Geophysical Research Abstracts
Vol. 18, EGU2016-6464, 2016
EGU General Assembly 2016

Effect of the presence of chlorates and perchlorates on the pyrolysis of organic compounds: implications for measurements done with the SAM experiment onboard the Curiosity rover

Maeva Millan (1), Cyril Szopa (1), Arnaud Buch (2), Imène Belmahdi (2), Patrice Coll (3), Daniel P. Glavin (4), Caroline Freissinet (4), Doug Archer (5), Brad Sutter (5), Roger E. Summons (6), Rafael Navarro-Gonzalez (7), Michel Cabane (1), and Paul Mahaffy (4)

(1) LATMOS, Univ. Pierre et Marie Curie, Univ. Versailles Saint-Quentin & CNRS, 78280 Guyancourt, France (maeva.millan@latmos.ipsl.fr), (2) Ecole Centrale Paris, LGPM, Châtenay-Malabry, France, (3) LISA, Univ. Paris-Est Créteil, Univ. Denis Diderot & CNRS, 94000 Créteil, (4) NASA Goddard Space Flight Center, Greenbelt, MD 20771, USA, (5) Jacbos, NASA Johnson Space Center, Houston, Texas, USA, (6) Department of Earth, Atmospheric and Planetary Sciences, Massachusetts Institute of Technology, Cambridge, MA 02139, USA, (7) Universidad Nacional Autónoma de México, México, D.F. 04510, Mexico

The Sample Analysis at Mars (SAM) experiment onboard the Curiosity rover of the Mars Science Laboratory mission is partly devoted to the in situ molecular analysis of gases evolving from solid samples collected on Mars surface/sub-surface. SAM has a gas-chromatograph coupled to a quadrupole mass spectrometer (GC-QMS) devoted to the separation and identification of organic and inorganic material [1]. Before proceeding to the GC-QMS analysis, the solid sample collected by Curiosity is subjected to a thermal treatment thanks to the pyrolysis oven to release the volatiles into the gas processing system.
As the Viking landers in 1976 [2], SAM detected chlorohydrocarbons with the pyrolysis GC-QMS experiment [3,4]. The detection of perchlorates salts in soil at the Phoenix Landing site [6] suggests that these chloro-hydrocarbons could come from the reaction of organics with oxychlorines. Oxychlorines indeed decomposed into molecular oxygen and volatile chlorine when heated and react with the organic matter in the samples by oxidation and/or chlorination processes. [3,5,7,8]. During SAM pyrolysis, samples are heated to 850°C. SAM detected C1 to C3 chloroalkanes, entirely attributed to reaction products occurring during the pyrolysis experiment between oxychlorines and organic carbon from instrument background [3] and chlorobenzene and C2 to C4 dichloroalkanes produced by reaction between Mars endogenous organics with oxychlorines [4]. To help understanding the influence of perchlorate and chlorate salts on organic matter during SAM pyrolysis, we systemically study the reaction products formed during pyrolysis of various organic compounds mixed with various perchlorates and chlorates. We selected organics from simple molecule forms as for instance PAHs and amino acids to complex material (>30 carbon atoms) such as kerogen. The perchlorate and chlorate salts are prepared at 1 wt % concentration in silica and mixed with the organics to study the potential qualitative and/or quantitative effects.
The experiments are performed on a laboratory GC-QMS with a Restek Rxi-5 column (30m x 0.25mm x 0.25μm) and an Intersciences pyrolyser. The mixture is pyrolyzed at different temperatures up to 900°C to cover the SAM temperature range. Different experiments are done to discriminate the pyrolysis products directly coming from the organics, and those produced from the reaction with oxychlorine. These experiments are under progress and should bring key information on the potential to identify Martian organics when pyrolyzing solid samples.
Depending on the organic families studied, we may find recurring molecules, which are potentially present in Mars' surface samples. This work could thus highlight some organic precursors of the chlorinated compounds found on Mars, and support the interpretation of SAM measurements.

References: [1] Mahaffy, P. et al. (2012) Space Sci Rev, 170, 401-478. [2] Biemann, K. et al (1977) JGR, 82, 4641-4658. [3] Glavin, D. et al. (2013), JGR 118, 1955-1973. [4] Freissinet, C. et al. (2015) JGR. [5] Leshin L. et al. (2013), Science. [6] Hecht, (2009), Science, 325 64-67. [7] Navarro-Gonzalez et al. (2010) JGR 115, EI12010. [8] Steninger, H. et al (2012) Planet. Space Sci. 71, 9-17.
Acknowledgments: French Space Agency (CNES) support for SAM-GC development and exploitation.