Concentrations and $\delta(2)$H values of cuticular n-alkanes vary significantly among plant organs, species and habitats in grasses from an alpine and a temperate European grassland

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n-Alkanes are long-chained hydrocarbons contained in the cuticle of terrestrial plants. Their hydrogen isotope ratios ($\delta(2)$H) have been used as a proxy for environmental and plant ecophysiological processes. Calibration studies designed to resolve the mechanisms that determine the $\delta(2)$H values of n-alkanes have exclusively focused on n-alkanes derived from leaves. It is, however, unclear in which quantities n-alkanes are also produced by other plant organs such as roots or inflorescences, or whether different plant organs produce distinct n-alkane $\delta(2)$H values. To resolve these open questions, we sampled leaves, sheaths, stems, inflorescences and roots from a total of 15 species of European C3 grasses in an alpine and a temperate grassland in Switzerland. Our data show slightly increased n-alkane concentrations and n-alkane $\delta(2)$H values in the alpine compared to the temperate grassland. More importantly, inflorescences had typically much higher n-alkane concentrations than other organs while roots had very low n-alkane concentrations. Most interestingly, the $\delta(2)$H values of the carbon autonomous plant organs leaves, sheaths and stems were in general depleted compared to the overall mean $\delta(2)$H value of a species, while non-carbon autonomous organs such as roots and inflorescences show $\delta(2)$H values that are higher compared to the overall mean $\delta(2)$H value of a species. We attribute organ-specific $\delta(2)$H values to differences in the H-NADPH biosynthetic origin in different plant organs as a function of their carbon relationships. Finally, we employed simple mass balance calculations to show that leaves are in fact the main source of n-alkanes in the sediment. As such, studies assessing the environmental and physiological drivers of n-alkanes that focus on leaves produce relationships that can be employed to interpret the $\delta(2)$H values of n-alkanes derived from sediments. This is despite the significant differences that we found among the $\delta(2)$H values in the different plant organs. Our study brings new insights into the natural variability of n-alkane $\delta(2)$H values and has implications for the interpretation of n-alkane $\delta(2)$H values in ecological and paleohydrological research.
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