

Trap Flux from R/V Oceanus cruises OC399-03, OC408-01, OC408-02 from the Northwestern Sargasso Sea roughly 35-28N and 58-68W, water depths always exceeded 4200m; 2004-2005 (NP project)

Website: <https://www.bco-dmo.org/dataset/3215>

Version: 03Sept2009

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Project

» [New Production During Winter Convective Mixing Events](#) (NP)

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Dataset Description

New Production - Particle Interceptor Trap (PIT) Flux

Methods & Sampling

Detailed methods for all data collected as part of this study can be found in one of the three publications arising from this study (references given below). This contains information on analytical machines and certified standards where applicable.

Sample QA/QC procedures followed those of the Bermuda Atlantic Time-series Study (BATS). At the point of collection, any leaking niskin bottles were noted on the master cast sheets and samples were taken from a different niskin fired at the same depth as the leaking bottle. No data are reported for leaking Niskin bottles. During sample analysis standard curves and/or certified standards were carefully examined to ensure that they were consistent with expectations and accurate. Next, data were plotted as depth profiles and compared to a quality control window for the February/March period at BATS. The QC window consisted of the upper and lower 95% confidence limits based upon all data collected at BATS during February/March from 1989-2005. If our data

fell well within these bounds it was considered 'acceptable'. For those data that fell near or outside the QC window, we went back to the original data run to ensure there was no miscalculation or other error. If nothing was found, then we examined other data from that Niskin to see if other samples are in question. If no obvious error or problem was found, the data were considered OK and in the range of extremes that this study hoped to observe.

Sample accuracy and precision. Sample accuracy was assessed by using certified standards, for those measurements where standards are available (dissolved oxygen, nutrients, salinity, dissolved inorganic and organic carbon). Certified standards were run with each analytical run and compared to long term control charts for respective analyses. Samples were not run until certified standards were shown to be accurate for that analytical run. Sample precision was determined by analyzing replicate samples (not replicate analyses on the same sample) and therefore is higher than analytical precision due to the inclusion of sampling error. At the concentrations observed during this study, sample precision was <5% for stock measurements and <10-15% for rate measurements. Some analyses, namely dissolved oxygen and salinity, were much better and often had a sample precision <1%. These precision estimates are consistent with the long term QA/QC seen with the BATS program.

The provided data files are complete matrices and therefore not every sample (columns) will be taken from every Niskin fired (rows). Data that were either not collected, or were associated with leaking Niskins, or were found to be in error for other reasons are denoted by "-nd" in the spreadsheets.

References:

Detailed information on phytoplankton analysis.

Lomas, M.W., Roberts, N., Lipschultz, F., Krause, J.W., Nelson, D.M., and Bates, N.R. 2009. Biogeochemical responses to late-winter storms in the Sargasso Sea. IV. Rapid succession of major phytoplankton groups. *Deep Sea Research I*, 56: 892-909. doi:10.1016/j.dsr.2009.03.004

Detailed information on all silica cycle measurements.

Krause, J.W., Nelson, D.M., and Lomas, M.W. 2009. Biogeochemical responses to late-winter storms in the Sargasso Sea. 2009. II. Increased rates of biogenic silica production and export. *Deep Sea Research I*, 56: 861-875. doi:10.1016/j.dsr.2009.01.002

Maiti, K., Benitez-Nelson, C.R., Lomas, M.W., and Krause, J. W. 2009. Biogeochemical responses to late-winter storms in the Sargasso Sea. IV. Comparison of Export Production by ²³⁴Th and Sediment Traps.

Deep Sea Research I, 56: 875-892. doi:10.1016/j.dsr.2009.01.008

Detailed information on general biogeochemical measurements.

Lomas, M.W., Lipschultz, F., Nelson, D.M., and Bates, N.R. 2009. Biogeochemical responses to late-winter storms in the Sargasso Sea. I. Pulses of new and primary production. *Deep Sea Research I*, 56: 843-861. doi:10.1016/j.dsr.2008.09.002

Data Processing Description

Most of the data given in this dataset are not derived variables and are calculated using reasonably standard equations as given in the appropriate reference above. The one exception is CTD data. Raw CTD data were processed using SBE-Data Processing software using configuration and calibration files provided by the Shipboard Science technician. Sensors were calibrated shortly before each cruise, however, most sensor data were 'calibrated' using data collected in this project. Manual determinations of dissolved oxygen, salinity and HPLC Chlorophyll a, once passing the above QA/QC steps, were taken as correct. CTD sensor data was regressed against the appropriate manual variable. In all cases save 1, regression statistics were very strong and linear, and represent an offset (y-intercept) and drop in sensitivity (slope of the regression). CTD data were corrected to manual measurements using the regression data and it is this corrected data that is given in the associated data files. OCE399-3 had a problem with the dissolved oxygen sensor that could not be resolved so only manual oxygen data are reported for that cruise.

