Depth profiles of seawater dissolved 143Nd/144Nd from RRS James Cook JC-57 in the southwest Atlantic, Punta Arenas (Chile) to Las Palmas (Spain), March 2011 (GEOTRACES-SWAT project)

Website: https://www.bco-dmo.org/dataset/672203
Data Type: Cruise Results
Version: 1
Version Date: 2017-01-06

Project
» A Critical Test of the Nd Paleocirculation Proxy (GA02) (Nd Paleocirculation Proxy)

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

Contributors	Affiliation	Role
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Abstract
This dataset includes depth profiles of seawater dissolved 143Nd/144Nd from samples collected on RRS James Cook cruise JC-57 in the southwest Atlantic, Punta Arenas (Chile) to Las Palmas (Spain) in March 2011. Results are described in Wu et al., 2022 (doi: 10.1016/j.epsl.2022.117846).

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Coverage

Spatial Extent: **N**:-0.18715 **E**:-28 **S**:-49.5472 **W**:-52.68811
Temporal Extent: 2011-03-05 - 2011-03-27

Methods & Sampling

Seawater samples were collected in the GEOTRACES GA02 Cruise Leg 3 from Punta Arenas (Chile) to Las Palmas (Spain), March-April 2011. 5-10 L of seawater were collected depending on the sample depth and stored in a cubitainer for each sample. The samples were filtered using 0.2 µm Sartobran cartridges and acidified using ultrapure Seastar hydrochloric acid (HCl) to pH ~ 2 shortly after sampling.

We preconcentrated rare earth elements from seawater using C18 cartridges (Waters Corp., Sep-Pak classic C18 cartridge 360 mg 55-105 µm) loaded with complexing agent of 2-ethylhexyl hydrogen phosphate (HDEHP) and 2-ethylhexyl dihydrogen phosphate (H2MEHP), which was first proposed by Shabani et al. (1992). In this study, we followed the method by Jeandel et al. (1998), Lacan and Jeandel (2004), Pahnke et al. (2012). Specifically, C18 cartridges were first cleaned in a 0.5N HCl bath overnight, then 10 mL of 6N HCl were introduced through the cartridge, and then they were flushed with > 500 mL of Milli-Q water. Cartridges were in a neutral environment (MilliQ® water) after cleaning. For each 5 L sample, 300 µL of complexing agent HDEHP/H2MEHP was loaded on a clean cartridge. Seawater samples were adjusted to pH ~ 3.5 by adding Optima® ammonium hydroxide. The seawater samples were pumped through the cartridges at 20mL/min by a peristaltic pump. Afterward, the cartridges were eluted with 10 mL of 0.01N HCl to remove barium. After barium elution, the cartridges were eluted with 35 mL of 6N hydrochloric acid at 10 mL/min by the peristaltic pump to collect the REEs. The REEs were dried and further purified by Eichrom RE-spec column chemistry. Nd fractions were extracted from REEs by LN-spec column chemistry.

The Nd isotopic ratios were measured on MC-ICP-MS (a ThermoScientific Neptune-Plus®) at Lamont-Doherty Earth Observatory of Columbia University. Nd fractions from column chemistry were dried by evaporation and dissolved in 600-800 µL of 3% nitric acid (HNO3). The international Nd standard JNdi-1 was analyzed between every sample and the average of the standards is reported relative to the recommended value of 143Nd/144Nd = 0.512115 (Tanaka, 2000). For different concentrations of JNdi-1, the measured 143Nd/144Nd isotopic ratios were 0.512079 ± 0.000014 (2σ, n = 126) for 20ppb solutions, 0.512079 ± 0.000013 (2σ, n = 190) for 15 ppb solutions, and 0.512058 ± 0.000022 (2σ, n = 37) for 10ppb solutions. Nd isotopic ratios were normalized to 146Nd/144Nd = 0.7219 for mass fractionation.

We are awaiting the results of Nd isotopic ratios at the crossover station (~40°S and ~42°W) from University of Cambridge.

Data Processing Description

The Nd isotopic composition is expressed as εNd = [(143Nd/144Ndsample/143Nd/144NdCHUR) - 1] × 104, where 143Nd/144NdCHUR = 0.512638 (Jacobsen and Wasserburg, 1980).

