THE GEOLOGY OF WESTERN EISTLA REGIO, VENUS: ANALYSIS OF MAGELLAN RADAR DATA. J. W. Head[1], D. A. Senske[1], and G. G. Schaber[2], 1) Department of Geological Sciences, Box 1846, Brown University, Providence, RI 02912. 2) U. S. Geological Survey, Flagstaff, AZ 86001.

Introduction. The highland of Western Eistla Regio (22° N, 355°) is a 2000 km x 2300 km radar-dark region which rises to an elevation of 2.0 km and forms part of the westward extension of the equatorial highlands from Aphrodite Terra. The highest part of this upland is dominated by the 1.7-km and 2.3-km high volcanoes Sif Mons and Gula Mons (1, 2). Although Sif and Gula are the largest volcanic features in this area, Magellan image and altimetry data have revealed the presence of eight other volcanic sources and centers along with several linear tectonic zones. In this paper, we discuss the general geologic character of this highland and its various centers of volcanism.

Geologic Characteristics. Four volcanic and three tectonic subdivisions have been mapped on the basis of radar brightness and texture using Magellan radar images (Fig. 1). These images were obtained at incidence angles between 42° to 45°. At these large angles the returned radar-backscatter is dominated by wavelength scale (12.6 cm) scatterers on the surface. Variations in brightness within the image are therefore primarily an indicator of changes in surface roughness. The most abundant unit, plains, are characterized by radar-dark to mottled textures. Dark regions of plains contain few individual volcanic centers--cones and domes, while mottled plains are typically characterized by abundant small shields and domes (2- to 10-km in diameter) and lava deposits. Also located in the plains are pervasive sinuous to linear ridges arrayed in a pattern concentric to the broad topographic rise. Large volcanic edifices, Sif Mons and Gula Mons, are characterized by abundant lava flows which range from radar-bright to radar-dark and extend for distances of 100's of km (3). Located at the summit of Sif Mons is a 40 km diameter summit caldera. Along its southern edge, the rim of the caldera is radar-bright and well defined, while the northern rim is diffuse. This relation is probably due to differences in height between the northern and southern rims, with the lower northern rim flooded by volcanics. Located in the north and northeastern part of the caldera are smaller nested calderae which range from 2.4- to 5.7-km in diameter. In contrast to Sif, there is no well defined caldera at the summit of Gula. Instead, Gula is characterized by a 30 km wide, 150 km long highly radar reflective (4) linear zone striking to the northeast. The characteristics of this region are more similar to a rift zone than a caldera and possesses characteristics similar to the source region for Mylitta Fluctus (5). Located to the north and abutting against Gula is a 225 km diameter, 630 m high ovoid structure. This feature is characterized by concentric ridges which are located in flanking "U" shaped troughs. Within the troughs are source regions for 150- to 350-km long radar-bright lava flows which appear to originate from fractures. Additional volcanic sources and centers are found on the flanks of both Sif and Gula and are superposed on the plains. Located to the south of Sif is a broad, 120 km diameter volcanic structure that rises 270 m above the surrounding plains. This region is characterized by abundant small shields and intercalcated bright and dark lava flows extending 100- to 200-km to the west. A volcanic center located to the east of Gula is characterized by a gentle, 180 m high topographic rise, with lava deposits possessing a mottled texture. These deposits along with the adjacent plains are cross-cut by sinuous ridges, indicating that both units predate ridge formation. An elliptical (300 km x 200 km) 360 m high volcanic rise is located to the west of the ovoid. Bright flows radiate from a low circular region in the southeast part of the structure suggesting the presence of a shallow caldera.

In addition to the volcanic structures in Western Eistla Regio, a number of tectonic features have also been mapped. Located to the north of Gula are several isolated (75 km x 100 km) blocks of tesserae, elevated deformed regions with multiple directions of deformation. These features are extensively embayed by surrounding plains and are interpreted as one of the oldest units in this region. In comparison with other highland regions in the equatorial region (eg. Beta Regio), tesserae do not make up a significant part of this highland (6). Three zones of faulting and linear deformation have been mapped; the two most prominent lie along a northeast strike, one extending to the northwest from Sif and the other to the southeast from Gula (Fig. 1). The zone intersecting Gula, Guor Linea, is made up of scarps and graben, is located within a trough on a topographic rise, and is interpreted as a rift zone. The rift continues to the southeast where if intersects Central Eistla Regio near Sappho. The zone of deformation extending to the northwest from Sif is characterized by faults and fractures and is part of a larger deformation zone extending from Eistla Regio to Beta Regio (7). The third zone of deformation, located in the plains to the south and between the two edifices, strikes along a northeast-southwest trend, oblique to the other deformation zones. The trend of this zone is interrupted by lava flows from Gula Mons, which themselves strike parallel to the faults and fractures, and is parallel to the region of deformation at the summit of Gula, suggesting that the zones may be linked. Patches of ridged terrain are located to the southeast of Gula and are made up of north-south trending ridges with a spacing of less than a kilometer to 2.5 km. This unit is embayed by both plains and volcanic deposits originating from a center on the east flank of Gula. Further to the south, an additional patch of ridged terrain is located within Guor Linea where it is cross-cut by faulting. On the basis of these relations this unit like the tessera is interpreted as one of the oldest on this part of the planet.

