Global ocean Particulate Organic Matter (POM) ratios from 1971-2014 (Biological C:N:P ratios project, Global POM project)

Website: https://www.bco-dmo.org/dataset/526747
Data Type: Cruise Results
Version: 2
Version Date: 2020-12-21

Project
» Biological Controls on the Ocean C:N:P ratios (Biological C:N:P ratios)
» Concentrations and ratios of particulate organic carbon, nitrogen, and phosphorus in the global ocean (Global POM)

Programs
» Dimensions of Biodiversity (Dimensions of Biodiversity)
» Ocean Carbon and Biogeochemistry (OCB)
» Historical Datasets (Historical)
» Ocean Carbon and Biogeochemistry (OCB)

Contributors	Affiliation	Role
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Abstract
Global Ocean POM Data Ratios from 1971-2014 (Biological C:N:P ratios project, Global POM project)

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Coverage

Spatial Extent: **N**:74.39 **E**:179.93 **S**:-78 **W**:-179.99
Temporal Extent: 1971-03-15 - 2010-07-12

Dataset Description

Concentrations and ratios of particulate organic carbon, nitrogen, and phosphorus in the global ocean.

When using this data, please cite the original publication:
Martiny AC, Vrugt JA, Lomas MW (2014) Concentrations and ratios of particulate organic carbon, nitrogen, and phosphorus in the global ocean. Scientific Data 1:140048. http://dx.doi.org/10.1038/sdata.2014.48

Additionally, please cite the Dryad data package:
Martiny AC, Vrugt JA, Lomas MW (2014) Data from: Concentrations and ratios of particulate organic carbon, nitrogen, and phosphorus in the global ocean. Dryad Digital Repository. http://dx.doi.org/10.5061/dryad.d702p

Methods & Sampling

Marine particulate organic carbon (POC), nitrogen (PON), and phosphorus (POP) from 70 cruises or time-series during the last 40 years are reported.

Nearly all POC and PON measurements were done by collecting seawater particles onto glass-fibers filters (i.e., GF/F) and quantified using a combustion GC-IR based elemental analyzer68. The only exceptions were 'EUMELI' and 'OLIPAC', where PON was measured using a chemical oxidation technique38. Particulate phosphorus was quantified using the ash-hydrolysis method26,69. We operationally defined station IDs as samples taken within a 1°×1° area on the same day11.

The data was gathered by searching available databases (i.e., PANGAEA, BCO-DMO, JGOFS, and IFREMER) as well as published literature. We aggregated all available datasets in order to create the most exhaustive global description of particulate organic nutrients and thus did not exclude any specific cruises or time-series. The only data excluded were samples subjected to a prior manipulation or incubation.

Data Processing Description

BCO-DMO Processing Notes
- Generated from original file: "CNP_data.xlsx" contributed by Adam Martiny
- Single column for Date inserted with combined Year, Month, Day formatted as YYYYMMDD
- Parameter names edited to conform to BCO-DMO naming convention found at Choosing Parameter Name
- Identified "Station" column as "Dataset_Station" since the station ids here don't agree with other data from similarly named datasets
- Padded decimal places to two places where appropriate
- Standardized bad data value at "nd"
- Note: Some non standard dates/times contained in original data contributed were changed to 'nd (no datda).

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Data Files

File
POM_Data.csv (Comma Separated Values (.csv), 2.58 MB) MD5:7a2ab7fb9f360ca44bcca47785309088 Primary data file for dataset ID 526747

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Related Publications

Martiny, A. C., Pham, C. T. A., Primeau, F. W., Vrugt, J. A., Moore, J. K., Levin, S. A., & Lomas, M. W. (2013). Strong latitudinal patterns in the elemental ratios of marine plankton and organic matter. Nature Geoscience, 6(4), 279–283. doi:10.1038/ngeo1757
Related Research

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

Martiny, A. C., Vrugt, J. A., & Lomas, M. W. (2015). Data from: Concentrations and ratios of particulate organic

carbon, nitrogen, and phosphorus in the global ocean (Version 1) [Data set]. Dryad. https://doi.org/10.5061/DRYAD.D702P https://doi.org/10.5061/dryad.d702p
Results

