

たんぽぽ計画におけるアミノ酸およびその前駆体の宇宙曝露：第1報

Space Exposure of Amino Acids and Their Precursors in the Tanpopo Mission: The First Analysis Report

*小林 憲正¹、三田 肇²、癸生川 陽子¹、中川 和道³、青木 涼平¹、原田 拓¹、三澤 柊介¹、内藤 敬介¹、佐藤 智仁¹、今井 栄一⁴、矢野 創⁵、橋本 博文⁵、横堀 伸一⁶、山岸 明彦⁶

*Kensei Kobayashi¹, Hajime Mita², Yoko Kebukawa¹, Kazumichi Nakagawa³, Ryohei Aoki¹, Taku Harada¹, Shusuke Misawa¹, Keisuke Naito¹, tomohito sato¹, Eiichi Imai⁴, Hajime Yano⁵, Hirofumi Hashimoto⁵, Shin-ichi Yokobori⁶, Akihiko Yamagishi⁶

1. 横浜国立大学、2. 福岡工業大学、3. 神戸大学、4. 長岡技術科学大学、5. 宇宙科学研究所、6. 東京薬科大学

1. Yokohama National University, 2. Fukuoka Institute of Technology, 3. Kobe University, 4. Nagaoka University of Technology, 5. JAXA/ISAS, 6. Tokyo University of Pharmacy and Life Sciences

Since a wide variety of organic compounds including amino acids have been detected in carbonaceous chondrites [1], it is plausible that organic compounds delivered by extraterrestrial bodies played important roles in the generation of terrestrial life. Cosmic dusts (IDPs) are another candidate of carriers of extraterrestrial organics [2]: Chyba and Sagan [3] suggested that cosmic dusts delivered much more organics to the primitive Earth than meteorites and comets. It is difficult, however, to detect bioorganics in cosmic dusts if they are collected in the terrestrial biosphere.

We initiated the first Japanese astrobiology mission on the International Space Station (ISS) named the Tanpopo Mission in 2015. In the mission, we intended to collect dusts flying in low Earth orbit by using ultra-low density silica gel (aerogel), and to expose organic compounds and microorganisms to space environments [4]. One of the major objectives is to examine possible delivery of organic compounds including amino acids by cosmic dusts. Thus amino acids in captured dusts are analyzed, and stability of selected organic compounds (free amino acids and their precursors) is evaluated in the mission. The first sample returned to the Earth in August 2016 after about 1 year's space exposure. Here we report the first analytical results of the organic exposure experiment in the Tanpopo Mission.

Two free amino acids (glycine, and isovaline) and their possible precursors (hydantoin and 5-ethyl-5-methylhydantoin), together with products by proton irradiation of a gas mixture of ^{13}CO , NH_3 and H_2O (hereafter abbreviated as CAW) were selected in the organic exposure experiment: CAW is a mixture of complex organic compounds including amino acid precursors [5]. All the organic materials used were labeled with ^{13}C . Aqueous solution of each of these materials was added to one of dimples on an aluminum plate, and dried. Then the surface of the materials was covered with hexatriacontane to avoid scattering. Each plate for space exposure was covered with a SiO_2 or MgF_2 window. The same kind of plates were prepared for (i) dark controls (exposed in space but no light allowed), (ii) cabin controls (stored in the JEM cabin), and (iii) ground controls.

Alanine thin film was used as a VUV dosimeter based on a dissociation experiment with a 172 nm excimer lamp [6]. Optically stimulated luminescence dosimeter (OSLD) and silver activated phosphate glass dosimeter (RPLD) were used as radiation dosimeters. The dosimeters and the exposure plates were combined together to be an exposure panel, which was attached to an ExHAM module and exposed on the Exposed Facility (EF) of Japanese Experimental Module (JEM) of ISS.

The material in each dimple was collected by using small amount of methanol and water. Amino acids were determined by HPLC (Amino acid precursors and CAW were determined after acid-hydrolysis). The materials were also analyzed by GC/MS and LC/MS.

Preliminary results and discussion will be shown in the poster. We are expecting return of another set of

samples in 2017 after 2 years' exposure.

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