
Relation between Interlayer Composition of Authigenic Smectite, Mineral Assemblages, I/S Reaction Rate and Fluid Composition in Silicic Ash of the Nankai Trough

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Abstract: The compositions, fabrics and structures of authigenic minerals that formed recently from silicic volcanic ash layers from a 1300-meter sediment column obtained at ODP Site 808 of the Nankai Trough were studied using XRD, STEM, AEM and SEM. Smectite and zeolites were first detected as alteration products of volcanic glass with increasing depth, as follows: smectite at 200 m below seafloor (mbsf) (20 ° C), clinoptilolite at 640 mbsf (60 ° C) and analcime at 810 mbsf (75 ° C).

A primitive clay precursor to smectite was observed as a direct alteration product of glass at 366 mbsf (approximately 30 ° C). High defect smectite with lattice fringe spacings of 12 to 17 Å and having a cellular texture filling pore space between altering glass shards occurs at 630 mbsf. Packets of smectite become larger and less disordered with increasing depth and temperature. The smectite that forms as a direct alteration product of volcanic glass has K as the dominant interlayer cation.

With increasing depth, smectite becomes depleted in K as the proportion of clinoptilolite increases, and then becomes depleted in Na as the proportion of analcime increases. The composition of the exchangeable interlayer of smectite appears to be controlled by the formation first of K-rich clinoptilolite and then Na-rich analcime, via the pore fluid, giving rise at depth to Ca-rich smectite. Smectite reacted to form illite in the interbedded shales but not in the bentonites. Paucity of K in smectite and pore fluids, due to formation of clinoptilolite under closed system conditions, is believed to have inhibited the reaction relative to shales.

Key Words: Chemical Controls • Glass Alteration • Illite/Smectite • Interlayer Cations • Porewater Composition • Precursor Clay Minerals • Silicic Ash • Smectite

Clays and Clay Minerals; August 1996 v. 44; no. 4; p. 443-459; DOI: [10.1346/CCMN.1996.0440402](https://doi.org/10.1346/CCMN.1996.0440402)

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