

Particle d15N values of amino acids from EXPORTS cruises SR1812 on R/V Sally Ride and RR1813 on R/V Roger Revelle in August to September 2018

Website: <https://www.bco-dmo.org/dataset/880041>

Data Type: Cruise Results

Version: 1

Version Date: 2022-09-12

Project

» [Collaborative Research: Isotopic Indicators for Mechanisms of Organic Matter Degradation in the Northeast Pacific \(EXPORTS\)](#) (EXPORTS Isotopes)

Program

» [Export Processes in the Ocean from Remote Sensing](#) (EXPORTS)

Contributors	Affiliation	Role
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Abstract

This dataset includes d15N values of individual amino acids from size-fractionated and sinking particles collected on the EXPORTS cruises (SR1812 on R/V Sally Ride and RR1813 R/V Roger Revelle) in August to September 2018.

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Coverage

Spatial Extent: N:50.672621 E:-144.80516 S:50.046084 W:-145.297716

Temporal Extent: 2018-08-15 - 2018-09-05

Methods & Sampling

In situ pump filtration was performed using large volume pumps (WTS-LV; McLane Research Laboratories, Inc.) outfitted with mini-MULVFS (Multiple Unit Large Volume in-situ Filtration System) filter holders (Bishop et al.

2012). Pumps were loaded with filter stacks of either 3 filter pore sizes (51- and 5-um acid cleaned Nitex screens and 1 um pre-combusted quartz fiber filter) or 4 filter pore sizes (51- and 6-um acid cleaned Nitex screens, a double layer of 1 um pre-combusted quartz fiber filters, and a double layer of 0.3 um of pre-combusted glass fiber filters). Samples were frozen at -80 degrees Celsius until laboratory analysis. Sediment trap collection was performed using surface tethered sediment traps (STT) and neutrally buoyant sediment traps (NBST). Particles were collected in polycarbonate tubes with a collection area of 0.0113 m² and triggered to close at the end of the sampling period. Samples were collected in 500 mL of 70 ppt salinity, 0.1% formaldehyde-poisoned brine, buffered to pH 8.5 with borate and overlain with 1-um filtered surface seawater. After collection and allowing particles to sink to the bottom of the tube on board the ship for an hour, brine was filtered through a 335-um polyester screen and rotary wet split onto pre-combusted glass fiber filters with a pore size of 0.7 um. Samples were frozen at -80 degrees Celsius until laboratory analysis.

6 um and 51 um Nitex filters were washed down onto 0.7 um GFFs and inspected using a dissecting microscope, removing foreign (non-natural) material. Samples were freeze-dried and then stored at -20 degrees Celsius for the remainder of preparation. Samples were hydrolyzed using 6N HCl at 110 degrees Celsius for 20 hours, filtered, purified (to remove organic molecules other than amino acids and amino acid like molecules) using cation exchange chromatography. Amino acids in samples were derivatized to their isopropyl ester-trifluoroacetyl derivatives in a two-step derivatization: esterification with 4:1 isopropanol:acetyl chloride (110 degrees C, 60 minutes) and acetylation with 3:1 dichloromethane:trifluoroacetic anhydride (100 degrees C, 15 minutes), with the headspace evacuated with N₂ prior to each reaction. They were de-salted using phosphate buffer and chloroform and then re-acetylated. The solvent was exchanged for ethyl acetate immediately prior to analysis.

Analyses were carried out using a Thermo Fisher Scientific Trace 1310 Gas Chromatograph (GC) coupled to a MAT 253 Plus Isotope Ratio Mass Spectrometer (IRMS) through a Thermo Fisher GC Isolink II system with a combined oxidation/reduction reactor held at 1000 degrees C, a liquid nitrogen trap, and a Conflo IV open split interface.

Data Processing Description

Data Processing:

Data were processed through Thermo Fisher Isodat 3.0 and Microsoft Excel.

BCO-DMO Processing:

- replaced "n/a" with "nd" as missing data value ("no data");
- replaced hyphens with underscores in parameter names to comply with BCO-DMO naming conventions;
- changed all date fields to format YYYY-MM-DD.

