

# Iron and nutrients from underway samples from RVIB Nathaniel B. Palmer NBP0601, NBP0608 cruises in the Ross Sea Southern Ocean (CORSACS project)

**Website:** <https://www.bco-dmo.org/dataset/3113>

**Version:** September, 2009

**Version Date:** 2009-09-01

## Project

» [Controls of Ross Sea Algal Community Structure](#) (CORSACS)

## Program

» [Ocean Carbon and Biogeochemistry](#) (OCB)

Contributors	Affiliation	Role
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## Dataset Description

dissolved iron, total iron, and nutrients from underway samples taken from the ship's underway sampling system

## Methods & Sampling

### Sampling and Analytical Methodology

Near-surface seawater samples were collected from ~3 m depth while underway at ~5 knots, using a towed, trace-metal clean pumping system developed by Ken Bruland and Geoffrey Smit (University of California, Santa Cruz). Briefly, seawater was collected through the intake of a 'towfish' deployed at ca. 3 m water depth and ca. 5 m outboard of the ship, and then pumped through acid-cleaned low-density polyethylene tubing into a shipboard clean-air laboratory container, where it was filtered in-line using a 0.2 µm Supor Acropak filter cartridge (Pall Corp.). The filtered seawater samples were acidified to pH 1.7 with Seastar Baseline ultrapure hydrochloric acid, stored for at least 24 hours, then dissolved iron (dFe) was determined by flow injection analysis modified after the method of Measures et al. [1995] with analytical figures of merit as detailed by Sedwick et al. [2005, 2008]. The efficacy of our analytical method for dissolved iron in seawater has been

verified in the SAFe intercomparison exercise [Johnson et al., 2007].  
Our laboratory values for SAFe seawater reference materials are as follows:  
SAFe surface seawater S1: dFe =  $0.11 \pm 0.01$  nM (n = 15) vs consensus value of  $0.097 \pm 0.043$  nM  
SAFe deep seawater D2: dFe =  $0.97 \pm 0.06$  nM (n = 14) vs consensus value of  $0.91 \pm 0.17$  nM.  
Dissolved macronutrients were measured at sea in 0.2- $\mu$ m filtered using JGOFS-standard autoanalyzer methods.

## References

Johnson, K. S., et al. (2007), The SAFe iron intercomparison cruise: An international collaboration, *Eos, Trans. Am. Geophys. Un.*, 88, 131-132.

Sedwick, P. N., T. M. Church, A. R. Bowie, C. M. Marsay, S. J. Ussher, K. M. Achilles, P. J. Lethaby, R. J. Johnson, M. M. Sarin, and D. J. McGillicuddy (2005), Iron in the Sargasso Sea (Bermuda Atlantic Time-series Study region) during summer: Eolian imprint, spatiotemporal variability, and ecological implications, *Global Biogeochemical Cycles*, 19, doi:10.1029/2004GB002445.

Sedwick, P. N., A. R. Bowie, and T. W. Trull (2008), Dissolved iron in the Australian sector of the Southern Ocean (CLIVAR-SR3 section): meridional and seasonal trends, *Deep-Sea Research I*, doi:10.1016/j.dsr.2008.03.011.

## Data Processing Description

### Data Processing

An acid blank (to account for iron present in acid added to samples) has been subtracted from raw dFe and TDFe concentrations. For the CORSACS-1 cruise, this blank was determined as 0.007 nM; for the CORSACS-2 samples, the blank was below the limit of quantification (i.e., negligible).

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## Data Files

File
<b>Fe_uway.csv</b> (Comma Separated Values (.csv), 11.69 KB) MD5:788d09c523b798a76fbaa74a56e5d11c
Primary data file for dataset ID 3113

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## Parameters

Parameter	Description	Units
cruise_id	ship's cruise designation	dimensionless
date_local	local date of sampling	YYYYMMDD
time_local	local time of sampling	hhmm
lat	latitude; North is positive, South is negative	decimal degrees
lon	longitude; East is positive, West is negative	decimal degrees
Fe_diss	dissolved iron concentration	nanomoles per liter
PO4	dissolved inorganic phosphate concentration	micromoles per liter
NO3_NO2	dissolved nitrate plus nitrite concentration	micromoles per liter
Si_acid	dissolved silicic acid concentration	micromoles per liter

