Hydrogen isotope ratios of lacustrine sedimentary n-alkanes as proxies of tropical African hydrology: Insights from a calibration transect across Cameroon

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Hydrogen isotope values (δ D) of sedimentary aquatic and terrestrial lipid biomarkers, originating from algae, bacteria, and leaf wax, have been used to record isotopic properties of ancient source water (i.e., precipitation and/or lake water) in several mid- and high-latitude lacustrine environments. In the tropics, however, where both processes associated with isotope fractionation in the hydrologic system and vegetation strongly differ from those at higher latitudes, calibration studies for this proxy are not yet available. To close this gap of knowledge, we sampled surface sediments from 11 lakes in Cameroon to identify those hydro-climatological processes and physiological factors that determine the hydrogen isotopic composition of aquatic and terrestrial lipid biomarkers. Here we present a robust framework for the application of compound-specific hydrogen isotopes in tropical Africa. Our results show that the δ D values of the aquatic lipid biomarker n -C 17 alkane were not correlated with the δ D values of lake water. Carbon isotope measurements indicate that the n -C 17 alkane was derived from multiple source organisms that used different hydrogen pools for biosynthesis. We demonstrate that the δ D values of the n -C 29 alkane were correlated with the δ D values of surface water (i.e., river water and groundwater), which, on large spatial scales, reflect the isotopic composition of mean annual precipitation. Such a relationship has been observed at higher latitudes, supporting the robustness of the leaf-wax lipid δ D proxy on a hemispheric spatial scale. In contrast, the δ D values of the n -C 31 alkane did not show such a relationship but instead were correlated with the evaporative lake water δ D values. This result suggests distinct water sources for both leaf-wax lipids, most likely originating from two different groups of plants. These new findings have important implications for the interpretation of long-chain n -alkane δ D records from ancient lake sediments. In particular, a robust interpretation of palaeohydrological data requires knowledge of the vegetation in the catchment area as different plants may utilise different water sources. Our results also suggest that the combination of carbon and hydrogen isotopes does help to differentiate between the metabolic pathway and/or growth form of organisms and therefore, the source of hydrogen used during lipid biosynthesis.

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