WHICH VENUS TESSERAE ARE MOST PRISTINE? M. S. Gilmore, Dept. of Earth and Environmental Sciences, Wesleyan University, Middletown CT 06459, mgilmore@wesleyan.edu.

Introduction: Tessera terrain consistently appears locally and perhaps even globally [1] as the stratigraphically oldest material on Venus which has an average surface crater age of ~300 [2] to ~800 Ma [3]. The composition, detailed morphology and geologic history of tessera terrain are currently unknown [e.g., 2, 5]; improved measurements of these parameters would critically constrain Venus geochemistry, geodynamics and the history of water on the planet.

Because of our ignorance, the Venus community tends to discuss the 35 million km^2 [1] of tessera terrain as if it is all the same material with the same age. However, multiple morphological and compositional terrains and contacts are suggested by the analyses of Magellan data [1, 4, 20] and VIRTIS data [5]. Missions proposed as part of the Discovery [e.g., Smrekar et al. and Glaze et al., this conference] and New Frontiers Programs offer the opportunity to make new measurements about tessera terrain at higher resolution, forcing us to consider how to find the rocks that are most likely to represent original tessera materials. The identification of such pristine tessera targets is key to the interpretation of any improved 1 micron emissivity, radar or altimetry data collected of the surface as well as for the interpretation of optical imagery collected from probes or balloons. Better knowledge of tessera provenance also enables geochemical and mineralogical measurements of tessera composition from surface landers.

Which material should we avoid to measure pristine tesserae terrain?

High Reflectivity Mountaintops. Materials at elevations >~6054 km have high radar reflectivity values, interpreted to result from an increase in the dielectric constant of the rocks [e.g., 6]. Most models agree that the materials are formed via a surface-atmosphere chemical reaction at the lower temperatures at these elevations [e.g., 7, 8]. The chemistry and extent of these reactions are poorly constrained. I would argue that these materials should be avoided if we want to directly measure primary tessera compositions, although tessera composition may be inferable if the near-surface atmosphere is well constrained.

Crater Parabolas. Campbell et al. [9] recognized parabolic deposits associated with some craters and interpreted to be crater ejecta entrained and redeposited westward by the upper level winds. For plains craters, this ejecta is nominally basaltic and may distribute cm-thick deposits of materials 100s - 1000 km away from the crater [9]. Observations of some parabolas in multipolarized Arecibo data show that the parabola deposites may extend further than what is visible in Magellan data and may persist in topographic hollows [10]. There are ~60 craters with parabolas recognized in Magellan [9, 11]. Observations of multiple parabola degradation states and the youthful appearance of parabola craters support the idea that the parabolas are young and ephemeral features, meaning that all craters above a certain diameter likely generated parabola deposits [e.g., 9, 12]. Certainly tesserae have received such aeolian deposits over the course of their lifetime. However, it is not clear that these deposits prohibit access to tessera rocks. Large (~10 km scale) mass movements are observed to occur on steep slopes along Venus chasmata [13] and we would expect the mass movements occur on steep slopes within tesserae as well. As on Earth, fresh extensional fault scarps are predicted to lie at 60-70° slopes, however, processes of mechanical weathering will serve to reduce these slopes to the angle of repose (~35°) on both planets. Measurements of 170 faults across Venus using radargrammetry yield an average slope of 36±2° [14] consistent with mass wasting along these faults. As weathering on Venus is largely limited to mass wasting, tessera surfaces similar to scree slopes in arid regions on Earth are expected, where submeter scale rocks form talus deposits of tessera rocks at the angle of repose. If the talus formation rate > the aeolian deposition rate, tesserae rocks should be readily available and widely distributed at the surface below these faults. In this case, one might target tessera regions with pervasive fractures and graben (e.g., Fortuna tessera) – a typical region in central Ovda Regio shows graben slopes comprise only 1% of the area. SAR radargrammetry data (~2 km spatial resolution) [15], show average kilometer scale slopes in a typical region in central Ovda Regio tessera terrain are ~5-10° and areas with slopes >10° are limited (0-5% of the region). High resolution image data are necessary to help constrain the nature of tessera weathering and deformation style.

Obducted and assembled materials. There are several examples of tessera boundaries where there is clear evidence that plains materials are being deformed, uplifted and incorporated onto older regions of tesserae. Prominent examples are W. Alpha Regio [4], SW Tellus Regio [16], and N. Ovda Regio [17]. Tellus and Ovda Regio also show evidence of assembly of regions of tessera with distinct structural fabrics [16, 18, 19]. These pieces can be placed in stratigraphic context, for example central Tellus Regio is deformed by and thus predates SW Tellus. There is also recognition of contacts within tessera terrain between materials with different structural fabrics and between older fabrics and plains materials that are subsequently deformed [e.g., 20, 21]. With higher resolution imagery and compositional data, such regions may provide a stratigraphic framework for geomorphic and material units.

