Size-fractionated major, minor, & trace particle composition and concentration from Leg 2 (Hilo, HI to Papeete, French Polynesia) of the US GEOTRACES Pacific Meridional Transect (PMT) cruise (GP15, RR1815) on R/V Roger Revelle from Oct to Nov 2018

Website: https://www.bco-dmo.org/dataset/919139
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Project
» US GEOTRACES Pacific Meridional Transect (GP15) (U.S. GEOTRACES PMT)
» US GEOTRACES PMT: the geochemistry of size-fractionated suspended particles collected by in-situ filtration (PMT Size-fractionated Suspended Particles)

Program
» U.S. GEOTRACES (U.S. GEOTRACES)

Contributors	Affiliation	Role
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Abstract
Size-fractionated particles were collected by in-situ filtration on the U.S. GEOTRACES GP15 Pacific Meridional Transect (PMT), which sampled from Alaska to Tahiti along 152°W Sept-Nov 2018. The PMT expedition was divided into two legs, with cruise IDs RR1814 and RR1815. This dataset results from leg 2, RR1815; data from RR1814 are available in a separate BCO-DMO dataset. This dataset includes a suite of trace elements (e.g. iron, aluminum, zinc, manganese, cadmium, copper, cobalt, titanium, and barium), some of which are required for life, and others that act as tracers of oceanographic processes, and major biologically-produced carrier phases (e.g. particulate organic carbon and the biominerals, calcium carbonate and biogenic silica) in the size-fractionated particles collected from the US PMT section. Along with collaboration with researchers from other institutions, these data are used to assess the relative importance of particle concentration, composition, and size distribution on the cycling and removal of trace elements and their isotopes (TEIs).

Table of Contents

Coverage

Location: Full ocean water column sampling along a meridional transect at 152°W from 56°N to 20°S
Spatial Extent: **N**:17.5 **E**:-151.969 **S**:-20 **W**:-152.029
Temporal Extent: 2018-10-26 - 2018-11-23

Methods & Sampling

Sampling:

Size-fractionated particles were collected using dual-flow McLane Research in-situ pumps (WTS-LV) and 142-millimeter (mm) "mini-MULVFS" filter holders (Bishop et al., 2012; Lam et al., 2018; Lam et al., 2015a; Xiang and Lam, 2020). At most of the stations, two casts of 8 pumps each and two filter holders per pump were deployed to collect samples at 16 depths throughout the water column. At super stations, a 24-depth profile was obtained with three casts. The targeted depths of the wire-out were corrected using pressure readings from a self-recording Seabird 19plus CTD at the end of the line. One filter holder/flowpath was loaded with a Sefar polyester mesh prefilter (51 micrometers (µm) pore size, called the "Qp" filter) and paired Whatman QMA quartz fiber filters (1 µm pore size) in series ("QMA-side"). The other filter holder/flowpath was also loaded with a 51 µm prefilter (called the "Sp" filter), but it was followed by paired 0.8 µm Pall Supor800 polyethersulfone filters ("Supor-side"). A 150 µm Sefar polyester mesh was placed underneath all 51 µm prefilters and QMA filters as a support to facilitate filter handling but not analyzed. All filters and filter holders were acid-leached before use based on the recommended methods in the GEOTRACES sample and sample-handling protocols Cutter et al., 2010). QMA filters were pre-combusted at 450 degrees Celsius (°C) for 4 hours after acid leaching.

A special plate was manufactured for one of the pumps that could hold two additional mini-MULVFS filter holders that were loaded with full filter sets but not connected to plumbing. These 'dipped blank' filters included the full filter sets (51 µm prefilter on top of paired QMA or paired Supor filters) with a 0.2um Supor polyethersulfone filter on top of the 51 µm polyester prefilters to exclude all particles from the main filter set. These were processed identically to the regular filters and functioned as full process blanks A total of 49 dipped blank filters were used for blank subtraction, calculations of uncertainties, and determination of detection limits (Table 2).

In this dataset, data reported from the 51 µm prefilter are referred to with an "LPT" suffix to indicate large particulate total concentrations (>51 µm). Samples could come from the QMA side ("Qp" filter) or the Supor side ("Sp" filter) and are treated equivalently. Data reported from the main filters (QMA—1-51 µm —or Supor—0.8-51 µm) are from the top filter of the pair only, and are referred to with an "SPT" suffix to indicate the small particulate total concentrations.

Analytical Procedures:

Particulate organic carbon (POC) and particulate nitrogen (PN):
For SPT particles, a 25 mm punch of QMA filter was dried at 55°C at sea. LPT (>51 µm) particles were rinsed at sea from the Sp filter using 0.2 µm-filtered seawater onto a 25mm 0.8µm Ag filter (Sterlitech) and dried at 55°C at sea. These samples were beta counted for ^{234}Th at sea by the CafeTh lab at WHOI, then sent to the Lam lab at UCSC for POC and PN analyses. POC and PN sample processing was similar to what was described in Xiang and Lam (2020). Filter samples were dismounted from the beta mounts. Typically, a 22 mm QMA subpunch or the entire 25 mm 0.8 µm Ag filter were fumed in a desiccator with concentrated HCl and dried in the oven at 60 °C overnight, and then pelletized with 30mm tin discs from EA Consumables. Tin disc encapsulated samples were measured using a CE Instruments NC 2500 model Carbon/Nitrogen Analyzer interfaced to a ThermoFinnigan Delta Plus XP isotope ratio mass spectrometer (IRMS) at the Stable Isotope Laboratory at University of California, Santa Cruz. Isotopic results obtained from the IRMS were calibrated using reference materials Acetanilide (C8H9NO). The effect of dissolved organic carbon sorption is corrected with isotopic values of dipped blanks. The isotopic data are expressed in the standard delta notation as per mil deviations (‰) with respect to international standards of Pee Dee Belemnite (PDB) and atmospheric nitrogen. The precision of the internal standard (Pugel) analyzed along with the samples in the run is 0.07‰ for d13C and 0.14‰ for d15N.

Particulate inorganic carbon (PIC):
A UIC Carbon dioxide coulometer was used for PIC measurement. Briefly, PIC on SPT QMA punches or 1/16 LPT QMA-side prefilter was converted to CO_2 by addition of 2 N sulfuric acid. CO_2 produced is carried by a gas stream into a coulometer cell where CO_2 is quantitatively absorbed by a cathode solution, reacted to form a titratable acid and measured based on the change in current.

Biogenic silica (bSi):
A 1-hour alkaline leach with 0.2 M NaOH at 85°C was used to leach bSi for both size fractions prior to the measurement on a Lachat QuikChem 8000 Flow Injection Analyzer at UCSC. A 4-hour time-series leaching approach to correct for the contribution from lithogenic Si was applied to a subset of stations and the deepest 3-4 bare bottom samples from all stations (cf., Barão et al., 2015; DeMaster, 1981; Lam et al., 2018). Lithogenic Si was only important for some near-bottom samples, so the intercept ("t0" value) was used for the near-bottom samples; the 1-hour timepoint was used for all other samples.

Particulate trace metals (pTM):

pTM total concentrations (SPT, LPT): The digestion method of pTM is based on a refluxing method (Cullen and Sherrell, 1999; Planquette and Sherrell, 2012) with light modifications similar to the "Piranha method" in Ohnemus et al. (2014). In brief, the Supor filter was adhered to the wall by surface tension in a 15-milliliter (mL) flat-bottom screw-cap Savillex vial to avoid immersion. After 4-hours of refluxing at 110 °C with an ultrapure (ARISTAR® or Optima grade) 50% HNO3/10% HF (v/v) mixture, digestion acids were transferred into secondary vials and heated to near dryness. The residue was heated in 50% HNO3/15% H2O2 (v/v) to dryness at 110 °C. The final residue was re-dissolved with 2 mL 5% HNO3 spiked with 1 ppb In. Two certified reference materials (BCR-414 and PACS-2) were digested routinely alongside the samples to assure the quality of each digestion.

pTM leachable concentrations (SPL): A 1/16th slice of Supor filter was leached using the "Berger Leach", a weak acid leach comprising 25% Q-grade acetic acid and 0.02M reagent grade hydroxylamine hydrochloride (Berger et al. 2008). Samples are submerged in the Berger Leach solution and heated in a 95°C water bath for 10 minutes, cooled at room temperature for about 1.3 hours, and then centrifuged for 30 minutes at 4100 rpm. Total leach time should be 2 hours. The supernatant is transferred to a 15 mL Savillex vial and dried for over an hour at 110°C. The residue is redissolved and dried in concentrated HNO3 twice and brought up in 5% HNO2 spiked with 1 ppb In. Two certified reference materials (BCR-414 and PACS-2) were leached routinely alongside the samples to assure the quality of each leach.

Analysis by ICP-MS: Sample solutions were analyzed using an Element XR high-resolution ICP-MS (Thermo Scientific) at the UCSC Plasma Analytical Facility. Elemental concentrations were standardized using multi-element, external standard curves prepared from NIST atomic absorption-standards in 5% HNO_3. Instrument drift and matrix effects were corrected using the internal 1ppb In standard and monitored using a mixed element run standard. Concentrations were determined using external standard curves of mixed trace elements standards. If a parameter was measured on the ICP-MS, the isotope and resolution (LR=Low Resolution; MR=Medium Resolution) used for the concentration measurement are indicated in Table 4.

Further details on instrumentation can be found in Table 3.

Derived parameters:

Particulate organic matter (POM):

Particulate organic matter (POM) was calculated from POC by multiplying a weight ratio of 1.88 g POM/g POC (Lam et al., 2011; Lam et al., 2017; Lam et al., 2015b), determined by Nuclear Magnetic Resonance (NMR) measurements of the phytoplankton biochemical composition (Hedges et al., 2002).