BCO-DMO Processing notes:
- added conventional header with dataset name, PI name, version date
- modified parameter names to conform with BCO-DMO naming conventions
- blank values replaced with no data value 'nd'
- replaced spaces with underscores
- converted BTL_ISO_DateTime_UTC to standard format
- reduced decimals of Nd values

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Data Files

File
Nd_diss_GA02.csv (Comma Separated Values (.csv), 48.84 KB) MD5:d127dcb6ff635a73256323d6ca5027a5 Primary data file for dataset ID 672203

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Related Publications

Jacobsen, S. B., & Wasserburg, G. J. (1980). Sm-Nd isotopic evolution of chondrites. Earth and Planetary Science Letters, 50(1), 139–155. doi:10.1016/0012-821x(80)90125-9 https://doi.org/10.1016/0012-821X(80)90125-9
Methods

Jeandel, C., Thouron, D., & Fieux, M. (1998). Concentrations and isotopic compositions of neodymium in the

eastern Indian Ocean and Indonesian straits. Geochimica et Cosmochimica Acta, 62(15), 2597–2607. doi:10.1016/s0016-7037(98)00169-0 https://doi.org/10.1016/S0016-7037(98)00169-0
Methods

Lacan, F., & Jeandel, C. (2004). Denmark Strait water circulation traced by heterogeneity in neodymium isotopic compositions. Deep Sea Research Part I: Oceanographic Research Papers, 51(1), 71–82. doi:10.1016/j.dsr.2003.09.006
Methods

Pahnke, K., van de Flierdt, T., Jones, K. M., Lambelet, M., Hemming, S. R., & Goldstein, S. L. (2012). GEOTRACES intercalibration of neodymium isotopes and rare earth element concentrations in seawater and suspended particles. Part 2: Systematic tests and baseline profiles. Limnology and Oceanography: Methods, 10(4), 252–269. doi:10.4319/lom.2012.10.252
Methods

Shabani, M. B., Akagi, T., & Masuda, A. (1992). Preconcentration of trace rare-earth elements in seawater by complexation with bis(2-ethylhexyl) hydrogen phosphate and 2-ethylhexyl dihydrogen phosphate adsorbed on a C18 cartridge and determination by inductively coupled plasma mass spectrometry. Analytical Chemistry, 64(7), 737–743. doi:10.1021/ac00031a008
Methods

Tanaka, T., Togashi, S., Kamioka, H., Amakawa, H., Kagami, H., Hamamoto, T., ... Dragusanu, C. (2000). JNdi-1: a neodymium isotopic reference in consistency with LaJolla neodymium. Chemical Geology, 168(3-4), 279–281. doi:10.1016/s0009-2541(00)00198-4 https://doi.org/10.1016/S0009-2541(00)00198-4
Methods

Wu, Y., Pena, L. D., Anderson, R. F., Hartman, A. E., Bolge, L. L., Basak, C., Kim, J., Rijkenberg, M. J. A., de Baar, H. J. W., & Goldstein, S. L. (2022). Assessing neodymium isotopes as an ocean circulation tracer in the Southwest Atlantic. Earth and Planetary Science Letters, 599, 117846. https://doi.org/10.1016/j.epsl.2022.117846
Results

