

Depth profiles of seawater particulate ²³²Th, ²³⁰Th, and ²³¹Pa from R/V Sonne cruise SO245 (UltraPac, GPpr09) during Dec 2015 to Jan 2016

Website: <https://www.bco-dmo.org/dataset/813317>

Data Type: Cruise Results

Version: 1

Version Date: 2020-06-03

Project

» [Supply and removal of trace elements in the subtropical South Pacific](#) (UltraPac Trace Elements)

Program

» [U.S. GEOTRACES](#) (U.S. GEOTRACES)

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Abstract

This dataset contains depth profiles of seawater particulate ²³²Th, ²³⁰Th, and ²³¹Pa from R/V Sonne cruise SO245 (UltraPac, GPpr09).

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Coverage

Spatial Extent: N:-23.490667 E:-84.930117 S:-39.310683 W:-169.971433

Temporal Extent: 2015-12-27 - 2016-01-24

Dataset Description

This dataset contains depth profiles of seawater particulate ²³²Th, ²³⁰Th, and ²³¹Pa from R/V Sonne cruise SO245 (UltraPac, GPpr09).

Dataset Notes:

Radionuclide concentrations are given as micro-Becquerel (10⁻⁶ Bq, μBq or micro-Bq) per kg seawater for

^{230}Th and ^{231}Pa , and pmol (10-12 mol) per kg seawater for ^{232}Th . A Becquerel is the SI unit for radioactivity and is defined as 1 disintegration per second. These units are recommended by the GEOTRACES community.

The "total particulate" (TP) data refers to the particle size class $>0.8\mu\text{m}$. The particulate samples were collected by in-situ pumping over paired 0.8m Pall Supor800 polyethersulfone filters (See Lam et al. 2015 for particulate sampling methodology, noting that our deployments did not include a $>51\mu\text{m}$ prefilter). Analysis of the paired Supor filters represents a particle size class approximating $>0.45\mu\text{m}$ (Bishop et al. 2012), while the top filter alone represents $>0.8\mu\text{m}$ and it is this size class referred to here as the total particulate fraction. On previous sampling campaigns, we measured a select number of top and bottom filters separately for radionuclides and found that the bottom filters had radionuclide levels that were indistinguishable from clean filter process blanks. Therefore whether or not samples were analyzed as top and bottom paired, or the top filter alone, we infer the total particulate data to represent $>0.8\mu\text{m}$ particles.

Parameter names are adopted based on a recommendation from the GEOTRACES community (http://www.geotraces.org/Parameter_Naming_Conventions.html)

Acquisition Description

Large-volume particulate samples were collected using McLane Research in-situ pumps (WTS-LV Standard Model). The wire-out was used to target depths during deployment, and a self-recording Seabird 19plus CTD deployed at the end of the line was used to correct for actual depths during pumping.

Filter holders used were 142 mm-diameter filter holders with a titanium baffle. Filter holders were loaded with paired $0.8\mu\text{m}$ Pall Supor800 polyethersulfone filters. Each cast also had "dipped blank" filters deployed. These were single filters, either $0.2\mu\text{m}$ or $0.8\mu\text{m}$, deployed inside Ziploc bags with holes cut in them to expose the filters to seawater, attached with plastic cable ties to a pump frame, and deployed. Dipped blank filters were exposed to seawater for the length of the deployment and processed and analyzed as regular samples, and thus functioned as full seawater process blanks. We analyzed 1/4 portions of the dipped blank from each pump cast.

All filters and filter holders were acid leached prior to use according to methods recommended in the GEOTRACES sample and sample-handling Protocols (Geotraces 2010).

