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Pyrolysis of Organic Compounds in Martian Soil Analogs

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Abstract

Detection and identification of organic molecules derived from present or past life is the goal of the Mars Organic Molecule Analyser of the 2016 ExoMars mission of ESA. One part of the instrument is a pyrolysis gas chromatograph mass spectrometer pyr-GC-MS while the other is a laser desorption mass spectrometer. In the pyr-GC-MS a soil sample of app. 200 mg can be mixed with small amounts of chemical reagents [1] and then heated to a temperature of 900°C. During this process the organic molecules either desorb from the surface or react with above mentioned reagent forming volatile organic molecules, capable to be separated on the column of the GC and identified in the MS.

The direct pyrolysis of soil samples or the chemical derivatization without previous extraction is an uncommon way of sample preparation. In addition to the parameters of the pyrolysis of pure samples, for example temperatures and specific reagents the soil influences the measurements in several ways.

To evaluate the influence of the relative large surface of the soil on the pyrolysis and derivatization several tests have been conducted with simple organic molecules.

Most of the material within a living cell, except water, are proteins, RNA/DNA, lipids, and sugar based polymers. Small building blocks of the substances mentioned above are fatty acids, sugars, amino acids and nucleic acids and a representative from each group has been chosen for the experiments. Carboxylic acids are stable intermediates in the oxidation of aromatic compounds and therefore the simplest aromatic carboxylic acid, benzoic acid was also tested. [2] The pyrolysis of benzoic acid in substance and mixed with a soil substrate shows that not only the intensity of the signals changes, but also the composition of the pyrolysis product changes significantly.

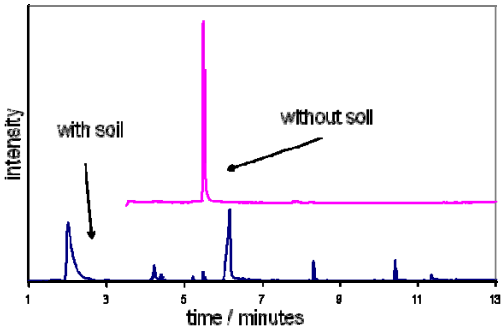

Figure 1: GC-plot of benzoic acid and benzoic acid on a soil substrate

In the GC plot without soil in Figure 1 the main product at around 6 minutes is benzoic acid, while the second plot with soil shows that the main products are benzene at around 2 minutes and benzophenone above 6 minutes. The surface catalyses several reaction and experiments with the other test compounds indicate that for most of the compounds the pyrolysis yields a wide variety of products making the clear identification difficult.

Using chemical reagents to improve the desorption and therefore decrease the necessary temperature is the proposed solution to avoid pyrolytic degradation of the organic material in the sample.

References

[1] Geffroy-Rodier, C., Grasset, L., Sternberg, R. Buch, A., Amblès, A. (2009) *J. Anal. App. Pyrolysis*, 85, 454–459.

[2] Benner, S., Devine, K. C., Matveeva L. N., Powell, D. H. (2000) *PNAS*, *97*, 2425–2430.