Characterization of iron sites in a fine grained illite

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Sorption to mineral surfaces is a major process controlling the concentration and mobility of radionuclides in natural environment. Therefore it is essential to understand the redox behaviour especially of clay minerals like illite or smectites, which strongly depends on the iron distribution and oxidation state within their structure.

In this study the occupancy of possible iron sites in the structure of the very fine grained and relatively iron-rich Illite du Puy was investigated. Furthermore the mineralogical characterization of the fraction < 0,2 µm gave hints for two additional sources for iron: a small amount of a illite/smectite mixed layer phase assoziated with the illite and a iron-oxide phase, which is still present in the fraction < 0.2 µm. Besides a strong doublet at 0.35mm/s and 0.7 mm/s of octahedrally coordinated Fe^{3+}, Mössbauer spectra additionally show a small and narrow peak at 2.5 mm/s which is attributed to Fe^{2+} also in an octahedral environment. This coordination of the Fe^{3+} was also visible in infrared spectra (Fig. 1). The iron was not only located in Fe-clusters (Fe-Fe-OH deformation band at 825 cm^{-1}), also Al-Fe-OH (874 cm^{-1}) and Fe-Mg-OH groups (765 cm^{-1}) were observed, showing a complex distribution of iron in the ocathedral sheet of this illite.

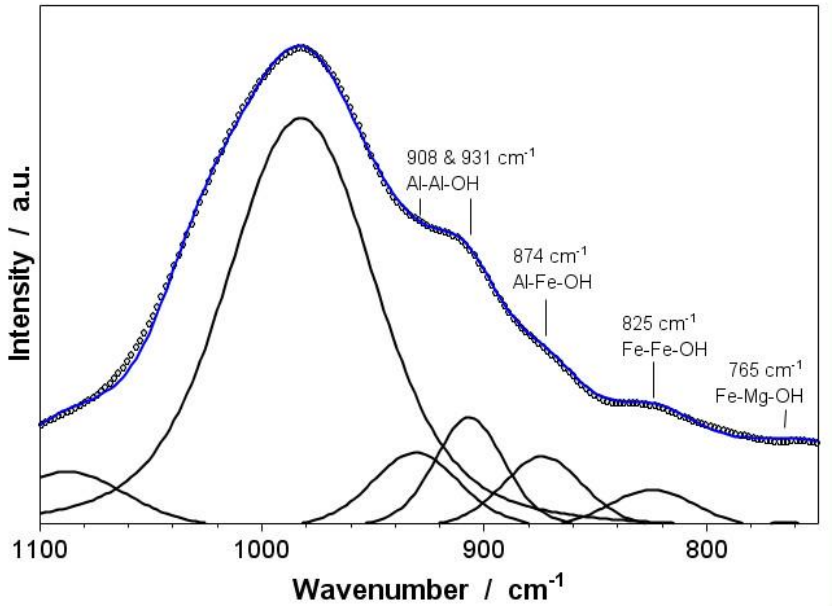

Figure 1. FTIR spectrum showing the OH-bending region of illite, with several bands which can be attributed to Fe-vibrations.