Analytical methods for particulate radionuclides:

Filters were folded into 60 mL Teflon jars and weighed aliquots of artificial isotope yield monitors ^{229}Th (1 pg) and ^{233}Pa (0.3-0.4 pg) and 7-8 mg dissolved Fe were added to each sample, which then sat overnight in 5 mL 16M HNO_3 [All acids and bases used were Fisher Chemical OPTIMA grade or equivalent from Trace Metal grade acids re-distilled in a Savillex™ DST-1000 sub-boiling still]. The next day, the filters were heated for ~ 1 hour at 180°C , at which point 4-5 ml HClO_4 was added and the hot plate temperature was increased to 220°C . Samples were heated until dense white fumes appeared. After 10-20 minutes, the samples were covered with a Teflon watch cover. After 30-60 minutes, rapid oxidation of the Supor material would occur, at which point the Supor material was almost completely broken down. The watch glasses were removed and beaker walls were rinsed down with 3 ml 8N HNO_3 . Ten drops of HF were added, and the samples were heated at 220°C until the HClO_4 dried down to a viscous residue.

The sample residue was taken up in dilute HCl, and transferred to 50 mL centrifuge tubes with Milli-Q water rinses. Fifteen to 25 drops of NH_4OH were added to raise pH to 8-8.5 when iron (oxy)hydroxide precipitated. This precipitate was then centrifuged, supernatant was decanted, and the precipitate was washed with Milli-Q H_2O . These step were repeated. The precipitate was then dissolved in 12 M HCl, ready for a series of anion-exchange chromatography steps to purify Th and Pa, as outlined in Anderson et. al., 2012. The purified Th and Pa solutions were dried down at $180\text{-}220^\circ\text{C}$ in the presence of 2 drops of HClO_4 and taken up in 0.5 mL of 0.16 M $\text{HNO}_3/0.026\text{ M HF}$ for mass spectrometric analysis.

Concentrations of ^{232}Th , ^{230}Th and ^{231}Pa were calculated by isotope dilution, relative to the calibrated tracers ^{229}Th and ^{233}Pa added at the beginning of sample processing. Analyses were carried out on a

Thermo-Finnegan ELEMENT XR Single Collector Magnetic Sector ICP-MS, equipped with a high-performance Interface pump (Jet Pump), and specially-designed sample (X) and skimmer (Jet) cones to ensure the highest possible sensitivity. All measurements were made in low-resolution mode ($\Delta m/M \approx 300$), peak jumping in Escan mode across the central 5% of the flat-topped peaks. Measurements were made on a MasCom™ SEM; 229Th, 230Th, 231Pa and 233Pa were measured in Counting mode, while the 232Th signals were large enough that they were measured in Analog mode. Two solutions of SRM129, a natural U standard, were run multiple times throughout each run. One solution was in a concentration range where 238U and 235U were both measured in counting mode, allowing us to determine the mass bias/amu (typical values varied from -0.01/amu to 0.03/amu). In the other, more concentrated solution, 238U was measured in Analog mode and 235U was measured in Counting mode, yielding a measurement of the Analog/Counting Correction Factor. These corrections assume that the mass bias and Analog Correction Factor measured on U isotopes can be applied to Th and Pa isotope measurements. Each sample measurement was bracketed by measurement of an aliquot of the run solution, used to correct for the instrumental background count rates. To correct for tailing of 232Th into the minor Th and Pa isotopes, a series of 232Th standards were run at concentrations bracketing the expected 232Th concentrations in the samples. The analysis routine for these standards was identical to the analysis routine for samples, so we could see the changing beam intensities at the minor masses as we increased the concentration of the 232Th standards. The 232Th count rates in our Pa fractions are quite small, reflecting mainly reagent blanks, compared to the 232Th signal intensity in the Th fraction. The regressions of 230Th, 231Pa, and 233Pa signals as a function of the 232Th signal in the standards was used to correct for tailing of 232Th in samples.

In addition to laboratory procedural blanks (reagents/labware blanks) and periodic measurements of an intercalibrated working standard solution of 232Th, 230Th and 231Pa, SW STD 2015-1, we also analyzed "dipped blank" filters, mentioned above, to determine the total blank, associated with the sample collection and handling in addition to the laboratory procedure.

We pooled all procedural blank-corrected "dipped" blanks to determine filter blank corrections. That is, the data were corrected by the average dipped blank values. Averages for "dipped" filter blanks from SO245 for a 1/4 filter fraction for 232Th, 230Th, and 231Pa at LDEO were 8.67 ± 4.26 pg, 1.56 ± 0.7 fg, and 0.09 ± 0.04 fg, respectively.

