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UV Protection of Bacteria Under Simulated Martian Conditions

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Ultraviolet (UV) irradiation on the surface of Mars is an important factor affecting the survivability of microorganisms on Mars. The possibility of Martian brines made from $Fe_2(SO_4)_3$, $MnSO_4$, and $MgSO_4$ salts providing a habitable niche on Mars via attenuation of UV radiation was investigated on the bacteria Bacillus subtilis and Enterococcus faecalis. Results demonstrated that it is possible for brines containing $Fe_2(SO_4)_3$ on Mars to provide protection from harmful UV radiation, even at concentrations as low as 0.5%. Brines made from $MnSO_4$ and $MgSO_4$, did not provide significant UV protection and most spores/cells died over the course of short-term experiments.

However, $Fe_2(SO_4)_3$ brines are strongly acidic, and thus, were lethal to E. faecalis. In contrast, B. subtilis, as a spore-forming bacterium resistant to pH extremes, was unaffected by the acidic conditions of the brines and did not experience any significant lethal effects. Any extant microbial life in Martian $Fe_2(SO_4)_3$ brines (if present) would need to be capable of surviving acidic environments, if these brines are to be considered a possible habitable niche.

The results from this work are important to both the search for life on planets with an atmosphere unable to significantly attenuate UV radiation (i.e., like Mars); and for planetary protection, since it is possible that terrestrial bacteria in the genus Bacillus are likely to survive in Fe-sulfate brines on Mars.

Furthermore, preliminary work on UV and photosynthetically active radiation (PAR) light transmission and scattering through simulated Martian regolith and rock samples are also presented. Regoliths that block UV but allow for PAR would be likely candidates for supporting bacterial life.