RADAR-BRIGHT HALOES OF LOUKHA PLANITIA: IMPLICATIONS FOR VENUS VOLCANIC STYLE: Klose, K.B., Harvard-Smithsonian Center for Astrophysics, Cambridge, MA 02138

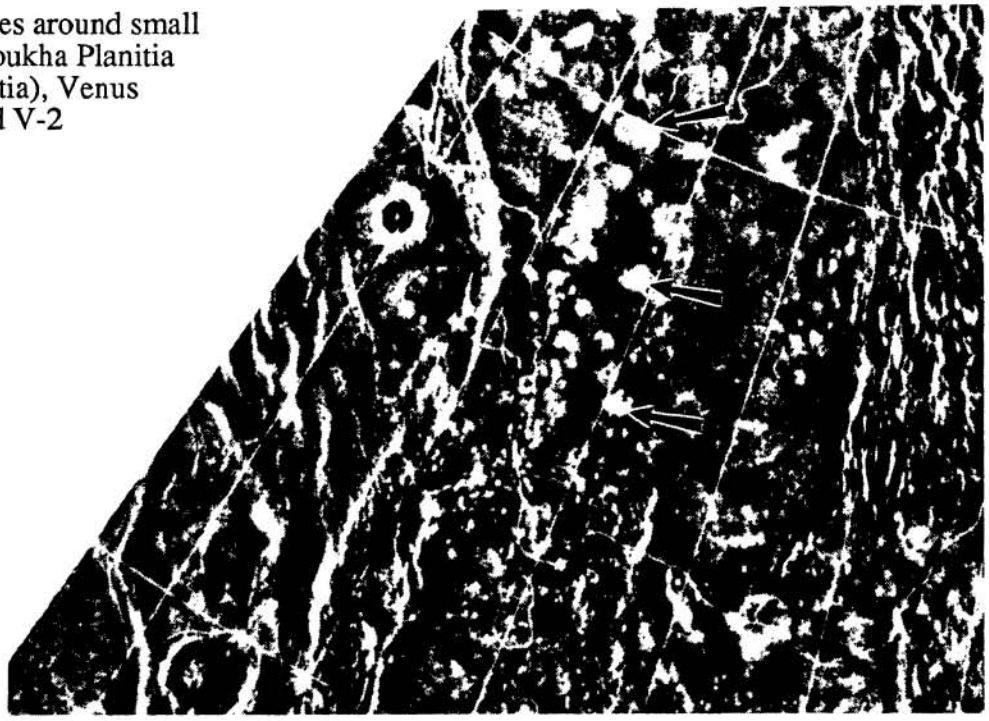

Fig. 1. Bright haloes around small volcanic domes, Loukha Planitia (NE Atalanta Planitia), Venus Venera 15/16 Quad V-2

A narrow zone of small volcanic hills surrounded by roughly circular radar-bright haloes blotches the surface of Venus in the northeast corner of Atalanta Planitia (Fig.1). Nothing like this chain of haloes is visible anywhere else in the Venera coverage: though a few domes with bright haloes show up elsewhere, they never occur more than two or three together, and never form such a large, continuous unit. Sukhanov & Pronin noted this "spotted plain" in their initial survey of the geology of Venera 15/16 quad V-2 and suggested the haloes were due to some specific property of the volcanism at this site [1]. Analysis of the haloes' distribution, shape, and radar properties thus gives clues about the style of the eruptions that produced this unique volcanic chain.

DISTRIBUTION. Thirty-five to forty domes with bright haloes 4-25 km across, plus 5-10 non-haloed domes lie between latitudes 77.5-183 N, longitudes 175-183 E, covering an area of about 800 x 150 km (Fig. 1). Some haloes overlap, but usually 5-20 kilometers of smooth radar-dark plains separate them. The band of haloed domes seems to be a continuous unit with an axis along azimuth 330, continuing the trend of Lauma Dorsa, a N-S ridge belt which pinches out just south of the first haloes.

SHAPE. The haloes form slightly elongated radial patterns about their domes, with the domes usually almost in the center of each halo. Eighty percent of the haloes are less than 1.4 times longer than they are wide, and 30% are exactly as long as wide and seem close to perfectly circular. The long axes of the elongated haloes show no dramatic preferred orientation, although none point within 20 degrees of directly north or south.

RADAR PROPERTIES. The haloes show a reflectivity of .03-.014 and rms slopes (roughness) of 1.0-3.2, according to Kryuchkov and Abramov [2,3]. Some parts of the halo unit

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are distinguishable from the surrounding ridge-belt and plains units on Abramov's maps of roughness and reflectivity [3]. Within each halo there is little change in brightness, but along the entire band the haloes seem to grow larger and more diffuse to the northward.

DISCUSSION. Several factors may cause the haloes to reflect brightly. At Venera wavelength and incidence angle, local topographic slope should be the major influence [4]. However, Aubele suggests the haloes have no topographic relief [5], so surface reflectivity, and roughness at the 8-cm scale of the Venera radar are probably responsible for the brightness [4]. The halo unit shows low-to-average reflectivity values on Abramov's map of reflectivity [3]. This map does not resolve the haloes themselves but integrates the reflectivities of the haloes with the dark plains around them. Kryuchkov contends roughness is the major cause of brightness [2], but his data are near the limits of their 8% error margin. Further, Ford's study of the appearance of rough crater ejecta suggests that rough material should show bilateral symmetry about the radar illumination vector [6], while the haloes of Loukha show no such pattern. Thus surface reflectivity may be causing the brightness. Ford also suggests that the shape of impact craters is distorted on SAR images because of the topographic relief of crater rims [6]. If the haloes are flat, as Aubele believes [5], their shapes on the Venera images are probably distorted only minimally.

CONCLUSIONS. Since the shapes of the haloes are probably little distorted, their sizes and outlines give evidence of the style of the eruptions tht emplaced the bright material. Kryuchkov suggests young, rough basaltic lava flows cause the brightness [2]. This seems possible if roughness in fact outweighs reflectivity in causing the brightness. According to Head & Wilson's rheology model [7], a dry tholeiitic eruption would need an effusion rate of about 700 m^3/s to form the haloes. Abramov's averaged reflectivity data imply a rock density of about 2.5 g/cm^3 [8], consistent with basalt [3].

On Earth pyroclastic volcanism can produce circular deposits around volcanoes [9]. If recent rough pyroclastic deposits [10] created the haloes of Loukha -- which would require 3-4% dissolved volatiles in the magma [7] -- then the haloes might be expected to be stretched in the direction of prevailing winds. Since the long axes of the haloes show little preferred orientation despite Venus' unvarying E-W winds [11], the haloes are probably not the sign of a pyroclastic process, and the halo magma probably has low volatile content.

The lowest reflectivity readings suggest the presence of porous rock or soil [3, 4] in the halo unit. This could be pumice; or one of several soil-deposition process could be at work in the plains below the domes. Individual haloes may have higher reflectivity than the integrated data reveal. If so, the haloes may be a manifestation of the process responsible for the high reflectivity found all across eastern Atalanta -- possibly a broad regional difference in composition [4].

Their size makes the domes and haloes of Loukha an ideal target for Magellan. Just visible to Venera, this unique chain of haloes will stand in sudden clarity when the new spacecraft turns its high-resolution eye on Loukha Planitia late in the nominal mission. Age relationships revealed among the haloes and in the surrounding plains would be especially helpful in unlocking still deeper secrets of Venus' volcanic style.

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