

Compound specific isotope data of amino acids for abyssal macrofauna, megafauna, sediments, sediment traps, and in situ filtered particles at Station ALOHA off Hawaii and Station M off California from 2019 to 2020

Website: <https://www.bco-dmo.org/dataset/922789>

Data Type: Cruise Results

Version: 1

Version Date: 2024-04-29

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
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Abstract

This dataset includes compound specific isotope data of amino acids for abyssal macrofauna, megafauna, sediments, sediment traps, and in situ filtered particles from off California (Station M) and Hawaii (Station ALOHA) collected from 2019 to 2020. These data were collected as part of a food web project to evaluate the relative importance of small and large particle types to abyssal communities.

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Coverage

Location: Eastern North Pacific (Station M) and North Pacific Subtropical Gyre (Station ALOHA)

Spatial Extent: N:34.5 E:-123.06 S:22.6 W:-158

Temporal Extent: 2018-12-16 - 2020-08-03

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; 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 centimeters (cm)). Macrofauna at Station Aloha were collected using a Brenke epibenthic sled towed across the seafloor 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 degrees Celsius (°C)) for 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 micrometers (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.

Sediment samples were taken with ROV-operated push cores and sliced into 1 cm sections. Frozen samples were freeze dried, acidified, and then used for isotopic analysis. Sediment traps were McLane Parflux traps using formalin fixed collection cups varying from 10 to 30 day sample integration. Swimmers were removed from the samples under a dissecting microscope prior to concentration, freeze drying, and acidification for isotopic analysis.

Compound specific isotopic analysis of amino acids followed the protocols outlined in Hannides et al 2013.

BCO-DMO Processing Description

- Imported original file "Abyssal food web AACSIAXLSX.xlsx" into the BCO-DMO data system.
- Flagged "NA" as a missing data value. Missing data are empty/blank in the final CSV file.
- Converted date fields to YYYY-MM-DD format.
- Converted positive Longitude values to negative (to indicate the direction is west).
- Renamed fields to comply with BCO-DMO naming conventions.
- PI provided updated copy of file named as "922789_v1_compound_specific_isotope_dataV2.csv".
- Imported the new file, "922789_v1_compound_specific_isotope_dataV2.csv", into the BCO-DMO system; converted dates and renamed fields as described above.
- Saved the final file as "922789_v1_compound_specific_isotope_data.csv".

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Data Files

File
922789_v1_compound_specific_isotope_data.csv (Comma Separated Values (.csv), 41.84 KB) MD5:745f16b62536afe3e50bc5d209370c73
Primary data file for dataset ID 922789, version 1

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Related Publications

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](https://doi.org/10.4319/lo.2013.58.6.1931)
Methods

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Parameters

Parameter	Description	Units
Sample	Sample identification code	unitless
Cruise	Cruise designation	unitless
Date_initial	Sampling initial date (UTC)	unitless
Date_final	Sampling final date (UTC)	unitless
Site	Site designation: StM = Station M; StALOHA = Station ALOHA	unitless

