Overview of the MOMA Mass Spectrometer and Examination of Some Mineral Matrices as Learning Curve for MOMA Return Data

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The Mars Organic Molecule Analyzer (MOMA), a linear ion trap (LIT) mass spectrometer-based investigation of potential extinct or extant life on Mars, has been delivered in Europe and is installed inside the Rosalind Franklin rover in preparation for ExoMars launch in July, 2020.

The LIT is capable of measuring ion masses from m/z 50-1000 by making use of two distinct ion sources. For higher volatility molecules over m/z 50-500, an electron ionization (EI) source is implemented with front end based on pyrolysis of crushed drill samples taken from a depth up to 2 meters where cosmic radiation has not penetrated. Gas chromatography both with and without chemical derivatization is applied from any of four columns including one sensitive to molecular chirality. For lower volatility molecules over m/z 100-1000, a laser desorption/ionization (LDI) source is implemented directly on crushed particulate samples, delivered to a tray underneath a 266 nm laser capable of 140 uJ with 1 ns wide pulses.

At GSFC a second instrument duplicating the MOMA flight model is being installed into an environmental chamber to support Mars surface operations under identical conditions (5-7 Torr and temperatures from -45 to 0 °C). As this “flight spare” must maintain very low contamination levels to permit real-time diagnosis during the mission, an engineering test unit with full flight functionality is now available for testing of operating procedures and interpretation of Mars data based on analog analyses. This unit has been updated and cleaned to permit investigation of the complex LDI mass spectra produced by pulsed UV LDI of complex mineral mixtures with and without admixed organics, as to support

development of advanced methods for detection and spectral interpretation. A discussion of the MOMA mass spectrometer will be presented and an initial examination of mineral matrix spectra will be discussed.