PLANETARY ANALOGS AS MODELS FOR BIOLOGICALLY RELEVANT EXTRATERRESTRIAL EXPLORATION. A-L. Paul[1], S. Toghranegar[1], C. Amalfitano[1], A. Sarafan[1], A. Giongo[1], E. Triplett[1], P. Lee[2], A. Berinstain[3] and R. J. Ferl[1] ([1]University of Florida, Gainesville FL, 32611-0690; alp@ufl.edu / robferl@ufl.edu) ([2] Mars Institute, [3]Canadian Space Agency)

Introduction: There are two reciprocal, biologically relevant questions for planetary exploration: 1) what are the potential life systems present and 2) can exploration-environment resources support terrestrial organisms? We have applied a variety of molecular tools to evaluate these questions in impact breccias collected from a well characterized analog site, the Haughton Crater on Devon Island. We addressed the first question through the interaction of geology and biology within the impact crater environment by using plants and microbes as measures of diversity among breccias from distinct sites. These experiments serve as models of approaches that could be taken in planetary sortie and lander experiments, but also provides insight into the biological relevance of a seemingly desolate terrain. The microbial diversity of sample sites was evaluated with high-throughput DNA sequencing that produced a set of uniquely tagged DNA sequences for each site that provide an indication of the mibrobial populations. The end result was a cataloging of the microorganisms at 11 breccia sites of Haughton Crater for relative abundance and diversity. Each collection had a distinct microbial profile which is being correlated with mineralogical features and the ability to support plant growth.

Support of Plant Growth: Breccia samples were evaluated for their ability to support plant growth with and without supplemental nutrients. The results show that the breccias of Haughton Crater are complex with regard to supporting plant life, and further, that there is not a direct correlation between amount of supplemental nutrients and plant vigor. Figure 1 shows a sample set of plants growing materials from several different breccias from Haughton Crater, and well as a lunar stimulant and a non-breccia material from the crater (E). In some cases, adding nutrients to those materials can have a positive impact on plant growth. This result is in keeping with the native micro-oasis phenomenon of the region [1]. However, it is not always the case (e.g. Figure 1C), suggesting there are clearly more factors involved than simple nutrient abundance.

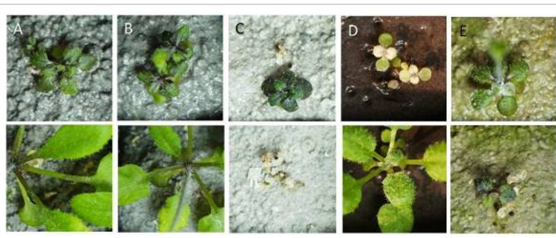

Figure 1. Several breccias from Haughton Crater (A,B,C), lunar stimulant JSC1a (D) and a non-breccias sample (E) from Haughton Crater (E). The top row plants given water alone, the bottom row was augmented with a 10% MS nutrient solution.

Microbial Diversity: The microbial diversity of samples taken from a variety of sites in and around the Haughton Crater was evaluated with a high-throughput DNA sequencing. Briefly, DNA was isolated from crater samples and amplified with DNA primers to microbial 16s ribosomal DNA, which were tagged with unique "barcodes" – one barcode for each sample site. This technique produced a set of DNA sequences for each of the 11 sample sites that could then be used for measure of microbial presence and diveristy. Samples were collected in the field with sterile gloves into sterile bags, and kept in a dark container. Upon return to the University of Florida, the samples were handled aseptically and kept in the dark until DNA extraction procedures. Table 1 shows an overview of microbial diversity for each of the sites. The two sites with the highest diversity of microorganisms were represented in collections from "Drill Hill" and "Gemini Hills".

Haughton Crater Site	Shannon Diversity Index
Drill Hill surface	5.39
Drill Hill 12.5 cm below	5.41
Drill Hill 48 cm below	4.86
Gemini Hills surface	5.44
Bruno Escarpment surface	4.31

Table 1. Shannon Diversity Index [e.g. 2] values for several sites in the Haughton Crater. The diversity of microorganisms varies among sample sites. The index values shown are for the species level.

References: [1] Cockell, C.S, Lee, P., Schuerger, A., Hidalgo, L., Jones, J. and Stokes, M. (2001) *Arctic, Antarctic, and Alpine Research*. 33:306. [2] Giongo, A., Crabb, D., Davis-Richardson A., Chauliac, D., Mobberley, J., Gano, K., Mukherjee, N, Casella, G., Roesch L, Walts B, Riva A, King, G. and Triplett, E. (2010) ISME Journal 4, 852–861.