LOUTH CRATER AND DEPOSITIONAL MODE FLIPS. A. J. Brown[1], J. Bapst[2], S. Byrne[2]. [1]SETI Institute, 189 N. Bernardo Ave, Mountain View, CA (abrown@seti.org) [2]Lunar and Planetary Laboratory, University of AZ

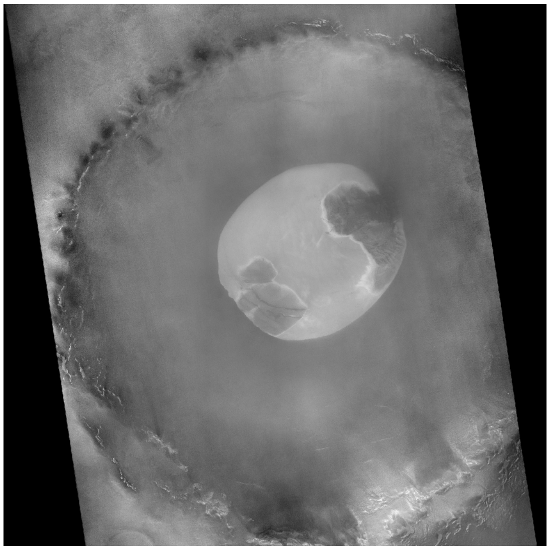

Figure 1 – Louth Crater captured by CTX image G05_020213_2503_XN_70N256W at L_s=183 showing an unexplained dark pattering in this early-fall setting.

Introduction: It has recently been observationally established that regions of the north polar cap of Mars undergo sublimation/depositional 'mode flips' in late northern summer [1]. These mode flip events are likely linked to albedo brightening detected in Viking imagery [2] and MEX-OMEGA observations [3]. We are currently investigating whether this phenomenon extends to perennially-ice-covered craters away from the north polar cap, such as Louth Crater. We report herein on our findings thus far.

Louth Crater: Louth Crater is a 36km diameter crater on the northernmost tip of Utopia Planitia at 70°N, 103.2°E (Fig. 1) that is highly appealing site for investigation of polar processes due to the presence of a 15km wide perennial water ice mound which displays layering and has been likened to the North Polar Residual Cap [4]. Louth crater is covered with seasonal CO_2 ice each winter and is subsequently uncovered between L_s=50-60 each Mars year [5]. In addition, ongoing thermal modeling of the stability of the ice

