RELATIONSHIP BETWEEN SMALL SHIELD VOLCANOES AND ANNULAR DEFORMATION PATTERNS WITHIN THE NEMESIS TESSERA QUADRANGLE, VENUS.

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INTRODUCTION: The shield volcano is the most abundant morphological feature on Venus [1]. Small volcanic edifices with diameters of <20 km cover a large portion of the surface. It is therefore important to understand the formation of these small edifices, and how they relate to other features on the surface of Venus. Aubele [2] has observed small groups of shield volcanoes associated with "large circular features of unknown origin." The Nemesis Tessera quadrangle (V14, centered at 37.5° N 195°) has several fields of shield volcanoes, and some areas where the shield volcanoes are found within annular deformation patterns ranging from 70 km to 190 km in diameter. This study focuses on three specific plains regions (with dimensions: 285.5 km by 249.8 km, 428.2 km by 428.2 km, and 231.9 km by 160.6 km) within V14 (respectively centered at 37.6°N 206.4°E, 28.3°N 205.0°E, and 30.0°N 192.1°E), which contain five of these annular deformation pattern and shield volcano combinations (Figure 1). The volcanic and structural features in these areas were mapped at FMAP resolution, and the density distribution of small shield volcanoes was analyzed in order to explore the relationship between small shield volcanoes and annular deformation patterns in the quadrangle.

METHODS: In this study the three areas were mapped using Magellan FMAP images and C1MIDR scale synthetic stereo data sets. Lineaments, identified by their brightness, were mapped at a scale of 1:250,000. Small shield volcanoes were also mapped at a scale of 1:250,000. Large numbers of small shield volcanoes appeared on most surfaces. These volcanoes were identified using the synthetic stereo data and apparent topography as well as radar dark and radar bright patterns illustrated and described by Aubele [3]. Inverse stretches were used at times to enhance the identification of both the volcanic edifices and lineaments.

After the initial mapping process, the boundaries of the annular features were defined (Figure 1) to compare small shield volcano densities. Of the 844 small shield volcanoes mapped, 614 fell inside the annular deformation pattern boundaries.

To calculate shield volcano densities, a circle shaped sample area of 250 km^2 (diameter of 17.84 km) was selected. Shield fields are defined as having 4 to 10 edifices per 1000 km^2 [4, 5, 6, 7, 8], but 1000 km^2 samples were too large to examine two of the smaller deformation patterns; one forth of that area was a reasonable sample size. Grids with lines spaced 17.84 km apart were constructed for each of the three regions. The circle density sample areas were centered on each intersection of the grid. The number of small shield volcanoes inside each circle was recorded; contour intervals of 1, 3, 5, etc. were drawn. Contoured shield density data and mapped deformation patterns were compared by creating a composite of the two sets (Figure 2). A contour at 2 shield volcanoes per 250 km^2 was marked to represent the edge of the upper bound of shield field densities (1 to 2.5 edifices per 250 km^2).

The average small shield volcano density for each annular pattern was calculated. Average densities ranged from 5 to 8 volcanic edifices per 1000 km^2.

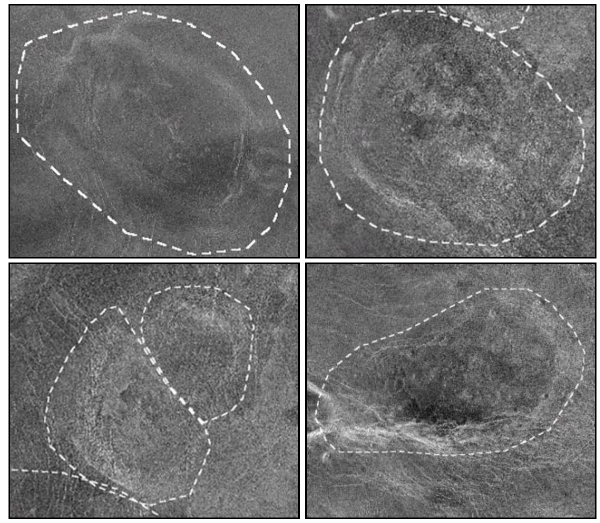

Figure 1: Annular deformation patterns containing small shield volcanoes centered at (clockwise from upper left) 37.6°N 206.4°E (140 km diameter, MVC: arachnoid), 27.4°N 204.6°E (190 km diameter, MVC: corona), 30.0°N 192.2°E (110 km diameter, MVC: shield field), 29.2°N 205.7°E (70 km diameter, MVC: arachnoid) and 28.8°N 205.3°E (90 km diameter, MVC: with 29.2°N 205.7°E as an arachnoid).

DISCUSSION: In each contoured region, high densities of shield volcanoes are found within the deformation patterns; these contour lines mimic the deformation patterns in a few cases (Figure 2).

Shield fields are defined as having 4 to 10 edifices per 1000 km^2 [4, 5, 6, 7, 8] and diameters ranging from 50 to 350 km with a mode of 100 to 150 km [6]. Densities within the annular deformation patterns reflect densities associated with defined shield fields that are not associated with annular deformation patterns [9]. Notably, densities higher than 3 volcanic edifices per 250 km^2 are rarely found outside of the annular deformation pattern in the three study areas.

