Testing the Incorporation of Portable Infrared Imaging for Future Human Missions: Second Year of Field Work

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Abstract. Portable, hand-held geochemical and mineralogical instruments are likely to be incorporated into the sample collection and site documentation procedures for future human missions to planetary bodies. The main purpose of these instruments is to allow fast in situ analyses of rocks and soils so that astronauts can quickly document sample characteristics and context, and make strategic decisions that are most consistent with scientific objectives. Even though portable geochemical and mineralogical instruments from commercial manufacturers have been released, there is currently insufficient documentation regarding effective methods for instrument incorporation into fieldwork. As part of the Remote, In Situ, and Synchrotron Studies for Science and Exploration (RIS^4E) Solar System Exploration Research Virtual Institute, we test the performance of candidate instruments and operational procedures through fieldwork expeditions that simulate lunar and asteroid environments on Earth. The Kilauea Volcano, Hawaii field site is a volcanic lava field with landscape and mineralogy that represent a reasonable analog to the Moon and some differentiated asteroids. The mineralogy and surface properties of this volcanic field are well-characterized, making Kilauea Volcano an appropriate field site for testing instruments and operational procedures. This project focuses on the use of a commercial Forward Looking Infrared (FLIR) T-640 Thermal Imager modified with five custom filters. This customized instrument provides multispectral emissivity output which can be used for mineralogical interpretations. We conducted our first field study in 2014 at Kilauea Volcano, and explored the applicability of this customized thermal infrared camera in manned surface operations as well as field operational procedures for such an instrument. Samples were collected in this expedition, and emissivity spectra of the samples were acquired with laboratory instrumentation to compare to the field emissivity spectra and verify the validity of our customization technique. The results from our previous expedition showed relatively strong agreement between laboratory and field acquired spectra, but noticeable differences between the two highlighted the need for improved calibration of the instrument. Additionally, our previous expedition allowed us to better understand how to acquire data of optimal quality and the types of reduced data products that will be most useful for sample selection. The identified issues from past work will be mitigated as best as possible for our next expedition that will take place in June of 2015. Improved measurement accuracy and more efficient field operational procedures are expected from our next expedition. With this, we will be better able to assess the incorporation of portable infrared imaging instruments into a sampling workflow to enhance science return by astronauts.