

**INFRARED OBSERVATIONS OF MARS SOUTH POLAR RESIDUAL CAP: WHEN EATING SWISS CHEESE – USE A FORK.** T. N. Titus<sup>1</sup>, A. Brown<sup>2</sup>, F. P. Seelos<sup>3</sup>, S. L. Murchie<sup>3</sup>, S. Piqueux<sup>4</sup>, P. R. Christensen<sup>4</sup>, The CRISM Team<sup>3</sup>, <sup>1</sup>U.S.G.S., 2255 N. Gemini Dr., Flagstaff, AZ 86001 (ttitus@usgs.gov), <sup>2</sup>SETI Institute, 515 N. Whisman Rd Mountain View, CA 94043, <sup>3</sup>JHU Applied Physics Laboratory, 11100 Johns Hopkins Road, Laurel, MD 20723, <sup>4</sup>Arizona State University, Tempe, AZ 85287

**Introduction:** In 1972, the Mariner 9 spacecraft imaged a part of the Mars southern residual cap (SPRC) that has become informally known as “the fork” region [1]. Five years later, Viking images of the same region found significant change in CO<sub>2</sub> ice coverage [1]. This region continues to be of scientific interest. It lies on the edge of the SPRC, contains scarps, CO<sub>2</sub> mesas informally referred to as “Swiss cheese” terrain [2], and a strip of exposed H<sub>2</sub>O ice ~10 km wide [3,4,5]. The area of exposed H<sub>2</sub>O ice, which typically is where the last of the seasonal CO<sub>2</sub> is found, may indicate where a larger SPRC once extended [3,6]. The “Swiss cheese” terrain is pocked with CO<sub>2</sub> mesas, which based on models and thermal imaging, are believed to be surrounded by moats of exposed H<sub>2</sub>O ice [7]. It is in this region that we combine thermal imaging with high spatial resolution visible and near-infrared imaging to spectrally confirm the presence of exposed H<sub>2</sub>O ice in the Swiss cheese moats and to map out other local H<sub>2</sub>O ice deposits.

**Data:** The observations used for this study are from the Mars Odyssey (ODY) Thermal Emission Imaging System (THEMIS) and the Mars Reconnaissance Orbiter (MRO) Compact Reconnaissance Imaging Spectrometer for Mars (CRISM). These two instruments provide imaging of the fork region in the wavelength range from 0.35 μm to 4 μm and 6 μm to 15 μm at spatial resolutions between 18m/pixel and 200m/pixel. THEMIS provides visible imaging at 18 meter resolution and thermal imaging at 100 meter resolution. CRISM spans the visible, near-infrared, and short-wave infrared at spatial resolutions from as high as ~18m to as low as 200m, thus allowing the spectral identification of both CO<sub>2</sub> and H<sub>2</sub>O ices.

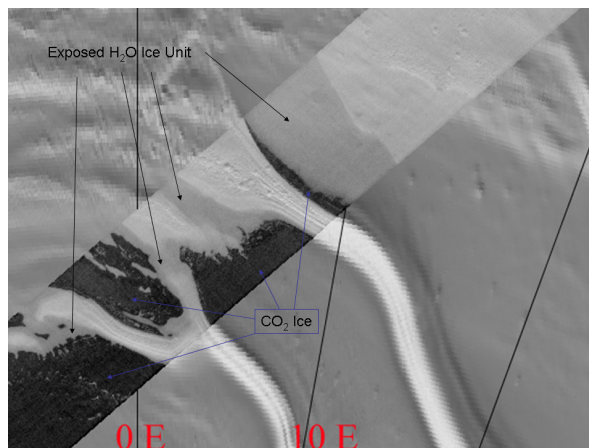
**Regions of Interest (ROI):** Three regions were identified to monitor using the Full Resolution Target (FRT) mode of CRISM. These areas are T1 (11°E, 85.20°S), T2 (10°E, 85.47°S), and T3( 4°E, 85.56°S)

