Dissolved iron-binding ligand concentrations and conditional stability constants from field samples collected on US GEOTRACES GP17-ANT cruise NBP24-01 on RVIB Palmer in the Amundsen Sea from Nov 2023 to Jan 2024

Website: https://www.bco-dmo.org/dataset/994890
Data Type: Cruise Results
Version: 1
Version Date: 2026-03-17

Project
» Collaborative Research: U.S. GEOTRACES GP17-OCE and GP17-ANT: Characterizing iron-binding organic ligands in the Southern Ocean and implications for iron cycling in the global ocean (GP17-OCE and GP17-ANT organic iron-binding ligands)
» US GEOTRACES GP17 Section: Amundsen Sea Sector of the Antarctic Continental Margin (GP17-ANT) (GP17-ANT)

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

Contributors	Affiliation	Role
Buck, Kristen Nicolle	Oregon State University (OSU)	Principal Investigator, Contact, Data Manager
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Mahieu, Léo	Oregon State University (OSU)	Scientist
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Abstract

Iron is an essential micronutrient for marine life, and its distribution across the world ocean is mostly driven by its complexation by a fraction of the dissolved organic matter pool called iron-binding ligands. This dataset includes the concentration and conditional stability constant of dissolved iron-binding ligands of samples collected during the U.S. GEOTRACES GP17-ANT cruise. This cruise was aiming to investigate the distribution of trace metals and dependent variables in the Amundsen Sea (Antarctica), hotspot of primary production and of major interest in carbon cycling. The cruise departed Punta Arenas (Chile) on November 29th, 2023 and arrived in Lyttelton (New Zealand) on January 28th 2024, after sample collection in the Amundsen Sea (Antarctica). Seawater samples were collected with a tow-fish and a trace metal clean rosette equipped with 24 GoFlo bottles, placed in acid-clean FLPE bottles, and stored frozen (-20 degrees Celsius) until onboard analysis by Dr. Léo Mahieu, if not analyzed within 24 hours after collection. The Amundsen Sea is the site of some of the biggest phytoplanktonic blooms happening seasonally across the world ocean, and is, therefore, an important zone for carbon fixation and export. Yet, uncertainty remains about the processes fueling this bloom, notably for iron. The Amundsen Sea is characterized by shallow depth allowing for connectivity between sediment resuspension and phytoplankton iron supply, and by one of the higher rates of the sea-ice melt rate observed on the Antarctic continent. This dataset is the first one to present iron-binding ligand characteristics in samples deeper than 300 m in the Amundsen Sea, and allows us to report on the impact of sediment resuspension, ice melting, and biological productivity on iron-binding ligand characteristics and on their role in transporting iron in the Amundsen Sea.

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Coverage

Location: Amundsen Sea sector of the Antarctic coastal margin
Spatial Extent: **N**:-66.9774 **E**:-99.6837 **S**:-74.3808 **W**:-133.0225
Temporal Extent: 2023-12-08 - 2024-01-13

Methods & Sampling

Sample Collection:
This work was funded by the U.S. National Science Foundation and the samples collected on the U.S. GEOTRACES GP17-ANT cruise in the Amundsen Sea onboard the RVIB Nathaniel B. Palmer from November 28, 2023 until January 28, 2024 (cruise ID NBP24-01). Water column sampling was accomplished with a trace-metal clean towed fish (Mellett and Buck, 2020) and a rosette equipped with 12-liter (L) GO-Flo bottles (General Oceanics; Cutter et al., 2017). The seawater was filtered inline through 0.2-micrometer (µm) (Pall Acropak) capsule filters, collected in acid-clean Milli-Q conditioned 500 milliliter (mL) fluorinated high-density polyethylene (FLPE; Nalgene) bottles, and stored frozen at -20 degrees Celsius (°C) immediately after collection and until analysis (e.g., Buck et al., 2018) if not analyzed within the next 24 hours following collection. 27 full-depth profiles were collected for iron-binding ligands (398 samples).

