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Life in a Mars analog: Microbial activity associated with carbonate cemented lava breccias from NW Spitsbergen

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Low-temperature carbonate deposits in volcanic centres on NW Spitsbergen (Norway) comprise carbonate globules near identical to those in ALH84001[1] and represent a unique opportunity to examine water-rock interaction and possible microbial activity in a Mars analogue environment. Field observations show that abundant magnesite and dolomite were deposited in vertical lava conduits after eruption, likely in the presence of standing water. SEM, PCR and fluorescence data suggest that there is microbial activity within vesicular lava breccias in these conduits. Raman spectroscopy demonstrated the presence of disordered carbon within the vesicles.

Handpicked fragments of carbonate coating and vesicular lava were analysed for δ13C and δ15N before and after leaching with 6N HCl to demineralise the samples. Lichen from the breccia outcrop was analysed for reference. Carbonate coating and unleached basalt show δ13C values (‰ PDB) between 1.0 and 1.5, organic carbon from leached basalt shows δ13C between -11 and -13 and δ15N around -4 to 1. Lichen carbon attached to the rocks show δ13C between -22 and -26 and δ15N between -8 and 1.

It would appear from these investigations that microbial cells occur within vesicles in the carbonate cemented lava breccias and are possibly using isotopically heavy carbon organic material as a food source. Further implications and the results of DNA extraction and sequencing as well as ToFSIMS and GCMS data will be presented.

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References

[1] Treiman A. H. et al. (2002) *Earth Planet Sci. Lett.*, **204**, 323-332.

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Non-contact rapid detection of chemical biosignatures in rock and sediment

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We are in the midst of a three year campaign to understand how chemical complexity in rock and sediment affect the ability to recognize detectable chemical biosignatures associated with hypolithic and cryptoendolithic microbes. Our field sites are mineralogically diverse and encompass carbonate facies, mixed evaporite facies, and silicate facies in deserts of Eastern California (USA); sulfide mounds at hydrothermal vent sites in the Pacific Ocean and the McMurdo Dry Valleys, Antarctica.

We have developed a trio of non-contact instruments that are non-invasive and do not require sample preparation for this investigation. The instrument package is called "SPISE[3]" (**S**cience **P**ackage for the **I**n **S**itu **E**xploration of **E**xtreme **E**nvironments). SPISE[3] components include a spectroradiometer that measures reflected light from 380 nm to 2500 nm, a multichannel deep ultraviolet excitation (224.3 nm) fluorescence detector and a portable gas chromatograph. We also use a fiber probe Raman spectrometer for identifying mineralogical context in the field. Presently all the instruments are commanded by laptop computer.

The SPISE[3] science data sets are challenging to integrate and this integration is being addressed through multivariate statistical techniques and an artificial neural network, the ultimate purpose of which is to evolve a level of autonomy for SPISE[3] so that it might ultimately be deployed on the delivery platform of a landed space mission.