TEP and CSP particles collected from Station ALOHA for HOT time series during R/V Kilo Moana cruises from Jan 2020 to Sep 2022

Website: https://www.bco-dmo.org/dataset/968732
Data Type: Cruise Results
Version: 1
Version Date: 2025-07-15

Project
» Collaborative Research: Transparent exopolymer and phytoplankton vertical migration as sources for preformed nitrate anomalies in the subtropical N. Pacific Ocean (TEP and phytoplankton migration)

Contributors	Affiliation	Role
Letscher, Robert T.	University of New Hampshire (UNH)	Principal Investigator
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Abstract
These data include transparent exopolymer particle (TEP) and Coomassie stainable particle (CSP) concentrations within the upper 350 meters collected on 15 cruises to Station ALOHA over the period of January 2020 through September 2022. Particle concentrations are measured spectrophotometrically using Alcian blue (TEP) and Coomassie blue (CSP) dyes and reported in the semi-quantitative concentration units of xanthan gum equivalents µg / L (TEP) and bovine albumen equivalents µg / L (CSP). Also included are total dissolved carbohydrate concentrations in µM C / L units on a subset of 9 cruises. These analyses are a contribution to the project, "Collaborative Research: Transparent exopolymer and phytoplankton vertical migration as sources for preformed nitrate anomalies in the subtropical N. Pacific Ocean" funded by the Chemical and Biological Oceanography Programs at NSF.

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Coverage

Location: Station ALOHA in the subtropical North Pacific Ocean, 22.75 N 158 W, upper 350 meters depth
Spatial Extent: **Lat**:22.75 **Lon**:-158
Temporal Extent: 2020-01-31 - 2022-09-02

Dataset Description

TEP = transparent exopolymer particle
CSP = Coomassie stainable particle
HOT = Hawaii Ocean Time Series
Station ALOHA = Station ALOHA is the focal point of a range of oceanographic studies conducted over great

temporal scale that intend to understand and explain the trends of the greater North Pacific Ocean
NSF = National Science Foundation
GF/F = glass fiber filter

Methods & Sampling

TEP and CSP particles were collected onto 0.4 µm polycarbonate filters from 1 liter each of whole water collected via the CTD/Rosette Niskin bottles into 1 L polycarbonate media bottles. Filtration was achieved using a peristaltic pump and silicone tubing through a 25 mm polycarbonate filter holder. Filters containing particles were immediately stained with Alcian blue (TEP) or Coomassie blue (CSP) dyes and stored frozen at -20degC until analysis on shore back at the University of New Hampshire. TEP and CSP particle concentrations were measured following the spectrophotometric method of Bittar et al. 2018 in Limnology & Oceanography Methods (doi:10.1002/lom3.10268) and standardized with xanthan gum and bovine albumen, respectively. Total dissolved carbohydrates were measured using the spectrophotometric method of Myklestad et al. 1997 in Marine Chemistry (doi:10.1016/S0304-4203(96)00074-6). Seawater samples were previously filtered via gravity filtration and silicone tubing connected to Niskin bottles at sea, passed through a 47mm glass fiber filter (GF/F; 0.7 µm) held in a polycarbonate filter holder, into 40 mL glass EPA vials with silicone septa tops and frozen at -20degC until analysis on shore back at the University of New Hampshire.

BCO-DMO Processing Description

* Table within submitted file "HOT_TEP_CSP_2020_2022.csv" was imported into the BCO-DMO data system for this dataset. Values "-999" imported as missing data values. Table will appear as Data File: 968732_v1_tep-and-csp-hot.csv (along with other download format options).

Missing Data Identifiers:
* In the BCO-DMO data system, missing data identifiers are displayed according to the format of data you access. For example, in csv files it will be blank (null) values. In Matlab .mat files it will be NaN values. When viewing data online at BCO-DMO, the missing value will be shown as blank (null) values.

* Column names adjusted to conform to BCO-DMO naming conventions designed to support broad re-use by a variety of research tools and scripting languages. [Only numbers, letters, and underscores. Can not start with a number]

* Date converted to ISO 8601 format

* Prefix "HOT-" add to numeric cruise ids for consistency with HOT program. Cruise ID km2108 case changed to KM2108 for consistency with other datasets and cruise databases.

