RELATIONSHIP BETWEEN RADAR-BRIGHT AREAS AND GEOLOGIC LANDFORMS IN VENUSIAN TESSERAE. M. Jodhpurkar[1], J. L. Whitten[2], and C. M. Bailey[1] [1]College of William and Mary, Williamsburg, VA, 23185. [2]Tulane University, New Orleans, LA 70118.

Introduction: Tessera terrain comprises 8-10% of Venus's surface and is thought to have an average age of 900 ± 220 Ma [1]. This terrain was first recognized as a heavily deformed unit unique to Venus and subsequent research has allowed for a clearer definition of its properties [2]. Tesserae are characterized by the presence of intersecting sets of tectonic features, such as graben, and have high relief relative to their surroundings, making them easily distinguishable from Venusian plains [1, 3]. Additionally, the intense deformation leads to a high degree of small-scale surface roughness [4]. This fine-scale roughness leads tessera terrain to appear as areas of high radar backscatter in radar imagery, making these areas unusually radar-bright and thus easy to differentiate from most other Venusian terrains [1].

The aforementioned radar brightness is very notable in Magellan radar imagery, collected during the 1990s. Much of the information about the composition, stratigraphic relationships, and formation mechanisms of these tesserae is still debated so investigating them in greater detail is crucial [1].

Previous research has focused on studying impact crater ejecta and finding correlations between these features and radar brightness variations in tesserae [5, 6]. However, there are areas where radar brightness variations in tessera terrain are not obviously associated with crater ejecta. In these areas, other geologic landforms and morphologic characteristics are still visible, leading to the interpretation that there may be other features or processes that can cause radar brightness variations in tesserae.

In this study we explored the correlations between radar brightness variations and geologic landforms in three tesserae across Venus: Ananke, Pasom-mana, and Cocomama tesserae. Since radar brightness is a function of surface roughness and crater ejecta tends to smooth terrain wherever it is deposited, we hypothesized that other geologic processes (such as volcanism) could have similar effects. The presence of such a relationship would give us more insight into the processes active on Venus.

Methods: For this study, three tesserae located in the northern, equatorial and southern regions of Venus were selected as study sites. These were Ananke, Pasom-mana, and Cocomama tessera, respectively. Since these three sites are located at different latitudes, we also compare radar properties such as backscatter, topography, and emissivity across latitudes to determine whether any significant correlations exist between these parameters. This project primarily consisted of mapping radar backscatter in tesserae using ESRI ArcGIS software and observing which geologic landforms and morphologies correlate. The radar brightness measurements were taken near the ridge crests in tesserae, to avoid sampling material deposited in the troughs between ridges. This was done by placing points on backslopes and extracting the DN values, which were then used to calculate the backscatter coefficient [7] .

Once this procedure was completed, geologic landforms were mapped, beginning with craters and volcanic features. The USGS Venus nomenclature shapefile was used as a reference to identify the location of different landforms within tesserae. The results from the backscatter coefficient calculations were qualitatively compared with the locations of the other geologic landforms in the tesserae. These results were compared within and amongst all three study areas to determine whether there were correlations between radar brightness variations and geologic landforms in tessera terrain.

Results and Discussion: Thus far, the initial step of mapping the backslopes for all three tesserae has been completed. In addition to the radar backscatter coefficient, there are topography and emissivity values for all of the points. In total, 20,000 points were mapped in the three tesserae – roughly 7,000 for both Ananke and Cocomama and 5,000 for Pasom-mana. Thus, even if there were some errors in the placement of points, the sample is large enough that those errors would not significantly affect the overall result.

Backscatter coefficient, topography and emissivity seemed to follow similar patterns in Ananke and Cocomama tessera, while these values show more distinct trends in Pasom-mana tessera. In Pasom-mana tessera, certain areas show an inverse relationship between emissivity and radar backscatter, which is most notable in the high emissivity values present in an unusually radar-dark area (Fig. 1). Since the shape of this area is not consistent with the range of predicted ejecta deposits for Purev crater, there must be an additional explanation for this relationship.

Pasom-mana tessera is further of interest because of the presence of unusually radar-bright and radar-dark areas so close to one another. Further work is necessary to interpret the regional stratigraphy and the cause of these unusual properties, particularly since they seem to be unexplained by impact ejecta.

