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CLAY MINERALS FROM SOILS OF BANAT AREA

C. CRĂCIUN[1], M. EFTENE[1], Victoria MOCANU[1], D. ȚĂRĂU[2]

[1)]Institutul Național de Cercetare Dezvoltare pentru Pedologie, Agrochimie şi Protecția Mediului – ICPA Bucureşti
[2)]USAMV Timişoara

Abstract: *The study by X-ray diffraction of clay below 2µm from 27soil profiles belonging to different soil types gave some useful information concerning the clay mineralogical composition and the influence of parent material on the clay quality. The identified clay minerals also distinct phases from soils of Banat area are illite, smectite, chlorite and kaolinite. With exception of luvosols in which all clay minerals are present, in other soil types illite, smectite and kaolinite were identified. The quantitative mineralogical differences between soil profiles referring to the contents of the clay minerals can be due to parent material and pedogenesis. The dominant clay minerals are illite and smectite (exception luvosols) their ratio (S/I) indicating a decrease trend to the profile surface. The most reduced of value of his ratio in the surface horizon could be related to natural (a stronger alterations of K-bearing minerals, preferential migration of the smectite) and artificial (K-fertilization) causes. The established positive relationship between the soil clay content on the side and the clay content of smectite, and smectite/illite ratio on the other side suggests that between a clay quantity and clay quality is a direct relation due to a textural influence of the parent material. The direct established relationship between the content of each clay mineral from the clay of the surface horizon and from the deep horizon considered as belonging to parent material indicates the mineralogical influence of the parent material on the clay mineralogy.*

Key words*: *clay, clay minerals,clay – parent material relationships

INTRODUCTION

Numerous papers pointed out the influence of clay quantity and quality on the properties and functions of edaphic environment.

Clay minerals are the principal components of the soil clay fraction (below 2µm). They represent the most active mineral part of the soil, due to the highest reaction surface area which is associated with smallest their particle size.

This paper is a synthesis of the results of mineralogical researches performed in Banat area. Its purpose is to present some aspects concerning the mineralogical composition of the clay from the soils of this region.

MATERIALS AND METHODS

A number of 27 soil profiles belonging to different soil types (table 1) from the mineralogical point of view were investigated.

Table 1

The mineralogical investigated soil profiles

Soil type	Profile
Cernozems (Chernozems)	Lovrin, Sântana, Toager, Deta, Săcălaz
Eutricambosols (Eutric cambisols)	Bacova, Peciu Nou, Recaş, Arad, Curtici
Preluvosols (Luvisols)	Fibiş, Sintea Mare, Mehadia, Nicolinț, Oravița, Cenei
Luvosols (Luvisols)	Ilova, Caransebeş, Ohaba, Sudriaş
Gleiosols (Gleysols)	Sat Chinez,
Vertisols (Vertisols)	Cheglevici, Dudeștii Vechi, Valcani

The clay fraction separated by pipette method, was studied by X-ray diffraction. (CRĂCIUN & GÂȚĂ, 1986).

For the X-ray investigation, the K and Ca saturated and etylene glicol treated sample were prepared. The identification of clay minerals was made after BRINDLLY AND BROWN (1980).

RESULTS AND DISCUSSION

Clay mineralogical composition

In the table 2 the average clay mineralogical composition of the genetic horizons for the studied composition of the genetic horizons for the studied soils is presented. In this table some quantitative and qualitative differences between the investigated soil profiles can be observed.

From the qualitative point of view the studied profiles can be grouped in two categories.

A first category is formed by luvosols. Their clay consists of 3-4 mineralogical components, but the characteristics are presence of chlorite minerals.

The second category formed by the other soil types, which have a clay which consist always of only 3 mineralogical components (illite, smectite and kaolinte minerals).

From the quantitative point of view, the mineralogical differences between soil profiles refer to the contents of the clay minerals. These differences can be ascribed to parent material and pedogenesis, and are more frequent at the level of surface horizons.

