ANOMALOUS RADAR PROPERTIES OF MAXWELL MONTES: RESULTS FROM REFINED STEREO ALTIMETERY.

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Introduction: Maxwell Montes, on the eastern side of Ishtar Terra, is the highest and steepest mountain range on Venus, and has been of great interest for both tectonic origin and material properties. Maxwell's region is characterized by a 'snow line' of radar properties – an elevation at which radar-backscatter, emissivity, etc. change abruptly [1,2]. We mapped features in detail on Maxwell's north- and south-facing flanks with refined stereo-DEMs [3], and search for trends that might be apparent at higher spatial resolution than of Magellan altimetry & emissivity [4].

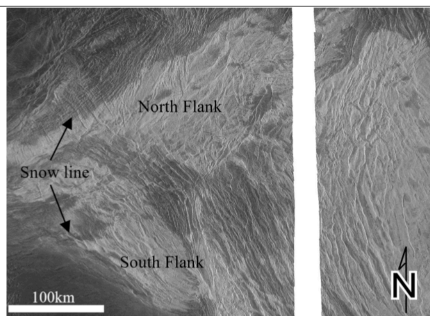

Figure 1: *Magellan SAR image of western Maxwell Montes; image center ~[359.7E, 66.6N]. The highest elevations (center) have lower backscatter than the foothills, and the south flanks of Maxwell have lower backscatter than north.*

Data and Methods: All data are from the Magellan Venus orbiter mission, mostly downloaded from USGS "Map-a-Planet" and JMARS. Magellan altimetry was augmented with the stereo radar DEM of [3]. We focused on SAR swaths of limited longitude range in western Maxwell (Fig. 1). Images were processed and interpreted in ArcGIS. Small areas of constant elevation and SAR backscatter were chosen, and those data were correlated (Fig. 2).

Maxwell Montes 'Snow': Magellan Synthetic Aperture Radar (SAR) images of Maxwell Montes show a distinct 'snowline:' elevated radar backscatter above a critical elevation of ~5 km, Fig. 1 [1,2]. The north and south flanks of Maxwell show distinctly different patterns of radar response (Figs. 1, 2). At elevations above ~ 7.5 km on the north flank, both emissivity and SAR backscatter have values intermediate between those of the lowlands and the "snow," Figs. 1 & 2. On the south flanks, however, neither emissivity nor backscatter shows clear trends with elevation (Fig. 2). Surface roughness affects SAR backscatter more than emissivity (compare north flank data, Fig. 2), but roughness alone seems insufficient to explain the differences between north and south flanks.

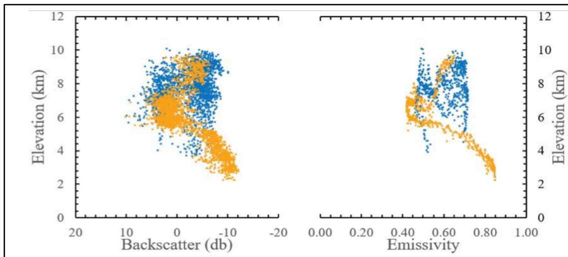

Figure 2: *Backscatter (left) and emissivity (right) vs. elevation of Maxwell Montes. Orange and blue symbols are for north and south flanks respectively.*

Discussion / Interpretation: The cause(s) of the 'snow line' on Maxwell have been controversial [2,4,5-10], and most commonly ascribed to the presence of semiconductor compounds (e.g., Te, PbS, BiTe), deposited from the atmosphere [6,7], or formed by chemical reactions between rock and the atmosphere (e.g., pyrite FeS_2, magnetite Fe_3O_4) [8,9]. These ideas do not, of themselves, explain either the change in radar properties at ~7.5 km nor the difference between Maxwell's north and south flanks.

In general, the variations in radar properties could represent different rock materials or atmospheric conditions. On one hand, it is possible that rock types across Maxwell vary enough to allow different products or proportions of rock-atmosphere chemistry. The decrease in SAR backscatter at high elevation on Maxwell could be ascribed to the presence of a ferroelectric material [1,11], although the notional substance on near-equatorial highlands (chlorapatite [1]) is not appropriate for these elevations. On the other hand, the atmosphere might be different on either flank of Maxwell, possibly as a result of equatorward meridional flow at low elevations [12]. Such a flow might experience orographic lift as it crossed Maxwell, allowing different conditions on its north and south flanks.

References: [1] Treiman A.H. et al. (2016) I*carus* 280, 172-182. [2] Campbell B. et al. (1999) *JGR* 104, 1897-1916. [3] Herrick R.R. et al. (2012) EOS 93(12), 125-126. [4] Klose K. et al. (1992) *JGR* 16353-16369. [5] Pettengill G.H. et al. (1992) *Science* 272, 1628-1631. [6] Brackett R.A. et al. (1995) *JGR* 100, 1553-1563. [7] Kohler E. et al. (2015) *LPSC* 45th, Abstract #2563. [8] Pettengill G.H. et al. (1996) *JGR* 97, 13091-13102. [9] Fegley B. et al. (1997) *Venus II,* 591-636. [10] Fegley B. & Treiman A.H. (1992) *Venus and Mars: Atmos., Iono., and Solar Wind* Int., 7-71. [11] Arvidson R. et al. (1994) *Icarus* 112, 171-186. [12] Lebonnois S. et al. (2016) *Icarus 278*, 38-51.