

Dissolved cobalt, nutrients, and hydrography from the Pacific ProteOMZ Expedition, FK160115, on R/V Falkor in 2016

Website: <https://www.bco-dmo.org/dataset/831323>

Data Type: Cruise Results

Version: 1

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Project

» [The ProteOMZ Expedition: Investigating Life Without Oxygen in the Pacific Ocean](#) (ProteOMZ (Proteomics in an Oxygen Minimum Zone))

Contributors	Affiliation	Role
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Abstract

Dissolved cobalt, nutrients, and hydrography from the Pacific ProteOMZ Expedition, FK160115, on R/V Falkor in 2016. Dissolved cobalt (dCo) samples were analyzed in Nov-Dec 2017 by cathodic stripping voltammetry (CSV) as originally described by (Saito and Moffett 2001) and modified by (Saito et al. 2010; Hawco et al. 2016).

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Coverage

Spatial Extent: N:17 E:-139.8 S:-10.563 W:-156

Temporal Extent: 2016-01-18 - 2016-02-04

Methods & Sampling

Dissolved seawater samples were collected on the ProteOMZ FK150116 expedition (Jan-Feb 2016) using a 12-bottle trace metal clean rosette equipped with 8 L X-Niskin bottles (Ocean Test Equipment), a titanium frame, and a Kevlar cable, as described in (Cutter and Bruland 2012). Seawater from the Go-Flo bottles was subsampled in a trace metal clean plastic "bubble" equipped with HEPA filters providing positive air pressure. Dissolved Co subsamples were filtered using a 142 mm polycarbonate plastic sandwich filter (Geotech Environmental Equipment) equipped with a 0.2 um Supor membrane filter (Pall Corporation) and stored until analysis in the laboratory in a 60 mL LDPE bottle (Nalgene) that had been soaked for ~1 week in Citranox, an acidic detergent, rinsed with Milli-Q water (Millipore), soaked for ~2 weeks in 10% trace metal grade HCl (Optima), and rinsed with lightly acidic Milli-Q water (<0.1% HCl). To preserve the samples for future analysis after the cruise, all samples were filled entirely with no remaining headspace, stored with one oxygen-absorbing satchel (Mitsubishi Gas Chemical, model RP-3K) per 60 mL water sample, heat-sealed in plastic bags, and stored at 4°C.

Dissolved cobalt (dCo) samples were analyzed in Nov-Dec 2017 by cathodic stripping voltammetry (CSV) as originally described by (Saito and Moffett 2001) and modified by (Saito et al. 2010; Hawco et al. 2016). One portion of the samples (stations 1-10) were analyzed in the Saito laboratory in Woods Hole, MA, and the remaining samples (stations 11-14) were analyzed at sea on the CICLOPS NBP-1801 cruise in the trace metal plastic "bubble". This was done so that all of the samples could be run together using the same batch of DMG and EPPS reagents.

Dissolved Co was measured using a Metrohm 663 VA and uAutolabIII system equipped with a hanging mercury drop working electrode. All reagents were run through treated Chelex-100 resin columns (BioRad) to remove trace metal contaminants, except DMG which was purified by recrystallization. The Chelex was resin prepared as described in (Price et al. 1988/89) and reagents were purified as described in Saito et al., 2002. 0.2 μm filtered water samples were UV-irradiated in acid-washed quartz tubes for one hour using a water-cooled UV irradiation system (Metrohm 705 UV Digestor) to destroy natural ligand-bound Co complexes. Then, 11 mL of sample seawater was aliquoted into 15 mL acid-washed polypropylene vials, and 100 μL of 0.1 M dimethylglyoxime (DMG, Sigma Aldrich) and 130 μL of 0.5 M N-(2-hydroxyethyl)piperazine-N-(3-propanesulfonic acid) (EPPS, Sigma Aldrich) buffer was added. The samples were then processed on an autosampler (Metrohm 858 Sample Processor), which added 8.5 mL of the sample solution and 1.5 mL of a 1.5 M NaNO_2 reagent (Merck) to a Teflon cup for electrochemical analysis. The mercury electrode performed a fast linear sweep from -1.4 V to -0.6 V at a rate of 5 V s^{-1} , which reduced the Co bound in the $\text{Co}(\text{DMG})_2$ complex from Co(II) to Co(0) and produced a Co reduction peak at -1.15 V (Saito and Moffett 2001) with a height linearly proportional to the amount of dCo present in the sample. A standard addition curve was generated for each sample analyzed with 4 automated additions of a 25 μM CoCl_2 (Fisher Scientific) standard made fresh in for this sample batch.

