EPSC Abstracts
Vol. 6, EPSC-DPS2011-1460, 2011
EPSC-DPS Joint Meeting 2011


# The Sample Analysis at Mars experiment onboard the MSL 2011 rover: study of the present and past Mars surface environment through in situ chemical analyses

**C. Szopa** (1), P. Coll (2), M. Cabane (1), D. Coscia (1), S. Teinturier (1), F. Stalport (2,3), A. Buch (4), A. Noblet (2), P. Mahaffy (3), D. Glavin (3), J. Eigenbrode (3), P. Conrad (3), A. McAdam (3), H. Frantz (3), C. Freissinet (3,4), A. Brault (4), C. Webster (5) and the SAM GC team
(1) LATMOS, UPMC-UVSQ-CNRS, France, (2) LISA, CNRS-Univ. Paris 7 and 12, France, (3) NASA/GSFC, USA, (4) Ecole Central Paris, France, (5) JPL, USA.

## Abstract

Characterization of the physical and chemical properties of materials present at the Mars surface is of primary importance to determine its current and past environmental conditions, and to find clues on the existence of a past or present life form. In this frame, the Sample Analysis at Mars (SAM) experiment, of the Mars Science Laboratory (MSL) surface mission, is devoted to analyse in situ the chemical composition of the atmosphere and soil samples collected by the rover Curiosity. This work aims at presenting the experiment and an overview of its analytical performances, with a focus on the gas chromatograph-mass spectrometer instrumentation that constitutes the core of SAM.

## 1. Introduction

The MSL mission will really start by the end of this year with the launch of the Curiosity rover that will reach the surface of Mars in summer 2012. This mission to the Mars surface is the most ambitious one since the Viking landers of the 1970's. Indeed, the rover will carry an impressive scientific payload on a large distance, estimated to be around 20 km. The main objectives of this mission are : 1. to assess the biological potential of the Mars surface; 2. to characterize the geology of the landing region; 3. To characterize planetary processes relevant to past habitability; 4. To characterize the radiation present at the surface in order to prepare the human exploration. With this aim, the rover carries several complementary instruments among which SAM will be devoted to the chemical investigation of the surface environment, including both the atmosphere and soil samples collected by the rover.

## 2. The SAM experiment and chemical analysis at the Mars surface

The SAM experiment is composed of three instruments: a tunable laser spectrometer (TLS), a gas chromatograph (GC), and a quadrupole mass spectrometer (QMS). These instruments have been associated to provide complementary information allowing to identify and to quantify the volatile species present in the atmosphere, or released by thermal treatment of soil samples. This includes isotopes of species of particular interest, such as noble gases or methane, and also enantiomeric organic species which are important to seek for a biological activity.

From the nature and amount of the chemical species detected with SAM, it should be possible to : list the organic molecules present on Mars, and possibly determine their origin (exogenous vs endogenous) and characterize the chemical processes in which they are involved (e.g. oxidation); identify specific minerals containing structural gases that can be released by thermal treatment, and hence give information on the past environmental conditions at the exploration site (such as the presence of liquid water and its duration); give an accurate composition of the near surface atmosphere enabling to deduce information on the evolution of the atmosphere through the geological times, and to better understand the seasonal climate of the planet.

Due to the potential high number and variety of the chemical species susceptible to be analysed, the core of SAM is the composed of the GC-QMS instrumentation. The GC is devoted to separate the chemical species present in the analysed sample, and to detect the most abundant one (~ppmv level). The QMS coupled to the GC is used as an evolved analyser of the gases going out the GC, detecting species present in lower abundance in the sample (~ppbv level), and providing structural data on the analysed molecules that are precious for the identification of the analytes. Figure 1 gives an example of analysis done with a test mixture with the flight model.

Based on results obtained with laboratory tests performed during the development of the GC, and also on first tests performed with the engineering and flight models of the GC and QMS coupled together, we will give a general view of the analytical capability for the experiment to detect and identify a broad range of organic and inorganic molecules, focusing on species of astrobiological interest.

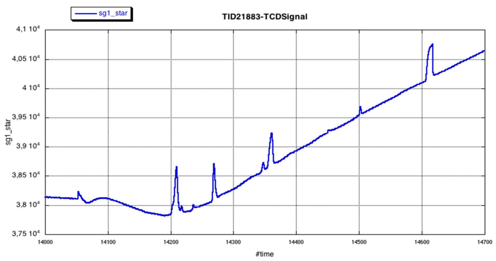


Figure 1: Chromatogram (GC detector response versus time of analysis) obtained when injecting a hydrocarbons gas mixture in the GC flight model under operating conditions mimicking those to be applied on Mars.