Throughout $ is generic null/not given/not available placeholder

Project Name:

SEEDS-II

Subarctic-Pacific Iron Experiment for Ecosystem Dynamics Study
This is a follow on to SEEDS I (also known as SEEDS 2001)

Acronym: SEEDS II

Synonym: $

Program: Subarctic-Pacific Iron Experiment for Ecosystem Dynamics Study

Project url: http://www.seeds-exp.jp/en/index.html (English)
http://www.seeds-exp.jp/index.html (Japanese)

Related Program: SOLAS-Japan (Surface Ocean Lower Atmosphere Study).
http://solas.jp/index.html

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The University of Tokyo, Japan.

Other responsible investigators and their contact information:

This table pasted from excel file: Seeds-II_metadata_withoutKMdata.xls
n.b. a few typos fixed below
PRR person = Nojiri
Spelling atmospheric
Spelling satellite.

All abbreviations are explained below under the "metadata" section.

Full names, current affiliations (August 2008) and contact details by Doug Mackie.

Measurement	PI_name	PI_Affiliation
TS	Tsuda	ORI
Chl	Tsuda	ORI
Nuts	Nojiri/Ogawa	NIES/ORI
Sal	Tsuda	ORI
DO	Ogawa	ORI
POC/N	Nojiri	NIES
PSi	Nojiri	NIES
13C	Nojiri	NIES
PCa	Nojiri	NIES
Phyto+zoo taxo	Tsuda	ORI
HNF	Tsuda	ORI
Viral infect. & prod.	Higgins	UTK
Chl size	Tsuda	ORI
Primary Production	Kudo	Hokkaido U.
N-uptake	Kudo	Hokkaido U.
Bacterial produc.	Kudo	Hokkaido U.
DOM	Ogawa	ORI
Virus dilution	Kudo	Hokudai
DMS	Toda	ORI
Ra-226	Aono	NIRS
Suspended particles	Uematsu	ORI
SF6	Watanabe	Hokkaido U.
HPLC (GF/F)	Suzuki	Hokkaido U.
HPLC-size (5um, 20um)	Suzuki	Hokkaido U.
FCM bacteria	Suzuki	Hokkaido U.
FRRF	Suzuki	Hokkaido U.
Flavodoxin	Suzuki	Hokkaido U.
Algal cell viability	Suzuki	Hokkaido U.
13C-PE curve	Suzuki	Hokkaido U.
a*	Suzuki	Hokkaido U.
P-Phos	Yoshimura	CRIEPI
TEP	Takeda	Univ. Tokyo
Phyto-FCM	Sato	Univ. Tokyo
Si dissolution	Takeda	Univ. Tokyo
POC/Si decomposition	Takeda	Univ. Tokyo
Life Cycle exp	Takeda	Univ. Tokyo
CH4	Sasakawa	Hokkaido U.
N2O	Kameyama	Hokkaido U.
CO	Nakagawa	Hokkaido U.
NMHC	Nakagawa	Hokkaido U.
Dilution	Tsuda	ORI
DIC/Alk	Ono	HNF
DMS Prod.	Caron/Lizotte	Laval U.
T-Fe	Nishioka	CRIEPI
D-Fe	Nishioka	CRIEPI

Sol-Fe	Nishioka	CRIEPI
Solubility Fe	Nishioka	CRIEPI
Fe:C ratio	Nishioka	CRIEPI
Trace metal	Nakatsuka	Hokkaido U.
D-REEs	Obata	ORI
T-REEs	Obata	ORI
T-210Pb-210Po	Obata	ORI
D-210Pb-210Po	Obata	ORI
D-ligand	Takeda	Univ. Tokyo
Soluble-ligand	Takeda	Univ. Tokyo
UV-ligand	Takeda	Univ. Tokyo
Fe regeneration	Sato	Univ. Tokyo
DFB exp	Nishioka	CRIEPI
PUV	Kondo	Univ. Tokyo
PRR	Nojiri	NIES
Traps	Imai/Nojiri	ORI/NIES
Zooplankton	Tsuda	ORI
Copepod gut pigment	Tsuda	ORI
Marine Snow Camera	Tsuda	ORI
PAR	Suzuki	Hokkaido U
Atmospheric	Kato	Metro U.
Aerosol	Uematsu	ORI
Patch dynamics	Tsumune	CRIEPI
Surface Monitor	Tsuda	ORI
ADCP	Tsumune	CRIEPI
XBT	Tsumune	CRIEPI
pCO2	Nojiri	NIES
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Iron fertilization	Nishioka	CRIEPI
In-situ filtration	Aono	NIRS

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Central Research Institute of Electric Power Industry (CRIEPI)

Start date:
13 July 2004

End date:
27 July 2004

Logo url:
$

Geolocation:
Western subarctic gyre in the North Pacific at 48.5°N, 165°E.
(i.e. 93 km SE of SEEDS I).

Description:

As at August 2008 the Tsuda 2007 paper is the only one to carry a general description.

Tsuda, A., et al. (2007): Evidence for the grazing hypothesis: Grazing reduces phytoplankton responses of the HNLC ecosystem to iron enrichment in the western subarctic pacific (SEEDS II). *J. Oceanogr*. 63(6), 983-994.

> A mesoscale iron-enrichment study (SEEDS II) was carried out in the western subarctic Pacific in the summer of 2004. The iron patch was traced for 26 days, which included observations of the development and the decline of the bloom by mapping with sulfur hexafluoride. The experiment was conducted at almost the same location and the same season as SEEDS (previous iron-enrichment experiment). However, the results were very different between SEEDS and SEEDS II. A high accumulation of phytoplankton biomass (~18 mg chl m–3) was characteristic of SEEDS. In contrast, in SEEDS II, the surface chlorophyll-*a* accumulation was lower, 0.8 to 2.48 mg m–3, with no prominent diatom bloom. Photosynthetic competence in terms of *F*v/*F*m for the total phytoplankton community in the surface waters increased after the iron enrichments and returned to the ambient level by day 20. These results suggest that the photosynthetic physiology of the phytoplankton assemblage was improved by the iron enrichments and returned to an iron-stressed condition during the declining phase of the bloom. Pico-phytoplankton (<2 μm) became dominant in the chlorophyll-*a* size distribution after the bloom.

We observed a nitrate drawdown of 3.8 μM in the patch (day 21), but there was no difference in silicic acid concentration between inside and outside the patch. Mesozooplankton (copepod) biomass was three to five times higher during the bloom-development phase in SEEDS II than in SEEDS. The copepod biomass increased exponentially. The grazing rate estimation indicates that the copepod grazing prevented the formation of an extensive diatom bloom, which was observed in SEEDS, and led to the change to a pico-phytoplankton dominated community towards the end of the experiment.

see also:
http://www.pices.int/meetings/workshops/2005_workshops/SEEDS%20II/SEEDS_II.aspx

SEEDS II was conduced in the same western subarctic Pacific region as the initial SEEDS experiment, and was an international collaborative study utilizing two research vessels (R.V. Hakuho Maru and R.V. Kilo Moana). This experiment was designed to characterize the evolution of the fertilized patch over a longer time scale (1 month) and with a greater range of parameters than measured during SEEDS.

