Thorium isotope data summaries from R/V Yuzhmorgeologiya, RVIB Nathaniel B. Palmer AMLR2006-Leg1, NBP0606 in the Southern Ocean from January to August 2006 (Ant2006 project, BWZ project)

Website: https://www.bco-dmo.org/dataset/3086
Version: 11 March 2009
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Project
» Plankton Community Structure and Iron Distribution in the Southern Drake Passage and Scotia Sea (Ant2006)
» Blue Water Zone (BWZ)

Contributors	Affiliation	Role
Charette, Matthew A.	Woods Hole Oceanographic Institution (WHOI)	Principal Investigator
Dulaiova, Henrieta	University of Hawai'i at Mānoa (SOEST)	Co-Principal Investigator
Gegg, Stephen R.	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

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Dataset Description

Thorium isotope data summaries from AMLR and NBP cruises to the Antarctic in 2006

Particulate organic Carbon (POC) flux was determined through measuring Thorium (234Th) reported in dpm/kg .

Cruises

AMLR (Antarctic Marine Living Resources) R/V Yuzhmorgeologiya Jan2006:
The research program was focused in the southern Drake Passage
along the Shackelton Shelf located near the Bransfield Strait.
Samples were obtained from the R/V Yuzhmorgeologiya and inflatables
that were taken to island locations.
Lat/Lon Bounding Box
-62.2538Lat, -62.9966Lon
-63.2335Lat, -59.0332Lon
-59.9964Lat, -55.7612Lon
-61.4995Lat, -53.9996Lon

NBP (Nathaniel B. Palmer) R/V Nathaniel B. Palmer July2006:
The research was conducted in the same region of the Drake Passage as the AMLR cruise.
Samples were obtained aboard the R/V Nathaniel B. Palmer

Lat/Lon bounding box
-60.4991Lat, -58.5613Lon
-62.3599Lat, -58.0392Lon
-60.2783Lat, -57.4509Lon
-61.2683Lat, -54.2852Lon

Associated Publications

Brzezinski, M.A., Nelson, D.M., Franck, V.M. and Sigmon, D.E., 2001. "Silicon dynamics within an intense open-ocean diatom bloom in the pacific sector of the southern ocean." Deep-Sea Research Part II 48, pp. 3997-4018

Michiel Rutgers van der Loeff, Manmohan M. Sarin, Mark Baskaran, Claudia Benitez-Nelson, Ken O. Buesseler, Matt Charette, Minhan Dai, Örjan Gustafsson, Pere Masque, Paul J. Morris, Kent Orlandini, Alessia Rodriguez y Baena, Nicolas Savoye, Sabine Schmidt, Robert Turnewitsch, Ingrid Vöge, James T. Waples. "A review of present techniques and methodological advances in analyzing 234Th in aquatic systems" Marine Chemistry, Volume 100, Issues 3-4, 1 August 2006, Pages 190-212

Pike, S.M., K.O. Buesseler, J. Andrews and N. Savoye, 2005. "Quantification of 234Th recovery in small volume sea water samples by inductively coupled plasma mass spectrometry." (PDF) Journal of Radioanalytical and Nuclear Chemistry, 263(2): 355-360.

Willard S. Moore and Ralph Arnold (1996). "Measurement of 223Ra and 224Ra in coastal waters using a delayed coincidence counter." Journal of Geophysical Research, vol. 101, no. c1, pages 1321-1329, January 15, 1996.

Methods & Sampling

Sampling and Analytical Methodology

Particle sinking rates were determined using the 4 liter measurement of 234Th (Pike et al., 2005). Samples were collected from hydrocasts from a shipboard CTD. The unfiltered 4-liter samples were immediately acidified to pH ~1.5 using concentrated Nitric acid. Samples were shaken vigorously and 230Th added as a yield monitor. The samples were shaken again and allowed to equilibrate for 8 hours. Concentrated NH4OH was subsequently added to each sample to adjust the pH to 8. Extraction of thorium from seawater was then accomplished by co-precipitation via a MnO2 precipitate onto a 25-mm-diameter QMA filter. The filtered samples were air dried and counted on a RISO beta detector (Rutgers van der Loeff et al., 2006). All samples were counted for at least 24 hours or until the counting error was < 3%. Samples were recounted after >150 days (~6 half lives) to determine the sample background. Detector calibration was confirmed with 3000m deep water sample.

