Sinking particle from R/V Kilo Moana cruise KM1910 in June 2019

Website: https://www.bco-dmo.org/dataset/852779
Data Type: Cruise Results
Version: 1
Version Date: 2021-06-01

Project
» EAGER Collaborative Research: Early career chief scientist training for biological and chemical oceanographers (Chief Sci KM1910)

Contributors	Affiliation	Role
Church, Matthew J.	University of Montana	Principal Investigator
Ferrón, Sara	University of Hawai'i at Mānoa (SOEST)	Co-Principal Investigator
Goetze, Erica	University of Hawai'i at Mānoa (SOEST)	Co-Principal Investigator
White, Angelicque E.	University of Hawai'i at Mānoa (SOEST)	Co-Principal Investigator
Black, Erin E.	University of Rochester	Scientist
Maloney, Ashley	Princeton University	Scientist, Contact
Subhas, Adam V.	Woods Hole Oceanographic Institution (WHOI)	Scientist
Kenyon, Jennifer	Massachusetts Institute of Technology (MIT)	Student
Newman, Sawyer	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
Phosphorus, carbon (total and organic), and nitrogen flux and bulk isotope composition (C and N) from 3-day pit trap deployments in June 2019 at station ALOHA during cruise KM1910.

Table of Contents

Coverage

Spatial Extent: **N**:23.1312 **E**:-157.786 **S**:22.1516 **W**:-158.44
Temporal Extent: 2019-06-16 - 2019-06-20

Dataset Description

Phosphorus, carbon (total and organic), and nitrogen flux and bulk isotope composition (C and N) from 3-day pit trap deployments in June 2019 at station ALOHA during cruise KM1910.

Methods & Sampling

Sampling and analytical procedures:

Particle flux measurements from the Chief Scientist Training cruise generally followed the methods of the Hawaii Ocean Time-Series (HOT). Measurements were made at 75 m, 150 m, and 300 m using multiple cylindrical particle interceptor traps deployed on a free-floating array for approximately 3 days twice during cruise KM1910 at station ALOHA. Sediment trap design and collection methods are described in Winn et al. (1991). Three traps from each depth from both deployments were analyzed for POC at WHOI , one trap from each depth was analyzed for PIC at WHOI, three traps from each depth from first deployment were analyzed for PC, PN, d13C and d15N at Princeton lab, and three traps from each depth from the first deployment were analyzed for PP at University of Hawaii.

Acquisition Description

The information below was adapted from the BCO-DMO HOT Dataset: Particle Flux page at https://www.bco-dmo.org/dataset/737393 (last visited on 2021-03-30) and the HOT Field & Laboratory Protocols page, found at http://hahana.soest.hawaii.edu/hot/protocols/protocols.html# (last visited on 2021-03-30). Differences between this dataset and a typical HOT particle flux data set include 1) depths sampled, 2) units in mmol m-2 d-1 (instead of mg m-2 d-1), and 3) suite of analyses (PP, PC, and PN but not Si, additionally POC (by acidifying filters) and PIC).

SUMMARY: Passively sinking particulate matter is collected using a free-floating sediment array and, after prescreening (335 µm) to remove zooplankton and micronekton carcasses, the sample materials are analyzed for P (at UH), POC and PIC (at WHOI), C and N (mmol m-2 d-1) and d13C (permil vs. VPDB) and d15N (permil vs. air-N2) (at Princeton).

1. Principle

Sediment traps capture the downward flux of particulate matter (different from in situ suspended particles) and allow for its chemical analysis. During the KM1910 cruise we deployed a free-drifting sediment trap array with 12 individual collectors positioned at 75, 150 and 300 m. The deployment periods were 3.3875 days and 3.04027 days. The passively sinking particles are subsequently analyzed for a variety of chemical properties.

