Carbonate system data from the US GETORACES GP17-OCE cruise on R/V Roger Revelle (RR2214) across the South Pacific and Southern Oceans from December 2022 to January 2023

Website: https://www.bco-dmo.org/dataset/995080
Data Type: Cruise Results
Version: 1
Version Date: 2026-03-18

Project
» US GEOTRACES GP17-OCE and GP17-ANT: Inorganic Carbon Cycling in the South Pacific and Southern Oceans by Direct Measurement (GP17-OCE and GP17-ANT Inorganic Carbon)
» US GEOTRACES GP17 Section: South Pacific and Southern Ocean (GP17-OCE) (GP17-OCE)

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

Contributors	Affiliation	Role
Woosley, Ryan	Massachusetts Institute of Technology (MIT)	Principal Investigator
Moon, Jiyoung	Massachusetts Institute of Technology (MIT)	Scientist
Lahn, Lou	Massachusetts Institute of Technology (MIT)	Student
Neithardt, Daina	Massachusetts Institute of Technology (MIT)	Student
Bruno, Jessica A.	Massachusetts Institute of Technology (MIT)	Technician
Rauch, Shannon	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract

This dataset includes total alkalinity (TA), dissolved inorganic carbon (DIC), and pH on the total scale (pHt) at 25 degrees Celsius collected on the GEOTRACES GP17-OCE cruise onboard the R/V Revelle between December 1, 2022 and January 25, 2023. All three were collected from the ODF rosette, with pHt also being collected from the FISH. The pHt was measured at 25 degrees Celsius onboard, while the TA and DIC were collected into borosilicate glass bottles and returned to the laboratory for analysis. These data can be used in conjunction with trace element and isotope (TEI) data also collected on the cruise to better understand the role of TEIs on carbon cyclings as well as decadal-scale changes and variability in South Pacific carbon chemistry when combined with prior (or future) occupations in the same region.

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Coverage

Location: South Pacific Ocean
Spatial Extent: **N**:-2.14 **E**:-1.2 **S**:-67.24 **W**:-152.26

Temporal Extent: 2022-12-04 - 2023-01-24

Methods & Sampling

All samples were collected and analyzed following best practices guidelines (Dickson et al. 2007). The total alkalinity (TA) and dissolved inorganic carbon (DIC) were collected in 250 milliliter (mL) borosilicate glass reagent bottles and sealed using Apiezon L grease and a rubber band held in place with a plastic hose clamp. TA and DIC were analyzed from the same bottle. The pHt was collected in 150 mL borosilicate glass serum bottles and sealed with a butyl-rubber cap and aluminum seal. All bottles were filled in the same manner. A silicone tube was attached to the niskin valve. A small amount of water was added to the bottle and the bottle was swirled to cover all surfaces and dumped out. This rinse was repeated a total of three times. Then the tube was placed near the bottom of the bottle and filled. The tube was tapped against the bottom to dislodge any bubbles, and care was taken to overflow any bubbles. Once full, the water was allowed to overflow for at least half the volume of the bottle (as estimated by time to fill the bottle) and all visible bubbles were gone. Overflow water was used to rinse the caps. With the water still flowing, the tube was gently, but quickly, removed leaving the bottle full to the brim. A pipette was then used to remove a precise amount of water leaving ~1% headspace once bottle was capped. After removing the water for headspace, a saturated mercuric chloride solution was added to a total volume of 0.04% of the sample. The DIC/TA was then capped with a glass stopper with apiezon L grease, twisting the cap to ensure even distribution of grease, creating an airtight seal. A rubber band and hose clamp were then placed on the cap to keep it in place. For pHt, the rubber stopper was inserted and an aluminum seal was crimped on top. Once sealed, bottles were gently inverted several times in order to mix the mercuric chloride. After collection, DIC/TA bottles were placed in plastic crates with protective foam and stored at room temperature for shipping back to the laboratory at the end of the cruise. The pHt samples were immediately placed in a 25 degree Celsius water bath to equilibrate the temperature before analysis.

