Japan Geoscience Union Meeting 2013
(May 19-24 2013 at Makuhari, Chiba, Japan)

BAO01-06 Room:301A Time:May 21 11:30-11:45

Exposure experiments of organic compounds in space environments in the TANPOPO mission

Hajime Mita[1*], Shin-ichi Yokobori[2], Hirofumi Hashimoto[3], Masumi Higashide[4], Eiichi Imai[5], Yuko Kawaguchi[2], Hideyuki Kawai[6], Yukinori Kawamoto[7], Kazuhiro Knada[8], Kensei Kobayashi[7], Kazumichi Nakagawa[9], Issay Narumi[10], Kyoko Okudaira[11], Makoto Tabata[3], Hikaru Yabuta[12], Masamichi Yamashita[3], Hajime Yano[3], Satoshi Yoshida[13], Akihiko Yamagishi[2], Tanpopo WG[3]

[1]Fukuoka Inst. Technol., [2]Sch. Life Sci., Tokyo Univ. Pharm. Life Sci., [3]JAXA/ISAS, [4]Innovative Tech. Res. Cen., JAXA, [5]Nagaoka Univ. Tech., [6]Grad. Sch. Sci., Chiba Univ., [7]Grad. Sch. Eng., Yokohama Natl. Univ., [8]LASTI, Univ. Hyogo, [9]Grad. Sch. Human Develop. Environ., Kobe Univ., [10]Quantum Beam, JAEA, [11]Univ. Aizu, [12]Grad. Sch. Sci., Osaka Univ., [13]NIRS

The Tanpopo mission is a Japanese astrobiological experiment which will be conducted on the Japanese Experiment Module (JEM) of the International Space Station (ISS). The Tanpopo mission consists of six subthemes: 1) capture of microbes in space, 2) exposure of microbes in space, 3) exposure of organic compounds in space, 4) capture of organic compounds (in micrometeoroids) in space, 5) evaluation of ultra low-density aerogel developed for the Tanpopo mission, and 6) capture of space debris at the ISS orbit (approximately 400 km altitude).

Here, we overview the exposure experiment of organic compound in space environment. Since many kinds of organic compounds, especially, amino acids which are ones of most important organic compounds in living organisms, are found from extraterrestrial materials, extraterrestrial and outer-solar environments are thought as the place for the prebiotic organic compound synthesis. Then, it is proposed that the first organisms on the earth was born from the prebiotic organic compounds delivered into the early earth on meteorites, micrometeorites and/or comets. In order to discuss the possibility of the hypothesis, alteration of prebiotic compounds in space environments should be clear. Therefore, we will expose some prebiotic organic compounds on the exposure facility at ISS-JEM.

Glycine, isovaline, hydantoin, ethylmethylhydantoin and complex organics (CAW) are chosen for the exposure. Hydantoin and ethylmethylhydantoin are plausible low molecular weight precursors for glycine and isovaline, respectively. CAW which is a simulated material of interstellar medium prepared by proton radiation into mixture of CO, NH_3 and H_2O is a different type of plausible precursors for amino acids. In the space environments, uv-light and cosmic rays (heavy ions and gamma-rays) will cause the alteration of organic compounds. Therefore, simulation experiments were studied using Xe-excimer lamp (uv 172 nm), synchrotron radiation at NewSUBARU BL06 (uv $>$ 130 nm), 60Co gamma-ray radiation (JAEA Takasaki) and carbon ion beams (290MeV, NIRS). gamma-Ray and heavy ion beam irradiation with dose of ISS environment for one year induced little decomposition of organic compounds. However, uv irradiation was critical for organic compounds. Although almost all glycine and isovaline were decomposed, remains of hydantoin and ehtylmethyl hydantoin were approximately 29% and 72%, respectively, with uv dose of ISS environment for one year. Furthermore, CAW was more stable than hydantoins. Amino acids precursors, especially, complex organics were more stable than free amino acids. Therefore, extraterrestrial amino acids precursors would be effective source for origins of life on the earth. We will demonstrate this conclusion on the ISS-JEM.

In addition, Nakagawa and his colleagues were found that dialanine was formed from alanine films by uv-irradiation. We will demonstrate a peptide synthesis with uv-irradiation in the space environment. Furthermore, piece of meteorite will be also exposed in order to examine the weathering effect in the ISS environment.

Keywords: Tanpopo, exposure of organics, ISS, amino acids