PARGA AND HECATE CHASMATA, VENUS: STRUCTURE, VOLCANISM AND MODELS OF FORMATION, Ellen R. Stofan, Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA 91109; Victoria E. Hamilton, Department of Geology, Occidental College, Los Angeles, CA 90041; Kristen Cotugno, Department of Geology and Geography, University of Massachusetts, Amherst, MA 01003.

Linear zones of deformation in the equatorial zone of Venus characterized by extension and volcanism have previously been identified in Pioneer Venus and Arecibo data [1, 2]. Two of these zones, Parga and Hecate Chasmata, are seen in Magellan data to be characterized by systems of fractures along which lie numerous coronae and corona-like features. The relationship between tectonic deformation, corona formation and volcanism in Parga and Hecate Chasmata is examined using Magellan image and altimetry data. We examine several hypotheses for the origin of these zones, including extension and upwelling [2, 3] and delamination or subduction [2, 4]. In a companion abstract [5], we examine a section of Hecate Chasma in detail.

Hecate and Parga Chasmata extend to the northeast and southeast, respectively, from Atla Regio. Atla is a junction from which the four 'arms' of Ganis, Parga, Hecate, and Dali Chasmata radiate [6]. Parga Chasma is a zone over 10,000 km long extending to the southeast of Atla Regio. Its southern termination is at Themis Regio, a small (<1000 km across, 0.5-1.0 km high) highland region characterized by coronae, volcanic edifices, and rifting. Hecate Chasma is a complex 8000 km long zone of linear features and coronae between Atla Regio and Asteria Regio. Neither system is a well-defined rift system such as Devana Chasma. Instead, they are complex branching networks with several discontinuous offsets along the main trend. The region between Parga, Hecate, and Devana Chasmata is characterized by a high concentration of volcanic features [7].

Tectonic characteristics. Linear features along Parga and Hecate are dominantly graben which occur in broad, diffuse zones or narrow, highly concentrated, parallel groups of troughs and fractures. The narrow, intense zones of fracturing are generally located where a trough is particularly well-expressed, and the lineaments tend to correspond well with the topographic depressions. In regions where the graben and fractures form broad diffuse groups, the faulting and fracturing is not restricted to the troughs and frequently cuts across them. Some ridge features interpreted to be compressional in origin are located within both systems. These include low, widely-spaced wrinkle ridges along with more closely-spaced ridges within the annuli of some coronae.

Five types of coronae and corona-like features are identified along Parga and Hecate. These include Asymmetric, Double Ring, Radial/Concentric coronae and Radial corona-like features and arachnoids. In addition to the over 75 features that can be reliably classified as coronae and corona-like features [3], a large number of arcuate segments and highly subdued features are identified that may be remnants of coronae. In some places, it is possible to identify superposition relationships between adjacebnt coronae. In addition, some features appear to be nearly covered by volcanic material associated with the trough systems. The circular features along both Hecate and Parga superpose and are cut by graben and faults, indicating that deformation and corona formation has overlapped in time.

Volcanic Characteristics. Along the length of Parga and Hecate Chasmata, numerous types of volcanic features are identified including flows, edifices and domes. Flows originate at the margins or from the interior of coronae and corona-like features, from edifices and domes, and from fractures along the trough systems. Volcanism typically appears to be the most recent event, with flows embaying coronae, infilling portions of the troughs, and covering fractures. In several locations along both Hecate and Parga, however, flows have been fractured by subsequent tectonic activity.

Models of Origin. Three possible models of origin are considered for the origin of Parga and Hecate Chasmata. (1) Hotspot model. The zones may represent a hotspot track, similar to the Hawaii-Emperor seamount chain [2, 3]. This model is not favored, due to the lack of evidence for large-scale plate motions on Venus [8]. Features along a hotspot track would be expected to

show a systematic progression in age, indicated by changing morphology of the coronae consistent with the stages of coronae evolution [3, 9-11]. (2) Extension and upwelling. The trough systems are major zones of extension, along which diapiric upwellings form coronae and corona-like features [2, 3]. This model is consistent with the abundance of extensional features, the faulting and rifting in Parga and Hecate Chasmata, and the proposed origin for coronae and coronae -like features as sites of upwelling [3, 9-11]. (3) Delamination or subduction. Parga and Hecate may represent zones along which subduction and/or delamination are occurring [2, 4]. Subduction has been suggested on the basis of the curvature and the asymmetry of topographic profiles in places along both systems [4]. Major asymmetries exist in both relatively linear zones of fracturing and along the rims of some coronae [5]. Asymmetric topographic profiles at coronae are also consistent with gravitational relaxation of the feature [9], and rifing [5].

The general morphology and topography of Parga and Hecate Chasmata are most consistent with major zones of extension along which diapiric upwellings form coronae and corona-like features. Relative age relationships between tectonic features, volcanism and corona formation indicate that these processes have overlapped in time, with abundant late-stage volcanism. Further detailed mapping and analysis of the morphology and temporal relationships between features in these regions is ongoing, and will hopefully lead to a better understanding of the formation and evolution of the complex equatorial zone of Venus.

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