CLIMATE CHANGES IN THE AFRICAN TROPICS OVER THE LAST GLACIAL/POST-GLACIAL PERIOD. WHAT DO LAKE SEDIMENTS TELL US?

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One major question currently addressed in the IGBP–PAGES Pole-Equator-Pole Afro–European transect project (PEP III) is how do tropics respond to changes in major climate forcing factors, and how tropics may influence climate globally.

Through isotopic data from lake sediments, this paper aims at understanding the response of tropical continental systems to changes in: (i) summer solar radiation, as a controlling factor of the monsoonal circulation; (ii) tropical sea surface temperature (SST) and related availability in atmospheric moisture; (iii) atmospheric CO_2 concentration, as a forcing factor on tropical vegetation cover. Selected examples focus on the timing of the last deglaciation and of major hydrological changes in the southern and northern tropics, in order to reconcile tropical land, ocean, and polar ice records from both hemispheres.

In the northern tropics of East Africa (i.e., L. Abiyata, Ethiopian Rift, 7° 40' N, 1578 m. a. s. l.) and the Sahel, several lacustrine cores have been analyzed for sediment mineralogy, carbonate ($\delta^{18}O$ and $\delta^{13}C$) and organic matter ($\delta^{13}C$) isotopic composition, and diatoms. The carbonate $\delta^{18}O$ records are primarily interpreted in terms of changes in the Precipitation minus Evaporation balance (P–E). The $\delta^{13}C$ isotope composition is closely linked to biological processes within both the lake and its catchment. The records document: (i) a LGM with (P–E) similar or lower than today; (ii) high lake levels from 34 to 24 ‰, and from 11 to 7 ‰ cal kyr; (iii) a re-establishement of wet conditions during the last deglaciation in two major steps, at 15 and 11.5 cal kyr. A number of sites reveal a $\delta^{13}C$ decrease of 10 ‰ or more in total organic matter (TOM) and/or isolated organic fractions during the last deglaciation. This has been primarily interpreted as a shift from C4 to C3-dominated plants. This shift is accompanied by the development of trees in the catchment and by lake-level rises, in response to orbitally-induced monsoon rainfall strengthening. Few records are available from the southern tropics. The shallow crater lake Tritrivakely (19° 47' S, 1780 m. a. s. l), Madagascar highlands, has provided a 40 kyr multi-proxy paleoclimatic record. It shows: (i) a Last Glacial Maximum (LGM) drier and cooler than today; (ii) episodes of positive P–E balance from 39.5 to 32 ‰ cal kyr and from 17 to 8 ‰ cal kyr; (iii) a deglaciation warming in two steps at 17 and 15 cal kyr. The $\delta^{13}C$ values of total organic matter and of isolated terrestrial or emergent plant fragments are heaviest during the Glacial period, and decrease progressively from 20 cal kyr upwards. Despite similarities with the northern tropics records, high $\delta^{13}C$ values coincide here with the predominance of high-altitude woody elements (C3-plants); the $\delta^{13}C$ decrease occurred when Gramineae (C3 or C4) and woody savanna pollen developed in the catchment, and when *Cyperaceae* colonized the waterbody. Lower atmospheric CO_2 concentration during glacial times may have contributed to the mountain vegetation shift to lower altitude, decreased carbon-isotope discrimination in C3-land plants, enhanced HCO_3^- assimilation of aquatic plants during lake episodes, and favoured C4-emergent plants in the LGM lowstand. Episodes of maximum P–E balance in the northern and southern tropics are out of phase, as expected from orbital forcing. However, drier conditions during the LGM are evidenced in both hemispheres. This is attributed to lower tropical SST and related low atmospheric concentration in water vapour. During the last deglaciation, the two step re-establishment of wet conditions in the northern tropics is in phase with major temperature changes as recorded in Greenland ice cores. It lags about 2 kyrs the deglaciation events observed in the southern tropics, where abrupt changes do not easily reconcile with the smooth Antarctica warming between 20 and 10 cal kyr. Lacustrine isotope archives provide a means of extending our knowledge on amplitude and causes of climate changes. In all cases, the isotope signal interpretation should be supported by a multi-proxy approach. Calibration from modern reference systems remains a priority to transfer isotope proxies in terms of quantitative environment and climate variables.