CONTRIBUTIONS TO THE STUDY OF MINERALOGY AND GEOCHEMISTRY OF HORTIC ANTHROSOLS FROM BACĂU GLASSHOUSES

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In this paper are presented the preliminary results of studies regarding the mineralogy and geochemistry of hortic anthrosol (profile BC. 1) from Bacău glasshouse (Romania). Have been special followed the aspects concerning to the distribution of occurrence forms of minerals and organic components, and genetic correlations between these in hortic antrosols conditions, respectively. According with the pedogeochemical characteristics, the studied soil is proxy-calcaric hortic anthrosol evolutes on fluviatil deposits with the following composition: Apk – Atpk – Ahok – Bvk1 – Bvk2 – Ck. The pedogeochemical characteristics of Ahok horizon are sensible different in comparison with the others horizons of studied profile, but rather similar with the pedogeochemical characteristics of horizons described in literature as frangipane horizons. Ours data not exclude the possibility that the Ahok horizon from studied profile to be admitted in frangipane horizons category, but it development way in profile, the chemical-mineralogical characteristics and formation conditions are not in agreement with the opinion of other researchers. Characteristics for the studied anthrosol are intense modifications of soil profile, relative large variability of mineralogy and chemism, and salinization processes of superior horizons. From chemical point of view, the hortic anthrosol is characterized by high values of bases saturation, accessible phosphorus and ration between humic and fulvic acids. From mineralogical point of view, the studied hortic anthrosol is characterized by a high heterogeneity degree, both as contents, and as occurrence and distribution forms of mineral and organic components in profile. Predominant quantitatively are clay minerals (39.86-48.75 %, average: 44.40 %), and as variety, the crystalline forms are most abundant (36.17-45.63 %, average: 40.49 %). As regard the clay minerals type, the kaolinite (14.97-25.19 %, average: 21.84 %) and illite

9.58-17.57 %, average: 13.28 %) have dominant weights in comparison with smectite (4.55-8.49 %, average: 6.33 %) and the other mineral components.

***Key words**: hortic anthrosol, geochemistry, mineralogy*

Both in the international systems [11, 17], and in Soil Taxonomy Romanian System (SRTS-2003) [10], the Anthrosols class have been recently included. According with SRTS-2003, the Anthrosols are soils strong influenced by human activity, these resulting from pedogenetic transformation of initial soil coating by addition of organic and inorganic materials, or / and as a direct consequence of specific exploitation technologies of these soils [10]. The hortic anthrosols (soils from glasshouses and solariums) represent an important sub-type of anthrosols, which are characterized from pedogeochemcial point of view by an extremely large variety of mineralogy and chemism. This is traduced by intense modifications of superior horizons; in many cases are conditions for the apparition of new pedogenetic horizons, by "neo-pedogenesis" processes [7, 15]. From this point of view, the definition of some general chemical-mineralogical characteristics is very difficult, practically, each hortic anthrosol having distinct chemical-mineralogical characters. According with some opinions, not are two kindred hortic antrosols, the mineralogy and chemism of each hortic anthrosol being treated as particular cases, most determined by the nature of parental material and by the specific exploitation technologies of these soils [5, 15, 18]. In this paper are presented the preliminary results of studies regarding the mineralogy and geochemistry of hortic anthrosol (profile BC. 1) from Bacău glasshouse (Romania). Have been special followed the aspects concerning to the distribution of occurrence forms of minerals and organic components, and genetic correlations between these in hortic anthrosols conditions, respectively. Characteristic for the studied hortic anthrosol are the intense modifications of soil profile, the large variability of mineralogy and chemism and the salinization processes of superior horizons. From chemical point of view, the hortic anthrosol is characterized by high values of bases saturation, accessible phosphorus and ration between humic and fulvic acids. From mineralogical point of view, the studied hortic anthrosol is characterized by a high heterogeneity degree, both as contents, and as occurrence and distribution forms of mineral and organic components in profile.

MATERIAL AND METHOD

The experimental studies have been done using hortic anthrosol samples drawing from Bacău glasshouses perimeter – BC. 1 profile. The experimental strategy follow in this study was in agreement with literature [1, 9], and was presented by as in several previous studies [2, 8]. The chemical-mineralogical composition of soil samples has been estimated on the basis of results obtained by: (**i**) optic microscopy: optic microscope MEYJ type, on thin-sections, in natural and polarized light [4], (**ii**) X-ray diffraction (DRX): Phillips Diffractometer, powder methods, radiation CuKα [20], (**iii**) IR spectrometry: IR spectrometer Bio-Rad type, KBr pellet techniques, matrix addition in blank method [2, 19], (**iv**) Raman Spectrometry: Confocal Raman Spectrometer

LabRAM INV-Horiba Jobin Yvon [3, 6], (**v**) differential thermal analysis: thermo-balance Netzsch type TG.209; Pt crucible, α-Al_2O_3 reference, heat rate: 2.5°C/min. [16]; (**vi**) chemical analysis [6, 12]. All the analyses have been performing according with the technical manuals of apparatus and the papers from literature. For to increase the analyses precision, the soil samples have been previous fractioned by isodynamic magnetic method and by heavy liquids methods (bromophorme) [2, 13, 14], and whither was necessary by plan electrophoresis and selective extraction in aqueous polyethylene glycol-based two-phase systems. The details about work procedures have been presented in several previous papers [2, 3].

