ENABLING MID-INFRARED SPECTRAL ANALYSIS ON THE LUNAR SURFACE. K. A. Shirley[1], T. D. Glotch[1], G. Ito[1] and A. D. Rogers[1], [1]Geosciences Department, Stony Brook University, Stony Brook, NY 11794. katherine.shirley@stonybrook.edu.

Introduction: The lunar environment is harsh, with extreme thermal gradients in the top few hundred microns of regolith. However, the Moon is the most likely potential target for near-term exploration by crewed missions. When we return, we will need to determine locations of scientific or resource value, and while we will utilize orbital data for surface exploration, handheld instruments for astronaut use will be invaluable. Additionally, we will need the ability to accurately analyze results from such instruments taking the lunar environment conditions into account.

The use of handheld instruments by humans at the lunar surface aids astronauts' ability to characterize what they see and identify regions of interest. Handheld visible/near-infrared (VNIR) equipment has long been in use in terrestrial field work, and scientists are continuing to create and test new field tools for the mid-infrared (MIR). Ito et al. [1] have done extensive field tests in Hawaii and New Mexico on the utility of a handheld thermal IR camera, and have demonstrated its ability to identify regions of interest in a scene, as well as differentiate geological units invisible to the human eye.

Analysis of spectra acquired by a hand-held instrument on the lunar surface would require a database of spectra acquired under lunar-like conditions [2]. In the lab, we can simulate the thermal environment on the Moon at low pressure to measure VNIR and MIR spectra for comparison with data from remote sensing instruments like the Moon Mineralogy Mapper and the Diviner Lunar Radiometer Experiment. The Planetary and Asteroid Regolith Spectroscopy Environmental Chamber (PARSEC) at Stony Brook University is one such instrument capable of measuring samples under simulated lunar environment (SLE). The SLE spectral libraries we are developing are already useful for analysis of orbital data and will be even more so, when humans or rovers on the surface make measurements at the same frequencies. Additionally, information we can gather from the surface, such as a direct thermal gradient readings would greatly enhance our ability to accurately simulate environmental conditions in the lab.

Our previous work has involved measuring the spectra of pure minerals, mixtures, simulants, and simulated space weathered samples to understand how a simulated lunar environment affects MIR spectra and necessity of measuring under SLE to compare to lunar spectra.

Methods: PARSEC achieves SLE conditions by passive liquid nitrogen cooling under ~10^{-6} mbar vacuum, and heating samples from above and below to create a lunar-like thermal gradient. Chamber temperatures reach <150 K and the sample is heated to reach surface brightness temperatures of ~350 K. Emissivity spectra are calibrated via the methods of [3&4]. The samples used in the experiments were ground, cleaned, and sieved into varying size fractions.

Results: Particle size influences MIR spectra, notably by shifting the position of the Christiansen feature, and the spectral contrast of the Reststrahlen bands [5].

Mineral mixtures of <32 um also show a change in spectral shape, but a Christiansen feature position shift that is consistent with that observed under terrestrial conditions with varying the weight percent of the mineral constituents.

Simulated space-weathered material also shows a shift in Christiansen feature position from that measured under terrestrial conditions and further experiments show a correlation between sample albedo and CF position.

Discussion: The SLE experiments performed here demonstrate the power of environmental conditions to alter MIR spectra from those measured on Earth and the necessity for a SLE spectral library to characterize material sensed remotely and measurements performed on the lunar surface. Additionally, these experiments highlight the importance of variables previously unstudied or only understood as they affect spectra on Earth.

When used in concert with handheld MIR instruments [e.g., Ito et al., 2016], these spectral analyses and the development of an SLE spectral library will allow future astronauts to identify geologic interests within a region. Efficiency of these measurements will allow astronauts to quickly assess a scene to recognize areas useful for both science and exploration purposes.

References: [1] Ito G. et al. (2016) *LPSC XLVII*, Abstract 1953. [2] Logan L.M. et al. (1973) *JGR*, 78(23) [3] Ruff S.W. et al. (1997) *JGR*, 102, doi:10.1029/97JB00593. [4] Thomas I.R. et al. (2012) *Rev. Sci. Intrum.*, 83(12), 124502. [5] Shirley K.A. and Glotch T.D. (2016) *LPSC XLVII*, Abstract 2552.