Size fractionated organic C and N concentrations and stable isotopes from the Eastern Tropical North Pacific on the R/V Kilo Moana cruise KM1920 in October 2019

Website: https://www.bco-dmo.org/dataset/948682
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Project
» Dimensions: Diversity, assembly and function of microbial communities on suspended and sinking particles in a marine Oxygen Deficient Zone (ETNP_ParticleOmics)

Program
» Dimensions of Biodiversity (Dimensions of Biodiversity)

Contributors	Affiliation	Role
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Abstract
Size fractionated Organic Particle Carbon and Nitrogen concentrations and stable C and N isotopes from the Eastern Tropical North Pacific were obtained from the R/V Kilo Moana on cruise KM1920 in the Eastern Tropical North Pacific at two stations in October 2019: St P2 (16.9ºN 107ºW) and St P3 (21.8°N 109.9°W). These two stations included an anoxic Oxygen Deficient Zone from 110-820 m for St P2 and 160-650 m for St P3. For size fractionated particulate organic C and N analyses, water was obtained from Niskin bottles on a CTD rosette, by opening the bottom of the Niskin bottle. Water was gravity filtered through stacked mesh with the following pore sizes: 500 um, 180 um, 53 um, 20 um, and 5 um. Each fraction was resuspended off the mesh and vacuum filtered it onto pre-combusted GF/C filters (nominal pore size 1.2 um). Samples were wafted with HCl to remove carbonate and sent to the UC Davis Stable Isotope Facility (Davis, CA) for C and N analysis utilizing an elemental analyzer attached to an isotope ratio mass spectrometer. The samples were obtained to determine particle size to carbon and nitrogen relationships for models, while gaining insights into the origins of particulate organic matter in the Oxygen Deficient Zone. Samples were collected by Jacob Cram of Horn Point Laboratory (University of Maryland Center for Environmental Science) and his lab members. Filters were prepped in the lab, and data were analyzed by Clara Fuchsman of Horn Point Laboratory, a part of the University of Maryland Center for Environmental Science.

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Coverage

Location: Eastern Tropical North Pacific Oxygen Deficient ZoneDepth profiles at two stations in October 2019: St P2 (16.9ºN 107ºW) and St P3 (21.8°N 109.9°W)

Dataset Description

These data were supported by NSF award DEB-1542240 and Horn Point Laboratory startup funds.

Methods & Sampling

For size fractionated suspended particulate organic matter in October 2019, samples were obtained from Niskin bottles but were collected by opening the bottom of the Niskin bottle into an acid cleaned bucket. This ensured that particles that had sunk below the spigot of the Niskin bottle were included. Between 100 and 120 L of water was gravity filtered, in sequence, through nylon mesh (142 mm diameter) of decreasing pore size (500, 180, 53, 20 µm) and a subset of this 20 µm filtered water (~20 L) was then filtered through a 5 µm mesh. For mesh sizes 20 µm and above, the large diameter of the mesh and abundance of functional pore-space prevented clogging, and water flowed through the mesh quickly, indicating that clogging did not occur. Water filtered more slowly through the 5 µm mesh (on the order of 30 minutes). After filtration, each nylon mesh was back rinsed with ~500 ml of prefiltered “rinse water” to produce a resuspension of particulate matter from particles from each size class. The “rinse water” had been generated during transit by pumping surface water in sequence through water filters of size 10, 5, 1 µm to remove particles, followed by a 0.2 µm filter (Pall AcroPak 1500 Capsule with a Supor Polyethersulfone membrane) capsule which removes bacteria and a 30 kd tangential flow filter which removed viruses (Pillicon Capsule with Ultracel Membrane 0.1 m^2; Millipore PCC030C01). After back-rinsing, the resuspended particles were split with one half used for particulate matter measurements. In all cases the actual volumes were carefully recorded and used for normalization during analysis. The resuspended particulate matter from each sample and size class was collected by vacuum filtration through a 1.2 µm nominal pore size, 25 mm diameter, GF/C glass fiber filter (Whatman WHA1822025). These filters had been previously pre-combusted for at least two hours at 400°C. One to two depths were sampled per day and multiple days were combined to represent each station. Nine depths were obtained at St P2 (16.9ºN 107ºW), five depths were obtained at St P3 (21.8°N 109.9°W).

At Horn Point, samples were wafted with HCl overnight to remove carbonate, dried at 40°C, packed in both silver and tin capsules, and sent to the UC Davis Stable Isotope Facility for C and N analysis utilizing an Elemental Analyzer (Elementar Vario EL Cube) attached to an Isotope Ratio Mass Spectrometer (Isoprim VisION). Blank combusted GF/C filters were included in analyses and did not show measurable material.

Data Processing Description

ug of C and N were converted to concentrations in Microsoft Excel using volumes filtered.

Problem Description

One filter went missing-- from St P3, 127m, the 180-500 um size fraction.

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Parameters

Parameters for this dataset have not yet been identified

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Deployments

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

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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.

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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.

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Funding

Funding Source	Award
NSF Division of Environmental Biology (NSF DEB)	DEB-1542240

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