The chemical composition of mineral components separated from soil samples has been determined: (**i**) direct on solid samples, by X-ray fluorescence Spectrometry: XRF Spectrometer model XRF-Epsilon 5, (**ii**) solubilization with mixture of HF and $HClO_4$ concentrated solutions, followed by the determination of chemical elements by usual procedures: Si – gravimetrical, phosphorus – spectrophotometrical (ammonia molibdate method), and other elements – atomic absorption spectrometry (AAS Vario 6 FL Flame Atomic Spectrometer with mono-element lamps) [6, 12].

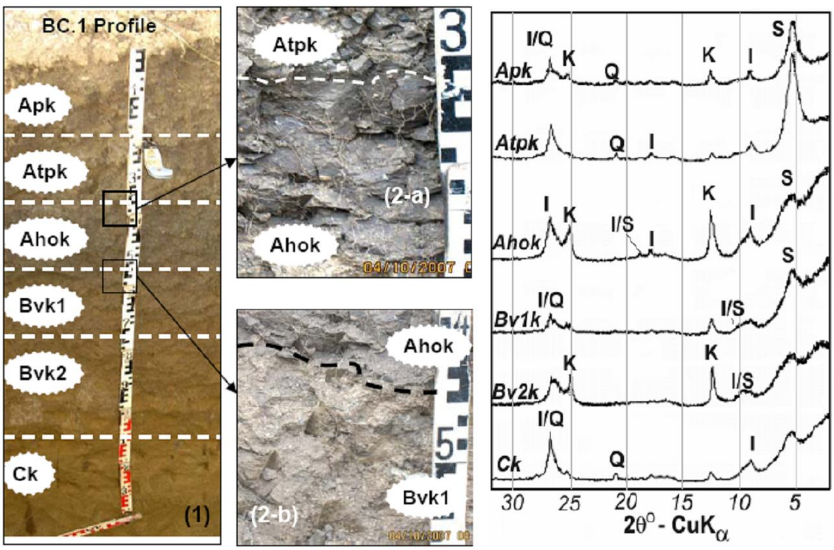

Figure 1 **Section by studied hortic antrosol profile (1), the separation limits between Ahok and Bv1k horizons (2-b) and X-ray diffraction spectra for clay fractions from each horizon of profile. Notations: S – smectites, I – illites, K – kaolinite, Q – quartz.**

RESULTS AND DISCUSSION

According with pedogeochemical characters, the studied soil is a hortic anthrosol evolutes by Haplic Chernozem formed on fluviatile deposits, with the following composition: Apk – Atpk – Ahok – Bvk1 – Bvk2 – Ck (*fig. 1*). The Ahok horizon has pedogeochemical properties different to other horizons, being partially similar with those of horizons described in literature as frangipane horizons. As regards frangipane horizons, both the nomenclature and the pedogeochemistry are not clearly defined in literature, the most opinions being in contradiction [5, 7, 8, 10, 11]. Ours data (*tab. 1, 2*) not exclude the possibility that the Ahok horizon from studied profile to be admitted in frangipane horizons category, but it development way in studied profile (*fig. 1*) and formation conditions are not in agreement with the opinion of other researchers. Must be underlined that in case of Copus glasshouse (Iaşi) the frangipane characters of Ahok(x) horizons are very well contoured, while in case of glasshouses from Bacău, the frangipane characters of this horizon are weak expressed.

From geochemical and mineralogical point of view, the hortic anthrosol from Bacău glasshouse (BC. 1 profile) is significant different towards to the hortic anthrosols from Bârlad and Copou (Iaşi) glasshouses, and the Ahok horizon not determined a segregation so sever in pedogeochemical evolution of hortic anthrosol. From mineralogical point of view, the hortic anthrosol is characterized by a high heterogeneity degree, both as contents, and as occurrence and distribution forms of organic and mineral components in profile (*tab. 1, 2*). Predominant quantitatively are clay minerals (39.86-48.75 %, average: 44.40 %), and as variety, the crystalline forms are most abundant (36.17-45.63 %, average: 40.49 %). As regard the clay minerals type, the kaolinite (14.97-25.19 %, average: 21.84 %) and illites 9.58-17.57 %, average: 13.28 %) have dominant weights in comparison with smectites (4.55-8.49 %, average: 6.33 %) and the other mineral components.

