THE IMPORTANCE OF SAMPLE COLLECTION STRATEGY AND CURATION IN PLANETARY SURFACE EXPLORATION. K. E. Young[1], K. V. Hodges[1], and C. Evans[2], [1]School of Earth and Space Exploration, Arizona State University, Tempe, AZ 85287. Kelsey.E.Young@asu.edu [2]Johnson Space Center, Houston, TX, 77058.

Introduction: As humans prepare themselves to once again explore other planetary surfaces, technology must be developed to support this new phase of exploration. While curation policies and procedures once the samples have been returned to Earth are a crucial part of sample acquisition, another important step is the high-grading and curation of samples by humans or robots while on a planetary surface. Technologies must be developed and tested now so future generations of explorers are ready when the next step of exploration takes place. We are investigating technologies such as a handheld spectrometer as well as a habitat laboratory for humans to use to process samples while in the field.

Handheld Spectroscopy:

Technology Overview: Conducting field geology on Earth often involves return trips to one field area as the observer develops multiple working hypotheses that seek to explain the area's geologic history. Terrestrial geologists seeking to evaluate a unit's geochemistry often collect samples from the field to analyze in research laboratories. Planetary explorers will likely not have the chance to return to their sampling locations, so having real-time access to compositional data is key in developing hypotheses that would potentially impact the rest of the traverses in one surface excursion.

Field Testing of Technology: We have been developing the use of handheld x-ray fluorescence (XRF) technology to use as a planetary field tool. We have deployed this technology in three different modalities. The XRF was placed on a reconnaissance robot (the K10 robot developed by the Intelligent Robotics Group at NASA Ames) in order to evaluate its effectiveness on a robot operating remotely on another surface. The XRF was also evaluated in a habitat lab setting in NASA's Desert Research and Technology Studies (D-RATS) field test. Astronauts simulating a 14-day traverse to a planetary surface traveled in two habitat rovers across a volcanic field, collecting samples and making initial interpretations about the geologic history of the region. Following their traverses, they ran selected samples through instruments in this habitat lab in order to choose which samples should be returned to Earth. Lastly, we are developing this technology in a handheld modality in order to test its effectiveness on an extravehicular activity (EVA), or spacewalk.

Sample High-Grading and Curation: The future of planetary surface exploration will most likely involve long-term habitation of other planetary bodies. We will have the opportunity for astronauts to bring samples back from these bodies for geologists on Earth to analyze. In order to select the most scientifically diverse collection of samples to return to Earth, strategies for sample collection will have to be developed. The D-RATS field test is already evaluating these strategies to determine how to best train astronauts in sample collection. This test places one trained field geologist and one astronaut in each habitat rover to allow for the maximum amount of experience in both science and mission operations. Each EVA is carefully planned between the crewmembers to make sure all local units are analyzed and sampled and any key observations are noted and recorded. This data acquisition process is a crucial part of any sample return from other planetary bodies and must be examined and tested before humans once again return to planetary surfaces.

Preserving the motivation behind each sample collection while in the field is crucial in preserving the development of each traverse in the area. The sample must then be processed and transferred to the case in which it is returned to Earth. The D-RATS mission field tests the Pressurized Excursion Module (PEM), a habitat laboratory designed to initially process collected samples and prepare them for return. The Geo-Lab, or the unit of the PEM that deals solely with scientific pursuits, contains a handheld XRF and macro- and microscopic imagers with which astronauts can assess the samples on the surface of interest before prepping them for return. If the astronauts discover that many of the collected samples are similar geochemically, they can high-grade this collection to ensure the geologic diversity of all samples returned to Earth. This additional curation step while on the surface will yield greater scientific return than with the lack of initial sample processing.

Conclusions: The development of mature sample collection strategies, as well as the initial assessment and curation of collected samples on a planetary surface, is key if the next generation of planetary explorers hope to make the most of traverses conducted on the Moon, Mars, or an asteroid. The work discussed in this abstract helps to develop these strategies by deploying technologies in the NASA D-RATS field test. The results that will be discussed highlight the importance of training and preparation for the next round of sample returns from another planetary body.