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Data Files

File
particle_AA_d15N.csv (Comma Separated Values (.csv), 15.83 KB) MD5:fddef138ff5d7e6f78b103248624ccdb
Primary data file for dataset ID 880041

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Related Publications

Buesseler, K. O., Benitez-Nelson, C. R., Roca-Martí, M., Wyatt, A. M., Resplandy, L., Clevenger, S. J., Drysdale, J. A., Estapa, M. L., Pike, S., & Umhau, B. P. (2020). High-resolution spatial and temporal measurements of particulate organic carbon flux using thorium-234 in the northeast Pacific Ocean during the EXport Processes in the Ocean from RemoTe Sensing field campaign. *Elementa: Science of the Anthropocene*, 8(1). <https://doi.org/10.1525/elementa.2020.030> <https://doi.org/10.1525/elementa.030>
Methods

Estapa, M., Buesseler, K., Durkin, C. A., Omand, M., Benitez-Nelson, C. R., Roca-Martí, M., Breves, E., Kelly, R. P., & Pike, S. (2021). Biogenic sinking particle fluxes and sediment trap collection efficiency at Ocean Station Papa. *Elementa: Science of the Anthropocene*, 9(1). <https://doi.org/10.1525/elementa.2020.00122>
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/lb.2009.54.1.0050](https://doi.org/10.4319/lb.2009.54.1.0050)
Methods

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](https://doi.org/10.1016/s1936-7961(07)01012-3)
Methods

Wojtal, P. K., Doherty, S. C., Shea, C. H., Popp, B. N., Benitez-Nelson, C. R., Buesseler, K. O., Estapa, M. L., Roca-Martí, M., & Close, H. G. (2023). Deconvolving mechanisms of particle flux attenuation using nitrogen isotope analyses of amino acids. *Limnology and Oceanography*. Portico. <https://doi.org/10.1002/lno.12398>
Results

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Parameters

Parameter	Description	Units
Cruise	Cruise designation	Unitless
Cruise_SampleID	Sample Number given to each filter	Unitless
R2R_Event	R2R catalog identifier for this cruise	Unitless
Latitude	Latitude in decimal degrees North	Decimal degrees North
Longitude	Longitude in decimal degrees West	Decimal degrees West
ISO_DateTime_UTC	Date and time (UTC) of sampling in ISO8601 format: YYYY-MM-DDThh:mm:ssZ	Unitless
Date	Sampling date (UTC); format: YYYY-MM-DD	Unitless
Time	Sampling time (UTC); format: hh:mm:ss	Unitless
Depth	Depth of pump deployment	meters (m)
Size_Fraction_Min	Minimum size fraction captured on filter	micrometers (mm)
Size_Fraction_Max	Maximum size fraction captured on filter	micrometers (mm)
Volume_Filtered	Volume of water filtered through the filter	liters (L)
Start_R2R_Event	R2R catalog identifier for the start of the sediment trap deployment for this cruise	Unitless
End_R2R_Event	R2R catalog identifier for the end of the sediment trap deployment for this cruise	Unitless
Deploy_Latitude	Latitude at time of sediment trap deployment in decimal degrees North	Decimal degrees North
Deploy_Longitude	Longitude at time of sediment trap deployment in decimal degrees West	Decimal degrees West
Resurfaced_Latitude	Latitude at time of sediment trap resurface in decimal degrees North	Decimal degrees North
Resurfaced_Longitude	Longitude at time of sediment trap resurface in decimal degrees West	Decimal degrees West

