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Kaolinite transformation into dickite during burial diagenesis

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Abstract

The mechanism of kaolinite transformation into dickite has been investigating using 13 samples from the Frøy and Rind oil fields (Broad Fourteens basin, North Sea), 3 kaolinite specimens with different crystal order (KGa-2, Kaolinite API 17, Keokuk kaolinite), and 2 dickite-rich samples (Natural History Museum collection). Detailed analysis of XRD, thermal analysis, and SEM data show that: (1) as dickite content increases, there is also an increase of the crystal order of kaolinite; (2) in dickite-rich specimens kaolinite and dickite have crystals (or XRD-coherent domains) of the same size; (3) there is no specific dehydroxylation temperature for each polytype, rather particle size and crystal order control dehydroxylation temperature independently of polytype; (4) with progressive dickite content, the development of both particle size and the size of the coherent crystal domains within particles is greater in the *c* direction than in the *a*-*b* plane; (5) the growth of defect-free segments in the *c* direction is not connected with the growth in the *a* and *b* directions, as would be expected in crystallization from solution; (6) textural features indicate coalescence of kaolin plates with burial; (7) there is a very weak positive correlation between particle dimensions and relative kaolinite-dickite content. These results are interpreted as resulting from a double reaction taking place in the solid state with burial. Some kaolinite domains grow in size and crystal order while other domains are transformed into dickite. Presumably, also the dickite domains formed early in the transformation grow in crystal order. The transformation into dickite stops at 90–95% dickite because the remaining kaolinite domains are so large and stable that the stability increase produced by the polytype transformation would be negligible.

Keywords: Polytypism, dickite, kaolinite, TGA, XRD data