THE CASE FOR THE MARIUS HILLS LUNAR PIT AS A HIGH-PRIORITY LANDING SITE. D. M. Hooper[1], S. W. Ximenes[2], R. Wells[1], E. L. Patrick[3], and M. Necsoiu[4]. [1]WEX Foundation, 110 E. Houston Street, 7th Floor, San Antonio, TX 78205 (dhooper@wexfoundation.org), [2]XArc Exploration Architecture Corporation, San Antonio, TX 78205 (sximenes@explorationarchitecture.com), [3]Southwest Research Institute®, San Antonio, TX 78238, [4]U.S. Army Research Laboratory, Adelphi, MD 20783.

Introduction: Recent data from the JAXA KAGUYA (SELENE) and NASA LRO missions have resulted in discoveries of numerous "skylights" or "pits" caused by lava tube ceiling collapse in mare basalts [1-3]. The discovery of a prominent pit at Marius Hills (14.1º N., 303.2º E) has once again brought attention to this volcanic complex in Oceanus Procellarum, a region noted for its diverse assortment of lava flows, domes, cones, pits, and sinuous rilles [4-6]. Lava tubes are potentially important sites for the long-term human presence on the Moon because they provide shelter from surface hazards like micrometeorites, radiation, extreme temperatures, and dust [7-9]. We make the case for the Marius Hills Pit (MHP) to be a high-priority landing site with substantial scientific value.

Science and Technology Demonstrations: Permanently shadowed regions at the lunar poles are believed to serve as cold traps for the possible accumulation of volatiles, including water frost and ice [10]. It is not known whether lunar lava tubes or caves serve as similar reservoirs and future exploration should address this question. Additionally, understanding lunar regolith permeability is important for the possible recovery and utilization of water. Also, to understand lunar regolith permeability and its importance in the use of water, a series of permeability tests conducted by our team with JSC-1A lunar simulant demonstrated significant permeation of volatiles takes place in laboratory conditions analogous to those at the lunar surface [11].

Our Leto mission concept deploys a Multi-Utility Legged Explorer (MULE) for robotic reconnaissance of MHP [9, 12]. The MULE, which can be equipped with tools like LiDAR or a compact spectrometer, is a critical component for initial exploration.

We are conducting lunar regolith simulant research to support robotics testing, landing pad brick construction, dust measurements in a simulated lunar environment, 3-D printed manufacturing, and general testing between simulant variants.

Perceived Impact and Relevance for Lunar Science Goals: Volatile flux, lunar volcanism, regolith processes, and the dust environment encompass science concepts and goals identified within the guiding documents by LEAG [13] and the National Research Council [14].

MHP developed as a framework for planetary cave research [15] improves the community's understanding of lava tubes, skylights, and other sublunarean voids. Emerging robotic reconnaissance technologies are paving the way for descending and entering these pristine cave-like environments for the first time in a non-disturbing way. Our novel "green reconnaissance" approach safeguards the science inherent in such environments during first contact by human and robot explorers [12].

Ingress/egress of MHP would provide the first opportunity to observe a major vertical stratigraphic sequence for constraining theories of lunar lava-flow thermodynamics and mare emplacement to address questions regarding the age and composition of lunar mare basalt flows, but also the flux of regional lunar volcanism and its evolution in space and time.

Conclusion: We select MHP as a site for investigation because of its volcanic setting, proximity to the lunar equator, and habitability and economic value. The discovery of MHP provides compelling motivation for robotic and human exploration missions to these sites for in situ investigations to determine viability for long-term habitation and utilization of lunar resources. New technologies necessary for exploring planetary caves will benefit other fields of planetary research.

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