Piracicaba River, where it is inferred that this lower altimetric level portion suffered preteritally the influence of alluvial fan formation, generating soils of greater thickness and with ferruginous characteristics.

Keywords: ferruginous soils, soil Genesis, Quadrangle Iron
Financial support:

(4030 - 502) Typical and extreme Vertisols in space and time

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Typical Vertisols (WRB, 2015) are churning, heavy clay soils formed on parent material with a high proportion of swelling clays. They have deep wide cracks when dry, and occur in depressions and level to undulating areas, mainly in tropical, subtropical, semi-arid to subhumid and humid climates with an alternation of wet and dry seasons. Typical vegetation is savannah, grassland and/or woodland. They may have a gilgai microrelief. Vertisols are recognized by vertic horizon with wedge-shaped aggregates and slickensides starting ≤ 100 cm from the soil surface. The aim of our research is to evaluate the extreme environments for Vertisol formation i.e. the full range of possible climate (MAAT and MAP), vegetation, geomorphology, parent material and time, where they occur. We also aimed to estimate the change of leading soil forming factor and its impact on shrink-swell process and formation of vertic features in the extreme cases, and to find the special attributes, characteristic for each extreme case. Most Vertisols occur in semi-arid tropics with MAP 500–1000 mm/yr. Meanwhile they are known in extremely dry (50 mm) or wet (3000 mm) climates. The MAAT in Vertisols areas is generally in between of 15-26 ^{O}C. But they occur in areas with MAAT 30 ^{O}C, and have been recently found in Siberia with MAAT –4.2 ^{O}C. Typically Vertisols are montmorillonitic. At the same time kaolinite (in Australia, Hawaii, Cambodia, Salvador, Sudan), illite (Australia, Bulgary) and polymineral (Trinidad) Vertisols also occur. Gilgai indicating strongest shrinking, swelling and shearing vary in lateral size from 3-4 up to 20 m, have amplitude from 5-30 up to 100 cm, and a range of forms. The most common gilgai are rounded. Tank, melon-hole, wavy, lattice, dendritic gilgai also occur. Extremal gilgai in Australia having an amplitude > 240 m and wavelength ~120 m was named giant. The age of Vertisols is known from < 100 yrs to ~2.5 billion yrs. Extreme Vertisols (i.e. formed in atypical environment or having atypical attributes) may be the result of various combinations of texture, mineralogy, geomorphology, and hydrothermic conditions. On the other hand, extreme Vertisols can be associated with the history of soils and landscapes development being in fact relic soils (exhumed or non-buried paleosol), or initial Vertisols started to shrink/swell due to climatic changes (drying, wetting, warming) or at a next appropriate stage of the climatic cycle.

Keywords: soil geography, pedogenesis, morphology, evolution, landscapes, climate change
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(3925 - 615) unity of soils evolution during time

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The process of soil formation is uniform for all corners of the land and there are no soil-forming processes. There are specific features in the direction of soil formation, due to the composition and quality of the parent rocks, climate, and relief. The essence of soil formation is in the biological weathering, accumulation and transformation of weathering products of mineral and organic matter. In evolutionary development, soils sequentially undergo stages from birth on the rock to their natural death (neo-breed). The first stage is the beginning of soil formation. There is a settlement of vegetation on the initial soil-forming rock. The second stage is accelerated soil formation. The formation of the upper genetic horizons begins and the main soil features and differentiation of the profile appear. The third stage is slowed down soil formation. All genetic horizons of soils continue to form and the profile capacity and fertility level increase. The fourth stage is mature soil. The formation of the soil profile and all genetic horizons is completed. It is used to call this stage climacteric when the stage of equilibrium functioning comes and all the processes take place within the framework of relatively stable biochemical cycles. But is it possible to achieve equilibrium and constancy in open biological systems with constant inflow and outflow of matter and energy? The weathering of the mineral base, the alienation of the elements of nutrition continues and the depletion of soils is inevitable. The fifth stage is the aging of the soil. Further weathering of minerals leads to a significant difference in their qualitative composition between the soil and the soil-forming rock. The amount of organic matter and elements of nutrition is reduced. Soil fertility decreases. The sixth stage is the death of soils. The mineralogical composition of soils and soil-forming rocks is radically different from each other. The bulk is made up of poor in chemical composition of newly formed minerals. Soil can no longer satisfy the needs of plants in the elements of mineral nutrition. Depending on climatic conditions, the first four stages can last from ten to one hundred thousand years, the fifth stage from one to two million years. The given scheme of evolution can be successfully applied only in the wet zone. Naturally, in conditions of dry or moderately damp climate of steppes, the duration of the stages is longer and it is impossible to expect the death of soils.

