GEOLOGIC MAP OF THE MTM -85080 QUADRANGLE, MARS; Ken E. Herkenhoff, JPL and Bruce C. Murray, Caltech

The geologic map presented here covers the portion of Mars between latitudes 82.5°S to 87.5°S, longitudes 60-100°W. The Viking Orbiter 2 images used to construct the photomosaic base used for mapping were taken during the southern summer of 1977, with resolutions no better than 135 meters/pixel. A digital mosaic of Mariner 9 images was also constructed to aid in mapping. The Mariner 9 images were taken during the southern summer of 1971-72, and have resolutions as high as 95 meters/pixel. However, usefulness of the Mariner 9 mosaic is limited by incomplete coverage and atmospheric dust opacity.

The most common bedrock unit in this quadrangle is the polar layered deposits, first described by Murray *et al.* [1] and Cutts [2]. A subjacent pitted unit is exposed at the northeastern edge of the map. Sharp [3] concluded that this unit is a massive sedimentary blanket that rests unconformably upon older, massive units with near-vertical structures. He argued that the pits were exhumed by winds, perhaps aided by evaporation of subsurface volatiles. Condit and Soderblom [4] found layered deposits in some of the pits during their mapping using Mariner 9 images, indicating that erosion of the pits preceded deposition of the layered deposits. Tanaka and Scott [5] used Viking Orbiter images to recognize flow fronts in areas far outside this map in the Hesperian age Dorsa Argentea Formation. They included the pitted plains found on this map (unit Hp) in the lower member of this volcanic unit, and concluded that the pits were formed by basal melting of ground ice. Plaut and others [6] disagreed with this interpretation, as they found that the pitted unit overlies the volcanic plains units wherever the contact is visible. Their measurements of pit depths and crater counts indicate that the pitted unit is no more than 1 km thick and Late Hesperian in age. We find no evidence of flow features in the pitted unit within this map area, so that we prefer the sedimentary interpretation.

The residual polar cap, areas of partial frost cover and two nonvolatile surface units overlying the layered deposits are also mapped here. These units were first recognized and mapped by Herkenhoff and Murray [7] at 1:2,000,000 scale using a color mosaic of Viking Orbiter images. This mosaic and an additional Viking color mosaic were used to confirm the identification of five color/albedo units within this quadrangle: (1) bright, neutrally colored polar frost (unit Arc), (2) bright red dust mantle (unit Am), (3) darker, less red layered deposits (unit Ald), (4) a mixture of frost and bare ground having intermediate color and albedo (unit Apf), and (5) dark, neutrally colored saltating material (unit Ad). The colors and albedos of these units are presented in Table 1, where Lambert albedos were derived by dividing the observed reflectance (corrected for atmospheric scattering) by the cosine of the incidence angle. The numbering scheme in Table 1 follows that used by Herkenhoff and Murray [7]. Because the resolution of the color mosaics is not sufficient to map these units in detail at 1:500,000 scale, contacts between them were recognized and mapped using higher resolution (black and white) Viking and Mariner 9 images.

The bright, red dust mantle (unit Am) does not appear to obscure topography, and is therefore probably no more than a few meters thick, and perhaps much less. The extent of the dust mantle changed in some areas during the 3 Mars years between the Mariner 9 and Viking missions, indicating that it is ephemeral. Dust on or near the surface of the residual polar cap may sink into the frost after individual grains are heated by insolation, effectively removing them from view [8].

The location of dark, neutrally colored material (unit Ad) in topographic depressions here and elsewhere in the south polar region indicates that it is transported by saltation [7]. It may be composed of sand-sized particles or low-density aggregates of dust grains, and is more abundant in other parts of the layered terrain outside of this map area. Unit Ad is found only on exposed layered deposits, suggesting that saltation of dark particles strips away the dust mantle. Local saltation of the dark particles in unit Ad would also be expected to eject dust grains into suspension, or allow them to trickle down between dark particles and out of sight. This unit may have been deposited recently, perhaps with particle motion continuing until the present. Image resolution is insufficient to resolve dune forms, and there is no evidence of temporal variations in the extent or location of the dark material.

Areas mapped as partially covered by frost (unit Apf) generally have uniform albedo at the resolution of available images. This unit is interpreted as a mixture of seasonal frost and bare ground based upon its albedo, color, and temporal variability. Although patches of frost and bare ground can be distinguished in some places, the length scale of mixing is commonly below the resolution of the images. Areas of this unit are observed to darken as summer progresses, suggesting that CO_2 frost is subliming throughout the season. Topographic roughness on centimeter to decameter scales may allow seasonal frost to remain in shadowed depressions, protected from solar heating [7]. Many of the boundaries between the partial frost cover and adjacent units are narrowly gradational at the resolution of the images.

With the exception of areas covered by perennial frost, the south polar layered deposits appear to have undergone net erosion in the recent geologic past. Solar heating of the deposits causes sublimation of the water ice within them [9,10], probably forming a lag deposit of non-volatile material. Such a nonvolatile layer would protect underlying water ice from further sublimation. Herkenhoff [11] proposed that minor amounts of dark, magnetic dust exist in the layered deposits along with the bright, red dust (unit Am) that covers much of the Martian surface. The magnetic dust may preferentially form filamentary sublimation residue particles [12] that eventually erode and saltate, ejecting the remaining dust into suspension. Dark particles that are about 100 microns in size will continue to saltate until trapped by an obstacle or in a depression, forming isolated patches of unit Ad. Eventual destruction of such particles could allow the dark dust to be recycled back into new layered deposits via atmospheric suspension.

The above scenario is consistent with the color, albedo, and geology of the units mapped here. The thin dust mantle appears to be a temporary feature, perhaps deposited during a major global dust storm such as that observed in 1971. Where it has been removed by winds, the water ice in the layered deposits is protected from further sublimation by a weathering rind of dust and residue particles. Layers may be currently forming where frost remains on the surface throughout the year [7].

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Unit	Interpretation	Violet	Red	R/V
(1) Arc	residual polar ice cap	0.18-0.43	0.27-0.53	1.2-1.6
(2) Am	dust mantle	0.04-0.05	0.14-0.18	3.2-3.8
(3) Ald	layered deposits	0.03-0.05	0.10-0.13	2.5-3.2
(4) Apf	partial frost cover	0.05-0.09	0.14-0.21	2.2-2.9
(5) Ad	dark material	0.02-0.05	0.04-0.10	1.8-2.1

TABLE 1. Lambert albedos and colors of surface units