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Radiating Dyke Swarms in the BAT Region on Venus: A Study From the Helen Planitia Quadrangle

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The Beta-Atla-Themis (BAT) region on Venus is characterized by large volcanic rises, major rift zones (chasmata), radiating, linear, and circumferential graben-fissure systems, and coronae. Its most prominent features are the volcanically-dominated structures of Atla, Beta, Phoebe, and Themis Regiones and the enclosure formed by three major rift systems: Hecate, Devana, and Parga Chasmata.

Graben-fissure systems are interpreted to be the surficial expression of underlying dyke swarms. They often propagate radially from or circumscribe magmatic centres, including the type known as coronae. Coronae are quasi-circular volcanic structures that often feature a depressed central “crater” and a raised exterior annulus of circumscribing fractures. They are thought to be formed through domal uplift and subsequent gravitational relaxation above a thermally buoyant mantle upwelling (Stofan et al., 1991; Martin et al., 2007).

The primary objective of this research project is to establish a relative chronology of the magmatic and tectonic events that occurred along a 1500 km section of the Parga Chasma rift system using cross-cutting relationships between the extensional lineaments: graben-fissure systems (overlying dyke swarms) and rift faults. The selected study area falls within the coordinates of 262 – 275°E and 23 – 33°S (approximately 1.5 million km²). The relative chronology was determined by examining the following cross-cutting relationships: (1) intersecting graben-fissure systems belonging to different magmatic centres; (2) graben-fissure systems interacting with rift fault lineaments of Parga Chasma; and (3) the effect of

young lava flows obscuring the trace of both graben-fissure systems and/or rift faults. Current mapping has revealed over 36 graben-fissure systems, 5 – 7 possible coronae, and multiple rift zone segments. Graben-fissure systems appear to be dispersed fairly equally throughout the study area. However, there is some spatial clustering in close proximity to the rift segments of Parga Chasma.

Based on a comparison with terrestrial rifts, the formation of Parga Chasma is interpreted to have occurred over a relatively short time span of 10 – 50 Myr, and this rifting is placed in the centre (acting as a baseline) of the proposed chronological timeline. All graben-fissure systems were then analyzed for cross-cutting relationships between neighbouring systems and/or the rift faults of Parga Chasma. Systematic assessment of cross-cutting relationships has determined that 45% of systems appear to pre-date the rifting; 15% post-date rifting; and 40% were synchronous to rifting. With the emplacement of the majority of graben-fissure systems (overlying dyke swarms) either pre-dating or being synchronous with the onset of rifting, it can be inferred that local magmatic centres (at the focus of the radiating dyke swarms) may strongly influence the location of individual segments of the Parga Chasma rift system.

References

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