

GEOLOGIC MAPPING OF THE DEVANA CHASMA (V-29) QUADRANGLE, VENUS. E. R. Tandberg^{1,2} and L. F. Bleamaster, III^{1,2}, ¹Planetary Science Institute, 1700 E. Ft. Lowell Rd., Suite 106, Tucson AZ, 85719, ²Trinity University Geosciences Department, One Trinity Place #45, San Antonio TX, 78212.

Introduction: The Devana Chasma quadrangle (V-29; 0-25°N/270-300°E) is situated over the north-eastern apex of the Beta-Atla-Themis (BAT) province and includes the southern half of Beta Regio, the northern and transitional segments of the Devana Chasma complex, the northern reaches of Phoebe Regio, Hyndla Regio, and Nedolya Tesserae, and several smaller volcano-tectonic centers and impact craters.

Methodology & Data Sets: Aiming to discover the types of processes that have shaped the Venusian surface, geologic mapping began with the identification of major structural and morphologic features (lava flow boundaries, shield fields and edifices, radial and concentric deformation zones) and follows with the formal delineation of geologic map units. Temporal constraints are determined by embayment and cross-cutting relations as well as crater morphology and crater halo modification and degradation [1].

All data used were acquired during NASA's Magellan mission (operational 1989-1994) and includes: Synthetic Aperture Radar (SAR; basemap provided by the United States Geological Survey at 75 meter/pixel), altimetry and reflectance (~10 x 10 km footprint), and emissivity (~20 x 20 km footprint). Mapping is facilitated with the use of a georeferenced digital synthetic stereo (red-blue anaglyph, which merges SAR and altimetry together). ESRI ArcGIS software is used along with a WACOM Cintiq 21 inch interactive monitor and digitizing pen; important geological features are digitized and attributed in the ArcGIS geodatabase as a location feature (point), linear feature (line), or geocontact (polyline features that will be converted into polygon features at a later time). While the published map scale will be 1:5M, linework is constructed at a scale larger than the published scale. Location features and linear features are mapped at a scale of 1:300,000; geocontacts are mapped at a scale of 1:500,000. Excess linework (i.e., very closely spaced lineament sets) may be edited prior to printed map publication but will be preserved in digital archives. The accuracy of the linework is controlled using streaming (500 map units) and snapping tolerances (set to 250 map units). Upon the completion of mapping, the geodatabase within ArcGIS will allow for efficient data analysis.

Preliminary mapping: Devana Chasma. The most prominent feature, and hence namesake of the V-

29 quadrangle, is Devana Chasma - a narrow (~150 km) 1000 km long, segmented topographic trough (1-3 km deep with respect to the surrounding terrain), which accommodates 3 to 9 kilometers of extension [2]. Devana Chasma is one of three radiating arms of tectonic lineaments that trends south from Beta Regio and marks a physiographic divide between the relatively young Beta-Atla-Themis province to the west and the older highlands and plains to the east according to Average Surface Model Age (ASMA) [3,4]. Near the center of the map area (8°N, 286°E), Devana Chasma's northern lineament suite decreases in lineament density and changes trend to the southeast where it meets the southern section of Devana Chasma, which trends north and veers to the northwest. Preliminary mapping has delineated major structural trends (mostly large normal faults, which agree with previous investigators [5-8]), but has yet to reveal significant temporal constraints between the northern and southern segments. Identification and delineation of nearby volcanic units and assessment of their relative timing may help constrain the timing of Devana Chasma lineaments, which deform the local and regional flows.

Tessera. Geologic contacts are drawn in order to define individual geologic units. In the case of tessera, geologic contacts mark regions of highly deformed material characterized by intersecting structures. In the Devana Chasma quadrangle, tesserae are typically high standing regions with a polygonal, mosaic-like surface, and are located predominantly to the east of Devana Chasma. Tessera units are easily recognized in the SAR by their distinct polygonal surface and bright radar properties but altimetry is also useful in defining their boundaries. Two major tessera units are defined in V-29 (Nedolya Tesserae and Hyndla Regio); each is part of much larger tessera provinces outside of the V-29 cartographic boundaries. In addition to the two large tessera units, several smaller outliers, or kipuka, of tessera are found throughout the V-29 quadrangle; some kipuka clearly represent lateral extensions of tesserae underneath embaying flows, whereas other kipuka cannot be tied to larger expanses of tesserae.

