Geomicrobiological characterization of Antarctic sandstones – Preliminary results

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Antarctica supports some of the most unexplored and isolated ecosystems of the planet, wherein existence of life under the most extreme conditions is still being questioned. In the driest and coldest ice-free areas of continental Antarctica, the McMurdo Dry Valleys, the environmental conditions reach the limits for supporting life through endolithism. These regions are considered as a perfect testbed for astrobiological studies, supporting future exploration missions finalized to the search for life on other planets. In these areas, Antarctic sandstone is characterized by a peculiar colorization due to the stratification of microorganisms into a cryptoendolithic community [1]. An unfavorable change of environmental conditions results in death of the community, followed by the formation of a mummified microbial community [2]. Sandstone exhibits exfoliation mosaic patterns during the microorganisms' mummification process [3], as well as a reddish color on the top surface layer [2].
In the context of the ESA BioSigN project (BioSignatures and habitable Niches: experiment on the International Space Station) for investigating the habitability of Mars and icy moons as well as the stability and detection of biosignatures in general and in particular on microfossils), for the first time, we characterized Antarctic sandstone, sampled at Timber Peak locality (Northern Victoria Land), from a combined geomicrobiological point of view by merging different and complementary techniques. Raman and InfraRed spectroscopy analyses identified the presence of organic matter and functional groups associated with biological molecules at the observable reddish top surface layers, giving also an accurate mineralogy characterization. A confocal laser scanning fluorescence microscopy detected chitin remnants and the occurrence of eukaryotic microorganisms' features (e.g. septa and anastomosing filaments), probably associated with fungal filaments. These findings were further supported by cultivation analyses, which allowed the isolation of several fungal morphologies. In association with spherical cell-like morphologies, similar structures were also discovered using scanning electron microscopy (SEM) and energy-dispersive X-ray spectroscopy (EDX) analysis.

References

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