2. Precautions

Because particle fluxes in oligotrophic habitats are expected to be low, special attention must be paid to the preparation of individual sediment trap collector tubes so that they are clean and free of dust and other potentially contaminating particles. Traps should be capped immediately after filling and immediately after retrieval. Pay particular attention to airborne and/or shipboard particulate contamination sources. In addition, the time interval between trap retrieval and subsample filtration should be minimized in order to limit the inclusion of extraneous abiotic particles and the post-collection solubilization of particles.

3. Field Operations

3.1. Hardware

Our free-floating sediment trap array is patterned after the MULTITRAP system pioneered by Knauer et al. (1979) and used extensively in the decade-long VERTEX program. Twelve individual sediment trap collectors (0.0039 m2) are typically deployed at three depths (150, 300 and 500 m). The traps are affixed to a PVC cross attached to 1/2" polypropylene line. The traps are tracked using VHF radio and Argos satellite transmitters and strobelights.

3.2. Trap solutions

Prior to deployment, each trap is cleaned with 1 M HCl, rinsed thoroughly with deionized water then filled with a high-density solution to prevent advective-diffusive loss of extractants and preservatives during the deployment period and to eliminate flushing of the traps during recovery (Knauer et al., 1979). The trap solution is prepared by adding 50 g of NaCl to each liter of surface seawater. This brine solution is pressure filtered sequentially through a 1.0 and 0.5 µm filter cartridge prior to the addition of 10 ml 100% formalin l-1. Individual traps are filled and at least 10 l of the trap solution is saved for analysis of solution blanks (see section 4.1). Tubes for PIC and POC were not fixed i.e. did not receive an addition of formalin. Tubes for POC used trace metal clean NaCl.

3.3. Post-recovery processing

3.3.1.

Upon recovery, individual traps are capped and transported to the shipboard portable laboratory for analysis. Care is taken not to mix the higher density trap solutions with the overlying seawater. Trap samples are processed from deep to shallow in order to minimize potential contamination.

3.3.2.

The depth of the interface between the high density solution and overlying seawater is marked on each trap. The overlying seawater is then aspirated with a plastic tube attached to a vacuum system in order to avoid disturbing the high density solution. Because some sinking particulate material collects near the interface between the high density solution and the overlying seawater, the overlying seawater is removed only to a depth that is 5 cm above the previously identified interface.

3.3.3.

After the overlying seawater has been removed from all the traps at a given depth, the contents of each trap is passed through an acid rinsed 335 µm NitexR screen to remove contaminating zooplankton and micronekton which entered the traps in a living state and are not truly part of the passive flux. Immediately before this sieving process, the contents of each trap are mixed to disrupt large amorphous particles. The traps are rinsed with a portion of the <335 µm sample in order to recover all particulate matter, and the 335 µm NitexR screen is examined to determine whether residual material, in addition to the so-called "swimmers", is present. If so, the screens are rinsed again with a portion of the 335 µm filtrate. After all traps from a given depth have been processed, the 335 µm screen is removed and placed into a vial containing 20 ml of formalin- seawater solution, and stored at 4 °C for subsequent microscopic examination and organism identification and enumeration.

4. Data

4.1. Determination of PP flux

Followed Particulate Phosphorus HOT methods: https://hahana.soest.hawaii.edu/hot/protocols/protocols.html# Briefly, triplicate samples from each depth were combusted in 16 x 100 mm clean glass test tubes at 450°C for 4.5 hours in a muffle furnace. The samples are then allowed to cool and immersed in 10ml 0.15N HCL/vortex/ 1 hour leach/vortex/30 Minute Spin/ 1 hour color development) (5ml sample : 500ul Mixed Reagent).The liberated orthophosphate is reacted with a mixed reagent of molybdic acid, ascorbic acid and trivalent antimony to form phosphomolybdic acid. This heteropoly acid is then reduced to the colored molybdenum blue complex by ascorbic acid and the solution is measured spectrophotometrically. This procedure measures all forms of phosphorus which can be released by combustion and acid hydrolysis.