Analysis of iron-binding ligands:
The samples were prepared and analyzed onboard following an established method (Rue and Bruland, 1995; Buck et al. 2007, 2012; Mahieu et al. 2024). The samples were thawed overnight at room temperature in the dark prior to analysis if not analyzed fresh. Aliquots of 10 milliliters (mL) of sample were placed in 16 conditioned tubes (50 mL, MetalFree, Labcon) and spiked with 50 microliters (µL) of a 1.5 M borate acid (99 + %, Thermo Scientific) in 0.4 molar (M) ammonium (Optima, Fisher Chemical) buffer for a final pH of 8.2. The aliquots were then spiked with iron standard (prepared by dilution of atomic absorption spectrometry grade, AA; Fisher Chemical in 0.024 M trace metal grade HCl) for final concentration of 0, 0, 0.1, 0.25, 0.5, 0.75, 1, 1.5, 2, 2.5, 3, 4, 5, 7.5, 10 and 15 nanomolar (nM) in each 10 mL of sample. After at least 2 hours of equilibration, the tubes were spiked with 50 µL of a 5 millimolar (mM) salicylaldoxime (98 + %, TCI America) solution made in methanol (LC/MS Grade Optima, Fisher Chemical) for a final concentration of 25 micromolar (µM) and left to equilibrate for at least 15 minutes before analysis.

Each aliquot was analyzed after being placed in a fluorinated ethylene propylene (FEP) cell originally manufactured by Princeton Applied Research, on a controlled mercury growth electrode (CGME) from BioAnalytical Systems, Inc. (BASi) set on drop size 14 in Static Mercury Drop Electrode (SMDE) mode and equipped with a platinum wire counter electrode, a chloride/silver chloride reference electrode, and commercially available quadruple-distilled elemental mercury (Bethlehem Apparatus) as working electrode. The CGME was controlled by an Epsilon Ɛ2 electrochemical analyzer (BASi; 2 systems were used simultaneously). The following parameters were applied through the software EpsilonEC (BASi): analysis with differential pulse adsorptive cathodic stripping voltammetry (DP-AdCSV), deposition at +0.05 volts (V) while stirring, 15 seconds of equilibration (no stirring), stripping from 0 to -0.85 V with a 6 millivolt (mV) step, 50 mV amplitude, 35 milliseconds (ms) pulse width and 200 ms pulse period (Mahieu et al., 2024).

The height of the reduction peak was determined using an automated procedure presented and tested by Mahieu et al. (2024). Briefly, the 4th derivative of the scan was produced through the software ECDSoft (Omanović and Branica, 1998), and the peak height defined with a linear baseline using adaptive scan mode. The peak heights were then compiled in a custom-made Excel spreadsheet, and the data fitted on the software ProMCC (Omanović et al., 2015) using complete complexation fitting model and considering a detection of α_{AL} of 79 (e.g., Buck et al., 2007).

Data Processing Description

Data were flagged using the SeaDataNet quality flag scheme following GEOTRACES guidelines, see: https://www.geotraces.org/geotraces-quality-flag-policy/. Additional notes specific to the application of these flags to this project 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 replicate measurements or reference samples were available to check 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: [Not detected: Used to denote ligand classes not detected in the samples. These values are represented by "nd"].

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. [Not used.]

BCO-DMO Processing Description

- Imported original file "Fe-ligands_GP17-ANT_BCO-DMO_Mahieu_Buck.xlsx" (sheet 1) into the BCO-DMO system.
- Flagged "nd" as a missing data value (missing data are empty/blank in the final CSV file).
- Renamed fields to comply with BCO-DMO naming conventions.
- Converted date format to YYYY-MM-DD.
- Saved the final file as "994890_v1_gp17-ant_fe-binding_ligands.csv".