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## Instruments

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

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## Deployments

**NBP0601**

<b>Website</b>	<a href="https://www.bco-dmo.org/deployment/57985">https://www.bco-dmo.org/deployment/57985</a>
<b>Platform</b>	RVIB Nathaniel B. Palmer
<b>Report</b>	<a href="http://data.bco-dmo.org/CORSACS/cruises/Dunbar_Hydrography_report_NBP0601.pdf">http://data.bco-dmo.org/CORSACS/cruises/Dunbar_Hydrography_report_NBP0601.pdf</a>
<b>Start Date</b>	2005-12-17
<b>End Date</b>	2006-01-30
<b>Description</b>	This was the first of two Controls of Ross Sea Algal Community Structure (CORSACS) project cruises and was funded by the NSF Office of Polar Programs. The NBP0601 cruise was conducted in the Ross Sea in December 2005 and January 2006, Ross Sea, ca. 65.21°S-78.65°S, 164.98°E-164.70°W, and supported by NSF research grant, OPP-0338097. The 'Science Plan and Project Description' document includes details of the cruise sampling strategy. Related Files: Science Plan and Project Descriptions (PDF file) Cruise track map (PDF file) Photo of Ice Breaker Nathaniel B. Palmer on station near Beaufort Island (JPG image) Related Sites: MGDS catalog: <a href="http://www.marine-geo.org/tools/search/entry.php?id=NBP0601">http://www.marine-geo.org/tools/search/entry.php?id=NBP0601</a>

#### NBP0608

<b>Website</b>	<a href="https://www.bco-dmo.org/deployment/57986">https://www.bco-dmo.org/deployment/57986</a>
<b>Platform</b>	RVIB Nathaniel B. Palmer
<b>Report</b>	<a href="http://data.bco-dmo.org/CORSACS/cruises/Dunbar_Hydrography_report_NBP0608.pdf">http://data.bco-dmo.org/CORSACS/cruises/Dunbar_Hydrography_report_NBP0608.pdf</a>
<b>Start Date</b>	2006-11-01
<b>End Date</b>	2006-12-15
<b>Description</b>	This was the second of two Controls of Ross Sea Algal Community Structure (CORSACS) project cruises and was funded by the NSF Office of Polar Programs. The NBP0608 cruise was conducted in the Ross Sea in November and December 2006, ca. 65.21°S-78.65°S, 164.98°E-164.70°W. Related files: Cruise track map (PDF file) Related Sites: MGDS catalog: <a href="http://www.marine-geo.org/tools/search/entry.php?id=NBP0608">http://www.marine-geo.org/tools/search/entry.php?id=NBP0608</a>

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## Project Information

### Controls of Ross Sea Algal Community Structure (CORSACS)

**Website:** <http://www.whoi.edu/sites/corsacs>

**Coverage:** Ross Sea Southern Ocean

### Project summary

The Controls of Ross Sea Algal Community Structure (CORSACS) project was funded by the NSF Office of Polar Programs as "Collaborative Research: Interactive Effects of Iron, Light and Carbon Dioxide on Phytoplankton Community Dynamics in the Ross Sea". Two cruises were completed in 2006 to investigate the interactions between the primary productivity of the Ross Sea and pCO<sub>2</sub>, iron and other trace elements. Data sets of carbon, nutrient, metal, and biological measurements will be reported.

The main objective in the proposed research was to investigate the relative importance and potential interactive effects of iron, light and CO<sub>2</sub> levels in structuring algal assemblages and growth rates in the Ross Sea. The investigators hypothesized that the interaction of these three variables largely determines the bottom-up control on these two dominant Southern Ocean phytoplankton taxa. While grazing and other loss processes are important variables in determining the relative dominance of these two taxa, the CORSACS research project was designed to focus on the bottom-up control mechanisms. It is important to understand such

environmentally-driven taxonomic shifts in primary production, since they are expected to impact the fixation and export of carbon and nutrients, and the production of DMS, thus potentially providing both positive and negative feedbacks on climate.