4.2. Determination of PC, POC, PIC and PN flux

The quantities of particulate PC, POC, and PN in the prescreened trap solutions are determined from three replicate traps. The samples analyzed in the Princeton lab were not acidified and represent total C, the samples analyzed at WHOI were acid-fumed to represent organic C. An equivalent volume of the time-zero sediment trap solution, filtered through the appropriate filters is used as a C or N blank.

4.3. Determination of C and N bulk isotope composition

The bulk isotope composition of total C and N sinking material in the prescreened trap solutions are determined from three replicate traps.

4.4 Determination of PIC flux

A single sample was analyzed for PIC at WHOI. PIC samples were analyzed on a Picarro 2101i cavity ring-down CO2 isotope analyzer system with an AutoMate prep device front end. Detailed instrument methods are established and published in Dong et al., 2019 and Subhas et al., 2019. Samples were acidified manually in 12mL exetainers and left to sit for 1h to dissolve all PIC before mounting in the autosampler rack. Standards were run before, during, and after the samples in the same analytical session to calculate PIC concentration, using a well-characterized pure calcite standard of known isotopic composition (Iceland Spar). Calibrated PIC quantities (in micromoles) were blank-corrected using the mean value of McLane pump dipped blank filters. Blank-corrected quantities were then normalized to the volume of brine in each tube, length of deployment, and area of each tube, to calculate a flux in mmol/m2/d.

Problem report:

No PIC fluxes were measured on Trap Deployment 1 because all tubes were allocated to other analyses. PP, PC, PN, d15N, d13C were not measured on Trap Deployment 2 because all tubes were allocated to other analyses.

Data Processing Description

BCO-DMO Processing:

- converted date_HST to YYYY-MM-DD format;
- created UTC date/time field in ISO8601 format.

[table of contents | back to top]

Data Files

File
sinking_particles.csv (Comma Separated Values (.csv), 1.42 KB) MD5:15f640a414929fd4b8d603e47bf04596 Primary data file for dataset ID 852779

[table of contents | back to top]

Related Publications

Dong, S., Berelson, W. M., Rollins, N. E., Subhas, A. V., Naviaux, J. D., Celestian, A. J., Liu, X., Turaga, N., Kemnitz, N. J., Byrne, R. H., & Adkins, J. F. (2019). Aragonite dissolution kinetics and calcite/aragonite ratios in sinking and suspended particles in the North Pacific. Earth and Planetary Science Letters, 515, 1–12. https://doi.org/10.1016/j.epsl.2019.03.016
Methods

Fujieki, L., F. Santiago-Mandujano, C. Fumar, R. Lukas and M. Church. (2015) Hawaii Ocean Time-series Program Data Report 24: 2012.
Methods

Knauer, G. A., Martin, J. H., & Bruland, K. W. (1979). Fluxes of particulate carbon, nitrogen, and phosphorus in the upper water column of the northeast Pacific. Deep Sea Research Part A. Oceanographic Research Papers, 26(1), 97–108. doi:10.1016/0198-0149(79)90089-x https://doi.org/10.1016/0198-0149(79)90089-X
Methods

Subhas, A. V., McCorkle, D. C., Quizon, A., McNichol, A. P., & Long, M. H. (2019). Selective Preservation of Coccolith Calcite in Ontong-Java Plateau Sediments. Paleoceanography and Paleoclimatology, 34(12), 2141–2157. doi:10.1029/2019pa003731
Methods

Winn, C., C. Sabine, D. Hebel, F. Mackenzie and D. M. Karl. (1991) Inorganic carbon system dynamics in the central Pacific Ocean: Results of the Hawaii Ocean Time-series program. EOS, Transactions of the American Geophysical Union 72, 70.
Related Research

[table of contents | back to top]

