

EMPLACEMENT OF MULTIPLE FLOW UNITS ON VERY SHALLOW SLOPES, EAST KAWELU PLANITIA FLOW FIELD, VENUS. Michael B. Helgerud (Carleton College, Northfield, MN 55057), and James R. Zimbelman (CEPS/NASM, Smithsonian Institution, Washington, DC 20560)

Lobate flows with variable radar brightness occur at several locations on Venus (1). Here we present preliminary mapping results for a lava flow field on the eastern side of Kawelu Planitia, centered at approximately 41° N, 251° E. Numerous individual flows of varying brightness can be traced for up to 400 km at this location. Magellan image F-MIDRP.40N251;1 (Fig. 1) contains two major flow complexes as well as a distinct minor flow field associated with a volcanic dome (Fig. 3). The southern flow field (unit F) changes from radar dark to radar bright in a convex arc from west to east. The flow path is diverted (see below) by a ridge system (unit B) and associated N-S faulted zone (unit A) evident in the Magellan altimetry data (2; Fig. 2). The 130-km-long radar-bright flow field located at 41.5° N and 249 - 250° E is comprised of a narrow, channeled flow (unit E) overlying an intermediate brightness flow (unit D), all of which appears to emanate from a solitary dome at 249° E. The southern lobe of unit E disappears under a broad leveed channel (41.3° N, 250.1° E) in unit 5 (discussed below), only to reappear south of the unit 5 boundary. The source of this largest flow field is not evident, but could be associated with the region of small domes west of the F-MIDRP image (centered at 41° N, 246° E). Another possible source is the fractured area south of unit C. The flow complex is clearly a conglomeration of many flow episodes, not necessarily from a single source. For this reason, individual flows within unit 6 are not traceable, except for the radar dark region at 40.8° N. The northern edge of the dark region is superposed on unit 6 flows while the southern margin is superposed by unit 6 flows. East of 250° longitude the relationships of flow termini provide evidence for the stratigraphy of 5 flow units. Unit 1 is the oldest, and it is covered by all other distinguishable flows. Unit 2 is the extensive radar-dark region which forms a broad "foot" on top of the eastern portion of unit 1 and which underlies units 3 and 4. Unit 3 is the partially exposed remnant of a multi-lobed, radar-bright flow east of 250° longitude. On top of this was emplaced a radar-dark flow (unit 4) traceable to approximately 250° E, where the flow has been breached by a thin lobe associated with unit 5, the youngest distinguishable flow unit. Units 3 and 4 cover and therefore postdate the graben which run north-south at 253° E, but the graben in the southwest corner formed after unit 6 had been emplaced, as evidenced by graben that crosscut the flows.

The captivating feature in this image is the distinct bend which the northern flow field undergoes at approximately 250° E. Before this investigation, it was assumed that the cause of such a pattern would be due to either topography or tectonic processes. Topography is clearly the explanation in the case of the southern flow field (unit F). The arc of the northern boundary of this flow field precisely follows the ridge belt. Altimetry data (Fig. 2) show that the slope in this region does not exceed 1 - 2° , and is considerably less in most places. For the northern flow field (units 1-6), the average slope is only $.05^{\circ}$, less than the $.1$ - $.2^{\circ}$ associated with very fluid lunar flows (3,4). Despite the minute slope, the flow field extends for nearly 500km. We suggest that these flows could have had viscosities considerably less than that generally postulated for either Venusian (6) or lunar flows (3). The only explanation for the bend in the northern flow field is found in the presence of a ridge belt (unit B) located at 40.4° N, 250° E (Fig. 1) with < 100 m relief (Fig. 3). This ridge belt is located in the correct position to deflect the flow pattern to the north and is embayed on the west by lava, clearly demonstrating its older age with respect to the flow field. In addition the northern edge of this ridge terminates at precisely the point where the flow makes its sharp angle, as it would if it were just clearing a deflecting obstacle. The lack of a radar bright boundary for the flow complex suggests that the boundary lacks a high degree of relief, despite the clear evidence of multiple flow episodes. Alternatively, a combination of higher eruption temperatures on Venus (6) and reduced cooling of an active flow under Venusian conditions may be sufficient to explain the long flows. Computer simulations are in progress to investigate these possibilities (7).

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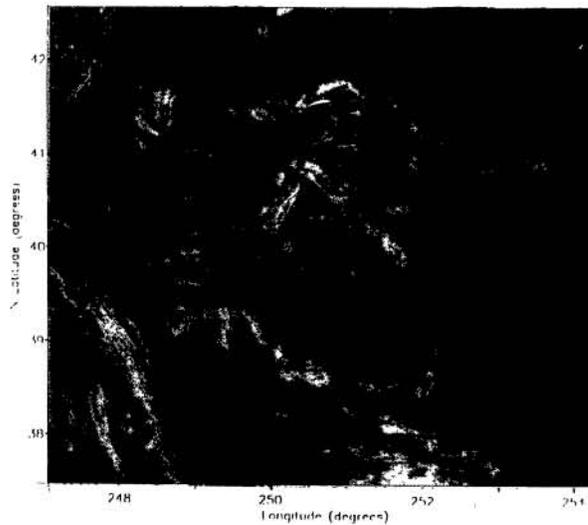


Figure 1. Magellan radar mosaic F-MIDRP.40N25;1 (see ref. 5), showing the lava flow field in eastern Kawelu Planitia.

