MAPPING SWISS CHEESE TERRAIN AT THE MARTIAN SOUTH POLE TO UNDERSTAND ITS POSSIBLE ATMOSPHERIC INTERACTIONS. A. C. Innanen[1], M. E. Landis[2], P.O. Hayne[2] and J.E. Moores[1], [1]Centre for Research in Earth and Space Science, York University, Toronto, Ontario (ainnanen@yorku.ca), [2]Laboratory for Atmospheric and Space Physics, University of Colorado, Boulder, CO.

Introduction: The South Polar Residual Cap (SPRC) of Mars is a thin layer of CO_2 ice that covers the water-ice south polar layered deposits (SPLD) [1]. The CO_2 deposits of the SPRC have a variety of textures including linear ridges (informally known as fingerprint terrain) and quasi-circular depressions known as 'Swiss cheese' features [2,3] (Fig. 1). The Swiss cheese features have flat floors, where underlying H_2O ice could be exposed, and steep sides which grow outward yearly by a few meters [4]. This growth rate could cause the SPRC to resurface every ~100 years [5]. Our work examines the potential water vapor release if temporally evolving Swiss cheese terrain removed enough of the CO_2 ice at the surface of the SPRC to uncover H_2O ice.

This work is motivated by observations in 1969 of an unusually large amount of H_2O vapor over the SPRC during the south polar summer [8]. It has been suggested that this could be due to the complete removal of the CO_2 residual cap, leaving the underlying H_2O ice entirely exposed [9,10].

Thomas et al. [6] defined four different morphological units of the SPRC. For this work we consider the A1 unit, which consists of the circular, curl, or heart-shaped depressions of the Swiss cheese terrain (Fig. 1). The total area of the A1 unit is ~1294 km^2 [7].

We present initial work on examining if the Swiss cheese pits have an appreciable contribution to atmospheric water vapor, and under what Swiss cheese conditions it could be possible to recreate the 1969 water vapor observation through removal of the CO_2 layer of the SPRC.

Methods: We use the Murray Lab Mosaic [11], which uses images from the Context Camera (CTX) aboard the Mars Reconnaissance Orbiter (MRO) [12]. The Thomas et al. [6] areas of Unit A1 were identified, and the Swiss cheese pits within the unit were mapped using the polygon tool in ArcMap (Fig. 2). Due to the large total area of the unit, only those areas that were under 10 km^2 were mapped in their entirety. For areas greater than 10 km^2, about 25% of the total area was mapped (Table 1). Very small areas less than 0.5 km^2 have been excluded.

While some pits are simply circular or heart-shaped depressions, others have raised areas within them, which we refer to as 'mesas'. The areas of these mesas are excluded from the total area of the Swiss cheese features in which they are contained, as they are likely remnants of the overlying CO_2 ice of the SPRC. From this we can determine the ratio of the amount of terrain carved out by the Swiss cheese features to the high-standing terrain.

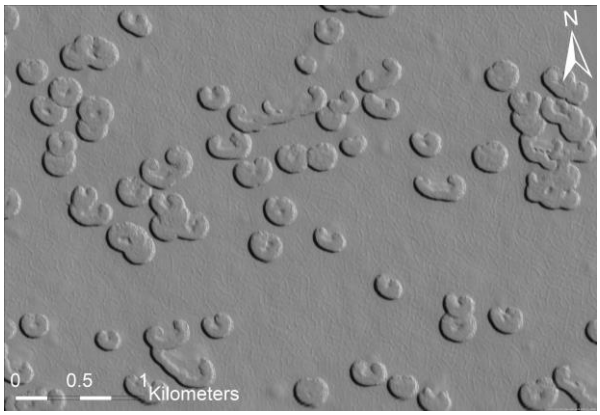

***Fig. 1**: Example Swiss Cheese features in the A1 Unit, from the Murray Lab Mosaic at 86.9°S, 6.6°W [11].*

Results: There is some variety in how densely areas of the A1 unit are covered with the Swiss cheese features. Some features are distinct pits or curls, but in other areas the features have grown into one another, creating more dendritic features. Fig. 1 shows both the distinct Swiss cheese pits and the combination features, to the right in the figure.

The amount of the SPRC carved out by Swiss cheese pits is given in Table 1 for three areas of the A1 Unit.

Table 1. Percent coverage of Swiss cheese features for three areas.

Centre Coordinates	Total Area (km^2)	Percent Mapped	Percent CO_2 Ice Removed
88.4°S, 33.4°W	1.04	100	22.66
85.8°S, 67.9°W	6.75	100	47.15
87.7°S, 22.2°W	12.00	25	47.32

Connection to the Martian Climate: We will use surface temperature retrievals from the Mars Climate Sounder (MCS) [13], also aboard MRO, in order to determine sublimation from the Swiss cheese features (example data shown in Fig. 3).

