POM concentrations for carbon, nitrogen, and phosphorus from GO-SHIP Line I07N RB1803 in the Western Indian Ocean from April to June 2018 (Ocean Stoichiometry Project)

Website: https://www.bco-dmo.org/dataset/879076
Data Type: Cruise Results
Version: 1
Version Date: 2022-08-24

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: 33RO20180423), acting under the auspices of the Global Ocean Ship-based Hydrographic Investigations Program (GO-SHIP), I07N GO-SHIP/CO2 Repeat Hydrography Cruise in 2018.

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Coverage

Spatial Extent: **N**:17.9987 **E**:69.4832 **S**:-30.0118 **W**:40.0075
Temporal Extent: 2018-04-25 - 2018-06-04

Dataset Description

The operating area was in the western Indian Ocean. The I07N section runs across the Madagascar and Mascarene Basins in the south, crosses the Amirante Trench, and after the Seychelles Bank it crosses the Somalia Basin, Carlsberg Ridge, and the Arabian Sea in the north.

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 the underway system. Before sampling, the carboys used were rinsed twice with the pre-filtered underway seawater.

POM samples smaller than < 30µmwere collected hourly and at noon samples were collected in triplicate. 30 µm nylon mesh pre-filter was attached to the underway outlet for all standard samples to separate and remove POM samples larger than > 30µm (e.g., large plankton and particulates). After filtration, all POP triplicates were rinsed with approximately 2-5 mL of a 0.17 M Na2SO4 solution to remove dissolved phosphorus.

POM samples larger than > 30µm were collected on nitex mesh for ~1 hour. The flow rate was measured by measuring volume in an 8L carboy over a duration of several minutes. Mesh was rinsed into a container with filter seawater and then split onto duplicate GF/F samples for POC/PON.

All POM samples were folded in half with the top sides toward each other, sealed inside pieces of precombusted 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 from 0.2-1.5 mg) and measured using a Flash EA elemental analyzer.

Associated GO-SHIP I07N underway and bottle datasets can be found on the CLIVAR and Carbon Hydrographic Data Office Section I07N homepage: https://cchdo.ucsd.edu/cruise/33RO20180423.

Data Processing Description

Researcher processing notes:

- 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."

BCO-DMO processing notes:

- Rounded Latitude and Longitude values to 5th decimal place
- In columns POC_µM, PON_µM, POP_µM, POC_large_µmol, PON_large_µmol, the character "µ" was changed to "u"

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Data Files

File
final_bcodmo_submission_i07.csv (Comma Separated Values (.csv), 79.75 KB) MD5:df593b9292f05e2cf7f55bb9e7e6efab Primary data file for dataset ID 879076

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Related Publications

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. A., Larkin, A. A., Garcia, N. S., Fagan, A. J., & Martiny, A. C. (2022). Global patterns and predictors of C:N:P in marine ecosystems. Communications Earth & Environment, 3(1). https://doi.org/10.1038/s43247-022-00603-6
Results

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Parameters

Parameter	Description	Units
Sample	sample numbers 0-790	unitless
Station	stations for cruise I07_###	unitless
Latitude	negative values indicate West	decimal degrees
Longitude	positive values indicate North	decimal degrees
ISO_DateTime_UTC	datetime in UTC; format: %Y-%m-%dT%H:%MZ	unitless
Datenum	days since Jan-0-0000	days
Replicate	replicates collected at noon	replicates
Vol_CN_L	seawater volume in liters for POC and PON sample	liters
Vol_POP_L	seawater volume in liters for POP sample	liters
Vol_largeCN_L	seawater volume for large POC and PON sample, calculated from Flowrate (L/min) and time	liters
POC_uM	particulate organic carbon, underway seawater collected on 25mm GF/F with 30 µm nitex mesh prefilter	micromoles per liter (µM)
PON_uM	particulate organic nitrogen, underway seawater collected on 25mm GF/F with 30 µm nitex mesh prefilter	micromoles per liter (µM)
POP_uM	particulate organic phosphorus, underway seawater collected on 25mm GF/F with 30 µm nitex mesh prefilter	micromoles per liter (µM)
POC_large_umol	particulate organic carbon, underway seawater size-fractionated above 30 µm nitex mesh for ~1 hour and then filtered onto GF/F	micromoles per liter (µM)
PON_large_umol	particulate organic nitrogen, underway seawater size-fractionated above 30 µm nitex mesh for ~1 hour and then filtered onto GF/F	micromoles per liter (µM)

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Instruments

Dataset-specific Instrument Name	CN FlashEA 1112 Elemental Analyzer (Thermo Scientific, Waltham, Massachusetts)
Generic Instrument Name	Elemental Analyzer
Dataset-specific Description	Samples analyzed at UCI were packed into tin packets alongside Atropine (C17H23NO3) standards (ranging from 0.2-1.5 mg) and measured using a Flash EA 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
Dataset-specific Description	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.
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

RB1803

Website	https://www.bco-dmo.org/deployment/852241
Platform	NOAA Ship Ronald H. Brown
Report	http://dx.doi.org/10.7942/C25H2B
Start Date	2018-04-23
End Date	2018-06-06
Description	IO7N GO-SHIP/CO2 Repeat Hydrography Cruise aboard the National Oceanic and Atmospheric Administration (NOAA) vessel the Ronald H. Brown acting under the auspices of the Global Ocean Ship-based Hydrographic Investigations Program (GO-SHIP). Expocode 33RO20180423. Ports: Durban (South Africa) to Victoria (Seychelles) The Cruise Report and additional data from the cruise are available from CCHDO: Volkov, D. and Menezes, V. (2018). Hydrographic Cruise 33RO20180423, exchange version. Accessed from CCHDO https://cchdo.ucsd.edu/cruise/33RO20180423. Access date 2021-05-21. CCHDO cruise DOI: 10.7942/C25H2B

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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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