

Size Fractionated Particulate Thorium-234 measurements collected during the 2012-2013 Palmer Field Season

Website: <https://www.bco-dmo.org/dataset/881137>

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 size-fractionated particles 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. Particles were sampled from 0, 10, 20, or 30 m depth and filtered through a 50- μ m sieve before being concentrated onto a GF/F filter for carbon and Th-234 analyses.

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Coverage

Location: Western Antarctic Peninsula near Anvers Island

Spatial Extent: Lat:-64.815 Lon:-64.0405

Temporal Extent: 2012-11-08 - 2013-02-11

Methods & Sampling

Particulate organic carbon, nitrogen, and ^{234}Th associated with >50- μ m particles was measured at depths from the surface to 30 m at Station E near Palmer Station. Samples were collected using two different methods. For surface sampling, 20-L carboys were filled with surface seawater and gently poured through a 50- μ m sieve. For samples from depth, water was pumped to the surface using a Monsoon pump and filtered through a 50- μ m sieve. Volumes filtered varied depending on particle load but were typically between 50 and 100 L. Sieves were rinsed onto pre-combusted glass fiber (GF/F) filters. 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. (2022).

Data Processing Description

The data detection limits for N measurements in the data file are: 0,1.

BCO-DMO Processing Description

- Spaces removed from column names and replaced with underscores (" _ ")
- Row containing units removed from the data file
- Converted date values in the data file from %m/%d/%y %H:%M %p format to %Y-%M-%DT%H:%M format
- 'below detection' values were removed from the N column of the data file and a new field was created called N_flag; this new column indicates if a blank N value indicates if this measurement was 'below detection' limits
- Datetime in data file converted from local time at Palmer Station (UTC-3) to UTC time

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Data Files

File
881137_v1_palmer_station_size_fractionated_particulate_thorium.csv (Comma Separated Values (.csv), 2.92 KB) MD5:578a2da70b34b63e405a864a21811eac Primary data file for dataset ID 881137, 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_Time	Date and time of collection in UTC.	unitless
Depth	Depth at which sample was collected.	meters (m)
Particulate_Th234	Thorium isotope 234Th adsorbed onto >50-um particles.	decays per minute per minute per liter (dmp/min/L)
Uncertainty	Uncertainty in thorium isotope th234Th on >50-um particles.	decays per minute per minute per liter (dmp/min/L)
C	Particulate organic carbon (POC) in >50-um particles.	milligrams of carbon per cubic meter (mg C/m ⁻³)
N	Particulate nitrogen in >50-um particles.	milligrams of carbon per cubic meter (mg C/m ⁻³)
N_flag	Flag column indicating rows where blank particulate nitrogen values indicate that a measurement was "below detection." The data detection limits for N in the data file are: 0,1.	unitless

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Instruments

Dataset-specific Instrument Name	Elemental analyzer
Generic Instrument Name	Elemental Analyzer
Dataset-specific Description	Sea water samples were acidified to remove CaCO ₃ and analyzed in an elemental analyzer to determine particulate organic carbon and particulate nitrogen on filters.
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 multiscouter
Dataset-specific Description	Collected sediment trap samples were dried, mounted in RISO plachets and counted on a RISO low-level beta multi-counter.
Generic Instrument Description	A gas flow multiscouter (GM multiscouter) is used for counting low-level beta doses. GM multiscouters can be used for gas proportional counting of ^{32}Si to ^{32}P . For more information about GM multiscouter 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 ^{234}Th 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 ^{238}U - ^{234}Th disequilibrium approach utilizes changes in the activity of the particle-active radio-isotope ^{234}Th relative to its parent nuclide ^{238}U to quantify the flux of sinking carbon out of the surface ocean (over a time-scale of ~one month). This proposal will fund ^{234}Th 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 ^{234}Th 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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