Molecular mapping of lipid biomarkers with Time-of-Flight - Secondary Ion Mass Spectrometry (TOF-SIMS): a feasibility study.

Time of Flight - Secondary Ion Mass Spectrometry (TOF-SIMS) has become a routine analytical tool in material research where it is mainly used for the characterisation of surface properties and composition. Specifically with the development of new polyatomic primary ion sources, TOF-SIMS can be used to perform high-quality chemical imaging by rastering over the sample surface and quasicontinuously collecting mass spectra. A molecular map of a sample area can thus be generated for any compound that produces a diagnostic mass peak in the spectrum. Although these advantageous features exactly meet the demands of many modern geobiological approaches, the potential of TOF-SIMS for such applications remains yet to be explored. In this project, we will systematically evaluate the capabilities and limits of TOF-SIMS in order to open a new analytical window in organic biomarker studies. Emphasis is placed on (1) the generation and interpretation of basic spectral reference data for major biolipids and geolipids, and (2) the identification and molecular mapping of these biomarkers in geobiological materials ranging from microbial mats to solid rocks. This project is designed as a feasibility study that will form the basis for a geobiological follow-on project on the sources and distributions of organic molecules in active microbial systems, and in related minerals and rocks.