Concentrations of dissolved inorganic macronutrients, chlorophyll a, phaeophytin, PON, and POC measured during phytoplankton shipboard incubation experiments on the FeOA cruise SKQ202209S on R/V Sikuliaq in the NE Pacific from June to July 2022

Website: https://www.bco-dmo.org/dataset/945375
Data Type: Cruise Results
Version: 1
Version Date: 2024-12-09

Project
» Collaborative Research: The Effect of Ocean Acidification on Fe Availability to Phytoplankton in Coastal and Oceanic Waters of the Eastern North Pacific (pH-Fe availability)

Contributors	Affiliation	Role
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Abstract
This dataset includes the concentrations of dissolved inorganic macronutrients (phosphate, nitrate plus nitrite (N+N), silicic acid, and nitrite), chlorophyll a and phaeophytin, and particulate organic nitrogen and carbon measured shipboard in samples collected from phytoplankton shipboard incubation experiments conducted on the FeOA cruise SKQ202209S on R/V Sikuliaq in the Northeast Pacific from June to July 2022. This project investigates the effects of ocean acidification on the associations between iron and organic ligands in seawater and on iron bioavailability to marine phytoplankton communities. The project used a combination of shipboard incubation experiments and depth profiles to characterize iron speciation and cycling across coastal upwelling, oligotrophic open ocean, and iron-limited subarctic oceanographic regimes in the NE Pacific. Surface seawater was incubated at pH of 8.1, 7.6, and 7.1 with natural iron and with dissolved iron amendments in order to investigate interactions between pH and iron bioavailability across the different regimes. Understanding how pH influences iron and its relationship with ligands provides important information for assessing the impacts of ocean acidification on primary production and biogeochemical processes.

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Coverage

Location: Northeast Pacific Ocean
Spatial Extent: **N**:50 **E**:-125.56 **S**:35 **W**:-145
Temporal Extent: 2022-06-10 - 2022-06-30

Methods & Sampling

Incubation Setup:
Surface water was collected for shipboard incubations in June 2022 aboard the R/V Sikuliaq using a trace metal clean surface pump "towfish" system (Mellett and Buck, 2020). Filtered (<0.2-micrometer (µm), Acropak) seawater from the towfish was homogenized in three acid-cleaned and seawater rinsed 50-liter (L) carboys that were filled round-robin style (Burns et al., 2023). Each carboy was then bubbled overnight with a custom CO2-air mixture to achieve the target pH levels of pH 8.1, 7.6, and 7.1, which was verified with shipboard spectrophotometric pH analyses using the Byrne MICA system (Adornato et al., 2016). Unfiltered surface seawater was then collected and homogenized in a fourth acid-cleaned and seawater-rinsed carboy using the trace metal clean towfish. Trace metal clean polycarbonate incubation bottles were then filled two-thirds with filtered seawater and one-third unfiltered seawater, amended for the nutrient and/or iron treatment, sealed with the caps/threads wrapped in parafilm and electrical tape, and delivered to deckboard flow-through seawater incubators that were covered in screening to mimic surface light levels. Once all incubation bottles were in the incubators, the time-zero sampling of each incubation began. Six incubations were conducted, two each at a coastal upwelling station (Inc 1, 2; 40.112 ºN, 125.56 ºW), in the oligotrophic central North Pacific (Inc 3, 4; 35 ºN, 145 ºW), and at Ocean Station PAPA (Inc 5, 6; 50 ºN, 145 ºW) in the subarctic North Pacific. For incubations 1-4, all incubation bottles were spiked with chelexed stocks of nitrate and phosphate, and aged (for trace metal cleanliness) silicic acid stocks, to target additions of 10 micromolar (µM) nitrate, silicic acid, and 0.8 µM phosphate; no macronutrients were added to Incs 5 and 6, which were already macronutrient replete. Replicates of pH treatment were additionally spiked with 1 nanomolar (nM) 57FeCl3 as a dissolved iron addition. Incubation bottles were labeled according to treatment and were the same across light bottles all incubations: A = pH 8.1, B = pH 8.1 + Fe, C = pH 7.6, D = pH 7.6 + Fe, E = pH 7.1, F = pH 7.1 + Fe. Replicates of each treatment were also incubated in heavy-duty black contractor bags to serve as dark controls (G = A, H = B, I = C, J = D, K = E, L = F), which were sampled on day final only.

