Shipboard FIA of Dissolved Al, Fe, and Mn 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 September to October 2018

Website: https://www.bco-dmo.org/dataset/876137
Data Type: Cruise Results
Version: 1
Version Date: 2022-06-27

Project
» US GEOTRACES Pacific Meridional Transect (GP15) (U.S. GEOTRACES PMT)
» US GEOTRACES PMT: Shipboard determination of key dissolved trace elements (PMT Al Fe Mn)

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

Contributors	Affiliation	Role
Hatta, Mariko	University of Hawai'i at Mānoa	Principal Investigator
Measures, Christopher I.	University of Hawai'i (UH)	Co-Principal Investigator
Rauch, Shannon	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
This dataset reports shipboard Flow Injection Analysis (FIA) of dissolved Aluminum (Al), Iron (Fe), and Manganese (Mn) (0.2µm AcroPak filter) from samples collected by the GTC (GEOTRACES Trace-metal clean CTD carousel) and tow fish during Leg 1 (Seattle, WA to Hilo, HI) of the US GEOTRACES Pacific Meridional Transect (PMT) cruise (GP15, RR1814) on R/V Roger Revelle from September to October 2018.

Table of Contents

- Coverage
- Dataset Description
  - Methods & Sampling
  - Data Processing Description
- Data Files
- Related Publications
- Related Datasets
- Parameters
- Instruments
- Deployments
- Project Information
- Program Information
- Funding

Coverage

Spatial Extent: **N**:56.1 **E**:-152 **S**:19.7 **W**:-157
Temporal Extent: 2018-09-24 - 2018-10-21

Dataset Description

Note: This version of the dataset includes only dissolved Aluminum (Al). Fe and Mn have not yet been contributed to BCO-DMO.

Methods & Sampling

Sampling methods:
The water column samples were collected from The U.S. GEOTRACES trace-metal clean CTD carousel (GTC). This

sampler has a plastic-coated aluminum frame, titanium pressure housings for electronics and sensors, no sacrificial zinc anodes, and 24 ×12 liter General Oceanics GO-FLO bottles modified for trace metal sampling (Cutter and Bruland, 2012). Before deployment and immediately upon recovery, the tops and bottoms of the GO-FLO bottles were covered with polyethylene shower-caps, and the bottles were removed from the frame and carried into the U.S. GEOTRACES clean container laboratory for sub-sampling. The GO-FLO bottles were pressurized to 6 psi using 0.2 µm HEPA-filtered compressed air, and samples were passed through 0.2 µm Pall ACROPAK SUPOR filter capsules that had been pre-cleaned by soaking overnight and flushed with 5 L of unacidified seawater.

For the Loihi Seamount stations (Station 18.3 and 18.6), the seawater samples were also collected from a 36 place, ~10 liter Niskin bottle rosette (ODF) in order to avoid questions of colocation due to short term time and space scale variability between hydrocasts. The samples were filtered through 0.8/0.45 µm Pall ACROPAK 500 capsules that had been pre-cleaned by soaking three days with 10% hydrochloric acid (1.2 M HCl) and flushed with 3-5 L of Milli-Q water, and stored refrigerated between casts. The capsule filter was pre-flushed with 0.5-1 L of unacidified seawater. The filtered seawater samples were acidified to pH 2 using sub-boiling distilled hydrochloric acid. Although the samples were drawn from a non trace-metal clean Niskin rosette, the Fe and Mn values are much larger than measured contamination levels for this system.

In order to evaluate the potential contamination for dAl from the 36 place Niskin rosette, the seawater samples were collected at Station 35 from GTC and ODF casts.

Surface seawater sampling was carried out using a towfish deployed from the starboard side of the vessel at a depth of ~3 m (Bruland et al., 2005), with seawater pumped through Teflon tubing from the fish into a clean “bubble” set up onboard. Filtered samples (0.2 µm Acropak) were taken while underway just before arrival at each hydro-station and occasionally during transit approximately halfway between stations. Sampling into acid-cleaned plastic bottles was conducted following GEOTRACES protocols (Cutter et al., 2017).

