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FEASIBILITY AND DEFINITION OF A LUNAR POLAR VOLATILES PROSPECTING MISSION

Abstract

The recent Lunar Crater Observing and Sensing Satellite (LCROSS) mission has provided evidence for significant amounts of cold-trapped volatiles in Cabeus crater near the Moon's south pole. Moreover, LRO/Diviner measurements of extremely cold lunar polar surface temperatures imply that volatiles can be stable outside of areas of strict permanent shadow. These discoveries suggest that orbital neutron spectrometer data point to extensive deposits at both lunar poles.

The physical state, composition and distribution of these volatiles are key scientific issues that relate to source and emplacement mechanisms. These issues are also important for enabling lunar in situ resource utilization (ISRU). An assessment of the feasibility of cold-trapped volatile ISRU requires a priori information regarding the location, form, quantity, and potential for extraction of available resources.

A robotic mission to a mostly shadowed but briefly sunlit location with suitable environmental conditions (e.g., short periods of oblique sunlight and subsurface cryogenic temperatures which permit volatile trapping) can help answer these scientific and exploration questions. Key parameters must be defined in order to identify suitable landing sites, plan surface operations, and achieve mission success. To address this need, we have conducted an initial study for a lunar polar volatile prospecting mission, assuming the use of a solar-powered robotic lander and rover. Here we present the mission concept, goals and objectives, and landing site selection analysis for a short-duration, landed, solar-powered mission to a potential hydrogen volatile-rich site.