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[DS3] Modelling of Soil Properties and Processes-Challenges and Opportunities

Modeling the Formation and Evolution of Some Characteristics of Anthrosols: Studies of Amazonian Dark Earths (terra Preta De Indio), Shell Mounds (sambaquis) and Earthworks (geoglifos) in Brazil

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Old anthropic soil horizons in the tropics are only relatively recently being thoroughly investigated. To understand their formation and evolution is a rare opportunity not only to clarify cultural practices of prior civilizations but also to comprehend mechanisms to preserve carbon and to hold nutrients in the constantly leached soils of the tropics. The characteristics and challenges to model the process of formation and evolution of three distinct anthropic horizons found widespread in Brazil are presented. The Amazonian Dark Earths (Terra Preta de Índio - TPI), the anthropic shell mounds (sambaquis) and large ditches from human earthworks (called geoglifos). TPI refers to expanses of anomalously dark, fertile soil horizons, created by pre-Columbian populations largely during the period from 500 to 2500 year B.P, they are found mainly in the Amazon Basin. TPI anthropic horizons exhibit high densities of ceramic sherds and greatly increased levels of total and available phosphorus and other minerals as Ca, Mg, Zn, Mn, Ba and Sr, when compared with surrounding soils. TPI owes its name to the dark color originated from a large stocks of carbon and it is believed that large part is preserved because a pyrogenic origin from incomplete combustion of organic materials. However new hypothesis to this preservation have been studied. In spite of a relatively intensive history of investigations concerning Amazonian Dark Earths the studies carried out so far were interdisciplinary, but the research groups did not investigate the same site. Presently an Embrapa project is trying to model the creation and evolution of a specific TPI site located in the Research Station of Caldeirão in the Central Brazilian Amazon (Projeto Terra Preta). The sambaquis are found mainly along the Brazilian coast and are predominantly constituted of piled up mollusk shells and sediments in very complex stratigraphic configurations. Frequently they contain burial remains covered by dark soil and rare lithic artifacts. The sambaquis are believed to have been intentionally built by a population that inhabited the region for over 6000 years. Frequently they show dark horizons not only in the top horizon, but also dispersed in a complex stratigraphic sequence. Some studies are trying to understand the contributions from natural depositional processes and cultural deposition to their characteristics and results also indicated that those dark horizons have a large amount of phosphorus and carbon. The mechanism of stabilization of the carbon in the sambaquis is not clear, but probably is involved in the heating of organic material (pyrolysis) and large amounts of available calcium carbonate from the shells. The geoglifos are constructed earthworks of large and precise geometric forms (mainly circular or rectangular). They are characterized by excavated ditches and earthen banks, formed by deposition of the excavated soil frequently they are connected by roads believed to have built by a large and sophisticated pre-Columbian civilizations in the Upper Amazon Basin. Until now the investigations carried out have not found dark soil horizons related with the geoglifos or near them. What is intriguing in this case is the absence of dark horizons or clearly chemical signatures typical of anthropic modifications. To build ditches with a diameter larger than 300 meters with 10 meters wide and over four meters deep, surely a huge human work force was required and these people needed to be fed. Many facts and myths that have been created about those anthropic soil modifications since they were first reported in the 19th century. To understand so complex processes to face spatial statistics and a systemic modeling approached will be necessary. Therefore, it is still a large open field for multidisciplinary research and many lessons are waiting to be learned about soil modification and mechanisms to preserve the carbon and hold the nutrients in the tropical soils. understanding the management used to create those anthropic soil s have possibility to provide new soil management practices for soil reclamation, sustainable production, and to enhance soil carbon storage and nutrient holding capacity.

Keywords : Biochar, Terra Preta de Indio, Anthrosols, Shell mounds, antropic horizons