The pHt at 25°C was analyzed within 6 hours of collection. The samples were allowed approximately 2 hours for temperature equilibration before analysis was started. The pHt was then measured spectrophotometrically with purified metacresol purple (mCP) dye (Woosley lab batch 4) obtained from the laboratory of Robert H. Byrne (University of South Florida), using a custom-designed automated system similar to that of Carter et al. (2013). The instrument uses a 10 mL Kloehn syringe pump to draw the sample from the bottle, rinse the flow-through 10 cm quartz spectrophotometric cell (Starna, Inc.), add and mix the mCP indicator, and finally rinse the cell after analysis. An Agilent 8454 UV/VIS spectrophotometer was used to take the blank and full spectra with mCP. The absorbances at 434, 578, 730, and 488 nanometers (nm) were used for calculations. The equations of Liu et al. (2011) were used to calculate pHt, and the isobestic absorbance at 488 nm was used to determine the indicator perturbation adjustment following the method described in Carter et al. (2013). The dye perturbation slope and intercept were -0.0732 and 0.071, respectively. Duplicate samples, Certified reference material provided by the laboratory of Andrew G. Dickson (University of California, San Diego), and TRIS buffers prepared according to Paulsen and Dickson (2020) were used to check precision and "accuracy". The mean absolute difference between duplicate samples was 0.0017 ± 0.0016 (N=50). The mean and standard deviation of CRM (Batch 179) was 8.0920 ± 0.0020 (N =41), and for TRIS (Woosley Lab Batch 5) 8.0949 ± 0.0022 (N = 58).

The DIC/TA samples were stored in the science hold at room temperature after collection, shipped to the land-based laboratory at MIT, and then stored at room temperature in a closet until analysis. Analyses were performed between 15 and 20 months after the end of the cruise. DIC was analyzed first then handed off to an analyst for TA. Both analyses were always performed on the same day and generally within 10-15 minutess of each other.

DIC was analyzed using a custom-designed DIC extractor (DICE) built by NOAA PMEL (Pacific Marine Environmental Laboratory). It is a modern version of the original SOMMA system (Johnson 1992) and follows the methods described in Dickson et al. (2007) in SOP 2. Analysis is performed at 20°C. The instrument uses a calibrated pipette to precisely dispense the volume of sample into a stripper chamber where 8.5% phosphoric acid had been added. The acid converted all the DIC to CO2 gas. A pure N2 carrier gas then carried the evolved CO2 through a condensor to remove water vapor followed by a silica gel to remove any organic acids and finally into the coulometer (UIC, Inc.) for detection. The instrument was calibrated at the start of each coulometer cell (1 per day) with a blank, 2 pure (99.999% CO2) gas loops, each run at least twice, and certified reference material (CRM) provided by the laboratory of Andrew G. Dickson (University of California, San Diego). Sample values were adjusted to the CRM value for that day using a constant offset from the certified value. Two duplicates per cast were analyzed to assess precision. The mean and standard deviation of the absolute difference between duplicates was 2.5 ± 2.3 (N = 44). Two batches of CRM were used, the overall mean difference from the certified value was -2.5 ± 4.1 (N = 118), the Batch 199 values were -2.6 ± 4.4 (N = 102) and Batch 216 were -1.8 ± 0.8 (N = 16).

TA was analyzed using an instrument custom-designed and built by the laboratory of Andrew G. Dickson (UCSD) and described in Dickson et al (2003, 2007). Analysis is performed at 20°C. A sample of approximately 100 - 130 grams (g) is weighed and added to a clean, dry water jacketed beaker with a stir bar, and a cap with a Metrohm ECotrode electrode, thermometer, acid line, and air line is placed on top. A computer-controlled dosimat then adds enough acid to reach a pH of ~3.5. The sample is then stirred and bubbled with lab air for 300 seconds to drive off evolved CO2. Then, 15-20 fine additions of 50 microliters (µL) of acid are added, and voltages and temperatures are recorded. Once complete, a non-linear least squares fitting method is used to calculate the TA as well as calibrate the E0 of the electrode. The fitting method is described in Dickson et al. (2003). A CRM was analyzed at the beginning and end of each day. Sample values were NOT adjusted to the certified value. Two duplicates per cast were analyzed to assess precision. The acid was ~0.1 N HCl prepared in ~0.6 M NaCl to match the approximate ionic strength of seawater. The exact concentration was calibrated by borax titration following the method of Kolthoff (1926). The mean and standard deviation of the absolute difference between duplicates was 2.3 ± 2.2 (N = 43). The mean and standard deviation of the CRM difference from certified value was 2.25 ± 2.22 (N = 118). CRM batches 189, 199, and 216 were used.

