Nutrients and bottle oxygen measured by the Scripps ODF group on the US GEOTRACES GP17-OCE cruise on R/V Roger Revelle (RR2214) from December 2022 to January 2023 in the South Pacific and Southern Oceans

Website: https://www.bco-dmo.org/dataset/933861
Data Type: Cruise Results
Version: 2
Version Date: 2025-07-24

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

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

Contributors	Affiliation	Role
Twining, Benjamin	Bigelow Laboratory for Ocean Sciences	Principal Investigator
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Abstract
This dataset includes the nutrients and bottle oxygen measurements made by the Ocean Data Facility (ODF) group of Scripps Institution of Oceanography during the US GEOTRACES GP17-OCE cruise. The cruise took place on R/V Roger Revelle (cruise ID RR2214) from December 2022 to January 2023 in the South Pacific and Southern Oceans.

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Coverage

Location: South Pacific and Southern Ocean
Spatial Extent: **N**:-19.99984 **E**:-75.09712 **S**:-67.00024 **W**:-152.00026
Temporal Extent: 2022-12-03 - 2023-01-24

Methods & Sampling

For GP17-OCE, a Scripps Institution of Oceanography (SIO) STS 36-place yellow rosette and bottles were used.

The rosette was loaded on Revelle in early November 2022. The rosette and bottles were built before P06 2017, making this the fifteenth time this package has been deployed. A steel bridle was added to the top of the rosette to adapt to the winch head. The bottles were made with new PVC, with new non-baked o-rings and electro-polished steel springs. Springs within the Bullister-style Niskin bottles were electropolished stainless steel. Bottle lanyards were made from 300-pound monofilament. In addition to the standard CTDO package on GO-SHIP cruises, a UVP, oxidation reduction potential (ORP), and turbidity sensor were mounted on the rosette. During the cruise, a handful of problems were encountered. These are described in the cruise report prepared by the Ocean Data Facility (ODF) (see Supplemental Files).

ODF rosette casts were performed with a package consisting of a 36-bottle rosette frame, a 36-place carousel, and 36 Bullister style Niskin bottles with an absolute volume of 10.6 liters (L). Underwater electronic components primarily consisted of a SeaBird Electronics housing unit with Paroscientific pressure sensor with dual plumbed lines where each line has a pump, temperature sensor, conductivity sensor, and exhaust line. A SeaBird Electronics membrane oxygen sensor was mounted on the "primary" line. A reference thermometer, RINKO oxygen optode, transmissometer, chlorophyll-a fluorometer, and altimeter were also mounted on the rosette. UVP, ORP, and turbidity instruments were deployed with the CTD/rosette package and their use is outlined further in the cruise report.

Data Processing Description

Calculation of nutrient concentrations: For nutrients and oxygen, seawater density was calculated using TEOS-10. ODF used the bottle salinity if available, if not they used the CTD trip value. The temperature used for the nutrient density conversions are the lab temperatures measured during analysis. For oxygen, the draw temperature was used for the density conversions. The pressure used was the surface pressure (0 dbar).

Quality Flags: Quality flags are assigned using the WOCE/WHP codes, described at http://cchdo.ucsd.edu/WHP_Exchange_Description.pdf and as follows:

WOCE Bottle Quality Codes
1: Bottle information unavailable.
2: No problems noted.
3: Leaking.
4: Did not trip correctly.
5: Not reported.
6: Significant discrepancy in measured values between Gerard and Niskin bottles.
7: Unknown problem.
8: Pair did not trip correctly. Note that the Niskin bottle can trip at an unplanned depth while the Gerard trips correctly and vice versa.
9: Samples not drawn from this bottle.

WOCE Water Sample Quality Codes
1: Sample for this measurement was drawn from water bottle but analysis not received.
2: Acceptable measurement.
3: Questionable measurement.
4: Bad measurement.
5: Not reported.
6: Mean of replicate measurements.
7: Manual chromatographic peak measurement.
8: Irregular digital chromatographic peak integration.
9: Sample not drawn for this measurement from this bottle.