Particulate carbon was collected through a McLane WTS-LV in-situ pump and filtered through a 142mm GFF filter. 22mm subsamples were collected, dried and transported back to the WHOI laboratory for CHN analysis on the Flash EA1112. The samples were pelletized in ultra clean tin capsules, combusted at 900oC, separated in a gas chromatographic column, and measured through a thermal conductivity detector. The CHN analyzer was calibrated by using an acetanilide standard. A second subsample was taken and analyzed for biogenic silica (Brzezinski et al 2001). Sodium Hydroxide was added to the filter and heated to 95oC for 45minutes. It was placed on ice and neutralized with hydrochloric acid. After centrifuging, the supernatant is then analyzed for silicate on a Lachat Quickchem 8000.

Data Processing Description

Data Processing

CHN: Linear regression of standards is used to determine the carbon content of the sample

Th: Thorium is measured using the Riso betacounters. Results published include removal ofsample

background, detector efficiency correction, correction of radioactive decay, and chemistry efficiency through analysis of tracer (230Th).

Modifications to original data made to conform to BCO-DMO database convention

Cruise_ID added
Spaces in Sample_ID replaced with dashes for consistency with Radium summary data empty cells filled with "nd" (no data)
Latitude/Longitude headers converted to lat/lon
date reformatted to YYYYMMDD
time reformatted to HHMM
decimal data values padded to consistent decimal places
spaces, minus signs, and "<'"s replaced with underscores or text in misc data headers
POC/PON used in place of Part Organic Carbon/Nitrogen in headers
"No Sample" values replaced with "nd" in Sample_Ids FA-494, FA-495
"Surface" values in Depth data replaced with "1"

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Data Files

File
Thorium_Summary.csv (Comma Separated Values (.csv), 42.98 KB) MD5:80d154eaca96e4f6349e46054233c7a3 Primary data file for dataset ID 3086

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Parameters

Parameter	Description	Units
Cruise_ID	Antarctica 2006 Cruise Id	text
Sample_ID	Antarctica 2006 Sample Id	text
Station_ID	Antarctica 2006 Station Id	text
date	Date of sample collection (GMT)	YYYYMMDD
time	Time of sample collection (GMT)	HHMM
lat	Latitude position of sample. Decimal degs (South is negative).	decimal degrees
lon	Longitude position of sample. Decimal degs (West is negative)	decimal degrees
depth	Depth of sample	meters
cast	CTD cast number	integer
bottle	CTD bottle number	integer
Total_Thorium	Total thorium dpm at collection	dpm/kg
Thorium_net_err	Total_Thorium net err	+/- dpm
POC_gt54_micron	Particulate Organic Carbon (>54microns)	uM/Liter
PON_gt54_micron	Particulate Organic Nitrogen (>54microns)	uM/Liter
POC_1_to_54_micron	Particulate Organic Carbon (1-54microns)	uM/Liter
PON_1_to_54_micron	Particulate Organic Nitrogen (1-54microns)	uM/Liter
BioAvail_Silicate	Biological Available Silicate	uM/Liter

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Instruments

Dataset-specific Instrument Name	Conductivity, Temperature, Depth
Generic Instrument Name	CTD - profiler
Dataset-specific Description	Shipboard CTD
Generic Instrument Description	The Conductivity, Temperature, Depth (CTD) unit is an integrated instrument package designed to measure the conductivity, temperature, and pressure (depth) of the water column. The instrument is lowered via cable through the water column. It permits scientists to observe the physical properties in real-time via a conducting cable, which is typically connected to a CTD to a deck unit and computer on a ship. The CTD is often configured with additional optional sensors including fluorometers, transmissometers and/or radiometers. It is often combined with a Rosette of water sampling bottles (e.g. Niskin, GO-FLO) for collecting discrete water samples during the cast. This term applies to profiling CTDs. For fixed CTDs, see https://www.bco-dmo.org/instrument/869934.

