CTD hydrography and nutrients from casts conducted on R/V Kilo Moana cruises KM1919 and KM1920 from September to October 2019

Website: https://www.bco-dmo.org/dataset/849710
Data Type: Cruise Results
Version: 1
Version Date: 2021-04-20

Project
» Dimensions: Diversity, assembly and function of microbial communities on suspended and sinking particles in a marine Oxygen Deficient Zone (ETNP_ParticleOmics)
» Permanence of the recent expansions of the OMZ and denitrification regimes in the eastern tropical North Pacific (ETNP OMZ Denitrification)

Program
» Dimensions of Biodiversity (Dimensions of Biodiversity)

Contributors	Affiliation	Role
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Abstract
The dataset contains the processed bottle files, i.e., depths and associated data collected electronically by the CTD, for all CTD casts during cruises KM1919 and KM1920, along with all nutrient data on casts from which it was collected. The nutrients include nitrate, nitrite, silicate, phosphate, and ammonium. The concentrations for all nutrients are in micromoles per kg as is the CTD oxygen concentration. These two cruises took place on the R/V Kilo Moana from September to October 2019 in the Eastern Tropical North Pacific, off the coast of Mexico and Southern California. The data were collected as part of NSF grant numbers 1542240 to Gabrielle Rocap, Rick Keil, Allan Devol, and Curtis Deutsch along with NSF-1657958 to Allan Devol.

Table of Contents

Coverage

Spatial Extent: **N**:22.6667 **E**:-106.88594 **S**:13.99972 **W**:-110.00235
Temporal Extent: 2019-09-26 - 2019-10-19

Methods & Sampling

Data were collected CTD during cruises KM1919 and KM1920.

The CTD data has been reprocessed and aligned, and outliers have been removed. Nutrient samples were filtered (Sterivex 0.22um) before analysis and analyzed using the US-JGOFS protocols (http://usjgofs.whoi.edu/protocols_rpt_19.html). All data are considered preliminary.

Known Problems:
Calibration salinity samples analyzed using an AutoSal salinometer agreed with CTD sensor 0, but sensor 1 was significantly off. Consequently, salinity values and derived values (density, oxygen, oxygen saturation) were calculated only from sensor 0. Sensor 1 data not included.

Data Processing Description

Data Processing:
Raw data from the CTD was processed using SeaBird software programs (Data conversion, Align, Thermal mass, Derive, Bin average and Bottle Summary).

BCO-DMO Processing:
- converted dates from Excel format to YYYY-MM-DD;
- renamed fields to comply with BCO-DMO naming conventions;
- added Cruise_ID field based on date;
- corrected date for station 8, second occupation.

[table of contents | back to top]

Data Files

File
KM1919-20_CTD.csv (Comma Separated Values (.csv), 85.18 KB) MD5:475343ef959a95a86064839bf17e27cb Primary data file for dataset ID 849710

[table of contents | back to top]

Parameters

Parameter	Description	Units
Cruise_ID	cruise designation; name	unitless
station	station identifier	unitless
Date	date (GMT); format: YYYY-MM-DD	unitless
Longitude	longitude, in decimal degrees	decimal degrees East
Latitude	latitude, in decimal degrees	decimal degrees North
Press	pressure	decibars

Depth	sample depth below the sea surface	meters (m)
T_0	temperature sensor 0	degrees Celsiu
Sal_0	salinity sensor 0	psu
Sigma_theta	sigma theta	kilograms per cubic meter (kg/m3)
Fluor	chlorophyll a	micrograms per liter (ug/l)
Attn	Beam attenuation (loss of light) of a narrow, well collimated beam of light; beam attenuation due to particles; the particulate beam attenuation coefficient (cp)	1/m
Trans	light transmission, as percent	percent (%)
Par	Photosynthetically Available [Active] Radiation; downwelling irradiance	microEinsteins per square meter per second (uEinsteins/m2/sec)
O2_0	O2 sensor 0	micromoles per kilogram (umol/kg)
O2sat	O2 saturation sensor 0	percent (%)
PO4	Orthophosphate (phosphate, reactive phosphorus)	micromoles per kilogram (umol/kg)
Si_OH4	Silicate (Orthosilicic Acid)	micromoles per kilogram (umol/kg)
NO3	Nitrate	micromoles per kilogram (umol/kg)
NO2	Nitrite	micromoles per kilogram (umol/kg)
NH4	Ammonium	micromoles per kilogram (umol/kg)

[table of contents | back to top]

Instruments

Dataset-specific Instrument Name	CTD-SBE 911
Generic Instrument Name	CTD Sea-Bird 911
Dataset-specific Description	CTD-SBE 911; factory calibrations.
Generic Instrument Description	The Sea-Bird SBE 911 is a type of CTD instrument package. The SBE 911 includes the SBE 9 Underwater Unit and the SBE 11 Deck Unit (for real-time readout using conductive wire) for deployment from a 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, fluorescence, light (PAR), light transmission, etc.). More information from Sea-Bird Electronics.

