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Plio-Pleistocene hominin evolution in the Malawi Rift: Persistent C_3 vegetation in heterogeneous wooded savanna ecosystems

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The Plio-Pleistocene expansion of Eastern Africa savanna ecosystems was a major driver for morphological and behavioral innovations in hominin evolution. Most evidence for hominin ecosystem reconstructions originates from the Eastern Rift in today's Somali-Masai Endemic Zone. The studied deposits (ca. 4.3 to 0.6 Ma) in the Karonga Basin (NE Lake Malawi) comprise abundant pedogenic carbonates and fossil remains of a diverse fauna, including two hominid fossil finds: a maxillary fragment of *Paranthropus boisei* and a mandible of *Homo rudolfensis*, both dated at around 2.4 Ma [1,2].

Here we present the first pedogenic Plio-Pleistocene long-term carbon ($\delta^{13}C$) and clumped isotope (Δ_{47}) records from the Chiwondo Beds, one of the earliest hominid fossil sites in the East African Rift (EAR). We contrast these paleosol proxies with data from different suid, bovid, equid, elephant and hippopotamus species.

Our data represent a southern hemisphere record in the EAR, a region particularly interesting for reconstructing vegetation patterns across the Intertropical Convergence Zone (ITCZ). We provide data on the evolution and migration of early hominids and the proposed boundary shift between different savanna types. As our study site is situated between the well-known hominid-bearing sites of eastern and southern Africa it fills an important geographical gap for early hominid research.

Constant $\delta^{13}C$ values around -9 ‰ from over pedogenic carbonate (n = 321) and suidae enamel (n = 18) spanning the last ca. 4.3 Ma indicate a C_3-dominated environment in the Karonga Basin [3]. Presence of specialized grazers with more positive $\delta^{13}C$ enamel values around -1 ‰ is indicative of localized patches of C_4-grassland. The overall fraction of woody cover (60-70%) near paleolake Malawi reflects higher canopy density in the Malawi Rift than in the Eastern Rift [3]. The discrepancy between the two savanna types increases since the Late Pliocene, when the Somali-Masai ecosystem started to show clear evidence for an open, C_4-dominated landscape. Therefore, the evolution of East African ecosystems follows different patterns along the rift axis.

The appearance of C_4-grasses is considered as a driver of evolutionary faunal shifts, but despite the difference of ecosystem evolution, similar hominins occurred in both landscapes, pointing to distinct habitat flexibility and nutritional versatility.

References:

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[2] Kullmer et al. (1999) J. Hum. Evol. 37: 121-127
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