Dataset-specific Instrument Name	Large Volume Pumping System -WTS-LV
Generic Instrument Name	McLane Large Volume Pumping System WTS-LV
Dataset-specific Description	McLane WTS-LV Large Volume, High Accuracy, Oceanographic Sampling Pump
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	Pump5
Generic Instrument Name	Pump - Surface Underway Ship Intake
Dataset-specific Description	Ship's clean water intake pump (surface sample)
Generic Instrument Description	The 'Pump-underway ship intake' system indicates that samples are from the ship's clean water intake pump. This is essentially a surface water sample from a source of uncontaminated near-surface (commonly 3 to 7 m) seawater that can be pumped continuously to shipboard laboratories on research vessels. There is typically a temperature sensor near the intake (known as the hull temperature) to provide measurements that are as close as possible to the ambient water temperature. The flow from the supply is typically directed through continuously logged sensors such as a thermosalinograph and a fluorometer. Water samples are often collected from the underway supply that may also be referred to as the non-toxic supply. Ideally the data contributor has specified the depth in the ship's hull at which the pump is mounted.

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Deployments

AMLR2006-Leg1

Website	https://www.bco-dmo.org/deployment/57975
Platform	R/V Yuzhmorgeologiya
Start Date	2006-01-11
End Date	2006-02-13

Description	AMLR (Antarctic Marine Living Resources) R/V Yuzhmorgeologiya Jan 2006: The research program was focused in the southern Drake Passage along the Shackelton Shelf located near the Bransfield Strait. Samples were obtained from the R/V Yuzhmorgeologiya and inflatables that were taken to island locations. Lat/Lon Bounding Box -62.2538Lat, -62.9966Lon -63.2335Lat, -59.0332Lon -59.9964Lat, -55.7612Lon -61.4995Lat, -53.9996Lon Antarctic Marine Living Resources (AMLR) Cruise Reports **Methods & Sampling** Sampling and Analytical Methodology Particle sinking rates were determined using the 4 liter measurement of 234Th (Pike et al., 2005). Samples were collected from hydrocasts from a shipboard CTD. The unfiltered 4-liter samples were immediately acidified to pH ~1.5 using concentrated Nitric acid. Samples were shaken vigorously and 230Th added as a yield monitor. The samples were shaken again and allowed to equilibrate for 8 hours. Concentrated NH4OH was subsequently added to each sample to adjust the pH to 8. Extraction of thorium from seawater was then accomplished by co-precipitation via a MnO2 precipitate onto a 25-mm-diameter QMA filter. The filtered samples were air dried and counted on a RISO beta detector (Rutgers van der Loeff et al., 2006). All samples were counted for at least 24 hours or until the counting error was < 3%. Samples were recounted after >150 days (~6 half lives) to determine the sample background. Detector calibration was confirmed with 3000m deep water sample. Particulate carbon was collected through a McLane WTS-LV in-situ pump and filtered through a 142mm GFF filter. 22mm subsamples were collected, dried and transported back to the WHOI laboratory for CHN analysis on the Flash EA1112. The samples were pelletized in ultra clean tin capsules, combusted at 900oC, separated in a gas chromatographic column, and measured through a thermal conductivity detector. The CHN analyzer was calibrated by using an acetanilide standard. A second subsample was taken and analyzed for biogenic silica (Brzezinski et al 2001). Sodium Hydroxide was added to the filter and heated to 95oC for 45minutes. It was placed on ice and neutralized with hydrochloric acid. After centrifuging, the supernatant is then analyzed for silicate on a Lachat Quickchem 8000. **Processing Description** Data Processing CHN: Linear regression of standards is used to determine the carbon content of the sample Th: Thorium is measured using the Riso betacounters. Results published include removal ofsample background, detector efficiency correction, correction of radioactive decay, andchemistry efficiency through analysis of tracer (230Th). Modifications to original data made to conform to BCO-DMO database convention Cruise_ID added Spaces in Sample_ID replaced with dashes for consistency with Radium summary data empty cells filled with "nd" (no data) Latitude/Longitude headers converted to lat/lon date reformatted to YYYYMMDD time reformatted to HHMM decimal data values padded to consistent decimal places spaces, minus signs, and "