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Related Publications

Buck, K. N., Lohan, M. C., Berger, C. J. M., & Bruland, K. W. (2007). Dissolved iron speciation in two distinct river plumes and an estuary: Implications for riverine iron supply. Limnology and Oceanography, 52(2), 843–855. doi:10.4319/lo.2007.52.2.0843
Methods

Buck, K. N., Moffett, J., Barbeau, K. A., Bundy, R. M., Kondo, Y., & Wu, J. (2012). The organic complexation of iron and copper: an intercomparison of competitive ligand exchange-adsorptive cathodic stripping voltammetry (CLE-ACSV) techniques. Limnology and Oceanography: Methods, 10(7), 496–515. doi:10.4319/lom.2012.10.496
Methods

Buck, K. N., Sedwick, P. N., Sohst, B., & Carlson, C. A. (2018). Organic complexation of iron in the eastern tropical South Pacific: Results from US GEOTRACES Eastern Pacific Zonal Transect (GEOTRACES cruise GP16). Marine Chemistry, 201, 229–241. https://doi.org/10.1016/j.marchem.2017.11.007
Methods

Cutter, G. A., & Bruland, K. W. (2012). Rapid and noncontaminating sampling system for trace elements in global ocean surveys. Limnology and Oceanography: Methods, 10(6), 425–436. doi:10.4319/lom.2012.10.425
Methods

Cutter, Gregory, Casciotti, Karen, Croot, Peter, Geibert, Walter, Heimbürger, Lars-Eric, Lohan, Maeve, Planquette, Hélène, van de Flierdt, Tina (2017) Sampling and Sample-handling Protocols for GEOTRACES Cruises. Version 3,

August 2017. Toulouse, France, GEOTRACES International Project Office, 139pp. & Appendices. DOI: http://dx.doi.org/10.25607/OBP-2
Methods

Mahieu, L., Omanović, D., Whitby, H., Buck, K. N., Caprara, S., & Salaün, P. (2024). Recommendations for best practice for iron speciation by competitive ligand exchange adsorptive cathodic stripping voltammetry with salicylaldoxime. Marine Chemistry, 259, 104348. https://doi.org/10.1016/j.marchem.2023.104348
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

Omanović, D. & Branica, M. (1998). Automation of voltammetric measurements by polarographic analyser PAR 384B. Croatica Chemica Acta, 71(2), 421–433. https://hrcak.srce.hr/file/195371
Methods

Omanović, D., Garnier, C., & Pižeta, I. (2015). ProMCC: An all-in-one tool for trace metal complexation studies. Marine Chemistry, 173, 25–39. doi:10.1016/j.marchem.2014.10.011
Methods

Rue, E. L., & Bruland, K. W. (1995). Complexation of iron(III) by natural organic ligands in the Central North Pacific as determined by a new competitive ligand equilibration/adsorptive cathodic stripping voltammetric method. Marine Chemistry, 50(1-4), 117–138. doi:10.1016/0304-4203(95)00031-l
Methods

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Parameters

Parameter	Description	Units
CRUISE	Cruise identifier	unitless
SAMPLE_ID	GEOTRACES sample ID number	unitless
STATION	Station number	unitless
DATE	Date of field sampling deployment (UTC)	unitless
LATITUDE	Ship position when incubation setup water was collected in decimal °N	decimal degrees
LONGITUDE	Ship position when incubation setup water was collected in decimal °E	decimal degrees
PLATFORM	Sampling system used for incubation setup water collection. TMC CTD = trace metal clean CTD rosette. FISH = towfish.	unitless
DEPTH	Depth in meters of sample collection. Depth of towfish sampling estimated at 2 m in all cases.	meters (m)
Fe_D_CONC	Dissolved iron concentration considered for the interpretation of the iron-binding ligand titration.	Nanomole per liter (nM)

