CHEMOTAXONOMIC IDENTIFICATION AND PHYSIOLOGICAL STATUS OF PHYTOPLANKTON IN THE NORTH PACIFIC SUBTROPICAL GYRE

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Giacomo Ruggiero DiTullio

Dissertation Committee:

Edward A. Laws, Chairman
David M. Karl
Satoru Taguchi
Paul K. Bienfang
Harry Y. Yamamoto

ABSTRACT

The physiological status of natural phytoplankton populations was assessed using ^{14}C labeling of total particulate carbon (PC), Chl *a*, and macromolecular compounds. The species composition of these phytoplankton communities in the oligotrophic gyre was determined using HPLC pigment analyses. Size fractionation techniques were performed to determine the contribution made by picoplankton to the total depth-integrated PC and PN production rates. High PC (506 ± 91 mg C m^{-2} d^{-1}) and PN (71 ± 11 mg N m^{-2} d^{-1}) production rates were recorded using trace-metal free techniques. Cyanobacterial production accounted for 39-47% of the total gross primary production rate in the upper euphotic zone (0-40 m). "New" production rates ranged from 12 to 32% of total production.

A spring storm which passed through our study site (26°N 155°W) on April 4-12, 1986, enabled us to investigate the effects of a storm on phytoplankton growth dynamics. The storm caused areal phytoplankton biomass to double. During the storm, large increases in chlorophytes, prymnesiophytes, and chrysophytes were detected near the base of the photic zone, relative to pre-storm levels. Dinoflagellate concentrations also increased in the lower photic zone, but only after the storm period. In contrast, cyanobacteria decreased progessively during and after the storm period. Incorporation of ^{14}C into Chl a and protein indicated that phytoplankton populations in the North Pacific Subtropical Gyre were rapidly growing at rates of ~1 dbls/d with a relative growth rate of ~75% μ_m. Phytoplankton growth rates doubled during the storm period.

The picoplankton (< 1μm) population was responsible for 61 ± 12% of the the total depth-integrated (to 150m) N-assimilation rate. Storm-induced transport of nitrate across the pycnocline resulted in a 72% increase in the integrated submicron N-assimilation rate, relative to the pre-storm rate. Inhibitor experiments revealed that the cyanobacterial N-assimilation rate did not increase as a result of the storm. It is hypothesized that the eukaryotic picoplankters were responsible for "outcompeting" the cyanobacteria for uptake of the nitrate pulse. These results suggest that cyanobacteria may be dependent upon regenerated NH_4^+ for the majority of their nitrogenous nutrition. In contrast, eukaryotic picoplankters appear to be able to rapidly and efficiently assimilate "new" nitrogen, a fact which may partially explain their dominance near the nitracline.

Field testing of the protein labeling technique indicated that the percentage of labeled protein was neither biased by grazing processes nor by heterotrophic assimilation of DON compounds and hence appears to be a valid method for estimating phytoplankton N-assimilation and relative growth rates in the open ocean.