NBP0606

Website	https://www.bco-dmo.org/deployment/57976
Platform	RVIB Nathaniel B. Palmer
Start Date	2006-07-01
End Date	2006-08-15
Description	NBP (Nathaniel B. Palmer) R/V Nathaniel B. Palmer July2006: The research was conducted in the same region of the Drake Passage as the AMLR cruise. Samples were obtained aboard the R/V Nathaniel B. Palmer Lat/Lon bounding box -60.4991Lat, -58.5613Lon -62.3599Lat, -58.0392Lon -60.2783Lat, -57.4509Lon -61.2683Lat, -54.2852Lon **Methods & Sampling** Sampling and Analytical Methodology Particle sinking rates were determined using the 4 liter measurement of 234Th (Pike et al., 2005). Samples were collected from hydrocasts from a shipboard CTD. The unfiltered 4-liter samples were immediately acidified to pH ~1.5 using concentrated Nitric acid. Samples were shaken vigorously and 230Th added as a yield monitor. The samples were shaken again and allowed to equilibrate for 8 hours. Concentrated NH4OH was subsequently added to each sample to adjust the pH to 8. Extraction of thorium from seawater was then accomplished by co-precipitation via a MnO2 precipitate onto a 25-mm-diameter QMA filter. The filtered samples were air dried and counted on a RISO beta detector (Rutgers van der Loeff et al., 2006). All samples were counted for at least 24 hours or until the counting error was < 3%. Samples were recounted after >150 days (~6 half lives) to determine the sample background. Detector calibration was confirmed with 3000m deep water sample. Particulate carbon was collected through a McLane WTS-LV in-situ pump and filtered through a 142mm GFF filter. 22mm subsamples were collected, dried and transported back to the WHOI laboratory for CHN analysis on the Flash EA1112. The samples were pelletized in ultra clean tin capsules, combusted at 900oC, separated in a gas chromatographic column, and measured through a thermal conductivity detector. The CHN analyzer was calibrated by using an acetanilide standard. A second subsample was taken and analyzed for biogenic silica (Brzezinski et al 2001). Sodium Hydroxide was added to the filter and heated to 95oC for 45minutes. It was placed on ice and neutralized with hydrochloric acid. After centrifuging, the supernatant is then analyzed for silicate on a Lachat Quickchem 8000. **Processing Description** Data Processing CHN: Linear regression of standards is used to determine the carbon content of the sample Th: Thorium is measured using the Riso betacounters. Results published include removal ofsample background, detector efficiency correction, correction of radioactive decay, andchemistry efficiency through analysis of tracer (230Th). Modifications to original data made to conform to BCO-DMO database convention Cruise_ID added Spaces in Sample_ID replaced with dashes for consistency with Radium summary data empty cells filled with "nd" (no data) Latitude/Longitude headers converted to lat/lon date reformatted to YYYYMMDD time reformatted to HHMM decimal data values padded to consistent decimal places spaces, minus signs, and "

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Project Information

Plankton Community Structure and Iron Distribution in the Southern Drake Passage and Scotia Sea (Ant2006)

Coverage: Antarctica, Southern Drake Passage and Scotia Sea

Collaborative Research: Plankton Community Structure and Iron Distribution in the Southern Drake Passage and Scotia Sea

The Shackleton Fracture Zone (SFZ) in Drake Passage of the Southern Ocean defines a

boundary between low and high phytoplankton waters. Low chlorophyll water flowing through the southern Drake Passage emerges as high chlorophyll water to the east, and recent evidence indicates that the Southern Antarctic Circumpolar Current Front (SACCF) is steered south of the SFZ onto the Antarctic Peninsula shelf where mixing between the water types occurs. The mixed water is then advected off-shelf with elevatediron and phytoplankton biomass.

