Sediment grain size data collected from a shallow subterranean estuary (STE) in Gloucester Point, Virginia USA, from 2018 to 2019

Website: https://www.bco-dmo.org/dataset/894323
Data Type: Other Field Results
Version: 1
Version Date: 2023-05-01

Project
» Collaborative Research: Cryptic nitrogen cycling in the anoxic subterranean estuary (Subsurface cryptic N cycle)

Contributors	Affiliation	Role
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Abstract
These data were collected from a sandy subterranean estuary (STE) located in Gloucester Point, Virginia, USA, which is located along the York River Estuary, a tributary of the Chesapeake Bay. Sediments were measured for grain size analyses between 2018 and 2019.

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Coverage

Spatial Extent: **Lat**:37.2489 **Lon**:-76.5053
Temporal Extent: 2018-07-10 - 2019-01-16

Methods & Sampling

The grain size of sediment samples was collected from a sandy subterranean estuary (STE) located in Gloucester Point (GP), Virginia, USA. Sediments were measured for grain size with a laser diffraction particle size analyzer (LDPSA, model: LS 13 320, Beckman Coulter). Particle size distributions of GP-STE sediment were determined with an LDPSA using the Fraunhofer Theory. Samples were subsampled from sediment vibracores collected at the GP-STE in July 2018 and replicate samples (0 centimeters, 50 centimeters, and 100 centimeters) from the January 2019 core. The data output produced by the LDPSA corresponds to the Wentworth scale range of sediment grain size categories. Samples were prepped with 10 percent (%) Calgon

solution prior to analysis.

Data Processing Description

BCO-DMO Processing Description:
- Split the column “Location” into “Latitude” and “Longitude”
- Converted the “Date” column to %Y-%m-%d to comply with BCO-DMO standards
- Longitude values were converted to decimal degrees where negative values denote the Southern hemisphere

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Data Files

File
crypticn_sediment_grainsize-1.csv (Comma Separated Values (.csv), 1.91 KB) MD5:cc5665fc586862c5357f419064975364 Primary data file for dataset 894323, version 1.

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Supplemental Files

File
Wentworth grain size chart filename: Wentworth_scale_chart.pdf (Portable Document Format (.pdf), 69.93 KB) MD5:ab666be7627bc1f6686ab18356266b24 Wentworth grain size chart from United States Geological Survey Open-File Report 2006-1195.

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Related Publications

Hvorslev, M. J. (1951). Time lag and soil permeability in ground-water observations (No. 36). Waterways Experiment Station, Corps of Engineers, US Army.
Methods

Williams, S. J., Arsenault, M. A., Buczkowski, B. J., Reid, J. A., Flocks, J., Kulp, M. A., ... & Jenkins, C. J. (2006). Surficial sediment character of the Louisiana offshore Continental Shelf region: a GIS Compilation (No. 2006-1195). US Geological Survey.
Methods

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Related Datasets

IsRelatedTo

Wilson, S. J., Song, B., Anderson, I. C., Tobias, C. (2023) **Water level data from a slug test within a shallow, sandy subterranean estuary (STE), Gloucester Point, Virginia USA in May 2021.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2023-05-09 doi:10.26008/1912/bco-dmo.894312.1 [view at BCO-DMO]

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Parameters

Parameter	Description	Units
Season_Sampled	Season sediment vibracore was collected	unitless
Latitude	Latitude of coring location	decimal degrees
Longitude	Longitude of coring location	decimal degrees
Date	Date of sampling	unitless
Depth_Interval	Depth section of the sediment core used for analysis	centimeters (cm)
Mean_Grain_Size	Mean sediment grain size	micrometers (um)
Percent_Sand	Percent of sediment sample that is sand	percent (%)
Percent_Mud	Percent of sediment sample that is mud	percent (%)
Percent_Very_Coarse_Sand	Percent of sediment sample that is very coarse sand	percent (%)
Percent_Coarse_Sand	Percent of sediment sample that is coarse sand	percent (%)
Percent_Medium_Sand	Percent of sediment sample that is medium sand	percent (%)
Percent_Fine_Sand	Percent of sediment sample that is fine sand	percent (%)
Percent_Very_Fine_Sand	Percent of sediment sample that isvery fine sand	percent (%)
Percent_Silt	Percent of sediment sample that is silt	percent (%)
Percent_Clay	Percent of sediment sample that is clay	percent (%)
Median_Grain_Size	Median sediment grain size	micrometers (um)
d10	Effective size that directly corresponds to the percentage by weight of grains that equal to 10% on the Wentworth grain-size diagram	millimeters (mm)

d50	Effective size that directly corresponds to the percentage by weight of grains that equal to 50% on the Wentworth grain-size diagram	millimeters (mm)

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Instruments

Dataset-specific Instrument Name	LDPSA, model: LS 13 320, Beckman Coulter
Generic Instrument Name	Laser Diffraction Particle Size Analyzer
Generic Instrument Description	Laser diffraction is particle sizing technique for materials ranging from hundreds of nanometers up to several millimeters in size. Laser diffraction measures particle size distributions by measuring the angular variation in intensity of light scattered as a laser beam passes through a dispersed particulate sample. One example is the Beckman Coulter LS200.