Further details on analysis of seawater particulate radionuclides are given by Anderson et al. (2012).

Derived Parameters:

Th_230_TP_XS_CONC_PUMP - The total particulate excess Th-230 refers to the measured total particulate Th-230 corrected for a contribution of Th-230 originating from U-bearing minerals or lithogenic Th-230. Some of this lithogenic Th-230 will be still intact within minerals and some after partial dissolution will have adsorbed to particle surface to contribute in part to the total adsorbed Th-230. Using the measured total particulate Th-232 and a lithogenic Th-230/232 atomic ratio of $4e-6$, and not taking into account the fact that some of the measured particulate Th-232 is adsorbed, corrects for all of the lithogenic Th-230 whether it be adsorbed or within intact minerals. This excess Th-230 is what should be used in scavenging or particle flux studies where it is desired to compare particulate Th-230 concentrations to Th-230 production by decay of uranium dissolved in seawater. An additional conversion factors converts picomoles to micro-Becquerels.

$$\text{Th}_{230_TP_XS_CONC_PUMP} = \text{Th}_{230_TP_CONC_PUMP} - 4.0e-6 * 1.7473e5 * \text{Th}_{232_TP_CONC_PUMP}$$

Pa_231_TP_XS_CONC_PUMP - The total particulate excess Pa-231 refers to the measured total particulate Pa-231 corrected for a contribution of Pa-231 originating from U-bearing minerals or lithogenic Pa-231. Some of this lithogenic Pa-231 will be still intact within minerals and some after partial dissolution will have adsorbed to particle surface to contribute in part to the total adsorbed Pa-231. Using the measured total particulate Th-232 and a lithogenic Pa-231/Th-232 atomic ratio of $8.8e-8$, and not taking into account the fact that some of the measured particulate Th-232 is adsorbed, corrects for all of the lithogenic Pa-231 whether it be adsorbed or within intact minerals. This excess Pa-231 is what should be used in scavenging or particle flux studies where it is desired to compare particulate Pa-231 concentrations to Pa-231 production by decay of uranium dissolved in seawater. An additional conversion factor converts picomoles to micro-Becquerels.

$$\text{Pa}_{231_TP_XS_CONC_PUMP} = \text{Pa}_{231_TP_CONC_PUMP} - 8.8\text{e-}8 * 4.0370\text{e}5 * \text{Th}_{232_TP_CONC_PUMP}$$

Processing Description

Data Processing:

The reported errors for radionuclide concentrations represent the propagation of one sigma errors based on the standard isotope ratios collected by ICP-MS, estimated error in the 229Th or 233Pa spike concentration, and the blank correction of the individual isotopes for each sample batch.

Individual uncertainties for thorium were calculated to include contributions from (a) blank correction using the variance of the blanks measured over the course of the analyses, (b) standard error of the ratios of the analysis (typically close to counting statistics) and (c) spike calibration. For Pa we also included assessment of the correction from the yield correction, mass bias and machine background. In order to assess the reproducibility of the procedure, repeat analyses were performed on the GEOTRACES 2015-1 standard (SW STD 2015-1). For standards run alongside SO245 particle samples at LDEO, the reproducibility for each isotope was 0.92% for 230Th, 5.86% for 232Th and 3.50% for 231Pa.

Data quality flags:

SeaDataNet data quality flags have been assigned to all reported parameters except for the derived parameters Th_230_TP_XS_CONC_BOTTLE and Pa_231_TP_XS_CONC_BOTTLE. More information on SeaDataNet flags is available from GEOTRACES at <http://www.geotraces.org/library-88/geotraces-policies/1577-geotraces-quality-flag-policy> and from SeaDataNet at <https://www.seadatanet.org/Standards/Data-Quality-Control>. In summary:

- 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 (BDL);
- 7 = value in excess;
- 8 = interpolated value;
- 9 = missing value.

Flag definitions for Th_230_TP_XS_CONC_BOTTLE:

- 1 = Both 230Th and 232Th data good;
- 2 = 232Th data bad but 230Th data good;
- 3 = 230Th data bad.

