Fluorometric chlorophyll from Niskin and TM bottle samples from R/V Melville, R/V Roger Revelle cruises COOK19MV, DRFT08RR from the Southern Ocean, south of New Zealand in 2002 (SOFeX project)

Website: https://www.bco-dmo.org/dataset/2933
Version: 6 November 2008
Version Date: 2008-11-06

Project
» Southern Ocean Iron Experiment (SOFeX)

Programs
» Ocean Carbon and Biogeochemistry (OCB)
» Iron Synthesis (FeSynth)

Contributors	Affiliation	Role
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Coale, Kenneth H.	Moss Landing Marine Laboratories (MLML)	Co-Principal Investigator
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Dataset Description

Fluorometric chlorophyll from Niskin and TM bottle samples

Methods & Sampling

dates: 23 January 2002 to 21 February 2002 (20020123-20020221)
location: N: -52.385 S: -66.612 W: -172.693 E: -166.946
project/cruise: SOFeX/MV

08 February 2008: Prepared for OCB data system by Dave DuBois (WHOI) Cyndy Chandler, OCB DMO (WHOI)

from documentation contributed by originating PI, data analysts and technicians.

Original Excel file downloaded from MBARI: copy of original Excel file

Contact: Anna Hilting (Duke University Marine Laboratory)

R/V Melville Extracted Chlorophyll Methodology
Please direct questions to Sara Tanner (tanner@mlml.calstate.edu) or Jodi Brewster (jbrewster@mlml.calstate.edu)
Water samples were collected from 12 depths on the CTD Rosette and 8 depths on the TM Rosette. The TM Rosette depths were chosen at the 100, 45, 30, 16, 10, 5, 1, and 0.1 percent light levels (so phytoplankton production can be related to phytoplankton biomass) (Evans et al 1987). The CTD also had 2 more depths scattered between .1 and 100 percent and one each at 200m and 300m. The water from the CTD and TM rosettes was collected using opaque brown bottles in 250, 500, 1000, and 2000 ml or white 100 ml bottles. The differing volumes depended upon the depth of the sample and whether the samples were taken within the patch or not. Sampling from the TM Rosette was done with gloves. Each bottle was rinsed three times with the sample water before filling to the neck of the bottle.

A Whatman G/FF glass Fiber Filter, (~0.7um) Polycarbonate 5 um filter, or Polycarbonate 20 micron filter was placed in a 25 mm diameter Gelman filter holder. Water was pumped through the filter, being careful the vacuum pressure did not get above 6 psi to avoid cell lyse. After filtration, the vacuum was turned off and the filter was added with forceps to a tube filled with 8 ml of 90% acetone. The tube was labeled and stored in a freezer for a minimum of 24 hours.

After the minimum 24 hours extraction time, the filter was removed from the tube and the tube was wiped down with Chem Wipes. The fluorescence of the chlorophyll extracts were read on a 10AU Turner Designs fluorometer. Two drops of 10 % HCl was added and the fluorescence was reread and recorded again. The "before" and "after" readings were plugged into equation chl-a = K * (Rb-Ra) * (vol ext/vol filtered)*dil to calculate chlorophyll a values.

A standard made from Sigma Chl-a in 90% acetone was calibrated on a spectrophotometer and used to calibrate the fluorometer at the beginning, mid and end of the cruise. Due to the fact the fluorometer drifted both ± according to the solid standard, and a high correlation was found between the low solid standard and the calibration curve, Chlorophyll-a values were corrected using the ratio of the low solid standard.

PI Notes
from Richard Barber (rbarber@duke.edu) and Anna Hilting (ahilting@duke.edu)

Chlorophyll a was determined by fluorometric methods. Fresh samples were extracted in 90% acetone at -20 degrees C for 24-30 h (Venrick and Hayward, 1984) and quantified using a Turner Designs fluorometer (Holm-Hansen et al., 1965; Lorenzen, 1966). Contact A. Hilting (Duke) for information.

These data have been edited for quality control but will be processed further for size-fraction analysis and integration using the Morel Model. See Barber et al., 1997 and Hiscock et al., 2002. Incubated depth will be calculated using the Morel model and added later.

