THE FREDEGONDE (V-57) QUADRANGLE, VENUS: CHARACTERIZATION OF THE VENUS MIDLANDS. 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) in the southern hemisphere of Venus represents a typical region of midlands (0-2 km above MPR, [1,2]). Midlands are the most widespread topographic province on Venus (~80%) and display the richest variety of features [3-12]. Geological mapping in the V-57 quadrangle provides the possibility of defining and characterizing units that make up a region of midlands and to establish the general sequence of events there and thus address questions about the modes of formation and chronology of midlands on Venus. The map area is in contact with the uplands in the central portion of Lada Terra to the west and the lowlands of Aino Planitia to the northeast. This position also provides a transitional zone between the other two major topographic provinces, similar to that of the Meskhent Tessera (V-3) area [13]. Here we report on the results of our mapping in the V-57 quadrangle, describe the major features, units, and structural assemblages exposed there, and outline the main episodes of geologic history.

Major geologic and topographic features of the V-57 area: The Fredegonde quadrangle (Fig. 1) covers the eastern (midland) portion of Lada Terra. The most prominent features in the map area are several coronae (large and small) that occur within two chains of circular structures interconnected by belts of extensional structures, grooves and graben. The largest chain includes four coronae (Ilyana, Ambar-ona, Dunne-Musun, and Triglava) and extends in a NNE direction for several thousands of km through the central portion of the quadrangle. The second chain is in the NW corner of the map area and includes two coronae (Shyv-Amashe and Marzyana) that occur within a broad deformational zone of extensional structures. Deep canyons (Geyaguga and Xaratanga Chasmata) characterize this zone. The associations of coronae and groove belts within the Frdegonde quadrangle in many ways resembles the corona-rift/corona-groove belt complexes that occur within the marginal zones near large equidimensional basins such as Lavinia (V-55) and Atalanta (V-4) Planitiae [14,15]. Subordinate structural zones within the V-57 area are fragments of belts of contractional structures (ridges in the zone of Oshumare Dorsa) that are seen in the central portion of the quadrangle. The corona-groove chains and belts of ridges represent broad (100s of km wide) and relatively low (100s of m up to a kilometer high) topographic ridges. Extensive and shallow basin-like features (100s of km across, 100s of m deep) of Mugazo, Alma-Merghen, and Laimdota Planitiae are located between the corona-groove-chains. Mildly deformed plains units cover the surface of the basins.

Material and structural units and their relationships: The variety of material and structural units that make up the surface of the V-57 quadrangle can be combined into three groups of distinctly different relative ages (Fig. 1). (I) Group I: This group of oldest units consists of two material units, densely lineated plains (pdl) and ridged plains (pr), and one structural unit of groove belts (gb). Densely lineated plains occur as small outliers in the central map area. Ridged plains form fragments of the Oshumare Dorsa ridge belt. Groove belts consist of dense swarms of fractures and graben that interconnect coronae within the corona-groove chains. All units of this group form either local (pdl) or regional (pr and gb) elevated areas that are embayed by vast plains units. (II) Group II: This group constitutes the middle portion of the regional stratigraphic column and consists of two material units, shield plains (psh) and regional plains (rp). These units cover the majority of the quadrangle. Abundant small shield- and cone-like features (interpreted to be small volcanoes [16-18]) characterize the surface of shield plains. The volcanoes appear to be sources of the adjacent plains material. Regional plains have a morphologically smooth surface and uniform radar backscatter; sources of the plains material are not known. Wrinkle ridges deform both units of this group and sometimes cut the surface of the older units. Topographically, shield plains and regional plains occur at relatively low levels and fill the broad basins between elevated zones of groove and ridge belts. (III) Group III: This group forms the top of the regional stratigraphic column and consists of two material units, smooth plains (ps) and lobate plains (pl). Smooth plains have a featureless surface with uniform and preferentially low radar albedo, whereas lobate plains are characterized by distinctive internal flow-like features and have lobate and digitate boundaries. Both units are tectonically undeformed and embay most tectonic structures, including wrinkle ridges. Lobate plains are spatially associated with some coronae (e.g. Dunne-Musun). Individual flows of this unit extend down the regional slopes and partly fill the basin-like topographic lows.

Summary: Mapping in the V-57 quadrangle (Fig. 1) permits reconstruction of the major episodes characterizing the geologic and topographic evolution of the eastern portion of Lada Terra. Linear tectonic deformation patterns dominated during formation of the units of Group I at the early stages of observable geologic history. The most prominent tectonic features are still exposed in the deformational zones of ridge belts and in the corona-groove chains. The relationships between the older contractional and extensional structures suggest that the ridge belts are relatively older and the features of the corona-groove chains are younger. The tectonic components of coronae (annulae, fracturing in the core, etc.) appear to be partly synchronous with the linear segments of the groove swarms that connect the

coronae. The vast plains of the second group of units broadly embay the corona-groove complexes and, thus, are relatively younger. The most important topographic features in the map area, the broad topographic ridges and the basins, were formed during the earlier episodes of regional geologic history.