The dominant mineralogical components of the clay remain illite and smectite (exception luvosols), their ratio being variable on the profile. Usually, the values of smectite/illite ratio increases with depth, the most reduced values being in the surface horizons. A possible explanation could be related to natural causes (a strong alteration of the K being minerals at the profile surface, a preferential migration of the smectite component and artificial causes (K-fertilization).

At the level of the A horizon an increase tend of smectite/illite ratio in order chernozem, preluvosol, eutricambosol, vertosol can be remarked.

Tabel 2

The average clay mineralogical composition of the genetic horizons for the studied soils

Sol	Profil	Orizontul A				Orizontul E				Orizontul B				Orizontul C			
		I	S	Cl	C	I	S	Cl	C	I	S	Cl	C	I	S	Cl	C
Chernozems	Lovrin	64	29		7									63	29		8
	Sântana	47	49		4					37	58		5	29	65		5
	Toager	33	63		4					24	71		5	27	67		6
	Deta	45	50		5					39	56		5				
	Săcălaz	51	45		4					37	59		4	39	58		3
Eutricambosols	Bacova	42	53		5					35	61		4	34	61		5
	Peiciu nou	68	27		5									35	59		6
	Pischia	36	57		7					44	51		5	30	65		5
	Recaș	34	60		6					31	63		6	28	68		4
	Arad	33	61		6					32	63		5	30	64		6
	Curtici	66	28		6					53	42		5	39	56		5
Preluvosols	Fibiș	52	43		5					37	58		5				
	Sintea Mare	46	47		7					32	63		5	34	61		5
	Mehadia	56	38		6					50	46		4	63	34		3
	Nicolinț	33	61		6					29	67		4	26	69		5
	Oravița	42	53		5					42	51		7	33	61		6
	Pischia	46	40		14					39	48		13	13	77		10
	Cenei	30	64		6					25	71		4	25	69		5
	Sânandrei	62	32		6					47	47		6	35	60		5
Luvosols	Ilava	47	19	25	9	44	33	18	5	46	27	20	7	33	36	26	5
	Caransebeș	55		32	13	53		33	14	65		23	12				
	Ohaba	44		46	10	40	25	27	8	30	38	28	4				
	Sudriaș	56		29	15	53		33	14	48	41		11	51	39		10
Gleiosols	Sat chinez	50	46		4									38	57		5
Vertosols	Cheglevici	27	69		4					21	76		3	21	76		3
	Dudești vechi	32	65		3					27	70		3	23	75		2
	Valcani	17	81		2					17	81		2	27	67		4

At the level of B and C horizons, with the rare exceptions (Lovrin, Mehadia, Sudrias) the smectite/illite ratio becomes favorable to smectite, its values being supraunitary.

In the case of luvosols we can distinguish some situations concerning the mineralogical composition of the clay. Typically is the presence of chlorite minerals (integrade).

These minerals can be accompanied in all horizons by the smectite minerals (and also illite and kaolinite) as at Ilova profile, and Ohaba profile (E and B horizons), or can substitute the smectite component as in the case of Caransebeş (all horizons) and Sundriaş (E and B horizons).

Influence of parent material on the clay mineralogical composition.

In spite of the fact that its influence varies from a soil type to another, the parent material remains an important factor in soil formation. The results of previous researches (Crăciun, 2002) pointed ont that this influence is related to its textural and mineralogical features. The attempt to correlate some parameters which express the clay quality with the clay content of the soil gave the significant results in the case of smectite minerals.

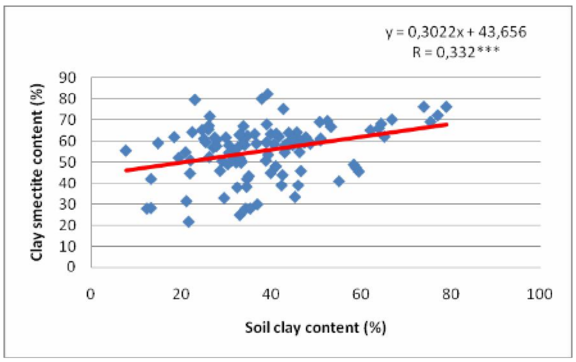

Fig. 1 Relationship between clay smectite content an soil clay content

As can be observed in the figure 1 between soil clay content and smectite content of the clay these is a direct linear relationship, which shows that an increase of the soil clay content determines an increase of the semctite content of the clay. Explanation could be related to the fact that an increase of the clay content determines an evolution of the environment to a confined environment (Millot, 1970).

