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Early- to Mid-Holocene hydroclimate shifts in tropical East Africa: the multi-proxy sediment record from Lake Rutundu, Kenya

Gijs De Cort (1,2), Mike Creutz (1), Lucia Barao (3), Daniel Conley (4), Gerald Haug (5), Samuel Bodé (6), Maarten Blaauw (7), Dan Engstrom (8), and Dirk Verschuren (1)

(1) Ghent University, Department of Biology, Limnology Unit. K.L. Ledeganckstraat 35, B-9000 Gent, Belgium, (2) Royal Museum for Central Africa, Department of Geology and Mineralogy. Leuvensesteenweg 13, B-3080 Tervuren, Belgium, (3) University of Antwerp, Department of Biology. Universiteitsplein 1, B-2610 Wilrijk, Belgium, (4) Lund University, Department of Geology. Sölvegatan 12, S-223 62 Lund, Sweden, (5) ETH Zürich, Geologisches Institut. Sonneggstrasse 5, 8092 Zürich, Switzerland, (6) Department of Applied Analytical and Physical Chemistry, Ghent University. Coupure Links 653, B-9000 Gent, Belgium, (7) Queen's University Belfast, School of Geography, Archaeology and Palaeoecology. 42 Fitzwilliam Street, Belfast BT9 6AX, UK, (8) St. Croix Watershed Research Station, Science Museum of Minnesota. Marine on St. Croix, MN 55047, USA

Following the generally arid conditions of the Last Glacial Maximum (LGM), a large part of the African continent experienced the Early to Mid-Holocene as a much more humid period than today. This so-called African Humid Period (AHP) coincided with high summertime insolation over the Northern Hemisphere subtropics, causing invigorated monsoons to create moist conditions over the northern parts of the continent. Similarly, equatorial and even low-latitude southeastern Africa experienced a wetter climate due to the post-glacial increase in atmospheric greenhouse gasses ultimately leading to altered Atlantic and Indian Ocean monsoon dynamics. The timing and abruptness of the onset and ending of the AHP in the different regions of the continent have been the subject of major discussion. On the other hand, shorter-lived climate fluctuations within the AHP have received much less attention, due to a scarcity of well-dated, high-resolution African paleoclimate records spanning the entire Holocene.

In this study we used the sediment record of Lake Rutundu, a high-altitude crater lake on Mount Kenya, to document multidecadal to millennial-scale hydroclimate variability on the East African equator from the LGM to the present. A multiproxy approach combining core-surface scanning techniques (magnetic susceptibility, X-ray fluorescence) and close-interval bulk-sediment analyses (organic matter and biogenic Si content, grain size, organic δ15N and δ13C) resulted in a high-resolution record firmly anchored in time by an age model based on 210Pb dating and sixteen calibrated radiocarbon ages. This new Lake Rutundu hydroclimate record confirms that moister conditions following the LGM returned to East Africa ca.16 kyr BP, and it contains a perfectly timed Younger Dryas episode (12.8-11.5 kyr BP) of intermittent drought. We find that the Early- to Mid-Holocene period, which in African records is often described as uniformly wet, was in fact punctuated by three distinct, century-scale drought episodes. The first of these provides robust evidence that the 8.2 kyr cooling event, well-known from high northern latitudes, impacted tropical East Africa's moisture balance as well. The two other drought episodes, centered at c.6.5 and 5.5 kyr BP, punctuate the mid-Holocene drying which eventually ended the AHP in this region around 4 kyr BP.