CHARACTERISTICS OF A BASAL UNIT OUTCROP BENEATH THE MARS NORTH POLAR CAP
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Introduction: We have discussed the possible origin of the Mars north polar basal unit [Fishbaugh and Head, this volume]. Here, we describe the detailed characteristics of an outcrop of that unit and implications for its depositional history.

Observations: We have created a detailed sketch map of a basal unit outcrop in MOC image E02/01209 (Fig. 1). The layering within the unit is complex, with no single layer extending across the entire image (a distance of about 3.3 km). The outcrop exhibits 3 main sequences. At the bottom of the image, lying stratigraphically at the base is a rough textured, dark material. This texture could be a result of the presence of hummocks, boulders, or small dunes. Above this lie alternating bands of bright and dark material, and above this are the PLD (about 125 m thick).

Within the alternating light and dark bands of the basal unit is a section just below the PLD with steeper slopes (about 40°) than the more exposed basal layers below it. There are about eight dark layers in this section. Note that the data in the MOLA profile (Fig. 2) include no data points within this section of the PLD. However, it can be estimated from the surrounding data points that this section is about 300 m thick; therefore, each dark layer is about 35 - 40 m thick. As explained, below, the lighter layers are much thinner than the darker. Within this section, no particular layers extend across the entire image. The PLD unconformably overlie the basal unit as illustrated by the fact that the top basal unit layer does not extend uniformly across the image but is instead eroded in some places (Fig. 1).

Between the dark material and Layer 1, there exists a narrow, bright halo of material. Either this represents 1) a very thin layer or 2) material which has mass wasted from the material above and collected here. Layer 1 forms the base of the basal unit. This layer is characterized by a relatively low albedo and by lineations likely of eolian origin which may either be yardangs or longitudinal dunes. Darker layers above and the dark material below this show no such evidence of eolian reworking. It is thus assumed that the eolian features are not currently forming but have been exhumed by erosion of overlying layers.

Overlying Layer 1 is the brighter Layer 2. Since the texture of Layer 1 shows through in Layer 2, it can be assumed that Layer 2 is thin compared to Layer 1. This same relationship is apparent throughout the basal unit in this outcrop. The bright halo at the base of Layer 1 may consist of material eroded from the brighter layers. Note its diffuse, irregular nature. Bright streaks cross-cut many of the layers just below the PLD. There is little to no evidence of mass wasting of the darker material. Therefore, the brighter material is interpreted to be more mobile than the darker. While ridges of unknown origin appear in a few of the dark layers above Layer 1, these layers are for the most part featureless.

Although this image does not contain any dunes, a nearby, partially overlapping image does contain dunes which overlie the basal unit layers. Thin layers with low albedo like the dunes can be traced in the lower PLD and may be the source for these dunes.

Discussion: If the darker material indeed consists in large part of sand, then the mobility of the brighter material is consistent with a dust composition. However, as of yet, the possibility cannot be ruled out that the bright layers are actually mass-wasted deposits from the PLD or frost deposits which have collected at the base of the scarps associated with each dark layer. Relationships between light and dark layers are complex, and the layers exhibit horizontal discontinuity and pinching-out. Thus, the basal unit was not deposited as one 500 m-thick pile of sediment, and the layers of the basal unit have not all been deposited in the same environment. In almost no places are two dark layers superposed without an intervening bright layer. Formation of each dark layer may have been followed by a period of relative inactivity while dust covered the layer. The PLD unconformably overlie the basal unit, presumably indicating that some erosion of the basal unit occurred before deposition of the PLD. While a few candidate impact craters dot the lower layers of the basal unit in this outcrop, there is not enough exposure of the upper basal unit layers and lower PLD layers (and therefore of craters within these layers) to confidently identify them or estimate the time span separating the two units. If the dark layers in the lower PLD of a nearby image are the source of dunes, they may have been deposited during the transition between basal unit and PLD deposition.

Summary: The basal unit has had a complex depositional history. Internal layers exhibit differential erosion, differing amounts of eolian reworking, pinching-out, alternating relatively high/low albedos., and possible small-scale deformation. The basal unit/PLD contact is also complex, exhibiting unconformities and possibly being the source of the north polar dunes. We will continue to examine more outcrops in detail to better understand the depositional environments of this unit, its relationship with the overlying PLD and dunes, and its possible origin (see Fishbaugh and Head, this volume).
Figure 1. (bottom) MOC image E02/01209 at edge of polar cap (centered at 237.80°W, 83.85°N) showing outcrop of PLD and eroding layers of the basal unit. Arrow indicates illumination direction. Line indicates MOLA profile location. (top) Sketch map of MOC image below outlining major layers. Numbers refer to specific layers discussed in the text and increase upwards stratigraphically.

Figure 2. MOLA profile extending across MOC image in Fig. 1. Vertical exaggeration = 124x.