Particles and Zooplankton Amino Acid Compound Specific Isotope Analyses (AA-CSIA) and zooplankton biomass at Station ALOHA and the Equatorial Pacific from R/V Kilo Moana cruises KM1407, KM1418, & KM1515 from 2014-2015

Website: https://www.bco-dmo.org/dataset/806502
Data Type: Cruise Results
Version: 1
Version Date: 2020-03-19

Project
» Evaluating the relative importance of suspended and sinking particles to the meso and bathypelagic food web in the central North Pacific (SuspendSinkPart)
» Collaborative Research: Isotopic insights to mercury in marine food webs and how it varies with ocean biogeochemistry (Hg_Biogeochemistry)

Contributors	Affiliation	Role
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Abstract
Particles and Zooplankton Amino Acid Compound Specific Isotope Analyses (AA-CSIA) and zooplankton biomass at Station ALOHA and the Equatorial Pacific from R/V Kilo Moana cruises KM1407, KM1418, & KM1515 from 2014-2015.

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Coverage

Spatial Extent: **N**:22 **E**:-155 **S**:5 **W**:-158
Temporal Extent: 2014-02-19 - 2015-09-08

Methods & Sampling

Particles were collected using in situ McLane pumps equipped with mini-MULVFS (Bishop et al. 2012) 2-tiered filter holders. Particle collection captured sequentially large (>53 µm) particulates on acid-cleaned Nitex mesh filters and small particles (<53 µm) on pre-combusted GFF or QMA filters at discrete depths for amino acid compound-specific isotope analysis (AA CSIA) and for particulate carbon and nitrogen. This method is designed to exclude motile metazoans but include all other ambient, non-swimming particulate matter (see Bishop et al. 2012). Immediately after collection, large particles were rinsed off of the Nitex screens and onto pre-combusted 25-mm QMA filters using 0.2 µm filtered seawater. All filters were frozen at -20°C or -80°C as soon as possible after collection.

Zooplankton were collected using a 1-m² MOCNESS net during the day (~09:00-15:00) and at night (~20:00-03:00). Night and day tows were repeated to obtain replicate samples for biomass and isotopic analyses. Upon collection, each sample was size-fractionated using 0.2, 0.5, 1.0, 2.0 and 5.0 mm mesh sieves, filtered onto pre-weighed 47 mm filters of 0.2 mm Nitex mesh and stored frozen at -80ºC.

For nitrogen isotope composition of the amino acids, particles and zooplankton samples were freeze dried and analyzed following the methods Hannides et al. (2013). $\delta^{15}N$ values of source amino acids ($\delta^{15}N_{Src-AA}$) for both particles and zooplankton were calculated as the average $\delta^{15}N$ of: serine, phenylalanine, lysine and glycine. Freeze-dried zooplankton filters for all size fractions were weighed to calculate zooplankton biomass (mg in dry weight/m³) at each depth during the day and at nighttime.

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Data Files

File
aacsia.csv (Comma Separated Values (.csv), 96.37 KB) MD5:5230b894c748ab4cd4f61c3ba5223dfd Primary data file for dataset ID 806502

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Related Publications

Bishop, J. K. B., Lam, P. J., & Wood, T. J. (2012). Getting good particles: Accurate sampling of particles by large volume in-situ filtration. Limnology and Oceanography: Methods, 10(9), 681–710. doi:10.4319/lom.2012.10.681
Methods

Hannides, C. C. S., Popp, B. N., Choy, C. A., & Drazen, J. C. (2013). Midwater zooplankton and suspended particle dynamics in the North Pacific Subtropical Gyre: A stable isotope perspective. Limnology and Oceanography, 58(6), 1931–1946. doi:10.4319/lo.2013.58.6.1931
Methods

Hannides, C. C. S., Popp, B. N., Close, H. G., Benitez-Nelson, C. R., Ka'apu-Lyons, C. A., Gloeckler, K., … Drazen, J. C. (2020). Seasonal dynamics of midwater zooplankton and relation to particle cycling in the North Pacific Subtropical Gyre. Progress in Oceanography, 182, 102266. doi:10.1016/j.pocean.2020.102266
Methods

Wiebe, P. H., K.H. Burt, S. H. Boyd, A. W. Morton (1976). A multiple opening/closing net and environment sensing system for sampling zooplankton. J. Mar. Res., 34, 313-326.
Methods

