Total dissolved sulfide (TDS) and carbonyl sulfide (OCS) from surface fish and CTD rosette samples collected on the US GEOTRACES GP17-OCE cruise on R/V Roger Revelle (RR2214) in the South Pacific and Southern Oceans from December 2022 to January 2023

Website: https://www.bco-dmo.org/dataset/1001179
Data Type: Cruise Results
Version: 1
Version Date: 2026-06-17

Project
» US GEOTRACES GP17 Section: South Pacific and Southern Ocean (GP17-OCE) (GP17-OCE)
» US GEOTRACES GP17-OCE: Hydrogen sulfide as a strong ligand affecting the speciation and solubility of key trace metals (GP17-OCE H2S)

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

Contributors	Affiliation	Role
Cutter, Gregory A.	Old Dominion University (ODU)	Principal Investigator
Buckley, Nicole R.	Old Dominion University (ODU)	Student
Rauch, Shannon	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
These data include water column GeoFish and bottle total dissolved sulfide (TDS) and carbonyl sulfide (OCS) collected on the US GEOTRACES GP17-OCE cruise aboard the R/V Roger Revelle in the South Pacific and Southern Oceans from December 2022 to January 2023. Due to its high metal-ligand stability constants, the abundance and distribution of hydrogen sulfide has implications on the cycling of certain trace metals in seawater. These data were collected by Dr. Gregory Cutter from the Department of Ocean and Earth Sciences at Old Dominion University.

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Coverage

Location: South Pacific and Southern Ocean
Spatial Extent: **N**:-19.895 **E**:-75.748 **S**:-67.005 **W**:-152
Temporal Extent: 2022-12-03 - 2023-01-23

Methods & Sampling

Total dissolved sulfide (TDS) and carbonyl sulfide (OCS) were collected from the Oceanographic Data Facility (ODF) Niskin bottles and the GeoFish and stored in 4 liter (L) polyethylene cubitainers. The cubitainers were rinsed 3 times with the sample before filling hermetically with approximately 1.5 L of seawater sample and stored in a refrigerator until analyzed at sea, within 8 hours of collection using the Radford-Knoery and Cutter (1993) method.

Roughly 100 milliliters (mL) of the seawater sample was used to rinse the gas stripping vessel, and then filled with 300 mL of seawater sample and purged with helium (120 mL/minute) for 2 minutes. After 2 minutes, the cryogenic trap was immersed in liquid nitrogen followed by injecting 1.5 M phosphoric acid and stripped/trapped the gases for 20 minutes before quantifying TDS and OCS using a gas chromatograph coupled with a flame photometric detector.

This method quantifies TDS as free ions and metal-sulfide complexes with detection limits of 0.2 picomoles per liter (pmol/L) for TDS and 1.3 pmol/L for OCS for 300 mL samples (Radford-Knoery and Cutter, 1993). Dissolved sulfide water samples were analyzed primarily in duplicate, occasionally triplicate when time permitted. To ensure accuracy, the H_2S and OCS gases were calibrated using permeation tubes whose permeation rates have been gravimetrically measured for 2 to 4 years. By trapping and measuring known amounts of permeated H_2S and OCS over a range of times, linear calibration curves for each gas were assembled daily and applied to unknown samples.

Data Processing Description

The output signal from the detector was processed using Agilent’s ChemStation software. The sulfide peaks were manually integrated in the software and converted to a value in pmol S using the slope calculated from the system's calibration immediately before or after processing the samples. The values for TDS and OCS were converted to pmol S/L by accounting for the volume of seawater sample analyzed in the gas stripping vessel (300 mL).

Quality flags were applied following the GEOTRACES policy (https://www.geotraces.org/geotraces-quality-flag-policy/), which recommends the SeaDataNet Scheme:
0 = no quality control;
1 = good value;
2 = probably good value;
3 = probably bad value;
4 = bad value;
5 = changed value;
6 = value below detection;
7 = value in excess;
8 = interpolated value;
9 = missing value;
A = value phenomenon uncertain.

