HIRISE OBSERVATIONS OF THE SOUTH POLAR REGION OF MARS. K. E. Herkenhoff[1], S. Byrne[2], K. Fishbaugh[3], C. Hansen[4], P. Russell[5], and the HiRISE Team, [1]USGS Astrogeology Team, Flagstaff, AZ 86001, [2]LPL, University of Arizona, [3]CEPS, Smithsonian Institution, [4]Caltech/JPL, [5]Universität Bern, Switzerland.

Introduction: The High Resolution Imaging Science Experiment (HiRISE) on MRO has observed the south polar region throughout the spring and summer seasons on Mars. Full-resolution HiRISE images are typically 20,000 monochrome pixels (~6 km) wide with color data in the central 4000 pixels [1]. Here we summarize preliminary analyses of these data, focusing on seasonal processes and the south polar layered deposits (SPLD). HiRISE observations of the north polar region have been discussed previously [2,3], and results for the south polar residual cap are discussed by Byrne *et al*. [4].

Seasonal Processes: Over 200 very high-resolution images (~0.25 m/pixel, resolution < 1 m) were acquired to study sublimation of Mars' CO_2 seasonal cap at a number of sites in the cryptic terrain throughout southern spring. Selected sites were imaged frequently and in stereo to study the sublimation process (Fig. 1). Erosional processes extant in high latitude regions on Mars are unlike anything experienced on Earth.

Fans of dust have been hypothesized to come from gas jets [5-9]. The scenario is summarized as follows: a seasonal layer, ~0.5 m thick, of transparent CO_2 ice forms during southern winter. In the spring sunlight penetrates through the clear, impermeable ice and warms the ground below, initiating CO_2 sublimation from the bottom of the ice layer. The gas is trapped under pressure, released either explosively or continuously through vents, entraining loose dust and lofting it up above the seasonal ice surface. "Spiders" are hypothesized to channel sublimating gas to the gas jets [6]. Prevailing winds carry the dust downwind to form spots and fans of (relatively) dark dust. Eventually patches of dust lower the overall albedo of the cryptic terrain. With sublimation of the seasonal ice layer the surface returns to a homogenous albedo. Color HiRISE images illustrate the dark fans and bright fine-grained frost on top of the translucent ice covering the surface (Fig. 1).

Study of numerous araneiform (spider-like) and other channel morphologies in HiRISE images (Fig. 2) suggests the following yearly cycle: 1) Dust blown out of an opening in the seasonal ice layer settles on top of the translucent seasonal ice on the surface. The vent size ranges from small depressions accessing the subsurface to lengthier openings along a channel side. 2) The dust is blown across the surface, preferentially getting trapped in the channels. This thicker layer of dust in a channel is only loosely consolidated, based on the way it drapes across the small-scale undulations of the surface. 3) Seasonal ice sublimes completely, and channels carved in the substrate are still visible but fans tend to blend back in with the surface material. 4) The next winter seasonal CO_2 coats the ground relatively evenly, conformally coating the surface. 5) In channels however the underlying dust is more permeable than underlying hard ice-cemented ground, which facilitates gas transport in the same place year after year. 6) Channels grow as CO_2 gas flows through and entrains material from the sides and floor of the channel year after year. Competing with this growth is the quantity of dust redistributed by the escaping gas, which may completely fill a channel. The texture of the surface adjacent to the channels suggests that channels form and grow, but may also fill and get choked off, then form new channels numerous times.

Figure 1. "Ithaca" images PSP_002622_0945 and PSP_002675_0945, acquired 106 hours apart, show dramatic changes in the color, morphology, and extent of the fans. Images were taken on Ls = 185 and 187.

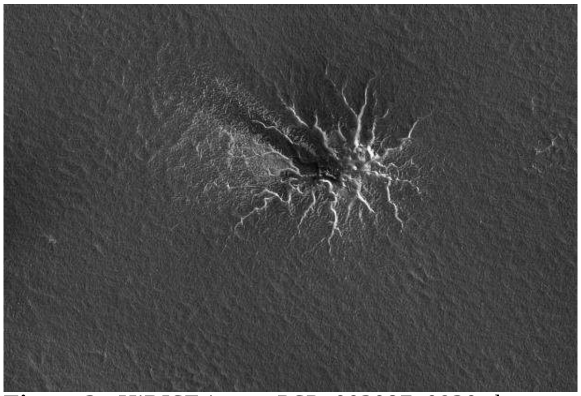

Figure 2. HiRISE image PSP_003087_0930 shows an example of a 190 x 210 m "spider" (cluster of radiating channels) with a dark spot emanating from the center and dust blown downwind.

South Polar Layered Deposits: The polar layered deposits on Mars are widely believed to record recent global climate variations [10]. Based on Viking Orbiter and MOC crater counts, the surface age of the SPLD is much greater than that of the north polar layered deposits (NPLD) [11,12]. HiRISE images of the polar regions support this conclusion, showing more small craters on the SPLD than seen in the north, although areal coverage is limited. Layering in the SPLD appears more degraded than in the NPLD, complicating stratigraphic analyses.

