

Barium concentration and isotopic data collected along the California Coastline during July 2014 from R/V Melville cruise MV1405

Website: <https://www.bco-dmo.org/dataset/770447>

Data Type: Cruise Results

Version: 1

Version Date: 2019-06-10

Project

» [U.S. GEOTRACES Pacific Meridional Transect: Tracing Basin-scale Nutrient Cycling and Carbon Export with Dissolved and Particulate Barium-isotopic Distributions](#) (GEOTRACES PMT Barium)

Contributors	Affiliation	Role
Horner, Tristan J.	Woods Hole Oceanographic Institution (WHOI)	Principal Investigator
Rauch, Shannon	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract

Barium concentration and isotopic data collected along the California Coastline during July 2014 from R/V Melville cruise MV1405.

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Coverage

Spatial Extent: N:39.001 E:-125.746 S:38.99 W:-125.75

Temporal Extent: 2014-07-12

Methods & Sampling

Samples were collected using GO-FLO Teflon Trace Metal Bottles, filtered to 0.2 μm or 0.45 μm (depending on filter type), acidified to pH \approx 2 with hydrochloric acid, and stored for several years prior to processing. Aliquots containing five milliliters of seawater were cleanly subsampled from each sample, weighed, and an appropriate quantity of ^{136}Ba - ^{135}Ba double spike added. Following spike-sample equilibration, barium was co-precipitated with calcium carbonate via dropwise addition of sodium carbonate. The resultant precipitate was dissolved in hydrochloric acid and twice passed through cation-exchange columns to purify Ba from matrix elements.

Samples were aspirated, desolvated, and analyzed using a 100 $\mu\text{L}/\text{min}$ nebulizer, Aridus II desolvation system, and ThermoFisher Neptune multi-collector ICP-MS, respectively. All instrumentation was sited at the WHOI Plasma Facility. Barium-isotopic compositions were calculated from simultaneous monitoring of ion beams corresponding to m/z 131 (Xe, xenon), 135 (Ba), 136 (Xe; Ba; Ce, cerium), 137 (Ba), 138 (Ba; La, lanthanum; Ce), 139 (La) and 140 (Ce).

Problem Report:

Sample from 1,000 m (Event #42; St. 12b) has an asymmetric uncertainty due to possible evaporative losses; positive uncertainty is +1.4 nmol/kg, whereas negative uncertainty is −6.3 nmol/kg (both are one standard deviation).

Data Processing Description

Data reduction was performed in MATLAB using the baseline-corrected ion beam output from the instrument software. Barium-isotopic compositions were calculated using an iterative, three-dimensional geometric interpretation of the double spike problem, with additional nested loops for interference corrections. All sample compositions are reported as parts per one thousand deviations (i.e., ‰; per mille) relative to NIST SRM 3104a.

Quality Control: Refer to the Certified Reference Materials (CRMs) [supplemental file](#) (PDF).

"_FLAG" columns follow the ODV flag scheme, defined as:

1 = Good Value: Used when replicate samples were analyzed for a particular concentration/isotopic composition.

2 = Probably Good Value: Used when the reported value reflects analysis of a single replicate.

3 = Probably Bad Value: Used when a value appears abnormally high or low (oceanographically inconsistent) based on adjacent depths or typical profile variability and shape using the context of relevant nearby stations.

6 = Value Below Detection Limit: Used when value is below the detection limit for that given element. Empty values are reported rather than zero or a detection limit value.

BCO-DMO Processing:

- replaced blanks (no data) with "nd".

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Data Files

File
Barium_MV1405.csv (Comma Separated Values (.csv), 797 bytes) MD5:e58ccc07bb3d383238766c93edbbb5cb Primary data file for dataset ID 770447

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Supplemental Files

File
Certified Reference Materials - Barium concentration and isotopic results for GEOTRACES seawater standards filename: NIRVANA_GEOTRACES-std_info.pdf (Portable Document Format (.pdf), 206.56 KB) MD5:a9fdef500b6b09380fedc7a9fe274c70 Certified Reference Materials - Barium concentration and isotopic results for GEOTRACES seawater standards

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Related Publications

Bates, S. L., Hendry, K. R., Pryer, H. V., Kinsley, C. W., Pyle, K. M., Woodward, E. M. S., & Horner, T. J. (2017). Barium isotopes reveal role of ocean circulation on barium cycling in the Atlantic. *Geochimica et Cosmochimica Acta*, 204, 286–299. doi:[10.1016/j.gca.2017.01.043](https://doi.org/10.1016/j.gca.2017.01.043)

