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DETECTION AND CHARACTERIZATION OF LAVA TUBES USING SURFACE GRAVITY MEASUREMENTS IN SUPPORT OF FUTURE LUNAR AND MARTIAN MISSIONS.

Abstract

Lava tubes form when mafic lava flows on a planetary surface and burns channels into the ground. Lava flowing on top of a channel cools and forms a solid roof while magma continues to flow beneath the roof in a newly formed, subterranean tube. When the volcanic event ends, the tube is left as a subsurface void. The solid-rock roof of lava tubes provides protection from cosmic radiation and surface thermal fluctuations. Numerous studies indicate that lava tubes would be ideal locations to install habitations and laboratories on the Moon and Mars.

An effective method of lava tube detection on Earth is the gravity method. Gravity surveying provides information about subsurface density contrasts. Lava tubes are spatial voids and therefore provide a sharp density contrast with the host rock; this density contrast should make detection of lava tubes easy. Following a reconnaissance survey of the area in August 2016, a detailed gravity survey will be conducted in August 2017 at Craters of the Moon National Monument in Idaho, USA. The survey region is composed of Holocene basaltic lava fields and features several lava tubes.

The primary target of the 2017 survey is Indian Tunnel, a lava tube that is approximately 250m long, 22m wide and 12m high. Its roof is up to 6m thick. Preliminary forward models indicate that a void of these dimensions should result in a 500μGal gravity anomaly. Field gravity data will be inverted in 3D to provide spatial and geometric properties of Indian Tunnel. The 3D models from inverse modelling will be compared with high resolution (mm scale) 3D LiDAR images from inside Indian Tunnel.