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Influence of Magnesium Perchlorate on the Pyrolysis of Organic Compounds in Martian Soil Analogs

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Detection and identification of organic molecules derived from present or past life is the goal of the Martian Organic Molecule Analyser of the 2018 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 and then heated to a temperature of 900°C. [1] During this process the organic molecules desorb from the surface and are separated on the column of the GC and identified in the MS.
The direct pyrolysis of soil samples 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 the soil composition 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.
The Phoenix mission discovered considerable amounts of magnesium perchlorate in the soil at the landing site. Perchlorates are oxidizing components and therefore might interact with the expected organics within the soil, especially if the soil is heated within the pyrolysis ovens. The end-product of this oxidation would be carbon dioxide which is indistinguishable from the atmospheric carbon dioxide. For the test several organic compounds have been used, for example phenylalanine and benzoic acid. Carboxylic acids are stable intermediates in the oxidation of aromatic compounds and therefore the simplest aromatic carboxylic acid, benzoic acid has been considered to be present on Mars. [2]
Along with oxidation of the used compounds also chlorination of the aromatic rings was observed. This reaction leads to a large variety of chlorinated aromatics which would be easy to detect in the GC-MS. A further investigation on the concentration dependency of this reaction is planned.

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.