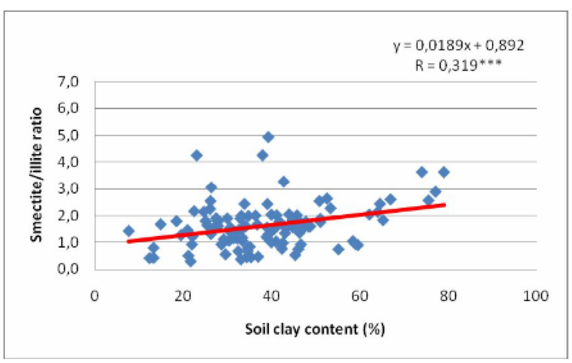

Fig. 2 Influence of soil clay content on the smectite/illite ratio

As can be see in the figure 2 a such of environment is favorable to smectite formation. The established relation between smectite/illite ratio and clay content is direct and linear. The data are very significant correlated.

Naturally a such of confined environment is not favorable to kaolinite formation; clay mineral which is favorised by the acid condition. On that account the linear relationship between clay kaolinite content and soil clay content is negative one (fig. 3).

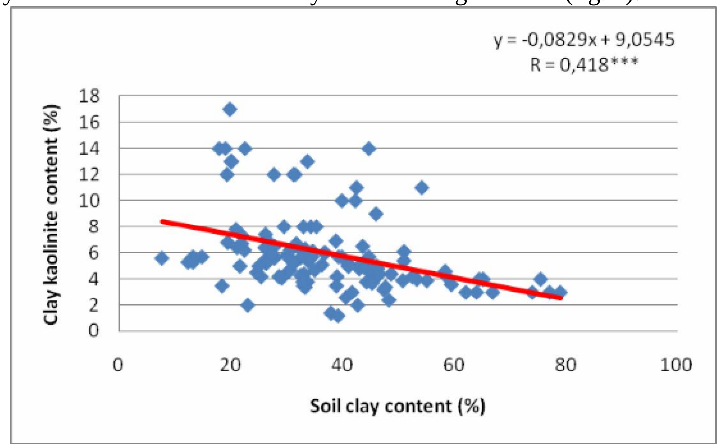

Fig. 3 Relationship between clay kaolinite content and soil clay content

In order to obtain information concerning the mineralogical influence of the parent material on the clay quality we tried to correlate the content of the each clay mineral from the clay of the surface horizon and from the deep horizon (usually C horizon) considered as parent material.

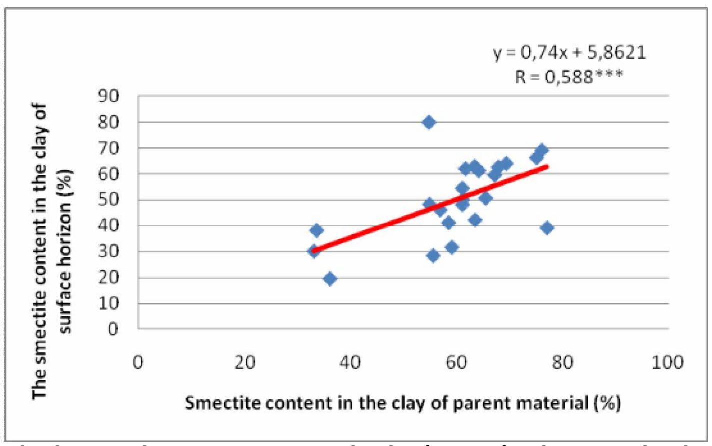

Fig. 4 Relationship between the smectite content in the clay from surface horizon and in the clay of parent material

In the figures 4, 5 and 6 are presented these relations in the case of smectite, illite and kaolinite, respectively. In all situations relations are direct and linear. Results are distinct significant in the case of smectite and illite, and very significant in the case of kaolinite, the value of correlation ratio decreasing in order kaolinite-illite-smectite.

