Some Deformation Trends and Topographic Characteristics of Tesserae on Venus

Maribeth Price and John Suppe
Dept. of Geological and Geophysical Sciences, Princeton University, Princeton, NJ 08544

Abstract: Mapping of dominant trends of deformation and topographic analysis of tesserae reveal that 1) consistent patterns of deformation exist between individual tesserae; 2) regional deformation associated with coronae and rifts commonly overprints tesserae fabrics; 3) normalized area frequency plots of tesserae display a strongly bimodal distribution between -70 to 70 degrees latitude; and 4) the relief at tessera margins is relatively constant and independent of tessera elevation. We are continuing to expand these observations and test their implications for the formation of tesserae and for global models of deformation on Venus.

Introduction: Tesserae are complexly deformed, usually steep-sided highlands which cover approximately 10-20% of the planet Venus [1]. Others have mapped individual tessera regions in detail, including Alpha and Tellus Regio, and agree that tesserae are at least partially the result of compression [2,3]. We have started to map and analyze large-scale occurrence patterns and deformation fabrics on a global scale, to uncover additional clues to tessera formation which may not be apparent when they are studied as individual regions.

Observations: We have mapped tessera boundaries and sketched the most obvious large-scale deformation fabrics both inside and outside tessera blocks discernible on C2 (twice compressed) MIDRs. The fabrics, although often complex, commonly show coherent patterns when viewed globally. Consistent trends occur between some adjacent tessera blocks up to 900 km apart as seen in examples in several locations (figure 1, a,b,c,d). In tessera groups showing ring-like or arcuate outcrop patterns [3], fabric trends usually are consistent within the group; sometimes they parallel the curve (e), but may also cut across it (f). These observations suggest a shared history between some groups of tessera, especially the ring and arcuate types which might be collapsed and extensively embayed remains of previously intact tessera. However, dominant fabrics in tesserae often result from fractures associated with nearby coronae or rifts which continue into the tessera block, overprinting previous fabrics (g,h). Hence tesserae deformation structures must be considered to possibly have formed over a wide range of ages and conditions, and do not necessarily reflect a discrete process which formed the tessera. Detailed mapping of structures both within and without tesserae will be necessary to provide constraints for models of their formation.

Areally, tesserae are strongly concentrated at equatorial and near-polar latitudes, in addition to being concentrated between 0-150 degrees longitude [3]. Tessera normalized areas, binned by latitude between -70° and 80° (figure 2), exhibit a strongly bimodal distribution characterized by asymmetric peaks near the equator and the high northern latitudes. It has been suggested that poleward convergence in the northern hemisphere is causing compressional deformation expressed as north-trending fold belts, producing a geometric increase in fold belt area with latitude [4]. This bimodal distribution of tesserae is quite different, and we must begin to consider ways to include the tessera terrain in our model of global organization of tectonic deformation on Venus [4,5].

Analysis of the topographic characteristics of tesserae using compressed 20 km resolution altimetry data from Magellan reveals several intriguing observations. Relief at the margins of most tesserae seems to be essentially independent of the elevation of the surrounding plains. We have constructed 258 topographic profiles over the margins of tesserae from 70° to -70° latitude, and plotted the mean elevation of the tessera edge versus the mean elevation of the surrounding plains (figure 3). An analogous plot for fold belt toes and crests reveals a strongly linear trend with slope ≈ 2, and it has been suggested that factors affecting the depth to the brittle-plastic transition are controlling fold belt relief [6]. In contrast, most tessera points fall between the fold belt trend and the line of no relief (slope = 1), but a significant number appear to plot closer to the fold belt trend, especially in Fortuna and Tellus Tesserae and Ovda Regio. Whatever process which is proposed to control fold belt relief could have important implications for tesserae relief. We are currently examining these data in greater detail to discover additional clues to the factors affecting relief of compressional features on Venus.

References: [1] Ivanov, M.A. (1992) LPSC XXIII:2, pp. 581-582. [2] Bindschaedler, D.L. et al. (1992) JGR 97:E8, pp. 13563-13578. [3] Bindschaedler, D.L. and Tatsumura, M.J. (1992) LPSC XXIII:2, pp. 103-104. [4] Bilotti, F., Connors, C. and Suppe, J. (1992) Int'l Colloquium on Venus, 10 (abs). [5] Bilotti, F., Connors, C. and Suppe, J. (1993), this issue. [6] Suppe, J. and Connors, C. (1992) JGR 97:E8, pp. 13545-13562.

