Using multiple chronometers to establish a long, directly-dated lacustrine record: constraining >600,000 years of environmental change at Chew Bahir, Ethiopia

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Abstract

There is much debate regarding the role of climate and environmental change in human evolution and dispersal. Despite eastern Africa being regarded as a key location in the story of the emergence of anatomically modern humans (AMH) and their subsequent dispersal out of Africa, there is a paucity of long, well-dated climate records in this region. To address this issue, duplicate deep-drill sediment cores were retrieved from the Chew Bahir basin in the south Ethiopian Rift, extending to 279 m and 266 m below the present sediment surface. Chew Bahir is located in a climatically sensitive region, lying between the boundaries of various influencing air masses and wind systems (i.e. the Intertropical Convergence Zone (ITCZ), the Congo Air Boundary, and the Indian Ocean monsoon). Critically, the site is also located close to the earliest eastern African AMH site of Omo Kibish, and close to the proposed dispersal routes for AMH out of Africa.

The climate and environmental history of Chew Bahir was reconstructed from a ~290 m composite core using various proxy datasets, including core-scanned XRF geochemical data, XRD mineralogy, MSCL logging, grain size analysis, biological proxies, and isotopic datasets (see other papers on Chew Bahir at this meeting). Key to these sensitive records of climate and environmental change is the establishment of a reliable chronology. The Chew Bahir sediments were directly-dated using multiple chronometers, including radiocarbon, argon-argon, and optically stimulated luminescence dating, combined with correlations to known-age tephras. A Bayesian age-depth model was developed based on these ages. The resulting chronology forms one of the longest independently dated lacustrine sediment records from eastern Africa, spanning the entire timescale of modern human evolution and dispersal, and encompassing the transition from Acheulean to Middle Stone Age (MSA) technology, and subsequently to Later Stone Age (LSA) technology.