SIMULATION OF THE MAGELLAN (VENUS) SAR'S ABILITY TO CLASSIFY VOLCANIC UNITS; S. D. Wall, E. Theilig*, . and R. S. Saunders, Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA

L-band scatterometer data have been used to simulate synthetic-aperture radar (SAR) data for the Magellan SAR, which will map the surface of Venus in 1990-91 at S-band (12-cm) wavelength. Since Magellan will maximize its incidence angle from about 15 to 50 degrees as a function of latitude to preserve signal-to-noise ratio in the image data, it is vital to have some advance knowledge of how the ability to discriminate surface features will vary with incidence angle (and thus with latitude). In this study we use simulated Magellan data and a classification technique to investigate this variation.

Because there is evidence that basaltic volcanism has been an important process on Venus [1 - 5], data taken over Pisgah lava field (California) were used for the simulation. Pisgah consists of flows from three eruptive phases, two with predominantly pahoehoe surface texture and one with aa. A meso-scale texture formed by tumuli and pressure ridges is present within all three units. Flow margins, particularly on the west, have been modified by eolian and alluvial deposits and form an additional texture unit. The lava field is bordered by alluvial and playa sediments. Calibrated L-band (19-cm) fan-beam radar scatterometer data taken by the NASA/Johnson Space Center scatterometer over the Pisgah field were time-sorted into 5-degree incidence angle bins from 15 to 50 degrees. The scatterometer data were interpolated to match the 23-degree Seasat (SAR) incidence angle. The scatterometer track was located on a Seasat image of Pisgah, first visually and then by a least-squares fit [6]. Three flow units, a playa unit, and two different-aged alluvial units were identified along the data track using geologic maps and aerial photographs. The average of all data from each unit are graphed as a function of incidence angle in Figure 1. These curves were used to define a training set for a linear discriminant analysis program [7,8]. The program sorted each scatterometer data point into one of the six classes. Plots of the percent of samples correctly classified versus incidence angle were then used to evaluate the optimum angles for identifying the flow units.

Data points taken from the playa unit were about 80% correctly sorted, with no clear preference for incidence angle. The alluvial units, taken together, are best classified at incidence angles near 30 degrees. All lava units taken together are best identified at angles between 25 and 40 degrees. The difficulty in correctly identifying units below 25 degrees may be a function of the similarity in mesoscale surface texture. Tumuli and pressure ridges form local slopes commonly equal to or less than 30 degrees which may result in the addition of quasispecular reflection to the returned signal. In this case the amount of backscatter may be dependent partly on the size, distribution and orientation of the ridges.

Future application of this technique will be made on a part of the Craters of the Moon lava field, Idaho, where a greater variety of basaltic surface textures exists. In addition, we plan to use cluster analysis methods to investigate discrimination among the volcanic units as a function of latitude. The research described in this paper was carried out at the Jet Propulsion Laboratory, California Institute of Technology, under contract with the National Aeronautics and Space Administration.

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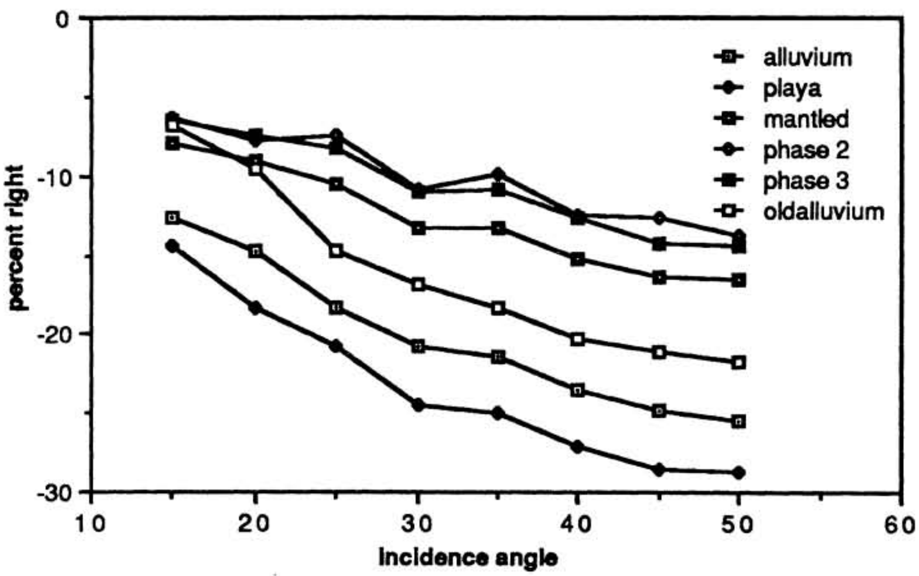

Figure 1. Curves of L-band backscatter vs. incidence angle for units identified at Pisgah lava field.