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Partitioning the sourcing of lake sediment organic matter using isotopic, elemental, and biomarker-based approaches

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Lake sediment organic matter is often a mixture of aquatic and terrestrial derived sources, and ascribing the ratio of these sources using elemental ratios (e.g., C/N) and carbon isotopes ($d^{13}C$) of bulk organic matter (OM) is challenging. Aquatic organic matter has a wide range in $d^{13}C$ values in many lakes because $d^{13}C$ values of the C-sources utilized by phytoplankton is dependent on many factors (e.g., DIC, CO_2 exchange, lake productivity). Additionally, terrestrial and aquatic sources may have similar $d^{13}C$ values and some organic matter sources have C/N ratios more closely resembling terrestrial OM. To explore these controls, we sampled 50 lakes across nine states and three ecoregions including Northern Forests, Eastern Temperate Forests, and the Great Plains. These lakes vary in their annual temperatures (2.6 to 9.9 ºC), water chemistries (e.g., pH, salinity, ORP), sizes (0.02 km^2 to 322 km^2), depths (1.6 to 38 m), and trophic states (oligotrophic to eutrophic). Sediment cores were collected using a gravity corer from the deepest point of each lake and the sediment-water interface to 5 cm was sampled. Lake water chemistry was analyzed including pH, salinity, water temperature, conductivity, ORP, light penetration (Secchi disc), chlorophyll concentration, DIC, and $d^{13}C_{DIC}$. Sediment samples were analyzed for $d^{13}C_{OM}$, C/N ratios, and concentrations and $d^{13}C$ values of terrestrial and aquatic biomarkers, including diatom-derived highly branched isoprenoids (HBIs), *n*-alkanes, and other source-specific biomarkers. We evaluated the carbon isotope systematics in each lake to estimate $d^{13}C$ values of aquatic C sources and used this in combination with the source specific biomarkers to evaluate the sediment OM sourcing. Many lakes had OM that was primarily aquatically sourced, but some lakes were dominated by terrestrial OM. Interestingly, pH (range of 5.1 to 8.9) was positively correlated with sediment C/N ratios, possibly reflecting the low pH of lakes in forested environments compared to high pH lakes that are high marl producers. We are working now to define the $d^{13}C$ values of aquatic OM sources using biomarkers, which will better characterize sediment OM sourcing.