HIRISE IMAGES OF SOUTHERN SEASONAL POLAR CAP SUBLIMATION FOR A SECOND SPRING ON MARS.

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Introduction: Enigmatic surface morphologies at high southern latitudes are erosional features formed by sublimation of the seasonal carbon dioxide ice cap. The Mars Reconnaissance Orbiter (MRO) High Resolution Imaging Science Experiment (HiRISE) has imaged this terrain in unprecedented detail throughout two southern spring seasons. It has been postulated [1, 2, 3] that translucent ice traps gas sublimating from the bottom of the ice layer. Where the pressure is released the escaping gas jet entrains loose surface material and carries it to the top of the ice where it is carried downwind and deposited in a fan shape. Radially-organized channels (dubbed "spiders") eroded into the surface were hypothesized to channel sublimating gas [4]. Originally it was thought that this process was confined to the cryptic region at high southern latitudes [4] however we have found these erosional features, preferably refered to as "araneiform terrain" [5] in areas not previously identified as cryptic. Araneiform terrain is covered with radially-organized channels, 1 to 2 m deep. Similar terrain with interconnecting channels, not radially-organized, is refered to as lace [5].

Investigation: Several areas in the south polar region were selected for observation of the seasonal sublimation process. These areas were imaged numerous times throughout southern spring in Mars years 28 and 29. Some sites were the same as the first year in order to investigate interrannual variability. Other new areas were also selected in the second year in order to broaden the types of terrain imaged systematically.

Second Spring First Impressions: There are significant differences between the two Mars springs in the level of activity. Figure 1a and Figure 1b compare Mars year 28 and year 29. The difference in L_s between the two images is just 0.25^0. The high density of fans in Figure 1a corresponds to the araneiform terrain and the number of fans is ~similar between the two years. The area with few fans at the top of Figure 1a, lace terrain, can be contrasted with the same region in Figure 1b. There are many more fans in the lace terrain at approximately the same time in the second year.

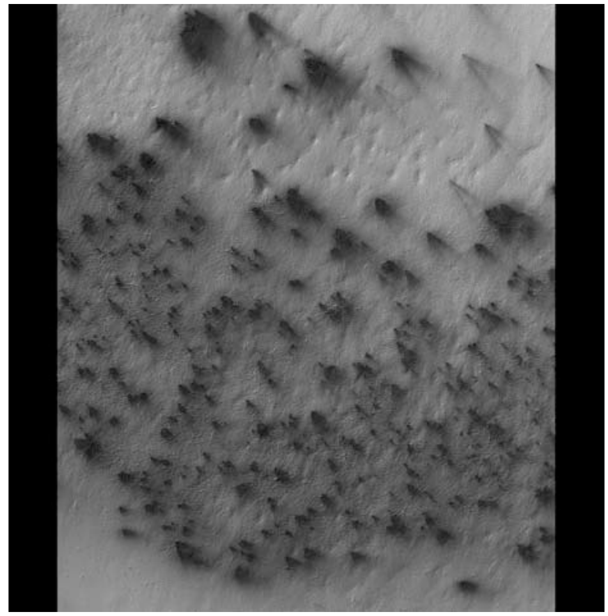

Figure 1a. PSP_002850_0935 was acquired on L_s = 195.40. The higher density of fans covers araneiform terrain. Note the lack of fans at the top of the image. The latitude / longitude is -86.387 (planetocentric) / 99.002 E. The width of the image is ~5 km.

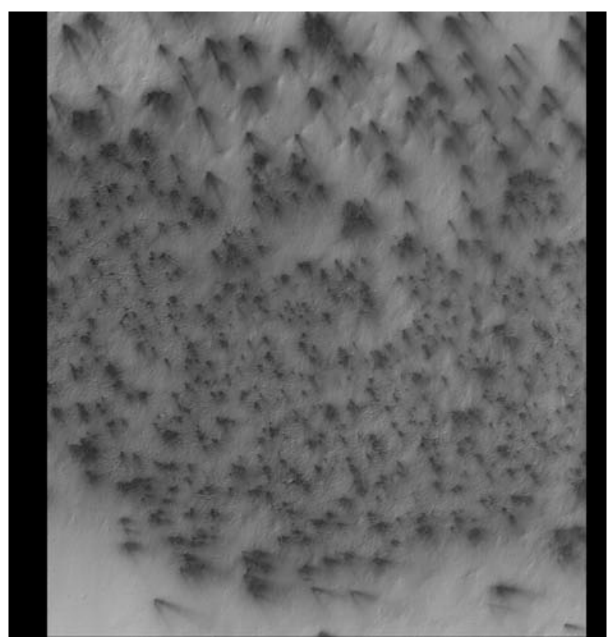

Figure 1b. ESP_011671_0935 was acquired on L_s = 195.65. The top of the image has a significantly greater number of fans.

