Concentrations of trace metals and dissolved macronutrients and CTD sensor data from four cruises in the Bermuda Atlantic Time-series Study (BATS) region in March, May, August and November 2019

Website: https://www.bco-dmo.org/dataset/937302
Data Type: Cruise Results
Version: 1
Version Date: 2024-09-26

Project
» NSFGEO-NERC: Collaborative Research: Using Time-series Field Observations to Constrain an Ocean Iron Model (BAIT)

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

Contributors	Affiliation	Role
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Abstract
These data include the concentrations of trace metals (dissolved and soluble iron, dissolved and soluble manganese, dissolved aluminum) and dissolved macronutrients (nitrate+nitrite, phosphate, reactive silicate) determined in water-column samples collected using a trace-metal clean CTD rosette, or an inflatable dinghy, during four cruises in the Bermuda Atlantic Time-series Study (BATS) region in March, May, August and November 2019. Also presented are CTD sensor data (pressure, temperature, salinity, chlorophyll fluorescence, dissolved oxygen) and derived variables (water depth, density) corresponding to the CTD-rosette bottle samples. The samples and associated data were collected for the BAIT project (GEOTRACES Process Study GApr13). Post-cruise sample analyses were performed at Old Dominion University (trace metals) and the Bermuda Institute of Ocean Sciences (macronutrients).

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Coverage

Location: Bermuda Atlantic Time-series Study (BATS) site
Spatial Extent: **N**:32.151 **E**:-63.58 **S**:31.177 **W**:-64.815

Methods & Sampling

Data are from samples collected during the four cruises of the BAIT project (all were piggybacked on the regular BATS program cruises), EN631, AE1909, AE1921, AE1930.

Water-column samples for trace metal measurements were collected from the Bermuda Atlantic Time-series Study (BATS) site (31°40'N, 64°10'W) and adjacent BATS spatial stations during cruises in March (spring), May (early summer), August (late summer), and November (fall) 2019 aboard R/V Atlantic Explorer and R/V Endeavor. The seawater samples and hydrographic data were collected using a trace-metal clean conductivity-temperature-depth sensor (SBE 19 plus, SeaBird Electronics) mounted on a custom-built trace-metal clean carousel (SeaBird Electronics) fitted with custom-modified 5-liter (L) Teflon-lined external-closure Niskin-X samplers (General Oceanics) and deployed on an Amsteel non-metallic line. On the August cruise, we also collected near-surface samples (~0.3 meters (m) depth) in a Niskin-X sampler deployed from an inflatable dinghy ~500 m upwind of the research vessel, to avoid contamination from the ship.

After recovery, the seawater samples were filtered through pre-cleaned 0.2-micrometer (μm) pore AcroPak Supor filter capsules (Pall) using filtered nitrogen gas inside a shipboard clean laboratory (Sedwick et al., 2020, 2022). For analysis of dissolved iron (DFe) and dissolved manganese (DMn), the seawater filtrate was collected in acid-cleaned 125-milliliter (mL) low-density polyethylene (LDPE) bottles (Nalgene) and acidified to pH 1.7 post-cruise by addition of 6 M ultrapure hydrochloric acid (Fisher Optima). For analysis of dissolved aluminum (DAl), the seawater filtrate was collected in acid-cleaned 100 mL LDPE bottles (Bel-Art) and acidified to pH 1.7 post-cruise by addition of 6 M ultrapure hydrochloric acid (Fisher Optima). For dissolved macronutrient determinations, 40 mL of seawater filtrate was collected in sample-rinsed 50 mL polypropylene Falcon tubes (Becton Dickinson) and then stored at -20 degrees Celsius (°C) until analysis. For analysis of soluble iron (sFe) and soluble manganese (sMn), the 0.2 μm seawater filtrate was subsequently filtered through 0.02 μm Anotop syringe filters (Whatman) that were pre-rinsed with dilute hydrochloric acid followed by sample, using a peristaltic pump (Ussher et al. 2010); the resulting 0.02 μm filtrate was stored in acid-cleaned 60 mL LDPE bottles (Nalgene) and acidified to pH 1.7 post-cruise by addition of 6 M ultrapure hydrochloric acid (Fisher Optima).

