TPC, PIC, POC, TPN, and Th-234 from in-situ pumps at the Porcupine Abyssal Plain Sustained Observatory (PAP-SO) site in the Northeast Atlantic Ocean during RRS Discovery cruise DY077 in April of 2017

Website: https://www.bco-dmo.org/dataset/765850
Data Type: Cruise Results
Version: 2
Version Date: 2019-06-26

Project
» Collaborative Research: Are all traps created equal? A multi-method assessment of the collection and detection of sinking particles in the ocean (Are Traps Equal)

Contributors	Affiliation	Role
Buesseler, Kenneth O.	Woods Hole Oceanographic Institution (WHOI)	Principal Investigator
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Abstract
TPC, PIC, POC, TPN, and Th-234 from in-situ pumps at the Porcupine Abyssal Plain Sustained Observatory (PAP-SO) site in the Northeast Atlantic Ocean during RRS Discovery cruise DY077 in April of 2017.

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Coverage

Spatial Extent: **N**:48.9835 **E**:-16.4953 **S**:48.8656 **W**:-16.5907
Temporal Extent: 2017-04-19 - 2017-04-26

Dataset Description

This dataset contains TPC, PIC, POC, TPN, and Th-234 from in-situ pumps at the Porcupine Abyssal Plain Sustained Observatory (PAP-SO) site in the Northeast Atlantic Ocean during RRS Discovery cruise DY077 in April of 2017.

Related datasets collected during the same cruise:
Water column Th-234 activities: https://www.bco-dmo.org/dataset/765859
Sediment trap fluxes: https://www.bco-dmo.org/dataset/765835

Methods & Sampling

Samples were collected during two deployment cycles (termed “deployment 1” and “deployment 2”) occupied during the RRS Discovery cruise DY077 to the Porcupine Abyssal Plain Sustained Observatory (PAP-SO) Site in April 2017 (Figure 1). In each of the cycles, we conducted particle flux sampling method intercomparisons between fluxes derived from upper water column deficits of 234Th vs. its parent isotope 238U, two types of neutrally buoyant sediment traps (NBST and PELAGRA), and a surface tethered array of sediment traps (STT). DY077 samples analyzed in US (WHOI and Skidmore College) are archived here; DY077 samples analyzed in the UK (NOC) are archived in the British Oceanographic Data Centre.

Two McLane in-situ battery powered pumps were deployed two times for the collection of size fractionated particles. The water passes first through a 51-micron screen followed by a nominal 1-micron quartz filter. Filter diameters are both 142 mm and a baffled opening developed for the GEOTRACES program keeps particles from washing off the top screen during retrieval of the pumps as they ascend on the wire. The pumps were programmed with a 1-hour delay time before turning on at depths of 200 and 350 m. After a pumping time of 2 hours, the pumps shut off and were retrieved. After retrieval, volumes were noted (measured by dual flow meters), any water that remained in the pump was drained through the filters, and the screen was rinsed with prefiltered seawater onto a 1-µm pore size silver filter (25-mm diameter).

The Ag filter and a 25-mm subsample from the QMA were dried at 45°C, mounted, and immediately counted for low-level β emission onboard the ship. At WHOI, a subset of samples was re-counted approximately one month later on shore. Final background counts to measure non-234Th related β emissions were conducted approximately six months later. At this point, filters were unmounted, re-dried, and gravimetrically subdivided into four sections. One half of the filter was analyzed for total carbon and nitrogen after high-temperature combustion on a Thermo Electron FlashEA 1112 C/N analyzer. Coulometric analysis for PIC after sample acidification was performed on a quarter of the filter (Johnson et al, 1985; Honjo et al, 2000). The remainder of the filter was archived.

Porcupine Abyssal Plain Sustained Observatory (PAP-SO) site in the Northeast Atlantic Ocean (49°N, 16.5°W).

Data Processing Description

Per-filter blank values were subtracted before calculating TPN, TPC, and PIC concentrations. 234Th blank values are reported for reference but were not subtracted. Reported uncertainties for measurements made using 25-mm QMA subsamples are propagated from counting statistics for 234Th and the standard deviation of blank analyses for C and N. Users should note that 10% relative uncertainty may exist due to punch-to-punch variability (Maiti et al. 2012). The reported analytical uncertainties should be used for ratios computed from a common filter punch. An additional 10% relative uncertainty should be applied to absolute concentrations.

