STRATIGRAPHY OF SMALL VOLCANOES AND PLAINS TERRAIN IN VELLAMO PLANITIA-SHIMTI TESSERA REGION, VENUS

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INTRODUCTION As part of the Venus Data Analysis Program, a study has been underway to define the relationship between the abundant small volcanoes and the extensive plains terrain of Venus by using the tool of geologic mapping. The plains terrain on Venus covers approximately 80% of the surface [1]; and the mechanism of formation, total crustal contribution, and age (or range of ages) represented by the plains is presently uncertain or unknown. Fundamental questions and theories regarding the thermal evolution of the planet [2,3] can only be tested by an understanding of plains stratigraphy. While the Venus plains can be assumed, by analogy with Moon and Mars, to be volcanic in origin with subsequent modification by tectonism, impact cratering, and aeolian processes [4-8], there is a paucity of individual volcanic centers, particularly large volcanic edifices, occurring within the lowland plains terrain [9,10]. The volcanic features that do commonly occur are lava channels [11,12] and clusters of small hills that have been interpreted to be predominantly shield-type volcanoes [1,13,14]. These clusters of volcanoes may be similar to volcanic "fields" in the terrestrial volcanological sense of the term [15]; and each "field" appears to have some volume of associated material covering an area beyond the actual edifices. A major question that is the focus of the VDAP-funded research and mapping reported here is the relationship between material extruded or intruded in association with these "shield fields" and the formation or resurfacing of the plains terrain with which they are associated.

DATA AND PRELIMINARY ANALYSIS Venus quadrangles V12 (Vellamo Planitia), centered at 37°N and 135°, and V11 (Shimti Tessera), centered at 37°N and 105°, were selected for mapping on the following basis: (1) presence of a large number of small volcanoes; (2) occurrence of lowland plains terrain; and (3) low abundance of large features that might complicate the geologic evolution of the surface and obscure stratigraphic evidence. Four possible stratigraphic models can be tested on the basis of stratigraphic relationships interpreted from geologic mapping: (1) the small volcanoes are the source of flows that form or resurface the plains; (2) the small volcanoes and the plains formed simultaneously; (3) the small volcanoes predate - or (4) postdate - the formation of extensive plains terrain.

Geologic Units. As has been reported by other workers in other areas, tesserae (Complex Ridged Terrain or CRT) appears to be the oldest stratigraphic unit in the area. In Vellamo Planitia, tessera is embayed by three plains units, all of which show a small scale pattern of orthogonal ridges. The oldest of these plains units has a very large number of small hills which are interpreted to be volcanic edifices. Average density of the edifices in this unit is $4500/10^6$ km^2. This unexpected and newly defined plains unit has been named "Hilly Mottled Plains Material" (Psh) on the preliminary geologic map. It is a discrete geologic unit with well-defined contacts and consistent stratigraphic relationships, it overlays and embays tesserae throughout the mapped area; and it is overlain by two plains units that contain few volcanic edifices and are distinguished by differences in radar backscatter and embayment relationships along contacts. Therefore, the small volcanoes in this region are predominantly associated with (and probably the source of) a distinctive plains unit which is a potential regional stratigraphic marker. Analysis of the adjacent quadrangle V11 has determined the unit's regional areal extent and relationship with other areas of small volcano concentration. Use of similar "small volcano plains units" in other areas may aid in mapping and stratigraphic analysis of the surface evolution of Venus. The stratigraphic relationship between this and other "small volcano plains units" is currently being studied.

[1]Guest et al, JGR 97, 15949, 1992 ; [2]Schaber et al, JGR 97, 13257, 1992; [3]Phillips et al, JGR 97, 15923, 1992; [4]Squyres et al, JGR, 97, 13579, 1992; [5]McGill, LPI 789 (abst), 67, 1992; [6]Arvidson et al, JGR 97, 13303, 1992 [7]Greeley et al, JGR 97, 13319, 1992; [8]Campbell et al, JGR 97, 16249, 1992; [9]Head et al, JGR 97, 13153, 1992; [10]Crumpler et al, Sci 261, 591, 1993; [11]Baker et al, JGR 97, 13421, 1992; [12]Parker et al, LPSC XXIII (abst), 1035, 1992; [13]Aubele & Slyuta, EMP 50/51, 493, 1990; [14]Garvin & Williams, GRL 17, 9, 1381, 1990; [15]Aubele et al, LPSC XXIII (abst), 47, 1992.

