Investigating the Microbial Potential of Gale Crater, Mars. A. H. Stevens[1] and C. S. Cockell[1], [1]UK Centre for Astrobiology, James Clerk Maxwell Building, University of Edinburgh, EH9 3FD, UK

Introduction: The Curiosity rover has found evidence for a long-lived habitable environment in the sedimentary record of Gale Crater on Mars. The geochemistry of the mudstones suggests that the lake filling the crater had a neutral pH, low salinity and contained all the elements required by life [1]. We investigated whether this environment would be habitable and what type of microbial community might be present if it were.

Analogue material: We produced a geochemical analogue (named Y-Mars) that simulates the Sheepbed mudstone of Gale Crater by mixing minerals in proportion to match XRD data from Curiosity [2]. Some replacements were required due to lack of bulk terrestrial availability (Table 1), but otherwise we recover a substrate that reproduces an XRD diffractogram qualitatively similar to that observed by Curiosity (Figure 1).

Component	Wt%
Plagioclase feldspar	31.1
Saponite	30.5
Augite	13.1
Magnetite	5.3
Enstatite	4.2
Dunite Periodite	3.9
Anhydrite	3.6
Sanidine	1.7
Pyrrhotite	2.9
Selenite	1.4

Table 1 - Final mineral composition of the Y-Mars analogue.

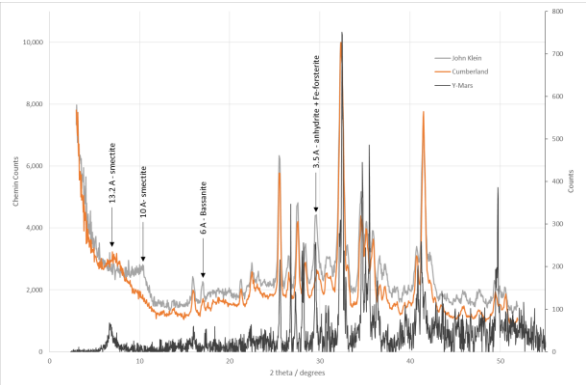

Figure 1 - XRD comparison of the Y-Mars analoge with Chemin data from MSL.

Microbial inoculation: The Y-Mars analogue material was then used as a substrate for a biological inoculate to assess whether it is capable of supporting a microbial community with with minimal additional input of carbon or nitrogen. The inoculate was collected from a local anaerobic lactustrine environment, in order to collect a broad range of species and metabolisms from an environment analogous to the lake that filled Gale Crater.

Two gram samples of the Y-Mars analogue were incubated with 4 ml of deionized water and 100 µl of inoculate under anaerobic conditions at room temperature for three months. Two 50 µl transfers were made onto new analogue material to reduce the amount of carbon and nitrogen transfer, giving a total incubation time of nine months, allowing even the slowest anaerobic organisms chance to grow. The long incubation time allowed for environmental selection of the microorganisms most suited to the mineral, carbon and nitrogen availability matching the environment of the sedimentary system that formed the Sheepbed mudstone.

Results: Cell counts using fluorescence microscopy were at levels of 10^5-10^7 cells ml^{-1} for anaerobic cultures and 10^6 cells ml^{-1} for comparative aerobic controls. This suggests a robust microbial population growing over the incubation period. Sequencing of DNA extracted from the individual analogue microcosms will inform about the microbial diversity and the metabolisms that are able to exploit the simulated Gale Crater environment.

References:

[1] Grotzinger, J.P., et al., Science, 2014. **343**(6169).
[2] Vaniman, D.T., et al., Science, 2014. **343**(6169).