Parameters

Parameter	Description	Units
cruise_id	Cruise identifier	unitless
sta	Station number	unitless
deployment	Name of sediment trap deployment	unitless

lon_deploy	Longitude (degrees E) of deployment	decimal degrees
lat_deploy	Latitude (degrees N) of deployment	decimal degrees
deploy_ISO_DateTime_UTC	Datetime (UTC) of trap deployment	unitless
date_deploy_HST	Local date (HST) of trap deployment	unitless
time_deploy_HST	Local time (HST) of trap deployment (24 hour time)	unitless
lon_recover	Longitude (degrees E) of recovery	decimal degrees
lat_recover	Latitude (degrees N) of recovery	decimal degrees
recover_ISO_DateTime_UTC	Datetime (UTC) of trap recovery	unitless
date_recover_HST	Local date of trap recovery	unitless
time_recover_HST	Local time (HST) of trap recovery	unitless
depth_m	Depth of traps in meters (m)	meters (m)
float_time_d	Total length of deployment in days (d)	days (d)
PP_UH	Particulate Phosphate (PP) flux [mmol/m2/d] average from 3 FIXED traps (d,e,f), analyzed at UH	millimoles per meter squared per day (mmol/m2/d)
sd_PP_UH	Particulate Phosphate (PP) flux [mmol/m2/d] standard deviation from 3 FIXED traps (d,e,f), analyzed at UH	millimoles per meter squared per day (mmol/m2/d)
PC_Pton	Particulate total Carbon (PC) flux [mmol/m2/d] average from 3 FIXED traps (a,b,c) (filters analyzed at Princeton not acidified)	millimoles per meter squared per day (mmol/m2/d)
sd_PC_Pton	Particulate total Carbon (PC) flux [mmol/m2/d] standard deviation from 3 FIXED traps (a,b,c) (filters analyzed at Princeton not acidified)	millimoles per meter squared per day (mmol/m2/d)
PN_Pton	Particulate Nitrogen (PN) flux [mmol/m2/d] average from 3 FIXED traps (a,b,c) (filters analyzed at Princeton not acidified)	millimoles per meter squared per day (mmol/m2/d)
sd_PN_Pton	Particulate Nitrogen (PN) flux [mmol/m2/d] standard deviation from 3 FIXED traps (a,b,c) (filters analyzed at Princeton not acidified)	millimoles per meter squared per day (mmol/m2/d)
Pton_13C	Delta-13C of PC (permil vs. VPDB) average from 3 FIXED traps (a,b,c) analytical uncertainty 0.1 permil (filters analyzed at Princeton not acidified)	permil vs. VPDB
sd_13C_Pton	Delta-13C of PC (permil vs. VPDB) standard deviation from 3 FIXED traps (a,b,c) (filters analyzed at Princeton not acidified)	permil vs. VPDB
Pton_15N	Delta-15N of PN (permil vs. air-N2) average from 3 FIXED traps (a,b,c) analytical uncertainty 0.2 permil (filters analyzed at Princeton not acidified)	permil vs. air-N2
sd_15N_Pton	Delta-15N of PN (permil vs. air-N2) standard deviation from 3 FIXED traps (a,b,c) (filters analyzed at Princeton not acidified)	permil vs. air-N2
POC_WHOI	Particulate total Carbon (PC) flux [mmol/m2/d] average from 3 UNFIXED traps (g,h,i) (samples acid fumed) analyzed at WHOI	millimoles per meter squared per day (mmol/m2/d)
sd_POC_WHOI	Particulate total Carbon (PC) flux [mmol/m2/d] standard deviation from 3 UNFIXED traps (g,h,i) (samples acid fumed) analyzed at WHOI	millimoles per meter squared per day (mmol/m2/d)

PIC_WHOI	Particulate Inorganic Carbon flux [mmol/m2/d] from 1 UNFIXED trap (e) analyzed at WHOI	millimoles per meter squared per day (mmol/m2/d)

[table of contents | back to top]

Instruments

Dataset-specific Instrument Name	Flash AE1112 Carbon/Nitrogen Analyzer
Generic Instrument Name	CHN Elemental Analyzer
Dataset-specific Description	POC was acid fumed with concentrated HCl and then POC was measured by combustion via a Flash AE1112 Carbon/Nitrogen Analyzer using a Dynamic Flash Combustion technique.
Generic Instrument Description	A CHN Elemental Analyzer is used for the determination of carbon, hydrogen, and nitrogen content in organic and other types of materials, including solids, liquids, volatile, and viscous samples.