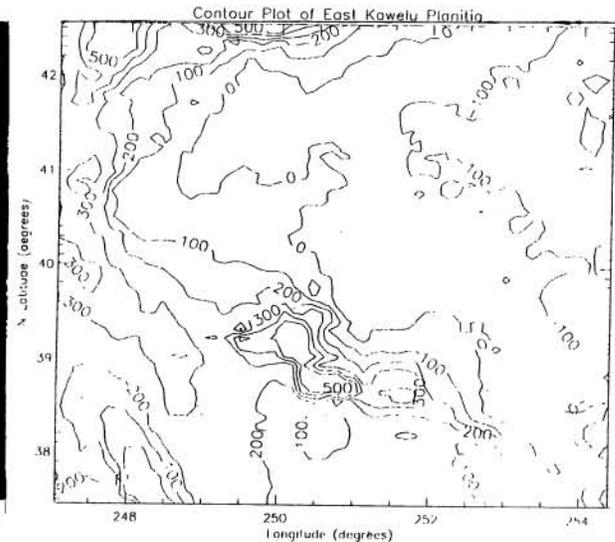


Figure 2. Contoured Magellan radar altimetry (see ref. 2) for the area shown in Fig. 1. The zero contour corresponds to the mean Venusian radius of 6051 km adopted by the altimetry team.

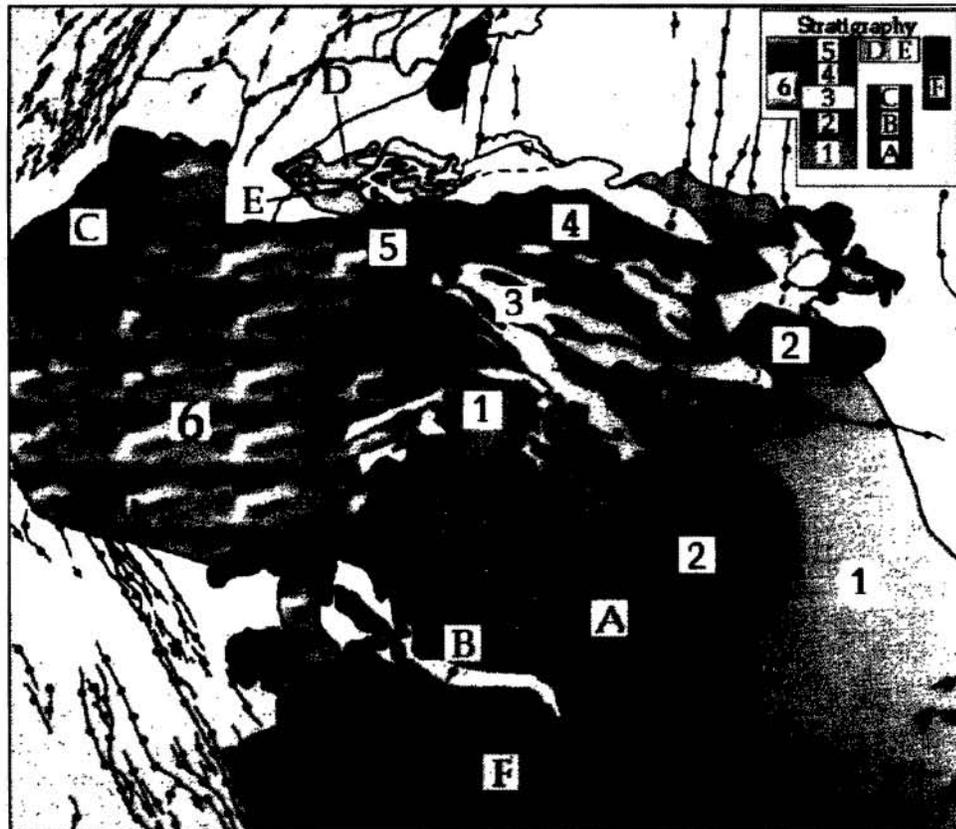


Figure 3. Simplified geological sketch map for the area shown in Fig. 1 (see text). Individual flow units in the northernmost portion of the flow field are divided into 6 units based on the stratigraphic relationships in the image. Additional units in the area are labeled A through F.

REFERENCES: 1) Head, J. W. et al., 1992, *J. Geophys. Res.* **97**, 13153-13197. 2) Magellan Altimetry, GxDR CD, MG3001 V1. 3) Schaber, G. G., 1973, *Proc. LPSC 4th*, 73-92. 4) LTO maps 39C2, 40A1, 40A4 (250). 5) Magellan F-Mosaics CD, MG 0044 V1. 6) Head, J.W., and Wilson, L., 1986, *J. Geophys. Res.* **91**, 9407-9446. 7) Zimelman, J.R., et al., 1993, *LPS XXIV*, this volume. [This work was carried out while M. Helgerud was an Undergraduate Intern at NASM.]