Contribution ID: **10** Type: **Poster presentation**

# Hydrothermal processing of triglycine and its detection in Enceladean ice grains

*Wednesday 6 September 2023 17:40 (20 minutes)*

Evidence for water-rock interactions and hydrothermal (HT) reactions at the ocean-floor of Enceladus was found via the mass spectrometers onboard the Cassini spacecraft –the Cosmic Dust Analyzer and the Ion and Neutral Mass Spectrometer. Organic material of astrobiological interest, containing various moieties (N-, O- and aryl groups), was detected in ice grains coming from vents on Enceladus'south pole, as well as prebiotically relevant high mass fragments (mass > 200) and low mass (mass < 100) compounds.
These low-mass compounds, soluble and reactive, could provide building blocks for the synthesis of prebiotic monomers like amino acids (AA) under Enceladus hydrothermal conditions (EHTC). AAs play a distinct role in the origins of life on Earth - both as monomers and polymers like peptides or proteins and enzimes- and are key biosignatures for the identification of extraterrestrial life. Therefore, it is of investigating the hydrothermal processing (HTP) of AAs and peptides under EHTC is of great importance. A tripeptide of glycine, an AA relevant for astrobiology investigations, was studied in this work. Triglycine (GGG) formation is inhibited under conditions relevant to Enceladus'HT system, thus the detection of GGG, and its degradation products, in Enceladean ice grains may hint at biotic or hitherto unknown abiotic processes in the moon's interior.
The mass spectral appearance of GGG in ice grains after processing under EHTC (80 ℃, 80 bar; [GGG]=0.005 M; 1:20 peridotite-water) was investigated. Different solutions were prepared and HT processed for 2 and 4 hours: 1) GGG 2) GGG + Enceladus ocean simulant (EOS; pH=9, [NaCl]=0.1 M), 3) GGG + minerals, 4) GGG + EOS + minerals. This systematic methodology is adopted in order to assess degradation pathways of GGG during HTP.
Processed and unprocessed HT samples, were measured using laser-induced liquid beam ion desorption (LILBID), which accurately simulates hypervelocity impact ionization mass spectra of ice grains. Partial degradation of GGG in HT processed solutions 1 and 2 was identified, while 3 and 4 showed no signs of degradation. Spectral differences were found in solutions 1 and 2, hinting at NaCl having an effect on the degradation pathway of GGG. There was a lack of evidence for HTP found in spectra of solutions 3 and 4, which might indicate the mineral used for fulfils a preservative role.

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**Session Classification:** Poster session