The SFZ is therefore an ideal natural laboratory to improve the understanding of plankton community responses to natural iron fertilization, and how these processes influence export of organic carbon to the ocean interior. The bathymetry of the region is hypothesized to influence mesoscale circulation and transport of iron, leading to the observed patterns in phytoplankton biomass.

The position of the Antarctic Circumpolar Current (ACC) is further hypothesized to influence the magnitude of the flow of ACC water onto the peninsula shelf, mediating the amount of iron transported into the Scotia Sea. To address these hypotheses, a research cruise will be conducted near the SFZ and to the east in the southern Scotia Sea. A mesoscale station grid for vertical profiles, water sampling, and bottle incubation enrichment experiments will complement rapid surface surveys of chemical, plankton, and hydrographic properties. Distributions of manganese, aluminum and radium isotopes will be determined to trace iron sources and estimate mixing rates.

Phytoplankton and bacterial physiological states (including responses to iron enrichment) and the structure of the plankton communities will be studied. The primary goal is to better understand how plankton productivity, community structure and export production in the Southern Ocean are affected by the coupling between bathymetry, mesoscale circulation, and distributions of limiting nutrients. The proposed work represents an interdisciplinary approach to address the fundamental physical, chemical and biological processes that contribute to the abrupt transition in chl-a which occurs near the SFZ. Given recent indications that the Southern Ocean is warming, it is important to advance the understanding of conditions that regulate the present ecosystem structure in order to predict the effects of climate variability. This project will promote training and learning across a broad spectrum of groups. Funds are included to support postdocs, graduate students, and undergraduates. In addition, this project will contribute to the development of content for the Polar Science Station website, which has been a resource since 2001 for instructors and students in adult education, home schooling, tribal schools, corrections education, family literacy programs, and the general public.

Radium and Thorium isotope data summaries from AMLR and NBP cruises to the Antarctic in 2006

Naturally occurring radium isotopes (224Ra, 226Ra, 228Ra) were used in determining lateral mixing processes which are reported in dpm/m3.

Particulate organic Carbon (POC) flux was determined through measuring Thorium (234Th) reported in dpm/kg.

Cruises

AMLR (Antarctic Marine Living Resources) R/V Yuzhmorgeologiya Jan/2006:
The research program was focused in the southern Drake Passage
along the Shackelton Shelf located near the Bransfield Strait.
Samples were obtained from the R/V Yuzhmorgeologiya and inflatables
that were taken to island locations.
Lat/Lon Bounding Box
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NBP (Nathaniel B. Palmer) R/V Nathaniel B. Palmer July/2006:
The research was conducted in the same region of the Drake Passage as the AMLR cruise.
Samples were obtained aboard the R/V Nathaniel B. Palmer
Lat/Lon bounding box
-60.4991Lat, -58.5613Lon
-62.3599Lat, -58.0392Lon
-60.2783Lat, -57.4509Lon
-61.2683Lat, -54.2852Lon

NASA GCMD Link: NASA GCMD

Blue Water Zone (BWZ)

Coverage: Antarctica, Drake Passage, N: -52.6061, S: -65.1877 , E: -52.965, W: -68.325

NSF Proposal Title: Collaborative Research: Plankton Community Structure and Iron Distribution in the Southern Drake Passage and Scotia Sea