* trailing zeros added for lat lon to clarify precision for all values should be hundredths place. The data submitter explained the integers in the lat, lon columns not rounded to degree (e.g. -158 is precision 158.00).

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Data Files

File	
968732_v1_tep-and-csp-hot.csv	(Comma Separated Values (.csv), 7.91 KB) MD5:b08885d5f0eb1f81cc82bb7e806f3276
Primary data file for dataset ID 968732, version 1. TEP, CSP, and total dissolved carbohydrates measured at Station ALOHA as part of the Hawaiian Ocean Time-series.	

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Related Publications

Bittar, T. B., Passow, U., Hamaraty, L., Bidle, K. D., & Harvey, E. L. (2018). An updated method for the calibration of transparent exopolymer particle measurements. Limnology and Oceanography: Methods, 16(10), 621–628. doi:10.1002/lom3.10268
Methods

Curran, K., Villareal, T., & Letscher, R. T. (2024). A time series analysis of transparent exopolymer particle distributions and C:N stoichiometry in the subtropical North Pacific: a key process in net community production and preformed nitrate anomalies? https://doi.org/10.5194/egusphere-2024-1416
Results

Myklestad, S. M., Skånøy, E., & Hestmann, S. (1997). A sensitive and rapid method for analysis of dissolved mono- and polysaccharides in seawater. Marine Chemistry, 56(3–4), 279–286. https://doi.org/10.1016/s0304-4203(96)00074-6 https://doi.org/10.1016/S0304-4203(96)00074-6
Methods

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Related Datasets

IsRelatedTo

Letscher, R. T., Curran, K. (2025) **TEP and CSP particle concentrations from samples collected from Station ALOHA to 31ºN in the North Pacific in June 2021 on the R/V Kilo Moana cruise KM2108.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2025-07-15 doi:10.26008/1912/bco-dmo.968636.1 [view at BCO-DMO]
Relationship Description: These datasets were colleted as part of the same study and both include data from R/V Kilo Moana cruise KM2108.

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Parameters

Parameter	Description	Units
Cruise	Cruise identifier. Integer cruise IDs correspond to HOT cruises (e.g. "319" is equivalent to "HOT-319")	unitless
Date	Date (ISO 8601 format)	unitless
Longitude	Longitude	decimal degrees
Latitude	Latitude	decimal degrees
Depth	Depth	meters (m)
Transparent_Exopolymer_Particles	Transparent Exopolymer Particles	micrograms xanthan gum equivalents per liter (ug XG equiv./L)
Coomassie_Stainable_Particles	Coomassie Stainable Particles	micrograms bovine albumen equivalents per liter (ug BA equiv./L)
Total_Dissolved_Carbohydrates	Total Dissolved Carbohydrates	micromolar (uM C)

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Instruments

Dataset-specific Instrument Name	Masterflex L/S MasterSense Peristaltic Pump
Generic Instrument Name	Pump
Generic Instrument Description	A pump is a device that moves fluids (liquids or gases), or sometimes slurries, by mechanical action. Pumps can be classified into three major groups according to the method they use to move the fluid: direct lift, displacement, and gravity pumps

Dataset-specific Instrument Name	Shimadzu UV-1800 Dual Beam UV-Vis Spectrophotometer
Generic Instrument Name	UV Spectrophotometer-Shimadzu
Generic Instrument Description	The Shimadzu UV Spectrophotometer is manufactured by Shimadzu Scientific Instruments (ssi.shimadzu.com). Shimadzu manufacturers several models of spectrophotometer; refer to dataset for make/model information.

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Deployments

KM2108

Website	https://www.bco-dmo.org/deployment/968661
Platform	R/V Kilo Moana
Start Date	2021-06-05
End Date	2021-06-16
Description	A 12-day June 2021 cruise aboard the R/V Kilo Moana (KM-2108) that visited Station ALOHA to 31 N nominally along 158 W in the subtropical North Pacific. Cruise information provided by Chief Scientist Robert Letscher as it was not yet available at R2R.

