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Coupling 2H and 18O biomarker results provides new insight into palaeohumidity changes in East Africa during the last glacial

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We couple compound-specific δ^2H results of leaf wax-derived n-alkanes with compound-specific δ^{18}O results of hemicellulose-derived sugars extracted from the loess-paleosol-sequence Maundi (3°10'27.5"S, 37°31'05.8"E) located on the south-eastern slopes of Mt. Kilimanjaro at $\sim$ 2780 m above sea level. This coupled biomarker approach allows inter alia establishing a ca. 100 ka record of the isotopic composition of leaf water. Accordingly, the deuterium-excess of leaf water may serve as a proxy for palaeohumidity. Furthermore, the coupled biomarker approach allows reconstructing the isotopic composition of palaeoprecipitation (by using the slope the local evaporation line derived from a simple Craig-Gordon model).

Our results suggest that sedimentary $\delta^2H_{leaf-wax}$ records should not be interpreted directly in terms of reflecting δ^2H_{prec} because variable leaf water evaporative enrichment can strongly overprint the δ^2H_{prec} signal. The Maundi $\delta^2H_{n-alkane}$ record can be compared with δ^2H_{wax} records from Lake Challa, Lake Tanganyika and Lake Malawi. Accordingly, the Maundi $\delta^2H_{n-alkane}$ record is generally in good agreement with the Lake Challa and the Lake Tanganyika $\delta 2H_{wax}$ records. However, a clear altitude effect can be seen in the δ^2H records (Maundi: 2780 m a.s.l.; Lake Challa: 880 m a.s.l.; Lake Tanganyika: 773 m a.s.l.; Lake Malawi: 474 m a.s.l.). Moreover, the Maundi $\delta^2H_{n-alkane}$ record reveals a clear smaller range compared to the other δ^2H_{wax} records. Finally, especially the Lake Malawi δ^2H_{wax} record reveals also clearly different features than the other available δ^2H_{wax} records. These differences resulted in different interpretations of the δ^2H_{wax} records (amount effect vs. source effect).

Our coupled $\delta^{18}O_{sugar}$ and $\delta^2H_{n-alkane}$ approach sheds new light into this discussion. In brief, reconstructed low deuterium-excess$_{leaf-water}$ values during the African Humid Period (AHP) indicate humid climatic conditions. By contrast, higher deuterium-excess$_{leaf-water}$ values indicate that arid climatic conditions prevailed during the Younger Dryas (YD), the Last Glacial Maximum (LGM) and during a mega drought period (MD) having occurred $\sim$ 70-60 ka BP.

Including the Maundi precipitation record in a circum pacific comparison may help to identify the drivers of past isotopic composition on east equatorial African precipitation.