POM [µg/L] = POC [µM] × 12 [µg POC/µmol POC] × 1.88 [g POM/g POC]

Calcium carbonate ($CaCO_3$):

The mass concentration of $CaCO_3$ was calculated from PIC using a constant weight ratio:

$CaCO_3$ [µg/L] = PIC [µM] × 100.08 [(µg $CaCO_3$)/µmol PIC]

Opal:

A hydrated form of silica as SiO_2•(0.4 H_2O) was assumed in order to calculate the mass concentrations of opal (Mortlock and Froelich, 1989):

Opal [µg/L] = bSi [µM] × 67.2 [µg opal/µmol bSi]

Lithogenic particles (Litho):

Aluminum (Al) is highly abundant in the crust and relatively invariant between two main lithogenic sources, upper continental crust (UCC Al = 8.04 wt%) and bulk continental crust (BCC Al = 8.41 wt%) (Taylor and McLennan, 1995), serving as an appropriate tracer for lithogenic particles. We assumed that most of particulate Al originates from lithogenic sources and use UCC Al wt% to calculate concentrations of lithogenic particles.

LITHO [µg/L] = Al [nmol/L] × 27×10^{-3} [µg/nmol] / 0.0804 [µg Al/µg UCC]

Fe and Mn (oxy)hydroxide (Fe(OH)3 & MnO2):

For the small size fraction, these were calculated from the leachable Fe and Mn concentrations using the “Berger Leach” (Berger et al., 2008). Fe oxyhydroxides are treated as $Fe(OH)_3$ (ferrihydrite approximation) and Mn oxides are as MnO_2 (birnessite approximation). We apply the formula weights of 106.9 g $Fe(OH)_3$/mol Fe and 86.9 g MnO_2/mol Mn, respectively.

$Fe(OH)_3$ [µg/L] = (leachFe [nM]) × 106.9 [(ng $Fe(OH)_3$)/nmol Fe] × [10^{-3} µg/ng]

MnO_2 [µg/L] = (leachMn [nM] × 86.9 [(ng MnO_2)/nmol Mn] × [10^{-3} µg/ng])

For the large size fraction, where Berger Leaches were not conducted, excess Fe and Mn beyond their lithogenic contributions were assumed to be Fe and Mn (oxy)hydroxide and calculated by subtracting the lithogenic Fe and Mn from the totals. The UCC Fe/Al (0.2106) and Mn/Al (0.00367) ratios were used in the lithogenic corrections. Fe oxyhydroxides are treated as $Fe(OH)_3$ (ferrihydrite approximation) and Mn oxides are as MnO_2 (birnessite approximation). We apply the formula weights of 106.9 g $Fe(OH)_3$/mol Fe and 86.9 g MnO_2/mol Mn, respectively. Negative numbers were set to 0.

$Fe(OH)_3$ [μg/L] = (Fe [nM] - (Al [nM] × 0.2106 [nmol Fe/nmol Al]))

×106.9 [(ng $Fe(OH)_3$)/nmol Fe] × [10^{-3} μg/ng]

MnO_2 [μg /L] = (Mn [nM] - (Al [nM] × 0.00367 [nmol Mn /nmol Al]))

× 86.9 [(ng MnO_2)/nmol Mn] × [10^{-3} μg/ng]

SPM (PARTICLEMASS):
Direct comparisons between gravimetric and chemical dry weight have been made in the equatorial Atlantic, and they were found to be quite similar to each other (Bishop et al., 1977). The chemical dry weight is used to estimate SPM for each size fraction in this paper, as the sum of all major particle composition, which is the sum of POM, $CaCO_3$, opal, lithogenic material (Litho), and Fe and Mn (oxyhydr)oxides.

SPM [μg/L] = POM [μg/L] + $CaCO_3$ [μg/L] + OPAL [μg/L] + LITHO [μg/L]

+ $Fe(OH)_3$ [μg/L] + MnO_2 [μg/L]

Note that the resolution of this data is dictated by the lowest resolution of the component parts.

Errors in derived parameters are calculated based on rules of error propagation.

Data Processing Description

Blank subtraction:
Dipped blanks were assessed for each analyte for spatial trends, indicating potential variation in adsorption blanks, and grouped accordingly (see Table 1). Outliers for each measurement type were excluded using Chauvenet's criterion (Glover et al., 2011). The median of the appropriately grouped db filters was then used in blank subtraction to take into account the adsorption and sample handling blanks.

No blank corrections were made to the stable isotopic composition of C (d13C) and N (d15N) for the LPT and SPT particles and are given as raw values. Note that poorly loaded filters will have great uncertainty in the isotopic compositions.

Error propagation:
For most parameters, we could not routinely run replicates, so almost all errors reported are determined from the standard deviation of dipped blank filters (Table 1), converted to concentrations using volume filtered. This assumes that the blank subtraction is the largest source of error.

Quality Flags:
The detection limit was defined as three times the standard deviation of the dipped blank filters. Values below the detection limit were flagged as QF=6 in the GTSPP convention (also adopted by SeaDataNet and recommended by the GEOTRACES programme).

Lab quality control (QC) included running standard reference materials for POC&PN (acetanilide), and for pTM (BCR414 and PACS-2; see Table 2), as well as participation in intercalibration exercises.

All data have been assigned quality flags using the GTSPP convention and interpretation:

1 = good; passed lab QC and oceanographically consistent.

2 = possibly good; oceanographically consistent, but have minor sampling/instrumental issues.

3 = possibly bad; not oceanographically consistent, or have major sampling/instrumental issues

4 = bad; failed lab QC (including all failed pumps when only small or no volume was pumped through the filter), or known issue with samples. For a measured parameter from a failed pump, if the filter sample was analyzed and a non-zero volume was recorded so that a concentration could be derived, this concentration is reported with QF=4. These

values are generally not reliable because recorded volumes for failed pumps are probably not correct. If a zero volume was recorded, then a concentration could not be derived, and the value is reported as "NaN" with QF=4. For a derived parameter from a failed pump, this QF=4 applies if any of the parameters on which it is based had a QF=4 but is not "NaN".

6 = below detection limit.

9 = data missing (including all "nd"). For a measured parameter, this QF applies to lost or missing samples that were not measured. For a derived parameter, this QF=9 applies if any of the parameters on which it is based is missing (QF=9) or is "NaN".

BCO-DMO Processing Description

- Imported original file "RR1815_allparams_DoOR_data_submit_Lam_v1.xlsx" into the BCO-DMO system.
- Added the start date and start time columns from the RR1815 event log, based on GEOTRACES event number; used event log (v4) obtained from BCO-DMO (dataset ID 776755) on 2024-01-30.
- Renamed fields/columns to comply with BCO-DMO naming conventions.
- Removed empty columns.
- Rounded depth column to 1 decimal place (only if values had more than 1 decimal place); rounded all other numeric columns to 5 decimal places.
- Saved the final file as "919139_v1_rr1815_size-fractionated_particles.csv".

Update/Correction to Table 4:
On 2025-03-06, the units of measurement for bSi were corrected to nmol/L in both the Parameters section of the metadata and in the Table 4 supplemental file. They were previously reported incorrectly as pmol/L.

[table of contents | back to top]

Data Files

File
919139_v1_rr1815_size-fractionated_particles.csv (Comma Separated Values (.csv), 259.58 KB) MD5:f55899fc42d71f2cadcd5c8c5c5aaa5c Primary data file for dataset ID 919139, version 1

[table of contents | back to top]

Supplemental Files

File	
Table1_v3.pdf	(Portable Document Format (.pdf), 92.00 KB) MD5:373aa26d628fca48e4d0f9b1f07e10ad
Supplemental file for dataset IDs 918811 and 919139. Table 1: The median and standard deviation of LPT, SPT, and SPL dipped blanks (db), expressed in amount per filter. The active filter area is 125 cm^2. The detection limit (DL) was defined as three times the standard deviation of the dipped blanks and is reported in concentration units by dividing by the average volume filtered through the appropriate filter type (Qp and QMA: 1092 L; Sp and Supor: 407L). Original file name from PI = "GP15_db_summary_v4_Table1.pdf". This file was updated on 2025-10-24.	
Table_2.pdf	(Portable Document Format (.pdf), 326.01 KB) MD5:a74c32f846c51bb75c9853f84e3dfed1
Supplemental file for dataset IDs 918811 and 919139. Table 2: Recoveries of pTM for certified reference materials (BCR-414 plankton and PACs-2 sediment).	
Table_3.pdf	(Portable Document Format (.pdf), 371.53 KB) MD5:a0dd87d4cd3ce8e33bcf4fb5cd49d5e2
Supplemental file for dataset IDs 918811 and 919139. Table 3: Instrumentation used in the sample analysis.	
Table_4_v2.pdf	(Portable Document Format (.pdf), 290.23 KB) MD5:14124b33f1d7e192e5b0ad165eeba7bb
Supplemental file for dataset IDs 918811 and 919139. Table 4: Descriptions of all measured and derived parameters. If a parameter was measured on the ICP-MS, the isotope and resolution (LR=Low Resolution; MR=Medium Resolution) used for the concentration measurement are indicated in this table. Please see the quality flags section and the parameters section of the metadata for additional information. This file was updated on 2025-03-05. The previous version had the incorrect units of measurement for bSi; the correct units are nmol/L.	

