VARIABILITY OF TESSERA RADAR EMISSIVITY ON VENUS. M. S. Gilmore and A. J. Stein, [1]Planetary Science Group, Wesleyan University, 265 Church St., Middletown CT 06438, mgilmore@wesleyan.edu, wesleyan.edu/planetary

Introduction: Tessera terrain is a heavily tectonized morphologic unit that comprises 8% of the Venus surface [1]. Importantly, they are stratigraphically older than the volcanic plains and edifices that cover the remainder of the planet [1]. The relative youth of the plains ca. 1 Ga or less [2] prevents access to the bulk of Venus history Thus tessera terrain is a remnant from an earlier time and the most likely to harbor rocks from the first 80% of the history of Venus.

From both a scientific and exploration perspective, it is important to identify differences amongst the tesserae to better understand its history. Of particular interest is tessera composition. Their plateau shape [3], the elemental composition of the Venus surface detected by Venera 8 [4], and tessera IR emissivity [5] suggest the tessera are compositionally different from the plains and may be composed of more chemically evolved compositions. This may indicate their formation via crustal recycling in the presence of water in a preceding era.

One known mechanism that may affect tessera composition is the deposition of air fall deposits generated from impact craters. A portion of impact ejecta is lofted into high elevation winds that spread the ejecta westward into a parabola-shaped sedimentary unit [6]. The parabolas may obfuscate the original surface composition of the tesserae; indeed, parabola deposits have been observed in radar images of tesserae indicating that the structural features typical of tesserae may collect this material [7].

In this study, we examine the radar emissivity of several parabola units on the tesserae to determine the location of the least altered tesserae and to examine any systematic differences in the emissivity signature of these units.

Methods: Following [8], we developed a pipeline to correct the Magellan GEDR emissivity for incidence angle and import it into ArcGIS for study [9]. We divided the planet into a number pf physiographic units. We considered tessera terrain covered by parabolas of craters derived from plains units. This includes the visible parabolas measured by [6], and also modeled parabolas from all plains craters, using the assumption that every crater >11 km has a parabola that is eventually removed by winds [17]. We used the empirical formula for modeling parabolas provided by [10]. This allowed us to isolate regions in tesserae that have not been affected by any parabolas.

Importantly, we excluded pixels that occur above the "snow line", areas with radar reflectivity <0.7 [11] or high elevation > 6054 km [12]. We used crater locations from [13].

Results and Discussion: In our interpretation, we consider the two main drivers for radar emissivity: dielectric constant which decreases with emissivity and surface roughness which increases with emissivity.

Tessera Units. We define 5 units in the tesserae: 1) all tessera below the snowline, 2) tessera with no parabolas, tessera beneath 3) visible parabolas, 4) modeled plains parabolas and 5) modeled tessera parabolas (Fig. 1). The three units in tesserae that lie beneath parabolas all have lower emissivity than that of the tessera with no parabolas. This is consistent with decreased roughness in the tessera presumably due to the deposition of fines. This is supported by the fact that the visible parabolas have the lowest emissivity values as they are expected to have the thickest ejecta blankets [e.g. 5, 14]. The modeled plains and tessera parabolas have lower emissivity than the tessera with no parabolas supporting the retention of these older materials amongst tessera structures as has been suggested by [7] based on radar backscatter.

The modeled tessera parabolas have a lower emissivity than modeled plains parabolas. This may also be due to a lower surface roughness than modeled plains craters, due to the fact that tessera craters are by definition in the tessera and thus more likely to include the thickest part of the ejecta blanket.

Another interpretation is that parabolas increase the dielectric constant of the surface. Fine-grained materials may increase porosity and facilitate enhanced chemical weathering of minerals with a higher dielectric constant (e.g., hematite vs pyroxene) [8].

