Dissolved Fe stable isotope ratios and concentrations collected from the RRS Discovery (D357) and RRS James Cook (JC068) from the North Atlantic in 2010-2011

Website: https://www.bco-dmo.org/dataset/637784
Data Type: Cruise Results
Version: 2
Version Date: 2016-11-30

Project
» Trace-metal isotopes in Atlantic seawater and particles from Geotraces transects A03 and A10 (TMI_GEOTRACES-UK)

Contributors	Affiliation	Role
John, Seth G.	University of South Carolina	Principal Investigator
Conway, Timothy M.	University of South Carolina	Contact
Copley, Nancy	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

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Methods & Sampling

Samples were provided from the UK GEOTRACES Titanium sampling rosette and were sampled and filtered into acid-cleaned 1L LDPE bottles by the onboard clean sampling team. water samples were filtered using Millipore 25 mm 0.4 µm polyethersulfone (PES) filters (>75 m depth) or 0.2 µm AcroPak Supor Pall PES capsules (<75 m depth or fish samples). Upon receipt of samples on shore, they were acidified to pH 2 using clean hydrochloric acid and left at this pH for at least 3 months before processing. Every sample was simultaneously extracted and purified for the analysis of d56Fe and [Fe] using published methods (Conway *et al.*, 2013). Briefly, Fe, double-spike was added to the acidified samples and allowed to equilibrate for > 1 hour. Metals were then extracted from seawater onto an ethylenediaminetriacetic acid resin (Nobias PA-1; Hitachi) for 2 hours at pH 2. Metals were eluted off this resin using 3 N HNO_3, and were then purified by anion exchange chromatography before being reconstituted in 0.1 N HNO_3 for analysis.

Concentrations and stable isotope ratios were determined simultaneously by analysis on a Neptune multi-collector ICP-MS in high resolution mode. Every sample was analyzed twice, and the mean isotope ratios are presented here, expressed relative to the international isotope standard IRRM-014. Instrumental and procedural isotopic fractionation was corrected for using a double-spike data reduction scheme.

Concentrations were calculated using isotope-dilution to calculate ng of metal per sample, and then converted to nmol kg-1 or pmol kg-1 using the weight of each sample processed. Concentration numbers represent the mean of two ICP-MS analyses of each sample. The largest sources of error for concentration analyses are determining the weight of the sample and determining the volume of double-spike added to each sample. We approximate 2% error for each sample based on the combination of these two factors. Accuracy of this technique for concentrations were checked by analysis of S, D1 and D2 SAFe reference standards (for which we determined values identical to the consensus values; see Conway et al, 2013) and inter-comparison with two other groups measuring trace metal concentrations on US GEOTRACES GA03 samples (Middag *et al.*,

2015).

Uncertainty for isotope ratios in the dataset is expressed as the 2 sigma uncertainty on the average isotope ratio, calculated from a combination of the internal standard error of each of two measurements and the bracketing isotope standards used, as described in Conway *et al.*, (2013). We also estimate external precision for these samples (0.05‰), based on replicate analyses of S. Atlantic seawater samples (see Conway, John and Lacan, in review).

References:

Conway, T. M., John, S. G. and Lacan, F. (2016). Intercomparison of dissolved iron isotope profiles from reoccupation of three GEOTRACES stations in the Atlantic Ocean. Marine Chemistry. 183. 50-61. doi:10.1016/j.marchem.2016.04.007.

Conway, T.M., Rosenberg, A.D., Adkins, J.F., and S.G. John. (2013). A new method for precise determination of iron, zinc and cadmium stable isotope ratios in seawater by double-spike mass spectrometry. Analytica Chimica Acta, 793: 44-52.

Middag, R., Sefarian, R., Conway, T. M., John, S. G., Bruland, K. W. and de Baar, H. J. W. (2015). GEOTRACES Intercomparison of Dissolved Trace Elements at the Bermuda Atlantic Time Series Station. *Mar. Chem.* 177 (3). 476-479.

Data Processing Description

Data are flagged as 1 (good) or 2 (questionable). Data points flagged as questionable are considered to be potential outliers. This is because the bottle tripped at the wrong depth or data appear oceanographically inconsistent (e.g. values which are very different from samples taken above and below or from the GA02 section at Station 18), even though there is no obvious analytical reason to dismiss them.

