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

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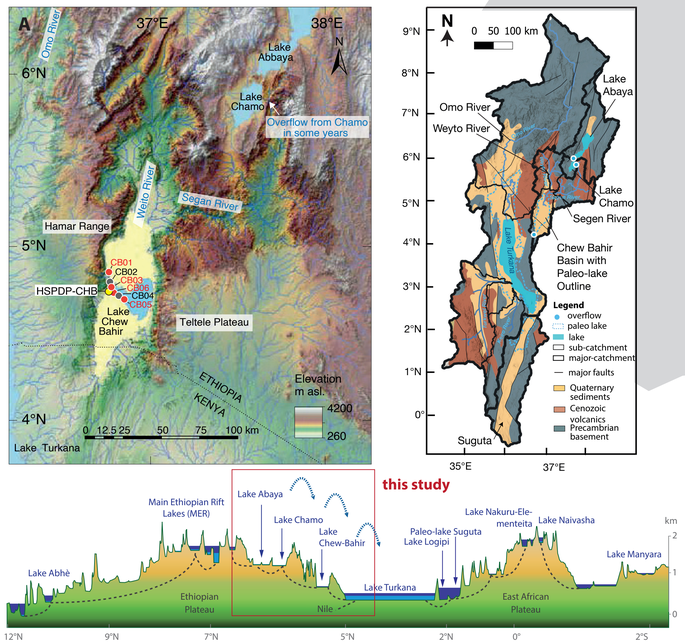
Introduction & Geological Setting



Introduction | Analysis of the ICDP-Chew Bahir drill core CHB14 **(top left)** reveales that over the past 620 ka phases of environmental stability and instability occured contemporaneously with milestones in human history, including pulsed dispersal events out of Africa coinciding with potential humid periods. Although proxies in Chew Bahir sediments have been intensely tested for their reliability we still lack quantitative information on water availability and an understanding of the driving and competing mechanisms. **Here we present** the first $^{87}Sr/^{86}Sr$ record from aquatic microfossils in the sediments, that are hypothesized to record water provenance. During major wet periods, Lakes Chamo-Abaya, located in a volcanic rocks catchment **(top right)**, have overflowed into Lake Chew Bahir **(bottom)**, dominated by a metamorphic rocks catchment. Due to the different lithologies, $^{87}Sr/^{86}Sr$ differ and are recorded in the aquatic microfossils living in the corresponding water bodies. (modiefied maps from Förster et al., 2018, P3; Markowska et al., 2022, QSR; Junginger & Trauth, 2013, GLOPACHA).

Methods - Proxys

Figure | $^{87}Sr/^{86}Sr$ ratios measured on leached calcite crystals, ostracods and fish bones. All samples were chemical prepared in a clean laboratory and measured by Thermal ionization mass spectrometry (TIMS) in Amsterdam or Mainz.

50,000-Year Strontium Isotope Record

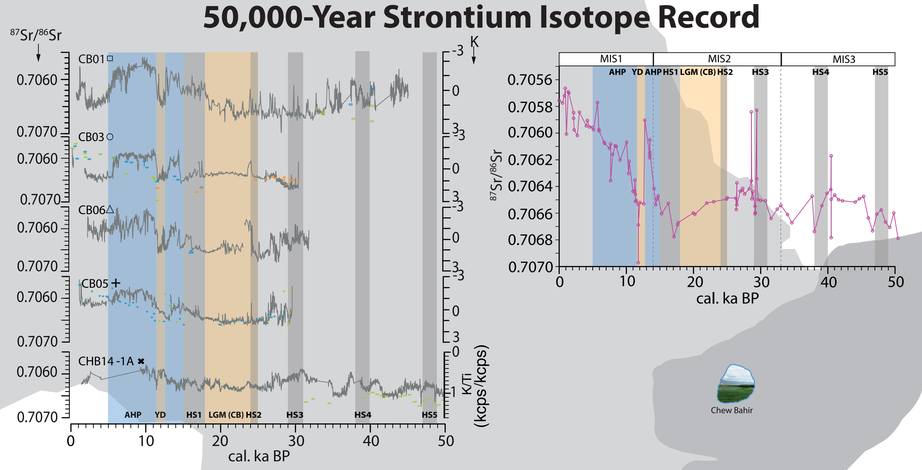


Figure | $^{87}Sr/^{86}Sr$ from fish bones (blue), ostracods (green) and calcite crystals (orange) extracted from cores CB01, CB03, CB05, CB06, and CHB14-1A in comparison to K-XRF data (Förster et al., 2015, QSR; Trauth et al., 2018, Quat. Research) from each core. Errorbars of Sr-isotope values are equal or smaller than the date points. Parallel measurements on fish bones, ostracods and calcite crystals revealed similar values (correlation 0.977) showing the robustnes of the proxy. Larger discrepancies are usually seen during supposedly dry intervals, when most likely several small ponds prevailed instead of one uniform lake. African humid period (AHP), Younger dryas (YD) and Last glacial maximum (LGM) are shown for reference, while the timing of Heinrich events H2–H6 should be viewed as approximative.

