MACROMOLECULAR ORGANIC COMPOUNDS EMERGING FROM THE ENCELADUS OCEAN

Frank Postberg[1], Nozair Khawaja[1], Christopher R. Glein[2], Hsiang-Wen Hsu[3], Sascha Kempf[3], Fabian Klenner[1], Lenz Nölle[1], Juergen Schmidt[4], Gabriel Tobie[5], J. Hunter Waite[2]

[1] University of Heidelberg, Heidelberg, Germany, [2] Southwest Research Institute, San Antonio, Texas, United States, [3] University of Colorado at Boulder, Boulder, Colorado, United States, [4] University of Oulu, Oulu, Finland, [5] University of Nantes, Nantes, France

Introduction: Saturn's icy moon Enceladus harbors a global subsurface ocean, which is thickest (50 km) below the south polar region. There, through warm fractures in the less than 5 km thick ice crust, jets of vapor and nanometer to micrometer-sized ice grains emerge from the ocean into space. Two mass spectrometers aboard the Cassini spacecraft frequently carried out compositional in situ measurements of material emerging from the subsurface of Enceladus. These measurements were made inside both the plume and the E ring. The Cosmic Dust Analyser (CDA) showed that a large fraction of the ice grains are direct samples of subsurface alkaline ocean water with mild salinity. The CDA also uncovered the first evidence of hydrothermal activity taking place at the interface of the moon's rocky core and its ocean. The detection of molecular hydrogen in the plume by the Ion and Neutral Mass Spectrometer (INMS) provided further support for fluid-rock interactions, most consistent with exothermic serpentinization reactions, similar to certain alkaline hydrothermal systems of Earth's oceans, such as Lost City in the Atlantic Ocean. Because of the relatively low density (2500 kg/m3) of the moon's core it is likely porous and percolated by ocean water. Hydrothermal reactions thus probably take place deep inside the core and are likely powered by tidal dissipation.

Results Previous CDA and INMS measurements showed that the plume emits organic material of low molecular weight both, in the gas phase and in about 25% of the ice grains, so-called Type 2 grains but complex organics emerging from Enceladus oceans have not been reported before. Here we will present spectra of emitted ice grains containing concentrated, macromolecular organic material with molecular masses clearly above 200u. The data provides key constraints on the macromolecular structure and is suggestive of thin a organic-rich film on top of the oceanic water table. We suggest that it originates from Enceladus' rocky core and might be a product of hydrothermal roch/water ineraction.

We suggest a large-scale ocean convection mechanism that, together with bubbles of volatile gases, transports these and other materials from the moon's core up to the ocean surface. There, organic nucleation cores generated by bubble bursting and ejected into space, allow probing of Enceladus' organic inventory in drastically enhanced concentrations.