GEOLOGY OF THE LAVINIA PLANITIA AREA, VENUS; James Head, Kari Magee, Susan Keddie, Martha Gilmore, and Aileen Yingst, Department of Geological Sciences, Brown University, Providence RI 02912 USA

BACKGROUND: The Lavinia Planitia area is one of the several large relatively equidimensional lowland areas of Venus and as such is an important region for study in the analysis of processes of lowland formation and volcanic flooding. Prior to Magellan it was known to be a lowland area (1) surrounded by several corona-like features and rift-like fractures parallel to the basin margin to the east and south (2,3). Arecibo data showed that the interior was populated with complex patterns of ridge-belt like deformational features and volcanic plains, and several regions along the margins were seen to be the sources for extensive outpourings of digitate lava flows into the interior (2,3). Early Magellan results showed that the ridge belts were composed of complex deformational structures of both extensional and compressional origin (4) and that the complex lava flows (fluctus) along the margins (5) emanated from a variety of sources ranging from volcanoes to coronae (6). In addition, Lavinia Planitia is an area deficient in the distribution of distinctive volcanic sources and corona-like features (7). Indeed, the characteristics and configuration of Lavinia Planitia have been cited as evidence for the region being the site of large-scale mantle downwelling (8). Thus, this region is a laboratory for the study of the formation of lowlands, the emplacement of volcanic plains, the formation of associated tectonic features, and the relationship of these to mantle processes. We have begun mapping the V55 Lavinia Planitia Quadrangle with these goals in mind. Summarized below are the results from our initial analyses, including a model for the regional stratigraphy (Fig. 1).

REGIONAL SETTING: The Lavinia Planitia Quadrangle consists of a centralized deformed lowland surrounded by Dione Regio to the west, Alpha Regio tessera and Eve corona to the northeast, an extensive rift zone and coronae belt to the east and south, Mylitta Fluctus to the south, and Helen Planitia to the southwest.

PLAINS: There are several plains types and they include mottled plains, dark plains, and digitate flows. Mottled Plains are characterized by abundant superposed ridges, locally large numbers of shields; sometimtes radar dark, sometimes radar bright, but brighter is usually the older member and contains the shields. Dark Plains have fewer superposed wrinkle ridges and commonly occur as small patches adjacent to or within fracture belts. Digitate Flows are clearly younger than most deformation and only locally have wrinkle ridges. Sources for these latter flows are localized around the margins of the basin (5,6).

STRUCTURE: Deformation belts consist of ridge belts which are similar in morphology to the wrinkle ridges in plains and in general are topographically lower than fracture belts, which generally deform mottled plains but not dark plains; digitate plains always embay them (4). Components of fracture belts are similar in morphology to grooves in the plains, but are more concentrated. Wrinkle ridges form on all units throughout the plains sequence, even in the youngest digitate plains, but are much less abundant in the youngest units; orientations are distinctive regionally and therefore do not seem to have changed much with time. Grooves, oriented orthogonal to wrinkle ridges, appear to be younger than mottled and dark plains, but do not cut digitate plains. Not all the structures are contemporaneous. There is a significant variability between belts, and between individual deformation belts and plains. Many ridge belts are parallel to wrinkle ridge orientation in plains, and the same is true for groove belts; there are cases where one belt turns into another where it changes orientation. Some individual ridges and grooves within deformation belts grade into ridges and grooves in ridged or fractured plains. Central Lavinia is characterized by lowland plains which generally overlie highly deformed tectonic ridge and groove belts. There are two distinctive directions of background deformation; these are at high angles to one another and are clearly superimposed (ENE first, and NNW second). The initial ENE deformation is predominantly extensional in the NW area, but then appears to be compressional as one works toward the SE and down into Lavinia Planitia (4).

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STRATIGRAPHIC SEQUENCE: The stratigraphic sequence according to our preliminary mapping is as follows: the youngest units are the Dark Haloed craters; older craters are observed but none of them in the quadrangle are embayed by lava. Younger plains include the fluctus, which appear as floods with few domes, and mostly emerge from sources in the adjacent rift and coronae belt to the east and south (5,6). Medial plains include many distributed domes and are commonly mottled. Older plains are cut by NNW trending graben. The oldest unit, tessera, is well developed in Alpha Regio and may underlie larger parts of the quadrangle, but definitive exposures and thus evidence of its presence is lacking over most of the quadrangle.

INTERPRETED GEOLOGIC HISTORY: Volcanism prior to downwelling produced background plains which were deformed by subsidence of the basin. Ridge belts are interpreted to be fold belts that formed by buckling of strong upper crust in response to ridge-normal compression. Subsequent volcanism produced extensive volcanic plains between and among the deformation belts apparently from sources within the basin. The latest volcanism issued from centers located along the edge of the basin (associated primarily with the extensive rift zone extending for 6000 km along the western and southern margin of Lavinia Planitia) and flowed into the basin, but intrabasin sources at this time are not obvious (5,6). We believe that these structural features and this stratigraphic sequence supports models which suggest that mantle downwelling first produces a topographic low and deforms crust into ridges. Late-stage marginal rifting and volcanism may be related to upwelling counterflow linked to the general downwelling. The lack of abundant evidence of features that might be linked to small-scale mantle instabilities (e.g., coronae, large volcanoes) in central Lavinia (7) appears to support the general downwelling model (8).

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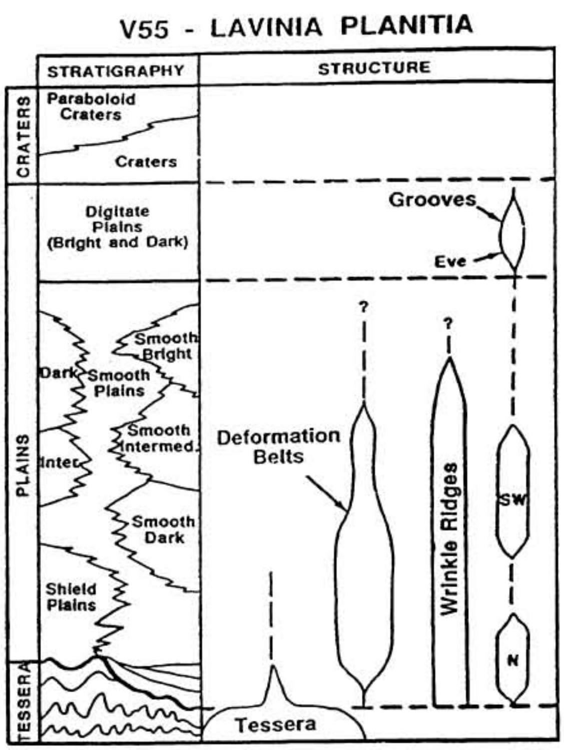

Figure 1