Dataset-specific Instrument Name	Wet labs C-Star
Generic Instrument Name	WET Labs {Sea-Bird WETLabs} C-Star transmissometer
Dataset-specific Description	Beam attenuation and transmission were by Wet labs C-Star.
Generic Instrument Description	The C-Star transmissometer has a novel monolithic housing with a highly intgrated opto-electronic design to provide a low cost, compact solution for underwater measurements of beam transmittance. The C-Star is capable of free space measurements or flow-through sampling when used with a pump and optical flow tubes. The sensor can be used in profiling, moored, or underway applications. Available with a 6000 m depth rating. More information on Sea-Bird website: https://www.seabird.com/c-star-transmissometer/product?id=60762467717

Dataset-specific Instrument Name	Wetlabs ECO-AFL/FL
Generic Instrument Name	WETLabs ECO-FLNTU
Dataset-specific Description	Chlorophyll was measured by Wetlabs ECO-AFL/FL.
Generic Instrument Description	The ECO FLNTU is a dual-wavelength, single-angle sensor for simultaneously determining both chlorophyll fluorescence and turbidity.

[table of contents | back to top]

Deployments

KM1919

Website	https://www.bco-dmo.org/deployment/849503
Platform	R/V Kilo Moana
Start Date	2019-09-21
End Date	2019-10-01
Description	More information is available from the Rolling Deck to Repository (R2R): https://www.rvdata.us/search/cruise/km1919 Cruise DOI: 10.7284/908382

KM1920

Website	https://www.bco-dmo.org/deployment/849547
Platform	R/V Kilo Moana
Start Date	2019-10-02
End Date	2019-10-22
Description	More information is available from the Rolling Deck to Repository (R2R): https://www.rvdata.us/search/cruise/km1920 Cruise DOI: 10.7284/908379

[table of contents | back to top]

Project Information

Dimensions: Diversity, assembly and function of microbial communities on suspended and sinking particles in a marine Oxygen Deficient Zone (ETNP_ParticleOmics)

Coverage: Eastern Tropical North Pacific

Extracted from the NSF award abstract:

Marine oxygen deficient zones (ODZs) are waters that are functionally devoid of oxygen. Without oxygen, some microbes are capable of converting nitrogen in the water into N2 gas, which then leaves the ocean and enters the atmosphere. This loss of an important nutrient from the ocean has impacts on phytoplankton growth and marine food webs. While oxygen deficient zones occupy a very small percentage of the ocean, they account for as much as half of the oceanic loss of N as N2. Moreover, the size of these regions is predicted to expand during this century due to climate change. The microbes that are capable of producing N2 gas are extremely diverse, and use several different biochemical pathways to carry out this process. They may occur both free-floating in the water and attached to small particles that are suspended or sinking from the surface waters and providing them a carbon source. However the importance of these two lifestyles (free-living vs particle attached) in terms of contributions to N loss from the oceans is not well understood. This project will identify the major organisms that result in N2 gas production on both suspended and sinking particles, the chemical reactions they carry out, and the rates at which this occurs. This information will be used to improve global climate models to better predict rates of N loss in a future ocean. Elementary and middle school teachers enrolled in a Masters in Science for Science Teachers program will be involved in the project and the graduate students and post-doctoral researchers supported by the project will have opportunities to participate in their classrooms. Underserved populations will also be integrated into the research at the undergraduate and middle school level through a series of summer internships.

