GEOLAB 2010 HARDWARE in NASA's PRESSURIZED EXCURSION MODULE. M. J. Calaway[1], C. A. Evans[2], and M. S. Bell[1]. [1]Jacobs Technology (ESCG) at NASA Johnson Space Center, Astromaterials Acquisition and Curation Division, Houston, TX 77058, michael.calaway-1@nasa.gov, [2]NASA at NASA Johnson Space Center, Astromaterials Acquisition and Curation Division, Houston, TX 77058.

Introduction: NASA is designing and building the Habitat Demonstration Unit – 1 in a Pressurized Excursion Module (HDU1- PEM) configuration for analog testing at NASA's annual Desert Research and Technology Studies (DRATS) near Flagstaff, Arizona in late summer 2010. The HDU1-PEM design is based on NASA Constellation program's Lunar Scenario 12.1 (nicknamed "Lunabago"; fig. 1). This scenario uses Lunar Electric Rovers (LER) and a PEM for long-distance lunar exploration. The 2010 HDU version 1.0 will be an unpressurized PEM that contains a GeoLab in one of the eight PEM sections (fig. 2). The GeoLab is designed to facilitate sample curation protocol development including such activities as preliminary examination, sample archiving, and high grading of astromaterials for return to Earth. Geolab operations will be integrated with the DRATS science traverses and operations [1, 2, 3].

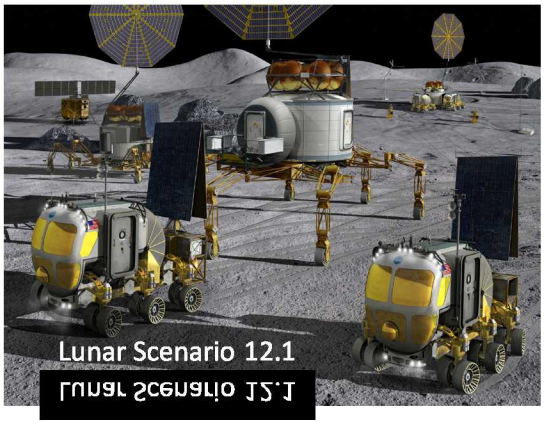

Fig. 1: Artist sketch of Lunar Scenario 12.1 with PEM and two LERs.

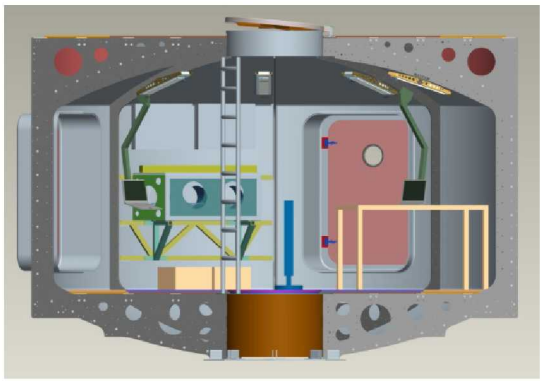

Fig. 2: CAD HDU –PEM mockup with a view of the GeoLab in section B between two hatches.

Glovebox Design: The GeoLab is designed around a positive pressure enriched nitrogen environment glovebox to reduce sample handling contamination (fig. 3). The glovebox will be manufactured with 304 stainless steel, viton seals, and clear polycarbonate materials that are known to offer low off-gassing and particle shedding properties. Two 10 inch gloveports will be installed in the front polycarbonate window with long-sleeve hypalon gloves.

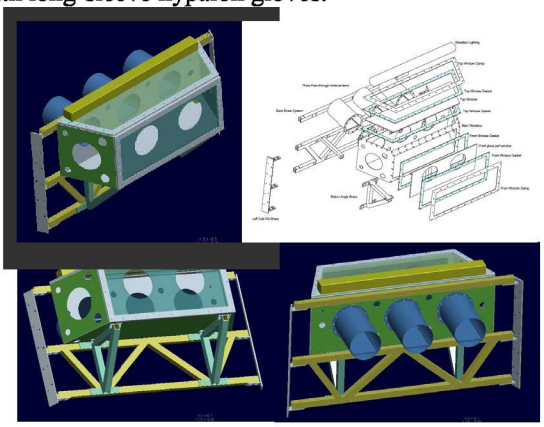

Fig. 3: CAD drawings of the GeoLab glovebox.

The unusual trapezoidal-shape glovebox design follows the PEM structural rib design and can accommodate more space for analytical instruments on the right and left side of the glovebox. The right side has a 10 in. instrument port with four other ports to accommodated sensors and cameras. The left side has a 6 in. instrument port to house an instrument or a rapid transfer container port along with four smaller ports to house sensors and cameras. The back of the glovebox includes three vacuum rated pass-through antechambers to transfer samples from outside the PEM directly into the glovebox reducing the risk of sample cross-contamination inside the PEM. The back of the glovebox will also be equipped with eight ports to accommodate environmental monitoring sensors, electrical/computer cables, and nitrogen inlet and outlet. The top of the glovebox will be the main viewing window constructed with high visibility polycarbonate along with LED lighting for enhanced sample viewing. On the bottom of the glovebox, two dust/sediment traps are positioned in the back two corners to purge clean the glovebox between sample analyses.

