PRESERVATION OF LAYERED PALEODEPOSITS IN HIGH-LATITUDE PEDESTAL CRATERS ON MARS. S. J. Kadish[1] and J. W. Head[1], [1]Brown University, 324 Brook St, Box 1846, Providence, RI, 02912 (Seth_Kadish@Brown.edu).

Introduction: Pedestal craters (Pd) on Mars were first identified almost 40 years ago in Mariner 9 data [1], and have since been defined as an impact morphology characterized by a crater perched near the center of a plateau, surrounded by a scarp [2,3]. Our recent analyses offer evidence that the target material from which Pd form must be ice-rich [4-6]. The sublimation model for Pd formation posits that impacts occur into ice-rich targets during periods of higher obliquity. The impact armors the proximal surface of the ice-rich deposit. During return to lower obliquity, the deposit sublimates, lowering the elevation of the intercrater terrain. Beneath the armored cover around the crater, however, the ice-rich deposit is preserved, yielding a pedestal. For a more detailed description of the formation model, see [5].

Supporting work from climate models [e.g. 7] has shown that the ice-rich material necessary to produce Pd can gradually accumulate (~10-20 mm/yr) at mid to high latitudes under certain atmospheric and obliquity conditions. Madeleine et al. (2009) specifically identify the need for a high dust opacity in order to form these deposits, which accumulate episodically on both short timescales, due to seasonal effects, and longer timescales, due to obliquity cycles. Given the episodicity in accumulation, we would expect to see layers of dust and ice, similar to those in the polar layered deposits [e.g. 8,9], exposed along the marginal scarps of Pd. Here, we provide evidence for these layers in high-latitude Pd (poleward of 65°) in both hemispheres.

Exposed Layers: We have identified 12 Pd with visible layers, five in the northern and seven in the southern hemisphere [10]. The presence of layering is usually established on the basis of albedo differences between adjacent layers. However, in some cases, layers are primarily expressed topographically, creating stepped pedestal margins, without providing any significant albedo variations. The layers in most pedestals, however, are expressed both by albedo and topography (Fig. 1). The number of layers in a pedestal can range from three to more than thirty, with the thicknesses of individual layers varying between two and more than twenty meters as measured from MOLA shot data. These layer thicknesses are not constant in any given pedestal. Layers are often continuous around the entire perimeter of the pedestal, although some are interrupted by material overlying the scarp, and may disappear for several kilometers (Fig. 2).

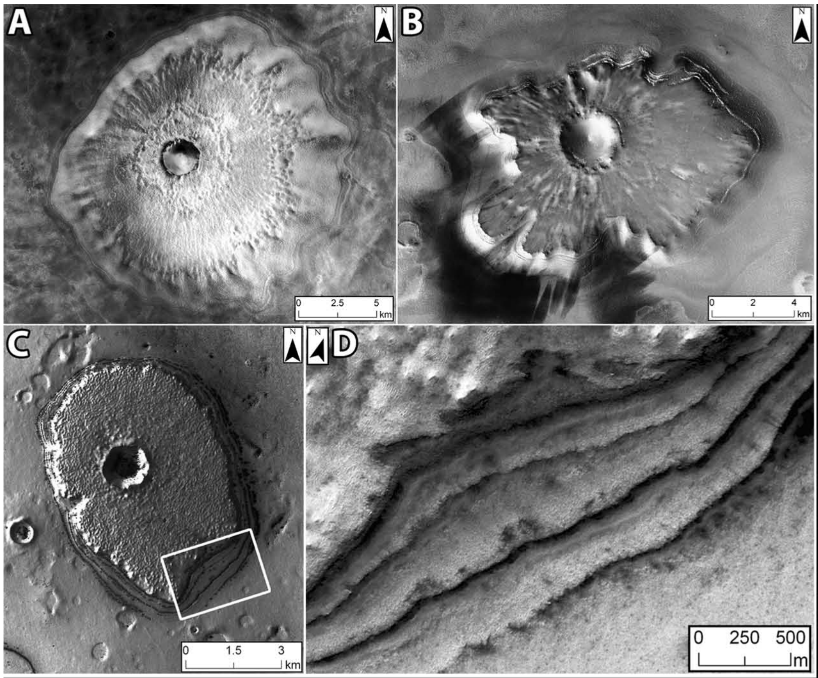
There is one Pd on the south polar layered deposits (SPLD) that has armored the proximal surface (Fig. 3). The surrounding intercrater terrain has since sublimated/eroded, exposing a clear sequence of layers along the pedestal's scarp. The SPLD are ice-rich, with dielectric properties consistent with a bulk composition of nearly pure water ice [9]. The stratigraphically lower layers in this pedestal are contiguous with surrounding layers of the SPLD, but the pedestal has preserved some layers just beneath the armored surface which are no longer present in the proximal region. As such, this particular example offers empirical evidence of the ability of Pd to preserve ice-rich layers.

