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Characterization of High Radar CPR Surfaces Associated with Lunar Secondary Craters

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Abstract

Recent work has shown that lunar secondary craters of Copernican age are sometimes associated with higher-than-average radar circular polarization ratios (CPR) [4]. High radar CPR indicates roughness on the radar wavelength scale. We investigate the nature of these high-CPR features by comparing 13-cm Arecibo-Green Bank Telescope (GBT) radar maps to Lunar Reconnaissance Orbiter Camera (LROC) Wide Angle Camera (WAC) and Narrow Angle Camera (NAC) images. Preliminary results indicate that these areas of high CPR are often correlated with "braided" terrains on scales of tens of meters. At smaller scales, the surface in these high-CPR regions does not appear unusually rough. This could mean that the roughness is confined to the 13-cm scale and smaller (below LROC resolution), or that rough scatterers are buried by a thin layer of smooth material.

1. Introduction

Secondary craters at large distances from their parent primary crater can be difficult to identify because of their resemblance to small primary craters [e.g., 3]. Wells et al. (2010) found that some such far-field secondary craters can be identified by the presence of high-CPR regions [4]. In order to further investigate the nature of high CPR regions associated with secondary craters, we have compared Tycho secondary craters with high CPR features to imaging data from the LROC WAC and NAC.

2. Data

Figure 1 shows an LROC WAC image of the floor of Clavius crater (D=225 km) with an Arecibo-GBT radar CPR map overlaid on top of it. The full resolution of the 643-nm WAC image is 64.6 m/pixel. The 13-cm radar map resolution is 80 m/pixel but this is degraded in the CPR image to 160 m/pixel.

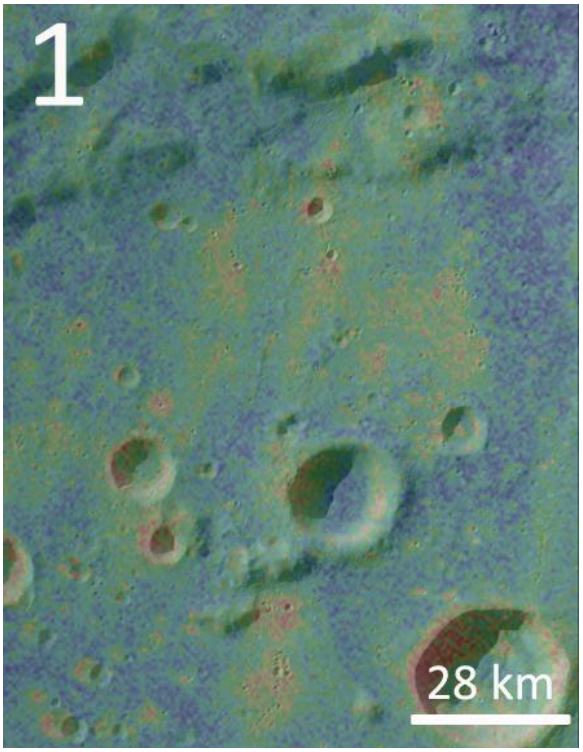

Figure 1: LROC WAC image M119956789M of Clavius crater, overlaid with a 13-cm Arecibo-GBT radar CPR map. High CPR regions, shown in red and yellow, are correlated with Tycho secondary craters. M119956789M was obtained from the PDS.

Areas of high radar CPR, indicated by yellow and red, are correlated with the presence of Tycho secondary craters found on the Clavius floor. Some of these secondary craters exhibit classic secondary morphology, such as clustering and elliptical planform, while others are more isolated and might be confused with small primary craters using the WAC image alone. LROC NAC images were used to characterize the surface morphology of regions of high-CPR on the Clavius floor where Tycho secondary craters were also present.

