VOLCANO-TECTONICS ON VENUS: A COMPARISON OF PARGA AND HECATE CHASMATA AND PERUNITSA AND KHOSEDEM FOSSAE. P. Martin[1], E. R. Stofan[2] and S. E. Smrekar[3], [1]Durham University, Dept. of Earth Sciences, Science Laboratories, South Road, Durham, DH1 3LE, UK, (paula.martin@durham.ac.uk), [2]Proxemy Research, 20528 Farcroft Lane, Laytonsville, MD 20882 USA (ellen@proxemy.com), [3]Jet Propulsion Laboratory, 4800 Oak Grove Dr., MS 183-501, Pasadena, CA 91106, USA (ssmrekar@jpl.nasa.gov).

Introduction:

Linear zones in the equatorial region of Venus characterized by extension and volcanism have previously been identified in Pioneer Venus and Arecibo data [1-3], and have been mapped in detail following the Magellan mission [4, 5]. The origin of these rift systems and the circular features along them have been a subject of debate, with theories ranging from extension and diapiric upwelling [6, 7] to subduction [8, 9]. Chasmata on Venus have also been suggested to form by lithospheric extension over heated mantle [10]; this heated mantle is also likely to produce melt associated with the many large flow fields, volcanoes and coronae located along chasmata.

Most Type 1 coronae (68%) occur along chasmata or fracture belts [11-13]. Some chasmata coronae have high associated volcanism, possibly indicating the intersection of upwellings with extensional zones [14, 15], while other coronae along rifts have little associated volcanism [16]. In previous studies, we have seen no clear age progression of coronae along rift zones, and chasmata also appear to be relatively young, cutting most of the surrounding plains units, and forming at least coincident with if not postdating many coronae and volcanic features [4, 16-18].

Our studies to date have focused on Parga and Hecate Chasmata, the two largest rift systems on Venus. We have determined that chasmata do not form as a propagating crack driven by loading due to corona formation, in a mechanism similar to that proposed by [19], but rather support a regional extension model; corona formation extends beyond the rift indicating two scales of processes; Hecate Chasma conforms to a uniform rifting model, with portions fit by a narrow rift model and other parts better fit by a wide rift mode; and that Parga Chasma is not fit well by any simple models [16, 20, 21]. We have also suggested that, rather than one large zone of activity covering the whole of the Beta-Atla-Themis (BAT) region, the concentration of volcanic features in this region may actually result from three independent but overlapping broad zones of deformation, corona formation and enhanced volcanism associated with the three rifts (Parga, Hecate and Devana Chasmata), which is more consistent with the gravity signatures of the [16]. However, by studying the two most complex rift systems on Venus, we have been left with more questions than answers: Does the complexity in gravity and topography signatures at Parga represent a more evolved (older) state?; Why do the zone of coronae and volcanism at Parga and Hecate extend for hundreds of kilometers beyond the rift itself, and is that characteristic of all rift/corona systems on Venus?; Why are some rifts corona-dominated and others not? In this study, we are addressing these questions through comparative analysis of chasmata and fracture belt systems on Venus.

Perunitsa and Khosedem Fossae:

The relative locations and scales of Parga and Hecate Chasmata and Perunitsa and Khosedem Fossae are illustrated in Figure 1: Parga and Hecate Chasmata both run from Atla Regio in the center-left of the image, Parga Chasma trending NW-SE through Themis Regio in the lower-right of the image and Hecate Chasma trending SW-NE through Beta Regio in the upper right of the image; Perunitsa and Khosedem Fossae are located in the center-right of the image.

