SMALL SHIELD VOLCANOES IN GUINEVERE PLANITIA, VENUS: CHARACTERISTICS AND MODES OF OCCURRENCE; **James W. Head and Jayne C. Aubele,** (Dept. Geo. Sci., Brown University, Providence, RI), **Evgeny N. Slyuta,** (Vernadsky Institute, Moscow, USSR), and **Donald B. Campbell** (National Astronomy and Ionosphere Center, Cornell University, Ithaca, NY)

INTRODUCTION. Small "domes" have been described and discussed previously as the most abundant geologic feature on the surface of Venus, numbering $2X10^4$ in the area imaged by Venera 15/16 [1-5], and interpreted to represent dominantly effusive shield volcanoes [2,4,5,6]. Based on Venera images, these features were described as circular in planimetric outline, less than 100-200 m in height, diameters most commonly ranging from 2-8 km with a defined maximum of 20 km, and occurring in groups or clusters [1-5]. Local concentrations were found to occur in association with coronae, arachnoids, and larger volcanic constructs and calderas [3,5]. Two major regional concentrations were found to occur approximately 180° in longitude apart centered in Akkruva Colles and Guinevere Planitia [4,5]. However, resolution of previous data sets was insufficient to determine the detailed surface morphology of these small edifices, occurrence of summit calderas and smallest edifice diameter, or their relationship to plains formation and modes of occurrence in association with local and regional structure.

MAGELLAN OBSERVATIONS. Magellan data reveal these characteristics in detail and Guinevere Planitia, as an area of high concentration of domes [4,5], is an excellent region for study. At Magellan resolution, four basic types of small edifices are observed: (1) shield-shaped (uniformly low slopes and broad, rounded summits); (b) flat-topped or table-like (steeper flank slopes and flat summits); (c) dome-shaped (steep, non-uniform flank slopes and broad, rounded summits); and (d) cone-shaped (steep slopes and pointed summits). A total of 616 edifices have been measured and examined so far. The edifices range in basal diameter (all diameters are measured along-track) from 975 m to 16.9 km with a modal basal diameter of 3-4 km. By edifice type, 85% are shield-shaped. Summit pits occur in 76% of the edifices and the pits range in diameter from 225 m to 1.9 km. Multiple summit pits or summit domes occur rarely. The dominant style of edifice appears to be shield-shaped with a single summit pit. Edifices and pits are generally circular in planform. The minimum diameter of measured edifices is approximately 1.0 km. Pits are identifiable at minimum diameters of 200 m, so that edifices $\lesssim$1 km in diameter should be visible unless there is a change in the characteristics of slope or radar backscatter for very small edifices such that they cannot be resolved in Magellan images. Dome diameter frequency plots show similar distributions to previous data measured from Venera 15/16 [5] and can be best described by an exponential distribution. The fit to an exponential distribution implies that *if* small edifices exist below the limit of Magellan resolution, their number would represent a very small component of the total abundance. The correlation between diameters of summit pits and their edifices is r=0.4. The slope of the least squares fit between pit and edifice diameter is 0.07. As previously observed in Venera images [1-5], domes occur predominantly in clusters (fields) of edifices. To begin analysis of the characteristics of these clusters and their significance, several well-defined clusters in Guinevere Planitia have been mapped and studied.

