CTD data from R/V Hugh R. Sharp cruise HRS2110 in the Chesapeake Bay during August 2021

Website: https://www.bco-dmo.org/dataset/868879
Data Type: Cruise Results
Version: 1
Version Date: 2022-01-26

Project
» Nitrite Oxidation in Oxygen Minimum Zones (NO2Ox_OMZs)

Contributors	Affiliation	Role
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Abstract
This dataset includes CTD data from R/V Hugh R. Sharp cruise HRS2110 in the Chesapeake Bay during August 2021. These data are associated with the "Nitrate Oxidation in Oxygen Minimum Zones" project.

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Coverage

Spatial Extent: **N**:39.1405 **E**:-76.0922 **S**:35.0061 **W**:-76.4395
Temporal Extent: 2021-08-04 - 2021-08-10

Methods & Sampling

Water samples were collected using a 12 x 10-liter Niskin bottle rosette sampler equipped with a conductivity, temperature, and pressure instrument package (SBE9, Sea-Bird Electronics, Bellevue, Washington, U.S.A.), a sensor for dissolved oxygen (SBE43, Sea-Bird), and a sensor for chlorophyll fluorescence (FluoroWetlabECO, AFL FL Sensor).

Data Processing Description

CTD data were processed with Seasave V 7.26.0.7.

BCO-DMO Processing Notes:
- Standardized UTC time formatting;
- Added a UTC datetime field in ISO 8601 format;
- Renamed fields to remove all special characters except underscores.

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Data Files

File
cb_2021_compiledctdfiles-1.csv (Comma Separated Values (.csv), 90.12 KB) MD5:84db1a8541471dc87cb5aec3cc3fd161 Primary data file for dataset ID 868879

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Parameters

Parameter	Description	Units
Cast	cast number	unitless
Station	station name	unitless
ISO_DateTime_UTC	Datetime of cast; YYYYY-MM-DDTHH:MM:SSZ	unitless
Date	Date of cast; YYYY-MM-DD	unitless
time_UTC	Time of deployent, UTC; HH:MM:SS	unitless
timeS	Time, Elapsed	seconds
depSM	Depth [salt water]	m
prDM	Pressure, Digiquartz	decibars
t090C	Temperature	oC
t190C	Temperature, 2	oC
c0S_per_m	Conductivity	S/m
c1S_per_m	Conductivity, 2	S/m
sal00_1	Salinity, Practical	PSU
sal11_1	Salinity, Practical, 2	PSU

timeQ	Time, NMEA	seconds
timeY	Time, System	seconds
latitude	Latitude	decimal degrees
longitude	Longitude	decimal degrees
svCM_1	Sound Velocity	m/s
flECO_AFL	Fluorescence, WET Labs ECO-AFL/FL	mg/m3
sbeox0ML_per_L	Oxygen, SBE 43	ml/l
sbox0Mm_per_Kg	Oxygen, SBE 43	µmol/kg
sbeox0Mg_per_L	Oxygen, SBE 43	mg/l
sigma_E00	Density [sigma-theta]	kg/m3
sigma_E11	Density, 2 [sigma-theta]	kgk/m3
potemp090C	Potential Temperature	oC
potemp190C	Potential Temperature, 2	oC
svCM_2	Sound Velocity [Chen-Millero]	m/s
sal00_2	Salinity, Practical	PSU
sal11_2	Salinity, Practical, 2	PSU
flag	flag	unitless

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Instruments

Dataset-specific Instrument Name	CTD Sea-Bird 9
Generic Instrument Name	CTD Sea-Bird 9
Dataset-specific Description	A conductivity, temperature, and pressure instrument package (SBE9, Sea-Bird Electronics, Bellevue, Washington, U.S.A) attached to the Niskin bottle rosette used for sample collection.
Generic Instrument Description	The Sea-Bird SBE 9 is a type of CTD instrument package. The SBE 9 is the Underwater Unit and is most often combined with the SBE 11 Deck Unit (for real-time readout using conductive wire) when deployed from a research vessel. The combination of the SBE 9 and SBE 11 is called a SBE 911. The SBE 9 uses Sea-Bird's standard modular temperature and conductivity sensors (SBE 3 and SBE 4). The SBE 9 CTD can be configured with auxiliary sensors to measure other parameters including dissolved oxygen, pH, turbidity, fluorometer, altimeter, etc.). Note that in most cases, it is more accurate to specify SBE 911 than SBE 9 since it is likely a SBE 11 deck unit was used. more information from Sea-Bird Electronics

Dataset-specific Instrument Name	Niskin bottle rosette sampler
Generic Instrument Name	Niskin bottle
Dataset-specific Description	Water samples were collected using a 12 x 10 L Niskin bottle rosette sampler, which was equipped with CTD Sea-Bird 9, Sea-Bird SBE 43 Dissolved Oxygen, and Wet Labs ECO-AFL/FL Fluorometer sensors.
Generic Instrument Description	A Niskin bottle (a next generation water sampler based on the Nansen bottle) is a cylindrical, non-metallic water collection device with stoppers at both ends. The bottles can be attached individually on a hydrowire or deployed in 12, 24, or 36 bottle Rosette systems mounted on a frame and combined with a CTD. Niskin bottles are used to collect discrete water samples for a range of measurements including pigments, nutrients, plankton, etc.

