

GEOLOGIC MAPPING OF THE BETA-ATLA-THEMIS (BAT) REGION OF VENUS; A PROGRESS REPORT. Leslie F. Bleamaster III, Planetary Science Institute, corporate address - 1700 E. Ft. Lowell Rd., Suite 106, Tucson, AZ 85719; mailing – Trinity University, Geosciences Department, One Trinity Place #45, San Antonio, TX 78212; lbleamas@psi.edu

Introduction. The BAT province is of particular interest with respect to evaluating Venus' geologic, tectonic, and volcanic history and provides tests of global paradigms regarding her thermal evolution. The BAT is “ringed” by volcano-tectonic troughs (Parga, Hecate, and Devana Chasmata), has an anomalously high-density of volcanic features with concentrations 2-4 times the global average [1], and is spatially coincident with “young terrain” as illustrated by Average Surface Model Ages [2, 3]. The BAT province is key to understanding Venus' current volcanic and tectonic modes, which may provide insight for evaluating Venus' historical record.

Several quadrangles, two 1:5,000,000 scale – Isabella (V-50) Quadrangle and Devana Chasma (V-29) Quadrangle and two 1:10,000,000 scale – Helen Planitia (I-2477) and Guinevere Planitia (I-2457), are in various stages of production (Figure 1). This abstract will report on their levels of completion as well as highlight some current results and outstanding issues.

Isabella Quadrangle (V-50; 25-50°S, 180-210°E) is nearing completion; all units are mapped and the DOMU, SOMU, and text are being finalized. It is anticipated that V-50 will be ready for submission in fall '09. The primary unit within Isabella Quadrangle is a regional expanse of plains material (located in Nsomeka and Wawalag Planitiae), consisting of both high- and low-radar backscatter sub-members [4]. This unit is the northern extension of plains from the Barrymore Quadrangle (V-59) [5], located to the south. Within V-50, the plains are warped by broad north-trending topographic ridges and penetratively deformed by fine-scale north-trending lineaments (mostly wrinkle ridges). The plains also host numerous coronae and small volcanic centers (paterae and shield fields), which contribute local materials. With minimal tessera or highland material within the quadrangle, the majority of the oldest materials are the plains forming units; shield fields with relatively small flows embay the plains. In the northwest, several flows emerge and flow to the southeast from

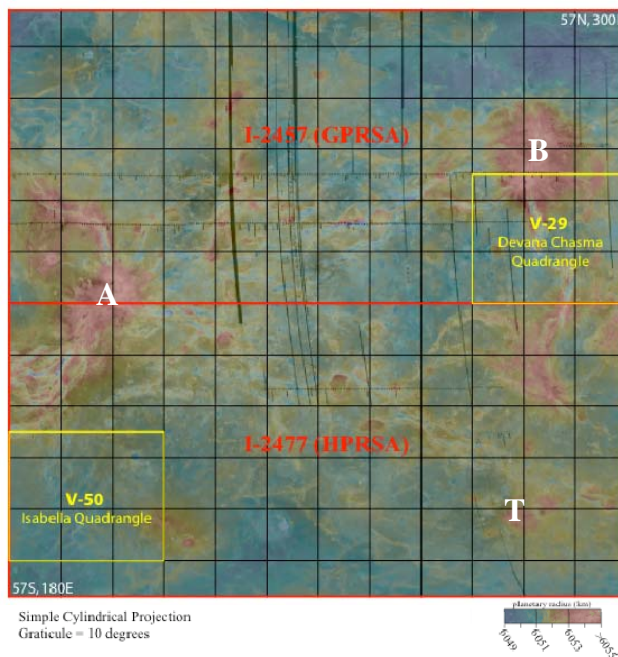


Figure 1. The BAT province is a region of anomalously high volcanic, tectonic, and relatively youthful activity. USGS cartographic boundaries of map regions (red – 1:10M: Guinevere Planitia in north, Helen Planitia in south; yellow – 1:5M: Devana Chasma in north, Isabella in south).

Diana-Dali Chasmata. In general, map relations are consistent with interfingered deformation (both extension and contraction) and volcanism; however, volcanic units in the northwest, near Diana-Dali Chasmata, preferentially embay contemporary topography and are less deformed by plains structures, suggesting that this area is a locus of more youthful activity.

