VENUS: EVIDENCE FOR HIGH DIELECTRIC CONSTANTS IN ELEVATED REGIONS; G. H. Pettengill, P. G. Ford and S. D. Nozette, Dept. Earth and Planetary Sci., MIT, Cambridge, MA 02139

Observations made by the Pioneer Venus Orbiter Radar Mapper have yielded global data on the altitude (1,2), roughness (1,2) and radar reflectivity (3) of the Venus surface. The distribution of the Fresnel power-reflection coefficient obtained from these observations at a wavelength of 17 cm is shown in Fig. 1. A major surprise was the finding of a number of regions with power-reflection coefficients at normal incidence averaging between 0.3 and 0.4 (corresponding to the brightest regions in Fig. 1). All of these regions are associated with the highest elevations in their vicinity. Unfortunately, the areas yielding the highest coefficients, namely the Akna, Freyja and Maxwell Montes of Ishtar Terra and the Ovda and Thetis Regiones of Aphrodite Terra are also associated with some of the roughest terrain on the planet, a factor which complicates the extraction of reflectivity in the data analysis and casts doubt on its accuracy.

Fortunately, the PVO Radar Mapper was also able to measure, albeit crudely, the thermal radio emission from the surface and, since the physical surface temperatures are known, to estimate the corresponding surface emissivity. For Ovda and Thetis, the emissivity was estimated at 0.54±0.05 (4), a result implying a total scattering coefficient of about 0.46. That this value is somewhat higher than that obtained from the radar observations is not surprising, since the radar, through the backscattering

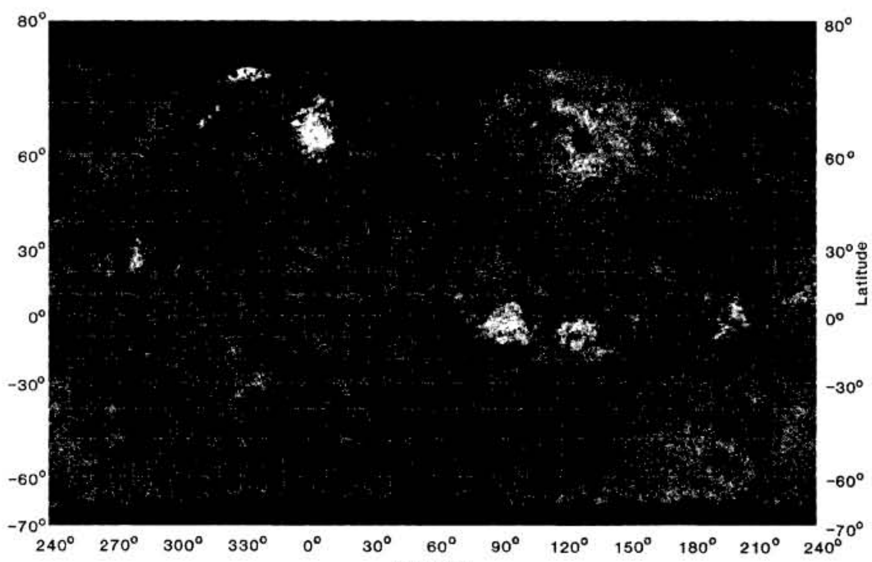

Fig. 1. Global map of the variation in the power reflection coefficient of the surface of Venus obtained at a wavelength of 17 cm by the Pioneer Venus radar altimeter. The brightest areas have reflectivities of 0.25 or more, while the darkest correspond to 0.05 or less. The large bright areas centered at 65°N,5°E and 5°S,95°E correspond to the Maxwell Montes and elevated regions of Terra Aphrodite, respectively. Also bright and elevated is a relatively small region surrounding Theia Mons at 24°N,281°E, a feature that may be volcanic.

model used in the reduction, "sees" only the coherently reflected component. The diffusely scattered incoherent component, known to be significant in these regions, is not included in the radar estimates, but is implicit in the total scattering coefficient derived from emissivity. In any event, the suggestion from the radar data that normal-incidence power reflectivities of the order of 0.4 are found in many elevated regions seems amply confirmed by the radiometric emission data.

Using the standard formula relating the dielectric constant of a homogeneous medium at an interface, we obtain $\varepsilon' = 27 \pm 7$ for the (assumed real) bulk dielectric constant of the surface material in the highly reflective regions. How can a value so much higher than the range 4-9 characteristic of usual terrestrial rocks be explained? Our guess as to the most likely cause is the presence of small conducting inclusions, electrically insulated from each other within a matrix of more or less normal rock. Such a "loaded" dielectric is well known to yield high values of bulk dielectric constant, with values as high as 100 or more often seen in iron-nickel-rich meteorites (5). While we do not expect metallic iron or nickel to remain for long in the oxidizing environment of the Venus surface, iron sulfides (particularly pyrites) have the necessary high conductivity and have been postulated (6) as a possible source of reduced sulfur in the Venus atmosphere.

How large a concentration of sulfides would be needed to raise the dielectric constant to 27? In an attempt to answer this question, we have begun a program at MIT to measure the dielectric properties of terrestrial rocks containing known amounts of iron sulfides. While we will eventually be able to simulate Venus surface temperatures during our measurements, our intital work has been done near room temperature on a sample containing 5% FeS_2, 2% other iron sulfides by volume. At a wavelength of 17 cm, the real and imaginary parts of the dielectric constant were 22 and 8, respectively (loss tangent of 0.4). We estimate that about 10% FeS_2 by volume (20% by weight) would produce a dielectric constant of 27.

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