MODEL FOR MARS DEPOLARIZED RADAR ECHOES; T. W. Thompson and H. J. Moore, Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA 91109 and United States Geological Survey, Menlo Park CA 94205

Recent radar observations of Mars at Arecibo in 1980 and 1982 (Harmon, et. al. 1982 and 1985) and at Goldstone in 1986 were conducted by transmitting pure sinusoidal signals and receiving Doppler spread signals at Earth. Radar transmissions were circularly polarized and the radar echoes were recorded in both senses of circular polarization. Thus, radar echoes from Mars were separated into the polarized (OC, opposite-sense circular) and the depolarized (SC, same-sense circular) components.

Here we have modelled depolarized echoes using areas where we expect to find large concentrations of fine-scale (decimeter-sized) roughness elements as sources of enhanced radar echoes. These areas (Figure 1) include the four large montes of the Tharsis region, Elysium Mons, and the extensive lava plains that surround them. These areas are assigned backscatter up to ten times that of other Martian areas. More detailed definition of our model is planned, including refinement of anomaly boundaries and inclusion of other areas.

Our model assumes that Martian depolarized radar echoes are uniformly bright so that backscatter varies as cosine (angle-of-incidence). This is the behavior observed for depolarized echoes from the Moon, where lunar radar echoes mimic the appearance of the full-moon's uniform disk at visual wavelengths. We assume further that the Martian anomalies behave like the large, young lunar craters such as Tycho, Copernicus, Aristarchus, Langrenus, Theophilus, and Kepler. These craters, regardless of their angle of incidence, backscatter ten times more depolarized power than average lunar areas.

Our model accounts for the major parts of the depolarized echo spectra. There is a good match with the variation of total depolarized (SC) radar cross-section with longitude. In Figure 2, the solid line is the model; the hatched area includes 1986 data from Goldstone; the circles are 1980 and 1982 data from Arecibo; and the X's are our model predictions. Our model also predicts spectra shapes that compare favorably to those observed (see Figure 3).

The Tharsis region provides the largest anomaly and is responsible for the broad enhancement seen in the fifteen spectra of Harmon, Campbell and Ostro, (1982, Figure 2b). This anomaly occupies about two-thirds of the echo-spectra and moves from left-to-right across the fifteen spectra. The Tharsis region also produces the broad increase in total depolarized cross-section centered near longitude 125 (Fig. 2). Tharsis as well as the Elysium and Amazonis Planitia anomalies are responsible for three features in the model spectra (Fig. 3). In addition, the Elysium and Amazonis Planitia areas produce the variation in longitude seen as the ramp from longitudes 230 to 190 in Figure 2.

References

J. K. Harmon, D. B. Campbell, and S. J. Ostro (1982), Dual-Polarization Radar Observations of Mars: Tharsis and Environs, Icarus, 52, 171-187.
J. K. Harmon and S. J. Ostro (1985, Mars: Dual-Polarization Radar Observations with Extended Coverage, Icarus, 62, 110-128.

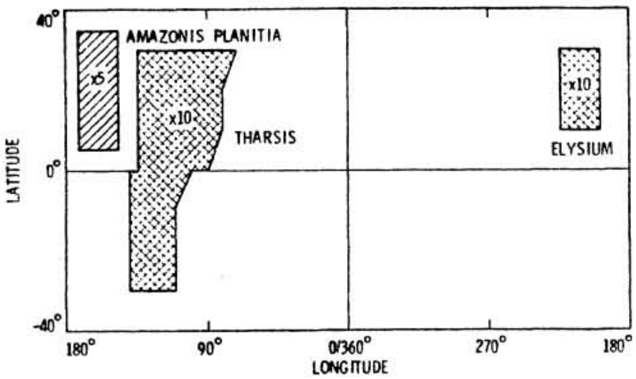

Figure 1. Generalized Areas for the Assumed Martian Radar Anomalies

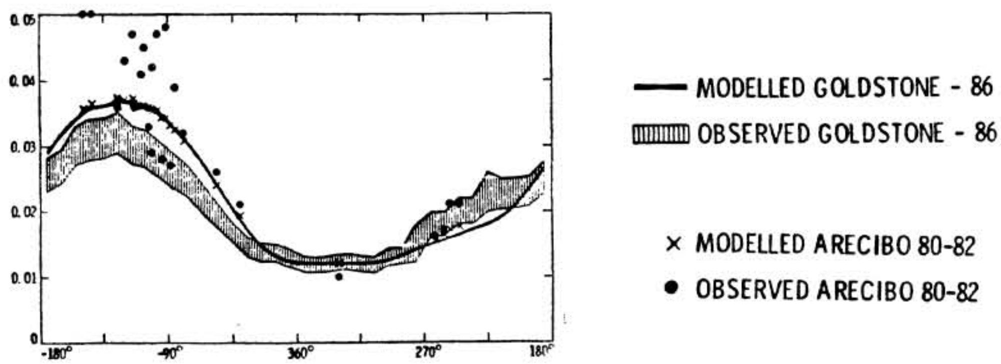

Figure 2. Model and Observed Depolarized Radar Cross-Sections Versus Longitude

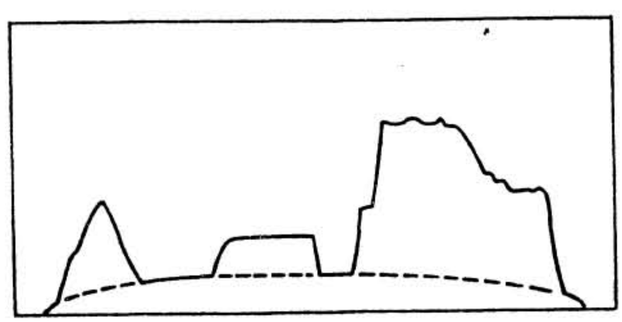

Figure 3: Model Spectra for Arecibo Observation at 24.8°N, 149.3°W. See Figure 3d of Harmon and Ostro, 1985.