Definition and Characterization of Subtypes of the Venus Tesserae. D.L. Bindschadler and J.W. Head, Brown University Dept of Geological Sciences, Providence, RI, 02912

The tesserae (or parquet terrain) of Venus were discovered from Venera 15–16 radar images of the surface [1] and were defined as consisting of orthogonal to obliquely oriented set of ridges and valleys [2]. Tesserae cover more area (~15% of the area north of 30°N) than any of the other tectonic units mapped from Venera data [3,4]. Regions of tessera are strongly concentrated in the region between longitudes 0° E and 150° E and thus lie between a proposed center of crustal extension and divergence in Aphrodite [5,6] and a proposed region of intense deformation [7], crustal convergence and orogenesis in western Ishtar Terra [8,9]. Increased understanding of the tesserae has important implications for these as well as for any model of Venus tectonics. As part of an effort to understand this unusual terrain type, we examine the characteristics of the tesserae in order to develop a classification system which may us help to understand the origin and evolution of the tesserae.

Observations

Pioneer Venus Radar: Pioneer Venus data show that the tessera lie at higher elevations than surrounding plains and are characterized by higher values of rms slope [4] (a measure of roughness at a scale of ~0.5 m to 10's of m) [10,11]. Tesserae are also characterized by greater cm–scale roughness than the plains which we interpret to be due to erosion linked to extensive deformation and possibly to greater relative age [4]. Craters are sufficiently sparse to make determination of the relative age of the tesserae unreliable [12].

Gravity Anomalies: For the largest regions of tesserae, line of sight (LOS) gravity data may be used to infer depths of compensation of these high regions. Of the three largest regions of tessera (Tellus Regio, Laima Tessera and Fortuna Tessera) LOS gravity data extend far enough to the north to cover Tellus Regio, to partially cover Laima Tessera, and have not been examined for Fortuna Tessera. These measurements show approximately no anomaly associated with the 2.5 km of topography in Tellus, leading Sjogren et al. [13] to suggest that the region is compensated at relatively shallow depths (i.e. less than the 100 to 300 km depths suggested for regions such as Aphrodite Terra and Beta Regio). Laima Tessera also shows no apparent gravity signature. Large gravity anomalies are associated with the Montes Maxwell and Freyja surrounding Lakshmi Planum [14] but no examination has been made of gravity data over Fortuna Tessera in eastern Ishtar Terra.

Morphology: As an aid to understanding the possible modes of origin of the tesserae structures, we extend Basilevsky et al.'s [2] definition for tesserae (described above). In order to be classified as tessera, we suggest that a region must by characterized by (1) a complex appearance, (2) numerous linear to curvilinear ridges and valleys of wavelengths on the order of 5 to 25 km; (3) at least two distinct intersecting sets of structural features with all trends restricted to the region of tessera. This last restriction excludes features such as intersecting ridge belts.

Examination of Venera data of many of the regions of tessera reveals three morphologic subtypes for the terrain. These are the sub–parallel ridged terrain (T_{sr}), trough and ridge terrain (T_{tr}), and disrupted terrain (T_{ds}); each is defined below. Sketch maps of type areas are shown in Figures 1a–1c. accompanied by Venera images of the type areas. In the sketches, narrow lines are ridges, broad lines are troughs, and dashed lines are lineaments.

The sub–parallel ridged terrain (T_{sr}, Fig. 1a) is similar to ridge belts in that it consists of sub–parallel ridges. However, T_{sr} ridges are less sinuous and do not intertwine. Ridges tend to be disrupted along linear zones of consistent orientation and often form en echelon groups, perhaps indicating strike–slip offset. The two structural orientations consist of the ridges and the lineations along which they are disrupted. Type locale: Fortuna Tessera, east of Maxwell Montes.

Structures in the trough and ridge terrain (T_{tr}, Fig. 1b) are expressed as troughs in one direction and as ridges and/or valleys in another. The troughs may appear both as broad (~50km) and narrow (< 20 km) structures. Ridges occasionally show en echelon offset. They tend to be spaced approximately 5 to 10 km apart, more closely than the minor troughs (spacing ~10–20 km). Type locale: Eastern Laima Tessera

The disrupted terrain (T_{ds}, Fig. 1c) is characterized by a general lack of continuous ridges or valleys longer than ~50 km. The terrain is often blocky to chaotic in appearance, depending upon the consistency of ridge orientations. Even in cases where ridge orientations are chaotic, lineaments defined by short troughs, ridges and by discontinuities in ridges preserve consistent orientations over the region of tessera. Disrupted terrain is usually transitional with the T_{tr} or T_{sr}. Type locale: Central Tellus Regio.