BCO-DMO Processing Description

- Loaded sheet 1 of original file "RR2214_dataTemplate_TDS-OCS-only.xlsx" into the BCO-DMO system, treating "nd" as a missing data value (missing data values are empty/blank in the final CSV file).
- Renamed columns to comply with BCO-DMO naming conventions.
- Applied find/replace to normalize Start_Date_UTC values: converted dd-mm-yy format to YYYY-mm-dd and dd/mm/YYYY format to YYYY-mm-dd.
- Applied same date normalization to End_Date_UTC; additionally corrected the erroneous value "2022-29-29" to "2022-12-29".
- Combined Start_Date_UTC and Start_Time_UTC into a new ISO 8601 datetime column Start_ISO_DateTime_UTC (format %Y-%m-%dT%H:%M:%SZ, UTC).
- Combined End_Date_UTC and End_Time_UTC into a new ISO 8601 datetime column End_ISO_DateTime_UTC (format %Y-%m-%dT%H:%M:%SZ, UTC).
- Saved the final file as "1001179_v1_gp17-oce_tds_ocs.csv".

Problem Description

Some OCS values reported are suspected of bottle contamination and are accordingly labeled with a quality control flag of 3 (see flag definitions at: https://www.geotraces.org/geotraces-quality-flag-policy/). During the first several stations, we suspect several Niskin bottles were impacted by this as they had not been rinsed with seawater enough to "clean" the contaminated Niskin bottles prior to Station 1. After several ODF deployments, we suspect that most of the contaminated Niskin bottles had been rinsed and were no longer displaying signs of anonymously high OCS values. Two Niskin bottles continued to display anonymously high OCS values compared to other bottles at the same depth. And so, for all future casts, TDS and OCS samples from those two depths were collected from a Niskin bottle in a different position on the rosette.

No data was reported for Station 10 due to a ruptured gasket on the peristaltic pump of the VWR hydrogen generator which interrupted analyses. After 2.5 days repairing and checking the system, the hydrogen generator was replumbed to deliver deionized water to the cell from the reservoir by gravity, allowing us to bypass the peristaltic pump and resume sample collection and analyses by Station 12.

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Related Publications

Buckley, N. (2024). Hydrogen Sulfide as a Strong Ligand Affecting Trace Metal Cycling in the Pacific and Southern Oceans [Doctoral Dissertation, Old Dominion University]. https://www.proquest.com/docview/3111167063
Results

Radford-Knoery, J., & Cutter, G. A. (1993). Determination of carbonyl sulfide and hydrogen sulfide species in natural waters using specialized collection procedures and gas chromatography with flame photometric detection. Analytical Chemistry, 65(8), 976–982. doi:10.1021/ac00056a005
Methods

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Related Datasets

IsRelatedTo

Cutter, G. A., & Buckley, N. R. (2022). *Total dissolved sulfide (TDS) and carbonyl sulfide (OCS) 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* (Version 1) [Dataset]. Biological and Chemical Oceanography Data Management Office (BCO-DMO). https://doi.org/10.26008/1912/BCO-DMO.873908.1 https://doi.org/10.26008/1912/bco-dmo.873908.1

Cutter, G. A., & Buckley, N. R. (2022). *Total dissolved sulfide (TDS) and carbonyl sulfide (OCS) from Leg 2 (Hilo, HI to Papeete, French Polynesia) of the US GEOTRACES Pacific Meridional Transect (PMT) cruise (GP15, RR1815) conducted on R/V Roger Revelle from October to November 2018* (Version 1) [Dataset]. Biological and Chemical Oceanography Data Management Office (BCO-DMO). https://doi.org/10.26008/1912/BCO-DMO.873927.1 https://doi.org/10.26008/1912/bco-dmo.873927.1

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Parameters

Parameter	Description	Units
Station_ID	Station number	unitless

Event_ID	Event number	unitless
Gear_ID	Instrument type	unitless
Start_ISO_DateTime_UTC	Date and time (UTC) at start of sampling event in ISO 8601 format	unitless
Start_Date_UTC	Date at start of sampling event	unitless
Start_Time_UTC	Time (UTC) at start of sampling event	unitless
End_ISO_DateTime_UTC	Date and time (UTC) at end of sampling event in ISO 8601 format	unitless
End_Date_UTC	Date at end of sampling event	unitless
End_Time_UTC	Time (UTC) at end of sampling event	unitless
Start_Latitude	Latitude at start of sampling event	decimal degrees
Start_Longitude	Longitude at start of sampling event	decimal degrees
End_Latitude	Latitude at end of sampling event	decimal degrees
End_Longitude	Longitude at end of sampling event	decimal degrees
Rosette_Position	Position on rosette	unitless
Sample_ID	GEOTRACES sample ID number	unitless
Sample_Depth	Sample depth	meters (m)
TDS_D_CONC_FISH_c1d4vj	Total dissolved sulfide (TDS) determined from GeoFish samples	picomoles per liter (pmol/L)
SD1_TDS_D_CONC_FISH_c1d4vj	One standard deviation of TDS_D_CONC_FISH	picomoles per liter (pmol/L)
Flag_TDS_D_CONC_FISH_c1d4vj	Quality flag for TDS_D_CONC_FISH	unitless