Keywords: Key words: evolution, stages of soil formation, weathering, aging, death of soils.
Financial support:

(5933 - 1924) Weathering of metamorphic rocks and formation of planosols in semi-arid environment, Brazil

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In the Brazilian semi-arid region, the evolution of the surface tends to the flattening with monotonous landscapes of smooth undulating relief where large expanses of Planosols occur. The action of the time, with perpetuation of the aridity conditions, results in the formation of shallow soils, physical and chemical denudation with loss of the superficial layers, water regime with evapotranspiration that exceeds the precipitation, making these areas naturally susceptible to degradation. However, recent studies of soil genesis in the region have shown that the lithology of felsic rocks is the main factor that leads to the Planosols pedogenesis imposing on the soil the main physical, chemical and mineralogical attributes. The objective of this work was study the evolution of the weathering front in gneiss saprolites (felsic rocks) in two profiles of Planosols under different levels of severity of degradation (point 1 incipient degradation and point 2 degradaded area under desertified area in Pernambuco. In order to deepen the knowledge of the role of the source material in the intrinsic characteristics of the soils. The primary assembly and pedological features were determined using optical microscopy techniques in thin sections of the R / Cr horizon. The variability in the contents of the series albite up to anorthite was determined by the Michael-Levy diagram, as well as the domains of primary mineralogy and accessory minerals. The secondary assembly was identified by X-ray diffractometry, coupled with complementary techniques such as SEM / EDS scanning electron microscopy, thermogravimetric and differential (DTA /GT), vibrational analyzes using InfraRed (IR). The results showed that felsic rocks present great variability in types and proportions of alkali and plagioclase feldspar, including perthites, with alteration routes and quite different secondary products. Point 1 has higher concentrations of quartz, K-feldspar, biotite and presence of pertites. The secondary mineralogy is dominated by alumina smectites. Alteration route with K-feldspar / biotite > Ilite> beidelite. It presented pedalities with b-factories and biological cavities. In point 2 the quartz domain and higher concentrations of placiocases in relation to alkalis-feldspar, domain of smectites with octahedral sites of negative charge in the secondary, possible route Plagioclase / sericite / biotite > kaolinite / montmorilonoite. It presented weak pedality.

Keywords: Desertification; Mineral alteration; feldspar; plagioclase; perthitas; beidelitas; montmorillonite
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C1.3.3 - Anthrosols - the human constructed soils

(7005 - 1629) Amazonian Dark Earth: proposal of modification of the pretic horizon criteria