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Parameters

Parameter	Description	Units
cruise_id	Cruise name	unitless
cruise_name	Cruise section	unitless
station	Station number	unitless
cast	Cast number	unitless
cast_type	Cast type	unitless
instrument	Sampling Device	unitless
bottle	Bottle number	unitless
BODC_Bottle	British Oceanographic Data Center Bottle Number	unitless
depth_CTD	Sampling depth of CTD	meters
depth_GEOTRC_CTD_round	Sampling depth rounded to nearest meter	meters
BTL_ISO_DateTime_UTC	UTC date and time of collection formatted as yyyy-mm--ddTHH:MM:SSZ	unitless
lat_sta	Latitude; north is positive	degrees north
lon_sta	Longitude; east is positive	degrees east
press_CTD	Sampling pressure of CTD	dbar
temp_CTD	Sampling temperature of CTD	degrees Celsius
sal_CTD	Sampling salinity of CTD	PSU
O2_CTD	Sampling oxygen concentration of CTD	micromole/kilogram (umol/kg)
Phosphate	Phosphate concentration	micromole/kilogram (umol/kg)
Silicate	Silicate concentration	micromole/kilogram (umol/kg)
Nitrate	Nitrate concentration	micromole/kilogram (umol/kg)
Nd_143_144_D_Ratio	143Nd/144Nd isotopic ratio	dimensionless
Nd_143_144_D_Ratio_Flag	Quality flag: Flag 1: data evaluated as Good; Flag 2: data quality not evaluated or unknown; Flag 3: data quality assessed to be questionable; Flag 4: data quality assessed to be Bad; Flag 9: no data	unitless
Nd_143_144_D_Ratio_Int_2SE	Internal 2 standard errors of each sample	dimensionless
Nd_143_144_D_Ratio_Ext_2SD	External 2 standard deviations of repeatedly measured JNdi standards during the analysis	dimensionless
Nd_D_Epsilon	Final 143Nd/144Nd normalized to 0.512638 in parts per 10000	dimensionless
Nd_D_Epsilon_Flag	Quality flag: Flag 1: data evaluated as Good; Flag 2: data quality not evaluated or unknown; Flag 3: data quality assessed to be questionable; Flag 4: data quality assessed to be Bad; Flag 9: no data	unitless
Nd_D_Epsilon_Int_2SE	Internal 2 standard errors of each sample normalized to 0.512638 in parts per 10000	dimensionless
Nd_D_Epsilon_Ext_2SD	External 2 standard deviations of repeatedly measured JNdi standards during the analysis normalized to 0.512638 in parts per 10000	dimensionless

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Instruments

Dataset-specific Instrument Name	
Generic Instrument Name	CTD - profiler
Generic Instrument Description	The Conductivity, Temperature, Depth (CTD) unit is an integrated instrument package designed to measure the conductivity, temperature, and pressure (depth) of the water column. The instrument is lowered via cable through the water column. It permits scientists to observe the physical properties in real-time via a conducting cable, which is typically connected to a CTD to a deck unit and computer on a ship. The CTD is often configured with additional optional sensors including fluorometers, transmissometers and/or radiometers. It is often combined with a Rosette of water sampling bottles (e.g. Niskin, GO-FLO) for collecting discrete water samples during the cast. This term applies to profiling CTDs. For fixed CTDs, see https://www.bco-dmo.org/instrument/869934.

Dataset-specific Instrument Name	MC-ICP-MS (ThermoScientific Neptune-Plus)
Generic Instrument Name	Inductively Coupled Plasma Mass Spectrometer
Dataset-specific Description	Measured Nd isotopic ratios
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.

Dataset-specific Instrument Name	
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.

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Deployments

JC057

Website	https://www.bco-dmo.org/deployment/672215
Platform	RRS James Cook
Report	http://dmoserv3.bco-dmo.org/data_docs/GEOTRACES/SWAT/JC057_eventlog/Cruisereport_Geotraces_leg3_250511.pdf
Start Date	2011-02-03
End Date	2011-06-03

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Project Information

A Critical Test of the Nd Paleocirculation Proxy (GA02) (Nd Paleocirculation Proxy)

Coverage: SW Atlantic Ocean

Extracted from the NSF award abstract:

Neodymium (Nd) isotopes are increasingly used in paleoceanographic studies as "quasi-conservative" water mass tracers. However, the limitations of this proxy are not yet fully understood. The proposed work aims to address this uncertainty by critically evaluating the behavior of Nd isotopes as tracers of water mass mixing. The project, led by researchers at Columbia University's Lamont-Doherty Earth Observatory, will analyze in-hand seawater and surface sediment samples collected along a meridional transect in the southwest Atlantic (0 to 50 degrees S) during a GEOTRACES cruise. The sample suite will be used to test 1) whether Nd isotope ratios deviate from expected values for mixing along circulation transport paths, 2) whether Nd isotopes behave quasi-conservatively away from continental margins, 3) whether seafloor features (e.g., continental shelf, volcanic seamounts) add significant external Nd to the system, and 4) whether the Southern Hemisphere wind zones impact Nd isotope values through aeolian deposition. The relationship between Nd isotopes in authigenic surface sediments and those in the overlying seawater will be calibrated for the first time.

By testing an emerging tool in the study of past ocean dynamics, this research will enable a more accurate understanding of changes in the ocean-climate system. The project will support an early-career researcher and a graduate student. Undergraduate students will be involved through an NSF-supported summer internship program at LDEO.

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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-1260514

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