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Indian ocean sea surface temperature control on the 50,000-year strontium isotope Chew Bahir lake record, Eastern Africa

Charlotte Zachow[1,2], Hubert Vonhof[2], Stephen J. G. Galer[2], Verena Foerster[3], Monika Markowska[2,4], and Annett Junginger[1,5]
[1]Department of Geosciences, Eberhard Karls University Tuebingen, Tuebingen, Germany (charlotte.zachow@student.uni-tuebingen.de)
[2]Max Planck Institute for Chemistry, Climate Geochemistry Department, Mainz, Germany
[3]Institute of Geography Education, University of Cologne, Cologne, Germany
[4]Department of Geography and Environmental Sciences, Northumbria University, Newcastle, UK
[5]Senckenberg Centre for Human Evolution and Paleoenvironment (SHEP), Tübingen, Germany

The role that climate played in human evolution has been controversially discussed among scientists for decades. Inspired by these discussions, the Hominin Sites Paleolakes Drilling Project (HSPDP) conducted five deep drilling campaigns adjacent to key hominin fossil sites in eastern Africa, including the Chew Bahir Basin in southern Ethiopia. Analysis of the Chew Bahir lacustrine sedimentary record revealed that over the past 620,000 years, phases of environmental stability and instability occurred contemporaneously with milestones in human history, including pulsed dispersal events out of Africa coinciding with potential humid periods. Although proxies from Chew Bahir sediments have provided important qualitative information about relative changes in environmental conditions, we still lack quantitative information on water availability and an understanding of the dominant climatic forcings controlling water balance. Here we present the first radiogenic strontium isotope ($^{87}Sr/^{86}Sr$) record covering the past 50,000 years from four Chew Bahir sediment short cores (CB01, CB03, CB05, CB06) and one long core HSPDP-CHB-1A in a resolution of 100 to 1000 years measured on fish bones, endogenic calcites, and ostracods. We interpret the Sr isotope proxy to reflect water provenance changes, particularly controlled by the varying contribution of water overflowing from a series of lakes further north in Ethiopia. Our new Sr-isotope record shows a remarkable correlation with global sea level variability and does not show a pattern of precession paced cycles. Superimposed on this pattern, we see concurrent excursions in the Sr-isotope record of centennial- to millennial scale events such as Heinrich Event 1 (H1) or the Younger Dryas (YD). As Chew Bahir dominantly receives Indian Ocean moisture, the most likely driver of moisture availability in this part of eastern Africa is the temperature of western Indian Ocean surface water that varies in pace with glacial-interglacial climate change. Also on shorter time scales, reduced Indian Ocean surface temperatures correspond to reduced moisture in the tropical rainbelt resulting in dry conditions around H1 and the YD. Where other paleohydrological proxy data from lake fossils can be comparatively noisy because of the high spatial and seasonal variability in such tropical systems, the relatively conservative hydrochemistry of the Sr isotope signal in lakes like Chew Bahir makes this proxy relatively insensitive to seasonal

variability while it faithfully captures decadal to longer time scale signals.