ARCHAEOLOGICAL BLACK EARTH: PRODUCTS OF HUMID CLIMATE OVER PRE-HISTORIC AND HISTORIC HUMAN SETTLEMENTS

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Archaeological and Mineralogical Aspects

Several sites with Archaeological Black Earth (ABE) have been recorded in the Amazon region since the turn around of the last century (Kern and Kaempf, 1989; Costa *et al.*1999), when the region were visited by many naturalists. Although each site of ABE occupies small areas (2 to 3 ha), the ABEs are very common and located close together (Kern and Kaempf, 1989; Costa *et al.*1999), along the river bank and lake margins. They present a deep A- soil horizon bearing fragments of ceramic and lithic artefacts and display a deep black colour coming from their high content of decomposed organic matter (Fig. 1). The A-horizon soil colour of ABE when compared to neighboring soils is much more black and deep, which lets to distinguish one to each other. The

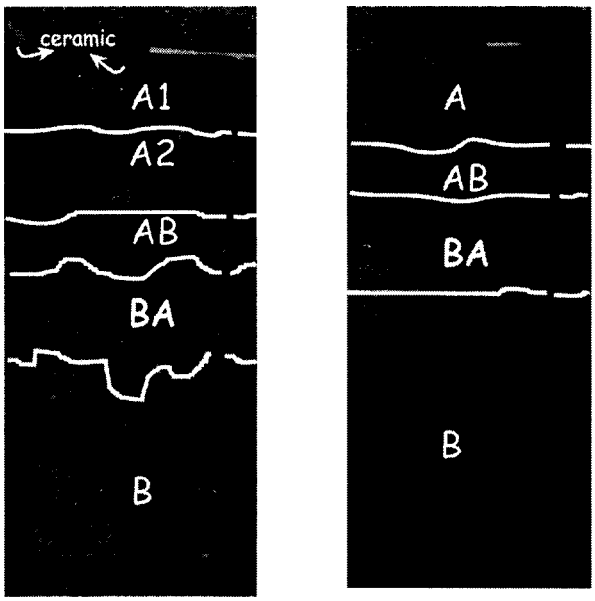

Fig. 1 – The soil profiles for ABE (left) and neighboring latosols (right)by Oriximiná-PA.

A horizons were developed firstly over the A-horizons of latosols and podzols but during their evolution they reach then the B-horizons of these soils. The high contents of ceramic fragments and as well as lithic artifacts show the influence of human occupation. Besides organic matter the A-horizons contain large quantity of quartz and kaolinite, some goethite and hematite, which constitute the matrix of the archaeological artifacts.

The Chemistry of ABE-Soil

Multi-element chemical analysis carried out by ICP-AES (Tab. 1) and geochemistry evaluation of the A and B-horizons show that these soils are chemical and geochemically different from the neighboring latosols and podzols. For example the relative contents of P, Ca, Mg, Ba, Mn, Zn and Cu are hiher inside of the ABE in comparison to neighboring latosol (Tab. 1). This can be better observed when one compared the content of the exchangeable elements.

Tab. 1 – Chemical composition of A_1 horizon of ABE and neighboring latosol in Caxiuanã after Costa *et al.*(1999).

	ABE/Latosol		ABE/Latosol
SiO_2 Wt.%	60.98 /57.45	C	3.04/2.61
Al_2O_3	10.63/23.32	P_2O_5 ppm	877 /595
Fe_2O_3	2.77/2.70	Ba	124/127
MgO	0.15/0.11	Cu	64/4
CaO	0.41/0.23	Mn	168/103
Na_2O	0.18/0.26	Sr	76/63
K_2O	0.13/0.10	Zn	29/20
TiO_2	1.470.96	Zr	1229/1165
		Hg ppb	148 /144

The ABE-soils display a characteristic geochemical signature, P-Ca-Mg-Sr-Ba-Mn-Zn-Cu, incompatible with the common soil of the Amazon region. This signature detaches the contribution of organic matter used and discarded continuously by pre-historic and historic human occupation of the area. The areal distribution of these chemical element throughout the different horizon let follow the chemical modification of the former latosols into ABE and allow to identify the human influence, as shown by P_2O_5 and MgO distribution (Figs. 2 and 3). Phosphor is well concentrated inside of the area occupied by ABE. On the other hand elements as Fe, Ga, V, Cr, Pb, Nb, Zr, Sc, Co, ando so on, do not display any significant changing and correspond to gechemical signature of latosols.

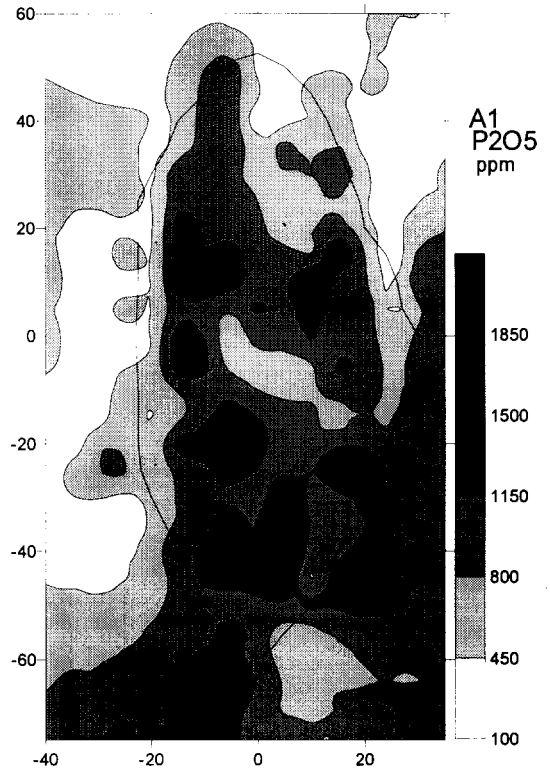

Fig. 2 – P_2O_5 (ppm) distribution in the A_1-Horizon of ABE in Caxiuanã after Costa *et al.*(1999).