3. Results

The LROC NAC image M117601986 (left and right image pair), shown in Figure 2(b), contains two main clusters of Tycho secondary craters and corresponding high-CPR features. The inset in Figure 2(c) shows one of these high-CPR regions in finer detail. Downrange from the secondary crater cluster in the upper right-hand corner of Figure 2(c) is an area of textured terrain reminiscent of the "braided" terrains observed by Lucchitta (1977) in association with Tycho secondary craters near the Apollo 17 landing site, as well as the "surge" morphologies described by Dundas and McEwen (2007) [1, 2]. At ten-meter scales and smaller, the terrain appears to be very smooth. However, the radar wavelength scale is below the resolution of the NAC image, and it is possible the roughness is confined to these scales. An alternate explanation is that the scatterers responsible for the high CPR signal are buried by a thin, smooth layer.

References

[1] Dundas, C. M., and McEwen, A. S.: Rays and secondary craters of Tycho, Icarus, 186, 31–40, 2007.

[2] Lucchitta, B.: Crater clusters and light mantle at the Apollo 17 site - A result of secondary impact from Tycho, Icarus, vol. 30, pp. 80-96, 1977.

[3] McEwen, A. S., et al.: The rayed crater Zunil and interpretations of small impact craters on Mars, Icarus, 176, 351–381, 2005.

[4] Wells, K. S., Campbell, D. B., Campbell, B. A., and Carter, L. M.: Detection of small lunar secondary craters in circular polarization ratio radar images, JGR, vol. 115, Issue E6, 2010.

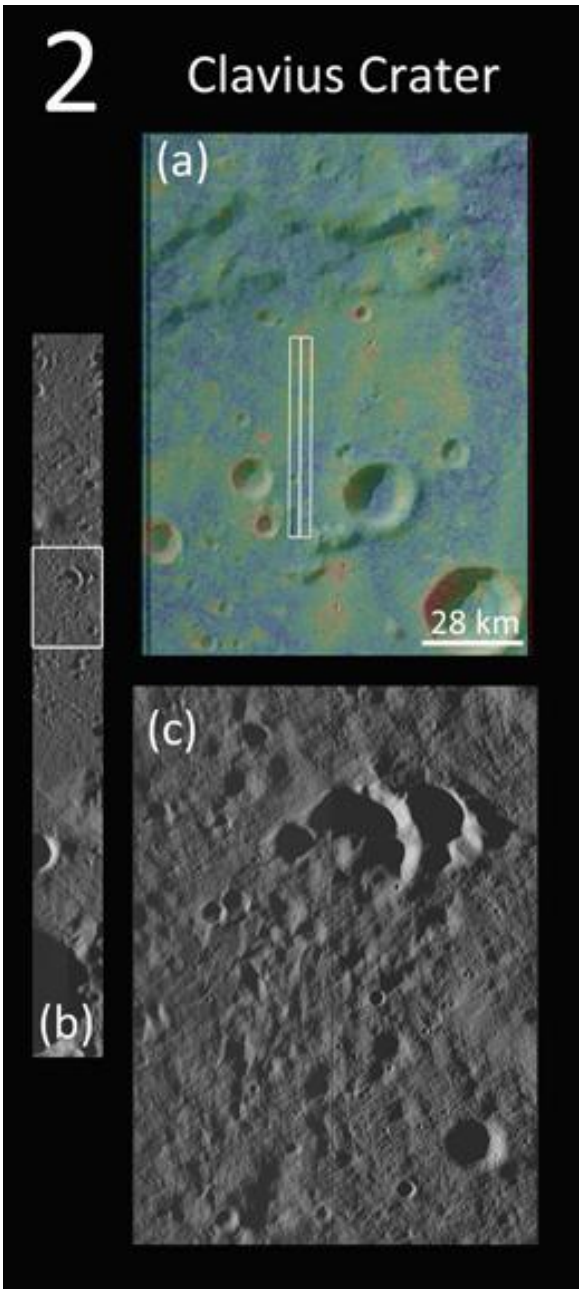

Figure 2: (a) A radar CPR map overlaid on WAC image M119956789M of Clavius crater. The location of NAC image M117601986 is indicated by white boxes. (b) NAC image M117601986 (left and right image pair), obtained from the PDS. (c) Tycho secondary craters from the boxed region of (b). The hummocky, textured terrain downrange from the secondary craters is reminiscent of "braided" terrains associated with other Tycho secondary crater clusters [2].