The preliminary results from SEEDS II showed both the iron-induced increase and subsequent decline in phytoplankton biomass. However, the iron-initiated bloom was much less intense than observed in SEEDS. Chlorophyll-*a* concentrations increased only 2 to 3 times over initial values, and the drawdown of nutrients and pCO_2 were small. The aim of the SEEDS-II Workshop is to provide a forum for exchanging scientific information and expertise to better understand the underlying cause for the dramatically different chemical and biological responses observed in these two mesoscale experiments.

Publications:

As at AUGUST 2008: 4 publications (ABSTRACTS at END of this document)

Tsuda, A., et al. (2007): Evidence for the grazing hypothesis: Grazing reduces phytoplankton responses of the HNLC ecosystem to iron enrichment in the western subarctic pacific (SEEDS II). *J. Oceanogr.* 63(6), 983-994.

Sato, M., Takeda, S. & Furuya, K. (2007): Iron regeneration and organic iron(III)-binding ligand production during in situ zooplankton grazing experiment. *Marine Chemistry* 106(3-4), 471-488.

Kondo, Y., Takeda, S., Nishioka, J., Obata, H., Furuya, K., Johnson, W. K. & Wong, C. S. (2008): Organic iron(III) complexing ligands during an iron enrichment

experiment in the western subarctic North Pacific. *Geophys. Res. Lett.* 35(12), L12601, doi:10.1029/2008GL033354.

Roy, E. G., Wells, M. L. & King, D. W. (2008): Persistence of iron(II) in surface waters of the western subarctic Pacific. *Limnol. Oceanogr.* 53(1), 89-98.

A special issue of Deep Sea Research II is also being prepared (due late 2008?)

A related paper collected samples during SEEDS-II to describe "natural" (i.e. not Fe-fertilised) methane processes:

Sasakawa, M., Tsunogai, U., Kameyama, S., Nakagawa, F., Nojiri, Y. & Tsuda, A. (2008): Carbon isotopic characterization for the origin of excess methane in subsurface seawater. *J. Geophys. Res.*, 113(C3), C030121-C030127.

Also a talk was given at the 2007 Goldschmidt conference:

Nakatsuka, S., Sohpjn, Y., Norisuye, K., Okamura, K., Takeda, S. & Nishioka, J. (2007): Physicochemical speciation of trace metals during the mesoscale iron enrichment (SEEDS II) in the western North Pacific. *Geochim. Cosmochim. Acta* 71(15), A704-A704,

Also two talks were given at the 2008 ASLO Ocean Sciences meeting.

Saito/Hiroaki, H; Tsuda/Atsushi, A; Ota/Takashi, O; Nojiri/Yukihiro, Y; Aramaki/Takafumi, T; Imai/Keiri, K; Kiyosawa/Hiroshi, H; Nishioka/Jun, J; Ogawa/Hiroshi, H; Suzuki/Koji, K; ROLES OF ECOSYSTEM COMPONENTS FOR BIOGEOCHEMICAL CYCLING IN THE HNLC SUBARCTIC PACIFIC: IMPORTANCE OF TOP-DOWN CONTROL

Wells, M L; Trick, C G; Cochlan, W P; FE(III) COMPLEXING ORGANIC LIGANDS STRONGLY RESTRICT ECOSYSTEM RESPONSES TO ATMOSPHERIC IRON ENRICHMENT IN HIGH NITRATE LOW CHLOROPHYLL WATERS

Also a workshop as part of PICES

Also a workshop as part of PICES.

The following 9 oral presentations and 14 posters were presented at a SEEDS II workshop held at Ocean Research Institute, The University of Tokyo on October 17-18, 2005. (The meeting was part of the North Pacific Marine Science Organization (PICES) program). Presumably the topics listed below will form the basis for some of the papers to be published.

http://www.pices.int/meetings/workshops/2005_workshops/SEEDS%20II/SEEDS_II.aspx

Talks:

Background and introduction of SEEDS II
A. Tsuda

Physical behavior of the iron-fertilized patch by SF6 tracer release
D. Tsumune, Y. Watanabe, A. Shimamoto

Iron and trace metal chemistry
J. Nishioka, H. Obata, S. Takeda, K. Johnson, M. Wells, S. Nakatsuka, Y. Kondo, S. Takada, Y. Sorin

Biological responses
H. Saito, K. Suzuki, H. Kiyosawa, A. Tsuda

Primary production, bacterial production and nitrogen assimilation dynamics during SEEDS II
I. Kudo, T. Aramaki, W. Cochlan, Y. Noiri, T. Ono, and Y. Nojiri

Complexity of grow-out experiments: further iron stimuration of communities from an iron fertilized patch
W. Cochlan, M. Wells, C. Trick

DMS in the seawater and atmosphere measured during the iron fertilization experiment (SEEDS-II) in the sub-arctic North Pacific
I. Nagao, S. Hashimoto, M. Uematsu

The role of bacteria in modulating the impact of Fe on DMS production in HNLC waters
M. Levasseur, M. Lizotte and G. Caron

Distribution of marine biogases and their fates between surface seawater and marine atmospheric boundary layer during the SEEDS II cruise in the northern North Pacific
M. Uematsu, Y. Narita, Y. Iwamoto, M. Kondo, K. Yoshida, I. Nagao, S. Hashimoto, S. Toda, S. Kato, K. Kajii

Posters:

Meso- and microzooplankton dynamics in SEEDS II.
A. Tsuda, H. Saito and R. Machida

Dynamics of mass flux and particulate matter flux during SEEDS II
T. Aramaki, Y. Nojiri, and K. Imai

Release of organic iron-binding ligands during grazing on phytoplankton and its effect on phytoplankton community structure.
M. Sato, S. Takeda and K. Furuya

Complexation of iron (III) by natural organic ligands during SEEDS II.
Y. Kondo, S. Takeda, J. Nishioka and K. Furuya

Iron oxidation status during the SEEDS II mesoscale experiment and its potential biological implications.
E. Roy, M. Wells, C. Trick and W. Cochlan

Trace gasses in the water.
U. Tsunogai

Geochemistry of bioactive trace metals during an in-situ iron enrichement in the subarctic western North Pacific Gyre (SEEDS II).
S. Nakatsuka, J. Nishioka, M. Kinugasa, Y. Sorin

Phytoplankton dynamics.
K. Suzuki, H. Kiyosawa (cancelled)

Ammonium inhibition of nitrate uptake during mesoscale iron-enrichment experiments: A comparison of the planktonic response during SOFEX and SEEDS II.
W. Cochlan, J. Herndon, J. Betts, D. Costello, C. Trick and M. Wells

Behavior of rare earth elements and 210Po-210Pb during the iron fertilization experiment
Y. Hara, H. Obata, T. Doi, Y. Hongo, T. Gamo

Behavior of thorium and particles obtained by the multiple-unit large-volume in situ filtration system in SEEDS II.
T. Aono, T. Nakanishi, J. Zheng, M. Yamada and M. Kusakabe

Temporal variability of cosmogenic radionuclides 32P, 33P and 7Be in SEEDS II
T. Nakanishi, T. Aono, M. Yamada and M. Kusakabe

Phosphorus dynamics during the SEEDS II
T. Yoshimura

Effects of iron fertilization on the distribution of volatile organic compounds in seawater.
S. Toda, Y. Narita, H. Oda, Y. Akatsuka, T. Nagai, M. Kurihara, M. Uematsu, S. Hashimoto

Metadata:

There is one large Microsoft Excel 2003 file (xls format) that describes samples collected:

Seeds-II_metadata_withoutKMdata.xls
Version 03 April 2008

NO DATA. The file contains no data; only times and locations of samples.

