PIT CRATER CHAIN CLUSTERING IN GANIKI PLANITIA, VENUS: OBSERVATIONS AND IMPLICATIONS. Sarah C. Davey[1], Claire Samson[1], Richard E. Ernst[1, 2], Eric B. Grosfils[3], [1]Carleton University, 1125 Colonel By Drive, Ottawa, ON, Canada K1S 5B6, sdavey@connect.carleton.ca; [2]Ernst Geosciences, 43 Margrave Avenue, Ottawa, ON, Canada KIT 3Y2; [3]Geology Department, Pomona College, 185 E. 6th Street, Claremont, CA 91711, USA.

Introduction: Pit craters are bowl-shaped, circular to elliptical features common on the surface of Venus and many other terrestrial planets and moons [1-5]. Often found as a series of several pits distributed irregularly or aligned, pits may exist independently, contiguously or coalesce into troughs (Figure 1). Pit crater chains may range in length from tens to thousands of kilometers and in width from seventy-five meters to a few kilometers [2, 5].

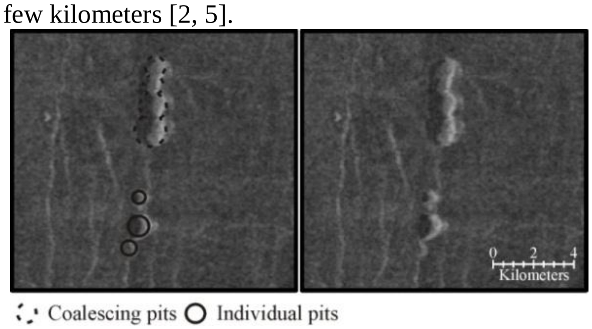

Figure 1: Magellan synthetic aperture radar image of a pit crater chain in cluster A displaying both coalescing (dashed lines) and independent pits (solid lines).

Pit crater chains are found in association with corona, chasmata, and radiating graben-fissure systems [2, 5]. These features are commonly host to local or regional tensile stresses that induce mode I fractures, stoping and later roof collapse [3]. Several mechanisms have been proposed for pit chain formation but dyke intrusion is commonly interpreted as the most viable mode of origin for those recognized on Venus [5]. By examining the distribution of pit crater chains in the Ganiki Planitia (V14) quadrangle of Venus, where pit chains occur in three dominant clusters (A-C; Figure 2), we intend to test this assertion further. Specifically, using GIS we can begin assessing whether pit chain formation is statistically linked to specific lithologies, structures and/or volcanic feature types.

Ganiki Planitia (V14) quadrangle: Extending from 180-210°E and from 25-50°N, Ganiki Planitia is juxtaposed between the volcanically complex Beta-Atla-Themis zone to the southeast and an area of extensive volcanic flooding [6], Atalanta Planitia, to the northwest. The geology of V14 has been mapped and interpreted by [7]. Over half of the quadrangle is host to volcanically derived regional plains units varying in surface roughness. Less abundant lithologies are scattered throughout the area and include tessera terrain and deformation belts, local plains units, corona, volcanic edifice-related flows and impact materials. The quadrangle is also freckled by volcanic edifices differing in size and extent. Of the major volcanic centers located in Ganiki Planitia there are eight corona, five mons, four patera and one tholus. Additional volcanic features include two radiating graben fissure systems in the quadrangle [7, 8]. Thousands of small shield volcanoes, with diameters ranging from 1- 20 kilometers, are found in clusters throughout the area.

In addition to material units, both contractional deformation, in the form of wrinkle ridges, and extensional deformation expressed as graben, troughs and lineaments, are present in Ganiki Planitia. It is this diverse assembly of lithologies, volcanic features and structures in Ganiki Planitia that provide an excellent opportunity to study the distribution of pit crater chains in different geological circumstances.

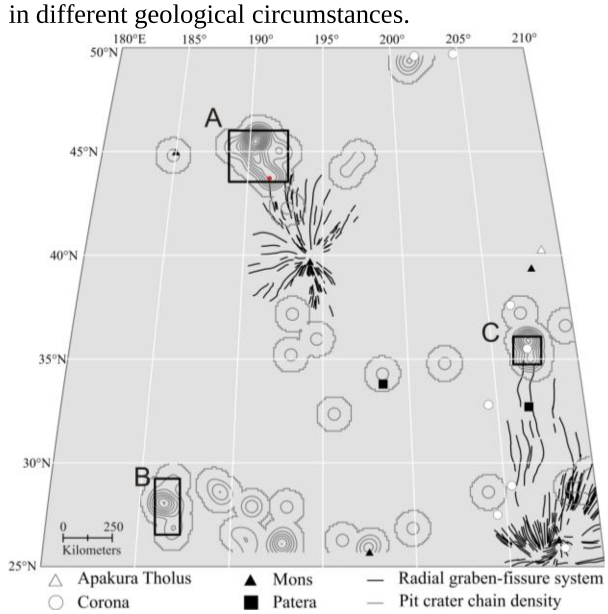

Figure 2. The density and distribution of pit crater chains and large volcanic features in Ganiki Planitia; areas A-C denote regions of particularly high pit cluster density. The pit crater chain shown in Figure 1 is indicated as a red dot.

