POM concentrations for carbon, nitrogen, and phosphorus from GO-SHIP Line C13.5/A13.5 in 2020

Website: https://www.bco-dmo.org/dataset/868908
Data Type: Cruise Results
Version: 1
Version Date: 2022-01-31

Project
» Convergence: RAISE: Linking the adaptive dynamics of plankton with emergent global ocean biogeochemistry (Ocean Stoichiometry)

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Abstract
This dataset includes particulate organic matter (POM) concentrations for carbon, nitrogen, and phosphorus. Data are from samples collected from NOAA Ship R/V Ronald H. Brown (cruise EXPOCODE: 33RO20200321), acting under the auspices of the Global Ocean Ship-based Hydrographic Investigations Program (GO-SHIP), A13.5 GO-SHIP/CO2 Repeat Hydrography Cruise in 2020.

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Coverage

Spatial Extent: **N**:34.5045 **E**:17.3055 **S**:-41.4917 **W**:-73.507
Temporal Extent: 2020-03-21 - 2020-04-16

Methods & Sampling

POM sample collection:
General equipment preparation in the lab before shipment included an HCl bath (1.0 M HCl overnight) and milli-Q rinse for the 8 L carboys, tubing, and filter holders. Additionally, the carboys were autoclaved. The 25 mm, 0.7 µm GF/F filters and aluminum foil used to wrap the filters were combusted (500 °C for 5 hours) in aluminum foil packets to remove any traces of carbon present. The forceps that came in contact with the samples were wiped with 70% ethanol before and between uses. Seawater for the POM samples was collected from the onboard flow through underway system. The underway intake was located off the bow of the ship at a depth of approximately 5.3 m from the sea surface and the length of the pipe from the intake location to the output lab was 11.8 m. A 30 µm nylon mesh pre-filter was attached to the underway outlet for all standard

samples to remove large plankton and particulates. Before sampling, the carboys used were rinsed twice with the pre-filtered underway seawater. Triplicate sampling occurred roughly at four-hour intervals with a shift forward of one hour each day. For example, if samples were taken at 01:00, 05:00, and 09:00 on one day, samples would be taken at 02:00, 06:00, and 10:00 the following day to avoid any diurnal bias. The water was vacuum filtered through combusted GF/F filters and the volume of seawater filtered was determined on a per station basis, ranging from 3-8 L. The volume was raised if the previous stations' filtration times exhibited a decreasing trend and lowered if filtration time exhibited an increasing trend in an attempt to normalize the amount of collected material. The large sampling volume and initial rinsing steps limit the effect of a time delay from underway inlet to sampling station. After filtration, all POP triplicates were rinsed with approximately 2-5 mL of a 0.17 M Na2SO4 solution to remove dissolved phosphorus. All POM samples were folded in half with the top sides toward each other, sealed inside pieces of combusted aluminum foil, and stored in a -20 C freezer until analysis.

POP assay:
The POP data were obtained using an ash/hydrolysis method and comparing the samples to a set of standard phosphorus concentrations (Lomas et al., 2010, *Biogeosciences*, **7**(2), 695-710, doi:10.5194/bg-7-695-2010). The sample filters were unfolded and placed face up into acid-bathed and combusted scintillation vials. Along with each set of samples, 10 different volumes (ranging 0 - 0.5 mL) of 0.1 M KH2PO4 solution were added to scintillation vials. 2 mL of a 0.017 M MgSO4 drying solution was added to each scintillation vial and then all vials were placed into an 80-90 °C oven overnight to dry. After drying, the vials were heated at 500 °C for 2 hours, then left to cool before adding 5 mL of 0.2 M HCl to each vial and being returned to the 80-90 C oven for 30 minutes after being brought up to temperature. The solutions were then transferred to 15 mL glass centrifuge tubes (prepared in the same way as the scintillation vials). The sample vials were rinsed with 5 mL of milli-Q each, which was also added to the centrifuge tubes. 1 mL of a mixed reagent containing 2:5:1:2 parts Ammonium Molybdate ((NH4)6Mo7O24), 5.0 N H2SO4, Potassium Antimonyl Tartrate (C8H4K2O12Sb2), and Ascorbic Acid (C6H8O6) respectively was added to each centrifuge tube in 30-second intervals. Each of the sample tubes was centrifuged to isolate any glass fibers that could interfere with the absorbance reading. Lastly, after allowing the mixed reagent to react for exactly 30 min, the standards and samples were analyzed in 30-second intervals in a spectrophotometer at an 885 nm wavelength using a blank of ~0.1 M HCl solution and rinsing the cuvette with the blank solution between measurements.

