Silica production rates and concentrations quantified using 32Si and PDMPO using samples from the R/V Point Sur cruise PS1312 along the Central California coast from June to July of 2013 (Diatom Group Si Prod project)

Website: https://www.bco-dmo.org/dataset/701579
Data Type: Cruise Results
Version:
Version Date: 2018-03-12

Project
» Group-Specific Diatom Silica Production in a Coastal Upwelling System (Diatom Group Si Prod)

Contributors	Affiliation	Role
Krause, Jeffrey W.	Dauphin Island Sea Lab (DISL)	Principal Investigator
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Coverage

Spatial Extent: **N**:38.265 **E**:-121.981 **S**:36.455 **W**:-123.969
Temporal Extent: 2013-06-27 - 2013-07-05

Dataset Description

This dataset includes diatom silica production rates, and concentrations quantified using 32Si and PDMPO (see below) tracers. Gross and biomass-normalized silica measurements from 12 hour and 24 hour incubations are provided as well as concentrations of phosphate, nitrate+nitritie, total chlorophyll, chlorophyll a, phaeopigments, and CTD measurements (e.g. temperature, salinity).

PDMPO = 2-(4-pyridyl)-5-((4-(2-dimethylaminoethylaminocarbamoyl)methoxy)phenyl)oxazole

Methods & Sampling

Multiple hydrocasts conducted at stations denoted in the bottle file meta data. A SeaBird CTD was used with redundant sensors for temperature and conductivity; the instrument package was owned and operated by the R/V Point Sur (Moss Landing Marine Laboratories, Moss Landing, California). All hydrocast data was processed to1-m bins. Prior to the cruise, the transmissometer was not calibrated and many data anomalies were observed; therefore, these data are suspect and not reported with the bottle data.

Samples were collected in the euphotic zone, or just below, to a maximum of ~60 m. Water was filtered (0.6 um pore size) for dissolved inorganic nutrient analysis (N+N, SRP, Si(OH)4), and analyzed at the University of California Santa Barbara Marine Science Institute's Analytical Laboratory using flow injection techniques on a QuickChem 8000 analyzer (Lachat Instruments Division, Zellweger Analytics) as described in Brzezinski and Washburn (2011). Chlorophyll a was also quantified using the protocol followed in Brzezinski and Washburn (2011). ~175 – 350 mL of seawater was filtered through a 0.45 um-pore 47mm diameter HAWP Millipore filter, immediately frozen until analysis on shore (<2 weeks) via extracting with 90% acetone for 24 hours at -20C and quantification of fluorescence on a calibrated Turner Designs 10AU fluorometer with and without acidification. For biogenic silica analysis, 630 mL of seawater was filtered through a 1.2 um-pore polycarbonate filter (47 mm diameter) and frozen immediately. On shore, filters were dried and analyzed using a NaOH digestion in Teflon tubes which provide low and stable blank values (Krause et al., 2009).

Diatom rate processes were quantified using 32Si and PDMPO tracers. Samples were incubated in acrylic incubators cooled with continually flowing surface water under a series of neutral density screens to simulate light levels at the depth of collection. Four 250-mL bottle replicates were taken for each measurement, two for a 12-hour incubation (in daylight) and two for a 24-hour incubation; Si(OH)4 one replicate for each incubation duration was amended by +20 uM (i.e. Enrichment or "E" samples).

Note: no ionophore rinse was used during the DYEatom cruise, this was added later in the McNair et al. (2015) protocol.

Data Processing Description

DMO Data Manager Processing Notes:
* added a conventional header with dataset name, PI name, version date
* modified parameter names to conform with BCO-DMO naming conventions
* blank values replaced with no data value 'nd'
* added minus sign to longitudes
* param name % lo -> irradiance due to unsupported characters
* tilda character replaced with "nd" as it indicated no data
* -999 changed to "nd"
* SEQ_NUM(CAST) added so it can be matched with CTD bottle and profile data
* params starting 12_hr and 24_hr changed to ending _12hr and _24hr due to unsupported names with leading number.
* added ISO_DateTime_UTC
* changed cruise value from DYEatom to PS13-12 to be consistent with CTD files
* params starting 32Si changed to Si32 due to unsupported names with leading number.
* Dataset version 2018-03-12 replaces version 2017-08-17. In version 2018-03-12 the following data parameters were added: Total_SiOH4,bSiO2,Si32_Rho_12hr,Si32_Vb_12hr,Si32_RhoE_12hr,Si32_VbE_12hr,Si32_Rho_24hr,Si32_Vb_24hr,Si32_RhoE_24hr,Si32_VbE_24hr,PDMPO_Rho_12hr,PDMPO_RhoE