The file has been modified by Doug Mackie in August 2008 to include a worksheet called “samples”. This worksheet lists which parameters were measured at each station.

There are 55 (56 including “samples”) worksheets in the workbook. Each sheet describes a single parameter. Data exist for each of the parameters listed above for associate investigators:

TS	temperature
Chl	chlorophyll
Nuts	nutrients; NO3, NH4, PO4, Silicate
Sal	salinity
DO	dissolved oxygen
POC/N	particulate organic carbon, particulate organic nitrogen
PSi	particulate silicon
13C	
PCa	particulate Ca
Phyto+zoo taxo	taxonomy of phytoplankton and soo plankton
HNF	heterotrophic nanoflagellates
Viral infect. & prod.	
Chl size	size fractionated chlorophyll
Primary Production	
N-uptake	Nitrogen uptake
Bacterial produc.	bacterial production
DOM	dissolved organic matter
Virus dilution	
DMS	dimethyl sulfoxide
Ra-226	Radon 226
Suspended particles	
SF6	sulphur hexafluoride
HPLC GF/F	phytoplankton pigments filtered on glass fibre F ~0.7 um by HPLC
HPLC-size 5um, 20um	phytoplankton pigments filtered 5 and 20 um by HPLC
FCM bacteria	bacteria cell count by flow cytometry
FRRF	fast repetition rate fluorimeter; gives Fv/Fm
Flavodoxin	

Algal cell viability	
13C-PE curve	
a*	
P-Phos	particulate phosphate
TEP	transparent exopoloymer
Phyto-FCM	phytoplankton cell count by flow cytometry
Si dissolution	
POC/Si decomposition	particulate organic carbon and silicon decomposition
Life Cycle exp	
CH4	methane
N2O	
CO	
NMHC	non methane hydrocarbons
Dilution	
DIC/Alk	dissolved inorganic carbon and alkalinity
DMS Prod.	dimethylsulfoxide production
T-Fe	total iron
D-Fe	dissolved iron
Sol-Fe	soluble iron
Solubility Fe	solubility of iron
Fe:C ratio	iron to carbon ratio in cells
Trace metal	
D-REEs	dissolved rare earth elements; crustal marker
T-REEs	total rare earth elements
T-210Pb-210Po	total 210-Pb to 210-Po ratio; dating
D-210Pb-210Po	dissolved 210-Pb to 210-Po ratio
D-ligand	dissolved iron binding ligands
Soluble-ligand	soluble iron binding ligands
UV-ligand	iron binding ligands destroyed by UV irradiation
Fe regeneration	
DFB exp	desferoximine-B as strong competitive iron binding ligand
PUV	profiling ultraviolet radiometer; UV profile
PRR	photorepair radiation; measure of UV damage to DNA
Traps	sediement traps
Zooplankton	
Copepod gut pigment	
Marine Snow Camera	
PAR	photosynthetic radiation; to define euphotic zone
Atmospheric	
Aerosol	
Patch dynamics	
Surface Monitor	

ADCP	Acoustic Doppler Current Profiler
XBT	expendable bathythermograph
pCO2	
Satellite observations	
Iron fertilization	
In-situ filtration	

The excel file provided is: Seeds-II_metadata_withoutKMdata.xls

KM refers to the Kilo-Moana;
a support vessel run by NSF / University of Maine. PI Mark Wells.

Mark Wells was contacted by Doug Mackie (author of this metadata.doc) in June 2008 and said: That the KM had been occupied by the team from the HM (while HM returned to port for resupply) and that datasets had been combined. (Though NSF participants did conduct deckboard experiments):

Hello Doug,

Yes, it is a bit confusing, but I'll do my best to explain. We participated in the SEEDS II experiment, and had some Japanese Scientists on board, but "we" (the NSF participants) did not do any of the in-out patch monitoring. We were conducting deckboard experiments, and providing the vessel for our Japanese colleagues (led by Takeda-san) to continue monitoring the patch while the Hakuho-Maru had to return to port for crew/supply exchange. So I have no metadata on the SEEDSII patch monitoring. I know that samples were collected (though we did no mapping) but they were returned to Japan for analyses (to the best of my recollection).

My suggestion would be to contact Takeda-san (Shigenobu) again and ask for his clarification. I believe the two dataset's (measurements from Hakuho-Maru and KM) have been combined (at least that is what I have seen in their presentations), but Takeda-san will be able to confirm this is the case.

36 CTD casts were made during the cruise and almost all analysis (except underway) was on water collected from Niskin bottles on the CTD.

Tsuda, A., et al. (2007): Evidence for the grazing hypothesis: Grazing reduces phytoplankton responses of the HNLC ecosystem to iron enrichment in the western subarctic pacific (SEEDS II). *J. Oceanogr*. 63(6), 983-994.

The in- and out-patch survey consisted of vertically stratified water sampling with a CTD-Carousel multi sampling system and ultra clean sampling using Kevlar wire and acid-cleaned Niskin-X bottles, near the center of the patch and the outside patch. The hydrocast station in and outside the patch were determined by the horizontal survey of SF_6 and pCO2 concentrations

Casts made:

PRE (4 casts)

IN patch (12 daily casts + 2x7 multiple casts = 24)
Days: 2, 3, 4, 5, 7, 8, 10, 11, 12, 23, 25, 31
Day 3: 7 casts at the IN patch station at ~1 hour intervals (predawn)

OUT of patch (5 daily casts)
Days: 5, 8, 11, 24, 32
Day 9: 7 casts at the IN patch station at ~1 hour intervals (predawn)

The next 55 paragraphs describe the tabs in the excel spreadsheet (Seeds-II_metadata_withoutKMdata.xls)

? presume that "depth, layers" field in xl worksheets refers to depth of cast and number of bottles per cast.

1. SEEDS II

Vessel and PI information.
Also timetable of daily ship activities.

2. Hakuho-Maru

Abbreviated list of associate investigators (used to compile list above).

3. CTD

Times and locations for 36 CTD casts.
No data or methods.

Pre: PS, PC, PN, D00

IN: D02-I, D04-I, D05-I, D07-I, D07-I, D08-I, D10-I, D11-I, D12-I, D23-I, D25-I, D31-I
D03S1, D03S2, D03S3, D03S4, D03S5, D03S6, D03S7

OUT: D02-O, D05-O, D08-O, D11-O, D24-O, D32-O
D09S3, D09S2, D09S1, D09S4, D09S5, D09S6, D09S7

4. XBT

Times and locations for 42 XBT drops.
NOT same as CTD
No data or methods.

5. DO

Times and locations for 2 DO measurements.
0-150 m, 10 layers.
Same as CTD.
No data or methods.

6. Nutrients

Times and locations for 36 nutrient samples.
Same as CTD.
0-150 m, 10 layers.
No data or methods.

