VENUS SOUTHERN HEMISPHERE: AGE AND GEOLOGIC CHARACTERISTICS OF MAJOR TERRAINS IN THE THEMIS REGIO-ALPHA REGIO-LADA TERRA REGION; D. B. Campbell[1], J. W. Head[2], D. A. Senske[2], A. A. Hine[3], N. J. Stacy[1], and P. C. Fisher[2]. [1]Nat'l Astronomy & Ionosphere Ctr., Cornell Univ., Ithaca, NY 14853; [2]Dept. of Geological Sciences, Brown Univ., Providence RI 02912; [3]Nat'l Astronomy & Ionosphere Ctr., Arecibo Observatory, Arecibo, Puerto Rico 00612.

Altimetry data from the Pioneer-Venus mission[1] has shown the presence of a variety of topographic regions (Regiones, Planitiae, Terrae, Montes) in the southern hemisphere. The actual geological characteristics and origin of these features have largely been a matter of conjecture. High resolution (1.5-2.0 km) radar images of about 40 x 10^6 km^2 of the southern hemisphere (Fig. 1) recently acquired by the Arecibo Observatory provide evidence for the nature of some of these major features. Here we describe the major features, discuss their similarity to features observed in other parts of Venus[2,3], and make a preliminary assessment of the age of this part of the planet.

All or parts of four distinct Upland/Highland areas are seen. Alpha Regio, a square 1300 km wide upland plateau[4] rises up to about 2 km above mean planetary radius (6051.4), is characterized by high surface roughness and low reflectivity, and predicted to be tessera on the basis of its radar properties[5]. The new data show that the plateau is characterized by a system of 5-10 km wide parallel ridges and troughs whose dominant orientation is generally N-S and whose length ranges from 15 to over 100 km. A second set of less prominent linear structures is observed and has an orientation approximately orthogonal to the N-S ridges and troughs. Larger, more throughgoing linear trends are also observed in these same directions. For example, a lineament at least 900 km in length bisects Alpha and parallels the N and S boundaries. Oval to linear patches of radar-dark plains 20-200 km long oriented parallel to the major structural trends are observed, and a large oval to circular structure (about 500 km in diameter) is observed in the NW quadrant of Alpha. Alpha is thus very similar to tessera terrain mapped elsewhere in Venera images[2] and possesses elements of several of the tessera terrain subtypes observed there[6].

Phoebe Regio is known to be characterized by a linear rift system extending southward from Beta Regio[3,7]. Topographically, the region is characterized by two NW trending topographic prongs extending toward Lavinia Planitia (Fig. 1). The western linear rise is characterized by a 200 km wide linear zone disrupted by bright lineaments on and parallel to the rise crest; this zone has many similarities to the Devana Chasma rift[3,8]. On the basis of this similarity it is interpreted as a rift zone. Several associated volcanic centers are also observed. The eastern linear rise has similar characteristics (bright lineaments on and parallel to the rise crest) but the structure is not as radar-bright and appears to be generally more subdued. A local rise several hundred km in diameter (a possible volcanic construct) is observed at the end of the prong and is separated from Ushas Mons, several hundred km to the SE, by a part of Navka Planitia. Themis Regio[9] is characterized by two major types of features, concentric ring to oval structures 250 to 400 km in diameter, and volcanic edifices. Several densely packed and interconnected ring/oval structures and superposed volcanoes form Themis itself and a chain of ring/oval structures and volcanoes extends from Themis to the east for about 2200 km. These structures are similar to coronae[10] in size and presence of concentric annular ridges, but differ in their polygonality, close spacing and chain-like nature. These structures are separated from Hathor Mons by a prong of Lavinia Planitia. The structure of Themis is similar to the Beta-Eisila Deformation Zone[10], but neither the origin of the circular/oval structures, nor their exact relationship to the corona structures seen in Venera data[11], are clear at the present time. Only the northernmost border of Lada Terra (the south polar highland region rising up to 2 km above mpr) is seen. It is characterized by radar-dark plains and by a 150-200 km wide linear belt of bright lineaments paralleling the slope at the northern edge of Lada and having similarities to ridge belts seen in the Venera data[2]. Additional belts of bright lineaments are seen to the north of Lada Terra on the southern slopes of Lavinia Planitia. These belts of bright lineaments are not as topographically pronounced and distinctive as the linear rises of Phoebe and Themis.

Three prominent Montes (Ushas, Innini, Hathor) form a generally N-S trending upland rise between Navka/Guinevere and Lavinia Planitia (Fig. 1). These peaks rise 1.5-2 km above mpr, are separated from each other by 800-1200 km, are the locus of flow-like deposits that often appear to embay surrounding structure, and they are interpreted to be volcanic edifices similar to volcanoes seen in the northern hemisphere (Sif, Theia, etc.).[12] Several types of structures are radial to these features, including paired bright lineaments forming 20-40 km wide zones, and broader zones of bright lineaments 50-150 km wide one of which extends south into Lavinia Planitia. These are tentatively interpreted as zones of extension. The Planitiae (Lavinia, Navka) are low in elevation (< mpr) and form broad areas of plains of apparent volcanic origin between the upland/highlands and montes (Fig. 1). Navka and Lavinia contain several apparent volcanic sources (domes, flow centers, etc) and Lavinia is disrupted by abundant linear deformation zones, features also seen in the northern Venus plains[2,3].

A total of about 30 impact crater-like features have been mapped in this region. The distribution of the craters tends to show a concentration within the plains rather than in the uplands/highlands. This is opposite to the trend seen in the Beta-Eisila region[3]. Of the 30 craters, 12 appear highly degraded and their mode of origin is less certain. The density of craters therefore may be in the range of 0.4-0.7 craters per $10^6 km^2$, in the range seen in the Beta-Eisila region[3] (0.4-0.7) and less than that observed for the northern high latitudes (>30°) (1.1). This strongly suggests a young age for this region, less than the 0.15-1.0 by age interpreted for the northern high latitudes[13,14].

In summary, each of the four major terrains (Alpha Regio, Phobe Regio, Themis Regio, and Lada Terra) has different characteristics and this indicates a diversity of tectonic and volcanic processes active in the formation and evolution of uplands and highlands in the southern hemisphere. The general paucity of impact craters provides further evidence for the young age of the surface of Venus.

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Fig. 1. Geomorphic sketch map of the Themis-Alpha-Lada region of the southern hemisphere. Hatchured line surrounds regions lying below mpr (6051.4 km); stippled areas are generally about 1 km or more above mpr. Dashed line surrounds Montes, each of which locally rises above 1 km.