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Data Files

File
Si_Productivity.csv (Comma Separated Values (.csv), 18.11 KB) MD5:4d73b89f514b2ebd80466bd3850d4f6d Primary data file for dataset ID 701579

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Related Publications

Brzezinski, M. A., & Washburn, L. (2011). Phytoplankton primary productivity in the Santa Barbara Channel: Effects of wind-driven upwelling and mesoscale eddies. Journal of Geophysical Research, 116(C12). doi:10.1029/2011jc007397 https://doi.org/10.1029/2011JC007397
Methods

Krause, J. W., Brzezinski, M. A., & Jones, J. L. (2011). Application of low-level beta counting of 32Si for the measurement of silica production rates in aquatic environments. Marine Chemistry, 127(1-4), 40–47. doi:10.1016/j.marchem.2011.07.001
General

Krause, J. W., Brzezinski, M. A., Villareal, T. A., & Wilson, C. (2012). Increased kinetic efficiency for silicic acid uptake as a driver of summer diatom blooms in the North Pacific subtropical gyre. Limnology and Oceanography, 57(4), 1084–1098. doi:10.4319/lo.2012.57.4.1084
General

Krause, J. W., Nelson, D. M., & Lomas, M. W. (2009). Biogeochemical responses to late-winter storms in the Sargasso Sea, II: Increased rates of biogenic silica production and export. Deep Sea Research Part I: Oceanographic Research Papers, 56(6), 861–874. doi:10.1016/j.dsr.2009.01.002
Methods

McNair, H. M., Brzezinski, M. A., & Krause, J. W. (2015). Quantifying diatom silicification with the fluorescent dye, PDMPO. Limnology and Oceanography: Methods, 13(10), 587–599. doi:10.1002/lom3.10049
Methods