Martiny, A. C., Vrugt, J. A., Primeau, F. W., & Lomas, M. W. (2013). Regional variation in the particulate organic carbon to nitrogen ratio in the surface ocean. Global Biogeochemical Cycles, 27(3), 723–731. doi:10.1002/gbc.20061
Related Research

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Parameters

Parameter	Description	Units
Dataset	Dataset – Cruise or Time Series Dataset Identifier	text
Dataset_Station	Dataset_Station **BCO-DMO Note: Station numbers are unique to this dataset. They do not correspond to station ids/numbers for other data from Projects with the same DataSet name.**	dimensionless
Date	Date	YYYYMMDD
Depth	Sample Depth	meters
Latitude	Station Latitude (South is negative)	dec degs
Longitude	Station Longitude (West is negative)	dec degs
POP	Particulate Organic Phosphorus (POP)	umol L-1
PON	Particulate Organic Nitrogen (PON)	umol L-1
POC	Particulate Organic Carbon (POC)	umol L-1

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Instruments

Dataset-specific Instrument Name	CHN_EA
Generic Instrument Name	CHN Elemental Analyzer
Dataset-specific Description	Nearly all particulate carbon and nitrogen measurements were done using by collecting seawater particles onto glass-fibers filters (i.e., GF/F) and quantified using an elemental analyzer. Particulate phosphorus was quantified using the ash-hydrolysis method
Generic Instrument Description	A CHN Elemental Analyzer is used for the determination of carbon, hydrogen, and nitrogen content in organic and other types of materials, including solids, liquids, volatile, and viscous samples.

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Deployments

Global_POM

Website	https://www.bco-dmo.org/deployment/526743
Platform	UC-Irvine Martiny
Report	http://data.bco-dmo.org/Martiny_Lomas/POM_data_paper_052714.pdf
Start Date	1997-01-01
End Date	2011-12-31
Description	Text below extracted from: Adam C. Martiny, Jasper A. Vrugt, and Michael W. Lomas. Concentrations and ratios of particulate organic carbon, nitrogen, and phosphorus in the global ocean. In review. 2014. To address this issue, we here present a compilation of measurements of marine particulate organic carbon, nitrogen, and phosphorus from 70 cruises or time-series during the last 40 years (Table 1). The dataset includes a total 60811 measurements of particulate organic nutrients and covers 5365 unique stations from all major ocean regions (Figure 1). 89% of the samples originate from the top 200m of the water and thus the dataset is skewed towards processes occurring in or near the euphotic zone (Figure 2A). The data is also biased towards regions of oceanographic research. This includes samples near the Palmer Station in the Southern Ocean, North Atlantic Ocean and Eastern North Pacific Ocean (including HOT station and California Current) (Figure 2B,C). Thus, this compilation of data also identifies regions where we currently have sparse data (e.g., the South Pacific, South Atlantic, and Eastern Indian Ocean). Overall, the median C:P, N:P, and C:N ratios are 163, 22, and 6.6, respectively, in this dataset but the data covers a wide range for all three ratios (Figure 2D-F). Combined with the wide geographic extent of the data, this compilation will enable a range of studies of elemental ratios in particulate organic matter.

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Project Information

Biological Controls on the Ocean C:N:P ratios (Biological C:N:P ratios)

Coverage: western North Atlantic; 60N to 20N along 66W longitude; 20N to 15S in the tropical Pacific

One of the fundamental patterns of ocean biogeochemistry is the Redfield ratio, linking the stoichiometry of surface plankton with the chemistry of the deep ocean. There is no obvious mechanism for the globally consistent C:N:P ratio of 106:16:1 (Redfield ratio), especially as there is substantial elemental variation among

plankton communities in different ocean regions. Thus, knowing how biodiversity regulates the elemental composition of the ocean is important for understanding the ocean and climate as a whole -- now and in the future.