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Parameters

Parameter	Description	Units
Cruise	Cruise identifier	unitless
Date_initial	Sampling initial date (UTC); format: yyyy-mm-dd	unitless
Date_final	Sampling final date (UTC); format: yyyy-mm-dd	unitless
Site	Site identifier	unitless
Latitude	Latitude	degrees N
Longitude	Longitude	degrees W
Season	Season: Winter = February; Summer = August and September	unitless
DayNight	DayNight: Day = 9:00 – 15:00; Night = 20:00 – 3:00	unitless
Type	Type of sample	unitless
SizeFraction_min	Minimum size fraction of a sample	micrometers (um)
SizeFraction_max	Maximum size fraction of a sample	micrometers (um)
Depth	Sampling depth	meters (m)
DepthInterval_max	Maximum depth of MOCNESS net	meters (m)
DepthInterval_min	Minimum depth of MOCNESS net	meters (m)
d15NSrcAA	Average nitrogen isotopic composition of source amino acids: phenylalanine, serine, glycine and lysine of a sample	‰, vs AIR
Propagation_error	Propagation error of the replicate measurement of nitrogen isotopic composition of source amino acids of a sample	‰, vs AIR
POC	Particulate Organic Carbon	micrograms per liter (ug L-1)
PC	Total Particulate Carbon	ug L-1
Biomass	Zooplankton biomass	mg DW m-3

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Instruments

Dataset-specific Instrument Name	isotope ratio mass spectrometer
Generic Instrument Name	Isotope-ratio Mass Spectrometer
Dataset-specific Description	Nitrogen isotope composition of the amino acids determined using an isotope ratio mass spectrometer (Thermo Scientific Delta V Plus or Thermo Scientific MAT 253 IRMS) interfaced with a Thermo Finnigan GC-C III.
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	McLane pumps
Generic Instrument Name	McLane Pump
Dataset-specific Description	Particles were collected using in situ McLane pumps equipped with mini-MULVFS (Bishop et al. 2012) 2-tiered filter holders.
Generic Instrument Description	McLane pumps sample large volumes of seawater at depth. They are attached to a wire and lowered to different depths in the ocean. As the water is pumped through the filter, particles suspended in the ocean are collected on the filters. The pumps are then retrieved and the contents of the filters are analyzed in a lab.

Dataset-specific Instrument Name	1-m2 MOCNESS
Generic Instrument Name	MOCNESS
Dataset-specific Description	Multiple opening-closing net and environmental sensing system (MOCNESS; Wiebe et al. 1976) net with 1 m2 opening using 0.2 mm mesh plankton nets.
Generic Instrument Description	The Multiple Opening/Closing Net and Environmental Sensing System or MOCNESS is a family of net systems based on the Tucker Trawl principle. There are currently 8 different sizes of MOCNESS in existence which are designed for capture of different size ranges of zooplankton and micro-nekton Each system is designated according to the size of the net mouth opening and in two cases, the number of nets it carries. The original MOCNESS (Wiebe et al, 1976) was a redesigned and improved version of a system described by Frost and McCrone (1974).(from MOCNESS manual) This designation is used when the specific type of MOCNESS (number and size of nets) was not specified by the contributing investigator.

Dataset-specific Instrument Name	MULVFS
Generic Instrument Name	Multiple Unit Large Volume Filtration System
Dataset-specific Description	Particles were collected using in situ McLane pumps equipped with mini-MULVFS (Bishop et al. 2012) 2-tiered filter holders.
Generic Instrument Description	The Multiple Unit Large Volume Filtration System (MULVFS) was first described in Bishop et al., 1985 (doi: 10.1021/ba-1985-0209.ch009). The MULVFS consists of multiple (commonly 12) specialized particulate matter pumps, mounted in a frame and tethered to the ship by a cable (Bishop et al., 1985; Bishop and Wood, 2008). The MULVFS filters particulates from large volumes of seawater, although the exact protocols followed will vary for each project.

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Deployments

KM1407

Website	https://www.bco-dmo.org/deployment/635932
Platform	R/V Kilo Moana
Start Date	2014-02-19
End Date	2014-02-28
Description	Original cruise data are available from the NSF R2R data catalog

KM1418

Website	https://www.bco-dmo.org/deployment/636002
Platform	R/V Kilo Moana
Start Date	2014-08-29
End Date	2014-09-11
Description	Original cruise data are available from the NSF R2R data catalog

KM1515

Website	https://www.bco-dmo.org/deployment/657964
Platform	R/V Kilo Moana
Start Date	2015-08-15
End Date	2015-09-12

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Project Information

Evaluating the relative importance of suspended and sinking particles to the meso and bathypelagic food web in the central North Pacific (SuspendSinkPart)

Coverage: Subtropical waters north of Hawaii; Station Aloha (22° 45'N, 158° 00'W)