The relationship between the annular deformation patterns and the shield volcanoes within the patterns can be explained in one of two ways:

1. The shield volcanoes now found inside the annular deformation patterns were emplaced, then lineaments cut around the densely populated volcanic plains; or
2. The shield volcanoes and lineaments were emplaced around the same time. Localized mantle upwelling formed the shield volcanoes; deformation took place as a result of this volcanic process.

We favor the second hypothesis at this time, however a study of the stratigraphic relationships in these regions is necessary to understand the formation of these features.

CONCLUSIONS: High densities of shield volcanoes are found within annular deformation patterns in the Nemesis Tessera quadrangle. Further research must be conducted to understand the apparent relationship between the volcanism and tectonism associated with the annular patterns. The stratigraphic relationships between the deformation patterns and shield volcanoes are essential to understanding the formation of the annular features studied. Continued research should focus on these relationships.

REFERENCES: [1] Aubele, J.C. and E.N. Slyuta. (1990) *GSA: Abstracts w/ Programs*: v. 22, no. 7: 80. [2] Aubele, J.C. (1989) *LPSC XX*, 28-29. [3] Aubele, J.C. (1993) *LPSC XXIV,* 47-48. [4] Grosfils, E.B. (1999) *LPSC XXX*, #2035. [5] Addington, E.A. (1999) *LPSC XXX*, #1038. [6] Crumpler, L.S. et al. (1997) *Venus II*, 697-756. [7] Aubele, J.C. et al. (1992) *LPSC XXIII*, 47-48. [8] Crumpler, L.S., and J.C. Aubele (2000) *Encyclopedia of Volcanoes*, 727-769. [9] Polit, A.T. et al. (2002) *LPSC XXXIII*, this volume.

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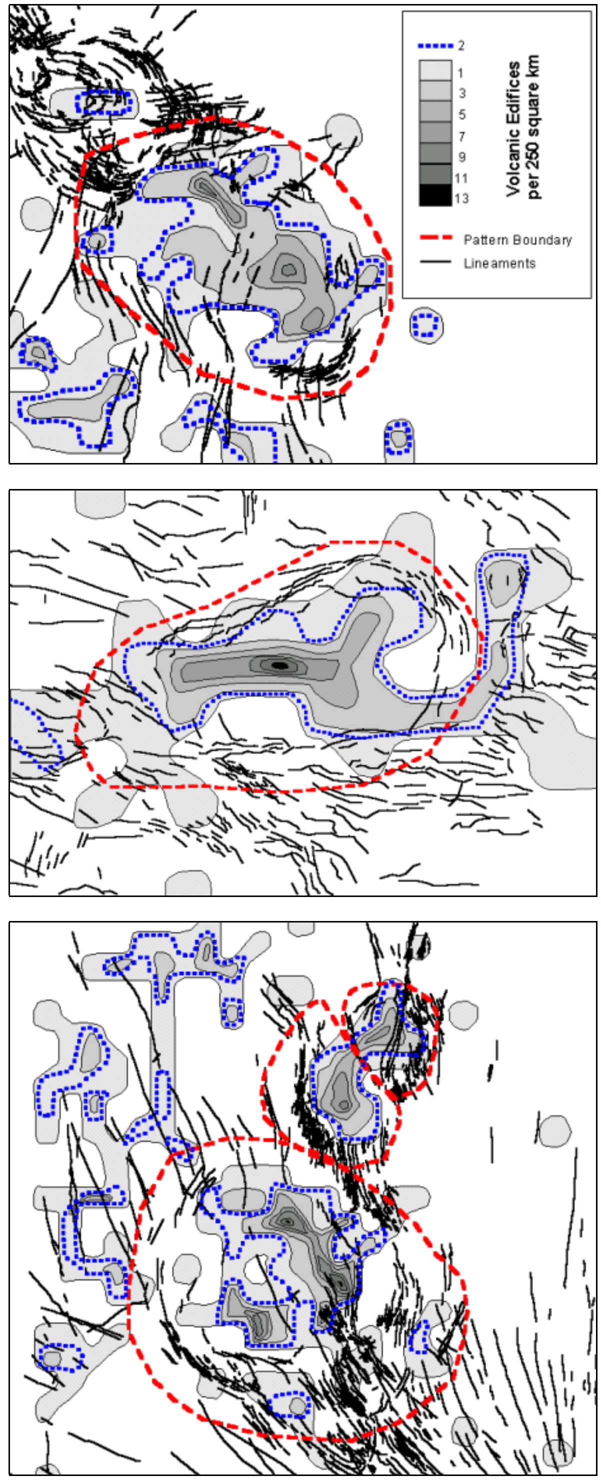

Figure 2: Contours of shield volcano densities shown at 2 edifices per 250 km^2 intervals, with lineaments overlaid. (Centers of regions from top to bottom: 37.6°N 206.4°E, 30.0°N 192.1°E, and 28.3°N 205.0°E.