How to polymerize single amino acids into peptides is the most fundamental question for origin of life. In addition, there exist no clear constraints as to which geological conditions are suitable for such peptide formations. Previous experiments indicated that high-pressure environments (>20 MPa) would be suitable for polymerization of amino acids. This leads to the hypothesis that the first peptides may have formed in the Hadean crustal environments. In the present study, experiments simulating the crustal conditions were performed with various pressures (1~175 MPa) and temperatures (100~200°C) using autoclaves. Purified powders (100mg) of alanine, glycine, valine and aspartic acid were used in the present experiments without activating each amino acid or mixing with catalyses. The products were analyzed using HPLC and LC-MS.

Results indicate that: (1) glycine was polymerized up to 11-mer, which was not formed in any previous experiments without catalyses; (2) valine was polymerized up to 3-mer; and (3) aspartic acid was polymerized to 4-mer, accompanied with production of other amino acids. It is noteworthy that all examined polymerization reactions were promoted under high-pressure and water-poor conditions. Such situations would have happened inside of deep oceanic crusts of the early Earth. This process only could happen on the water-covered and crust-available planets, thus Earth.