Science Instruments: GeoLab version 1 was designed with various port sizes to test and accommodate

a variety of future analytical instruments. For DRATS 2010 analog tests, we selected scientific instruments based on science community input from LEAG and CAPTEM [2].

The glovebox will be equipped with a Leica M80 stereomircoscope with HD camera system. The stereomicroscope will be used to image samples for identification and initial sample characterization. We plan to integrate a small handheld Niton XL3t XRF spectrometer installed in the left 10 in. port. The XRF is equipped with a 50 kV Ag anode with a Geometrically Optimized Large Drift Detector (GOLDD) which can document elemental abundances from Mg to U. We also plan to integrate a small handheld innoRam Raman spectrometer installed on the right side 6 in. port. The innoRam will have a 300 mW laser at 785 nm excitation wavelength with a spectral range of 65 – 2980 cm^{-1} and resolution of 2 cm^{-1} (FWHM).

Additional Equipment: A four camera video surveillance system is integrated with the GeoLab for operational observation and sample imaging. Two Axis 211M cameras will be placed on the right and left side of the glovebox for internal monitoring. An Axis 214 PTZ camera with 18x optical zoom will be installed directly above the glovebox for overhead monitoring and overview imaging of samples. On the outside of the HDU, an Axis 215 PTZ-E camera with 12x optical zoom will monitor outside pass-through antechambers and sorting operations.

The glovebox will be equipped with environmental monitoring sensors. This will include oxygen sensor (ppm), moisture/humidity sensor (ppm), temperature, and pressure sensors for internal and antechamber observations. The glovebox will also be equipped with an A&D weighing balance for determining sample mass. A rock splitter, hammer, chisel, and a variety of sample manipulation tools will be available for sample characterization inside the glovebox. Primary nylon and teflon sample bags will also be available for sample isolation and curation.

Two HP touchsmart 600xt all-in-one computers will be installed above the glovebox (fig. 4). The touch-screen technology will control all aspects of the camera systems, instruments, and monitoring sensors without the need for a keyboard and mouse.

The outside of the HDU will house sample stowage containers for Earth return samples as well as samples to be analyzed and high graded (fig. 5). The three antechambers allow for multiple sample isolation and system redundancy. For HDU1-PEM, steps and a platform provide access to the glovebox antechambers.

Summary: The GeoLab is designed to test the feasibility of advanced curation protocols including preliminary sample examination, sample archiving, and high grading of lunar samples for Earth return. Advanced curation technologies and procedures must be developed and tested inside a pressurized habitat for future sample return missions involving human space flight. The GeoLab will be the first generation human interaction geology laboratory that will test current Constellation lunar surface operations and architectures.

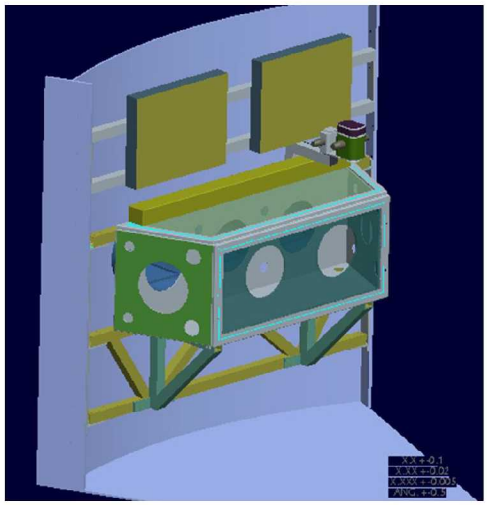

Fig. 4: CAD drawing of the glovebox integrated into section B between two ribs. Above the glovebox are two HP touchsmart comuters and a stereomicroscope.

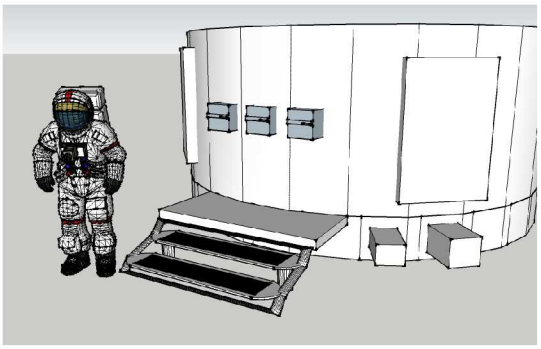

Fig. 5: A sketch drawing of the glovebox's three sample pass-through antechambers with outside stair to platform access. Sample stowage conatiners will also be placed on the ouitside of the HDU for sample sorting and Earth return.

References: [1] Treiman, A.H. (1993) Curation of Geological Materials at a Lunar Outpost, JSC-26194 and Office of the Curator Publication #187. [2] Shearer, C. et al. (2009) Review of Sample Acquisition and Curation During Lunar Surface Activities, LEAG and CAPTEM White paper, in press. [3] Evans, C., et al (2010) GeoLab in NASA's First Generation Pressurized Excursion Module: Operational Concepts, this vol.