Mars Brine Chemistries: Habitability, Biosignatures, and Detection

Anushree Srivastava*†[1], Victoria Pearson‡[1], Terry Mcgenity§[2], Susanne Schwenzer¶[1], and Karen Olsson-Francis‖[1]

[1]The Open University – School of Environment, Earth and Ecosystem Sciences, Milton Keynes, MK7 6AA, United Kingdom

[2]University of Essex – School of Biological Sciences, Colchester, CO4 3SQ, United Kingdom

Abstract

The surface of present-day Mars is considered detrimental for life; however, on early Mars, the conditions were more clement and less oxidizing with a possible warmer climate and denser atmosphere that could provide protection from UV and cosmic radiation.
Martian rovers and orbiters have found convincing evidence for a suite of evaporite salts on the Noachian to Hesperian terrains signifying the aqueous history of Mars. These salt deposits are suggested to be formed either in deep ancient hydrothermal environments or via evaporative sequences of groundwater-fed lacustrine systems. On Earth, in analogous environments, microbial growth is supported by redox reactions that can drive metabolism. Hence, salt deposits formed via these processes are high-priority targets for astrobiology-focused missions. However, there is limited work investigating the survivability and detection of microorganisms within these different brine chemistries or their associated evaporites.

Here, our principal aim is to determine the feasibility of detecting microbial signatures within evaporite deposits on the surface of Mars. We will expose terrestrial microbial analogues to a range of simulated Mars brine chemistries (carbonates, sulfates, chlorides, and perchlorates) to assess the life-limiting or life-promoting capabilities of these chemistries. We will simulate the brine evaporation, precipitation, and microbial entombment process to better understand the viability and preservation potential of these saline substrates. This will be conducted under simulated past and present Martian conditions. A selection of isolates with varying metabolisms e.g. chemolithotrophic, heterotrophic, and mixed-microbial communities from Mars analogue sites will be tested for: i) their viability in Mars brine chemistries and ii) their preservation in their crystalline phases. A fluorescent staining technique, sensitive to microbial detection will be used to calculate the percentage of survivability. Our experimental plan will include examining the efficiency of various spectroscopic instruments, currently working, or to be deployed, on future robotic missions to Mars, to provide non-destructive, unambiguous detection of biosignatures within various evaporites.
Results from this study will contribute to our understanding of saline environments on Mars

*Speaker
†Corresponding author: anushree.srivastava@open.ac.uk
‡Corresponding author: victoria.pearson@open.ac.uk
§Corresponding author: tjmcgen@essex.ac.uk
¶Corresponding author: susanne.schwenzer@open.ac.uk
‖Corresponding author: karen.olsson-francis@open.ac.uk

that are likely to preserve biosignatures and to our working knowledge of instrumentation deployed to study those environments both in situ and in the laboratories on Earth after sample return.