POC/PON assay:
POC and PON measurements were analyzed both in-lab at UCI. The preparation for all samples was the same; the samples were each removed from their foil packets and placed into acid-bathed and combusted scintillation vials and dried in a 55 °C oven overnight. The scintillation vials were then placed in a desiccator containing a beaker of 12 M HCl overnight before being dried at 55 °C at least overnight once more. Samples sent to UCSB were then capped and shipped to the lab. Samples analyzed at UCI were packed into tin packets alongside Atropine (C17H23NO3) standards (ranging 0.2-1.5 mg) and measured using a Flash EA elemental analyzer.

Associated GO-SHIP A13.5 underway and bottle datasets can be found on the CLIVAR and Carbon Hydrographic Data Office Section A13.5 homepage: https://cchdo.ucsd.edu/cruise/33RO20200321

Data Processing Description

Data Processing:
Matlab v2021a and R4.1.0 were used for data processing and wrangling.
Blank values in this dataset are displayed as "nd" for "no data."

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Data Files

File
C13_5_A13_5_POM.csv (Comma Separated Values (.csv), 13.47 KB) MD5:f2d51fe458e4437d0c5ec9bb745fc3a7
Primary data file for dataset ID 868908

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Related Publications

Barbero, L. (2020). A13.5 2020 (partial) [Data set]. CCHDO: CLIVAR and Carbon Hydrographic Data Office. https://doi.org/10.7942/C2894Z
IsRelatedTo

Fagan, A. J., Larkin., Garcia, N. S., Martiny A. C. (in prep) Regional Variability of Particulate Organic Matter and Stoichiometric Ratios across the Atlantic Ocean.
Results

Lomas, M. W., Burke, A. L., Lomas, D. A., Bell, D. W., Shen, C., Dyhrman, S. T., & Ammerman, J. W. (2010). Sargasso Sea phosphorus biogeochemistry: an important role for dissolved organic phosphorus (DOP). Biogeosciences, 7(2), 695–710. doi:10.5194/bg-7-695-2010
Methods

Tanioka, T., Garcia, C., Larkin, A., Garcia, N., Fagan, A., & Martiny, A. (2022). Global patterns and drivers of C:N:P in marine ecosystems. https://doi.org/10.21203/rs.3.rs-1344335/v1
Results

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Parameters

Parameter	Description	Units
Sample	Sample identifier	unitless
Station	Station number	unitless
Latitude	Latitude; positive values = North	decimal degrees
Longitude	Longitude; positive values = East	decimal degrees
ISO_DateTime_UTC	Date and time of collection (UTC) in ISO8601 format yyyy-mm-ddTHH:MMZ	unitless
Vol_CN1	Filtration volume for POC and PON samples for replicate 1	liters (L)
Vol_CN2	Filtration volume for POC and PON samples for replicate 2	liters (L)
Vol_CN3	Filtration volume for POC and PON samples for replicate 3	liters (L)
Vol_POP1	Filtration volume for POP sample for replicate 1	liters (L)
Vol_POP2	Filtration volume for POP sample for replicate 2	liters (L)
Vol_POP3	Filtration volume for POP sample for replicate 3	liters (L)
POC_Rep1	Particulate organic carbon < 30 um for replicate 1	micromoles per liter (uM)
POC_Rep2	Particulate organic carbon < 30 um for replicate 2	micromoles per liter (uM)
POC_Rep3	Particulate organic carbon < 30 um for replicate 3	micromoles per liter (uM)
PON_Rep1	Particulate organic nitrogen < 30 um for replicate 1	micromoles per liter (uM)
PON_Rep2	Particulate organic nitrogen < 30 um for replicate 2	micromoles per liter (uM)
PON_Rep3	Particulate organic nitrogen < 30 um for replicate 3	micromoles per liter (uM)
POP_Rep1	Particulate organic phosphorus < 30 um for replicate 1	nanomoles per liter (nM)
POP_Rep2	Particulate organic phosphorus < 30 um for replicate 2	nanomoles per liter (nM)
POP_Rep3	Particulate organic phosphorus < 30 um for replicate 3	nanomoles per liter (nM)

