Depth profiles of nutrients and dark carbon fixation rates collected from the San Pedro Ocean Time-series (SPOT) R/V Yellowfin cruise in the San Pedro Basin on February 19, 2025

Website: https://www.bco-dmo.org/dataset/1005611
Data Type: Cruise Results, experimental
Version: 1
Version Date: 2026-08-19

Project
» Collaborative Research: The impact of ocean warming on bioactive trace metal requirements and use efficiencies of marine nitrifying microorganisms (Nitrifiers_TMReqs_OceanWarming)

Contributors	Affiliation	Role
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Abstract
This dataset contains depth-resolved measurements of nutrients and dark carbon fixation collected during the SPOT cruise in the San Pedro Ocean Time-series (Southern California Bight) on February 19, 2025. Samples were collected from depths ranging from 15 to 100 m. The dataset includes concentrations of ammonia, nitrite, and nitrate, as well as dark carbon fixation rates and associated standard deviations. These data characterize nutrient distributions and microbial carbon fixation activity in the water column.

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Coverage

Location: SPOT station in the Southern California Bight (33°33′N, 118°24′W), a coastal marine environment
Spatial Extent: **Lat**:33.55 **Lon**:-118.4
Temporal Extent: 2025-02-19

Methods & Sampling

Water samples for nutrient analyses were collected from CTD Niskin bottles at discrete depths (15–100 m) from a single CTD cast. Approximately 40 mL of seawater was filtered onboard through 0.22 µm sterile syringe filters (Basix™ PES) and immediately frozen using an ethanol and dry ice bath prior to storage. Ammonia concentrations were determined using the o-phthaldialdehyde (OPA) fluorescence method following Holmes et al. (1999). Nitrite concentrations were measured spectrophotometrically using the sulfanilamide–NED method

as described in Grasshoff et al. (1999). Nitrate concentrations were determined using the vanadium(III) chloride reduction method following García-Robledo et al. (2014).

For dark carbon fixation measurements, seawater was collected from CTD Niskin bottles from the same CTD cast and maintained in the dark at near in situ temperature. Four subsamples (90 mL each) were transferred into separate 110 mL acid-cleaned HDPE brown bottles. All subsamples were collected from the same Niskin bottle at each depth and divided into replicate incubations. All bottles were amended with approximately 6 µCi of 14C-labeled bicarbonate. One subsample was treated with 2.5% glutaraldehyde as a killed control, while the remaining three subsamples were incubated as biological replicates. Incubations were conducted in the dark at temperatures approximating in situ conditions (~15 °C for the 15m sample and ~11 °C for deeper samples). After ~60 hours of incubation, samples were processed following standard 14C carbon fixation protocols, including filtration and radioactivity measurement by liquid scintillation counting.

Data Processing Description

Carbon fixation rates were calculated from 14C incorporation measurements. Measured disintegrations per minute (DPM) were converted to carbon fixation rates using the known activity of added 14C-bicarbonate and the ambient dissolved inorganic carbon (DIC) pool. Background activity was corrected using the killed control sample. Rates are reported as carbon fixed per unit volume per day.

BCO-DMO Processing Description

This section documents curation actions performed prior to publication review with the submitter, and additional information relevant to understanding and reusing this dataset. It distinguishes changes made to the submitted (meta)data from unresolved issues and/or enhancements that improve future reuse and interoperability.

CURATION ACTIONS PERFORMED ON DATA

- Loaded XLSX file "SPOT_nutrients and dark carbon fixation_20250219.xlsx" (sheet 1), naming the table spot_nutrients_dark_carbon_fixation, header row set to row 1, with preserve_formatting and adjust_floating_point_error enabled; set empty string and "nd" as missing values via schema override
- Renamed columns to fix a naming convention violation caused by a "/" character and to remove units from parameter names: DCF_nM_C/day to DCF, Depth_m to Depth, Ammonia_nM to Ammonia, Nitrite_nM to Nitrite, Nitrate_uM to Nitrate
- Output as 1005611_v1_spot_nutrients_dark_carbon_fixation.csv

