Peptide synthesis under Enceladus hydrothermal condition

W. TAKAHAGI[1,2,3], K. ADACHI[1,2,3], T. SHIBUYA[2], K. FUJISHIMA[3,4], Y. TAKANO[2,5], M. TOMITA[1,3] & K. TAKAI[2,4]

[1]Department of Environment and Information Studies, Keio University, Japan
[2]Japan Agency for Marine-Earth Science and Technology, Japan
[3]Institute for Advanced Biosciences, Keio University, Japan
[4]Earth-Life Science Institute, Tokyo Institute of Technology, Japan
[5]Department of Earth and Planetary Sciences, The University of Tokyo, Japan

Enceladus is one of the moons of Saturn, and it has been known to harbor interior ocean beneath the icy crust. The mass spectrometry data obtained by *Cassini* spacecraft indicates the presence of salty, and most likely alkaline ocean containing various organic compounds. While geochemical and other radiation related processes for *in situ* production of organics remain elusive, thermally unaltered carbonaceous chondrites, consisting the main body of Enceladus are known to be enriched with organic matters potentially including the building blocks of life (e.g., amino acids and amino acid precursors). Assuming that abiotic amino acids exist in the Enceladus alkaline seawater, we hypothesized that water-rock interaction may contribute to condensation of localized amino acids leading to peptide formation. In order to test this hypothesis, we have developed the Enceladus hydrothermal reactor based on the chemical constraints obtained through previous experimental and theoretical studies. We have added six different amino acids and introduced a thermal fluctuation system simulating the periodic tidal heating of the interior chondritic core. Total, eight sea water samples were obtained over the course of 147 days of experiment. While detection of peptide using Capillary Electrophoresis Time-of-Flight Mass Spectrometry (CE-TOF/MS) is still at the preliminary stage, so far presense of various molecules larger than the mass of a single amino acid have been comfirmed. The pH monitoring and H2 and CO2 Gas Chromatography (GC) data clearly indicated the occurrence of serpentinization / carbonation reaction. These results suggest the interaction between amino acids, aqueous alteration reaction and thermal cycling processes for the role of abiotic peptide formation under alkaline hydrothermal condition.