Incubation sampling:
Triplicate bottles from each incubation were sampled daily over the course of the experiments. Incubation bottles were brought in from the incubators into a clean lab bubble in the ship, where they were washed down with Milli-Q and transferred into a clean hood. After gently inverting to mix, one liter of whole water was transferred into amber high-density polyethylene bottles for parallel filtering (< 100 millimeters (mm) Hg) of chlorophyll a on 5 µm membrane (Poretics) filters and on 0.7 µm GF/F (Whatman) filters and for filtering particulate organic carbon (POC), and particulate organic nitrogen (PON) filtering on combusted GF/F filters using a glass and stainless steel Millipore filtration rig in the main lab. Filters for chlorophyll a were frozen at -20 degrees Celsius (°C) in the dark prior to their extraction and analysis at sea; filters for POC and PON were wrapped in foil and stored in a -80 ºC freezer until analyzed on shore at the University of South Florida (MEC lab). The remaining contents of each bottle were filtered in the bubble clean hood on a custom acrylic filtration rig outfitted with dual stage Teflon filtration holders (Savillex) that allows the filtrate to go directly into sample bottles after passing through consecutive 5 µm and 0.4 µm acid-cleaned polycarbonate track-etched (PCTE; Whatman) filters. Samples for dissolved macronutrients were collected into acid-cleaned and triple-rinsed 15-milliliter (mL) polycarbonate Falcon tubes and stored in zipper bags in the fridge until analyzed shipboard following recommended practices (Becker et al., 2020), typically within 24 hours of collection (Caitlyn Parente, Kristen Buck lab). Samples for dissolved trace metals were collected in acid-cleaned and triple-rinsed narrow mouth low density polyethylene bottles, acidified with 0.024 molar (M) ultrapure hydrochloric acid (to pH ~1.8), and stored for shore-based analysis at the University of Nagasaki (Yoshiko Kondo). Samples for dissolved iron and nickel speciation were collected in acid-cleaned, Milli-Q-conditioned, and triple-rinsed narrow mouth fluorinated high density polyethylene bottles (Nalgene) and analyzed shipboard for dissolved iron speciation (Lise Artigue, Kristen Buck lab) before freezing at -20 ºC for shore-based dissolved nickel speciation analyses at Oregon State University (Matthew Koteskey, Kristen Buck lab). Filters containing the size-fractionated particulate material were folded into eighths, stored in acid-cleaned and dry snap-cap centrifuge tubes, and stored frozen at -20 ºC for shore-based particulate metal analyses at Oregon State University.

Sample analyses - macronutrients:
Filtered macronutrient samples were analyzed shipboard for phosphate, nitrate+nitrite, silicic acid, and nitrite on a QuAAtro39 AutoAnalyzer (SEAL Analytical) according to standard colorimetric methods (Strickland and

Parsons, 1972). All reagents were prepared in dedicated labware with high purity Milli-Q (>18 MΩ cm) water. Working standards were prepared fresh daily in an artificial seawater (ASW; 35 grams per liter (g/L) sodium chloride, 0.5 g/L sodium bicarbonate) matrix using calibrated volumetric pipettes. Nine-point standard curves were analyzed at the beginning of each run with multiple reagent blanks. Quality control checks were analyzed every twelfth sample with ASW blanks and standards. The highest standard from the calibration curve was analyzed approximately every twenty samples to check for drift during the runs. Subsamples of reference material for nutrients in seawater (Konso) were measured in each run. Detection limits for each parameter were determined from three times the standard deviation of replicate lowest standards. Average limits of detection across the cruise dataset were 0.022 µM for phosphate, 0.108 µM for nitrate+nitrite, 0.107 µM for silicate, and 0.013 µM for nitrite. Values below these limits of detection are reported as 0 µM with accompanying QC Flag 6. Sample analyses for macronutrients were performed by MS student Caitlyn Parente shipboard.

