GEOLOGICAL MAP OF THE FREDEGONDE (V-57) QUADRANGLE, VENUS: STATUS REPORT. 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 Fredegonde quadrangle (V-57; 50-75°S, 60-120°E, Fig. 1) corresponds to the northeastern edge of Lada Terra and covers a broad area of the topographic province of midlands (0-2 km above MPR [1,2]). This province is most abundant on Venus and displays a wide variety of units and structures [3-11]. The sequence of events that formed the characteristic features of the midlands is crucially important in understanding of the timing and modes of evolution of this topographic province.

Topographically, the Fredegonde quadrangle is within a transition zone between the elevated portion of Lada Terra to the west (Quetzalpetlatl-Boala Coronae rise, ~3.5 km) and the lowland of Aino Planitia to the north and northeast (~-0.5 km). This transition is one of the key features of the V-57 quadrangle. In this respect the quadrangle resembles the region of V-4 quadrangle [12] that shows transition between the midlands and the lowlands of Atalanta Planitia. One of the main goals of our mapping within the V-57 quadrangle is comparison of this region with the other transitional topographic zones such as quadrangles V-4 and V-3 [13].

The most prominent features in the V-57 quadrangle are linear deformational zones of grooves and large coronae. The zones characterize the central and NW portions of the map area and represent broad (up to 100s of km wide) ridges that are 100s of m high. Morphologically and topographically, these zones are almost identical to the groove belt/corona complexes at the western edge of Atalanta Planitia [12]. Within the Fredegonde area, however, the zones are oriented at high angles to the general trend of elongated Aino Planitia, whereas within the V-4 quadrangle they are parallel to the edge of Atalanta Planitia. Relatively small (100s of km across, 100s of m deep) equidimensional basins occur between the corona-groove-chains in the area of V-57 quadrangle. These basins are similar to those that populate the area of the V-3 quadrangle [13]. Broad regional plains cover the surface of the basins in both regions. In contrast to Fredegonde, the area of the V-3 quadrangle displays a greater diversity of units and features [13].

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 group* consists of heavily tectonized units. (1) Densely lineated plains (pdl) with a surface that is heavily dissected by subparallel narrow and dense lineaments a few hundred meters wide and several kilometers long. Usually the lineaments completely obscure the morphology of the underlying materials. In some occurrences, however, remnants of the older lava plains are visible between the lineaments. The unit pdl is interpreted as volcanic plains, heavily deformed by extensional and/or shear structures. Type locality: 59.0°S, 85.2°E. (2) Ridged plains (pr): displays a morphology of smooth lava plains that are deformed by broad (5-10 km) and long (10s of km) linear and curvilinear ridges with rounded and slightly undulating hinges. The ridges appear to be symmetrical in cross section and sometimes form prominent belts (Oshumare Dorsa). Type locality: 57.1°S, 78.1°E. (3) Groove belts (gb) form a structural unit that consists of swarms of linear and curvilinear, long (many 10s of km), and radar bright lineaments. They are usually wide enough to show the morphology of fractures. Within the V-57 quadrangle, groove belts form the most prominent structural and topographic zones hundreds of km long and many tens of km wide that are often associated with coronae. Rims of most coronae in the map area consist of arcuate swarms of grooves. Type locality: 58.8°S, 91.6°E.

II. The second group includes three material units. (1) Shield plains (psh): are characterized by the presence of numerous small (<10 km) shield-like features that are interpreted as volcanic edifices [14-16]. Materials of shield plains (shields and intershield plains) embay all units from the first group. Shield plains represents the oldest unit that displays no pervasive tectonic structures and is mildly deformed by wrinkle ridges Type locality: 59.4°S, 76.2°E. (2) Regional plains (lower unit, rp_1): are morphologically smooth and usually have a homogeneous albedo pattern that can be locally mottled. The radar backscatter of the surface is relatively low. Numerous low, narrow, and sinuous wrinkle ridges deform the surface of the lower unit of regional plains. This unit makes up ~50% of the map area (the most abundant unit) and preferentially occurs on the floor of the low-lying basins. Type locality: 52.7°S, 107.9°E. (3) Regional plains (upper unit, rp_2): have a morphologically smooth surface that is moderately deformed by wrinkle ridges of the same family that cut the unit rp_1. Both units of regional plains embay shield plains and the units of the first group. The key

difference between the upper and lower units of regional plains is their radar albedo. In contrast to the uniform and relatively low albedo of rp_1, the upper member of the plains is noticeably brighter and sometimes displays flow-like features. The unit rp_2 covers ~10-15% of the map area and forms equidimensional or slightly elongated occurrences from tens of kilometers to several hundred kilometers across. Type locality: 61.0°S, 74.6°E.