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Parameters

Parameter	Description	Units
CAST_NUM	CTD cast number	unitless
Cruise	Cruise identifier	unitless
Latitude	Latitude in decimal degrees	unitless
Longitude	Longitude in decimal degrees	unitless
Event_num	Event Number (YYYYMMDDHHHH; Zulu)	unitless
Activity	CTD number	unitless
Date_Local	Date (local) in format dd-mmm-yy	unitless
Date_Zulu	Time (local) in format hh:mm	unitless
Time_Local	Date (UTC) in format dd-mmm-yy	unitless
Time_Zulu	Time (UTC) in format hh:mm	unitless
ISO_DateTime_UTC	ISO timestamp based on the ISO 8601:2004(E) standard in format YYYY-mm-ddTHH:MMZ (UTC)	unitless
Station	Station name	unitless
Bottom_Depth	Bottom depth	meters
Actual_Depth	Depth of sample. Mid-point of niskin bottle at depth of collection (Depth sensor minus 0.5 m)	meters
Bottle_num	Bottle number	unitless
Irradiance_percent	Percentage of irradiance; measured just below the surface	percent (%)
Phosphate	Autoanalyzer soluble reactive phosphorus	micromoles per liter (umol/L)
Nitrate_plus_Nitrite	Autoanalyzer nitrate+nitrite	micromoles per liter (umol/L)
total_chl	Total chlorophyll	micrograms per liter (ug/L)
chl_a	Chlorophyll a	micrograms per liter (ug/L)
phaeo	Phaeopigment	micrograms per liter (ug/L)
Total_SiOH4	Manual dissolved silicic acid (Si(OH)4) concentration	micromoles per liter (umol/L)
bSiO2	Biogenic silica (µmol Si/L)	micromoles of silicon per liter (umol Si/L)
Si32_Rho_12hr	12-hr incubation, Silicon-32-measured Gross biogenic silica production (Greek letter Rho)	micromoles of silicon per liter per day (umol Si/L/d)
Si32_Vb_12hr	12-hr incubation, Silicon-32-measured Biomass-normalized biogenic silica production (Vb)	per day (d-1)
Si32_RhoE_12hr	12-hr incubation, Silicon-32-measured Gross biogenic silica production +20µmol Si/L concentration (Greek letter RhoE)	micromoles of silicon per liter per day (umol Si/L/d)
Si32_VbE_12hr	12-hr incubation, Silicon-32-measured Biomass-normalized biogenic silica production +20µmol Si/L concentration (VbE)	per day (d-1)
Si32_Rho_24hr	24-hr incubation, Silicon-32-measured Gross biogenic silica production (Greek letter Rho)	micromoles of silicon per liter per day (umol Si/L/d)
Si32_Vb_24hr	24-hr incubation, Silicon-32-measured Biomass-normalized biogenic silica production (Vb)	per day (d-1)
Si32_RhoE_24hr	24-hr incubation, Silicon-32-measured Gross biogenic silica production +20µmol Si/L concentration (Greek letter RhoE)	micromoles of silicon per liter per day (umol Si/L/d)
Si32_VbE_24hr	24-hr incubation, Silicon-32-measured Biomass-normalized biogenic silica production +20µmol Si/L concentration (VbE)	per day (d-1)
PDMPO_Rho_12hr	12-hr incubation, PDMPO-measured Gross biogenic silica production (Greek letter Rho)	nanomoles of PDMPO per liter per day (nmol PDMPO/L/d)
PDMPO_RhoE_12hr	12-hr incubation, PDMPO-measured Gross biogenic silica production +20µmol Si/L concentration (Greek letter RhoE)	nanomoles of PDMPO per liter per day (nmol PDMPO/L/d)
PDMPO_Rho_24hr	24-hr incubation, PDMPO-measured Gross biogenic silica production (Greek letter Rho)	nanomoles of PDMPO per liter per day (nmol PDMPO/L/d)
PDMPO_RhoE_24hr	24-hr incubation, PDMPO-measured Gross biogenic silica production +20µmol Si/L concentration (Greek letter RhoE)	nanomoles of PDMPO per liter per day (nmol PDMPO/L/d)
Temperature0	Primary temperature from CTD (Seasave parameter T090C)	degrees Celsius
Temperature1	Secondary temperature from CTD (Seasave parameter T190C)	degrees Celsius
Conductivity0	Primary conductivity from CTD (Seasave parameter C0S/m)	Siemens per meter (S/m)
Conductivity1	Secondary conductivity from CTD (Seasave parameter C1S/m)	Siemens per meter (S/m)
Salinity0	Primary salinity from CTD (Seasave parameter Sal00)	Practical Salinity Units (PSU)
Salinity1	Secondary sailinity from CTD (Seasave parameter Sal11)	Practical Salinity Units (PSU)
Density0	Primary sigma-theta from CTD (Seasave parameter Sigma/e00)	kilograms per meter cubed (kg/m3)
Density1	Primary sigma-theta from CTD (Seasave parameter Sigma/e11)	kilograms per meter cubed (kg/m3)
Fluorescence	Fluorescence from Wet Labs ECO-AFL sensor on CTD (Seasave parameter FlECO/AFL)	milligrams per meter cubed (mg/m3)
SBE_Oxygen	Dissolved Oxygen from CTD (Seasave parameter Sbeox0Mm/Kg)	micromoles per kilogram (umol/kg)
PAR	Photosynthetically Active Radiation (PAR) from CTD (Seasave parameter Par)	microeinsteins per square meter per second (uE/m2/s)
Surface_PAR	Surface Photosynthetically Active Radiation (PAR) from CTD (Seasave parameter Spar)	microeinsteins per square meter per second (uE/m2/s)
CTD_file	File name of the CTD profile data (.asc) file associated with this sample (contains cast number in name)	unitless
Bottle_file	File name of the CTD bottle data (.btl) file associated with this sample (contains cast number in name)	unitless

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Instruments

Dataset-specific Instrument Name	
Generic Instrument Name	CTD Sea-Bird 9
Generic Instrument Description	The Sea-Bird SBE 9 is a type of CTD instrument package. The SBE 9 is the Underwater Unit and is most often combined with the SBE 11 Deck Unit (for real-time readout using conductive wire) when deployed from a research vessel. The combination of the SBE 9 and SBE 11 is called a SBE 911. The SBE 9 uses Sea-Bird's standard modular temperature and conductivity sensors (SBE 3 and SBE 4). The SBE 9 CTD can be configured with auxiliary sensors to measure other parameters including dissolved oxygen, pH, turbidity, fluorometer, altimeter, etc.). Note that in most cases, it is more accurate to specify SBE 911 than SBE 9 since it is likely a SBE 11 deck unit was used. more information from Sea-Bird Electronics

