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ANALYSIS OF AROMATIC ACID SALTS BY GAS CHROMATOGRAPHY-MASS SPECTROMETRY: INFLUENCE OF THE NATURE OF THE CATION AND IMPLICATIONS FOR IN SITU DETECTION ON MARS. C. Szopa¹, O. McIntosh¹, C. Hajlaoui¹, V. Moulay¹, C. Freissinet¹, A. Buch², M. Millan¹, A.J. Williams³, J. M. T. Lewis^{4,5,6}, J. Eigenbrode⁴, T. Fornaro⁷ and J. Brucato⁷, ¹LATMOS, UVSQ, (11 Boulevard d'Alembert, 78280 Guyancourt, France, cyril.szopa@latmos.ipsl.fr), ²Laboratoire Génie des Procédés et Matériaux, CentraleSupélec, (University Paris-Saclay, 8-10 rue Joliot-Curie, 91190, Gif-sur-Yvette, France); ³Department of Geological Sciences, University of Florida, (Gainesville, FL 32611); ⁴NASA Goddard Space Flight Center, (Greenbelt, MD, USA), ⁵Center for Research and Exploration in Space Science and Technology, (NASA GSFC, Greenbelt, MD, USA), ⁶Department of Physics and Astronomy, (Howard University, Washington, DC, USA), ⁷INAF- Astrophysical Observatory of Arcetri, (L.go E. Fermi 5, 50125 Firenze, Italy).

Introduction: Aromatic carboxylic acids are thought to be potential abundant organic species present in the soil of Mars because they are in stable intermediate oxidation states and can be formed from the oxidation of Mono or Polycyclic Aromatic Hydrocarbons (PAHs) coming from endogenous or exogenous sources. Benner et al. [1] suggested that the low volatility of these salts could compromise their *in situ* detection through thermal extraction analyses as performed by analytic chemistry laboratories onboard past, present, and future Martian surface probes. However, no extended study was ever published considering the different conditions of thermal extraction that can be used, or the nature of the cation present in the salt. This is the reason why we addressed this question through a laboratory experimental work reproducing the sample preparation used in space experiments onboard Mars surface probes.

Experiments and results: Our team performed systematic gas chromatography-mass spectrometry analyses in the laboratory, of various aromatic acid salts bearing different cations in order to assess the influence of the cation on the analysis. The extraction of the molecules from the test synthetic samples was done using pyrolysis, derivatization, and thermochemolysis in conditions aiming to simulate those used, or to be used, by the analytical laboratory dedicated to search for organic molecules on the Mars surface, including the Sample Analyzer at Mars (SAM) experiment onboard the Curiosity rover [2]. The main objective is to determine the possibility to identify *in situ* the organic salts tested through their direct or indirect detection using the chemical species they produce when submitted to the different sample preparation treatment.

Even though when submitted to pyrolysis, a substantial degradation of the acid molecule under its salty state is generally observed, it is interesting to notice that the acid can stay one among the major molecules detected when the cation is the Fe³⁺ which is abundant on Mars. Moreover, when using the different types of reactants used for derivatization and

thermochemolysis, it is observed that the chances to recover the organic acid part of the salts is significantly enhanced compared to pyrolysis.

This communication aims to present the results obtained with the different studied cations in the different sample preparation conditions, and to discuss the detectability of these aromatic organic salts *in situ* at Mars surface.

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References: [1] Benner S.A. *et al.* (2000) *PNAS*, 97, 2425-2430 (2000). [2] Mahaffy P.R. *et al.* (2012) *Space Science Reviews* 170, 401-478.