Silicon Uptake Kinetics sampled aboard the R/V Pelican during during PE17-04 and PE17-20 along the 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/822037
Data Type: Cruise Results
Version: 1
Version Date: 2020-08-31

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

Contributors	Affiliation	Role
Krause, Jeffrey W.	Dauphin Island Sea Lab (DISL)	Principal Investigator
Maiti, Kanchan	Louisiana State University (LSU-DOCS)	Co-Principal Investigator
Marquez Jr., Israel A.	Dauphin Island Sea Lab (DISL)	Student
Acton, Sydney	Dauphin Island Sea Lab (DISL)	Technician
Haskins, Christina	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
Silicon Uptake Kinetics sampled aboard the R/V Pelican during PE17-04 (August & September 2016) and PE17-20 (May 2017) in Northern Gulf of Mexico, specifically the Louisiana Shelf region dominated by the discharge of the Mississippi River plume.

Table of Contents

Coverage

Spatial Extent: **N**:29.06997 **E**:-89.74933 **S**:28.49727 **W**:-91.6109
Temporal Extent: 2016-08-29 - 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 dissolved silicic acid (Si(OH)4) using a manual colorimetric method (Krause et al. 2009). 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 rate processes were quantified using a radioisotope (32Si) and fluorescent dye (PDMPO) tracers. Samples bottles were incubated for <12 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). Kinetic experiments were set up by filling eight 250-mL bottles and then adding increasing enrichments of Si(OH)4 (ambient to +20 µM). The 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 enriched in Si(OH)4 as described above, incubated in the same conditions as the 32Si samples, and processed as in McNair et al. (2015).

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_Local and Time_Local to create ISO_DateTime_Local
* set Types for each data column

[table of contents | back to top]

Related Publications

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

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

Pickering, R. A., Cassarino, L., Hendry, K. R., Wang, X. L., Maiti, K., & Krause, J. W. (2020). Using Stable Isotopes to Disentangle Marine Sedimentary Signals in Reactive Silicon Pools. Geophysical Research Letters, 47(15). doi:10.1029/2020gl087877 https://doi.org/10.1029/2020GL087877
Methods

[table of contents | back to top]

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
Date_Local	Local date of hydrocast	yyyy-mm-dd
Time_Local	Local time of hydrocast	hh:mm
ISO_DateTime_Local	Date/Time (Local) ISO formatted	YYYY-MM-DDTHH:MM
Station_Number	Specific to cruise	unitless
Depth	experiment sample depth	meter (m)
bSi	particulate biogenic silica	umol Si/L
Total_Silicate	dissolved silicate from ambient (lowest) to +20 uM	umol/L
Ave_Incubation_Time	experimental incubation time, averaged among samples	days
Uptake_32Si_rho	32Si-based Gross biogenic silica production	umol Si/L/d
Uptake_32Si_Vb	32Si-based Biomass-normalized biogenic silica production	d-1
PDMPO_Blank	PDMPO-blank value at associated dissolved silicate	RFU
PDMPO_Uptake_rho	PDMPO-based Gross biogenic silica production proxy	nmol PDMPO/L/d

[table of contents | back to top]

Instruments

Dataset-specific Instrument Name	Trilogy fluorometer (Turner Designs)
Generic Instrument Name	Fluorometer
Dataset-specific Description	Quantification of bulk PDMPO was done using a Trilogy fluorometer (Turner Designs) using a crude-oil module. The sample matrix was hydrofluoric acid and boric acid. 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	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 .

[table of contents | back to top]

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

[table of contents | back to top]

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.

[table of contents | back to top]

Funding

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

[table of contents | back to top]