Water Provenance & Quantification - Prestudy

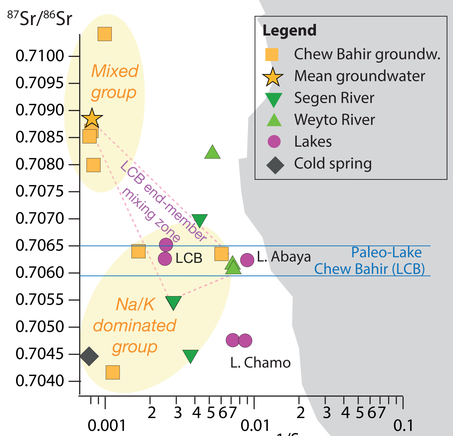


Figure | Cross plot of $^{87}Sr/^{86}Sr$ and 7/Sr (ppb) showing the end-member mixing zone for Lake Chew Bahir (Markowska et al. 2022, QSR)

Picture | Water sampling in the Chew Bahir basin 2018.

Global Comparison & Conclusion

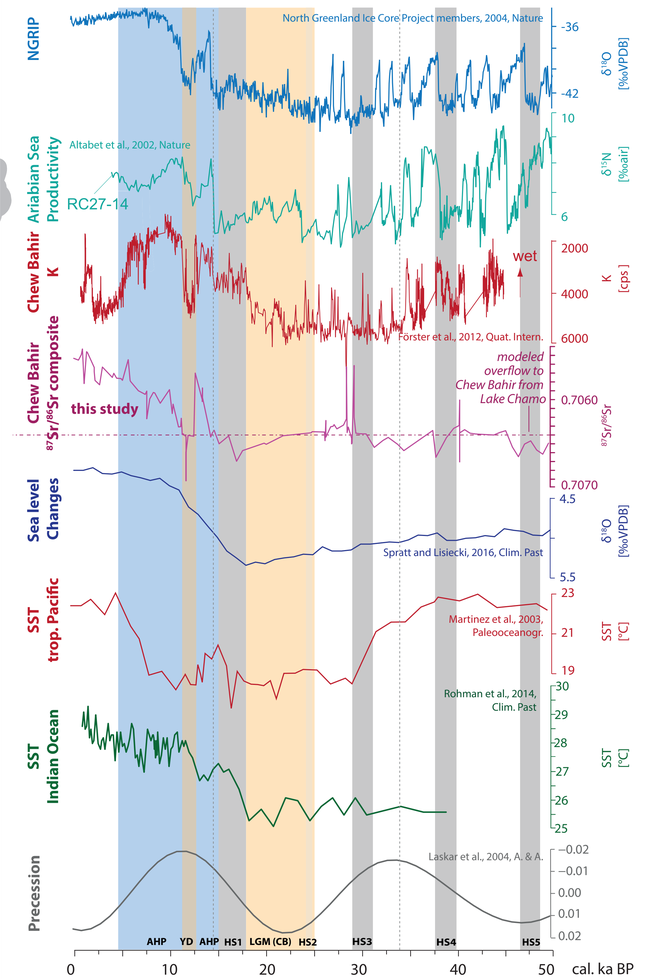


Figure | Comparison of our results from the $^{87}Sr/^{86}Sr$ project (purple line) with other regional and global paleo-climate records. **Conclusion |** The comparison suggests, that $^{87}Sr/^{86}Sr$ in the aquatic microfossils and thus the hydrology of Chew Bahir seem to follow glacial-interglacial cycles, rather than orbital parameters. Furthermore, Chew Bahir's $^{87}Sr/^{86}Sr$ react very sensitively towards even moderate climate changes and clearly reflect short-term variations, such as the Younger Dryas (YD). While being not in phase with precession and thus insolation, their forced long-term variations, such as the AHP, are also expressed in the Chew Bahir $^{87}Sr/^{86}Sr$, marked by a rather abrupt onset, with a pronounced long-term decrease in $^{87}Sr/^{86}Sr$.