MINERALIZATION AND POTENTIAL FOR FOSSILIZATION OF AN EXTREMOTOLERANT BACTERIUM ISOLATED FROM A PAST MARS ANALOG ENVIRONMENT.

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Introduction: Several decades dedicated to the study of Mars has enabled scientists to understand that, during its history, environmental conditions on early Mars strongly contrasted with the present-day conditions, hostile for life. Indeed, previous (Mars Express, Viking…) and more recent (MSL) missions confirmed that liquid water, heat (volcanism, hydrothermalism), organic matter, and redox conditions probably occurred on the planet, thus enabling scientists to seriously consider early Mars as being habitable ans suitable for the emergence of Martian life [1].

However, the detection of past life on Mars, if it existed, also requires that biomarkers (i) be preserved over geological time scales and that (ii) they remained detectable.

Therefore, as terrestrial analogues for Mars, astrobiologists are addressing questions related to microbial adaptation, lifestyles and survival in extraterrestrial environments [2].

In this context, the European MASE project (Mars Analogues for Space Exploration) aims at better understanding habitability, microbial lifestyles and biomarker preservation in such environmental analogues. To do this, one of the goals of MASE is to better characterize the evolution and preservation of diverse biomarkers during the microbial fossilization process [3].

Methods and objectives : A poly-extremotolerant *Yersinia* strain, isolated from a cold-acidic-oligotrophic lake in Iceland, was artificially mineralized in SiO_2 and $CaSO_4$ to evaluate its potential for further fossilization over geological times. Morphological, biogeochemical, and physical aspects of the process were studied using GC-MS, SEM, TEM, FT-IR or RAMAN spectroscopy.

We also evaluated the impact of microbial stress induced by Mars-like conditions by studying mineralization of cells after exposing the model to both dessication and radiation stresses.

Results : We show that only a part of the cell culture was rapidly embedded in minerals, even after 6 months of mineralization, and thus *Yersinia* populations remain largely viable after that time.

Considering our methodology, no difference could be observed in the reaction of the strain, with and without stress, to mineralization, thus suggesting that physiological responses to these stresses do not alter the mineralization process. It also seems clear that some approaches are more relevant than other for biomarkers detection.

Geochemical data obtained with Rock-eval also confirmed that the fossilization potential of this strain over geological times is quite limited.

To conclude, it should be kept in mind that, in the microbial world, not all groups are prone to fossilization, even those inhabiting past Mars analog environments (cf [4]. Nevertheless, although the physical structure of certain microorganisms may not be susceptible to mineralisation and preservation in the rock record, the degraded remains of the organic molecules making up the organism could be preserved dispersed in anaerobic fine-grained sediments of primary or secondary mineral deposits [1].

References:

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