Concentrations of DFe, sFe, DMn and sMn were determined in the acidified seawater filtrate using inductively-coupled plasma mass spectrometry (ICP-MS, Thermo Fisher Scientific ElementXR), with in-line separation-preconcentration (Elemental Scientific SeaFAST SP3) modified after Lagerström et al. (2013). Calibration standards were prepared in low-analyte concentration filtered seawater for which initial concentrations were determined using the method of standard additions. Calibration standards were introduced using the same in-line separation-preconcentration procedure as the seawater filtrate samples, with yttrium was used as an internal standard for all samples except where indicated. Analytical blank concentrations were assessed by applying the in-line separation-preconcentration procedure including all reagents and loading air in place of the seawater filtrate sample ("air blank"), yielding mean blank concentrations that were not statistically different from zero: -0.006 ± 0.0178 nanomolar (nM) for DFe (n = 62), and -0.007 ± 0.010 nM for DMn (n = 46). Analytical limits of detection, defined as the concentrations equivalent to three times the standard deviation on the mean blank, were 0.054 nM DFe and 0.030 nM for DMn. These same blanks and limits of detection are assumed to apply to sFe and sMn, respectively. Mean concentrations of multiple, separate-day determinations of the GEOTRACES GSP seawater consensus material were 0.177 ± 0.030 nM DFe (n = 10) and 0.795 ± 0.023 nM DMn (n = 13), which are within the analytical uncertainties (defined by ± one standard deviation on the mean) of the current consensus concentrations of 0.155 ± 0.045 nM and 0.778 ± 0.034 nM, respectively. Analytical precision at the concentration levels of the GSP consensus material, expressed as ± one relative standard deviation on the mean, are ± 17% for DFe and ± 2.9% for DMn.

Concentrations of DAl were determined in the acidified sewater filtrate using flow injection analysis with fluorometric detection, without in-line preconcentration, following the method of Resing & Measures (1994). Multiple, separate-day determinations of one of the samples of lowest concentration yielded a mean DAl concentration of 3.19 ± 0.68 nM (n = 12), indicating an estimated analytical uncertainty of ± 21% (expressed as ± one relative standard deviation on the mean). Multiple, separate-day analyses of the GEOTRACES GSP seawater consensus material yielded a mean DAl concentration of 1.52 ± 0.28 nM (n = 6), although there is so far no consensus concentration available for this material. In the absence of a reagent blank for this direct flow injection analysis method, a conservative estimate of the analytical limit of detection is three times the standard deviation on the mean DAl concentration of the low-concentration GSP seawater consensus material, which yields 0.84 nM.

Concentrations of the dissolved inorganic macronutrients nitrate+nitrite ($NO_3^- + NO_2^-$), orthophosphate (PO_4^{3-})

and reactive silicate (Si) were determined at the Bermuda Institute of Ocean Sciences using continuous flow analysis following the protocols of the Bermuda Atlantic Time-series Study (BATS, 2023). Limits of detection, defined as the concentrations equivalent to three times the standard deviation on the mean baseline signal, are 0.03 micromolar (µM) for NO3-+NO2-, PO43- and Si. Accuracy was verified by the analysis of the KANSO seawater certified reference material during each analytical run.

In-situ temperature was measured using a conductivity-temperature-depth sensor (SBE 19 plus, SeaBird Scientific), with data processed using the SBE Data Processing software. Salinity was calculated from in-situ conductivity, as measured using a conductivity-temperature-depth (CTD) sensor (SBE 19 plus, SeaBird Electronics), with data processed using the SBE Data Processing software. In-situ chlorophyll fluorescence was measured using a WET Labs ECO-FL(RT)D deep chlorophyll fluorometer with 125 micrograms per liter (µg L-1) range mounted on the CTD rosette, with data processed using the SBE Data Processing software. In-situ dissolved oxygen concentration was measured using an SBE 43 Dissolved Oxygen Sensor mounted on the CTD rosette, with data processed using the SBE Data Processing software.

Data Processing Description

Inductively-coupled plasma mass spectrometer: Instrumental data were collected using ElementXR processing software (Thermo Fisher Scientific), and post-analysis calculations were performed using Microsoft Excel.