HiRISE images of the SPLD show interesting features, such as rectilinear fractures on exposures of SPLD (Fig. 23). The fractures are continuous across several layers and their orientation is not affected by the topography of the exposure, suggesting that they were formed before erosion of the SPLD in this area. They may be similar to a joint set that extends laterally and vertically through the SPLD.

Another example of brittle deformation of the SPLD is previously-recognized faults. Several faults have been observed by HiRISE in the SPLD, showing structural details including reverse fault splays that merge into bedding planes and possible evidence for thrust duplication. The faults may be the result of basal sliding (decollements) ramping into thrust faults near the margin of the SPLD. These and other HiRISE images of the SPLD will be discussed at the conference.

References: [1] McEwen, A. S. *et al*. (2007) *JGR 112*, doi:10.1029/2005JE002605. [2] Herkenhoff, K. E. *et al*. (2007) *Science 317*, 1711. [3] Fishbaugh, K. *et al*., *LPS XXXIX*, abstract #1781; Russell *et al*., *LPS XXXIX*. [4] Byrne, S. *et al*., *LPS XXXIX*, abstract #2252. [5] Kieffer, H. H. (2000) *LPI Contribution* #1057. [6] Piqueux, S. *et al*. (2003) *JGR 108*, 3-1. [7] Christensen, P. R. *et al*. (2005) *EOS Trans. AGU 86*, P23c-04. [8] Kieffer, H. H. *et al*. (2006) *Nature 442*, 793. [9] Kieffer, H. H. (2007) *JGR 112*, doi:10.1029/2006JE002816. [10] Thomas P. et al. (1992) In *Mars* (H.H. Kieffer et al., Eds.), pp. 767-795. Univ. Arizona Press, Tucson. [11] Herkenhoff, K. E. and Plaut, J. J. (2000) *Icarus 144*, 243. [12] Koutnik, M. *et al*. (2002) *JGR 107*, doi:10.1029/2001JE001805.

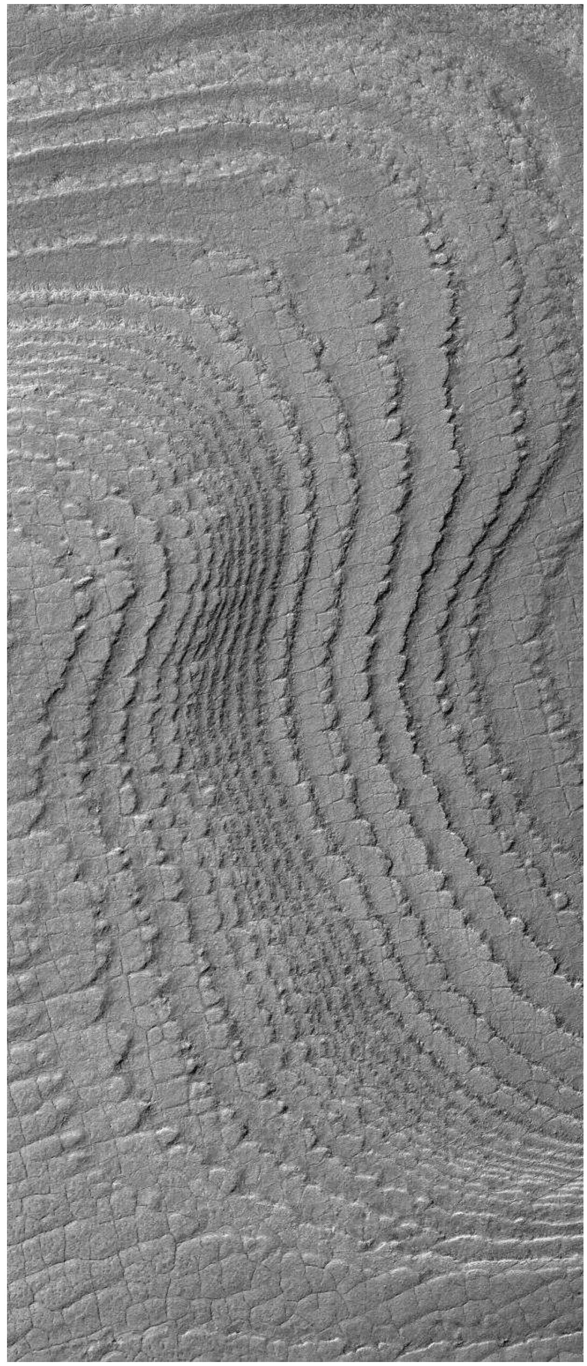

Figure 2. Part of HiRISE image PSP_004959_0865 showing polygonal fractures on an exposure of SPLD. Scene is 6 km wide, illumination from top.