



A comparative study of water adsorption and desorption of swellable and non-swellable 2:1 layer silicates

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Our society aims for sustainable use of natural resources and conscientious land use. By far the most abundant natural resources are phyllosilicate-containing geomaterials (clays and soils) that are utilized as they occur in nature in various applications. One of the most important type of clays are bentonites. Bentonites act as binders of mineral particles and as hydraulic sealing by swelling under hydration. Bentonites consist of swellable clay minerals (smectites) and other phases (minerals, liquids, organic matter and air). Smectites hydrate and swell. Saturation depends on available moisture and compaction of the bentonites, which determine the ratio between strongly bound water in hydration shells of interlayer cations and surface bound water together with pore water. Thus, understanding of hydration of smectites is mandatory for understanding and controlling related processes and for monitoring of the hydration state in different applications. The hydration properties and the resulting interlayer organization of water (0W, 1W, 2W) were thoroughly studied for interlayer cations in particular by Ferrage et al., 2005; 2007 (and references herein). However, correlation with structure properties (layer charge, aspect ratio) was restricted to few samples. The influence of the ratio of interlayer to edge exchangeable cations is even more pronounced for small particles with an increased contribution from edge sites to CEC [Emmerich et al., 2011]. For a better understanding of hydration behavior of clay minerals, swellable and non-swellable 2:1 clay minerals are compared with respect to layer charge, exchangeable cations and particle size properties. The aim of the present work is to study the adsorption and desorption of water on homoionic smectites and vermiculite compare to a non-swellable illite. First results from water vapor adsorption isotherms show different kinetics of smectite hydration at low and high relative humidity (r. h.) with respect to equilibration time. Currently, infrared spectroscopic measurements are in progress to investigate the microscopic structure of water adsorption.

Bérend, I. et al., (1995) *Clays Clay Miner.* 43, 324-336

Cases, J.M. et al., (1997) *Clays Clay Miner.* 45, 8-22

Emmerich, K., 2011. In: G.E. Christidis (ed.) 9th EMU notes in Mineralogy, 129-170

Ferrage, E. et al., (2005). *Am Mineral* 90, 1358-1374

Ferrage, E. et al., (2007). *Am Mineral* 92, 1731-1743