Only nutrient analyses were close to analytical method detection limits (MDL). MDLs were estimated as 3x the standard deviation of the lowest standard used for the analysis and are 1.5nM for nitrate and nitrite using a standard autoanalyzer with a 1m fiber optic flow cell, ~20nM for phosphate on a standard autoanalyzer, and <100nM for Si(OH)₄ by manual analysis and a 10cm cuvette. Samples below the MDL are reported as calculated

for the reason that they somewhere between the MDL and a true zero; we consider listing them as either to be incorrect. Carbon productivity rate measurements, particularly at the base of the euphotic or below, on occasion are negative due to subtraction of the dark incubated sample from the light incubated sample. This was not considered below the MDL because there is a reasonable explanation for negative values. These measurements were ~14h deployments and it is possible that at very low light there can be less 14C in the light bottles due to grazing, than in the dark bottles that are subtracted from the light bottles. Moreover, light and dark respiration rates are not the same and therefore this correction is not a perfect correction for inherent respiration by the autotrophs.

BCO-DMO Edits

- Parameter names modified to conform to BCO-DMO convention
- Cruiseld, date, time, lat, lon added from event log

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Data Files

File
Trap_Flux.csv (Comma Separated Values (.csv), 1.91 KB) MD5:4fd2dd85040996a6a53915758bd0752c
Primary data file for dataset ID 3215

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Parameters

Parameter	Description	Units
Cruiseld	Cruise Id	text
station	CTD drop number	integer
date	date operation occurred (GMT)	YYYYMMDD
time	time operation occurred (GMT)	HHMM
lon	Longitude position (West is negative)	decimal degrees
lat	Latitude position (South is negative)	decimal degrees
year	year of cruise	YYYY
deployment	PITS spar deployment number	integer
depth	depth where particle interceptor trap was suspended	meters
POC	particulate organic Carbon	millimoles/meter ² /day
PON	particulate organic Nitrogen	millimoles/meter ² /day
PSi	particulate Silicate	millimoles/meter ² /day

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Instruments

Dataset-specific Instrument Name	Particle Interceptor Trap
Generic Instrument Name	Sediment Trap - Particle Interceptor
Dataset-specific Description	MLML Particle Interceptor Sediment Trap (MLML = Moss Landing Marine Laboratory)
Generic Instrument Description	A Particle Interceptor Trap is a prototype sediment trap designed in the mid 1990s to segregate 'swimmers' from sinking particulate material sampled from the water column. The prototype trap used 'segregation plates' to deflect and segregate 'swimmers' while a series of funnels collected sinking particles in a chamber (see Dennis A. Hansell and Jan A. Newton. September 1994. Design and Evaluation of a "Swimmer"-Segregating Particle Interceptor Trap, Limnology and Oceanography, Vol. 39, No. 6, pp. 1487-1495).

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Deployments

OC399-03

Website	https://www.bco-dmo.org/deployment/57994
Platform	R/V Oceanus
Report	http://data.bco-dmo.org/NewProduction/NP_Cruise_report_Oceanus399-03.pdf
Start Date	2004-02-15
End Date	2004-03-15
Description	New Production During Winter Convective Mixing Events: A Missing Component of Current Estimates Cruise Summary In 2004 the New Production research group conducted a 30-day research cruise in the Sargasso Sea from February 15th to March 15th. The primary objective of this cruise was to study the biological response to the passage of winter storms. From Julian Day 66.5 to 74, we 'caught' a significant storm event and were indeed able to follow the biological response. Original cruise data are available from the NSF R2R data catalog

OC408-01

Website	https://www.bco-dmo.org/deployment/57995
Platform	R/V Oceanus
Report	http://data.bco-dmo.org/NewProduction/NP_Cruise_report_Oceanus408-1and2.pdf
Start Date	2005-02-15
End Date	2005-03-04
Description	New Production During Winter Convective Mixing Events: A Missing Component of Current Estimates Original cruise data are available from the NSF R2R data catalog

OC408-02

Website	https://www.bco-dmo.org/deployment/57996
Platform	R/V Oceanus
Report	http://data.bco-dmo.org/NewProduction/NP_Cruise_report_Oceanus408-1and2.pdf
Start Date	2005-02-15
End Date	2005-03-16
Description	New Production During Winter Convective Mixing Events: A Missing Component of Current Estimates Note the break in the cruise was due to the loss of the CTD. Returned to Bermuda to pick up a spare CTD that had been flown in from WHOI. Original cruise data are available from the NSF R2R data catalog

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Project Information

New Production During Winter Convective Mixing Events (NP)

Website: http://www.bios.edu/Labs/pel/Research%20Pages/Research_NP.html

Coverage: Northwestern Sargasso Sea roughly 35-28N and 58-68W. Water depths always exceeded 4200m

New Production During Winter Convective Mixing Events: A Missing Component of Current Estimates

Daily biogeochemical data collected during winter convection in the Sargasso Sea.