Data Processing Description

Data Processing:

Peak heights were determined by NOVA 1.10 software. A linear regression of the standard addition peak heights allowed for the calculation of the initial amount of Co present in the sample, as described in (Saito and Moffett 2001). Triplicate technical replicates were run on every sample.

Quality Flags:

The dataset includes quality assurance flags described in the GEOTRACES Quality Flag Policy, which is available at <https://www.geotraces.org/geotraces-quality-flag-policy/>. Some dCo values reported are suspected misfires and are accordingly labeled with a QC flag of 3.

Brief flag descriptions:

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

BCO-DMO Processing:

- renamed fields;
- added fields for date-time in ISO8601 format;
- replaced 'NaN' with 'nd' as the missing data identifier;
- rounded Cobalt values as specified by data submitter;
- 2022-09-08: made a correction to the Acquisition Description section of the metadata. The filter size used on dissolved Co subsamples was 0.2 μm (not 0.4 μm as previously stated).

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Data Files

File
dCo.csv (Comma Separated Values (.csv), 34.52 KB) MD5:767380b69da625df4bdf49ae7d11ed30
Primary data file for dataset ID 831323

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Related Publications

Cutter, G. A., & Bruland, K. W. (2012). Rapid and noncontaminating sampling system for trace elements in global ocean surveys. *Limnology and Oceanography: Methods*, 10(6), 425–436. doi:[10.4319/lom.2012.10.425](https://doi.org/10.4319/lom.2012.10.425)
Methods

Hawco, N. J., Ohnemus, D. C., Resing, J. A., Twining, B. S., & Saito, M. A. (2016). A dissolved cobalt plume in the oxygen minimum zone of the eastern tropical South Pacific. *Biogeosciences*, 13(20), 5697–5717. doi:[10.5194/bg-13-5697-2016](https://doi.org/10.5194/bg-13-5697-2016)
Methods

Neil M. Price, Gail I. Harrison, Janet G. Hering, Robert J. Hudson, Pascale M. V. Nirel, Brian Palenik & François M. M. Morel (1989) Preparation and Chemistry of the Artificial Algal Culture Medium Aquil, *Biological Oceanography*, 6:5-6, 443-461, DOI: [10.1080/01965581.1988.10749544](https://doi.org/10.1080/01965581.1988.10749544)
Methods

Saito, M. A., & Moffett, J. W. (2001). Complexation of cobalt by natural organic ligands in the Sargasso Sea as determined by a new high-sensitivity electrochemical cobalt speciation method suitable for open ocean work. *Marine Chemistry*, 75(1-2), 49–68. doi:[10.1016/s0304-4203\(01\)00025-1](https://doi.org/10.1016/s0304-4203(01)00025-1)
Methods

Saito, M. A., & Moffett, J. W. (2002). Temporal and spatial variability of cobalt in the Atlantic Ocean. *Geochimica et Cosmochimica Acta*, 66(11), 1943–1953. doi:[10.1016/s0016-7037\(02\)00829-3](https://doi.org/10.1016/s0016-7037(02)00829-3)
Methods

Saito, M. A., Goepfert, T. J., Noble, A. E., Bertrand, E. M., Sedwick, P. N., & DiTullio, G. R. (2010). A seasonal study of dissolved cobalt in the Ross Sea, Antarctica: micronutrient behavior, absence of scavenging, and relationships with Zn, Cd, and P. *Biogeosciences*, 7(12), 4059–4082. doi:[10.5194/bg-7-4059-2010](https://doi.org/10.5194/bg-7-4059-2010)
Methods

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Parameters

Parameter	Description	Units
Station_ID	Station ID number	unitless
Start_Date_UTC	Date at start of sample collection; format: DD/MM/YYYY	unitless
Start_Time_UTC	Time (UTC) at start of sample collection; format: hh:mm	unitless
Start_ISO_DateTime_UTC	Date and time (UTC) at start of sample collection formatted to ISO8601 standard: YYYY-MM-DDThh:mmZ	unitless
End_Date_UTC	Date at end of sample collection; format: DD/MM/YYYY	unitless
End_Time_UTC	Time (UTC) at end of sample collection; format: hh:mm	unitless
End_ISO_DateTime_UTC	Date and time (UTC) at end of sample collection formatted to ISO8601 standard: YYYY-MM-DDThh:mmZ	unitless

