

MARS RADAR MAPPING: STRONG DEPOLARIZED ECHOES FROM THE ELYSIUM/AMAZONIS OUTFLOW CHANNEL COMPLEX; J. K. Harmon, M. P. Sulzer, and P. Perillat, National Astronomy and Ionosphere Center, Arecibo, PR 00613.

The strength and degree of depolarization of the diffuse component of radar backscatter can be used to identify those regions on Mars which are extremely rough on scales comparable with the wavelength of the radar. However, progress in the radar reflectivity mapping of Mars has been impeded by the fact that, because it is an "overspread" target, conventional delay-Doppler techniques are not applicable. It has been known for several years from Arecibo CW observations (1,2) that the diffuse radar echo from Mars shows strong spatial variations; these measurements indicated that the strongest diffuse scatter is from Tharsis, Amazonis and Elysium whereas the heavily cratered uplands give a relatively weak diffuse echo. These results have been confirmed by the radar maps recently obtained by Muhleman *et al.* (3) from a bistatic Goldstone-VLA experiment.

During the 1990 Mars opposition we made the first attempt to make delay-Doppler reflectivity maps of Mars using the "random code" or "coded long pulse" technique, a method developed to overcome the overspreading problem in ionospheric radar measurements (4,5). In this technique a random (non-cyclic) code is transmitted. Then, instead of decoding the echo by correlating over a code cycle to produce one sample for the spectral analysis, we simply spectrum analyze the time series formed from the product of the received signal and a shifted replica of the transmitted code. The delay-Doppler array produced by this method includes a range clutter component; however, because the code is random, this clutter only contributes additive white noise. We have made a score of observations using this technique with the S-band ($\lambda=12.6$ cm) radar at Arecibo from September to December 1990. Most of the observations were made using a transmitted code with a 100 μ sec baud. The maps which we have made include the north-south ambiguity about the Doppler equator which is inherent in the delay-Doppler technique. However, the 10° excursion in subradar latitude during the three-month observing period has allowed us to resolve much of the ambiguity from eyeball comparison of maps obtained early and late in the opposition.

Although the mapping analysis is still at a preliminary stage, some interesting results have already been obtained. Of these, perhaps the most interesting is the mapping of the radar-bright features which together make up the depolarized enhancement which had previously been seen in the general region of Elysium (2). One of the maps from this region is shown in Fig. 1; this is a radar reflectivity map of the depolarized echo component, with brighter shades corresponding to stronger echo. Superimposed on this map is a grid of latitude-longitude lines with a 10° spacing; the subradar point for this observation is at 217°W , 9.4°S . Note the north-south ambiguity about the Doppler equator. From comparison with maps obtained at 3.6°S we have established that all of the prominent features seen in this map come from north of the Doppler equator. The northernmost feature which can be discerned is a faint patch near 210°W , 25°N which coincides with the eastern flank of Elysium Mons. A faint band can also be seen extending from this feature towards the southeast. The brightest features on the map are concentrated between 180°W and 215°W at latitudes from 5°S to 10°N . This breaks down into three separate bright patches which we will denote Feature A (near 210°W , 7°N), Feature B (near 196°W , 2°S), and Feature C (a large bow-shaped structure extending from 180°W to 200°W). These three features lie within (and, taken together, roughly delineate) the boundaries of the vast Elysium/Amazonis outflow channel complex as mapped by Tanaka (6). The consensus of opinion is that this province represents the erosional remnants of catastrophic flooding which occurred during a recent epoch. Tanaka (6) states that the flood plains consist of "low-albedo material marked by light, wispy streaks." A study of the Viking photomosaic maps of this region show that radar Features A and B correspond to well-defined regions for which Tanaka's description is particularly apt. Feature C coincides precisely with what may be the outflow channel-proper, a continuous flow of dark streaks which the photomosaics show as starting near 195°W , 5°N , dipping down toward the equator, and then trending NE to about 175°W , 25°N .

