THE THICK FESTOON FLOW AND ADJACENT DARK FLOW, OVDA REGIO, VENUS; *J.L. Permenter* and *R.L. Nusbaum*, Department of Geology, College of Charleston, Charleston, SC 29424

SUMMARY: The thick flow in the Ovda Regio is one of two festoon flows identified on Venus [1,2,3]. From the general appearance of the festoon flow in the Ovda Regio and a dark flow adjacent to the south, it has been postulated that the two flows may be the result of a single volcanic episode, although a source vent was not identified [4]. The thickness of the marginal flow lobes of the festoon flow is suggestive of possible evolved compositions on Venus [5]. We investigated cycle 1 and cycle 2 SAR images of the flows to determine their relative age, source areas, and emplacement histories. Thickness estimates were combined with radar data to calculate the yield strengths and Bingham viscosities of the flows. The results of our study indicate the following: 1) the radar-bright festoon flow was emplaced continuously, from a source near its center; 2) the dark flow is younger than the festoon flow, thick, and originated from a separate source within the dark flow area; 3) proposed sources for both flows are topographic depressions suggesting collapse following magma withdrawal; and 4) yield strengths and Bingham viscosities estimated for the festoon flow are comparable to those of terrestrial silicic lava flows, the Unusual Volcano (Mahuea Tholus) flows [2,3], and some of the 145 steep-sided domes identified on the venusian surface [5].

INTRODUCTION: The radar-bright, festoon flow centered at 6°S 95.5°E in the Ovda Regio has well defined boundaries with the surrounding tessera. Stratigraphic relations with the dark flow adjacent to the south are not apparent, however [4]. The thickness of the festoon flow is unusual on Venus, and suggestive of an evolved composition [5]. We investigated cycle 1 and cycle 2 SAR images of the flows to determine their relative age, source areas, and episodicity of emplacement. Thickness estimates were combined with radar data to calculate the yield strengths and Bingham viscosities of the flows for comparison to other venusian flows and terrestrial flows.

RESULTS AND DISCUSSION: Although irregular in outline, we estimated the aerial extents of the the bright festoon flow and the dark flow to be 150 X 300 km and 75 X 150 km, respectively. Both flows are traversed by NW-SE and NE-SW trending fracture systems which are parallel to fractures within the tessera. The festoon flow is radar bright with prominent flow ridges across much of its surface. Within the body of the festoon flow are lava 'windows' which expose older tessera. These 'windows' have rounded to lobate interior margins suggesting that they are primary features resulting from viscous lava flow. The margins of the festoon flow adjacent to tessera are lobate and readily distinguished from adjacent tessera. Some of the marginal lobes were apparently channeled into lower elevation tessera troughs. The marginal lobe thicknesses and 'window' depths are summarized in Table 1. As we had little success with parallax measurements over the rough terrain, we used a

Table 1. Dimensions of the Flows

Area of flows: Festoon flow	45,000 km^2
Dark flow	9,400 km^2
Festoon flow thickness estimates	
Marginal lobes	52-108 m (n=12)
Flow interior 'windows'	52-144 m (n=12)
Dark flow thickness estimates	
Marginal lobes	69-86 m (n=4)
Festoon flow volume estimate	4,545 km^3

single-look method [6] which assumes symmetry of features being measured. The method was applied to individual marginal lobes and 'windows' as a check of symmetry, using paired left-looking (incidence angle = 43.7°) and right-looking (incidence angle =24.8°) SAR images.

Ovda Regio flows: Permenter, J.L., and Nusbaum, R.L.