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Ten craters interpreted to be of impact origin are located within the mapped area; six of which have diameters greater than 15 km and giving a density of 2.1 craters per 10^6 km^2. This value is substantially higher than the 0.7 craters/10^6 km^2 calculated for the equatorial region from Arecibo data (2) and higher than the 0.88 craters/10^6 km^2 and 1.1 craters/ 10^6 km^2 calculated for the Venus southern Hemisphere and northern high latitudes (8, 9). This suggests that this area has a crater retention age higher than the planetary average and may be older than the 0.5 to 1.0 b.y. age calculated for other parts of the planet (10).

Conclusions. On the basis of geologic mapping, the central part of Western Eistla Regio is shown to be characterized by numerous volcanic centers along with the large volcanoes Sif Mons and Gula Mons. Both of the large edifices are located at the end of linear deformation zones made up of fractures, faults, and graben, with Guor Linea interpreted as a rift zone. Unlike the large edifices Theia Mons and Rhea Mons in Beta Regio, Sif Mons and Gula Mons do not appear to be split by faulting and rifting. The lack of apparent split and separated topography along zones of faulting and linear deformation suggests that the amount of extension is small. On the basis of cross-cutting and embayment relations, units of tessera and ridged terrain are interpreted to be the oldest within this region. In comparison with areas such as Beta Regio, tessera is only a minor unit within Western Eistla Regio. We are presently mapping this area in detail in order to assess the relationship between volcanic centers and models for the formation of this highland (1).

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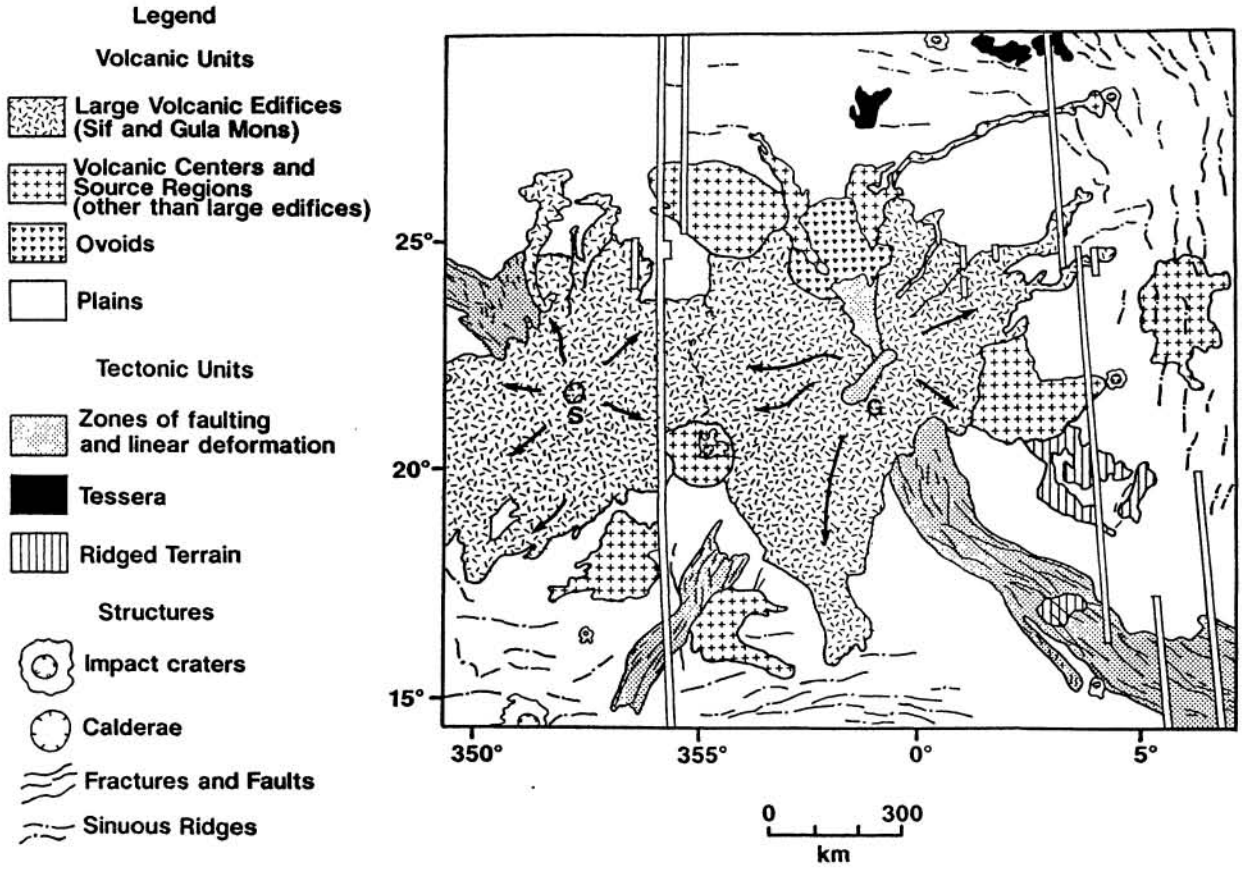

Figure 1. Sketch map of the central part of Western Eistla Regio. This region is made up various volcanic centers in addition to the large edifices Sif Mons and Gula Mons, labelled "S" and "G". The arrows indicate the primary direction of lava flows.