What plant is that? Chemotaxonomy from n-alkane molecular distributions of East African plants with implications for paleoecology

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Abstract

Plant wax n-alkanes serve as reliable biomarkers given their abundance, stability, and distribution in the sedimentary record. As a result, their utility as isotopic indicators of vegetation and hydroclimate is well-established. A less well studied aspect of plant n-alkanes is the use of their molecular distributions, or differences in the relative abundances of homologues, for chemotaxonomy. Limited plant n-alkane datasets from southern and western Africa suggest molecular distributions can differentiate C4 grasses from C3 woody vegetation. Here we examine a suite of plants from East Africa, where almost no plant biomarkers data exists from modern plants. In this study, over 100 samples of 19 species of plants were collected monthly from the Samburu National Reserve in Kenya from October 2001 to March 2003, across multiple growing seasons; n-alkane distributions and concentrations from both individual species and designated plant functional types (PFTs) - based on both photosynthetic pathway and growth form - were investigated. Previously published n-alkane data from western and southern Africa, or the "All Africa" dataset, were examined to further understand potential spatial differences in biomarker distributions. n-alkane distributions in both datasets vary in both individual species and within PFTs. Principal Components Analysis (PCA) was used to analyze distributions of n-alkanes in individual species and in PFTs, to determine the primary sources of variability. Results indicate that n-alkane distributions can be used to separate some individual species - namely, C4 grasses - and can be used to separate PFTs. C4 grasses and C3 woody vegetation were successfully separated in both datasets. Additionally, we found that n-alkane concentrations vary by four orders of magnitude across homologues and PFTs. A compiled African plant data set shows that C31 concentration is the most representative of the plant community for C4 grasses, C3 shrubs, and C3 trees and thus, is most ideal for stable isotope vegetation reconstructions. These data suggest that an organic geochemical approach to plant taxonomy is crucial to future biomarker applications for reconstructing vegetation distribution and structure in past ecosystems.

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