Within the Nedolya and Hyndla tessera units, localized low-lying areas exhibit a dark radar characteristic of intra-tessera plains. We hypothesize two possi-

ble scenarios for this dark material. The first possibility is that the material is produced by shields within the tessera. The second is that dark plains material flowed through the troughs seen in the tessera and in-filled the low-lying areas. Both of these possibilities require that the dark material be younger than the bright material. Although timing is clear, identifying pathways for these materials to the plains is difficult given the present topographic resolution.

Volcanic Features. Contacts have been drawn to define the major volcanic edifices found in the V-29 quadrangle including Beta Regio and the smaller Tuulikki Mons (diameter of approximately 1000 kilometers). The contact around Beta Regio is well defined in places by lobate lava flows that superimpose the surrounding plains units. However, the bright radar characteristic of Devana and Žverine Chasmata southwest of Beta Regio (due to higher density of structural lineaments) interferes with individual flow boundaries making the contact difficult to follow; the contact here is inferred. The contact to the southeast of Beta is defined by a transition from mottled terrain with fractures, which radiate outward from Beta, to homogeneous plains with polygonal lineaments. Shield clusters roughly follow this boundary and may indicate a transition in the types of volcanic processes at work. The contact around Tuulikki Mons is largely defined by flow aprons that superpose the plains and/or interfingered with flows from other volcanic centers. Flow arrow symbology has been used to indicate where flow margins are clearly visible and can be traced to their source(s).

A variety of small volcanic edifices (< 20 km in diameter) are present in V-29, including: densely populated shield fields, pancake domes, edifices with scalloped margins and flat-topped relief, edifices with steep margins and concentric flat-topped relief and a cratered center, and edifices where radar backscatter suggests a more conical shape. It is unclear whether there is a relationship between the types of volcanic edifices present and the difference in terrain between the eastern and western regions of the V-29 quadrangle. However, it is clear that there is a difference in the concentration of small volcanic edifices between these two regions. The concentration to the west of Devana Chasma is ~ 1.4 volcanoes/ 10^6 km² whereas the concentration to the east is ~ 0.73 volcanoes/ 10^6 km². Beta Regio and the rift itself have small, localized, densely clustered shield fields but the overall concentration

and distribution is difficult to determine because of the lack of radar contrast in these “bright” terrains.

Craters. There are 19 impact craters in the V-29 quadrangle that range in size from 2.8 km to 102.2 km in diameter [9]. The ejecta from craters is identified by its bright radar characteristics; however, many craters also exhibit more diffuse ejecta with darker radar properties that radiate farther from the center of the crater than the bright ejecta and have been assigned to a second ejecta unit. Lava flows, which may have formed during the time of impact, are also seen and mapped as crater flow material (i.e., Rosa Bonheur and Boivin craters).

Conclusion: Distinct morphologic differences are observed between the western and eastern portions of the map region. The terrain to the east of Devana is dominated by thousands of square kilometers of tessera (see above), whereas the west contains Tuulikki Mons, a higher concentration of small shield edifices and shield-type plains, and only a few isolated kipuka of tessera. Local ebayment relations between the large tessera regions and plains, including the intra-tessera plains, suggests that tessera are locally the oldest units within the V-29 quadrangle. Tesserae are laterally extensive to the east, and their high-standing nature facilitates their preservation whereas the lower-lying plains to the west are more susceptible to resurfacing by intermediate and small scale volcanism (e.g., Tuulikki Mons, and shields). The geographic distribution of our preliminary geologic units corresponds to the age relations delineated by the ASMA studies [3, 4].

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