Samples of the 0.2 µm-filtered seawater were collected acid pre-washed 125 mL polymethylpentene bottles (PMP) after three rinses and were stored in plastic bags in the dark at room temperature before determination which was usually within 12 -36 hours of collection. Samples were analyzed shipboard for dissolved Al, Fe & Mn using flow injection analysis methods (Resing and Measures, 1994; Measures et al., 1995, Resing and Mottl, 1992 respectively). Prior to determination samples were acidified to 0.006 M hydrochloric acid (HCl) using sub-boiling distilled HCl and were microwaved in groups of 4 for 3 minutes in a 900 W microwave oven to achieve a temperature of 60±10 ˚C. Samples were allowed to cool for at least 1 hour prior to determination. Samples were determined in groups of 8.

For preparation for standard solutions:
Shipboard mixed standards (Al and Fe, Mn) were prepared in the shore-based laboratory by serial dilution of commercial Al, Fe, and Mn standards (BDH Aristar) into distilled water which was acidified with the equivalent of 4 ml sub-boiled 6N HCl. Standards for instrument calibration were prepared daily from filtered seawater by acidifying 1 L of low Fe seawater from a previous cast with 1 ml of 6N HCl and microwaving for 5 minutes to reach a temperature of 60±10˚C. After 1 hour, 200±2 ml of the cooled seawater was added to each of three 250 ml PMP bottles each of which had been rinsed three times with the microwaved seawater and shaken dry. Working standards were prepared by adding 0, +100µL, +200µL spikes of the shipboard mixed standard to these bottles, to yield a standard curve of +4.94nM and +9.88nM for Al, +0.60nM and +1.20 nM for Fe, +0.62 nM and +1.23 nM for Mn. The system blank from the addition of the acid and buffer to samples was determined by double spiking a replicate sample i.e. by adding 2 x 125 µl 6N HCl and 5 ml of sample buffer to the replicate bottle and comparing the resulting signal to the original sample.

For dissolved Al analysis:
Dissolved Al was determined using a Flow Injection Analysis scheme with fluorometric detection. Major components were a Rabbit peristaltic pump, a Dynamax FL-1 flourometer, a Rainin A/D board and a Macintosh G3 computer running Rainin MacIntegrator v 1.4.3 to log and reduce data. The analytical scheme produces a complex between lumogallion and dissolved Al which when excited at 484 nm produces flourescence at 552 nm. Detailed description of the methodology is published in Resing and Measures (1994). A 3-minute pre-concentration of sample (~9 ml) onto an 8-hydroxyquinoline (8-HQ) resin column yielded a detection limit of 0.14 and a precision of 1.8% at 2.51 nM.

For dissolved Fe analysis:
Dissolved Fe was determined using a Flow Injection Analysis scheme with spectrophotometric detection (Rainin Dynamax UV-C). Major components were a Rabbit peristaltic pump, a Rainin Dynamax UV-C, a Rainin A/D board and a Macintosh G3 computer running Rainin MacIntegrator v 1.4.3 to log and reduce data. The spectrophotometric detection of the iron eluted from the column is achieved through its catalytic effect on the oxidation of N,N-dimethylp-phenylenediamine dihydrochloride (DPD) the oxidized product is measured at 514 nm. Detailed description of the methodology is published in Measures et al (1995). A 3-minute pre-concentration of sample (~9 ml) onto an 8-hydroxyquinoline (8-HQ) resin column yielded a detection limit of 0.071 nM and a precision of 1.9% at 1.4 nM.