L1Fe_D_CONC_BOTTLE_7vrudm	Iron-binding ligand concentration falling in the strong class (log K > 11.8) measured in the bottle samples.	nM
L1_FLAG_BOTTLE_7vrudm	Quality flag for strong iron-binding ligand concentration measured in the bottle samples.	unitless
L1_95pcnt_CI_BOTTLE_7vrudm	Error of the strong iron-binding ligand concentration measured in the bottle samples. If one analysis was performed, the value corresponds to the error provided by the fitting software. If more than one analysis was performed, the value corresponds to the standard deviation of the results from the different analysis.	nM
L1Fe_D_LogK_BOTTLE_iqa9ow	Iron-binding ligand conditional stability constant falling in the strong class (log K > 11.8) measured in the bottle samples.	unitless
Log_K1_FLAG_BOTTLE_iqa9ow	Quality flag for strong iron-binding ligand conditional stability constant measured in the bottle samples.	unitless
Log_K1_95pcnt_CI_BOTTLE_iqa9ow	Error of the strong iron-binding ligand conditional stability constant measured in the bottle samples. If one analysis was performed, the value corresponds to the error provided by the fitting software. If more than one analysis was performed, the value corresponds to the standard deviation of the results from the different analysis.	unitless
L2Fe_D_CONC_BOTTLE_hci3xl	Iron-binding ligand concentration falling in the intermediate class (11.1 < log K < 11.8) measured in the bottle samples.	nM
L2_FLAG_BOTTLE_hci3xl	Quality flag for intermediate iron-binding ligand concentration measured in the bottle samples.	unitless
L2_95pcnt_CI_BOTTLE_hci3xl	Error of the intermediate iron-binding ligand concentration measured in the bottle samples. If one analysis was performed, the value corresponds to the error provided by the fitting software. If more than one analysis was performed, the value corresponds to the standard deviation of the results from the different analysis.	nM
L2Fe_D_LogK_BOTTLE_ep1ypm	Iron-binding ligand conditional stability constant falling in the intermediate class (11.1 < log K < 11.8) measured in the bottle samples.	unitless
Log_K2_FLAG_BOTTLE_ep1ypm	Quality flag for intermediate iron-binding ligand conditional stability constant measured in the bottle samples.	unitless

Log_K2_95pcnt_CI_BOTTLE_ep1ypm	Error of the intermediate iron-binding ligand conditional stability constant measured in the bottle samples. If one analysis was performed, the value corresponds to the error provided by the fitting software. If more than one analysis was performed, the value corresponds to the standard deviation of the results from the different analysis.	unitless
L3Fe_D_CONC_BOTTLE	Iron-binding ligand concentration falling in the weak class (log K < 11.1) measured in the bottle samples.	nM
L3_FLAG_BOTTLE	Quality flag for weak iron-binding ligand concentration measured in the bottle samples.	unitless
L3_95pcnt_CI_BOTTLE	Error of the weak iron-binding ligand concentration measured in the bottle samples. If one analysis was performed, the value corresponds to the error provided by the fitting software. If more than one analysis was performed, the value corresponds to the standard deviation of the results from the different analysis.	nM
L3Fe_D_LogK_BOTTLE	Iron-binding ligand conditional stability constant falling in the weak class (log K < 11.1) measured in the bottle samples.	unitless
Log_K3_FLAG_BOTTLE	Quality flag for weak iron-binding ligand conditional stability constant measured in the bottle samples.	unitless
Log_K3_95pcnt_CI_BOTTLE	Error of the weak iron-binding ligand conditional stability constant measured in the bottle samples. If one analysis was performed, the value corresponds to the error provided by the fitting software. If more than one analysis was performed, the value corresponds to the standard deviation of the results from the different analysis.	unitless
L1Fe_D_CONC_FISH_7e95ka	Iron-binding ligand concentration falling in the strong class (log K > 11.8) measured in the fish samples.	nM
L1_FLAG_FISH_7e95ka	Quality flag for strong iron-binding ligand concentration measured in the fish samples.	unitless
L1_95pcnt_CI_FISH_7e95ka	Error of the strong iron-binding ligand concentration measured in the fish samples. If one analysis was performed, the value corresponds to the error provided by the fitting software. If more than one analysis was performed, the value corresponds to the standard deviation of the results from the different analysis.	nM
L1Fe_D_LogK_FISH_xvfeba	Iron-binding ligand conditional stability constant falling in the strong class (log K > 11.8) measured in the fish samples.	unitless