CURATION ACTIONS PERFORMED ON METADATA

- Adjusted title to conform with BCO-DMO conventions

ISSUES POTENTIALLY IMPACTING REUSE

- The source or calculation of the ambient dissolved inorganic carbon (DIC) values used to calculate dark carbon fixation rates was not provided

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Related Publications

García-Robledo, E., Corzo, A., & Papaspyrou, S. (2014). A fast and direct spectrophotometric method for the sequential determination of nitrate and nitrite at low concentrations in small volumes. Marine Chemistry, 162, 30–36. https://doi.org/10.1016/j.marchem.2014.03.002
Methods

Grasshoff, K., Kremling, K., & Ehrhardt, M. (Eds.). (1999). Methods of Seawater Analysis. doi:10.1002/9783527613984
Methods

Holmes, R. M., Aminot, A., Kérouel, R., Hooker, B. A., & Peterson, B. J. (1999). A simple and precise method for measuring ammonium in marine and freshwater ecosystems. Canadian Journal of Fisheries and Aquatic Sciences, 56(10), 1801–1808. doi:10.1139/f99-128
Methods

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Parameters

Parameter	Description	Units
Date_of_sampling	Date of sampling in Pacific Standard Time	unitless
Latitude	Latitude of sampling location, positive is North	decimal degrees
Longitude	Longitude of sampling location, negative is West	decimal degrees
Depth	Sampling depth	meters (m)
Ammonia	Ammonia concentration in seawater	nanomole per liter (nM)
Nitrite	Nitrite concentration in seawater. Nitrite values not detected or below the detection limit are not included in the dataset.	nanomole per liter (nM)
Nitrate	Nitrate concentration in seawater	micromole per liter (µM)
DCF	Dark carbon fixation rate	nanomole carbon per liter per day (nM C d^{-1})
DCF_stdev	Standard deviation of dark carbon fixation rate across three replicates	nanomole carbon per liter per day (nM C d^{-1})

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Instruments

Dataset-specific Instrument Name	Wallac System 1400 liquid scintillation counter
Generic Instrument Name	Liquid Scintillation Counter
Dataset-specific Description	Dark carbon fixation rates were determined using 14C-bicarbonate incorporation and quantified by liquid scintillation counting (Wallac System 1400 liquid scintillation counter).
Generic Instrument Description	Liquid scintillation counting is an analytical technique which is defined by the incorporation of the radiolabeled analyte into uniform distribution with a liquid chemical medium capable of converting the kinetic energy of nuclear emissions into light energy. Although the liquid scintillation counter is a sophisticated laboratory counting system used to quantify the activity of particulate emitting (ß and a) radioactive samples, it can also detect the auger electrons emitted from 51Cr and 125I samples. Liquid scintillation counters are instruments assaying alpha and beta radiation by quantitative detection of visible light produced by the passage of rays or particles through a suitable scintillant incorporated into the sample.

Dataset-specific Instrument Name	Niskin bottles
Generic Instrument Name	Niskin bottle
Dataset-specific Description	Water samples for nutrient analyses were collected from CTD Niskin bottles at discrete depths (15–100 m) from a single CTD cast.
Generic Instrument Description	A Niskin bottle (a next generation water sampler based on the Nansen bottle) is a cylindrical, non-metallic water collection device with stoppers at both ends. The bottles can be attached individually on a hydrowire or deployed in 12, 24, or 36 bottle Rosette systems mounted on a frame and combined with a CTD. Niskin bottles are used to collect discrete water samples for a range of measurements including pigments, nutrients, plankton, etc.

Dataset-specific Instrument Name	Sea-Bird Electronics SBE 9plus
Generic Instrument Name	Sea-Bird SBE 9plus CTD
Dataset-specific Description	CTD rosette systems (Sea-Bird Electronics SBE 9plus or equivalent) were used for seawater collection.
Generic Instrument Description	High precision and accuracy CTD comprising an SBE 9plus underwater unit (SBE 3plus temperature, SBE 4C conductivity, and Paroscientific Digiquartz pressure sensors, and an SBE 5T submersible pump). Can be used for either real-time data acquisition or for autonomous operations at a sampling speed of up to 24 Hz. The instrument package also includes a TC duct, to reduce salinity spiking caused by ship heave for improved resolution of water column features, and to ensure that temperature and conductivity measurements are made on the same parcel of water. Supplied with both an aluminium and titanium main housing, allowing for use up to 6800 and 10,500 metre depths respectively. Also capable of measuring from eight auxiliary sensors.

