

Bulk isotopic composition (d15N and d13C) of abyssal megafauna and macrofauna from Stations M and Aloha

Website: <https://www.bco-dmo.org/dataset/866774>

Data Type: Cruise Results

Version: 1

Version Date: 2022-01-12

Project

» [Collaborative Research: Assessing the relative importance of small vs large particles as sources of nutrition to abyssal communities](#) (Abyssal food web)

Contributors	Affiliation	Role
Drazen, Jeffrey C.	University of Hawaii at Manoa (SOEST)	Principal Investigator
Popp, Brian N.	University of Hawaii at Manoa (SOEST)	Co-Principal Investigator
Smith, Craig R.	University of Hawaii at Manoa (SOEST)	Co-Principal Investigator
Rauch, Shannon	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract

This dataset includes bulk isotopic composition (d15N and d13C) of abyssal megafauna and macrofauna from Station M and Station Aloha. Macrofauna and megafauna were collected in May and October 2019 using the HOV Alvin and the ROV Doc Ricketts, respectively, at Station M and in July 2019, January 2020, and July 2020 using ROV Lu'ukai at Station Aloha. Macrofauna at Station M were collected using HOV-operated Ekman cores (20x20 cm).

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Coverage

Spatial Extent: N:34.833 E:-123 S:22.75 W:-158

Temporal Extent: 2019-04-30 - 2020-08-02

Methods & Sampling

Macrofauna and megafauna were collected in May and October 2019 using the HOV *Alvin* and the ROV *Doc Ricketts*, respectively, at Station M (34° 50'N, 123° 00'W) and in July 2019, January 2020, and July 2020 using ROV Lu'ukai at Station Aloha (22° 45'N, 158° 00'W). Macrofauna at Station M were collected using HOV-operated Ekman cores (20x20 cm). Macrofauna at Station Aloha were collected using a Brenke epibenthic sled towed across the seafloor (detailed in Glover et al 2016), due to the considerably lower macrofaunal densities at this oligotrophic site. Megafauna were collected using the submersible vehicle's manipulator arm and/or slurp gun. Upon retrieval to the surface, samples were placed in a cool room (5°C) for their further processing. Specimens of megafauna were weighed and measured, then they were dissected using a scalpel. All tissue samples were placed in cryovials and frozen in liquid nitrogen, and subsequently stored at -80°C. Sieved (300

um) macrofauna samples were preserved in 10% buffered formalin. In the laboratory, macrofauna were further sorted by taxon. Samples of megafauna body tissues or macrofauna were freeze dried and ground to a homogenous powder using mortar and pestle.

For analysis of bulk nitrogen and carbon isotopic composition, ~0.7 and 3 mg of body tissue from holothurians and echinoids, respectively, ~ 5 mg of gut content, and ~ 20 mg of sediments were placed in silver capsules. Samples were acidified to remove carbonates with 1M HCl, which was added dropwise until bubbling ceased, then dried at 60°C and packed.

Data Processing Description

BCO-DMO Processing:

- replaced "NA" and "na" with "nd" (no data);
- renamed fields to comply with BCO-DMO naming conventions;
- changed format of end dates to YYYY-MM-DD;
- replaced commas in the Comments and animal_mass fields with semi-colons;
- replaced erroneous cruise IDs of KM2009-KM2076 with KM2008;
- replaced erroneous date of 2019-04-31 with 2019-04-30.

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Data Files

File
abyssal_bulk_isotopes.csv (Comma Separated Values (.csv), 66.77 KB) MD5:949148db540f6d56aa80bece1fae0747
Primary data file for dataset ID 866774

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Related Publications

Glover, A., Dahlgren, T., Wiklund, H., Mohrbeck, I., & Smith, C. (2016). An End-to-End DNA Taxonomy Methodology for Benthic Biodiversity Survey in the Clarion-Clipperton Zone, Central Pacific Abyss. *Journal of Marine Science and Engineering*, 4(1), 2. doi:[10.3390/jmse4010002](https://doi.org/10.3390/jmse4010002)
Methods

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Related Datasets

IsRelatedTo

Drazen, J. C., Benitez-Nelson, C. R. (2024) **Particulate Th data from samples collected on 5 cruises at Station ALOHA off Hawaii and Station M off California from 2019 to 2020**. Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2024-03-20
doi:10.26008/1912/bco-dmo.922922.1 [[view at BCO-DMO](#)]

