

# Microbial membrane-enriched metaproteome (< 0.8 um fraction) from R/V Knorr KN192-05 in the South Atlantic subtropical gyre and Benguela upwelling region from November to December 2007 (CoFeMUG project)

**Website:** <https://www.bco-dmo.org/dataset/3444>

**Version:** 1

**Version Date:** 2011-03-10

## 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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## Abstract

Microbial membrane-enriched metaproteome (< 0.8 um fraction) from R/V Knorr KN192-05 in the South Atlantic subtropical gyre and Benguela upwelling region from November to December 2007.

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## Table of Contents

- [Dataset Description](#)
    - [Methods & Sampling](#)
    - [Data Processing Description](#)
  - [Data Files](#)
  - [Parameters](#)
  - [Instruments](#)
  - [Deployments](#)
  - [Project Information](#)
  - [Program Information](#)
  - [Funding](#)
- 

## Dataset Description

List of stations at which sampling for Microbial membrane-enriched metaproteome (< 0.8 um fraction) took place

Reference:

Morris, R. M., B. Nunn, C. Frazar, D. Goodlett, Y.S. Ting and G. Rocap. 2010. Comparative metaproteomics reveals ocean-scale shifts in microbial nutrient utilization and energy transduction ISME Journal 4:673-685

## Methods & Sampling

Microorganisms were concentrated from large volume (100–200 l) surface seawater samples (5–8 m) collected from a surface pump. We targeted the < 0.8 um size fraction to obtain the same bacterioplankton community used for GOS shotgun sequencing (Rusch et al., 2007). All concentrations were performed in a 50 l polystyrene reservoir using a Pellicon 2 cassette tangential flow filtration system equipped with one 30kD Biomax Polyethersulfone cassette (Millipore Corporation, Billerica, MA, USA). Seawater was continuously added to the concentration reservoir until cell densities reached  $\sim 10^8$  cells/ml. In all, 100–200 ml of cell concentrate was obtained in 1.5–3h. Concentrated cells were flash frozen in liquid nitrogen and stored at -80 C until further

processing on shore.

A cell pellet was prepared from each tangential flow filtration concentrated sample by centrifugation at 4 1C for 60 min (17 000 g). The supernatant was discarded and cell pellets were resuspended in 3 ml of 20 m Tris buffer pH 7.4. Crude extracts were prepared by passing the cells through a French pressure mini cell at 8000 lb inch<sup>-2</sup> two times and subsequent centrifugation at 4 1C for 30 min (18 000 g). Crude pellet and soluble fractions were separated and pellets were rinsed with 100ml 20mM Tris buffer pH 7.4. Highly enriched membrane material for proteomic analyses was obtained from soluble cell fractions by centrifugation at 4 1C for an additional 60 min (104 000 g). Membrane- enriched material was isolated and rinsed with 100 ml 20 mM Tris buffer pH 7.4.

## Data Processing Description

Proteomic analyses were performed on the membrane-enriched cell fraction. For details of mass spectrometry methods and consensus annotation approach used to assign taxonomy and function to identified peptides, see Morris et al 2010.

Reference:

Morris, R. M., B. Nunn, C. Frazar, D. Goodlett, Y.S. Ting and G. Rocap. 2010. Comparative metaproteomics reveals ocean-scale shifts in microbial nutrient utilization and energy transduction ISME Journal 4:673-685

[ [table of contents](#) | [back to top](#) ]

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## Data Files

File
<b>MetaProteome.csv</b> (Comma Separated Values (.csv), 311 bytes) MD5:f7822e2de8c38c291d0323a8a514a865 Primary data file for dataset ID 3444

[ [table of contents](#) | [back to top](#) ]

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## Parameters

Parameter	Description	Units
Station	Station	integer
Cast	Cast	text
Depth	Depth	integer
Microbial_Membrane_Metaproteome	Microbial Membrane Metaproteome (yes/no)	text

[ [table of contents](#) | [back to top](#) ]

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## Instruments

<b>Dataset-specific Instrument Name</b>	Pump surface
<b>Generic Instrument Name</b>	Pump - Surface Underway Ship Intake
<b>Generic Instrument Description</b>	The 'Pump-underway ship intake' system indicates that samples are from the ship's clean water intake pump. This is essentially a surface water sample from a source of uncontaminated near-surface (commonly 3 to 7 m) seawater that can be pumped continuously to shipboard laboratories on research vessels. There is typically a temperature sensor near the intake (known as the hull temperature) to provide measurements that are as close as possible to the ambient water temperature. The flow from the supply is typically directed through continuously logged sensors such as a thermosalinograph and a fluorometer. Water samples are often collected from the underway supply that may also be referred to as the non-toxic supply. Ideally the data contributor has specified the depth in the ship's hull at which the pump is mounted.

[ [table of contents](#) | [back to top](#) ]

## Deployments

### KN192-05

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

<b>Description</b>	<p>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 <a href="http://www.nsf.gov/awardsearch/showAward.do?AwardNumber=0452883">http://www.nsf.gov/awardsearch/showAward.do?AwardNumber=0452883</a> 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 (pjam 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)</p>
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[ [table of contents](#) | [back to top](#) ]

## 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](http://www.aslo.org/lo/toc/vol_57/issue_4/0989.pdf))

[ [table of contents](#) | [back to top](#) ]

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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 CO<sub>2</sub> 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.

[ [table of contents](#) | [back to top](#) ]

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## Funding

Funding Source	Award
<a href="#">NSF Division of Ocean Sciences (NSF OCE)</a>	<a href="#">OCE-0723866</a>

[ [table of contents](#) | [back to top](#) ]