HPLC analyses of algal pigment concentrations from the CoFeMUG cruise (KN192-05) in the South Atlantic subtropical gyre during 2007

Website: https://www.bco-dmo.org/dataset/3480
Version: 18 May 2011
Version Date: 2011-05-18

Project
» Cobalt, Iron and Micro-organisms from the Upwelling zone to the Gyre (GAc01) (CoFeMUG)

Programs
» Ocean Carbon and Biogeochemistry (OCB)
» U.S. GEOTRACES (U.S. GEOTRACES)

Contributors	Affiliation	Role
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Dataset Description

HPLC analyses of algal pigment concentrations from the CoFeMUG cruise.

Methods & Sampling

Algal HPLC pigment samples (2L-4L) were collected from CTD profiles, filtered under low vacuum through GF/F filters, and frozen in LN for onshore analyses. Samples were extracted overnight in cold (-20 degrees C) 100% acetone and analyzed using an Agilent 1100 Model HPLC system equipped with autosampler, photodiode array, and fluorescence detectors. The gradient elution program used was a slight modification of the Zapata et al. gradient elution method (2000). Complete details of the HPLC method are described elsewhere (DiTullio and Geesey 2002). Detection limits for the pigments were on the order of 1 nanogram with a coefficient of variation of <3% for replicate HPLC pigment standard injections. Pigments were isolated from unialgal cultures grown in our lab.

DITULLIO, G. R., AND M. E. GEESEY. 2002. Photosynthetic pigments in marine algae and bacteria, p. 2453 - 2470.*In* G. Bitton [ed.], The Encyclopedia of Environmental Microbiology. Wiley.

ZAPATA, M., F. RODRIGUEZ, AND J. L. GARRIDO. 2000. Separation of chlorophylls and carotenoids from marine phytoplankton: A new HPLC method using a reversed phase C8 column and pyridine-containing mobile phases. Mar. Ecol. Prog. Ser. 195: 29 - 45.

Data Processing Description

Standard curves relating pigment concentration to peak area were run for each pigment.

Related files and references:
DITULLIO, G. R., AND M. E. GEESEY. 2002. Photosynthetic pigments in marine algae and bacteria, p. 2453 - 2470.*In* G. Bitton [ed.], The Encyclopedia of Environmental Microbiology. Wiley.

ZAPATA, M., F. RODRIGUEZ, AND J. L. GARRIDO. 2000. Separation of chlorophylls and carotenoids from marine phytoplankton: A new HPLC method using a reversed phase C8 column and pyridine-containing mobile phases. Mar. Ecol. Prog. Ser. 195: 29 - 45.

BCO-DMO Processing Notes
Generated from original .xls file 'CoFeMug Station Pigs.xls' contributed by Tyler Cyronak

BCO-DMO Edits
- Parameter names modified to conform to BCO-DMO convention
- Date reformatted to YYYYMMDD
- Time (GMT and Local) reformatted to HHMM
- Blank lines removed
- lat deg/min and lon deg/min columns removed (lat/lon in decimal degrees preserved)
- 'nd' (no data) value inserted in blank cells
- '-999' bad data flag replaced with 'nd'

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Data Files

File
pigments.csv (Comma Separated Values (.csv), 44.34 KB) MD5:151963d352de59e486deadd1d01e579a Primary data file for dataset ID 3480

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Parameters

Parameter	Description	Units
station	Station number	integer
cast	Cast number	integer
date	date (GMT)	YYYYMMDD
time_start_gmt	Start time (GMT)	HHMM
time_start_local	Start time (Local)	HHMM
lat	Station latitude (South is negative)	decimal degrees

lon	Station longitude (West is negative)	decimal degrees
depth	Sample depth	meters
Niskin	Niskin bottle number	integer
Amb_Bot	Ambient bottle number	integer
Fluoro_Chl_a_Conc	Fluoro_Chl_a_Conc	ug/L
MgDVP	MgDVP	ng L-1
Chl_c2	Chl_c2	ng L-1
Chl_c1	Chl_c1	ng L-1
Peridinin	Peridinin	ng L-1
But_19	19_But	ng L-1
Fuco	Fuco	ng L-1
Neo	Neo	ng L-1
Prasino	Prasino	ng L-1
Viola	Viola	ng L-1
Hex_19	19_Hex	ng L-1
Diadino	Diadino	ng L-1
Cis_Fuco	Cis_Fuco	ng L-1
Allo	Allo	ng L-1
Diato	Diato	ng L-1

