**PORIS, An Astronaut-Borne Portable infrared Imaging Spectrometer For Rapid Assessment and Downselect of Potential Rock and Soil Samples.** P. G. Lucey,[1] J. Akagi,[2] A. Lee,[3] K. Yamamoto[2], C. Ferrari-Wong,[1] A. Flom,[1] A. Nagamine.[2] [1]Hawaii Institute of Geophysics and Planetology, University of Hawaii, Honolulu, HI, USA, lucey@higp.hawaii.edu; [2]Spectrum Photonics, Inc. Honolulu, HI, USA,[3]Institute for Astronomy, University of Hawaii, Honolulu, HI, USA

**Introduction:** Next generation orbital remote sensing may provide assessment of composition and physical properties of rock and soil units at Artemis and other landing sites at the meter scale, to greatly add to the effectiveness of pre-mission planning compared to Apollo (see Ferrari-Wong et al., this volume, but ultimately crew will have to select and sample rocks and soils at the centimeter scale not available from orbit. Here we describe an extremely compact and low mass imaging spectrometer that provides real-time compositional and thermal imaging at scales from cm to millimeters, as well as on-surface verification of orbital measurements at the meter scale from ranges of hundreds of meters. The instrument is suitable for helmet, tripod, rover, or support robotic assistant mounting.

**Instrument:** The instrument, PORIS (PORtable infrared Imaging Spectrometer), is a 500 g thermal infrared hyperspectral image based on a Fabry-Perot Fourier Transform spectrometer in a form factor roughly like a digital SLR camera that operates from 5 to 25 microns to capture silicate and oxide mineralogy, as well as the regolith content of molecular water (Fig 1). The current implementation includes 10 and 20 degree field of view versions that return compositional imaging in real time with sub-minute latency, including modes that can collect panoramas up to 360 degrees in a few minutes, again with compositional and thermal analysis with sub-minute latency.

**Field Testing:** We recently fielded two prototype versions of PORIS to demonstrate the basic capabilities. In this case the wavelength regions were limited to 8-14 microns owing to the limited transparency of the Earth's atmosphere. However, this range still contains rich spectral phenomena revealing the silicate mineralogy of surfaces. One unit was produced by the Hawaii Institute of Geophysics and Planetology at the University of Hawaii, and the second by Spectrum Photonics Inc, a University spin-off.

The three field sites were a lava tube in Iceland as part of the CHILL-ICE astronaut analogy project [1]; Meteor Crater, Arizona, a kilometer scale impact crater on private land that features publicly accessible overlooks viewing the interior of the crater, and Grand Canyon National Park, also in Arizona, that features views of thick sections of geologic units, including some of those exposed at Meteor Crater.

**Results:** For CHILL-ICE, which demonstrated the deployment of a habitat in a lava tube, export controls prevents use of an infrared version of PORIS; instead we deployed a visible range version to assess the usability of the equipment and test operational aspects (Fig. 2).

**Figure 1:** One of two PORIS prototypes, here fielded at Meteor Crater, AZ. The 1 lb. instrument is mounted on a tripod (out of view to the bottom), and includes a compact scan motor controlled by a tablet computer that also collects and processes the hyperspectral data.

