Stability of amino acids in sediment with artificial seawater at hydrothermal condition

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In order to estimate the stability and the dissolution rate of amino acids in natural sediments at seafloor hydrothermal condition, hydrothermal experiments were performed using the carbonaceous clays sediment taken by a box core from the west of Hawaii (20 degree N, 175 degree 56 minute E) and artificial seawater.

5.0 g of dry powdered sediments and 150 ml artificial seawater were enclosed in a titanium vessel. The sealed vessel was heated at 70-200 degree C for 3-240 hours in a mantle heater. The reacted seawater was collected at intervals and the residual seawater and sediment were also collected. The collected sample seawaters and sediment were hydrolyzed with HCl at 110 degree C for 22 hours. 20 species of amino acids and 2 species of hexosamine in the prepared solution were analyzed by HPLC (Shimazu LC-9A).

The total concentration of amino acids (TAA) in the starting sediments was 3129 pmol/mg, which was smaller than that in shallow sea sediments (i.e., 21400pmol/mg in the sediment of East China Sea, Terashima 1979). It was higher than that from Loihi seamount (630pmol/mg), which was affected high temperature hydrothermal activity. TAA in the sediment after hydrothermal reaction decreased with increasing temperature. Under 200 degree C and after 168 hours TAA become to 216 pmol/mg. TAA in artificial sea water increased with time at 70 degree C, while it decreased at 120 degree C after 120 hours reaction. The maximum concentration of TAA in artificial seawater was recorded after 3 hours at 200 degree C, however, it turned to decreased after that.

Most of the amino acids were lost from the artificial seawater by decomposition after 168 hours at 200 degree C. However, arginine, tyrosine and g-amino butyric increased in the same solutions with time.

The solubility of amino acid obtained in these experiments discorded with those obtained from the similar experiments using pure water. For example, Akahori (1983) reported that proline is the most soluble at 70 degree C, and serine and glycine are the second and third. In our study, arginine (15) showed the highest degree of solubility, expressed by the ratio of (amino acids after reaction) /(amino acids in origin sediment), histidine and proline are the second and third. Thus, it is important to know the physico-chemical properties of amino acids at laboratory hydrothermal experiments using natural materials when considering the stability of amino acids in the naturally geologic system.