Zeaxanthin	Zeaxanthin	ng L-1
Lutein	Lutein	ng L-1
Crocoxanthin	Crocoxanthin	ng L-1
DV_Chl_a	DV_Chl_a	ng L-1
Chl_a	Chl_a	ng L-1
Chlc_Like	Chlc_Like	ng L-1
a_Car	a_Car	ng L-1
b_Car	b_Car	ng L-1
Chl_c3	Chl_c3	ng L-1
Chl_b	Chl_b	ng L-1
Chl_cMVP	Chl_cMVP	ng L-1
Phaeophorobide	Phaeophorobide	ng L-1
Phaeophytin	Phaeophytin	ng L-1

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Instruments

Dataset-specific Instrument Name	Niskin bottle
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	CTD Sea-Bird SBE 911plus
Generic Instrument Name	Sea-Bird SBE 911plus CTD
Generic Instrument Description	[tethered, real-time] The Sea-Bird SBE 911 plus is a type of CTD instrument package for continuous measurement of conductivity, temperature and pressure. The SBE 911 plus includes the SBE 9plus Underwater Unit and the SBE 11plus Deck Unit (for real-time readout using conductive wire) for deployment from a vessel. The combination of the SBE 9 plus and SBE 11 plus is called a SBE 911 plus. The SBE 9 plus uses Sea-Bird's standard modular temperature and conductivity sensors (SBE 3 plus and SBE 4). The SBE 9 plus CTD can be configured with up to eight auxiliary sensors to measure other parameters including dissolved oxygen, pH, turbidity, fluorescence, light (PAR), light transmission, etc.). more information from Sea-Bird Electronics

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Deployments

KN192-05

Website	https://www.bco-dmo.org/deployment/57852
Platform	R/V Knorr
Report	http://bcodata.whoi.edu/CoFeMUG/CruiseReport_KN192-5.pdf
Start Date	2007-11-16
End Date	2007-12-13

Description	The South Atlantic subtropical gyre and Benguela Upwelling region were sampled for chemistry and biological properties relating to the trace metal nutrition and phytoplankton diversity and productivity. Specifically cobalt and iron dissolved seawater concentrations will be measured and related to the abundance of cyanobacteria including nitrogen fixers and eukaryotic phytoplankton. The phytoplankton of the Benguela Upwelling region were also examined to determine if their growth was iron or cobalt limited. A total of 27 station locations were occupied in the study area to collect the water chemistry and biological samples for these analyses (see cruise track). Iron and cobalt analyses will be conducted using inductively coupled plasma mass spectrometry and cathodic stripping voltammetry electrochemical methods. The sample preparation and subsequent analyses are technically demanding, but data generated from the cruise samples are being contributed beginning in mid 2009. The CoFeMUG KN192-5 cruise was supported by NSF OCE award # 0452883 http://www.nsf.gov/awardsearch/showAward.do?AwardNumber=0452883 A station map showing the 27 sampling locations is available as a PDF file. Original cruise data are available from the NSF R2R data catalog CoFeMUG - South Atlantic 2007 Cruise Participant List 1. Mak Saito (Chief Scientist/WHOI) 2. Abigail Noble (Saito/WHOI) 3. Alysia Cox (Saito/WHOI) 4. Whitney Krey (Delong/Saito/MIT/WHOI) 5. Carl Lamborg (clamborg AT whoi.edu/WHOI) 6. Phoebe Lam (pjlam AT whoi.edu WHOI) 7. Chad Hammerschmidt (chammerschmidt AT whoi.edu, Wright State) 8. Caitlin Frame (cframe AT whoi.edu, WHOI/Casciotti Student) 9. Tyler Goepfert (tgoepfert AT whoi.edu Webb/Saito) 10. Jill Sohm (sohm AT usc.edu) 11. Maria Intermaggio 12. Jack DiTullio (leep AT cofc.edu U. Charleston) 13. Peter Lee (DiTullio U. Charleston) 14. Sarah Riseman (DiTullio U. Charleston) 15. Amanda McLenan (amanda.mclennon AT gmail.com, DiTullio U. Charleston) 16. Mike Seracki (Bigelow) 17. Nicole Poulton (Bigelow) 18. Juan Alba, juanalba AT usp.br (Bigelow) 19. Jane Heywood (Bigelow) 20. Gabrielle Rocap (rocap AT whoi.edu, U. Washington) 21. Emily Nahas (enahas AT u.washington.edu) 22. Michele Wrable (mlw22 AT u.washington.edu) 23. Bob Morris (rmorris AT lifesci.ucsb.edu) 24. Christian Frazar (Chris, U. Washington, Morris lab) 25. Jason Hilton (Zehr, UCSC) 26. Reserved for Angolan Observers 27. Reserved for Angolan Observers Collecting GEOTRACES-compliant samples for: 1. Laura Robinson (Pa Th isotopes) 2. Bob Anderson (Pa Th isotopes - intercalibration) 3. Olivier Rouxel (Se and Fe isotopes) 4. Karen Casciotti (N isotopes) 5. Ben Reynolds (Si and Fe isotopes) 6. Chris Measures (Al) 7. Kristin Buck (FeL)

