AN UNUSUAL THICK LAVA FLOW IN OVDA REGIO, VENUS; P. Schenk, Lunar and Planetary Institute, Houston, TX; H.J. Moore, US Geologic Survey, Menlo Park, CA

Perhaps the most unusual volcanic landforms discovered on Venus during the Magellan mission [1] are relatively thick ridged flows that are several hundred kilometers across, only two of which are known. The first occurs in the lowland plains between Artemis Chasma and Imdr Regio, and has been described previously [2]. The thickness and widely spaced ridge and trough segments observed on the surface of this flow suggest relatively high silica contents, relative to flows elsewhere on Venus. In this abstract we describe the second of these flows (Fig. 1), which occurs along the crest of Ovda Regio, part of the Aphrodite highlands.

FLOW MORPHOLOGY

The area and flow surface morphology of the Ovda flow (Fig. 1), located at 6° S, 98° E, are very similar to those of the Artemis-Imdr flow [1]. The Ovda flow is 280 by 320 km, with a surface area of ~45000 km². Numerous concentric ridge and trough segments occur on both flows and those on the Ovda flow have average spacings of 625 to 770 meters, depending on location. These flow ridges usually parallel the overall flow margins (Fig. 2). Source vents for the flow have not yet been identified but the quasi-concentric surface ridge pattern suggests vent(s) in the south central portion of the flow and beneath dark deposits to the south. Radar image distortions of numerous individual flow lobes several kilometers across along the flow margin have been used to estimate thicknesses of the flow. Thickness estimates range from 180 to 280 meters. Because numerous unflooded Ovda ridges are still visible as kipukas (or 'islands') within the flow and even near the center, the total flow thickness is probably less than a kilometer or so. These and other buried mountain ridges have clearly deflected the outward flow of lava, as demonstrated by deflections in the surface ridge patterns.

Altimeter data indicates that the west central region of the flow is depressed by a kilometer or so relative to the margins. This long-wavelength topographic expression may have been overprinted on the flow as part of the regional deformation of Ovda. The highest elevation within the flow occurs along the southern margin, which is partially obscured by a low-backscatter materials associated with the crest of Ovda Regio (5 km above mean planet radius). These materials appear to be superposed on the Ovda flow (Fig. 2). With one exception, the surface of the Ovda flow has not been deformed by the pervasive tectonic fabric of Ovda, rather the digitate lobes along the flow margin follow the preexisting local topography. Several lobes have clearly flowed along graben floors (Figs. 1, 2). The flow has been deformed by a set of NW-SE trending scarps, interpreted as normal faults, that parallel a similar structural set in Ovda Regio proper (Fig. 1). This structural episode is therefore the last to have deformed this region and dates the Ovda flow sometime between the predominant orthogonal fracturing and folding episode(s) and the final NE-SW extensional episode. The flow surface has also been affected by larger scale topographic undulations that affected most of Ovda Regio.

FLOW RHEOLOGY

The topography and dimensions of surface ridges on the flow can be used to model the rheology of the extruded material. The shapes of digitate flow lobes on the margins are used to model the Bingham yield strength of the flow [2]. Yield strengths range from 2 x 10⁵ to 6 x 10⁵ Pascals. These values are up to an order of magnitude higher than those estimated for the Artemis-Imdr flow [1], and by analogy with terrestrial volcanos suggest a slightly higher silica content. The Artemis-Imdr flows were interpreted as being basaltic-andesite in composition. The Ovda flow may be somewhat more silicic in composition.

The numerous parallel ridges are interpreted to be surface folding of a more rigid flow crust. The spacing of these ridges is related to the viscosities of the flow interior and surface and the strain rate during folding [3]. As a first approximation, we assume strain rates on the order of 10⁻⁶ to 10⁻⁷ s⁻¹, equivalent to a ridge formation time of an hour to a week. For ridge spacings of 625-770 m, we obtain surface and interior viscosities of on the order of 10¹⁰ Pa·s and 10⁶ Pa·s, respectively, for this flow, similar to those estimated for the Artemis-Imdr flow [2]. These values are at least consistent with an intermediate composition for these flows. Of course, all these models are only crude approximations to the true rheology, which is probably non-Newtonian. They do
allow a convenient empirical comparison with flows on other planets and elsewhere on Venus, however.

The only two flows of this type occur in very different tectonic settings. The Artemis-Imdr flow is located in ridged and fractured lowland plains several hundred kilometers from Artemis Chasma. The Ovda flow is located along the crest of the equatorial highlands mountain belt and formed sometime during the latter stages of that deformation. A low-viscosity rapidly-moving debris flow of the type identified as being a precursor to the thick Artemis-Imdr flow [1,4] has not been identified in association with the Ovda flow. Either this precursor flow was restricted in development by the mountainous topography (which may also mask its appearance) or such a deposit never formed in association with the thick Ovda flow. Pyroclastic ground-hugging deposits of this type are associated with some thick silicic flows in the Central Andes [5], for example. However, the low-backscatter materials of Ovda may be pyroclastic or air-fall deposits of some type.