OCS_D_CONC_FISH_qh7i0b	Dissolved carbonyl sulfide (OCS) determined from GeoFish samples	picomoles per liter (pmol/L)
SD1_OCS_D_CONC_FISH_qh7i0b	One standard deviation of OCS_D_CONC_FISH	picomoles per liter (pmol/L)
Flag_OCS_D_CONC_FISH_qh7i0b	Quality flag for OCS_D_CONC_FISH	unitless
TDS_D_CONC_BOTTLE_rllzgm	Total dissolved sulfide (TDS) determined from bottle samples	picomoles per liter (pmol/L)
SD1_TDS_D_CONC_BOTTLE_rllzgm	One standard deviation of TDS_D_CONC_BOTTLE	picomoles per liter (pmol/L)
Flag_TDS_D_CONC_BOTTLE_rllzgm	Quality flag for TDS_D_CONC_BOTTLE	unitless
OCS_D_CONC_BOTTLE_zextjm	Dissolved carbonyl sulfide (OCS) determined from bottle samples	picomoles per liter (pmol/L)
SD1_OCS_D_CONC_BOTTLE_zextjm	One standard deviation of OCS_D_CONC_BOTTLE	picomoles per liter (pmol/L)
Flag_OCS_D_CONC_BOTTLE_zextjm	Quality flag for OCS_D_CONC_BOTTLE	unitless

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Instruments

Dataset-specific Instrument Name	VWR circulating water bath (model 1130S)
Generic Instrument Name	circulating water bath
Dataset-specific Description	TDS and OCS were quantified using an Agilent 8890 gas chromatograph coupled with an Agilent flame photometric detector plus. The output signal from the detector was processed using Agilent's ChemStation software. Hydrogen (130 mL/min) and air (130 mL/min) were used for the flame photometric detector's flame while ultra-high purity helium was used as the carrier gas (30 mL/min) and the stripping gas (120 mL/min). While cylinders were used as the source of air and ultra-high purity helium, a VWR hydrogen generator (model H2PEM-165) was used for the hydrogen source. A VWR circulating water bath (model 1130S) was used to maintain 40°C for H2S and OCS permeation devices (Metronics) which were used to calibrate the instrument for H2S and OCS.
Generic Instrument Description	A device designed to regulate the temperature of a vessel by bathing it in water held at the desired temperature. [Definition Source: NCI]

Dataset-specific Instrument Name	36-bottle ODF rosette
Generic Instrument Name	CTD Sea-Bird SBE 911plus
Dataset-specific Description	Dissolved seawater samples were collected using a trace metal clean GeoFish and a 36-bottle ODF rosette equipped with 10.4 L Niskin bottles.
Generic Instrument Description	The Sea-Bird SBE 911 plus is a type of CTD instrument package for continuous measurement of conductivity, temperature and pressure. The SBE 911 plus includes the SBE 9plus Underwater Unit and the SBE 11plus Deck Unit (for real-time readout using conductive wire) for deployment from a vessel. The combination of the SBE 9 plus and SBE 11 plus is called a SBE 911 plus. The SBE 9 plus uses Sea-Bird's standard modular temperature and conductivity sensors (SBE 3 plus and SBE 4). The SBE 9 plus CTD can be configured with up to eight auxiliary sensors to measure other parameters including dissolved oxygen, pH, turbidity, fluorescence, light (PAR), light transmission, etc.). more information from Sea-Bird Electronics

