RESIDUAL SOUTH POLAR CAP OF MARS: CONTINUING CHANGES AND THEIR SIGNIFICANCE

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Introduction: The residual south polar cap (RSPC) is a unique layered deposit of CO_2, consisting of at least two major units [1] and currently undergoing sublimational erosion of a variety of forms of depressions [1,2]. Continued monitoring by Mars Global Surveyor and now by Mars Reconnaissance Orbiter allows development of a view of the stratigraphy and its possible significance for Martian climate and seasonal weather. This report provides results of measurements of 3 full years of changes and expands on the mapping of morphologic types given earlier [1]

Basic makeup of the RSPC: The older unit (Unit A; ref. 1) is made up of 4-6 ~2-m layers, has an upper surface marked by shallow polygonal troughs, and is cut by a variety of depressions up to ~1 km across, but typically 200-600 m in diameter. A younger Unit B overlies erosional remnants of A and fills depressions eroded in A. It consists of at least 3 ~1-m layers, one of which probably formed after Mariner 9 imaging in 1972. Preferential widths of moats indicate a specific history of backwasting interrupted by deposition of layers.

Observed changes in the RSPC: Expansion of depressions in the RSPC was observed for 1 Mars year [2]; and 2 Mars years [1]. Change continued through a third Mars year [3]. The current southern spring and summer will provide data on the fourth Mars year, where changes of ~1 m can be observed. The 3-year rates are similar to the two-year rates wherein unit A erodes substantially faster than does Unit B (Fig. 1).

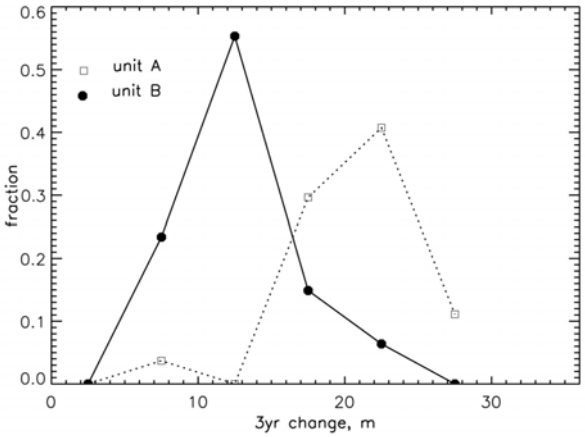

Figure 1. 3-Mars year (MY 24-27) backwasting in the RSPC. Change is the difference in diameter of depressions or width of septa between depressions. Single-year, single-face rate is obtained by dividing by 6.

Observed changes are overwhelmingly those of backwasting of steeper slopes; the upper surfaces of both units A and B appear stable on long time scales. Exceptions occur, and are noted below.

Stratigraphic context of observed changes: The sequence of erosion and deposition can be combined with the observed rates of erosion to estimate a history of the cap. A crucial element is assumption of the length of time represented by deposition of individual layers. Because they are less than a factor of 2 thicker than present annual layers, and because unit A's greater erosion rate suggests greater porosity, we assume they are single year events. As such, the RSPC has a history of over 100 Mars years [1,4], with deposition being the unusual events, and erosion being the norm.

Unresolved issues and continuing work: While most erosion is backwasting, unit A appears to collapse in some places. Mars Orbiter Camera (MOC) images of the third year of changes confirmed these piles of debris are shrinking. Early spring images by Mars Reconnaissance Orbiter Context Imager (CTX) indicate we will be able to follow development of the whole range of debris and slope processes in all parts of the RSPC to test for the conditions that give the different forms of erosion. CTX will allow complete mapping of the cap and will follow in detail seasonal processes such as albedo changes and erosion, in all RSPC terrains; these were sampled only incompletely by MOC.

Continuing coverage will allow delineation of additional units within the cap; while units A and B occur throught the cap, intercalation of other types of layers is possible, and would expand the complexity of the stratigraphic story.

References: [1] P. C. Thomas et al. (2005) *Icarus, 174*, 535-559. [2] M. C. Malin, M. A. Caplinger, S. D. Davis (2001) *Science 294*, 2146-2148. [3] P. B. James et al. (2007) submitted to *Iacrus*. [4] S. Byrne, A. P. Ingersoll (2003) Geophys. Res. Lett. 30, 29-1-29-4.