At the Margins of the Martian Southern Seasonal Cryptic Terrain, Evolution at CTX Scales. W. M. Calvin[1], K. D. Seelos[2], and P. B. James[3], [1]Department of Geological Sciences, University of Nevada, Reno, wcalvin@unr.edu, [2]JHU Applied Physics Laboratory, (kim.seelos@jhuapl.edu), [3]Planetary Science Institute, (pjames@cableone.net).

Introduction: The "Cryptic Region" is a large area in the retreating southern seasonal cap of Mars that develops a low albedo, but retains the cold temperature of CO_2 ice in equilibrium with the atmosphere [1]. This area has since been observed to be associated with jetting of material from underneath seasonal ice creating debris fans that darken the upper surface of the seasonal cap and mask the signature of the CO_2 ice features of the seasonal deposit [2-5]. These vent or jet sites leave surface gouges that have been dubbed "spiders" based on their radial and dendritic morphologies ([2,4,6,7].

Calvin et al. [8] observed the seasonal retreat in four Mars Years (MY 28 to 31) using MARCI. They found the large-scale boundary of this area was similar in all MY, with many small scale variations from year to year. Why the cryptic area occurs where it does and not throughout the retreating seasonal cap remains puzzling and not easily explained by elevation, deposition, or topography.

MARCI Scale Views Lead to New Observations: More detailed examination of MARCI mosaics at ~2 km/pixel identified several phenomena (also shown in Figures 1-3) that we wished to explore at higher spatial resolution using CTX and CRISM color data. The hemisphere opposite the cryptic region ("anti-cryptic") develops redder hued material than the classic dark color of the cryptic region. Near the margins of the cryptic area there is a complex interplay of dark (presumably sand), red (dust), and retreating frost. MARCI data show clear defrosting of crater rims well within the seasonal boundary (Figure 2) demonstrating that CO_2 is not an even blanket across the terrain and local accumulations appear to vary widely in depth and cover. Dark terrain consistently develops between 80° and 75°S, and 25°E to 45°E ultimately leading to the isolation of the Mountains of Mitchel from the rest of the retreating seasonal cap, but MARCI does not have the resolution to determine if this is caused by development of vent-like dust accumulation.

Based on these low resolution views, new CTX and CRISM acquisitions were requested for Reynolds and a second nearby crater (74 S, 160W and 73S 156W), Main Crater (75S, 312W), the boundary of Promethei Rupes (79S, 304W), and regions in Dorsa Argentea over the "anti-cryptic" area that retains seasonal frost very late. These observations began in MY 34 and are planned from Ls 180 to 330 in order to monitor seasonal changes in color, albedo and terrain evolution.

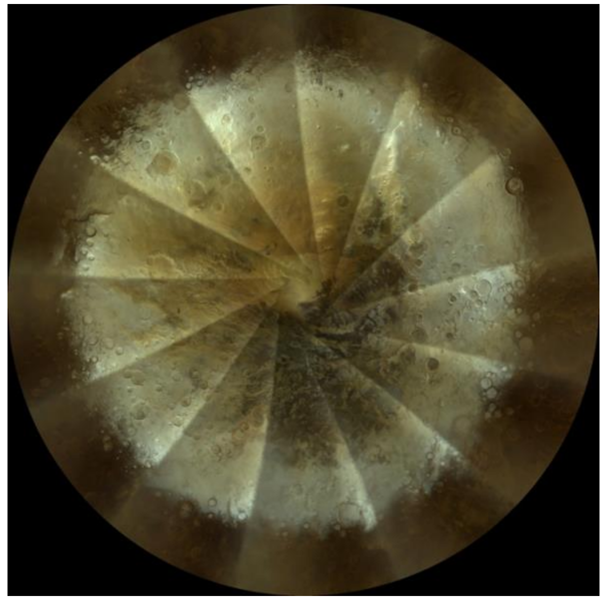

Figure 1: MARCI view of the retreating south cap and fully developed "cryptic region" in the hemisphere on the lower right, Ls 210, 2/15/2009, in MY29.

