Investigating Lunar Caves with Diviner Thermal Infrared Data and Numerical Models

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Program: FY21 SURP **Strategic Focus Area: Lunar science**

Objectives

- Understand thermal environments of lunar pits and caves
- Investigate volatile trapping potential as function of pit geometry and latitude

Background

- Understanding origin/evolution of lunar volatiles is key to understanding solar system evolution
- Pits are plentiful on the Moon [1], and high latitude pits [2,3] may be cold enough to trap water and other volatiles on long timescales
- The composition of trapped volatiles could reveal whether they were sourced from lunar volcanism or a cometary impact
- Water trapped in pits/caves could provide a resource for future lunar missions

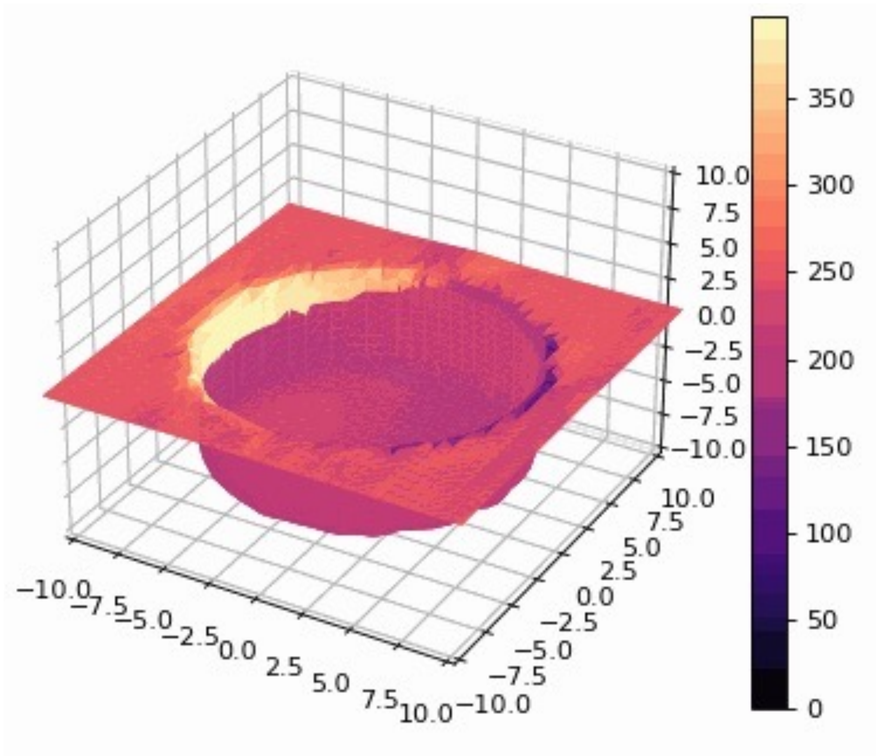

Figure 1. Modeled surface temperatures at local noon for a cylindrical pit at 80° S latitude, with diameter of 16 m and depth of 7 m. The scale bar shows the temperature in Kelvin.

Significance to JPL/NASA

- Axel Rover makes JPL uniquely qualified to explore lunar pits
- The results of this 3-yr project can be used to develop science objectives for future missions to lunar pits investigating the origin of volatiles on the Moon.

Approach

- Developed 3D thermophysical model
- Performed model validation and applied to notional pit geometries (Fig. 1)
- Developed framework for modeling pit/cave temperatures with varying geometries/latitudes
- Established methodology for ballistic volatile transport model

Results

- Multiple-scattering of radiation gives cylindrical pits higher temperatures than bowl-shaped terrain at same latitudes, despite increased shadowing [A]
- Cylindrical pit interior temperatures are fairly uniform across shadowed regions [A]

Publications

[A] Andrew Wilcoski, Paul Hayne, Catherine Elder, and Tyler Horvath (2021) “Thermal Environments and Volatile- trapping Potential of Lunar Pits and Caves,” *AGU Fall Meeting*.

References

[1] Robert Wagner, and Mark Robinson (2014), *Icarus* 237: 52-60. [2] Lee, P. (2018), *49th Lunar and Planetary Science Conference,* #2083. [3] Avent, W. M., and P. Lee (2021), *52nd Lunar and Planetary Science Conference* #2548.

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