The Shackleton Fracture Zone (SFZ) in Drake Passage of the Southern Ocean defines a boundary between low and high phytoplankton waters. Low chlorophyll water flowing through the southern Drake Passage emerges as high chlorophyll water to the east, and recent evidence indicates that the Southern Antarctic Circumpolar Current Front (SACCF) is steered south of the SFZ onto the Antarctic Peninsula shelf where mixing between the water types occurs. The mixed water is then advected off-shelf with elevated iron and phytoplankton biomass. The SFZ is therefore an ideal natural laboratory to improve the understanding of plankton community responses to natural iron fertilization, and how these processes influence export of organic carbon to the ocean interior. The bathymetry of the region is hypothesized to influence mesoscale circulation and transport of iron, leading to the observed patterns in phytoplankton biomass. The position of the Antarctic Circumpolar Current (ACC) is further hypothesized to influence the magnitude of the flow of ACC water onto the peninsula shelf, mediating the amount of iron transported into the Scotia Sea. To address these hypotheses, a research cruise will be conducted near the SFZ and to the east in the southern Scotia Sea. A mesoscale station grid for vertical profiles, water sampling, and bottle incubation enrichment experiments will complement rapid surface surveys of chemical, plankton, and hydrographic properties. Distributions of manganese, aluminum and radium isotopes will be determined to trace iron sources and estimate mixing rates. Phytoplankton and bacterial physiological states (including responses to iron enrichment) and the structure of the plankton communities will be studied. The primary goal is to better understand how plankton productivity, community structure and export production in the Southern Ocean are affected by the coupling between bathymetry, mesoscale circulation, and distributions of limiting nutrients. The proposed work represents an interdisciplinary approach to address the fundamental physical, chemical and biological processes that contribute to the abrupt transition in chl-a which occurs near the SFZ. Given recent indications that the Southern Ocean is warming, it is important to advance the understanding of conditions that regulate the present ecosystem structure in order to predict the effects of climate variability. This project will promote training and learning across a broad spectrum of groups. Funds are included to support postdocs, graduate students, and undergraduates. In addition, this project will contribute to the development of content for the Polar Science Station website, which has been a resource since 2001 for instructors and students in adult education, home schooling, tribal schools, corrections education, family literacy programs, and the general public.

PUBLICATIONS PRODUCED AS A RESULT OF THIS RESEARCH

Hewes, C. D., Reiss, C.S., .Kahru, M. , Mitchell, B.G. , and Holm-Hansen, O.. "Control of phytoplankton biomass by dilution and mixed layer depth in the western Weddell-Scotia Confluence (WSC)," Marine Ecology Progress Series, v.366, 2008, p. 15.

Hiscock, M. , Lance, V. , Apprill, A., Bidigare, R , Mitchell, B., Smith Jr. W., Barber, R.. "Photosynthetic maximum quantum yield increases are an essential component of the Southern Ocean phytoplankton response to iron," Proceedings of the National Academy of Sciences, v.105(2), 2008, p. 4775.

Holm-Hansen, O., Kahru, M., Hewes, C.. "Deep chlorophyll a maxima (DCMs) in pelagic Antarctic waters. II. Relation to bathymetric features and dissolved iron concentrations," Marine Ecology-Progress Series, v.297, 2005, p. 71.

Hopkinson, B., Mitchell, B. G., Reynolds, R. A., Wang, H., Selph, K., Measures, C., Hewes, C., Holm-Hansen, O., Barbeau, K.. "Iron limitation Across Chlorophyll Gradients in the Southern Drake Passage: Phytoplankton Responses to Iron Addition and Photosynthetic Indicators of Iron Stress," Limnology and Oceanography, 2007, p. 2540.

Hopkinson, B., Mitchell, B. G., Reynolds, R. A., Wang, H., Selph, K., Measures, C., Hewes, C., Holm-Hansen, O., Barbeau, K.. "Iron limitation Across Chlorophyll Gradients in the Southern Drake Passage: Phytoplankton Responses to Iron Addition and Photosynthetic Indicators of Iron Stress," Limnology and Oceanography, v.52, 2007, p. 2540.

Kahru, M., Mitchell, B. G., Gille, S. T., Hewes, C. D. and Holm-Hansen, O.. "Eddies enhance biological production in the Weddell-Scotia Confluence of the Southern Ocean," Geophys. Res. Let., 34,, v.24, 2007, p. L14603.

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Funding

Funding Source	Award
NSF Antarctic Sciences (NSF ANT)	ANT-0443869

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