Pre: PS, PC, PN, D00

IN: D02-I, D04-I, D05-I, D07-I, D07-I, D08-I, D10-I, D11-I, D12-I, D23-I, D25-I, D31-I
D03S1, D03S2, D03S3, D03S4, D03S5, D03S6, D03S7

OUT: D02-O, D05-O, D08-O, D11-O, D24-O, D32-O
D09S3, D09S2, D09S1, D09S4, D09S5, D09S6, D09S7

7. Chl-a

Times and locations for 36 Chl-a samples.
Same as CTD
0-150 m, 10 layers.
No data or methods.

Pre: PS, PC, PN, D00

IN: D02-I, D04-I, D05-I, D07-I, D07-I, D08-I, D10-I, D11-I, D12-I, D23-I, D25-I, D31-I
D03S1, D03S2, D03S3, D03S4, D03S5, D03S6, D03S7

OUT: D02-O, D05-O, D08-O, D11-O, D24-O, D32-O
D09S3, D09S2, D09S1, D09S4, D09S5, D09S6, D09S7

8. Zooplankton

Times and locations for 24 Zooplankton samples.
Times and locations slightly different from CTD casts.
?presumable net hauls were made?
?no indication given for what “M” stations are
but locations correspond with IN patch.
0-20, 20-50, 50-100, 100-200 m, 4 layers

No data or methods.

Pre: D00
IN: D02-I, D04-I, D05-I, D07-I, D07-I, D08-I, D10-I, D11-I, D12-I, D23-I, D31-I.
OUT: D02-O, D08-O, D11-O, D24-O, D32-O,
M: D02-M, D02-M, D08-M, D08-M, D11-M, D11-M, D24-M, D24-M

Tsuda, A., et al. (2007): Evidence for the grazing hypothesis: Grazing reduces phytoplankton responses of the HNLC ecosystem to iron enrichment in the western subarctic pacific (SEEDS II). *J. Oceanogr*. 63(6), 983-994.

> *A VMPS net (opening-closing multi-layer net: 50 x 50 cm mouth opening, 0.33 mm mesh opening, Terazaki and Tomatsu, 1997) was towed from 200-m depth to the surface on HK, and a NORPAC net (45 cm mouth diameter, 0.33 mm mesh opening) from 20-m depth on KM for estimations of standing stock of mesozooplankton in the iron patch. The sampling layers of the VMPS net were divided into 0-20, 20-50, 50-100, 100-200 m. The samples were immediately preserved with 10% buffered formalin seawater. In a laboratory, all individuals except for small copepods (mainly Oithona spp.) were sorted for measurements of wet weight. Carbon biomass was estimated using the wet weight and a conversion factor of 0.08 (Peters and Downing, 1984).*

9. Salinity

Times and locations for 19 salinity samples.
no depths given
Same as CTD
No data or methods.

Pre: D00

IN: D02-I, D04-I, D05-I, D07-I, D07-I, D08-I, D10-I, D11-I, D12-I, D23-I, D25-I, D31-1

OUT: D02-O, D05-O, D08-O, D11-O, D24-O, D32-O

10. Marine snow camera

Times and locations for 19 marine snow camera samples.
no depths given
Same as CTD
No data or methods.

Pre: D00

IN: D02-I, D04-I, D05-I, D07-I, D07-I, D08-I, D10-I, D11-I, D12-I, D23-I, D25-I, D31-1

OUT: D02-O, D05-O, D08-O, D11-O, D24-O, D32-O

11. POC N ratio

Times and locations for 19 POC/N samples.
Same as CTD
0-150 m, 8 layers.
No data or methods.

Pre: D00

IN: D02-I, D04-I, D05-I, D07-I, D07-I, D08-I, D10-I, D11-I, D12-I, D23-I, D25-I, D31-1

OUT: D02-O, D05-O, D08-O, D11-O, D24-O, D32-O

12. Particulate Si

Times and locations for 15 particulate Si samples.
Same as CTD.
0-150 m, 8 layers.
No data or methods.

Pre: PS, D00

IN: D02-I, D04-I, D08-I, D10-I, D11-I, D12-I, D23-I, D25-I, D31-I

OUT: D02-O, D08-O, D24-O, D32-O

13. Particulate 13-C

Times and locations for 14 particulate 13-C samples
Same as CTD
0-150 m, 8 layers.
No data or methods.

Pre: D00

IN: D02-I, D04-I, D08-I, D10-I, D11-I, D12-I, D23-I, D25-I, D31-I

OUT: D02-O, D08-O, D24-O, D32-O

14. Particulate Ca

Times and locations for 14 particulate Ca samples
Same as CTD
0-150 m, 8 layers.
No data or methods.

Pre: D00

IN: D02-I, D04-I, D08-I, D10-I, D11-I, D12-I, D23-I, D25-I, D31-I

OUT: D02-O, D08-O, D24-O, D32-O

15. Phytoplankton taxonomy

Times and locations for 20 phytoplankton taxonomy samples.
Same as CTD
5, 10, 30 m
No data or methods.

Pre: D00

IN: D02-I, D04-I, D05-I, D07-I, D07-I, D08-I, D10-I, D11-I, D12-I, D23-I, D25-I, D31-1

OUT: D02-O, D05-O, D08-O, D11-O, D24-O, D32-O
D09-S3

16. Heterotrophic Nano Flagellates

Times and locations for 20 heterotrophic nanoflagellate (HNF) samples.
Same as CTD
5, 10, 30 m
No data or methods.

Pre: D00

IN: D02-I, D04-I, D05-I, D07-I, D07-I, D08-I, D10-I, D11-I, D12-I, D23-I, D25-I, D31-1

OUT: D02-O, D05-O, D08-O, D11-O, D24-O, D32-O
D09-S3

17. Virus infection rates

Times and locations for 28 virus infection rate samples
(?infection of what?).
Same as CTD
5, 10, 30 m
No data or methods.

Pre: D00

IN: D02-I, D04-I, D05-I, D07-I, D07-I, D08-I, D10-I, D11-I, D12-I
D03S1, D03S2, D03S3, D03S4, D03S5, D03S6, D03S7

OUT: D02-O, D05-O, D08-O, D11-O
D09S3, D09S2, D09S1, D09S4, D09S5, D09S6, D09S7

18. Chlorophyll size fraction

Times and locations for 19 chlorophyll size fraction samples.
(sizes not given)
Same as CTD
depths not given. ? same as chl-a
No data or methods.

Pre: D00

IN: D02-I, D04-I, D05-I, D07-I, D07-I, D08-I, D10-I, D11-I, D12-I, D23-I,
D25-I, D31-1

OUT: D02-O, D05-O, D08-O, D11-O, D24-O, D32-O

19. 13-C primary production

Times and locations for 11 13-C primary production samples.
Same as CTD
0-150 m, 6 layers.
No data or methods.

Pre: D00

IN: D02-I, D05-I, D08-I, D11-I, D23-I, D25-I, D31-1,

OUT: D11-O, D24-O, D32-O

20. 15-N uptake

Times and locations for 10 15-N uptake samples.
Same as CTD
0-150 m, 6 layers.
No data or methods.

