Geophysical Research Abstracts
Vol. 15, EGU2013-11396, 2013
EGU General Assembly 2013

Wet Chemistry on SAM: How it Helps to Detect Organics on Mars

Arnaud Buch (1), Caroline Freissinet (2), Cyril Szopa (3), Danny Glavin (2), Patrice Coll (4), Michel Cabane (3), Jen Eigenbrode (2), Rafael Navarro-Gonzalez (5), Jen Stern (2), David Coscia (3), Samuel Teinturier (3), Jason Dworkin (2), Paul Mahaffy (2), and The MSL Science Team (6)

(1) Ecole centrale Paris, LGPM, Chatenay-Malabry, France (arnaud.buch@ecp.fr), (2) NASA Goddard Space Flight Center, 8800 Greenbelt Rd, Greenbelt, MD 20771, (3) LATMOS, Univ. Pierre et Marie Curie, Univ. Versailles Saint-Quentin & CNRS, 75005 Paris, France, (4) LISA, Univ. Paris-Est Créteil, Univ. Denis Diderot & CNRS, 94000 Créteil, France, (5) Universidad Nacional Autónoma de México, México, D.F. 04510, Mexico, (6) Jet Propulsion Laboratory, California Institute of Technology, Passadena, CA, USA

For the first time in the history of space exploration, a mission of interest to astrobiology could be able to analyze refractory organic compounds in the soil of Mars with wet chemistry. This analytical technique modifies organic components in such a way that improves their detection, either by releasing the compounds from sample matrices, or by changing the chemical structure to be amenable to analytical conditions. The latter effect is particularly important when polar compounds are present. Sample Analysis at Mars (SAM), on the Curiosity rover of the Mars Science Laboratory mission, onboards two wet chemistry experiments: derivatization [1-2] and thermochemolysis [3-4]. Here we report on the nature of the MTBSTFA derivatization experiment in SAM, the detection of MTBSTFA in the first SAM analyzes, and the implications of this detection.

Chemical derivatization of polar molecular compounds is achieved by the MTBSTFA (N-Methyl-N-tert-butyldimethylsilyltrifluoroacetamide) / DMF (Dimethylformamide) silylation reaction in order to transform refractory polar compounds into a more volatile form that can be analyzed and detected by GCMS.

The first samples of Martian soil (Rocknest, Gale crater) have been analyzed by evolved gas analysis (EGA) and via GC using thermal conductivity (TCD) and MS detection. The samples have been heated up to approximately 840°C with a heating rate of 35°C/min under He flow. The evolved gas was analyzed directly by the QMS in EGA mode. For GC analyses, the majority of the gas released was trapped on a hydrocarbon trap (silica beads, Tenax TA, Carbosieve G) over a specific temperature range. Trapped volatiles were then released by heating the trap to $\sim$300 °C and sent to the GC under He flow.

The first results obtained when running an analysis with an empty cup (no solid sample) showed the presence of MTBSTFA in the system. MTBSTFA was first detected in the EGA-QMS analysis blank then by GC-TCD-QMS analysis. This means that MTBSTFA is part of the background signal under its gaseous phase and is derived from at least one of the seven MTBSTFA/DMF derivatization cups in SAM. Since MTBSTFA is able to react in the gaseous phase, its detection implies the possibility to have some MTBSTFA reactions with all the labile compounds possibly present in the Martian soil, in the sampling system and/or inside the SAM instrument.

In addition, we also have observed the presence of compounds resulting from the derivatization reaction between MTBSTFA and water. Indeed, water has been detected by two ways: the EGA experiment and the GC-TCD-MS run. Due to the presence of mono- and bi-silylated water derivatives, several characteristic ions can be detected in the EGA mode (e.g. m/z = 147, 73), and two characteristic peaks in the GC-TCD-MS analysis are also observed.

In addition to water, a sylilated chloride compound has been detected after pyrolysis of the Rocknest soil. This compound is the simplest chloride derivative compound: chloro(1,1-dimethylethyl)dimethyl-silane, and it co-elutes with the mono-sylilated water derivative.

[1] Buch, A. et al. (2009) J chrom. A, 43, 143-151.
[2] Stalport, F. et al. (2012) Planet. Space Sci. 67: 1-13.
[3] Geffroy-Rodier, C. et al. (2009) JAAP, 85, 454-459.