Amino acid compound specific isotope values for micronekton from R/V Kilo Moana KM1109, KM1123, KM1407, KM1418, and other cruises in the Central North Pacific, Station ALOHA, Tropical Pacific, 2007-2014

Website: https://www.bco-dmo.org/dataset/750972
Data Type: Cruise Results
Version: 1
Version Date: 2018-12-05

Project
» 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
This dataset contains amino acid compound specific concentrations in micronekton collected during R/V Kilo Moana cruises around the ALOHA observatory (KM1407, KM1418, KM2011, and a few other undocumented cruises). For more information about the ALOHA observatory see: http://aco-ssds.soest.hawaii.edu/. These data were published in Gloeckler et al (2018), Supporting Information file lno10762-sup-0001-suppinfo1.xlsx

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Coverage

Spatial Extent: **Lat**:22.75 **Lon**:-158
Temporal Extent: 2007-04 - 2014-09

Dataset Description

This dataset contains amino acid compound specific concentrations in micronekton collected during R/V Kilo

Moana cruises around the ALOHA observatory (KM1407, KM1418, KM2011, and a few other undocumented cruises).

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Methods & Sampling

Micronekton were collected using a 10 m2 multiple opening-closing net and environmental sensing system (MOCNESS) at Station ALOHA (22.75˚N, 158˚W) in March and August of 2011 and in February and September of 2014 with a few samples from other locations around Oahu in 2011 (Choy et al 2015). Micronekton were collected over five depth zones between the surface and 1500 m: 0 – 100 m, 100 – 500 m, 500 – 700 m, 700 – 1000 m and 1000 – 1500 m. At sea, micronekton were sorted and identified to the most specific taxonomic level, then measured and photographed. Standard length measurements were taken for fish, carapace length and total length were taken for crustaceans and both mantle length and total length were taken for cephalopods. For most fishes, white muscle tissue was removed and frozen in a cryovial in liquid nitrogen. Small fishes, crustaceans and gelatinous organisms were frozen whole or individuals were pooled for sufficient tissue required for stable isotope analysis. Specimens were transferred to a -80˚C freezer until the samples could be prepared for stable isotope analysis.

Eighty-three samples (individual specimens or small groups of conspecifics) were selected for stable isotope analysis. Samples selected for stable isotope analysis represented different combinations of trophic strategies (suspension feeding, zooplanktivores, micronektonivores), depth guilds (epipelagic, mesopelagic, bathypelagic) and migrating behaviors based on available ecological information (e.g., Clarke 1973, Maynard 1982). Each sample was freeze-dried and ground using a ceramic mortar and pestle. For bulk tissue carbon and nitrogen isotope analysis approximately 0.5 mg of each sample was weighed and placed into a tin boat. Carbon and nitrogen isotopic compositions were determined using an isotope ratio mass spectrometer (DeltaPlusXP) coupled to an elemental analyzer (Costech Model 4010). Isotopic ratios are given in δ-notation relative to the international standards VPDB and atmospheric N2. Accuracy and precision were 0.2‰ based on glycine and homogenized fish tissue reference materials analyzed every ten samples. The isotopic compositions of the reference materials have been extensively characterized using NIST certified reference materials in the UH laboratory and verified independently in other isotope laboratories.

Amino acid-specific stable N isotope composition was determined on approximately 15 mg (dry weight) of each sample underwent acid hydrolysis and derivatization yielding trifluoroacetic (TFA) amino acid esters following the methods of Popp et al. (2007) and Hannides et al. (2009b).; The nitrogen isotope composition of the trifluoroacetic amino acid esters were 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. Samples were injected onto a BPx5 forte capillary column (60m x 0.32 mm x 1.0 µm film thickness) at an injector temperature of 180˚C with a constant helium flow rate of 1.4 mL/min. The column was initially held at 50˚C for two minutes and then increased at a rate of 15˚C/min to 120˚C. Temperature was then increased at a rate of 4˚C/min to 195˚C, then to 255˚C at a rate of 5˚C/min and finally to 300˚C at a rate of 15˚C/min, holding at the final temperature for eight minutes. Each sample was analyzed in triplicate and co-injected with the reference compounds norleucine (Nor) and aminoadipic acid (AAA) of known isotopic composition. A suite of pure amino acids of known nitrogen isotopic composition (Ala, Thr, Ile, Pro, Glu, and Phe) was also injected every three runs as an extra measure of accuracy for the instrument. Reference compounds Nor and AAA, as well as the suite of amino acids, were used to normalize the measured isotope values. Standard deviation for all amino acids averaged ±0.4‰ (range 0.0-3.1‰).

Data Processing Description

BCO-DMO Processing Notes:
- added conventional header with dataset name, PI name, version date
- modified parameter names to conform with BCO-DMO naming conventions

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Data Files

File
micronekton_amino_acids.csv (Comma Separated Values (.csv), 22.54 KB) MD5:911cbf63ea20bfa049c49ddd4c35919a Primary data file for dataset ID 750972

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Related Publications

Choy, C. A., Popp, B. N., Hannides, C. C. S., & Drazen, J. C. (2015). Trophic structure and food resources of epipelagic and mesopelagic fishes in the North Pacific Subtropical Gyre ecosystem inferred from nitrogen isotopic compositions. Limnology and Oceanography, 60(4), 1156–1171. doi:10.1002/lno.10085
Methods

Clarke, T. A. (1973) Some aspects of ecology of lanternfishes (Myctophidae) in Pacific-Ocean near Hawaii. Fish. Bull. 71: 401–434.
General