Characteristics of V14 pit crater chains: With an average concentration of 14 pit crater chains for every million square kilometers, a total of 93 pit crater chains are present. The average pit crater chain contains four pits over a length of three kilometers. A total of 75 (80%) of pit crater chains are not spatially superimposed on extensional features. Additionally, 23 pit crater chains contain only individual pits, 53 either exhibit contiguous or coalescing pits (Figure 1), and the remaining 17 display various combinations of individual, contiguous or coalescing pits.

Distribution of V14 pit crater chains: Figure 2 illustrates the distribution of pit crater chains and major volcanic edifices in Ganiki Planitia. The spatial distribution of pit crater chains features clusters; three of these, denoted as areas A, B and C, contain 55 (60%) of all pit crater chains. The three clusters are significantly different from each other with respect to lithologies, structures and volcanic edifices. Only cluster C is centered on a major volcanic edifice, the Qakma Corona.

Dominant host lithologies: When analyzed relative to material units mapped by [7], pit crater chains are found in many different units including tesserae, regional and local plains units as well as local volcanic edifice flows and corona rims. The only units that do not host a pit crater chain are impact-related. The primary host lithologies are regional plains-2 (pr2), shield plains (ps) and lineated plains (pl). The most extensive unit, pr2, occupies many of the lower elevations, covers 40.6% of Ganiki Planitia, and is interpreted as a relatively thin, low viscosity volcanic deposit [7]. Both the shield plains and lineated plains are less extensive, covering 8.4% and 5.1% of Ganiki Planitia, respectively. Shield plains are spotted in appearance because of small shield volcanoes and their local volcanic flows [7]. Lineated plains (pl) are volcanic plains units that have experienced extensional and contractional deformation [7].

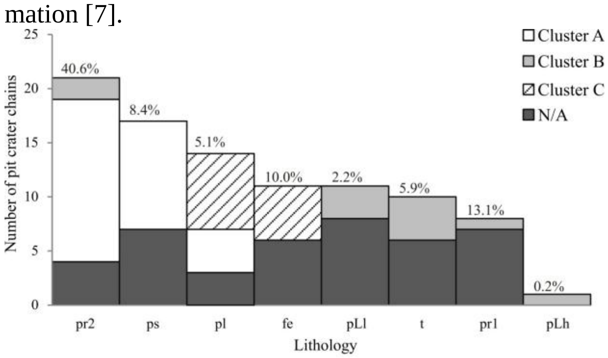

Figure 3. The number of pit crater chains in different lithologies. N/A indicates pit crater chains outside clusters A, B or C. Percentages above each column denote the total area of Ganiki Planitia covered by each unit. Lithological units: regional plains-2 (pr2), shield plains (ps), lineated plains (pl), volcano edifice flows (fe), Lahevhev lineated plains (pLl), tessera (t), regional plains-1 (pr1) and Lahevhev hummocky plains (pLh).

Cluster A: Covering an area of approximately 78,400 km^2, cluster A contains 29 pit crater chains. Predominant host lithologies include regional plains-2 (pr2), shield plains (ps) and lineated plains (pl). Stratigraphically older tessera and deformation belts, as well as a stratigraphically younger homogeneous plains unit (ph), fail to exhibit pit crater chains. Wrinkle ridges are located on the western portion of cluster A in an east-west trend, whereas extensional lineaments exhibit a general north-south trend. Approximately 50% of the area's pit crater chains are located along these extensional lineaments. Pit crater chains that are not located along extensional lineaments are often found parallel to other nearby pit crater chains and/or extensional lineaments.

Cluster B: Located near the southern border of Ganiki Planitia, cluster B contains 12 pit crater chains and spans 36,405 km^2. Host lithologies include: tessera (t), Lahevhev hummocky plains (pLh), Lahevhev lineated plains (pLl), regional plains-1 (pr1) and regional plains-2 (pr2). The pit crater chains are distributed almost evenly through these units with no preferred host lithology. Wrinkle ridges are located primarily in both regional plains units-1 and -2, which are found on the east and west fringe of cluster B. Extensional lineaments, in general, are oriented in a northwest- southeast trend. Unlike cluster A, pit crater chains are not found directly along extensional lineaments. However pit crater chains are found sub parallel to parallel with nearby pit crater chains and/or extensional lineaments

Cluster C: Concentrated on Qakma Corona, cluster C is the only locale with a clear connection to a major volcanic feature. Covering an area of 20,046 km^2, it includes 12 pit crater chains. The dominant host lithologies are centered on the corona and are comprised of volcano edifice flows (fe) partially surrounded by lineated plains (pl). Here, pit crater chains are found circumscribing the corona often independently but in some cases along graben. Interestingly, west of the corona lies regional plains-2 material which hosts extensional lineaments but not pit crater chains.

Conclusion: The three principal clusters of pit crater chains examined in Ganiki Planitia have yet to unveil clear lithological, structural or volcanic associations. The alignment of pit crater chains and extensional lineaments in clusters A and C indicate a dyke-related origin; whereas, a regional tensile stress related origin is indicated by the seemingly random alignments in clusters B and parts of cluster A. Future work will be focused on examining relationships between pit crater chains, and local and regional extensional lineaments. Additional analysis will aim at further constraining lithological associations. Through understanding the intricate relationships between pit crater chains, lithology and structure, a better understanding of their origin and environment may be established.

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