Data Processing Description

For pHt, the raw absorbance values were used to calculate pHt on the total scale using the equations of Liu et al. (2011). The indicator perturbation adjustment was applied following the method of Carter et al. (2013).

For DIC, the raw coulometer counts were converted to DIC following the equations in Dickson et al. (2007), with the blank and gas calibration factor determined for each coulometer cell. Values were corrected to the CRM using a constant offset from the CRM measured on the same cell as the sample.

For TA, the titration data were fit using the non-linear least squares fit method described in Dickson et al. (2003, 2007). No adjustment was made to the CRM.

BCO-DMO Processing Description

currently being processed

Problem Description

No significant issues occurred for pHt or DIC. There was a period when the TA electrodes were sometimes not stable and switching to a new electrode did not always improve the stability. In such cases, no samples were analyzed and the instrument was shut down for the day. Later testing indicated the diaphragm of the electrodes was likely clogged, and the electrodes could be revived using the Metrohm electrode cleaning solution. Analysis was always halted when issues arose (typically at the start of the day before any samples had been run) and is unlikely to have impacted the results. Any samples which may have been impacted are flagged as questionable or bad. An HDPE bottle was also tested for collecting TA samples. The bottles were found to be unsatisfactory. The data from that experiment can be found at 10.26008/1912/bco-dmo.957644.1 and are published in Woosley et al. (2025).

The WOCE quality flag scheme was used:
2 = good
3 = questionable
4 = bad
5 = sample lost
6 = average of two duplicates
9 = not sampled

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Related Publications

Carter, B. R., Radich, J. A., Doyle, H. L., & Dickson, A. G. (2013). An automated system for spectrophotometric

seawater pH measurements. Limnology and Oceanography: Methods, 11(1), 16–27. doi:10.4319/lom.2013.11.16
Methods

Dickson, A. G., Afghan, J. D., & Anderson, G. C. (2003). Reference materials for oceanic CO2 analysis: a method for the certification of total alkalinity. Marine Chemistry, 80(2), 185–197. https://doi.org/10.1016/S0304-4203(02)00133-0
Methods

Dickson, A.G.; Sabine, C.L. and Christian, J.R. (eds) (2007) Guide to best practices for ocean CO2 measurement. Sidney, British Columbia, North Pacific Marine Science Organization, 191pp. (PICES Special Publication 3; IOCCP Report 8). DOI: https://doi.org/10.25607/OBP-1342
Methods

Johnson, K. M. (1992). Single-operator multiparameter metabolic analyzer (SOMMA) for total carbon dioxide (C{sub T}) with coulometric detection. Operator`s manual. Office of Scientific and Technical Information (OSTI). https://doi.org/10.2172/10194787
Methods

Kolthoff, I. M. (1926). THE STANDARDIZATION OF HYDROCHLORIC ACID WITH POTASSIUM IODATE AS COMPARED WITH BORAX AND SODIUM CARBONATE AS STANDARD SUBSTANCES. Journal of the American Chemical Society, 48(6), 1447–1454. https://doi.org/10.1021/ja01417a001
Methods

Paulsen, M., & Dickson, A. G. (2020). Preparation of 2-amino-2-hydroxymethyl-1,3-propanediol (TRIS) pHT buffers in synthetic seawater. Limnology and Oceanography: Methods, 18(9), 504–515. Portico. https://doi.org/10.1002/lom3.10383
Methods

Woosley, R. J., Neithardt, D., Bruno, J. A., & Lahn, L. (2025). On the use of high-density polyethylene bottles for long-term storage of total alkalinity samples. Limnology and Oceanography: Methods, 23(8), 594–600. Portico. https://doi.org/10.1002/lom3.10703
Methods

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Related Datasets

IsRelatedTo

Woosley, R., Neithardt, D., & Lahn, L. (2025). *Total alkalinity determined through experiments comparing usage of high-density polyethylene (HDPE) and borosilicate glass bottles for collection and storage of water samples collected on the GEOTRACES GP17-OCE cruise (R/V Roger Revelle RR2214)* (Version 1) [Data set]. Biological and Chemical Oceanography Data Management Office (BCO-DMO). https://doi.org/10.26008/1912/BCO-DMO.957644.1 https://doi.org/10.26008/1912/bco-dmo.957644.1