What could cause this difference in activity? Possibilities could be a difference in ice thickness or a difference in ice albedo, that would allow ruptures and gas release to occur earlier in the season. Year-to-year differences in seasonal cap properties are not unusual both on small and large scales.

The seasonal process of sublimation was tracked for the "spiders" shown in Figure 2a [5], a sub-image of PSP_002850_0935. In the second Mars year imaged by HiRISE we zoom in on the same two spiders, in the sub-images shown in Figure 2b, a sub-image of ESP_01671_0935. Even in this region of araneiform terrain we see more small fans in the second year than were observed in the first year. The fans were larger in the first year however, so it will be important to quantify the amound of material moved – the overall gas flow may be equivalent.

Figure 2a. This sub-image of PSP_002850_0935 zooms in on two spiders studied in detail in the first year of HiRISE operation [5].

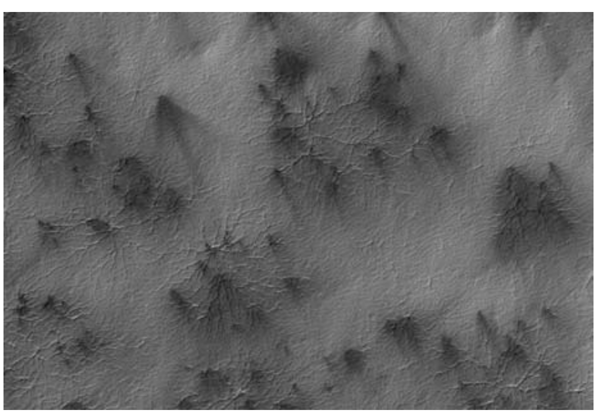

Figure 2b. This sub-image of ESP_011671_0935 zooms in on the same area. More small fans are visible at the same L_s.

Other New Findings: Images taken in areas previously not identified as cryptic terrain show similar erosional morphologies and fans. This suggests that if this mechanism of trapped gas release is correct then the seasonal ice may at least at times be translucent, or that subsurface thermal conduction alone is an adequate source of energy [6].

New images obtained show fans associated with polygonal cracks as described in [7]. Gas flow from polygonal cracks preceeds flow from the spiders, forming fans earlier in the season, shown in Figure 3.

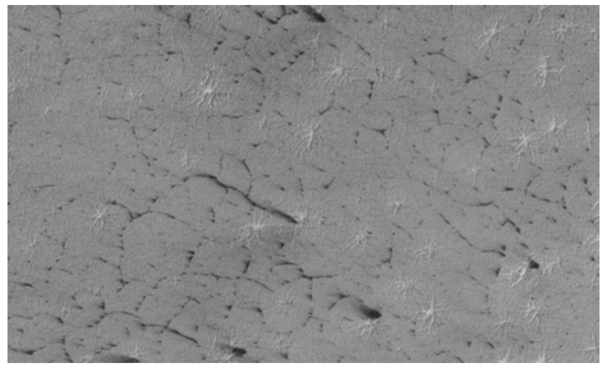

Figure 3. Sub-image of ESP_012821_0865 shows fans emerging from polygonal cracks before spiders.

References: [1] Kieffer, H. (2000) LPI Contribution #1057. [2] Kieffer, H. (2006) Nature 442:793. [3] Kieffer, H. (2007) JGR 112:E08005. [4] Piqueux, S., S. Byrne, and M. Richardson (2003) JGR 108(E8):3-1. [5] Hansen, C. J. et al., submitted to Icarus (2008). [6] Aharonson, O., et al. (2004) JGR 109:E05004. [7] Piqueux, S. and P. R. Christensen (2008) JGR 113:E06005.

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