Latitude	Latitude; positive values = North	decimal degrees
Longitude	Longitude; negative values = West	decimal degrees
Type	Type of sample: Body = deposit feeder body tissue; Fgut = foregut, first 3rd of digestive tract; Filter = in situ filtered particles; Hgut = hindgut, last 3rd of digestive tract; Mgut = midgut, second 3rd of digestive tract; Sediment = surface sediment (0-5 mm) Sediment trap = particles from moored sediment trap array.	unitless
Species	Species of animal	unitless
Type_filter	Filter size	unitless
Depth	Depth of sample collection	meters (m)
d15N	Bulk nitrogen isotopic composition	‰, vs AIR
d13C	Bulk carbon isotopic composition	‰, vs VPDB
ALA_N	Mean d15N value of all injections for amino acid alanine (ALA)	‰, vs AIR
GLY_N	Mean d15N value of all injections for amino acid glycine (GLY)	‰, vs AIR
THR_N	Mean d15N value of all injections for amino acid threonine (THR)	‰, vs AIR
SER_N	Mean d15N value of all injections for amino acid serine (SER)	‰, vs AIR
VAL_N	Mean d15N value of all injections for amino acid valine (VAL)	‰, vs AIR
LEU_N	Mean d15N value of all injections for amino acid leucine (LEU)	‰, vs AIR
ILE_N	Mean d15N value of all injections for amino acid isoleucine (ILE)	‰, vs AIR
PRO_N	Mean d15N value of all injections for amino acid proline (PRO)	‰, vs AIR
ASX_N	Mean d15N value of all injections for amino acid aspartic Acid + asparagine	‰, vs AIR
GLX_N	Mean d15N value of all injections for amino acid glutamic acid + glutamine	‰, vs AIR
PHE_N	Mean d15N value of all injections for amino acid phenylalanine (PHE)	‰, vs AIR
TYR_N	Mean d15N value of all injections for amino acid tyrosine (TYR)	‰, vs AIR
LYS_N	Mean d15N value of all injections for amino acid lysine (LYS)	‰, vs AIR
ALA_N_SD	Standand deviation of d15N values from all injections for amino acid alanine (ALA)	‰, vs AIR
GLY_N_SD	Standand deviation of d15N values from all injections for amino acid glycine (GLY)	‰, vs AIR
THR_N_SD	Standand deviation of d15N values from all injections for amino acid threonine (THR)	‰, vs AIR
SER_N_SD	Standand deviation of d15N values from all injections for amino acid serine (SER)	‰, vs AIR

VAL_N_SD	Standand deviation of d15N values from all injections for amino acid valine (VAL)	‰, vs AIR
LEU_N_SD	Standand deviation of d15N values from all injections for amino acid leucine (LEU)	‰, vs AIR
ILE_N_SD	Standand deviation of d15N values from all injections for amino acid isoleucine (ILE)	‰, vs AIR
PRO_N_SD	Standand deviation of d15N values from all injections for amino acid proline (PRO)	‰, vs AIR
ASX_N_SD	Standand deviation of d15N values from all injections for amino acid aspartic acid + asparagine	‰, vs AIR
GLX_N_SD	Standand deviation of d15N values from all injections for amino acid glutamic acid + glutamine	‰, vs AIR
PHE_N_SD	Standand deviation of d15N values from all injections for amino acid phenylalanine (PHE)	‰, vs AIR
TYR_N_SD	Standand deviation of d15N values from all injections for amino acid tyrosine (TYR)	‰, vs AIR
LYS_N_SD	Standand deviation of d15N values from all injections for amino acid lysine (LYS)	‰, vs AIR
ALA_C	Mean d13C value of all injections for amino acid alanine (ALA)	‰, vs VPDB
GLY_C	Mean d13C value of all injections for amino acid glycine (GLY)	‰, vs VPDB
THR_C	Mean d13C value of all injections for amino acid threonine (THR)	‰, vs VPDB
SER_C	Mean d13C value of all injections for amino acid serine (SER)	‰, vs VPDB
VAL_C	Mean d13C value of all injections for amino acid valine (VAL)	‰, vs VPDB
LEU_C	Mean d13C value of all injections for amino acid leucine (LEU)	‰, vs VPDB
ILE_C	Mean d13C value of all injections for amino acid isoleucine (ILE)	‰, vs VPDB
PRO_C	Mean d13C value of all injections for amino acid proline (PRO)	‰, vs VPDB
ASX_C	Mean d13C value of all injections for amino acid aspartic acid + asparagine	‰, vs VPDB
GLX_C	Mean d13C value of all injections for amino acid glutamic acid + glutamine	‰, vs VPDB
PHE_C	Mean d13C value of all injections for amino acid phenylalanine (PHE)	‰, vs VPDB
TYR_C	Mean d13C value of all injections for amino acid tyrosine (TYR)	‰, vs VPDB
LYS_C	Mean d13C value of all injections for amino acid lysine (LYS)	‰, vs VPDB
ALA_C_SD	Standand deviation of d13C values from all injections for amino acid alanine (ALA)	‰, vs VPDB
GLY_C_SD	Standand deviation of d13C values from all injections for amino acid glycine (GLY)	‰, vs VPDB