Fluorescence detector for flow-injection analysis: After analog-to-digital conversion, peak areas were integrated using FCS software (Graeme Cross), and post-analysis calculations were performed using Microsoft Excel.

CTD sensors: Primary and derived data from the CTD sensors (temperature, conductivity, depth, in-situ chlorophyll fluorescence, dissolved oxygen) were processed using using the SBE Data Processing software (SeaBird Scientific).

Quality Flags:
Data quality flags are provided in the data to denote the following:
1 = good;
2 = likely contaminated or questionable;
3 = questionable because analysis used scandium as an internal standard;
4 = not determined;
5 = below detection.

GEOTRACES Parameter Names:
These data sets have been registered via GEOTRACES DoOR, with the following associated bar codes:

Cruise EN361 (BAIT-I):
- NO2+NO3_D_CONC_BOTTLE::nrjw8v
- PHOSPHATE_D_CONC_BOTTLE::bgaawx
- Mn_S_CONC_BOTTLE::lu1p7p
- Al_D_CONC_BOTTLE::nyicgx
- Fe_D_CONC_BOTTLE::qgisg0
- Mn_D_CONC_BOTTLE::up0xno
- Fe_S_CONC_BOTTLE::a5pzjt
- SILICATE_D_CONC_BOTTLE::idjbwe
- CTDTMP_UP_T_VALUE_SENSOR::v2sf9w
- CTDSAL_UP_D_CONC_SENSOR::fwn2wq

Cruise AE1909 (BAIT-II):
- Mn_D_CONC_BOTTLE::llr9fa
- NO2+NO3_D_CONC_BOTTLE::xwogud
- Fe_S_CONC_BOTTLE::w2gse0
- Al_D_CONC_BOTTLE::6i6r0c
- PHOSPHATE_D_CONC_BOTTLE::ucjrky
- SILICATE_D_CONC_BOTTLE::19bitw
- Fe_D_CONC_BOTTLE::qrejkj
- Mn_S_CONC_BOTTLE::pmuw6o
- CTDTMP_UP_T_VALUE_SENSOR::s7ovrk
- CTDSAL_UP_D_CONC_SENSOR::rddj9l

Cruise AE1921 (BAIT-III):

- Mn_S_CONC_BOTTLE::z49awl
- Fe_D_CONC_BOTTLE::k9zqca
- Al_D_CONC_BOTTLE::tzsmv1
- NO2+NO3_D_CONC_BOTTLE::12l4cd
- Fe_S_CONC_BOTTLE::aoxogq
- SILICATE_D_CONC_BOTTLE::tizucw
- Mn_D_CONC_BOTTLE::tgpx8g
- PHOSPHATE_D_CONC_BOTTLE::mftrbt
- CTDTMP_UP_T_VALUE_SENSOR::cg4pcl
- CTDSAL_UP_D_CONC_SENSOR::9p9jgp

Cruise AE1930 (BAIT-IV):
- Mn_D_CONC_BOTTLE::e9h8va
- SILICATE_D_CONC_BOTTLE::cf3hyt
- Al_D_CONC_BOTTLE::u1ydd2
- Fe_S_CONC_BOTTLE::ynhtgd
- NO2+NO3_D_CONC_BOTTLE::kidyhy
- Mn_S_CONC_BOTTLE::cpgrz2
- Fe_D_CONC_BOTTLE::bnuivj
- PHOSPHATE_D_CONC_BOTTLE::lzvdkt
- CTDTMP_UP_T_VALUE_SENSOR::anjcri
- CTDSAL_UP_D_CONC_SENSOR::epwqn2

BCO-DMO Processing Description

- Imported original file "BAIT_Bottle_Data_TM_CTD.xlsx" into the BCO-DMO system.
- Renamed fields to comply with BCO-DMO naming conventions.
- Created separate flag columns for NO3_NO2, PO43, and Si to indicate BDL and ND.
- Removed "BDL" and "ND" from data columns. Missing data are empty/blank in the final CSV file (quality flags of 5 = BDL and 4 = ND).
- Created date-time column in ISO 8601 format.
- Saved the final file as "937302_v1_bait_ctd_bottle_data.csv".

