Some Evidence Supporting the Existence of Polar Layers in Mixed-Layer Illite/Smectite

J. Cuadros* **and J. Linares**

Departamento de Ciencias de la Tierra y Química Ambiental Estación Experimental del Zaidín (CSIC) Profesor Albareda 1, 18008 Granada, Spain

* Present address: Department of Geology, University of Illinois, 245 Natural History Building, 1301 West Green Street, Urbana, Illinois 61801, USA.

Abstract: The fraction <20 μm of a bentonitic material was selected to study the transformation of smectite into illite under hydrothermal conditions. Powder XRD showed that the studied material was composed of 97% dioctahedral smectite and 3% of quartz, cristobalite and plagioclase. The XRD analysis of the oriented, glycolated sample showed that the smectitic phase was actually a randomly interstratified illite/smectite with 11% illite. The chemical analysis of the sample yielded the structural formula: $K_{0.25}Na_{0.25}Ca_{0.12}Mg_{0.13}(Al_{2.76}Fe_{0.33}Mg_{1.03})(Si_{7.66}Al_{0.34})O_{20}(OH)_4$. The reaction conditions of the hydrothermal experiments were: KCl concentrations 0.025, 0.05, 0.1, 0.3, 0.5, 1 M; temperature 60, 120, 175, 200 ° C; run time 1, 5, 15, 30, 90, 180 days; solid : solution ratio 1:5. XRD of run products showed an important transformation of smectite into illite, in contrast with all other techniques (DTA, IR, NMR), which did not detect any transformation of the original material. This suggests that illite quantification in I/S by means of XRD patterns after hydrothermal experiences can be much affected by other variables. The original material and the run products were analysed by means of DTA. The starting material displayed two dehydroxylation peaks, one at 560 ° C corresponding to illite, and the other at 650 ° C corresponding to smectite. Quantification of the two dehydroxylation peaks also yielded a content of 11% illite. The run products displayed DTA diagrams in which the smectitic peak remained unaltered, but the illitic one was reduced or eliminated by the presence of exchangeable K in the interlayer. When exchangeable K was removed the illitic dehydroxylation peak appeared again. The coherence of XRD and DTA in quantifying the proportion of illite layers and the effect of exchangeable K on dehydroxylation of illite layers in mixed-layer illite/smectite seem to be positive proofs of the existence of polar layers.

Key Words: Differential Thermal Analysis • Mixed-layer illite/smectite • Polar layer

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