Dataset-specific Instrument Name	Agilent flame photometric detector plus
Generic Instrument Name	flame photometric detector
Dataset-specific Description	TDS and OCS were quantified using an Agilent 8890 gas chromatograph coupled with an Agilent flame photometric detector plus. The output signal from the detector was processed using Agilent’s ChemStation software. Hydrogen (130 mL/min) and air (130 mL/min) were used for the flame photometric detector’s flame while ultra-high purity helium was used as the carrier gas (30 mL/min) and the stripping gas (120 mL/min). While cylinders were used as the source of air and ultra-high purity helium, a VWR hydrogen generator (model H2PEM-165) was used for the hydrogen source. A VWR circulating water bath (model 1130S) was used to maintain 40°C for H2S and OCS permeation devices (Metronics) which were used to calibrate the instrument for H2S and OCS.
Generic Instrument Description	The determination of sulfur or phosphorus containing compounds is the job of the flame photometric detector (FPD). This device uses the chemiluminescent reactions of these compounds in a hydrogen/air flame as a source of analytical information that is relatively specific for substances containing these two kinds of atoms. The emitting species for sulfur compounds is excited S2. The lambda max for emission of excited S2 is approximately 394 nm. The emitter for phosphorus compounds in the flame is excited HPO (lambda max = doublet 510-526 nm). In order to selectively detect one or the other family of compounds as it elutes from the GC column, an interference filter is used between the flame and the photomultiplier tube (PMT) to isolate the appropriate emission band. The drawback here being that the filter must be exchanged between chromatographic runs if the other family of compounds is to be detected.

Dataset-specific Instrument Name	Agilent 8890 gas chromatograph
Generic Instrument Name	Gas Chromatograph
Dataset-specific Description	TDS and OCS were quantified using an Agilent 8890 gas chromatograph coupled with an Agilent flame photometric detector plus. The output signal from the detector was processed using Agilent's ChemStation software. Hydrogen (130 mL/min) and air (130 mL/min) were used for the flame photometric detector's flame while ultra-high purity helium was used as the carrier gas (30 mL/min) and the stripping gas (120 mL/min). While cylinders were used as the source of air and ultra-high purity helium, a VWR hydrogen generator (model H2PEM-165) was used for the hydrogen source. A VWR circulating water bath (model 1130S) was used to maintain 40°C for H2S and OCS permeation devices (Metronics) which were used to calibrate the instrument for H2S and OCS.
Generic Instrument Description	Instrument separating gases, volatile substances, or substances dissolved in a volatile solvent by transporting an inert gas through a column packed with a sorbent to a detector for assay. (from SeaDataNet, BODC)

Dataset-specific Instrument Name	trace metal clean GeoFish
Generic Instrument Name	GeoFish Towed near-Surface Sampler
Dataset-specific Description	Dissolved seawater samples were collected using a trace metal clean GeoFish and a 36-bottle ODF rosette equipped with 10.4 L Niskin bottles.
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	VWR hydrogen generator (model H2PEM-165)
Generic Instrument Name	hydrogen generator
Dataset-specific Description	TDS and OCS were quantified using an Agilent 8890 gas chromatograph coupled with an Agilent flame photometric detector plus. The output signal from the detector was processed using Agilent's ChemStation software. Hydrogen (130 mL/min) and air (130 mL/min) were used for the flame photometric detector's flame while ultra-high purity helium was used as the carrier gas (30 mL/min) and the stripping gas (120 mL/min). While cylinders were used as the source of air and ultra-high purity helium, a VWR hydrogen generator (model H2PEM-165) was used for the hydrogen source. A VWR circulating water bath (model 1130S) was used to maintain 40°C for H2S and OCS permeation devices (Metronics) which were used to calibrate the instrument for H2S and OCS.
Generic Instrument Description	A gas generator that generates hydrogen gas.

Dataset-specific Instrument Name	Niskin bottles
Generic Instrument Name	Niskin bottle
Dataset-specific Description	Dissolved seawater samples were collected using a trace metal clean GeoFish and a 36-bottle ODF rosette equipped with 10.4 L Niskin bottles.
Generic Instrument Description	A Niskin bottle (a next generation water sampler based on the Nansen bottle) is a cylindrical, non-metallic water collection device with stoppers at both ends. The bottles can be attached individually on a hydrowire or deployed in 12, 24, or 36 bottle Rosette systems mounted on a frame and combined with a CTD. Niskin bottles are used to collect discrete water samples for a range of measurements including pigments, nutrients, plankton, etc.