Profile chlorophyll sampling comments:
The following embedded comments were preserved from the original profile chlorophyll data file, MelvilleChlorophyll.xls:

Station	Cast	Value	Target	Bottle	Filter	Comment
M004	CTD013	34.10	0	5		ahilting: was 64.10. 34.10 is the value in the original SOFeX Station Chl-a.xls file.
M004	CTD013	0.355	5	20		ahilting: error = .02*dilution = .14 ug
M004	CTD013	0.455	3	20		ahilting: error = .02*dilution = .14 ug
M006	TM0011	0.52	4	20		ahilting: max error (.02*dilution = .14 ug)
M006	TM0011	0.52 (2nd entry)	4	20		ahilting: max error (.02*dilution = .14 ug)
M006	TM0011	0.53	3	20		ahilting: max error (.02*dilution = .14 ug)
M006	TM0011	0.53 (2nd entry)	3	20		ahilting: max error (.02*dilution = .14 ug)
M010	TM0017	0.37	3	5		was 0.21 switched with 20 um value at 5%
M010	TM0017	0.21	3	20		ahilting: was 0.37 switched with 5 um value at 5%

Plots of chlorophyll and primary productivity for Revelle and Melville (PDF file created from MS Word .doc original format from Barber and Hilting)

Data Processing Description

Change history:
070119: downloaded original data (MelvilleChlorophyll.xls) from SOFeX project data web site;
080208: data prepared for OCB database by Dave duBois (WHOI, OCB)
080813: added to OCB database by Cyndy Chandler, OCB DMO, (cchandler@whoi.edu);
no position or depth reported with these data
081106: cast changed to ev_type to match cruise event log; lat, lon, event and date
added from event log; depth is from the SIO_bottle data object

OCB DMO Processing Notes for Profile Chlorophyll

Data file records were sorted by 'Ship Station', then by 'Cast', then by 'Target Bottle'. Some manual sorting was required for TM008 where the 'Sample Bottle' did not track the 'Target Bottle'. Also performed manual sort within 'Ship Station' M004, where TM0010 was listed before TM008 according to sort rules. CTD013 bucket samples were reordered to be listed at the top of that 'Cast' sequence.

SCUFA Underway Chlorophyll Survey Data

SCUFA underway survey data are reported separately.

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Parameters

Parameter	Description	Units
ship_sta	ship station	alphanumeric
ev_type	event type; profile cast number	alphanumeric
event	unique sampling event composite of day of year and time (UTC)	doYhhmm
date	date sampling began (UTC)	YYYYMMDD
lon	longitude, negative denotes West	decimal degrees
lat	latitude, negative denotes South	decimal degrees
bot_target	target bottle	dimensionless
bot_samp	sample bottle	text
depth	depth of sample bottle	meters
filt	filter size	microns
filt_rig	filter rig	dimensionless
person	scientist responsible for data from event	dimensionless
chl_mg_m3	chlorophyll	milligrams per cubic meter
phaeo_mg_m3	phaeophytin??	milligrams per cubic meter
f0	initial fluorescence	dimensionless
fa	fluorescence after acidification	dimensionless
f0_to_fa	ratio f0 to fa	dimensionless
cast	CTD cast number	alphanumeric
fluor	fluoresence, from CTD??	V ?? voltage
temp	temperature, from CTD??	degrees Celsius
sal	salinity, from CTD??	dimensionless
dens	density, from CTD??	kilograms/meter^3
O2_mM_kg	oxygen, from CTD??	millimoles/kilogram
trans	transmissivity	percent

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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	Trace Metal Bottle
Generic Instrument Name	Trace Metal Bottle
Generic Instrument Description	Trace metal (TM) clean rosette bottle used for collecting trace metal clean seawater samples.

