CORRELATION OF MULTIPLE REFLECTIONS FROM THE VENUS SURFACE WITH TOPOGRAPHY: K.A. Tryka, D.O. Muhleman, B. Butler, G. Berge, California Institute of Technology, Pasadena, California 91125, M. Slade, Jet Propulsion Laboratory, Pasadena, California 91125, A. Grossman, University of Maryland, College Park, Maryland 20742

In anticipation of the Magellan mission, and in order to obtain a calibrated map of Venus depolarized reflectivities we performed a radar experiment using the technique described by Muhleman et al. (1). We illuminated Venus, using the Goldstone antenna in California, with a 3.5 cm, right circularly polarized signal and received a right circularly polarized (depolarized) signal at the Very Large Array in New Mexico. Using the Earth-rotation synthesis technique we were able to make a radar map of the entire venusian disk in a single day. The signal received in the depolarized mode represents radiation that has been multiply scattered, primarily in the subsurface. This experiment was performed twice, on the 18th and 25th of February in 1990, resulting in two depolarized maps of Venus.

After each day's map was calibrated (with respect to an extra galactic radio source), it was deconvolved using the CLEAN algorithm. For both maps the size of a pixel is about 45km×45km at the subearth point. After making further corrections to the data to compensate for attenuation of the radar signal as it travels between the Earth and Venus and also to compensate for the fact that at 3.5 cm the venusian atmosphere is not transparent, final maps were made which represent what we will call the depolarized reflectivity of the surface of Venus.

On day one (February 18th) the subearth point (lon, lat) of Venus was 11.8°,-6.1°. In this orientation Alpha Regio, Maxwell Montes, and the western edge of Aphrodite Terra were in view. On day two (February 25th) the subearth point was 25.5°,-5.3°. Alpha Regio and Maxwell Montes were still both visible, but much more of Aphrodite Terra had rotated into the field of view. The maps have several striking features. On both maps Maxwell is clearly visible, although because of its position on the limb of the planet the atmospheric correction has not been calculated accurately and thus, the absolute value of its reflectivity is poorly known. Surprising is the fact that Alpha Regio has a high depolarized reflectivity (as seen on both maps), and in the case of the first day's map, contains the point of highest reflectivity (if the values of Maxwell are ignored). Both days' maps also clearly show Aphrodite Terra. On the second day's map, the point of highest reflectivity is in the region of Aphrodite which was not visible on the previous day's observations. On both maps there are also many very small areas (some only a few pixels across), which have large depolarized reflectivities. Certain of these seem to correspond to mapped, elevated areas such as Gula Mons, Sif Mons and Bell Regio. Others do not correspond to any topographic features (as seen by Pioneer Venus).

From a visual inspection it is strikingly clear that there is correlation between depolarized reflectivities and elevation. The same type of visual inspection of the Pioneer Venus 'polarized' reflectivity (ie. the reflections mainly derived from single scattering events) does not show such a strong correlation.

The correlation coefficient, computed point by point, between the Pioneer Venus reflectivities and the Pioneer Venus altimetry shows that there is no correlation between the reflectivities

Files Correlated	Whole Disk	Alpha Region
Polarized(1), Altitude(1)	0.017	0.168
Polarized(2) Altitude(2)	0.128	-0.038
Depolarized(1), Altitude(1)	0.121	0.525
Depolarized(2), Altitude(2)	0.185	0.514
Depolarized(1), Polarized(1)	0.097	0.053
Depolarized(2), Polarized(2)	0.065	-0.034

Table 1: Correlation coefficients. (1) and (2) refer to the fact that the data has been projected onto the same geometry as our day one and day two observations.

and the topography (see Table 1). This lack of correlation agrees with previous works by Head et al. (and authors cited therein) (2) and our visual inspection. Computing the correlation coefficient between our depolarized reflectivities and the Pioneer Venus altimetry shows a somewhat higher correlation over the whole disk and a much stronger correlation over Alpha Regio. We argue that in this case correlation coefficients of 0.52, and perhaps 0.15, are statistically significant. This is because if you had two data sets which were perfectly correlated and added random noise to both of them, you would not find a correlation of 1.0. The value calculated (which will be less than 1.0) would become the benchmark for 'perfect' correlation, thus allowing values that would not normally be considered significant, to acquire statistical significance. We also find that the Pioneer Venus reflectivities have little correlation with the depolarized reflectivities (as shown in Table 1).

The strong correlation between large depolarized reflectivities and areas of high elevation suggests that these areas may be more porous, more fractured, or contain larger amounts of subsurface scatters embedded in a porous matrix than less elevated areas in order to produce the signature of enhanced multiple scattering which we observe.

REFERENCES:

(1) Muhleman et al. Science 248, p 975-980 (1990).
(2) Head et al. JGR 90, p 6873-6885 (1985)