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Deployments

RR2214

Website	https://www.bco-dmo.org/deployment/905754
Platform	R/V Roger Revelle
Report	https://www.bodc.ac.uk/resources/inventories/cruise_inventory/reports/rogerrevelle_rr2214.pdf
Start Date	2022-12-01
End Date	2023-01-25
Description	The U.S. GEOTRACES GP17-OCE expedition departed Papeete, Tahiti (French Polynesia) on December 1st, 2022 and arrived in Punta Arenas, Chile on January 25th, 2023. The cruise took place in the South Pacific and Southern Oceans aboard the R/V Roger Revelle with a team of 34 scientists led by Ben Twining (Chief Scientist), Jessica Fitzsimmons, and Greg Cutter (Co-Chief Scientists). 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 a second leg (GP17-ANT; December 2023-January 2024) into coastal and shelf waters of Antarctica's Amundsen Sea. The GP17-OCE section encompassed three major transects: (1) a southbound pseudo-meridional section (~152-135 degrees West) from 20 degrees South to 67 degrees South; (2) an eastbound zonal transect from 135 degrees West to 100 degrees West; (3) and a northbound section returning to Chile (100-75 degrees West). Additional cruise information is available from the following sources: R2R: https://www.rvdata.us/search/cruise/RR2214 CCHDO: https://cchdo.ucsd.edu/cruise/33RR20221201 More information can also be found at: https://usgeotraces.ldeo.columbia.edu/content/gp17-oce

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Project Information

US GEOTRACES GP17 Section: South Pacific and Southern Ocean (GP17-OCE) (GP17-OCE)

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

Coverage: Papeete, Tahiti to Punta Arenas, Chile

The U.S. GEOTRACES GP17-OCE expedition departed Papeete, Tahiti (French Polynesia) on December 1st, 2022 and arrived in Punta Arenas, Chile on January 25th, 2023. The cruise took place in the South Pacific and Southern Oceans aboard the R/V Roger Revelle (cruise ID RR2214) with a team of 34 scientists lead by Ben Twining (Chief Scientist), Jessica Fitzsimmons and Greg Cutter (Co-Chief Scientists). 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 a second leg (GP17-ANT; December 2023-January 2024) into coastal and shelf waters of Antarctica's Amundsen Sea.

The South Pacific and Southern Oceans sampled by GP17-OCE play critical roles in global water mass circulation and associated global transfer of heat, carbon, and nutrients. Specific oceanographic regions of interest for GP17-OCE included: the most oligotrophic gyre in the global ocean, the Antarctic Circumpolar Current (ACC) frontal region, the previously unexplored Pacific- Antarctic Ridge, the Pacific Deep Water (PDW) flow along the continental slope of South America, and the continental margin inputs potentially emanating from South America.

Further information is available on the US GEOTRACES website and in the cruise report (PDF).

NSF Project Title: Collaborative Research: Management and Implementation of US GEOTRACES GP17 Section: South Pacific and Southern Ocean (GP17-OCE)

NSF Award Abstract:
This award will support the management and implementation of a research expedition from Tahiti to Chile that will enable sampling for a broad suite of trace elements and isotopes (TEI) across oceanographic regions of importance to global nutrient and carbon cycling 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 understanding of processes that shape their distributions, such as ocean currents and material fluxes, and also the processes that depend on these elements, such as the growth of phytoplankton and the support of ocean ecosystems. The proposed cruise will cross the South Pacific Gyre, the Antarctic Circumpolar Current, iron-limited Antarctic waters, and the Chilean margin. In combination with a proposed companion GEOTRACES expedition on a research icebreaker (GP17-ANT) that will be joined by two overlapping stations, the team of investigators will create an ocean section from the ocean's most nutrient-poor waters to its highly-productive Antarctic polar region - a region that plays an outsized role in modulating the global carbon cycle. The expedition will support and provide management infrastructure for additional participating science projects focused on measuring specific external fluxes and internal cycling of TEIs along this section.