[table of contents | back to top]

Related Publications

Amaral, V. J., Lam, P. J., Marchal, O., & Kenyon, J. A. (2024). Cycling Rates of Particulate Organic Carbon Along the GEOTRACES Pacific Meridional Transect GP15. Global Biogeochemical Cycles, 38(1). Portico. https://doi.org/10.1029/2023gb007940 https://doi.org/10.1029/2023GB007940
Results

Barão, L., Vandevenne, F., Clymans, W., Frings, P., Ragueneau, O., Meire, P., ... Struyf, E. (2015). Alkaline-extractable silicon from land to ocean: A challenge for biogenic silicon determination. Limnology and Oceanography: Methods, 13(7), 329–344. doi:10.1002/lom3.10028
Methods

Berger, C. J. M., Lippiatt, S. M., Lawrence, M. G., & Bruland, K. W. (2008). Application of a chemical leach technique for estimating labile particulate aluminum, iron, and manganese in the Columbia River plume and coastal waters off Oregon and Washington. Journal of Geophysical Research, 113. doi:10.1029/2007jc004703 https://doi.org/10.1029/2007JC004703
Methods

Bishop, J. K. B., Amaral, V. J., Lam, P. J., Wood, T. J., Lee, J.-M., Laubach, A., Barnard, A., Derr, A., & Orrico, C. (2022). Transmitted Cross-Polarized Light Detection of Particulate Inorganic Carbon Concentrations and Fluxes in the Ocean Water Column: Ships to ARGO Floats. Frontiers in Remote Sensing, 3. https://doi.org/10.3389/frsen.2022.837938
Results

Bishop, J. K. B., Edmond, J. M., Ketten, D. R., Bacon, M. P., & Silker, W. B. (1977). The chemistry, biology, and vertical flux of particulate matter from the upper 400 m of the equatorial Atlantic Ocean. Deep Sea Research, 24(6), 511–548. doi:10.1016/0146-6291(77)90526-4
Methods

Bishop, J. K. B., Lam, P. J., & Wood, T. J. (2012). Getting good particles: Accurate sampling of particles by large volume in-situ filtration. Limnology and Oceanography: Methods, 10(9), 681–710. doi:10.4319/lom.2012.10.681
Methods

Chmiel, R., Lanning, N., Laubach, A., Lee, J.-M., Fitzsimmons, J., Hatta, M., Jenkins, W., Lam, P., McIlvin, M., Tagliabue, A., & Saito, M. (2022). Major processes of the dissolved cobalt cycle in the North and equatorial Pacific Ocean. Biogeosciences, 19(9), 2365–2395. https://doi.org/10.5194/bg-19-2365-2022
Results

Cullen, J. T., & Sherrell, R. M. (1999). Techniques for determination of trace metals in small samples of size-fractionated particulate matter: phytoplankton metals off central California. Marine Chemistry, 67(3-4), 233–247. doi:10.1016/s0304-4203(99)00060-2 https://doi.org/10.1016/S0304-4203(99)00060-2
Methods

Cutter, G., Andersson, P., Codispoti, L., Croot, P., François, R., Lohan, M. C., Obata, H. and Rutgers v. d. Loeff, M.

(2010). Sampling and Sample-handling Protocols for GEOTRACES Cruises, [Miscellaneous] Version 1. http://www.geotraces.org/libraries/documents/Intercalibration/Cookbook.pdf
Methods

DeMaster, D. J. (1981). The supply and accumulation of silica in the marine environment. Geochimica et Cosmochimica Acta, 45(10), 1715–1732. doi:10.1016/0016-7037(81)90006-5
Methods

Glover, D.M., Jenkins, W.J. and Doney, S.C., 2011. Modeling methods for marine science. Cambridge University Press. ISBN: 9780521867832
Methods

Hedges, J. I., Baldock, J. A., Gélinas, Y., Lee, C., Peterson, M. L., & Wakeham, S. G. (2002). The biochemical and elemental compositions of marine plankton: A NMR perspective. Marine Chemistry, 78(1), 47–63. doi:10.1016/S0304-4203(02)00009-9
Methods

Lam, P. J., Doney, S. C., & Bishop, J. K. B. (2011). The dynamic ocean biological pump: Insights from a global compilation of particulate organic carbon, CaCO3, and opal concentration profiles from the mesopelagic. Global Biogeochemical Cycles, 25(3), GB3009. doi:10.1029/2010gb003868
Methods

Lam, P. J., Lee, J.-M., Heller, M. I., Mehic, S., Xiang, Y., & Bates, N. R. (2018). Size-fractionated distributions of suspended particle concentration and major phase composition from the U.S. GEOTRACES Eastern Pacific Zonal Transect (GP16). Marine Chemistry, 201, 90–107. doi:10.1016/j.marchem.2017.08.013
Methods

Lam, P. J., Ohnemus, D. C., & Auro, M. E. (2015). Size-fractionated major particle composition and concentrations from the US GEOTRACES North Atlantic Zonal Transect. Deep Sea Research Part II: Topical Studies in Oceanography, 116, 303–320. doi:10.1016/j.dsr2.2014.11.020
Results

Lam, P.J., Xiang, Y., in press. The geochemistry of marine particles, in: Paytan, A. (Ed.), Treatise in Geochemistry, third edition. Elsevier. https://isbnsearch.org/isbn/978-0-08-098300-4
Results

Lanning, N. T., Jiang, S., Amaral, V. J., Mateos, K., Steffen, J. M., Lam, P. J., Boyle, E. A., & Fitzsimmons, J. N. (2023). Isotopes illustrate vertical transport of anthropogenic Pb by reversible scavenging within Pacific Ocean particle veils. Proceedings of the National Academy of Sciences, 120(23). https://doi.org/10.1073/pnas.2219688120
Results

Mortlock, R. A., & Froelich, P. N. (1989). A simple method for the rapid determination of biogenic opal in pelagic marine sediments. Deep Sea Research Part A. Oceanographic Research Papers, 36(9), 1415–1426. doi:10.1016/0198-0149(89)90092-7
Methods

Ohnemus, D. C., Auro, M. E., Sherrell, R. M., Lagerström, M., Morton, P. L., Twining, B. S., … Lam, P. J. (2014). Laboratory intercomparison of marine particulate digestions including Piranha: a novel chemical method for dissolution of polyethersulfone filters. Limnology and Oceanography: Methods, 12(8), 530–547. doi:10.4319/lom.2014.12.530
Methods

Planquette, H., & Sherrell, R. M. (2012). Sampling for particulate trace element determination using water sampling bottles: methodology and comparison to in situ pumps. Limnology and Oceanography: Methods, 10(5), 367–388. doi:10.4319/lom.2012.10.367
Methods

Taylor, S. R., & McLennan, S. M. (1995). The geochemical evolution of the continental crust. Reviews of Geophysics, 33(2), 241. doi:10.1029/95rg00262
Methods

Xiang, Y., & Lam, P. J. (2020). Size-Fractionated Compositions of Marine Suspended Particles in the Western Arctic Ocean: Lateral and Vertical Sources. Journal of Geophysical Research: Oceans, 125(8). doi:10.1029/2020jc016144
Methods

[table of contents | back to top]

Related Datasets

Continues

Lam, P. J., Lee, J., Amaral, V. J., Laubach, A., Carracino, N., Rojas, S., Mateos, K. (2024) **Size-fractionated major,**

minor, & trace particle composition and concentration from Leg 1 (Seattle, WA to Hilo, HI) of the US GEOTRACES Pacific Meridional Transect (PMT) cruise (GP15, RR1814) on R/V Roger Revelle from Sept to Oct 2018. Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2024-01-30 doi:10.26008/1912/bco-dmo.918811.1 [view at BCO-DMO]
Relationship Description: GP15 was made up of two cruise legs, RR1814 (Leg 1) and RR1815 (Leg 2).

[table of contents | back to top]

Parameters

Parameter	Description	Units
Station_ID	Station ID number	unitless
Event_Date_Start	Date (UTC) at start of the sampling event; values were added from the RR1815 event log	unitless
Event_Time_Start_UTC	Time (UTC) at start of the sampling event; values were added from the RR1815 event log	unitless
Event_Date_End	Date (UTC) at end of the sampling event; values were added from the RR1815 event log	unitless
Event_Time_End_UTC	Time (UTC) at end of the sampling event; values were added from the RR1815 event log	unitless
Start_Latitude	Latitude at start of sample collection (positive values = North)	decimal degrees
Start_Longitude	Longitude at start of sample collection (negative values = West)	decimal degrees
Cast_number	Cast number	unitless
Event_ID	Event number	unitless
Sample_ID	GEOTRACES sample ID number	unitless
Sample_Depth	Sample depth	meters (m)
Ag_LPT_CONC_PUMP_9wzxke	Concentration of particulate Ag from the large size fraction ("LPT" = "large particulate total")	picomoles per liter (pmol/L)
Ag_SPL_CONC_PUMP_mplsri	Small particulate leachable ("SPL") concentration of Ag determined after Berger Leach	picomoles per liter (pmol/L)
Ag_SPT_CONC_PUMP_6aqs3w	Concentration of particulate Ag from the small size fraction ("SPT" = "small particulate total")	picomoles per liter (pmol/L)

Al_LPT_CONC_PUMP_2zutj7	Concentration of particulate Al from the large size fraction ("LPT" = "large particulate total")	picomoles per liter (pmol/L)
Al_SPL_CONC_PUMP_52kuhc	Small particulate leachable ("SPL") concentration of Al determined after Berger Leach	picomoles per liter (pmol/L)
Al_SPT_CONC_PUMP_mcejsh	Concentration of particulate Al from the small size fraction ("SPT" = "small particulate total")	picomoles per liter (pmol/L)
Ba_LPT_CONC_PUMP_j5qpzs	Concentration of particulate Ba from the large size fraction ("LPT" = "large particulate total")	picomoles per liter (pmol/L)
Ba_SPL_CONC_PUMP_ggzdxd	Small particulate leachable ("SPL") concentration of Ba determined after Berger Leach	picomoles per liter (pmol/L)
Ba_SPT_CONC_PUMP_mi2bpv	Concentration of particulate Ba from the small size fraction ("SPT" = "small particulate total")	picomoles per liter (pmol/L)
bSi_LPT_CONC_PUMP_7o3veb	Concentration of biogenic silica from the large size fraction ("LPT" = "large particulate total")	nanomoles per liter (nmol/L)
bSi_SPT_CONC_PUMP_cg7jpz	Concentration of biogenic silica from the small size fraction ("SPT" = "small particulate total")	nanomoles per liter (nmol/L)
Cd_LPT_CONC_PUMP_2crfkw	Concentration of particulate Cd from the large size fraction ("LPT" = "large particulate total")	picomoles per liter (pmol/L)
Cd_SPL_CONC_PUMP_pe4jju	Small particulate leachable ("SPL") concentration of Cd determined after Berger Leach	picomoles per liter (pmol/L)
Cd_SPT_CONC_PUMP_2smbud	Concentration of particulate Cd from the small size fraction ("SPT" = "small particulate total")	picomoles per liter (pmol/L)
Co_LPT_CONC_PUMP_1lca6v	Concentration of particulate Co from the large size fraction ("LPT" = "large particulate total")	picomoles per liter (pmol/L)
Co_SPL_CONC_PUMP_jxhcbl	Small particulate leachable ("SPL") concentration of Co determined after Berger Leach	picomoles per liter (pmol/L)
Co_SPT_CONC_PUMP_clxvlz	Concentration of particulate Co from the small size fraction ("SPT" = "small particulate total")	picomoles per liter (pmol/L)
Cu_LPT_CONC_PUMP_swn1en	Concentration of particulate Cu from the large size fraction ("LPT" = "large particulate total")	picomoles per liter (pmol/L)

