Incorporation of Portable Infrared Spectral Imaging into Planetary Geological Field Work: Analog Studies at Kilauea, Hawaii

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Abstract. During geological work in future planetary missions, portable/hand-held infrared spectral imaging instruments have the potential to benefit science objectives by providing valuable information that is not easily observable by the human eye. These instruments could aid astronauts by giving them the capability to analyze geological materials in-situ, quickly document the sampling site, and contribute to making strategic decisions in the context of predefined scientific objectives. We assess how well ground-based infrared spectral imaging can be incorporated into geological field work in a planetary setting through a series of field campaigns at analog sites. Kilauea Volcano, Hawaii, is a volcanic lava field with landscape and mineralogy that represent a reasonable analog to the Moon and some differentiated asteroids, and the mineralogy and surface properties of this site are well-characterized, making it an appropriate field site for testing instruments and operational procedures. Using commercially available products, we have assembled a five band spectral imager that operates in 8-12 μm wavelengths, covering the terrestrial atmospheric window and capturing major spectral features of silicate minerals. We calibrate this prototype instrument to provide emissivity spectra and use this output to make colored images that enhance the display of mineralogical and textural variability within the scene. From the scenes captured by the instrument, samples were collected, and mid-infrared (MIR) and visible-near infrared (VNIR) spectra of the samples were acquired in the laboratory to compare to the instrument data taken in the field. Additionally, we compare the mineralogical interpretations made using infrared results to chemical analysis from hand-held X-ray fluorescence (XRF) results. For a select number of samples collected in 2015, mineralogy inferred from the instrument was consistent with those inferred from laboratory MIR/VNIR measurements and compatible with chemistry measured with XRF. This has indicated that our prototype instrument is appropriate for testing the incorporation efforts of infrared spectral imaging into geological field work. From this, we evaluated the role of portable infrared spectral instruments both in our current technologically limited condition and more developed future mission conditions. Here, we include possible geological sampling workflows that benefits the science return of missions from using portable infrared spectral imaging in a planetary scenario.