

INFRARED OBSERVATIONS OF MARS SOUTH POLAR RESIDUAL CAP: WHEN EATING SWISS CHEESE – USE A FORK. T. N. Titus¹, A. Brown², F. P. Seelos³, S. L. Murchie³, S. Piqueux⁴, P. R. Christensen⁴, The CRISM Team³, ¹U.S.G.S., 2255 N. Gemini Dr., Flagstaff, AZ 86001 (ttitus@usgs.gov), ²SETI Institute, 515 N. Whisman Rd Mountain View, CA 94043, ³JHU Applied Physics Laboratory, 11100 Johns Hopkins Road, Laurel, MD 20723, ⁴Arizona 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 CO₂ ice coverage [1]. This region continues to be of scientific interest. It lies on the edge of the SPRC, contains scarps, CO₂ mesas informally referred to as “Swiss cheese” terrain [2], and a strip of exposed H₂O ice ~10 km wide [3,4,5]. The area of exposed H₂O ice, which typically is where the last of the seasonal CO₂ is found, may indicate where a larger SPRC once extended [3,6]. The “Swiss cheese” terrain is pocketed with CO₂ mesas, which based on models and thermal imaging, are believed to be surrounded by moats of exposed H₂O 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 H₂O ice in the Swiss cheese moats and to map out other local H₂O 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 CO₂ and H₂O 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 H₂O ice.

Edge of Scarps. FRT 72D6 (Figures 3 & 4) clearly shows the spectral signature of H₂O ice at the base of a scarp.

“I” Unit. CRISM Image FRT-72D6 (ROI T2) shows the edge of the permanent CO₂ unit and the I Unit, even prior to the sublimation of seasonal CO₂.

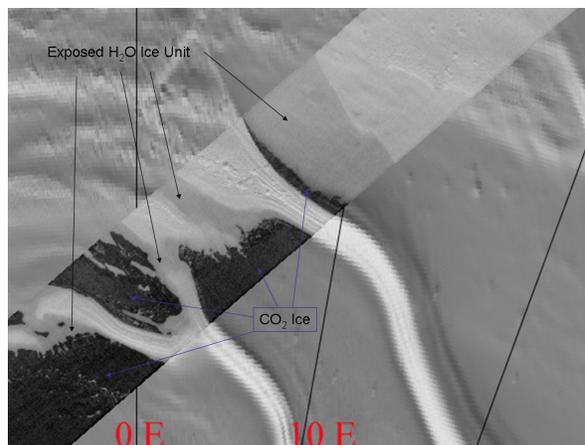


Figure 1: A JMARS [9] image showing THEMIS thermal infrared image I25959009 overlaid on MOLA shaded relief. This image was acquired at L_s 335°. The regions of exposed water ice are typically ~190K, while the exposed scarps are > 200K. Warm walls (not shown) and moats are also seen in the Swiss cheese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

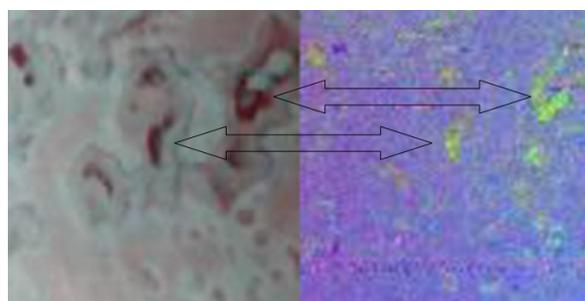


Figure 2: CRISM NIR FRT 7B82 (L_s 315) showing Swiss cheese. The left Panel is false color NIR image, red is the I/F at 3.22 μm, green is the I/F at 2.44 μm and blue is I/F at 1.72 μm. The right panel is false color NIR image where red is 3.8 μm, green is the 1.5 μm H₂O index, and blue is the 1.435 μm CO₂ index. The arrows are pointing out H₂O exposures in the moats surrounding many of the Swiss cheese mesas.