Dataset-specific Instrument Name	SBE43, Sea-Bird
Generic Instrument Name	Sea-Bird SBE 43 Dissolved Oxygen Sensor
Dataset-specific Description	A dissolved oxygen sensor attached to the Niskin bottle rosette used for sample collection.
Generic Instrument Description	The Sea-Bird SBE 43 dissolved oxygen sensor is a redesign of the Clark polarographic membrane type of dissolved oxygen sensors. more information from Sea-Bird Electronics

Dataset-specific Instrument Name	FluoroWetlabECO, AFL FL Sensor
Generic Instrument Name	Wet Labs ECO-AFL/FL Fluorometer
Dataset-specific Description	A sensor for chlorophyll fluorescence attached to the Niskin bottle rosette used for sample collection.
Generic Instrument Description	The Environmental Characterization Optics (ECO) series of single channel fluorometers delivers both high resolution and wide ranges across the entire line of parameters using 14 bit digital processing. The ECO series excels in biological monitoring and dye trace studies. The potted optics block results in long term stability of the instrument and the optional anti-biofouling technology delivers truly long term field measurements. more information from Wet Labs

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Deployments

HRS2110

Website	https://www.bco-dmo.org/deployment/868888
Platform	R/V Hugh R. Sharp
Start Date	2021-08-03
End Date	2021-08-21
Description	See more information about this cruise in Rolling Deck to Repository (R2R): https://www.rvdata.us/search/cruise/HRS2110

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Project Information

Nitrite Oxidation in Oxygen Minimum Zones (NO2Ox_OMZs)

Coverage: Eastern Tropical South Pacific and Chesapeake Bay

NSF Award Abstract:
This research is grounded in the fundamental role of nitrogen in limiting production in the ocean. Nitrite is a pivotal compound in the nitrogen cycle: it can be oxidized to nitrate, and thus retained as an available nutrient, or it can be reduced to dinitrogen gas, and thus lost from the bioavailable nitrogen pool. Oxidation of nitrite by nitrite oxidizing bacteria (NOB) is the only biological pathway by which nitrate is produced, and all known NOB require oxygen for life. The reduction pathway is also carried out by microbes, in this case, bacteria that thrive only in the absence of oxygen. In previous experiments, however, both oxidation and reduction of nitrite were detected in the same samples from ocean waters in the absence of oxygen. We will investigate three explanations for the apparent oxidation of nitrite in the absence of oxygen on a research cruise to the low oxygen waters off the coast of Peru: 1) The presence of unknown kinds of NOB that do not require oxygen; 2) a new reaction called dismutation, which is possible but never detected in nature; 3) an artifact associated with oxygen stress in NOB. This research could lead to discovery of novel mechanisms and or novel organisms that determine the fate of nitrite and the availability of nitrogen to support primary production in the long run. This project will advance discovery and understanding while promoting teaching, training and learning by providing opportunities for Princeton students to get involved in and have hands on experience in research in the lab and potentially at sea. Both undergraduate and graduate students will participate in the research through

internships and field experiences. We will also integrate our work at sea into teaching in the classroom via videos and assignments based on data collected during the cruise.

Nitrite oxidation is the only known biological process that produces nitrate, which comprises the largest fixed nitrogen reservoir in the ocean. Nitrite oxidation is carried out by nitrite oxidizing bacteria (NOB), and all known species are obligate aerobes. Nitrite reduction to N2 occurs in multiple microbial pathways, generally under anoxic conditions. Despite their apparent incompatibility regarding oxygen, both processes are detected in the low oxygen or anoxic waters of oxygen minimum zones (OMZs). Thus, the fate of nitrite in OMZs has implications for the global fixed N budget. Nitrite oxidation is detected at high rates in essentially zero oxygen water in the most oxygen depleted depth intervals in OMZ regions, which suggests that some nitrite oxidizers might possess anaerobic metabolic capabilities. Nitrite disproportionation (or dismutation), in which nitrite is simultaneously oxidized to nitrate and reduced to N2, is a thermodynamically favorable reaction, which would link the two processes in one organism – but it has never been observed in nature. The research proposed here will address two big questions about nitrite in the ocean: 1) How does anaerobic nitrite oxidation work? 2) What determines the fate of nitrite? The experimental approach will investigate three possible explanations for anaerobic nitrite oxidation: 1) Nitrite is oxidized to nitrate by different clades of NOB, which exhibit different tolerances/requirements for oxygen; 2) Nitrite dismutation, also performed by NOB, partially explains the cooccurrence of oxidation and reduction of nitrite; 3) Apparently anaerobic nitrite oxidation is indeed biologically mediated but does not always represent net production of nitrate from nitrite; rather it results from isotopic equilibration during enzyme-catalyzed interconversion of nitrite and nitrate. These questions will be addressed by performing a suite of 15N-tracer incubations at stations located within and outside of one of the major OMZs in the ocean, the Eastern Tropical South Pacific. The dependence of the rate processes on oxygen concentrations will be determined, and the composition of the microbial assemblages will be assessed in order to determine whether different microbial components are involved under different environmental conditions. The expression of genes involved in oxidation/reduction/ respiratory metabolisms at low oxygen concentrations will be measured across oxygen gradients and in oxygen manipulations to identify their potential role in supporting “anaerobic” nitrite oxidation. The possibility that the apparently anaerobic nitrite oxidation is due to an enzyme level interconversion between nitrite and nitrate, which does not lead to net nitrate production and is not linked to growth of nitrite oxidizing bacteria, will also be investigated.

This award reflects NSF's statutory mission and has been deemed worthy of support through evaluation using the Foundation's intellectual merit and broader impacts review criteria.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1946516

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