Log_K1_FLAG_FISH_xvfeba	Quality flag for strong iron-binding ligand conditional stability constant measured in the fish samples.	unitless
Log_K1_95pcnt_CI_FISH_xvfeba	Error of the strong iron-binding ligand conditional stability constant measured in the fish samples. If one analysis was performed, the value corresponds to the error provided by the fitting software. If more than one analysis was performed, the value corresponds to the standard deviation of the results from the different analysis.	unitless
L2Fe_D_CONC_FISH_saguog	Iron-binding ligand concentration falling in the intermediate class (11.1 < log K < 11.8) measured in the fish samples.	nM
L2_FLAG_FISH_saguog	Quality flag for intermediate iron-binding ligand concentration measured in the fish samples.	unitless
L2_95pcnt_CI_FISH_saguog	Error of the intermediate iron-binding ligand concentration measured in the fish samples. If one analysis was performed, the value corresponds to the error provided by the fitting software. If more than one analysis was performed, the value corresponds to the standard deviation of the results from the different analysis.	nM
L2Fe_D_LogK_FISH_nv0tcf	Iron-binding ligand conditional stability constant falling in the intermediate class (11.1 < log K < 11.8) measured in the fish samples.	unitless
Log_K2_FLAG_FISH_nv0tcf	Quality flag for intermediate iron-binding ligand conditional stability constant measured in the fish samples.	unitless
Log_K2_95pcnt_CI_FISH_nv0tcf	Error of the intermediate iron-binding ligand conditional stability constant measured in the fish samples. If one analysis was performed, the value corresponds to the error provided by the fitting software. If more than one analysis was performed, the value corresponds to the standard deviation of the results from the different analysis.	unitless
L3Fe_D_CONC_FISH	Iron-binding ligand concentration falling in the weak class (log K < 11.1) measured in the fish samples.	nM
L3_FLAG_FISH	Quality flag for weak iron-binding ligand concentration measured in the fish samples.	unitless
L3_95pcnt_CI_FISH	Error of the weak iron-binding ligand concentration measured in the fish samples. If one analysis was performed, the value corresponds to the error provided by the fitting software. If more than one analysis was performed, the value corresponds to the standard deviation of the results from the different analysis.	nM

L3Fe_D_LogK_FISH	Iron-binding ligand conditional stability constant falling in the weak class (log K < 11.1) measured in the fish samples.	unitless
Log_K3_FLAG_FISH	Quality flag for weak iron-binding ligand conditional stability constant measured in the fish samples.	unitless
Log_K3_95pcnt_CI_FISH	Error of the weak iron-binding ligand conditional stability constant measured in the fish samples. If one analysis was performed, the value corresponds to the error provided by the fitting software. If more than one analysis was performed, the value corresponds to the standard deviation of the results from the different analysis.	unitless
LFetot	Iron-binding ligand concentration measured in the sample for any conditional stability constant. ‘na’ for ‘not applicable’ used when no sample was collected for this parameter, ‘dna’ if no data was collected.	nM eq Fe
LFetot_95pcnt_CI	Error of the iron-binding ligand concentration.	nM eq Fe
eLFetot	Excess iron-binding ligand concentration measured in the sample for any conditional stability constant (equal to iron-binding ligand concentration minus dissolved iron concentration).	nM eq Fe
eLFe1	Excess iron-binding ligand concentration measured in the sample falling in the strong class (log K > 11.8) (equal to strong iron-binding ligand concentration minus dissolved iron concentration).	nM eq Fe
Log_Ktot	Iron-binding ligand conditional stability constant (no separation by classes).	unitless
Log_Ktot_95pcnt_CI	Error of the iron-binding ligand conditional stability constant.	unitless

