

LUNAR AND MARTIAN LAVA TUBE EXPLORATION AS PART OF AN OVERALL SCIENTIFIC SURVEY

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Introduction: Lava tubes exist on the Moon and almost certainly on Mars. If we can locate, characterize, and gain entry to one of these caverns, very considerable advantages may be found for both scientific exploration and surface systems architecture. Due to the extreme cost of bringing technology to the Moon, it is quite probable that a great savings in landed mass can be accomplished by using a lava tube as a shelter for a habitat and science lab. Such a habitat would be completely protected from radiation, extreme temperature variations, and regolith dust.^[1]

Implications for Science: The implications for logistical and mission planners are that a substantially larger fraction of the payload mass landed on a planetary surface can be dedicated to life support and science mission support. This could enable longer duration missions without risk of radiation overdosing, better reliability and a more diverse set of scientific technology, and a larger habitat area in which to work.

Importantly, the effort required to discover and qualify a candidate uncollapsed lava tube has a high degree of synergy with other compatible science missions, and it may be possible to multi-task the same equipment for this purpose. While gaining entry to a tube may be difficult, it is within our capability.

The confirmation of Martian lava tubes^[2,3] would present the scientific community with a compelling opportunity as well as a quandary. Tubes and caves represent a prime location to focus the search for life and liquid water, and they would provide numerous opportunities for geological studies that could reveal much about the history of Mars^[4,5]. They could also provide a means of reducing the landed payload mass for manned Mars missions by providing shelter from UV radiation, wind storms, and large temperature fluctuations. However, preinvestigation of the tubes would be necessary to assure that the environment is sterile,

and precautions would need to be taken to prevent the translocation of terrestrial microorganisms.

The difficult environmental conditions that exist on the surfaces of the Moon and Mars are equally concerning to planetary scientists and habitat and surface systems designers. The existence of natural caverns on both bodies represents an opportunity to enable more ambitious planetary science investigations and the search for these features should be approached collaboratively by scientists, engineers and mission planners. There is great opportunity for multi-purposing technologies that can be used to discover these tubes and to exploit them. Lava tubes and caves should be given high priority in the planning of future exploration missions.

References:

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