Goldschmidt 2024 Abstract
https://doi.org/10.46247/gold2024.22368

Diatom-derived highly branched isoprenoids and their carbon and hydrogen isotopes across a wide range of lakes are influenced by diatom community, metabolism, and lake water hydrogen isotopes

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Diatom-derived highly branched isoprenoids (HBIs) are well-preserved in lake sediments and the types of HBIs and their carbon and hydrogen isotopes have potential for reconstructing past environmental information, including lake C-metabolism and lake water evaporation. To expand on prior work, we collected lake surface sediment samples, water samples, and filtered photic zone water for ~50 lakes from the Great Plains, Midwest, and northeastern regions of the US. These lakes vary in their seasonal and annual temperatures, water chemistries (e.g., pH, salinity, ORP), sizes, depths, and trophic states. These lakes also vary widely in their diatom species assemblages. We characterized the HBI assemblages in each of the lakes and found 16 different HBI compounds from each of the major HBI skeletons including C_{20}, C_{25}, and C_{30} HBIs. We also identified C_{21} HBI in many of the lake sediments. Nearly all lakes contain C_{20} HBI, and when present, is usually the most abundant HBI compound. A few high salinity lakes did not contain C_{20} HBI. With a few exceptions, the HBI types and concentrations are independent of the diatom species assemblages. Based on this observation, we suggest there are many unrecognized groups of diatoms producing HBI compounds. We compared the δ^2Hvalues of C_{20} HBI to the δ^2H of lake water (lw) to explore using C_{20} HBIs as a lake water proxy for paleo applications. The C_{20} HBI hydrogen isotopic fractionation ($\varepsilon^2H_{HBI\text{-}lw}$) is largely consistent across the lakes with a mean of –133‰ (± 27‰, 1sd) with a few of these lakes having ε^2H values that could be considered outliers. These outlier lakes include some of the shallowest and/or highest trophic status, possibly suggesting that these lakes have unique HBI-producing species present. The δ^{13}C values of the C_{20} HBI is varies widely from –40.9 to –21.5‰, but is strongly correlated to the δ^{13}C of dissolved inorganic carbon (DIC). When this effect is removed, a correlation between $\delta^{13}C_{HBI}$ and $\varepsilon^2H_{HBI\text{-}lw}$ emerges, suggesting that changing lipid biosynthesis (MEP, MVA) explains some of the unexplained variance in $\varepsilon^2H_{HBI\text{-}lw}$ values, likely suggesting that species composition, lipid biosynthesis, and metabolism influence $\varepsilon^2H_{HBI\text{-}lw}$ values.