Temporal decoupling of carbon and nitrogen dynamics in a mesocosm diatom bloom

Engel, Anja, Sarah Goldthwait, Uta Passow, Alice Alldredge

Limnol. Oceanogr., 47(3), 2002, 753-761 | DOI: 10.4319/lo.2002.47.3.0753

ABSTRACT: Flows of the major biogeochemical elements (C, N, P, Si) and of transparent exopolymer particles (TEP) were traced during a bloom of a natural assemblage of marine diatoms in a mesocosm (1 m^3) to determine whether the exudation and subsequent gelation of carbon-rich phytoplankton exopolymers can account for the formation and potential export of carbon in excess of that predicted by Redfield ratios. Exponential growth of the phytoplankton community in the mesocosm extended for 10 d until nitrate concentration fell below detection and concentrations of dissolved inorganic and particulate organic nitrogen and phosphorus remained stable. Tight covariation of particulate organic elements occurred as long as nutrients were replete. But, after nitrate depletion, decoupling of carbon dynamics from that of nitrogen and phosphorus was observed, with a large flow of carbon into TEP. An uptake of 72% more dissolved inorganic carbon (DIC) than inferred from nitrate supply and Redfield stoichiometry (referred to as carbon overconsumption) occurred during the study, largely during the postbloom phase, and was almost entirely traced to the particulate organic matter (POM) pool. Marine snow (aggregates >0.5 mm) appeared at the onset of nitrate depletion and coincided with rapid increase in TEP concentrations. Elemental composition of marine snow differed from the Redfield ratio by an enrichment in carbon and a depletion in phosphorus relative to nitrogen. It is suggested that sinking of TEP-rich marine snow could be a possible mechanism for export of carbon above calculations that are based on the Redfield stoichiometry.

Article Links

Download Full-text PDF

Return to Table of Contents