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VEGETATION CHANGES AND WET/ARID PHASES IN THE SOUTHEASTERN AFRICAN TROPICS DURING THE PAST 23,000 YEARS

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Changes in the hydrological cycle have a far greater impact on human welfare in tropical Africa than does the relatively small range of temperature variability. Therefore, understanding the timing of past arid and wet phases in low-latitude regions is critical to understanding human and faunal migrations as well as the role and response of the tropics in global climate change. Here, we examine the record of plant leaf wax (*n*-alkane) carbon isotopes and lignin phenols from a well-dated Lake Malawi sediment core in order to examine vegetation changes in southeastern Africa since the Last Glacial Maximum (LGM). Tropical vegetation is a sensitive indicator of aridity and its distribution is mainly controlled by precipitation, which, in tropical East Africa, is influenced by the position and seasonal migration of the Intertropical Convergence Zone (ITCZ). Plants utilizing the C_4 photosynthetic pathway are characterized by higher water use efficiency than C_3 plants, and are common today in tropical savannahs, temperate grasslands, and in semi-arid regions. As aridity is recognized as the dominant control on the large-scale distribution of C_3 versus C_4 vegetation in tropical Africa (Schefuβ et al., 2003), changes in aridity can be examined by determining the past distribution of C_3 versus C_4 vegetation.

Results of this study show that cinnamyl to vanillyl (C/V) ratios of lignin phenols, used to distinguish between inputs of non-woody vs. woody vegetation (Goñi and Hedges, 1992), correlate closely with *n*-alkane $\delta^{13}C$ values in Lake Malawi. Higher C/V ratios are noted when *n*-alkane $\delta^{13}C$ values are heavier, thus indicating increased inputs of non-woody C_4 grass tissues. Peak wet phases in southeastern Africa occurred at 13.6 and 4.9 cal ka, while arid phases are noted during the LGM (23-18 cal ka), the Younger Dryas (12.9-11.9 cal ka), in the early Holocene (10-7.7 cal ka) and during the Little Ice Age (1700-1880 AD).

When compared ice core methane records from Antarctica and Greenland (Brook et al., 2000), indicative of global tropical wetness, we find wet/arid phases in the southeastern

African tropics closely paralleling high latitude ice core methane records from the Last Glacial Maximim (LGM) until ~11 cal ka (Figure 1). At the start of the Holocene this in-phase relationship abruptly deteriorates and a generally anti-phase relationship prevails, with dry conditions at Lake Malawi correlating with wet conditions in equatorial and northern Africa. The abrupt switching of the dominant mechanisms controlling aridity is likely related to a change in the mean latitudinal position of the ITCZ during the last glacial, as southward displacements occur during northern hemisphere cold periods (Broccoli et al., 2006). Following northern hemisphere ice sheet retreat, the influence of precessional variability in summer insolation on moisture availability in the southern tropics became relatively more important, and anti-phased with the northern African tropics.

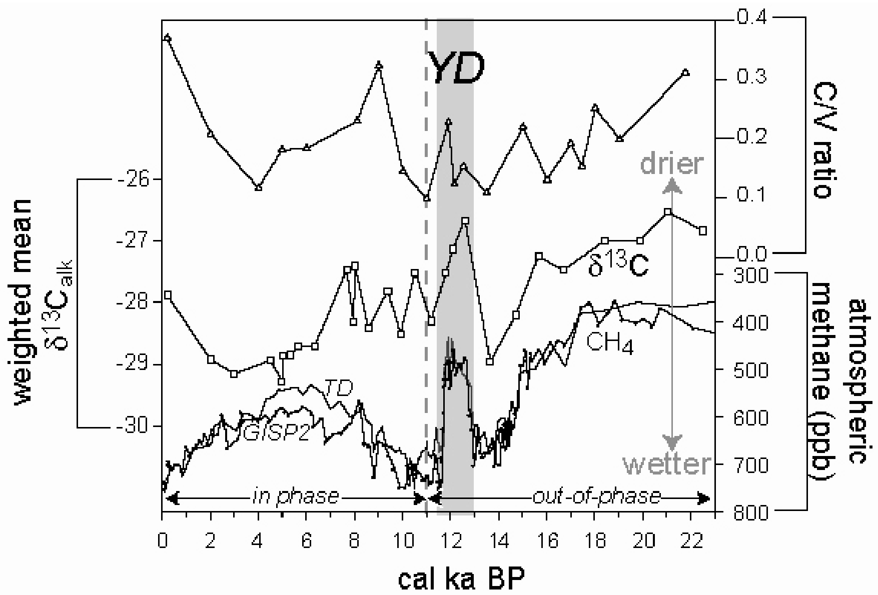

Figure 1. Lake Malawi *n*-alkane $\delta^{13}C$ (the weighted mean of the C_{27}-C_{31} *n*-alkanes) and lignin phenol C/V ratios compared to the Greenland (GISP2) and Antarctica (Taylor Dome) atmospheric methane records (CH_4 data from Brook et al., 2000). The Younger Dryas (YD) cold period is indicated by the grey shading.

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