SURFACE PROPERTIES OF ASCRAEUS MONS: DUST DEPOSITS ON A THARSIS VOLCANO, J.R. Zimbelman, Lunar and Planetary Institute, Houston, 3303 NASA Rd. 1, Texas, 77058

Ascraeus Mons (11°N, 104.5°W) is the northernmost of the Tharsis Montes shield volcanoes. Remote sensing data collected at several wavelengths were analyzed in order to relate surface properties to the geologic history of the volcano (1). The results are discussed here in relation to the abundance of fine-grained material on the volcano.

OBSERVATIONS

Photointerpretation. Flow fronts and leveed channels are abundant and clearly visible near the summit of the volcano but all surface relief is increasingly subdued with decreasing elevation (401B01-24). The areal density of craters < 270 m in diameter also decreases with decreasing elevation; summit area craters are well defined with sharp rims but both subdued and sharp-rimmed craters are visible at low elevations.

Visual reflectance. Summit area albedos are very uniform (0.05 and 0.16 at violet and red wavelengths; 696A41 and 47) when the photometric effects of the volcano slopes are taken into account. A zone of lower albedo surrounds the summit area below an elevation of approximately 19 km (0.05 and 0.14 at violet and red wavelengths).

Thermal infrared. Summit area thermal inertias of 2.0 to 2.5 ($\times 10^{-3}$ cal cm^{-2} $sec^{-1/2}$ K^{-1}) are comparable to or larger than the thermal inertias for the Tharsis plains that surround the volcano. The uppermost caldera walls are the only terrain unit with distinguishable thermal inertias (I = 4.5); all flow-related terrains have equivalent thermal inertias, even where individual flows can be spatially resolved. Flank thermal inertias increase with decreasing elevation but they return to summit area values at the shield-plains contact. Thermal inertias on the flanks of the volcano are radially symmetric about the summit. Temperatures measured in all of the IRTM thermal bands indicate the presence of some suspended dust in the atmosphere, even above the summit, but there is no evidence of water vapor clouds (after 2,3).

Radar. No returns were received from Ascraeus Mons for either continuous-wave (4) or delay-Doppler (5,6) radar observations, even from groundtracks that passed directly over the volcano(4). These analyses dealt with the quasi-specular portion of the radar signal but radar data from the Tharsis region are dominated by the diffuse component of the radar signal (7).

ANALYSIS

Thermal inertia can be related to an effective particle size for an idealized surface consisting of only one particle size (8); < 50 um for the summit area, increasing to 100 um near the base of the volcano. The increase in size may be related to an increase in the abundance of sand-sized particles, perhaps including aggregates of clay-sized particles (9). Sand-sized materials would be most easily set in motion by the wind (10) and it is difficult to initiate aeolian activity in silt or clay-sized particles without the presence of sand (11). The wavelength dependence of the summit area albedos parallels the reflectance spectra of Arabia, interpreted to contain dust deposits (12), but Ascraeus Mons is consistently darker than Arabia.

The thickness of the surface deposits can be broadly constrained from the different data sets. Visible relief indicates that surface deposits in the summit area are probably << 15 m in thickness while at the base of the volcano the deposits are probably > 15 m in thickness and may be > 45 m at some locations (1). The presence of both subdued and sharp-rimmed craters at lower elevations indicates that the degradation of surface relief is not due to atmospheric obscuration of surface details. The low thermal inertia of the summit area requires that at least 2 cm of the fine-grained materials be present over much of the surface (13). The diffuse component of the radar signal is most likely due to scattering by objects comparable in size to the 13 cm wavelength of the radar (7). Either the radar signal penetrates the fine-grained material responsible for the thermal inertia or the scattering occurs from areally less abundant objects at or near the surface (e.g. rocks).

Both a volcanic and an aeolian origin are possible for the surface properties but a volcanic origin appears less likely. The lack of correlation between flow features and the thermal data indicates that flow textures do not contribute significantly to the observed thermal inertia (consistent with the presence of material deposited over the original flow surface). The degradation of surface relief indicates increasing deposit thickness with decreasing elevation; this relationship is opposite to what might be expected for a pyroclastic source near the summit of the volcano. The radial symmetry of the thermal inertias around the summit caldera is also difficult to justify with a pyroclastic source separate from the volcano. The 2 cm minimum thickness for fine-grained materials in the summit area can be combined with the calculated dust deposition rate to indicate that at least 1500 years of average dust deposition are needed to produce the observed thermal inertias. Albedo variations are observed to occur on the Tharsis Montes and Olympus Mons over timescales of days to weeks (14) so that dust erosion (or remobilization) must accompany the dust deposition; the thermal inertias probably represent dust accumulations through several thousands of years.

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