BCO-DMO Curation Notes

Version 1:
(version date: 2024-09-25)
- Imported original file "33RR20221201_odf_only_hy1.csv" into the BCO-DMO system.
- Flagged "-999" as a missing data value (missing data are empty/blank in the final CSV file).
- Renamed fields to comply with BCO-DMO naming conventions.
- Created date-time field in ISO 8601 format.

- Removed the UWAY columns (not used).
- Saved the final file as "933861_v1_gp17-oce_odf_nutrients.csv".

Version 2:
(version date: 2025-07-24)
- Imported original file "33RR20221201_odf_only_hy1.csv" into the BCO-DMO system.
- Flagged "-999" as a missing data value (missing data are empty/blank in the final CSV file).
- Renamed fields to comply with BCO-DMO naming conventions.
- Created date-time field in ISO 8601 format.
- Removed the UWAY columns (not used).
- Made the following corrections to event numbers:
-- Replaced EVENT_NUMBER "20221207.0419.001" with "20221207.0238.001" (STNNBR 3, CASTNO 6)
-- Replaced EVENT_NUMBER "20221213.0511.001" with "20221213.0501.001" (STNNBR 7, CASTNO 3)
-- Replaced EVENT_NUMBER "20221217.0507.001" with "20221217.0511.001" (STNNBR 10, CASTNO 6)
-- Replaced EVENT_NUMBER "20230115.1113.001" with "20230116.0036.001" (STNNBR 32, CASTNO 4)
- Saved the final file as "933861_v2_gp17-oce_odf_nutrients.csv".

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Data Files

File
933861_v2_gp17-oce_odf_nutrients.csv (Comma Separated Values (.csv), 1.18 MB) MD5:47f9cc1cb29376948dd4cf88d2caa73b Primary data file for dataset ID 933861, version 2

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Supplemental Files

File
GP17-OCE_ODF_cruise_report.pdf (Portable Document Format (.pdf), 6.80 MB) MD5:c4260f60dd2438f7a7198713705282dd GP17-OCE ODF cruise report

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Related Datasets

IsRelatedTo

Twining, B., Cutter, G. A., Fitzsimmons, J. N. (2025) **Bottle data from CTD profiles from the ODF rosette deployed on the US GEOTRACES GP17-OCE cruise on R/V Roger Revelle (RR2214) from December 2022 to January 2023.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 2) Version Date 2025-07-25 doi:10.26008/1912/bco-dmo.955717.2 [view at BCO-DMO]

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Parameters

Parameter	Description	Units
EXPOCODE	Cruise expocode	unitless

SECT_ID	Cruise name/ID	unitless
STNNBR	Station number	unitless
CASTNO	Cast number	unitless
SAMPNO	Sample number	unitless
BTLNBR	Bottle number	unitless
BTLNBR_FLAG_W	Bottle flag	unitless
EVENT_NUMBER	Event number	unitless
GEOTRC_SAMPNO	GEOTRACES sample number	unitless
ISO_DateTime_UTC	Date and time (UTC) of event in ISO 8601 format	unitless
DATE	Date of event	unitless
TIME	Time (UTC) of event	unitless
LATITUDE	Latitude of event; negative values = South	decimal degrees
LONGITUDE	Longitude of event; negative values = West	decimal degrees
DEPTH	Sample depth	meters (m)
REFTMP	Reference temperature	degrees Celsius
REFTMP_FLAG_W	Quality flag for REFTMP	unitless
BTL_ISO_DateTime_UTC	Date and time (UTC) when bottle was fired in ISO 8601 format	unitless
BTL_DATE	Date when bottle was fired	unitless