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Instruments

Dataset-specific Instrument Name	Controlled Mercury Growth Electrodes (CGME)
Generic Instrument Name	BASi Controlled Growth Mercury Electrode
Dataset-specific Description	The analyses were performed on two BioAnalytical Systems Inc. (BASi) Controlled Mercury Growth Electrodes (CGME). They were controlled with two Epsilon Ɛ2 electrochemical analyzers (BASi). Electrochemical measurements were performed through the interface of the software EpsionEC (BASi).
Generic Instrument Description	Bioanalytical Systems (BASi) Mercury drop electrodes are generated by the BASi Controlled Growth Mercury Electrode (CGME) in three modes: DME (Dropping Mercury Electrode) - mercury is allowed to flow freely from the reservoir down the capillary and so the growth of the mercury drop and its lifetime is controlled by gravity. (The optional 100 um capillary is recommended for this mode.) SMDE (Static Mercury Drop Electrode) - the drop size is determined by the length of time for which the fast-response capillary valve is opened, and the drop is dislodged by a drop knocker. The dispense/knock timing is microprocessor-controlled and is typically coordinated with the potential pulse or square-wave waveform. This mode can also used to generate the Hanging Mercury Drop Electrode required for stripping experiments. CGME (Controlled Growth Mercury Electrode) - the mercury drop is grown by a series of pulses that open the capillary valve. The number of pulses, their duration, and their frequency can be varied by PC control, providing great flexibility in both the drop size and its rate of growth. This CGME mode can be used for both polarographic and stripping experiments. http://www.basinc.com/products/ec/cgme.php

Dataset-specific Instrument Name	two Epsilon Ɛ2 electrochemical analyzers (BASi)
Generic Instrument Name	BASi EC-epsilon 2 Autoanalyzer
Dataset-specific Description	The analyses were performed on two BioAnalytical Systems Inc. (BASi) Controlled Mercury Growth Electrodes (CGME). They were controlled with two Epsilon Ɛ2 electrochemical analyzers (BASi). Electrochemical measurements were performed through the interface of the software EpsionEC (BASi).
Generic Instrument Description	The Bioanalytical Systems EC epsilon is a family of potentiostat/galvanostats for electrochemistry. The most basic epsilon instrument can be used for standard techniques, as well as chronopotentiometry for materials characterization (e.g., characterization of transition metal complexes by cyclic voltammetry and controlled potential electrolysis, or of biosensors by cyclic voltammetry and constant potential amperometry). Pulse, square wave, and stripping techniques can be added by a software upgrade, and a second channel can be added by a hardware upgrade.

Dataset-specific Instrument Name	tow-fish
Generic Instrument Name	GeoFish Towed near-Surface Sampler
Dataset-specific Description	Surface samples were collected using a tow-fish, a custom system made of an acid clean Teflon tubing passing through a weighed structure to pump surface water using a Teflon diaphragm pump powered by the ship compressed air.
Generic Instrument Description	The GeoFish towed sampler is a custom designed near surface (2 meters or less) sampling system for the collection of trace metal clean seawater. It consists of a PVC encapsulated lead weighted torpedo and separate PVC depressor vane supporting the intake utilizing all PFA Teflon tubing connected to a deck mounted, air-driven, PFA Teflon dual-diaphragm pump which provides trace-metal clean seawater at up to 3.7L/min. The GeoFish is towed at up to 13kts off to the side of the vessel outside of the ship's wake to avoid possible contamination from the ship's hull. It was developed by Geoffrey Smith and Ken Bruland (University of California, Santa Cruz).

Dataset-specific Instrument Name	Go-Flo bottles (General Oceanics)
Generic Instrument Name	GO-FLO Bottle
Dataset-specific Description	Depth profile samples have been collected with the GEOTRACES Trace Element Carousel sampling system (GTC) that includes an A-frame, a Seabird SBE 32 carousel/CTD equipped with 24 Go-Flo bottles (General Oceanics) of 12 L, a Dynacon winch with 7300 m of Vectran cable with conductors, and clean lab van for bottle sub-sampling (Cutter and Bruland, 2012).
Generic Instrument Description	GO-FLO bottle cast used to collect water samples for pigment, nutrient, plankton, etc. The GO-FLO sampling bottle is specially designed to avoid sample contamination at the surface, internal spring contamination, loss of sample on deck (internal seals), and exchange of water from different depths.

