GEOLOGICAL EVOLUTION OF LADA TERRA, VENUS. P. Senthil Kumar[1,2] and James W. Head[2], National Geophysical Research Institute, CSIR, Hyderabad 500606, India (senthilngri@yahoo.com); [2]Department of Geological Sciences, Brown University, Providence, RI02912, USA (james_head@brown.edu)

Introduction: In this study, we present the history of geologic processes at Lada Terra (V-56 Quadrangle) in the southern hemisphere of Venus, through geologic mapping at 1:5,000,000 scale, using 250-m-per-pixel Magellan SAR image and ArcGIS 9.3 software, following the methods of geologic unit definition and characterization of planetary surfaces [1-3]. Geological units in the V-56 were products of tectonics, volcanism, and impact cratering with characteristic geomorphic expressions (Figure 1). Basically, this quadrangle addresses how coronae evolved in association with regional extensional belts, in addition to evolution of tessera, regional plains and impact craters, which are also significant geological units of Lada Terra.

Mapped Units, Features and Relationships: The mapped material units are divided into three groups: heavily deformed terrain materials, regional plains materials and volcanogenic plains materials. The heavily deformed materials are categorized based on unique deformational structures observed within these units. They constitute about 17% of V-56. Tessera terrain materials (t), tessera-like terrain materials (tlt) and densely lineated plains materials (pdl) constitute this group. The second group, the regional plains materials are characterized by relatively smooth radar surfaces and are younger than the first group. Two types of plains characterize this group (pwr and pr, regional plains materials and wrinkle-ridged plains materials, respectively) and constitute about 35% of V-56. These plains also host a variety of younger deformational structural features (large-scale extensional belts and coronae) that also traverse the adjoining material units. The third group, volcanogenic plains materials are characterized by the primary volcanic structures present in them, for example, shields, channels, and lobate flow features. These units contain smooth radar surfaces that vary in small-scale surface roughness to yield a range of radar brightness with well-defined unit boundaries. They are classified into shield plains materials (psh and pshc), intra-tessera basin materials (itbl, itbm and itbu), and lobate plains materials (pll, plm and plu). They are the most abundant material units in V-56 area, covering 48% of the surface area. There are fifteen impact craters, in which eight are complex craters. Complex craters are made up of ejecta (ce), rim and wall (cw), floor (cf) and central peak (cf), though the simple craters lack central peaks. Impact craters are generally the youngest geologic units identified, except for one that is deformed by an extensional belt. Impact craters occupy only a fraction of V-56 (~0.5%). Marsh and Flagstad depict outflow features inundating the ejecta deposits. Lineaments are abundant in V-56. These are principally secondary deformation features such as fractures, faults, grabens, linear ridges, and wrinkle ridges. In V-56, there are three concentric coronae (e.g., Quetzalpetlatl, Eithinaho, and Serpantium), one double ringed corona (Otygen), seven asymmetric coronae (e.g., Derceto, Demvamvit, Toyo-uke, Dyamenyuo and Ekhe-Burkhan) and one astra-like structure (Loo-Wit Mons). Radial and concentric fractures and grabens define the coronae structures. The large extensional belts are composed of fractures, grabens and strike-slip zones. The most prominent tectonic features are the traverses of four large-scale extensional belts [4]. These include: (a) NNW-SSE trending, 6000-km long and 50-200 km wide Alpha - Lada belt, (b) NNE-SSW trending, 2000 km long and 300 km wide Derceto-Quetzalpetlatl belt, (c) N-S trending Dyamenyuo belt, and (4) ENE-WSW trending Geyaguga belt. The latter two extensional belts form branches of the Alpha-Lada belt. Corona structures preferentially occur along the extensional belts.

Geologic History: The processes making up the heavily deformed terrains (t, tlt, and pdl) represent the earliest geologic activity. Tectonic features suggest that the most vigorous geodynamic processes occurred in the earliest period. The second period involved the emplacement of regional plains materials. Origin of the plains is unknown. This plains emplacement event was followed by the second episode of intense tectonic activity that involved the formation of large-scale extensional belts and corona. A complex network of grabens, fractures, and faults formed in a wide zone of intense tectonic activity that traversed along the four main belts. Chains of corona structures were also emplaced along these extensional belts. The third period involved the emplacement of volcanogenic plains. This period of shield volcanism was followed by significant volcanic eruptions around coronae that lead to the formation of large-scale lobate plains that extended several hundreds of kilometers and covered almost half of the total surface area of V-56. Volcanic processes also occurred inside the tessera terrain, probably synchronously with the coronae volcanism, although some lava flows were transported from the exterior of the tessera materials to the interior basins associated with these units. Impact events produced simple and complex craters. Mantle upwelling operates on Venus at different spatial scales with chains of pronounced melting anomalies leading to formation of the most material and structural units in the Lada Terra and significant crustal uplift [5].