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Instruments

Dataset-specific Instrument Name	CN FlashEA 1112 Elemental Analyzer (Thermo Scientific, Waltham, Massachusetts)
Generic Instrument Name	Elemental Analyzer
Generic Instrument Description	Instruments that quantify carbon, nitrogen and sometimes other elements by combusting the sample at very high temperature and assaying the resulting gaseous oxides. Usually used for samples including organic material.

Dataset-specific Instrument Name	Genesys 10vis spectrophotometer (#840-208100, Thermo Scientific, Waltham, Massachusetts)
Generic Instrument Name	Spectrophotometer
Generic Instrument Description	An instrument used to measure the relative absorption of electromagnetic radiation of different wavelengths in the near infra-red, visible and ultraviolet wavebands by samples.

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Deployments

RB2002

Website	https://www.bco-dmo.org/deployment/868934
Platform	NOAA Ship Ronald H. Brown
Start Date	2020-03-21
End Date	2020-04-17
Description	Location: Meridional section through the Eastern part of the South Atlantic (N: 34.5044 E:17.3055 S:-41.4917 W:-73.51) Ports: Cape Town, South Africa to Norfolk, VA Website: https://www.aoml.noaa.gov/ocd/gcc/A13.5_2020/ CLIVAR and Carbon Hydrographic Data Office (CCHDO) Section A13.5 homepage: https://cchdo.ucsd.edu/cruise/33RO20200321, https://doi.org/10.7942/C2894Z

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Project Information

Convergence: RAISE: Linking the adaptive dynamics of plankton with emergent global ocean biogeochemistry (Ocean Stoichiometry)

NSF Award Abstract:
Due to their sheer abundance and high activity, microorganisms have the potential to greatly influence how ecosystems are affected by changes in their environment. However, descriptions of microbial physiology and diversity are local and highly complex and thus rarely considered in Earth System Models. Thus, the researchers focus on a convergence research framework that can qualitatively and quantitatively integrate eco-evolutionary changes in microorganisms with global biogeochemistry. Here, the investigators will develop an approach that integrates the knowledge and tools of biologists, mathematicians, engineers, and geoscientists to understand the link between the ocean nutrient and carbon cycles. The integration of data and knowledge from diverse fields will provide a robust, biologically rich, and computationally efficient prediction for the variation in plankton resource requirements and the biogeochemical implications, addressing a fundamental challenge in ocean science. In addition, the project can serve as a road map for many other research groups facing a similar lack of convergence between biology and geoscience.

Traditionally, the cellular elemental ratios of Carbon, Nitrogen, and Phosphorus (C:N:P) of marine communities have been considered static at Redfield proportions but recent studies have demonstrated strong latitudinal variation. Such regional variation may have large - but poorly constrained - implications for marine biodiversity, biogeochemical functioning, and atmospheric carbon dioxide levels. As such, variations in ocean community C:N:P may represent an important biological feedback. Here, the investigators propose a convergence research framework integrating cellular and ecological processes controlling microbial resource allocations with an Earth System model. The approach combines culture experiments and omics measurements to provide a molecular understanding of cellular resource allocations. Using a mathematical framework of increasing

complexity describing communicating, moving demes, the team will quantify the extent to which local mixing, environmental heterogeneity and evolution lead to systematic deviations in plankton resource allocations and C:N:P. Optimization tools from engineering science will be used to facilitate the quantitative integration of models and observations across a range of scales and complexity levels. Finally, global ocean modeling will enable understanding of how plankton resource use impacts Earth System processes. By integrating data and knowledge across fields, scales and complexity, the investigators will develop a robust link between variation in plankton C:N:P and global biogeochemical cycles.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1848576

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