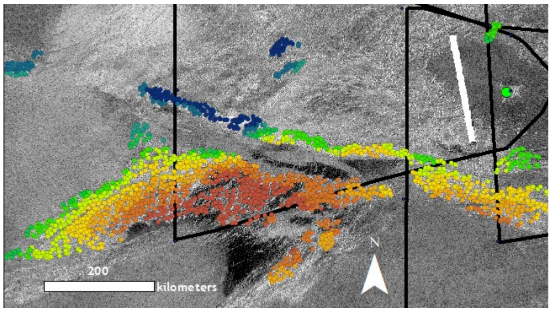

Figure 1: Portion of Pasom-mana tessera, with dots symbolizing emissivity, black lines marking out the ideal extent of the ejecta, and larger green dot marking the location of Purev crater.

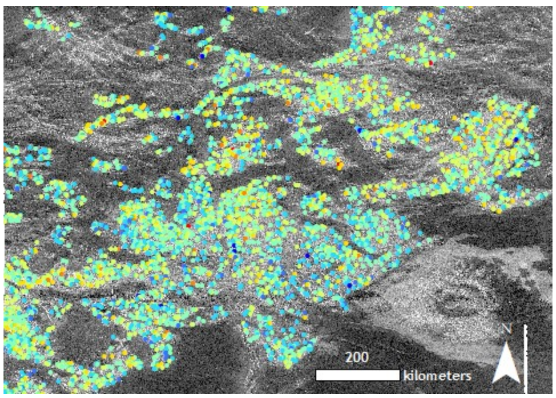

Figure 2: Portion of Ananke tessera, with the dots symbolizing radar backscatter (blue dots indicate smoother areas while red is rougher terrain). Cochran crater appears in the bottom right.

In Ananke tessera, the most distinct brightness variations appear to be related to impact ejecta (Fig. 2). There is a concentration of radar-dark material along a path to the west of Cochran crater. This is likely because the ejecta material from the crater has blanketed the rough tessera terrain. Apart from this distinguishable instance, the radar backscatter throughout Ananke tessera appears to be fairly uniform, in spite of the fact that there are many large crater ejecta parabolas that are predicted to overlap this area. More detailed observations are necessary to find other instances of this relationship.

Similarly, in Cocomama tessera, there are numerous instances where the crater parabolas are associated with areas of radar-dark material (Fig. 3). These examples of craters ejecta are concentrated in the northern half of Cocomama. In the southern half, however, there is an area of radar darkness that does not correspond to a hypothesized ejecta parabola. It does seem to correlate directly with a lava flow (Fig. 4). If the lava flow filled in some of the tessera material it would effectively smooth the surface and thus appear darker in the Magellan SAR data.

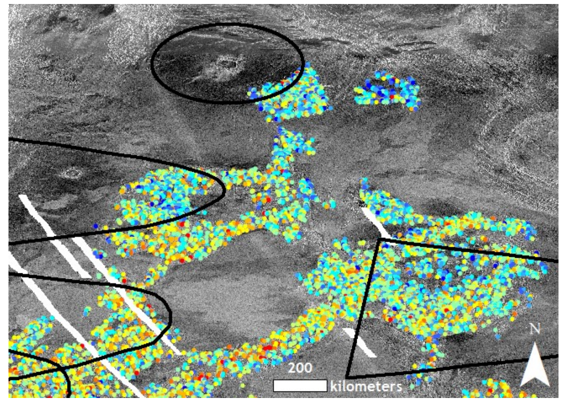

Figure 3: Northern portion of Cocomama tessera, with dots symbolizing radar backscatter (blue dots indicate smoother areas while red is rougher terrain). Black lines mark out the hypothesized extent of the ejecta.

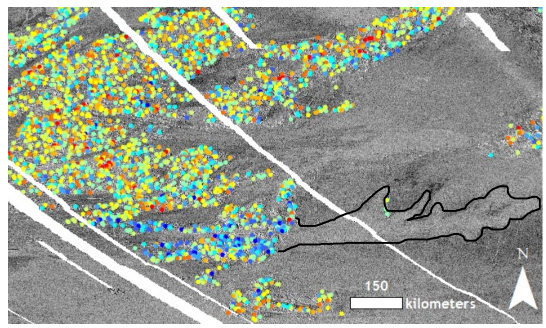

Figure 4: Southern portion of Cocomama tessera, with dots symbolizing backscatter (blue dots indicate smoother areas while red is rougher terrain). The lava flow starts on the right side of the image and continues into the tessera.

In conclusion, Pasom-mana tessera stands out as an area with unusual properties that warrant studying in greater depth, and future work will focus on understanding it better. At present, there is not enough evidence to suggest latitude has a definitive role in influencing tessera properties, so future work will be done to define that relationship further. There are clear instances of radar brightness variations both associated with and not associated with impact craters and ejecta parabolas, so future work will focus on identifying what the other geologic landforms could be associated with and causing these radar brightness variations.

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