A 23,000 year molecular isotopic record of variability in SE African vegetation and hydrology from Lake Malawi

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Vegetation change is controlled primarily by the influences of temperature, hydrology, and atmospheric [CO_2]. In tropical Africa, hydrological variations appear to be more important than either temperature or [CO_2]. Furthermore, hydrological variability in tropical Africa has a much more profound impact on human welfare than temperature or [CO_2]. Thus, reconstructing the timing of past wet and arid phases in this region is critical to understand the role and response of the tropics to global climate change. Here, we present a molecular isotopic record of vegetation and climate change from a well-dated sediment core from Lake Malawi spanning the period from the Last Glacial Maximum (LGM) to the present.

Our data show that the region surrounding Lake Malawi was cooler and drier during the LGM and the Younger Dryas (YD) than through the Holocene. This change of hydrology directly influenced the vegetation in the surrounding watershed, with a greater proportion of C4 plants such as grasses (which compete well in dry conditions) during these times. Conversely, the wetter and warmer Holocene is characterized by an increase in the proportion of C3 plants (such as trees) that require greater amounts of moisture to be successful. Finally, we note that at 11 cal ka there is a shift in the coherence between the Lake Malawi aridity record and high latitude ice core methane records (records of global tropical wetness); these records are in phase prior to 11 cal ka, and antiphased after this time. We attribute this to a shift in the dominant mechanisms controlling aridity associated with a shift in the mean latitudinal position of the Intertropical Convergence Zone.

The origin of high $^3He/^4He$ values in oceanic lavas: Arguments against a heterogeneous upper mantle source

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One of the contentious issues fuelling the debate on the origin of intraplate magmatism is the source of high $^3He/^4He$ ratios in oceanic lavas. The contemporary hotspot hypothesis posits that the high $^3He/^4He$ signature is coming from a distinct source reservoir that lies relatively deep in the mantle whereas others argue that there is no such a reservoir. For example, the SUMA (Statistical Upper Mantle Assemblage - *Meibom & Anderson, EPSL* **17**, *2003*) hypothesis argues that the compositional variability of oceanic lavas results from sampling upon melting of the heterogeneous upper mantle. It claims that extreme isotopic signals, such as high $^3He/^4He$ ratios, of some oceanic lavas are due to small degrees of partial melting that preferentially sample dispersed, anomalous mantle components. In contrast, large degrees of partial melting sample a larger volume, and hence many components of the heterogeneous mantle; these also promote more effective mixing of the resulting melts, producing a relatively homogeneous composition typified by that of N-type MORB. To constrain the source of high $^3He/^4He$ lavas, we analyzed a ~dozen representative samples from the axis and near-ridge seamounts in the 11°45'N to 15°00'N segment of the EPR. Axial lavas are N- to T-type MORB that came from a heterogeneous mantle source (*Castillo et al., G^3* **1**, *2000*). Seamount lavas extend the compositional variability of axial lavas to both higher and lower Sr, Nd and Pb isotope values, suggesting that seamount lavas indeed result from smaller degrees of partial melting of the heterogeneous mantle beneath the region. Our preliminary results, however, also show that the majority of both axial and near-ridge seamount lavas have indistinguishable, MORB-like $^3He/^4He$ values, at 8 +/- 1 R_A, over a range of He concentrations. The remainder have $^3He/^4He$ < 8 R_A. Thus we conclude that the heterogeneous Pacific upper mantle cannot provide the high $^3He/^4He$ signature in oceanic lavas.