Dataset-specific Instrument Name	
Generic Instrument Name	Vibracore
Generic Instrument Description	Vibracoring is a sediment sampling technology to obtain undisturbed cores of unconsolidated, sediment in saturated or nearly saturated conditions by driving sampling tubes with a high-frequency-low-amplitude vibrating device. During sediment coring, the high-frequency vibration transfers the energy to the sediment and aids in the liquefaction of the surrounding sediment. It greatly reduces the friction between the core tube and sediment and eases the core tube to penetrate into the sediment layer. Comparing to non-vibratory coring devices, such as box cores, gravity cores, and piston cores, vibracore has higher core sample recoveries. Vibracorers are effective in both shallow and deep environments. They retrieve core samples with different lengths depending on sediment lithology.

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Project Information

Collaborative Research: Cryptic nitrogen cycling in the anoxic subterranean estuary (Subsurface cryptic N cycle)

Coverage: Temperate (Mid-Atlantic), Sandy Beach along the York River Estuary, Gloucester Point, Virginia, USA (37.24884N/76.505324W)

NSF Award Abstract:
Nitrogen is an important nutrient that maintains high coastal ecosystem productivity. Yet excess nitrogen delivery can cause serious water quality deterioration including harmful algal blooms, fish kills, and oxygen free dead zones. Numerous nitrogen transformations regulate the balance between nitrogen delivery and nitrogen removal in coastal environments and the majority of these reactions occur in sediments where seawater passes through the subsurface and mixes with groundwater transported from uplands. This mixing zone,

referred to as the subterranean estuary, is characterized by very different geochemistry than either the seawater above it or the groundwater below it. Thus, it has the potential to host a variety of unique reactions that affect nitrogen availability to the overlying water. Scientists from the College of William and Mary, Virginia Institute of Marine Science (VIMS), and the University of Connecticut (UConn) propose to examine the importance of a cryptic nitrogen cycle, a novel and potentially widespread nitrogen cycling process in the subterranean estuary. The cryptic nitrogen cycle comprises anoxic ammonium oxidation to nitrite (anoxic nitrification) coupled with anaerobic ammonium oxidation (anammox) or denitrification producing harmless dinitrogen gas. The proposed project represents highly transformative science because it has the potential to change the current paradigm detailing operation of the biogeochemical nitrogen cycle in anoxic environments. Occurrence of the cryptic nitrogen cycle would have broad implications for the nitrogen budget of terrestrial and groundwater systems and the coastal ocean. Characterization of the cryptic nitrogen cycle will allow us to better understand interactions among the nitrogen, metals, and sulfur cycles, and potential impacts of ongoing human modification of coastal environments. Educational contribution of this project focuses on graduate and undergraduate student training. Two graduate students at VIMS and UConn will receive interdisciplinary training in microbiology, molecular ecology, and biogeochemistry while several undergraduates recruited through the VIMS REU (Research Experience for Undergraduates) Program and the UConn marine science programs will also participate in the project. In addition, three summer undergraduate interns will be recruited from Hampton University, a historically Black college, and trained to enhance minority education and research in marine science. Public outreach will be achieved through popular venues such as VIMS Marine Science Day, and the VIMS After Hours Public Lecture Series at VIMS. Tobias at UConn also provides educational contributions and outreach efforts through the UConn Marine Scholars and Early College Experience programs and an exhibit at Mystic Aquarium.

A cryptic nitrogen cycle is proposed as a new process coupling anoxic nitrification to microbial nitrogen removal pathways such as anammox and denitrification. Unlike anammox, which refers to the oxidation of ammonium by nitrite to form dinitrogen (N2) gas, anoxic nitrification occurs by oxidation of ammonium in the absence of oxygen using other common chemical oxidants such as metal oxides (namely, Fe and Mn) or sulfate, abundant in many marine and coastal systems. The thermodynamic favorability of these reactions relies on coupling nitrite formed via these oxidants with anammox or denitrification. Due to the coupling, nitrite will not accumulate or be measurable in anoxic marine systems. Thus, a cryptic N cycle responsible for nitrite production can occur as a novel N transforming process in anoxic environments, serve as a vital link to N2 production, and attenuate N loads discharging from a subterranean estuary (STE). Preliminary results from a STE in the York River Estuary located in Virginia showed substantial N2 production, representing removal of 50-75% of the fixed groundwater N, in ferruginous and sulfidic zones where neither nitrite nor nitrate were detectable. Stable isotope incubation experiments using the 15N tracer and molecular analysis of microbial communities suggest that coupled anoxic nitrification and anammox processes are the dominant N2 production pathways rather than canonical denitrification in the STE. Therefore, coupled anoxic nitrification-anammox in coastal groundwater may be a major unrecognized sink for fixed nitrogen at the land-sea interface. In addition to coastal groundwater, the cryptic N cycle has potential importance in anoxic zones and ocean basins. This proposal focuses on the STE because geochemical conditions there appear optimal for the proposed reactions to occur, and our preliminary data show strong evidence for a cryptic N cycle. The proposed work uses a combined geochemical, 15N isotope tracer and microbiological approach to evaluate environmental controls on the cryptic N cycle as well as to estimate its contribution to reduction of fixed N fluxes to the coastal ocean. Four approaches are proposed: (1) Field characterization of anoxic nitrification reactions and associated microbial communities in a subterranean estuary; (2) Laboratory incubation experiments to identify hotspots of the cryptic N cycle; (3) Controlled microcosm experiments to determine geochemical controls on anoxic nitrification; and (4) in situ assessment of anoxic nitrification to estimate the importance of the cryptic N cycle in a coastal aquifer.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1658135

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