Flag definitions for Pa_231_TP_XS_CONC_BOTTLE:

- 1 = Both 231Pa and 232Th data good;
- 2 = 232Th data bad but 231Pa data good;
- 3 = 231Pa data bad.

BCO-DMO Processing:

- renamed fields;
- rounded values to precision request by data submitter;
- added ISO8601 date/time columns.

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Related Publications

Andersen, M. B., Stirling, C. H., Zimmermann, B., & Halliday, A. N. (2010). Precise determination of the open ocean 234U/238U composition. *Geochemistry, Geophysics, Geosystems*, 11(12), n/a–n/a.

doi:10.1029/2010gc003318 <https://doi.org/10.1029/2010GC003318>

General

Anderson, R. F., Fleisher, M. Q., Robinson, L. F., Edwards, R. L., Hoff, J. A., Moran, S. B., ... Francois, R. (2012). GEOTRACES intercalibration of 230Th, 232Th, 231Pa, and prospects for 10Be. *Limnology and Oceanography: Methods*, 10(4), 179–213. doi:[10.4319/lom.2012.10.179](https://doi.org/10.4319/lom.2012.10.179)

Methods

Auro, M. E., Robinson, L. F., Burke, A., Bradtmiller, L. I., Fleisher, M. Q., & Anderson, R. F. (2012). Improvements to 232-thorium, 230-thorium, and 231-protactinium analysis in seawater arising from GEOTRACES intercalibration. *Limnology and Oceanography: Methods*, 10(7), 464–474.

doi:[10.4319/lom.2012.10.464](https://doi.org/10.4319/lom.2012.10.464)

General

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

doi:[10.4319/lom.2012.10.681](https://doi.org/10.4319/lom.2012.10.681)

Methods

Chen, J. H., Lawrence Edwards, R., & Wasserburg, G. J. (1986). 238U, 234U and 232Th in seawater. *Earth and Planetary Science Letters*, 80(3-4), 241–251. doi:10.1016/0012-821x(86)90108-1

[https://doi.org/10.1016/0012-821X\(86\)90108-1](https://doi.org/10.1016/0012-821X(86)90108-1)

General

Cheng, H., Lawrence Edwards, R., Shen, C.-C., Polyak, V. J., Asmerom, Y., Woodhead, J., ... Calvin Alexander, E. (2013). Improvements in 230Th dating, 230Th and 234U half-life values, and U–Th isotopic measurements by multi-collector inductively coupled plasma mass spectrometry. *Earth and Planetary Science Letters*, 371-372, 82–91. doi:[10.1016/j.epsl.2013.04.006](https://doi.org/10.1016/j.epsl.2013.04.006)

General

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

Methods

Owens, S. A., Buesseler, K. O., & Sims, K. W. W. (2011). Re-evaluating the 238U-salinity relationship in seawater: Implications for the 238U–234Th disequilibrium method. *Marine Chemistry*, 127(1-4), 31–39.

doi:[10.1016/j.marchem.2011.07.005](https://doi.org/10.1016/j.marchem.2011.07.005)

General

Roy-Barman, M., Coppola, L., & Souhaut, M. (2002). Thorium isotopes in the western Mediterranean Sea: an insight into the marine particle dynamics. *Earth and Planetary Science Letters*, 196(3-4), 161–174.

doi:10.1016/S0012-821x(01)00606-9 [https://doi.org/10.1016/S0012-821X\(01\)00606-9](https://doi.org/10.1016/S0012-821X(01)00606-9)

General

Taylor, S. R., & McLennan, S. M. (1995). The geochemical evolution of the continental crust. *Reviews of Geophysics*, 33(2), 241. doi:10.1029/95rg00262 <https://doi.org/10.1029/95RG00262>

General

Weyer, S., Anbar, A. D., Gerdes, A., Gordon, G. W., Algeo, T. J., & Boyle, E. A. (2008). Natural fractionation of 238U/235U. *Geochimica et Cosmochimica Acta*, 72(2), 345–359.

doi:[10.1016/j.gca.2007.11.012](https://doi.org/10.1016/j.gca.2007.11.012)

