MORE THAN JUST A BIG BROWN BLOB: MAPPING VENUS TESSERAE FOR THE DAVINCI PROBE. Margaret C. Deahn[1], Martha S. Gilmore[1], James B. Garvin[2], Giada Arney[2], and Stephanie Getty[2], [1]Department of Earth and Environmental Sciences, Wesleyan University, 265 Church St., Middletown CT 06459 (mdeahn@wesleyan.edu); [2]NASA GSFC, Greenbelt MD 20771

Introduction: Current imagery used to study the surficial geology of Venus are from Magellan SAR (~100 m/pixel) [1]. The DAVINCI in situ probe is tasked with collecting higher resolution (~m/pixel) [2] imagery of the tessera, or oldest identifiable terrain on the planet. These images will be taken by the Venus Descent Imager (VenDI) onboard the probe in two NIR channels (0.74-1.03 μm and 0.98-1.03 μm) over the probes target descent area, Alpha Regio. In addition to providing NIR emissivity data, this will allow for the creation of digital elevation models (DEMs) of the surface [2,3]. These images will help us better understand the composition and history of some of the oldest preserved materials on Venus.

Standard small-scale geologic maps of Venus group the tesserae as one-or-so "brown" units. We propose that mapping the tesserae at a higher resolution will reveal multiple distinct units with broader morphologies, types, and compositions. The goal of this study is to provide an updated 1:600,000 map of the ~150 x 400 km area around the DAVINCI target ellipse (~100 x 350 km) to understand the geologic context and history of the materials that may be imaged by the probe during descent [4].

Methods: The primary dataset used is the Venus Magellan SAR FMAP Left Look Global Mosaic clipped to the Alpha Regio region at ~75 m/pixel resolution downloaded from Map-A-Planet 2 (https://astrogeology.usgs.gov). ArcGIS Pro is used to map the area around the target ellipse at 1:150,000 scale.

Structural features are categorized as ridges, troughs, graben, and lineaments. Ridges and troughs are pairs of alternating bright and dark sinuous features identified by (if possible) their topography. Graben are pairs of radar dark and bright parallel walls in left-looking imagery. They are typically cross-cut by perpendicular lineaments. Lineaments are prominent linear features that's origins are otherwise unknown. Geologic contacts are drawn between regions with noticeable changes in radar backscatter value. Further supported by differences in deformation pattern, the orientation, size, and spacing of a variety of structural features, and changes in local topography. Surficial features are outlined where random clusters of knobs overlap, but do not fully conceal underlying contacts and units.

Units are defined and named according to USGS guidelines [5,6]. The order of formation of units is determined by observing embayment and cross-cutting relationships between units. Structures that terminate abruptly, are partially infilled, or create distinct patterns across units can also be used to evaluate the stratigraphic history of the region.

Geologic History: Ten units are identified and characterized into three groups: tectonized, plains, and knobby. Tectonized materials comprise of ~48% of the area of the map, trend NW/SE in orientation, and are dominantly found in the SW corner of the region. Plains materials make up ~50% of the map area, infill the low topography regions around the tectonized units, and are dominant in the NE. The knobby unit has ~2% area and is dispersed in random pockets throughout the entire study area.

The Early Compressional Regime: The tectonized material are composed of four units that are typically found in higher topography regions. Two of these units preserve evidence of the earliest tectonic history of the tessera. The *heavily tectonized* (ht) materials are radar bright, rough-textured blocky or rectangular-shaped features that are heavily dissected by sets of perpendicular structures. These are parallel to subparallel lineaments cross-cut by perpendicular pervasive extensional features. The *lineated tectonized* (lt) materials are also radar bright and rough in texture, but elongate to sinuous in morphology and dominated by parallel to subparallel lineaments.

We interpret these to be the oldest units preserved in the study area due to the extent of their deformation and embayment by the plains units. The oldest unit, ht, preserves a unique episode of tectonic activity: lineaments trending parallel to the ridge and trough topography, and the offset of these lineaments by what appear to be a perpendicular, pervasive set of graben-like features. The pervasive structures are not found in any other units, which suggests they formed after or contemporaneously to the initial compression episode. The lt materials consistently embay the ht unit and contain no evidence of pervasive perpendicular graben-like features, which suggest it postdates the formation and primary deformation of the ht unit. These materials are also preserved in the ridges with parallel lineations, which suggests continued compression of the tessera in the NE/SW orientation after the embayment of these units.

