GEOLOGICAL MAP OF THE FREDEGONDE (V-57) QUADRANGLE, VENUS, M. A. Ivanov[1,2] and J. W. Head[2], [1]Vernadsky Institute, RAS, Moscow, Russia, mikhail_ivanov@brown.edu, [2]Brown University, Providence, RI, USA, james_head@brown.edu.

Introduction: The area of V-57, the Fredegonde quadrangle (50-75°S, 60-120°E, Fig.1), is located within the eastern portion of Lada Terra within the topographic province of midlands (0-2 km above MPR [1,2]). Midlands form the most abundant portion of the surface of Venus and are characterized by diverse sets of units and structures [3-11]. The area of the Fredegonde quadrangle is in contact with the elevated portion of Lada Terra to the W and with the lowland of Aino Planitia to the NE. The transitions of the midlands to the lowlands and highlands are, thus, one of the main themes of the geology within the V-57 quadrangle. The character of the transitions and distribution and sequence of units/structures in the midlands are crucially important in understanding the time and modes of formation of this topographic province. The most prominent features in the map area are linear deformational zones consisting of swarms of grooves and graben and large coronae. The zones characterize the central and NW portions of the map area and represent regionally important, broad (up to 100s km wide) ridges that are 100s m high. Relatively small (100s km across, 100s m deep) equidimensional basins occur between the corona-groove-chains in the west and border the central chain from the east.

Here we describe units that make up the surface within the V-57 quadrangle and present a summary of our geological map that shows the areal distribution of the major groups of units.

Material and structural units and their relationships: During our mapping we have defined the following material units that can be divided into four groups on the basis of embayment and cross-cutting relationships. **I. The first, older, group** of heavily tectonized units includes two material units (pdl and pr) and one structural unit (gb). (1) Densely lineated plains material (pdl): The surface of this unit is heavily dissected by numerous densely packed lineaments (fractures), which are narrow (<100s m), short (10s km), and parallel or subparallel to each other. In the majority of occurrences of pdl the lineaments are packed so densely that they completely obscure the morphology of the precursor materials. In some fragments of the plains, however, remnants of the older lava plains are visible between the lineaments. These materials are interpreted to be volcanic plains, heavily deformed by extensional and/or shear structures. Type locality: 59.0°S, 85.2°E. (2) Ridged plains material (pr): characterized by morphology of lava plains that are deformed by broad (5-10 km) and long (10s km) linear and curvilinear ridges. The ridges typically have a smooth surface and rounded and slightly undulating hinges, and appear to be symmetrical in cross section. In places, the ridges form prominent belts (Oshumare Dorsa). Type locality: 57.1°S, 78.1°E. (3) Groove belts (gb): represent a structural unit that is formed by swarms of numerous linear and curvilinear subparallel lineaments that are usually wide enough to be resolved as fractures or graben. The main morphologic differences between groove belts and densely lineated plains material are the shape and dimensions of occurrences (belts for gb and patch-like occurrences for pdl), as well as larger spacing, width, and length of structures in fracture belts. Type locality: 58.8°S, 91.6°E.

II. The second, middle, group consists of three material units. (1) Shield plains material (psh): is characterized by the presence of numerous small (<10 km) shield-like features that are interpreted as volcanic edifices [12-14]. The surface of both the shields and plains between them is morphologically smooth. Material of shield plains embays all units from the first group and represents the first unit in the stratigraphic scheme that displays no pervasive deformation and is mildly deformed by tectonic structures (wrinkle ridges). Type locality: 59.4°S, 76.2°E. (2) Material of lower unit of regional plains (rp_1): has a morphologically smooth surface with a homogeneous and relatively low radar backscatter but can be locally mottled. This unit is the most abundant within the quadrangle (~30% of the map area) and preferentially occurs on the floor of the low-lying basins. Type locality: 52.7°S, 107.9°E. (3) Material of upper unit of regional plains (rp_2): has a morphologically smooth surface that is moderately deformed by numerous low, narrow, and sinuous wrinkle ridges of the same family that deforms the unit rp_1. The key difference between the upper and lower units of regional plains is albedo variation. In contrast to the uniform and relatively low albedo of rp_1, the upper member of the plains has a noticeably higher albedo. The unit rp_2 covers ~20% of the map area and occurs usually as equidimensional or slightly elongated patches of flow-like shape from tens of kilometers to several hundred kilometers across. Type locality: 61.0°S, 74.6°E. Material of both units of regional plains embays shield plains and the older materials/structures.

