
Diagenesis of Dioctahedral and Trioctahedral Smectites from Alternating Beds in Miocene to Pleistocene Rocks of the Niigata Basin, Japan

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Abstract: Clay mineral diagenesis in the Niigata basin is documented by mineralogical and chemical analysis of clay minerals from cuttings from the Shinkumoido SK-1D (SSK-1D) well which is characterized by alternating beds containing dioctahedral and trioctahedral smectite minerals with increasing depth. Dioctahedral smectite shows a progressive increase in illite interstratification with increasing depth. The transition of dioctahedral smectite to interstratified illite-smectite (I-S) is supported chemically by an increase in K and Al and a decrease in Si with increasing depth. In contrast, trioctahedral smectite (saponite) reacts to form a 1:1 interstratified chlorite-smectite (C-S) with increasing burial depth and temperature. Considering the geology and the occurrence of smectite, the SSK-1D smectites probably altered diagenetically from two different parent materials: dioctahedral smectite is derived from clastic sediments and transforms to interstratified illite-smectite, whereas trioctahedral smectite is derived from andesitic pyroclastic rocks and transforms to interstratified chlorite-smectite.

The C-S occurs at the same depth of ~ 3200 m as the conversion of randomly interstratified ($R = 0$) I-S to ($R = 1$) I-S. Furthermore, the depth is compatible with a T_{\max} temperature of $430\text{--}435^\circ\text{C}$, which indicates the starting temperature for oil generation from organic matter. The temperature of the conversion of ($R = 0$) I-S to ($R = 1$) I-S and the start of corrensite formation is estimated at $110\text{--}120^\circ\text{C}$ based on the time-temperature model suggested by others. The clay-mineral diagenesis in the SSK-1D further suggests that I-S and C-S can act as geothermometers in clastic and pyroclastic sediments provided that the effect of time is considered.

Key Words: Chlorite-Smectite • Clay Mineral Diagenesis • C-S • Geothermometer • Illite-Smectite • I-S • Niigata Basin • Saponite

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