2010 GSA Denver Annual Meeting (31 October –3 November 2010)

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Presentation Time: 10:45 AM-11:00 AM

EXPLORING THE LUNAR SUBSURFACE ICE HYPOTHESIS USING EVA AND ROBOTIC FOLLOW-UP: THE HAUGHTON CRATER LUNAR ANALOG STUDY

HEGGY, Essam[1], HELPER, Mark A.[2], FONG, Terry[3], LEE, Pascal[4], DEANS, Matthew[5], BUALAT, Maria[5], HURTADO, Jose Miguel Jr[6], ALTOBELLI, Martha[2], PALMER, Elizabeth[7], and HODGES, Kip V.[8], (1) NASA, Jet Propulsion Laboratory, 4800 Oak Grove Drive, MS 300-243, Pasadena, CA 91109, eheggy@jpl.nasa.gov, (2) Geological Sciences, Univ of Texas at Austin, Austin, TX 78712, (3) Intelligent Robotics Group, NASA Ames Research Center, Moffett Field, CA 94043, (4) SETI Institute/NASA Ames Research Center, Mars Institute, MS245-3, Moffett Field, CA 94035-1000, (5) Intelligent Systems Division, Ames Research Center, Mail Stop 269-3, Moffett Field, CA 94035, (6) Department of Geological Sciences, University of Texas at El Paso, 500 West University Avenue, El Paso, TX 79968, (7) Case Western Reserve University, 10900 euclid ave, Cleveland, OH 44106, (8) School of earth and space exploration, Arizona State University, Tempe, AZ 85287

Recent orbital observations from the Lunar Crater Observation and Sensing Satellite (LCROSS), the mini-RF Synthetic Aperture Radar onboard the Lunar Reconnaissance orbiter (LRO) and Moon Mineralogy Mapper (M^3) on board Chandrayaan-1 all suggest that the lunar subsurface contains traces of cometary ice in the permanently shadowed areas at the lunar poles. Although the presence of ice in the lunar subsurface is supported by an increasing set of remote sensing observations, its depth, composition, and concentration remain poorly quantified. Quantifying these parameters will increase our understanding of the ice transport to the lunar surface and are vital to future plans to use it as a potential resource for long-term human presence. Future EVAs and robotic follow-up are hence crucial to characterize the ice budget at the lunar poles. To address this, a two-year analog experiment using simulated EVAs and robotic follow-up was designed to simulate geologic and geophysical fieldwork to map volatiles on the moon. In 2009, we simulated a 9-hour geophysical survey EVA in concept space suits and motorized traverses in a simulated rover at Haughton crater, Devon Island, Canada. The main objective was to explore for ice along the western crater rim. Two ground penetrating radars (GPR) with four antennas with different probing depths, resolutions, and operational constraints, were mounted on the rover and also deployed manually. Traverses along the crater rim were designed to visit areas where gullies have been observed in high-resolution visible images and that have anomalous polarimetric signatures in L- and X-Band Synthetic Aperture Radar (SAR) images. Observations suggest the presence of ice in the subsurface. GPR has been used explore the depth and the state of this ice in the shallow subsurface and to optimize shallow sampling to better understand the presence of volatiles. In 2010, a follow-up mission was performed using the LiDAR, GPR, panoramic- and micro-imaging cameras, and XRF instruments on the Ames K10 robot to re-explore the sites. The main objective of the robotic follow-up was to provide measurements to quantify ice depth, concentration, and large-scale distribution. Both the LiDAR and panoramic images provided a correlation between gully depth, surface polygon sizes, and ice layer depth as determined with GPR.

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