

CTD data from R/V Hugh R. Sharp cruise HRS2212 in the Chesapeake Bay during August 2022

Website: <https://www.bco-dmo.org/dataset/896097>

Data Type: Cruise Results

Version: 1

Version Date: 2023-05-23

Project

» [Nitrite Oxidation in Oxygen Minimum Zones](#) (NO₂O_x_OMZs)

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Abstract

This dataset includes CTD data from R/V Hugh R. Sharp cruise HRS2212 in the Chesapeake Bay during August 2022. These data are associated with the "Nitrate Oxidation in Oxygen Minimum Zones" project.

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Coverage

Spatial Extent: N:38.9972 E:-76.3665 S:38.5648 W:-76.4407

Temporal Extent: 2022-08-12 - 2022-08-19

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:

- removed "-9.99E-29" as missing data value and replaced with blanks/empty cells;
- added date-time field in ISO 8601 format;
- renamed fields to comply with BCO-DMO naming conventions.

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Data Files

File
cb_2022_ctd.csv (Octet Stream, 69.67 KB) MD5:e370ac7a76de7992da1d1775a83c671a
Primary data file for dataset ID 896097.

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Parameters

Parameter	Description	Units
Cast	cast number	unitless
Station	station name	unitless
ISO_DateTime.UTC	Date and time (UTC) of cast in ISO 8601 format	unitless
Date	Date of cast	unitless
time.UTC	time of deployent, UTC	unitless
timeS	Time, Elapsed	seconds
depSM	Depth [salt water]	meters (m)
prDM	Pressure, Digiquartz	decibars
t090C	Temperature	degrees Celsius
t190C	Temperature, 2	degrees Celsius
c0S_per_m	Conductivity	Siemens per meter (S/m)
c1S_per_m	Conductivity, 2	Siemens per meter (S/m)
sal00_1	Salinity, Practical	PSU
sal11_1	Salinity, Practical, 2	PSU
timeQ	Time, NMEA	seconds
timeY	Time, System	seconds
latitude	Latitude (positive values = North)	decimal degrees
longitude	Longitude (negative values = West)	decimal degrees
svCM_1	Sound Velocity	meters per second (m/s)
fIECO_AFL	Fluorescence, WET Labs ECO-AFL/FL	milligrams per cubic meter (mg/m ³)
sbeox0ML_per_L	Oxygen, SBE 43	milliliters per liter (mL/L)
sbox0Mm_per_Kg	Oxygen, SBE 43	micromoles per kilogram (umol/kg)
sbeox0Mg_per_L	Oxygen, SBE 43	milligrams per liter (mg/L)
sigma_E00	Density [sigma-theta]	kilograms per cubic meter (kg/m ³)
sigma_E11	Density, 2 [sigma-theta]	kilograms per cubic meter (kg/m ³)
potemp090C	Potential Temperature	degrees Celsius
potemp190C	Potential Temperature, 2	degrees Celsius
svCM_2	Sound Velocity [Chen-Millero]	meters per second (m/s)
sal00_2	Salinity, Practical	PSU
sal11_2	Salinity, Practical, 2	PSU
flag	flag	unitless

Instruments

Dataset-specific Instrument Name	Sea-Bird 9
Generic Instrument Name	CTD Sea-Bird 9
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	10-liter Niskin bottle rosette
Generic Instrument Name	Niskin bottle
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
Generic Instrument Name	Sea-Bird SBE 43 Dissolved Oxygen Sensor
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
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

Deployments

HRS2212

Website	https://www.bco-dmo.org/deployment/896459
Platform	R/V Hugh R. Sharp
Start Date	2022-08-11
End Date	2022-08-20
Description	See additional cruise information in R2R: https://www.rvdata.us/search/cruise/HRS2212

Project Information

Nitrite Oxidation in Oxygen Minimum Zones (NO₂O_x_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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