The conceptual hypotheses for this study are as follows: 1. The C:N:P ratio of a cell is constrained by its broad taxonomic group, which determines, for example, whether it has an outer shell, its size, functional metabolism, membrane lipid composition. 2. Within a taxon, there is high genetic diversity. Some of this genetic diversity is potentially laterally transferred, or can be lost within taxa, and confers various functional abilities (organic phosphate assimilation, nitrate assimilation, photoheterotrophy, etc.). Functional diversity provides the cell with further flexibility, such as the ability to respond to varying nutrient supply rates/ratios, and affects a cell's C:N:P ratio within the range specified by the taxon. 3. Given these taxonomic and genetic constraints, a cell is physiologically plastic and modifies how it allocates cellular resources in response to nutrient supply rates/ratios in the environment. 4. The microbial diversity (taxonomic, genetic, and functional) of the surface ocean varies over time and space, driven by many factors in addition to nutrients. The sum of this mixture composes the ecosystem C:N:P, the ratio that Redfield described.

Based on this framework, the CoPIs will make field observations of taxon-specific stoichiometry and growth rates, genomic analyses, and conduct laboratory chemostat experiments to improve understanding of how ocean taxonomic, genetic, and functional biodiversity control the stoichiometry of the surface ocean plankton. Their analyses of these data would lead to a mechanistic understanding of variations in the Redfield ratio, both spatially and temporally.

This study will greatly expand knowledge of the genomic diversity among ocean microbes and how this diversity affects biogeochemistry. The stoichiometry of the ocean's microbes is a parameter that nearly every chemical or biological oceanographer uses, from converting measurements made in one element to another, to estimating regional and global nitrogen budgets. The research also has important implications for the global carbon budget and any changes that might result from climate change.

To understand mechanistically temporal and spatial variability of the plankton C:N:P ratio, biodiversity must be studied not only at the traditional taxonomic level, but at the genetic and functional levels which dictate organism response to their environment. Data will be integrated into a combined ocean ecological, evolutionary, and biogeochemical model, with flexible stoichiometry, including cellular biochemical allocations. Seeding a coupled physical-biological model of the oceans with multiple competing genotypes enables the exploration of ecological and evolutionary patterns of resource acquisition and C:N:P ratios. Developing a more mechanistic examination of the course of ecology and evolution, in which laboratory and field data define tradeoffs between different growth and nutrient acquisition strategies, would estabblish the framework of adaptive dynamics for determining "evolutionarily convergence". Finally, model outcomes will be evaluated against field data.

The field work planned for this project includes several cruises: BV46 (September/October 2011), BV48 (September 2012), a June 2013 cruise from Bermuda to the Labrador Sea, and a cruise from Hawaii to Tahiti (May 2014). Additionally, samples will be be acquired during cruises of opportunity.

Concentrations and ratios of particulate organic carbon, nitrogen, and phosphorus in the global ocean (Global POM)

Website: http://www.ess.uci.edu/researchgrp/amartiny/adam-martiny-lab

Coverage: Global

Knowledge of concentrations and elemental ratios of suspended particles are important for understanding many biogeochemical processes in the ocean. These include patterns of phytoplankton nutrient limitation as well as linkages between the cycles of carbon and nitrogen or phosphorus. To further enable studies of ocean biogeochemistry, we here present a global dataset consisting of 100,605 total measurements of particulate organic carbon, nitrogen, or phosphorus analyzed as part of 70 cruises or time-series. The data are globally distributed and represent all major ocean regions as well as different depths in the water column. The global median C:P, N:P, and C:N ratios are 163, 22, and 6.6, respectively, but the data also includes extensive variation between samples from different regions. Thus, this compilation will hopefully assist in a wide range of future studies of ocean elemental ratios.

Related References:
Martiny, A. C., Vrugt, J. A., Primeau, F. W. & Lomas, M. W. Regional variation in the particulate organic carbon to nitrogen ratio in the surface ocean. Global Biogeochem. Cycles 27, 723–731 (2013).

