CHARACTERIZATION OF ENDOLITHIC HABITATS IN SHOCKED BASALT FROM LONAR CRATER.

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Introduction: Significant work has been completed characterizing the biogenicity of the shocked crystalline lithologies of the Haughton impact structure on Devon Island, Nunavut, Canada [1-3]. This impact structure has served as an excellent analogue for Martian impact environments as it is currently the best-preserved impact crater located in a polar desert environment, however, most Martian impact structures are likely to have formed within basaltic targets. Different rock types respond differently to impact events (*i.e.* sedimentary lithologies experience melting and recrystallization above 35 GPa), however, our understanding of how gneisses from the Haughton structure respond to impact should closely mirror the response of more mafic crystalline targets [4]. What is not clear, however, is whether biology would have the same relationship with a basaltic/granodioritic target, as it does with the shocked gneisses.

The microorganisms living within the shocked gneisses of the Haughton impact structure do not strongly utilize the substrate for metabolic nutrients, evidenced by the lack of microbial weathering seen in these substrates [3], as it is heavily silicic. In contrast to this, surficial suevites from the Ries impact structure, Germany, show biologically formed tubules within the generated impact glass [5], which contains higher amounts of biologically relevant nutrients such as iron and magnesium. These tubules are characteristic of similar bioalteration textures in volcanic glasses from ophiolites from the Ontong Java Plateau [6]. Knowing that basalts are a source of increased nutrients for microorganisms that is readily accessed, the question then is how does biology interact with impact-generated substrates in basaltic targets?

Methodology and Results: Shocked samples from Lonar Crater have been provided courtesy of Shawn Wright (University of Auburn), and have been analysed using a suite of physical, chemical and imaging techniques. Colonization by bacteria and fungi were observed on all collected samples (Fig. 1), and work is currently underway to determine how biomass levels scale with shock metamorphism (as in [3]). The amount of photosynthetically active radiation (PAR) reaching the subsurface community, as well as the ability of the substrate to act as an effective UV quenching agent, strongly affects the subsurface community [1]. In shocked gneisses, transmittance of all light is reduced with increasing shock, however due to the increased presence of pore spaces, 100% transmittance can occur over a large area of the sample [3]. In all cases, light penetrates the substrate more easily in the visible range than in the deeper near-UV range. For Lonar samples, wafers of an average thickness were cut, and transmission measurements currently collected over the UV range (200nm–500nm). There is a large spike in transmittance between 250nm–300nm, corresponding to UVC radiation, however for most of the range, transmission is reduced by an order of magnitude.

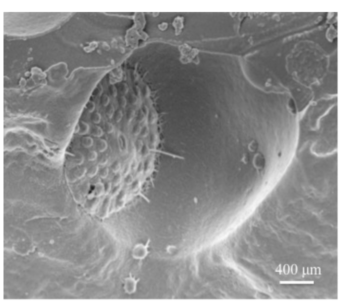

Figure 1. SEM micrograph of microbial colony on impact-shocked basalt, Class 2.

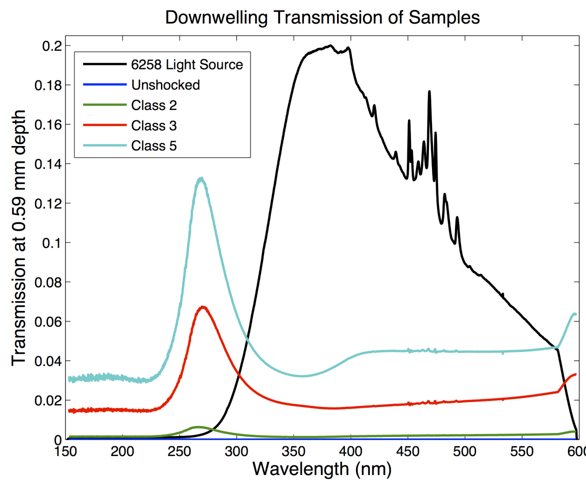

Figure 2. Transmission of UV radiation through wafers of shocked basalt. Transmission increases with shock metamorphism, from "Unshocked" samples through to Class 5.

Conclusions: Detailed SEM and CSLM investigations of these substrates are currently underway, but preliminary results reveal a substrate that is highly UV quenching, as well as colonizable. Further work is currently planned to investigate biosignature preservation within these shocked basalts, and especially within the hydrothermally altered regions of the crater.

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