Dataset-specific Instrument Name	Seabird SBE 32 carousel/CTD
Generic Instrument Name	Seabird SBE 32 Carousel Water Sampler
Dataset-specific Description	Depth profile samples have been collected with the GEOTRACES Trace Element Carousel sampling system (GTC) that includes an A-frame, a Seabird SBE 32 carousel/CTD equipped with 24 Go-Flo bottles (General Oceanics) of 12 L, a Dynacon winch with 7300 m of Vectran cable with conductors, and clean lab van for bottle sub-sampling (Cutter and Bruland, 2012).
Generic Instrument Description	The SBE 32 is a Carousel Water Sampler. With an accessory Deck Unit, the Carousel provides water sampling and real-time CTD data acquisition with any Sea-Bird profiling CTD (requires electro-mechanical cable and slip-ring equipped winch). With an accessory underwater unit, the Carousel can operate autonomously with a Sea-Bird Scientific profiling CTD and can be programmed to close bottles at selected depths, allowing deployment using non-electrical wire or line. The Carousel is available in two models: • Full-size SBE 32 for a 12 or 24-position system (36-position custom). • Compact SBE 32C for a 12-position sampler with bottles up to 8 liters, for use with limited vertical clearance.

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Deployments

NBP2401

Website	https://www.bco-dmo.org/deployment/969543
Platform	RVIB Nathaniel B. Palmer
Report	https://www.bodc.ac.uk/resources/inventories/cruise_inventory/reports/nathanielbpalmer_nbp2401.pdf
Start Date	2023-11-28
End Date	2024-01-28
Description	See more information at: R2R https://www.rvdata.us/search/cruise/NBP2401 BODC https://www.bodc.ac.uk/resources/inventories/cruise_inventory/report/18091/ US GEOTRACES https://usgeotraces.ldeo.columbia.edu/content/gp17-ant Description: The U.S. GEOTRACES GP17-ANT expedition departed Punta Arenas, Chile on November 29th, 2023 and arrived in Lyttelton, New Zealand on January 28th, 2024. The cruise took place in the Amundsen Sea aboard the R/V Nathaniel B. Palmer with a team of 35 scientists led by Peter Sedwick (Old Dominion University), Phoebe Lam (University of California, Santa Cruz), and Robert Sherrell (Rutgers University). GP17 was planned as a two-leg expedition, with its first leg (GP17-OCE) as a southward extension of the 2018 GP15 Alaska-Tahiti expedition and this second leg (GP17-ANT) into coastal and shelf waters of Antarctica's Amundsen Sea.

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Project Information

Collaborative Research: U.S. GEOTRACES GP17-OCE and GP17-ANT: Characterizing iron-binding organic ligands in the Southern Ocean and implications for iron cycling in the global ocean (GP17-OCE and GP17-ANT organic iron-binding ligands)

NSF Award Abstract

Iron is an essential element for life and plays an important role in defining how much atmospheric carbon dioxide is taken up into the ocean by phytoplankton. However, iron cycling is closely governed by the chemistry of seawater; nearly all iron in seawater is associated with various unknown organic compounds, called iron-binding ligands, which impact whether and how iron is utilized by organisms and the distribution of iron throughout the ocean. Detail understanding of the cycling of organic iron-binding ligands is necessary to understand iron cycling in the oceans and the connections between iron cycling and atmospheric carbon. The proposed research will be carried out as a part of US GEOTRACES expedition to test the hypothesis that the Southern Ocean is a globally significant source of iron-binding organic ligands, and that different sources of these organic molecules lead to different iron-ligand characteristics. The US GEOTRACES program is a large collaborative effort to sample ocean systems at high resolution for a suite of key trace elements and isotopes. The South Pacific and Southern Ocean regions targeted by the upcoming US GEOTRACES GP17 cruises are important locations of water mass formation and the subsequent transport of carbon and nutrients to the global ocean. Organic ligands produced in these regions thus have important implications for the stabilization, reactivity, and residence time of iron along the path of global water mass circulation and could impact the global oceanic inventory of dissolved iron.

This project will measure the distribution of iron-binding organic ligands, and identify specific organic molecules that comprise these ligands, in field and experimental samples collected on upcoming US GEOTRACES cruises in the South Pacific (GP17-OCE) and Southern Ocean (GP17-ANT). These datasets will be utilized to conduct the first extensive intercalibration of the two most widely used approaches for characterizing iron-binding organic ligands, providing important insight into these datasets and how they can be synthesized to improve understanding of iron cycling in the oceans. All data from this project will be made publicly available. Project activities will provide educational and training opportunities for middle school, high school, undergraduate, and graduate students, and results will be shared with the public through the development of virtual reality modules and via local outreach events.