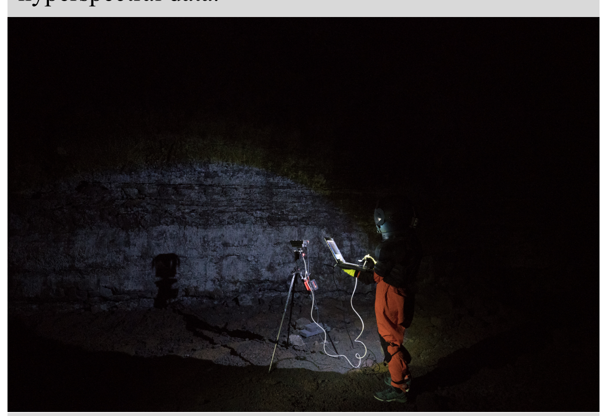

**Figure 2:** PORIS Visible in operation at CHILL-ICE lunar analog activity in a lava tube in Iceland

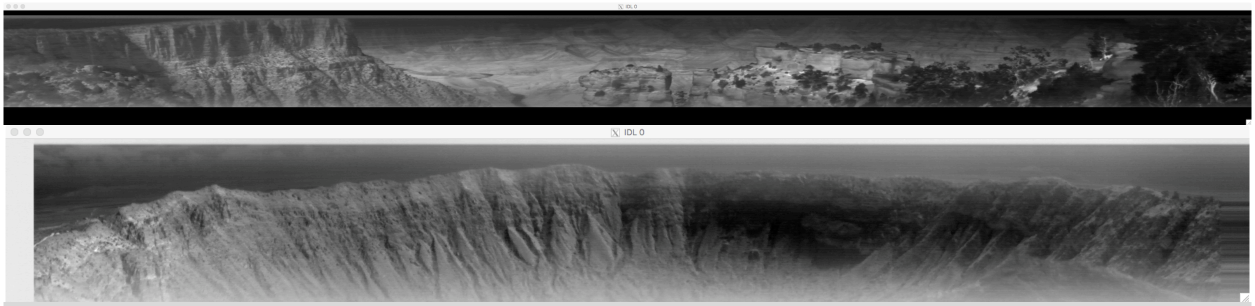

**Figure 3:** Broadband imagery of the Grand Canyon (top) and Meteor Crater (bottom).

At Meteor Crater and the Grand Canyon several scans were taken with both instruments resulting in very high quality broadband thermal imagery [Fig. 3] demonstrating the quality of the data. Data collected at Meteor Crater had sufficient sensitivity to collect high quality spectra of quartz-bearing deposits (sandstones, Fig. 4), use those data to visualize quartz bearing units with simple infrared false color (Fig. 5).

**References:** [1] Heemskerk MV, Pouwels CR, Heemskerk RS, Kerber S, Foing BH. CHILL-ICE (Construction of a Habitat Inside a Lunar-Analogue Lava Tube): Building and Testing of a Deployable Habitat in Icelandic Lava Tubes for Space Exploration Purposes. In 52nd Lunar and Planetary Science Conference 2021 Mar (No. 2548, p. 2762).

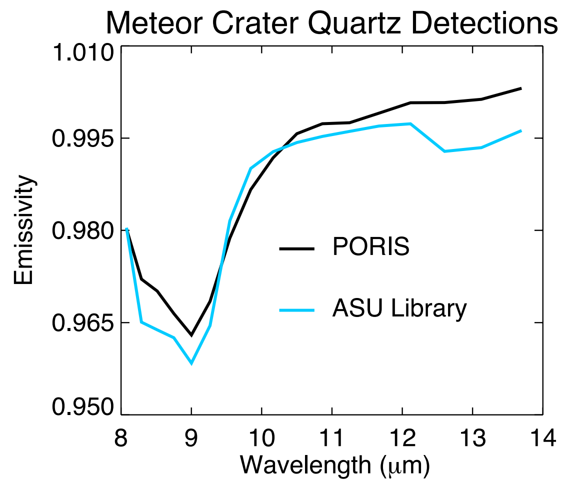


**Figure 4:** Spectrum from PORIS (black) and Arizona State Spectrum Library (blue)

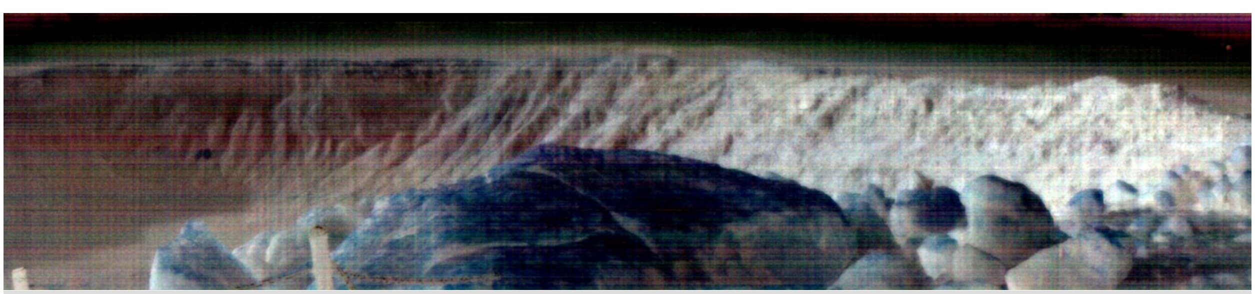

Figure 5. Thermal Infrared false color image constructed of 9 microns (blue), 10 microns (green) and 11 microns (red). Forground and subtle background blue features are quartz-bearing units with low emissivity at 9 microns.