General

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Parameters

Parameter	Description	Units
Station_ID	Station number	unitless

Start_Date.UTC	Start date (UTC); format: DD/MM/YYYY	unitless
Start_Time.UTC	Start time (UTC); format: hh:mm	unitless
Start_ISO_DateTime.UTC	Start date and time (UTC) formatted to ISO8601 standard: YYYY-MM-DDThh:mmZ	unitless
End_Date.UTC	End date (UTC); format: DD/MM/YYYY	unitless
End_Time.UTC	End time (UTC); format: hh:mm	unitless
End_ISO_DateTime.UTC	End date and time (UTC) formatted to ISO8601 standard: YYYY-MM-DDThh:mmZ	unitless
Start_Latitude	Start latitude	degrees North
Start_Longitude	Start longitude	degrees East
End_Latitude	End latitude	degrees North
End_Longitude	End longitude	degrees East
Event_ID	Event number	unitless
Sample_ID	Sample number	unitless
Sample_Depth	Sample depth	meters (m)
Th_232_TP_CONC_PUMP_oboqio	Total particulate Th-232 concentration	pmol/kg
SD1_Th_232_TP_CONC_PUMP_oboqio	One standard deviation of Th_232_TP_CONC_PUMP_oboqio	pmol/kg
Flag_Th_232_TP_CONC_PUMP_oboqio	Quality flag for Th_232_TP_CONC_PUMP_oboqio	unitless
Th_230_TP_CONC_PUMP_e6mfsz	Total particulate Th-230 concentration	uBq/kg
SD1_Th_230_TP_CONC_PUMP_e6mfsz	One standard deviation of Th_230_TP_CONC_PUMP_e6mfsz	uBq/kg
Flag_Th_230_TP_CONC_PUMP_e6mfsz	Quality flag for Th_230_TP_CONC_PUMP_e6mfsz	unitless
Pa_231_TP_CONC_PUMP_r0ifiu	Total particulate Pa-231 concentration	uBq/kg
SD1_Pa_231_TP_CONC_PUMP_r0ifiu	One standard deviation of Pa_231_TP_CONC_PUMP_r0ifiu	uBq/kg
Flag_Pa_231_TP_CONC_PUMP_r0ifiu	Quality flag for Pa_231_TP_CONC_PUMP_r0ifiu	unitless
Th_230_TP_XS_CONC_PUMP	Total particulate excess Th-230 (see notes for full explanation)	uBq/kg
SD1_Th_230_TP_XS_CONC_PUMP	One standard deviation of Th_230_TP_XS_CONC_PUMP	uBq/kg
Flag_Th_230_TP_XS_CONC_PUMP	Quality flag for Th_230_TP_XS_CONC_PUMP	unitless
Pa_231_TP_XS_CONC_PUMP	Total particulate excess Pa-231 (see notes for full explanation)	uBq/kg
SD1_Pa_231_TP_XS_CONC_PUMP	One standard deviation of Pa_231_TP_XS_CONC_PUMP	uBq/kg
Flag_Pa_231_TP_XS_CONC_PUMP	Quality flag for Pa_231_TP_XS_CONC_PUMP	unitless

Instruments

Dataset-specific Instrument Name	Seabird 19plus CTD
Generic Instrument Name	CTD Sea-Bird
Generic Instrument Description	Conductivity, Temperature, Depth (CTD) sensor package from SeaBird Electronics, no specific unit identified. This instrument designation is used when specific make and model are not known. See also other SeaBird instruments listed under CTD. More information from Sea-Bird Electronics.

Dataset-specific Instrument Name	McLane Research in-situ pumps (WTS-LV Standard Model)
Generic Instrument Name	McLane Large Volume Pumping System WTS-LV
Generic Instrument Description	The Large Volume Pumping System-WTS-LV can be one of several different models of Water Transfer Systems (WTS) Large Volume (LV) pumping systems designed and manufactured by McLane Research Labs (Falmouth, MA, USA). The Large Volume Water Transfer System (WTS-LV) is a large volume single-event sampler that collects suspended and dissolved particulate samples in situ into a 142mm membrane filter. The WTS-LV allows for a choice of pump size and filter porosity for a range of specimen collection. Collection targets include chlorophyll maximum, particulate trace metals, and phytoplankton.