Problem Description

A number of the water-column sFe samples, mainly those collected and processed during the BAIT-I and BAIT-IV cruises, were apparently contaminated during the shipboard ultrafiltration procedure, as sFe concentrations are significantly higher than DFe concentration. These samples have been flagged as "likely contaminated" in the data set (quality flag of 2).

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Data Files

File
937302_v1_bait_ctd_bottle_data.csv(Comma Separated Values (.csv), 28.76 KB) MD5:e172b6756d1c153349775dce5ad211a1
Primary data file for dataset ID 937302, version 1

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Related Publications

BATS (2023). Protocols for the Bermuda Atlantic Time-series Study Core Measurements. Bermuda Institute of Ocean Sciences, 142 pp.
Methods

Lagerström, M. E., Field, M. P., Séguret, M., Fischer, L., Hann, S., & Sherrell, R. M. (2013). Automated on-line flow-injection ICP-MS determination of trace metals (Mn, Fe, Co, Ni, Cu and Zn) in open ocean seawater: Application to the GEOTRACES program. Marine Chemistry, 155, 71–80. doi:10.1016/j.marchem.2013.06.001
Methods

Resing, J. A., & Measures, C. I. (1994). Fluorometric Determination of Al in Seawater by Flow Injection Analysis with In-Line Preconcentration. Analytical Chemistry, 66(22), 4105–4111. doi:10.1021/ac00094a039
Methods

Sedwick, P. N., Bowie, A. R., Church, T. M., Cullen, J. T., Johnson, R. J., Lohan, M. C., Marsay, C. M., McGillicuddy, D. J., Sohst, B. M., Tagliabue, A., & Ussher, S. J. (2020). Dissolved iron in the Bermuda region of the subtropical North Atlantic Ocean: Seasonal dynamics, mesoscale variability, and physicochemical speciation. Marine Chemistry, 219, 103748. https://doi.org/10.1016/j.marchem.2019.103748
Methods

Sedwick, P. N., Sohst, B. M., Buck, K. N., Caprara, S., Johnson, R. J., Ohnemus, D. C., Sofen, L. E., Tagliabue, A., Twining, B. S., & Williams, T. E. (2023). Atmospheric Input and Seasonal Inventory of Dissolved Iron in the Sargasso Sea: Implications for Iron Dynamics in Surface Waters of the Subtropical Ocean. Geophysical Research Letters, 50(6). Portico. https://doi.org/10.1029/2022GL102594
Results

Sedwick, P. N., Sohst, B. M., O'Hara, C., Stammerjohn, S. E., Loose, B., Dinniman, M. S., Buck, N. J., Resing, J. A., & Ackley, S. F. (2022). Seasonal Dynamics of Dissolved Iron on the Antarctic Continental Shelf: Late-Fall Observations From the Terra Nova Bay and Ross Ice Shelf Polynyas. Journal of Geophysical Research: Oceans, 127(10). Portico. https://doi.org/10.1029/2022jc018999 https://doi.org/10.1029/2022JC018999
Methods

Sofen, L. E., Antipova, O. A., Buck, K. N., Caprara, S., Chacho, L., Johnson, R. J., Kim, G., Morton, P., Ohnemus, D. C., Rauschenberg, S., Sedwick, P. N., Tagliabue, A., & Twining, B. S. (2023). Authigenic Iron Is a Significant Component of Oceanic Labile Particulate Iron Inventories. Global Biogeochemical Cycles, 37(12). Portico. https://doi.org/10.1029/2023gb007837 https://doi.org/10.1029/2023GB007837
Results

Tagliabue, A., Buck, K. N., Sofen, L. E., Twining, B. S., Aumont, O., Boyd, P. W., Caprara, S., Homoky, W. B., Johnson, R., König, D., Ohnemus, D. C., Sohst, B., & Sedwick, P. (2023). Authigenic mineral phases as a driver of the upper-ocean iron cycle. Nature, 620(7972), 104–109. https://doi.org/10.1038/s41586-023-06210-5
Results

Ussher, S. J., Achterberg, E. P., Sarthou, G., Laan, P., de Baar, H. J. W., & Worsfold, P. J. (2010). Distribution of size fractionated dissolved iron in the Canary Basin. Marine Environmental Research, 70(1), 46–55. doi:10.1016/j.marenvres.2010.03.001
Methods