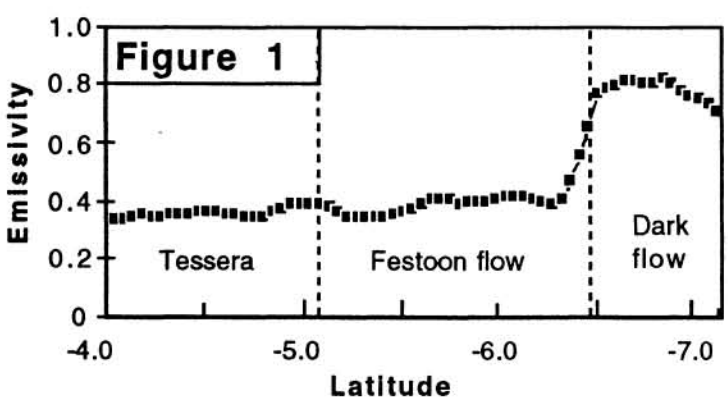
Vectors constructed perpendicular to festoon flow ridges indicate that the flow was emplaced during a single continuous episode, from a source area near the center of the flow. A younger, thick, radar-bright flow is superimposed on the festoon flow near its southern margin. The younger bright flow originated from the dark flow area. The gradational contact between the younger bright flow and the dark flow appears to be elevation dependent, suggesting that the dark flow and the younger bright flow are the same unit. Both proposed sources of the flows are topographic depressions, suggesting collapse after magma withdrawal

Radiothermal emissivity of the dark flow is greater than that of the older festoon flow (Figure 1, Table 2) despite the overall greater elevation of the dark flow [4]. The emissivity increase begins within the area labeled as festoon flow, at approximately the contact with the younger festoon flow (Fig. 1). Most of the festoon and the dark flows are well above the critical elevation for the Ovda Regio, which suggests that the dark flow may contain a large component of unweathered rock [7]. Emissivity and corrected reflectivity mean values for the 'unweathered' dark flow were used to estimate bulk densities of the flows: 3,010 kg/m^3 and 2,550 kg/m^3, respectively. Both values are within the range expected for mafic to intermediate terrestrial glasses [8].

Table 2. Radar Properties of Units

	Festoon flow	Dark flow	Tessera
Emissivity	0.42 ± 0.06	0.78 ± 0.04	0.37 ± 0.02
Corrected reflectivity	0.46 ± 0.07	0.16 ± 0.05	0.45 ± 0.13

Thickness estimates of the festoon flow, and younger bright flow (and thus, the dark flow) are indicative of viscous lava emplacement. The argument is enhanced by the abundance of flow ridges, particularly for the festoon flow, which have a mean wavelength of 640 m. In an attempt to quantify lava rheology, we estimated yield strength and Bingham viscosity using the bulk density estimates derived in the preceding paragraph. Due to irregular slopes of the 'basement' tessera, we used the slope independent equation of Orowan [9] to estimate the yield strength, which ranges from 1.3×10^4 to 1.84×10^5 Pa. Viscosity estimates using the equation of Moore and Ackerman [10] range from 2.0×10^7 to 2.6×10^9 Pa s. These are comparable to those of terrestrial silicic lava flows, the Mahuea Tholus flows [2,3], and some of the 145 steep-sided domes identified on the venusian surface [5]. Based on rheology estimates alone, however, mafic compositions for the thick Ovda flows cannot be ruled out.



[1] Head, J.W., et al., *J. Geophys. Res.*, **97**, 13,153-13,198, 1992. [2] Moore, H.J., et al., *J. Geophys. Res.*, **97**, 13,479-13,494, 1992. [3] Moore, H.J., et al., LPSC, **XXIV**, 1003. [4] Pettengill G.H., et al., *J. Geophys. Res.*, **97**, 13,091-13,102, 1992. [5] Pavari B., et al., *J. Geophys. Res.*, **97**, 13,445-13,478, 1992.

[6] Leberal, F. et al., *Photog. Engr. Rem. Sens.* **57**, 1561, 1991. [7] Klose, K.B., et al., *J. Geophys. Res.*, **97**, 16.353-16,369, 1992. [8] Carmichael, I.S.E., et al., Igneous Petrology, 739 p., 1974. [9] Orowan, E., *J. Glaciol.*, **1**, 231, 1949. [10] Moore, H.J. and Ackerman, J.A., LPSC, *NASA Tech. Memo*, **TM-4130**, 387-389, 1989. Acknowledgement: This research was funded by grants from the NASA-JOVE Program and the South Carolina Space Grant Consortium.