III. The third group includes three units that postdate units from the previous groups. There is no good evidence to establish relative ages among the units from this group (1) Shield clusters (sc): are morphologically similar to shield plains (psh) [17] but tectonically undeformed. Type locality: 69.7°S, 86.7°E. (2) Smooth plains (ps): have morphologically smooth, tectonically undisturbed, and featureless surfaces, which are usually dark. The unit occurs as small equidimensional and elongated patches several tens of km across. Type locality: 71.6°S, 92.5°E. (3) Lobate plains (pl): have a morphologically smooth and undeformed surface. The characteristic feature of the unit is its albedo pattern that consists of numerous bright and dark flow-like features that can be several tens of km long. Occurrences of the unit form equidimensional fields many tens of km across that are associated with Dunne-Musun and Ambar-ona Coronae. Type locality: 62.0°S, 91.6°E.

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

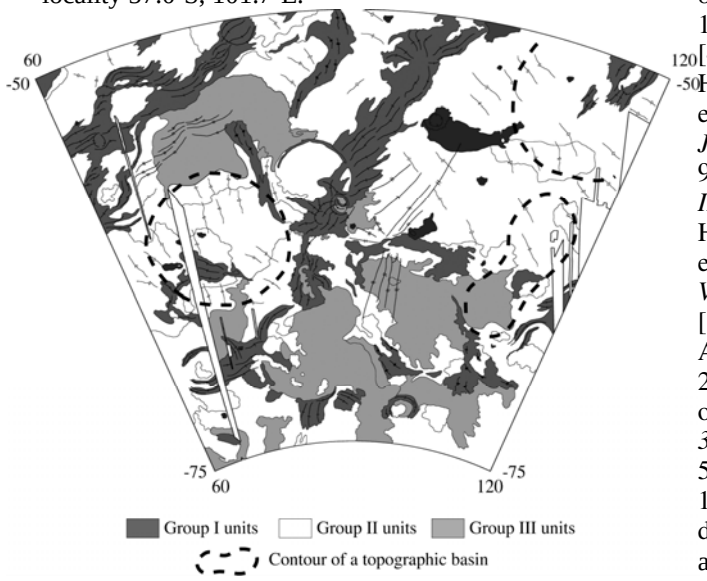

Fig. 1. Preliminary geological map of the V-57 quadrangle.

Summary: Preliminary results of the mapping of the V-57 quadrangle suggest the following sequence of major episodes in the geologic history of this region. Tectonic deformation prevailed over volcanism at the beginning of history recorded in surface geological units. Tectonic structures overprinted volcanic materials and were related to formation of the deformational belts, the most prominent of which are the corona-groove chains. Main topographic features of the region (broad linear ridges and equidimensional basins) formed during this period.

During the middle stages of evolution, regional volcanism was more important and resulted in formation of vast plains units such as psh, rp_1 and rp_2. Tectonics played a secondary role and led to the formation of pervasive but small structures of wrinkle ridges. There is little evidence suggesting continued development of 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 structures of coronae predate shield plains and regional plains but the youngest lobate plains are typically associated with some coronae. This means that these coronae evolved during the majority of the discernible geologic record of the region. The other coronae that demonstrate only tectonic elements probably died out in the early stages of the geologic history.

References: [1] Masursky, H., et al., *JGR*, 85, 8232, 1980; [2] Pettengill, G.H., et al., *JGR*, 85, 8261, 1980; [3] Barsukov, V.L. et al., *JGR*, 91, D399, 1986; [4] Solomon, S.C. et al., *JGR*, 97, 13199, 1992; [5] Head, J.W. et al., *JGR*, 97, 13153, 1992; [6] Guest, J.E. et al., *JGR*, 97, 15949, 1992; [7] Stofan, E.R. et al., *JGR*, 97, 13347, 1992; [8] Roberts, K.M. et al., *JGR*, 97, 15991, 1992; [9] Basilevsky, A.T. et al., in: *Venus II* S.W. Bougher et al. eds., UAP, 1047, 1997; [10] Hansen, V.L. et al., in: *Venus II* S.W. Bougher et al. eds., UAP, 797, 1997; [11] Smrekar, S.E. et al., in: *Venus II* S.W. Bougher et al. eds., UAP, 845, 1997; [12] Ivanov, M.A. and J.W. Head, Geologic map of the Atalanta Planitia (V-4) quadrangle, *USGS Map 2792*, 2004; [13] Ivanov, M.A. and J.W. Head, Geologic map of the Meskhent Tessera (V-3) quadrangle, *USGS Map 3018*, 2008; [14] Aubele, J.C. and E.N. Slyuta, *EMP*, 50/51, 493, 1990; [15] Addington, E.A., *Icarus*, 149, 16, 2001; [16] Ivanov, M.A. and J.W. Head, *JGR*, 109, doi:10.1029/2004JE002252, 2004; [17] Ivanov, M.A. and J.W. Head, Geologic map of the Mylitta Fluctus (V-61) quadrangle, *USGS Map 2920*, 2006.