**Results:**

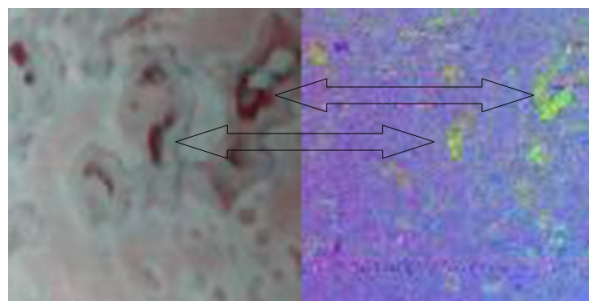
*Swiss Cheese.* FRT-7B82 (Fig 2. ROI T2) clearly shows Swiss cheese moats with the spectral signature of H<sub>2</sub>O ice.

*Edge of Scarps.* FRT 72D6 (Figures 3 & 4) clearly shows the spectral signature of H<sub>2</sub>O ice at the base of a scarp.

*“I” Unit.* CRISM Image FRT-72D6 (ROI T2) shows the edge of the permanent CO<sub>2</sub> unit and the I Unit, even prior to the sublimation of seasonal CO<sub>2</sub>.



**Figure 1:** A JMARS [9] image showing THEMIS thermal infrared image I25959009 overlaid on MOLA shaded relief. This image was acquired at L<sub>s</sub> 335°. The regions of exposed water ice are typically ~190K, while the exposed scarps are > 200K. Warm walls (not shown) and moats are also seen in the Swiss cheese terrain.



**Figure 2:** CRISM NIR FRT 7B82 (L<sub>s</sub> 315) showing Swiss cheese. The left Panel is false color NIR image, red is the I/F at 3.22 μm, green is the I/F at 2.44 μm and blue is I/F at 1.72 μm. The right panel is false color NIR image where red is 3.8 μm, green is the 1.5 μm H<sub>2</sub>O index, and blue is the 1.435 μm CO<sub>2</sub> index. The arrows are pointing out H<sub>2</sub>O exposures in the moats surrounding many of the Swiss cheese mesas.