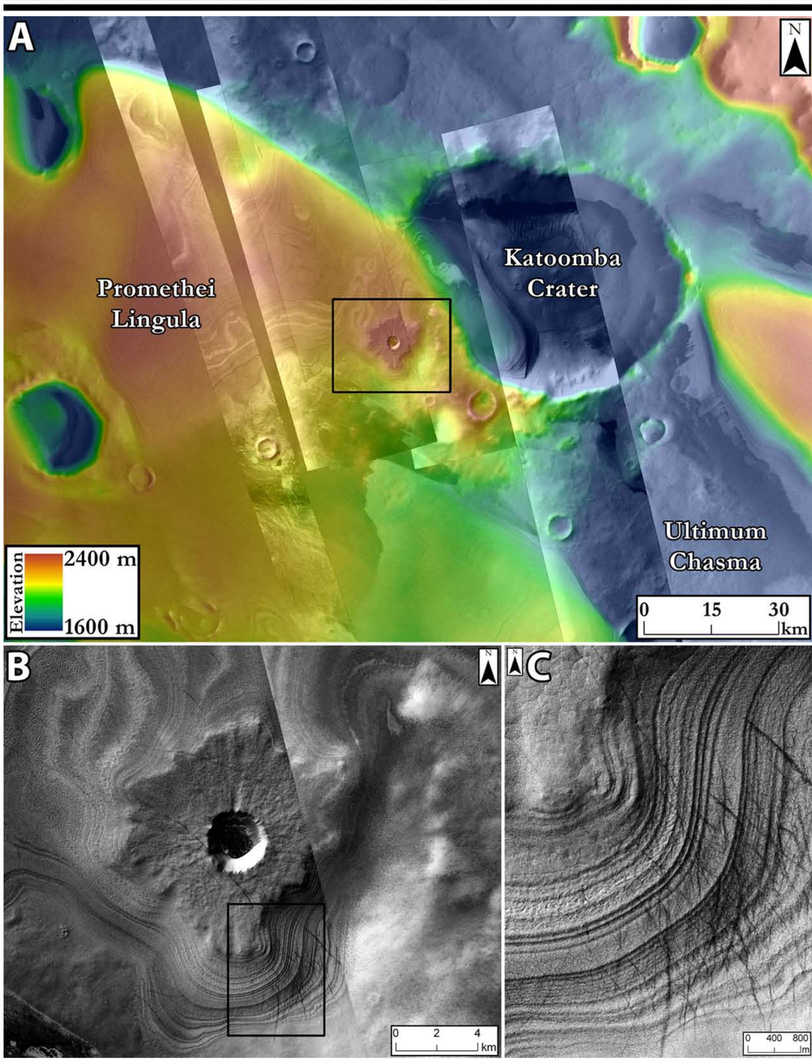
Discussion: The existence of high-latitude Pd with exposed layers (Fig. 1), where thick deposits of snow and ice have been repeatedly deposited throughout the Amazonian [11], supports the model that Pd form from impacts into ice-rich material. Although the ice-rich material does not need to be layered for Pd to form, the episodicity in ice accumulation on both seasonal and obliquity-cycle timescales, in conjunction with the need for a high dust opacity [7], supports the interpretation that the deposits would be layered.

