THE VAPoR FIELD UNIT AND FUTURE FIELD TESTING. I. L. ten Kate[1,2], D. P. Glavin[1], and E. H. Cardiff[1]. [1]NASA Goddard Space Flight Center, Greenbelt, MD 20771, inge.l.tenkate@nasa.gov, [2]GEST-UMBC, Baltimore, MD 21228.

Introduction: The Volatile Analysis by Pyrolysis of Regolith (VAPoR) instrument is currently under development at NASA Goddard Space Flight Center. VAPoR is a miniature pyrolysis mass spectrometer instrument suite that is designed to identify water, oxygen, hydrocarbons, noble gases, and other volatiles released from crushed rock and regolith samples on the Moon or other airless bodies. The instrument will analyze regolith samples by ramped heating up to at least 1200 °C and simultaneous measurement of the evolving gases using a mass spectrometer. In order to understand the challenges associated with field operations, the VAPoR instrument will be field tested as part of the 2010 ISRU-Surface Operations Field Test in Hawaii.

Field unit: The first version of VAPoR is a field portable instrument consisting of a stainless steel vacuum cross equipped with a high temperature pyrolysis oven, replaceable sample holders, a quadrupole mass spectrometer (RGA), an atmospheric inlet leak valve, a drag/turbopumping station, an ion gauge, and a power supply and temperature controller for the oven (Fig. 1). The field unit will evolve with time as additional instrument components, including an automated sample manipulation system built by Honeybee Robotics, and a miniature time of flight mass spectrometer built at GSFC, become available for integration and testing.

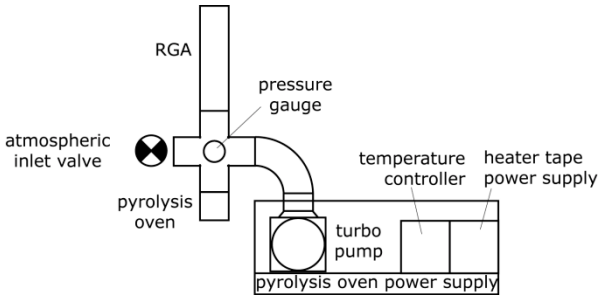

Figure 1. Schematic of VAPoR field unit, not to scale.

Laboratory results: The first measurements of analogue samples in the laboratory using a field-like instrument breadboard have validated the concept. Fig. 2 shows an example of two sets of evolved gas traces obtained by the VAPoR breadboard. Besides a range of organics and/or mineral phases in different terrestrial lunar and mars analogues (Fig. 2, left panel), also helium has been clearly detected in an Apollo 16 regolith sample (Fig. 2, right panel).

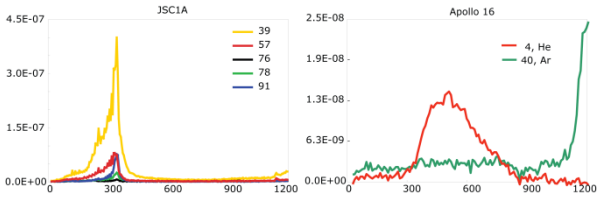

Figure 2. Evolved gas profiles, showing alkane (39, 57) and hydrocarbon fragments (39, 76, 78, 91) in the JSC1A lunar analogue (left panel) and helium and argon in an Apollo 16 regolith sample (right panel).

Planned field work activities: As part of the VAPoR development, the instrument will be deployed during the upcoming ISRU-Surface Operations Field Test most likely at the Pu'hu'hiwahini site located at the Mauna Kea volcano, Hawaii. Different locations on this field site will be sampled, and both soil and rock samples will be collected. Rock samples will be crushed before VAPoR analysis. Samples will then be heated to temperatures up to 1200°C, while the RGA will continuously record spectra of the gases the evolve. With these analyses we will be able to characterize the volatile composition of the fieldsite, as well as provide input for ISRU instruments on where to extract volatiles useful for ISRU purposes.

Besides soil samples, atmospheric samples and gaseous samples from potential venting locations will be analyzed as well.

Objectives: The primary science objective for this years field study is a characterization of the volatile content of rock samples at the field site including concentration data for volatiles of interest for ISRU purposes. The key technical objective is the field testing of the flight prototype pyrolysis heater in a harsh environment at low temperatures and in the presence of dust.