Description from NSF award abstract:
The ocean's midwaters are the largest living space on the planet. The mesopelagic food web plays key roles in the biological carbon pump and the production of food for commercially harvested species, but its functioning is understudied because it is remote and technologically challenging to sample. Recent estimates indicate respiratory demand outstrips measured sinking particle supply by up to 2-3 orders of magnitude suggesting that some food inputs to the mesopelagic food web have been underestimated or missed. Suspended particles frequently are not sampled effectively and may be an overlooked food source. Because identifying the principal inputs of organic matter to the deep-sea food web is critical to understanding its function, the investigators propose to evaluate the relative importance of suspended and sinking particles to the meso- and bathypelagic food web in the central North Pacific. They will characterize the isotopic compositions of specific groups of mesopelagic and bathypelagic zooplankton and micronekton, and identify the extent to which they consume suspended or sinking particles using mass balance approaches. The investigators recently have recognized differences in delta 15N and delta 13C values of amino acids (AA) of sinking and suspended particles; these patterns diverge with depth, providing a means to distinguish between food web pathways. The research will define the source-specific isotopic values of suspended and sinking particles at several depths from the surface to the bathypelagic and test proposed microbial mechanisms driving these depth patterns. At corresponding depths, MOCNESS trawls will sample diverse metazoa: zooplankton size fractions, plus targeted resident, migrating and likely suspension-feeding taxa of zooplankton and micronekton. Preliminary data suggest that suspended particles are a secondary food source, containing less labile organic matter than sinking particles that exhibit a seasonal cycle in flux in the central North Pacific. This study will determine if

suspended particles become more important to zooplankton and micronekton during a time of year when sinking particle flux is low (Jan/Feb) in comparison to when it is high (Aug), allowing an evaluation of how temporal change in surface ocean productivity affects the functioning of mesopelagic food webs.

Recent research has called for additional study of the ocean's deep midwaters. This study will provide new insights into the functioning of the meso- and bathypelagic food web and its coupling with surface ocean processes in the central North Pacific. The recently-demonstrated ecological tool of amino acid-specific isotopic analysis will provide a novel and comprehensive approach with which to address our hypotheses, and the project will develop the first AA isotopic dataset spanning particles to fish. Results will help identify the ecological underpinnings of increasing delta 15N values with depth in zooplankton -- apparently a common pattern. Zooplankton consumption of suspended particles also could constitute a mechanistic link between the microbial loop and higher trophic levels. The processes controlling the enormous attenuation of particle flux by mesopelagic consumers -- and thereby the strength of carbon sequestration to the deep ocean -- are not understood. Seasonal sampling will help us relate mesopelagic food web processes to changes in surface ocean productivity, furthering our understanding of future climate change impacts on deep-sea food webs and carbon flux. With regard to fisheries, many oceanic top predators such as tuna and swordfish feed on mesopelagic micronekton. A clearer understanding of the structure of mesopelagic food webs will help inform ecosystem models which are used to understand variation in fisheries production.

Collaborative Research: Isotopic insights to mercury in marine food webs and how it varies with ocean biogeochemistry (Hg_Biogeochemistry)

Coverage: Pacific Subtropical Gyre, Station ALOHA 22.75N 158W; equatorial Pacific (10N 155W, 5N 155W)

NSF award abstract:
Mercury is a pervasive trace element that exists in several states in the marine environment, including monomethylmercury (MMHg), a neurotoxin that bioaccumulates in marine organisms and poses a human health threat. Understanding the fate of mercury in the ocean and resulting impacts on ocean food webs requires understanding the mechanisms controlling the depths at which mercury chemical transformations occur. Preliminary mercury analyses on nine species of marine fish from the North Pacific Ocean indicated that intermediate waters are an important entry point for MMHg into open ocean food webs. To elucidate the process controlling this, researchers will examine mercury dynamics in regions with differing vertical dissolved oxygen profiles, which should influence depths of mercury transformation. Results of the study will aid in a better understanding of the pathways by which mercury enters the marine food chain and can ultimately impact humans. This project will provide training for graduate and undergraduate students, and spread awareness on oceanic mercury through public outreach and informal science programs.

Mercury isotopic variations can provide insight into a wide variety of environmental processes. Isotopic compositions of mercury display mass-dependent fractionation (MDF) during most biotic and abiotic chemical reactions and mass-independent fractionation (MIF) during photochemical radical pair reactions. The unusual combination of MDF and MIF can provide information on reaction pathways and the biogeochemical history of mercury. Results from preliminary research provide strong evidence that net MMHg formation occurred below the surface mixed layer in the pycnocline and suggested that MMHg in low oxygen intermediate waters is an important entry point for mercury into open ocean food webs. These findings highlight the critical need to understand how MMHg levels in marine biota will respond to changes in atmospheric mercury emissions, deposition of inorganic mercury to the surface ocean, and hypothesized future expansion of oxygen minimum zones. Using field collections across ecosystems with contrasting biogeochemistry and mercury isotope fractionation experiments researchers will fill key knowledge gaps in mercury biogeochemistry. Results of the proposed research will enable scientists to assess the biogeochemical controls on where in the water column mercury methylation and demethylation likely occur.

Related background publication with supplemental data section:
Joel D. Blum, Brian N. Popp, Jeffrey C. Drazen, C. Anela Choy & Marcus W. Johnson. 2013. Methylmercury production below the mixed layer in the North Pacific Ocean. Nature Geoscience 6, 879–884. doi:10.1038/ngeo1918

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Funding

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NSF Division of Ocean Sciences (NSF OCE)	OCE-1433846

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