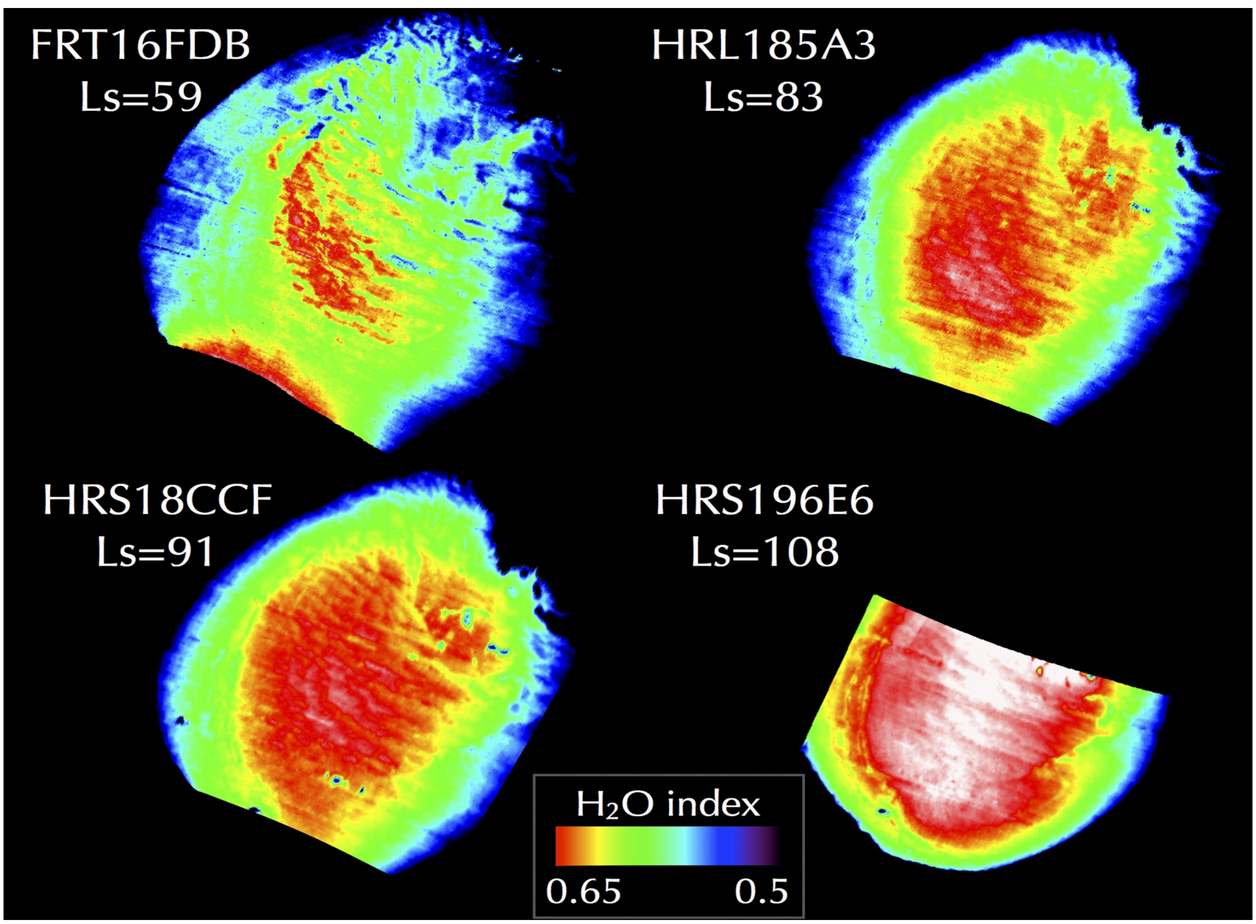

Figure 2 – Mars Year 30 CRISM observations of the evolution of the H_2O index for late spring and early summer for Louth crater ice mound and the surrounding regolith. North is up. High H_2O indexes correspond to larger grained water ice, primarily seen in the interior of the ice mound.

mound at Louth allows us to place constraints on aspects of the mound which are difficult to directly observe, such as the conductivity, porosity and layering in the ice mound and surrounding regolith [6,7,8].

H_2O depositional mode flips: As reported in [1], we have previously used observations from the CRISM VNIR hyperspectral instrument of the north polar cap during late summer for four Martian years, to monitor the summertime water cycle in order to place quantitative limits on the amount of water ice deposited and sublimed in summer. The most compelling result of this mapping is that we have identified regions and periods of 'net deposition' and 'net sublimation' on the summer north polar cap. This seasonal event enables us to place firmer estimates on the dynamics by using the concept of depositional mode flips, a previously unknown observable that is also applicable to testing and verifying Martian Global Climate Models (GCMs) and 1D thermal models of the crater [6,7,8].

Methods: We previously used CRISM H_2O index maps [1] to show that in a key region in the interior of the north polar cap, the absorption band depths grow until L_s=130°, as reported in [9], followed by a period when they begin to shrink, until they are obscured at the end of summer by the north polar hood. This 'mode flip' happens earlier for regions closer to the pole, and later for regions close to the periphery of the cap. In this way, this mode flip behavior is thought to be transferable over the entire north polar cap. Our ***scientific goal*** is to test this hypothesis using Louth Crater as an exemplar and investigate the summer depositional regime of the ice mound.

Results: Fig. 2 shows the H_2O index for four periods during mid northern summer in MY30, showing change in water ice over the Louth ice mound, with a stretch that is intended to bring out changes on the high side of the index. This shows conclusively that the H_2O index increases over this period, from L_s=59, when seasonal CO_2 is finally disappearing, to L_s=108. Fig. 3 shows the same images with a stretch that is designed to show small changes in the index on the lower end of the scale. This has the effect of bringing out subtle changes in water ice in a halo around the Louth ice mound.

