Images of particles collected in sediment traps for quantitative analysis from multiple platforms from 2016-2017

Website: https://www.bco-dmo.org/dataset/749412
Data Type: Cruise Results
Version: 1
Version Date: 2018-11-07

Project
» Collaborative Research: EAGER: Particle-specific DNA sequencing to directly observe ecological mechanisms of the biological pump (EAGER DNA BioPump)

Contributors	Affiliation	Role
Durkin, Colleen	Moss Landing Marine Laboratories (MLML)	Principal Investigator
Estapa, Margaret L.	Skidmore College	Co-Principal Investigator
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Abstract
Images of particles collected in sediment traps for quantitative analysis from multiple platforms from 2016-2017

Table of Contents

Coverage

Spatial Extent: **N**:39.94 **E**:-70.8119 **S**:21.52 **W**:-151.779
Temporal Extent: 2016-06-13 - 2017-11-07

Dataset Description

Samples were collected at the New England shelf break aboard the R/V Endeavor on 3-7 November 2017 (EN572) and 13-18 June 2016 (EN581) and on a transit between Honolulu, Hawaii and Portland, Oregon aboard the R/V Falkor between 24 January-20 February, 2017 (FK170124). Sediment trap collector tubes were deployed on various platform designs, including a neutrally-buoyant sediment trap (NBST), a surface tethered sediment trap (STST), and a Wire Walker (WW) trap. The location, time, duration, depth, and collection types from each trap deployment are listed in Trap Deployment Log.

Methods & Sampling

The NBST carried 4 collection tubes with a diameter of 12 cm (Valdes and Price 2000). The STST included 5 frames (KC Denmark) clipped onto a surface-tethered, free drifting array line at increasing depths and each frame carried 4, 7 cm diameter collection tubes. The WW trap consisted of one, 4-tube trap frame (KC Denmark) tethered by a bungee below the profiling component of the WW array. To prepare tubes for deployment, seawater was collected from a depth of 150 m using a CTD rosette and pumped through a 1 µm filter cartridge. Trap tubes were filled with filtered water overlying a jar containing a polyacrylamide gel layer (Durkin et al. 2015). Trap platforms were deployed for between 1 day and 3.5 days (see Trap Deployment Log). Identically prepared tubes were incubated in parallel onboard the ship to serve as process blanks.

Upon recovery, collection tubes were allowed to settle for at least 1 hour before the overlying water was siphoned off. Jars containing polyacrylamide gel were removed from trap tubes and the remaining overlying water was carefully pipetted off the gel. Gels were stored at 4 degrees C and imaged within the following 2 days before being stored at -80 degrees C.

Polyacrylamide gel layers were imaged on a dissecting microscope (Olympus SZX16) with either a Luminera Infinity 2 (FK170124) or an Allied Vision Technologies StingRay (EN572 and EN581) camera attachment. Particles collected in gel layers during EN572 and EN581 were imaged under brightfield illumination. Particles collected in gel layers during FK170124 were imaged under both brightfield and oblique illumination, producing two separate sets of images for each sample. EN572 gel layers were imaged with a transparent grid to assist in tracking gel location during imaging. The grid was not used when imaging samples collected during subsequent cruises because the pronounced grid lines complicated image analysis. All gel layers were imaged at 4 increasing magnifications, though the combination of magnifications varied by cruise: at 7x, 20x, 40x, and 115x for EN572 samples, at 7x, 20x, 40x, and 80x for EN581 samples, and at 7x, 20x, 50x, and 115x for FK170124 samples. At magnifications greater than 7x, multiple focal planes within a field of view were imaged to capture particles embedded in different depths of the gel layer. The number of focal planes imaged was consistent across all fields of view for a given magnification but varied across cruises due to variation in gel thickness and particle types present. To determine whether measured particle properties changed if gel layers are frozen, samples collected during FK170124 were thawed after being stored for approximately 1 year at -80 degrees C and imaged again under both brightfield and oblique illumination.

Data Processing Description

Infinity Capture for Mac

BCO-DMO Processing Notes:

- images have been zipped into packages.