Start_Latitude	Latitude at start of sample collection	degrees North
Start_Longitude	Longitude at start of sample collection	degrees East
End_Latitude	Latitude at end of sample collection	degrees North
End_Longitude	Longitude at end of sample collection	degrees East
Event_ID	Event ID number	unitless
Sample_ID	Sample ID number	unitless
Sample_Depth	Sample depth	meters (m)
Co_D_CONC_BOTTLE_cc9oxz	Concentration of dissolved Co (after UV oxidation) from Niskin bottle	picomolar (pM)
SD1_Co_D_CONC_BOTTLE_cc9oxz	One standard deviation of Co_D_CONC_BOTTLE_cc9oxz	picomolar (pM)
Flag_Co_D_CONC_BOTTLE_cc9oxz	Quality flag for Co_D_CONC_BOTTLE_cc9oxz	unitless
PHOSPHATE_D_CONC_BOTTLE_fxqtpr	Concentration of dissolved phosphate, samples may or may not have been filtered	micromoles per kilogram (umol/kg)
SD1_PHOSPHATE_D_CONC_BOTTLE_fxqtpr	One standard deviation of PHOSPHATE_D_CONC_BOTTLE_fxqtpr	micromoles per kilogram (umol/kg)
Flag_PHOSPHATE_D_CONC_BOTTLE_fxqtpr	Quality flag for PHOSPHATE_D_CONC_BOTTLE_fxqtpr	unitless
NO2_NO3_D_CONC_BOTTLE_h3f4lh	Concentration of dissolved NITRITE plus NITRATE, samples may or may not have been filtered	micromoles per kilogram (umol/kg)
SD1_NO2_NO3_D_CONC_BOTTLE_h3f4lh	One standard deviation of NO2_NO3_D_CONC_BOTTLE_h3f4lh	micromoles per kilogram (umol/kg)
Flag_NO2_NO3_D_CONC_BOTTLE_h3f4lh	Quality flag for NO2_NO3_D_CONC_BOTTLE_h3f4lh	unitless
SILICATE_D_CONC_BOTTLE_jdlfin	Concentration of dissolved silicate, samples may or may not have been filtered	micromoles per kilogram (umol/kg)
SD1_SILICATE_D_CONC_BOTTLE_jdlfin	One standard deviation of SILICATE_D_CONC_BOTTLE_jdlfin	micromoles per kilogram (umol/kg)
Flag_SILICATE_D_CONC_BOTTLE_jdlfin	Quality flag for SILICATE_D_CONC_BOTTLE_jdlfin	unitless
NITRITE_D_CONC_BOTTLE_h9224x	Concentration of dissolved NITRITE, samples may or may not have been filtered	micromoles per kilogram (umol/kg)
SD1_NITRITE_D_CONC_BOTTLE_h9224x	One standard deviation of NITRITE_D_CONC_BOTTLE_h9224x	micromoles per kilogram (umol/kg)
Flag_NITRITE_D_CONC_BOTTLE_h9224x	Quality flag for NITRITE_D_CONC_BOTTLE_h9224x	unitless
NH4_D_CONC_BOTTLE_enhcwu	Concentration of dissolved ammonium, samples may or may not have been filtered	micromoles per kilogram (umol/kg)
SD1_NH4_D_CONC_BOTTLE_enhcwu	One standard deviation of NH4_D_CONC_BOTTLE_enhcwu	micromoles per kilogram (umol/kg)

Flag_NH4_D_CONC_BOTTLE_enhcu	Quality flag for NH4_D_CONC_BOTTLE_enhcu	unitless
NITRATE_D_CONC_BOTTLE_wmeegn	Concentration of dissolved NITRATE, samples may or may not have been filtered	micromoles per kilogram (umol/kg)
SD1_NITRATE_D_CONC_BOTTLE_wmeegn	One standard deviation of NITRATE_D_CONC_BOTTLE_wmeegn	micromoles per kilogram (umol/kg)
Flag_NITRATE_D_CONC_BOTTLE_wmeegn	Quality flag for NITRATE_D_CONC_BOTTLE_wmeegn	unitless
CTDTMP_zcmqyu	Temperature from CTD sensor in the ITS-90 convention	degrees Celsius
SD1_CTDTMP_zcmqyu	One standard deviation of CDTMP_zcmqyu	degrees Celsius
Flag_CDTMP_zcmqyu	Quality flag for CDTMP_zcmqyu	unitless
CTDSAL_po5mds	Practical salinity from CTD sensor on the PSS-1978 scale	unitless
SD1_CTDSAL_po5mds	One standard deviation of CTDSAL_po5mds	unitless
Flag_CTDSAL_po5mds	Quality flag for CTDSAL_po5mds	unitless
CTDOXY_rfrw1n	Concentration of dissolved oxygen from sensor on CTD	micromoles per kilogram (umol/kg)
SD1_CTDOXY_rfrw1n	One standard deviation of CTDOXY_rfrw1n	micromoles per kilogram (umol/kg)
Flag_CTDOXY_rfrw1n	Quality flag for CTDOXY_rfrw1n	unitless