Drazen, J. C., Benitez-Nelson, C. R. (2024) **Total Th data from samples collected on 5 cruises at Station ALOHA off Hawaii and Station M off California from 2019 to 2020**. Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2024-03-20
doi:10.26008/1912/bco-dmo.923028.1 [[view at BCO-DMO](#)]

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Parameters

Parameter	Description	Units
Sample_ID	Sample identification code	unitless
Cruise	Cruise designation	unitless
Station	Site designation: Station M or Station Aloha	unitless
Start_date	First date of collection or only date if sample was collected at a single point in time; format: MM-DD-YY	unitless
End_date	Last date of collection for pooled samples; format: YYYY-MM-DD	unitless
Taxon	Lowest taxon specimen was identified to	unitless
animal_mass	Mass of the animal	grams (g)
tissue_type	Type of sample: animal, gut content, muscle, liver, etc.	unitless
Sample_weight	Weight of dry sample analyzed	milligrams (mg)
Acidified	Whether sample was acidified prior to analysis	unitless
lipid_extracted	Whether sample was lipid extracted prior to analysis	unitless
ug_N	Micrograms (ug) of Nitrogen in sample	micrograms (ug)
d15N_v_AIR	Bulk nitrogen isotopic composition	per mil (‰), vs AIR
ug_C	Micrograms (ug) of Carbon in sample	micrograms (ug)
d13C_PC_v_VPDB	Bulk carbon isotopic composition	per mil (‰), vs VPDB
Comments	Comments	unitless

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Instruments

Dataset-specific Instrument Name	Costech Model 4010
Generic Instrument Name	Costech International Elemental Combustion System (ECS) 4010
Dataset-specific Description	Bulk nitrogen and carbon isotopic composition were determined using an isotope ratio mass spectrometer (DeltaPlusXP or Delta-V-Advantage) coupled to an elemental analyzer (Costech Model 4010).
Generic Instrument Description	The ECS 4010 Nitrogen / Protein Analyzer is an elemental combustion analyser for CHNSO elemental analysis and Nitrogen / Protein determination. The GC oven and separation column have a temperature range of 30-110 degC, with control of +/- 0.1 degC.

Dataset-specific Instrument Name	DeltaPlusXP or Delta-V-Advantage
Generic Instrument Name	Isotope-ratio Mass Spectrometer
Dataset-specific Description	Bulk nitrogen and carbon isotopic composition were determined using an isotope ratio mass spectrometer (DeltaPlusXP or Delta-V-Advantage) coupled to an elemental analyzer (Costech Model 4010).
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	Thermo Scientific Delta V Plus
Generic Instrument Name	Isotope-ratio Mass Spectrometer
Dataset-specific Description	Nitrogen isotope composition of amino acids was determined using an isotope ratio mass spectrometer (Thermo Scientific Delta V Plus) 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	Thermo-Fisher Scientific MAT 253
Generic Instrument Name	Isotope-ratio Mass Spectrometer
Dataset-specific Description	Carbon isotope composition of amino acids was measured using a Thermo-Fisher Scientific MAT 253 isotope ratio mass spectrometer interfaced with a Trace Ultra GC-III via ConFlo IV.
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).

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Deployments

KM2002

Website	https://www.bco-dmo.org/deployment/866784
Platform	R/V Kilo Moana
Start Date	2020-01-17
End Date	2020-01-26
Description	See additional cruise information from Rolling Deck to Repository (R2R): https://www.rvdata.us/search/cruise/KM2002

AT42-10

Website	https://www.bco-dmo.org/deployment/840850
Platform	R/V Atlantis
Start Date	2019-04-28
End Date	2019-05-09
Description	Collaborative Research: Assessing the relative importance of small vs large particles as sources of nutrition to abyssal communities AT42-10; Alvin Dive numbers: D5027-D5030

KM1914

Website	https://www.bco-dmo.org/deployment/866828
Platform	R/V Kilo Moana
Start Date	2019-07-18
End Date	2019-07-28
Description	See additional cruise information from Rolling Deck to Repository (R2R): https://www.rvdata.us/search/cruise/KM1914