[ ]

Parameters

Parameter	Description	Units
Cruise_ID	UNOLS/BAIT/GEOTRACES cruise identifier	unitless
Station	hydrocast station identifier	unitless
Sample_ID	unique identifier for each water-column sample	unitless
Pressure	in-situ pressure from CTD	decibars
Depth	sample collection depth estimated from pressure	meters (m)

Lat	hydrocast station latitude of recovery	decimal degrees North
Long	hydrocast station longitude of recovery	decimal degrees East
ISO_DateTime_UTC	hydrocast recovery date and time (UTC) in ISO 8601 format	unitless
Date_UTC	hydrocast recovery date (UTC)	unitless
Time_UTC	hydrocast recovery time (UTC)	unitless
Temp	in-situ temperature from CTD	degrees Celsius
Sal	salinity calculated from CTD conductivity	unitless
Chl	chlorophyll estimated from in-situ fluorescence	milligrams per cubic meter (mg/m^3)
O2	in-situ dissolved oxygen concentration from CTD	micromoles per kilogram (umol/kg)
Sigma_theta	density calculated as sigma-theta	unitless
DFe	dissolved iron (<0.2 micrometers) concentration	nanomoles per liter (nM)
DFe_Flag	Data quality flag for DFe. Descriptions: 1 = good; 2 = likely contaminated or questionable; 3 = questionable because analysis used scandium as an internal standard; 4 = not determined; 5 = below detection.	unitless
sFe	soluble iron (<0.02 micrometers) concentration	nanomoles per liter (nM)
sFe_Flag	Data quality flag for sFe. Descriptions: 1 = good; 2 = likely contaminated or questionable; 3 = questionable because analysis used scandium as an internal standard; 4 = not determined; 5 = below detection.	unitless

DMn	dissolved manganese (<0.2 micrometers) concentration	nanomoles per liter (nM)
DMn_Flag	Data quality flag for DMn. Descriptions: 1 = good; 2 = likely contaminated or questionable; 3 = questionable because analysis used scandium as an internal standard; 4 = not determined; 5 = below detection.	unitless
sMn	soluble manganese (<0.02 micrometers) concentration	nanomoles per liter (nM)
sMn_Flag	Data quality flag for sMn. Descriptions: 1 = good; 2 = likely contaminated or questionable; 3 = questionable because analysis used scandium as an internal standard; 4 = not determined; 5 = below detection.	unitless
DAl	dissolved aluminum (<0.2 micrometers) concentration	nanomoles per liter (nM)
DAl_Flag	Data quality flag for DAl. Descriptions: 1 = good; 2 = likely contaminated or questionable; 3 = questionable because analysis used scandium as an internal standard; 4 = not determined; 5 = below detection.	unitless
NO3_plus_NO2	dissolved nitrate+nitrite concentration	micromoles per kilogram (umol/kg)
NO3_plus_NO2_Flag	Data quality flag for NO3_plus_NO2. Descriptions: 1 = good; 2 = likely contaminated or questionable; 3 = questionable because analysis used scandium as an internal standard; 4 = not determined; 5 = below detection.	unitless
PO4	dissolved orthophosphate concentration	micromoles per kilogram (umol/kg)

PO4_Flag	Data quality flag for PO4. Descriptions: 1 = good; 2 = likely contaminated or questionable; 3 = questionable because analysis used scandium as an internal standard; 4 = not determined; 5 = below detection.	unitless
Si	dissolved reactive silicate concentration	micromoles per kilogram (umol/kg)
Si_Flag	Data quality flag for Si. Descriptions: 1 = good; 2 = likely contaminated or questionable; 3 = questionable because analysis used scandium as an internal standard; 4 = not determined; 5 = below detection.	unitless

Instruments

Dataset-specific Instrument Name	continuous flow analysis
Generic Instrument Name	Continuous Flow Analyzer
Dataset-specific Description	continuous flow analysis following the protocols of the Bermuda Atlantic Time-series Study
Generic Instrument Description	A sample is injected into a flowing carrier solution passing rapidly through small-bore tubing.