Sample analyses - chlorophyll a:
Samples for chlorophyll a were placed in glass test tubes and 8 mL of 100% ethanol was added to each tube (Jespersen and Christoffersen, 1987; Wasmund et al., 2006). The tubes were capped and placed in the dark for the extraction at room temperature. After 12 hours, the fluorescence readings were subsequently measured following the standard acidification protocol (Parsons et al., 1984; Arar and Collins, 1992) using a Turner Designs model 10-AU fluorometer calibrated at the beginning of the cruise with pure chlorophyll a standards (Turner Designs; Anacystis nidulans) following standard JGOFS protocols (Knap et al., 1996).

Sample analyses – particulate organic carbon and nitrogen:
Combusted filters for POC and PON were dried in an oven at 450 ºC for 5 hours. Nitrogen and carbon isotope and bulk composition on the filters were measured by CF-EA-irms (Continuous Flow Elemental Analyzer Isotope Ratio Mass Spectrometry) at the University of South Florida College of Marine Science Marine Environmental Chemistry Laboratory using commonly accepted procedures (Werner et al 1999). Isotope compositions were measured on a ThermoFinnigan Delta+XL IRMS, are reported in per mil (‰) notation and are scaled to VPDB (d13C) and AT-Air (d15N). Secondary reference materials (NIST 8574 d13C = +37.63 ± 0.10 ‰, d15N = +47.57 ± 0.22 ‰, N = 9.52%, C = 40.81%, C:N (molar) = 5.0; NIST 8573 d13C = -26.39 ± 0.09‰, d15N = -4.52 ± 0.12‰ N = 9.52%, C = 40.81%, C:N (molar) = 5.0) were used to normalize raw measurements to the VPDB (d13C) and AT-Air (d15N) scales (Werner et al 2001, Qi et al 2003, Coplen et al 2006) and to calibrate elemental N, C and C:N. Measurement uncertainties, expressed as ±1 standard deviation of n=82 measurements of a laboratory reference material (NIST1577b d13C = -21.69 ± 0.14‰, d15N = 7.83 ± 0.16‰, %N = 9.95 ± 0.48%, %C =48.04 ± 0.71%, C:N (molar) = 5.63 ± 0.27) were ±0.11‰ for d13C ±0.20‰ for d15N, ±1.52 %RSD for N, ±1.73 %RSD for C, and ±1.94 %RSD for C:N.

Data Processing Description

Missing Data Values: Throughout the dataset, "nda" or "NDA" are used to mean "no data available" or missing information; "na" is used to mean "not applicable" to that sample.

Quality Flags: Data were flagged using the SeaDataNet quality flag scheme recommended by GEOTRACES (https://www.geotraces.org/geotraces-quality-flag-policy/) and described below. Notes specific to the application of these flags to this dataset are noted in brackets […].

0: No Quality Control: No quality control procedures have been applied to the data value. This is the initial status for all data values entering the working archive. [Not used].

1: Good Value: Good quality data value that is not part of any identified malfunction and has been verified as consistent with real phenomena during the quality control process. [Used for analyses that included replicates and/or reference samples].

2: Probably Good Value: Data value that is probably consistent with real phenomena, but this is unconfirmed or data value forming part of a malfunction that is considered too small to affect the overall quality of the data object of which it is a part. [Used when no replicates or reference samples were available to further verify the quality of the data].

3: Probably Bad Value: Data value recognized as unusual during quality control that forms part of a feature that is probably inconsistent with real phenomena. [Not used].

4: Bad Value: An obviously erroneous data value. [Not used].

5: Changed Value: Data value adjusted during quality control. Best practice strongly recommends that the value before the change be preserved in the data or its accompanying metadata. [Not used].

