



## **Development of a “one-pot/one-step” sample preparation procedure for the *in situ* analysis by GC/MS of the Martian soil: application to the Sample Analysis at Mars experiment (SAM for MSL 2009)**

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In the frame of the MSL2009 exploratory mission to Mars a new one-pot/one step method to analyse *in-situ* the Martian soil and a new space compatible reactor have been developed. The goal is to detect, if they exist, the key compounds of the origin of life such as carboxylic acids, amino acids and nucleobases.

Before their analysis by GC/MS all the targeted refractory compounds should be extracted and derivatized. With a classical procedure [1], extraction and derivatization are carried out in a two steps process, which needs separation and evaporation of the extraction solvent in order to preconcentrate the extracted compounds.

With the new procedure, extraction and derivatization are carried out in a one-pot and one step procedure by sublimating or just heating the sample prior to the derivatization. In order to desorb organic compounds, 0.5 g of the sample is introduced in a new space compatible reactor and heated in the range of 200°C to 500°C during about 5 minutes. Then, the derivatizing agent is deposited on the soil and the derivatization is performed at 75°C during 30 minutes [2]. The gaseous phase thus obtained in the

reactor is flushed by the carrier gas (He) in the column of the GCMS.

This sample preparation method has been tested on soil samples collected from the Atacama desert in Chile described as one of the best “Mars-like” analog given the presence of oxidizing materials, trace quantities of organic compounds, and extremely low levels of culturable bacteria [2]. All the targeted compounds already detected by the classical two steps procedure (extraction and derivatization) have been found without significant sensitivity loss.

These results showed that a one-pot/one step sample preparation compatible within space instrumentation and operating conditions is possible without any significant a loss of information about the targeted organic compounds contained in the Atacama soil.

[1] Buch A., Marchetti C., Meunier D., Sternberg R., Raulin F., *Solvent extraction of organic molecules of exobiological interest for in situ analysis of the Martian soil*, Journal of Chromatography A. 999 (2003) 165-174.

[2] Buch A., D.P. Glavin, R. Sternberg, C. Szopa, C. Rodier, R. Navarro-González, F. Raulin, M. Cabane and P.R. Mahaffy, *A new extraction technique for in situ analyses of amino and carboxylic acids on Mars by gas chromatography mass spectrometry*, Planetary Space Science 54(15) (2006) 1592-1599.

[3] Navarro-González, R., Rainey, F. A., Molina, P., Bagaley, D. R., Hollen, B. J., Rosa, J., Small, A. M., Quinn, R. C., Grunthaner, F. J., Cáceras, L., Gomez-Silva, B., and McKay, C. P., 2003, Mars-like soils in the Atacama Desert, Chile, and the dry limit of microbial life, *Science* 302, 1018-1021.