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From Lake Malawi Drilling: East African Climate May Have Caused Major Evolutionary Turnover in Mammalian Species During MIS 14

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Hominin evolution underwent important changes in the last 1.3 million years, including the extinction of Paranthropus at about 1.2 Ma, leaving Homo as the sole hominin genus. Our genus experienced a major increase in cranial capacity at about 500 ka, and our species, H. sapiens, first appeared at ∼200 ka. There was a major turnover in mammalian species in East Africa between 540 and 400 ka, favoring descendants of smaller size and less specialized diet. An understanding of what drove evolution in these directions is fundamental to understanding the development of modern H. sapiens. Climate certainly played a role, for it is the principal factor that influences the distribution of vegetation and habitability on the landscape. We present a 1.3 million year record of temperature and hydroclimate in the basin of Lake Malawi, the second deepest lake in Africa, derived from a 380 m sediment sequence taken from a water depth of 590 m by the Lake Malawi Drilling Project. Seismic reflection profiles used to select the site portray an undisturbed sedimentary section that was not impacted by erosion, turbidity currents or mass wasting events. Sediment samples were analyzed to produce records of temperature (TEX86) and aridity (Ca content and leaf wax δ13C). The temperature record displays progressively larger amplitude glacial-interglacial variations from MIS 13 (∼500 ka) to MIS 5 (∼125 ka). Intervals of low Ca abundance, which reflect lake high stands, correlate with times of depleted δ13Cwax and relatively warm temperatures. The Malawi basin experienced warm, wet interglacials and cooler (by about 2 - 4ºC), dry glacial periods, with roughly a 100 ky periodicity since the Mid-Pleistocene Transition (MPT), about 900 ka. The paleoclimate record from Lake Malawi sediments portrays a transition from a highly variable and predominantly arid climate prior to 900 ka to a progressively more humid environment after the MPT dominated by 100 ky cycles consisting of warm, wet interglacial periods alternating with relatively cool, dry glacial periods. One of the coldest, and most prolonged dry periods of the last million years in the Malawi basin occurred around 540 ka (MIS 14). This perturbation in the climate may have been a factor in the substantial mammalian extinctions and increased cranial capacity of Homo that occurred during this time. As more long-term, high-resolution histories of climate are recovered from the other great lakes of East Africa, we will be able to address key questions raised by the Malawi record, e.g., the extent of the rift valley that shifted to wetter conditions over the past million years, and whether MIS 14 was an unusually cold ice age throughout the region. Future drilling campaigns on the East African Great Lakes will offer unique opportunities to understand the changing landscape where our ancestors evolved, migrated, and advanced their cultures.