DEVELOPING ADVANCED SMARTTOOLS FOR ADVANCED PLANETARY FIELD GEOLOGY. K.E. Young¹, K.V. Hodges², H.H. Schmitt³, and K.M. Ford⁴. ¹School of Earth and Space Exploration, Arizona State University, P.O. Box 871404, Tempe, AZ 85282, USA (Kelsey.E.Young@asu.edu), ²Institute for Human and Machine Cognition, 40 S. Alcaniz St., Pensacola, FL 32502.

Introduction: Emerging plans for renewed human exploration of the Moon, Mars, and/or other destinations provide an opportunity to invent a new paradigm for advanced planetary field geology that embraces coordinated human and robotic research activities and introduces an operational flexibility that is more like that of traditional field geology than was the Apollo exploration experience. In order to gain the advantages of this increased freedom during planetary exploration, it is imperative for field geologists on Earth to begin now to learn how best to incorporate advanced technologies in their research. Geologic studies of analog sites on Earth, employing new technology-enabled strategies rather than traditional research methods, provide ideal opportunities to test and refine emerging designs for advanced planetary field geologic studies as well as to gain new insights into terrestrial geologic processes.

Together, the Institute for Human and Machine Cognition (IHMC) and the School of Earth and Space Exploration (SESE) at Arizona State University are working to define and implement these protocols, and to develop advanced geologic field tools that would enable efficient data collection. We are concentrating on the “tools of the trade” of advanced planetary field geology, specifically the conceptualization and evaluation of handheld or stand-alone devices (SmartTools) that might improve the scientific and operational efficiency of astronaut explorers and extend the utility of NASA’s prototype Lunar Electric Rover (LER).

SmartStaff: One of the first ideas we are exploring is that of a “SmartStaff”. Arising from NASA Exploration Systems Mission Directorate (ESMD)-sponsored “Blue Sky” brainstorming sessions coordinated by IHMC in 2008, this idea centers on a tool that could provide stability and improve the ease of locomotion of explorer-astronauts – much like a hiking pole – but that could also provide enhanced situational awareness (e.g., location, chemical or mineralogical composition of rock or regolith, data recording capability, etc.). We are examining the feasibility and utility of this concept through terrain analog testing in the desert Southwest. Operational prototypes are based on a commercially available, shock-absorbing hiking pole and a variety of attachable devices that could enhance field geology operations. For example, we are developing applications for the Apple iPhone 3G S that enable georegistered note taking, structural measurement, and surface imagery using the SmartStaff. (The iPhone is an inexpensive, easily portable, and highly capable device for such prototyping inasmuch as it includes global positioning, accelerometer, and compass chips that can be integrated into situational awareness and navigation applications through relatively straightforward Objective-C/Cocoa programming.

Chemical Analysis. Our prototyping and testing efforts extend to in situ analysis using a Thermo Niton XL3t x-ray fluorescence analyzer mounted on a second (and more robust) staff. The Niton XL3t is a small (~1.3 kg) device built for quantitative field measurements of elemental abundances. It has become a valuable tool for minerals exploration geology and could be hardened for planetary exploration applications in the future. This device can provide rapid, high-precision contact measurements of a wide variety of elements with a spatial resolution of about 3 mm. We are adapting it to the prototype SmartStaff in such a way that its triggering mechanism is in the grip of the staff and the data it collects can be transmitted by Bluetooth to the iPhone.

Field testing: Plans are currently being developed for field testing of these prototypes in the early Spring of 2010. Our plan is to evaluate the extent to which these simple prototypes improve astronaut mobility on rough terrain, the speed and quality of geologic data collection, and permit more effective sample selection on outcrop. Such studies can be done with student “volunteers” and thus do not require integration with more sophisticated studies of areas that are geologic analogues of planetary exploration targets. However, we are also collaborating with teams at NASA-Ames and NASA-JSC on incorporating some of the SmartStaff technologies into future analog tests including the NASA Desert Research and Technology Studies (D-RATS) exercises.