THR_C_SD	Standand deviation of d13C values from all injections for amino acid threonine (THR)	‰, vs VPDB
SER_C_SD	Standand deviation of d13C values from all injections for amino acid serine (SER)	‰, vs VPDB
VAL_C_SD	Standand deviation of d13C values from all injections for amino acid valine (VAL)	‰, vs VPDB
LEU_C_SD	Standand deviation of d13C values from all injections for amino acid leucine (LEU)	‰, vs VPDB
ILE_C_SD	Standand deviation of d13C values from all injections for amino acid isoleucine (ILE)	‰, vs VPDB
PRO_C_SD	Standand deviation of d13C values from all injections for amino acid proline (PRO)	‰, vs VPDB
ASX_C_SD	Standand deviation of d13C values from all injections for amino acid aspartic acid + asparagine	‰, vs VPDB
GLX_C_SD	Standand deviation of d13C values from all injections for amino acid glutamic acid + glutamine	‰, vs VPDB
PHE_C_SD	Standand deviation of d13C values from all injections for amino acid phenylalanine (PHE)	‰, vs VPDB
TYR_C_SD	Standand deviation of d13C values from all injections for amino acid tyrosine (TYR)	‰, vs VPDB
LYS_C_SD	Standand deviation of d13C values from all injections for amino acid lysine (LYS)	‰, vs VPDB

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Instruments

Dataset-specific Instrument Name	Ekman cores
Generic Instrument Name	Bottom Sediment Grab Samplers
Generic Instrument Description	These samplers are designed to collect an accurate representative sample of the sediment bottom. The bite of the sampler should be deep enough so all depths are sampled equally. The closing mechanism is required to completely close and hold the sample as well as prevent wash-out during retrieval. Likewise, during descent the sampler should be designed to minimize disturbance of the topmost sediment by the pressure wave as it is lowered to the bottom.

Dataset-specific Instrument Name	Brenke epibenthic sled
Generic Instrument Name	Epibenthic Sled
Generic Instrument Description	An epibenthic sled is a semi-quantitative bottom-sampling device designed to trawl just above the bottom at the sediment water interface (the epibenthic zone). The sled consists of a rectangular steel frame with a mesh net (often more than one) attached to it. Towed along the ocean floor, its weight scrapes into the benthos, collecting any organisms on the surface or in the first few centimeters of sediment. It also collects the organisms in the water column just above the benthos. Descriptions from WHOI and Census of Marine Life.

Dataset-specific Instrument Name	trace gas chromatograph (GC)
Generic Instrument Name	Gas Chromatograph
Dataset-specific Description	TFA derivatives of amino acids were analyzed for stable N isotopic composition using a Thermo Scientific Delta V Plus IRMS interfaced to a trace gas chromatograph (GC) fitted with a 60 m BPx5 forte capillary column (0.32 mm internal diameter with 1.0 mm film thickness) through a GC-C III combustion furnace (980 °C), reduction furnace (680 °C), and liquid nitrogen cold trap.
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	mortar and pestle
Generic Instrument Name	Homogenizer
Generic Instrument Description	A homogenizer is a piece of laboratory equipment used for the homogenization of various types of material, such as tissue, plant, food, soil, and many others.

Dataset-specific Instrument Name	HOV Alvin
Generic Instrument Name	HOV Alvin
Generic Instrument Description	Human Occupied Vehicle (HOV) Alvin is part of the National Deep Submergence Facility (NDSF). Alvin enables in-situ data collection and observation by two scientists to depths reaching 6,500 meters, during dives lasting up to ten hours. Commissioned in 1964 as one of the world's first deep-ocean submersibles, Alvin has remained state-of-the-art as a result of numerous overhauls and upgrades made over its lifetime. The most recent upgrades, begun in 2011 and completed in 2021, saw the installation of a new, larger personnel sphere with a more ergonomic interior; improved visibility and overlapping fields of view; longer bottoms times; new lighting and high-definition imaging systems; improved sensors, data acquisition and download speed. It also doubled the science basket payload, and improved the command-and-control system allowing greater speed, range and maneuverability. With seven reversible thrusters, it can hover in the water, maneuver over rugged topography, or rest on the sea floor. It can collect data throughout the water column, produce a variety of maps and perform photographic surveys. Alvin also has two robotic arms that can manipulate instruments, obtain samples, and its basket can be reconfigured daily based on the needs of the upcoming dive. Alvin's depth rating of 6,500m gives researchers in-person access to 99% of the ocean floor. Alvin is a proven and reliable platform capable of diving for up to 30 days in a row before requiring a single scheduled maintenance day. Recent collaborations with autonomous vehicles such as Sentry have proven extremely beneficial, allowing PIs to visit promising sites to collect samples and data in person within hours of their being discovered, and UNOLs driven technological advances have improved the ability for scientific outreach and collaboration via telepresence Alvin is named for Allyn Vine, a WHOI engineer and geophysicist who helped pioneer deep submergence research and technology. (from https://www.whoi.edu/what-we-do/explore/underwater-vehicles/hov-alvin/ , accessed 2022-09-09)