Pre: D00

IN: D02-I, D05-I, D08-I, D11-I, D25-I, D31-1,

OUT: D11-O, D24-O, D32-O

21. Bacterial Production

Times and locations for 11 bacterial production samples.
Same as CTD
0-150 m, 6 layers.
No data or methods.

Pre: D00

IN: D02-I, D05-I, D08-I, D11-I, D23-I, D25-I, D31-1,

OUT: D11-O, D24-O, D32-O

22. Dissolved Organic Matter (DOM)

Times and locations for 33 DOM samples.
Same as CTD
0-150 m, 10 layers.
No data or methods

Pre: D00

IN: D02-I, D04-I, D05-I, D07-I, D07-I, D08-I, D10-I, D11-I, D12-I, D23-I, D25-I, D31-I
D03S1, D03S2, D03S3, D03S4, D03S5, D03S6, D03S7

OUT: D02-O, D05-O, D08-O, D11-O, D24-O, D32-O
D09S3, D09S2, D09S1, D09S4, D09S5, D09S6, D09S7

23. DMS DMSP (Dimethyl sulfoxide)

Times and locations for 33 DMS samples.
Same as CTD
0-150 m, 10 layers.
No data or methods

Pre: D00

IN: D02-I, D04-I, D05-I, D07-I, D07-I, D08-I, D10-I, D11-I, D12-I, D23-I, D25-I, D31-I
D03S1, D03S2, D03S3, D03S4, D03S5, D03S6, D03S7

OUT: D02-O, D05-O, D08-O, D11-O, D24-O, D32-O
D09S3, D09S2, D09S1, D09S4, D09S5, D09S6, D09S7

24. DMS Production and decomposition

Times and locations for 33 DMS production and decomposition samples.

Same as CTD
0-150 m, 10 layers.
No data or methods

Pre: D00

IN: D02-I, D04-I, D05-I, D07-I, D07-I, D08-I, D10-I, D11-I, D12-I, D23-I, D25-I, D31-I
D03S1, D03S2, D03S3, D03S4, D03S5, D03S6, D03S7

OUT: D02-O, D05-O, D08-O, D11-O, D24-O, D32-O
D09S3, D09S2, D09S1, D09S4, D09S5, D09S6, D09S7

25. Ra Th P Be (Radium, Thorium, ?Protactinium, Beryllium)

Times and locations for 5 radioisotope samples.
NOT same as CTD
0-150 m, 8 layers.
No data or methods

IN: D02, D04

OUT: D09, D23, D31

26. PUV

Times and locations for 5 PUV samples.
Same as CTD
no depths given
No data or methods

IN: D23-I, D25-I, D31-1

OUT: D24-O, D32-O

27. PRR

Times and locations for 20 PRR samples.
Same as CTD – **except** PF (taken 20 minutes before PS)
no depths given
No data or methods

PRE: PF, D00

IN: D02-I, D04-I, D05-I, D07-I, D07-I, D08-I, D10-I, D11-I, D12-I, D23-I, D25-I, D31-1

OUT: D02-O, D05-O, D08-O, D11-O, D24-O, D32-O

28. Suspended Particulates

Times and locations for 21 suspended particulate samples.
Same as CTD
Surface, 10, 20, 30 m
No data or methods

PLUS another 29 samples collected between port (Tokyo) and SEEDDS II site

PRE: PS, PC, PN, D00

IN: D02-I, D04-I, D05-I, D07-I, D07-I, D08-I, D11-I, D12-I, D23-I, D25-I, D31-1
D03S1

OUT: D02-O, D05-O, D08-O, D11-O, D24-O, D32-O

29. SF6

Times and locations for 33 SF6 samples.
Same as CTD
0-150 m, 10 layers.
No data or methods

Pre: D00

IN: D02-I, D04-I, D05-I, D07-I, D07-I, D08-I, D10-I, D11-I, D12-I, D23-I, D25-I, D31-I
D03S1, D03S2, D03S3, D03S4, D03S5, D03S6, D03S7

OUT: D02-O, D05-O, D08-O, D11-O, D24-O, D32-O
D09S3, D09S2, D09S1, D09S4, D09S5, D09S6, D09S7

30. HPLC Pigment

Times and locations for 19 HPLC pigment samples.
Same as CTD
5, 10 m
No data or methods

Pre: D00

IN: D02-I, D04-I, D05-I, D07-I, D07-I, D08-I, D10-I, D11-I, D12-I, D23-I, D25-I, D31-1

OUT: D02-O, D05-O, D08-O, D11-O, D24-O, D32-O

31. Microzooplankton

Times and locations for 19 microzooplankton samples.
Same as CTD
5, 10, 30 m
No data or methods

Pre: D00

IN: D02-I, D04-I, D05-I, D07-I, D07-I, D08-I, D10-I, D11-I, D12-I, D23-I, D25-I, D31-1

OUT: D02-O, D05-O, D08-O, D11-O, D24-O, D32-O

32. FCM (Flowcytometry) bacterial cell concentration.

Times and locations for 19 bacterial cell counts samples.
0-150 m, 10 layers.
Same as CTD
No data or methods

Pre: D00

IN: D02-I, D04-I, D05-I, D07-I, D07-I, D08-I, D10-I, D11-I, D12-I, D23-I, D25-I, D31-1

OUT: D02-O, D05-O, D08-O, D11-O, D24-O, D32-O

33. FRRF (fast repetition rate flurimetry)

Times and locations for 36 FRRF samples.
5 m (1 layer only)
Same as CTD.
No data or methods.

Pre: PS, PC, PN, D00

IN: D02-I, D04-I, D05-I, D07-I, D07-I, D08-I, D10-I, D11-I, D12-I, D23-I, D25-I, D31-I
D03S1, D03S2, D03S3, D03S4, D03S5, D03S6, D03S7

OUT: D02-O, D05-O, D08-O, D11-O, D24-O, D32-O
D09S3, D09S2, D09S1, D09S4, D09S5, D09S6, D09S7

34. Proteins

Times and locations for 19 protein samples.
surface (1 layer only)
Same as CTD
No data or methods

Pre: D00

IN: D02-I, D04-I, D05-I, D07-I, D07-I, D08-I, D10-I, D11-I, D12-I, D23-I, D25-I, D31-1

OUT: D02-O, D05-O, D08-O, D11-O, D24-O, D32-O

35. algal cell viability

Times and locations for 19 algal cell viability samples.
5 m (1 layer only)
Same as CTD
No data or methods

Pre: D00

IN: D02-I, D04-I, D05-I, D07-I, D07-I, D08-I, D10-I, D11-I, D12-I, D23-I, D25-I, D31-1

OUT: D02-O, D05-O, D08-O, D11-O, D24-O, D32-O

36. 13C PE

Times and locations for 19 13C-PE samples.
5 m (1 layer only)
Same as CTD
No data or methods

Pre: D00

IN: D02-I, D04-I, D05-I, D07-I, D07-I, D08-I, D10-I, D11-I, D12-I, D23-I, D25-I, D31-1

OUT: D02-O, D05-O, D08-O, D11-O, D24-O, D32-O

37. a-star

Times and locations for 19 a-star samples.
5 m (1 layer only)
Same as CTD
No data or methods

