VENUS GEOLOGIC MAPPING: INSIGHTS INTO CRUSTAL EVOLUTION ON LOCAL, REGIONAL, AND GLOBAL SCALES. S. M. McColley and J. W. Head, III, Dept of Geological Sciences, Brown University, Providence, RI 02912. Shawn_McColley@brown.edu

Introduction and Background: The surface of Venus is geologically young with a crater retention age of 300-500 Ma [1, 2, 3]. A broad range of geodynamic models have been proposed to explain the apparent youth of the surface. Models include: heat pipe mechanisms [4], hot/cold spot tectonics [5], stagnant lid convection [6], mantle overturn [7], a thin-to-thick lid transition [8], shift from plate tectonics to a one-plate planet [9], and several other derivations. Each geodynamic model contains implications regarding the evolution of Venus both internally and on the surface. A critical assumption embedded in most models is the way in which heat is transferred from the interior to the exterior of Venus. It is this process that predominantly dictates feature (tectonic, volcanic, etc.) formation on the surface as well as the type and style of volcanism that occur with time. Over the last several years, two views have emerged regarding the large scale evolution of the crust of Venus. A global stratigraphic model supported by [10] and [11] has been defined as directional by [12]; [10] and [11] find evidence for a time-dependent evolution in both surface feature formation and style of volcanism for the visible geologic past of Venus. [12] suggested that coronae, rifts, wrinkle ridges, small and large edifices, and large flow fields have all formed throughout the visible history of Venus implying a more nondirectional evolution. Thus, what type of features might be predicted within the framework of one or a combination of the geodynamic models listed above and does the model or combination of models imply a more directional or nondirectional evolution for the observable history of Venus.

Method: In an attempt to constrain better the evolution (at a variety of scales) of Venus, we have undertaken several mapping projects ranging from the regional-scale (the Lada Terra (V-56) quadrangle) down to the detailed mapping of individual volcanic deposits. Lada Terra quadrangle (Figure 1a) lies between 50-75°S and 0-60°E. The quadrangle contains a sufficient representation of currently identified Venusian geologic units, such that we feel it and surrounding quadrangles may hold significant clues to the overall evolution of Venus. We are utilizing all available Magellan data (C1MIDR, C2MIDR, FMIDR, GXDR, and gravity) to identify local and regional variations in geology and structure, as well as styles of volcanism.

Description: Figure 1b is an example of high resolution (FMAP scale) mapping from within the quadrangle. The eastern third of Eithionha Corona is shown as well as the Chang Xi Chasmata. The fractured plains (Pf, Figure 1b) that radiate from Eithionha Corona fall short of reaching the tessera terrain (Tt, Figure 1b), however, they are partly superposed on the plains with wrinkle ridges (Pwr, Figure 1b) which embay the Tt. The implication is that the Pf are at least partly younger than the Pwr, which is younger than the Tt. Lobate flows (Pl, Figure 1b), sourced from rift-related fractures, are observed superposing all other mapped units in Figure 1b as well as embaying a volcanic shield (marked E in Figure 1b) which is superposed on the Pwr adjacent to the Tt.

Figure 1c shows another region of high resolution (FMAP scale) mapping from within the quadrangle. This region lies just to the east of Quetzalpetlal Corona and was chosen for comparison with Figure 1b based on the similarity of tectonic features between the two areas. The tessera terrain (Tt, Figure 1c) is the oldest unit in this region. The plains with wrinkle ridges (Pwr, Figure 1c), embay and extend into the tessera fabric through graben and troughs. Extending to the northeast from Quetzalpetlal Corona is a unit of fractured plains (Pf, Figure 1c). The density of fractures within the Pf unit diminishes greatly as the Tt unit is approached, however, at FMAP resolution it is clear that several fractures extend into and superpose the fabric. Lobate flows (Pl, Figure 1c) superpose all other mapped units in this region, suggesting that they are the youngest unit.

Conclusions: The observations discussed above suggest (at a local scale) consistent superposition relationships with respect to the mapped units in each region. The tessera appear to be the oldest unit in both regions followed by plains with wrinkle ridges, fractured plains appear both younger and older than the plains with wrinkle ridges, and lobate flows respectively. The relationship between the lobate flows and the volcanic shield in Figure 1b suggests a shift in the style of volcanism for that region, but the lack of shields in the second region prevents a similar conclusion. Thus, a geodynamic model representing these two sections of Lada Terra quadrangle must incorporate mechanisms that produce: 1) a possible shift in volcanic style (shield to rift), 2) regional plains emplacement, 3) regional wrinkle ridge formation, 4) rift formation, and 4) local/regional crustal shortening, faulting and folding to produce tessera.