BCO-DMO Data Manager Processing Notes:
* added a conventional header with dataset name, PI name, version date
* modified parameter names to conform with BCO-DMO naming conventions
* blank values in this dataset are displayed as "nd" for "no data." nd is the default missing data identifier in the BCO-DMO system.
* added ISO_DateTime_start column from date and time columns

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Data Files

File
pump.csv (Comma Separated Values (.csv), 1.34 KB) MD5:33bce8a18fd591fb545a7011e2229f5c Primary data file for dataset ID 765850

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Supplemental Files

File
Figure 1. Locations of platforms filename: Fig1.png (Portable Network Graphics (.png), 945.63 KB) MD5:dc3d6d1d9c796de9027e51149381b31b Figure 1. Locations of platforms during deployment 1 (19-21 Apr) and deployment 2 (24-27 Apr).
Table 1: Locations and water volumes pumped for McLane in-situ pump deployments. filename: Table1.csv (Plain Text, 378 bytes) MD5:056f02bab89fccbaeb6fe6e6f7ce6cd9 Locations and water volumes pumped for McLane in-situ pump deployments. Water was pumped for 2 h.
Table 2. Per-filter blank values for in-situ pump samples. filename: Table2.csv (Comma Separated Values (.csv), 278 bytes) MD5:e63959521a01cd7ed0eea0d5ba44f1b9 Per-filter blank values for in-situ pump samples.

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Related Publications

Buesseler, K. O., Pike, S., Maiti, K., Lamborg, C. H., Siegel, D. A., & Trull, T. W. (2009). Thorium-234 as a tracer of spatial, temporal and vertical variability in particle flux in the North Pacific. Deep Sea Research Part I: Oceanographic Research Papers, 56(7), 1143–1167. doi:10.1016/j.dsr.2009.04.001
Methods

Honjo, S., Francois, R., Manganini, S., Dymond, J., & Collier, R. (2000). Particle fluxes to the interior of the Southern Ocean in the Western Pacific sector along 170°W. Deep Sea Research Part II: Topical Studies in Oceanography, 47(15-16), 3521–3548. doi:10.1016/s0967-0645(00)00077-1 https://doi.org/10.1016/S0967-0645(00)00077-1
Methods

Johnson, K. M., King, A. E., & Sieburth, J. M. (1985). Coulometric TCO2 analyses for marine studies; an introduction. Marine Chemistry, 16(1), 61–82. doi:10.1016/0304-4203(85)90028-3
Methods

Maiti, K., Buesseler, K. O., Pike, S. M., Benitez-Nelson, C., Cai, P., Chen, W., … Xu, C. (2012). Intercalibration studies of short-lived thorium-234 in the water column and marine particles. Limnology and Oceanography: Methods, 10(9), 631–644. doi:10.4319/lom.2012.10.631
Methods

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Parameters

Parameter	Description	Units
deployment	deployment cycle during cruise DY077	unitless
station	station occupied during cruise DY077	unitless
depth	depth of water sample collection	meters (m)
pore_size	nominal pore size of filter used to collect particles	micrometers (um)
lat	latitude of in-situ pump deployment	decimal degrees (DD)

lon	longitude of in-situ pump deployment	decimal degrees (DD)
date_start	date sample collection began (GMT) in ISO 8601 format yyyy-mm-dd	unitless
time_start	time sample collection began (GMT) in ISO 8601 format hh:mm:ss	unitless
date_end	date sample collection ended (GMT) in ISO 8601 format yyyy-mm-dd	unitless
time_end	time sample collection ended (GMT) in ISO 8601 format hh:mm:ss	unitless
ISO_DateTime_start	Date time sampling began (GMT) in format yyyy-mm-ddTHH:MMZ	unitless
volume	water volume filtered by in-situ pump	liters (L)
TPN	total particulate nitrogen concentration	micromoles per liter (umol/L)
TPN_err	total particulate nitrogen uncertainty. For <51-µm particles, determined as 3 x SD of typical QMA dip blanks, scaled by the volume filtered and fraction of the filter area analyzed. See note in Processing Description regarding QMA punch-to-punch variability. Total particulate nitrogen uncertainty for >51-µm particles is unavailable because blanks were below the analytical detection limit.	micromoles per liter (umol/L)
TPC	total particulate carbon concentration	micromoles per liter (umol/L)
TPC_err	total particulate carbon uncertainty, determined as 3 x SD of blanks, scaled by the volume filtered and fraction of the filter area analyzed. See note in Processing Description regarding QMA punch-to-punch variability.	micromoles per liter (umol/L)
PIC	total particulate inorganic carbon concentration	micrograms per liter (ug/L)
PIC_err	total particulate inorganic carbon uncertainty, determined as 3 x SD of blanks, scaled by the volume filtered and fraction of the filter area analyzed. See note in Processing Description regarding QMA punch-to-punch variability.	micrograms per liter (ug/L)
POC	total particulate organic carbon concentration, computed as the difference between TPC and PIC	micromoles per liter (umol/L)
POC_err	total particulate organic carbon uncertainty, POC_err = (TPC_err2 + PIC_err2)1/2. See note in Processing Description regarding QMA punch-to-punch variability.	micromoles per liter (umol/L)

