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Stepwise climate change recorded in Plio/Pleistocene paleosols from Hungary

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Paleosols and Pleistocene loess–paleosol sequences preserve important information on landscape stability and soil formation, paleoclimate, and paleoenvironment. The nature of clay mineral assemblages (mineral composition of the clay fraction, <2 μm) is primarily a function of climate. Therefore, clay mineralogy is considered to be a powerful tool for interpreting weathering conditions and paleoclimate. Interpretation of the time sequence of climate/environmental change however requires careful determination of pedogenic mineral phases from phases altered by later diagenesis. Red clays and paleosols in Hungary overlain by loess–paleosol sequences were studied. Elemental oxide analyses of red clays and paleosols were determined by X-ray florescence (XRF), and X-ray powder diffraction (XRD) was used for mineral identification and oriented specimens for clay mineral analyses. In this study, we aim to determine the temporal changes of clay minerals due to chemical weathering and time.
Upper Pliocene red kaolinitic clay contains typically disordered kaolinite, mixed-layer smectite/kaolinite, smectite and little gibbsite. It could be formed in the local subaerial weathering crust in warm, humid, subtropical or monsoon climate (Köppen climate classification Cfa) which is a climate zone characterized by hot, humid summers and generally mild to cool winters. Kaolinite together with gibbsite in this type of the studied red clays can be inherited from pre-Pliocene lateritic soils, potentially formed during the Eocene–Middle Miocene. A temperate wet condition can be suggested for the Late Pliocene. Lower Pleistocene red (or "reddish") clay contains relatively fresh material (illite, chlorite), the weathering products are predominantly smectite and goethite formed under warm-summer Mediterranean climate (Csb). This subtype of the Mediterranean climate experiences warm (but not hot) and dry summers, winters are rainy and can be mild to chilly.
Mid-Pleistocene paleosols of the loess–paleosol sequences and red clays contain similar material as the underlying red clays belonging to the Lower Pleistocene unit. The slightly but significantly lesser degree of weathering (more illite and chlorite, less smectite) indicates cooling of the climate. Based on the results, the climatic conditions were similar to the previously discussed. It was also Csb, but cooler with less precipitation.
Results from geochemical climofunctions applied to Upper Pliocene–Lower Pleistocene red clays and paleosols located in the Carpathian Basin, and clay mineralogy, indicate that the paleoclimate was considerably more humid and warmer during the Late Pliocene–Early Pleistocene, in comparison to modern values.

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