Western Science

Department of Earth Sciences

Ph.D. Geology Public Lecture

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Terrestrial Surface Properties of Planetary Analogue Environments

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Via ZOOM

Abstract

Studies of planetary analogue environments are one of the key methods by which planetary scientists investigate surface processes and properties also found on other planets and moons. Planetary analogue studies can be invaluable for interpreting data from other planetary surfaces as well as planning for spacecraft landing and mission operations. In this work, we present the results of field work from July to August 2022 in conjunction with remote sensing data to assess the 2014–2015 Holuhraun lava flow-field in Iceland as an analogue for rock-strewn surfaces on Mars, from dust-sized particles to meter-scale rocks. Specifically, we first couple C-band radar data with ground penetrating radar (GPR) data to measure the amount of radar attenuation by sediment over regions of the lava from 2015 until 2022, finding that the dielectric properties of sediments at Holuhraun present pure surface scattering, as opposed to attenuation by mantled sediment, as the predominant source of the change in radar backscatter. We then expand our investigation at Holuhraun to larger silicic material, in particular cm-to-m-scale rocks that both present potential hazards for spacecraft landing environments and are on the scale that would greatly affect radar scattering at C-band (~5.6 cm), S-band (~12 cm), and L-band (~24 cm) wavelengths. Tying radar backscatter returns to rock frequencies produced from high-resolution topography could help establish constraints on the rock abundance of a planetary surface, in addition to thermal and optical datasets. However, we report that correlations between C-band radar and rock frequencies on a scale similar to the C-band wavelengths are only weakly positive, and do not appear to diminish with increasing the rock size for the particular frequency. We shift our considerations of analogue environments to the Haughton Impact Structure in Devon Island, Nunavut as an analogue for the landing environment of NASA's Dragonfly rotorcraft, set to investigate the potential of Saturn's largest moon Titan for prebiotic chemistry. As Dragonfly will be sampling the impact melt around Selk crater, we assess the variation in impact melt composition at Haughton, finding little variation site-to-site, though possibly finding evidence for fluvial incision exposing less "processed" impact melt material.

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