



Decrease in molecular weight of photosynthetic products of marine phytoplankton during early diagenesis

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ABSTRACT: Changes in the size and neutral aldose (NAld) composition of phytoplankton photosynthetic products during the early diagenetic process were experimentally examined using ^{13}C as a tracer. Most (94.7%) of the photosynthetically produced (P-) organic carbon (OC) was found to be particulate organic carbon (POC) after a 12-h light incubation. An increase in the concentration of P-dissolved organic carbon (DOC) was found after the shift to the dark incubation, probably due to a leakage of cellular constituents. An increase in the concentration of P-DOC was mainly due to an increase in the high molecular weight (HMW: >10 kDa) fraction that reached its maximum concentration on day 3 and then declined at a relatively high rate. The change in the concentration of the low molecular weight (LMW: <10 kDa) DOC fraction was less marked than that in the HMW fraction, and the rate of decrease was much slower, indicating a more biorefractory nature of P-LMW DOC. P-dissolved carbohydrates (DCHO) accounted for 38% and 50% in P-HMW DOC and P-LMW DOC, respectively, after a 12-h light incubation. The concentration of P-LMW DCHO showed a rapid decrease in the early stage of the dark incubation, whereas the concomitant increase in the concentration of P-LMW dissolved noncarbohydrate (DnonCHO) was noticed. The decrease in the contribution of CHO was noticed both in P-POC and P-HMW DOC fractions, but the decline rates were slower than that in P-LMW DOC fraction. On day 60, the remaining P-OC accounted for 4.6% of photosynthetic material originally produced. The distribution of the size fractions of the remaining P-OC on day 60 (POC, 14%; HMW DOC, 22%; LMW DOC, 64%) indicates that phytoplankton photosynthetic products were rapidly degraded to the less bioreactive LMW DOM during early diagenesis. The present results indicate that the annual global ocean production rate of semilabile DOC with lifetimes exceeding 2 months is 1.91 PgC yr^{-1} .

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