Shield Fields and Associated Features: Implications for Shield Field Formation Processes

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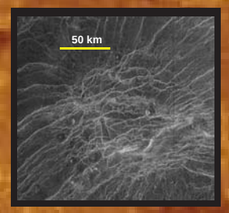
1. Abstract

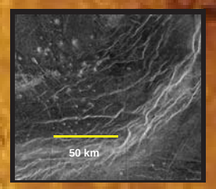
It is unknown how shield fields form on Venus or even whether they form via similar processes. By observing features surrounding these shield fields, associations may be made to origin processes. 165 shield fields (of approximately 650) were analyzed for spatial relationships between structural lineations (ridges, rifts and grabens), other volcanic features and impact structures. It was found that 100% of the shield fields were within 100 km of structural features, 73% were within the structural features, 67% were near other volcanic features, 30% were near or within coronae, arachnoids or stellate fractures and 10% were near impact features. These results are interpreted to show a common relationship of shield field formation to structural features.

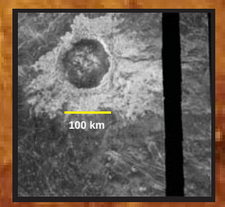
2. Background

- Defined as "4 - 10 shield edifices per 10^3 km^2
- 647 Shield Fields randomly present on surface of Venus (see figures 1 and 3)
- First observed by Venera missions, then confirmed by Magellan
- Represent largest number of volcanic features on Venus
- Shield Fields have been:
  - counted
  - categorized
  - mapped
  - placed into stratigraphic sequence
- Four models of formation (figure 2):
  -"Islands"
  - Form above broad, shallow magma chambers
  - Each shield has its own magma chamber
  - Form above deep reservoir melts
- Above models do not address effects of tectonism in formation
- Step 1: Are there any associated tectonic features?

Example Images







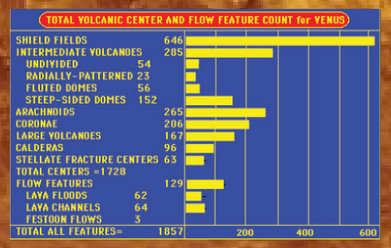


Figure 1. Volcanic features on Venus. Notice shield fields are the most represented feature more than doubling the next closest volcanic edifice type.

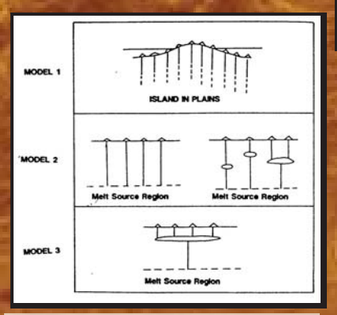
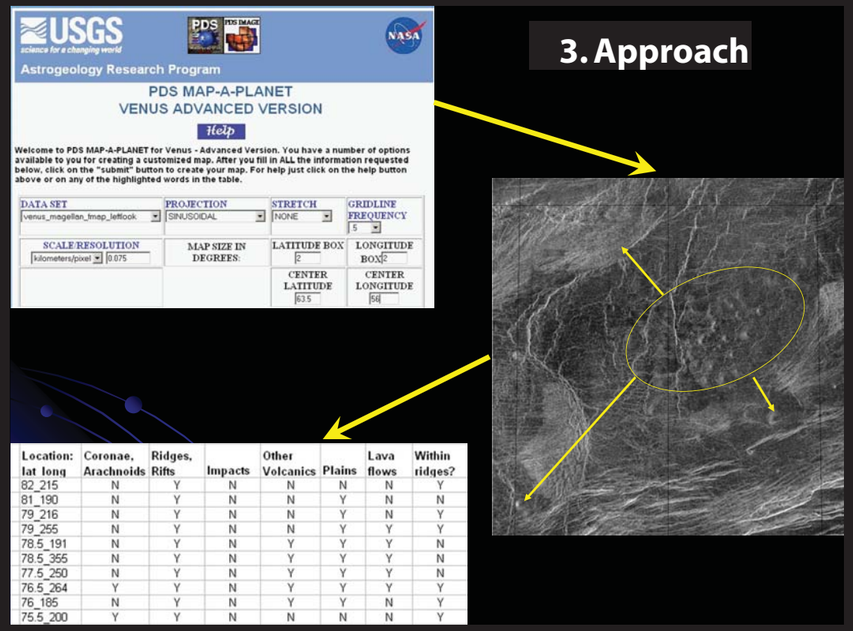


Figure 2. Three models of Shield Field formation (Aubele et al., 1992). Grosfils (1999) proposed the fourth where magma ascends from a deep melt source.

3. Approach



Location: lat_long	Coronae, Arachnoids	Ridges, Rifts	Impacts	Other Volcanics	Plains	Lava flows	Within ridges?
82_215	N	Y	N	N	N	N	Y
81_190	N	Y	N	N	Y	N	N
79_216	N	Y	N	N	Y	N	Y
79_255	N	Y	N	N	Y	Y	Y
78.5_191	N	Y	N	Y	Y	Y	N
78.5_355	N	Y	N	Y	Y	Y	N
77.5_250	N	Y	N	Y	Y	Y	N
76.5_264	Y	Y	N	Y	Y	Y	Y
76_185	N	Y	N	Y	Y	N	Y
75.5_200	Y	Y	N	N	N	N	Y

A. Input central coordinates of Shield Field into PDS "Map-a-Planet" for Venus
B. Construct a window of 4 square degrees surrounding Shield Field
C. Analyze images for spatial relationship to impacts, tectonic and other volcanic features
D. Tabulate associated features and calculate totals
E. Assume 100km = genetic association

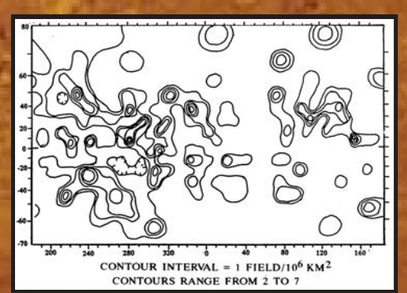


Figure 3. Density of Shield Fields. Fields are arranged in a mostly random fashion with a slightly greater concentration in the Beta-Atla-Themis Regio (Aubele et al., 1992).

4. Results

100% of Shield Fields near/within linear structures
30% near/within coronae/arachnoids
67% near other volcanic features
78% near/within plains units (but all near edges)
10% near impact craters

- 165 Shield Fields near structural lineations
- 49 near coronae or arachnoids
- 111 near other volcanic features (not included within the Shield Field)
- 128 showed associated plains units (all were near edges)
- 17 near impact craters
- 122 showed discernably different associated lava flows

5. Conclusions and Future Work

- All Shield Fields analyzed are within 100 km of structural features
- Relationship between features and formation of fields

- Future studies include analyzing ALL Shield Fields
- Analog field studies in the Snake River Plain of Idaho and the Michoacan-Guanajuato Volcanic Field in central Mexico would also prove useful
- Modeling processes that develop wrinkle ridges and determining locations on Earth that follow those conditions

6. References

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