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What we can learn from deltoidal icositetrahedrons about climate: Authigenic mineral transformation as sensitive climate proxy in the Chew Bahir sediment cores (southern Ethiopia)

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Six sites in Ethiopia and Kenya, all adjacent to key paleoanthropological sites have been investigated as part of the Hominin Sites and Paleolakes Drilling Project (HSPDP), aiming at an enhanced understanding of climatic influences on human physical and cultural evolution. The recovered sediment cores from the six sites all together span the last ∼3.5 Ma. The sediment core records archive environmental change during diverse milestones in human evolution, and times of dispersal and technological and cultural innovation. The 280 m-long Chew Bahir lacustrine record, recovered from a tectonically-bound basin in the southern Ethiopian rift in late 2014, covers the past ∼600 ka of environmental history, a time period that includes the transition to the Middle Stone Age, and the origin and dispersal of modern Homo sapiens.

Developing a continuous climate history based on sediment core composition is not straightforward because on one hand some indicators might only be preserved intermittently and on the other hand the physical and chemical properties of the sedimentary deposits do not have a linear relationship to climate. Here we present the first outcome of our ongoing work on deciphering direct paleoenvironmental information from authigenic mineral transformations in the long (∼280 m) Chew Bahir sediment cores. First results suggest mineralogical and geochemical indicators record wet, dry and hyper-arid climate intervals. Preliminary work suggests that the most extreme evaporative phases are represented by authigenic mineral assemblages including Mg-enriched clays, low-temperature authigenic illite and euhedral analcime. SEM and Energy Dispersive Spectrometer (EDS) analyses confirm that the variations in the analcime abundance that are evident in the XRD dataset seem to be distinctly formed deltoidal icositetrahedrons. These are known to form in highly saline and alkaline brines (pH 9 and higher) and can be associated with pronounced arid phases. Understanding and determining the degree of authigenic mineral alteration in the Chew Bahir records will enable interpretation of μXRF-derived indicators (e.g. K correlated with aridity), and provide direct paleohydrologic data. Together with a well-constrained age-model, our growing understanding of site-specific proxy formation and the establishment of climate proxies for Chew Bahir will provide a robust environmental history on decadal to orbital timescales.