

Sources, sinks and migration patterns of dark veneers in the northern polar deposits of Mars

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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. 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, are characterized by higher-albedo, and appear to lack unconformities, which suggests that its formation did not involve significant erosional stages.

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, 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-erodable materials. 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. 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; (2) the deepest part of undulations are marked by elongate enclosed troughs, which typically contain dark deposits; (3) dark deposits are common near the trough emergence zones.

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. 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.

References. [1] Tanaka K.L. (2005) *Nature* 437, 991-994. [2] Howard A.D. et al. (1982) *Icarus* 50, 161-215.