HOT_cruises

Website	https://www.bco-dmo.org/deployment/58879
Platform	Multiple Vessels
Report	http://hahana.soest.hawaii.edu/hot/
Start Date	1988-10-31
Description	Since October 1988, the Hawaii Ocean Time-series (HOT) program has investigated temporal dynamics in biology, physics, and chemistry at Stn. ALOHA (22°45' N, 158°W), a deep ocean field site in the oligotrophic North Pacific Subtropical Gyre (NPSG). HOT conducts near monthly ship-based sampling and makes continuous observations from moored instruments to document and study NPSG climate and ecosystem variability over semi-diurnal to decadal time scales.

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Project Information

Collaborative Research: Transparent exopolymer and phytoplankton vertical migration as sources for preformed nitrate anomalies in the subtropical N. Pacific Ocean (TEP and phytoplankton migration)

Coverage: North Pacific Gyre, Hawaii Ocean Time-Series

NSF Award Abstract:
The ocean is usually layered, with light and oxygen in the warmer surface and nutrients at the cooler depths. Biological and physical processes determine this distribution. Marine algae grow in the well-lit upper layers but need nutrients to grow. However, in the subtropics, the ocean's largest biome, the relationship between oxygen and nitrate (a key nutrient required for photosynthesis) is different from expected. Two processes could explain this. Nutrients could be transported upward by migrating giant single-celled algae (phytoplankton). Another explanation is that the production of an organic material called transparent exopolymer (TEP) takes up carbon without using nutrients or exporting carbon to depth, as would occur in photosynthesis. While both processes could be occurring, the relative contribution of migrating phytoplankton versus TEP would tell us whether the observed oxygen pattern in the upper ocean results from photosynthesis. This problem relates to the general question of where and how nutrients reach the well-lit surface waters to enable photosynthesis. These hypotheses are tested at the Hawaii Ocean Time-Series using in-situ camera systems to image and quantify the giant phytoplankton and direct water samples to measure the vertical distribution of TEP. The data are entered into numerical models to calculate the nitrate to oxygen relationships and add information about the carbon cycle. In addition to training of undergraduate students and a postdoctoral fellow, the cruises provide an opportunity to prepare a cadre of communication fellows who will develop materials and media, including videos, to translate this highly complex scientific concepts for the

general public. The social media campaign #SaveOur70 provides a valuable venue to reach and engage with the public.

Quantifying nutrient transport, utilization, and its relationship to carbon drawdown in the subtropical gyres is fundamental to our understanding of the carbon cycle. Geochemical distributions from the well-characterized time-series sites near Hawaii and Bermuda have long-served to identify previously unknown links between subsurface nitrate fields, summertime dissolved inorganic carbon (DIC) drawdown, and net community production in the absence of known nutrient sources. Two recently suggested processes rise to prominence to explain anomalies in subtropical distributions of dissolved carbon, oxygen, and nitrate in the upper ocean: 1) nutrient transport by giant phytoplankton that vertically migrate, and 2) cycling of low N organic matter between the mixed layer and the upper nutricline as transparent exopolymer particles (TEP) or gel-like organic material (GLOM). While linked at a fundamental level (phytoplankton are TEP producers), the outcome of the two processes are distinct. Vertical migration of phytoplankton is an active transport of nitrate, acquired in the nutricline, to the surface. There is an implication of subsequent reduction, photosynthetic carbon fixation and eventual export. TEP/GLOM cycling results in apparent DIC drawdown but there is no net export out of the surface layer and no requirement for additional nutrient sources in the mixed layer. This project collects the data to quantify the contribution of these two processes to the observed anomalies in nitrate to oxygen distribution at the time-series station at Hawaii (HOT). This is accomplished by enumerating the vertically migrating, aflagellate flora (VMF), implementing a 1-D model on vertical migration, and coupling these results with a 1-D model of the contribution of N-poor carbon cycling patterns in the upper water column derived from TEP and carbohydrate measurements. The combined VMF and TEP/GLOM 1-D models are used to model the dissolved oxygen, carbon, and nitrate budgets at HOT allowing for attribution of both hypothesized processes to the observed preformed nitrate distribution, its formation rate, and summertime inorganic carbon drawdown.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1923687

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