Aerosol and seawater beryllium-7 concentrations from 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/927107
Data Type: Cruise Results
Version: 1
Version Date: 2024-05-14

Project
» US GEOTRACES GP17 Section: South Pacific and Southern Ocean (GP17-OCE) (GP17-OCE)
» GEOTRACES GP-17 OCE: Measurement of 7Be as a Tracer of Upper Ocean Processes (GP17-OCE Be-7)

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

Contributors	Affiliation	Role
Stephens, Mark	Florida International University (FIU)	Principal Investigator
Rauch, Shannon	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
Beryllium-7, a radioactive isotope with a half-life of 53.3 days, is formed in the atmosphere, attaches to aerosol particles, and is deposited on the earth's surface through wet and dry processes. In this project, we measured Be-7 concentrations in aerosol particles and in seawater samples (depths < 200 meters) collected on the GEOTRACES GP17-OCE cruise aboard R/V Roger Revelle. The cruise originated in Papeete, Tahiti, French Polynesia on 1 December 2022 and concluded on 25 January 2023 in Punta Arenas, Chile. Sixteen aerosol samples and seawater from twelve stations in the South Pacific and Southern Oceans were collected. The dataset will be used to study the deposition of trace elements and isotopes (TEIs) and upper ocean mixing processes. Aerosol deposition is an important source of TE micronutrients to open ocean areas that are far removed from riverine sources. But, while the collection aerosol of samples for TEI analysis is straightforward, estimating the deposition flux also requires an appropriate deposition velocity (i.e. deposition flux is the product of the aerosol concentration and deposition velocity). Because Be-7 is supplied to the open ocean exclusively through aerosol deposition and it is removed through radioactive decay, the water column inventory and aerosol concentration of Be-7 can be used to derive the deposition velocity applicable to aerosol TEIs. The penetration of dissolved Be-7 below the ocean mixed layer is limited by the isotope's half-life and the rate of vertical diffusive mixing. Through modeling, the shape of the Be-7 profile below the mixed layer provides an estimate for the vertical diffusivity coefficient (Kz), which can be used to calculate fluxes of chemical species (e.g. oxygen) and physical properties (e.g. heat).

Table of Contents

Coverage

Location: South Pacific and Southern Oceans
Spatial Extent: **N**:-18.499 **E**:-75.751 **S**:-67.007 **W**:-152.002
Temporal Extent: 2022-12-03 - 2023-01-19

Methods & Sampling

Seawater sampling: The procedures used on the GEOTRACES GP17-OCE cruise were identical to those described for the GEOTRACES GP15 and GP16 cruises by Kadko et al. (2017, 2020). Briefly, a 1 horsepower (hp) centrifugal pump on deck pulled seawater from selected depths via a 1.5-inch PVC hose. 400 to 700 liters (L) of seawater were delivered to large plastic tanks in this manner. Beryllium-7 (Be-7) was then extracted by pumping the seawater through 200 grams of iron impregnated acrylic fibers at a rate of ~10 liters per minute (Lai et al., 1988; Krishnaswami et al., 1972; Lee et al., 1991). A portable CTD (model: YSI EXO1) was attached to the end of the hose so that temperature, depth, and salinity could be recorded.

Aerosol sampling: Aerosol samples were collected according to protocols set forth in the GEOTRACES cookbook using a Tisch TE-5170V-BL high-volume aerosol sampler modified to collect 12 replicate samples on 47-millimeter (mm) diameter Whatman-41 (W-41) filters (Wallace et al, 1977; Baker et al., 2006). In order to minimize filter blanks, the W-41 filters were pre-cleaned inside a HEPA-filtered laminar flow hood using three cycles of leaching with 0.5M HCl (Optima) and then rinsing with ultra-high purity water (UHP water) according to trace element protocols (Morton et al., 2013; similar to Baker et al., 2006). Sector control, which was accomplished via a Campbell Scientific data logger, was set such that the sampler would only operate during winds of >0.5 meters per second (m/s) and from ± 60° of the ship's bow to avoid sampling air influenced by the ship's exhaust. Three replicate filters from each deployment, placed in PetriSlides, were sent to FIU for Be-7 analysis.

Analytical procedures: Samples were counted for Be-7 onshore using low background germanium gamma detectors at Florida International University (FIU). FIU's facilities include four HPGe detectors: three Ortec Coaxial GEM series detectors and one Canberra Broad Energy gamma detector. For aerosols, the three replicate 47 mm filters were stacked in a Petri dish for counting. For seawater, the fibers were dried and then ashed. The powder remaining after ashing was pressed into a 5.8-centimeter (cm) diameter pellet, and the pellet thickness was measured. The iron hydroxide pellet was placed in a Petri dish for gamma counting. Be-7 has a readily identifiable gamma peak at 478 kiloelectron volts (keV), and the spectra were evaluated using Maestro (Ortec) or Genie 2000 (Canberra) software.

