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A Mineralogical and Organic Geochemical Overview of the Effects of Holocene Changes in Amazon River Flow on Floodplain Lakes

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A synthesis of the impacts of the Amazon River hydrological changes on the sedimentation process of organic matter (OM) in three different floodplain lakes (Santa Ninha, Maracá, and Comprido lakes) is presented in this study. Today the Santa Ninha and Maracá lakes are directly and permanently connected with the main channel of the Amazon River, in contrast to Comprido Lake, which is indirectly and periodically influenced by the Amazon River due to its high distance from the main channel. All the sedimentary lake records showed a reduced river inflow due to dry climatic conditions during the Early and Middle Holocene followed by a humid Late Holocene with an increased fluvial input. In Santa Ninha and Maraca Lakes the reduced river inflow period was characterized by sediments with a low abundance of smectite (on average ∼20 wt. %), a clay mineral mainly transported by the fluvial system, high total organic carbon (TOC) contents (on average ∼8.2 wt. %) and a predominant acidic soil OM input evidenced by high branched glycerol dialkyl glycerol tetraethers (GDGT) concentrations (on average 180 μg g_{TOC}^{-1}). During the Late Holocene, a higher smectite abundance (on average ∼43 wt. %) and a low TOC content (on average ∼1.4 wt. %) pointed to dilution with the riverine lithogenic matter. This was accompanied by a proportional increase in the aquatically-produced crenarchaeol, suggesting an increased lake water level. In Comprido Lake, a sedimentation gap occurred during the Early and Middle Holocene. The humid Late Holocene, after 3,000 cal years BP, was characterized by high TOC values (on average ∼9 wt. %) as well as a sharp increase in soil OM input as revealed by the increase in branched GDGT concentrations (on average ∼81 μg g_{TOC}^{-1}), but the smectite content was low (on average ∼14 %). This suggests that in Comprido Lake the soil OM input from the local catchment area was predominant during the humid Late Holocene due to its high distance from the Amazon River main stem. Consequently, our study shows that the sedimentation processes of OM in Amazonian floodplain lakes are strongly influenced by variations in the hydrodynamic regime of the Amazon River during the Holocene. However, its impacts on floodplain lakes were different, mainly depending on the distance from the main stem of the Amazon River.