6: Value Below Detection Limit: The level of the measured phenomenon was less than the limit of detection (LOD) for the method employed to measure it. The accompanying value is the detection limit for the technique or zero if that value is unknown. [Values below detection are reported as 0.00 µM for macronutrients and trace metals concentrations in the data file. Detection limits for each parameter are listed in the "methods and sampling" section of the metadata. For the POC, PON, del15PON and del13POC datasets, values below limits of detection were assigned 'nda' for 'no data available'].

7: Value in Excess: The level of the measured phenomenon was too large to be quantified by the technique employed to measure it. The accompanying value is the measurement limit for the technique. [Not used].

8: Interpolated Value: This value has been derived by interpolation from other values in the data object. [Not used].

9: Missing Value: The data value is missing. Any accompanying value will be a magic number representing absent data [When sample was not collected the notation 'na' for 'not applicable' was used; when sample was collected but there is no result for this parameter, the notation 'nda' for 'no data available' was used].

A: Value Phenomenon Uncertain: There is uncertainty in the description of the measured phenomenon associated with the value such as chemical species or biological entity. [Used for POC, PON, del15PON, and del13POC values that were above limits of detection but below confidence in quantification.]

BCO-DMO Processing Description

- Imported original file "BCO-DMO_FeOA_Incubations_NutsChl-submit241106.xlsx" into the BCO-DMO system.
- Renamed fields to comply with BCO-DMO naming conventions.
- Created date-time fields in ISO 8601 format (local time zone of AKDT).
- Created date-time fields in ISO 8601 format in UTC.
- Added columns for latitude and longitude of water collection.
- Removed the following empty columns: EVTNBR, LATITUDE, LONGITUDE, DEPTH.
- Removed non-numeric characters from the BTLNBR_INC column.
- Saved the final file as "945375_v1_shipboard_incubations.csv"

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Data Files

File	
945375_v1_shipboard_incubations.csv	(Comma Separated Values (.csv), 134.31 KB) MD5:be7f6b29ea76e453bd7b6b990d38a5d8
Primary data file for dataset ID 945375, version 1	

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Related Publications

Adornato, L., Kaltenbacher, E., Byrne, R. H., Liu, X., & Sharp, J. (2016). Development of a portable carbon system sensor for ocean acidification research. OCEANS 2016 MTS/IEEE Monterey, 1–7. https://doi.org/10.1109/oceans.2016.7761163 https://doi.org/10.1109/OCEANS.2016.7761163
Methods

Arar, E. J. & Collins, G. B. (1992). In vitro determination of chlorophyll a and phaeophtin a in marine and freshwater phytoplankton by fluorescence – USEPA Method 445.0. In: USEPA methods for determination of chemical substances in marine and estuarine environmental samples. Cincinnati, OH. https://cfpub.epa.gov/si/si_public_record_report.cfm?Lab=NERL&dirEntryId=309417
Methods

Becker, S., Aoyama, M., Woodward, E. M. S., Bakker, K., Coverly, S., Mahaffey, C., & Tanhua, T. (2020). GO-SHIP Repeat Hydrography Nutrient Manual: The Precise and Accurate Determination of Dissolved Inorganic Nutrients in Seawater, Using Continuous Flow Analysis Methods. Frontiers in Marine Science, 7. https://doi.org/10.3389/fmars.2020.581790
Methods

Burns, S. M., Bundy, R. M., Abbott, W., Abdala, Z., Sterling, A. R., Chappell, P. D., Jenkins, B. D., & Buck, K. N. (2023). Interactions of bioactive trace metals in shipboard Southern Ocean incubation experiments. Limnology and Oceanography, 68(3), 525–543. Portico. https://doi.org/10.1002/lno.12290
Methods

Coplen, T. B., Brand, W. A., Gehre, M., Gröning, M., Meijer, H. A. J., Toman, B., & Verkouteren, R. M. (2006). New Guidelines for δ13C Measurements. Analytical Chemistry, 78(7), 2439–2441. https://doi.org/10.1021/ac052027c
Methods

Jespersen, A.-M., & Christoffersen, K. (1987). Measurements of chlorophyll-a from phytoplankton using ethanol as extraction solvent. Archiv Für Hydrobiologie, 109(3), 445–454. https://doi.org/10.1127/archiv-hydrobiol/109/1987/445
Methods

