Characterizing terrestrial samples with pyrolysis-GC-MS similar to MOMA aboard ExoMars-2018.

H. Steininger[1], W. Goetz[1], F. Goesmann[1], C. Freissenet[2] and S. Siljeström[3], [1]Max Planck Institut für Sonnensystemforschung, Katlenburg-Lindau, Germany (steininger@mps.mpg.de, Fax: +49-5556-979240, [2]NASA Goddard Space Flight Center, Greenbelt, MD 20771, USA, [3]Department of Chemistry and Materials Technology, SP Technical Research Institute of Sweden, 501 15 Borås, Sweden.

Introduction: The ExoMars-2018 rover mission will combine both in-situ analysis of Martian (sub) surface material and caching of samples to be returned to Earth at a later time. The Mars Organic Molecule Analyzer (MOMA) aboard the rover shall characterize the organic compounds in these samples and thereby support the sample selection process for caching. MOMA will use a modified pyrolysis technique (similar to the SAM instrument of Mars Science Laboratory, MSL) next to Laser Desorption and Ionization (LDI) coupled to a Mass Spectrometer (MS). The data obtained by MOMA will be a key indicator if the sample is worth of sample return.

Pyrolysis-GC-MS (Gas Chromatography - Mass Spectrometery) is one of the principal operational modes of the instrument. This mode does not require any sample preparation except crushing. In geochemistry pyrolysis-GC-MS is used for the analysis of kerogenes, while the more volatile materials are solvent-extracted (rather than heated) and analyzed by GC-MS. Here we present pyrolysis-GC-MS data acquired both by a commercial setup and an early MOMA prototype, in order to demonstrate, how MOMA will be able to support the sample selection for caching.

Experiments: The samples described here were collected during the joint ESA-NASA Arctic Mars Analogue Svalbard Expedition AMASE 2011 [1]: (a) Coletthøgda, Butterfinger (float, largely calcite, some dolomite and quartz, possibly bioherm), and (b) Colethödga, Kit Kat (float, mainly dolomite with some quartz, possibly from stratified part of outcrop below Butterfinger). The samples were ground in a mortar, placed onto a small platinum filament and pyrolysed at temperatures above 800°C in a Pyrola pyrolysis unit. The evolved gas was analyzed with a Varian 4000 GC-MS. Several of the samples contain only minute amounts of organics and therefore no GC-MS data could be acquired. However, the more organic rich ones contain always benzene, toluene and some other simple organic molecules. The resulting GC-MS plots are complex. However, their analysis can be simplified by selecting some specific molecular masses.

Results: Patterns in the distribution of long-chain hydrocarbons provide information on the origin and geochemical evolution of the organics in the sample.The two samples show very significant differences in long-chain hydrocarbon distribution (Figs. 1 and 2)

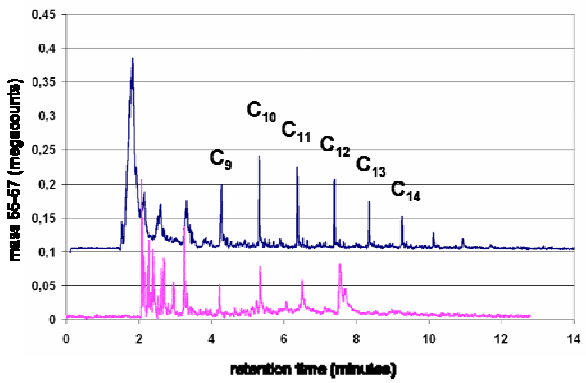

Figure 1: Pattern of long-chain hydrocarbons in the GC-MS plot of the Butterfinger sample. Upper plot (blue) shows data obtained in commercial setup, lower plot (pink) shows experimental data obtained by a flight-like breadboard of MOMA. Selected masses: 55-57 u.

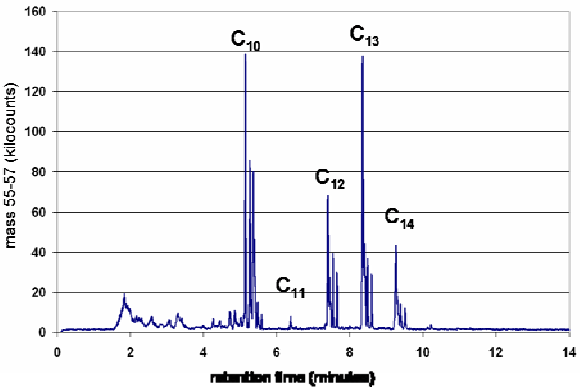

Figure 2: Pattern of long-chain hydrocarbons in the GC-MS plot of the Kit Kat sample. Selected masses:55-57 u.

The a flight-likebreadboard of MOMA and the commercial Pyrola/Varian instrument give similar results, although the larger masses are absent due to temperature limitations of the breadboard (Fig. 1).

MOMA has two further operational modes: (1) derivatization GC-MS and (2) Laser Desorption MS. Both modes widen the field of view of the instrument but the current status of the instrument's breadboard does not include these two modes.

References: [1] Steele, A. et al. (2010), *LPS XLI*, Abstract #2398.