Particulate organic carbon, nitrogen, and Thorium-234 measurements collected during the 2012-2013 Palmer Field Season (WAP Carbon export project)

Website: https://www.bco-dmo.org/dataset/881127
Data Type: Other Field Results
Version: 1
Version Date: 2022-08-02

Project
» Quantifying Processes Driving Interannual Variability in the Biological Carbon Pump in the Western Antarctic Peninsula (WAP Carbon export)

Contributors	Affiliation	Role
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Abstract
Sinking organic carbon, nitrogen, and Th-234 fluxes measured using bottom-tethered, VERTEX-style sediment traps during the 2012-2013 field season of the Palmer LTER program near Anvers Island in the Western Antarctic Peninsula. These flux measurements allow investigation of the ocean's biological carbon pump. Sediment trap deployments span the ice-free season near Anvers Island. Deployments lasted between 2 and 8 days, depending on ocean conditions.

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Coverage

Location: Western Antarctic Peninsula near Anvers Island
Spatial Extent: **N**:-64.7795 **E**:-64.0405 **S**:-64.815 **W**:-64.0725
Temporal Extent: 2012-01-06 - 2013-01-27

Methods & Sampling

Data comes from VERTEX-style, bottom-tethered (moored) sediment trap deployments. Particle interceptor tubes were deployed on cross-pieces with 4 tubes attached at a depth of 50 m. Tubes were deployed with a dense formaldehyde brine created by adding NaCl and formaldehyde to filtered seawater. After recovery, overlying seawater was removed from each tube by gentle suction. Tubes were then gravity filtered through a 200-micron nitex mesh filter, and the 200-micron filters were carefully analyzed under a stereomicroscope and all metazoan zooplankton "swimmers" were removed from the sample. Filtrate and remaining material on the 200-micron filter were then each filtered through separate pre-combusted quartz (QMA) filter. Samples were then dried, mounted in RISO planchets and counted on a RISO low-level beta multi-counter. After subsequent background counts, samples were acidified to remove calcium carbonate and analyzed for carbon and nitrogen on an elemental analyzer.

BCO-DMO Processing Description

- Spaces removed from column names and replaced with underscores ("_")
- Special characters removed from column names and replaced with textual representation (e.g., ">" was replaced with "greater_than", "<" was replaced with "less_than", "σ" (theta) was replaced with "standard_error", etc.)
- Row containing units removed from the data file
- Converted date values in the data file from %m-%d-%y %H:%M format to %Y-%M-%DT%H:%M format
-'b.d' (below detection) values removed from the N_greater_than_200 and standard_error_N_greater_than_200 columns of the data file and two new fields were created called N_greater_than_200_flag and standard_error_N_greater_than_200_flag; these new columns indicate if blank values in the original two columns indicate measurements were 'below detection' limits
- 'NaN' values in the data file were replaced with blank values ("")

Problem Description

Blank values in the dataset indicate that the samples were lost and/or the data is otherwise unavailable.

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Data Files

File	
881127_v1_palmer_station_sediment_trap.csv	(Comma Separated Values (.csv), 3.80 KB) MD5:ed84faacaf572871100c195d70cfede0
Primary data file for dataset ID 881127, version 1	

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Related Publications

Stukel, M. R., Asher, E., Couto, N., Schofield, O., Strebel, S., Tortell, P., & Ducklow, H. W. (2015). The imbalance of new and export production in the western Antarctic Peninsula, a potentially “leaky” ecosystem. Global Biogeochemical Cycles, 29(9), 1400–1420. Portico. https://doi.org/10.1002/2015gb005211 https://doi.org/10.1002/2015GB005211
Methods

Stukel, M. R., Schofield, O. M. E., & Ducklow, H. W. (2022). Seasonal variability in carbon:234thorium ratios of suspended and sinking particles in coastal Antarctic waters: Field data and modeling synthesis. Deep Sea Research Part I: Oceanographic Research Papers, 184, 103764. https://doi.org/10.1016/j.dsr.2022.103764
Methods

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Parameters

Parameter	Description	Units
Station	Palmer LTER Station Name from which sample was collected	unitless

Latitude	Station Latitude in decimal degrees; a positive value indicates a Northern coordinate	decimal degrees
Longitude	Station Longitude in decimal degrees; a positive value indicates an Eastern coordinate	decimal degrees
Date_Deployed	Date of deployment in local time at Palmer Station (UTC-3).	unitless
Date_Recovered	Date of deployment in local time at Palmer Station (UTC-3).	unitless
Depth	Depth of sample collection.	meters (m)
Corg	Particulate organic carbon (POC) flux.	milligrams of carbon per square meter per day (mg C/m^2/d)
standard_error_Corg	Standard error of POC flux.	milligrams of carbon per square meter per day (mg C / m^2 / d)
N	Particulate nitrogen flux.	milligrams of nitrogen per square meter per day (mg N/m^2/d)
standard_error_N	Standard error of particulate nitrogen flux.	milligrams of nitrogen per square meter per day (mg N/m^2/d)
Corg_less_than_200	POC flux (<200 microns).	milligrams of carbon per square meter per day (mg C/m^2/d)
standard_error_Corg_less_than_200	Standard error of POC flux (<200 microns).	milligrams of carbon per square meter per day (mg C/m^2/d)
Corg_greater_than_200	POC flux (>200 microns).	milligrams of carbon per square meter per day (mg C/m^2/d)
standard_error_Corg_greater_than_200	Standard error of POC flux (>200 microns).	milligrams of carbon per square meter per day (mg C/m^2/d)
N_less_than_200	PN flux (<200 microns).	milligrams of nitrogen per square meter per day (mg N/m^2/d)

