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Mireralogy and chemistry fragments of archaeological ceramic from Achaeological Dark Earth soils

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Mineralogical and chemical studies of archaeological ceramic fragments (CF) are being widely used to study the raw materials and production techniques employed in the past. More recently it has helped to infer about preterit use of these materials, as well as in the case of those from Archaeological Dark Earth (ADE) soils, its contribution to maintaining the recognized fertility of these soils. In this study, samples from sites Monte Dourado (Pará, Brazil-CF-MD), Jabuti (Pará, Brazil-CF-Jab), and Da Mata (Maranhão, Brazil-CF-MD) have been investigated on its chemical and mineralogical characteristics in order to infer about the different raw materials and the possible CF contribution to soil after burial. The mineral components of the CF were identified using X-ray diffraction (XRD) through the powder method and were analyzed by the commercial AcmeLabs laboratory) using Inductively Coupled Plasma Emission Spectroscopy (ICP-OES), based on the laboratory's 4A&4B analysis group. CF-MD are constituted of quartz, anatase, microcline and muscovite, as the CF-Jab present in addition to these minerals crandallite-goyazite. Crandallite-goyazita is typically a mineral neoformed after burning cooking vessels related to the use of food preparation. Moreover, CF-MD present distinct mineralogy also including ilmenite, cordierite, segelerite, cristobalite and anorthite. Cristobalite is related to the use of cariapé (formed by amorphous silica) as temper (after burning crystallizes into cristobalite). Segelerita, as cradallita-goyazita, is neoformed, but formed after burial, since these phosphates represent anaerobic conditions are related to the accumulation of organic matter and its interaction with existing and Fe minerals action by microbiological oxidation-reduction mechanisms. These minerals reflect the raw material and are used according to the geology of the area of each site, except as crandallite-goyazita, cristobalite and segelerita. However, mineralogical distinctions also indicate that those CF-MD employees were certainly related to materials still saprolite. Therefore, the mineralogical differences observed indicate different raw materials and geology. By normalizing the chemical composition of CF PAAS stand out from the enrichment of TiO_2, $Fe2O_3$, CaO in the CF-MD corroborating the presence of ilmenite and albite. It should be noted that the CF-Jab also have CaO content higher than those normally found in CF reflecting the use of shells as temper and the presence of neoformed mineral crandallite-goyazite. However, enrichment of P2O5 is most evident and occurs in all CF (CF-Jab> CF-MD> CF-DM). P2O5 in high levels of CF (1-3%, usually) has been related to the act of boiling, but are usually represented by amorphous phase as occurs in CF-DM (1.04% P2O5, on average) where were not identified phosphorus minerals, identification of minerals such as crandallite-goyazite is restricted to the CF-Jab where P2O5 is 6.79% on average. When considering that CF will be weathered after burial, these materials can contribute to soil fertility in relation to nutrients especially P, Ca (highlighting CaO content of 3.47% on average from CF-MD , CaO 2.1% CF-Jab, on average), Mg (in particular, here 1.98% MgO, on average, CF-MD), and K in minor proportions (concentrations ranging from 0.29 to 0.73 %).