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Project Information

Cobalt, Iron and Micro-organisms from the Upwelling zone to the Gyre (GAc01) (CoFeMUG)

Coverage: South Atlantic subtropical gyre and Benguela upwelling region

The geochemistries of dissolved cobalt (Co) and iron (Fe) in the oceanic water column share several characteristics such as extremely low concentrations, redox chemistry, low solubility,and utilization as micronutrients by marine microbes. Iron has been the subject of considerable research focus in recent years due to its role in limiting phytoplankton productivity in oceanic and coastal upwelling environments. Cobalt has been much less studied, but recent data show it may be important in influencing primary productivity or phytoplankton community composition in certain geographical areas.

The CoFeMUG project predated GEOTRACES, so while it is not formally recognized as a GEOTRACES section, it is considered a GEOTRACES-related project and the CoFeMUG data are GEOTRACES compliant.

State-of-the-art geochemical and molecular biological techniques were used to address biogeochemical questions in the South Atlantic, and focus especially on the two trace metals, cobalt and iron. The 27-day cruise in November and December 2007 to the South Atlantic was designed to study cobalt and iron biogeochemistry and focus on four major hypotheses.

(1) Large fluxes of labile cobalt are associated with upwelling systems even in Aeolian dominated environments. (2) Cobalt and phosphate show correlations in (and only in) surface waters due to micronutrient utilization and

rapid remineralization. The slope of the correlation is dependent on the chemical speciation of cobalt.
(3) The absence of Trichodesmium populations in the subtropical and tropical South Atlantic is caused by iron limitation.
(4) Based on work from the California and Peru Upwelling regimes, primary productivity in the Benguela upwelling regime off of South West Africa may be iron limited or iron-cobalt colimited.

A combination of geochemical and biological/molecular analyses were made across an oligotrophic-upwelling transition to examine how changing metal regimes affect the physiology and growth of the important primary producers Trichodesmium and Synechococcus.

CoFeMUG project results are published in:
Noble, Abigail E., Carl H. Lamborg, Dan C. Ohnemus, Phoebe J. Lam, Tyler J. Goepfert, Chris I. Measures, Caitlin H. Frame, Karen L. Casciotti, Giacomo R. DiTullio, Joe Jennings, and Mak A. Saito (2012) Basin-scale inputs of cobalt, iron, and manganese from the Benguela-Angola front to the South Atlantic Ocean. Limnology & Oceanography. Vol. 57(4), July 2012. pgs 989-1010. doi:10.4319/lo.2012.57.4.0989 (www.aslo.org/lo/toc/vol_57/issue_4/0989.pdf)

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Program Information

Ocean Carbon and Biogeochemistry (OCB)

Website: http://us-ocb.org/

Coverage: Global

The Ocean Carbon and Biogeochemistry (OCB) program focuses on the ocean's role as a component of the global Earth system, bringing together research in geochemistry, ocean physics, and ecology that inform on and advance our understanding of ocean biogeochemistry. The overall program goals are to promote, plan, and coordinate collaborative, multidisciplinary research opportunities within the U.S. research community and with international partners. Important OCB-related activities currently include: the Ocean Carbon and Climate Change (OCCC) and the North American Carbon Program (NACP); U.S. contributions to IMBER, SOLAS, CARBOOCEAN; and numerous U.S. single-investigator and medium-size research projects funded by U.S. federal agencies including NASA, NOAA, and NSF.

The scientific mission of OCB is to study the evolving role of the ocean in the global carbon cycle, in the face of environmental variability and change through studies of marine biogeochemical cycles and associated ecosystems.

The overarching OCB science themes include improved understanding and prediction of: 1) oceanic uptake and release of atmospheric CO2 and other greenhouse gases and 2) environmental sensitivities of biogeochemical cycles, marine ecosystems, and interactions between the two.

The OCB Research Priorities (updated January 2012) include: ocean acidification; terrestrial/coastal carbon fluxes and exchanges; climate sensitivities of and change in ecosystem structure and associated impacts on biogeochemical cycles; mesopelagic ecological and biogeochemical interactions; benthic-pelagic feedbacks on biogeochemical cycles; ocean carbon uptake and storage; and expanding low-oxygen conditions in the coastal and open oceans.

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-0728683

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