Sets of sediment cores taken for isotope pairing and other nitrogen cycle parameters seasonally since November 2013 from two oyster farm and control sites in Rhode Island and New York

Website: https://www.bco-dmo.org/dataset/661581
Data Type: Other Field Results
Version: 14 October 2016
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Project
» Microbial Regulation of Greenhouse Gas N2O Emission from Intertidal Oyster Reefs (Oyster Reef N2O Emission)

Contributors	Affiliation	Role
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Dataset Description

Sets of sediment cores taken for isotope pairing and other nitrogen cycle parameters seasonally since November 2013 from two oyster farm and control sites.

Status: Data are restricted from public access until 08 November 2017. Please contact the PI for prior access.

Methods & Sampling

Samples were collected at coastal oyster farms in Rhode Island (41 22' 45" N, 71 38' 43" W) and New York (41 16' 9" N, 71 59' 29" W). At both locations, the approximate depth is 2 meters.

Coupled direct denitrification (DNF), direct DNF, and dissimilatory nitrate reduction to ammonium (DNRA) are measured in sediments collected from each site in areas that are influenced by oysters and areas that are not. Seasonally five intact sediment cores are taken from directly underneath oyster growth and from control sites in both farms. Cores are incubated at in situ temperature with no air headspace and 15N-NO3- tracer added to the overlying water. Each core is sacrificed and slurried as a single time point. Water column dissolved inorganic nitrogen (DIN) samples are analyzed colorimetrically for concentration (WestCo SmartChem). N2 isotopologues are measured on the membrane inlet mass spectrometer (MIMS) and are used to calculate rates of both coupled and direct DNF via the isotope pairing method (IPT, Steingruber et al. 2001). Sediment bound 15N-NH4+ enrichment is measured using the azide hypobromide method (Zhang et al. 2007) and are run on the isotope ratio mass spectrometer (IRMS). 15N-NH4+ enrichment is then used to calculate rates of DNRA. Additionally, sediment sub-samples are run on an elemental analyzer (EA) coupled to IRMS for sediment

C:N, 15N, and 13C. Finally, in order to constrain the overall 15N mass balance intermediate pools such as NO2 and N2O are also analyzed.

Related references:
Steingruber, S. M., Friedrich, J., Gächter, R., & Wehrli, B. 2001. Measurement of denitrification in sediments with the 15N isotope pairing technique. Applied and Environmental Microbiology, 67(9), 3771-3778. doi:10.1128/AEM.67.9.3771-3778.2001

Zhang, L., M. A. Altabet, T. Wu, O. Hadas. 2007. Sensitive measurement of NH4+ 15N/14N (15NH4+) at natural abundance levels in fresh and salt waters. Analytical Chemistry 79:5297-5303. doi:10.1021/ac070106d

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Parameters

Parameter	Description	Units
date	Date of sampling formatted as yyyy-mm-dd	unitless
season	Season of sampling	unitless
location	Sampling location name	unitless
state	State of sampling location (NY or RI)	unitless
lat	Latitude of sampling location	decimal degrees
lon	Longitude of sampling location	decimal degrees
site	Site (Oyster or Control)	unitless
N2O_flux	N2O flux	micromoles per square meter per hour (umol m-2 h-1)
NO2_flux	NO2 flux	micromoles per square meter per hour (umol m-2 h-1)
NO3_flux	NO3 flux	micromoles per square meter per hour (umol m-2 h-1)
sediment_15N	Sediment 15N	micromoles (umol)
pcnt_OM	Percent organic matter	percent (%)
gC_per _gsed	grams of Carbon per grams of sediment	g C / g sediment
d13C	d13C	per mil
d15N	d15N	per mil
mgN_per_gsed	milligrams of Nitrogen per grams of sediment	mg N / g sediment
C_to_N	C:N	dimensionless (ratio)

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Instruments

Dataset-specific Instrument Name	WestCo SmartChem
Generic Instrument Name	Discrete Analyzer
Dataset-specific Description	Water column DIN samples are analyzed colorilmetrically for concentration (WestCo SmartChem).
Generic Instrument Description	Discrete analyzers utilize discrete reaction wells to mix and develop the colorimetric reaction, allowing for a wide variety of assays to be performed from one sample. These instruments are ideal for drinking water, wastewater, soil testing, environmental and university or research applications where multiple assays and high throughput are required.

