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Hydration properties of synthetic high-charge micas saturated with different cations: An experimental approach

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ABSTRACT

An understanding of the interaction mechanisms between exchangeable cations and layered silicates is of interest from both a basic and an applied point of view. Among 2:1 phyllosilicates, a new family of swelling high-charge synthetic micas has been shown to be potentially useful as decontaminant. However, the location of the interlayer cations, their acidity and the water structure in the interlayer space of these silicates are still unknown. The aim of this paper was therefore to study the hydration state of the interlayer cations in the interlayer space of high-charge expandable micas and to evaluate the effect that this hydration has on the swelling and acidity behavior of these new materials. To achieve these objectives, three synthetic micas with different charge density total layer charges (ranging between 2 and 4 per unit cell) and with five interlayer cations (Na^+, Li^+, K^+, Mg^{2+}, and Al^{3+}) were synthesized and their hydration state, interlayer space, and acidity analyzed by DTA/TG, XRD, and ^{1}H MAS NMR spectroscopy. The results showed that the hydration state depends on both the layer charge and the nature of the interlayer cation. A high participation of the inner-sphere complexes in the highly charged confined space has been inferred and proposed to induce Brønsted acidity in the solid.

Keywords: Swelling, synthetic micas, Brønsted acidity, hydration, inner sphere, DTA, XRD, NMR