It is very interesting to point out that this order generally, is the similar with decreasing particle size of these minerals.

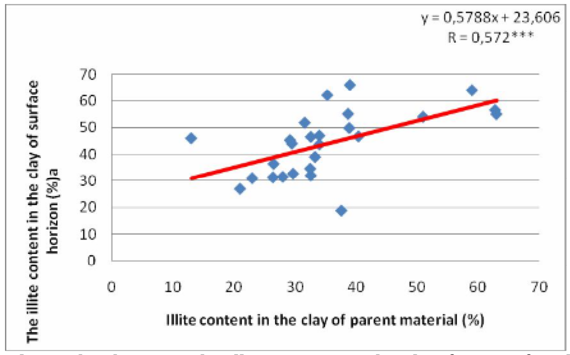

Fig. 5 Relationship between the illite content in the clay from surface horizon and in the clay of parent material

The attempt to correlate the values of smectite/illite ratio from the clay in the two levels of depth gave significant results only in the case of using a power equation (fig. 7).The weak significance of the results could be related in the fact that this relation involve different soil types from the point of view of clay dynamic on the profile.

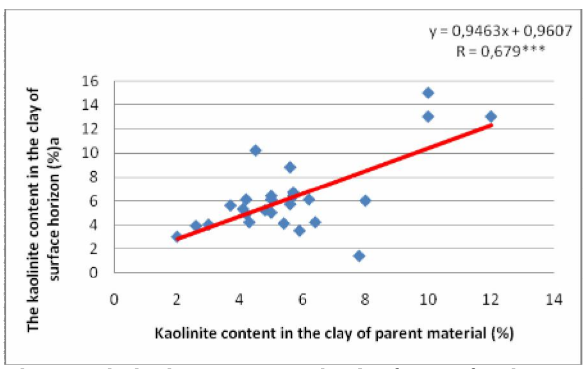

Fig. 6 Relationship between the kaolinite content in the clay from surface horizon and in the clay of parent material

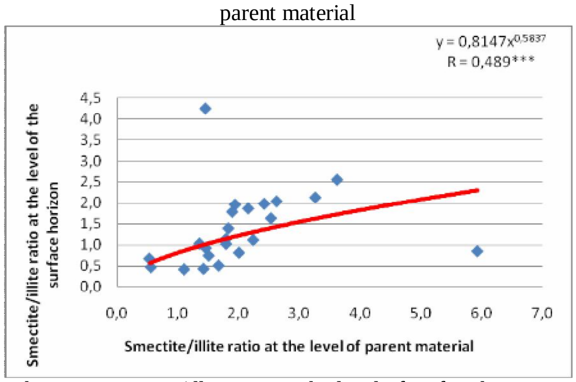

Fig. 7 Relationship between smectite/illite ratio at the level of surface horizon and parent material

CONCLUSIONS

- The identified clay minerals as distinct phases from soils of Banat area are illite, smectite, chlorite and kaolinite. With exception of luvosols in which all clay minerals are present, in other soil types illite, smectite and kaolinite were identified.
- The quantitative mineralogical differences soil profile referring to the contents of the clay minerals can be due to parent material and pedogenesis.
- The dominant clay minerals are illite and smectite (exception luvosols) their ratio (S/I) indicating a decrease trend to the profile surface. The most reduced of value of his ratio in the surface horizon could be related by natural (a stronger alterations of K-beaning minerals, preferential migration of the smectite) and artificial (K-fertilization) causes.
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- The direct established relationship between the content of each clay mineral from the clay of the surface horizon and from the deep horizon considered as belonging to parent material indicate the mineralogical influence of the parent material on the clay mineralogy.

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