[table of contents | back to top]

Data Files

File	
EN572_Gel_Images filename: EN572_Gel_Images.tar.gz Geltrap micrographs of particles collected in sediment traps for quantitative analysis from cruise EN572.	(GZIP (.gz), 138.03 MB) MD5:cf636515048a3f1b8a03a6d6d593184b
EN581_Gel_Images filename: EN581_Gel_Images.tar.gz Geltrap micrographs of particles collected in sediment traps for quantitative analysis from cruise EN581.	(GZIP (.gz), 75.77 MB) MD5:9c8401e30e8f8dc3a271e8841431cf5b
FK170124_Gel_Images filename: FK170124_Gel_Images.tar.gz Geltrap micrographs of particles collected in sediment traps for quantitative analysis from cruise FK170124.	(GZIP (.gz), 33.33 GB) MD5:563e7855e8e15406a8c526c46d41f683
FK170124_Gel_Images_after_freezing filename: FK170124_Gel_Images_after_freezing.tar.gz Geltrap micrographs of particles collected in sediment traps for quantitative analysis from cruise FK170124.	(GZIP (.gz), 21.88 GB) MD5:f85a9f4f2efa61e91b06e685a17a95af
trap_deploy_log.csv Primary data file for dataset ID 749412	(Comma Separated Values (.csv), 2.49 KB) MD5:238b8eeb62545a5c43ca10c01606cc05

[table of contents | back to top]

Related Publications

Durkin, C. A., Estapa, M. L., & Buesseler, K. O. (2015). Observations of carbon export by small sinking particles in the upper mesopelagic. Marine Chemistry, 175, 72–81. doi:10.1016/j.marchem.2015.02.011
General

[table of contents | back to top]

Related Datasets

IsRelatedTo

Durkin, C., Estapa, M. L., Omand, M. (2021) **Particle fluxes calculated from gel trap images taken on R/V Endeavor and R/V Falkor cruises off the New England shelf break and in the North Pacific during 2016-2017.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2021-04-08 doi:10.26008/1912/bco-dmo.847036.1 [view at BCO-DMO]

IsSourceOf

Durkin, C., Estapa, M. L., Omand, M. (2021) **Images and associated metadata of individually classified particles imaged and quantified in sediment trap gel layers collected on four research cruises conducted between 2015 and 2018.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2021-09-14 doi:10.26008/1912/bco-dmo.860725.1 [view at BCO-DMO]
Relationship Description: Particles detected in gel image micrographs were manually sorted into distinct classes.

[table of contents | back to top]

Parameters

Parameter	Description	Units
Cruise	Cruise identifier	unitless
Trap_Platform	trap identifier	unitless
Additional_Trap_Label	additional trap label	unitless
Depth	depth of trap	meters
Deployment_Duration_days	deployment duration	days
Deploy_Latitude	deployment latitude with positive values indicating North	decimal degrees
Deploy_Longitude	deployment longitude with negative values indicating West	decimal degrees
Deploy_Date_UTC	date of deployment in UTC following ISO-8601 convention	unitless
Deploy_Time_UTC	Time of deployment in UTC following ISO-8601 convention	unitless
Recover_Latitude	recover latitude with positive values indicating North	decimal degrees
Recover_Longitude	recover longitude with negative values indicating West	decimal degrees
Recover_Date_UTC	date of recover in UTC following ISO-8601 convention	unitless
Recover_Time_UTC	Time of recover in UTC following ISO-8601 convention	unitless
deploy_date_time	deployment date and time following ISO-8901 convention	yyyy-MM-dd'T'HH:mm
recover_date_time	recover date and time following ISO-8901 convention	unitless

[table of contents | back to top]

Instruments

Dataset-specific Instrument Name	Luminera Infinity 2 microscope camera
Generic Instrument Name	Camera
Dataset-specific Description	Polyacrylamide gel layers were imaged on a dissecting microscope (Olympus SZX16) with either a Luminera Infinity 2 (FK170124) or an Allied Vision Technologies StingRay (EN572 and EN581) camera attachment.
Generic Instrument Description	All types of photographic equipment including stills, video, film and digital systems.

Dataset-specific Instrument Name	Olympus SZX16 Stereomicroscope
Generic Instrument Name	Microscope - Optical
Dataset-specific Description	Polyacrylamide gel layers were imaged on a dissecting microscope (Olympus SZX16)
Generic Instrument Description	Instruments that generate enlarged images of samples using the phenomena of reflection and absorption of visible light. Includes conventional and inverted instruments. Also called a "light microscope".