Knap, A. H., Michaels, A., Close, A. R., Ducklow, H., & Dickson, A. G. (1996). Protocols for the joint global ocean flux study (JGOFS) core measurements. http://hdl.handle.net/10013/epic.27912
Methods

Mellett, T., & Buck, K. N. (2020). Spatial and temporal variability of trace metals (Fe, Cu, Mn, Zn, Co, Ni, Cd, Pb), iron and copper speciation, and electroactive Fe-binding humic substances in surface waters of the eastern Gulf of Mexico. Marine Chemistry, 227: 103891. doi:10.1016/j.marchem.2020.103891
Methods

Parsons, T. R., Maita, Y., & Lalli, C.M. (1984). A manual of chemical and biological methods for seawater analysis. Pergamon Press. doi:10.1016/c2009-0-07774-5 https://doi.org/10.1016/C2009-0-07774-5
Methods

Qi, H., Coplen, T. B., Geilmann, H., Brand, W. A., & Böhlke, J. K. (2003). Two new organic reference materials for δ13C and δ15N measurements and a new value for the δ13C of NBS 22 oil. Rapid Communications in Mass Spectrometry, 17(22), 2483–2487. doi:10.1002/rcm.1219
Methods

Strickland, J. D. H. and Parsons, T. R. (1972). A Practical Hand Book of Seawater Analysis. Fisheries Research Board of Canada Bulletin 157, 2nd Edition, 310 p.
Methods

Wasmund, N., Topp, I., & Schories, D. (2006). Optimising the storage and extraction of chlorophyll samples. Oceanologia, 48(1).
Methods

Werner, R. A., & Brand, W. A. (2001). Referencing strategies and techniques in stable isotope ratio analysis. Rapid Communications in Mass Spectrometry, 15(7), 501–519. Portico. https://doi.org/10.1002/rcm.258
Methods

Werner, R. A., Bruch, B. A., & Brand, W. A. (1999). ConFlo III - an interface for high precision δ13C and δ15N analysis with an extended dynamic range. Rapid Communications in Mass Spectrometry, 13(13), 1237–1241. https://doi.org/10.1002/(sici)1097-0231(19990715)13:13<1237::aid-rcm633>3.0.co;2-c
Methods

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Parameters

Parameter	Description	Units
FeOA_NBR	Unique sample number for the FeOA cruise project	unitless

ISO_DateTime_Start_Local	Date and ship time (AKDT) when sample collection started. 'nda' for 'no data available' or missing information; 'na' for 'not applicable' to that sample	unitless
ISO_DateTime_Start_UTC	Date and ship time (UTC) when sample collection started. 'nda' for 'no data available' or missing information; 'na' for 'not applicable' to that sample	unitless
ISO_DateTime_Stop_Local	Date and ship time (AKDT) when sample collection ended. 'nda' for 'no data available' or missing information; 'na' for 'not applicable' to that sample	unitless
ISO_DateTime_Stop_UTC	Date and ship time (UTC) when sample collection ended. 'nda' for 'no data available' or missing information; 'na' for 'not applicable' to that sample	unitless
Collection_Latitude	Latitude where sample was collected	decimal degrees
Collection_Longitude	Longitude where sample was collected; negative values = West	decimal degrees
PLATFORM	Sampling system used. TMC CTD = trace metal CTD rosette. FISH = tow fish. TM PUMP = trace metal pump. INC = incubation.	unitless
STNNBR	Station number; 'na' for 'not applicable' to that sample	unitless
INCNBR	Number assigned to incubation experiment as a series	unitless
INCDAY	Day after start of incubation that sample was collected (day 0 is initiation of incubation)	unitless
INCTREATMENT	Incubation treatment. A and G: pH 8.1; B and H: pH 8.1 + Fe; C and I: pH 7.6; D and J: pH 7.6 + Fe; E and K: pH 7.1; F and L: pH 7.1 + Fe. Treatments A-F incubated in screened light, treatments G-L incubated in dark	unitless
BTLNBR_INC	Unique number assigned to incubation bottle; bottles were reused between experiments but number remained the same, allowing for follow of any bottle effects	unitless
INCLABEL	Label used to describe incubation number and day.	unitless
NUTS_ID	Unique number assigned to all polypropylene falcon tubes containing dissolved macronutrient samples.	unitless

