MAGELLAN: PRELIMINARY DESCRIPTION OF VENUS SURFACE GEOLOGIC UNITS.

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This preliminary report summarizes geologic observations from approximately one-half of the Magellan nominal eight-month mission to map Venus. Preliminary compilation of initial geologic observations of the planet reveals a surface dominated by plains that are characterized by extensive and intensive volcanism and tectonic deformation. We have identified four broad categories of units- Plains Units, Linear Belts, Surficial Units and Terrain Units.

PLAINS: The surface of Venus is dominated by plains; 80% of the surface lies within 0.5 km of the mean planetary radius[1]. Four types of plains have been classified in the Magellan data analyzed to date. Plains may have discernible flow units, and may be characterized by small domical hills. The data reveal a far more complex surface of the plains than previous data. (1) **Smooth plains**- planar, areally extensive units characterized by a featureless appearance with no discernible flow units and few domical hills or linear features. These plains are interpreted to be emplaced by volcanic flooding where the flows have homogenized with time or by coalescing shield emplacement with shields of too low slope to be detected in high incidence angle radar images. (2) **Reticulate plains**- planar, areally extensive units characterized by one or more sets of sinuous, radar-bright lineaments unresolvable as ridges or grooves. An example can be seen in Guinevere Planitia where the reticulate plains are embayed by younger radar-dark flows. Linear features within the reticulate plains tend to be spaced > 5 km apart. Reticulate plains are interpreted to be flood or shield-type plains, that embay underlying structure and/or have been subjected to later deformation. 3) **Lobate plains**- planar regions characterized by radar-bright and/or radar-dark lobate regions that extend for 10's to 100's of kilometers. The type example of Lobate plains is seen at Mylitta Fluctus. The plains tend to be topographically controlled. Lobate plains have few or no linear features; if present, fractures tend to control emplacement of plains materials. Lobate plains are interpreted to be volcanic in origin, representing coalescing flows and flow complexes. (4) **Grid Plains**- planar, areally extensive regions characterized by intersecting orthogonal sets of radar-bright lineaments. The example located in Guinevere Planitia, extends for hundreds of kilometers with very regular spacing. Linear features within the Grid Plains lack sinuosity of linears seen in Reticulate Plains, and tend to be spaced closer (<5 km). These plains are interpreted to have been affected by complex tectonic deformation.

LINEAR BELTS: Two types of linear belts have been identified- ridge belts and groove belts. These units were also identified in Venera 15/16 data of the northern hemisphere of Venus, with the largest number of belts located in the Atalanta Planitia region[2]. The units are identified based on the predominant form of tectonic feature and the topography. (1) **Ridge belts**- belts of linear structures predominated by ridges. A large grouping of ridge belts is found in Lavinia Planitia,. Ridges tend to lie in linear belts of increased radar brightness interpreted to be increased roughness due to mechanical erosion. Belts tend to extend for 100's of kilometers, and have topographic relief of 1 km or less. Ridges within the belts tend to be spaced 5-20 km apart. Ridge belts are interpreted to be compressional in origin, sometimes cut by later episodes of extensional deformation. (2) **Groove Belts**- belts of linear structures predominated by grooves or troughs. Several groove belts are seen in Lavinia Planitia, with grooves spaced 5-20 km apart. The groove belts generally have greater topographic relief than the ridge belts. The grooves are interpreted to be extensional in origin.

SURFICIAL UNITS: Magellan has revealed a number of material units not previously identified in previous data sets, with the exception of the crater materials unit. Six material units have been identified. (1) **Crater materials-** radar-bright deposits located within and surrounding craters. Material surrounding the craters generally has lobate boundaries and a hummocky appearance. Crater materials units are interpreted to be of impact origin. (2) **Channel materials-** generally sinuous, radar-dark, 1-3 km across materials located in both plains and highland regions. A channel located in Guinevere Planitia is a few kilometers across, and extends for over 500 km. The channel materials are interpreted to be basaltic lava. In some cases channels are carved into the older surface and are analogous to Lunar sinuous rilles. (3) **Bright Lobate surficial material-** radar-bright to mottled materials contiguous with crater materials, characterized by lobate boundaries. The deposits may extend for 100s of km and may be 10s of km wide, and may surround small shields or domes of probable volcanic origin. Emplacement of material tends to be topographically controlled, and boundaries of the unit tend to have increased brightness. Bright Lobate Surficial Material units are interpreted to be outflow of highly fluid material, probably volcanic in origin, caused by the cratering process. (4) **Bright material-** Relatively radar-bright materials that tend to have linear or feathered appearance. Bright material frequently appears contiguous with ridges or small domical hills, or appears as long (>100 km) linear units. Bright material is interpreted to be areas of increased roughness of the surface due to deposition of removal of material by the wind. (5) **Dark material-** relatively radar-dark materials that have a circular diffuse appearance or appear as long (>100 km) linear units. Dark material is interpreted to be areas of increased smoothness due to deposition of material. (6) **Linear faceted material-** linear occurrences of relatively radar-bright facets. The material occurs in groups of lineations, typically extending for <100 km. This unit may represent sand dunes.

TERRAIN UNITS: A number of terrain units have been identified in Magellan data. Two of them, Groove and Ridge Terrain and Cross-lineated Terrain, are in regions previously identified as tessera[3]. The units here follow more typical unit divisions based on morphology, and may be thought of as morphologic subdivisions of larger, more complex geomorphologic regions called tessera. (1) **Groove and Ridge Terrain-** relatively raised (<1 km) units characterized by intersecting sets of grooves and ridges. Groove and ridge terrain tends to occur in small patches, surrounded by smooth or reticulate plains, as seen in fragments of this terrain on Lakshmi Planum. Grooves and ridges tend to be spaced less than 10 km apart. Regions of Groove and Ridge Terrain tend to be relatively radar-bright and approximately equidimensional. This unit is usually part or all of a region of tessera, and is interpreted to be highly deformed basement unit that has been subsequently embayed. (2) **Cross-lineated Terrain-** relatively high (<1 km), areally extensive, equidimensional terrain characterized by intersecting sets of lineaments generally unresolvable as ridges or grooves. The lineaments are spaced approximately 10 km apart, and are in some cases identifiable as graben. This unit has formed by complex deformation. (3) **Mountainous Terrain-** high (highest elevations >1 km above surrounding region) terrains characterized by long (>100 km) linear ridges and valleys frequently cut by shorter grooves and ridges. Mountainous terrain sometimes has either a belt-like or a more equidimensional appearance, and tends to be radar-bright. Mountain belts form the borders of Lakshmi Planum. The mountains are interpreted to form from compressional deformation, followed by relaxation and extension.

The Venusian surface appears to be geologically young yet quite geologically active. Highlands show geomorphologically diverse appearances, possibly indicating multiple origins and modes of evolution for highland terrain on Venus. This classification is preliminary, and will evolve as we see more of Venus. The Soviet Venera 15/16 data and the geologic analysis [3] has provided invaluable guidance in planning and carrying out our preliminary analysis.

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