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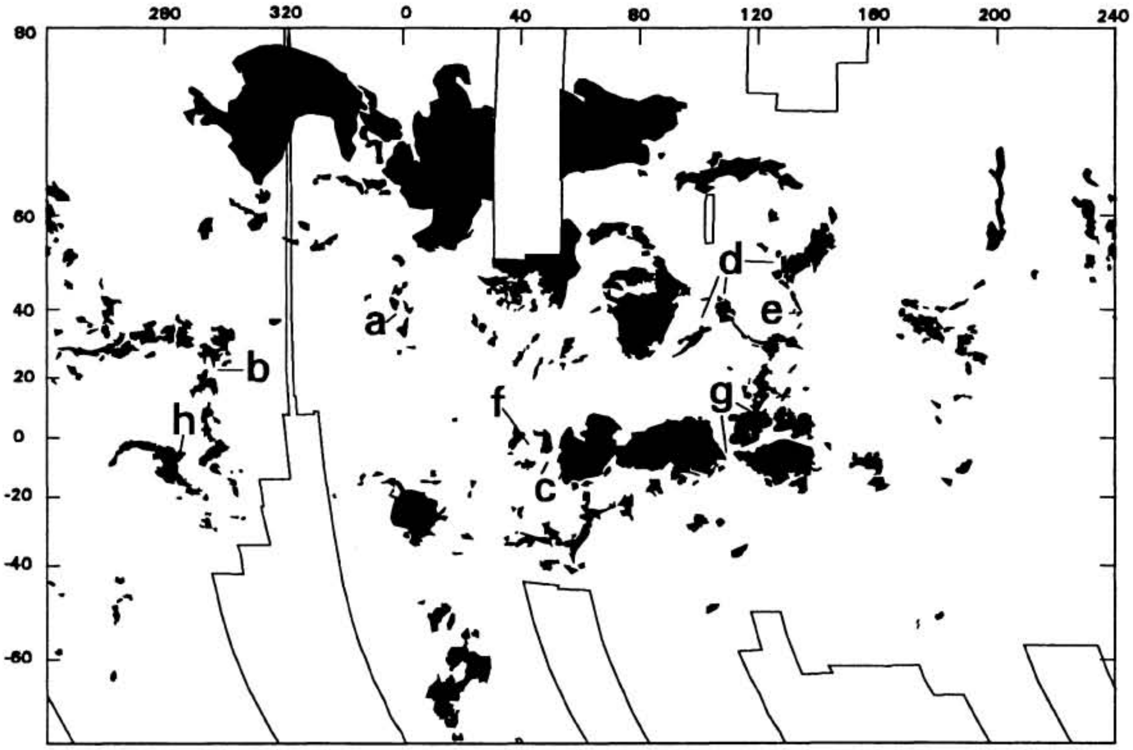

Figure 1. Global map of tesserae (black) as mapped from C2 MIDRs. Letters refer to features discussed in the text. Boxed white areas are data gaps.

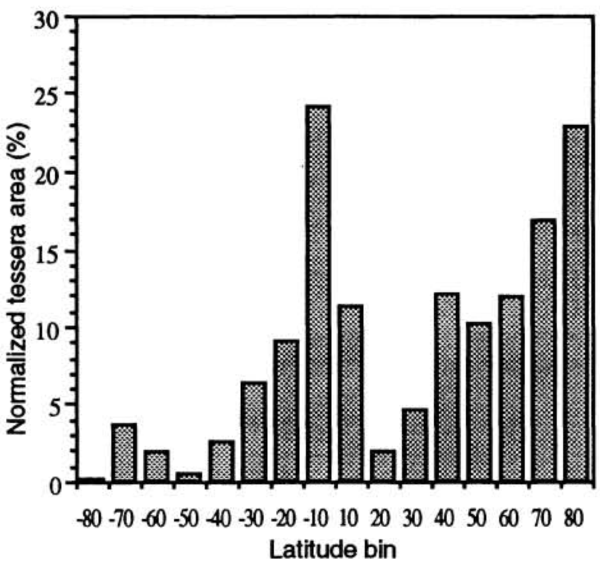

Figure 2. Normalized area histogram of tesserae binned by latitude. Areas of no C2 SAR coverage were subtracted from the total area in each bin before normalizing.

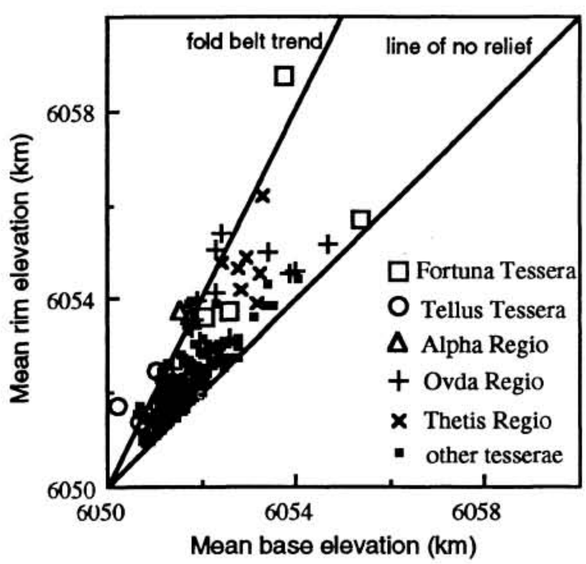

Figure 3. Observed relationship between elevation of tesserae rims and elevation of the surrounding plains. Notice that the relief is fairly constant (0-1 km) and does not vary with mean base elevation, with a few interesting exceptions.