Water column data sampled aboard the R/V Pelican during August and September 2016 and May 2017 in Northern Gulf of Mexico, specifically the Louisiana Shelf region dominated by the discharge of the Mississippi River plume.

Website: https://www.bco-dmo.org/dataset/822048
Data Type: Cruise Results
Version: 1
Version Date: 2020-09-01

Project
» The biotic and abiotic controls on the Silicon cycle in the northern Gulf of Mexico (CLASiC)

Contributors	Affiliation	Role
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Abstract
Water column data sampled aboard the R/V Pelican during August and September 2016 and May 2017 in Northern Gulf of Mexico, specifically the Louisiana Shelf region dominated by the discharge of the Mississippi River plume.

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Coverage

Spatial Extent: **N**:29.07107 **E**:-89.45227 **S**:28.2633 **W**:-91.6109
Temporal Extent: 2016-08-28 - 2017-05-12

Acquisition Description

Hydrocasts were conducted at identified stations. A SeaBird CTD and rosette system, owned and maintained by Louisiana Universities Marine Consortium (LUMCON), operating institution for the R/V Pelican, was used for sampling. Calibration information can be found associated with the CTD data. Unless otherwise stated, samples used for rate measurements were collected based on the percent irradiance relative to that just below the surface.

Water was sampled from Niskin bottles and pooled into 10 L acid-cleaned carboys. For inorganic nutrients, water was filtered using 0.6 µm pore size polycarbonate membrane and immediately frozen until analysis. Filtered water was analyzed for total dissolved nitrogen (TDN), nitrate+nitrite (NO3 + NO2), nitrite, soluble reactive phosphate (SRP), and ammonium (NH4) colorimetrically using Skalar autoanalyzer (Dzwonkowski et al. 2017), and for dissolved silicic acid (Si(OH)4) using a manual colorimetric method (Krause et al. 2009). Water for Chlorophyll *a* was filtered through a 0.45 µm-pore 47mm diameter HAWP Millipore filter, immediately frozen, and analyzed on shore (<2 weeks) using an acetone extraction/acidification method (Lomas et al. 2019). For biogenic silica analysis, seawater was filtered through a 1.2 µm-pore polycarbonate filter (47 mm diameter) and frozen immediately. On shore, filters were dried and analyzed using a sodium-carbonate time course digestion, to correct for lithogenic silica interference, in polymethylpentene tubes (Pickering et al. in review). In 2016, NaOH digestions were also done for biogenic silica, followed by an HF digestion to quantify lithogenic silica as in Krause et al. (2009). Diatom abundance was quantified by fixing samples with Bouin's solution; in the laboratory, cells were settled in a chamber and enumerated (Utermöhl 1958).

Diatom rate processes were quantified using a radioisotope (32Si) and fluorescent dye (PDMPO) tracers. Sample bottles were incubated for 12 or 24 hours 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 (i.e. see above). Measurement for ambient (Amb) conditions (i.e. no enrichment of Si(OH)4) and enhanced (Enh) conditions (i.e. +20 µM enrichment of Si(OH)4) were made at most stations and depths using 32Si. The gross rate of biogenic silica production was measured using the radioisotope tracer 32Si with high specific activity (>40 kBq µg Si-1) as described in Krause et al. (2011). For PDMPO uptake, dye was added to samples at ambient or enriched Si(OH)4, incubated in the same conditions as the 32Si samples, and processed as in McNair et al. (2015). The net rate of biogenic silica production was calculated from biogenic silica standing stock at the time of sampling and after a 24-hour incubation, under the same conditions as the 32Si and PDMPO, as described in Krause et al. (2010).

Processing Description

Data were processed in Microsoft Excel.

BCO-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 in this dataset are displayed as "nd" for "no data." nd is the default missing data identifier in the BCO-DMO system.
* removed all spaces in headers and replaced with underscores
* removed all units from headers
* converted dates to ISO Format yyyy-mm-dd
* merged Date_Zulu and Time_Zulu to create ISO_DateTime_UTC and then removed Zulu columns
* set Types for each data column
* merged the CLASiC 2016 and 2017 Water Column data files into one dataset
* replaced - and , in Rosette_Bottle column with ;

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Related Publications

Dzwonkowski, B., Greer, A. T., Briseño-Avena, C., Krause, J. W., Soto, I. M., Hernandez, F. J., … Graham, W. M. (2017). Estuarine influence on biogeochemical properties of the Alabama shelf during the fall season. Continental Shelf Research, 140, 96–109. doi:10.1016/j.csr.2017.05.001
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
Methods

