Composition of *n*-Alkanes in Individual Fossil Leaves from the Paleocene-Eocene Boundary

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Long-chain *n*-alkanes (C_{21} to C_{35}) are distinctive plant lipid biomarkers that are not only remarkably ubiquitous across many terrestrial and marine environments but also can survive for millions of years in the geologic record. Their molecular and stable isotopic compositions can provide records of ancient environments. Most fossil *n*-alkanes are extracted from paleosols and bulk sediments, and therefore can be considered as mixtures of inputs from local plants. *n*-Alkanes from fluvial sediments in the Bighorn Basin, Wyoming, USA, have been examined across the Paleocene-Eocene boundary, including the Paleocene-Eocene Thermal Maximum (PETM) carbon isotope excursion. To date, interpretations of *n*-alkanes from these rocks have depended on comparison with modern plant *n*-alkanes, which are isolated from the leaves of individual plants. In order to avoid this mismatch between lipids from individual modern plants and bulk lipids from ancient sediments, we have examined the *n*-alkane compositions of individual fossilized leaves from fluvial channel fill deposits within the same Bighorn Basin stratigraphic sections where sedimentary *n*-alkane and bulk carbon isotope records have been measured. Initial comparisons of compression fossils with the directly adjacent sediment matrix for multiple fossil leaves show the lipids are much more concentrated in the fossil leaves than the surrounding matrix, and this suggests the lipids come from the leaf rather than being dispersed in the sediment.

Analysis of the lipid signatures of individual leaf morphotypes, as well as comparison of those fossil morphotypes with one another and with modern species lipid data, further our understanding of the relationship between paleosol *n*-alkanes and the source plant community. Changes in both the molecular and carbon isotopic compositions of sedimentary *n*-alkanes across the PETM have been previously ascribed to changes in the local plant community, where deciduous gymnosperms were a large component before and after, but not during, the PETM. By focusing on leaf fossils such as *Ginkgo* as well as locally abundant angiosperms, we can assess the relative importance of different plant lipid sources – most importantly, distinguishing between gymnosperms, angiosperms, and deciduous and evergreen plants. The relationship between carbon isotopic content and *n*-alkane chain length can be assessed for fossil species and then compared with the same data in modern species. Analysis of fossil leaves builds on previous modern plant data demonstrating that deciduous gymnosperms show a trend of increasingly negative carbon isotope values with increasing *n*-alkane chain length similar to that observed in deciduous angiosperms. This modern data is in contrast to the hypothesis that gymnosperms and angiosperms can be distinguished from one another based on the relationship between carbon isotope value and *n*-alkane chain length. *n*-Alkane molecular distributions appear similar between paired fossil and modern leaves, and carbon isotope values from the fossil leaves will further illuminate the nature of this relationship and its preservation in the fossil record.