between gypsum-layers. Microbial pigments were observed in the upper part of the selenitic gypsum in formed and preserved GS as well as microbial mats, and their fluorescence fingerprints indicated that phototrophic cells were intact and healthy. The microbial community was dominated by Proteobacteria, Bacteroidetes, and Cyanobacteria. LDChip-3000 confirms that Cyanobacteria prefers selenitic crystals stead of gypsum crusts and humid sediments. Selenitic crystals showed a predominance of Thermi and Cyanobacteria, like Chroococcidiopsis which has been reported in hyper-arid habitats. Conversely, gypsum crust is dominated by Proteobacteria and Bacteroidetes.
The different salinity gradient in lagoons, gypsum textures (like grains, layers, and crusts), and development of domical mounds exhibiting selenitic crystals growing syntaxially at the top of the structure suggest the microbial participation in the deposition process. Thus, searching for evidence of microbial induction or influence on gypsum precipitation and on the GS’s formation is relevant for the exploration of biosignatures.