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Deployments

COOK19MV

Website	https://www.bco-dmo.org/deployment/57826
Platform	R/V Melville
Report	http://ocb.whoi.edu/SOFeX/CRUISES/proj_description.pdf
Start Date	2002-01-19
End Date	2002-02-26
Description	Brief cruise plan description: Three ships were involved in the SOFeX experiment. Each ship operated in the study area at a different time to afford the longest observation time. The designations SOFeX-N and SOFeX-S are sometimes used to distinguish between two iron enriched patches - one in low silicate waters north of the polar front (SOFEX-N), and the other in high silicate waters south of the polar front (SOFEX-S). All three ships, Melville (MV), Revelle (RR) and Polar Star (PS), worked in SOFEX-S, but only the Revelle and Melville worked in the SOFeX N patch and shuttled between the two patches. The R/V MELVILLE sailed several weeks after the R/V REVELLE to arrive in the study area just as the 'patches' were forming in response to iron fertilization. The MELVILLE's team planned to make detailed measurements of phytoplankton physiology and rate processes, and to sample daily for phytoplankton growth rates and biomass, soluble and particulate iron and zooplankton biomass. A cruise logbook includes daily entries filed by the Chief Scientist aboard each vessel. **Methods & Sampling** dates: 23 January 2002 to 21 February 2002 (20020123-20020221) location: N: -52.385 S: -66.612 W: -172.693 E: -166.946 project/cruise: SOFeX/MV 08 February 2008: Prepared for OCB data system by Dave DuBois (WHOI) Cyndy Chandler, OCB DMO (WHOI) from documentation contributed by originating PI, data analysts and technicians. Original Excel file downloaded from MBARI:copy of original Excel file Contact: Anna Hilting (Duke University Marine Laboratory) R/V Melville Extracted Chlorophyll Methodology Please direct questions to Sara Tanner (tanner@mlml.calstate.edu) or Jodi Brewster (jbrewster@mlml.calstate.edu) Water samples were collected from 12 depths on the CTD Rosette and 8 depths on the TM Rosette. The TM Rosette depths were chosen at the 100, 45, 30, 16, 10, 5, 1, and 0.1 percent light levels (so phytoplankton production can be related to phytoplankton biomass) (Evans et al 1987). The CTD also had 2 more depths scattered between .1 and 100 percent and one each at 200m and 300m. The water from the CTD and TM rosettes was collected using opaque brown bottles in 250, 500, 1000, and 2000 ml or white 100 ml bottles. The differing volumes depended upon the depth of the sample and whether the samples were taken within the patch or not. Sampling from the TM Rosette was done with gloves. Each bottle was rinsed three times with the sample water before filling to the neck of the bottle. A Whatman G/FF glass Fiber Filter, (~0.7um) Polycarbonate 5 um filter, or Polycarbonate 20 micron filter was placed in a 25 mm diameter Gelman filter holder. Water was pumped through the filter, being careful the vacuum pressure did not get above 6 psi to avoid cell lyse. After filtration, the vacuum was turned off and the filter was added with forceps to a tube filled with 8 ml of 90% acetone. The tube was labeled and stored in a freezer for a minimum of 24 hours. After the minimum 24 hours extraction time, the filter was removed from the tube and the tube was wiped down with Chem Wipes. The fluorescence of the chlorophyll extracts were read on a 10AU Turner Designs fluorometer. Two drops of 10 % HCl was added and the fluorescence was reread and recorded again. The "before" and "after" readings were plugged into equation chl-a = K * (Rb-Ra) * (vol ext/vol filtered)*dil to calculate chlorophyll a values. A standard made from Sigma Chl-

	a in 90% acetone was calibrated on a spectrophotometer and used to calibrate the fluorometer at the beginning, mid and end of the cruise. Due to the fact the fluorometer drifted both ± according to the solid standard, and a high correlation was found between the low solid standard and the calibration curve, Chlorophyll-a values were corrected using the ratio of the low solid standard. PI Notes from Richard Barber (rbarber@duke.edu) and Anna Hilting (ahilting@duke.edu) Chlorophyll a was determined by fluorometric methods. Fresh samples were extracted in 90% acetone at -20 degrees C for 24-30 h (Venrick and Hayward, 1984) and quantified using a Turner Designs fluorometer (Holm-Hansen et al., 1965; Lorenzen, 1966). Contact A. Hilting (Duke) for information. These data have been edited for quality control but will be processed further for size-fraction analysis and integration using the Morel Model. See Barber et al., 1997 and Hiscock et al., 2002. Incubated depth will be calculated using the Morel model and added later. Profile chlorophyll sampling comments: The following embedded comments were preserved from the original profile chlorophyll data file, MelvilleChlorophyll.xls: Station Cast Value Target Bottle Filter Comment M004 CTD013 34.10 0 5 ahilting: was 64.10. 34.10 is the value in the original SOFeX Station Chl-a.xls file. M004 CTD013 0.355 5 20 ahilting: error = .02*dilution = .14 ug M004 CTD013 0.455 3 20 ahilting: error = .02*dilution = .14 ug M006 TM0011 0.52 4 20 ahilting: max error (.02*dilution = .14 ug) M006 TM0011 0.52 (2nd entry) 4 20 ahilting: max error (.02*dilution = .14 ug) M006 TM0011 0.53 3 20 ahilting: max error (.02*dilution = .14 ug) M006 TM0011 0.53 (2nd entry) 3 20 ahilting: max error (.02*dilution = .14 ug) M010 TM0017 0.37 3 5 was 0.21 switched with 20 um value at 5% M010 TM0017 0.21 3 20 ahilting: was 0.37 switched with 5 um value at 5% Plots of chlorophyll and primary productivity for Revelle and Melville (PDF file created from MS Word .doc original format from Barber and Hilting) **Processing Description** Change history: 070119: downloaded original data (MelvilleChlorophyll.xls) from SOFeX project data web site; 080208: data prepared for OCB database by Dave duBois (WHOI, OCB) 080813: added to OCB database by Cyndy Chandler, OCB DMO, (cchandler@whoi.edu); no position or depth reported with these data 081106: cast changed to ev_type to match cruise event log; lat, lon, event and date added from event log; depth is from the SIO_bottle data object OCB DMO Processing Notes for Profile Chlorophyll Data file records were sorted by 'Ship Station', then by 'Cast', then by 'Target Bottle'. Some manual sorting was required for TM008 where the 'Sample Bottle' did not track the 'Target Bottle'. Also performed manual sort within 'Ship Station' M004, where TM0010 was listed before TM008 according to sort rules. CTD013 bucket samples were reordered to be listed at the top of that 'Cast' sequence. SCUFA Underway Chlorophyll Survey Data SCUFA underway survey data are reported separately.