Cu_SPL_CONC_PUMP_95ui4c	Small particulate leachable ("SPL") concentration of Cu determined after Berger Leach	picomoles per liter (pmol/L)
Cu_SPT_CONC_PUMP_5ya9jb	Concentration of particulate Cu from the small size fraction ("SPT" = "small particulate total")	picomoles per liter (pmol/L)
Fe_LPT_CONC_PUMP_ywqshb	Concentration of particulate Fe from the large size fraction ("LPT" = "large particulate total")	picomoles per liter (pmol/L)
Fe_SPL_CONC_PUMP_4rra6y	Small particulate leachable ("SPL") concentration of Fe determined after Berger Leach	picomoles per liter (pmol/L)
Fe_SPT_CONC_PUMP_zgpllg	Concentration of particulate Fe from the small size fraction ("SPT" = "small particulate total")	picomoles per liter (pmol/L)
Mn_LPT_CONC_PUMP_n0hvvs	Concentration of particulate Mn from the large size fraction ("LPT" = "large particulate total")	picomoles per liter (pmol/L)
Mn_SPL_CONC_PUMP_k9wfuv	Small particulate leachable ("SPL") concentration of Mn determined after Berger Leach	picomoles per liter (pmol/L)
Mn_SPT_CONC_PUMP_dqcxib	Concentration of particulate Mn from the small size fraction ("SPT" = "small particulate total")	picomoles per liter (pmol/L)
Mo_LPT_CONC_PUMP_7hiexx	Concentration of particulate Mo from the large size fraction ("LPT" = "large particulate total")	picomoles per liter (pmol/L)
Mo_SPL_CONC_PUMP_e5fbqo	Small particulate leachable ("SPL") concentration of Mo determined after Berger Leach	picomoles per liter (pmol/L)
Mo_SPT_CONC_PUMP_mio6a9	Concentration of particulate Mo from the small size fraction ("SPT" = "small particulate total")	picomoles per liter (pmol/L)
N_15_14_LPT_DELTA_PUMP_ocgple	d15N of particulate N from the large size fraction ("LPT" = "large particulate total")	permil
N_15_14_SPT_DELTA_PUMP_lihnii	d15N of particulate N from the small size fraction ("SPT" = "small particulate total")	permil
N_LPT_CONC_PUMP_ngffdd	Concentration of particulate N from the large size fraction ("LPT" = "large particulate total")	micromoles per liter (umol/L)
N_SPT_CONC_PUMP_azqtvo	Concentration of particulate N from the small size fraction ("SPT" = "small particulate total")	micromoles per liter (umol/L)
Nd_LPT_CONC_PUMP_5bazh1	Concentration of particulate Nd from the large size fraction ("LPT" = "large particulate total")	picomoles per liter (pmol/L)

Nd_SPL_CONC_PUMP_6qib6c	Small particulate leachable ("SPL") concentration of Nd determined after Berger Leach	picomoles per liter (pmol/L)
Nd_SPT_CONC_PUMP_grfyr5	Concentration of particulate Nd from the small size fraction ("SPT" = "small particulate total")	picomoles per liter (pmol/L)
Ni_LPT_CONC_PUMP_ht2zen	Concentration of particulate Ni from the large size fraction ("LPT" = "large particulate total")	picomoles per liter (pmol/L)
Ni_SPL_CONC_PUMP_mjuk5w	Small particulate leachable ("SPL") concentration of Ni determined after Berger Leach	picomoles per liter (pmol/L)
Ni_SPT_CONC_PUMP_zod9vl	Concentration of particulate Ni from the small size fraction ("SPT" = "small particulate total")	picomoles per liter (pmol/L)
P_LPT_CONC_PUMP_q9l8b8	Concentration of particulate P from the large size fraction ("LPT" = "large particulate total")	picomoles per liter (pmol/L)
P_SPL_CONC_PUMP_bg4thw	Small particulate leachable ("SPL") concentration of P determined after Berger Leach	picomoles per liter (pmol/L)
P_SPT_CONC_PUMP_4iizsc	Concentration of particulate P from the small size fraction ("SPT" = "small particulate total")	picomoles per liter (pmol/L)
PARTICLEMASS_LPT_CONC_PUMP_49lcau	Concentration of suspended particulate mass from the large size fraction ("LPT" = "large particulate total")	micrograms per liter (ug/L)
PARTICLEMASS_SPT_CONC_PUMP_9aonje	Concentration of suspended particulate mass from the small size fraction ("SPT" = "small particulate total")	micrograms per liter (ug/L)
Pb_LPT_CONC_PUMP_p1cxtq	Concentration of particulate Pb from the large size fraction ("LPT" = "large particulate total")	picomoles per liter (pmol/L)
Pb_SPL_CONC_PUMP_bym2rx	Small particulate leachable ("SPL") concentration of Pb determined after Berger Leach	picomoles per liter (pmol/L)
Pb_SPT_CONC_PUMP_wv969j	Concentration of particulate Pb from the small size fraction ("SPT" = "small particulate total")	picomoles per liter (pmol/L)
PIC_LPT_CONC_PUMP_hffs8s	Concentration of particulate inorganic carbon from the large size fraction ("LPT" = "large particulate total")	nanomoles per liter (nmol/L)
PIC_SPT_CONC_PUMP_easlzh	Concentration of particulate inorganic carbon from the small size fraction ("SPT" = "small particulate total")	nanomoles per liter (nmol/L)

POC_13_12_LPT_DELTA_PUMP_os7wxq	d13C of particulate organic carbon from the large size fraction ("LPT" = "large particulate total")	permil
POC_13_12_SPT_DELTA_PUMP_eqzact	d13C of particulate organic carbon from the small size fraction ("SPT" = "small particulate total")	permil
POC_LPT_CONC_PUMP_pp7tiq	Concentration of particulate organic carbon from the large size fraction ("LPT" = "large particulate total")	micromoles per liter (umol/L)
POC_SPT_CONC_PUMP_0octny	Concentration of particulate organic carbon from the small size fraction ("SPT" = "small particulate total")	micromoles per liter (umol/L)
Sc_LPT_CONC_PUMP_btme9l	Concentration of particulate Sc from the large size fraction ("LPT" = "large particulate total")	picomoles per liter (pmol/L)
Sc_SPL_CONC_PUMP_cqbuow	Small particulate leachable ("SPL") concentration of Sc determined after Berger Leach	picomoles per liter (pmol/L)
Sc_SPT_CONC_PUMP_m4j4ua	Concentration of particulate Sc from the small size fraction ("SPT" = "small particulate total")	picomoles per liter (pmol/L)
Th_LPT_CONC_PUMP_ghyvh1	Concentration of particulate Th from the large size fraction ("LPT" = "large particulate total")	picomoles per liter (pmol/L)
Th_SPL_CONC_PUMP_1ihnrn	Small particulate leachable ("SPL") concentration of Th determined after Berger Leach	picomoles per liter (pmol/L)
Th_SPT_CONC_PUMP_eq7rsp	Concentration of particulate Th from the small size fraction ("SPT" = "small particulate total")	picomoles per liter (pmol/L)
Ti_LPT_CONC_PUMP_srcvhe	Concentration of particulate Ti from the large size fraction ("LPT" = "large particulate total")	picomoles per liter (pmol/L)
Ti_SPL_CONC_PUMP_kl9tvc	Small particulate leachable ("SPL") concentration of Ti determined after Berger Leach	picomoles per liter (pmol/L)
Ti_SPT_CONC_PUMP_sgsclv	Concentration of particulate Ti from the small size fraction ("SPT" = "small particulate total")	picomoles per liter (pmol/L)
V_LPT_CONC_PUMP_vc0ilo	Concentration of particulate V from the large size fraction ("LPT" = "large particulate total")	picomoles per liter (pmol/L)
V_SPL_CONC_PUMP_yyfpss	Small particulate leachable ("SPL") concentration of V determined after Berger Leach	picomoles per liter (pmol/L)

V_SPT_CONC_PUMP_mv3tmv	Concentration of particulate V from the small size fraction ("SPT" = "small particulate total")	picomoles per liter (pmol/L)
Zn_LPT_CONC_PUMP_xhk90n	Concentration of particulate Zn from the large size fraction ("LPT" = "large particulate total")	picomoles per liter (pmol/L)
Zn_SPL_CONC_PUMP_rteqyt	Small particulate leachable ("SPL") concentration of Zn determined after Berger Leach	picomoles per liter (pmol/L)
Zn_SPT_CONC_PUMP_jxeygg	Concentration of particulate Zn from the small size fraction ("SPT" = "small particulate total")	picomoles per liter (pmol/L)
SD1_Ag_LPT_CONC_PUMP_9wzxke	Error estimate (one standard deviation) for Ag_LPT_CONC_PUMP_9wzxke	picomoles per liter (pmol/L)
SD1_Ag_SPL_CONC_PUMP_mplsri	Error estimate (one standard deviation) for Ag_SPL_CONC_PUMP_mplsri	picomoles per liter (pmol/L)
SD1_Ag_SPT_CONC_PUMP_6aqs3w	Error estimate (one standard deviation) for Ag_SPT_CONC_PUMP_6aqs3w	picomoles per liter (pmol/L)
SD1_Al_LPT_CONC_PUMP_2zutj7	Error estimate (one standard deviation) for Al_LPT_CONC_PUMP_2zutj7	picomoles per liter (pmol/L)
SD1_Al_SPL_CONC_PUMP_52kuhc	Error estimate (one standard deviation) for Al_SPL_CONC_PUMP_52kuhc	picomoles per liter (pmol/L)
SD1_Al_SPT_CONC_PUMP_mcejsh	Error estimate (one standard deviation) for Al_SPT_CONC_PUMP_mcejsh	picomoles per liter (pmol/L)
SD1_Ba_LPT_CONC_PUMP_j5qpzs	Error estimate (one standard deviation) for Ba_LPT_CONC_PUMP_j5qpzs	picomoles per liter (pmol/L)
SD1_Ba_SPL_CONC_PUMP_ggzdxd	Error estimate (one standard deviation) for Ba_SPL_CONC_PUMP_ggzdxd	picomoles per liter (pmol/L)
SD1_Ba_SPT_CONC_PUMP_mi2bpv	Error estimate (one standard deviation) for Ba_SPT_CONC_PUMP_mi2bpv	picomoles per liter (pmol/L)
SD1_bSi_LPT_CONC_PUMP_7o3veb	Error estimate (one standard deviation) for bSi_LPT_CONC_PUMP_7o3veb	nanomoles per liter (nmol/L)
SD1_bSi_SPT_CONC_PUMP_cg7jpz	Error estimate (one standard deviation) for bSi_SPT_CONC_PUMP_cg7jpz	nanomoles per liter (nmol/L)
SD1_Cd_LPT_CONC_PUMP_2crfkw	Error estimate (one standard deviation) for Cd_LPT_CONC_PUMP_2crfkw	picomoles per liter (pmol/L)