MODES OF OCCURRENCE. CLUSTER 1, centered at approximately 34.9°N, 331°, covers an area of $1.5X10^4$ km^2 and consists of 80 small volcanic features, 55 of which are distinguishable edifices and the others are either pits that are associated with edifices that can only partially be distinguished from the surrounding plains or pits that do not have identifiable associated edifices. Density of volcanic vents in this cluster is 5/1000 km^2. Dome basal diameter ranges from 1.3 to 6.5 km with modal basal diameter of 3-4 km which is identical to the modal diameter observed previously in Venera images [2,5] for the northern 25% of the planet. All of the edifice morphology types occur in this cluster except cone-shaped. Shield-shaped edifices account for 87% of the population of this cluster. 93% of the identifiable domes in this cluster have summit pits, with pits ranging in diameter from 0.3 to 1.4 km. Only one dome appears to have a double pit and 3 of the domes appear to have a small summit dome on top of the main edifice rather than a pit. Pit diameter/basal diameter ratio is 0.18. The average diameter of pits associated with edifices is 0.7 km and that of pits not associated with identifiable edifices, but interpreted to represent volcanic activity, is 0.8 km. Mapped geologic relationships show that the small edifices are associated with and apparently influenced by major regional structural trends. The cluster occurs in a region where two dominant structural trends, delineated by troughs and bright lineations interpreted to be scarps oriented WNW and NE, appear to intersect. The troughs are approximately 1 km wide and occur in segments 10^1 to 10^2 km in length. The edifices themselves are not always aligned along the lineations, but there appears to be a strong influence on the location of summit pits. In a few places, the major structural trends appear to be delineated by chains of aligned pits. There is no clear stratigraphic relationship between the formation of the regional structural trends and the formation of a majority of the edifices. Some edifices are clearly cut by local structure, while others can be identified on the basis of their burial of local structure. This implies that volcanism and tectonism in this region is associated and occuring contemporaneously. Associated flows, or radar-bright halos or aureoles extending beyond the shield edifice, cannot be identified in this cluster; however, edifices occur in association with a region of plains material that appears to thinly cover the local tectonic pattern in the area defined by the cluster. Therefore, the edifices appear to be the source of near-vent, thin flow units that resurface local pre-existing terrain but do not necessarily represent a significant percentage of the total crustal volume. **CLUSTER 2,** centered at 31.8°N, 332°, is located 330.0 km SE of cluster 1, and consists of a total of 85 volcanic features, edifices and pits not associated with edifices, in an area of approximately $8.4X10^3$ km^2. Density of volcanic vents in this cluster is 10/1000 km^2. This cluster is comparable to cluster 1 in basal diameter of edifices, percentage of shield shaped edifices, and percentage of edifices with single summit pits. Mapped geologic relationships show that, as in cluster 1, the edifice summit pits here are also associated with and influenced by the major regional structural trend. There are four structural trends in the general area of this cluster. The dominant trend is delineated by troughs, ≈1 km wide and extending in en echelon segments of 5-20 km in length, oriented NW. This trend strongly influences the location of pits within the edifice cluster. Two minor structural trends occur as troughs and bright lineations oriented WNW and NE. There is a veneer of plains material which appears to be associated with the edifices so that within the cluster the NW oriented structure can no longer be seen although the NW and WNW trends are only partially obliterated. To the SE and SW of this cluster is an area of very fine-scale parallel bright lineations oriented ENE that intersect at right angles to the dominant NW trend of segmented troughs. These lineations are not visible in the vicinity of the cluster and appear to be buried by material associated with outlier edifices of the cluster. **CLUSTER 3,** centered at 43.5N, 333.8, consists of 162 edifices and 19 pits without identifiable associated edifices in an area of approximately $4X10^4$ km^2. Density of volcanic vents in this cluster is 4/1000 km^2. The edifices in this cluster are similar to those of clusters 1 and 2 but represent a wider range in diameter and style. Edifice basal diameter ranges from 975 m to 10.3 km and 78% are shield-shaped. 73% of the edifices have a summit pit and pit diameter ranges from 225 m to 1.7 km. One edifice has a summit dome and one has a dome within a summit pit. Many of the edifices in this cluster are cut by the dominant structural trend consisting of closely spaced (≈5 km apart) troughs and bright lineations oriented N-S which exists only within the margins of the cluster and does not extend into the surrounding plains. Variations in radar backscatter and embayment relations with the surrounding plains suggest that the edifices in this cluster pre-date the formation of the plains surrounding the cluster.

CONCLUSIONS. Magellan images of Guinevere Planitia have confirmed previous interpretations that the geologic features known as domes on Venera images are predominantly shield shaped volcanic edifices [2,4,5,6]. New observations of these volcanic edifices include the high percentage of single summit pits associated with the edifices and an apparent minimum basal diameter of ≈1 km which may be a significant minimum diameter related to style of volcanic eruption. The 616 edifices examined range in basal diameter from 975 m to 16.9 km, have a modal basal diameter of 3-4 km, and 85% are shield-shaped. Summit pits occur in 76% of the edifices and the pits range in diameter from 225 m to 1.9 km. Magellan observations confirm the high concentration of small domes in Guinevere Planitia [4,5] and the occurrence of the majority of domes in clusters as discussed by previous studies [1-5]. Observations of these clusters at Magellan resolution has shown the importance of structural control in association with these clusters. The troughs of the dominant structural trends can be interpreted to be small graben that may be linked to the location and orientation of dikes which supplied magma for the edifice-building eruptions. The clusters studied are all located at the intersection of 2 or more regional extensional structural trends which serve as the locus of activity for the creation of the cluster. Cluster edifices and associated flows may then partially bury the regional structural trends. Cluster 3 may represent an older cluster that has been surrounded and embayed by subsequent voluminous plains formation from nearby sources.

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