Pre: D00

IN: D02-I, D04-I, D05-I, D07-I, D07-I, D08-I, D10-I, D11-I, D12-I, D23-I, D25-I, D31-1

OUT: D02-O, D05-O, D08-O, D11-O, D24-O, D32-O

38. particulate P

Times and locations for 9 particulate P samples.
2 m (1 layer only)
Same as CTD
No data or methods

Pre: D00
IN: D04-I, D08-I, D12-I, D23-I, D25-I, D31-1
OUT: D08-O, D24-O

39. TEP (transparent exoplymer)

Times and locations for 14 TEP samples.
0-75 m, 3 layers
Same as CTD
No data or methods

Pre: D00
IN: D02-I, D04-I, D08-I, D10-I, D11-I, D23-I, D25-I, D31-1
OUT: D02-O, D05-O, D11-O, D24-O, D32-O

40. Phytoplankton cell count by flowcytometry (FCM)

Times and locations for 19 phytoplankton cell counts samples.
0-75 m, 8 layers
Same as CTD
No data or methods

Pre: D00

IN: D02-I, D04-I, D05-I, D07-I, D07-I, D08-I, D10-I, D11-I, D12-I, D23-I, D25-I, D31-1

OUT: D02-O, D05-O, D08-O, D11-O, D24-O, D32-O

41. Methane

Times and locations for 14 CH4 samples.
0-200 m, 10 layers
Same as CTD
No data or methods

Pre: D00
IN: D02-I, D04-I, D08-I, D10-I, D11-I, D23-I, D25-I, D31-1
OUT: D02-O, D05-O, D11-O, D24-O, D32-O

42. N2O

Times and locations for 14 N2O samples.
0-200 m, 10 layers
Same as CTD
No data or methods

Pre: D00
IN: D02-I, D04-I, D08-I, D10-I, D11-I, D23-I, D25-I, D31-1
OUT: D02-O, D05-O, D11-O, D24-O, D32-O

43. CO

Times and locations for 14 CO samples.
0-200 m, 10 layers
Same as CTD
No data or methods

Pre: D00
IN: D02-I, D04-I, D08-I, D10-I, D11-I, D23-I, D25-I, D31-1
OUT: D02-O, D05-O, D11-O, D24-O, D32-O

44. Non-methane hydrocarbons (NMHC)

Times and locations for 14 NMHC samples.
0-200 m, 10 layers
Same as CTD
No data or methods

Pre: D00
IN: D02-I, D04-I, D08-I, D10-I, D11-I, D23-I, D25-I, D31-1
OUT: D02-O, D05-O, D11-O, D24-O, D32-O

45. Dilution exp.

Times and locations for 11 “dilution exp” samples.
no details about experiment
5 m (1 layer only)
Same as CTD
No data or methods

Pre: D00

IN: D02-I, D05-I, D07-I, D07-I, D23-I, D25-I, D31-O

OUT: D05-O, D24-O, D32-O

46. DIC (dissolved inorganic carbon), alkalinity

Times and locations for 33 DIC and alkalinity samples.
0-150 m, 10 layers
Same as CTD
No data or methods

Pre: D00

IN: D02-I, D04-I, D05-I, D07-I, D07-I, D08-I, D10-I, D11-I, D12-I, D23-I, D25-I, D31-I
D03S1, D03S2, D03S3, D03S4, D03S5, D03S6, D03S7

OUT: D02-O, D05-O, D08-O, D11-O, D24-O, D32-O
D09S3, D09S2, D09S1, D09S4, D09S5, D09S6, D09S7

47. TD Fe (Total dissolved Fe)

Times and locations for 33 total dissolved Fe samples.
0-150 m, 7-10 layers (variable)
Same as CTD
No data or methods

Pre: D00

IN: D02-I, D04-I, D05-I, D07-I, D07-I, D08-I, D10-I, D11-I, D12-I, D23-I, D25-I, D31-I
D03S1, D03S2, D03S3, D03S4, D03S5, D03S6, D03S7

OUT: D02-O, D05-O, D08-O, D11-O, D24-O, D32-O
D09S3, D09S2, D09S1, D09S4, D09S5, D09S6, D09S7

48. soluble Fe

Times and locations for 33 soluble Fe samples.
0-150 m, 7-10 layers (variable)
Same as CTD
No data or methods

Pre: D00

IN: D02-I, D04-I, D05-I, D07-I, D07-I, D08-I, D10-I, D11-I, D12-I, D23-I, D25-I, D31-I
D03S1, D03S2, D03S3, D03S4, D03S5, D03S6, D03S7

OUT: D02-O, D05-O, D08-O, D11-O, D24-O, D32-O
D09S3, D09S2, D09S1, D09S4, D09S5, D09S6, D09S7

49. Fe solubility

Times and locations for 19 Fe solubility samples.
0-75 m, 6 layers
Same as CTD
No data or methods

Pre: D00

IN: D02-I, D04-I, D05-I, D07-I, D07-I, D08-I, D10-I, D11-I, D12-I, D23-I, D25-I, D31-1

OUT: D02-O, D05-O, D08-O, D11-O, D24-O, D32-O

50. Fe:C ratio

Times and locations for 8 Fe:C samples.
5 m (1 layer only)
Same as CTD
No data or methods

Pre: D00
IN: D02-I, D07-I, D07-I, D12-I, D23-I, D25-I, D31-1

51. Trace metals

Times and locations for 33 trace metals samples.
no details of which metals
0-150 m, 7-10 layers (variable)
Same as CTD
No data or methods

Pre: D00

IN: D02-I, D04-I, D05-I, D07-I, D07-I, D08-I, D10-I, D11-I, D12-I, D23-I, D25-I, D31-I
D03S1, D03S2, D03S3, D03S4, D03S5, D03S6, D03S7

OUT: D02-O, D05-O, D08-O, D11-O, D24-O, D32-O
D09S3, D09S2, D09S1, D09S4, D09S5, D09S6, D09S7

52. Total dissolved Rare Earth Elements (REE)

Times and locations for 15 REE samples.
no details of which metals
0-150 m, 7 layers
Same as CTD
No data or methods

Pre: D00

IN: D02-I, D04-I, D08-I, D10-I, D11-I, D12-I, D23-I, D25-I, D31-1

OUT: D05-O, D08-O, D11-O, D24-O, D32-O

53. Total dissolved Pb and Po

Times and locations for 15 Pb and Po samples.
? presumably 210-Pb abd 210-Po
0-150 m, 5 layers
Same as CTD
No data or methods

Pre: D00

IN: D02-I, D04-I, D08-I, D10-I, D11-I, D12-I, D23-I, D25-I, D31-1

OUT: D05-O, D08-O, D11-O, D24-O, D32-O

54. Dissolved Fe ligands

Times and locations for 15 dissolved Fe ligand samples.
0-150 m, 6 layers
Same as CTD
No data or methods

Pre: D00

IN: D02-I, D04-I, D08-I, D10-I, D11-I, D12-I, D23-I, D25-I, D31-1

OUT: D05-O, D08-O, D11-O, D24-O, D32-O

55. Sinking particulate flux

Times and locations of (~3 daily) sediment trap deployment and recovery.
No data or methods

Tsuda, A., et al. (2007): Evidence for the grazing hypothesis: Grazing reduces phytoplankton responses of the HNLC ecosystem to iron enrichment in the western subarctic pacific (SEEDS II). *J. Oceanogr.* 63(6), 983-994.