SD1_Cd_SPL_CONC_PUMP_pe4jju	Error estimate (one standard deviation) for Cd_SPL_CONC_PUMP_pe4jju	picomoles per liter (pmol/L)
SD1_Cd_SPT_CONC_PUMP_2smbud	Error estimate (one standard deviation) for Cd_SPT_CONC_PUMP_2smbud	picomoles per liter (pmol/L)
SD1_Co_LPT_CONC_PUMP_1lca6v	Error estimate (one standard deviation) for Co_LPT_CONC_PUMP_1lca6v	picomoles per liter (pmol/L)
SD1_Co_SPL_CONC_PUMP_jxhcbl	Error estimate (one standard deviation) for Co_SPL_CONC_PUMP_jxhcbl	picomoles per liter (pmol/L)
SD1_Co_SPT_CONC_PUMP_clxvlz	Error estimate (one standard deviation) for Co_SPT_CONC_PUMP_clxvlz	picomoles per liter (pmol/L)
SD1_Cu_LPT_CONC_PUMP_swn1en	Error estimate (one standard deviation) for Cu_LPT_CONC_PUMP_swn1en	picomoles per liter (pmol/L)
SD1_Cu_SPL_CONC_PUMP_95ui4c	Error estimate (one standard deviation) for Cu_SPL_CONC_PUMP_95ui4c	picomoles per liter (pmol/L)
SD1_Cu_SPT_CONC_PUMP_5ya9jb	Error estimate (one standard deviation) for Cu_SPT_CONC_PUMP_5ya9jb	picomoles per liter (pmol/L)
SD1_Fe_LPT_CONC_PUMP_ywqshb	Error estimate (one standard deviation) for Fe_LPT_CONC_PUMP_ywqshb	picomoles per liter (pmol/L)
SD1_Fe_SPL_CONC_PUMP_4rra6y	Error estimate (one standard deviation) for Fe_SPL_CONC_PUMP_4rra6y	picomoles per liter (pmol/L)
SD1_Fe_SPT_CONC_PUMP_zgpllg	Error estimate (one standard deviation) for Fe_SPT_CONC_PUMP_zgpllg	picomoles per liter (pmol/L)
SD1_Mn_LPT_CONC_PUMP_n0hvvs	Error estimate (one standard deviation) for Mn_LPT_CONC_PUMP_n0hvvs	picomoles per liter (pmol/L)
SD1_Mn_SPL_CONC_PUMP_k9wfuv	Error estimate (one standard deviation) for Mn_SPL_CONC_PUMP_k9wfuv	picomoles per liter (pmol/L)
SD1_Mn_SPT_CONC_PUMP_dqcxib	Error estimate (one standard deviation) for Mn_SPT_CONC_PUMP_dqcxib	picomoles per liter (pmol/L)
SD1_Mo_LPT_CONC_PUMP_7hiexx	Error estimate (one standard deviation) for Mo_LPT_CONC_PUMP_7hiexx	picomoles per liter (pmol/L)
SD1_Mo_SPL_CONC_PUMP_e5fbqo	Error estimate (one standard deviation) for Mo_SPL_CONC_PUMP_e5fbqo	picomoles per liter (pmol/L)

SD1_Mo_SPT_CONC_PUMP_mio6a9	Error estimate (one standard deviation) for Mo_SPT_CONC_PUMP_mio6a9	picomoles per liter (pmol/L)
SD1_N_15_14_LPT_DELTA_PUMP_ocgple	Error estimate (one standard deviation) for N_15_14_LPT_DELTA_PUMP_ocgple	permil
SD1_N_15_14_SPT_DELTA_PUMP_lihnii	Error estimate (one standard deviation) for N_15_14_SPT_DELTA_PUMP_lihnii	permil
SD1_N_LPT_CONC_PUMP_ngffdd	Error estimate (one standard deviation) for N_LPT_CONC_PUMP_ngffdd	micromoles per liter (umol/L)
SD1_N_SPT_CONC_PUMP_azqtvo	Error estimate (one standard deviation) for N_SPT_CONC_PUMP_azqtvo	micromoles per liter (umol/L)
SD1_Nd_LPT_CONC_PUMP_5bazh1	Error estimate (one standard deviation) for Nd_LPT_CONC_PUMP_5bazh1	picomoles per liter (pmol/L)
SD1_Nd_SPL_CONC_PUMP_6qib6c	Error estimate (one standard deviation) for Nd_SPL_CONC_PUMP_6qib6c	picomoles per liter (pmol/L)
SD1_Nd_SPT_CONC_PUMP_grfyr5	Error estimate (one standard deviation) for Nd_SPT_CONC_PUMP_grfyr5	picomoles per liter (pmol/L)
SD1_Ni_LPT_CONC_PUMP_ht2zen	Error estimate (one standard deviation) for Ni_LPT_CONC_PUMP_ht2zen	picomoles per liter (pmol/L)
SD1_Ni_SPL_CONC_PUMP_mjuk5w	Error estimate (one standard deviation) for Ni_SPL_CONC_PUMP_mjuk5w	picomoles per liter (pmol/L)
SD1_Ni_SPT_CONC_PUMP_zod9vl	Error estimate (one standard deviation) for Ni_SPT_CONC_PUMP_zod9vl	picomoles per liter (pmol/L)
SD1_P_LPT_CONC_PUMP_q9l8b8	Error estimate (one standard deviation) for P_LPT_CONC_PUMP_q9l8b8	picomoles per liter (pmol/L)
SD1_P_SPL_CONC_PUMP_bg4thw	Error estimate (one standard deviation) for P_SPL_CONC_PUMP_bg4thw	picomoles per liter (pmol/L)
SD1_P_SPT_CONC_PUMP_4iizsc	Error estimate (one standard deviation) for P_SPT_CONC_PUMP_4iizsc	picomoles per liter (pmol/L)
SD1_PARTICLEMASS_LPT_CONC_PUMP_49lcau	Error estimate (one standard deviation) for PARTICLEMASS_LPT_CONC_PUMP_49lcau	micrograms per liter (ug/L)
SD1_PARTICLEMASS_SPT_CONC_PUMP_9aonje	Error estimate (one standard deviation) for PARTICLEMASS_SPT_CONC_PUMP_9aonje	micrograms per liter (ug/L)

SD1_Pb_LPT_CONC_PUMP_p1cxtq	Error estimate (one standard deviation) for Pb_LPT_CONC_PUMP_p1cxtq	picomoles per liter (pmol/L)
SD1_Pb_SPL_CONC_PUMP_bym2rx	Error estimate (one standard deviation) for Pb_SPL_CONC_PUMP_bym2rx	picomoles per liter (pmol/L)
SD1_Pb_SPT_CONC_PUMP_wv969j	Error estimate (one standard deviation) for Pb_SPT_CONC_PUMP_wv969j	picomoles per liter (pmol/L)
SD1_PIC_LPT_CONC_PUMP_hffs8s	Error estimate (one standard deviation) for PIC_LPT_CONC_PUMP_hffs8s	nanomoles per liter (nmol/L)
SD1_PIC_SPT_CONC_PUMP_easlzh	Error estimate (one standard deviation) for PIC_SPT_CONC_PUMP_easlzh	nanomoles per liter (nmol/L)
SD1_POC_13_12_LPT_DELTA_PUMP_os7wxq	Error estimate (one standard deviation) for POC_13_12_LPT_DELTA_PUMP_os7wxq	permil
SD1_POC_13_12_SPT_DELTA_PUMP_eqzact	Error estimate (one standard deviation) for POC_13_12_SPT_DELTA_PUMP_eqzact	permil
SD1_POC_LPT_CONC_PUMP_pp7tiq	Error estimate (one standard deviation) for POC_LPT_CONC_PUMP_pp7tiq	micromoles per liter (umol/L)
SD1_POC_SPT_CONC_PUMP_0octny	Error estimate (one standard deviation) for POC_SPT_CONC_PUMP_0octny	micromoles per liter (umol/L)
SD1_Sc_LPT_CONC_PUMP_btme9l	Error estimate (one standard deviation) for Sc_LPT_CONC_PUMP_btme9l	picomoles per liter (pmol/L)
SD1_Sc_SPL_CONC_PUMP_cqbuow	Error estimate (one standard deviation) for Sc_SPL_CONC_PUMP_cqbuow	picomoles per liter (pmol/L)
SD1_Sc_SPT_CONC_PUMP_m4j4ua	Error estimate (one standard deviation) for Sc_SPT_CONC_PUMP_m4j4ua	picomoles per liter (pmol/L)
SD1_Th_LPT_CONC_PUMP_ghyvh1	Error estimate (one standard deviation) for Th_LPT_CONC_PUMP_ghyvh1	picomoles per liter (pmol/L)
SD1_Th_SPL_CONC_PUMP_1ihnrn	Error estimate (one standard deviation) for Th_SPL_CONC_PUMP_1ihnrn	picomoles per liter (pmol/L)
SD1_Th_SPT_CONC_PUMP_eq7rsp	Error estimate (one standard deviation) for Th_SPT_CONC_PUMP_eq7rsp	picomoles per liter (pmol/L)

