ROUGHNESS MEASUREMENTS OF ICE-BEARING CRATERS ON MERCURY AND THE MOON. Ariel N. Deutsch[1,2], Jennifer L. Heldmann[1], Anthony Colaprete[1], Richard C. Elphic[1], and Kevin M. Cannon[3], [1]NASA Ames Research Center, Mountain View, CA 94035, USA (adeutsch@usra.edu), [2]Universities Space Research Association, [3]Colorado School of Mines, Golden, CO 80401, USA.

Introduction: Despite similar polar thermal environments [1], Mercury and the Moon show distinct differences in the abundance and purity of ice cold-trapped at their poles. While both Earth-based and orbital observations indicate there are extensive water-ice deposits within Mercury's polar regions [e.g., 2–5], data suggest water-ice exposures on the Moon are smaller in extent and less concentrated than those on Mercury [e.g., 6–8].

Here we continue to probe the disparity between polar ice on Mercury and the Moon by measuring surface roughness of polar craters on each body. We discuss how ice may be influencing surface roughness, and how roughness could be a useful tool for prospecting for ice.

Methods: We calculate surface roughness from standard deviation filtering of a 3×3-cell moving window. Roughness is expressed as the mean difference in elevation between a DEM cell and all directly adjacent cells. Because roughness can be sensitive to slope, we evaluate only surfaces with slopes <10°.

Mercury. We calculate roughness for 6 ice-bearing north polar craters, selected due to the availability of new high-resolution DEMs constructed from Mercury Laser Altimeter (MLA) data (125 m pixel^{-1}) [9]. Unlike on the Moon, surface ice deposits on Mercury have distinct boundaries resolvable in reflectance data and visible images [4, 5]. Thus, for Mercury, we are able to analyze how roughness varies across polar deposit boundaries onto ice-free portions of crater floors.

Moon. We calculate roughness for 6 north and 6 south polar craters using Lunar Orbiter Laser Altimeter (LOLA) DEMs with pixel resolutions of 120 m pixel^{-1}, resampled to 125 m pixel^{-1} for comparisons with mercurian DEMs. Craters were selected due to the presence of a distinct surface temperature contour of 112 K, separating portions of the surface where water ice is and is not stable within a single crater. Of these 12 craters, 7 have evidence for surface water-ice exposures [8].

Results and Discussion: *Mercury.* We find that roughness is relatively consistent across any given polar deposit, and that roughness increases at higher temperatures, on portions of crater floors where polar deposits are absent. Interestingly, some craters show a distinct decrease in roughness (i.e., a smoothing) at their boundaries (dotted lines in **Fig. 1**). This boundary effect may be related to ice concentration changes or sublimation/crater retention properties of the lag deposits insulating the investigated ice deposits.

Moon. In contrast to Mercury, polar roughness on the Moon is not as clearly linked to the presence of ice. In 8 of the 12 investigated craters, surfaces where water ice is stable (T < 112 K) are smoother than neighboring warmer surfaces. These comparatively smooth surfaces are observed in both craters that host surface water-ice exposures and also those that do not. It is possible that the presence of subsurface ice, rather than surface ice, may be responsible for the reduced roughness.

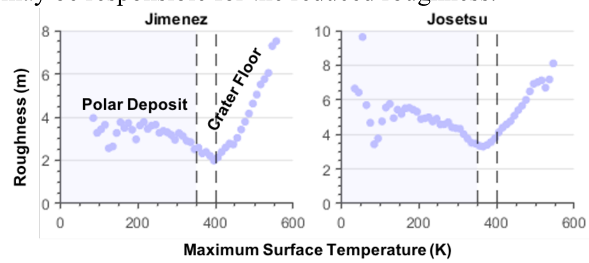

Fig. 1. Surface roughness as a function of temperature for two north polar craters on Mercury that host polar deposits.

Conclusion: Cold traps on Mercury and the Moon show distinct differences in the abundance, reflectance, and purity of ice [e.g., 2–8], which may be related to differences in the age of the ice [e.g., 10, 11]. Here we show how the surface roughness of cold traps are also distinctly different; on Mercury, the presence of surface ice clearly subdues the roughness, but on the Moon, roughness is subdued in ice stability regions both where surface ice has and has not been detected by [8]. On the Moon, smoothing in ice stability regions may be linked to the presence of subsurface ice. Ground measurements (specifically with neutron spectrometers, radar, and drilling) are essential for better understanding the nature of lunar subsurface ice. Identifying ice stability regions with anomalously smooth textures can help in the identification of interesting future exploration targets.

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