Particulate organic matter (PON, POC, POP) concentrations collected on R/V Roger Revelle cruise RR1604 along the hydrographic line IO9 in the Eastern Indian Ocean from March to April 2016

Website: https://www.bco-dmo.org/dataset/734915
Data Type: Cruise Results
Version: 3
Version Date: 2020-09-09

Project
» Collaborative Research: Regional variation of phytoplankton diversity and biogeochemical functioning in the subtropical Indian Ocean (IO Phytoplankton)

Contributors	Affiliation	Role
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Abstract
Particulate organic matter (PON, POC, POP) concentrations collected on R/V Roger Revelle cruise RR1604 along the hydrographic line IO9 in the Eastern Indian Ocean from March to April 2016.

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Coverage

Spatial Extent: **N**:17.8831 **E**:110.4547 **S**:-31.0335 **W**:84.7526
Temporal Extent: 2016-03-22 - 2016-04-24

Dataset Description

Particulate organic nitrogen, carbon, and phosphorus concentrations collected on R/V Roger Revelle cruise RR1604 along the hydrographic line IO9 in the Eastern Indian Ocean from March to April 2016.

Acquisition Description

Water was collected from a circulating seawater system distributed via plastic tubing for POC/PON/POP

around 3m deep. An underway system was chosen to vastly increase sampling coverage, replicate number, and sample volume. The water intake is located near the ship sea chest, which may have missed particle production in the subsurface. The circulating seawater was never turned off during the entirety of the transect and kept at a constant flow. Water was passed through a 30 µm nylon mesh (Small Parts #7050-1220-000-12) to remove larger plankton and particles from the sample. Each replicate was collected into a separate 8.5L plastic carboys (Thermo Scientific, Waltham, Massachusetts). In between stations, carboys were rinsed with 30 µm filtered sample water just prior to collection. Six 8 L seawater samples were divided into POC/PON and POP triplicates. Carboys were placed at ~45° angle to avoid particle settling below the nozzle. Each replicate was passed through a 25 mm pre-combusted (500°C for 5 h) GF/F filter (Whatman, Florham Park, New Jersey) with a nominal pore size of 0.7 µm. The vacuum filtration was an in-line setup with 25 mm filter holders connected to an aspirator pump at -0.08 MPa. POP filters were rinsed with 5 ml of 0.17 M Na_2SO_4 to remove traces of dissolved phosphorus from the filter. All filters were stored in pre-combusted aluminum packets and immediately frozen at -80°C during the cruise and -20°C for shipment.

Particulate Organic Carbon/Nitrogen: Prior to analysis, the filters for POC and PON were dried according to the JGOFS protocol (Knap et al., 1996). The protocol has a detection range of 0.43-43.13 µM for POC and 0.037-7.39 µM for PON in sea water (Knap et al., 1996). First, the filters were dried in an incubator at 55°C for 24-48 h and then stored in a desiccator with concentrated HCl fumes for 24 h to remove inorganic carbonates. Secondly, the filters were dried again at 55°C for 48 h before being folded and packed into pre-combusted tin capsules (CE Elantech, Lakewood, New Jersey). The packaged filters are analyzed on a CN FlashEA 1112 Elemental Analyzer (Thermo Scientific, Waltham, Massachusetts) against an atropine standard curve (chemical formula $C_{17}H_{23}NO_3$).

Particulate Organic Phosphorus: Particulate organic phosphorus (POP) were analyzed according to a modified ash-hydrolysis protocol (Lomas et al., 2010). Thawed filters were placed in along with a corresponding standard curve of KH_2PO_4. 2 mL of 0.017M $MgSO_4$ was added to the acid-washed glass vials containing filters and covered with pre-combusted aluminum foil. The vials were placed in an incubator at 90°C for 24 h and then combusted (500°C, 2 h). Once cooled, 5 mL 0.2 M HCl was added and incubated at 90°C for at least 30 min. Next, the supernatant plus 5 mL milli-Q water was mixed with 2:5:1:2 parts ammonium molybdate tetrahydrate, 5N sulfuric acid, potassium antimonyl tartrate, and ascorbic acid for 30 min. Finally the standards and samples were analyzed on a spectrophotometer (Genesys 10vis, Thermo Scientific, Waltham, Massachusetts) at a wavelength of 885 nm to determine POP concentration with an assay detection limit ~0.1 nmol l^{-1}.

Processing Description

BCO-DMO Processing:
- changed date format from mm/dd/yyyy HH:MM to yyyy-mm-ddTHH:MM;
- modified parameter names to conform with BCO-DMO naming conventions;
- 21 June 2018 (v2): replaced original file with new version where values contain 4 digits after the decimal (original version contained only 2 digits);
- 09 Sept 2020 (v3): replaced data with revised version that includes major corrections to the POP values, which were previously reported one magnitude too large.

