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Analysis of paleosol-based proxies from the Turkana Basin through paleo-landscape and paleoclimate reconstruction

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The Turkana Basin is world famous for its extensive outcrops that provide insights into the paleoclimate and paleolandscapes in which hominins evolved over the past ~4 Ma. The Nachukui Formation, part of the Omo Group, reflects basin-wide dynamic processes of interlaced sequences including floodplains, deltas, and river systems throughout the Plio-Pleistocene. Paleosols associated with floodplains of the fluvial systems provide a valuable window into better understanding key intervals within this record and are frequently associated with fossiliferous fluvial sequences. This study analyzed three paleosols taken from outcrops of the Kaitio and Natoo Members of the Nachukui Formation. In particular, the Kaitio Mmb was assumed to be simply a lacustrine environment deposited during the longest-lived part of Paleolake Lorenyang (~1.7-2 Ma). However, recent studies have worked to provide a more comprehensive understanding of this member, indicating it was a far more dynamic lacustrine margin than previously recognized. This research builds upon this stratigraphic framework to integrate paleosol-based geochemical proxies to better reconstruct the paleoclimate and paleoenvironment of West Turkana Kaitio (WTK). This includes 1) x-ray fluorescence (XRF) elemental analysis of bulk sediment, and 2) stable isotope analysis on both bulk sediment and pedogenic carbonates. These data allowed us to make estimates of mean annual precipitation (MAP), vegetation type, and paleotemperatures. Using the CalMag and CIA-K weathering indices, the MAP estimates range from 351-933 mm of rain/year, with the means for both proxies ranging from 351-917 mm with an average MAP of 761.75 mm. The CIA-K weathering index produced MAP values of 503-933 mm with an average 812.88 mm. Compared to modern average rainfall values in the basin (324.1-151.6 mm/yr), our MAP estimates indicate the basin experienced more precipitation in the Plio-Pleistocene than it does today. Pairing the geochemical data with our sedimentological assessment allowed us to better characterize these paleosols for a more in depth understanding of the depositional environment of the Kaitio Member.