Recover_Latitude	Latitude at time of sediment trap recovery in decimal degrees North	Decimal degrees North
Recover_Longitude	Longitude at time of sediment trap recovery in decimal degrees West	Decimal degrees West
ISO_DateTime.UTC_Deployed	Date and time (UTC) of sediment trap deployment in ISO8601 format: YYYY-MM-DDThh:mm:ssZ	Unitless
Date_Deployed	Sediment trap deployment date (UTC); format: YYYY-MM-DD	Unitless
Time_Deployed	Sediment trap deployment time (UTC); format: hh:mm:ss	Unitless
ISO_DateTime.UTC_AtDepth	Date and time (UTC) of sediment trap reaching sampling depth in ISO8601 format: YYYY-MM-DDThh:mm:ssZ	Unitless
Date_AtDepth	Sediment trap reaching sampling depth date (UTC); format: YYYY-MM-DD	Unitless
Time_AtDepth	Sediment trap reaching sampling depth time (UTC); format: hh:mm:ss	Unitless
ISO_DateTime.UTC_LidsClosed	Date and time (UTC) of sediment trap tube lids closing in ISO8601 format: YYYY-MM-DDThh:mm:ssZ	Unitless
Date_LidsClosed	Sediment trap tube lids closing date (UTC); format: YYYY-MM-DD	Unitless
Time_LidsClosed	Sediment trap tube lids closing time (UTC); format: hh:mm:ss	Unitless
ISO_DateTime.UTC_Resurfaced	Date and time (UTC) of sediment trap resurfacing in ISO8601 format: YYYY-MM-DDThh:mm:ssZ	Unitless
Date_Resurfaced	Sediment trap resurfacing date (UTC); format: YYYY-MM-DD	Unitless
Time_Resurfaced	Sediment resurfacing time (UTC); format: hh:mm:ss	Unitless
ISO_DateTime.UTC_Recovered	Date and time (UTC) of sediment trap recovery in ISO8601 format: YYYY-MM-DDThh:mm:ssZ	Unitless
Date_Recovered	Sediment trap recovery date (UTC); format: YYYY-MM-DD	Unitless
Time_Recovered	Sediment recovery time (UTC); format: hh:mm:ss	Unitless
Target_Depth	Target sampling depth for sediment traps	meters (m)
Actual_Depth	Actual sampling depth for sediment traps	meters (m)
Time_Elapsed_Deploy_to_Recover	Time elapsed between sediment trap being deployed and sediment trap being recovered	days (d)
Flux	Area of collection of the sediment traps divided by the number of days of collection	square meters per day (m ² /d)
d15N_Ala	The nitrogen isotopic composition of alanine	permil relative to AIR (‰)
d15N_Gly	The nitrogen isotopic composition of glycine	permil relative to AIR (‰)
d15N_Thr	The nitrogen isotopic composition of threonine	permil relative to AIR (‰)
d15N_Ser	The nitrogen isotopic composition of serine	permil relative to AIR (‰)

d15N_Val	The nitrogen isotopic composition of valine	permil relative to AIR (‰)
d15N_Leu	The nitrogen isotopic composition of leucine	permil relative to AIR (‰)
d15N_Iso	The nitrogen isotopic composition of isoleucine	permil relative to AIR (‰)
d15N_Pro	The nitrogen isotopic composition of proline	permil relative to AIR (‰)
d15N_Asx	The nitrogen isotopic composition of aspartic acid and asparagine	permil relative to AIR (‰)
d15N_Met	The nitrogen isotopic composition of methionine	permil relative to AIR (‰)
d15N_Glx	The nitrogen isotopic composition of glutamic acid and glutamine	permil relative to AIR (‰)
d15N_Phe	The nitrogen isotopic composition of phenylalanine	permil relative to AIR (‰)
d15N_Tyr	The nitrogen isotopic composition of tyrosine	permil relative to AIR (‰)
d15N_Lys	The nitrogen isotopic composition of lysine	permil relative to AIR (‰)
SD_d15N_Ala	The standard deviation of the nitrogen isotopic composition of alanine	permil relative to AIR (‰)
SD_d15N_Gly	The standard deviation of the nitrogen isotopic composition of glycine	permil relative to AIR (‰)
SD_d15N_Thr	The standard deviation of the nitrogen isotopic composition of threonine	permil relative to AIR (‰)
SD_d15N_Ser	The standard deviation of the nitrogen isotopic composition of serine	permil relative to AIR (‰)
SD_d15N_Val	The standard deviation of the nitrogen isotopic composition of valine	permil relative to AIR (‰)
SD_d15N_Leu	The standard deviation of the nitrogen isotopic composition of leucine	permil relative to AIR (‰)
SD_d15N_Iso	The standard deviation of the nitrogen isotopic composition of isoleucine	permil relative to AIR (‰)
SD_d15N_Pro	The standard deviation of the nitrogen isotopic composition of proline	permil relative to AIR (‰)
SD_d15N_Asx	The standard deviation of the nitrogen isotopic composition of aspartic acid and asparagine	permil relative to AIR (‰)
SD_d15N_Met	The standard deviation of the nitrogen isotopic composition of methionine	permil relative to AIR (‰)
SD_d15N_Glx	The standard deviation of the nitrogen isotopic composition of glutamic acid and glutamine	permil relative to AIR (‰)
SD_d15N_Phe	The standard deviation of the nitrogen isotopic composition of phenylalanine	permil relative to AIR (‰)
SD_d15N_Tyr	The standard deviation of the nitrogen isotopic composition of tyrosine	permil relative to AIR (‰)
SD_d15N_Lys	The standard deviation of the nitrogen isotopic composition of lysine	permil relative to AIR (‰)
d15N_THAA	The isotopic composition of the molar weighted sum of measured amino acids	permil relative to AIR (‰)

