FTIR Reflectance *vs.* EPR Studies of Structural Iron in Kaolinites

Thierry Delineau[1], Thierry Allard[2], Jean-Pierre Muller[2, 3], Odile Barres[1], Jacques Yvon[1] and Jean-Maurice Cases[1]

[1] Laboratoire Environnement et Minéralurige, UA 235 CNRS, ENSG-INPL, B.P.40, 54501 Vandoeuvre Cédex, France
[2] Laboratoire de Minéralogie et Cristallographie, Universités Paris VI et VII, 4, Place Jussieu, 75252 Paris Cedex 05, France
[3] O.R.S.T.O.M., Départment T.O.A., URIG, 213, rue Lafayette, 75480 Paris Cedex 10, France

Abstract: The substitution of Fe^{3+} in the kaolinite structure is studied by EPR spectrometry and by FTIR spectrometry on a large set of kaolins from different origins (sedimentary and primary ores, soil kaolins). The IR bands at 3598 and 875 cm^{-1}, observed in the literature only in the case of disordered kaolins or in Fe-rich environments (synthetic, lateritic), are revealed by high-resolution IR analysis, whatever the origin and the total Fe content of the samples. The EPR bands corresponding to Fe^{3+} substituted in sites II of the octahedral sheet increase when the IR absorbance near 3600 cm^{-1} increases. Two IR absorption bands near 4465 cm^{-1} and 7025 cm^{-1} are observed for the first time, both in transmission and diffuse reflectance on all samples. These bands are assigned to the combination of the 3598 and 875 cm^{-1} bands and to the first harmonic of the band at 3598 cm^{-1}, respectively. The area of the band at 4465 cm^{-1} in diffuse reflectance is quantitatively correlated to the abundance of Fe^{3+} located in centers II as measured by ESR. This directly confirms the assignment of the two IR bands at 3598 and 875 cm^{-1} to OH stretching and deformation vibration bands in octahedral FE^{3+} environment in the kaolinite structure, respectively. Effects due to the size of particles and to the main kaolins impurities on the near infrared spectra, are also discussed.

Key Words: EPR • Fe • Kaolinite • Mid and near infrared • Substitution

Clays and Clay Minerals; June 1994 v. 42; no. 3; p. 308-320; DOI: 10.1346/CCMN.1994.0420309