The contact between tesserae and plains is characterized by two types of boundaries. In the first (Type I), the boundary is highly irregular at the 100 km scale, consisting of numerous ovoidal to polygonal smooth plains regions that may separate small regions of tessera from the main body of a block. Structures within the tessera take on a subdued appearance as the boundary is approached and show little relation to the shape of the tessera–plains boundary. Type I boundaries thus appear to be an expression of embayment of the tessera by

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plains-forming materials. Type II boundaries are much more regular at the 100 km scale and typically characterized by the presence of the T_{sr} subtype of tessera as well as steep topography and the presence of small ridges or ridge belts within the adjacent plains. These boundaries appear to be places where the tesserae have formed at the expense of the plains.

Three morphologic subtypes of tessera have been identified from Venera radar images. Although a formal assessment has not yet been done, the greatest total area appears to be taken up by disrupted terrain (T_{ds}). The T_{sr} is found predominantly along the periphery of large regions of tessera, and the T_{tr} appears to predominate only within Laima Tessera. The three largest region of tessera appear to be split approximately 50% each between type I and II boundaries. A more detailed assessment will be useful for constraining and testing models for the formation of the tessera.

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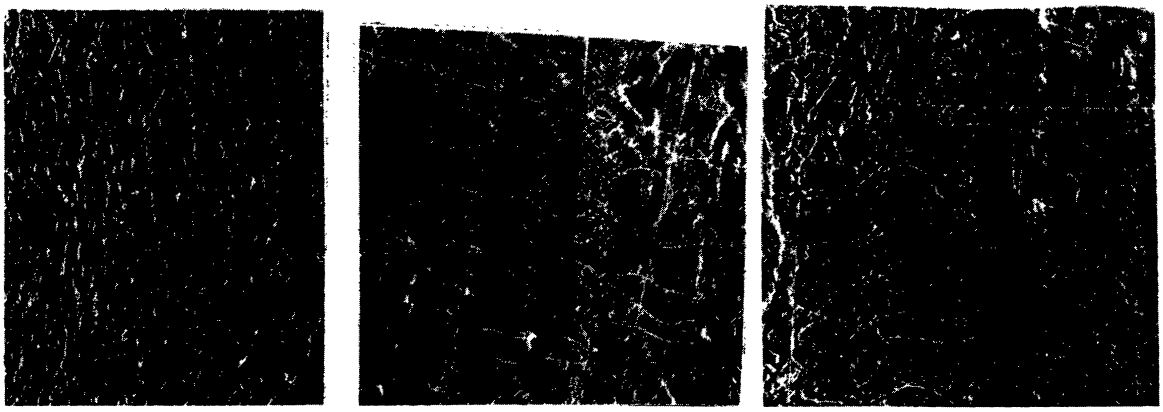

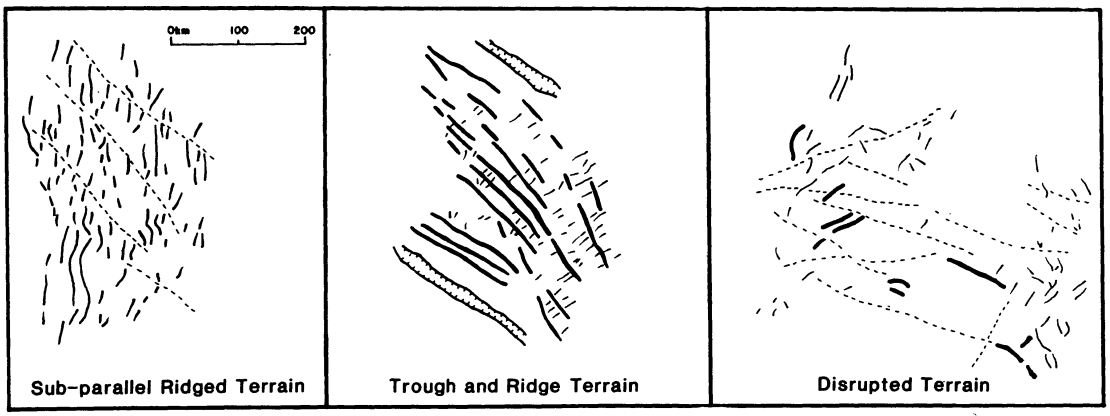

Figure 1a Figure 1b Figure 1c

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