Silica and nitrogen analyses from incubation experiments conducted using seagrass cores from 1m depth in Grand Bay in 2017.

Website: https://www.bco-dmo.org/dataset/819975
Data Type: experimental
Version: 1
Version Date: 2020-08-10

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
We report an assessment for determining the contribution by diatoms to community productivity and respiration within a coastal benthic ecosystem with multiple autotrophs. During summer, cores of open sediment and seagrass habitat were collected from a lagoon within the Northern Gulf of Mexico. Cores were maintained in an outdoor mesocosm. Germanic acid, an inhibitor of diatom cell division, was added to half the cores and quantification of production and respiration was done. Inhibition of diatoms reduced benthic productivity within the seagrass habitat. 71 to 83% of production was attributable to diatoms and this contribution moved the benthic system into net autotrophy. Diatom contribution to production in other habitat-community components was more variable (varied from 0 to 86%). Findings underscore the ecological importance of diatoms as producers in seagrass beds, the role of seagrasses in maintaining productivity, and infer that diatoms may have similar contributions in other aquatic vegetated habitats.

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Coverage

Spatial Extent: **Lat**:30.383174 **Lon**:-88.312561
Temporal Extent: 2017-06-28 - 2017-07-31

Methods & Sampling

Three repeated experimental trials were done in summer months. Thirty-two cores (27 cm diameter, 14 cm depth) were collected from 50 m2 area of seagrass bed at 1 m depth on: June 28, July 12 and July 26, 2017 for trials 1-3, respectively. On each date, 16 cores were collected from seagrass habitat in pairs. Another 16 cores were collected from open sediment (OS) habitat. Extracted, paired cores were placed upright into an open-top plastic tub (49 x 33 x 42 cm) to produce eight tubs of each habitat.

Tubs were transported to Dauphin Island Sea Lab (~30-minute drive) filled with seawater (to core depth of 16 cm) pumped from Mobile Bay (20 km, east of site) and arranged in four blocks within an outdoor mesocosm. Each block contained two tubs of each habitat. After two days, a diatom-specific inhibitor (3 µM solution of germanic acid, i.e. Ge treatment) was randomly added to water, i.e. two tubs per block, one of each habitat type. Germanium (Ge) at high Ge/Si ratios (> 0.01) prevents formation of siliceous cell wall (Azam and Chisholm 1976). We added 3 µM solution and allowed two days for Ge incorporation.

Metabolism measurements:

Two days after, we quantified productivity and respiration from changes in oxygen content within 2-3 hour incubations of chambers and bottles following methods in Anton et al. (2009).

Nitrogen and Silica:

At end of incubation, 100 mL of water from each clear chamber was filtered through 47 mm Whatman glass fiber filter. Filtered water was analyzed for total dissolved nitrogen (TDN) and nitrate+nitrite (NO3-+NO2-) 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).

Statistical analyses:

A series of two-way ANOVAs with trial and treatment as fixed factors were used to test for differences in environment in both habitats.

Data Processing Description

Excel, Sigma Plot

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. Added ND as a missing data identifier.
* removed all spaces in headers and replaced with underscores
* removed all units from headers
* converted dates to ISO Format yyyy-mm-dd
* set Types for each data column

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Data Files

File
ni_dsi.csv (Comma Separated Values (.csv), 5.32 KB) MD5:4291c321eee467dd0d840c95a79c4621
Primary data file for dataset ID 819975

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Related Publications

Anton, A., J. Cebrian, K. L. H. Jr, and J. Goff. 2009. Low impact of Hurricane Katrina on seagrass community structure and functioning in the Northern Gulf of Mexico. Bull. Mar. Sci. 85: 16
Methods

Azam, F., & Chisholm, S. W. (1976). Silicic acid uptake and incorporation by natural marine phytoplankton populations1. Limnology and Oceanography, 21(3), 427–435. doi:10.4319/lo.1976.21.3.0427
Methods

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., 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

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Parameters

Parameter	Description	Units
Analysis_ID	name given to the water sample for analysis	unitless
Sample_ID	name of the core water came from	unitless
Collection_Date	date the core was collected from field site	yyyy-mm-dd
Ge_Addition_Date	date Ge was added to cores	yyyy-mm-dd
Experimental_Trial_Date	date of the incubation	yyyy-mm-dd
Trial	indicates whether it is trial 1, 2, or 3	unitless
Core_Taken_From	indicates where the core was taken from	unitless
Ge_Control_Treatment	indicates whether the sample came from a core given Ge or a control (no Ge added)	unitless
Seagrass_Sediment_Habitat	indicates whether the core the sample came from was collected from a seagrass or sediment habitat	unitless
Light_Dark_Incubation	indicates whether the core the sample came from was incubated in a clear or a darkened container	unitless
NO3_NO2	NO3+NO2 value of the water sample	uM
NO2	NO2 value of the water sample	uM
NH4	NH4 value of the water sample	uM
TDN	Total dissolved nitrogen in the water sample	uM
SRP	soluble reactive phosphorous in the water sample	micromole per liter (umol/L)
Dsi	dissolved silica in the water sample	micromole per liter (umol/L)

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Instruments

Dataset-specific Instrument Name	HQ30d, Hach, Loveland, Colorado, USA
Generic Instrument Name	Multi Parameter Portable Meter
Generic Instrument Description	An analytical instrument that can measure multiple parameters, such as pH, EC, TDS, DO and temperature with one device and is portable or hand-held.

Dataset-specific Instrument Name	Skalar autoanalyzer
Generic Instrument Name	Nutrient Autoanalyzer
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.

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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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