BTL_TIME	Time (UTC) when bottle was fired	unitless
BTL_LAT	Latitude where bottle was fired; negative values = South	decimal degrees
BTL_LON	Longitude where bottle was fired; negative values = West	decimal degrees
CTDPRS	Pressure; measured by CTD	decibars (dbar)
CTDPRS_FLAG_W	Quality flag for CTDPRS	unitless
CTDTMP	Temperature; measured by CTD	degrees Celsius; ITS-90
CTDTMP_FLAG_W	Quality flag for CTDTMP	unitless
CTDSAL	Salinity; measured by CTD	PSU; PSS-78
CTDSAL_FLAG_W	Quality flag for CTDSAL	unitless
CTDOXY	Oxygen; measured by CTD	micromoles per kilogram (umol/kg)
CTDOXY_FLAG_W	Quality flag for CTDOXY	unitless
CTDFLUOR	Fluorescence; measured by CTD	volts
CTDFLUOR_FLAG_W	Quality flag for CTDFLUOR	unitless
CTDXMISS	Transmissometer reading from CTD	volts
CTDXMISS_FLAG_W	Quality flag for CTDXMISS	unitless
SILICATE_D_CONC_BOTTLE_ODF	Concentration of dissolved silicate (silicic acid), samples may or may not have been filtered; from bottle samples	micromoles per kilogram (umol/kg)
SILICATE_D_CONC_BOTTLE_ODF_FLAG_W	Quality flag for SILICATE_D_CONC_BOTTLE_ODF	unitless

NITRATE_D_CONC_BOTTLE_ODF	Concentration of dissolved nitrate, samples may or may not have been filtered; from bottle samples	micromoles per kilogram (umol/kg)
NITRATE_D_CONC_BOTTLE_ODF_FLAG_W	Quality flag for NITRATE_D_CONC_BOTTLE_ODF	unitless
NITRITE_D_CONC_BOTTLE_ODF	Concentration of dissolved nitrite, samples may or may not have been filtered; from bottle samples	micromoles per kilogram (umol/kg)
NITRITE_D_CONC_BOTTLE_ODF_FLAG_W	Quality flag for NITRITE_D_CONC_BOTTLE_ODF	unitless
PHOSPHATE_D_CONC_BOTTLE_ODF	Concentration of dissolved phosphate, samples may or may not have been filtered; from bottle samples	micromoles per kilogram (umol/kg)
PHOSPHATE_D_CONC_BOTTLE_ODF_FLAG_W	Quality flag for PHOSPHATE_D_CONC_BOTTLE_ODF	unitless
SILICATE_D_CONC_FISH_ODF	Concentration of dissolved silicate (silicic acid), samples may or may not have been filtered; from towed fish samples	micromoles per kilogram (umol/kg)
SILICATE_D_CONC_FISH_ODF_FLAG_W	Quality flag for SILICATE_D_CONC_FISH_ODF	unitless
NITRATE_D_CONC_FISH_ODF	Concentration of dissolved nitrate, samples may or may not have been filtered; from towed fish samples	micromoles per kilogram (umol/kg)
NITRATE_D_CONC_FISH_ODF_FLAG_W	Quality flag for NITRATE_D_CONC_FISH_ODF	unitless
NITRITE_D_CONC_FISH_ODF	Concentration of dissolved nitrite, samples may or may not have been filtered; from towed fish samples	micromoles per kilogram (umol/kg)
NITRITE_D_CONC_FISH_ODF_FLAG_W	Quality flag for NITRITE_D_CONC_FISH_ODF	unitless
PHOSPHATE_D_CONC_FISH_ODF	Concentration of dissolved phosphate, samples may or may not have been filtered; from towed fish samples	micromoles per kilogram (umol/kg)
PHOSPHATE_D_CONC_FISH_ODF_FLAG_W	Quality flag for PHOSPHATE_D_CONC_FISH_ODF	unitless