The South Pacific Gyre and Pacific sector of the Southern Ocean play critical roles in global water mass circulation and associated global transfer of heat, carbon, and nutrients, but they are chronically understudied for TEIs due to their remote locale. These are regions of strong, dynamic fronts where sub-surface water masses upwell and subduct, and biological and chemical processes in these zones determine nutrient stoichiometries and tracer concentrations in waters exported to lower latitudes. The Pacific sector represents an end member of extremely low external TEI surface fluxes and thus an important region to constrain inputs from the rapidly-changing Antarctic continent. Compared to other ocean basins, TEI cycling in these regions is thought to be dominated by internal cycling processes such as biological uptake, regeneration, and scavenging, and these are poorly represented in global ocean models. The cruise will enable funded investigators to address research questions such as: 1) what are relative rates of external TEI fluxes to this region, including dust, sediment, hydrothermal, and cryospheric fluxes? 2) What are the (micro) nutrient regimes that support productivity, and what impacts do biomass accumulation, export, and regeneration have on TEI cycling and stoichiometries of exported material? 3) What are TEI and nutrient stoichiometries of subducting water masses, and how do scavenging and regeneration impact these during transport northward? This management project has several objectives: 1) plan and coordinate a 55-day research cruise in 2021-2022; 2) use both conventional and trace-metal 'clean' sampling systems to obtain TEI samples, as well as facilitate sampling for atmospheric aerosols and large volume particles and radionuclides; 3) acquire hydrographic data and samples for salinity, dissolved oxygen, algal pigments, and macro-nutrients; and deliver these data to relevant repositories; 4) ensure that proper QA/QC protocols, as well as GEOTRACES intercalibration protocols, are followed and reported; 5) prepare the final cruise report to be posted with data; 6) coordinate between all funded cruise investigators, as well as with leaders of proposed GP17-ANT cruise; and 7) conduct broader impact efforts that will engage the public in oceanographic research using immersive technology. The motivations for and at-sea challenges of this work will be communicated to the general public through creation of immersive 360/Virtual Reality experiences, via a collaboration with the Texas A&M University Visualization LIVE Lab. Through Virtual Reality, users will experience firsthand what life and TEI data collection at sea entail. Virtual reality/digital games and 360° experiences will be distributed through GEOTRACES outreach websites, through PI engagement with local schools, libraries, STEM summer camps, and adult service organizations, and through a collaboration with the National Academy of Sciences.

US GEOTRACES GP17-OCE: Hydrogen sulfide as a strong ligand affecting the speciation and solubility of key trace metals (GP17-OCE H2S)

NSF Award Abstract:
Trace metals are present at very low parts per trillion concentrations in the ocean but in spite of their scarcity many, like iron and zinc, are essential to the growth of the microscopic plants called phytoplankton. Others, like mercury and arsenic, are toxic. In addition to very low concentrations, the essential or toxic nature of a trace metal also depends on the chemical form of the element – as a free dissolved ion all by itself or as charged ion interacting with other inorganic or organic ions. One of the inorganic ions in seawater that strongly interacts with trace metals is bisulfide, the ionic form of the foul-smelling gas hydrogen sulfide. Its reactivity with metals can be so strong that it forms metal-sulfide particles that sink out and are removed from the water. This research project will study how hydrogen sulfide interacts with trace metals like cadmium, copper, mercury, nickel, and zinc to form dissolved complexes that make these metals less reactive to other ions and phytoplankton, or insoluble particles that remove the metals. The researchers will conduct these studies on an oceanographic expedition from Tahiti to the ice edge around Antarctica to Chile as part of the U.S. GEOTRACES program with many other researchers measuring trace metals from the surface to the ocean bottom. All of this and more will be the subject of a graduate student’s doctoral research. In addition to learning how to work on a major oceanographic expedition and with other researchers, she will communicate her experiences and findings on a blog available to all who follow it. She will also help to create a presentation about her science that will be part of the “Sailing with GEOTRACES” virtual reality experience for schools, libraries/museums, festivals,

and public presentations.

The US GEOTRACES GP17-OCE cruise from Tahiti to the Antarctic ice edge to Chile will sample waters with large gradients in phytoplankton biomass and species, macronutrients, and trace metals. With anticipated changes in the concentrations and phases of hydrogen sulfide in the oxic water column, the transect offers an ideal opportunity to quantify the linked cycles of hydrogen sulfide and bioactive metals like cadmium, copper, and zinc, and the toxic element mercury. With an overall goal of quantifying the coupled cycles of trace metals and sulfide in the upper, oxic ocean, our specific research objectives for this research will be: (1) Quantify the sources and sinks of dissolved and particulate sulfide as it pertains to the cycling of key trace metals in order to accurately link their cycles; (2) Establish the conditions under which free sulfide reacts with and precipitates trace metals such as cadmium, copper, and zinc, and quantify this removal term; and (3) Evaluate whether nanoparticulate/colloidal pyrite exists in hydrothermal plumes and its contribution to iron transport relative to colloidal iron oxyhydroxides. A fully integrated set of shipboard measurements, laboratory studies, and data synthesis and speciation modeling are designed to meet these objectives. The approach includes close collaborations with investigations of dissolved and particulate trace metals and their speciation, as well as with those studying mixing processes using a variety of tracers.

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

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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-2049564

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