IDENTIFICATION OF CHLOROBENZENE IN MIXTURES WITH THE SUGGESTED PRECURSORS BENZENE, BENZOIC ACID, PHTHALIC ACID, AND MELLITIC ACID IN MARS SAMPLES

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The discovery of chlorobenzene detected in a soil sample obtained in Mars has been controversial. The original sample was subjected to pyrolysis before the analysis with the gas chromatography-mass spectrometry (GC-MS) of the Sample Analysis at Mars (SAM) instrument on the Curiosity rover. It is believed that chlorobenzene was a product of other organic molecules reacting with chlorates of the Martian soil. In this paper, synchronous fluorescence spectroscopy is suggested for analysis of Mars samples in future missions. Synchronous fluorescence spectroscopy is a variation of the fluorescence technique where the excitation and emission scans are detected simultaneously with a predetermined wavelength difference ($\Delta\lambda$) between the two and multiplied. Depending on the $\Delta\lambda$ chosen, the resulting signal could produce a narrow single fluorescence band with a peak wavelength that is characteristic of the compound. To demonstrate the utility of this technique for Mars samples and in general for planetary and astrochemical applications, we present laboratory results with the characteristic synchronous peaks of chlorobenzene, benzene, benzoic acid, phenol, phthalic acid, and mellitic acid in solutions of n-hexane or water. Finally, we demonstrate a successful application of the technique using a mixture of chlorobenzene in the presence of the likely organic precursors that have been suggested for the Cumberland drill sample on Mars. The application of SFS for solid samples of Mars analog soils is also discussed for future experiments.