Dataset-specific Instrument Name	Picarro 2101i
Generic Instrument Name	CO2 Analyzer
Dataset-specific Description	Picarro 2101i cavity ring-down CO2 isotope analyzer system with an AutoMate prep device front end. Detailed instrument methods are established and published in Dong et al., 2019 and Subhas et al., 2019.
Generic Instrument Description	Measures atmospheric carbon dioxide (CO2) concentration.

Dataset-specific Instrument Name	Elementar Isoprime
Generic Instrument Name	Elemental Analyzer
Dataset-specific Description	A Vario ISOTOPE select (Elementar Isoprime) was used to quantify total C, N, and d13C and d15N. Samples are combusted/reduced at high temperature to create gases (CO2 and N2); column chromatography separates the gases; a thermal conductivity detector determines the carbon and nitrogen concentrations, followed by an isotope ratio mass spectrometer for bulk isotope composition. Measurements were calibrated with an in-house aminocaproic acid standard (ACROS) and four USGS standards (#41, #41a, #65, #25). Analytical uncertainty (determined from standards with similar isotope values) was 0.2‰ for delta-15N and 0.1‰ for delta-13C.
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	Sediment trap array
Generic Instrument Name	Sediment Trap
Dataset-specific Description	Spar buoy, radiotransmitter, strobe light, floats, trap supports, collector tubes.
Generic Instrument Description	Sediment traps are specially designed containers deployed in the water column for periods of time to collect particles from the water column falling toward the sea floor. In general a sediment trap has a jar at the bottom to collect the sample and a broad funnel-shaped opening at the top with baffles to keep out very large objects and help prevent the funnel from clogging. This designation is used when the specific type of sediment trap was not specified by the contributing investigator.

[table of contents | back to top]

Deployments

KM1910

Website	https://www.bco-dmo.org/deployment/841636
Platform	R/V Kilo Moana
Report	https://datadocs.bco-dmo.org/docs/305/Chief_Sci_KM1910/data_docs/matt_church_EAGER_cruise_plan_06_17_2019.pdf
Start Date	2019-06-15
End Date	2019-06-24
Description	NSF Chief Scientist Training Cruise. For more information, see Rolling Deck to Repository (R2R): https://www.rvdata.us/search/cruise/KM1910 (cruise DOI: 10.7284/908380)

[table of contents | back to top]

Project Information

EAGER Collaborative Research: Early career chief scientist training for biological and chemical oceanographers (Chief Sci KM1910)

Coverage: Station ALOHA (22.75N, 158W), North Pacific Ocean

NSF Award Abstract:

Intellectual Merit
The PIs request funds to provide training in leading and organizing research cruises to early career researchers in the areas of Biological and Chemical Oceanography. Participants in this training program would be introduced to pre-cruise planning and logistics, receive training in commonly used oceanographic sampling equipment, and conduct shipboard measurements during a 10-day oceanographic cruise to the North Pacific Subtropical Gyre (NPSG). The goal of this training program is to prepare early career scientists for leading and participating in interdisciplinary oceanographic research at sea.

Broader Impacts
The proposed program addresses the broader impacts criteria successfully. The research cruise and follow-up

reports and publications focus on interdisciplinary questions important for advancing the field. Given the rapid changes that oceanic systems are undergoing, it is important to have a cadre of junior scientists who are adept at managing interdisciplinary collaborations and conducting research at sea. The PIs are considering ways to connect with diverse audiences in recruiting participants. The impact on early career oceanographers will be very strong. This will create an experience that will be a major impact on the careers of the trainees, especially if they stay in the oceanography field.

[table of contents | back to top]

Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1911831
NSF Division of Ocean Sciences (NSF OCE)	OCE-1911990

[table of contents | back to top]