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

Krause, J. W., Nelson, D. M., & Lomas, M. W. (2009). Production, dissolution, accumulation, and potential export of biogenic silica in a Sargasso Sea mode-water eddy. Limnology and Oceanography, 55(2), 569–579. doi:10.4319/lo.2010.55.2.0569
Methods

Lomas, M. W., Baer, S. E., Acton, S., & Krause, J. W. (2019). Pumped Up by the Cold: Elemental Quotas and Stoichiometry of Cold-Water Diatoms. Frontiers in Marine Science, 6. doi:10.3389/fmars.2019.00286
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

Utermöhl Hans. (1958). Zur vervollkommnung der quantitativen phytoplankton-methodik (Ser. Mitteilungen / internationale vereinigung für theoretische und angewandte limnologie, nr. 9). Schweizerbart.
Methods

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Parameters

Parameter	Description	Units
Cruise	Name of specific cruise, no units	unitless
Cast_Number	CTD Number (chronological)	unitless
Latitude	Latitude of hydrocast	decimal degrees
Longitude	Longitude of hydrocast	decimal degrees
ISO_DateTime_UTC	Date/Time (UTC) ISO formatted	YYYY-MM-DDTHH:MM:SS[.xx]Z
Date_Local	Local date of hydrocast	YYYY-MM-DD
Time_Local	Local time of hydrocast	HH:MM
Station_Number	specific to cruise	unitless
Bottom_Depth	depth of water	meter (m)
Actual_Depth	Niskin bottle sample depth	meter (m)
Rosette_Bottle	Niskin Bottle number(s) for specific depth	unitless
Target_pct_Io	Percent irradiance, relative to just below surface (Io), at sample depth	% Io

Phosphate	soluble reactive phosphorus	umol/L
Nitrate_Nitrite	dissolved nitrate plus nitrite	umol/L
Nitrite	dissolved nitrite	umol/L
Ammonium	dissolved ammonium	umol/L
TDN	total dissolved nitrogen	umol/L
Silicate	dissolved silicate	umol/L
Pheophytin	degraded phaeopigments	ug/L
Chlorophyll_a	chlorophyll a pigment	ug/L
bSi	particulate biogenic silica	umol Si/L
LSi	particulate lithogenic silica	umol Si/L
Total_Diatom_Abundance	diatom abundance	cells/L
Rho_Net	Average rate of net biogenic silica production	umol Si/L/d
Rho_Net_Stdev	Standard deviation for rate of net biogenic silica production	umol Si/L/d
Uptake_32Si_rho_Amb	32Si-based Gross biogenic silica production at ambient silicate	umol Si/L/d
Uptake_32Si_Vb_Amb	32Si-based Biomass-normalized biogenic silica production at ambient silicate	d-1
Uptake_32Si_rho_Enh	32Si-based Gross biogenic silica production at +20uM silicate above ambient	umol Si/L/d
Uptake_32Si_Vb_Enh	32Si-based Biomass-normalized biogenic silica production at +20uM silicate above ambient	d-1
PDMPO_Uptake_rho_Amb	PDMPO-based Gross biogenic silica production proxy at ambient silicate	nmol PDMPO/L/d
PDMPO_Uptake_Blank_Amb	PDMPO-blank value at ambient silicate	RFU
PDMPO_Uptake_rho_Enh	PDMPO-based Gross biogenic silica production proxy at +20uM silicate above ambient	nmol PDMPO/L/d
PDMPO_Uptake_Blank_Enh	PDMPO-blank value at +20uM silicate above ambient	RFU
Temperature	CTD Temperature	degrees Celsius
Salinity	CTD Salinity, Practical	PSU
Oxygen	CTD Oxygen sensor	mg/l
Beam_Transmission	Beam Transmission on WET Labs C-Star	percent (%)
Beam_Attenuation	Beam Attenuation on WET Labs C-Star	1/m
Fluorescence_Chl	Chlorophyll Fluorescence	ug/l
PAR_Irradiance	Photosynthetically Active Radiation/Irradiance	uE/m2/s

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Instruments

Dataset-specific Instrument Name	Trilogy fluorometer (Turner Designs)
Generic Instrument Name	Fluorometer
Dataset-specific Description	Quantification of Chlorophyll a and bulk PDMPO were done using a Trilogy fluorometer (Turner Designs). For Chlorophyll a, an acidification-method (acetone and HCl matrix) module was used; for PDMPO, a crude-oil module was used with a sample matrix of hydrofluoric acid and boric acid. Chlorophyll a was calibrated using a certified standard, PDMPO was calibrated using a sequential addition of stock dye purchased from the vendor.
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.