DRFT08RR

Website	https://www.bco-dmo.org/deployment/57824
Platform	R/V Roger Revelle
Report	http://ocb.whoi.edu/SOFeX/CRUISES/proj_description.pdf
Start Date	2002-01-06
End Date	2002-02-14
Description	Brief cruise plan description: Three ships were involved in the SOFeX experiment. Each ship operated in the study area at a different time to afford the longest observation time. The designations SOFeX-N and SOFeX-S are sometimes used to distinguish between two iron enriched patches - one in low silicate waters north of the polar front (SOFEX-N), and the other in high silicate waters south of the polar front (SOFEX-S). All three ships, Melville (MV), Revelle (RR) and Polar Star (PS), worked in SOFEX-S, but only the Revelle and Melville worked in the SOFeX N patch and shuttled between the two patches. The R/V ROGER REVELLE from Scripps Institution of Oceanography sailed first. The REVELLE team added iron to two areas referred to as 'the North and South patches'. After the iron and an inert chemical tracer (SF6) were added, the REVELLE's primary mission was to map the size and characteristics of the South patch using a SeaSOAR fish towed behind the ship that pumped water up to the ship for sampling and analysis. The REVELLE also collected samples for initial biological shipboard mapping of iron concentrations, nutrients, chlorophyll, and photosynthetic efficiency. A cruise logbook includes daily entries filed by the Chief Scientist aboard each vessel. **Methods & Sampling** dates: 10 January 2002 to 10 February 2002 (20020110-20020210) location: N: -54.09 S: -66.60 W: -172.15 E: -169.24 project/cruise: SOFeX/RR platform: R/V Roger Revelle Methodology: Chlorophyll a caught on GF/F filters with a nominal pore size of 0.7 micrometers was determined by conventional fluorometric methods. Chlorophyll is given in mg Chl/m3. Fresh samples were extracted in 90% acetone at -20 degrees C for 24-30 h (Venrick and Hayward, 1984) and quantified using a Turner Designs fluorometer (Holm-Hansen et al., 1965; Lorenzen, 1966). **Processing Description** Change history: 070516: downloaded original data (RevelleChlorophyll.xls) from SOFeX project data web site; 070522: data prepared by Dave DuBois (WHOI, OCB DMO) 080812: added to OCB database by Cyndy Chandler, OCB DMO, (cchandler@whoi.edu) OCB DMO Note: corrected sign of lat and lon values; when comparing these data to the cruise event log, ship_sta is similar to sta and cast indicates CTD or TM cast; note that depths are not sorted

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Project Information

Southern Ocean Iron Experiment (SOFeX)