SD1_Ti_LPT_CONC_PUMP_srcvhe	Error estimate (one standard deviation) for Ti_LPT_CONC_PUMP_srcvhe	picomoles per liter (pmol/L)
SD1_Ti_SPL_CONC_PUMP_kl9tvc	Error estimate (one standard deviation) for Ti_SPL_CONC_PUMP_kl9tvc	picomoles per liter (pmol/L)
SD1_Ti_SPT_CONC_PUMP_sgsclv	Error estimate (one standard deviation) for Ti_SPT_CONC_PUMP_sgsclv	picomoles per liter (pmol/L)
SD1_V_LPT_CONC_PUMP_vc0ilo	Error estimate (one standard deviation) for V_LPT_CONC_PUMP_vc0ilo	picomoles per liter (pmol/L)
SD1_V_SPL_CONC_PUMP_yyfpss	Error estimate (one standard deviation) for V_SPL_CONC_PUMP_yyfpss	picomoles per liter (pmol/L)
SD1_V_SPT_CONC_PUMP_mv3tmv	Error estimate (one standard deviation) for V_SPT_CONC_PUMP_mv3tmv	picomoles per liter (pmol/L)
SD1_Zn_LPT_CONC_PUMP_xhk90n	Error estimate (one standard deviation) for Zn_LPT_CONC_PUMP_xhk90n	picomoles per liter (pmol/L)
SD1_Zn_SPL_CONC_PUMP_rteqyt	Error estimate (one standard deviation) for Zn_SPL_CONC_PUMP_rteqyt	picomoles per liter (pmol/L)
SD1_Zn_SPT_CONC_PUMP_jxeygg	Error estimate (one standard deviation) for Zn_SPT_CONC_PUMP_jxeygg	picomoles per liter (pmol/L)
Flag_Ag_LPT_CONC_PUMP_9wzxke	Quality flag for Ag_LPT_CONC_PUMP_9wzxke; flags were assigned following the GEOTRACES quality flag policy (see 'Data Processing Description' for definitions)	unitless
Flag_Ag_SPL_CONC_PUMP_mplsri	Quality flag for Ag_SPL_CONC_PUMP_mplsri; flags were assigned following the GEOTRACES quality flag policy (see 'Data Processing Description' for definitions)	unitless
Flag_Ag_SPT_CONC_PUMP_6aqs3w	Quality flag for Ag_SPT_CONC_PUMP_6aqs3w; flags were assigned following the GEOTRACES quality flag policy (see 'Data Processing Description' for definitions)	unitless
Flag_Al_LPT_CONC_PUMP_2zutj7	Quality flag for Al_LPT_CONC_PUMP_2zutj7; flags were assigned following the GEOTRACES quality flag policy (see 'Data Processing Description' for definitions)	unitless
Flag_Al_SPL_CONC_PUMP_52kuhc	Quality flag for Al_SPL_CONC_PUMP_52kuhc; flags were assigned following the GEOTRACES quality flag policy (see 'Data Processing Description' for definitions)	unitless

Flag_Al_SPT_CONC_PUMP_mcejsh	Quality flag for Al_SPT_CONC_PUMP_mcejsh; flags were assigned following the GEOTRACES quality flag policy (see 'Data Processing Description' for definitions)	unitless
Flag_Ba_LPT_CONC_PUMP_j5qpzs	Quality flag for Ba_LPT_CONC_PUMP_j5qpzs; flags were assigned following the GEOTRACES quality flag policy (see 'Data Processing Description' for definitions)	unitless
Flag_Ba_SPL_CONC_PUMP_ggzdxd	Quality flag for Ba_SPL_CONC_PUMP_ggzdxd; flags were assigned following the GEOTRACES quality flag policy (see 'Data Processing Description' for definitions)	unitless
Flag_Ba_SPT_CONC_PUMP_mi2bpv	Quality flag for Ba_SPT_CONC_PUMP_mi2bpv; flags were assigned following the GEOTRACES quality flag policy (see 'Data Processing Description' for definitions)	unitless
Flag_bSi_LPT_CONC_PUMP_7o3veb	Quality flag for bSi_LPT_CONC_PUMP_7o3veb; flags were assigned following the GEOTRACES quality flag policy (see 'Data Processing Description' for definitions)	unitless
Flag_bSi_SPT_CONC_PUMP_cg7jpz	Quality flag for bSi_SPT_CONC_PUMP_cg7jpz; flags were assigned following the GEOTRACES quality flag policy (see 'Data Processing Description' for definitions)	unitless
Flag_Cd_LPT_CONC_PUMP_2crfkw	Quality flag for Cd_LPT_CONC_PUMP_2crfkw; flags were assigned following the GEOTRACES quality flag policy (see 'Data Processing Description' for definitions)	unitless
Flag_Cd_SPL_CONC_PUMP_pe4jju	Quality flag for Cd_SPL_CONC_PUMP_pe4jju; flags were assigned following the GEOTRACES quality flag policy (see 'Data Processing Description' for definitions)	unitless
Flag_Cd_SPT_CONC_PUMP_2smbud	Quality flag for Cd_SPT_CONC_PUMP_2smbud; flags were assigned following the GEOTRACES quality flag policy (see 'Data Processing Description' for definitions)	unitless
Flag_Co_LPT_CONC_PUMP_1lca6v	Quality flag for Co_LPT_CONC_PUMP_1lca6v; flags were assigned following the GEOTRACES quality flag policy (see 'Data Processing Description' for definitions)	unitless
Flag_Co_SPL_CONC_PUMP_jxhcbl	Quality flag for Co_SPL_CONC_PUMP_jxhcbl; flags were assigned following the GEOTRACES quality flag policy (see 'Data Processing Description' for definitions)	unitless
Flag_Co_SPT_CONC_PUMP_clxvlz	Quality flag for Co_SPT_CONC_PUMP_clxvlz; flags were assigned following the GEOTRACES quality flag policy (see 'Data Processing Description' for definitions)	unitless

Flag_Cu_LPT_CONC_PUMP_swn1en	Quality flag for Cu_LPT_CONC_PUMP_swn1en; flags were assigned following the GEOTRACES quality flag policy (see 'Data Processing Description' for definitions)	unitless
Flag_Cu_SPL_CONC_PUMP_95ui4c	Quality flag for Cu_SPL_CONC_PUMP_95ui4c; flags were assigned following the GEOTRACES quality flag policy (see 'Data Processing Description' for definitions)	unitless
Flag_Cu_SPT_CONC_PUMP_5ya9jb	Quality flag for Cu_SPT_CONC_PUMP_5ya9jb; flags were assigned following the GEOTRACES quality flag policy (see 'Data Processing Description' for definitions)	unitless
Flag_Fe_LPT_CONC_PUMP_ywqshb	Quality flag for Fe_LPT_CONC_PUMP_ywqshb; flags were assigned following the GEOTRACES quality flag policy (see 'Data Processing Description' for definitions)	unitless
Flag_Fe_SPL_CONC_PUMP_4rra6y	Quality flag for Fe_SPL_CONC_PUMP_4rra6y; flags were assigned following the GEOTRACES quality flag policy (see 'Data Processing Description' for definitions)	unitless
Flag_Fe_SPT_CONC_PUMP_zgpllg	Quality flag for Fe_SPT_CONC_PUMP_zgpllg; flags were assigned following the GEOTRACES quality flag policy (see 'Data Processing Description' for definitions)	unitless
Flag_Mn_LPT_CONC_PUMP_n0hvvs	Quality flag for Mn_LPT_CONC_PUMP_n0hvvs; flags were assigned following the GEOTRACES quality flag policy (see 'Data Processing Description' for definitions)	unitless
Flag_Mn_SPL_CONC_PUMP_k9wfuv	Quality flag for Mn_SPL_CONC_PUMP_k9wfuv; flags were assigned following the GEOTRACES quality flag policy (see 'Data Processing Description' for definitions)	unitless
Flag_Mn_SPT_CONC_PUMP_dqcxib	Quality flag for Mn_SPT_CONC_PUMP_dqcxib; flags were assigned following the GEOTRACES quality flag policy (see 'Data Processing Description' for definitions)	unitless
Flag_Mo_LPT_CONC_PUMP_7hiexx	Quality flag for Mo_LPT_CONC_PUMP_7hiexx; flags were assigned following the GEOTRACES quality flag policy (see 'Data Processing Description' for definitions)	unitless
Flag_Mo_SPL_CONC_PUMP_e5fbqo	Quality flag for Mo_SPL_CONC_PUMP_e5fbqo; flags were assigned following the GEOTRACES quality flag policy (see 'Data Processing Description' for definitions)	unitless
Flag_Mo_SPT_CONC_PUMP_mio6a9	Quality flag for Mo_SPT_CONC_PUMP_mio6a9; flags were assigned following the GEOTRACES quality flag policy (see 'Data Processing Description' for definitions)	unitless

