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How does the association of iron oxides and perchlorate salts influence organic matter evolution when using Sample Analysis at Mars pyrolysis onboard Curiosity?

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The Sample Analysis at Mars (SAM) instrument suite aboard the Curiosity rover is designed to characterize organic and inorganic volatiles thermally evolved from solid samples. It can analyze evolved volatiles directly with its quadrupole mass spectrometer (MS) to perform evolved gas analysis (EGA) or it can analyze volatiles after they have been sent through a gas chromatography column to perform pyrolysis-gas chromatograph-mass spectrometry (pyr-GC-MS) [1]. Three solid samples have been analyzed by SAM, a scoop of basaltic sand at Rocknest (RN) and two rocks drilled at Yellowknife Bay designated as John Klein (JK) and Cumberland (CB). All these samples contain an oxychlorine phase (e.g., a perchlorate salt) [2, 3] that evolves HCl, Cl2 and O_2 on heating leading to the possible chlorination and/or combustion of organic molecules [4]. Chlorohydrocarbons detected at RN, JK and CB are derived from reactions between martian oxychlorine compounds and terrestrial carbon that is part of the SAM background (e.g., MTBSTFA [2]) as well as potentially reactions with martian carbon and/or thermal desorption directly from the samples for the production of chlorobenzene evolved during pyrolysis of CB. RN, JK and CB samples also contain iron oxides (e.g., hematite, magnetite) [5] which could oxidize organic compounds and catalyze their decomposition [6] leading to differences in the amount and/or nature of pyrolysis products.

In order to help interpretation of in situ data obtained by SAM, we study the influence of an iron oxide, hematite, and an oxychlorine phase, Ca-perchlorate, individually, as well as mixed, on alanine, a common amino acid, under conditions simulating the SAM pyrolysis. This work aims to help to determine the influences of key sample minerals on the production of organic compounds detected with SAM in both GC-MS and EGA mode, and to identify potential parent molecules.

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