For dissolved Mn analysis:
Dissolved Mn was determined using a Flow Injection Analysis scheme with spectrophotometric detection (Rainin Dynamax UV-C). Major components were a Rabbit peristaltic pump, a Rainin Dynamax UV-C, a Rainin A/D board and a Macintosh G3 computer running Rainin MacIntegrator v 1.4.3 to log and reduce data. The spectrophotometric

detection of the manganese eluted from the column is achieved through its catalytic effect on the formation of malachite green which is measured at 620 nm. Detailed description of the methodology is published in Resing and Mottl (1992). A 3-minute pre-concentration of sample (~9 ml) onto an 8-hydroxyquinoline (8-HQ) resin column yielded a detection limit of 0.15 nM and a precision of 9.7% at 0.51 nM.

Calculation of each dissolved trace element concentration:
Calculation of sample concentrations was by dividing the peak height derived from sample using the A/D software by the calculated slope of the standard curve. Variations in the slope of the standard curve during a day's run were corrected by the following procedure.

The change in the value of the slope of the standard curve between each run of standards was divided by the number of samples run between those standards to provide a calculated value for the slope of the standard curve at the point each sample was run. The value of the peak height for each sample was then recalculated by the estimated ratio of the standard curve slope at the point that sample was run. The estimate of the slope at each sample run is calculated by: (Initial slope + (incremental change per sample X # of samples run since initial standard was run)). The sample concentration is then calculated from the initial standard curve slope.

The analytical blanks of dissolved Fe and Mn were determined by the shore-based ICPMS data that was measured by co-PI Dr. J. Fitzsimmons (Texas A&M University). The ICPMS data and its metadata will be submitted separately. The blank corrected FIA data was obtained from the intercept of the correlation plot between the ICPMS data and FIA data on each of the days the FIA was run.

Inter-calibration for dissolved Al:
GEOTRACES standard seawater and internal standard seawater were analyzed periodically. A large batch of seawater was acidified prior to the cruise and used as a primary standard during measurements. This standard seawater was run along with each sample analysis. Our laboratory has participated the GEOTRACES intercalibration effort using this flow injection method.

We report our laboratory values for the GEOTRACES GS standard analyses using this flow injection method to be: GEOTRACES GS = 29.63±1.15nM (n=2), D1=0.78, D2=0.88, GSP=1.10±0.03nM (n=2), GSC=0.54±0.08nM (n=2).

These results are in good agreement with this from the GEOTRACES intercalibration effort for Al and demonstrate that the methodologies employed to produce this dataset detect concentrations within the standard deviation of current consensus values.

The Al data at Station 35 from the GEOTRACES PMT cruise (GP15) were compared with the value at Station 36 from the GP16 EPZT cruise obtained by Joe Resing which all show very similar results throughout the water column.

Data Processing Description

Quality flags for dissolved Al, Fe, and Mn:
1 = Below detection limit (Measurement was determined but was found to be below the detection limit);
2 = Good;
3 = Questionable/suspect;
4 = Bad;
9 = Missing data (no sample)

BCO-DMO Processing:
- replaced "-999" and "-999.00" with "nd" (missing data value);
- renamed fields to comply with BCO-DMO naming conventions;
- added start and end data/time fields in ISO8601 format.

[table of contents | back to top]

Data Files

File
FIA_AlFeMn_Leg1.csv (Comma Separated Values (.csv), 48.50 KB) MD5:d921e565ef9fda53234e22a6ce7a57cf Primary data file for dataset ID 876137

[table of contents | back to top]

Related Publications

Bruland, K. W., Rue, E. L., Smith, G. J., & DiTullio, G. R. (2005). Iron, macronutrients and diatom blooms in the Peru upwelling regime: brown and blue waters of Peru. Marine Chemistry, 93(2-4), 81–103. doi:10.1016/j.marchem.2004.06.011
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 (Cookbook). Version 3, August 2017. Toulouse, France, GEOTRACES International Project Office, 139pp. & Appendices. http://hdl.handle.net/11329/409
Methods

