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Preservation and detection of biomarkers in mineralized communities and its potential link to the variations in ORP

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Abstract

The search for traces of life is one of the principal aims of Mars exploration. Within the MASE project (Mars Analogues for Space Exploration) we work to improve approaches and methods for biomarker detection and extraction from Mars analogue sites. One promising strategy to study the preservation of biosignatures in Mars conditions consists of the combined study of biomarkers detection and monitoring physicochemical parameters in mineralized samples. We have observed that it there is a correlation between biomarker detection and changes in oxi-reduction potential (ORP) during mineralization process. In addition, these methods and the study of samples from MASE sites have enabled us to develop an antibody microarray for competitive sandwich immunoassays as a potential tool for the detection of biomarkers in salty and anaerobic conditions.

1. Introduction

Physic-chemical processes of living organisms leave tell-tale signals in the environment. The search for these signatures is one of the main goals for Astrobiology and improving and optimizing its detection regarding Mars conditions is part of the MASE project objectives. Besides, the traces of some kinds of microorganisms can be well preserved, provided that they are rapidly mineralized and that the sediments in which they occur are rapidly cemented [1].

A developed antibody multiarray competitive immunoassay (MACIA) for the simultaneous detection of compounds of a wide range of molecular sizes or whole spores and cells [2] [3] is a suitable option for biomarker detection in samples with low biomass from Mars analogue sites as well as with biomineralized microorganism communities. Moreover, biomineralization is often the first step of fossilization and produces particular chemical, structural and morphological features that can be preserved in fossil biominerals or microfossils [4] and some parameters as ORP or pH vary over the process.

2. Methods and objectives

Samples from the three MASE campaigns in Iceland (Graenavatn Lake), United Kingdom (Boulby Mine) and Germany (Sippenauer Moor, Regensburg) were used to obtain enrichments and isolates as well as to extract and detect biomarkers in them. Some of the enrichments were exposed to mineralization to study, among others, the preservation of biosignatures by the assessment of antigen-antibody binding at different times. Simultaneously, the evolution of ORP through this process was monitored by two modules system (DTIVA: automated tools for microbial life detection) where ORP variations in those communities were followed through continuous measurements of nanosensors in closed chambers.

An additional objective for MASE project has been to develop a specific microarray with antibodies performanced from natural samples and isolates from MASE sampling sites.

3. Summary and Conclusions

The presence of traces from some microbial metabolic groups were detected in the mineralized communities at three different times over the fossilization process. It was undertaken by using a 168 antibody microarray for the immunoassay. There were observed variations in the resulting immunoprofiles. There seems to be a probably correlation between these changes and those in ORP through time. We consider that the simultaneous use

of both approaches arises a promising tool to broaden the knowledge and consequent improvement in the search for traces of past and present life.

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