Total water column Thorium-234 measurements collected during the 2012-2013 Palmer Field Season (WAP Carbon export project)

Website: https://www.bco-dmo.org/dataset/881459
Data Type: Cruise 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
Total water-column Th-234 measurements collected during the 2012-2013 field season of the Palmer LTER program near Anvers Island in the Western Antarctic Peninsula. 238U-234Th disequilibrium is used as a proxy for sinking particle flux out of the upper ocean. Vertical profiles of 234Th were measured using standard small-volume techniques approximately weekly. Measurements typically spanned from the surface to a depth of 100 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: 2012-10-31 - 2013-03-25

Methods & Sampling

Salinity and density were measured using a CTD. 4-L Samples for total water-column ^{234}Th activity were collected using Go-Flo bottles at 7 depths from the surface to 100 m. Sample volume was determined gravimetrically and then samples were acidified to a pH < 2 with nitric acid and a Th-230 tracer spike was added. Samples were shaken and allowed to equilibrate for 4 – 9 hours. Samples were then re-basified with ammonium hydroxide to a pH of 8 – 9, shaken, and allowed to equilibrate for >8 hours. Samples were then vacuum filtered at high vacuum pressure through a quartz (QMA) filter. Filters were mounted in RISO planchets and counted on a RISO low-level beta multi-counter at Palmer Station. Following a background count >6 months later, samples were dissolved in 8M nitric acid / 10% hydrogen peroxide solution and a Th-229 tracer spike was added. Samples were then shipped to the Woods Hole Analytical laboratory for analysis of the Th-229:Th-230 ratio, which was used to calculate the initial precipitation and filtration yield of Th-234. For

additional details, see Stukel et al. (2015) and Stukel et al. (2022).

BCO-DMO Curation Notes

- Spaces removed from column names and replaced with underscores ("_")
- Row containing units removed from the data file
- 'NaN' values in the data file were replaced with blank values ("")
- Collection_Date date format converted from %m-%d-%y to %Y-%m-%d
- Date format converted from local time at Palmer Station (UTC-3) to UTC

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	
881459_v1_palmer_station_thorium.csv	(Comma Separated Values (.csv), 26.53 KB) MD5:3e210840fc6532320ff757a0ba286661
Primary data file for dataset ID 881459, 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_Date_and_Time	Date and time of collection.	unitless
Depth	Depth at which sample was collected.	meter (m)
Salinity	Salinity.	PSU
Density	Density.	kilogram per liter (kg/L^-1)
Th234	Total water-column Thorium isotope 234Th.	decays per minute per liter (dpm/L^-1)
Uncertainty	Uncertainty in thorium isotope 234Th.	decays per minute per liter (dpm/L^-1)
Deficiency	238Uranium-234Thorium deficiency.	decays per minute per liter (dpm/L^-1)
Def_Uncertainty	Uncertainty in deficiency.	decays per minute per liter (dpm/L^-1)

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Instruments

Dataset-specific Instrument Name	Riso low-level GM beta multi-counter
Generic Instrument Name	GM multicounter
Dataset-specific Description	Samples were then vacuum filtered at high vacuum pressure through a quartz (QMA) filter. Filters were mounted in RISO planchets and counted on a RISO low-level beta multi-counter at Palmer Station.
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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