Martiny, A. C., C. T. A. Pham, F. W. Primeau, J. A. Vrugt, J. K. Moore, S. A. Levin, and M. W. Lomas (2013), Strong latitudinal patterns in the elemental ratios of marine plankton and organic matter, Nat. Geosci., 6(4), 279–283, doi:10.1038/ngeo1757.

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Program Information

Dimensions of Biodiversity (Dimensions of Biodiversity)

Website: http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=503446

Coverage: global

(adapted from the NSF Synopsis of Program)
Dimensions of Biodiversity is a program solicitation from the NSF Directorate for Biological Sciences. FY 2010 was year one of the program. [MORE from NSF]

The NSF Dimensions of Biodiversity program seeks to characterize biodiversity on Earth by using integrative, innovative approaches to fill rapidly the most substantial gaps in our understanding. The program will take a broad view of biodiversity, and in its initial phase will focus on the integration of genetic, taxonomic, and functional dimensions of biodiversity. Project investigators are encouraged to integrate these three dimensions to understand the interactions and feedbacks among them. While this focus complements several core NSF programs, it differs by requiring that multiple dimensions of biodiversity be addressed simultaneously, to understand the roles of biodiversity in critical ecological and evolutionary processes.

Ocean Carbon and Biogeochemistry (OCB)

Website: http://us-ocb.org/

Coverage: Global

The Ocean Carbon and Biogeochemistry (OCB) program focuses on the ocean's role as a component of the global Earth system, bringing together research in geochemistry, ocean physics, and ecology that inform on and advance our understanding of ocean biogeochemistry. The overall program goals are to promote, plan, and coordinate collaborative, multidisciplinary research opportunities within the U.S. research community and with international partners. Important OCB-related activities currently include: the Ocean Carbon and Climate Change (OCCC) and the North American Carbon Program (NACP); U.S. contributions to IMBER, SOLAS, CARBOOCEAN; and numerous U.S. single-investigator and medium-size research projects funded by U.S. federal agencies including NASA, NOAA, and NSF.

The scientific mission of OCB is to study the evolving role of the ocean in the global carbon cycle, in the face of environmental variability and change through studies of marine biogeochemical cycles and associated ecosystems.

The overarching OCB science themes include improved understanding and prediction of: 1) oceanic uptake and release of atmospheric CO2 and other greenhouse gases and 2) environmental sensitivities of biogeochemical cycles, marine ecosystems, and interactions between the two.

The OCB Research Priorities (updated January 2012) include: ocean acidification; terrestrial/coastal carbon fluxes and exchanges; climate sensitivities of and change in ecosystem structure and associated impacts on

biogeochemical cycles; mesopelagic ecological and biogeochemical interactions; benthic-pelagic feedbacks on biogeochemical cycles; ocean carbon uptake and storage; and expanding low-oxygen conditions in the coastal and open oceans.

Historical Datasets (Historical)

Coverage: global

This 'program' consists of data sets that are not part of a recognized program and are of historical interest, usually collected before 1980.

Ocean Carbon and Biogeochemistry (OCB)

Website: http://us-ocb.org/

Coverage: Global

The Ocean Carbon and Biogeochemistry (OCB) program focuses on the ocean's role as a component of the global Earth system, bringing together research in geochemistry, ocean physics, and ecology that inform on and advance our understanding of ocean biogeochemistry. The overall program goals are to promote, plan, and coordinate collaborative, multidisciplinary research opportunities within the U.S. research community and with international partners. Important OCB-related activities currently include: the Ocean Carbon and Climate Change (OCCC) and the North American Carbon Program (NACP); U.S. contributions to IMBER, SOLAS, CARBOOCEAN; and numerous U.S. single-investigator and medium-size research projects funded by U.S. federal agencies including NASA, NOAA, and NSF.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1046297
NSF Division of Ocean Sciences (NSF OCE)	OCE-0752366
NSF Division of Ocean Sciences (NSF OCE)	OCE-1045966
NSF Division of Ocean Sciences (NSF OCE)	OCE-0928544
NSF Division of Ocean Sciences (NSF OCE)	OCE-1258836

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