Dataset-specific Instrument Name	Thermo-Finnegan ELEMENT XR Single Collector Magnetic Sector ICP-MS
Generic Instrument Name	Inductively Coupled Plasma Mass Spectrometer
Generic Instrument Description	An ICP Mass Spec is an instrument that passes nebulized samples into an inductively-coupled gas plasma (8-10000 K) where they are atomized and ionized. Ions of specific mass-to-charge ratios are quantified in a quadrupole mass spectrometer.

Dataset-specific Instrument Name	
Generic Instrument Name	Centrifuge
Generic Instrument Description	A machine with a rapidly rotating container that applies centrifugal force to its contents, typically to separate fluids of different densities (e.g., cream from milk) or liquids from solids.

Deployments

S0245

Website	https://www.bco-dmo.org/deployment/813132
Platform	R/V Sonne
Report	https://datadocs.bco-dmo.org/docs/302/UltraPac_Trace_Elements/data_docs/awi_doi_10.2312_cr_so245.pdf
Start Date	2015-12-17
End Date	2016-01-28

Project Information

Supply and removal of trace elements in the subtropical South Pacific (UltraPac Trace Elements)

Coverage: South Pacific Gyre between Peru and Tahiti

NSF Award Abstract: With funding from this RAPID award, an American research team at the Lamont-Doherty Earth Observatory of Columbia University will study the supply and removal of trace elements in the South Pacific Subtropical Gyre (SPSG). This will be done in the context of an international program (UltraPac) under the direction of Dr. Tim Ferdelman of the Max Planck Institute in Bremen, Germany, who has invited the Lamont-Doherty team to join the German scientists aboard their expedition on the Research Vessel Sonne (December 2015 - January 2016) between Antofagasta, Chile and Wellington, New Zealand. UltraPac is a coordinated interdisciplinary study of the SPSG, including research on microbiology, molecular biology, zooplankton, aerosols, trace metals, nitrogen fixation, carbon and nutrient biogeochemistry, among other topics. The American team will measure dissolved and particulate concentrations of long-lived, naturally-occurring radioisotopes in the uranium and thorium decay series that can be used to provide constraints on the rates of supply and removal of trace elements within this regime. The project will also provide education, training and professional development for two PhD students that would otherwise be unavailable through other aspects of their PhD research. It will also provide an opportunity for the students to network with foreign collaborators, which will be very beneficial to their long-term career development. This project will enable the Lamont-Doherty scientists to quantify the rates of supply and removal of trace elements in the severely undersampled SPSG, the ocean's largest biogeographic province, characterized by a hyper-oligotrophic (low biological productivity) ecosystem and ultra-low dust fluxes. Evaluating the supply of trace elements from dust provides critical information about sources of essential micronutrients that influence the ecology and biogeochemistry of the SPSG. The award will cover the travel expenses for two people to participate in the cruise, shipping to and from the cruise, and instrument fees to analyze samples collected on the cruise. Comparing scavenging results from the SPSG with results from recent studies of other biogeographic provinces, including the North Pacific Subtropical Gyre, the Subarctic North Pacific, the North Atlantic Subtropical Gyre and the Eastern Tropical South Pacific, will build toward the team's long-range goal of characterizing the intensity of trace element removal from the ocean in terms of environmental, ecological and biogeochemical characteristics of ocean biogeographic provinces. The deep water column of the SPSG is influenced by the hydrothermal plume

emanating from the East Pacific Rise. Comparing SPSSG results with those from regions lacking significant influence by hydrothermal plumes will also enable them to constrain the role of these plumes in defining the global distribution of trace elements in the deep ocean. This effort should provide rates of supply and removal of biologically essential micronutrients, and of other trace elements, in an end-member ocean regime that is not scheduled for sampling by a GEOTRACES ocean section, thus filling a gap in the global database for trace elements and isotopes under development by GEOTRACES. Results will be obtained using GEOTRACES-compliant methods, and made available through the GEOTRACES database for use by investigators in other fields.

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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-1555726

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