SOURCES, SINKS AND MIGRATION PATTERNS OF DARK VENEERS IN THE NORTH POLAR DEPOSITS OF MARS. J.A.P. Rodriguez1, K.L. Tanaka2, and S. Sasaki3

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1. Introduction: We find that veneers of dark materials commonly mantle the surfaces of the upper and lower layered deposits (ULD and LLD, respectively [1-2]) in the Martian polar plateau. These veneers do not follow the topography and form thin coatings on the polar surface that darken and locally obscure the underlying topography. Dark veneers display serrated margins oriented in the wind direction (Fig.1). The LLD appear to consist of indurated, competent materials having unconformities that indicate a complex formational history of erosion and deposition. The ULD unconformably overlie the LLD [1], are characterized by higher albedo, and appear to lack unconformities, which suggests that its formation did not involve significant erosional stages.

Figure 1. A. Dark veneers form thin coatings over north polar layered deposits. (MOC image M2201239 centered at 285.34°W, 84.17°N; north is up.) B. Multiple dark veneers obscure the underlying topography. (MOC image R2300271 centered at 87.65°W, 86.93°N; north azimuth is 157.25°.) C. Region west of Chasma Boreale where the polar deposits show numerous troughs. The white arrows show dark veneers whose orientation indicates mass transfer from Chasma Boreale and into the polar cap. The black arrows show dark veneers whose orientation indicates mass transfer into Chasma Boreale. White dots show troughs infilled with dark deposits. (THEMIS VIS mosaic centered at 34.35°E, 82.10°N)

Figure 2. Dark layers within north polar troughs. A. The black arrows show a dark layer of the ULD that lies unconformably over LLD. The white arrows show zones where this layer has been eroded into a trough. (THEMIS VIS mosaic centered at 85.02°E, 82.82°N.) B. The arrows show a dark layer between the LLD and ULD, from which veneers of dark materials appear to source (right arrow). (THEMIS VIS mosaic centered at 24.26°E, 85.25°N.)

2. Sources of dark veneers within the northern polar layered deposits: We propose that the primary source of these dark materials is most likely a basal dark layer of the ULD shown in fig. 2, which sits unconformably on the LLD. In troughs, this layer is eroded and dark veneers emerge from it, which indicates that it consists of easily-erodible materials (Fig.2). We propose that prior to the formation of the ULD, these dark materials blanketed the LLD. The trough systems appear to have developed during the accumulation of the LLD [1]. Therefore, the emplacement of dark materials over a pre-existing irregular topography may have led to the formation of thick deposits over the troughs. Erosion of
these deposits would have been an important source for
the dark veneers.

3. Nature of polar surface undulations: We propose
that the surface undulations that are apparent on the
surface of the ULD formed due to the deposition of ULD
materials over troughs, whose vertical relief had been
subdued by the existence of thick deposits of dark
materials, which is consistent with the following
observations: (1) the trough systems have similar widths,
lengths, and orientations to the systems of undulations
(Fig.3); (2) the deepest part of undulations are marked by
elongate enclosed troughs, which typically contain dark
deposits (Fig.4); (3) dark deposits are common near the
trough emergence zones (Fig.3).

4. Patterns of migration and accumulation of dark
veneers over the polar surface: Dark veneers
commonly appear to record bimodal wind directions,
which appear to vary significantly at regional scales
(Figs.1, 5). Wind directional patterns are consistent with
significant mass transfer within Planum Boreum, and
between Planum Boreum and circum-polar plains, which
may have led to recent erosional and depositional
episodes (Fig. 5).

Figure 3. Portion of Planum Boreum west of Chasma
Boreale centered at 7.10°E, 80.59°N characterized by
arcuate trough systems and aligned enclosed
depressions where both the LLD and ULD are exposed.
A. In this THEMIS VIS mosaic, the troughs become
brighter towards the periphery of Planum Boreum (white
pointer). B. MOLA-derived DEM of the same region as
in A. Notice how the troughs and enclosed depressions
(green arrows) are continuous and parallel to
undulations in the ULD.

Figure 4. A. Enclosed and elongate trough that forms
the deepest part of a surface undulation that has a sub-
parallel trend to an adjacent trough (Fig. 3). Whereas
dark deposits are being eroded off the trough forming
dark veneers over its margin, these deposits are not
common along the surface depression that forms the
undulation, which indicates that the dark materials may
be the top of an underlying dark layer. B. Dark material
infilled enclosed trough that is adjacent to a trough that
opens to the circum polar terrains. Notice how the end
tip of the open trough (white pointer) is also infilled with
dark materials that are undergoing erosion, and that the
surrounding polar surface and trough surface appear to
be clean of these deposits.

Figure 5. THEMIS VIS composite centered at 40.45°E,
82.82°N. The white arrows show dark veneers whose
orientation indicates mass transfer from Chasma
Boreale and into the polar cap. The black arrows show
dark veneers whose orientation indicates mass transfer
into Chasma Boreale. The White dot shows a trough
infilled with dark deposits, and the black dot shows a
dune field. Both terrains appear to have undergone
recent erosion and deposition.