> *Knauer-type sediment traps were attached to a drifting system at a depth of 40 m inside and outside the patch, retrieved at 3 day intervals in the patch, and 4 to 7 day intervals outside the patch to collect sinking particles. The trap consisted of 8 plastic cylinders filled with hyper-saline seawater with sodium azide (10 mmol l–1). Part of the samples were filtered with a pre-combusted glass-fiber filter (GF/F) after removing the swimmers using a mesh (1 mm mesh opening) and stored in a freezer (–20°C). The filters were placed in acid fumes to remove the inorganic carbon content and organic carbon and nitrogen*

contents were measured with an elemental analyzer (CE Instruments, EA1110).

Platform notes: **Two vessels were used.**

Ship	Cruise	Leg	PI	date_start	port	date_end	port
Hakuho-Maru	KH-04-3	1	Tsuda	20040713	Tokyo	20040805	Kushiro
Hakuho-Maru	KH-04-3	2	Tsuda	20040809	Kushiro	20040827	Tokyo
Kilo Moana	KM0415	--	Wells	20040715	Honolulu	20040825	Honolulu

Platform Name:

platform type:

deployment:

Tsuda, A., et al. (2007): Evidence for the grazing hypothesis: Grazing reduces phytoplankton responses of the HNLC ecosystem to iron enrichment in the western subarctic pacific (SEEDS II). *J. Oceanogr*. 63(6), 983-994.

The first iron addition was carried out from 0:50 GMT on 20 July to 0:00 GMT on 21 July (GMT). Day 1 was defined as 21 July (GMT). The ship started to inject iron and sulfur hexafluoride (SF6) as an inert tracer of the water mass, executing an 8 km × 8 km grid pattern centered on the buoy with an interval of 400 m. The ship was navigated with a lagrangian coordination system (Tsumune *et al*., 2005), and buoy position was transmitted to the ship every 10 min to update the navigation frame of reference to account for surface water advection. The amount of iron added to the patch was 332 kg Fe as FeSO4. During the iron fertilization, 4000 L of saturated SF6 solution was also simultaneously injected. The saturated SF6 solution was made onboard using the method previously detailed in Tsumune *et al*. (2005). Note that the saturated SF6 concentration in seawater is about 0.2 mM (Ledwell and Watson, 1991). A second iron addition was performed on day 6 without SF6 tracer, when an additional 159 kg of iron was added to the patch, which was traced using the SF6 signal.

PUBLICATION ABSTRACTS:

A. Tsuda, S. Takeda, H. Saito, J. Nishioka, I. Kudo, Y. Nojiri, K. Suzuki, M. Uematsu, M. L. Wells, D. Tsumune, T. Yoshimura, T. Aono, T. Aramaki, W. P. Cochlan, M. Hayakawa, K. Imai, T. Isada, Y. Iwamoto, W. K. Johnson, S. Kameyama, S. Kato, H. Kiyosawa, Y. Kondo, M. Levasseur, R. J. Machida, I. Nagao, F. Nakagawa, T. Nakanish, S. Nakatsuka, A. Narita, Y. Noiri, H. Obata, H. Ogawa, K. Oguma, T. Ono, T. Sakuragi, M. Sasakawa, M. Sato, A. Shimamoto, H. Takata, C. G. Trick, Y. W. Watanabe, C. S. Wong and N. Yoshie, 2007, Evidence for the grazing hypothesis: Grazing reduces phytoplankton responses of the HNLC ecosystem to iron enrichment in the western subarctic pacific (SEEDS II), Journal of Oceanography, 63 (6), 983-994.

A mesoscale iron-enrichment study (SEEDS II) was carried out in the western subarctic Pacific in the summer of 2004. The iron patch was traced for 26 days, which included observations of the development and the decline of the bloom by mapping with sulfur hexafluoride. The experiment was conducted at almost the same location and the same season as SEEDS (previous iron-enrichment experiment). However, the results were very different between SEEDS and SEEDS II. A high accumulation of phytoplankton biomass (similar to 18 mg chl m(-3)) was characteristic of SEEDS. In contrast, in SEEDS II, the surface chlorophyll-a accumulation was lower, 0.8 to 2.48 mg m(-3), with no prominent diatom bloom. Photosynthetic competence in terms of F-v/F-m for the total phytoplankton community in the surface waters increased after the iron enrichments and returned to the ambient level by day 20. These results suggest that the photosynthetic physiology of the phytoplankton assemblage was improved by the iron enrichments and returned to an iron-stressed condition during the declining phase of the bloom. Pico-phytoplankton (< 2 mu m) became dominant in the chlorophyll-a size distribution after the bloom. We observed a nitrate drawdown of 3.8 mu M in the patch (day 21), but there was no difference in silicic acid concentration between inside and outside the patch. Mesozooplankton (copepod) biomass was three to five times higher during the bloom-development phase in SEEDS II than in SEEDS. The copepod biomass increased exponentially. The grazing rate estimation indicates that the copepod grazing prevented the formation of an extensive diatom bloom, which was observed in SEEDS, and led to the change to a pico-phytoplankton dominated community towards the end of the experiment." mesoscale iron-enrichment study (SEEDS II) was carried out in the western subarctic Pacific in the summer of 2004. The iron patch was traced for 26 days, which included observations of the development and the decline of the bloom by mapping with sulfur hexafluoride. The experiment was conducted at almost the same location and the same season as SEEDS (previous iron-enrichment experiment). However, the results were very different between SEEDS and SEEDS II. A high accumulation of phytoplankton biomass (similar to 18 mg chl m(-3)) was characteristic of SEEDS. In contrast, in SEEDS II, the surface chlorophyll-a accumulation was lower, 0.8 to 2.48 mg m(-3), with no prominent diatom bloom. Photosynthetic competence in terms of F-v/F-m for the total phytoplankton community in the surface waters increased after the iron enrichments and returned to the ambient level by day 20. These results suggest that the photosynthetic physiology of the phytoplankton assemblage was

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E. G. Roy, M. L. Wells and D. W. King, 2008, Persistence of iron(II) in surface waters of the western subarctic Pacific, Limnology and Oceanography, 53 (1), 89-98.