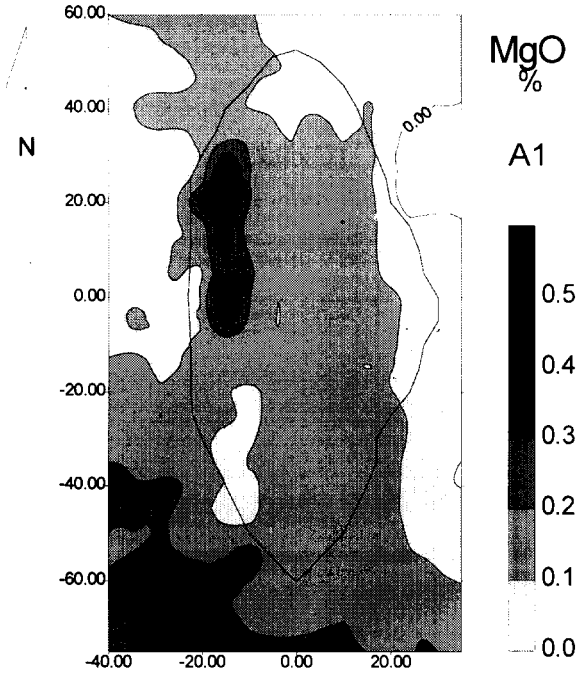

Fig. 3 – MgO (Wt.%) distribution in the A_1-Horizon of ABE in Caxiuanã after Costa *et al.*(1999).

The Mineralogy and Chemistry of ABE-Ceramic

The ceramic fragments found within the ABE, A-horizon mainly, show high content of phosphor (2.4 Wt. % of P_2O_5) (Tab. 2) as amorphous to low crystalline phosphate. Rarely one can found bone fragment made of apatite in the ceramics. The main minerals or substance equivalent to mineral are quartz (44.6%), albite (10.7 %), aluminossilicate (27.8 %), microcline (3.3 %), maghemite, hematite, goethite and anatase. The phosphor enrichment in the ceramics is supposed to be promoted during the daily use of the pottery as cooking vase, phosphor coming from animal foods and reacting with aluminoussilicate matrix of the low burned ceramic.

Tab. 2 – Average chemical composition of ABE-Ceramic from Oriximiná.

SiO_2 Wt.%	65.55	Na_2O	0.69
Al_2O_3	16.37	K_2O	0.90
Fe_2O_3	5.79	BaO	0.48
FeO	1.11	P_2O_5	2.37
MgO	0.63	L.O.I.	10.75

The Chemistry of Organic Matter of ABE-Ceramic

Another indication of the pre-historical and historical influence of human occupation during the formation of the ABE is the presence of fresh water spongyl (Cauixi: *Tubella reticulata and Parnula betesil*) and a tree out skin (cariapé: *Bignomiacea, Moquilea, Licania utilis and Turiuva*), made mainly of SiO_2 (Tab. 3) which are still now used by *caboclos* of Amazonia for making their pottery. Both material are very common in the region.

Tab. 3 – Chemical composition of Cauixi and Cariapé.

	Cauixi	Cariapé
SiO_2 Wt.%	82.90	56.40
Al_2O_3	0.38	<0.10
Fe_2O_3	0.60	<0.10
MgO	<0.10	0.11
Na_2O	<0.10	0.11
P_2O_5	0.10	0.05
L.O.I.	16.02	42.93
CO_2	4.04	15.61

The Contribution of Humid Climate

The high content of organic matter found in the ABE and the well development of the A horizons, as well as their mineralogical composition and texture show that the strong humid tropical climate established in the region during the late Holocene was the responsible for the formation of the ABE soils. The places where the pre-historic peoples lived must have been e immediate retaken by the rain forest which grew up very quickly, and transformed the pre-existing anthropogenic organic matter and incorporated its own material, and contributed to the formation of the deep black soil, called Archaeological Black Earth. The time needed to form this soils seems to be small (some hundred of years), since there are examples of ABE which developed after of European settler arrived. Even in the interior of the Amazon region, in places occupied and then abandoned by *caboclos*, a successor of the European settler and Indians, black earth are forming, promoted by the intense actual humid climate.

Conclusions

The presence of ceramic and lithic artifacts all over the black earth are clear indication of human contribution. The high content of organic matter in the A horizons reflect the action of humid climate and the rain forest activity. The young age of several ABE sites is indicated by the continuity of ceramic design and technic through the new peopling of the Amazonia, the Indians and Caboclos, which was confirmed by ^{14}C dating and the presence of organic matter (cauixi and cariapé) still in the present day ceramic.

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