Perunitsa and Khosedem Fossae are fracture belts cutting Dzerassa Planitia, with little associated topography, but a corona (Iweridd) and several volcanic features (Panina Patera, Aleksota Mons and Darago Fluctus) (Figure 2). These features are part of a zone of deformation between Beta and Eistla Regiones, identified in lower resolution Arecibo data prior to Magellan [22]. We are assessing the distribution, amount of volcanism, topography and stratigraphic relationships of coronae, distribution and stratigraphy of volcanoes (>100 km in diameter) and flow fields, constructing a series of topographic profiles across the rifts, and classifying the density and style of fracturing. These observations are being compared with theoretical models to assess the type of load for coronae and volcanoes [23] and analyze the gravity signatures of these features. From this data, we are in the process of determining the elastic thickness, the crustal thickness or apparent depth of compensation, and the type of compensation (top-load, bottom-load, or isostacy) of individual features and regions of the rift. We are comparing these data to narrow vs. wide models of rifting for Venus [21, 24]. Finally these results will be compared with similar results for Parga and Hecate Chasmata obtained in our previous studies [16, 20, 21].

Figure 1: Magellan image of Parga and Hecate Chasmata and Perunitsa and Khosedem Fossae, 45°N-45°S, 200°E – 320°E.
Image courtesy NASA/JPL.

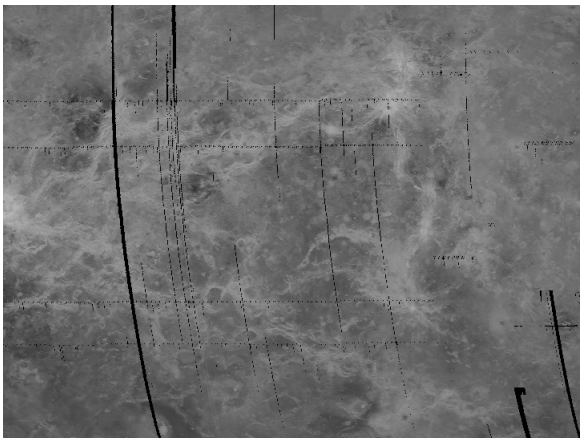
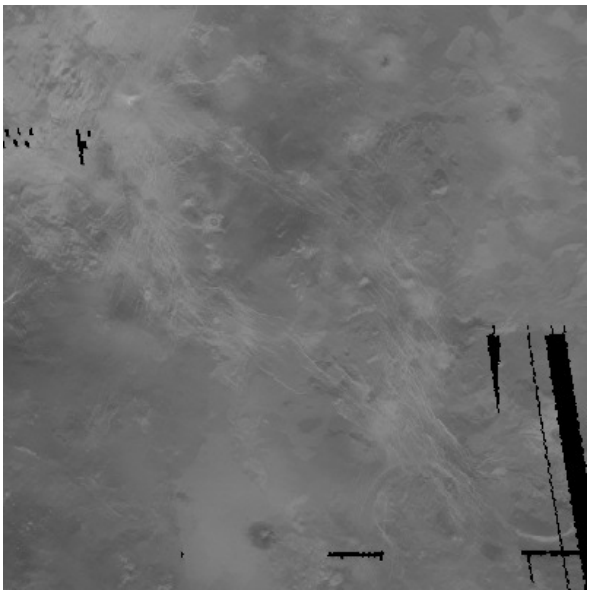


Figure 2: Magellan image of Perunitsa and Khosedem Fossae, 3°S-23°S, 295°E – 315°E.
Image courtesy NASA/JPL.



Initial observations:

The intensity of fracturing varies along the lengths of both Perunitsa and Khosedem Fossae, with both fossae having intense fracturing at their northwestern and southeastern ends and relatively wispy fracturing in their central portions. The intensity of fracturing along Parga and Hecate Chasmata has a much greater variability, with the intensity of fracturing changing from branch to branch and within each branch of both the Parga and Hecate rift systems.

Perunitsa and Khosedem Fossae are associated with a single corona (Iweridd), whereas Parga and Hecate Chasmata are both associated with over 100 coronae. There is significant amounts of volcanism associated with all four of the systems considered in this study. There are more than 50 volcanic features in total associated with Parga and Hecate Chasmata, whereas there are just three associated with Perunitsa and Khosedem Fossae. The comparison of volcano-tectonic features on Venus over a range of scales will help us to constrain models of the formation and evolution of rift systems and associated volcanic processes on Venus.

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