KM2008

Website	https://www.bco-dmo.org/deployment/866879
Platform	R/V Kilo Moana
Start Date	2020-07-24
End Date	2020-08-03
Description	See additional cruise information from Rolling Deck to Repository (R2R): https://www.rvdata.us/search/cruise/KM2008

Pulse 72

Website	https://www.bco-dmo.org/deployment/840845
Platform	R/V Western Flyer
Start Date	2019-10-16
End Date	2019-10-25
Description	Collaborative Research: Assessing the relative importance of small vs large particles as sources of nutrition to abyssal communities Dive numbers: D1196, D1197, D1201

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Project Information

Collaborative Research: Assessing the relative importance of small vs large particles as sources of nutrition to abyssal communities (Abyssal food web)

Coverage: California current, Station M (34° 50' N, 123° W) and North Pacific Subtropical Gyre, Station Aloha (22° 45' N, 158° W)

NSF Award Abstract:

The abyssal plains of the oceans cover roughly half of the earth's surface, host enormous reservoirs of biodiversity and mineral resources, and play important roles in nutrient recycling and carbon sequestration. The most important process controlling the structure and function of these ecosystems is the quantity and quality of food (mostly sinking organic particles) that reaches the deep-sea floor. However, we do not fully understand the processes provisioning this vast ecosystem. We propose to evaluate the relative importance of small and larger "marine snow" particles that sink to deep-sea benthic communities by using the stable isotope signature of amino acids within various food sources and trace their consumption by fauna on the seafloor. This project compares ecosystems from the productive waters off California with the nutrient poor central Pacific, north of Hawaii. This project provides novel insights into how surface ocean processes are coupled to food-webs at the deep ocean seafloor and how changes in food sources potentially impact deep-sea communities. This project also provides excellent training opportunities for graduate students, a postdoctoral researcher, and undergraduates at UH and USC, particularly underrepresented minorities who pursue majors in the geosciences. The project will sponsor an annual G6-12 teacher workshop to inform Hawaii educators about the deep sea and broadly disseminate knowledge to the community. All results are communicated broadly to inform the public as concerns regarding abyssal ecosystems are rising due to interests in deep-sea mining.

The most important process controlling the structure and function of abyssal ecosystems is the quantity and quality of organic material that ultimately reaches the deep-sea floor. Despite the strong relationship between euphotic zone export flux and benthic ecology, studies of abyssal ecosystems have observed a deficit between food supply and benthic community demand. Additional work is therefore needed, particularly with regards to understanding the sources of nutrition to the deep-sea benthos. Recent evidence suggests that small particles may be significant contributors to carbon export, increasing in relative importance with depth in the mesopelagic and reaching the abyssal seafloor. This project is to evaluate the relative importance of small and larger "marine snow" particles to deep-sea benthic communities using a combination of particle flux measurements and state of the art compound specific stable isotope analysis of amino acids (AA-CSIA) at two abyssal locations that contrast in overlying productivity, seasonality, and export magnitude. Time series measurements at these locations (Sta. M off California and Sta. Aloha off Hawaii) provide a rich context for the work. In the mesopelagic central North Pacific larger particles (>53 um) can be resolved from microbially reworked, smaller (0.7-53 um) particles using AA-CSIA. This project is characterizing the isotopic compositions of key individual compounds in a continuum of particle sizes (< 1.0 um suspended particles to large sinking particles >53 um) collected using in situ filtration near the seafloor and bottom-moored sediment traps, thereby defining source-specific isotopic signatures that can be traced into benthic fauna and sediments (that are collected by ROVs and epibenthic sleds). This research to understand pelagic-benthic coupling from particles to megafauna using isotopic measurements at the compound-level will yield novel insights into the importance of small microbially reworked particles to deep-sea benthic food webs. This will more precisely couple surface ocean processes to food-webs at the deep ocean seafloor with implications for understanding climate change effects and the efficiency of energy transfer to higher trophic levels. Furthermore, isotopic measurements can also be used to further parameterize ecosystem models by quantifying trophic position across size classes and thus estimate predator-prey mass ratios in relation to variation in body size spectra, functional type, and ultimately to carbon flux and remineralization. Finally, the results will help refine interpretations of deep-sea paleorecords of past nitrogen dynamics by calibrating potential changes in organic matter isotope values between the surface and seafloor archives.

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-1829612

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