

DEPOSITION AND EROSION ON MARTIAN CRATERED TERRAINS AS DETERMINED BY VIKING ORBITER MULTISPECTRAL IMAGE AND THERMAL OBSERVATIONS; M. Presley and R. Arvidson, McDonnell Center for the Space Sciences, Dept. of Earth and Planetary Sci., Washington Univ., St. Louis, MO 63130

Radiometrically calibrated Viking Orbiter images and Infrared Thermal Mapper (IRTM) data were used to examine the northwest section of the Sinus Sabaeus quadrangle (MC-20 NW) as the initial step of a quantitative study of the types and origins of materials exposed in the martian cratered terrains. Analyses of Viking Orbiter images show that the optical properties of the area can be divided into two groups, based on relative radiance values in the violet, green and orange parts of the spectrum. One group defines a trend that is bright and has relatively high orange to violet ratios. The other group defines a trend that is darker, with lower orange to violet ratios. The latter trend occupies a greater range of radiance values, varying from relatively low values of violet and orange and merging with the higher values displayed by the brighter trend. This merging suggests a mixing of the darker bluish material with the brighter, orange materials, although whether the mixing is via a simple checkerboard pattern or by intimate mixing of materials cannot be discerned from the data. Given that the passbands of the images are located in the spectral region dominated by ferrous and ferric charge transfer and electronic transition absorptions, it seems reasonable that the brighter, orange materials are more oxidized and perhaps finer grained than the darker, bluer materials. Both groups can be mapped to contiguous, well defined locations in the quadrangle by use of simple parallelepiped classifier techniques. Material corresponding to the brighter, orange trend is located in the north to northeast, corresponding to the region of Arabia, and in the south, where it corresponds to Deucalionis Regio. Material corresponding to the darker, bluish trend is also found in Sinus Sabaeus.

The IRTM data for the study area were processed by Christensen (in preparation) to produce two derived parameters: percent blockiness, and thermal inertia of fine-grained material presumed to exist between blocks. Histograms for the blockiness and the fine-component thermal inertia were compiled by us separately for regions corresponding to the two trends evident in the optical data. The histograms of percent blockiness for the two optical groups have statistically indistinguishable means and variances. This result suggests that blockiness does not vary appreciably with optical properties in this region. The two histograms of the fine-component thermal inertia, on the other hand, show distinct differences. Materials comprising the brighter, orange trend have relatively low thermal inertia values and occupy a wider inertia range than materials comprising the darker, bluer trend. The lower thermal inertias for the materials corresponding to the brighter, orange trend are consistent with the presence of finer grained deposits between blocks as compared to the darker, bluer materials.

To a first approximation, the detailed morphology as inferred from high resolution Viking images also correlates with the two optical units. The brighter, orange materials in Arabia correspond to surfaces that are

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relatively smooth between craters. In some places, wind erosion has apparently scoured deeply etched patterns into the smooth intercrater terrain. Bright dune deposits can be seen in some of the etched valleys. Zimbelman and Kieffer (1) have suggested that Arabia has been subject to aeolian deposition via a feedback mechanism, where deposition of fine-grained material smooths the surface and, as a consequence, makes wind erosion less likely. However, as pointed out by Christensen (2), such a model does not explain the presence of blocks in Arabia. The abundance of blocks must surely control surface roughness and thus erodability. We feel that it is more likely that an extensive, ancient sedimentary deposit has been removed from the darker, bluer areas. It is in the process of being removed in the etched areas, and it remains intact in the morphologically smooth, brighter, orange areas. Three models for origin of this postulated bright, orange deposit seem reasonable: aeolian deposition, ash volcanism, and extensive weathering of megaregolith. It is difficult to choose a preferred model from available data. One point is clear, however. Despite the primitive nature of the cratered terrains, as implied by high crater densities, it is clear that these terrains have been considerably modified if the Sinus Sabaeus quadrangle is a representative sample. Imaging spectrometer, gamma ray, or spectral emissivity observations from Mars Observer will have to be interpreted accordingly. Observations from these instruments will not be unequivocally sampling pristine materials in the cratered terrains.

REFERENCES:

- (1) Zimbelman, J.R. and Kieffer, H.H. (1979) J.Geophys.Res., 84, 8279-8251
- (2) Christensen, P.R. (1982) J.Geophys.Res., 87, 9985-9998