SILICATE_D_CONC_PUMP_ODF	Concentration of dissolved silicate (silicic acid), samples may or may not have been filtered; from pump samples	micromoles per kilogram (umol/kg)
SILICATE_D_CONC_PUMP_ODF_FLAG_W	Quality flag for SILICATE_D_CONC_PUMP_ODF	unitless
NITRATE_D_CONC_PUMP_ODF	Concentration of dissolved nitrate, samples may or may not have been filtered; from pump samples	micromoles per kilogram (umol/kg)
NITRATE_D_CONC_PUMP_ODF_FLAG_W	Quality flag for NITRATE_D_CONC_PUMP_ODF	unitless
NITRITE_D_CONC_PUMP_ODF	Concentration of dissolved nitrite, samples may or may not have been filtered; from pump samples	micromoles per kilogram (umol/kg)
NITRITE_D_CONC_PUMP_ODF_FLAG_W	Quality flag for NITRITE_D_CONC_PUMP_ODF	unitless
PHOSPHATE_D_CONC_PUMP_ODF	Concentration of dissolved phosphate, samples may or may not have been filtered; from pump samples	micromoles per kilogram (umol/kg)
PHOSPHATE_D_CONC_PUMP_ODF_FLAG_W	Quality flag for PHOSPHATE_D_CONC_PUMP_ODF	unitless
OXYGEN_D_CONC_BOTTLE_ODF	Concentration of dissolved oxygen from a bottle sample	micromoles per kilogram (umol/kg)
OXYGEN_D_CONC_BOTTLE_ODF_FLAG_W	Quality flag for OXYGEN_D_CONC_BOTTLE_ODF	unitless
OXYGEN_D_CONC_PUMP_ODF	Concentration of dissolved oxygen from a bottle attached to a pump	micromoles per kilogram (umol/kg)
OXYGEN_D_CONC_PUMP_ODF_FLAG_W	Quality flag for OXYGEN_D_CONC_PUMP_ODF	unitless
OXYGEN_D_CONC_UWAY_ODF	Concentration of dissolved oxygen from a ship's underway seawater sampling system	micromoles per kilogram (umol/kg)
OXYGEN_D_CONC_UWAY_ODF_FLAG_W	Quality flag for OXYGEN_D_CONC_UWAY_ODF	unitless

SALINITY_D_CONC_BOTTLE_ODF	Practical salinity from bottle sample on the PSS-1978 scale	PSU; PSS-78
SALINITY_D_CONC_BOTTLE_ODF_FLAG_W	Quality flag for SALINITY_D_CONC_BOTTLE_ODF	unitless
SALINITY_D_CONC_FISH_ODF	Practical salinity from a towed fish sample on the PSS-1978 scale	PSU; PSS-78
SALINITY_D_CONC_FISH_ODF_FLAG_W	Quality flag for SALINITY_D_CONC_FISH_ODF	unitless
SALINITY_D_CONC_PUMP_ODF	Practical salinity on the PSS-1978 scale; from pump samples	PSU; PSS-78
SALINITY_D_CONC_PUMP_ODF_FLAG_W	Quality flag for SALINITY_D_CONC_PUMP_ODF	unitless

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Instruments

Dataset-specific Instrument Name	altimeter (Valeport 500)
Generic Instrument Name	Altimeter
Generic Instrument Description	An instrument that measures height above a fixed surface. The data can be used to map ocean-surface topography and generate gridded surface height fields.

Dataset-specific Instrument Name	chlorophyll-a fluorometer (WetLabs ECO-FL-RTD)
Generic Instrument Name	Fluorometer
Generic Instrument Description	A fluorometer or fluorimeter is a device used to measure parameters of fluorescence: its intensity and wavelength distribution of emission spectrum after excitation by a certain spectrum of light. The instrument is designed to measure the amount of stimulated electromagnetic radiation produced by pulses of electromagnetic radiation emitted into a water sample or in situ.

Dataset-specific Instrument Name	Bullister-style Niskin bottles
Generic Instrument Name	Niskin bottle
Dataset-specific Description	ODF rosette casts were performed with a package consisting of a 36-bottle rosette frame, a 36-place carousel, and 36 Bullister style Niskin bottles with an absolute volume of 10.6 liters (L).
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	Digiquartz
Generic Instrument Name	Pressure Sensor
Generic Instrument Description	A pressure sensor is a device used to measure absolute, differential, or gauge pressures. It is used only when detailed instrument documentation is not available.