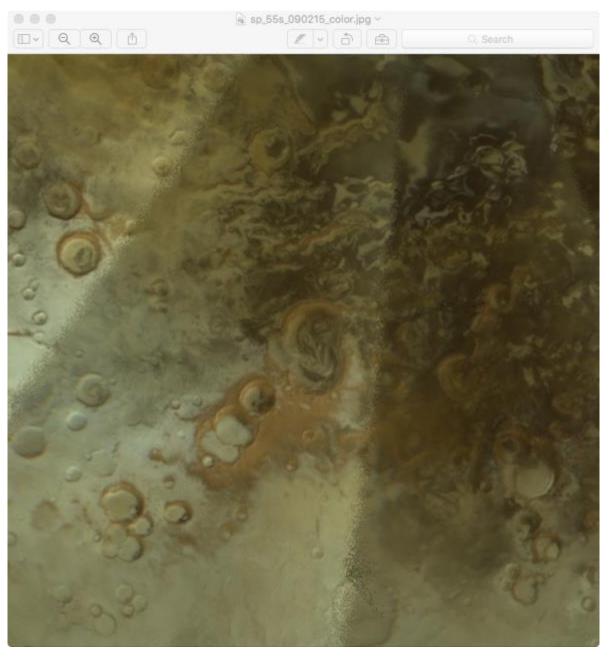

Figure 2: Close up of MARCI image from Fig. 1 over Reynolds Crater showing complex albedo and color patterns suggesting uneven seasonal frost cover and variable development of "cryptic" dark areas.

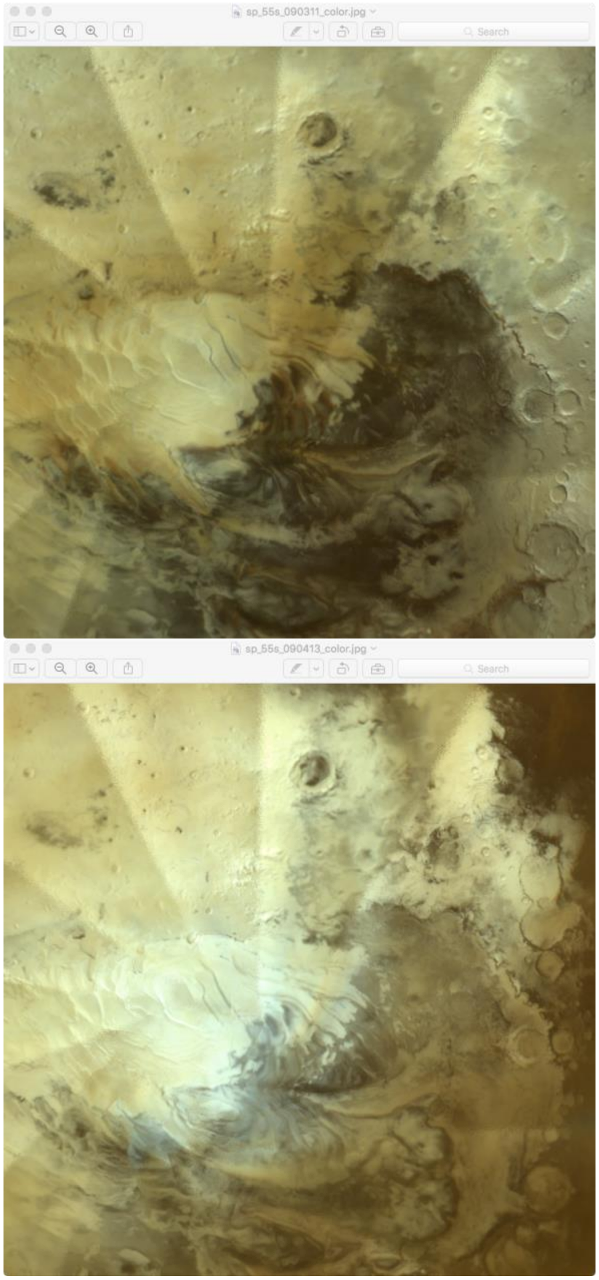

Figure 3: Close up views from MARCI in MY29 at Ls 225 (upper) and 246 (lower) over Main Crater and the boundary of Promethei Rupes selected for higher resolution imaging. Later in the retreat the cryptic terrain is obviously brighter.