The Wide Graben Event: Two younger tectonic units are identified in the region. The *moderately tectonized* (mt) materials are radar bright to moderate, and moderately dissected by intersecting lineaments. This unit embays the aforementioned materials. The *smooth tectonized* (st) materials are radar moderate to dark with a homogenous texture. They appear in massive, blocky morphologies that embay all the older tectonized units. This unit shows sparse tectonic evidence of shortening, and has been offset by well defined, periodic wide graben.

Both units display significantly less deformation than the older tectonized units, and are not preserved in obvious high topography regions like the ridges. This suggests they embayed the ht and lt units after the ridge forming event. The st unit shows minimal evidence of compression which suggests it embayed during or after a waning episode of compression. The wide graben are regional and deform all four tectonized units. The graben formation is not seen abruptly after the tectonized units. They record an episode of widespread extension after the waning of compression.

Widespread Plains Formation: Five plains units are identified, and lie in topographically low regions. Plains make up ~50% of the map area. The *lineated plains* (lp) are radar moderate with massive and sinuous morphologies. This unit embays the older tectonized units, erasing the wide graben, and is partially dissected by lineaments. The *bright plains* (bp) materials are radar bright, smooth, and show lobate and massive morphologies. They are irregularly dissected by small clusters of lineaments. The *rough plains* (rp) are radar moderate to dark, hummocky textured, and have lobate to sinuous morphologies. They are commonly dissected by anastomosing lineaments that appear to be remnants of older terrain. The *moderate plains* (mp) are radar moderate, smooth, lobate and dissected by infrequent, but well-defined lineaments. They are typically found pooling into areas of low topography and are some of the largest plains units in the regions. The *smooth plains* (sp) are the most radar- dark and smoothest materials. They are typically elongate and sinuous in morphology and show little to no evidence of deformation. It embays all of the older plains and tectonized units.

The plains materials are the youngest units on the map as they embay all of the tectonized units. They mark a period of waning deformation postdating the last period of extension in the region. The older plains units (lp and bp) embay the tectonized units, but show remnants of tectonic activity in their morphologies and preservation of lineations. The lineations in these units intersect randomly, showing no dominant orientation of structures. They also infill or erase evidence of the wide graben, which suggests they formed after the extensional episode ceased. The rp materials have a unique anastomosing morphology, where they infill the low topography regions between the older tectonized units. Some of the tectonized units are still preserved in the rp unit as small islands of bright-toned materials. The rp unit is embayed by the mp materials, whose darker backscatter value suggest they are smoother. These materials also pool into the largest basin areas, suggesting a greater eruption volume of materials during this period. The youngest plains, sp, have the smoothest textures and form in elongate, sinuous morphologies based on the underlying terrain. They are the smallest resolvable lava flows at the mapped scale, and it is noted that even smaller, likely younger flows can be identified within the region. The tessera have been modified and covered by multiple episodes of embayment of plains units in its more recent history.

Mass Wasting at the Probe Scale: The smallest unit by area are the knobby (k) materials. These are radar moderate and have a rough texture. It is deformed by small (100s m), seemingly random clusters of knobs. This unit is typically found in the lower topography regions at the base of scarps, and it observed to be both older and younger than the plains units. Similar knobby materials are seen overlapping contacts of all the older units and are mapped as separate surface features where the contacts are still visible beneath. This behavior is consistent with common mass wasting events that both entirely and partially interrupt the units present in the region.

References: [1] Ford J. P. et al (1993) *JPL Pub. 93-24*, 148. [2] Gilmore M. S. (2021) *GSA, 53*, 6. [3] Garvin J. B. et al. (2022) *Plan. Sci. J., 3, 117.*. [4] Deahn M. C. et al. (2022) *LPS LIII*, Abstract #2101. [5] Tanaka K. L. et al. (1993) *USGS* OFR 93-516. [6] Campbell (1995) *USGS* OFR 95-519 .