Cycling of colloidal organic carbon and nitrogen during an estuarine phytoplankton bloom

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ABSTRACT: To establish the influence of phytoplankton blooms on the cycling of dissolved and particulate species of organic carbon and nitrogen, we conducted a field study during a series of blooms in a coastal embayment on Shelter Island, NY. Using cross-flow filtration, we collected high- and low-molecular-weight (HMW and LMW) dissolved organic matter (DOM), along with particulate organic matter (POM). There was a significant and near equivalent enhancement in levels of particulate organic carbon (POC) and dissolved organic carbon (DOC) during phytoplankton blooms. HMW organic carbon was responsible for most (80%) of the DOC increase. In contrast, substantial amounts of organic nitrogen were produced in all size fractions (particulate organic nitrogen [PON], HMW, and LMW) during blooms. POC:PON and HMW C:N ratios exceeded Redfield stoichiometry and were well correlated with chlorophyll concentrations, which suggests that phytoplankton were the primary source of C-enriched particles and colloids in this system. DOM C:N ratios were higher during periods of elevated nitrate than during low nitrate conditions, which were dominated by phytoplankton with heterotrophic capabilities. This suggests that, in some coastal systems, the accumulation of C-enriched organic matter may be more dependent on algal species composition than ambient inorganic nitrogen levels. After the collapse of algal blooms, bacterial densities rose markedly, and all organic pools rapidly decreased to near prebloom levels. Despite substantial production and turnover rates of HMW organic carbon during blooms, longer residence times of other, more refractory, organic carbon pools such as the LMW fraction indicated that considerable portions of organic matter produced during estuarine phytoplankton blooms may be exported to continental shelves.