Identification of biomarkers in volcanic rocks from the Atacama Desert: Implications for the search of life traces on Mars

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When we are able to easily recognize life on Earth, we will be prepared to move beyond the confines of our planet [1]. Taking this quote into account, we consider the cryptoendolithic microbial communities living within volcanic rocks in the Atacama Desert as important targets for astrobiological studies of terrestrial analogues for the extreme arid conditions on Mars [2]. The survival of these microbial communities in extremely hyperarid and highly sun-irradiated environment is conditioned by subtle changes in external climatic conditions, which can lead to the death of these extremophiles. In the present study, we searched for biomarkers and biomineralization processes in samples of endolitihcally colonized ignimbrite rocks, using microscopy (SEM-BSE) and microanalytical (Raman and EDS spectroscopy) investigation strategies. The presence and distribution patterns of endolithic microorganisms (phototrophic cyanobacteria and heterotrophic bacteria) within the rocks were investigated by various independent microscopic and analytical methods. Raman spectroscopy, including novel Raman imagining (514 nm laser), allowed us to show the distribution maps of biomarkers such as carotenoids - the pigments associated with the cyanobacterial cells - within the endolithic habitat. Following the death of endolithic microbial communities, we observed post-mortem deposition of minerals on the organic template of endoliths, using SEM-BSE+EDS. This induced biomineralization process lead to the formation of biominerals rich in Si and Mg, which can be considered as geological evidence of extinct microbial life.

[1] Conrad & Nealson (2001) *Astrobiology* **1**, 15–24. [2] Wierzchos et al. (2013) *Icarus* **224**, 334-346.