Organic compounds in interplanetary dust particles and their relevance to origins of life

Kensei Kobayashi[1]; Yamagishi Akihiko Space Utilization Science Committee Working Group TANPOPO[2]

[1] Dept. Chem. Biotech., Yokohama Natl. Univ.; [2] -

http://www.bsk.ynu.ac.jp/lab/kobayashi-lab/index.html/

A wide variety of organic compounds have been found in extraterrestrial environments. Such bioorganic compounds as amino acids and nucleic acid bases were identified in extracts from carbonaceous chondrites. Organic globules were found in carbonaceous chondrites, and it was suggested that such organics were formed in quite cold environments.

These organic compounds found in extraterrestrial bodies seem to have been originally formed in dense clouds before formation of the solar system. Such molecules as carbon monoxide, methanol, ammonia and water were detected in interstellar dusts. We irradiated frozen mixtures of these molecules with high-energy particles from accelerators. The resulting organic compounds are quite complex having molecular weight of a few thousands. Amino acids were detected in hydrolysate of the products. It strongly suggested that complex organic compounds containing precursor of bioorganic compounds were formed in interstellar environments and that they were incorporated in such solar system small bodies as meteorites, comets, inter planetary dust particles (IDPs).

Organic compounds in comets and meteorites may have been destroyed during impacts to the Earth. It is suggested that organic carbons delivered to the early Earth by IDP were much more than those delivered by comets and meteorites. In addition, organics in IDPs seems to be more stable than cometary / meteoritic organics during introduction to the Earth. Thus organics in IDPs may have been more significant to the origin of terrestrial life than cometary / meteoritic organics.

IDPs have been usually collected in Antarctic ices or in deep-sea sediments. It is difficult to eliminate terrestrial contamination in analysis of organics in IDPs. Organics in IDPs near Earth are irradiated with strong UV light from the Sun, which can decompose or alter the IDP organics. We proposed a new astrobiology mission named TANPOPO: Astrobiology exposure and micrometeoroid capture, and accepted as a candidate experiments on Exposed Facility of Japan Experimental Module (JEM) of the International Space Station. In this mission, dusts will be collected by using ultra low-density aerogel, and microorganisms and organics in the dusts will be analyzed. In addition, organic compounds and microorganisms will be exposed to the actual space environments to see their stability. The present mission would give support of the chemical evolution scenario from interstellar organics to the terrestrial life.