Dataset-specific Instrument Name	Skalar autoanalyzer
Generic Instrument Name	Nutrient Autoanalyzer
Dataset-specific Description	Nutrients were analyzed colorimetrically using Skalar autoanalyzer, except for dissolved silicic acid (Si(OH)4) using a manual colorimetric method on a Genesys 10S UV-Vis spectrophotometer. Similarly, biogenic silica was digested in an alkaline solution (to solubilize particles) and analyzed as Si(OH)4 spectrophotometrically.
Generic Instrument Description	Nutrient Autoanalyzer is a generic term used when specific type, make and model were not specified. In general, a Nutrient Autoanalyzer is an automated flow-thru system for doing nutrient analysis (nitrate, ammonium, orthophosphate, and silicate) on seawater samples.

Dataset-specific Instrument Name	GM 25 Multicounters (Risø National Laboratory, Technical University of Denmark)
Generic Instrument Name	GM multicounter
Dataset-specific Description	Quantification of 32Si activity was done on a GM 25 Multicounters (Risø National Laboratory, Technical University of Denmark), each are configured to analyze five samples simultaneously. System setup includes an anti-coincidence module, which with considerable lead shielding reduces background activity to
Generic Instrument Description	A gas flow multicounter (GM multicounter) is used for counting low-level beta doses. GM multicounters can be used for gas proportional counting of 32Si to 32P. For more information about GM multicounter usage see Krause et. al. 2011 .

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Deployments

PE17-20

Website	https://www.bco-dmo.org/deployment/792830
Platform	R/V Pelican
Start Date	2017-05-03
End Date	2017-05-13

PE17-04

Website	https://www.bco-dmo.org/deployment/822209
Platform	R/V Pelican
Start Date	2016-08-26
End Date	2016-09-06

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Project Information

The biotic and abiotic controls on the Silicon cycle in the northern Gulf of Mexico (CLASiC)

Coverage: Northern Gulf of Mexico, specifically the Louisiana Shelf region dominated by the discharge of the Mississippi River on the western side of the delta

NSF Award Abstract: The Louisiana Shelf system in the northern Gulf of Mexico is fed by the Mississippi River and its many tributaries which contribute large quantities of nutrients from agricultural fertilizer to the region. Input of these nutrients, especially nitrogen, has led to eutrophication. Eutrophication is the process wherein a body of water such as the Louisiana Shelf becomes enriched in dissolved nutrients that increase phytoplankton growth which eventually leads to decreased oxygen levels in bottom waters. This has certainly been observed in this area, and diatoms, a phytoplankton which represents the base of the food chain, have shown variable silicon/nitrogen (Si/N) ratios. Because diatoms create their shells from silicon, their growth is controlled not only by nitrogen inputs but the availability of silicon. Lower Si/N ratios are showing that silicon may be playing an increasingly important role in regulating diatom production in the system. For this reason, a scientist from the University of South Alabama will determine the biogeochemical processes controlling changes in Si/N ratios in the Louisiana Shelf system. One graduate student on their way to a doctorate degree and three undergraduate students will be supported and trained as part of this project. Also, four scholarships for low-income, high school students from Title 1 schools will get to participate in a month-long summer Marine Science course at the Dauphin Island Sea Laboratory and be included in the research project. The study has significant societal benefits given this is an area where $2.4 trillion gross domestic product revenue is tied up in coastal resources. Since diatoms are at the base of the food chain that is the biotic control on said coastal resources, the growth of diatoms in response to eutrophication is important to study. Eutrophication of the Mississippi River and its tributaries has the potential to alter the biological landscape of the Louisiana Shelf system in the northern Gulf of Mexico by influencing the Si/N ratios below those that are optimal for diatom growth. A scientist from the University of South Alabama believes the observed changes in the Si/N ratio may indicate silicon now plays an important role in regulating diatom production in the system. As such, understanding the biotic and abiotic processes controlling the silicon cycle is crucial because diatoms dominate at the base of the food chain in this highly productive region. The study will focus on following issues: (1) the importance of recycled silicon sources on diatom production; (2) can heavily-silicified diatoms adapt to changing Si/N ratios more effectively than lightly-silicified diatoms; and (3) the role of reverse weathering in sequestering silicon thereby reducing diffusive pore-water transport. To attain these goals, a new analytical approach, the PDMPO method (compound 2-(4-pyridyl)-5-((4-(2-dimethylaminoethylamino-carbamoyl)methoxy)phenyl)oxazole) that quantitatively measures taxa-specific silica production would be used.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1558957

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