III. The third, young, group includes three units. (1) Shield cluster material (sc): appears to be morphologically similar to shield plains (psh) [15] but, in contrast, is tectonically undeformed and displays small

lava flows superimposed on lava plains nearby. Small shields that form shield clusters and material that immediately surrounds them appear to be superposed on the adjacent regional plains (rp_1, rp_2). These relationships suggest that most of the clusters postdate the emplacement of regional plains. Type locality: 69.7°S, 86.7°E. (2) Smooth plains material (ps): has a morphologically smooth, tectonically undisturbed, and featureless surface. Areas of smooth plains are usually dark (smooth at the scale of the radar wavelength). The unit occurs as small equidimensional and elongated occurrences a few tens of kilometers across. Type locality: 71.6°S, 92.5°E. (3) Lobate plains material (pl): has a morphologically smooth surface that occasionally is disturbed by a few extensional features. The most characteristic feature of lobate plains is their non-uniform albedo pattern consisting of numerous bright and dark flow-like features. The flows can be several tens of kilometers long. Occurrences of the unit form equidimensional fields many tens up to a few hundreds of km across. In the V-57 quadrangle, lobate plains are associated with Dunne-Musun and Ambar-ona Coronae. Material of lobate plains embays wrinkle ridges. Type locality: 62.0°S, 91.6°E. The age relationships among the units sc, ps, and pl are sometimes not clear and they appear to form roughly simultaneously.

IV. The fourth group includes materials related to emplacement of impact craters and consists of two units. (1) Impact crater materials, undivided (c): this unit includes materials of the central peak, floor, walls, rim, and continuous ejecta. Type locality: 56.2°S, 98.9°E (crater Addams), and (2) Impact crater outflow material (cf), type locality: 57.0°S, 101.7°E (outflow from crater Addams).

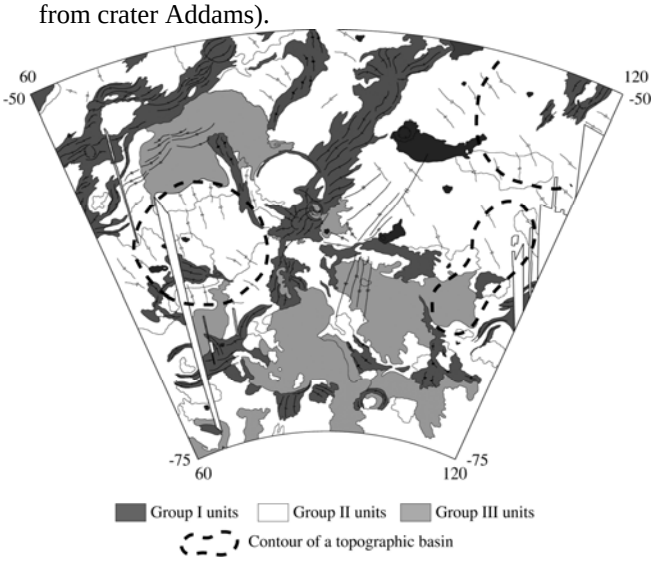

Fig. 1. Geological map of the V-57 quadrangle.

Summary: The results of the mapping in the V-57 quadrangle permit us to outline the major episodes of the geologic history of this region. Tectonic deformation played the most important role in the beginning of the history. The majority of deformation occurred early on and was related to the formation of the deformational belts, the most prominent of which are the corona-groove chains. During this period, the most important topographic features (broad linear ridges and equidimensional basins) of the midland portion of Lada Terra were established. During the middle and late periods, volcanism was more important and vast plains moderately deformed by tectonic structures were emplaced. There is a little evidence suggesting a continued development of the major topographic features during the middle stages of the geologic history of the region. The flow direction of lobate plains (from the broad ridges toward the floor of the basins) suggests that the overall topographic configuration of the midlands within the map area was established prior to emplacement of the youngest volcanic plains. The main topographic and structural elements of coronae appear to be older than both shield plains and regional plains. The youngest lobate plains, however, are typically associated with some coronae. This means that the corona structures were either reactivated late in the geologic history or volcanic activity at coronae continued until the late stages of history.

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