The CORSACS investigators considered a range of ambient iron, light and pCO<sub>2</sub> levels that span those typically observed in the Ross Sea during the growing season. That is, dissolved iron ranging from ~0.1 nM (low iron) to greater than 1 nM (high iron) (Fitzwater et al. 2000; Sedwick et al. 2000); mean irradiance (resulting from vertical mixing/self shading) ranging from less than 10% I<sub>0</sub> (low light) to greater than 40% (high light) (Arrigo et al., 1998, 1999), possibly adjusted based on field observations during the CORSACS cruises; and pCO<sub>2</sub> ranging (Sweeney et al. 2001) from ~150 ppm (low CO<sub>2</sub>) to the probable higher levels of pCO<sub>2</sub> - 750 ppm as a conservative estimate - that are likely to be attained later this century due to anthropogenic perturbation of the global carbon cycle (IPCC, 2001).

From the information previously available from both field observations and experiments, the investigators formulated the following specific hypotheses regarding the interactive role of iron, light and CO<sub>2</sub> in regulating algal composition in the Ross Sea: diatoms bloom in the southern Ross Sea only under optimum conditions of high iron, light and pCO<sub>2</sub>; colonial *Phaeocystis* dominate under conditions of high iron with either (or both) low light or low pCO<sub>2</sub>; and solitary *Phaeocystis* are predominant under conditions of low iron with either (or both) low light or low pCO<sub>2</sub>.

## References:

Fitzwater, S.E., K.S. Johnson, R.M. Gordon, K.H. Coale, and W.O. Smith, Jr. (2000). Trace metal concentrations in the Ross Sea and their relationship with nutrients and growth. *Deep-Sea Research II*, 47: 3159-3179.

Martin JH, Gordon RM, Fitzwater SE. Iron in Antarctic waters. *Nature* 1990 ;345(6271):156-158. Martin JH. 1990. Glacial-interglacial CO<sub>2</sub> change: The iron hypothesis. *Paleoceanography* 5(1):1-13

P. N. Sedwick, G. R. DiTullio, and D. J. Mackey, Iron and manganese in the Ross Sea, Antarctica: Seasonal iron limitation in Antarctic shelf waters, *Journal of Geophysical Research*, 105 (C5), 11,321-11,336, 2000.

Sweeney, C. K. Arrigo, and G. van Gijken (2001). Prediction of seasonal changes in surface pCO<sub>2</sub> in the Ross Sea, Antarctica using ocean color satellite data. 2001 Annual AGU meeting, San Francisco, CA Dec. 10-15.

IPCC, 2001: *Climate Change 2001: Synthesis Report*. A Contribution of Working Groups I, II, and III to the Third Assessment Report of the Intergovernmental Panel on Climate Change [Watson, R.T. and the Core Writing Team (eds.)]. Cambridge University Press, Cambridge, United Kingdom, and New York, NY, USA, 398 pp.

## Publications

Saito, M. A., Goepfert, T. J., Noble, A. E., Bertrand, E. M., Sedwick, P. N., and DiTullio, G. R.: A seasonal study of dissolved cobalt in the Ross Sea, Antarctica: micronutrient behavior, absence of scavenging, and relationships with Zn, Cd, and P, *Biogeosciences*, 7, 4059-4082, doi:10.5194/bg-7-4059-2010, 2010 (<http://www.biogeosciences.net/7/4059/2010/bg-7-4059-2010.html>)

Bertrand EM, Saito MA, Lee PA, Dunbar RB, Sedwick PN and DiTullio GR (2011) Iron limitation of a springtime bacterial and phytoplankton community in the Ross Sea: implications for vitamin B12 nutrition. *Front. Microbio.* 2:160. doi: 10.3389/fmicb.2011.00160 ([http://www.frontiersin.org/Aquatic\\_Microbiology/10.3389/fmicb.2011.00160/abstract](http://www.frontiersin.org/Aquatic_Microbiology/10.3389/fmicb.2011.00160/abstract))

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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.

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## Funding

Funding Source	Award
<a href="#">NSF Antarctic Sciences (NSF ANT)</a>	<a href="#">ANT-0338164</a>

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