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Documentation of primary production measurements

13. Primary production by 14C

Sylvie Mathot (ULB), Frank Jochem (IFM), Bernard Quéguiner (IEM)

Primary Production

Frank Jochem
{PPML.TOTPP, PPML.PP>20, PPML.PP5-20, PPML.PP2-5, PPML.PP<2}

Size-fractionated primary production from 12 hrs. in-situ incubation (stn 885 only) or 24 hrs. in-situ simulated deck incubation using neutral density filters in a seawater-cooled deck incubator (see below description by S. Mathot, ULB Bruxelles). Added activity = 50 µCi per 250 ml polycarbonate bottle; subsamples of 45 ml for measurements in size fractions of "total" (untreated), "<20" (net gauze), "<5" and "<2" (by 5.0 µm and 2.0 µm Nuclepore filters, respectively), fractionated subsamples filtered onto 0.2 µm membrane filters, dissolved in Lumagel SB and measured in a Beckman LS-1800 liquid scintillation counter. Two bottles treated with 1.5 x 10-5 nM DCMU were used as «dark bottles« and subtracted form the light bottle values. The unfractionated value {PPML.TOTPP} is the JGOFS variable and compatible with below {PP.Prim.Prod}.

Primary production

Sylvie Mathot
{PP.Prim.Prod}

Assessments according to JGOFS protocols with the exception of using deck incubators rather than in situ incubation. 250 ml samples were collected from depths closer to 100%, 70%, 45%, 22%, 10%, 4.5%, 1.5%, and 0.5% (neutral density screens) of incoming PAR. An additional sample was taken and kept in the dark as «dark bottle« for which then the value was subtracted from the values of the light bottles. Samples were incubated for 24 hours in the "*in-situ* simulated deck-incubator", in polycarbonate bottles with $NaH^{14}CO_3$ at a rate of 10µCi per 100 ml sample (Amersham, specific activity = 56 $mCi.mmol^{-1}$).

Samples were filtered on Whatman GF/F filters at the end of incubation time. Two drops of HCl 0.5N were added to the filters to release unassimilated $^{14}CO_2$. Scintillation cocktail was added to the filters prior to their radioactivity assaying in a Packard 1900CA Tri-Carb Liquid Scintillation Counter. Occasionally, size-fractionation was also performed onto 10µm and 0.8µm Poretics filters.

Photosynthetic assimilation rate, phytoplankton growth and respiration.

Sylvie Mathot
{PP.AssimRT, Phyto.GrowthRT}

This project was done in relation with above "Phytoplankton: chlorophyll, proteins, lipids, carbohydrates", see section 12. The experimental determination of physiological parameters characteristic of phytoplankton involved two kind of tracer experiments conducted in parallel under simulated *in-situ* conditions. For all these incubations, 100 to 250 ml seawater sample, which amount

was chosen according to phytoplankton biomass, were incubated in polycarbonate bottles with $NaH^{14}CO_3$ at a rate of 10µCi per 100 ml sample (Amersham, specific activity = 56 $mCi.mmol^{-1}$).

Experimental determination of photosynthetic parameters involved short-term (4 hours) ^{14}C incubations (based on the Steemann-Nielsen standard method), performed at various fractions of light intensity, either in an "*in-situ* simulated inside incubator" (0, 1, 4, 6, 10, 15, 20, 30, 40, 60, 80, 100%; Philips 500W halogen lamps) or in an "*in-situ* simulated deck-incubator" (0, 0.5, 1.5, 4.5, 10, 22, 45, 70, 100% of incoming PAR), both cooled by running seawater. Filters were treated as described above. Photosynthetic parameters K_{max}, a, and b were calculated by mathematical fitting of the data relative to the photosynthesis-light relationship using Platt et al.'s equation (1980).

Experimental determination of phytoplankton growth (net primary production) and respiration parameters was performed through long-term (24 hours) light-dark kinetics of ^{14}C assimilation into 4 pools of cellular constituents easily separable by biochemical procedure: small metabolites (composed of monomeric precursors for the synthesis of macromolecular compounds), lipids and polysaccharides (constituting together the reserve products of the phytoplankton cell), and proteins. Incubations were conducted at *in-situ* temperature under saturating illumination (100-170 $\mu E.m^{-2}.s^{-1}$). The light-dark cycle was fixed at 14:10 to simulate environmental conditions. Two drops of HCl 0.5N were added to the filters to release unassimilated $^{14}CO_2$. Scintillation cocktail was added to the filters prior to their radioactivity assaying in a Packard 1900CA Tri-Carb Liquid Scintillation Counter. Occasionnally, size-fractionation was also performed onto 10µm and 0.8µm Poretics filters. Filters for biochemical fractionations were kept frozen until analysis in the home laboratory. Details on experimental procedure and biochemical fractionation are described in Lancelot and Mathot (1985). Phytoplankton growth and respiration parameters were estimated by mathematical fitting of the data relative to the kinetics assimilation of ^{14}C into proteins and storage products, using the equations described in Lancelot et al. (1991).

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Carbon primary production (in relation to project 24.)
Bernard Quéguiner
{Biog.Si.PP}

250-ml samples were collected from depths closer to 100%, 25%, 10%, 3%, 1% and 0,1% incident PAR. Samples were spiked with 10µCi (370 kBq) $NaH^{14}CO_3$ and incubated during 24-h in a deck incubator maintained at sea surface temperature. Just after spiking, 100 ml is removed and immediately counted by liquid scintillation to determine the specific activity of each sample. After incubation samples were filtered onto 0.4 µm Nuclepore filters. Non-incorporated $NaH^{14}CO_3$ remaining on the filter is eliminated by adding a few ml of 0.01 N HCl in 0.4 µm-filtered seawater. Filters were then counted by liquid scintillation method.

14. Primary production by O_2

Frank Jochem (IFM), Rinus Manuels (NIOZ)

Except for one in situ incubation at drift station no data.