CRATER EJECTA AND THE SEARCH FOR FELSIC MATERIAL IN MAXWELL MONTES, VENUS.
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Introduction: Maxwell Montes on Venus may preserve evidence of a past water-rich environment. We combine Magellan and Arecibo radar data to characterize surface properties across Maxwell for orbital or landed investigations.

Radar Observations: The Magellan incidence angle for Maxwell is ~25º, where echoes from radar-facing slopes can dominate the radar return. The Arecibo maps come from 2015 observations at the same 12.6-cm wavelength as MGN, and the maps have spatial resolution of 1-2 km. A circular-polarized signal is transmitted, and the reflected signals in both circular modes (OCP and SCP) are received. The radar incidence angle at Cleopatra is ~63º, so the sensitivity of the echoes to radar-facing slopes is far less than for MGN. We also obtain a calibrated estimate of the SCP/OCP circular polarization ratio (CPR). The Earth-based data reveal a region surrounding and west of the 90-km crater Cleopatra with lower radar echoes and circular polarization ratio despite increased surface reflectivity inferred from Magellan data (Figs. 1).

Matching Emissivity and Topography: The topography of Maxwell is challenging to map with radar altimetry in areas with large elevation changes over scales comparable to the footprints. Likewise, MGN emissivity footprints are ~40 km diameter at this latitude. We use forward-modeling of blurred signals to predict observed E_H values for particular combinations of critical elevations and end-member dielectric values. This work shows that there are two abrupt shifts in the emissivity with altitude – a more gradual change is not a good fit to the data nor to Magellan images of the contacts. The surface undergoes a step-like shift from E_H~0.85 to E_H~0.35 at 6053.3 km radius, and a second abrupt shift back to E_H >0.6 above 6061.0 km.

Geologic Interpretations: If the emissivity does not change significantly with altitude between the two critical elevations, then variations in SCP and CPR signatures west of Cleopatra must reflect properties of the surface on scales comparable to the radar wavelength. A primary cause of reduced SCP or CPR is a smaller population of scattering objects, through either actual variations in the rock population or by mantling of a rock distribution by fine-grained material. The question is whether the roughness/rock-abundance differences across Maxwell stem from the formation processes that created the surface or from differences in later modification such as ejecta or impact melt from Cleopatra. An impact melt sheet this large is out of scale with similar Venus craters. Impact melt also forms a platy, radar-rough surface, and thus is not the best candidate for reduction of surface roughness.

Based on other Venus crater deposits and ejecta modeling, Cleopatra must have emplaced a significant fine-grained halo and parabola. We propose that this fine material, trapped by the ridged topography of Maxwell, mantles the terrain and reduces the visible rock population. In turn, this reduces the backscatter strength and CPR, which remain relatively high because the low-emissivity coating enhances scattering from the remaining visible rocky material. In the areas of higher SCP echoes and CPR to the north and south, higher original rock abundance or larger block sizes could mitigate the effect of a thin debris layer. The ejecta distribution may thus extend across all of Maxwell, with a maximum thickness on the decimeter scale.

Conclusions: We propose that fine-grained Cleopatra ejecta mantles much of Maxwell Montes, consistent with Venus distal crater ejecta patterns and the longevity of mantling debris in the highlands. Searches for felsic material formed during a water-rich period must consider the presence of ejecta, the source material at the impact site, and the effects of shock or melting on ejecta mineralogy.

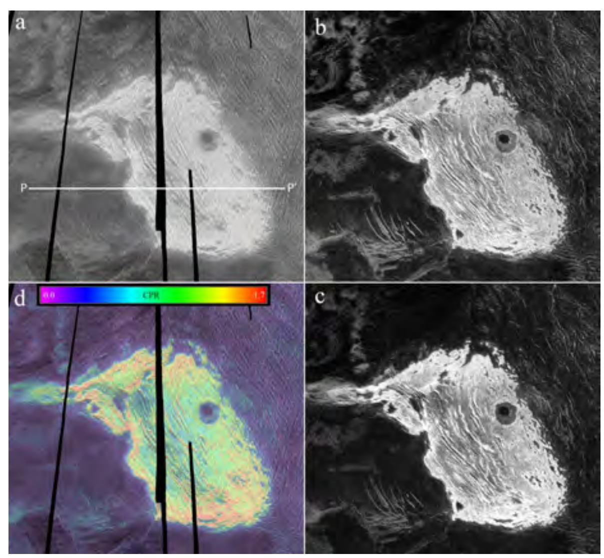

Fig. 1. Radar data for Maxwell Montes. (a) Magellan HH echo; (b) Arecibo OC echo; (c) Arecibo SC echo; (d) Arecibo CPR as color overlay on Magellan image. Note the low SCP echoes and CPR around and west of Cleopatra crater, cutting across areas with much brighter MGN returns.