During the middle periods of geologic history, volcanic activity dominated in the Fredegonde region and the vast plains units were emplaced. Tectonic processes played a subordinate role at this time and produced low and widely distributed wrinkle ridge structures. The plains of the second group filled the broad basin-like topographic features between linear deformation belts, but left significant portions of the older topographic ridges (ridge belts and corona-groove chains) exposed. The topographic distribution of shield plains and regional plains suggests that the general topographic configuration of the midlands within the map area was established prior to emplacement of the units from the middle stratigraphic level. The early formation of major topographic features on Venus has also been observed at regional [13] and global [19] scales.

The youngest units (lobate plains) often represent a volcanic component of several coronae (e.g. Dunne-Musun). This association of the younger volcanic materials with the older tectonic structures suggests that some coronae were either reactivated or their volcanic activity occurred in the late stages of the history. The direction of the flows of lobate plains (from the broad topographic ridges toward the floor of the basins) and the topographic position of the earlier shield plains and regional plains (within the basins) suggest that the general topographic configuration of the region within the V-57 quadrangle has remained stable from the time of emplacement of the vast plains units through the latest stages of the geologic history in this area. The midlands thus appear to represent the result of early formation of linear deformation belts and lowland basins, followed by their filling and topographic preservation [e.g., 19].

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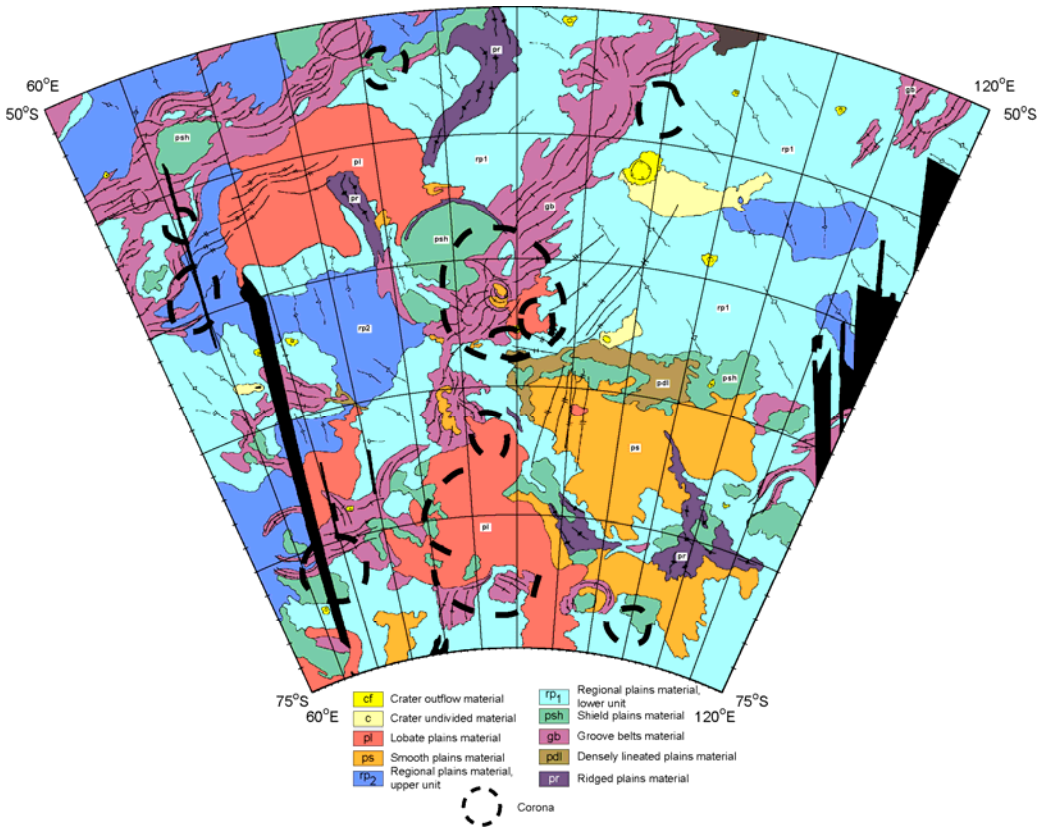

Fig. 1. Preliminary geological map of the Fredegonde (V-57) quadrangle