The new maps suggest that much of the Elysium/Amazonis outflow channel and flood plain is very rough on decimeter scales. Perhaps the most plausible explanation is that the enhanced diffuse backscatter arises from gravel or boulder fields which are erosional debris left by the floods.

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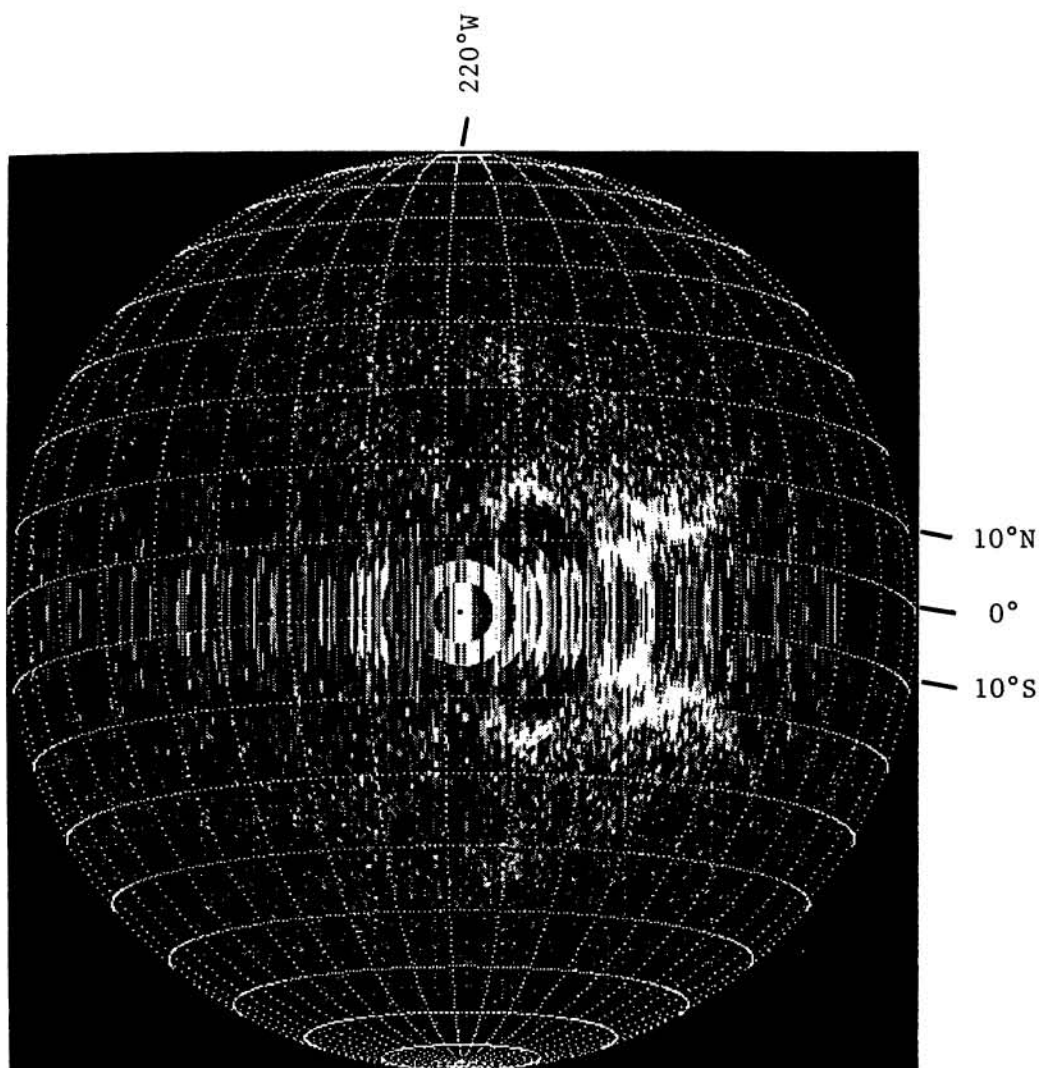


Fig. 1