DETECTION OF POLYCYCLIC AROMATIC HYDROCARBONS IN MARS ANALOGUES

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Introduction: We present the results of a series of laboratory experiments which were carried out in order to generate a diagnostic shortwave infrared (SWIR) spectrum for Polycyclic Aromatic Hydrocarbons (PAHs) of astrobiological interest. This has allowed detectability limits of PAHs to be established according to the sensitivity of orbital observations for environments analogous to Martian South Polar Residual Cap (SPRC) and Recurring Slope Lineae (RSL).

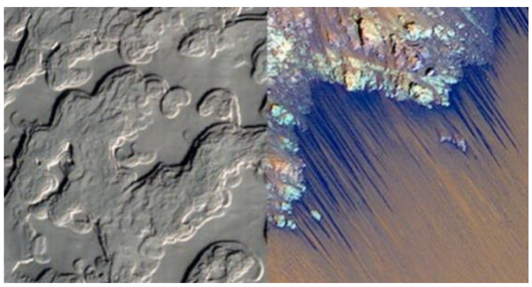

Figure 1: SPRC CO_2 ice features, ESP_012784_0935 (left) and RSL surface features, ESP_034830_1670 (right). Both from HiRISE, NASA/JPL/UoA

PAHs are a group of chemical compounds consisting of benzene rings of hydrogen and carbon considered to be 'building blocks' for life and can also be used as a biomarker for extant life [1]. PAHs are abundant on Earth and in interstellar space, and have been detected on various icy moons, comets and within Martian meteorites found on Earth [2, 3]. PAHs have not been detected on the surface of Mars to date, probably due to the deleterious effects of extreme ultraviolet (UV) radiation on the surface of the planet [4]. Our working hypothesis is that dynamic SPRC and RSL features may expose material that has previously been shielded from UV, and may therefore be candidate sites for PAH detection using orbital hyperspectral imaging.

Here we use the parameters of the (Compact Reconnaissance Imaging Spectrometer for Mars) CRISM instrument as a basis for the laboratory experiments, due to the fine spatial resolution capabilities of the instrument and the small scale of the SPRC and RSL features [5].

Laboratory Experiments: These experiments were performed to constrain the detectability limit of PAHs, and to establish PAH spectral features at wavelengths other than the well-known absorption feature at 3.29 µm. There is currently no published evidence of PAH detection within SPRC dynamic CO_2 ice features, which recede and expose dust. Ongoing research on the characterisation and nature of RSLs indicates that these dark surface streaks may be the result of upwelling of briny liquid water from beneath the Martian surface. These salty deposits could therefore be another prime site for organic detection. This work seeks to provide empirical laboratory data to improve interpretation of orbital data from CRISM, and to ascertain the effect of CO_2 ice sublimation and brine dehydration on organic spectra, as well as provide PAH reference spectra relevant to Mars.

The site of the laboratory experiments was the "Cold Surface Spectroscopy" facility (CSS) at the Institut de Planétologie et Astrophysique de Grenoble (IPAG) Grenoble, France using the spectro-gonio radiometer and its CarboN-IR environmental cell, which have been specifically developed for studying planetary analogues.

Results: The detectability limit of PAHs was established within SPRC and RSL analogues, end member spectra have been established for all components of interest, and new diagnostic absorption features for PAHs have been recorded at a number of wavelengths which will be presented. For RSL analogues, we found that drying brines within soil samples increased the detectability of PAHs compared with soil samples devoid of salt. This study provides the data necessary to improve interpretation of orbital data, and will form the basis for continuing research of dynamic features on Mars in order to detect organic material, and contribute to the search for habitable environments on Mars.

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