Dataset-specific Instrument Name	Shimadzu UV-1800 UV–Vis spectrophotometer
Generic Instrument Name	Spectrophotometer
Dataset-specific Description	Nutrient concentrations were measured using standard fluorescence and spectrophotometric methods with calibrated instruments (Turner Designs Trilogy fluorometer and Shimadzu UV-1800 UV–Vis spectrophotometer) and external standards.
Generic Instrument Description	An instrument used to measure the relative absorption of electromagnetic radiation of different wavelengths in the near infra-red, visible and ultraviolet wavebands by samples.

Dataset-specific Instrument Name	Turner Designs Trilogy fluorometer
Generic Instrument Name	Turner Designs Trilogy fluorometer
Dataset-specific Description	Nutrient concentrations were measured using standard fluorescence and spectrophotometric methods with calibrated instruments (Turner Designs Trilogy fluorometer and Shimadzu UV-1800 UV–Vis spectrophotometer) and external standards.
Generic Instrument Description	The Trilogy Laboratory Fluorometer is a compact laboratory instrument for making fluorescence, absorbance, and turbidity measurements using the appropriate snap-in application module. Fluorescence modules are available for discrete sample measurements of various fluorescent materials including chlorophyll (in vivo and extracted), rhodamine, fluorescein, cyanobacteria pigments, ammonium, CDOM, optical brighteners, and other fluorescent compounds.

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Deployments

SPOT_20250219

Website	https://www.bco-dmo.org/deployment/1005709
Platform	R/V Yellowfin
Start Date	2025-02-19
End Date	2025-02-19
Description	San Pedro Ocean Time-series

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Project Information

Collaborative Research: The impact of ocean warming on bioactive trace metal requirements and use efficiencies of marine nitrifying microorganisms (Nitrifiers_TMReqs_OceanWarming)

Coverage: Eastern North Pacific: HNLC and subtropical gyre; SPOT time-series station; HOT time-series station.

NSF Award Abstract:

This project seeks to provide a deeper understanding of how major biogeochemical cycles that support all living marine resources will respond to climate warming in a changing ocean environment. It will train one postdoctoral researcher and three graduate students, and provides research training opportunities for undergraduate students in microbial physiology and ecology, bioinformatics, trace metal biogeochemistry, and oceanography. Project personnel also conduct K-12 education and outreach activities. All data is freely available through the Biological and Chemical Oceanographic Data Management Office (BCO-DMO).

This project investigates how climate warming will interact with the unique trace metal requirements of marine nitrifying microorganisms (nitrifiers) to affect ammonia and nitrite oxidation pathways in the rapidly changing ocean. Four investigators with diverse expertise in microbial global change physiology, nitrogen and trace metal biogeochemistry, and mechanistic transcriptomics and proteomics combine their efforts, using well-controlled pure culture-based laboratory studies along with field incubation experiments with natural communities to systematically investigate 1) thermal effects on iron (Fe) and copper (Cu) requirements and use efficiencies in isolated cultures and natural populations of marine ammonia-oxidizing archaea and bacteria (AOA, AOB) and nitrite-oxidizing bacteria (NOB), 2) the underlying molecular and biochemical mechanisms that facilitate such thermally-driven adaptive responses, and 3) system-level feedbacks between global change, trace metal biogeochemistry, and marine nitrifiers and their associated microbial communities in diverse marine environments. Together, these studies enhance our understanding of the marine nitrogen cycle and trace metal biogeochemistry, and ultimately contribute to a more detailed understanding of the impact of rapid ocean warming on critical major nutrient and micronutrient cycles.

This award reflects NSF's statutory mission and has been deemed worthy of support through evaluation using the Foundation's intellectual merit and broader impacts review criteria.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-2336534
NSF Division of Ocean Sciences (NSF OCE)	OCE-2610907

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