

Influence of particle size on the experimental dissolution and Al-hydroxylation of K-vermiculite

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Weathering and Surface Processes

In acidic soil environments, the Al-hydroxylation process of 2:1 phyllosilicates is a major weathering process. The Al-hydroxylation process is most often described as resulting from the adsorption of aluminium and its subsequent polymerization in the interlayer of swelling phyllosilicates. The sources of aluminium could be either soil solution or dissolution of swelling clay minerals itself (auto-aluminisation). Formation of these hydroxy-interlayered (HI) layers leads to a decrease of the cationic exchange capacity of the soil.

Recently, the results obtained by X-ray diffraction profile modelling on different sub-fractions (<0.05, 0.05-0.1, 0.1-0.2, 0.2-2 μm) from the surface horizon of a forest Aluminic Cambisol [1], show that the amount of HI layers decreases with the size of particles.

In order to provide additional information on the impact of particle size on the mineral dissolution and formation mechanism of HI layers, an experimental auto-aluminisation study was undertaken. Three size fractions of K-saturated Santa Olalla vermiculite (0.1-0.2, 1-2 and 10-20 μm) were submitted to dissolution in flow-trough reactor in HCl at pH = 3 and 25°C. The dissolution and the degree of mineral transformation as a function of time were followed from both the chemical analysis of solutions and solid characterization using X-ray diffraction and chemical analyses on final and two intermediaries solid samples.

The obtained results show that the rate of dissolution increase when the size particle decreases. The release of chemical elements from the K-vermiculite in solution leads to its transformation. The kinetics contributions of dissolution, fixation or exchange of nutritive cations (Mg^{2+} , K^{+}) or toxic (Al^{3+}) are influenced by the size of particles. The general mineralogical transformations trends observed previously in natural media is reproduced in laboratory experiments.

[1] Viennet et al., (2015) *Geoderma* **241–242**, 75–86.