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# Biomarkers and taphonomic processes in fresh and fossil biosignatures from Hot Spring silica deposits in *El Tatio* Chile, as a Mars Analogue.

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## Abstract

Biomarkers characterization and taphonomic process of recent and fossil biosignatures in extreme environments with analogies to Mars is essential to understanding how life could develop and survive in this conditions. Siliceous sinter deposits on Mars where similar to those found in the hydrothermal hot springs and geysers from *El Tatio*, Chile. Here we present data on different lipids functional groups and characterize this systems. Biosignatures and organic preservation in this particular system over time could be used in future planetary exploration.

## 1. Introduction

Siliceous sinter deposits are hot spring related rocks formed by a dynamic process of evaporation and cooling of thermal waters; large underground hydrothermal systems open to the surface by hot springs and geysers, which are of mayor importance for geothermal and mineral exploration. Hot spring waters are characterized by the high concentration of many elements (chloride, sulphate, etc.) and can be supersaturated regard to an array of minerals.

Hot spring and their silica deposits are extreme environments that have received attention by many different research areas. Despite their importance in geothermal and ore exploration due to their link to high temperature (>175 ºC) hydrothermal reservoirs at depth [1]. They have value information about the development and preservation of life in extreme environments that can contribute to understand early Earth environments and thus to search for possible fossil life on Mars [2].

*El Tatio* hot springs and geysers have unique features, like their high altitude (4200 ma.s.l), high UV-A and UV-B radiation, a lower water boiling point (86 ºC), and a high concentration of toxic elements (As, B, etc.). These special characteristics lead to a particular interest in understanding the processes that govern the organic preservation in the hot-spring silica deposits.

### 2. Sample collection

Fresh and fossil hot spring sinters (n=4) and geysers (n=4) were sampled to investigate the preservation of organic matter, by using clean protocols. Samples were aluminum foil wrapped and disposed in close containers for further analysis. Water samples (n=4) from geysers and hot springs were also analyzed geochemically.

### 2. 1. Geolipid Extraction, Fractionation and Analysis

3. Target soil samples (100 g) were extracted with a mixture of dichloromethane/methanol (DCM/MeOH, 5:1, v/v) during 24 h with a Soxhlet apparatus. Internal standards (tetracosane-$D_{50}$ and 2-hexadecanol) were added prior to extraction. The total lipids extracts were concentrated using rotary evaporation to 2 ml. After this step, activated cooper was added and stay overnight for elemental sulfur removal. The extracted sample was separated in three fractions using a Bond-elute column chromatography (bond phase $NH_2$, 500 mg, 40 um particle size).

### 2.2. GC-MS Analysis

The samples (non-polar, acid and polar fraction) were analyzed by gas chromatography mass spectrometry using a 6850 GC system coupled to a 5975 VL MSD with a triple axis detector (Agilent Technologies) operating with electron ionization at 70 eV and scanning from m/z 50 to 650. The analytes were injected (1 ul) and separated on a HP-5MS column (30 m x 0.25 mm i.d. x 0.25 um film thickness) using He as a carrier gas at 1.1 ml $min^{-1}$.

## 3. Figures

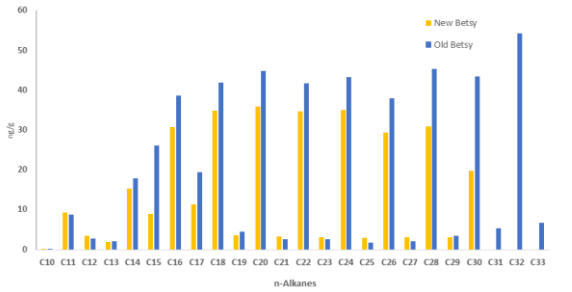


Figure 1. *n*-Alkane signature in the fresh and fossil sinter samples

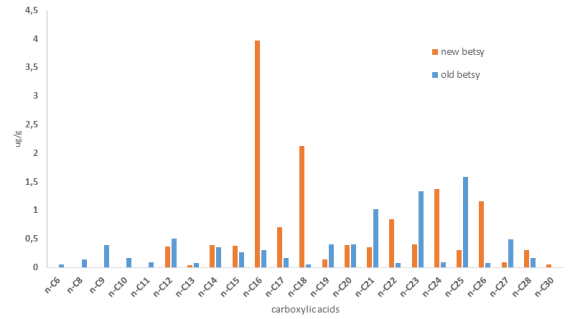


Figure 2. *n*-Carboxylic acids signature in the fresh and fossil sinter samples.

## 4. Summary and Conclusions

Organic preservation have been shown in this study. Many different labile functional groups (i.e., carboxylic acids, alcohols, aldehydes, etc.) were found in both "age" samples. A shift in congener pattern for the different lipids families were found and discuss. This results give insight in taphonomic processes actin in this extreme environment, which could be used as a baseline in Mars exploration..

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## References

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