

LEAP2: DEVELOPMENT OF A LUNAR ECOSYSTEM AND ARCHITECTURAL PROTOTYPE AT THE MARIUS HILLS SKYLIGHT

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Introduction: LEAP2 is a commercial lunar settlement program that addresses space architecture issues in lunar exploration, economic development, mining, and sustainment at a specific lunar site identified as the Marius Hills Skylight. Projects within the LEAP2 program address various technology solutions and missions for achieving multi-generational program goals to develop the site for human settlement.



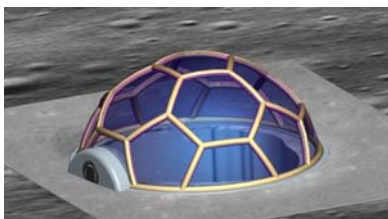
Scientific Robotic Reconnaissance Phase



Human / Robotic Reconnaissance Phase



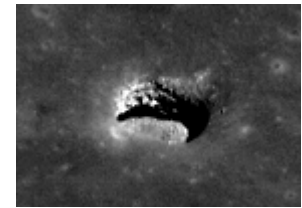
Outpost Development Phase



Settlement Phase

Marius Hills Skylight: The Skylight is a large deep pit, approximately 45 m in depth, and 48 m to 57 m in diameter [1]. It was formed from a lava tube ceiling collapse, and is believed to be the entrance to a lunar lava tube cave, indicated by a large overhang at the

pit's northeast side. The Skylight is located in the area of the Moon's Marius Hills region of Oceanus Procellarum at lunar coordinates 14.2°N, 303.3°E [1].



Mineral resources in the surrounding area have been postulated for surface mining operations and the potential for long term habitation and settlement within the protection of the lava tube form the basis for economic development of the site.

Current Investigations: LEAP2 will develop mission architectures and technologies for exploration and exploitation of the site, beginning with reconnaissance phase robotic missions. The research investigates operational scenarios, technologies, and human and robotic performance feats associated with the first missions of planetary cave exploration. The LEAP2 program works collaboratively with a network of partner organizations of varying disciplines and expertise.

LEAP2 is currently focused on site characterization techniques with remote sensing measurements; development of reconnaissance phase technologies needed to support entering and examining the site robotically and by astronauts for in situ investigations; STEM education outreach for Citizen Explorer participation; and business plan development.

One of the first challenges for reconnaissance at the Marius Hills Skylight is getting instruments, payloads and eventually astronauts down the pit hole and then back out in an unobtrusive manner which maintains integrity of the initial pristine site for science investigations. LEAP2 is developing a robotic concept for a grappling and anchoring platform to enable off-loading of instruments and payloads for access to subsurface features in planetary cave exploration [2]. Subsystem architecture elements are comprised of a transport platform, harpoon system, deployable mast, intelligent zipline, trolleys, and resources subsystems.

References: [1] Ashley, J. W. et al. (2011) 1st International Planetary Cave Research Workshop, Abstract #8008 [2] Ximenes S. W. (2012) *Intelligent Zipline - Green Reconnaissance for Lava Tube Skylights*, 13th Space Resources Roundtable and the Planetary & Terrestrial Mining Sciences Symposium.