The detectors were calibrated for each geometry by adding a commercially prepared mixed isotope solution of known gamma activities (Eckert & Ziegler Mixed Nuclide Solution 7500) to three W-41 filters (for aerosol samples) and pellets of various thicknesses (for seawater) to derive a calibration curve using peaks associated with following isotopes: Sn-113 @ 392 keV, Sr-85 @ 514 keV, Cs-137 @ 662 keV. The counting efficiencies of the four detectors ranges from 0.05686 to 0.11415 for Be-7 on aerosol filters. And for the seawater pellets from this cruise, the counting efficiencies ranged from 0.03480 to 0.08590.

Data Processing Description

Data Processing:
Be-7 has a readily identifiable gamma peak at 478 keV, and the spectra were evaluated using Maestro (Ortec) or Genie 2000 (Canberra) software.

Reported Be-7 activities were corrected to the time of sampling. The calculation is as follows:

[Be-7, dpm m-3] = {cpm • ct • λ • exp(λ•d) } / {CE • PE • FE • V • [1-exp(-λ•ct)]}, where:

cpm = background corrected counts per minute for the region of interest (ROI);
ct = count time (days);
λ = the Be-7 radioactive decay constant (0.013 day-1);
CE = counting efficiency;
PE = photon emission probability (0.104 for Be-7);
FE – fiber extraction efficiency (92 ±3%);
V= volume (m-3);

d = time from sample collection to start of count (days)

The error (in counts) associated with each measurement is the statistical counting error (σ) and the uncertainty in the blank, √(σ2 + σb2), multiplied by {ct • λ • exp(λ•d) } / {CE • PE • FE • V • [1-exp(-λ•ct)]}. The uncertainty of the extraction efficiency (3%) and the detector efficiency (2%) was in all cases smaller than the statistical counting error.

Quality Flags:
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; (see attached Supplemental File for detection limits for Be-7 samples)
7 = value in excess;
8 = interpolated value;
9 = missing value;
A = value phenomenon uncertain.

Intercalibration and detection limits are provided in the attached Supplemental File "RR2214_Intercal_and_Detection_Limits_Be7.pdf".

BCO-DMO Processing Description

- Imported original file "RR2214_dataTemplate (1).xlsx" into the BCO-DMO system.
- Renamed fields to comply with BCO-DMO naming conventions.
- Created ISO 8601 date-time fields.
- Converted date columns to YYYY-MM-DD.
- Removed empty columns (Gear_ID, Rosette_Position).
- Saved the final file as "927107_v1_gp17-oce_beryllium-7.csv".

[table of contents | back to top]

Data Files

File
927107_v1_gp17-oce_beryllium-7.csv (Comma Separated Values (.csv), 10.44 KB) MD5:e728479c3b6ddd2149a64add5005d03a Primary data file for dataset ID 927107, version 1

[table of contents | back to top]

Supplemental Files

File
Be-7 Intercalibration and detection limits filename: RR2214_Intercal_and_Detection_Limits_Be7.pdf (Portable Document Format (.pdf), 149.80 KB) MD5:e79028e616c9d7072c62a891c327ad4b Supplemental file for dataset ID 927107, version 1. Intercalibration results and detection limits for Be-7 samples.

[table of contents | back to top]

Related Publications

Baker, A. R., French, M., & Linge, K. L. (2006). Trends in aerosol nutrient solubility along a west–east transect of the Saharan dust plume. Geophysical Research Letters, 33(7). doi:10.1029/2005gl024764 https://doi.org/10.1029/2005GL024764
Methods

Kadko, D. (2017). Upwelling and primary production during the U.S. GEOTRACES East Pacific Zonal Transect. Global Biogeochemical Cycles. doi:10.1002/2016gb005554 https://doi.org/10.1002/2016GB005554
Methods

Kadko, D., Landing, W. M., & Buck, C. S. (2020). Quantifying Atmospheric Trace Element Deposition Over the Ocean on a Global Scale With Satellite Rainfall Products. Geophysical Research Letters, 47(7). Portico. https://doi.org/10.1029/2019gl086357 https://doi.org/10.1029/2019GL086357
Methods

Krishnaswami, S., Lal, D., Somayajulu, B. L. K., Dixon, F. S., Stonecipher, S. A., & Craig, H. (1972). Silicon, radium, thorium, and lead in seawater: In-situ extraction by synthetic fibre. Earth and Planetary Science Letters, 16(1), 84–90. doi:10.1016/0012-821x(72)90240-3
Methods

