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Assessing the role of climate change in human evolution and dispersal: a 600,000-year record from Chew Bahir, southern Ethiopia

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What role did climate dynamics play in the evolution and dispersal of *Homo sapiens* within and beyond Africa, and in key cultural innovations? Were gradual climatic changes, rapid shifts from wet to dry, or short-term climate flickers the main driver of human evolution and migration? As a contribution towards an enhanced understanding of those possible human-climate interactions the Chew Bahir Drilling Project, part of the Hominin Sites and Paleolakes Drilling Project (HSPDP) and the Collaborative Research Center (CRC) 806 "*Our way to Europe*", recovered two ~280 m-long sediment cores from a deep, tectonically-bound basin in the southern Ethiopian rift in late 2014. The Chew Bahir record covers the past ~600 ka of environmental history, a critical time period that includes the transition from the Acheulean to the Middle Stone Age, and the origin and dispersal of *Homo sapiens*.

Here we present the results from our multi-proxy study of the Chew Bahir 280 m-long composite core, providing a detailed and high-resolution record of eastern Africa's climate oscillations during the last ~600 ka. To determine sediment age we used a Bayesian model to combine ages derived from radiocarbon dating of ostracodes, optically-stimulated luminescence (OSL) dating of quartz, Argon-Argon ($^{40}Ar/^{39}Ar$) dating of feldspar grains from some key (micro)tephra layers, and correlation on the basis of geochemistry of a tephra unit in the core to a known and dated tephra in the outcrop. We used high-resolution geophysical and geochemical indicators, such as the established aridity proxy K, sediment colour and authigenic minerals to differentiate between

climate fluctuations on different time scales and magnitudes.

Our results show that the full proxy record from Chew Bahir can be divided into three phases with similar trends in central tendency and dispersion. Phase I from ~600 to ~430 kyr BP shows a long-term shift from humid to arid conditions while slightly increasing the variability and ending with the most extreme oscillations between full humidity and extreme aridity. The transition into Phase II (~430 to ~200 kyr BP) is marked by a pronounced millennial-scale humidity increase. Phase II reflects generally more humid conditions and there is evidence of double humidity increase tendency. Firstly, between ~430 and ~315 kyr BP (Phase IIa), and again from ~280 to ~195 kyr BP (Phase IIb), with only slight changes in long-term variability. Since ~200 kyr BP (Phase III), a long-term aridification trend sets in, similar to Phase I, but with a distinct increase in variability and amplitudes. All of these changes would have had significant implications for shaping our ancestors' living environments, both broadening and limiting their options in response to the different degrees and rates of climatic stress. The Chew Bahir record, one of the very few long terrestrial environmental records from continental eastern Africa, can contribute to testing the influence of low versus high latitude climate change in driving the expansion, contraction and fragmentation of early human habitats.