

Mineralogical stability of phyllosilicates in hyperalkaline fluids: Influence of layer nature, octahedral occupation and presence of tetrahedral Al

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ABSTRACT

Mineralogical changes in a set of phyllosilicates, differing in their layer nature, chemical composition, octahedral character, and Al content of the tetrahedral sheet, were analyzed after hydrothermal reaction in an alkaline solution. The composition of the alkaline solution was selected to simulate the first stage of cement degradation [NaOH-KOH-Ca(OH)₂]. The reaction products have been analyzed by XRD, ²⁹Si and ²⁷Al MAS NMR spectroscopy, SEM/EDX, and TEM. The results indicate that the main factor influencing the stability of the clays is the occupation of the octahedral sheet such that all trioctahedral members withstand the alkaline attack, whereas most of the dioctahedral clays suffer a complete dissolution and crystallization of new phases. Second, clays with Al in the tetrahedral sheet of their layers are shown to be less stable than those with a pure Si tetrahedral sheet.

Keywords: Clay minerals, stability, alkaline fluid, nuclear waste repositories, MAS NMR