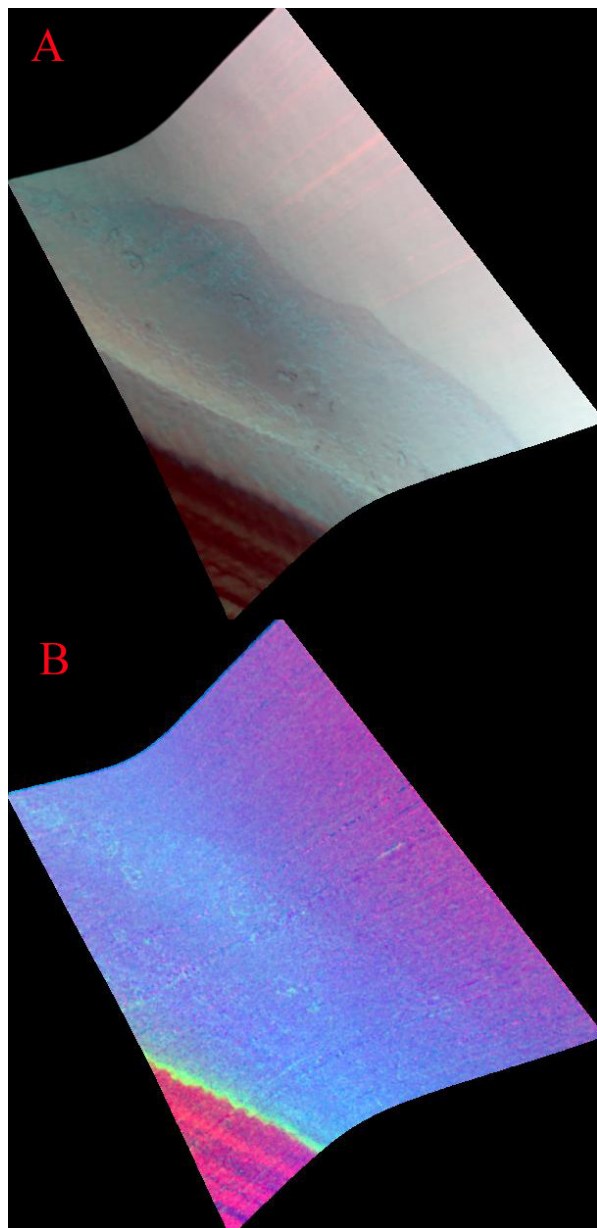


Figure 3: Map projected images of FRT 72D6 ( $L_s$  297°). (A) False color NIR image. Red is the I/F at 3.22 $\mu$ m, green is the I/F at 2.44 $\mu$ m and blue is I/F at 1.72 $\mu$ m. (B) False color NIR image where red is 3.8  $\mu$ m, green is the 1.5 $\mu$ m H<sub>2</sub>O index, and blue is the 1.425 $\mu$ m CO<sub>2</sub> index.

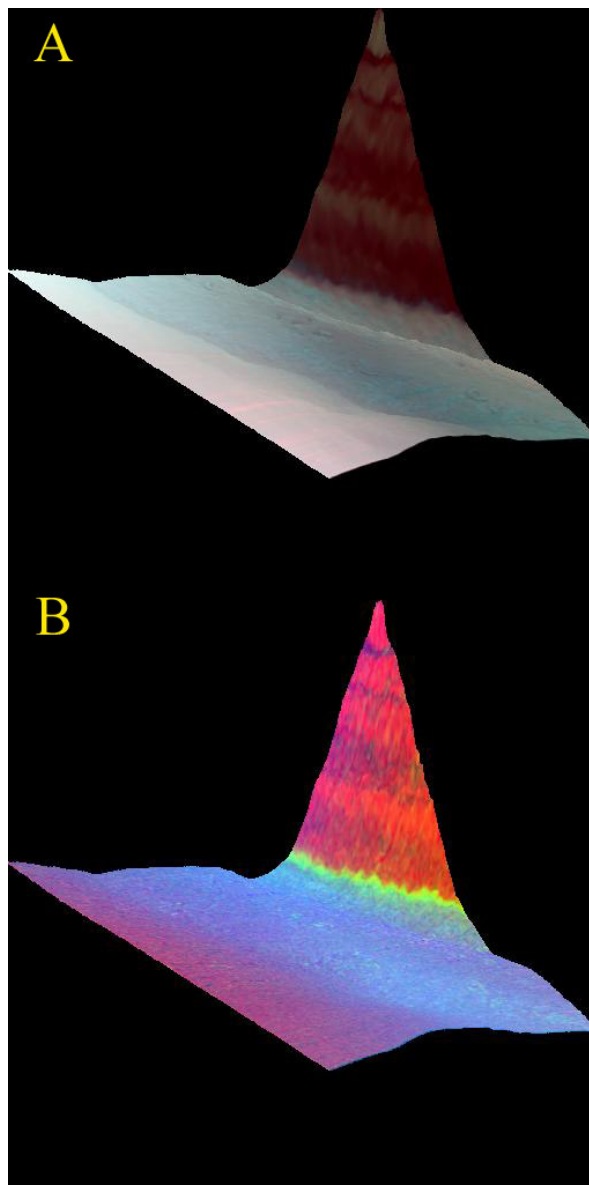


Figure 4: Map projected 3D images of the CRISM images shown in Figure 3. H<sub>2</sub>O ice is clearly present at the base of the scarp.

**Summary:** H<sub>2</sub>O ice has been spectrally confirmed to lie in the moats that surround many Swiss cheese mesas and at the edges of scarps. Additional CRISM and THEMIS imaging of the “fork” region will be presented.

**References:** [1] James, P. et al. (1979) *JGR*, 84, 2889. [2] Thomas, P. et al., (2000) *Nature*, 404, 161-164. [3] Titus, T.N. (2003) *Science* 299, 1048-1051. [4] Titus, T. (2004) *Nature*, 428, 610-611. [5] Bibring, J-P. et al. (2004) *Nature*, 428, 627-630. [6] Montmessin, F. et al. (2007) *JGR*, 112, CiteID E08S17. [7] Byrne, S. and A. Ingersoll (2003) *Science*, 299, 1051-1053. [9] <http://jmars.asu.edu>.