Table 1

The main minerals components (%, w / w in soil samples) of studied hortic antrosol

Horizons	H, cm	Clay minerals					SiO_2	FeOx	Carb.
		Kaol.	Illite	Smec.	Others	Total			
Apk	0-18	14.97	17.57	5.98	1.34	39.86	4.15	2.65	3.46
Atpk	18-35	19.35	15.10	6.24	1.85	42.54	2.93	3.17	3.95
Ahok	35-58	24.55	9.58	8.49	3.61	46.23	3.55	3.96	3.25
Bv1k	58-75	22.51	11.34	7.63	2.19	43.67	2.24	2.77	4.76
Bv2k	75-110	24.49	12.58	5.11	1.52	45.36	1.90	2.35	8.17
Ck	110-140	25.19	13.56	4.55	1.95	48.75	2.81	2.93	7.63
	*Average**	*21.84*	*13.28*	*6.33*	*2.07*	*44.40*	*2.93*	*2.97*	*5.20*

H – depth. *Average on profile. Kaol. – kaolinite. Smec. – smectites. Others – other clay minerals: dickite, halloysite, metahalloysite, hydromicas, glauconite, beidelite and vermiculite. Carb. – Carbonates (sum of occurrence forms) SiO_2 – sum of silica occurrence forms. FeOx – iron oxides and oxi-hydroxides.

The microscopic studies, by X-ray diffraction (*fig. 1*) and by IR spectrometry, as well as the chemical analysis have evidenced that most of clay minerals are present as two or three genetic types: (**i**) primary, associated with the minerals from parental material (feldspars), (**ii**) secondary – first generation: have a pedogenetic origin and were formed by transformation of some primary minerals (feldspars, biotite, chlorites, etc.), in glasshouse conditions; (**iii**) secondary minerals – second generation: have pedogenetic origin and were formed by transformation of primary clay minerals and from first generation. The correlations between clay minerals don't have regression coefficients higher enough which to permit establish of some cert genetic correlations between these. From this reason, the mineral paragenesis from studied anthrosol cannot be used for the sure and reproducible pedogenetical diagnostic.

The pedogenetic illite appears associated with variable quantities of organic matter and iron oxi-hydroxides. In hortic anthrosol conditions this can be formed, by alteration of potassium feldspars, biotite and / or muscovite (second generation), or by the transformation of other clay minerals (third generation). By hydration can pass in montmorillonite, and the kaolinite can partial substituted the illites (median and inferior horizons).

Table 2

Organic components (%, w / w in soil sample) of studied antrosol

Horizons	H, cm	Hum.Ac.	Ful.Ac.	Humine	Humus	OOC	Total COM*
Apk	0-18	4.97	1.27	0.079	6.319	1.410	7.73
Atpk	18-35	5.83	2.11	0.095	8.035	1.534	9.57
Ahok	35-58	7.63	2.95	0.234	10.814	1.235	12.05
Bv1k	58-75	4.18	1.86	0.108	6.148	0.801	6.95
Bv2k	75-110	3.05	1.18	0.065	4.295	0.334	4.63
Ck	110-140	1.51	0.73	0.038	2.278	0.311	2.59
	Media	*4.52*	*1.68*	*0.103*	*6.315*	*0.938*	*7.25*

Hum. Ac. – huminic acids. Ful. Ac. – fulvic acids. OOC – other organic compounds. *Total organic compounds.

The pedogenetical kaolinite appears associated with halloysite and montmorillonite. Not appear as individualized mineral and not form pseudo-morphoses. The kaolinite from second generation is associated with the feldspars and feldspatoides, and the kaolinite from third generation is associated with montmorillonite.

CONCLUSIONS

1. According with pedogeochemical characters, the studied soil is a proxy-calcaric hortic anthrosol evolutes by Haplic Chernosem formed on fluviatile deposits, with the following composition: Apk–Atpk–Ahok–Bvk1–Bvk2–Ck.

2. The Ahok horizon has pedogeochemical properties different to other horizons, being partially similar with those of horizons described in literature as horizons with incipient frangipane properties.

3. From mineralogical point of view, the studied hortic anthrosol is characterized by a high heterogeneity degree, both as contents, and as occurrence and distribution forms of mineral and organic components in profile. Predominant quantitatively are clay minerals and as variety, the crystalline forms are most abundant. As regard the clay minerals type, the kaolinite and illites have dominant weights in comparison with smectites and the other mineral components.

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