Lai, D., Chung, Y., Platt, T., & Lee, T. (1988). Twin cosmogenic radiotracer studies of phosphorus recycling and chemical fluxes in the upper ocean. Limnology and Oceanography, 33(6part2), 1559–1567. doi:10.4319/lo.1988.33.6part2.1559
Methods

Lee, T., Barg, E., & Lal, D. (1991). Studies of vertical mixing in the Southern California Bight with cosmogenic radionuclides 32P and 7Be. Limnology and Oceanography, 36(5), 1044–1052. doi:10.4319/lo.1991.36.5.1044
Methods

Morton, P. L., Landing, W. M., Hsu, S.-C., Milne, A., Aguilar-Islas, A. M., Baker, A. R., … Zamora, L. M. (2013). Methods for the sampling and analysis of marine aerosols: results from the 2008 GEOTRACES aerosol intercalibration experiment. Limnology and Oceanography: Methods, 11(2), 62–78. doi:10.4319/lom.2013.11.62
Methods

Wallace, G. T., Fletcher, I. S., & Duce, R. A. (1977). Filter washing, a simple means of reducing blank values and variability in trace metal environmental samples. Journal of Environmental Science and Health . Part A: Environmental Science and Engineering, 12(9), 493–506. doi:10.1080/10934527709374775
Methods

[table of contents | back to top]

Parameters

Parameter	Description	Units
Station_ID	Station ID number (blank values = no station number for aerosol sampler deployments)	unitless
Event_ID	Event ID	unitless
Start_Date_UTC	Sample collection start date	unitless
Start_Time_UTC	Sample collection start time (UTC)	unitless

Start_ISO_DateTime_UTC	Sample collection start date and time (UTC) in ISO 8601 format	unitless
End_Date_UTC	Sample collection end date (for aerosol sampler deployments)	unitless
End_Time_UTC	Sample collection end time (for aerosol sampler deployments) (UTC)	unitless
End_ISO_DateTime_UTC	Sample collection send date and time (UTC) in ISO 8601 format (for aerosol sampler deployments)	unitless
Start_Latitude	Latitude at start of sample collection	decimal degrees
Start_Longitude	Longitude at start of sample collection	decimal degrees
End_Latitude	Latitude at end of sample collection (for aerosol sampler deployments)	decimal degrees
End_Longitude	Longitude at end of sample collection (for aerosol sampler deployments)	decimal degrees
Sample_ID	GEOTRACES sample ID number	unitless
Sample_Depth	Depth of seawater sample	meters (m)
Be_7_D_CONC_PUMP_zo1nvd	Seawater beryllium-7 activity concentration	microBecquerel per kilogram (uBq/kg)
SD1_Be_7_D_CONC_PUMP_zo1nvd	One standard deviation for Be_7_D_CONC_PUMP_zo1nvd	microBecquerel per kilogram (uBq/kg)
Flag_Be_7_D_CONC_PUMP_zo1nvd	Quality flag for Be_7_D_CONC_PUMP_zo1nvd. SeaDatNet flag scheme.	unitless
Be_7_A_T_CONC_HIVOL_b7gzuk	Aerosol beryllium-7 activity concentration	milliBecquerel per cubic meter (mBq/m^3)
SD1_Be_7_A_T_CONC_HIVOL_b7gzuk	One standard deviation for Be_7_A_T_CONC_HIVOL_b7gzuk	milliBecquerel per cubic meter (mBq/m^3)

Flag_Be_7_A_T_CONC_HIVOL_b7gzuk	Quality flag for Be_7_A_T_CONC_HIVOL_b7gzuk. SeaDataNet flag scheme.	unitless

[table of contents | back to top]

Instruments

Dataset-specific Instrument Name	Tisch TE-5170V-BL high volume aerosol sampler
Generic Instrument Name	Aerosol Sampler
Generic Instrument Description	A device that collects a sample of aerosol (dry particles or liquid droplets) from the atmosphere.

Dataset-specific Instrument Name	Campbell Scientific data logger
Generic Instrument Name	Data Logger
Generic Instrument Description	Electronic devices that record data over time or in relation to location either with a built-in instrument or sensor or via external instruments and sensors.

