The Salar Grande hyperarid salts of the Atacama Desert (Chile), an analog of the Mars chloride-bearing deposits in Terra Sirenum


Introduction: The southern highlands on Mars contain ancient deposits of chlorides that were precipitated from hypersaline brines [1, 2]. Chlorides are formed during the evaporation of surface water or underground Cl-bearing waters on Earth. They have a great potential for preservation of very labile molecules essential for the biological origin of its biological origin. This is the case of DNA and RNA that have been detected in very ancient materials as the driest place on Earth that hosts modern microbes under low water activity. As a next step, we plan to analyze the occurrence of very labile molecules under the terrestrial hyperarid conditions similar to those produced the Mars chlorides.

Results: Salar Grande cores were obtained after drilling the salt body along several locations including proximal and distal areas in the ancient lake. The X-ray diffraction (XRD) analyses recovered from two of the different stratigraphic sections from the central part of the basin, which indicate the presence of different evaporites including gypsum, anhydrite, glauberite, halite and nitratine, and some detrital inputs like microcline, quartz, albite and illite (Fig. 1). We can identify at least two different sedimentary units based on the XRD data, a lower unit shows a high concentration of clay and detrital minerals, which is followed by an upper unit mostly enriched in chlorides (Fig. 1).

Discussion: The Atacama Desert has been exposed to hyperarid conditions over the last 10 Ma. Concretely, the Salar Grande experimented oversaturation of chloride- and sulfate-rich solutions by a progressive formation of endorheic basins. It promoted the saturation of solutions with a high content in chlorides and sulfates sourced in the subsurface geothermal system of the high Andes. The geochemical and mineral results are consistent with a tectonic cycle exposed to hyperarid conditions that start with detrital to sulfate materials, and end into chloride rich deposits, which record the progressive emplacement of an endorheic basin in the lake area. Under these conditions, the water activity has dropped below 0.76 (halite saturation), which promotes the preservation of organics at a concentration high enough to be detected by geochemical sensors. This might be the case of the enrichment of organics like the oxalates at the upper level of the salty sequence. These small organic acids may have been incorporated into the chlorides during the burial of microbes under low water activity.