BCO-DMO Processing Notes:

2016-04-15: Changed parameter description for d56Fe_mean from 54Fe/56Fe to 56Fe/54Fe. . Also slightly changed the Fe_err_2s description from "2 sigma uncertainty in dissolved Fe" to "2sigma error on the d56Fe parameter".

2016-11-28: Changed parameter name of d56Fe_mean to delta_56Fe, to match the GT10/11 (GA03) dataset. Changed metadata version from 2016-04-15 to 2016-11-28. Data made publicly accessible.

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Data Files

File
Fe_diss_UK_GA10.csv(Comma Separated Values (.csv), 21.19 KB) MD5:77fae80491efd0eede6589e64f6e9b24
Primary data file for dataset ID 637784

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Parameters

Parameter	Description	Units
cruise_id	cruise identification: D=RRS/Discovery; JC=RRS/James Cook	unitless
station	station identification	unitless
depth	depth	meters
inst	instrument: surface towed fish or titanium rosette	unitless
cast_CTD	CTD cast identification	unitless
cast	CTD cast number	unitless
bottle	bottle number	unitless
sample_GEOTRC	GEOTRACES sample number	unitless
lat_start	starting latitude; north is positive	decimal degrees
lon_start	starting longitude; east is positive	decimal degrees
date	UTC date	yyyy-mm-dd
time	UTC time	HH:MM
Fe	Fe concentration (< 2 micron)	nmol kg-1
Fe_err	Fe error; 2% of concentration	nmol kg-1
delta_56Fe	Fe stable isotope ratio: ((56Fe/54Fe)sample/(56Fe/54Fe)IRMM-014^-1)*1000	o/oo
Fe_err_2s	2 sigma uncertainty on the dissolved d56Fe	o/oo
flags	Data quality flag: 1 (good) or 2 (questionable) and comments	unitless

Instruments

Dataset-specific Instrument Name	
Generic Instrument Name	GeoFish Towed near-Surface Sampler
Generic Instrument Description	The GeoFish towed sampler is a custom designed near surface (

Dataset-specific Instrument Name	
Generic Instrument Name	Mass Spectrometer
Dataset-specific Description	Neptune multi-collector ICP-MS
Generic Instrument Description	General term for instruments used to measure the mass-to-charge ratio of ions; generally used to find the composition of a sample by generating a mass spectrum representing the masses of sample components.

Dataset-specific Instrument Name	
Generic Instrument Name	Trace Metal Bottle
Dataset-specific Description	1L LDPE bottles
Generic Instrument Description	Trace metal (TM) clean rosette bottle used for collecting trace metal clean seawater samples.

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Deployments

D357

Website	https://www.bco-dmo.org/deployment/637790
Platform	RRS Discovery
Report	http://dmoserv3.bco-dmo.org/data_docs/GEOTRACES/UK_GT/D357_cruise_report.pdf
Start Date	2010-10-18
End Date	2010-11-22
Description	UK GEOTRACES cruise

JC068

Website	https://www.bco-dmo.org/deployment/637791
Platform	RRS James Cook
Report	http://dmoserv3.bco-dmo.org/data_docs/GEOTRACES/UK_GT/JC068_cruise_report.pdf
Start Date	2011-12-24
End Date	2012-01-27
Description	UK GEOTRACES cruise

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Project Information

Trace-metal isotopes in Atlantic seawater and particles from Geotraces transects A03 and A10 (TMI_GEOTRACES-UK)

Coverage: South Atlantic Ocean

Trace metals significantly affect marine biogeochemistry and can be important tools of discovery, leading to information on nutrient supply and demineralization, ocean circulation, and earth?s climate history. Due to their importance, the international GEOTRACES effort was designed to measure the distribution of metals in the oceans. However, metal concentration distributions are only a part of the larger picture. To provide a more complete dataset, researchers from the University of South Carolina propose to measure trace metal isotopes (Fe, Cd, Cu, and Zn) and plan to apply these data to distinguish between the latest competing hypotheses of factors influencing metal biogeochemcial cycling. Many processes can fractionate the isotopes of elements and therefore differences in the isotope signal can be instructive of biogeochemical cycling of these elements. The goal of the project is to address the origin and amount of biologically available iron, its modification during internal cycling, its transfer between pools, and the factors that influence its bioavailability. In addition, Zn and Cd isotope analyses will yield information on modern and ancient oceans, which could help predict how oceans

change in future climates. the isotopes of cu will also be examined. Results will inform the ocean science community, and elucidate how trace-metals and other nutrients affect production and are impacted by climate change.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1131387
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