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MOJAVE REMOTE SENSING FIELD EXPERIMENT

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The Mojave Remote Sensing Field Experiment (MFE), conducted in June, 1988, involved acquisition of Thermal Infrared Multispectral Scanner (TIMS), C, L, P band polarimetric radar (AIRSAR) data, and simultaneous field observations at the Pisgah and Cima volcanic fields, and Lavic and Silver Lake Playas, Mojave Desert, California. A Landsat thematic mapper (TM) scene acquired on April 18, 1988, is also included in the MFE archive. TM-based reflectance and TIMS-based emissivity surface spectra were extracted for selected surfaces. Radiative transfer procedures were used to model the atmosphere and surface simultaneously, with the constraint that the spectra must be consistent with field-based spectral observations. AIRSAR data were calibrated to backscatter cross section using corner reflectors deployed at target sites.

Analyses of MFE data focused on extraction of reflectance, emissivity, and cross section for lava flows of various ages and degradation states. Generally, as flows age, weathering and mass movements remove roughness (1). In addition, the surfaces are mantled by quartz, feldspar, and clay-bearing aeolian deposits and covered with a basalt-cobble desert pavement (1). MFE data analyses show that the smoothing process increases reflectances, as does the exposure of aeolian deposits. For example, average reflectance varies from 0.10 for young flows to 0.20 for a 4 Ma old flow. Emissivity minima for young flows range from 9.5 to 9.7 micrometers, consistent with fundamental vibrational absorptions due to mafic minerals. Increasing age shifts the minima to shorter wavelengths because of the exposure of felsic minerals in the aeolian deposits. Polarized and depolarized radar cross sections decrease from young to 4 Ma old flows. However, the oldest flow examined (7 Ma) shows a reversal to lower reflectances, longer wavelength emissivity minima, and an increased P band backscatter cross section. These changes are a consequence of fluvial dissection that removes the aeolian mantle and roughens the surface at length scales relevant to P band backscatter.

Results have relevance for the evolution of volcanic plains on Venus and Mars. For example, Figure 1 shows radar cross sections for various surfaces extracted from Magellan and AIRSAR data. The dark plains on Venus, located in paraboloidal ejecta deposits (2) are as smooth as Lavic Lake playa. Some relatively young flows on Gula Mons have cross sections comparable to what is found for young a'a flows at the Cima volcanic field. Finally, we are pursuing an evaluation of the color and thermal properties of lava flows of varying stratigraphic age on the Tharsis Plateau, Mars, using MFE results as a guide to help interpret flow degradation styles.

References

(1) Wells et al., (1985) Geological Society of America Bulletin, 96, 1518-1529. (2) Arvidson et al., (1991) Science, in press. (3) Plaut, J.J. (1991) Ph.D. Thesis, Washington University, p. 351.

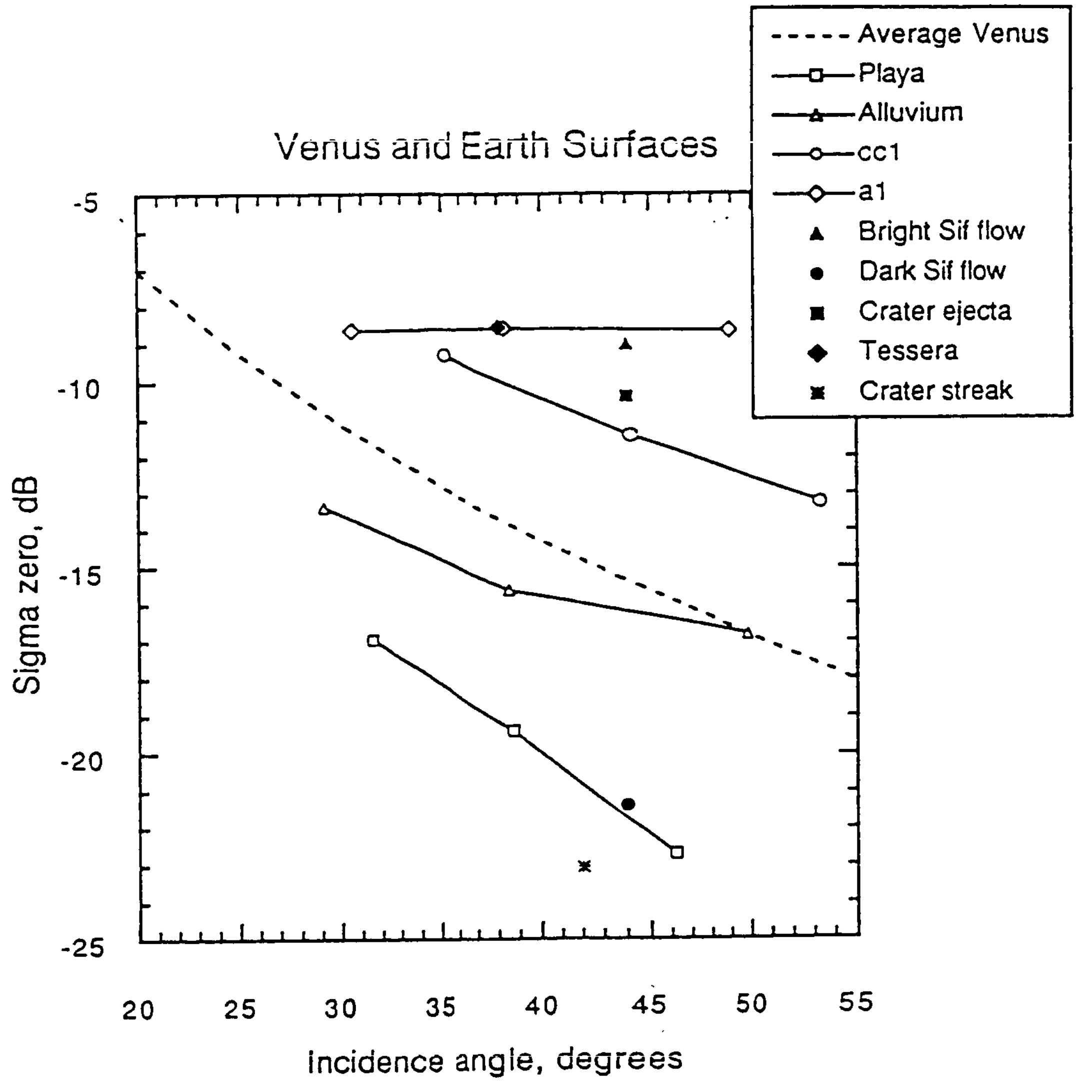

Figure 1- Radar cross section vs incidence angle for an average of Pre-Magellan results, Magellan data, and AIRSAR data for selected areas. Polarization is HH. Venus data are S-Band. AIRSAR S-Band data were simulated by a wavelength-weighted average of C and L-Band data. SIF flows are lavas. Crater streak is part of paraboloidal ejecta deposit. Figure from (3).