Dataset-specific Instrument Name	isotope ratio mass spectrometer
Generic Instrument Name	Isotope-ratio Mass Spectrometer
Dataset-specific Description	Sediment bound 15N-NH4+ enrichment is measured using the azide hypobromide method (Zhang et al. 2007) and are run on the isotope ratio mass spectrometer (IRMS).
Generic Instrument Description	The Isotope-ratio Mass Spectrometer is a particular type of mass spectrometer used to measure the relative abundance of isotopes in a given sample (e.g. VG Prism II Isotope Ratio Mass-Spectrometer).

Dataset-specific Instrument Name	membrane inlet mass spectrometer
Generic Instrument Name	Membrane Inlet Mass Spectrometer
Dataset-specific Description	N2 isotopologues are measured on the membrane inlet mass spectrometer (MIMS) and are used to calculate rates of both coupled and direct DNF via the isotope pairing method (IPT, Steingruber et al. 2001).
Generic Instrument Description	Membrane-introduction mass spectrometry (MIMS) is a method of introducing analytes into the mass spectrometer's vacuum chamber via a semipermeable membrane.

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Deployments

UConn_Tobias_2013-14

Website	https://www.bco-dmo.org/deployment/680942
Platform	Univ_Connecticut
Start Date	2013-10-25
End Date	2014-06-27

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Project Information

Microbial Regulation of Greenhouse Gas N2O Emission from Intertidal Oyster Reefs (Oyster Reef N2O Emission)

Extracted from the NSF award abstract:

Oyster reefs are biogeochemical hot spots and prominent estuarine habitats that provide disproportionate ecological function. Suspension-feeding eastern oysters, Crassostrea virginica, are capable of improving water quality and diminishing eutrophication by filtering nutrients and particles from the water and depositing them in the sediments. Remineralization of these deposits may enhance sedimentary denitrification that facilitates nitrogen removal in tidal estuaries. However, the scientific underpinning of oyster reef function has been challenged in various studies. In addition, recent studies of filter feeding invertebrates reported the production of nitrous oxide (N2O), a greenhouse gas, as an end product of incomplete denitrification by gut microbes. C. virginica could be another source of N2O flux from intertidal habitats. Preliminary work indicated substantial N2O production from individual oysters. The estimated N2O production from high density oyster reefs may exceed the N2O flux measured from some estuaries. With the new discovery of N2O emission and uncertainty regarding eutrophication control, the ecological value of oyster reef restoration may become equivocal.

This project will quantify N2O fluxes to understand the factors controlling N2O emission from oyster reefs. Sedimentary N processes will be examined to develop an oyster reef N model to estimate N2O emission from tidal creek estuaries relative to other N cycling processes. The PIs hypothesize that intertidal oyster reefs are a substantial source of N2O emission from estuarine ecosystems and the magnitude of emission may be linked to water quality. If substantial N2O flux from oyster reefs is validated, ecological benefits of oyster reef restoration should be reevaluated. This interdisciplinary research team includes a microbial ecologist, a biogeochemist, an ecologist and an ecosystem modeler. They will utilize stable isotope and molecular microbiological techniques to quantify oyster N2O production, elucidate microbial sources of N2O emission from oysters and sediments, and estimate seasonal variation of N2O fluxes from oyster reefs. Measurements from this study will be integrated into a coupled oyster bioenergetics-sediment biogeochemistry model to compare system level rates of N cycling on oyster reefs as a function of oyster density and water quality. Modeling results will be used to assess the relative trade-offs of oyster restoration associated with N cycling. They expect to deliver the following end products:1) estimation of annual N2O flux from oyster reefs as an additional source of greenhouse gases from estuaries, 2) a better understanding of the environmental and microbial factors influencing N2O and N2 fluxes in tidal estuaries, 3) transformative knowledge for the effect of oyster restoration on water quality enhancement and ecosystem function, 4) direct guidance for oyster restoration projects whose goals include water quality enhancement, and 5) a modeling tool for use in research and restoration planning.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1233372

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