NO3_NO2_CONC_INC	Concentrations of dissolved nitrate+nitrite in incubation samples.	Micromoles per liter (uM)
NO3_NO2_STDEV	Standard deviation of replicate nitrate+nitrite concentration measurements. If only 2 replicates, the difference about the mean was used to calculate error.	Micromoles per liter (uM)
NO3_NO2_pcnt_RSD	Percent relative standard deviation of replicate nitrate+nitrite concentration measurements. Calculated as NO3_NO2_STDEV divided by NO3_NO2 and multiplied by 100; 'na' for 'not applicable', used when value of 0 assigned to concentrations <LOD.	percent (%)
NO3_NO2_COUNT	Number of separate analyses of this sample used to compute average concentration, standard deviation, and % RSD.	unitless
NO3_NO2_FLAG	Quality flag for NO3_NO2.	unitless
PO4_CONC_INC	Concentrations of dissolved phosphate in incubation samples.	Micromoles per liter (uM)
PO4_STDEV	Standard deviation of replicate phosphate concentration measurements. If only 2 replicates, the difference about the mean was used to calculate error.	Micromoles per liter (uM)
PO4_pcnt_RSD	Percent relative standard deviation of replicate phosphate concentration measurements. Calculated as PO4_STDEV divided by PO4 and multiplied by 100; 'na' for 'not applicable', used when value of 0 assigned to concentrations <LOD.	percent (%)
PO4_COUNT	Number of separate analyses of this sample used to compute average concentration, standard deviation, and % RSD.	unitless
PO4_FLAG	6 = below limit of detection	unitless
SiO4_CONC_INC	Concentrations of dissolved silicic acid in incubation samples.	Micromoles per liter (uM)
SiO4_STDEV	Standard deviation of replicate silicate concentration measurements. If only 2 replicates, the difference about the mean was used to calculate error.	Micromoles per liter (uM)
SiO4_pcnt_RSD	Percent relative standard deviation of replicate silicate concentration measurements. Calculated as SiO4_STDEV divided by SiO4 and multiplied by 100.	percent (%)

SiO4_COUNT	Number of separate analyses of this sample used to compute average concentration, standard deviation, and % RSD.	unitless
SiO4_FLAG	Quality flag for SiO4.	unitless
NO2_CONC_INC	Concentrations of dissolved nitrite in incubation samples.	Micromoles per liter (uM)
NO2_STDEV	Standard deviation of replicate nitrate+nitrite concentration measurements. If only 2 replicates, the difference about the mean was used to calculate error.	Micromoles per liter (uM)
NO2_pcnt_RSD	Percent relative standard deviation of replicate nitrite concentration measurements. Calculated as NO2_STDEV divided by NO2 and multiplied by 100; 'na' for 'not applicable', used when value of 0 assigned to concentrations <LOD.	percent (%)
NO2_COUNT	Number of separate analyses of this sample used to compute average concentration, standard deviation, and % RSD.	unitless
NO2_FLAG	Quality flag for NO2.	unitless
CHLA_FLUOR_TP_CONC_INC	Concentrations of total chlorophyll a on GF/F filters from incubation samples.	micrograms per liter (ug/L)
CHLA_FLUOR_TP_FLAG	Quality flag for CHLA_FLUOR_TP.	unitless
PHAEO_FLUOR_TP_CONC_INC	Concentrations of total phaeophytin on GF/F filters from incubation samples.	micrograms per liter (ug/L)
PHAEO_FLUOR_TP_FLAG	Quality flag for PHAEO_FLUOR_TP.	unitless
CHLA_FLUOR_LP_CONC_INC	Concentrations of large particle chlorophyll a collected on 5 µm filters from incubation samples.	micrograms per liter (ug/L)
CHLA_FLUOR_LP_FLAG	Quality flag for CHLA_FLUOR_LP.	unitless
PHAEO_FLUOR_LP_CONC_INC	Concentrations of large particle phaeophytin on 5 µm filters from incubation samples.	micrograms per liter (ug/L)
PHAEO_FLUOR_LP_FLAG	Quality flag for PHAEO_FLUOR_LP.	unitless

