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The detection of biomarkers in sulphates. II Extraction by a microfluidic device

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Sulphate minerals are relatively ubiquitous on the surface of Mars and Earth, and may be present within the dark regions of Europa. They form by precipitation from water and can be present as evaporite deposits, hydrothermal deposits or secondary mineral phases. Sulphates crystals can trap material that is present in their parent solution as they precipitate and this can include biomolecules and biomarkers. Trapped material forms discrete inclusions that are protected from the external chemical environment. One method for analysing the organic content of these inclusions comprises sample dissolution followed by liquid-liquid extraction.

Liquid-liquid extraction performed on microfluidic devices has received considerable attention within the bioscience community as a method of sample preparation and is effectively “off-the-shelf” technology, but is also beginning to be applied to geological materials such as oil, sediments and soil. We are developing a lab-on-a-chip device that can extract the organic compounds present as inclusions within sulphate bearing materials and deliver them on-chip or off-line for analysis. The device is currently being configured for on-chip analysis by Resonance Raman, or Surface Enhanced Resonance Raman Spectroscopy, but could in theory deliver extracts to other analytical instruments.

Inclusions of fatty acids and PAH have been successfully extracted from laboratory precipitated magnesium sulphate by a microfluidic device. The device and methodology are being adapted for geological materials that contain less-soluble and insoluble mineral phases as well as materials that contain ice.