THE SEARCH FOR POLYCYCLIC AROMATIC HYDROCARBONS IN THE MARTIAN SOUTH POLAR RESIDUAL CAP USING CRISM INFRARED SPECTRA J. Campbell[1,2], P. Sidiropoulos[2] and J. P. Muller[2]: [1]School of Environment and Technology, University of Brighton, East Sussex, BN2 4AT, j.campbell4@uni.brighton.ac.uk [2]Imaging Group, Mullard Space Science Laboratory, University College London, Holmbury St Mary, Surrey, RH56NT, p.sidiropoulos@ucl.ac.uk, j.muller@ucl.ac.uk

Introduction: Since the fly-by of Mars by NASA's Mariner 4 in 1965, Mars has been frequently examined using high-resolution orbital imagery, and by spectrometers since Mariner 6 in 1969 [1]. The dynamic polar regions of Mars have been systematically studied in detail in more recent years by the European Space Agency's (ESA) Mars Express launched in 2003 and by NASA's Mars Reconnaissance Orbiter (MRO) launched in 2005. Mars' south polar cap consists of a permanent 400km diameter layer of solid CO_2 and water ice [2]. So-called "Swiss Cheese Terrain" is a unique surface feature found only in the Martian South Polar Residual Cap (SPRC). Its characteristic appearance (consisting of flat floored, circular depressions) is considered to be caused by seasonal differences in the sublimation rates of water and CO_2 ice [3].

MRO carries on board the visible-infrared spectrometer CRISM (Compact Reconnaissance Imaging Spectrometer for Mars) designed to search for mineralogical indications of past and present water, and this has provided extensive coverage of the south pole. The structural evolution of the SPRC has been investigated by Thomas et al. [4], who suggest the possibility that seasonal and long term sublimation may excavate dust particles from within the polar ice; this has implications for the detection of organic molecules that are usually destroyed at the Martian surface by UV radiation [5], as they may have been protected within the ice cap and later exhumed. Fig. 1 shows three images of the same area from 2009-2013. The feature highlighted in the red circle has undergone noticeable scarp retreat, and is therefore a region of interest for dust particle exposure and spectral analysis.

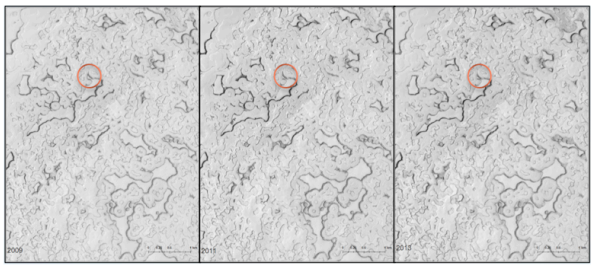

Figure 1: Scarp retreat of 'Swiss Cheese' festures, (CTX image B08_012572_0943)

Motivation: Polycyclic aromatic hydrocarbons (PAHs) are considered to be important in theories of abiogenesis [6] and could also indicate the degradation of Martian organisms [7]; they can therefore be employed as a biomarker for extinct or even extant life. The ability to identify PAHs on Mars using remote sensing could prove a crucial tool in the search for extraterrestrial organisms. There is evidence that PAHs have been detected on two icy Saturnian satellites from the Visual and Infrared Mapping Spectrometer (VIMS) on the Cassini spacecraft [8].

To date, the hypothesised connection of Martian Swiss Cheese Terrain and the presence of PAHs has not been systematically examined. Analysis of the Martian South Polar Residual Cap has been carried out using HiRISE, CTX, MOC-NA and HRSC imagery to better constrain regions of interest, and select CRISM scenes for spectral analysis. Fig.2 shows the areas of the SPRC covered with Swiss Cheese Terrain in pink, the location of the CTX footprint from Fig.1 in yellow, and the selected 55 CRISM scenes that will be used for spectral analysis in blue.

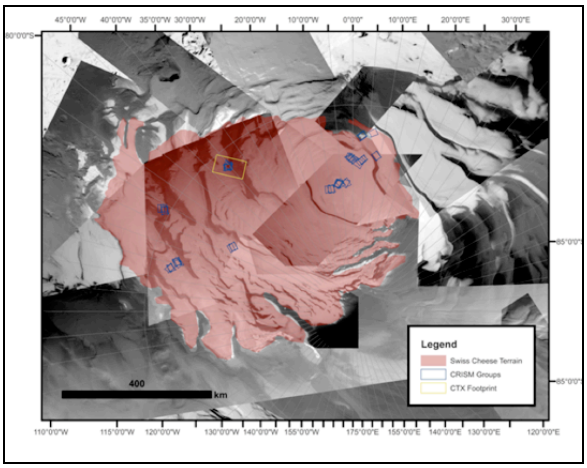

Figure 2: HRSC mosaic base map showing location of Swiss Cheese Terrain, CTX and CRISM scenes

Results: This preliminary work discusses how CRISM infrared spectra can be used to detect PAHs in Swiss Cheese Terrain, and work is being carried out to produce maps showing IR spectral profiles over south polar cap sublimation features. Currently we are identifying spectral features of interest (Fig.3) in order to compare and anlayse ratios of features and to ascertain spectral difference independent of albedo. Early results indicate shifts in spectral ratios over spatial and temporal areas of Swiss Cheese Terrain in the 3-4μm region (Fig.4).

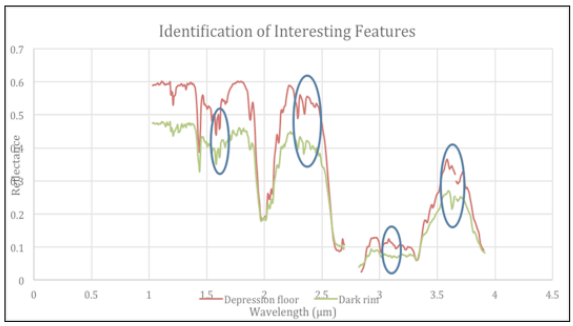

Figure 3: Spectral features of interest, (CRISM FRT0005D24)

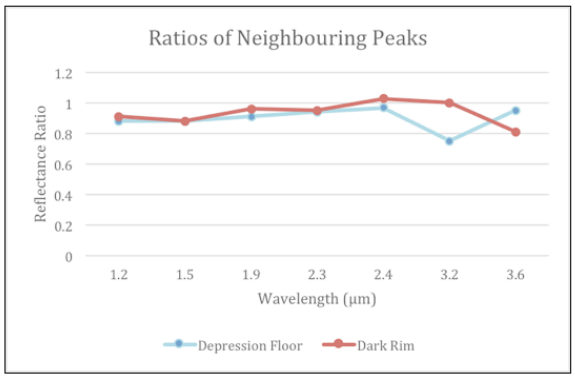

Figure 4: Albedo independent ratios of neighbouring peaks, (CRISM FRT00005D24)

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