Total_AA_Conc	The sum of all measured amino acids in samples collected by in situ pump filtration	micromoles per cubic meter (mmol/m ³)
Total_AA_Flux	The sum of all measured amino acids in samples collected by sediment trap	nanomoles per square meter per day (nmol/m ² /d)
Total_AA_OnFilter	The sum of all measured amino acids in samples on the entire filter	nanomoles (nmol)

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Instruments

Dataset-specific Instrument Name	Thermo Fisher Scientific Trace 1310 Gas Chromatograph
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	MAT 253 Plus Isotope Ratio Mass Spectrometer (IRMS)
Generic Instrument Name	Isotope-ratio Mass Spectrometer
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	large volume pumps (WTS-LV; McLane Research Laboratories, Inc.)
Generic Instrument Name	McLane Large Volume Pumping System WTS-LV
Generic Instrument Description	The WTS-LV is a Water Transfer System (WTS) Large Volume (LV) pumping instrument designed and manufactured by McLane Research Labs (Falmouth, MA, USA). It is a large-volume, single-event sampler that collects suspended and dissolved particulate samples in situ. Ambient water is drawn through a modular filter holder onto a 142-millimeter (mm) membrane without passing through the pump. The standard two-tier filter holder provides prefiltering and size fractioning. Collection targets include chlorophyll maximum, particulate trace metals, and phytoplankton. It features different flow rates and filter porosity to support a range of specimen collection. Sampling can be programmed to start at a scheduled time or begin with a countdown delay. It also features a dynamic pump speed algorithm that adjusts flow to protect the sample as material accumulates on the filter. Several pump options range from 0.5 to 30 liters per minute, with a max volume of 2,500 to 36,000 liters depending on the pump and battery pack used. The standard model is depth rated to 5,500 meters, with a deeper 7,000-meter option available. The operating temperature is -4 to 35 degrees Celsius. The WTS-LV is available in four different configurations: Standard, Upright, Bore Hole, and Dual Filter Sampler. The high-capacity upright WTS-LV model provides three times the battery life of the standard model. The Bore-Hole WTS-LV is designed to fit through a narrow opening such as a 30-centimeter borehole. The dual filter WTS-LV features two vertical intake 142 mm filter holders to allow simultaneous filtering using two different porosities.

Dataset-specific Instrument Name	mini-MULVFS (Multiple Unit Large Volume in-situ Filtration System)
Generic Instrument Name	Multiple Unit Large Volume Filtration System
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.

Dataset-specific Instrument Name	neutrally buoyant sediment traps (NBST)
Generic Instrument Name	Neutrally Buoyant Sediment Trap
Generic Instrument Description	In general, 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. The Neutrally Buoyant Sediment Trap (NBST) was designed by researchers at Woods Hole Oceanographic Institution. The central cylinder of the NBST controls buoyancy and houses a satellite transmitter. The other tubes collect sediment as the trap drifts in currents at a predetermined depth. The samples are collected when the tubes snap shut before the trap returns to the surface. (more: http://www.whoi.edu/instruments/viewInstrument.do?id=10286)

Dataset-specific Instrument Name	surface tethered sediment traps (STT)
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

RR1813

Website	https://www.bco-dmo.org/deployment/772777
Platform	R/V Roger Revelle
Report	https://datadocs.bco-dmo.org/docs/EXPORTS/data_docs/RR1813_Cruise_Report.pdf
Start Date	2018-08-10
End Date	2018-09-12
Description	Additional cruise information is available from the Rolling Deck to Repository (R2R): https://www.rvdata.us/search/cruise/RR1813

SR1812

Website	https://www.bco-dmo.org/deployment/880050
Platform	R/V Sally Ride
Start Date	2018-08-09
End Date	2018-09-13
Description	Additional cruise information is available from the Rolling Deck to Repository (R2R): https://www.rvdata.us/search/cruise/SR1812

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Project Information

Collaborative Research: Isotopic Indicators for Mechanisms of Organic Matter Degradation in the Northeast Pacific (EXPORTS) (EXPORTS Isotopes)

Website: http://oceanexports.org/projects/project_id_0000_close.html

Coverage: Station Papa, Northeast Pacific

NSF Award Abstract:

The biological pump is largely responsible for the vertical transport of organic carbon from the surface to the

ocean interior. However, only a small fraction of organic material produced in surface waters is sequestered in the deep ocean. The rest is consumed, or respired, by bacteria and larger organisms. The overarching goal of the proposed work is to characterize the relative influences of bacteria versus larger organisms on the degradation of organic material with depth. Guided by recent results from the subtropical Pacific, the investigators will use measurements of stable isotopes of nitrogen in different amino acids (compound-specific isotopic analysis of amino acids, known as AA-CSIA), along with measurements of the abundances of different forms of amino acids, and other parameters derived from these analyses to identify how the partitioning and flux of large and small particles are affected by different degradation processes. By improving the interpretive power of the AA-CSIA technique the investigators propose to determine: 1) the relative importance of microbial and zooplankton consumption on the efficiency of the biological carbon pump in the subarctic northeast Pacific, and 2) how much microbially-altered small particles fuel the metabolisms of mid-water zooplankton. This work capitalizes on an existing, comprehensive field program (NASA EXPORTS) specifically focused on building a predictive framework relating surface ocean properties to the vertical flux of organic carbon. The tremendous amount of data to be collected on all aspects of the biological pump as part of the EXPORTS program will aid the development and interpretation of the investigators' amino acid isotopic tool. Results will be broadly communicated via production and distribution of several episodes of Voice of the Sea, a local television program that will air in Hawaii and across many Pacific islands. Episodes also will be posted online and publicized through social media to the south Florida community. This project will support a Ph.D. student and an undergraduate student at University of Miami, which serves a 25% Hispanic population, and an M.S. student and an undergraduate student at University of Hawaii, which is a designated minority-serving institution.

The proposed work introduces a new geochemical framework to distinguish microbial versus zooplankton alteration of marine organic matter. Piloted on samples from the subtropical Pacific, this approach interrogates unamended sinking material directly, using amino acid compound-specific isotopic analysis (AA-CSIA) to determine the progressive, cumulative impact of microbial and zooplankton degradative pathways. The proposed work (1) will extend this interpretive framework to explicitly define end-member signatures such as fecal pellets and will apply this refined method to a study site in the subarctic northeast Pacific to (2) determine the vertical progression of degradative mechanisms in an oceanographic location with contrasting productivity and vertical length scales of flux attenuation and (3) determine whether microbially- degraded biomass is important for fueling midwater metazoans under contrasting carbon flux conditions. The proposed work will be conducted in collaboration with the NASA EXPORTS program at the Ocean Station Papa time-series site. Teaming with this program presents a unique opportunity to refine AA-CSIA interpretation in parallel with intensive data collection defining productivity, particle size distribution and flux, and numerous biological parameters. In comparing subtropical and subarctic Pacific locations, the proposed work will test how differences in productivity and plankton community structure influence vertical patterns of consumption and alteration of phytodetritus by microbes and zooplankton, from surface to mesopelagic depths.

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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Program Information

EXport Processes in the Ocean from Remote Sensing (EXPORTS)

Website: <http://oceanexports.org/>

EXport Processes in the Ocean from Remote Sensing (EXPORTS) is a large-scale NASA-led field campaign that will provide critical information for quantifying the export and fate of upper ocean net primary production (NPP) using satellite observations and state of the art ocean technologies.

Ocean ecosystems play a critical role in the Earth's carbon cycle and the quantification of their impacts for both present conditions and for predictions into the future remains one of the greatest challenges in oceanography. The goal of the EXport Processes in the Ocean from Remote Sensing (EXPORTS) Science Plan is to develop a predictive understanding of the export and fate of global ocean net primary production (NPP) and its implications for present and future climates. The achievement of this goal requires a quantification of the mechanisms that control the export of carbon from the euphotic zone as well as its fate in the underlying "twilight zone" where some fraction of exported carbon will be sequestered in the ocean's interior on time

scales of months to millennia. In particular, EXPORTS will advance satellite diagnostic and numerical prognostic models by comparing relationships among the ecological, biogeochemical and physical oceanographic processes that control carbon cycling across a range of ecosystem and carbon cycling states. EXPORTS will achieve this through a combination of ship and robotic field sampling, satellite remote sensing and numerical modeling. Through a coordinated, process-oriented approach, EXPORTS will foster new insights on ocean carbon cycling that maximizes its societal relevance through the achievement of U.S. and International research agency goals and will be a key step towards our understanding of the Earth as an integrated system.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1830016

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