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Instruments

Dataset-specific Instrument Name	Metrohm 858 Sample Processor
Generic Instrument Name	Laboratory Autosampler
Generic Instrument Description	Laboratory apparatus that automatically introduces one or more samples with a predetermined volume or mass into an analytical instrument.

Dataset-specific Instrument Name	Metrohm 663 VA and μ AutolabIII system
Generic Instrument Name	Metrohm 663 VA Stand mercury electrode
Generic Instrument Description	The Metrohm 663 VA stand forms the wet chemical part of a polarographic and voltammetric analytical system. It features a mercury electrode, an Ag/AgCl reference electrode and a glassy carbon counter electrode. The size of the mercury drop and the stirrer speed are set manually on the VA Stand. The VA Stand can be operated in Dropping Mercury Electrode (DME), Hanging Mercury Drop Electrode (HMDE) and Static Mercury Drop Electrode (SMDE) modes. The VA Stand can be controlled by a potentiostat in conjunction with the Metrohm IME663 interface.

Dataset-specific Instrument Name	8 L X-Niskin bottles (Ocean Test Equipment)
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	Metrohm 705 UV Digester
Generic Instrument Name	UV Digester
Generic Instrument Description	Digestion instrument for UV photolysis of water samples

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Deployments

FK160115

Website	https://www.bco-dmo.org/deployment/708387
Platform	R/V Falkor
Report	https://service.rvdata.us/data/cruise/FK160115/doc/FK160115_OfficialCruiseReport_Saito_v3.pdf
Start Date	2016-01-16
End Date	2016-02-11
Description	Project: Using Proteomics to Understand Oxygen Minimum Zones (ProteOMZ) More information is available from the ship operator at https://schmidtocean.org/cruise/investigating-life-without-oxygen-in-the... Additional cruise information is available from the Rolling Deck to Repository (R2R): https://www.rvdata.us/search/cruise/FK160115

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Project Information

The ProteOMZ Expedition: Investigating Life Without Oxygen in the Pacific Ocean (ProteOMZ (Proteomics in an Oxygen Minimum Zone))

Website: <https://schmidtocean.org/cruise/investigating-life-without-oxygen-in-the-tropical-pacific/#team>

Coverage: Central Pacific Ocean (Hawaii to Tahiti)

From Schmidt Ocean Institute's ProteOMZ Project page:

Rising temperatures, ocean acidification, and overfishing have now gained widespread notoriety as human-caused phenomena that are changing our seas. In recent years, scientists have increasingly recognized that there is yet another ingredient in that deleterious mix: a process called deoxygenation that results in less oxygen available in our seas.

Large-scale ocean circulation naturally results in low-oxygen areas of the ocean called oxygen deficient zones

(ODZs). The cycling of carbon and nutrients – the foundation of marine life, called biogeochemistry – is fundamentally different in ODZs than in oxygen-rich areas. Because researchers think deoxygenation will greatly expand the total area of ODZs over the next 100 years, studying how these areas function now is important in predicting and understanding the oceans of the future. This first expedition of 2016 led by Dr. Mak Saito from the Woods Hole Oceanographic Institution (WHOI) along with scientists from University of Maryland Center for Environmental Science, University of California Santa Cruz, and University of Washington aimed to do just that, investigate ODZs.

During the 28 day voyage named “ProteOMZ,” researchers aboard R/V *Falkor* traveled from Honolulu, Hawaii to Tahiti to describe the biogeochemical processes that occur within this particular swath of the ocean’s ODZs. By doing so, they contributed to our greater understanding of ODZs, gathered a database of baseline measurements to which future measurements can be compared, and established a new methodology that could be used in future research on these expanding ODZs.

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Funding

Funding Source	Award
Gordon and Betty Moore Foundation: Marine Microbiology Initiative (MMI)	GBMF3782
NSF Division of Ocean Sciences (NSF OCE)	OCE-1736599

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