Website: http://www.mbari.org/expeditions/SOFeX2002/

Coverage: Southern Ocean, south of New Zealand

Before he passed away in 1993, John Martin suggested that an increase in the flow of iron-rich dust to the ocean causes phytoplankton (single celled algae) to grow. The increased photosynthesis removes carbon dioxide from surface waters as the algae create biomass. This carbon dioxide is replaced by carbon dioxide gas that flows into the sea from the atmosphere. Reduced carbon dioxide in the atmosphere cools the planet (CO_2 is a greenhouse gas that warms the earth). The results of this work, funded by the National Science Foundation, the Department of Energy, and the US Coast Guard, will be a much better understanding of how biological processes may regulate climate. (see Related Info: Fe cycle)

A direct test of the 'Martin Hypothesis' that trace concentrations of Fe are responsible for phytoplankton's

ability to grow by direct experimental addition of Fe to the surface waters. Consequently the distribution of bioavailable Fe in the surface waters determines large geographical areas primary production and the following flux of fixed organic matter to the deep sea. The aim of the SOFeX project is to investigate the effects of iron fertilization on the productivity of the Southern Ocean. The results of this work will contribute significantly to our understanding of important biogeochemical processes which bear directly on the global carbon cycle, atmospheric carbon dioxide concentration, and climate control.

The SOFeX-N and SOFeX-S designations are sometimes used to distinguish between two iron enriched patches - one in low silicate waters north of the polar front (SOFEX-N), and the other in high silicate waters south of the polar front (SOFEX-S). All three ships, Melville (MV), Revelle (RR) and Polar Star (PS), worked in SOFEX-S, but only the Revelle and Melville worked in the SOFeX N patch and shuttled between the two patches.

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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.

Iron Synthesis (FeSynth)

Coverage: Global

The two main objectives of the Iron Synthesis program (SCOR Working Group proposal, 2005), are:
1. Data compilation: assembling a common open-access database of the *in situ* iron experiments, beginning with the first period (1993-2002; Ironex-1, Ironex-2, SOIREE, EisenEx, SEEDS-1; SOFeX, SERIES) where primary articles have already been published, to be followed by the 2004 experiments where primary articles are now in progress (EIFEX, SEEDS-2; SAGE, FeeP); similarly for the natural fertilizations S.O.JGOFS (1992), CROZEX (2004/2005) and KEOPS (2005).

2. Modeling and data synthesis of specific aspects of two or more such experiments for various topics such as physical mixing, phytoplankton productivity, overall ecosystem functioning, iron chemistry, CO2 budgeting, nutrient uptake ratios, DMS(P) processes, and combinations of these variables and processes.

SCOR Working Group proposal, 2005. "The Legacy of *in situ* Iron Enrichments: Data Compilation and Modeling".
http://www.scor-int.org/Working_Groups/wg131.htm

See also: SCOR Proceedings Vol. 42 Concepcion, Chile October 2006, pgs: 13-16 2.3.3 Working Group on The Legacy of *in situ* Iron Enrichments: Data Compilation and Modeling.

The first objective of the Iron Synthesis program involves a data recovery effort aimed at assembling a common, open-access database of data and metadata from a series of *in-situ* ocean iron fertilization experiments conducted between 1993 and 2005. Initially, funding for this effort is being provided by the Scientific Committee on Oceanic Research (SCOR) and the U.S. National Science Foundation (NSF).

Through the combined efforts of the principal investigators of the individual projects and the staff of Biological and Chemical Oceanography Data Management Office (BCO-DMO), data currently available primarily through individuals, disparate reports and data agencies, and in multiple formats, are being collected and prepared for addition to the BCO-DMO database from which they will be freely available to the community.

As data are contributed to the BCO-DMO office, they are organized into four overlapping categories:
1. Level 1, basic metadata
(e.g., description of project/study, general location, PI(s), participants);
2. Level 2, detailed metadata and basic shipboard data and routine ship's operations
(e.g., CTDs, underway measurements, sampling event logs);
3. Level 3, detailed metadata and data from specialized observations
(e.g., discrete observations, experimental results, rate measurements) and
4. Level 4, remaining datasets
(e.g., highest level of detailed data available from each study).

Collaboration with BCO-DMO staff began in March of 2008 and initial efforts have been directed toward basic project descriptions, levels 1 and 2 metadata and basic data, with detailed and more detailed data files being incorporated as they become available and are processed.

Related file

Program Documentation

The Iron Synthesis Program is funded jointly by the Scientific Committee on Oceanic Research (SCOR) and the U.S. National Science Foundation (NSF).

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