Preliminary Analysis: To date we have acquired imagery ~ every 5° of Ls from 180 until 260, and then every 10° of Ls is planned until Ls 330. Multi-spectral CRISM visible data has also been collected as ride-alongs. Although the MY34 dust storm largely obscures the retreating cap in the earliest stages [9], we can observe these boundaries from ~ Ls 225 forward. Figure 4 illustrates albedo evolution in Reynolds crater from Ls 180, 183, and 239 (left to right). The first two are before the storm and the third after the atmosphere had largely cleared. We note many large bright-dark boundaries and patterns are preserved and new jet events occur in the regions that were brightest at Ls 180. We will compare these regions to unfrosted coverage in order to understand the role of local topography on the evolution of these patterns. We will also present analysis of other locations at the meeting.

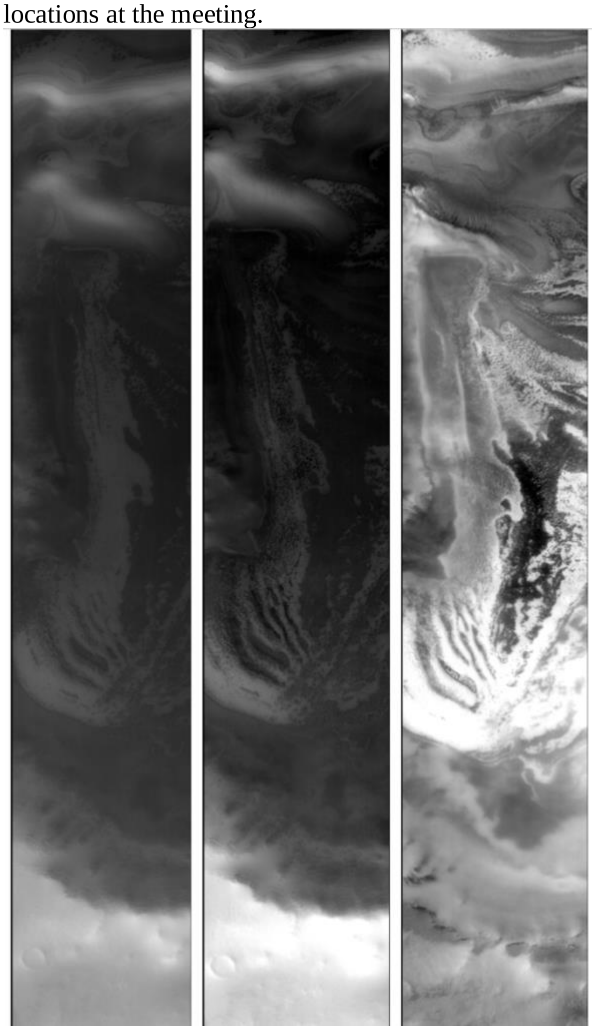

Figure 4: CTX images of albedo pattern evolution in Reynolds crater. Calibrated 8-bit data with linear stretch on each.

References: [1] Kieffer et al. JGR-Planets, 105, p. 9653, 2000. [2] Kieffer et al. Nature, 442, p. 793, 2006. [3] Langevin et al. Nature, 442, p. 790, 2006. [4] Kieffer JGR 112. http://dx.doi.org/10.1029/02006JE002816, 2007. [5] Pommerol et al. JGR, 116, E08007, 2010JE003790, 2011. [6]P iqueux and Christensen, JGR-Planets, 113, 2008. [7] Hansen et al. Icarus, 205, p. 283, 2010. [8] Calvin et al., Icarus, 292, p. 144, 2017. [9] Calvin et al. AGU, P43J-3860, 2018.