Photosynthetic uptake of CO₂ by oceanic phytoplankton and the export of the resulting organic carbon to the deep sea comprise a 'biological pump' (Volk and Hoffert, 1985), capable of extracting globally significant amounts of CO₂ from the atmosphere. As a consequence, it is important from the perspective of the global carbon cycle to understand both the present efficiency and the main controlling mechanisms of this important carbon pathway. In the open ocean the biological pump is driven by new production of organic matter (production supported by externally supplied nutrients) and export of that organic matter to depth. Many methods have been employed to estimate new production, with varying degrees of agreement.

In the Sargasso Sea, for example, geochemical estimates of new production largely exclude the winter mixing period (because their fundamental assumption are valid only during stratified periods). Biological methods suggest that the pre-stratification period can be as important, in terms of new production, as the remainder of the year. Those biological estimates are poorly constrained and based on sparse data. Because of the enormous spatial extent of subtropical gyres similar to the Sargasso Sea, uncertainty in the rate of new production and organic matter export in those systems leads to large uncertainty in biologically-driven carbon fluxes at the global-scale.

Short-term stochastic events are increasingly recognized as being disproportionately important for biogeochemical cycling and carbon storage in the ocean. Recent data suggest that in the Sargasso Sea, the passage of weather fronts leads to increased new production during the winter mixing period. We hypothesize that these events lead to enhanced NO₃-input, followed by a rapid biological response and accumulation of biomass, and an equally rapid export of that biomass. This rapid export may be systematically missed by the 3-4 day particle trap deployments of the Bermuda Atlantic Time-series Study (BATS) because they are hypothesized to happen during or immediately after the passage of frontal systems, when the vessel used for the BATS sampling program does not leave port. Such events have, however, been captured as increases in the fluorometer traces at the Bermuda Testbed Mooring (BTM) and increases in organic carbon flux in the continuous Ocean Flux Program (OFP) sediment traps, both of which are deployed in the Sargasso Sea near Bermuda

We propose a process-oriented study of new production and its control during the period before formation of the seasonal thermocline in the BATS/BTM/OFP region near Bermuda. This study will be conducted during two 30-day cruises (one in 2004 and one in 2005) during the winter mixing period when the passage of these

fronts is most common and when few data are available to constrain new production estimates. It will be crucial for this study to sample from a fully weather-capable research vessel, which can stay out and continue operations through most winter storms. We will use direct measurements of NO₃-entrainment, NO₃-uptake, phytoplankton community structure change, and dissolved and particulate organic matter export to elucidate the linkages between new production and export production as well as determine the main biological responses to short-term physical forcing. Particular emphasis will be placed on biogeochemically critical phytoplankton groups such as diatoms and coccolithophorids, which can exploit transiently favorable conditions of the kind we hypothesize to occur in late winter/early spring and which play a disproportionately large role in organic-matter export in many systems.

An understanding of ocean function is no longer important just to practicing ocean scientists. This project will provide information critical for biogeochemical modelers seeking to constrain future predictions of changes in the oceanic biological pump, and will also provide information of interest to students, teachers and the general public.

If in fact a significant, and previously unmeasured, amount of new production occurs in subtropical gyres during the winter mixing period, then biological processes in the central oceans play a greater role in the global carbon cycle - including regulation of atmospheric CO₂ - than we recognize at present. Regardless of whether or not our study shows that this is the case, we will explain the results and their implications to graduate and undergraduate courses through the teaching programs at BBSR and OSU, to high-school and elementary-school teachers through a targeted teacher-training program at BBSR and to the broader public in seminars and other public presentations.

Related files

[OC399-3 Cruise Report](#)
[OC408-1,2 Cruise Report](#)

References:

Detailed information on phytoplankton analysis.

Lomas, M.W., Roberts, N., Lipschultz, F., Krause, J.W., Nelson, D.M., and Bates, N.R. 2009. Biogeochemical responses to late-winter storms in the Sargasso Sea. IV. Rapid succession of major phytoplankton groups. *Deep Sea Research I*, 56: 892-909.
doi:10.1016/j.dsr.2009.03.004

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doi:10.1016/j.dsr.2009.01.002

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Deep Sea Research I, 56: 875-892.
doi:10.1016/j.dsr.2009.01.008

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Funding

Funding Source	Award
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