Dataset-specific Instrument Name	SBE 19 plus (SeaBird Electronics)
Generic Instrument Name	CTD Sea-Bird
Dataset-specific Description	CTD sensors (temperature, conductivity, depth): SBE 19 plus (SeaBird Scientific), calibrated prior to the cruises by SeaBird Scientific.
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	
Generic Instrument Name	Flow Injection Analyzer
Dataset-specific Description	Concentrations of DAI were determined in the acidified sewater filtrate using flow injection analysis with fluorometric detection. Fluorescence detector for flow-injection analysis: RF-10AXL HPLC detector (Shimadzu).
Generic Instrument Description	An instrument that performs flow injection analysis. Flow injection analysis (FIA) is an approach to chemical analysis that is accomplished by injecting a plug of sample into a flowing carrier stream. FIA is an automated method in which a sample is injected into a continuous flow of a carrier solution that mixes with other continuously flowing solutions before reaching a detector. Precision is dramatically increased when FIA is used instead of manual injections and as a result very specific FIA systems have been developed for a wide array of analytical techniques.

Dataset-specific Instrument Name	Niskin-X samplers (General Oceanics)
Generic Instrument Name	Niskin bottle
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	SBE 43 dissolved oxygen sensor (SeaBird Scientific)
Generic Instrument Name	Sea-Bird SBE 43 Dissolved Oxygen Sensor
Dataset-specific Description	Dissolved oxygen sensor: SBE 43 dissolved oxygen sensor (SeaBird Scientific), calibrated prior to the cruise by SeaBird Scientific.
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 Sea-Bird Electronics

Dataset-specific Instrument Name	SeaFAST SP3
Generic Instrument Name	SeaFAST Automated Preconcentration System
Dataset-specific Description	Inductively-coupled plasma mass spectrometer: ElementXR (Thermo Fisher Scientific), with SeaFAST SP3 in-line separation-preconcentration system and autosampler (Elemental Scientific).
Generic Instrument Description	The seaFAST is an automated sample introduction system for analysis of seawater and other high matrix samples for analyses by ICPMS (Inductively Coupled Plasma Mass Spectrometry).

Dataset-specific Instrument Name	ElementXR ICP-MS (Thermo Fisher Scientific)
Generic Instrument Name	Thermo Scientific ELEMENT XR high resolution inductively coupled plasma mass spectrometer
Dataset-specific Description	Inductively-coupled plasma mass spectrometer: ElementXR (Thermo Fisher Scientific), with SeaFAST SP3 in-line separation-preconcentration system and autosampler (Elemental Scientific).
Generic Instrument Description	A high-resolution (HR) inductively coupled plasma (ICP) mass spectrometer (MS) composed of a dual mode secondary electron multiplier (SEM) and a Faraday detector. The ELEMENT XR instrument has a dynamic range of 5 x 10^7 to 1 x 10^12 counts per second (cps), and allows simultaneous measurement of elements at concentrations over 1000 ug/g.

Dataset-specific Instrument Name	ECO-FL(RT)D deep chlorophyll fluorometer (WET Labs)
Generic Instrument Name	Wet Labs ECO-AFL/FL Fluorometer
Dataset-specific Description	Fluorometer (in-situ chlorophyll fluorescence): ECO-FL(RT)D deep chlorophyll fluorometer (WET Labs), calibrated prior to the cruise by SeaBird Scientific.
Generic Instrument Description	The Environmental Characterization Optics (ECO) series of single channel fluorometers delivers both high resolution and wide ranges across the entire line of parameters using 14 bit digital processing. The ECO series excels in biological monitoring and dye trace studies. The potted optics block results in long term stability of the instrument and the optional anti-biofouling technology delivers truly long term field measurements. more information from Wet Labs

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Deployments

EN631

Website	https://www.bco-dmo.org/deployment/869159
Platform	R/V Endeavor
Report	https://www.bodc.ac.uk/resources/inventories/cruise_inventory/reports/endeavor_en631.pdf
Start Date	2019-03-10
End Date	2019-03-15
Description	See additional cruise information at the Rolling Deck to Repository (R2R): https://www.rvdata.us/search/cruise/EN631