The distribution of dissolved iron(II) [Fe(II)] was studied in surface waters of the western subarctic Pacific during the Subarctic Pacific Iron Experiment for Ecosystem Dynamics Study-II (SEEDS II) iron enrichment experiment using highly sensitive flow injection-based luminol chemiluminescence. Vertical profiles of Fe(II) and total dissolved iron were measured outside of the fertilized patch to investigate the chemical speciation of iron in this high-nitrate low-chlorophyll (HNLC) region. Ambient total dissolved iron concentrations ranged from 50 pmol L-1 to 150 pmol L-1 depending on depth and sampling times. Unexpectedly, Fe(II) accounted for up to half of total dissolved iron, with concentrations up to similar to 50 pmol L-1. Fe(II) concentrations decreased exponentially with depth and were undetectable at depths below 50 m. There was no evidence of increased Fe(II) concentrations associated with the subsurface chlorophyll maximum, indicating that photolysis, rather than biological reduction of Fe(III), was the primary source of Fe(II). Because Fe(II) concentrations in the fertilized patch remained elevated for more than a week after enrichment, Fe(II) oxidation rates at near-ambient concentrations were measured. Indeed, the temperature-dependent Fe(II) oxidation rates were significantly slower than predicted by Fe(II) oxidation models and rates measured in ligand-free seawater. These findings suggest that Fe(II) binding ligands may exist in these HNLC waters, with conditional stability constants on the order of 10(8)-10(9) with respect to Fe2+. The accumulation of Fe(II) during daylight hours did not alleviate iron limitation of eukaryotic phytoplankton in these waters, contrary to expectations from recent iron uptake models." The distribution of dissolved iron(II) [Fe(II)] was studied in surface waters of the western subarctic Pacific during the Subarctic Pacific Iron Experiment for Ecosystem Dynamics Study-II (SEEDS II) iron enrichment experiment using highly sensitive flow injection-based luminol chemiluminescence. Vertical profiles of Fe(II) and total dissolved iron were measured outside of the fertilized patch to investigate the chemical speciation of iron in this high-nitrate low-chlorophyll (HNLC) region. Ambient total dissolved iron concentrations ranged from 50 pmol L-1 to 150 pmol L-1 depending on depth and sampling times. Unexpectedly, Fe(II) accounted for up to half of total dissolved iron, with concentrations up to similar to 50 pmol L-1.

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M. Sato, S. Takeda and K. Furuya, 2007, Iron regeneration and organic iron(III)-binding ligand production during in situ zooplankton grazing experiment, Marine Chemistry, 106 (3-4), 471-488.

To elucidate iron regeneration and organic iron(III)-binding ligand formation during microzooplankton and copepod grazing on phytoplankton, incubation experiments were conducted in the western subarctic Pacific. During 8 days of dark incubation of ambient water and that amended with plankton concentrate, dissolved iron and organic iron(III)-binding ligands accumulated, approximately proportionally to the decrease in chlorophyll a. The observed increases in dissolved iron concentration were much greater than those expected from the consumption of phytoplankton biomass and previously reported Fe:C value of cultured algal cells, suggesting resolution from colloidal or particulate iron adsorbed onto the algal cell surface. When copepods were added to the ambient water, organic iron(III)-binding ligands accumulated more rapidly than in the control receiving no copepod addition, although consumed phytoplankton biomass was comparable between the two treatments. Bioassay experiment using filtrates collected from the incubation experiment showed that organic ligands formed during microzooplankton grazing reduced the iron bioavailability to phytoplankton and suppressed their growth. Moreover, picoplankton Synechococcus sp. and Micromonas pusilla were more suppressed by the organic ligands than the diatom Thalassiosira weissflogii. In conclusion, through microzooplankton and copepod grazing on phytoplankton, organic iron(III)-binding ligands as well as regenerated iron are released into the ambient seawater. Because the ligands lower iron bioavailability to phytoplankton through complexation and the degree of availability reduction varies among phytoplankton species, grazing by zooplankton can shift phytoplankton community structure in iron-limited waters." To elucidate iron regeneration and organic iron(III)-binding ligand formation during microzooplankton and copepod grazing on phytoplankton, incubation experiments were conducted in the western subarctic Pacific. During 8 days of dark incubation of ambient water and that amended with plankton concentrate, dissolved iron and organic iron(III)-binding ligands accumulated,

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Y. Kondo, S. Takeda, J. Nishioka, H. Obata, K. Furuya, W. K. Johnson and C. S. Wong, 2008, Organic iron(III) complexing ligands during an iron enrichment experiment in the western subarctic North Pacific, Geophysical Research Letters, 35 (12), L12601. doi:10.1029/2008GL033354

Complexation of iron (III) with natural organic ligands was investigated during a mesoscale iron enrichment experiment in the western subarctic North Pacific (SEEDS II). After the iron infusions, ligand concentrations increased rapidly with subsequent decreases. While the increases of ligands might have been partly influenced by amorphous iron colloids formation (12-29%), most in-situ increases were attributable to the < 200 kDa fraction. Dilution of the fertilized patch may have contributed to the rapid decreases of the ligands. During the bloom decline, ligand concentration increased again, and the high concentrations persisted for 10 days. The conditional stability constant was not different between inside and outside of the fertilized patch. These results suggest that the chemical speciation of the released iron was strongly affected by formation of the ligands; the production of ligands observed during the bloom decline will strongly impact the iron cycle and bioavailability in the surface water." Complexation of iron (III) with natural organic ligands was investigated during a mesoscale iron enrichment experiment in the western subarctic North Pacific (SEEDS II). After the iron infusions, ligand concentrations increased rapidly with subsequent decreases. While the increases of ligands might have been partly influenced by amorphous iron colloids formation (12-29%), most in-situ increases were attributable to the < 200 kDa fraction. Dilution of the fertilized patch may have contributed to the rapid decreases of the ligands. During the bloom decline, ligand concentration increased again, and the high concentrations persisted for 10 days. The conditional stability constant was not different between inside and outside of

the fertilized patch. These results suggest that the chemical speciation of the released iron was strongly affected by formation of the ligands; the production of ligands observed during the bloom decline will strongly impact the iron cycle and bioavailability in the surface water.

Abstract of talk at 2007 Goldschmidt Conference

S. Nakatsuka, Y. Sohpjn, K. Norisuye, K. Okamura, S. Takeda and J. Nishioka, 2007, Physicochemical speciation of trace metals during the mesoscale iron enrichment (SEEDS II) in the western North Pacific, Geochimica Et Cosmochimica Acta, 71 (15), A704-A704.

The mesoscale iron-enrichment experiment SEEDS II was conducted near the edge of the subarctic Western Notrh Pacific gyre, where SEEDS I had been carried out [1, 2]. We investigated dissolved and particulate Co, Ni, Cu, Zn, Cd and Pb in seawater from both field observation for 26 days and shipboard incubation with a natural phytoplankton assemblage for 10 days. Discrete seawater samples were filtered through 0.2 μm filter and acidified to pH 2.2 for the determination of the dissolved species by ICP-MS. The filter was used to measure the particulate species by FI-ICP-MS. Before the iron enrichment, the average concentrations for dissolved Co, Ni, Cu, Zn, Cd and Pb in the surface mixed layer (0-20 m) were 70 pM, 4.9 nM, 2.1 nM, 1.6 nM, 0.48 nM and 52 pM, respectively, and those for the particulate species were 1.7 pM, 0.052 nM, 0.094 nM, 0.46 nM, 0.037 nM and 5.2 pM, respectively. After the enrichment, there was a threefold increase in chlorophyll *a* (~3 μg/L) by day 12. However, there was no detectable difference in the dissolved and particulate trace metals between inside and outside the patch. In the shipboard incubation, addition of 1 nM Fe caused a 30-fold increase in chlorophyll *a* (~9 μg/L) dominated by *Pseudo-nitzschia sp*. and increases in the particulate trace metal fraction up to 3-45%. These results suggest that Fe was a limiting factor for the growth of phytoplankton. In addition, enhanced-grazing by mesozooplankton presumably limited the growth of phytoplankton and the transformation of trace metal speciation during the mesoscale Fe enrichment.

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