Th234_part	particulate thorium-234 activity	disintegration per minute per liter (dpm/L)
Th234_part_err	particulate thorium-234 uncertainty, propagated from counting statistics. See note in Processing Description regarding QMA punch-to-punch variability.	disintegration per minute per liter (dpm/L)

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Instruments

Dataset-specific Instrument Name	Coulometer
Generic Instrument Name	CO2 Coulometer
Generic Instrument Description	A CO2 coulometer semi-automatically controls the sample handling and extraction of CO2 from seawater samples. Samples are acidified and the CO2 gas is bubbled into a titration cell where CO2 is converted to hydroxyethylcarbonic acid which is then automatically titrated with a coulometrically-generated base to a colorimetric endpoint.

Dataset-specific Instrument Name	Thermo Electron FlashEA 1112 C/N analyzer
Generic Instrument Name	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	
Generic Instrument Name	McLane Pump
Generic Instrument Description	McLane pumps sample large volumes of seawater at depth. They are attached to a wire and lowered to different depths in the ocean. As the water is pumped through the filter, particles suspended in the ocean are collected on the filters. The pumps are then retrieved and the contents of the filters are analyzed in a lab.

Dataset-specific Instrument Name	Riso Beta Counter
Generic Instrument Name	Riso Laboratory Anti-coincidence Beta Counters
Generic Instrument Description	Low-level beta detectors manufactured by Riso (now Nutech) in Denmark. These instruments accept samples that can be mounted on a 25mm filter holder. These detectors have very low backgrounds, 0.17 counts per minute, and can have counting efficiencies as high as 55%. Typically used in laboratory analyses. Designed to measure low levels of beta particle emission. The systems work on the principle of anticoincidence.

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Deployments

DY077

Website	https://www.bco-dmo.org/deployment/765832
Platform	RRS Discovery
Start Date	2017-04-14
End Date	2017-05-01

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Project Information

Collaborative Research: Are all traps created equal? A multi-method assessment of the collection and detection of sinking particles in the ocean (Are Traps Equal)

Coverage: Porcupine Abyssal Plain Sustained Observatory (PAP-SO) site in the Northeast Atlantic Ocean (49°N, 16.5°W)

NSF Award Abstract:

There is considerable need to understand the biological and ecological processes that through net primary production fix dissolved carbon dioxide (CO2) into organic matter in the upper ocean, and the processes that subsequently transport this organic carbon in to the ocean's interior. Most of the particulate organic carbon flux to the deep ocean is thought to be mediated by sinking particles. Ultimately it is the deep organic carbon transport and its sequestration that define the impact of ocean biota on atmospheric CO2 levels and hence climate. Currently, various methods are available to measure the amount of particles in the ocean that sink over a specified period of time commonly referred to as particle flux. Unfortunately, all of these methods are used independently of each other with very little intercomparison, leaving some uncertainty as to which approach provides the most accurate estimates. This study seeks to be the first concerted effort to standardize particle flux measurements. Seeking to keep the cost modest, the researchers are taking advantage of a collaboration with scientists in the United Kingdom to participate in an already scheduled research cruise. The proposed research will have much greater impact that merely standardization of particle flux measurements because it will provide the science and modeling community the ability to quantify the transfer of carbon throughout the surface ocean. Also, this project provides a variety of mentoring and training opportunities for students. A PhD student at Woods Hole Oceanographic Institute will get their first sea-going experience and will learn all of the processing steps for the study of an isotope of thorium (234Th). Skidmore College will have an undergraduate participant in the research and the results from the cruise will also be an excellent additional component for undergraduate oceanography classes.

Researchers from Woods Hole Oceanographic Institution and Skidmore College, in collaboration with a scientist from the National Oceanography Centre, Southampton will inter-compare direct, tracer, and optical-sensor methods used to determine sinking particle fluxes in the surface ocean. To do this, they will firstly conduct a comparison of two types of neutrally buoyant traps and one surface-tethered, drifting array. Secondly, measured trap fluxes will be compared to predicted 234Th fluxes from a 3D time-series of data. Lastly, optical sediment trap measurements will be compared to particle size distributions in the water column and gel traps, as well as size-fractionated particles on filters from large volume pumps. With this research, global ocean models, particularly carbon, will have greater accuracy and stronger conclusions will be able to be drawn from them.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1659995
NSF Division of Ocean Sciences (NSF OCE)	OCE-1660012

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