

Interannual and Seasonal Variability in the North Polar Region of Mars: Observations in Mars Years 29 and 30 by MARCI, CTX and CRISM. W. M. Calvin¹, P. B. James² and B. A. Cantor³, ¹Geological Sci. & Eng., MS 172, University of Nevada, Reno, NV 89557 (wcalvin@unr.edu), ²Space Science Institute, 4750 Walnut Street, #205, Boulder, CO, 80301, ³Malin Space Science Systems, San Diego, CA 92191.

Introduction: There is a long history of telescopic and spacecraft observations of the polar regions of Mars. The finely laminated ice deposits and surrounding layered terrains are commonly thought to contain a record of past climate conditions and change. Understanding the basic nature of the deposits and their mineral and ice constituents is a continued focus of current orbiter spacecraft. We have identified a number of seasonal variations and seek to understand their connections to the finely laminated units observed in high-resolution images. In particular, we hope to uncover how the transport of ices and dust between surface and atmosphere reservoirs and among various surface deposits is linked to the observed geomorphology as well as the dependence of observed changes on global and local weather systems.

Summary of Past Observations: Earlier workers noted the change in albedo in a number of north pole bright outliers and in the overall coverage by bright ice deposits both between Viking summers and between Viking and Mariner 9 [1-3]. These observations continued with MGS MOC and TES and Mars Express OMEGA instruments [4-6]. Variability in frosted patches between martian summers were noted, and though some events appeared correlated to large planet-encircling dust storms, a great deal of variation is noted that is likely related to local, rather than global weather events. The cap undergoes a period of defrosting and sublimation of fine-grained water frosts up to Ls ~100 to 105, followed by frost migration.

Most recently, Cantor et al. [7] report on a synthesis of Mars Reconnaissance Orbiter (MRO) MARCI and CRISM data from the 2008 northern summer season (Mars Year 29 or MY29). They note large, high albedo patches in Olympia Planitia, that had not been previously observed and changes in small anomalous "bright patches" that disappeared in this year. Large scale early defrosting and subsequent brightening of the Gemini Scopuli region was observed and could either be attributed to frost removal and redeposition or frost removal followed by dust removal to expose underlying high albedo deposits.

Data Products: MRO has just completed observations of the second northern summer season, MY30, in calendar 2010. In mapping orbit MARCI acquires roughly 10 images a day, the vast majority covering the polar regions allowing for high time fidelity synoptic coverage of the varying albedo deposits. These images are mosaicked into daily global maps at MSSS

and we reproject those images into polar stereographic coordinates. Many gaps or "gores" exist in these polar projections due to the spacecraft viewing targeted locations off-nadir. We compile the "gore-free" images into time evolution movies to observe seasonal changes. Still frames allow us to observe the state of the surface deposits at the same Ls value. Data also exist for MY 28, after Ls 110, from the first year of MRO mapping orbit.

As part of an on-going observational campaign, a number of outlier bright patches were also observed with CRISM and CTX, allowing us to explore seasonal evolution in frost type, dust content and grain size of high albedo deposits that come and go over the summer season. The majority of within summer repeat observations we have examined to date are from 2008 (MY29) in the Olympia Planitia region. These data allow us to compare different proposed models for albedo changes observed here and in Gemini Scopuli.

Interannual Variability: Figure 1 compares global mosaics from MARCI at selected Ls values throughout the summer season for MY 29 and 30. Near summer solstice we note that the Gemini Scopuli region shows fewer high albedo areas in MY 30 than in MY29. The high albedo deposits in the Olympia Planitia dune region seen in MY29 are not observed in MY 30. Just after solstice, Rupes Tenius and Abalos Mensa are significantly darker in MY30 than in MY29 and may be the source for a large dust plume that emerges over this area between 9/30/2010 and 10/1/2010. Later in the season the polar layer deposits remain darker in Gemini Scopuli, Rupes Tenius and Abalos Mensa. Comparison of high resolution images between the two years should begin to quantify the amount of material deposited or removed to account for these interannual differences.

Summer Season Mobility: A number of repeat coverage images from CRISM and CTX show removal and deposition of high albedo deposits. We are currently modeling the spectral properties of these materials and will present that at the meeting.