Dataset-specific Instrument Name	Thermo Scientific Delta V Plus IRMS
Generic Instrument Name	Isotope-ratio Mass Spectrometer
Dataset-specific Description	TFA derivatives of amino acids were analyzed for stable N isotopic composition using a Thermo Scientific Delta V Plus IRMS interfaced to a trace gas chromatograph (GC) fitted with a 60 m BPx5 forte capillary column (0.32 mm internal diameter with 1.0 mm film thickness) through a GC-C III combustion furnace (980 °C), reduction furnace (680 °C), and liquid nitrogen cold trap.
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	push cores
Generic Instrument Name	Push Corer
Generic Instrument Description	Capable of being performed in numerous environments, push coring is just as it sounds. Push coring is simply pushing the core barrel (often an aluminum or polycarbonate tube) into the sediment by hand. A push core is useful in that it causes very little disturbance to the more delicate upper layers of a sub-aqueous sediment. Description obtained from: http://web.whoi.edu/coastal-group/about/how-we-work/field-methods/coring/

Dataset-specific Instrument Name	ROV Doc Ricketts
Generic Instrument Name	ROV Doc Ricketts
Generic Instrument Description	The remotely operated vehicle (ROV) Doc Ricketts is operated by the Monterey Bay Aquarium Research Institute (MBARI). ROV Doc Ricketts is capable of diving to 4000 meters (about 2.5 miles). The R/V Western Flyer is the support vessel for Doc Ricketts and was designed with a center well whose floor can be opened to allow Doc Ricketts to be launched from within the ship into the water below. For a complete description, see: https://www.mbari.org/at-sea/vehicles/remotely-operated-vehicles/rov-doc...

Dataset-specific Instrument Name	ROV Lu'ukai
Generic Instrument Name	ROV Lu'ukai
Generic Instrument Description	The UH remotely operated vehicle (ROV) Lu'ukai is a small work-class ROV that can be operated from the R/V Kilo Moana to conduct investigations in waters up to 6,000 meters deep. After beginning operations in early 2018, the Lu'ukai has supported a study of deep-sea biodiversity and ecological processes in the western Clarion-Clipperton Zone, an area where numerous manganese nodule mining exploration claims are located; has maintained and upgraded sensors at the ALOHA Cabled Observatory, the world's deepest operating ocean observatory; and has recovered a failed telecommunications cable used to support acoustic research in local waters.

Dataset-specific Instrument Name	scalpel
Generic Instrument Name	scalpel
Generic Instrument Description	A scalpel, or lancet, or bistoury, is a small and extremely sharp bladed instrument used for dissection and surgery.

Dataset-specific Instrument Name	McLane Parflux traps
Generic Instrument Name	Sediment Trap
Generic Instrument Description	Sediment traps are specially designed containers deployed in the water column for periods of time to collect particles from the water column falling toward the sea floor. In general a sediment trap has a jar at the bottom to collect the sample and a broad funnel-shaped opening at the top with baffles to keep out very large objects and help prevent the funnel from clogging. This designation is used when the specific type of sediment trap was not specified by the contributing investigator.

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Deployments

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

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

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

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

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

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 μm) can be resolved from microbially reworked, smaller (0.7-53 μm) particles using AA-CSIA. This project is characterizing the isotopic compositions of key individual compounds in a continuum of particle sizes (< 1.0 μm suspended particles to large sinking particles >53 μm) 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.

Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1829612

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