Biomarker and carbon isotopic constraints on bacterial and algal community structure and functioning in a turbid, tidal estuary

Boschker, H. T. S., J. C. Kromkamp, J. J. Middelburg

Limnol. Oceanogr., 50(1), 2005, 70-80 | DOI: 10.4319/lo.2005.50.1.0070

ABSTRACT: We studied planktonic community structure and isotopic composition using compound-specific ^{13}C analysis of phospholipid-derived fatty acids (PLFA) along the Scheldt estuary during a spring bloom. A comprehensive set of other carbon cycle parameters was also determined. Based on dissolved carbon dioxide and oxygen concentrations and primary and bacterial secondary production, the trophic status of the estuary changed from strongly net heterotrophic in the upper to net autotrophic in the lower estuary. Concentrations of algal PLFA and pigments and microscopic identifications of dominant phytoplankton revealed the same trend: a mixed community of green algae and diatoms dominated the freshwater phytoplankton and there was a major diatom bloom at intermediate salinities. Bacterial biomass (also based on PLFA) was much lower for the diatom bloom in the lower estuary than in the net heterotrophic upper estuary. Carbon isotopic ratios of the main diatom marker PLFA, 20:5ω3, were mainly related to changes in $\delta^{13}C$ values of dissolved inorganic carbon and showed a residual variation of ~5‰, which is probably related to changes in growth conditions along the estuary. The green algal marker 18:3ω3 was much more depleted in ^{13}C than the diatom markers, suggesting that these two main phytoplankton groups use a different inorganic carbon source or carbon dioxide fixation mechanism. Isotopic ratios of the different bacterial PLFA detected were very similar and ranged between -30‰ and -21‰. They closely tracked $\delta^{13}CC$ values in particulate organic carbon (POC), indicating that POC or material with the same ^{13}C signature was the main bacterial carbon substrate. In the lower, marine side of the estuary, isotope ratios of bacterial and algal PLFA were similar, suggesting a coupling between primary production and bacterial consumption of organic matter. However, d13C values of bacterial PLFA in the upper estuary were enriched compared with algal PLFA (between 6‰ and 15‰), indicating an uncoupled algal-bacterial system with allochthonous subsidies, such as terrestrial C3 organic matter or sewage supporting bacterial growth.