The Shungura Formation Soil Carbonate Record: Evidence for an Ecosystem Buffered from Regional Environmental Change

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Preliminary isotopic results from Shungura Formation soil carbonates provide a new perspective on the terrestrial environmental record for East Africa in the Pliocene. Carbon and oxygen isotope values of paleosol carbonates from 34 distinct horizons between 3.02 and 1.88 Ma (Shungura Formation Members B-H) average -8.6‰ (1σ 1.3‰) and -4.7‰ (1σ 1.8‰), respectively. Low $\delta^{13}C$ values of paleosol carbonates suggest that trees and shrubs flanked the paleo-Omo River, except for the latest portions of the record when paleosol carbonate $\delta^{13}C$ values increase to -4.2‰. These results agree with the prevalence of woodland fossil bovid taxa in the Shungura Formation, but they differ from faunal and palynological analyses that point to an increase in grasslands between 2.8 and 2.5 Ma. Additionally, at 2.8 Ma Shungura terrestrial proxies and marine sediments record a trend towards increased aridity in East Africa, however, $\delta^{18}O$ values of the Shungura paleosol carbonates show no sign of increased aridity at this time. The isotopic record from the Shungura Formation suggests that during the Pliocene, the floodplain of the paleo-Omo River was buffered from the regional increases in C_4 vegetation and aridity that are documented elsewhere in the Turkana Basin. The Shungura paleosol carbonate $\delta^{13}C$ values imply a greater portion of C_3 vegetation than in the Busidima Formation at Gona, which represents another major river system sourced in the Ethiopian Highlands. However, $\delta^{18}O$ values of soil carbonates from Gona and Shungura are similar and lower than values from coeval sediments on the east and west sides of the Turkana Basin. This comparison affirms the uniqueness of C_3-dominated Shungura ecosystem and suggests that the Shungura and Busidima Formations were both influenced by the climate of the Ethiopian Highlands in the late Pliocene.

We can take several lessons from the Shungura soil carbonate record that may be springboards for future work: 1) variability in the terrestrial environmental record can and should be documented with increased sampling; 2) local ecosystems may be buffered from regional environmental change; 3) paleoenvironmental proxies do not always meet the same conclusion, however reconciling these differences will lead to better characterizations of terrestrial ecosystems; and 4) clear differences in the oxygen isotopic records within the Turkana Basin can be used to characterize how terrestrial water balance responds to climate change.