Devana Chasma Quadrangle (V-29; 0-25°N, 270-300°E), on the other hand, is just beginning. Base materials have just arrived and initial evaluation has begun. 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 (1-2 km deep with respect to the surrounding terrain). Devana Chasma is one of three radiating arms of tectonic

lineaments that trend south from Beta Regio; Beta Regio defines the northeastern apex of the BAT province (Figure 1, B). Approximately midway down the map from Beta Regio, Devana Chasma's lineament density decreases and changes trend to the southeast. Near the center of the map, the northern portion of Devana Chasma meets the southern section, which trends south and then veers to the west. Preliminary mapping has delineated major structural trends (mostly large normal faults), but has not revealed significant temporal relations between the north and south segments. Detailed evaluation of these troughs, stratigraphic, embayment, and crosscutting relations of their volcanic contributions, and structural analyses (estimating magnitudes of strain, evaluating orientations and spacing of structures) of the myriad of smaller structural elements will be conducted to constrain local timing and address the nature of the offset observed between these segments.

Helen Planitia (I-2477; 0-57°S/180-300°E) In conjunction with V-50, mapping of Helen Planitia, which covers over 70 million square kilometers (approximately 1/8th) of the surface of Venus, has been ongoing. This summer's efforts will focus on converting existing mapping into GIS compatible formats. This includes several hundred radial and circular structures and their associated digitate and lobate flows.

The majority of these radial/circular features lie within a few hundred kilometers of the Parga Chasmata rift system marking a southeast trending line of relatively young volcano-tectonic activity. Although some very localized embayment and crosscutting relationships display clear relative age relations between centers of activity, the majority of Parga Chasmata volcanism and tectonism overlaps in time from Atla Regio in the west to Themis Regio in the east, extending ~10,000 linear kilometers [6].

Dombard et al., [7] have used geophysical analyses to postulate seven sites within the BAT region that may represent contemporary activity. Four of these sites fall within the Helen Planitia region: Maram (600 km), Atete (600 km), Kulimina (170 km), and Shiwanokia (500 km). Mapping relations show that each of the four coronae represents some of the youngest local activity [8]. All four coronae also share similar

characteristics in plan form displaying radiating flows in excess of several hundred kilometers, fractures and faults that trend parallel to Parga Chasmata, and moderately steep concentric bounding scarps. They also fall directly along the main trend of Parga Chasmata rifting and may be indicative of active rifting and volcanism on the Venusian surface.

Guinevere Planitia (I-2457; 0-57°N/180-300°E) The Guinevere Planitia quadrangle covers the northern portion of the BAT and will allow an additional opportunity to study local relationships of a series of large and small volcano-tectonic features that transect several physiographic provinces (volcanic rises, to crustal plateaus, and through a region of lowland plains) and will include detailed mapping of the other potentially active centers identified by Dombard et al., [7]. Combining this mapping with prior work from the Helen Planitia area [8] will allow direct comparison (spatial, temporal, structural differences) between Parga and Hecate Chasmata, two bounding rifts of the BAT province. These two 1:10M maps will be the focus of the next funding cycle and will be submitted in GIS format within the next two years.

The degree which coronae and chasmata are related remains elusive given the inability to determine, at least with any certainty, Venus' surface age(s). This requires a more detailed determination of relative age than the static pre-, syn-, or post-tectonic classification. Evaluating spatial-temporal relations within the entire BAT province at a variety of scales and developing a detailed stratigraphic sequence (if one exists) coupled with ongoing geophysical examinations may provide the means to understand contemporary processes on Venus, which may then be cautiously extrapolated over the historical record – the present is the key to the past.

References: [1] Head et al., (1992) *J. Geophys. Res.*, 97(E8), 13, 153-13,197. [2] Phillips, R.J. and Izenberg, N.R. (1995) *Geophys. Res. Lett.*, 22, 1517-1520. [3] Hansen, V.L. and Young, D.A. (2007) *GSA Special Paper*. [4] Bleamaster III, L.F., (2007) *Ann. Meet. Planet. Geo. Maps., Open-File Report 2007-1233*. [5] Johnson, J.R. et al., (1999) *USGS Geo. Inv. Sers.* I-2610. [6] Bleamaster III, L.F. (2008), *Ann. Meet. Planet. Geo. Maps. NASA/CP-2008-215469* [7] Dombard et al., (2007) *J. Geophys. Res.*, 112, E04006, doi:10.1029/2006JE002731. [8] Bleamaster III, L.F. (2007) *LPSC XXXVIII, abstract 2434*.