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

US GEOTRACES GP17 Section: Amundsen Sea Sector of the Antarctic Continental Margin (GP17-ANT) (GP17-ANT)

Website: https://www.geotraces.org/

Coverage: Amundsen Sea Sector of the Antarctic Continental Margin

U.S. GEOTRACES extended its meridional transect, initiated on the 2018 GP15 Alaska-Tahiti expedition, south to the Antarctic ice edge and then east to Chile with GP17-OCE (December 2022 - January 2023). Because of the potentially important trace elements and isotopes (TEIs) inputs and transformations occurring in Antarctic waters and shelves, GP17 also had a second leg, GP17-ANT (November 29, 2023 - January 30, 2024) into coastal and shelf waters of Antarctica’s Amundsen Sea. Further information is available on the US GEOTRACES website.

NSF Project Title: Collaborative Research: Management and Implementation of US GEOTRACES GP17 Section: Amundsen Sea Sector of the Antarctic Continental Margin (GP17-ANT)

NSF Award Abstract:
This project will support the management and implementation of a 60-day research cruise to the Amundsen Sea sector of the Antarctic continental margin to collect samples for measurements of a broad suite of trace elements and isotopes ('TEIs'), as part of the U.S. GEOTRACES program. GEOTRACES is a global effort in the field of Chemical Oceanography, the goal of which is to understand the distributions of trace elements and their isotopes in the ocean. Determining 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. Key TEIs include essential micronutrients such as iron and zinc; 'tracers' such as aluminum, manganese, and isotopes of nitrogen, thorium and neodymium that can be used to investigate modern and ancient ocean processes; and elements such as lead that are indicative of human activities. In the Southern Ocean, the Antarctic continental margins are important as sources of micronutrient trace elements such as iron, which is required to support biological production and carbon export over the Antarctic shelf and in offshore waters of the Antarctic Circumpolar Current. Moreover, these regions are experiencing rapid environmental changes that are expected to impact oceanic circulation and biogeochemical cycles, for which TEIs provide crucial data needed to test and refine numerical models of the Earth system. The Amundsen Sea sector holds particular interest because of the pronounced, decadal-scale increases in the melting rates of glacial ice shelves that border the region, driven by intrusions of warm Circumpolar Deep Water onto the continental shelf. This melting has potentially major impacts on global sea level, on the formation of Antarctic Bottom Water in the Ross Sea, and on the regional ecosystem.

The cruise will comprise essential sampling operations (collection and shipboard processing) and ancillary measurements (hydrography, nutrients, algal pigments) in support of multiple, individual science projects, following the successful model of previous U.S. GEOTRACES cruises in the Atlantic, Pacific and Arctic ocean basins. The cruise will sample the ocean region between 100°W and 135°W, with stations ranging from 67°S in the Antarctic Circumpolar Current southward to the Amundsen Sea continental shelf, including stations adjacent to several rapidly melting ice shelves and in highly-productive shelf polynyas. Water column samples will be collected using conventional and trace-metal clean CTD-rosette systems, in-situ high-volume pumps, and a towed fish sampler or small boat, using established methods. Sampling time will also be provided for collection of sea ice, floating glacial ice, and seafloor sediments. To facilitate coordination with a complementary open-ocean cruise and ensure access to the study region to document the impact of biological processes, the cruise is planned for late austral summer (late January-late March). Beyond the disciplinary contributions, the proposed research will contribute knowledge concerning the cryosphere and its impacts on global sea level and ocean circulation, regional ecosystems and biological processes, ocean-atmosphere interactions, and past and future environmental change. The project will contribute to STEM education and outreach through the participation of an NSF-funded PolarTREC education professional, and a K-12 STEM program for students from underserved and underrepresented schools run by Rutgers University education specialists. To foster public engagement, the investigators will partner with the UCSC Science Communication Program to engage freelance science journalists to profile research in this spectacular and harsh Antarctic environment.

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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.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-2300915
NSF Division of Ocean Sciences (NSF OCE)	OCE-2219551

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