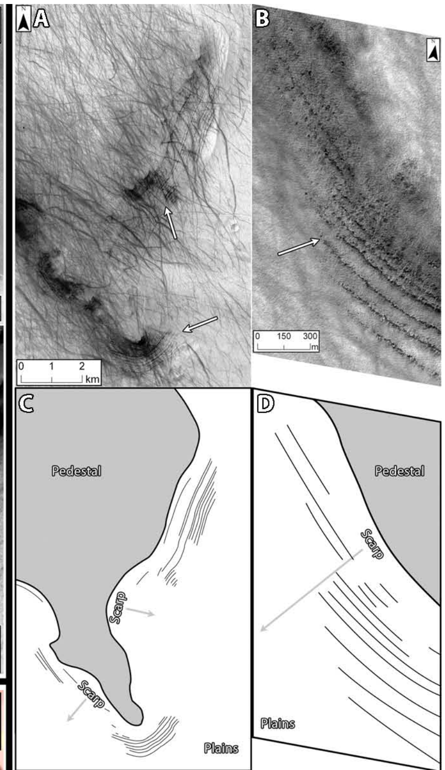
In order for a pedestal's layers to be visible, a fresh face of the marginal scarp must be exposed, but it is likely that most scarps have been covered via deposition (e.g. mantling) or degraded via mass wasting (e.g. slumping). We have identified numerous examples of discontinuous layers that have been partially covered (Fig. 2). This supports the notion that Pd that initially have layered exposures can be modified/buried to conceal these exposures. As such, the paucity of Pd with exposed layers is not surprising.

Although additional evidence is needed to establish whether all Pd contain ice-rich layers, the data in this study show that pedestals are capable of preserving ice-rich paleodeposits. Our measurements confirm the trend that layers tend to be visible only on the marginal scarps of Pd that are anomalously large and tall. This suggests that the process of covering layers occurs readily and repeatedly. We are currently utilizing new CRISM, HiRISE and SHARAD [12] data to identify water ice signatures along pedestal scarps, look for subtle expressions of partially concealed layers, and detect layers within large Pd.

References: [1] McCauley J. (1973) *JGR, 78*, 4123. [2] Arvidson R. (1976) *Icarus, 27*, 503. [3] Barlow N. et al. (2000) *JGR,* 105, 26733. [4] Kadish S. et al. (2008) *GRL, 35*, L16104. [5] Kadish S. et al. (2009) *JGR, 114*, E10001. [6] Kadish S. et al. (2010) *Icarus, 210,* 92-101. [7] Madeleine J.-B. et al. (2009) *Icarus, 203*, 390. [8] Milkovich S. and Head J. (2005) *JGR, 110*, E01005. [9] Plaut J. et al. (2007) *Science, 316,* 92. [10] Kadish S. and Head J. (2010) *Icarus,* under review. [11] Head J. et al. (2003) *Nature* 426, 797. [12] Nunes D. et al. (2010) *JGR,* under review.







(1 - Top Left): Three Pd that show layers along their marginal scarps. A) Layers are continuous around the base of the marginal scarp, but are not visible in the light-toned material that forms a halo around the edge of the Pd surface (CTX image P17_007516_2496). B) Topographically expressed layers (CTX image B01_010074_2564). C) Dark discontinuous layers surrounding a very rough-textured pedestal surface. The white box outlines the location of the image seen in part "D" (CTX image B08_012702_1012). D) The four visible layers have a distinctly lower albedo than the rest of the scarp, and create a stepped pedestal margin (MOC image s1101636).

(2 - Bottom Left): An example of a Pd that is superposed on the south polar cap. The armored surface is preserving the local SPLD sequence. A) A CTX/THEMIS mosaic with MOLA topography showing the geologic context. B) A CTX mosaic (images B11_013884_1011 and P06_003520_1009) of the Pd. The black box outlines the image in part "C". The layers are particularly clear along the south-facing section of the marginal scarp, where they closely mimic the curvature of the pedestal perimeter. C) An enlarged view of the layers, showing that the pedestal is responsible for preserving the ice-rich SPLD.

(3 - Top Right): Two distinct segments of the scarp of a massive Pd showing discontinuous layering at different scales. In both images, the lobes of material overlying the layered scarp are contiguous with the surrounding plains material, and in some cases are contiguous with the pedestal surface as well. Because of this, when a sequence of layers is only partially covered, the layers that are stratigraphically on top are usually the ones that remain exposed. A) A section of CTX image B12_014321_1131. B) A section of HiRISE image ESP_014031_1125. C-D) Sketch maps of the scenes, illustrating the striking discontinuity of the layers. Grey arrows point in the downslope direction along the marginal scarps.