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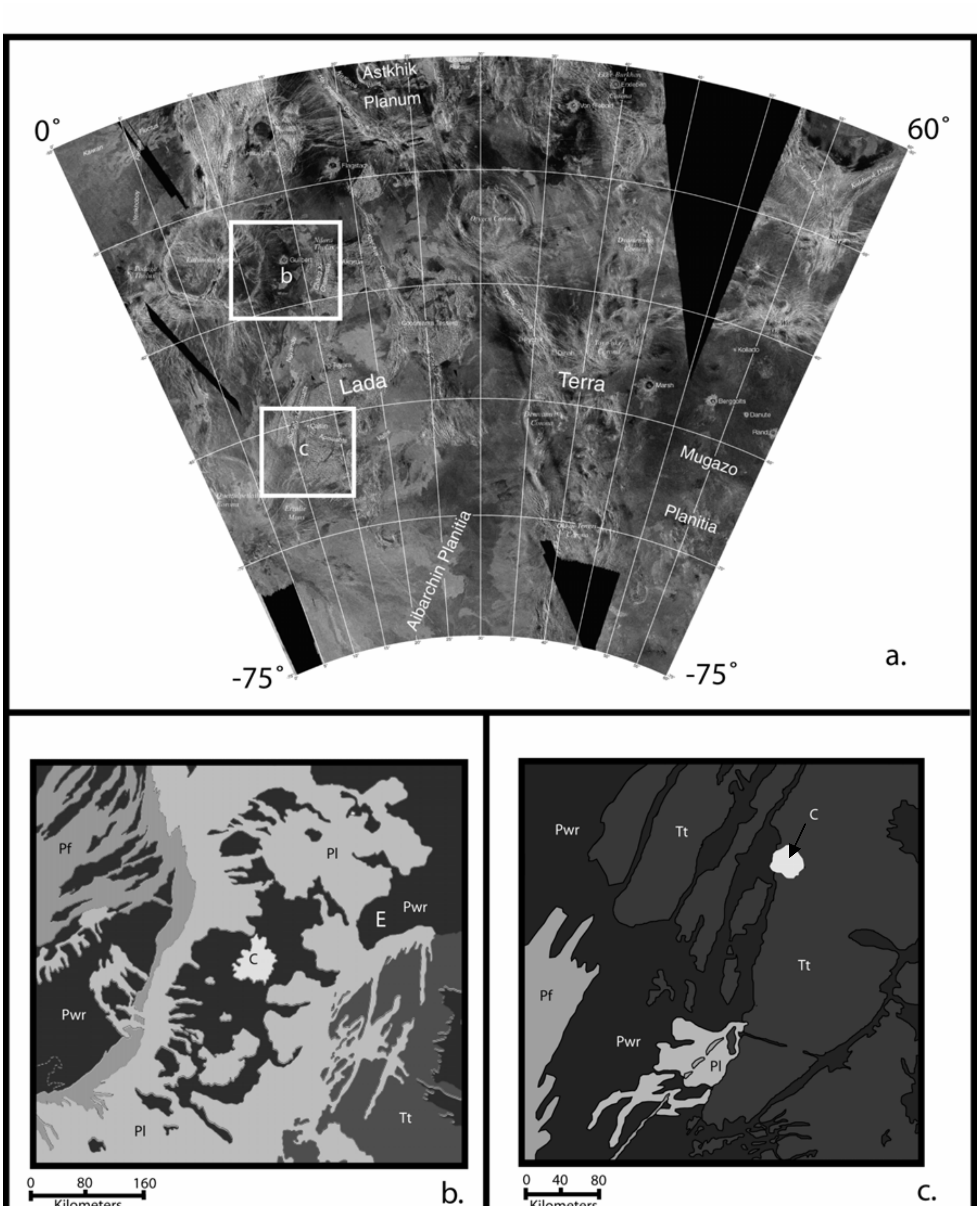

Figure 1. a) The Lada Terra (V-56) quadrangle (50-75°S, 0-60°E). The white boxes indicate the locations of the mapped regions shown in Figure 1b and 1c. b) Interpreted embayment and cross-cutting relationships for the region marked b in Figure 1a. Pwr = plains with wrinkle ridges, Pl = lobate flows, Tt = tessera terrain, Pf = fractured plains, C = crater, and E = volcanic edifice. c) Interpreted embayment and cross-cutting relationships for the region marked c in Figure 1a. All symbols are the same as Figure 1b.