Plains materials and flooding. North-central Tellus lies at very low elevations and is thoroughly flooded by plains. Several coronae intersect Ovda Regio. The structural fabric of Phoebe tessera is unlike all other major tessera occurrences in that is dominated by extensional structures [1] and may not be representative of the general characteristics of the terrain. These areas should be avoided.

Which rocks should we target to measure pristine tesserae terrain?

Tessera Craters. Gilmore et al. [22] conservatively recognized 80 craters on tessera terrain. Tessera craters of course will excavate and redistribute tessera materials from depth over large regions. We may identify the freshest of these craters via bright floors and preserved impact melt. Such candidates include crater Khatun in E. Tellus.

Summary. The qualitative analysis presented here suggests that the most unadulterated tessera surfaces can be found in W-Central Alpha, Tellus, central W. Ovda, eastern Fortuna, Meshkenet and N. of Thetis (Figure 1).

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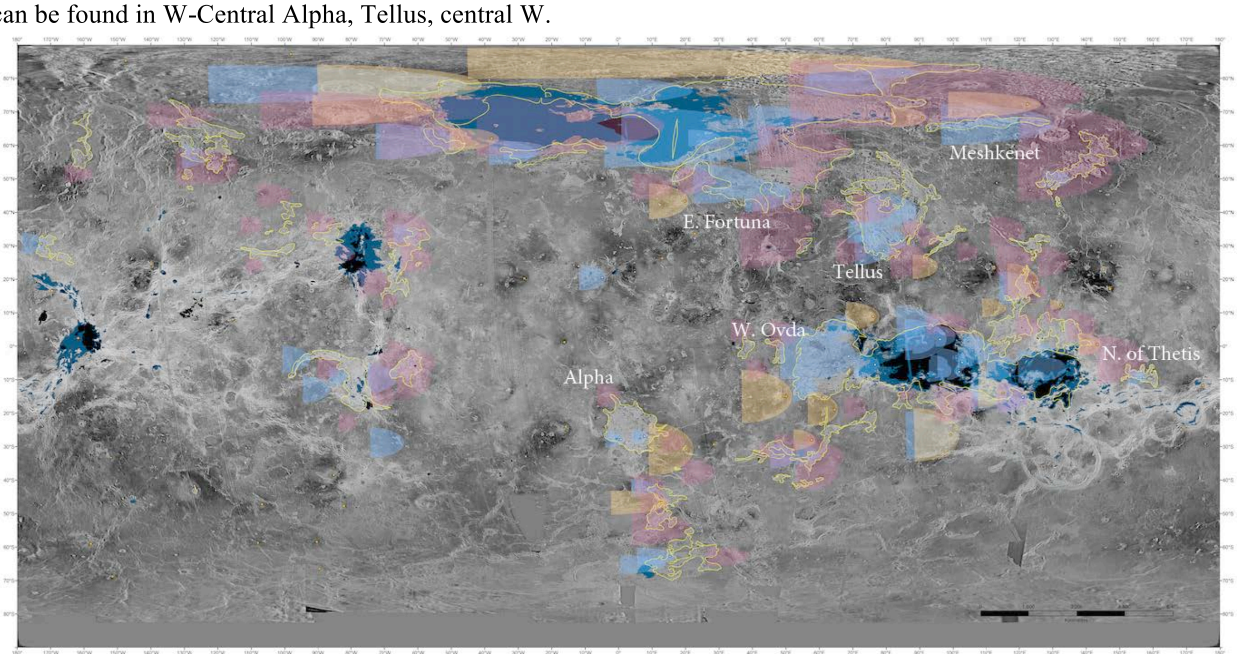

Fig. 1. Map of Venus, tesserae outlined in yellow. Black: Magellan reflectivity >0.7; Dark Blue: Elevations >6054 km; Orange: visible crater parabolas [9, 14] from craters on plains that intersect tesserae; Pink: Modeled crater parabolas that intersect tesserae [23] assuming all craters >11km once had a parabola (conservative model); Bright Blue: Tessera craters [22] may excavate fresh tessera materials. Relatively pristine tesserae materials may be found in regions that avoid parabolas and high reflectivity/elevation and coincide with tessera craters and include regions in Alpha, Tellus, W. Ovda, W. Fortuna, Meshkenet and N. of Thetis.