ODZs have very complex elemental cycles, implying great microbial diversity. Intertwined with the microbial complexity of ODZ regions is the relatively unexplored interplay between free-living bacteria and those living on either suspended or sinking particles. Determining how these communities and niches interact and relate is one of the most challenging components of ODZ system studies today. Current climate models portray the dynamics of particles in the ODZs and throughout the deep ocean through prescribed functions based on sparse data from the oxic ocean with microbes represented only by the net chemical reactions of the community. However, in reality a phylogenetically and metabolically diverse group of microbes, likely acting in consortia, are responsible for the nitrogen transformations that ultimately result in the production of N2. To

explore the processes maintaining the genetic diversity and functional redundancy in N loss processes, four research areas will be integrated: the community phylogenetic diversity (both taxonomic and genomic diversity) the genetic diversity of the proteins that carry out key N transformation processes (as seen through quantitative proteomics), the resulting biogeochemical functions (15N labeled nitrogen transformation rate measurements) and predictions about how this diversity and corresponding function may change in response to climate change (biogeochemical modeling). The approach will be to assay both phylogenetic (16S rRNA tag sequencing) and functional genetic diversity (genomics) on sinking particles collected using large-volume sediment traps. Phylogenetic and genomic studies will be intimately tied to measurements of activity - who is doing key biogeochemical transformations (proteomics) and what are the in situ rates at which they are doing them (using novel incubation systems). Data will then be used to model how diversity and corresponding function change on a range of time and space scales, from the sinking of a single particle to seasonal cycles. To understand the relationship of community diversity and function on suspended and sinking particles, a series of three cruises will be conducted in the Eastern Tropical North Pacific ODZ.

Permanence of the recent expansions of the OMZ and denitrification regimes in the eastern tropical North Pacific (ETNP OMZ Denitrification)

Coverage: Eastern tropical North Pacific 21N-12N: 130W-105W

NSF abstract:

Oxygen Deficient Zones (ODZs) are regions in the global ocean where concentrations of dissolved oxygen in seawater are very low. Low oxygen concentrations affect rates of denitrification, a microbial process in which nitrate is converted to nitrogen gas. This can lead to significant losses of nitrate from the ocean. Nitrate is an important nutrient in the ocean that supports ocean ecosystems. Ocean warming is likely to expand these ODZs making it imperative we understand the role of the ODZs on the chemistry and biology of these regions. This understanding requires repeated sampling of nutrient and oxygen concentrations through time. The investigator plans to utilize available ship time from an existing grant to sample the Eastern Tropical North Pacific (ETNP) ODZ six times over a two year period during the spring, summer, and winter months. The aim is to determine the permanence and seasonality of the recent expansion of the ODZ in the ETNP, as well as identify the processes responsible for any observed changes. This research will support the University of Washington's Masters in Science for Science Teachers program, which provides a link between researchers, graduate students, and elementary aged youth, and there will be funds provided for two undergraduate students to participate in two research cruises on the R/V Thompson.

This project seeks to answer whether observed increased rates of denitrification in the ODZ of the ETNP are solely due to a growing oxygen deficiency problem or can be attributed to sample timing and seasonality. Additionally, the increased loss of nitrate will be investigated to conclude whether it really is due to increased rates of denitrification in the ODZ or some other cause. Climate model simulations predict a large perturbation to the dissolved oxygen content of the ocean, which could have further consequences than purely oxygen chemistry. This study hopes to answer the question of how climate change impacts on dissolved oxygen will affect denitrification in the ocean, which in turn has a much larger effect on limiting marine productivity.

[table of contents | back to top]

Program Information

Dimensions of Biodiversity (Dimensions of Biodiversity)

Website: http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=503446

Coverage: global

(adapted from the NSF Synopsis of Program)
Dimensions of Biodiversity is a program solicitation from the NSF Directorate for Biological Sciences. FY 2010

was year one of the program. [MORE from NSF]

The NSF Dimensions of Biodiversity program seeks to characterize biodiversity on Earth by using integrative, innovative approaches to fill rapidly the most substantial gaps in our understanding. The program will take a broad view of biodiversity, and in its initial phase will focus on the integration of genetic, taxonomic, and functional dimensions of biodiversity. Project investigators are encouraged to integrate these three dimensions to understand the interactions and feedbacks among them. While this focus complements several core NSF programs, it differs by requiring that multiple dimensions of biodiversity be addressed simultaneously, to understand the roles of biodiversity in critical ecological and evolutionary processes.

[table of contents | back to top]

Funding

Funding Source	Award
NSF Division of Environmental Biology (NSF DEB)	DEB-1542240
NSF Division of Ocean Sciences (NSF OCE)	OCE-1657958

[table of contents | back to top]