Measures, C. I., Yuan, J., & Resing, J. A. (1995). Determination of iron in seawater by flow injection analysis using in-line preconcentration and spectrophotometric detection. Marine Chemistry, 50(1-4), 3–12. doi:10.1016/0304-4203(95)00022-j
Methods

Resing, J. A., & Measures, C. I. (1994). Fluorometric Determination of Al in Seawater by Flow Injection Analysis with In-Line Preconcentration. Analytical Chemistry, 66(22), 4105–4111. doi:10.1021/ac00094a039
Methods

Resing, J. A., & Mottl, M. J. (1992). Determination of manganese in seawater using flow injection analysis with on-line preconcentration and spectrophotometric detection. Analytical Chemistry, 64(22), 2682–2687. doi:10.1021/ac00046a006
Methods

[table of contents | back to top]

Related Datasets

IsContinuedBy

Hatta, M., Measures, C. I. (2022) **Shipboard FIA of Dissolved Al, Fe, and Mn 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 October to November 2018.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2022-06-27 doi:10.26008/1912/bco-dmo.876152.1 [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 number	unitless
Start_Date_UTC	Date (UTC) at start of sampling event; format: MM-DD-YYYY	unitless
Start_Time_UTC	Time (UTC) at start of sampling event; format: hh:mm	unitless
Start_ISO_DateTime_UTC	Date and time (UTC) at start of sampling event; format: MM-DD-YYYYThh:mmZ	unitless
End_Date_UTC	Date (UTC) at end of sampling event; format: MM-DD-YYYY	unitless

End_Time_UTC	Time (UTC) at end of sampling event; format: hh:mm	unitless
End_ISO_DateTime_UTC	Date and time (UTC) at end of sampling event; format: MM-DD-YYYYThh:mmZ	unitless
Start_Latitude	Latitude at start of sampling event	degrees North
Start_Longitude	Longitude at start of sampling event	degrees East
End_Latitude	Latitude at end of sampling event	degrees North
End_Longitude	Longitude at end of sampling event	degrees East
Cast_number	Cast number	unitless
Event_ID	Event number	unitless
Sample_ID	GEOTRACES sample number	unitless
Sample_Depth	Sample depth	meters (m)
Al_D_CONC_BOTTLE_hyrnln	Dissolved Aluminum concentration	nanomolar (nM)
SD1_Al_D_CONC_BOTTLE_hyrnln	One standard deviation of Al_D_CONC_BOTTLE_hyrnln	nanomolar (nM)
Flag_Al_D_CONC_BOTTLE_hyrnln	Quality flag for Al_D_CONC_BOTTLE_hyrnln	unitless
Al_D_CONC_FISH_mtz4rw	Dissolved Aluminum concentration	nanomolar (nM)
SD1_Al_D_CONC_FISH_mtz4rw	One standard deviation of Al_D_CONC_FISH_mtz4rw	nanomolar (nM)
Flag_Al_D_CONC_FISH_mtz4rw	Quality flag for Al_D_CONC_FISH_mtz4rw	unitless

[table of contents | back to top]

Instruments

Dataset-specific Instrument Name	Flow Injection Analysis scheme with spectrophometric detection
Generic Instrument Name	Flow Injection Analyzer
Dataset-specific Description	Dissolved Fe was determined using a Flow Injection Analysis scheme with spectrophometric detection (Rainin Dynamax UV-C). Major components of the scheme include a Rabbit peristaltic pump, a Dynamax FL-1 fluorometer, a Rainin A/D board, and a Macintosh G3 computer running Rainin MacIntegrator v 1.4.3 to log and reduce data.
Generic Instrument Description	An instrument that performs flow injection analysis. Flow injection analysis (FIA) is an approach to chemical analysis that is accomplished by injecting a plug of sample into a flowing carrier stream. FIA is an automated method in which a sample is injected into a continuous flow of a carrier solution that mixes with other continuously flowing solutions before reaching a detector. Precision is dramatically increased when FIA is used instead of manual injections and as a result very specific FIA systems have been developed for a wide array of analytical techniques.