Flag_N_15_14_LPT_DELTA_PUMP_ocgple	Quality flag for N_15_14_LPT_DELTA_PUMP_ocgple; flags were assigned following the GEOTRACES quality flag policy (see 'Data Processing Description' for definitions)	unitless
Flag_N_15_14_SPT_DELTA_PUMP_lihnii	Quality flag for N_15_14_SPT_DELTA_PUMP_lihnii; flags were assigned following the GEOTRACES quality flag policy (see 'Data Processing Description' for definitions)	unitless
Flag_N_LPT_CONC_PUMP_ngffdd	Quality flag for N_LPT_CONC_PUMP_ngffdd; flags were assigned following the GEOTRACES quality flag policy (see 'Data Processing Description' for definitions)	unitless
Flag_N_SPT_CONC_PUMP_azqtvo	Quality flag for N_SPT_CONC_PUMP_azqtvo; flags were assigned following the GEOTRACES quality flag policy (see 'Data Processing Description' for definitions)	unitless
Flag_Nd_LPT_CONC_PUMP_5bazh1	Quality flag for Nd_LPT_CONC_PUMP_5bazh1; flags were assigned following the GEOTRACES quality flag policy (see 'Data Processing Description' for definitions)	unitless
Flag_Nd_SPL_CONC_PUMP_6qib6c	Quality flag for Nd_SPL_CONC_PUMP_6qib6c; flags were assigned following the GEOTRACES quality flag policy (see 'Data Processing Description' for definitions)	unitless
Flag_Nd_SPT_CONC_PUMP_grfyr5	Quality flag for Nd_SPT_CONC_PUMP_grfyr5; flags were assigned following the GEOTRACES quality flag policy (see 'Data Processing Description' for definitions)	unitless
Flag_Ni_LPT_CONC_PUMP_ht2zen	Quality flag for Ni_LPT_CONC_PUMP_ht2zen; flags were assigned following the GEOTRACES quality flag policy (see 'Data Processing Description' for definitions)	unitless
Flag_Ni_SPL_CONC_PUMP_mjuk5w	Quality flag for Ni_SPL_CONC_PUMP_mjuk5w; flags were assigned following the GEOTRACES quality flag policy (see 'Data Processing Description' for definitions)	unitless
Flag_Ni_SPT_CONC_PUMP_zod9vl	Quality flag for Ni_SPT_CONC_PUMP_zod9vl; flags were assigned following the GEOTRACES quality flag policy (see 'Data Processing Description' for definitions)	unitless
Flag_P_LPT_CONC_PUMP_q9l8b8	Quality flag for P_LPT_CONC_PUMP_q9l8b8; flags were assigned following the GEOTRACES quality flag policy (see 'Data Processing Description' for definitions)	unitless
Flag_P_SPL_CONC_PUMP_bg4thw	Quality flag for P_SPL_CONC_PUMP_bg4thw; flags were assigned following the GEOTRACES quality flag policy (see 'Data Processing Description' for definitions)	unitless

Flag_P_SPT_CONC_PUMP_4iizsc	Quality flag for P_SPT_CONC_PUMP_4iizsc; flags were assigned following the GEOTRACES quality flag policy (see 'Data Processing Description' for definitions)	unitless
Flag_PARTICLEMASS_LPT_CONC_PUMP_49lcau	Quality flag for PARTICLEMASS_LPT_CONC_PUMP_49lcau; flags were assigned following the GEOTRACES quality flag policy (see 'Data Processing Description' for definitions)	unitless
Flag_PARTICLEMASS_SPT_CONC_PUMP_9aonje	Quality flag for PARTICLEMASS_SPT_CONC_PUMP_9aonje; flags were assigned following the GEOTRACES quality flag policy (see 'Data Processing Description' for definitions)	unitless
Flag_Pb_LPT_CONC_PUMP_p1cxtq	Quality flag for Pb_LPT_CONC_PUMP_p1cxtq; flags were assigned following the GEOTRACES quality flag policy (see 'Data Processing Description' for definitions)	unitless
Flag_Pb_SPL_CONC_PUMP_bym2rx	Quality flag for Pb_SPL_CONC_PUMP_bym2rx; flags were assigned following the GEOTRACES quality flag policy (see 'Data Processing Description' for definitions)	unitless
Flag_Pb_SPT_CONC_PUMP_wv969j	Quality flag for Pb_SPT_CONC_PUMP_wv969j; flags were assigned following the GEOTRACES quality flag policy (see 'Data Processing Description' for definitions)	unitless
Flag_PIC_LPT_CONC_PUMP_hffs8s	Quality flag for PIC_LPT_CONC_PUMP_hffs8s; flags were assigned following the GEOTRACES quality flag policy (see 'Data Processing Description' for definitions)	unitless
Flag_PIC_SPT_CONC_PUMP_easlzh	Quality flag for PIC_SPT_CONC_PUMP_easlzh; flags were assigned following the GEOTRACES quality flag policy (see 'Data Processing Description' for definitions)	unitless
Flag_POC_13_12_LPT_DELTA_PUMP_os7wxq	Quality flag for POC_13_12_LPT_DELTA_PUMP_os7wxq; flags were assigned following the GEOTRACES quality flag policy (see 'Data Processing Description' for definitions)	unitless
Flag_POC_13_12_SPT_DELTA_PUMP_eqzact	Quality flag for POC_13_12_SPT_DELTA_PUMP_eqzact; flags were assigned following the GEOTRACES quality flag policy (see 'Data Processing Description' for definitions)	unitless
Flag_POC_LPT_CONC_PUMP_pp7tiq	Quality flag for POC_LPT_CONC_PUMP_pp7tiq; flags were assigned following the GEOTRACES quality flag policy (see 'Data Processing Description' for definitions)	unitless
Flag_POC_SPT_CONC_PUMP_0octny	Quality flag for POC_SPT_CONC_PUMP_0octny; flags were assigned following the GEOTRACES quality flag policy (see 'Data Processing Description' for definitions)	unitless

Flag_Sc_LPT_CONC_PUMP_btme9l	Quality flag for Sc_LPT_CONC_PUMP_btme9l; flags were assigned following the GEOTRACES quality flag policy (see 'Data Processing Description' for definitions)	unitless
Flag_Sc_SPL_CONC_PUMP_cqbuow	Quality flag for Sc_SPL_CONC_PUMP_cqbuow; flags were assigned following the GEOTRACES quality flag policy (see 'Data Processing Description' for definitions)	unitless
Flag_Sc_SPT_CONC_PUMP_m4j4ua	Quality flag for Sc_SPT_CONC_PUMP_m4j4ua; flags were assigned following the GEOTRACES quality flag policy (see 'Data Processing Description' for definitions)	unitless
Flag_Th_LPT_CONC_PUMP_ghyvh1	Quality flag for Th_LPT_CONC_PUMP_ghyvh1; flags were assigned following the GEOTRACES quality flag policy (see 'Data Processing Description' for definitions)	unitless
Flag_Th_SPL_CONC_PUMP_1ihnrn	Quality flag for Th_SPL_CONC_PUMP_1ihnrn; flags were assigned following the GEOTRACES quality flag policy (see 'Data Processing Description' for definitions)	unitless
Flag_Th_SPT_CONC_PUMP_eq7rsp	Quality flag for Th_SPT_CONC_PUMP_eq7rsp; flags were assigned following the GEOTRACES quality flag policy (see 'Data Processing Description' for definitions)	unitless
Flag_Ti_LPT_CONC_PUMP_srcvhe	Quality flag for Ti_LPT_CONC_PUMP_srcvhe; flags were assigned following the GEOTRACES quality flag policy (see 'Data Processing Description' for definitions)	unitless
Flag_Ti_SPL_CONC_PUMP_kl9tvc	Quality flag for Ti_SPL_CONC_PUMP_kl9tvc; flags were assigned following the GEOTRACES quality flag policy (see 'Data Processing Description' for definitions)	unitless
Flag_Ti_SPT_CONC_PUMP_sgsclv	Quality flag for Ti_SPT_CONC_PUMP_sgsclv; flags were assigned following the GEOTRACES quality flag policy (see 'Data Processing Description' for definitions)	unitless
Flag_V_LPT_CONC_PUMP_vc0ilo	Quality flag for V_LPT_CONC_PUMP_vc0ilo; flags were assigned following the GEOTRACES quality flag policy (see 'Data Processing Description' for definitions)	unitless
Flag_V_SPL_CONC_PUMP_yyfpss	Quality flag for V_SPL_CONC_PUMP_yyfpss; flags were assigned following the GEOTRACES quality flag policy (see 'Data Processing Description' for definitions)	unitless
Flag_V_SPT_CONC_PUMP_mv3tmv	Quality flag for V_SPT_CONC_PUMP_mv3tmv; flags were assigned following the GEOTRACES quality flag policy (see 'Data Processing Description' for definitions)	unitless

Flag_Zn_LPT_CONC_PUMP_xhk90n	Quality flag for Zn_LPT_CONC_PUMP_xhk90n; flags were assigned following the GEOTRACES quality flag policy (see 'Data Processing Description' for definitions)	unitless
Flag_Zn_SPL_CONC_PUMP_rteqyt	Quality flag for Zn_SPL_CONC_PUMP_rteqyt; flags were assigned following the GEOTRACES quality flag policy (see 'Data Processing Description' for definitions)	unitless
Flag_Zn_SPT_CONC_PUMP_jxeygg	Quality flag for Zn_SPT_CONC_PUMP_jxeygg; flags were assigned following the GEOTRACES quality flag policy (see 'Data Processing Description' for definitions)	unitless

[table of contents | back to top]

Instruments

Dataset-specific Instrument Name	UIC Carbon dioxide coulometer
Generic Instrument Name	CO2 Coulometer
Dataset-specific Description	Used in the measurement of PIC, and to derive CaCO3.
Generic Instrument Description	A CO2 coulometer semi-automatically controls the sample handling and extraction of CO2 from seawater samples. Samples are acidified and the CO2 gas is bubbled into a titration cell where CO2 is converted to hydroxyethylcarbonic acid which is then automatically titrated with a coulometrically-generated base to a colorimetric endpoint.

Dataset-specific Instrument Name	CE Instruments NC2500
Generic Instrument Name	Elemental Analyzer
Dataset-specific Description	Used in the measurement of POC and PN, and to derive POM.
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	Element XR high-resolution ICP-MS (Thermo)
Generic Instrument Name	Inductively Coupled Plasma Mass Spectrometer
Dataset-specific Description	Used in the measurement of pTM, and to derive LITHO, FeOH3, and MnO2.
Generic Instrument Description	An ICP Mass Spec is an instrument that passes nebulized samples into an inductively-coupled gas plasma (8-10000 K) where they are atomized and ionized. Ions of specific mass-to-charge ratios are quantified in a quadrupole mass spectrometer.

Dataset-specific Instrument Name	ThermoFinnigan Delta Plus XP isotope ratio
Generic Instrument Name	Isotope-ratio Mass Spectrometer
Dataset-specific Description	Used in the measurement of d13C and d15N.
Generic Instrument Description	The Isotope-ratio Mass Spectrometer is a particular type of mass spectrometer used to measure the relative abundance of isotopes in a given sample (e.g. VG Prism II Isotope Ratio Mass-Spectrometer).

