In situ detection of organic molecules on the martian surface with the Mars Organic Molecule Analyzer (MOMA) on ExoMars 2018

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The Mars Organic Molecule Analyzer (MOMA) is a joint venture between the European Space Agency and NASA, and a key instrument on the ExoMars 2018 rover. The MOMA instrument is centered around a miniaturized linear ion trap (LIT) that facilitates two modes of operation: i) pyrolysis/gas chromatography mass spectrometry (pyr/GC-MS); and, ii) laser desorption/ionization mass spectrometry (LDI-MS) at ambient Mars pressures. The LIT also enables the structural characterization of complex molecules via complementary analytical capabilities, such as multi-frequency waveforms (i.e., SWIFT) and tandem mass spectrometry (MS/MS). Consequently, MOMA has the potential to reveal the presence of a wide range of organics preserved in a variety of mineralogical environments, and to begin to understand the structural character and potential origin of those compounds.

However, the pervasive presence of oxidative perchlorates across the martian surface provides a challenge to detecting organics via traditional *in situ* analytical techniques, such as evolved gas analysis (EGA) or pyr/GC-MS. The MOMA LDI-MS mode of operation, on the other hand, enables the detection and identification of fragile molecules that may otherwise decompose during sample heating. Using a high fidelity breadboard instrument, we show that via LDI-MS methods the MOMA instrument is capable of detecting μg/g-levels of organics in a suite of natural and synthetically-derived Mars analog samples, even in the presence of wt.%-levels of perchlorate. Spectra acquired from the commercial Thermo MALDI LTQXL serve as verification for the data presented here.