Dataset-specific Instrument Name	Flow injection for dFe DPD system with Rainin Dynamax Absorbance detector UV-C
Generic Instrument Name	Flow Injection Analyzer
Dataset-specific Description	Dissolved Fe was determined using a Flow Injection Analysis scheme with spectrophotometric detection (Rainin Dynamax UV-C). Major components were a Rabbit peristaltic pump, a Rainin Dynamax UV-C, a Rainin A/D board and a Macintosh G3 computer running Rainin MacIntegrator v 1.4.3 to log and reduce data. The spectrophotometric detection of the iron eluted from the column is achieved through its catalytic effect on the oxidation of N,N-dimethylp-phenylenediamine dihydrochloride (DPD) the oxidized product is measured at 514 nm.
Generic Instrument Description	An instrument that performs flow injection analysis. Flow injection analysis (FIA) is an approach to chemical analysis that is accomplished by injecting a plug of sample into a flowing carrier stream. FIA is an automated method in which a sample is injected into a continuous flow of a carrier solution that mixes with other continuously flowing solutions before reaching a detector. Precision is dramatically increased when FIA is used instead of manual injections and as a result very specific FIA systems have been developed for a wide array of analytical techniques.

Dataset-specific Instrument Name	Flow injection for dMn system with Rainin Dynamax Absorbance detector UV-C
Generic Instrument Name	Flow Injection Analyzer
Dataset-specific Description	Dissolved Mn was determined using a Flow Injection Analysis scheme with spectrophotometric detection (Rainin Dynamax UV-C). Major components were a Rabbit peristaltic pump, a Rainin Dynamax UV-C, a Rainin A/D board and a Macintosh G3 computer running Rainin MacIntegrator v 1.4.3 to log and reduce data.
Generic Instrument Description	An instrument that performs flow injection analysis. Flow injection analysis (FIA) is an approach to chemical analysis that is accomplished by injecting a plug of sample into a flowing carrier stream. FIA is an automated method in which a sample is injected into a continuous flow of a carrier solution that mixes with other continuously flowing solutions before reaching a detector. Precision is dramatically increased when FIA is used instead of manual injections and as a result very specific FIA systems have been developed for a wide array of analytical techniques.

Dataset-specific Instrument Name	Flow injection for dAl lumogallion system with Rainin Dynamax FL-1 flourometer
Generic Instrument Name	Flow injection lumogallion system with fluorometer
Dataset-specific Description	Dissolved Al was determined using a Flow Injection Analysis scheme with fluorometeric detection. The scheme produces a complex between lumogallion and dissolved Al. Major components of the scheme include a Rabbit peristaltic pump, a Dynamax FL-1 fluorometer, a Rainin A/D board, and a Macintosh G3 computer running Rainin MacIntegrator v 1.4.3 to log and reduce data.
Generic Instrument Description	An analytical system used to determine concentrations of chemical species in a sample based on the fluorescence from the reaction between lumogallion and the species of interest. The system typically comprises individual components typically including pumps, injection and autosampler valves, preconcentration columns and a fluorometer. The system is normally uniquely assembled for each analysis. (From SeaDataNet)