In sum, the progression of the lower emissivity and higher dielectric constant from tesserae lacking parabolas, to tesserae under modeled plains parabolas, to tesserae under modeled tessera parabolas to tesserae beneath visible parabolas is consistent with an increase in sediment thickness, porosity and/or dielectric constant. It is possible that tesserae have an intrinsically lower dielectric constant, which we can test based on analysis of fresh tessera craters:

Recent Tessera Craters. Seven craters are identified on tessera as relative recent based on bright floor deposits and/or the presence of visible ejecta (Akiko, Bernhardt, Boulanger, Hayashi, Khatun, Magnani, Recamier). Here we compare the ejecta from these craters to all other modeled tessera deposits on the tesserae and the plains (Fig 2). All materials on plains have a lower emissivity than materials on tessera due to lower roughness. For 5 of the seven craters, the peak of the ejecta on tessera is at higher emissivity than the modeled tessera ejecta on tesserae. This is consistent with a rougher surface. For 3 of these, the emissivity of the crater ejecta on the plains is also greater than the general case, also due to a rough and/or lower dielectric constant surface. These craters are likely the most recent and thus may make good targets for future, hopefully instrumented, investigation.

If we assume the freshest craters are rougher than older modeled craters, the fact that they and the least modified tessera have the same high emissivity suggest the signal is not from roughness but dominated by composition. Low dielectric materials indicate lower density or changes in composition [15]. This is also consistent with previously observed permittivity (real for of dielectric constant) of tessera [16].

Conclusion: Radar emissivity of crater ejecta deposits in tesserae are lower than tesserae without crater deposits. Emissivity appears to correlate with predicted thickness of the deposit (due to age or proximity) and/or the enhanced weathering of fines to higher dielectric minerals. However, fresh craters in the tesserae have similar values to tessera without parabolas. That fresh and rough material have the same signal as less rough materials suggest they share the lower dielectric constant. Thus, the tesserae may have an intrinsically lower density or different composition than the plains.

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Acknowledgements: With gratitude to Misha Ivanov for providing us his GIS map of tessera terrain. We also appreciate discussions with B. Campbell and J. Whitten.

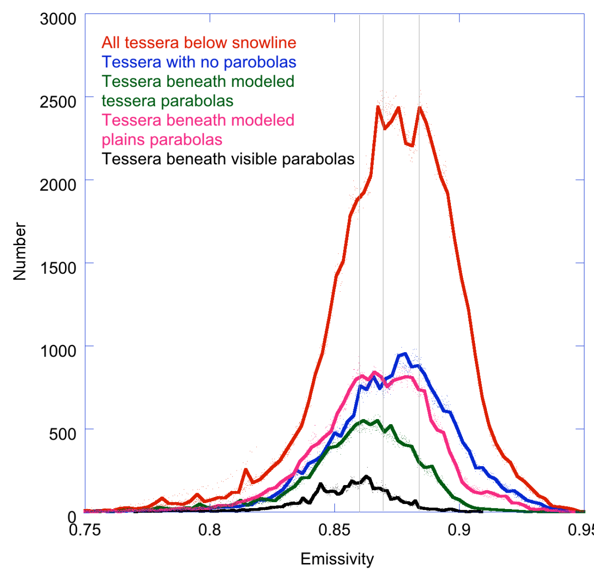

Fig. 1. Emissivity of physiographic provinces in tessera terrain. Line represents interpolation of the data.

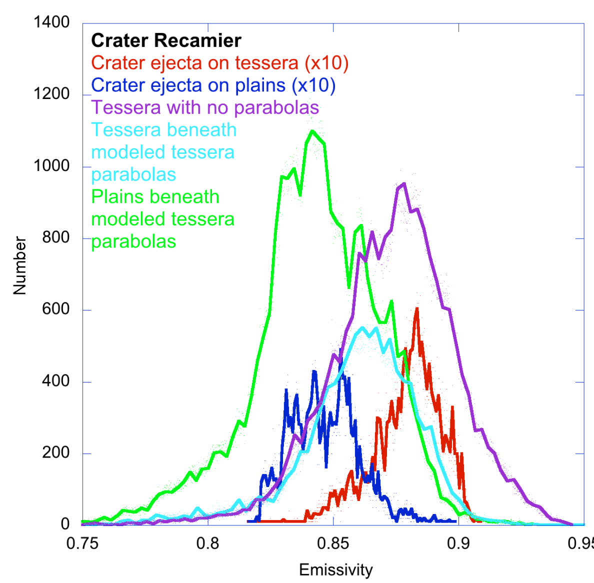

Fig. 2. Emissivity data for crater Recamier as an example of the relationship between this fresh crater and other units. Line represents interpolation of the data.