While the 1969 observation was about half the theoretical resurfacing period from present day, quantifying the amount of CO_2 ice that can be removed in the Swiss cheese terrain is an important step. Given the relative fractional area of the SPRC carved out by the Swiss cheese features, and the MCS surface

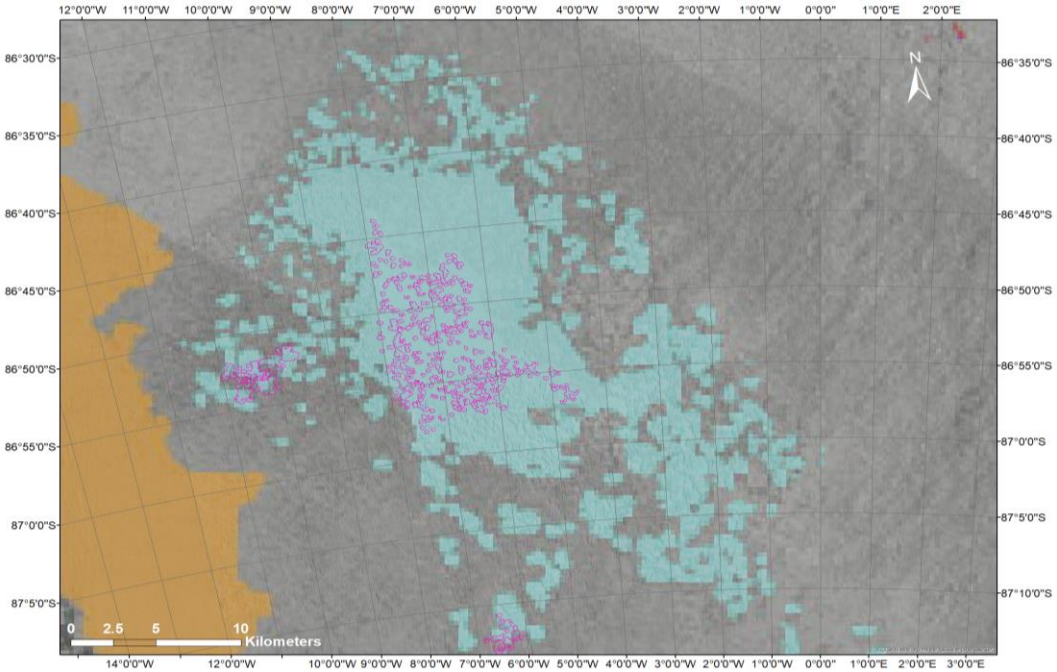

Fig. 2*: The Murray CTX Mosaic [11] (not shown) overlayed with the Thomas et al. Unit map (figure 1(A) in [6]). The cyan is unit A1, and the magenta polygons represent the mapped Swiss cheese features.*

temperature, we will calculate if water ice sublimation from Swiss cheese features is thermodynamically possible and how much water vapor could be sublimated from the current configuration of features, assuming the floors of these features contain exposed water-ice. Our results can then be extended to situations in which more of the SPRC is exposed by Swiss cheese features to determine if Swiss cheese terrain evolution could plausibly explain water vapor detections like those observed in 1969 [8].

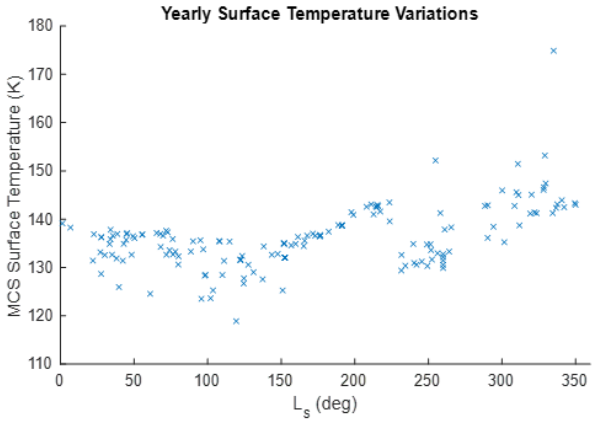

Fig. 3: *Surface temperature variations for the area bounded by 86.542°-86.953°S and 5.717°-8.14°W, taken over the span of MCS' mission.*

Acknowledgments: This work was funded in part by the Natural Sciences and Engineering Research Council of Canada (NSERC) Technologies for Exo-planetary Science (TEPS) Collaborative Research and Training Experience (CREATE) program. The authors also wish to thank the NASA Mars Reconnaissance Orbiter project and the Mars Climate Sounder team, and the Murray Lab.

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