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Related Publications

Knap, A. H., Michaels, A., Close, A. R., Ducklow, H., & Dickson, A. G. (1996). Protocols for the joint global ocean flux study (JGOFS) core measurements. http://hdl.handle.net/10013/epic.27912
Methods

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

Martiny, A. C., Vrugt, J. A., & Lomas, M. W. (2014). Concentrations and ratios of particulate organic carbon, nitrogen, and phosphorus in the global ocean. Scientific Data, 1, 140048. doi:10.1038/sdata.2014.48
Results

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Parameters

Parameter	Description	Units
Sample	Sample number	unitless
Station	GO-SHIP I9N transect station	unitless
Latitude	Latitude	decimal degrees North
Longitude	Longitude	decimal degrees East
ISO_DateTime_UTC	Date and time of sample collection (UTC); formatted to ISO 8601 standard (yyyy-mm-ddTHH:MM)	unitless
Volume	Volume of sea water filtered	liters
POC_Rep1	Particulate organic carbon replicate 1	micromolar (uM)
POC_Rep2	Particulate organic carbon replicate 2	micromolar (uM)
POC_Rep3	Particulate organic carbon replicate 3	micromolar (uM)
PON_Rep1	Particulate organic nitrogen replicate 1	micromolar (uM)
PON_Rep2	Particulate organic nitrogen replicate 2	micromolar (uM)
PON_Rep3	Particulate organic nitrogen replicate 3	micromolar (uM)
POP_Rep1	Particulate organic phosphorus replicate 1	nanomolar (nM)
POP_Rep2	Particulate organic phosphorus replicate 2	nanomolar (nM)
POP_Rep3	Particulate organic phosphorus replicate 3	nanomolar (nM)

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Instruments

Dataset-specific Instrument Name	Genesys 10vis spectrophotometer
Generic Instrument Name	Spectrophotometer
Dataset-specific Description	Genesys 10vis spectrophotometer (#840-208100, Thermo Scientific, Waltham, Massachusetts)
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.

Dataset-specific Instrument Name	CN FlashEA 1112 Elemental Analyzer
Generic Instrument Name	Elemental Analyzer
Dataset-specific Description	CN FlashEA 1112 Elemental Analyzer (Thermo Scientific, Waltham, Massachusetts)
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.

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Deployments

RR1604

Website	https://www.bco-dmo.org/deployment/723194
Platform	R/V Roger Revelle
Start Date	2016-03-21
End Date	2016-04-28

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Project Information

Collaborative Research: Regional variation of phytoplankton diversity and biogeochemical functioning in the subtropical Indian Ocean (IO Phytoplankton)

Coverage: GO-SHIP IO9N transect: 20S 95E to 20N 95E

Description from NSF award abstract:
The Indian Ocean accounts for nearly a fifth of global ocean photosynthesis and is likely a key component

in global ocean nutrient and carbon cycles. However, the Indian Ocean may be the least studied major marine body on the planet. Our limited understanding suggests extensive variations in physical and chemical environmental conditions, but how this variation influences biodiversity, nutrient stress, and more broadly regional differences in the functioning of phytoplankton is unknown. To help address these gaps, the investigators will conduct a study by joining an already-funded major research cruise to this region. It will cover a northern region with some of the highest temperatures recorded in open ocean waters, an area around 10°S of predicted (but not tested in situ) iron stress, and a southern subtropical gyre with unique nitrogen to phosphorous(or N:P) ratios. The focus of this project is to quantify and synthesize the interconnectedness of environmental conditions, phytoplankton diversity and genome content, and nutrient biogeochemistry, with the goal of understanding how these may lead to unique biogeochemical regions in Indian Ocean. The research will have broader impacts on many levels. First, it will increase public awareness of the role of phytoplankton on ocean functioning, climate, and people's lives through a new partnership with the Aquarium of the Pacific (AOP), which is the fourth most-attended aquarium in the nation. Secondly, the project will train a postdoctoral scholar as well as a graduate and undergraduate students. Third, the research will dramatically increase our basic knowledge ocean biogeochemistry and in many cases will be the first measurements of their kind made in the Indian Ocean.

This project will address two major questions: How do environmental conditions, phytoplankton diversity, phytoplankton physiology, and biogeochemistry vary across the central Indian Ocean? Are there distinct biogeochemical regimes in the central IO? The researchers hypothesize that environmental conditions, including the relative availability of nitrogen (N) and iron (Fe), lead to three distinct phytoplankton communities and biogeochemical regimes. They will employ a series of advanced analytical tools including high sensitivity measurements of dissolved and particulate nutrients (nitrogen, phosphorus, and iron), genomics, bioassays to test for nutrient stress, and cell-sorting of specific taxa followed by measures of nutrient content and uptake. A focus of this project is to quantify and synthesize the interconnectedness of environmental conditions, phytoplankton diversity and genome content, and nutrient biogeochemistry, and how these lead to unique biogeochemical regions in Indian Ocean. This extensive set of observations can ultimately be linked to ocean models and satellite data to provide a comprehensive view of regional differences in chemistry, biodiversity and phytoplankton biogeochemical functioning in the Indian Ocean.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1559002

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