Terrestrial dominance of organic matter in north temperate lakes

Grace M. Wilkinson,[1] Michael L. Pace,[1] and Jonathan J. Cole[2]

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[1] Aquatic ecosystems are hotspots of decomposition and sources of carbon dioxide to the atmosphere that are globally significant. Carbon exported from land (allochthonous) also supplements the carbon fixed by photosynthesis in aquatic ecosystems (autochthonous), contributing to the organic matter (OM) that supports aquatic consumers. Although the presence of terrestrial compounds in aquatic OM is well known, the contribution of terrestrial versus aquatic sources to the composition of OM has been quantified for only a handful of systems. Here we use stable isotopes of hydrogen and carbon to demonstrate that the terrestrial contribution (Φ_{Terr}) to particulate organic matter (POM) is as large or larger (mean = 54.6% terrestrial) than the algal contribution in 39 lakes of the northern highlands region of Wisconsin and Michigan. Further, the largest carbon pool, dissolved organic matter (DOM), is strongly dominated by allochthonous material (mean for the same set of lakes approximately 100% terrestrial). Among lakes, increases in terrestrial contribution to POM are significantly correlated with more acidic pH. Extrapolating this relationship using a survey of pH in 1692 lakes in the region reveals that, with the exception of eutrophic lakes, most of the OM in lakes is of terrestrial origin. These results are consistent with the growing evidence that lakes are significant conduits for returning degraded terrestrial carbon to the atmosphere.

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