

MAPPING OF SWISS CHEESE TERRAIN USING HRSC AND CRISM DATA

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ABSTRACT:

Since 1965 and NASA's Mariner 4, Mars has been frequently examined via high resolution orbital imagery, and with spectrometers since Mariner 6 in 1969 (NASA, 2015). The dynamic polar regions of Mars have been systematically studied in detail in more recent years by the European Space Agency's (ESA) 2003 Mars Express and NASA's Mars Reconnaissance Orbiter (MRO) launched in 2005; in particular, Mars' south polar cap consists of a permanent 400km diameter layer of solid CO₂ and water ice (Vita-Finzi, 2005). Swiss Cheese Terrain is a unique surface feature found only in the Martian south polar ice. Its characteristic appearance (consisting of flat floored, circular depressions) is considered to be caused by seasonal differences in the sublimation rates of water and CO₂ ice (Tokar et al. 2003).

A number of researchers have examined the properties of Swiss Cheese Terrain; Brown et al. (2014) examined H₂O ice deposition on the Martian south pole, using measurements from the OMEGA infrared spectrometer on board Mars Express and the Compact Reconnaissance Imaging Spectrometer for Mars (CRISM) on MRO to measure seasonal changes in water ice signatures around Swiss Cheese depressions. In a recent work, Smith et al. (2015) employed NASA Mars Odyssey's Thermal Emission Imaging System (THEMIS) and the Shallow Radar Instrument (SHARAD) on MRO to examine cloud cover and subsurface stratigraphy to study recent accumulation of precipitation in relation to Swiss Cheese formation.

Polycyclic aromatic hydrocarbons (PAHs) are considered to be important in theories of abiogenesis (Allamandola, 2011) and there is evidence that they have been detected on 2 icy Saturnian satellites from the Visual and Infrared Mapping Spectrometer (VIMS) on the Cassini spacecraft (Cruikshank et al., 2007). To date, the hypothesised connection of Martian Swiss Cheese Terrain with the presence of PAHs has not been systematically examined after initial indications from one CRISM scene. In this preliminary work, we are going to present results to determine whether CRISM infrared spectra can be used to detect PAHs in general in the Martian polar caps, but specifically in areas in which Swiss Cheese Terrain has been identified.

In this analysis, we further use visible spectrum data from High Resolution Stereo Camera (HRSC), which is on board Mars Express; the HRSC camera acquires high resolution (12.5m px⁻¹) orbital images of the Martian surface (Neukum et al., 2004). Individual level-3 HRSC images are being projected into polar stereographic projection within a GIS, and a map will be shown displaying the locations of south pole Swiss Cheese Terrain features along with temporally and spatially relevant CRISM measurements, which can then be used to systematically analyse these regions of interest for PAHs..

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