Detecting potential bio-signatures for Enceladus

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**Description:** The plumes emitted from the South Polar Region of Enceladus have been investigated extensively by the Cassini mission. Returned data implies they are fed by a global ocean situated below an ice shell atop a silicate interior [e.g., 1,2].

Further information regarding the sub-surface ocean has been obtained from the Ion and Neutral Mass Spectrometer instrument, which detected water, ammonia, molecular hydrogen, simple organic compounds, and potentially sulfur [3, 4]; whilst higher molecular weight organic molecules, salts, biologically-available nitrogen, and nanosilica particles have been detected in plume ice grains by the Cosmic Dust Analyzer [5, 6]. Based on these observations, it is predicted that all of the key elements required for life, e.g., C, N, O, P and S are expected to be present in the sub-surface ocean since they have either been detected in the plumes or are expected to be present owing to water-rock interaction at the ocean floor. Hence, Enceladus is of interest from an astrobiological perspective.

Although the sub-surface ocean may be deemed habitable, finding evidence of life is dependent on detecting the bio-signatures that are uniquely produced by microbial life. The aim of this studentship is to determine the feasibility of detecting biosignatures in the plumes of Enceladus. It will begin by identifying likely biosignatures generated in the sub-surface ocean, based on the results of previous simulations and modelling, and by subjecting analogue microorganisms to a simulated Enceladus sub-surface ocean environment. It will then determine the hypervelocity modification of these biosignatures during both plume emission and mass spectrometric analysis from a space craft using a combination of simulation facilities at the Open University, Freie University Berlin and the University of Stuttgart.

To investigate the feasibility of detecting bio-signatures from Enceladus the following experiments will be conducted and combined with data from Cassini:

1) Drawing on the results of previous simulations and modelling, subject analogue microorganisms to a simulated Enceladus sub-surface ocean environment;
2) Determine the organic biosignatures these organisms may generate and investigate their processing within the oceanic environment;
3) Subject the resulting molecules to the hypervelocity environment they may experience on ejection within plumes, using plume simulation facilities
4) investigate the effects of the hypervelocity environment that such biosignatures might experience as they are ejected within plumes, using dedicated plume simulation facilities;
5) Determine the modifications experienced by the molecules on ejection, and through analysis by spacecraft instrumentation.
References:


Qualifications required:

Students should have a strong background in organic chemistry/geochemistry, or a laboratory-based discipline.