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Open system incubation experiments of glycine-montmorillonite-water mixture at high temperature and high pressure

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There are several theories as to the place where primordial protein formed. Most of studies assume that polymerization of amino acids occurred in oceanic environments. However, there is a difficulty in the oligomerization of amino acids in oceans where huge amount of water exit, because the oligomerization of amino acid is a dehydration reaction. To address this contradiction, a model that hypnotizes the oligomerization proceeded in oceanic sediments was proposed. The effects of pressure in this model have been investigated previously. Clay minerals play an important role for the accumulation of amino acids in this model. However, the effect of clay minerals remains unclear. Therefore, this study investigated the effects of a typical clay mineral on the oligomerization of amino acids in a simulated diagenetic condition.

Glycine (Gly) adsorbed on montmorillonite was compressed and heated at 90^{o}C and 9 MPa with a piston cylinder for 7 days using silica powder as a pressure medium. Samples were collected and divided into three sections (S1, S2, and C1). The S1 was the outermost part of the sample, which was composed of mainly silica. S2 was the part between S1 and C1. Most of the S2 sample was silica. C1, the part of the center of the sample, was composed of mainly montmorillonite. Gly and peptides in these three samples were extracted with ammonia water. The extracted solution were filtered and concentrated to analyze the amount of Gly and peptides with LC/MS. Results show that Gly, diketopiperazine of Gly (Gly_{DKP}), and Gly dimer (Gly_2) were detected from three samples. The amount of Gly_2 and Gly_{DKP} were higher in C1 than in S1 and S2. Therefore, montmorillonite was considered to be effective to form peptides.