PON_15_14_TP_DELTA_INC	Delta 15N to 14N in total particulate organic nitrogen collected on combusted GF/F from incubation samples	per mil (‰), AT-Air
PON_15_14_TP_DELTA_FLAG	Quality flag for PON_15_14_TP_DELTA_INC.	unitless
POC_13_12_TP_DELTA_INC	Delta 13C to 12C in total particulate organic carbon collected on combusted GF/F from incubation samples.	per mil (‰), AT-Air
POC_13_12_TP_DELTA_FLAG	Quality flag for POC_13_12_TP_DELTA_INC.	unitless
PON_TP_CONC_INC	Concentration of total particulate organic nitrogen collected on combusted GF/F from incubation samples.	milligrams per milliliter (mg/mL)
PON_TP_FLAG	Quality flag for PON_TP_CONC_INC.	unitless
POC_TP_CONC_INC	Concentration of total particulate organic carbon collected on combusted GF/F from incubation samples.	milligrams per milliliter (mg/mL)
POC_TP_FLAG	Quality flag for POC_TP_CONC_INC	unitless
POC_PON_TP_RATIO_INC	Molar ratio of total particulate organic carbon to total particulate organic nitrogen collected on combusted GF/F from incubation samples.	molar ratio
POC_PON_TP_RATIO_FLAG	Quality flag for POC_ PON_TP_RATIO_INC	unitless

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Instruments

Dataset-specific Instrument Name	Thermo Flash Elemental Analyzer
Generic Instrument Name	Elemental Analyzer
Dataset-specific Description	Thermo Delta V plus Continuous Flow Elemental Analyzer Isotope Ratio Mass Spectrometer coupled to a Thermo Flash Elemental Analyzer for POC, PON, 15N, 13C analyses of incubation samples.
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	QuAAtro39 AutoAnalyzer (SEAL Analytical)
Generic Instrument Name	Nutrient Autoanalyzer
Dataset-specific Description	QuAAtro39 AutoAnalyzer (SEAL Analytical) was used to measure macronutrient concentrations in seawater samples.
Generic Instrument Description	Nutrient Autoanalyzer is a generic term used when specific type, make and model were not specified. In general, a Nutrient Autoanalyzer is an automated flow-thru system for doing nutrient analysis (nitrate, ammonium, orthophosphate, and silicate) on seawater samples.

Dataset-specific Instrument Name	Thermo Delta V plus Continuous Flow Elemental Analyzer Isotope Ratio Mass Spectrometer
Generic Instrument Name	Thermo Fisher Scientific DELTA V Plus isotope ratio mass spectrometer
Dataset-specific Description	Thermo Delta V plus Continuous Flow Elemental Analyzer Isotope Ratio Mass Spectrometer coupled to a Thermo Flash Elemental Analyzer for POC, PON, 15N, 13C analyses of incubation samples.
Generic Instrument Description	The Thermo Scientific DELTA V Plus is an isotope ratio mass spectrometer designed to measure isotopic, elemental and molecular ratios of organic and inorganic compounds. The DELTA V Plus is an enhanced model of the DELTA V series of isotope ratio mass spectrometers, which can be upgraded from the DELTA V Advantage. The DELTA V Plus can be operated in Continuous Flow or Dual Inlet mode and can accommodate up to 10 collectors, ensuring flexibility to cover many applications. The DELTA V Plus is controlled by an automated, integrated Isodat software suite. A magnet, whose pole faces determine the free flight space for the ions, eliminates the traditional flight tube. The magnet is designed for fast mass switching which is further supported by a fast jump control between consecutive measurements of multiple gases within one run. The sample gas is introduced at ground potential, eliminating the need for insulation of the flow path, ensuring 100 percent transfer into the ion source. The amplifiers register ion beams up to 50 V. The DELTA V Plus has refined optics, enabling greater ion transmission than the DELTA V Advantage. It has a sensitivity of 800 molecules per ion (M/I) in Dual Inlet mode and 1100 M/I in Continuous Flow mode. It has a system stability of < 10 ppm and an effective magnetic detection radius of 191 nm. It has a mass range of 1 - 96 Dalton at 3 kV.

