Polymerization of amino acids by dehydration in a high pressure and temperature environment of deep sediments

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1. Introduction

Most previous experiments and theories on the origin of life have been based on a priori assumption that chemical evolution had proceeded in the ancient oceanic environment such as hydrothermal vents and lagoon, etc. However, hydrolysis rather than dehydration is more favorable in such oceanic environments. The water-poor condition is more plausible environments to proceed the dehydration polymerization reaction and such water-poor conditions may occur during pressurized diagenetic stage or early metamorphism. Therefore, some experiments are performed in order to examine how amino acids polymerize in the high temperature, high pressure and water-poor conditions.

2. Experiments

L-alanine (Wako pure chemical industries, high grade) adsorbed on Na-montmorillonite (Kunimine Co., Kunipia F) was prepared as a model sample of the sediment. The samples were sealed in gold capsules together with CaO: CaO is the adsorbant of water produced by the dehydration reactions. The capsules were treated by an autoclave at 150 degrees C and 100 MPa for 7 days. Running products were extracted, evaporated and analyzed by the high-performance liquid chromatography (HPLC).

3. Results and discussion

HPLC analysis indicated that oligopeptides up to pentamer were formed by polymerization of alanine. The results clearly indicate that dehydration polymerization of amino acids more proceed in the water-poor condition rather than water-rich condition. In addition, oligoalanine over the trimer was not produced in the previous experiments that simulated the oceanic environment, and experiments in this study verified that the effect of water (thus water activity) is critical to peptide formation. New suggestion for chemical evolution is proposed here that the deep sediment may be more suitable environment to polymerize amino acids rather than oceanic environment.