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Carbonates' precipitation by halophilic bacteria as a potential biosignature for the search for life on Mars

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Abstract

In the present project, the microbial capability of bioprecipitation using EPS-secreting bacterial isolates from Lagoa Vermelha (RJ), a hypersaline lagoon was investigated by combining microbiological, microscopic and geochemical analytical techniques. The isolates were evaluated for their ability to produce bioprecipitates using Scanning Electron Microscopy (SEM) with Energy Dispersive X-ray Spectroscopy (EDS), powder X-ray Diffraction (XRD) and Raman spectroscopy. It was possible to characterize the carbonates formed by the bacteria isolated from Lagoa Vermelha. These carbonates could represent a target for astrobiological studies of potential biosignatures.

Key words: *Key words: Biossignatures, bioprecipitation, Lagoa Vermelha*

Introduction

The mechanisms of Mg-carbonate precipitation, as dolomite, in the Earth's modern sedimentary environments has not yet been completely elucidated. However, it is known that the microbial activity is significant to facilitate or induce mineral formation[1]. The organic EPS matrix secreted by microorganisms provide an ideal physicochemical environment to the mineral nucleation[2]. Sediments and water samples were collected at Lagoa Vermelha, Araruama (RJ), Brazil. This lagoon is characterized of being a hypersaline lake, where we can find a range of microorganisms known as halophilic and halotolerant extremophiles. A biosignature is any material of biological origin that can be analyzed as evidence of past or present life, that may be useful to test terrestrial and extraterrestrial habitats for life evidences, as some biominerals. The understanding of the mechanisms of organisms in extreme Earth's surface environments, as well as the study of their biosignatures, is fundamental for the investigation of the presence of life on Mars or other planetary bodies in the Solar System[3].

Results and Discussion

According to the 16S data we have isolated 7 strains of 4 genera (*Halomonas, Idiomarina, Salicola and Chromohalobacter*) of gamma-proteobacteria.

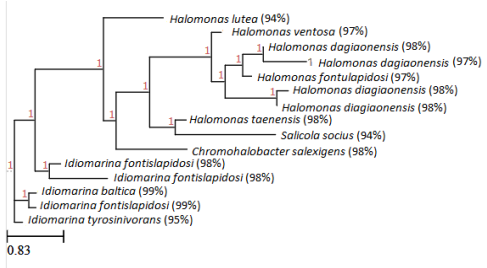

Figure 1: Construction of phylogenetic tree based on 16S rRNA gene sequencing by neighbor joining method.

It was possible to characterize the carbonates formed by the bacteria isolated from Lagoa Vermelha using a multi-technique approach.

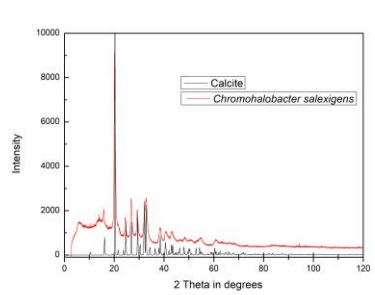

Figure 4: Comparison between the X-ray diffractograms of the minerals produced by Chromohalobacter salexigens and the calcite power pattern.

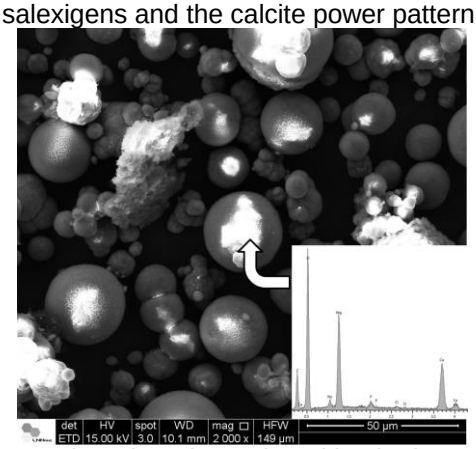

Figure 5: The minerals produced by the bacteria by scanning electron microscopy (SEM). EDS scan indicate the composition of the selected crystal.

Conclusions

Finally, these carbonates could represent a potencial target as a biosignature for astrobiological exploration to search for life beyond Earth.

Acknowledgement

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