Related Research

Geyman, B. M., Ptacek, J. L., LaVigne, M., & Horner, T. J. (2019). Barium in deep-sea bamboo corals: Phase

associations, barium stable isotopes, & prospects for paleoceanography. Earth and Planetary Science Letters, 525, 115751. doi:[10.1016/j.epsl.2019.115751](https://doi.org/10.1016/j.epsl.2019.115751)
Results

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Parameters

Parameter	Description	Units
Event	Event number	unitless
Station	Station number	unitless
lat	Latitude (positive values = North)	decimal degrees
long	Longitude (negative values = West)	decimal degrees
Depth	Sample depth	meters (m)
bottle_rosette	Bottle number from rosette	unitless
Ba_D_CONC_BOTTLE	Dissolved Ba (barium) concentration	nanomoles per kilogram (nmol/kg)
Ba_D_CONC_BOTTLE_stdev	One-sigma uncertainty about the barium concentration	nmol/kg
Ba_D_CONC_BOTTLE_FLAG	ODV quality flag for Ba_D_CONC_BOTTLE	unitless
Ba_138_134_D_DELTA_BOTTLE	Dissolved Ba-isotopic composition	per mil deviation rel. to NIST SRM 3104a
Ba_138_134_D_DELTA_BOTTLE_stdev	One-sigma uncertainty about the dissolved Ba-isotopic composition	per mil
Ba_138_134_D_DELTA_BOTTLE_FLAG	ODV quality flag for Ba_138_134_D_DELTA_BOTTLE	unitless
Notes	Any concerns or issues	unitless

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Instruments

Dataset-specific Instrument Name	GO-FLO Teflon Trace Metal Bottle
Generic Instrument Name	GO-FLO Teflon Trace Metal Bottle
Generic Instrument Description	GO-FLO Teflon-lined Trace Metal free sampling bottles are used for collecting water samples for trace metal, nutrient and pigment analysis. The GO-FLO sampling bottle is designed specifically to avoid sample contamination at the surface, internal spring contamination, loss of sample on deck (internal seals), and exchange of water from different depths.

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

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Deployments

MV1405

Website	https://www.bco-dmo.org/deployment/559966
Platform	R/V Melville
Start Date	2014-07-03
End Date	2014-07-26
Description	Deployment MV1405 on R/V Melville. Cruise took place during July 2014.

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Project Information

U.S. GEOTRACES Pacific Meridional Transect: Tracing Basin-scale Nutrient Cycling and Carbon Export with Dissolved and Particulate Barium-isotopic Distributions (GEOTRACES PMT Barium)

NSF Award Abstract:

The goal of the international GEOTRACES program is to understand the distributions of trace chemical elements and their isotopes in the oceans. This project would measure stable isotopes of barium on a 2018 U.S. GEOTRACES expedition in the Pacific Ocean. Barium is a trace element whose distribution is relevant to all three themes of the GEOTRACES program, as barium can be used to: study chemical cycling within the oceans; trace exchanges of elements at ocean boundaries; and infer past environmental conditions. The data collected here will be the first of their kind for barium isotopes and will illuminate the geochemical cycle of this element. Moreover, conducting this work as part of the GEOTRACES program will maximize the return on investment in the barium isotope data by providing a rich interpretative framework.

This project seeks to understand how the interplay between internal cycling and boundary processes sets

basin-scale barium concentration and isotopic distributions in the Pacific Ocean. Despite possessing a nutrient-like dissolved profile, marine barium cycling has a fundamentally different boundary condition to the major algal nutrients: barium cycling is not driven by production of organic matter but rather by its remineralization. Respiration of sinking organic matter in the ocean's 'twilight zone' releases carbon dioxide, mineralizes nutrients, and promotes precipitation of micron-size crystals of barite. Since barite is the major vector of particulate barium in seawater, the abundance and isotopic composition of barium in the oceans is tied to global carbon and nutrient cycling at the 'dark end' of the biological carbon pump. The data collected here will be used to test hypotheses across an unprecedented range of oceanographic conditions regarding: the formation, export, and regeneration of particulate material and the connection to seafloor processes; the importance of boundary sources to regional and global trace element and isotope budgets; the formation of putative soft-metal sulfides in oxygen-minimum zones; and the origin of enigmatic suspended particles in the deep open ocean. This proposal will contribute to education by training undergraduate research fellows and through presentation of seminars and guest lectures to regional science educators through collaboration with a regional conservation organization.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1736949

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