Dataset-specific Instrument Name	trace metal clean surface pump “towfish” system (Mellett and Buck, 2020)
Generic Instrument Name	towed unmanned submersible
Dataset-specific Description	Towfish: Seawater samples were collected with a custom surface sampling system, “towfish” (Mellett and Buck 2020), comprised of acid cleaned Bev-A-Line-IV tubing and an Almatec Double PTFE Diaphragm Pump.
Generic Instrument Description	A vehicle towed by rigid cable through the water column at fixed or varying depth with no propulsion and no human operator (e.g. Towfish, Scanfish, UOR, SeaSoar).

Dataset-specific Instrument Name	Turner Designs model 10-AU fluorometer
Generic Instrument Name	Turner Designs Fluorometer 10-AU
Dataset-specific Description	Turner AU10 fluorometer was used to measure chlorophyll a fluorescence.
Generic Instrument Description	The Turner Designs 10-AU Field Fluorometer is used to measure Chlorophyll fluorescence. The 10AU Fluorometer can be set up for continuous-flow monitoring or discrete sample analyses. A variety of compounds can be measured using application-specific optical filters available from the manufacturer. (read more from Turner Designs, turnerdesigns.com, Sunnyvale, CA, USA)

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Deployments

SKQ202209S

Website	https://www.bco-dmo.org/deployment/945379
Platform	R/V Sikuliaq
Start Date	2022-06-04
End Date	2022-07-01
Description	Additional information is available from R2R: https://www.rvdata.us/search/cruise/SKQ202209S

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Project Information

Collaborative Research: The Effect of Ocean Acidification on Fe Availability to Phytoplankton in Coastal and Oceanic Waters of the Eastern North Pacific (pH-Fe availability)

Coverage: North East Pacific, Ocean Station PAPA

NSF Award Abstract:
Iron is an important nutrient for algae in the ocean. Different forms of iron and their availability to algae are influenced by many factors including the acidity of seawater (or pH). This research project focuses on understanding the effects of ocean acidification (low pH) on the associations between iron and chemical substances that bind with iron in seawater. The investigators will work in coastal and oceanic waters of the Pacific Ocean. These waters are characterized by substances that have weak and strong associations with iron. Samples will be collected from coastal waters off Washington State, the northern edge of the North Pacific gyre, and Ocean Station PAPA in the northeast subarctic Pacific. Water samples will be collected to test phytoplankton responses to light, pH, forms of iron, and the composition of the substances that bind with iron. This project will support graduate and undergraduate students. The investigators will participate in a range of education and outreach activities.

This study addresses oceanic responses to rising anthropogenic CO2 and is broadly relevant to ocean biogeochemistry. The investigators will study the role of ocean acidification on iron availability in the Eastern North Pacific Ocean. The study location is characterized as a high nutrient low chlorophyll (HNLC) region of the ocean, where phytoplankton may be particularly sensitive to iron availability. The study region is also characterized by gradients in ligand composition and binding strength. This study will investigate how the

associations between iron and different ligands (organic compounds that bind with iron) are influenced by pH and how this, in turn, influences primary production and microbial community structure in the ocean. The investigators will use batch cultures, at pH 8.1 and 7.6, and under high and low light regimes, to examine the iron demand of phytoplankton. Understanding how pH influences iron and its relationship with ligands will provide important information for assessing the impacts of ocean acidification on primary production and biogeochemical processes.

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Funding

Funding Source	Award
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