Dehydration polymerization experiment of L-alanine under P-T condition of diagenesis

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1. Introduction

Almost all experiments and theories on the origins of life have been based on an a priori assumption that molecular evolution proceeded in the ancient oceanic environments such as hydrothermal vents and lagoon etc. This assumption faces, however, to the inconsistency that dehydration polymerization of organic molecules proceeds in the excess amounts of water. To solve this problem, following scenario has been proposed (Nakazawa et al., 1993): (1) Simple organic molecules in the ocean are adsorbed on clay particles and deposited on seafloor. (2) Dehydration polymerization of organic molecules occurred in sediments under diagenesis. (3) On the oceanic plate, seafloor sediments moved to and attached to the continental crust as accretionary prism. Thus organic polymers appeared on the Earth's surface.

The purpose of this study is to check weather amino acids adsorbed on clay minerals are polymerized in sediments under the probable pressure and temperature of diagenesis.

2. Experimental

L-alanine (Wako pure chemical industries) adsorbed on Na-montmorillonite (Kunipia F, Kunimine Co.) was prepared as a model sample of the seafloor sediment. The samples were sealed in gold capsules and heated in an autoclave at 150 to 250 degrees C and pressure of 100MPa for 24 hours. All products were extracted by 0.1% TFA aqueous solution and analyzed by a high performance liquid chromatography (HPLC). Some products of fairly high concentration were separated, collected, freeze-dried and analyzed by a Fourier transform infrared spectroscopy (FT-IR) to check the presence of peptide bond in the molecules.

3. Results

HPLC analysis indicated that various organic molecules were formed. The variety of molecular species increased as increasing temperature applied. FT-IR spectra showed that some organic molecules of them have surely peptide bonds.

4. Discussion

These results indicate that amino acids adsorbed on clay minerals are polymerized to polypeptide in sediments under the probable pressure and temperature of diagenesis. The formation of polypeptides supports strongly the hypothesis that chemical evolution proceeded in the upper crust of the Earth. Although identification of molecular species of products has not been completed yet, those polypeptides may play an important role in further evolution of organic molecules on the primitive Earth.