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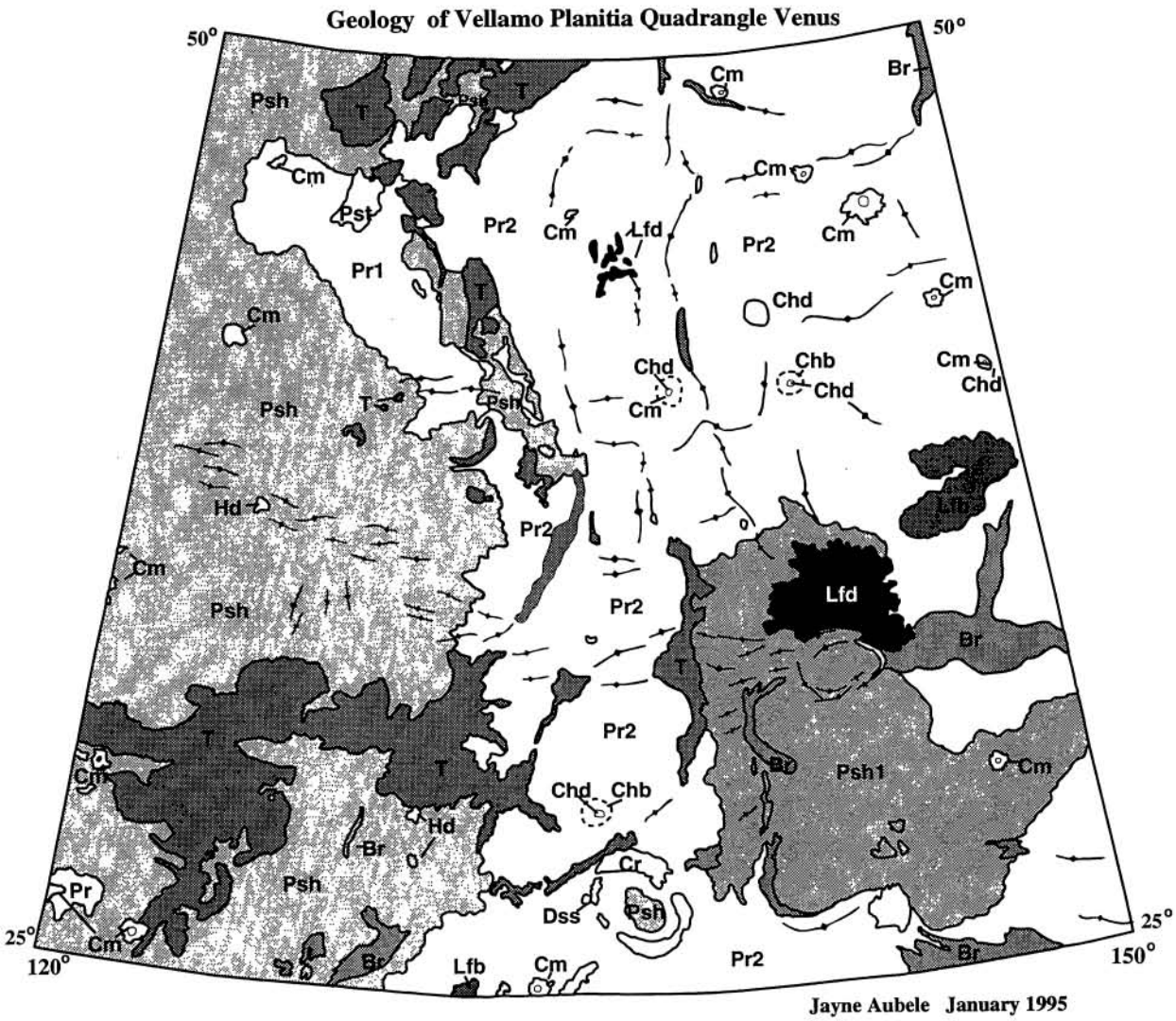

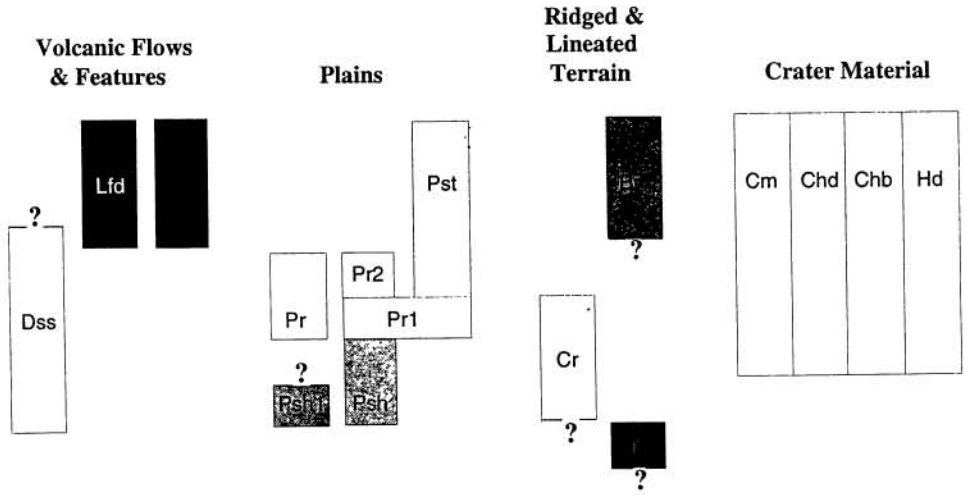

Note: Preliminary geologic map formatted and prepared using Adobe Photoshop, Illustrator and Streamline software with Macintosh Centris 650 and Tektronics color laser printer.