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Parameters

Parameters for this dataset have not yet been identified

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Instruments

Dataset-specific Instrument Name	custom-designed DIC extractor (DICE)
Generic Instrument Name	CO2 Coulometer
Dataset-specific Description	A custom DICE instrument (NOAA PMEL) acidifies samples with phosphoric acid, strips CO2 with N2 carrier gas through a condenser and silica gel, and detects CO2 coulometrically using a UIC, Inc. coulometer, following SOP 2 of Dickson et al. (2007).
Generic Instrument Description	A CO2 coulometer semi-automatically controls the sample handling and extraction of CO2 from seawater samples. Samples are acidified and the CO2 gas is bubbled into a titration cell where CO2 is converted to hydroxyethylcarbonic acid which is then automatically titrated with a coulometrically-generated base to a colorimetric endpoint.

Dataset-specific Instrument Name	GEOTRACES FISH
Generic Instrument Name	GeoFish Towed near-Surface Sampler
Dataset-specific Description	Water samples were collected from the ODF rosette, with pHt also being collected from the FISH
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	niskin bottle
Generic Instrument Name	Niskin bottle
Dataset-specific Description	Water samples were collected from the ODF rosette, with pHt also being collected from the FISH.
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.

Dataset-specific Instrument Name	Agilent 8454 UV/VIS spectrophotometer
Generic Instrument Name	Spectrophotometer
Dataset-specific Description	An Agilent 8454 UV/VIS spectrophotometer was used within a custom automated system to measure absorbance at 434, 578, 730, and 488 nm for spectrophotometric determination of pHt at 25°C using purified metacresol purple dye.
Generic Instrument Description	An instrument used to measure the relative absorption of electromagnetic radiation of different wavelengths in the near infra-red, visible and ultraviolet wavebands by samples.

Dataset-specific Instrument Name	custom-designed and built titrator
Generic Instrument Name	Titrator
Dataset-specific Description	A custom open-cell potentiometric titrator (Dickson lab, UCSD) uses a computer-controlled Metrohm dosimat to add ~0.1 N HCl in fine increments to a weighed seawater sample in a temperature-controlled beaker; a Metrohm ecotrode records voltages and temperatures, and TA is calculated via non-linear least squares fitting (Dickson et al. 2003, 2007).
Generic Instrument Description	Titrators are instruments that incrementally add quantified aliquots of a reagent to a sample until the end-point of a chemical reaction is reached.

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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-OCE and GP17-ANT: Inorganic Carbon Cycling in the South Pacific and Southern Oceans by Direct Measurement (GP17-OCE and GP17-ANT Inorganic Carbon)

Coverage: South Pacific and Amundsen Sea

NSF Award Abstract

The oceans help to slow climate change by absorbing about a quarter of the carbon dioxide (CO2) produced by burning of fossil fuels and other human activities. The Pacific and Southern Oceans are known to take up and store significant amounts of anthropogenic CO2, but many questions regarding the amount, variability, and biogeochemical and ecological impacts remain unanswered. This research will focus on answering some of those questions in two areas of the Pacific by analyzing samples for total CO2, total alkalinity, and pH on two GEOTRACES cruises, GP17-OCE and GP17-ANT. The project will support several undergraduate student researchers and create educational modules on ocean acidification for general public and K-12 students.

On the GP17-OCE expedition in the south Pacific, sub-decadal scale variability in the uptake of CO2 and resulting decrease in pH (termed ocean acidification) will be examined by comparing data collected on this expedition with data from prior occupations of the line in 1991, 2005 and 2014. An extended multilinear regression technique will be used to separate natural variability from human induced changes. The second expedition, GP17-ANT, covers the Amundsen Sea, an area with few prior carbon measurements. This sea is perennially ice-covered with several seasonal polynyas (areas of open water surrounded by sea ice) and exhibits complex water circulation making the contribution to the global carbon cycle uncertain. The data collected from this expedition will examine several hypotheses regarding how carbon is taken up, mixed, and recirculated in the region, how glacial ice melt, sea ice, and biological productivity influence the carbon cycle, and provide baseline measurements against future data to determine changes in the carbon cycle of the region over time. Both expeditions will leverage the myriad of other parameters being measured, particularly trace metals such as iron and zinc, to examine how cycling of carbon and trace metals are interlinked through pH.

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

US GEOTRACES GP17 Section: 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.

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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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