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Hydrogen and carbon isotopic compositions of high-latitudinal plants in Paleocene and Eocene

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Interpretation of stable isotopic values from plants living in polar areas needs to take into account possible isotopic fractionations under the influence of the high latitudinal light regime. To test whether the pattern of plant carbon and hydrogen isotopic signals was influenced by the unique continuous light regime of the Arctic summer, we analyzed bulk carbon isotopes of leaf and wood tissues, and molecular carbon and hydrogen isotopes of homologous n-alkanes lipids, from living *Metasequoia* and *Taxodium* (Cupressaceae), and *Larix* (Pinaceae). We compared the results from plants grown under three months of continuous light (CL), a simulation of summer light regime in the high Arctic, with the same species grown under diurnal light (DL, 45^0N Lat) in a greenhouse with identical controlled temperature, light intensity, and CO_2 concentration.

The exquisitely preserved early Tertiary deciduous coniferous floras in the polar region of the Canadian Arctic Archipelago (paleolatitude $\sim 80^0$N) yield bulk C isotopes of leaf tissues and molecular C and H isotopic compositions of leaf waxes preserved *in situ* in *Metasequoia, Glyptostrobus, Pseudolarix,* and *Larix*. For all species bulk carbon isotopes were more negative under CL than under DL. In *Larix*, the offset was up to 4.6 ‰. In contrast, molecular carbon isotopic values of n-alkanes from leaves were 1.8‰ to 2.1‰ more positive under CL than under DL. Grown with source water of known δD (-65.6‰), compound-specific δD values of n-alkanes in leaves were, on average, 20‰ to 39‰ more enriched in CL than in DL. Depending upon individual compounds, the H isotopic fractionation factors between source water and n-alkanes (ε_{water}) ranged 43-64‰, 58-87‰, and 61-73‰ in leaves of *Metasequoia, Larix,*

and *Taxodium* respectively grown in CL. Isotopic offsets between CL and DL plants, and variations observed among different taxa, are likely to be a consequence of adaptive physiological characteristics (gas exchanges, chlorophyll fluorescence, carbohydrate concentration, and stomatal density) and can be explained by the differences in photosynthetic capacity and water use efficiency of individual plant taxa under different light conditions.