References: [1] Bass et al. *Icarus*, 144, 382-396, 2000. [2] Kieffer, JGR, 96, 1481-1493, 1990, [3] Paige et al. *JGR*, 99, 25959-25991, 1994. [4] Cantor et al. *JGR*, 107(E3), 10.1029/2001JE001588, 2002. [5] Calvin, W.M. and T.N Titus, (2008) *Planet. Space Sci.* 56 (2), pp. 212-226. [6] Langevin, Y., et al. (2005), *Science*, 307, p. 1581. [7] Cantor, B. A. et al. (2010), *Icarus*, 208 (1), pp. 61-81.

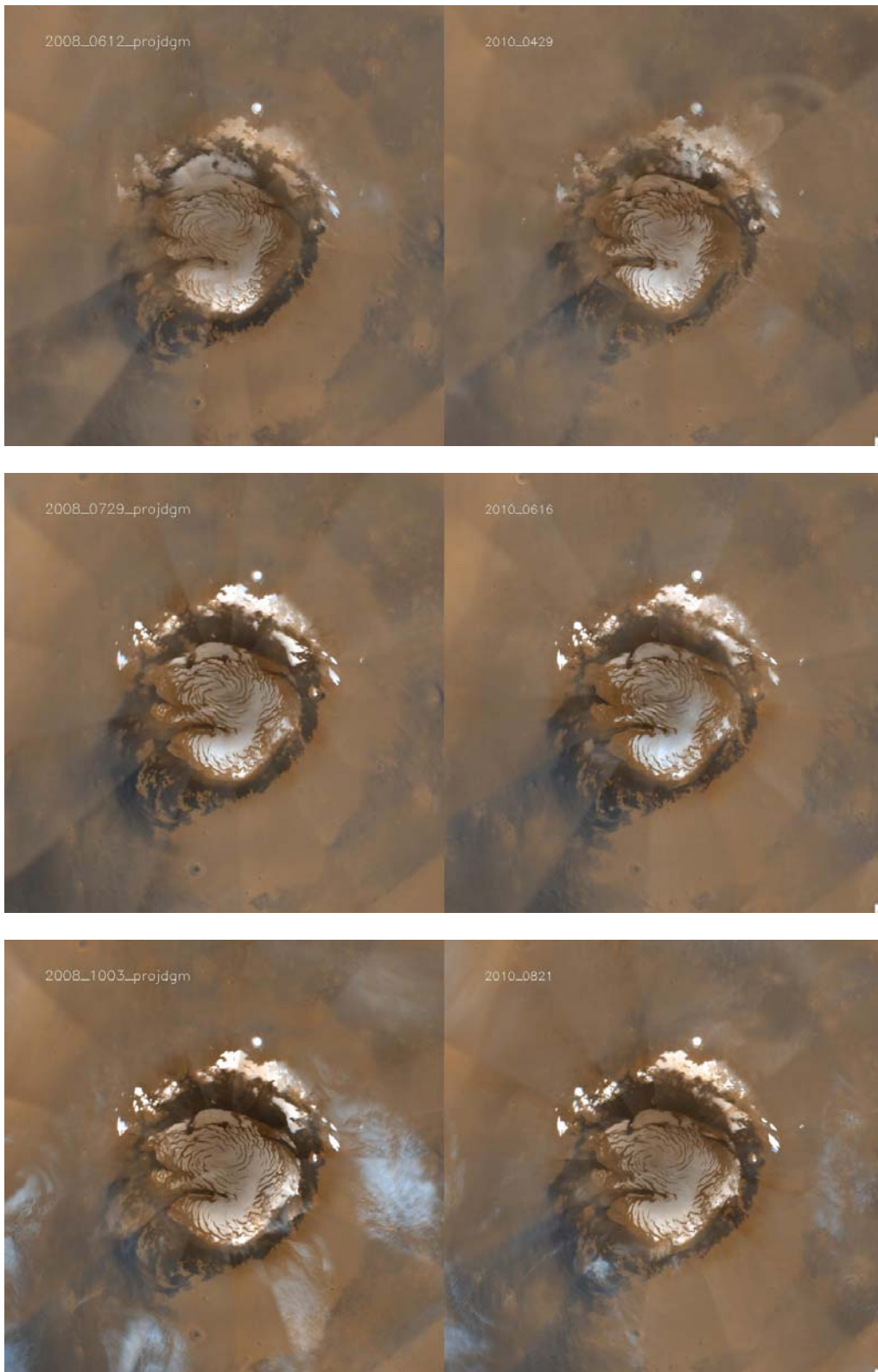


Figure 1 : MY 29 (left) and MY30 (right) MARCI mosaics for Ls 84 (top), Ls 105 (middle) and Ls 136 (bottom).