Near Real-Time Prospecting for Lunar Volatiles: Demonstrating RESOLVE Science in the Field A. Colaprete[1], R. Elphic[1], J. L. Heldmann[1], G. Mattes[2], K. Ennico[1], E. Fritzler[1], M. Marinova[1], R. McMurray[1], S. Morse[1], T. Roush[1], C. Stoker[1], Jerry Sanders[2], Jackie Quinn[3], Bill Larson[3], M. Picard[4], [1]NASA Ames Research Center, Moffett Field, CA, [2]NASA Johnson Space Center, Houston, TX, [3]NASA Kennedy Space Center, FL, [4]Candian Space Center, Québec, Canada.

Introduction: The Regolith and Environment Science and Oxygen & Lunar Volatile Extraction (RESOLVE) project aims to demonstrate the utility of "in situ resource utilization". In situ resource utilization (ISRU) is a way to rebalance the economics of spaceflight by reducing or eliminating materials that must be brought up from Earth and placed on the surface of the Moon for human use. RESOLVE is developing a rover-borne payload that (1) can locate near subsurface volatiles, (2) excavate and analyze samples of the volatile-bearing regolith, and (3) demonstrate the form, extractability and usefulness of the materials. Such investigations are important not only for ISRU but are also critically important for understanding the scientific nature of these intriguing lunar polar volatile deposits.

Temperature models and orbital data suggest near surface volatile concentrations may exist at briefly lit lunar polar locations outside persistently shadowed regions. A lunar rover could be remotely operated at some of these locations for the 4-7 days of expected sunlight at relatively low cost.

RESOLVE Field Test: In July 2012 the RESOLVE project conducted a full-scale field demonstration. In particular, the ability to perform the real-time measurement analysis necessary to search for volatiles and the ability to combine the various measurement techniques to meet the mission measurement and science goals. With help from the Pacific International Space Center for Exploration Systems (PISCES), a lunar rover prototype (provided by the Canadian Space Agency) was equipped with a suite of prospecting instruments (neutron spectrometer and near-infrared spectrometer), subsurface access and sampling tools, including both an auger and coring drill (provided by CSA) and subsurface sample analysis instrumentation, including a sample oven system, the Oxygen and Volatile Extraction Node (OVEN), and Gas Chromatograph / Mass Spectrometer system, the Lunar Advanced Volatile Analysis (LAVA) system. This paper will discuss how the RESOLVE science was demonstrated during the field campaign.

Real-time Prospecting and Combined Instrument Science: Given the relatively short time period this lunar mission is being designed to, prospecting for sites of interest needs to occur near real-time. The two instruments which are being used for prospecting are the neutron and NIR spectrometers (Fig. 1). In the flight mission the neutron spectrometer would sense hydrogen down to concentrations as low as 0.5WT% to a depth of approximately 80 cm. This instrument is the principle instrument for identifying buried volatiles. In flight the neutron source is the integration of galactic rays with the lunar regolith. In the field demo a small radioactive source provided the neutron flux. The NIR spectrometer, which includes its own light source, looks at surface reflectance for signatures of bound H2O/OH and general mineralogy. The RESOLVE flight instrument will work between 1.7-3.4 um; however for the field demonstration a LCROSS NIR spectrometer engineering unit was used which operates between 1.2-2.4 um. Once an area of interest was identified by the neutron and/or NIR spectrometer (what was referred to as a “hot spot”) the option to drill was considered. The drill could either auger or core. The auger drill worked to a depth of 50 cm and is monitored with a drill camera and the NIR spectrometer. As cuttings are brought up the NIR spectra is monitored. If a particular location is considered of high-interest then the decision to core could be made. The coring drill (a push-tube) allowed a 1-meter sample to be acquired and then processed by the OVEN/LAVA system. This presentation will provide details as to how these instruments worked together and how and if the planned measurements and science was obtained.

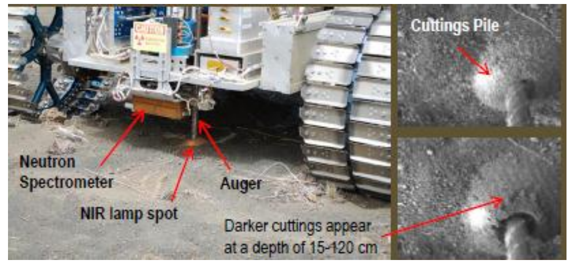

Figure 1. The RESOLVE Payload on the Artemis Jr. rover: Shown is an augering activity with the NIR lamp illuminating the drill spot the view from the Dril Camera.