Dataset-specific Instrument Name	low background germanium gamma detectors
Generic Instrument Name	Germanium detector
Dataset-specific Description	FIU's facilities include four HPGe detectors: three Ortec Coaxial GEM series detectors and one Canberra Broad Energy gamma detector. The detectors were calibrated for the each geometry by adding a commercially prepared mixed isotope solution of known gamma activities (Eckert & Ziegler Mixed Nuclide Solution 7500) to three W-41 filters (for aerosol samples) and pellets of various thicknesses (for seawater) to derive a calibration curve using peaks associated with following isotopes: Sn-113 @ 392 keV, Sr-85 @ 514 keV, Cs-137 @ 662 keV. The counting efficiencies of the four detectors ranges from 0.05686 to 0.11415 for Be-7 on aerosol filters. And for the seawater pellets from this cruise, the counting efficiencies ranged from 0.03480 to 0.08590.
Generic Instrument Description	Germanium detectors are semiconductor diodes having a p-i-n structure in which the intrinsic (i) region is sensitive to ionizing radiation, particularly x rays and gamma rays. Under reverse bias, an electric field extends across the intrinsic or depleted region. When photons interact with the material within the depleted volume of a detector, charge carriers (holes and electrons) are produced and are swept by the electric field to the p and n electrodes. This charge, which is in proportion to the energy deposited in the detector by the incoming photon, is converted into a voltage pulse by an integral charge sensitive preamplifier. Germanium detectors are mostly used for gamma spectroscopy in nuclear physics, as well as x-ray spectroscopy.

Dataset-specific Instrument Name	centrifugal pump
Generic Instrument Name	Pump
Dataset-specific Description	A 1 hp centrifugal pump on deck pulled seawater from selected depths via a 1.5-inch pvc hose.
Generic Instrument Description	A pump is a device that moves fluids (liquids or gases), or sometimes slurries, by mechanical action. Pumps can be classified into three major groups according to the method they use to move the fluid: direct lift, displacement, and gravity pumps

Dataset-specific Instrument Name	portable CTD (model: YSI EXO1)
Generic Instrument Name	YSI EXO multiparameter water quality sondes
Generic Instrument Description	Comprehensive multi-parameter, water-quality monitoring sondes designed for long-term monitoring, profiling and spot sampling. The EXO sondes are split into several categories: EXO1 Sonde, EXO2 Sonde, EXO3 Sonde. Each category has a slightly different design purpose with the EXO2 and EXO3 containing more sensor ports than the EXO1. Data are collected using up to four user-replaceable sensors and an integral pressure transducer. Users communicate with the sonde via a field cable to an EXO Handheld, via Bluetooth wireless connection to a PC, or a USB connection to a PC. Typical parameter specifications for relevant sensors include dissolved oxygen with ranges of 0-50 mg/l, with a resolution of +/- 0.1 mg/l, an accuracy of 1 percent of reading for values between 0-20 mg/l and an accuracy of +/- 5 percent of reading for values 20-50 mg/l. Temp ranges are from-5 to +50 degC, with an accuracy of +/- 0.001 degC. Conductivity has a range of 0-200 mS/cm, with an accuracy of +/-0.5 percent of reading + 0.001 mS/cm and a resolution of 0.0001 - 0.01 mS/cm.

[table of contents | back to top]

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

[table of contents | back to top]

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.

GEOTRACES GP-17 OCE: Measurement of 7Be as a Tracer of Upper Ocean Processes (GP17-OCE Be-7)

Coverage: South Pacific

NSF Award Abstract:
The International GEOTRACES Program was established to identify processes and quantify fluxes that control the distributions of key trace elements and their isotopes in the ocean as these chemical species play important roles as nutrients, as tracers of current and past oceanographic processes, and as contaminants derived from human activity. This is a proposal to make measurements of one such species (the radioactive isotope Beryllium-7) in the water column and on aerosols during the US GEOTRACES GP17-OCE section of the South Pacific and Southern Oceans. Beryllium-7 is a tracer that, because of its half-life (53.3 days), allows the study of processes such as biological production, nutrient regeneration, and atmospheric deposition, which occur over seasonal time scales and shallow depths (<200m). The data will be used to derive important biogeochemical rate information pertinent to interpreting sources and transformations of the extensive suite of trace elements and isotopes that will be measured during the expedition.

The proposed work will measure beryllium-7 in the surface waters and in the lower atmosphere to provide estimates of the atmospheric input of relevant trace elements and isotopes. The atmospheric input into the global ocean is an important budgetary component of numerous chemical species, but there is little-to-no data

from this region. Determination of the atmospheric input and its variability will allow observation of the oceanic response to this flux along the cruise track. The water column measurements of beryllium-7 will be used as a tracer of physical processes, such as mixing and upwelling, which redistribute biologically active species. The rate of oxygen utilization (OUR) within the upper thermocline will also be determined by water column measurements of beryllium-7 coupled with hydrographic data and observed oxygen distributions. Accurate characterization of this process within 200m of the euphotic zone, where carbon utilization is most intense, has been difficult owing to limitations of other available techniques which are characterized by multiyear to decadal timescales that likely miss the rapid organic matter remineralization occurring along shallow isopycnal surfaces. The seasonal timescale of beryllium-7 will allow for estimation of OUR within the shallow water just beneath the euphotic zone, where the most significant remineralization occurs. This research will support undergraduate researchers in a minority serving institution.

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.

[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-2147723

[table of contents | back to top]