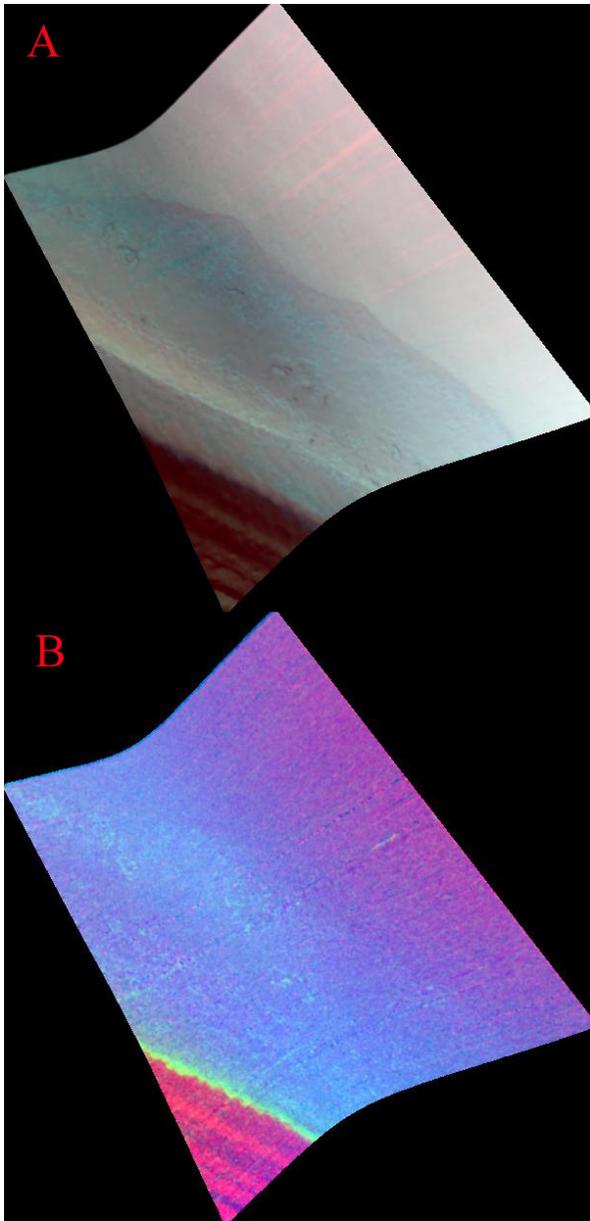


Figure 3: Map projected images of FRT 72D6 (L_s 297°). (A) False color NIR image. Red is the I/F at 3.22 μ m, green is the I/F at 2.44 μ m and blue is I/F at 1.72 μ m. (B) False color NIR image where red is 3.8 μ m, green is the 1.5 μ m H₂O index, and blue is the 1.425 μ m CO₂ index.

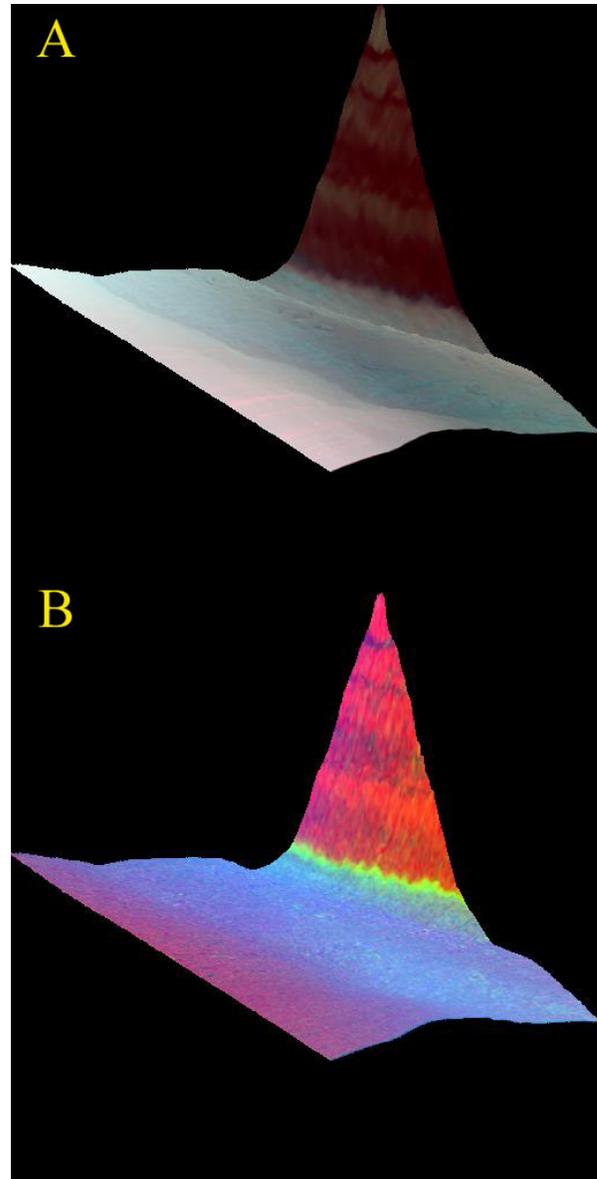


Figure 4: Map projected 3D images of the CRISM images shown in Figure 3. H₂O ice is clearly present at the base of the scarp.

Summary: H₂O 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. [8] Byrne, S. and A. Ingersoll (2003) *Science*, 299, 1051-1053. [9] <http://jmars.asu.edu>.