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Climate and Environmental Change in East Africa recorded in a Loess-Paleosol on Mount Kilimanjaro

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Loess-Paleosols deposited during the Late Quaternary on the slopes of Mount Kilimanjaro, Tanzania (∼3°S), are valuable archives to reconstruct climate and environmental history in East Africa. Here we present results from a 6.5 m deep soil pit and sediment core from a small depression at ∼2700 m asl on the eastern slopes, probably spanning most of the Late Quaternary (∼100 ka). Although a wide range of geochemical analyses has been performed (elemental composition, bulk isotope measurements, mineralogy, grain size), the most interesting results come from hydrogen isotopic measurements of long-chain fatty acids and alkanes, which provide qualitative estimates of past changes in precipitation.

Our record shows lowest δD values from ∼9 to 5 ka in the Early/Middle Holocene, consistent with regional evidence for an "African Humid Period". More arid conditions are inferred for the Earliest and Late Holocene (∼10‰ shift), yielding a Holocene moisture pattern opposite to what has recently been inferred from Lake Challa at the foot of Mt. Kilimanjaro and questioning the notion that "double-precession" is a dominant driver in controlling the moisture availability in equatorial East Africa on orbital timescales. A 10 kyr cyclicity is not prominent in the longer record either. Instead, the Younger Dryas and the Last Glacial Maximum are characterized by δD enrichment (=aridity) of ∼15‰ and ∼20‰ compared to the Early/Middle Holocene, suggesting that northern hemispheric boundary conditions and the resultant southward migration of the ITCZ influenced moisture advection. Much more arid conditions (∼30‰ enrichment) must be inferred for the paleosols older than ∼60 ka. Although further dating efforts are required to determine the exact timing, this corroborates earlier findings from African lakes that suggested 'megadroughts' occurred during Marine Isotope Stages 5 and 4.