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Optical spectroscopy of kaolins from the Amazon basin (Brazil)

A. DJEMAÏ[1], N. MALENGREAU[2],
G. LAUQUET[2], J.P. MULLER[1,2]

[1] ORSTOM, UR 12 "Géosciences de l'Environnement Tropical", Bondy
[2] Laboratoire de Minéralogie-Cristallographie, UA CNRS 09 and IPGP, Universités de Paris VI et VII

Natural kaolins commonly contain (Al,Fe)-oxides/oxihydroxides and Ti-oxides (Muller and Calas,1993).

Recent developments in spectroscopic methods allow to discuss in details the location of these oxides in soils and sediments (Malengreau et al. 1994,1995).

On account of its high sensitivity,second derivative Diffuse Reflectance Spectroscopy (DRS) allow their precise determination and their distribution (coatings or inclusions).Its provide clues about the evolution of physico-chemical conditions of clay minerals during the formation of sediments and soils.

The objective of this paper is to demonstrate that DRS investigation of kaolinites and associated Fe-oxides provide a basis for an interpretation of the formation of tropical soils (latosols) at the expense of sediments.

A latosol differentiated at the expense of cretaceous/tertiary kaolins from the Amazon basin (Pedro and Melfi, 1983; Lucas et al., 1986; Chauvel et al., 1987) has been selected for that demonstration.

Samples were collected along a transect cross cutting the sediments and the latosol system.

All kaolins were bleached using dithionite-citrate-bicarbonate (DCB) method of Mehra and Jackson (1960).

Diffuse reflectance spectra were recorded at room temperature in the UV-visible range using a CARY 2300 spectrophotometer.

Data reduction consists on application of the Kubelka-Munk (KM) formalism to model the absorption of the scattered light by tightly packed Fe-oxides (Barron and Torrent,1986; Jepson, 1988) under the form of a remission function,. which takes into account light scattering as well as absorption process (Wendlandt and Hecht,. 1966).. Noise reduction of the experimental spectra was performed by fitting each spectrum using a cubic spline smoothing function.Second derivative functions were then calculated using a numerical method(Kosmas et al,1984;Malengreau et al,1994).A key feature of the second derivative is its ability to show the location of ill-defined absorption bands and to resolve bands that are too close to be resolved in experimental spectra .

In the visible spectral range,the position of the absorption bands is indicated by minima on the second derivative curves (Huguenin and Jones, 1986).In the UV domain, the absorption edge position due to charge transfer phenomena was determined by the zero of the second derivative curve (Malengreau et al.,1995). The separation between the minimum and the maximum of each band measured in the second-derivative patterns were used to estimate the amount of Fe and Ti-phases associated with kaolinite .

Second derivative diffuse reflectance spectroscopy data of amazonian kaolins :

(i) allowed determination of the Fe and Ti-phases associated with kaolinite: Fe-gels, goethite, anatase trapped within kaolinites and goethite-hematite-anatase coatings,and,

(ii) yielded information on substituted(Fe^{3+}) in the crystal lattice

The estimate amount of the Fe and Ti-phases showed the following trends :

(i) in raw kaolins, anatase, goethite and hematite content increase from the sediment to the top of the latosol.

(i) in contrast,in bleached kaolins structural iron,together with trapped Fe-gels and goethite content decrease, The obtained spectroscopic data allow to distinguish different generations of kaolinites particles (kaolinite + trapped oxides) along the sediment-latosol sequence. There are interpreted in terms of successive dissolution-recrystallisation of kaolinites.

This process conducts to a progressive leaching of iron in kaolinites and in a parallel direction to an accumulation of Fe-oxides forming coatings.

REFERENCES:

Barron and Torrent.(1986). J.Soil.Sci.327,499-510

Chauvel,A.,. Lucas,Y., Boulet,R.(1987). Experientia.43,137-147.

Huguenin and Jones.(1986). J.Geophys.Res.91,9.585-9.598.

Jepson,W.B. (1988): In Iron in Soil and Clay Minerals. J.W.Stucki,B.A.Goodman and U. Schwertmann,eds.. Reidel.Dordrecht,. 467-536.

Kosmas et al.(1984). Soil Sci.Soc.Amer.J. 48, 401-405 .

Lucas,Y.,Chauvel,A.,Ambrosi,J.P.(1986):In Int.Symp.Proc.on Geoch.of the Earth Surface,. Granada,. 289-299..

Malengreau,. N, Muller, JP.,. Calas, G. (1994). Clays & Clay Minerals, 42,2,137-147.

Malengreau,N.,. Muller,JP.,. Calas,G.(1995).Clays & Clay Minerals.(in press).

Mehra and Jackson (1960): In Proc.7th Natl.Conf.Clays Clay Miner.,. Pergamon press,New york,317-327.

Muller J.P.. and Calas G. (1993) : In kaolin Genesis and Utilization, H.H. Murray,. W.M.Bundy and C.C. Harvey, eds. The Clay Minerals Society of America, Boulder, Colorado, 261-289.

Pedro and Melfi.(1983) : In II Int.Sem.Lat.Proc.,. Melfi and Carvalho Ed.,Sao-Paulo,3-13.

Wendlandt and Hecht.(1966).Interscience publishers, John Wiley & Sons,. New York, 298 pp.

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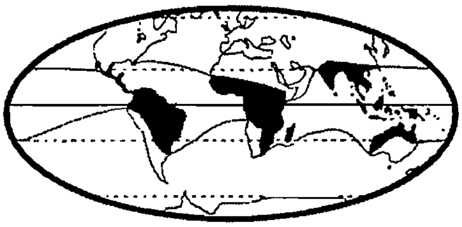

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