Dataset-specific Instrument Name	RINKO oxygen optode (JFE Advantech Rinko-III)
Generic Instrument Name	Rinko III ARO-CAV Oxygen Sensor
Generic Instrument Description	The RINKO III is a fast-response optical dissolved oxygen (DO) and temperature sensor. The DO sensor is coated with photostimulable phosphor (PSP) on the outside of the pressure-resistant acrylic optical window, measuring phosphorescence quenching phase shift. The excitation blue LED pulse generates a red phosphorescence pulse, which in turn has an inverse correlation with the oxygen partial pressure in the water. It is an analogue output version. It has a response time of less than 1 second in air, enabling dissolved oxygen measurements with continuous profiling at high speeds. The dissolved oxygen sensor has a non-linear accuracy of +/-2% of full scale (at 1atm, 25 deg C) and the temperature sensor +/-0.02 deg C. It has a pressure rating of 7000 m. This device is made by JFE Advantech Co. Ltd.

Dataset-specific Instrument Name	reference thermometer
Generic Instrument Name	Sea-Bird SBE 35 thermometer
Generic Instrument Description	An oceanographic thermometer with a measurement range of -5 to +35 deg C; an initial accuracy of 0.001 deg C; and a resolution of 0.000025 deg C. The sensor is an ultra-stable aged thermistor with a drift rate of less than 0.001deg C per year. It can be used both in fixed point cells and at depths up to 6800 metres in combination with an SBE water sampling carousel.

Dataset-specific Instrument Name	Primary temperature sensor (SBE3+)
Generic Instrument Name	Sea-Bird SBE 3plus Temperature Sensor
Generic Instrument Description	The Sea-Bird SBE 3plus water temperature sensor is designed for use on the SBE 9plus CTD system. The sensor operates over the range -5 to +35 °C, a resolution of 0.0003 °C at 24 Hz and an initial accuracy of ± 0.001 °C. The typical sampling rate is 24 Hz, and the sensor has a depth rating of 6800 meters (aluminium housing) or 10500 meters (titanium housing).

Dataset-specific Instrument Name	SBE43
Generic Instrument Name	Sea-Bird SBE 43 Dissolved Oxygen Sensor
Generic Instrument Description	The Sea-Bird SBE 43 dissolved oxygen sensor is a redesign of the Clark polarographic membrane type of dissolved oxygen sensors. More information from the manufacturer: https://www.seabird.com/products/sbe-43-dissolved-oxygen-sensor

Dataset-specific Instrument Name	SBE9+ and SBE-11+ (V1) deck unit
Generic Instrument Name	Sea-Bird SBE 911plus CTD
Generic Instrument Description	[tethered, real-time] 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	primary conductivity sensor (SBE4C)
Generic Instrument Name	Sea-Bird SBE-4 Conductivity Sensor
Generic Instrument Description	The Sea-Bird SBE-4 conductivity sensor is a modular, self-contained instrument that measures conductivity from 0 to 7 Siemens/meter. The sensors (Version 2; S/N 2000 and higher) have electrically isolated power circuits and optically coupled outputs to eliminate any possibility of noise and corrosion caused by ground loops. The sensing element is a cylindrical, flow-through, borosilicate glass cell with three internal platinum electrodes. Because the outer electrodes are connected together, electric fields are confined inside the cell, making the measured resistance (and instrument calibration) independent of calibration bath size or proximity to protective cages or other objects.

Dataset-specific Instrument Name	Cstar transmissometer
Generic Instrument Name	Transmissometer
Generic Instrument Description	A transmissometer measures the beam attenuation coefficient of the lightsource over the instrument's path-length. This instrument designation is used when specific manufacturer, make and model are not known.

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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.

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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-2023315
NSF Division of Ocean Sciences (NSF OCE)	OCE-2023206
NSF Division of Ocean Sciences (NSF OCE)	OCE-2023237

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