Dataset-specific Instrument Name	
Generic Instrument Name	Sediment Trap
Dataset-specific Description	Sediment trap collector tubes were deployed on various platform designs, including a neutrally-buoyant sediment trap (NBST), a surface tethered sediment trap (STST), and a Wire Walker (WW) trap.
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

FK170124

Website	https://www.bco-dmo.org/deployment/732225
Platform	R/V Falkor
Report	https://datadocs.bco-dmo.org/docs/302/EAGER_DNA_BioPump/data_docs/DurkinOmandEstapa_Cruise_report.pdf
Start Date	2017-01-24
End Date	2017-02-20
Description	Station 1: 01/28/2017 17:45 to 02/02/2017 05:43 (GMT) Station2: 02/05/2017 16:06 to 02/08/2017 17:20 (GMT) Station3_dep1: 02/12/2017 04:23 to 02/13/2017 16:42 (GMT) Station3_dep2: 02/13/2017 17:48 to 02/14/2017 18:46 (GMT)

EN572

Website	https://www.bco-dmo.org/deployment/749440
Platform	R/V Endeavor
Start Date	2015-11-03
End Date	2015-11-07

EN581

Website	https://www.bco-dmo.org/deployment/749505
Platform	R/V Endeavor
Start Date	2016-06-13
End Date	2016-06-18

[table of contents | back to top]

Project Information

Collaborative Research: EAGER: Particle-specific DNA sequencing to directly observe ecological mechanisms of the biological pump (EAGER DNA BioPump)

Coverage: Eastern Pacific

NSF Award Abstract:
Carbon is fixed into organic matter by phytoplankton growing in the surface ocean, and is naturally sequestered in the ocean interior when particles and organisms sink: a process called the "biological pump." Because of its recognized influence on the global carbon cycle, ocean scientists have studied the biological pump for decades. However, we still do not have a sufficient understanding of the underlying processes to accurately quantify and predict carbon cycling. Much of this uncertainty stems from an inability to directly link specific plankton in the surface ocean with the types of particles sinking out of the surface ocean. To address this missing link in biological pump research, this work will directly observe how plankton are transported out of the surface ocean using novel, particle-specific observational approaches embedded within an interdisciplinary field program that will finely resolve upper ocean plankton groups and the resulting amount of sinking carbon across space and in time. The genetic identity of organisms within different types of sinking particles will be determined by sequencing the genetic contents of individually collected particles. This new application of a molecular method will definitively link surface plankton with sinking particles at five locations across the Pacific Ocean. This work has the potential to transform our understanding of the biological pump by identifying previously unknown links between surface ecosystems and sinking carbon particles. Because this work is embedded within an interdisciplinary field program, including biogeochemical modelers and remote sensing scientists, these data will feed directly into new models of the biological pump, improving our ability to quantify and predict carbon uptake by the ocean. This project will train 1 graduate student and at least 2 undergraduate researchers. Findings will be communicated to the non-scientific public through blogs, videos, and the public communication channels of participating institutions.

Accurate prediction of the global carbon cycle requires an understanding of the specific processes that link surface plankton communities and sinking particulate carbon flux (export) out of the surface ocean, but current methodological paradigms in biological pump research do not directly observe these processes. This project will comprehensively determine who is exported from the surface ocean and how using new, particle-resolving optical and molecular techniques embedded within a sampling scheme that characterizes export events at high time and space resolution. The investigation suggests that different plankton types in the surface waters are transported out of the surface ocean by distinct export pathways, and that an understanding of these connections is critical knowledge for global carbon cycle modeling. If successful, this work has the potential to transform our conceptual understanding of the biological pump by directly identifying mechanisms that link surface plankton with particle export, without relying on bulk sampling schemes and large-scale correlation analysis. Particle export environments will be studied at five open ocean locations during a cruise from Hawaii to Seattle in January-February 2017. The surface plankton communities will be characterized by a combination of satellite observations, sensors attached to a free-drifting, continuously profiling WireWalker, an in situ holographic camera, microscopy, and by sequencing 18S and 16S rRNA gene fragments. Exported particles will simultaneously be captured by various specialized sediment traps and their characteristics will be directly related to their sources in the surface community by identifying the genetic contents of individual particle types. Individual particles will be isolated from gel layers and the 16S and 18S rRNA gene fragments will be amplified and sequenced. This work would, for the first time, combine molecular approaches with particle-specific observations to enable simultaneous identification of both which organisms are exported and the processes responsible for their export.

[table of contents | back to top]

Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1703664

[table of contents | back to top]