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Dissolved and particulate organic matter source-age characterization in the upper and lower Chesapeake Bay: A combined isotope and biochemical approach

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ABSTRACT: In order to characterize the sources and ages of organic matter contributing to river and estuarine outflow waters, the present study investigated $\Delta^{14}C$ and $\delta^{13}C$ signatures of the major operationally defined biochemical classes of ultrafiltered dissolved organic matter (UDOM) in conjunction with lipid biomarker and elemental compositions of UDOM and suspended particulate organic matter (POM) in the Chesapeake Bay. Freshwater (Susquehanna River) UDOM was dominated by a molecularly uncharacterized (MUC) fraction, followed by total carbohydrate (TCHO), total hydrolysable amino acid (THAA) and total lipid (TLE) components. In contrast, UDOM at the bay mouth (salinity ~22-24) was comprised mainly of TCHO, followed by MUC, THAA, and TLE. The $\Delta^{14}C$ and $\delta^{13}C$ signatures of both UDOM and its major biochemical classes indicate that Susquehanna DOM is derived in part from old allochthonous terrestrial sources, whereas young marine sources dominate at the bay mouth. In contrast to the other biochemical classes, lipophilic DOM at both sites was very old (~5,000- 7,000 years B.P.). In addition, factor analysis of lipid biomarker compounds revealed unique signatures for the UDOM and POM pools that imply disparate source and/or recycling properties as well as potential influences due to physical partitioning. Lipid biomarker compounds showed that although autochthonous riverine/estuarine sources dominated both the UDOM and POM pools, terrigenous lipids were elevated in the Susquehanna during high flow conditions. The presence of lipid biomarkers diagnostic of "fresh" algal material in UDOM further suggested its greater reactivity than POM. The observed biochemical and lipid biomarker compositions and isotopic signatures of UDOM and POM are consistent with previous findings suggesting that these two major organic matter pools have dissimilar reactivities and cycling times, and they derive from comparatively unique source-age materials in rivers and estuaries.

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