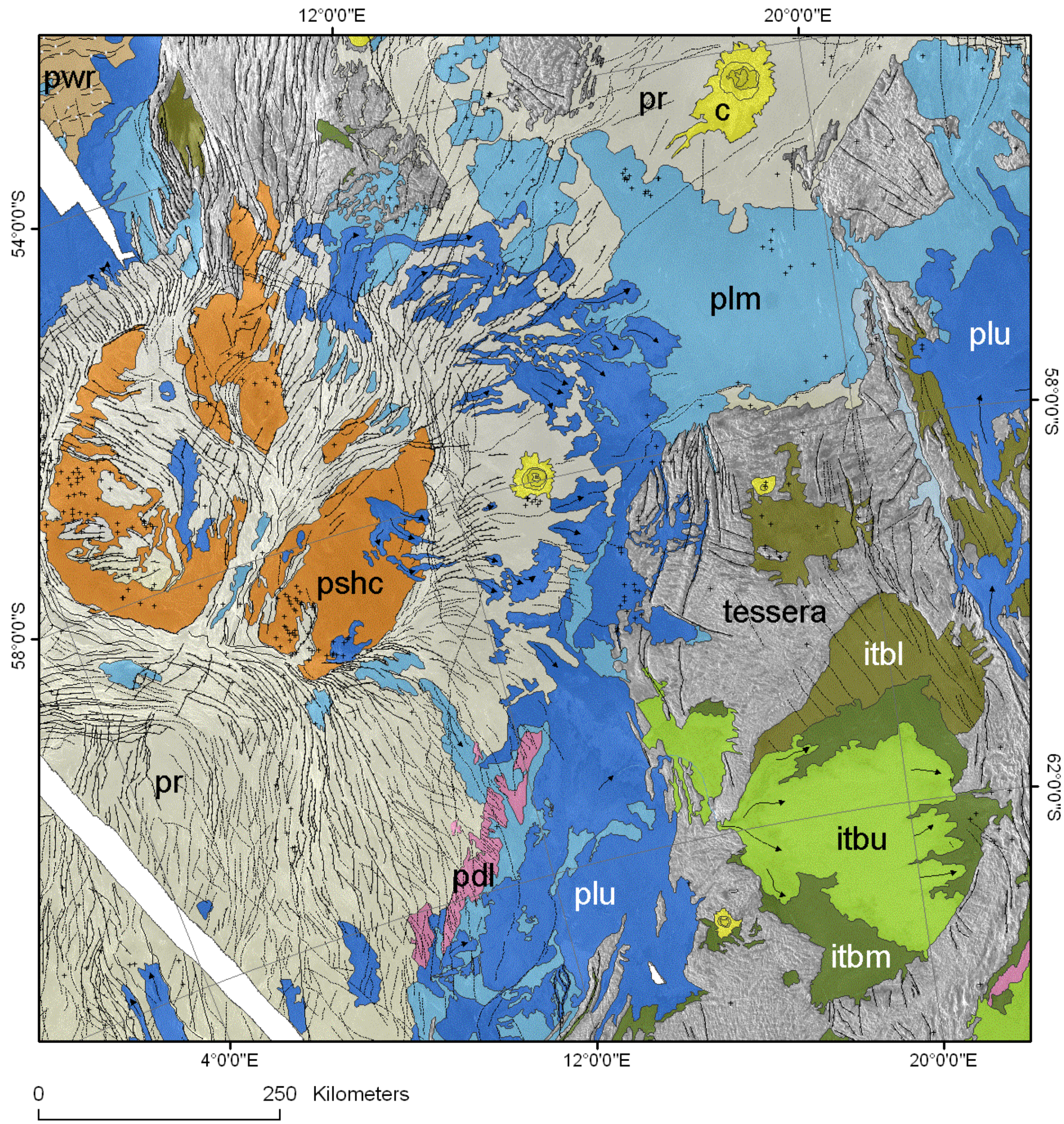

Figure 1: Geologic map of western Lada Terra covering the Eithinoha corona and Cocomama tessera. It shows a wide variety of tectonic structures, materials and superposition relations with the large-scale extensional belt that composed of grabens, fractures and faults. Intra-tessera basins are filled with lobate lava flows (itbl, itbm and itbu). Shield plains (pshc) are abundant within the Eithinoha corona. Lobate lava flows (plm and plu) also originate from the corona and travel very long distances and surround the tessera. The regional plains materials (pr) embay the older tessera terrain materials. Traces of densely lineated plains materials (pdl), two complex and two simple impact craters (c) are also present.

References: [1] Head, J.W. et al. (1978) *Icarus*, 33, 145-172. [2] Wilhelms, D. (1990) Cambridge University Press, 208p. [3] Tanaka, K. A. et al. (2009) PGM Handbook, 21p. [4] Baer, G. et al. (1994) *JGR*, 99, 8335-8369. [5] Ivanov, M. A. and Head, J. W. (2010) *Planet. Space Sci.*, in Press.