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# Smectite to Illite Conversion Rates: Effects of Solution Chemistry

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**Abstract:** Mixed-layer illite/smectite (I/S) was formed by reacting the Chambers or Polkville montmorillonite hydrothermally at 270° and 350° C from several hours to more than 15 weeks. Reactions were conducted in closed vessels containing K or mixed K-Na, K-Ca, or K-Mg solutions of varying concentrations. The reaction rate and the rate of ordering of I/S for the reaction smectite + K<sup>+</sup> → mixed-layer I/S + SiO<sub>2</sub> was inhibited by the addition of Na<sup>+</sup>, Ca<sup>2+</sup>, and Mg<sup>2+</sup>; the inhibitory strength of Na<sup>+</sup>, Ca<sup>2+</sup> and Mg<sup>2+</sup>, on an equivalent basis, increased approximately in the ratio 1:10:30. The first order reaction-rate constants for the reactions at 270° and 350° C indicate an activation energy of about 30 kcal/mole.

In the experimental system studied, the reaction smectite → mixed-layer I/S appeared to proceed by solid state transformation, as suggested by: (1) rapid dissolution of large amounts of silica, probably creating an Al-enriched residue; (2) similarity of particle size and morphology of the mixed-layer products to those of the original montmorillonite, implying no extensive dissolution of Al<sup>3+</sup>; and (3) relatively high activation energy compared to published values for silicate dissolution.

**Key Words:** Hydrothermal • Illite • Mixed layer • Reaction rate • Silica dissolution • Smectite

*Clays and Clay Minerals*; April 1981 v. 29; no. 2; p. 129-135; DOI: [10.1346/CCMN.1981.0290207](https://doi.org/10.1346/CCMN.1981.0290207)

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