Formation and stability of bioorganic compounds in simulated submarine hydrothermal systems

K. KOBAYASHI, T. HORIUCHI, MD. N. ISLAM AND T. KANEKO

Department of Chemistry and Biotechnology, Yokohama National University, Yokohama 240-8501, Japan (kkensei@ynu.ac.jp)

Submarine hydrothermal systems (SHSs) have been regarded as probable sites of the origin of life on the Earth since their discovery in the late 1970s. There have been many theoretical and experimental studies concerning the roles of SHSs in chemical evolution. Here we report our recent experiments simulating SHSs. In the earlier experimental studies, closed apparatus such as autoclaves were used to simulate them. The actual hydrothermal system is, however, considered as "a flow system" where quenching of the heated fluid by cold seawater occurs. Since late 1990s, flow reactor-type simulators have been used to study possible reactions in SHSs.

We constructed a novel supercritical water flow reactor (SCWFR). Sample solution can be heated rapidly up to such high temperature as 400°C within a few seconds with an infrared gold image, without preheating. Both the temperatures outside and inside the reaction tube can be monitored with thermocouples. The heated solution was then rapidly cooled to 273K in a cold bath.

Possible formation of amino acids in the SCWFR was examined. An aqueous solution containing KCN (0.1M), HCHO (0.1 M) and NH_4HCO_3 (0.05M) was heated at 323 - 673K for 2 min. Resulting products were acid-hydrolysed, then were determined with an amino acid analyser. At 373-523K, glycine and alanine were predominant among amino acids detected in the products. Glycine and alanine were also formed in the flow reactor from lower concentration (0.1mM) of KCN and HCHO in the flow reactor. Their yield decreased when the reaction temperature was raised. At higher temperatures (*i.e.*, 573-673K), ω-amino acids such as γ-aminobutyric acid and δ-aminovaleric acid were detected as major product.

We examined the stability of amino acids in SHSs by using the SCWFR. The stability depended on not only temperature, but also re-dox condition of the systems and the form of the amino acids: Amino acid precursors formed in simulated primitive atmospheres by radiation was much more stable than free amino acids.

It would be important to construct a new scenario of chemical evolution from extraterrestrial environments to submarine hydrothermal systems.

Litho-, bio-, and chemostratigraphy of the Middle to Upper Permian limestone at Chaotian, South China

NORITADA KOBAYASHI[1], YUKIO ISOZAKI[2], HODAKA KAWAHATA[3], AND JIANXIN YAO[4]

[1] Department of Earth Science and Astronomy, The University of Tokyo, Japan (nori@esa.c.u-tokyo.ac.jp)
[2] Department of Earth Science and Astronomy, The University of Tokyo, Japan (isozaki@chianti.c.u-tokyo.ac.jp)
[3] National Institute of Advanced Industrial Science and Technology, Japan (h.kawahata@aist.go.jp)
[4] Chinese Academy of Geological Sciences, China (yaojianxin@ccsd.org.cn)

About 10 million years before the Permo-Triassic boundary (PTB), another mass extinction comparable in magnitude to the PTB event occurred at the Middle-Upper Permian boundary (Guadalupian-Lopingian boundary; GLB).

The Middle to Late Permian shallow-water limestone of shelf facies crops out continuously at the Chaotian section, northern Sichuan, China. Field research and microscopic observation of 155 thin sections from this section clarified the following litho- and biostratigraphic characteristics.

The study section consists of the Guadalupian Maokou Formation (53 m thick) and overlying Lopingian Wuchiaping Formation (21 m thick). Limestone of both formations is bedded and rich in fossils, including fusulinids, algae, coral, and brachiopods. The Maokou Formation yields Guadalupian large-shelled fusulinids, such as *Schwagerina* and *Colania*, plus conodont *Jinogondolella*. The Wuchiaping Formation has only small-shelled fusulinids, such as *Codonofusiella*. The GLB is set at the Maokou/Wuchiaping Formation boundary, which is characterized by a 2 m thick acid tuff.

We report on the secular change in $\delta^{13}C$ of the Middle to Late Permian limestone at the Chaotian section and discuss its geological implication to the GLB mass extinction.