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

Website: https://www.bco-dmo.org/dataset/881116
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
Particle-bound Th-234 measurements and C:234Th ratios for particles (seston) collected during the 2012-2013 field season of the Palmer LTER program near Anvers Island in the Western Antarctic Peninsula. Particle-bound Th-234 is a useful tracer for particle scavenging and sinking processes in the ocean. Vertical profiles of particle-bound Th-234 and C:234Th ratios were measured approximately weekly. Measurements typically spanned from the surface to a depth of 65 m.

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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: 2012-11-10 - 2013-03-21

Dataset Description

The detection limit set for POC measurements in the data file is: 30, and the detection limit for PN measurements is 2.

Methods & Sampling

Particulate organic carbon, nitrogen, and ^{234}Th adsorbed onto particles were measured at 6 depths spanning the euphotic zone (surface to 65 m depth). 4-L samples were vacuum filtered through pre-combusted quartz microfiber (QMA) filters. Filtrate after filtration was collected and filtered through another filter to serve as an adsorption blank. Filters were dried and mounted in RISO planchets. Samples were then counted in a RISO

low-level beta multi-counter to determine activity of ^{234}Th. Background counts were conducted >6 half-lives after collection. Samples were then acidified to remove $CaCO_3$ and analyzed in an elemental analyzer to determine particulate organic carbon and particulate nitrogen on filters. For additional details, see Stukel et al. (2015) and Stukel et al. (2022).

BCO-DMO Processing Description

- Spaces removed from column names and replaced with underscores ("_")
- Row containing units removed from the data file
- Converted date times in the data file from %m-%d-%y %H:%M format to %Y-%M-%DT%H:%M format
- Added a column Collection_Datetime_UTC representing datetime values in UTC
- 'below detection' values removed from the POC and PN columns of the data file and two new fields were created called POC_flag and PN_flag; these new columns indicate if a blank POC or PN values indicate if measurements were 'below detection' limits

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Data Files

File	
881116_v1_palmer_station_particulate_thorium.csv	(Comma Separated Values (.csv), 14.46 KB) MD5:863b5d422895d94dd635584015f95b63
Primary data file for dataset ID 881116, 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
Collection_Datetime_Local	Date and time of collection in local time at Palmer Station (UTC-3).	unitless
Collection_Datetime_UTC	Date and time of collection in UTC time.	unitless
Depth	Depth.	meters (m)
Particulate_Th234	Thorium isotope 234Th adsorbed into particles.	decays per minute per liter (dpm/L^-1)
Uncertainty	Uncertainty in Thorium 234TH adsorbed into particles.	decays per minute per liter (dpm/L^-1)
POC	Particulate organic carbon.	milligrams of carbon per cubic meter (mg C / m^-3)
POC_flag	Flag column indicating rows where blank POC values indicate that a measurement was "below detection."	unitless
PN	Particulate nitrogen.	milligrams of carbon per cubic meter (mg C / m^-3)
PN_flag	Flag column indicating rows where blank PN values indicate that a measurement was "below detection."	unitless

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Instruments

Dataset-specific Instrument Name	Elemental Analyzer
Generic Instrument Name	Elemental Analyzer
Dataset-specific Description	After subsequent background counts using the RISO low-level beta multi-counter, samples were acidified to remove calcium carbonate and analyzed for carbon and nitrogen on an elemental analyzer.
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	Riso low-level GM beta multi-counter
Generic Instrument Name	GM multicounter
Dataset-specific Description	Samples from six euphotic zone depths (surface to 65 meters) were counted in a RISO low-level beta multi-counter to determine the activity of 234Th.
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.

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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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