Dissolved inorganic carbon sources for epipelagic algal production: Sensitivity of primary production estimates to spatial and temporal distribution of $^{14}$C

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Abstract

Estimates of epipelagic algal primary production using $^{14}$C are sensitive to whether the presumptive source of dissolved inorganic carbon (DIC) is the overlying water, the interstitial water, or both. To determine the source of DIC, we compared $^{14}$C uptake among intact sediment cores exposed to different $^{14}$C ratios between interstitial and overlying water. In addition, we evaluated the effect of varying time between addition of $^{14}$C and light incubation (preincubation time) and the effect of photosynthetic uptake on final distribution of $^{14}$C. Both preincubation time and photosynthetic uptake affected final $^{14}$C distribution, but the magnitude of the photosynthesis effect was larger. Estimates of primary production ranged between 50 and 200 mg C m$^{-2}$ h$^{-1}$, depending on the presumed DIC source and whether we accounted for differential photosynthetic depletion of $^{14}$C and DIC. Using nonlinear regression, our best estimate of epipelagic production was 114 mg C m$^{-2}$ h$^{-1}$, and the fraction of DIC sequestered from overlying water was 0.5 ($R^{2} = 0.84$). Similar assessments should be applied in other systems for accurate $^{14}$C estimates of epipelagic algal production.