**Mineralisation of an extremotolerant Bacterium Isolated from an Early Mars Analog Environment.**

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**Introduction:** Assessing the biological origin of microstructures present in rocky materials is very challenging mainly due to the degradation of microbial remains during diagenesis and to mineralogical processes leading to abiotic artifacts. To better understand the processes leading to microfossil formation and preservation, artificial mineralisation of microorganisms was first undertaken with the silicification of Cyanobacteria [1], followed by the mineralisation of eukaryotic and bacterial models [2] or of natural communities [3] and has since been notably extended to hyperthermophilic Archaea [4].

Although artificial mineralisation can also be applied to answer astrobiological questions, it has still not been used in the search for traces of life in extraterrestrial samples, notably in Martian rocks. However, it is now clear that environmental conditions on early Mars were very different to those of present-day Mars, allowing considering its past habitability and the emergence of life [5], especially for the Noachian period associated with intense volcanic activity, supplying heat and chemical energy to the planet, and with liquid water. Major changes in environmental conditions may have progressively challenged the potential Martian biological systems and thus, different scenarios can be envisaged for the history of Martian life depending on the degree of microbial colonization of Martian environments, notably the Martian subsurface [6].

Unlike studies about microbial mineralisation on Earth, Martian microbial mineralisation requires taking into account (i) physiological stresses that biological entities may have encountered during the changes in planetary conditions and (ii) mineralogy of martian rocks of the Neochian, that may have embedded microbial fossils.

Waiting for the return of Martian samples, in the meantime astrobiologists can use terrestrial analogues to study past Martian habitability. In this context, the European MASE project (Mars Analogue for Space Exploration) uses analogue environments and microorganisms to assess the habitability of Mars and the detection of life on the planet. In an effort to improve our knowledge of microbial mineralisation of species inhabiting Mars analogue environments, several strains were isolated from the Icelandic Graenavatn lake, an acidic (pH3), cold and oligotrophic volcanic crater lake. The polyextremotolerant bacterium *Yersinia intermedia* MASE-LG-1, was used as it revealed a strong tolerance to diverse Mars-like stresses such as low pressure, ionizing radiation, varying temperature, osmotic pressure and oxidizing chemical compounds and represents thus a relevant model for mineralisation.

**Experiments:** We here report on the mineralisation of *Y. intermedia* MASE-LG-1 in silica and gypsum, two minerals commonly reported on Mars, in cold and anoxic conditions, similar to Martian conditions. We also studied the effect of physiological status on mineralisation by exposing *Y. intermedia* MASE-LG-1 to two common stresses thought to have increased during Mars history, desiccation and radiation. The mineralisation process was studied using microbiological (microbial viability), morphological (scanning and transmission electron microscopy), biochemical (GC-MS, Microarray immunoassay and Rock-Eval) and spectroscopic (FTIR and RAMAN spectroscopy) methods. Based on these approaches, the potential of mineralised *Y. intermedia* MASE-LG-1 cells for further mineralisation over geological times is discussed.

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