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The Amazonian Dark Earths (ADE) were formed by influence of pre-Columbian anthropic activities and have being reported mainly in the Amazon Basin. According to the World Reference Base for Soil Resources (WRB), among the diagnostic horizons for the Anthrosol class, the pretic horizon is a mineral surface horizon characterized by its dark colour, the presence of artefacts and high contents of organic carbon, phosphorus, calcium, magnesium and micronutrients, usually contrasting with natural soils in the surrounding area. It typically contains visible remnants of charcoal. It has as diagnostic criteria: dark color; organic carbon (C org) ≥ 10 g kg^{-1}, P (Melich I) ≥ 30 mg kg^{-1} and Ca^{2+} + Mg^{2+} ≥ 2.0 cmol$_c$ kg^{-1}. The objective of this work was to classify profiles identified in Brazil as ADE using the WRB system. The profiles were compiled through a bibliographical research of soil surveys, thesis and dissertations, and other publications. Thirty profiles with anthropic horizons were identified with data sufficient to classify the soils using WRB. These ADE are distributed in the Brazilian states of Amazonas (24 profiles), Roraima (1 profile), Rondônia (1 profile), and Pará (4 profiles). From the horizons identified as anthropic (Au), only 30% were classified as pretic horizon. Therefore, considering the low correspondence of the taxonomic classification in the WRB with the identification of the ADE by Brazilian standards, new quantitative criteria are proposed for the pretic horizon: (i) thickness ≥ 20 cm; (ii) color (wet) with value ≤ 4 and chroma ≤ 3; (iii) Ca^{2+} + Mg^{2+} weighted: Σ [(Ca^{2+} + Mg^{2+} x thickness of the Au sub-horizons) / total thickness of the Anthropic A horizon] ≥ 2.0 cmol$_c$ kg^{-1}; (v) P (Melich I) weighted: Σ [(P x thickness of the sub-horizons Au) / total thickness of the anthropic horizon A] ≥ 30 mg kg^{-1}; and (v) C org weighted: Σ [(C org x thickness of the sub-horizons Au) / total thickness of the anthropic horizon A] ≥ 6.0 g kg^{-1}. It is also proposed to reduce the thickness of the pretic horizon required to be included in the Anthrosols class from 50 to 30 cm. Using these criteria 50% of the profiles that had a pretic horizon were classified as Anthrosols. The current WRB criteria for classification of pretic horizon and Anthrosols exclude 70% of the profiles identified in the literature from Brazil as ADE. Therefore, a revision of the criteria is recommended, since this horizon was created to encompass the so called Amazonian Dark Earths.

Keywords: Diagnostic surface horizon; 'Terra Preta de Indio'; Anthrosols.
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(7561 - 2497) Amazonian dark earths located in the fertile floodplains in the central Amazon - Brazil

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Amazonian Dark Earths (ADEs) are highly fertile soils horizons created by pre-Columbian Amerindian societies of the Amazon basin. However, there is still not agreement on whether these Anthrosols were produced intentionally to improve the unfertile Amazonian upland soils or whether resulted from the accumulation of waste from sedentary settlements. This study brings a pedogeochemical characterization of ADE found in the naturally fertile alluvial floodplains of the Amazon river in the Central Brazilian Amazon. The analyzes quantify total, exchangeable and available contents of elements and organic carbon in soil profiles. The ADEs showed higher contents of available, and total P, Ca, Zn and Cu. High contents of total Cr, Ni, Co and V indicate contribution of mafic minerals in the soil genesis, while higher contents of P, Zn, Ba and Sr in the ADEs indicate anthropic enrichment. The occurrence of ADE in floodplains brings strong evidence of non-intentional anthropic fertilization of the alluvial soils, which, in natural conditions have contents of P, Ca, Zn, Cu above of the critical levels to cultivate the most common plants. The presence of archaeological sites in the floodplains shows also that pre-Columbian populations lived on the floodplains as well as on the bluffs overlooking the Amazon river.

Keywords: Terra Preta de Índio, Gleisols, Anthrosols, pretic, Amazonian archaeology
Financial support: Embrapa Amazônia Ocidental, Universidade Federal do Amazonas – Programa Agronomia Tropical

(6704 - 2734) Anthropic soils in central Brazil archaeological sites

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Everything that surrounds us involves physical and chemical transformations, so that the understanding of these phenomena is essential for human development in every aspect. Making use of geochemistry, archaeometry and micromorphology techniques is fundamental to study the soils in archaeological context and its indicators of human occupation. Amid the biomes in Central Brazil, the *Cerrado* stands out for its biodiversity and tropical climate with two well defined seasons, humid in the summer and dry in winter and with a higher thermal amplitude than in the equatorial climate and lower rainfall. In this sense, the environment is an extremely important variable when it comes to chemical phenomena. An example is phosphorus which is considered a nutrient of low mobility in tropical soils, a behavior attributed to its fixation by the clay minerals. This element has a relevant presence in archaeological sites located in tropical environments that also present high levels of iron and aluminum oxides - with which P has a great affinity. Considering this, we use the archaeological sites Cangas I and Lago Rico (Goiás, Central Brazil) to study and understand the behavior of the chemical composition of anthropogenic soils in tropical environments and their pedological features (features inherited from the parental rock or formed by processes of deposition of transported material). Carbon, organic matter and some minerals stand out in the analyzes including phosphorus, calcium, zinc, potassium, barium and strontium. Among