Patterns in the Distribution of Small Volcanoes Around Coronae of Different Morphologies on the Surface of Venus;  A. A. Fosse, Evergreen Senior High School, Independent Science Research Class, M. Ellison, Evergreen Senior High School, Vancouver, WA 98684. Advisor: G. Komatsu (Lunar and Planetary Lab, University of Arizona, Tucson, AZ 85721)

The study of geothermal events is very important in understanding planetary evolution. Magellan’s high resolution SAR images will help us to better understand the geology of Venus. This research was conducted to determine if patterns exist in the way that small volcanoes (1 to 20 km in basal diameter) occur in and around the five classes [1] of coronae. Definite patterns in the distribution by distance were observed relating to three of the five corona classes. At 200 ±50 km from the centers of Concentric, Radial/concentric, and Asymmetric corona a significant increase in the number of small volcanoes is observed. On Multiple and Concentric Double-ring coronae a more random distribution is observed.

Small volcanoes were only mapped between one and twenty kilometers in basal diameter. Most occur preferentially between 1 and 3 kilometers. They are classified as: conical-shaped, shield-shaped, domical-shaped, and flat-tops [2]. Conical-shaped edifices are circular features with steep slopes and saturated flanks. Domical-shaped edifices are circular with large pits. Shield-shaped edifices have outlines that range from circular to irregular and have shallow slopes. Flat-tops have mesa-like flanks, a central pit, and flat summits. Flat-tops are similar to some seamounts, on the Earth, imaged by GLORIA [2].

Coronae studied range in size from 140 to 560 kilometers in average diameter. Coronae are classified into five categories: concentric, concentric-double ring, radial/concentric, asymmetric, and multiple. Concentric coronae have symmetric, well-defined tectonic annuli. Concentric coronae are circular to elongate and comprise 50% of all corona. Concentric-double ring coronae are surrounded by two distinct tectonic annuli of ridges and/or troughs. Each annulus is about 15-20 km in width and together they are about 60-70 km from inner to outer edge. Thirty-eight concentric-double ring coronae have been identified. Radial/concentric coronae are characterized by an asymmetry of form. There are sixty asymmetric corona identified. Multiple coronae consist of two or three linked structures, with a continuous annulus surrounding the entire corona. Coronae where a clear age progression can be identified are not included in this category [3].

Coronae are thought to form in a three step process [1]. First, buoyant magma rises towards the surface and its motion exerts stresses on the surrounding mantle material which leads to an associated flow field. This first step causes a general uplift of the crust above the diapir causing a domical rise. Secondly, as the diapir continues its upward motion it will eventually rise to, spread, and flatten against the underside of the lithosphere. As a large portion of the lithosphere has hot, buoyant magma beneath it the lithosphere will be more plateau-like instead of domical. Finally, as the diapir flattens against the underside of the lithosphere its new thinned shape will cause it to cool and the plateau-like rise that was created will sink in the middle to create a structure with a high ring and low center.

Methodology: Thirty-two F-MIDR’s (2.3% of the surface of Venus) were surveyed in this study. Measurements were made using Magellan F-MIDR’s and Image 1.49.2 4PDS on a Macintosh. The diameters of small volcanoes were measured in the east to west and north to south directions and averaged. Their latitude and longitude were recorded and their class was identified as per Aubele’s classification scheme [2]. This spherical distance equation was used to find distances between coronae and small volcanoes: $cos^2(\frac{(\cos(lat_1)\cos(long_1)\cos(lat_2))\pm(\sin(lat_1)\sin(lat_2))}{2})$

The Magellan Hypermap was used to locate and identify the diameters of each corona.

Results: In this study 3185 small volcanoes were mapped. These small volcanoes were compared to 15 coronae to find patterns in their distribution around the coronae. Small volcanoes were considered associated if they were within two diameters distance from the center of a corona. The fifteen coronae in this study are: Anala, Blathnat, Carpo, Demeter, Gertjon, Idem-kuva, Libera, Neyterkob, Nissiba, Purandhi, Rauni, Selu, Shiwanokia, Sunrta, and Tamfana.

There were seven Concentric Coronae (fig. 1b) in this study: Anala Sunrta, Idem-kuva, Demeter, Shiwanokia, Purandhi, and Nissiba. It appears that small volcanoes are not distributed randomly around coronae. Small volcano distribution around these coronae is almost identical to what was observed by Fosse and Gerlach in 1995 [4]. At a distance of approximately 150-225 km the number of small volcanoes increases (see figs). Also, at this distance the small volcanoes tend to group together. This phenomenon may occur due to dike emplacement at distance from the magma plume.
Small Volcanoes and Coronae on Venus: Fosse A. A.

creating the corona. This increase in the number of small volcanoes in a ring centered around 200±50 km appears to be representative of Concentric (fig 1b), Radial/Concentric (fig 1f), and Asymmetric (fig 1d) coronae. This is not seen on Multiple (fig 1e) or Concentric Double-ring (fig 1c) coronae where the number of small volcanoes gradually increase as area increases.

At this time density calculations for the small volcanoes around the coronae are incomplete. It can be estimated that the density between 150 and 225 km around Concentric coronae and between 200 and 300 km around Radial/ Concentric coronae will be one order of magnitude greater than any other distance from the coronae.