

MOMA-Ldms: Instrument concept and results

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The Mars Organic Molecule Analyzer (MOMA) is a powerful multi-source mass spectrometer-based instrument suite for investigation of potential life on Mars. MOMA has been selected as a core element of the Pasteur payload on the ESA ExoMars mission. The MOMA instrument is the next generation design for *in situ* life detection instrumentation. A key element of MOMA is the laser desorption mass spectrometer (LDMS) that incorporates several methods of volatilizing and ionizing chemical compounds from intact samples without further processing or manipulation. State-of-the-art laser desorption coupled to an ion trap mass spectrometer provides enhanced mass resolution over a broad dynamic range and detailed structural information on key organic molecules and compounds. Preliminary results on several Martian analog samples and carbonaceous chondrites using our MOMA LDMS breadboard instrument will also be presented.

Controlled growth of different calcium carbonate polymorphs as induced by the presence of dissolved molecules and mineral surfaces

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While vaterite is the least stable polymorph of CaCO₃ at ambient conditions, it may be one of the most 'underestimated' minerals in such that it is often an important precursor for the other polymorphs, that it may be more stable in certain organic and inorganic environments, and that the relative stabilities have not been determined at the nanoscale. Among the factors affecting the type of polymorph being grown, the presence of organics as additives or templates has been investigated in previous studies [1-4]. However, the role of inorganic molecules, such as ammonium, and of mineral surfaces, may have the same ability to promote growth of certain calcium carbonate polymorph surfaces in a controlled way. The goal of this study is to investigate how ammonium and different inorganic interfaces influence the CaCO₃ polymorphism.

When diffusing ammonia at a certain rate into supersaturated calcium-carbonate containing solutions, the presence of ammonium is capable to induce and stabilize vaterite. Positively charged ammonium molecules adsorb to the polar (001) surfaces of vaterite, as shown by using FTIR experiments, thus inhibiting the growth in the [001] direction, and therefore helping to create the hexagonal morphology of vaterite composed of layered crystal sheets terminated by (0001) faces. The presence of powders of muscovite, orthoclase, and quartz, have a decreasing ability to induce the formation of vaterite, rather than calcite, as shown by x-ray diffraction (XRD) and scanning electron microscopy (SEM) of the crystals formed. The percentage of vaterite among the whole CaCO₃ precipitation induced by the three silicate minerals has the same tendency as the cation exchange capacities of these minerals. Adsorption tendencies, interface stabilities, and FTIR frequencies are compared with molecular simulations.

[1] Ferris *et al.* (1989) *Metal Ions and Bacteria*, 413-441.

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