We used the "MR PRISM" software suite to project the images into the same geospatial space and then difference each of the CRISM images. Fig. 4 shows the difference or delta between the four images of Fig. 3.

Discussion: The increasing trend in H_2O index over the ice mound is clear from Fig. 3, however, the same figure also shows the increase is not uniform across the whole ice mound. For example, a large amount of water ice disappears from the halo surrounding the mound from L_s=59 to 91 In addition, the western edge of the mound experiences a large growth in H_2O index from L_s=83-91. This may be due to aeolian uncovering of large grained water ice, or thermal metamorphism. It is striking that the western edge halo also experiences a decrease in H_2O index, suggesting that there may be sublimation on the halo and deposition on the adjoining western edge of the ice mound.

Take away message: We have used CRISM VNIR hyperspectral data to map the changes in the H_2O index at Louth crater. We have presented data from the early summer of MY30 and have shown an increasing trend for the H_2O index across the mound and a decreasing trend for the H_2O index on the halo region outside the mound. We have not found conclusive evidence for a mode flip as yet, but this might be due to our sparse coverage in the L_s=140-160 time period.

References: [1] Brown A.J. et al. (2016) *Icarus 277* doi:10.1016/j.icarus.2016.05.007 [2] Bass D.S. and Paige, D.A. (2000) *Icarus*, **144** 397-409. [3] Appere T. et al. *JGR* **116** doi:10.1029/2010JE003762 [4] Brown A.J. et al. (2008) *Icarus* **196** 433-445 [5] Brown A.J. et al. (2010) *JGR* **115**, doi:10.1029/2009JE003333 [6] Babst, J. and Byrne, S. (2015) *LPSC 46* #2772 [7] Bapst, J. and Byrne, S. (2016) *LPSC 47* #3027 [8] Babst, J. et al. (2017) *this meeting* [9] Langevin, Y. et al. (2005) Science **307**, 1581.

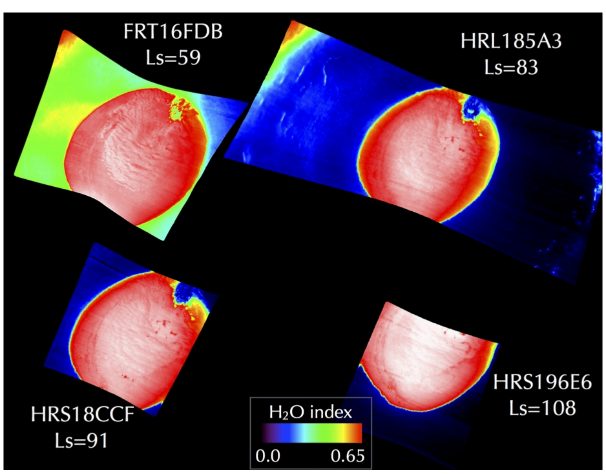

Figure 3 – As for Figure 2, but stretch is altered to show the fine grained water ice surrounding the water ice mound.

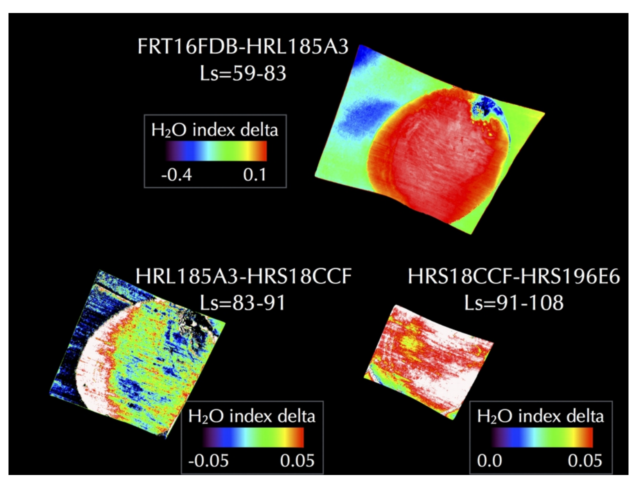

Figure 4 – Difference image for Figure 3, showing change in H_2O index over summer for water ice mound and surrounds.