
Alteration of Smectite in a System Including Alanine at High Pressure and Temperature

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Abstract: Transformation of montmorillonite was experimentally investigated using a model system of montmorillonite-alanine at 100 MPa and up to 500° C. Sodium-montmorillonite changed to a mixed layer mineral of sodium- and ammonium-montmorillonites (Na/NH₄-Mnt) in the temperature range from 150 to 400° C. Ammonium ions were the decomposition product of alanine above 150° C. The Na/NH₄-Mnt transformed to regularly and randomly interstratified minerals of NH₄-montmorillonite and NH₄-mica (o. NH₄-Mnt/NH₄-Mic and d. NH₄-Mnt/NH₄-Mic) at 400° C. These mixed layered minerals transformed to ammonium-mica at 500° C. Ammonium-analcime appeared and coexisted with the smectites at temperatures over 200° C, and with albite for those over 400° C.

In comparison with the results of previous experiments in which there was no organic component, the present results revealed that (1) some uncommon mineral phases appeared by replacement of sodium ions in montmorillonite with ammonium ions, i.e., NH₄-Mic, o. and d. NH₄-Mnts, o. and d. NH₄-Mnt/NH₄-Mics, and (2) ammonium-analcime appeared. The mineral assemblages and alteration sequences correspond better with those observed in the natural system than those known from experimental results in aluminosilicate-water system.

Key Words: Alanine • Albite • Ammonium-analcime • Ammonium-mica • Ammonium-montmorillonite • Diagenesis • High pressure • X-ray diffraction

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