standard_error_N_less_than_200	Standard error of PN flux (<200 microns).	milligrams of nitrogen per square meter per day (mg N/m^2/d)
N_greater_than_200	PN flux (>200 microns).	milligrams of nitrogen per square meter per day (mg N/m^2/d)
N_greater_than_200_flag	Flag column indicating rows where blank PN flux (>200 microns) values indicate that a measurement was "below detection."	unitless
standard_error_N_greater_than_200	Standard error of PN flux (>200 microns).	milligrams of nitrogen per square meter per day (mg N/m^2/d)
standard_error_N_greater_than_200_flag	Flag column indicating rows where blank standard error of PN flux (>200 microns) values indicate that a measurement was "below detection."	unitless
Th234	Thorium isotope 234Th flux.	decays per minute per meter squared per day (dmp/m^2/d)
standard_error_Th234	Uncertanty in Thorium isotope 234Th flux.	decays per minute per meter squared per day (dmp/m^2/d)

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Instruments

Dataset-specific Instrument Name	Riso low-level GM beta multi-counter
Generic Instrument Name	GM multicounter
Dataset-specific Description	Collected sediment trap samples were dried, mounted in RISO planchets and counted on a RISO low-level beta multi-counter.
Generic Instrument Description	A gas flow multicounter (GM multicounter) is used for counting low-level beta doses. GM multicounters can be used for gas proportional counting of 32Si to 32P. For more information about GM multicounter usage see Krause et. al. 2011.

Dataset-specific Instrument Name	Stereomicroscope
Generic Instrument Name	Microscope - Optical
Dataset-specific Description	Filtered seawater samples in 200-micron filters were carefully analyzed under a stereomicroscope and all metazoan zooplankton “swimmers” were removed from the sample.
Generic Instrument Description	Instruments that generate enlarged images of samples using the phenomena of reflection and absorption of visible light. Includes conventional and inverted instruments. Also called a "light microscope".

Dataset-specific Instrument Name	VERTEX-style bottom-tethered (moored) sediment trap
Generic Instrument Name	Sediment Trap
Dataset-specific Description	Particle interceptor tubes were deployed on cross-pieces with 4 tubes attached at a depth of 50 m. Tubes were deployed with a dense formaldehyde brine created by adding NaCl and formaldehyde to filtered seawater.
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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Project Information

Quantifying Processes Driving Interannual Variability in the Biological Carbon Pump in the Western Antarctic Peninsula (WAP Carbon export)

Coverage: Western Antarctic Peninsula (Palmer LTER Study Region)

NSF Award Abstract:
Algae in the surface ocean convert carbon dioxide into organic carbon through photosynthesis. The biological carbon pump transports this organic carbon from the atmosphere to the deep ocean where it can be stored for tens to hundreds of years. Annually, the amount transported is similar to that humans are currently emitting by burning fossil fuels. However, at present we cannot predict how this important process will change with a warming ocean. These investigators plan to develop a 15+ year time-series of vertical carbon transfer for the Western Antarctic Peninsula; a highly productive Antarctic ecosystem. This region is also rapid transition to warmer temperatures leading to reduced sea ice coverage. This work will help researchers better understand how the carbon cycle in the Western Antarctic Peninsula will respond to climate change. The researchers will develop the first large-scale time-series of carbon flux anywhere in the ocean. This research will also support the education and training of a graduate student and support the integration of concepts in Antarctic research into two undergraduate courses designed for non-science majors and advanced earth science students. The researchers will also develop educational modules for introducing elementary and middle-school age students to important concepts such as gross and net primary productivity, feedbacks in the marine and atmospheric systems, and the differences between correlation and causation. Results from this proposal will also be incorporated into a children’s book, “Plankton do the Strangest Things”, that is

targeted at 5-7 year olds and is designed to introduce them to the incredible diversity and fascinating adaptations of microscopic marine organisms.

This research seeks to leverage 6 years (2015-2020) of 234Th samples collected on Palmer LTER program, 5 years of prior measurements (2009-2010, 2012-2014), and upcoming cruises (2021-2023) to develop a time-series of summertime particle flux in the WAP that stretches for 15 years. The 238U-234Th disequilibrium approach utilizes changes in the activity of the particle-active radio-isotope 234Th relative to its parent nuclide 238U to quantify the flux of sinking carbon out of the surface ocean (over a time-scale of ~one month). This proposal will fund 234Th analyses from nine years' worth of cruises (2015-2023) and extensive analyses designed to investigate the processes driving inter-annual variability in the BCP. These include: 1) physical modeling to quantify the importance of advection and diffusion in the 234Th budget, 2) time-series analyses of particle flux, and 3) statistical modeling of the relationships between particle flux and multiple presumed drivers (biological, chemical, physical, and climate indices) measured by collaborators in the Palmer LTER program. This multi-faceted approach is critical for linking the measurements to models and for predicting responses to climate change. It will also test the hypothesis that export flux is decreasing in the northern WAP, increasing in the southern WAP, and increasing when integrated over the entire region as a result of earlier sea ice retreat and a larger ice-free zone. The project will also investigate relationships between carbon export and multiple potentially controlling factors including: primary productivity, algal biomass and taxonomic composition, biological oxygen saturation, zooplankton biomass and taxonomic composition, bacterial production, temperature, wintertime sea ice extent, date of sea ice retreat, and climate modes.

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-1756610
NSF Office of Polar Programs (formerly NSF PLR) (NSF OPP)	OPP-1951090
NSF Office of Polar Programs (formerly NSF PLR) (NSF OPP)	OPP-1340886
NSF Office of Polar Programs (formerly NSF PLR) (NSF OPP)	OPP-1440435

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