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

Website: https://www.bco-dmo.org/dataset/3112
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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Table of Contents

Dataset Description

dissolved iron, total iron, and nutrients from water column samples

GCMD DIF record: Entry ID: CORSACS-Fe
Iron data (dFe and TDFe) from CORSACS project (cruises NBP06-01 and NBP06-08)

Methods & Sampling

Sampling and Analytical Methodology

Water-column samples for trace metal analysis were collected in modified 5-L teflon-lined, external-closure Niskin-X samplers (General Oceanics Inc.) suspended from a non-metal line. In addition, a limited number of deeper water-column samples were collected by Mak Saito in 10-L teflon-lined GoFlo samplers (General Oceanics Inc.). All samples were filtered as soon as possible after collection using a 0.2 µm Supor Acropak filter cartridge (Pall Corp.), except for the Go-Flo samples which were filtered by Mak Saito through 0.4 µm polycarbonate membranes. 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 sample collection, sample processing and analytical methods for dissolved iron in seawater have 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 ± 0.01 nM (n = 15) vs consensus value of 0.097 ± 0.043 nM

SAFE deep seawater D2: dFe = 0.97 ± 0.06 nM (n = 14) vs consensus value of 0.91 ± 0.17 nM.

In addition, unfiltered splits of all samples were acidified to pH 1.7 with Seastar Baseline ultrapure hydrochloric acid, stored for at least 6 months, and then total-dissolvable iron (TDFe) was determined by flow injection analysis using the same method as used for dFe. Total-dissolvable iron is therefore equal to the concentration of dissolved iron plus acid-labile particulate iron [see Sedwick et al., 2005]. Dissolved macronutrients were measured at sea in 0.2-µm 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).

[table of contents | back to top]

Data Files

File
Fe_profile.csv(Comma Separated Values (.csv), 17.15 KB) MD5:c311dec14346fad657e24d123e0a0223 Primary data file for dataset ID 3112

[table of contents | back to top]

Parameters

Parameter	Description	Units
cruise_id	ship's cruise designation	dimensionless
date_local	local date of sampling	YYYYMMDD
lat	latitude; North is positive, South is negative	decimal degrees
lon	longitude; East is positive, West is negative	decimal degrees
sample_id	Sample lable composed of NX, station number and bottle number	dimensionless
sta	station number	dimensionless
bot	bottle number	dimensionless
depth	depth	meters
Fe_diss	dissolved iron concentration	nanomoles per liter
Fe_TD	total dissolvable iron concentration	nanomoles per liter
PO4	dissolved inorganic phosphate concentration	micromoles per liter
NO2	dissolved nitrite concentration	micromoles per liter
NO3_NO2	dissolved nitrate plus nitrite concentration	micromoles per liter
NH4	dissolved ammonium concentration	micromoles per liter
Si_acid	dissolved silicic acid concentration	micromoles per liter

[table of contents | back to top]

Instruments

Dataset-specific Instrument Name	GO-FLO Teflon Trace Metal
Generic Instrument Name	GO-FLO Teflon Trace Metal Bottle
Dataset-specific Description	10-L teflon-lined GoFlo samplers
Generic Instrument Description	GO-FLO Teflon-lined Trace Metal free sampling bottles are used for collecting water samples for trace metal, nutrient and pigment analysis. The GO-FLO sampling bottle is designed specifically to avoid sample contamination at the surface, internal spring contamination, loss of sample on deck (internal seals), and exchange of water from different depths.

Dataset-specific Instrument Name	Niskin-1010X
Generic Instrument Name	Niskin-1010X
Dataset-specific Description	5-L Niskin-X teflon-lined GO-FLO bottle with messenger on hydrowire
Generic Instrument Description	The Model 1010X NISKIN-X External Spring Niskin Water Sampler is a Niskin water sample bottle with the stainless steel closure springs mounted externally. The external closure mechanism is designed to support applications such as trace metal analysis where the inside of the sampler must be totally free of contaminants. The 1010X Niskin bottle, manufactured by General Oceanics Inc., is available in a variety of sizes (sample volume). It can be activated by the GO Devil Messenger (1000-MG) if individually or serially attached to a hydrocable or can be deployed as part of a Rosette multibottle array. The bottles can be teflon-lined and are available as GO-FLO bottles to further avoid sample contamination. (more from General Oceanics)

[table of contents | back to top]

Deployments

NBP0601

Website	https://www.bco-dmo.org/deployment/57985
Platform	RVIB Nathaniel B. Palmer
Report	http://data.bco-dmo.org/CORSACS/cruises/Dunbar_Hydrography_report_NBP0601.pdf
Start Date	2005-12-17
End Date	2006-01-30
Description	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 Pan 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: http://www.marine-geo.org/tools/search/entry.php?id=NBP0601

NBP0608

Website	https://www.bco-dmo.org/deployment/57986
Platform	RVIB Nathaniel B. Palmer
Report	http://data.bco-dmo.org/CORSACS/cruises/Dunbar_Hydrography_report_NBP0608.pdf
Start Date	2006-11-01
End Date	2006-12-15
Description	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: http://www.marine-geo.org/tools/search/entry.php?id=NBP0608

[table of contents | back to top]

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 pCO2, 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 CO2 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 pCO2 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% Io (low light) to greater than 40% (high light) (Arrigo et al., 1998, 1999), possibly adjusted based on field observations during the CORSACS cruises; and pCO2 ranging (Sweeney et al. 2001) from ~150 ppm (low CO2) to the probable higher levels of pCO2 - 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 CO2 in regulating algal composition in the Ross Sea: diatoms bloom in the southern Ross Sea only under optimum conditions of high iron, light and pCO2; colonial Phaeocystis dominate under conditions of high iron with either (or both) low light or low pCO2; and solitary Phaeocystis are predominant under conditions of low iron with either (or both) low light or low pCO2.

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 CO2 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 pCO2 in the Ross Sea, Antarctica using ocean color satellite data. 2001 Annual AGU meeting, San Fransisco, 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 theIntegovernmental 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)

[table of contents | back to top]

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.

[table of contents | back to top]

Funding

Funding Source	Award
NSF Antarctic Sciences (NSF ANT)	ANT-0338164

[table of contents | back to top]