Dataset-specific Instrument Name	tow fish
Generic Instrument Name	GeoFish-type Near-surface Towfish Sampler
Generic Instrument Description	This term describes a family of custom-designed, trace-metal-clean, near-surface seawater sampling systems based on the 'GeoFish' design developed by Geoffrey Smith and Ken Bruland at the University of California, Santa Cruz (UCSC). The systems consist of a weighted towed body or torpedo, clean intake tubing, a shipboard pneumatic pump, and a sampling manifold. They are deployed alongside a moving vessel, outside the ship's wake, with the intake typically positioned approximately 1 to 3 meters below the sea surface. Seawater is continuously pumped through the clean tubing to the ship for filtered and unfiltered sampling and, in some applications, direct connection to analytical instruments. This term includes the original GeoFish sampler, Super-GeoFISH variants, and subsequent modified towfish systems used on U.S. GEOTRACES cruises. These systems share the same basic sampling principle but may differ in body construction, depressor or stabilization design, deployment hardware, tubing, pump configuration, flow rate, and sampling manifold. The systems have been used for trace-metal, nutrient, biological, and other chemical measurements in both GEOTRACES and non-GEOTRACES studies, including Bruland et al. (2005).

Dataset-specific Instrument Name	Go-Flo sampling bottles
Generic Instrument Name	GO-FLO Bottle
Dataset-specific Description	Pre-conditioned, teflon-coated 12L Go-Flo sampling bottles (General Oceanics, Miami, FL) were deployed on a polyurethane powder-coated aluminum rosette with titanium pilings and pressure housings (Sea-Bird Electronics, Inc., Bellevue, WA) attached to a Kevlar, non-metallic conducting cable.
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.

[table of contents | back to top]

Deployments

RR1814

Website	https://www.bco-dmo.org/deployment/776913
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	2018-09-18
End Date	2018-10-21
Description	Additional cruise information is available from the Rolling Deck to Repository (R2R): https://www.rvdata.us/search/cruise/RR1814

[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: Shipboard determination of key dissolved trace elements (PMT Al Fe Mn)

Coverage: Alaska to Tahiti, Pacific Meridional Transect

NSF Award Abstract:
This project will provide shipboard measurements of the dissolved trace elements aluminum (Al), iron (Fe), and manganese (Mn) during an Alaska to Tahiti cruise that will sail as part of the US GEOTRACES Pacific Meridional Transect (PMT). The PMT expedition is part of the international GEOTRACES program designed to improve understanding of global ocean biogeochemical cycles. The growth of microscopic oceanic plants in surface waters depends on the availability of certain trace elements (particularly dissolved Fe). In addition, the distribution of this and other trace elements record current and past chemical and biological processes in the ocean. The PMT cruise track includes multiple unique oceanic conditions and thus the results of the work will provide important insight into diverse global ocean processes. For broader scientific impact, results will be incorporated into models that address the current and future role of the ocean in global processes. Assessing the distribution of trace elements in the Clarion-Clipperton Fracture Zone, along the cruise track, will also provide an important baseline for this region where seabed mining of manganese nodules is planned. Educational outreach will take place with a mid-cruise stop in Hilo, Hawaii to engage local students with visits to the ship. Direct exposure to a working oceanographic research vessel together with a post-cruise follow up visit will provide students with a unique opportunity to discuss the findings from the expedition directly with the scientists engaged in the project.

To develop the data sets required for new understanding of the relative importance of trace element input processes in establishing oceanic chemical distributions, seawater samples from the entire water column will be collected using a custom designed sampling package at 41 locations during the 62-day cruise. The northern part of the cruise track originates in a region where very low concentrations of dissolved Fe in surface waters limit plant growth. Further to the south, increased atmospheric deposition of mineral dust blown from the continents will be traced by measuring the dissolved Al concentration in surface waters. The addition of this dust also adds dissolved Fe. Potential additional inputs of Fe from coastal regions will be identified by coincident increases in dissolved Mn concentrations. The project will compare and correlate variations in Al, Fe, and Mn to quantify and identify distinct addition processes along the cruise track. By using shipboard flow injection analysis to provide near real-time measurements for these trace elements, the potential exists to modify sampling strategies for maximum scientific return. The shipboard results will also help identify any sampling contamination problems that are a constant risk when collecting these low-level trace elements. Altogether, the shipboard analysis of these essential elements is an essential activity to ensure success of the GEOTRACES PMT.

[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-1736906

[table of contents | back to top]