Dataset-specific Instrument Name	QuickChem 8000 analyzer
Generic Instrument Name	Flow Injection Analyzer
Dataset-specific Description	University of California Santa Barbara Marine Science Institute's Analytical Laboratory using flow injection techniques on a QuickChem 8000 analyzer (Lachat Instruments Division, Zellweger Analytics) as described in Brzezinski and Washburn (2011). Brzezinski, M. A., and L. Washburn. 2011. Phytoplankton primary productivity in the Santa Barbara Channel: Effects of wind-driven upwelling and mesoscale eddies. Journal of Geophysical Research Oceans, 116, C12013, doi:10.1029/2011JC007397.
Generic Instrument Description	An instrument that performs flow injection analysis. Flow injection analysis (FIA) is an approach to chemical analysis that is accomplished by injecting a plug of sample into a flowing carrier stream. FIA is an automated method in which a sample is injected into a continuous flow of a carrier solution that mixes with other continuously flowing solutions before reaching a detector. Precision is dramatically increased when FIA is used instead of manual injections and as a result very specific FIA systems have been developed for a wide array of analytical techniques.

Dataset-specific Instrument Name	Turner Designs 10AU fluorometer
Generic Instrument Name	Fluorometer
Generic Instrument Description	A fluorometer or fluorimeter is a device used to measure parameters of fluorescence: its intensity and wavelength distribution of emission spectrum after excitation by a certain spectrum of light. The instrument is designed to measure the amount of stimulated electromagnetic radiation produced by pulses of electromagnetic radiation emitted into a water sample or in situ.

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Deployments

PS1312

Website	https://www.bco-dmo.org/deployment/701341
Platform	R/V Point Sur
Start Date	2013-06-27
End Date	2013-07-06
Description	Cruise DOI: 10.7284/903425

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Project Information

Group-Specific Diatom Silica Production in a Coastal Upwelling System (Diatom Group Si Prod)

Coverage: In-, and off-shore, between Monterey Bay and Bodega Bay, CA

This study will examine the distribution of silica production among diatom species, using a novel combination of existing approaches, to evaluate the contributions of specific species or genera to total diatom silica production. Specific hypotheses regarding the distribution of silica production among species of diatoms will be tested by exploiting the strong contrasts in diatom community structure and silica production between a coastal upwelling system and in an oligotrophic subtropical gyre. Several lines of evidence support the idea that the diatoms responsible for the majority of silica production shifts from the most numerically abundant species in coastal systems to relatively rare, but very large, cells in offshore oligotrophic environments. This shift alters the role of diatoms in regional food webs and because many processes determining the role of phytoplankton groups in biogeochemical cycles are a function of cell size, such a shift has strong implications for regional differences in the contribution of diatoms to upper-ocean carbon cycling and the biological pump.

This study also seeks to understand of the role of silicon limitation in regulating diatom silica production at the species level. Si limitation of silica production has been detected in every system examined to date, ranging from the high Si waters of the Antarctic, to coastal upwelling systems and the oligotrophic subtropical gyres. Field studies of Si limitation are rarely accompanied by examination of the species present. When studies do have taxonomic data the lack of information on the performance of individual species makes it impossible to allocate the measured rates among cells, potentially leading to erroneous conclusions about the contribution of specific diatom groups to community composite rates.

The project will test five hypotheses. Each is related to the general theme of using species-specific data to improve understanding of the factors regulating diatoms' role in marine food webs. By combining bulk measures of silica production using the radioisotope 32Si with quantitative measures of silicon deposition rates by individual cells using the fluorescent probe 2-(4-pyridyl)-5((4-(2-dimethylaminoethyl-aminocarbamoyl)-methoxy)phenyl)oxazole, or PDMPO, the following will be determined: species-specific diatom contributions to total community silica production, regional differences in the distribution of silica production among diatom species as a function of cell size, species-specific kinetic parameters governing the ability of species to compete for dissolved silicon, and whether dominance of a particular diatom group or species can be explained by knowledge of their capacity to utilize Si and their numerical abundance (as opposed to other factors such as grazing or limitation by other nutrients).

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1155663

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