AE1909

Website	https://www.bco-dmo.org/deployment/869175
Platform	R/V Atlantic Explorer
Report	https://www.bodc.ac.uk/resources/inventories/cruise_inventory/reports/atlanticexplorer_ae1909.pdf
Start Date	2019-05-11
End Date	2019-05-17
Description	See additional cruise information at the Rolling Deck to Repository (R2R): https://www.rvdata.us/search/cruise/AE1909

AE1921

Website	https://www.bco-dmo.org/deployment/869176
Platform	R/V Atlantic Explorer
Report	https://www.bodc.ac.uk/resources/inventories/cruise_inventory/reports/atlanticexplorer_ae1921.pdf
Start Date	2019-08-16
End Date	2019-08-22
Description	See additional cruise information at the Rolling Deck to Repository (R2R): https://www.rvdata.us/search/cruise/AE1921

AE1930

Website	https://www.bco-dmo.org/deployment/869177
Platform	R/V Atlantic Explorer
Report	https://www.bodc.ac.uk/resources/inventories/cruise_inventory/reports/atlanticexplorer_ae1930.pdf
Start Date	2019-11-15
End Date	2019-11-21
Description	See additional cruise information at the Rolling Deck to Repository (R2R): https://www.rvdata.us/search/cruise/AE1930

Project Information

NSFGEO-NERC: Collaborative Research: Using Time-series Field Observations to Constrain an Ocean Iron Model (BAIT)

Coverage: Bermuda Atlantic Time-Series Study region, waters of the western Subtropical North Atlantic Gyre (ca. 30°N-33°N, 62°W-65°W)

NSF and NERC Award Abstract:
Iron is an essential nutrient for the growth of phytoplankton in the oceans. As such, iron plays key roles in regulating marine primary production and the cycling of carbon. It is thus important that models of ocean biology and chemistry consider iron, in order to explore past, present and future variations in marine productivity and the role of the ocean in the global carbon cycle. In this joint project involving researchers in the U.S. and the U.K., supported by both NSF and the Natural Environment Research Council (U.K.), field data from the Bermuda Atlantic Time-series Study (BATS) region will be combined with an established, state-of-the-art ocean biogeochemical model. By leveraging the known seasonal-scale physical, chemical and biological changes in the BATS region, the oceanographic context provided by the BATS core data, and an existing model of the regional physical circulation, the proposed study will yield process-related information that is of general

applicability to the open ocean. In particular, the proposed research will focus on understanding the atmospheric input, biological uptake, regeneration and scavenging removal of dissolved iron in the oceanic water column, which have emerged as major uncertainties in the ocean iron cycle. The project will include significant educational and training contributions at the K-12, undergraduate, graduate and postdoctoral levels, as well as public outreach efforts that aim to explain the research and its importance.

The ability of ocean models to simulate iron remains crude, owing to an insufficient understanding of the mechanisms that drive variability in dissolved iron, particularly the involvement of iron-binding ligands, colloids and particles in the surface input, biological uptake, regeneration and scavenging of dissolved iron in the upper ocean. Basin-scale data produced by the GEOTRACES program provide an important resource for testing and improving models and, by extension, our mechanistic understanding of the ocean iron cycle. However such data provide only quasi-synoptic 'snapshots', which limits their utility in isolating and identifying the processes that control dissolved iron in the upper ocean. The proposed research aims to provide mechanistic insight into these governing processes by combining time-series data from the BATS region with numerical modeling experiments. Specifically, seasonally resolved data on the vertical (upper 2,000 meters) and lateral (tens of kilometers) distributions of particulate, dissolved, colloidal, soluble and ligand-bound iron species will be obtained from the chemical analysis of water column samples collected during five cruises, spanning a full annual cycle, shared with the monthly BATS program cruises. These data, along with ancillary data from the BATS program, will be used to test and inform numerical modeling experiments, and thus derive an improved understanding of the mechanisms that control the distribution and dynamics of dissolved iron in the oceanic water column.

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.

This is a project jointly funded by the National Science Foundation's Directorate for Geosciences (NSF/GEO) and the National Environment Research Council (NERC) of the United Kingdom (UK).

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-1829833
NSF Division of Ocean Sciences (NSF OCE)	OCE-1829844

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