Dataset-specific Instrument Name	Lachat QuikChem 8000 Flow Injection Analyzer
Generic Instrument Name	Lachat QuikChem 8500 flow injection analysis system
Dataset-specific Description	Used in the measurement of bSi, and to derive OPAL.
Generic Instrument Description	The Lachat QuikChem 8500 Series 2 Flow Injection Analysis System features high sample throughput and simple, but rapid, method changeover. The QuikChem 8500 Series 2 system maximises productivity in determining ionic species in a variety of sample types, from sub-ppb to percent concentrations. Analysis takes 20 to 60 seconds, with a sample throughput of 60 to 120 samples per hour.

Dataset-specific Instrument Name	dual-flow McLane Research in-situ pumps (WTS-LV)
Generic Instrument Name	McLane Large Volume Pumping System WTS-LV
Dataset-specific Description	Size-fractionated particles were collected using dual-flow McLane Research in-situ pumps (WTS-LV). More details can be found in the patent description (https://patents.google.com/patent/US20130298702) and the official website of the manufacturer (https://mclanelabs.com/wts-lv-large-volume-pump/).
Generic Instrument Description	The WTS-LV is a Water Transfer System (WTS) Large Volume (LV) pumping instrument designed and manufactured by McLane Research Labs (Falmouth, MA, USA). It is a large-volume, single-event sampler that collects suspended and dissolved particulate samples in situ. Ambient water is drawn through a modular filter holder onto a 142-millimeter (mm) membrane without passing through the pump. The standard two-tier filter holder provides prefiltering and size fractioning. Collection targets include chlorophyll maximum, particulate trace metals, and phytoplankton. It features different flow rates and filter porosity to support a range of specimen collection. Sampling can be programmed to start at a scheduled time or begin with a countdown delay. It also features a dynamic pump speed algorithm that adjusts flow to protect the sample as material accumulates on the filter. Several pump options range from 0.5 to 30 liters per minute, with a max volume of 2,500 to 36,000 liters depending on the pump and battery pack used. The standard model is depth rated to 5,500 meters, with a deeper 7,000-meter option available. The operating temperature is -4 to 35 degrees Celsius. The WTS-LV is available in four different configurations: Standard, Upright, Bore Hole, and Dual Filter Sampler. The high-capacity upright WTS-LV model provides three times the battery life of the standard model. The Bore-Hole WTS-LV is designed to fit through a narrow opening such as a 30-centimeter borehole. The dual filter WTS-LV features two vertical intake 142 mm filter holders to allow simultaneous filtering using two different porosities.

[table of contents | back to top]

Deployments

RR1815

Website	https://www.bco-dmo.org/deployment/776917
Platform	R/V Roger Revelle
Report	https://datadocs.bco-dmo.org/docs/geotraces/GEOTRACES_PMT/casciotti/data_docs/GP15_Cruise_Report_with_ODF_Report.pdf
Start Date	2018-10-24
End Date	2018-11-24
Description	Additional cruise information is available from the Rolling Deck to Repository (R2R): https://www.rvdata.us/search/cruise/RR1815

[table of contents | back to top]

Project Information

US GEOTRACES Pacific Meridional Transect (GP15) (U.S. GEOTRACES PMT)

Website: http://www.geotraces.org/

Coverage: Pacific Meridional Transect along 152W (GP15)

A 60-day research cruise took place in 2018 along a transect form Alaska to Tahiti at 152° W. A description of the project titled "*Collaborative Research: Management and implementation of the US GEOTRACES Pacific Meridional Transect*", funded by NSF, is below. Further project information is available on the US GEOTRACES website and on the cruise blog. A detailed cruise report is also available as a PDF.

Description from NSF award abstract:
GEOTRACES is a global effort in the field of Chemical Oceanography in which the United States plays a major role. The goal of the GEOTRACES program is to understand the distributions of many elements and their isotopes in the ocean. Until quite recently, these elements could not be measured at a global scale. Understanding the distributions of these elements and isotopes will increase the understanding of processes that shape their distributions and also the processes that depend on these elements. For example, many "trace elements" (elements that are present in very low amounts) are also important for life, and their presence or absence can play a vital role in the population of marine ecosystems. This project will launch the next major U.S. GEOTRACES expedition in the Pacific Ocean between Alaska and Tahiti. The award made here would support all of the major infrastructure for this expedition, including the research vessel, the sampling equipment, and some of the core oceanographic measurements. This project will also support the personnel needed to lead the expedition and collect the samples.

This project would support the essential sampling operations and infrastructure for the U.S. GEOTRACES Pacific Meridional Transect along 152° W to support a large variety of individual science projects on trace element and isotope (TEI) biogeochemistry that will follow. Thus, the major objectives of this management proposal are: (1) plan and coordinate a 60 day research cruise in 2018; (2) obtain representative samples for a wide variety of TEIs using a conventional CTD/rosette, GEOTRACES Trace Element Sampling Systems, and in situ pumps; (3) acquire conventional CTD hydrographic data along with discrete samples for salinity, dissolved oxygen, algal pigments, and dissolved nutrients at micro- and nanomolar levels; (4) ensure that proper QA/QC protocols are followed and reported, as well as fulfilling all GEOTRACES intercalibration protocols; (5) prepare and deliver all hydrographic data to the GEOTRACES Data Assembly Centre (via the US BCO-DMO data center); and (6) coordinate all cruise communications between investigators, including preparation of a hydrographic report/publication. This project would also provide baseline measurements of TEIs in the Clarion-Clipperton fracture zone (~7.5°N-17°N, ~155°W-115°W) where large-scale deep sea mining is planned. Environmental impact assessments are underway in partnership with the mining industry, but the effect of mining activities on TEIs in the water column is one that could be uniquely assessed by the GEOTRACES community. In support of efforts to communicate the science to a wide audience the investigators will recruit an early career freelance science journalist with interests in marine science and oceanography to participate on the cruise and do public outreach, photography and/or videography, and social media from the ship, as well as to submit articles about the research to national media. The project would also support several graduate students.

US GEOTRACES PMT: the geochemistry of size-fractionated suspended particles collected by in-situ filtration (PMT Size-fractionated Suspended Particles)

Coverage: a meridional transect at 152°W from 56°N to 20°S

NSF Award Abstract:
A researcher at the University of California, Santa Cruz will analyze the chemical composition of marine particles collected from the ocean. Marine particles will be collected in two size classes, 1-51um and >51um along the U.S. GEOTRACES Pacific Meridional Transect (PMT), which will sample from Alaska to Tahiti along 152°W. The smaller particles generally remain suspended in seawater, where they can interact with dissolved elements in seawater, whereas the larger particles tend to sink which means these elements can be transported to the bottom of the ocean. We will measure a suite of trace elements (e.g. iron, aluminum, zinc, manganese, cadmium, copper, cobalt, titanium, and barium), some of which are required for life, and others that act as tracers of oceanographic processes, as well as the major biologically-produced carrier phases (e.g. particulate organic carbon and the biominerals, calcium carbonate and biogenic silica) in the size-fractionated particles collected from the US PMT section. The data will be used to assess the relative importance of particle concentration, composition, and size distribution on the cycling and removal of trace elements and their isotopes (TEIs). Results will not only contribute to the overall goal of the GEOTRACES program, but also provide critical information to other science communities interested in the role of particles in sequestering carbon from the atmosphere through a process known as the biological carbon pump. A graduate student and a postdoc will be supported and trained on this project, and undergraduate students will be involved in several aspects of this work. The results from this study will be integrated into class curricula taught by the researcher. The scientist will also work with a science journalist who will sail on the expedition to translate the process and initial results of this research to the public.

Particles play essential roles in the cycling and distribution of trace elements and isotopes (TEI) in the ocean by being sources and sinks for many TEIs. The scavenging of dissolved TEIs by particles is a major removal term for many particle-associated TEIs, but is poorly understood and represents a major uncertainty in our understanding of the biogeochemical cycling of many TEIs. The scavenging of TEIs is affected by particle size, concentration, and composition, whereas the subsequent removal of particles by sinking is influenced by particle dynamics processes such as particle aggregation and disaggregation. We will measure the major (particulate organic matter, calcium carbonate, opal, lithogenic particles) and minor (particulate trace metals) phase compositions of size-fractionated particles (1-51um; >51um) collected by in-situ filtration on the the US GEOTRACES Pacific Meridional Transect (PMT).

The PMT will be the first meridional section of the US GEOTRACES program and will cross many gradients in surface productivity, biological community composition, subsurface silica concentrations, and depth of the calcite saturation horizon. Therefore, the US PMT section is expected to vary dramatically in particle concentration, composition, and size distribution, allowing us to examine the factors controlling scavenging efficiency in the ocean.

[table of contents | back to top]

Program Information

U.S. GEOTRACES (U.S. GEOTRACES)

Website: http://www.geotraces.org/

Coverage: Global

GEOTRACES is a SCOR sponsored program; and funding for program infrastructure development is provided by the U.S. National Science Foundation.

GEOTRACES gained momentum following a special symposium, S02: Biogeochemical cycling of trace elements and isotopes in the ocean and applications to constrain contemporary marine processes (GEOSECS II), at a 2003 Goldschmidt meeting convened in Japan. The GEOSECS II acronym referred to the Geochemical Ocean Section Studies To determine full water column distributions of selected trace elements and isotopes, including their concentration, chemical speciation, and physical form, along a sufficient number of sections in each ocean basin to establish the principal relationships between these distributions and with more traditional hydrographic parameters;

> * To evaluate the sources, sinks, and internal cycling of these species and thereby characterize more completely the physical, chemical and biological processes regulating their distributions, and the sensitivity of these processes to global change; and
>
> * To understand the processes that control the concentrations of geochemical species used for proxies of the past environment, both in the water column and in the substrates that reflect the water column.

GEOTRACES will be global in scope, consisting of ocean sections complemented by regional process studies. Sections and process studies will combine fieldwork, laboratory experiments and modelling. Beyond realizing the scientific objectives identified above, a natural outcome of this work will be to build a community of marine scientists who understand the processes regulating trace element cycles sufficiently well to exploit this knowledge reliably in future interdisciplinary studies.

Expand "Projects" below for information about and data resulting from individual US GEOTRACES research projects.

[table of contents | back to top]

Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1736601

[table of contents | back to top]