Gloeckler, K., Choy, C. A., Hannides, C. C. S., Close, H. G., Goetze, E., Popp, B. N., & Drazen, J. C. (2017). Stable isotope analysis of micronekton around Hawaii reveals suspended particles are an important nutritional source in the lower mesopelagic and upper bathypelagic zones. Limnology and Oceanography, 63(3), 1168–1180. doi:10.1002/lno.10762
Results

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., Landry, M. R., & Graham, B. S. (2009). Quantification of zooplankton trophic position in the North Pacific Subtropical Gyre using stable nitrogen isotopes. Limnology and Oceanography, 54(1), 50–61. doi:10.4319/lo.2009.54.1.0050
Methods

Maynard, S. D. (1982) Aspects of the biology of the mesopelagic fishes of the genus Cyclothone (Pisces: Gonostomatidae) in Hawaiian waters. Ph.D. thesis. Univ. of Hawaii.
General

Popp, B. N., Graham, B. S., Olson, R. J., Hannides, C. C. S., Lott, M. J., López-Ibarra, G. A., … Fry, B. (2007). Insight into the Trophic Ecology of Yellowfin Tuna, Thunnus albacares, from Compound-Specific Nitrogen Isotope Analysis of Proteinaceous Amino Acids. Terrestrial Ecology, 173–190. doi:10.1016/s1936-7961(07)01012-3
Methods

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Parameters

Parameter	Description	Units
SpeciesID	Genus and species name of micronekton specimen	unitless
FamilyID	Taxonomic family of micronekton specimen	unitless
SpecimenID	specimen identifier	unitless
Sample_site	specimen collection site	unitless
Year	year of collection	unitless
Month	month of collection	unitless
CruiseID	cruise identifier	unitless
n	number of specimens in sample	individuals
Length_mm	length of specimen	millimeters
Length_Type	Length type is standard length (SL); total length (TL); carapace length (CL); fork length (FL); mantle length (ML)	length
Tissue_Type	Type of tissue samples taken: WMT = white muscle tissue; Whole = the whole specimen;	sample_type
delta15N_ppt_v_AIR	ratio of tissue 15N:14N isotopes relative to atmospheric N2	permil
delta13C_ppt_v_VPDB	ratio of tissue 13C:12C isotope relative to VPDB (Vienna Pee Dee Belemnite)	permil
C_N_mol_mol	Carbon to Nitrogen ratio	unitless
Alanine	ratio of tissue Alanine isotopes relative to atmospheric N2	unitless
Glycine	ratio of tissue Glycine isotopes relative to atmospheric N2	unitless
Threonine	ratio of tissue Threonine isotopes relative to atmospheric N2	unitless
Serine	ratio of tissue Serine isotopes relative to atmospheric N2	unitless
Valine	ratio of tissue Valine isotopes relative to atmospheric N2	unitless
Leucine	ratio of tissue Leucine isotopes relative to atmospheric N2	unitless
Isoleucine	ratio of tissue Isoleucine isotopes relative to atmospheric N2	unitless
Proline	ratio of tissue Proline isotopes relative to atmospheric N2	unitless
Aspartic_acid	ratio of tissue Aspartic_acid isotopes relative to atmospheric N2	unitless
Methionine	ratio of tissue Methionine isotopes relative to atmospheric N2	unitless
Glutamic_acid	ratio of tissue Glutamic_acid isotopes relative to atmospheric N2	unitless
Phenylalanine	ratio of tissue Phenylalanine isotopes relative to atmospheric N2	unitless
Tyrosine	ratio of tissue Tyrosine isotopes relative to atmospheric N2	unitless
Lysine	ratio of tissue Lysine isotopes relative to atmospheric N2	unitless
Arginine	ratio of tissue Arginine isotopes relative to atmospheric N2	unitless
Histidine	ratio of tissue Histidine isotopes relative to atmospheric N2	unitless

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Instruments

Dataset-specific Instrument Name	Costech Model 4010
Generic Instrument Name	Elemental Analyzer
Dataset-specific Description	Used to measure carbon and nitrogen isotopic compositions.
Generic Instrument Description	Instruments that quantify carbon, nitrogen and sometimes other elements by combusting the sample at very high temperature and assaying the resulting gaseous oxides. Usually used for samples including organic material.

Dataset-specific Instrument Name	Thermo Finnigan GC-C III
Generic Instrument Name	Gas Chromatograph
Generic Instrument Description	Instrument separating gases, volatile substances, or substances dissolved in a volatile solvent by transporting an inert gas through a column packed with a sorbent to a detector for assay. (from SeaDataNet, BODC)

Dataset-specific Instrument Name	Thermo Scientific Delta V Plus or Thermo Scientific MAT 253 IRMS
Generic Instrument Name	Isotope-ratio Mass Spectrometer
Dataset-specific Description	Used to measure carbon and nitrogen isotopic compositions.
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	
Generic Instrument Name	MOCNESS
Dataset-specific Description	Used to collect micronekton at specific depth strata.
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.

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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

KM1123

Website	https://www.bco-dmo.org/deployment/559102
Platform	R/V Kilo Moana
Start Date	2011-08-19
End Date	2011-08-25
Description	Additional cruise information and original data are available from the NSF R2R Data Catalog.

KM1109

Website	https://www.bco-dmo.org/deployment/751441
Platform	R/V Kilo Moana
Start Date	2011-03-04
End Date	2011-03-10

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Project Information

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

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1433846

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