Sediment trap data including biogenic particle fluxes from U.S. JGOFS sediment trap deployments in the North Atlantic in 1989 (U.S. JGOFS NABE project)

Website: https://www.bco-dmo.org/dataset/2598
Version: June 7, 1995
Version Date: 1995-06-07

Project
» U.S. JGOFS North Atlantic Bloom Experiment (NABE)

Program
» U.S. Joint Global Ocean Flux Study (U.S. JGOFS)

Contributors	Affiliation	Role
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Dataset Description

Sediment trap data, biogenic particle fluxes

Methods & Sampling

PI: Susumu Honjo and Steve Manganini
of: Woods Hole Oceanographic Institution
dataset: Sediment trap data, biogenic particle fluxes
dates: April 4, 1989 to April 17, 1990
location: N: 48 S: 34 W: -21 E: -21
project/cruise: North Atlantic Bloom Experiment cruises

NOTES: specific for each trap

Trap #1 at 34N - 21W
PERIODS 1 THRU 13 TRAP DEPTH = 1071M
PERIODS 14 THRU 27 TRAP DEPTH = 1248M
PERIODS 3 THRU 14, RESTRICTED COLLECTION DUE TO PARTIAL CLOGGING OF THE
SEDIMENT-TRAP APERTURE CAUSED BY A FISH-HEAD.
PERIOD 14 - NO DATA, MOORING REDEPLOYMENT
PERIOD 27 - NO DATA, TOTAL CLOGGING OF THE SEDIMENT-TRAP APERTURE DUE TO
A FISH-HEAD OBSTRUCTION.

Trap #2 at 34N - 21W
PERIODS 1 THRU 13 TRAP DEPTH = 2067M
PERIODS 14 THRU 27 TRAP DEPTH = 1894M

PERIOD 14 - NO DATA, MOORING REDEPLOYMENT

Trap #3 at 34N - 21W
PERIODS 1 THRU 13 TRAP DEPTH = 4564M
PERIODS 14 THRU 27 TRAP DEPTH = 4391M
PERIOD 14 - NO DATA, MOORING REDEPLOYMENT
PERIODS 9 AND 11 SAMPLES DESTROYED IN TRANSIT

Trap #1 at 48N - 21W
PERIODS 1 THRU 13 TRAP DEPTH = 1018M
PERIODS 14 THRU 27 TRAP DEPTH = 1202M
PERIOD 14 - NO DATA, MOORING REDEPLOYMENT

Trap #2 at 48N - 21W
PERIODS 1 THRU 13 TRAP DEPTH = 2018M
PERIODS 14 THRU 27 TRAP DEPTH = 2200M
PERIOD 14 - NO DATA, MOORING REDEPLOYMENT
PERIODS 18 THRU 27 NO DATA, SEDIMENT TRAP APERTURE CLOGGED

Trap #3 at 48N - 21W
PERIODS 1 THRU 13 TRAP DEPTH = 3718M
PERIODS 14 THRU 27 TRAP DEPTH = 3749M
PERIOD 14 - NO DATA, MOORING REDEPLOYMENT

Reference: Honjo, S and Steven Manganini, 1992. Biogenic Particle Fluxes at the 34N 21W and 48N 21W Stations, 1989-1990: Methods and Analytical Data Compilation. Woods Hole Oceanographic Institution Technical Report WHOI-92-15.

Sediment Trap Particle Flux data during the North Atlantic Bloom Experiment
Dr. Susumu Honjo and Dr. Steven J. Manganini

Woods Hole Oceanographic Institution

The following methods documentation was extracted from:

Honjo, S, and S. J. Manganini, 1992.
Biogenic Particle Fluxes at the 34N 21W and 48N 21W Stations, 1989-1990: Methods and Analytical Data Compilation. *Woods Hole Oceanographic Institution, Technical Report* **92-15**

Methods

A. Deployment of Sediment Traps and Mooring Arrays

1. Location, depths and timing:

   Two deep ocean mooring arrays were deployed at about 34N (depth to seafloor: 5,261 m and 5,083 m, for phase 1 and 2) and 48N (depth to seafloor: 4,418 m and 4,451 m). Table 1 gives more detailed information on mooring locations, trap depths and names of ships that were used for deployment and recovery. Three PARFLUX Mark 7G-13 time-series sediment traps with 13 rotary collectors on each were deployed on both moorings for a total of 6 traps. At each of the stations, traps were moored at approximately the same depth relative to the surface and the sea- floor (for the deepest trap); 1 km and 2 km from the surface and 0.7 km above bottom.

   TABLE 1

   Sediment Trap deployments, North Atlantic Bloom Exp., Dr. S. Honjo

Mooring Stations and Trap Depths

Phase 1: Periods 1 to 13, April 3, 1989 to Sept. 26, 1989
Phase 2: Periods 14 to 27, Oct. 16, 1989 to April 16, 1990
Hiatus : Sept. 26 1989 to Oct 16, 1989

	34N 21W Station		48N 21W Station	
	Phase 1	Phase 2	Phase 1	Phase 2
Latitude	33°49.3'N	33°48.4'N	47°42.9'N	47°43.6'N
Longitude	21°00.5'W	21°02.2'W	20°52.5'W	20°51.5'W
Bottom Depth **	5,261 m	5,083 m	4,418 m	4,451 m
Trap Depth	1,070 m	1,248 m	1,018 m	1,202 m
" "	2,067 m	1,894 m	2,018 m	2,200 m
" "	4,564 m	4,391 m	3,718 m	3,749 m
Deployed by	R/V Atlantis II	R/V Endeavor	R/V Atlantis II	R/V Endeavor
Recovered by	R/V Endeavor	RRV Darwin	R/V Endeavor	RRV Darwin

** Depths are all corrected values

Arrays were deployed in March and April 1989, recovered and redeployed in September 1989, and totally recovered in April 1990 (Table 1). During the 376-day deployment (including 20 days of hiatus in the middle), each sediment trap was opened and closed 26 times, providing continuous time-series sampling at 14-day intervals, except for two periods. Table 2 lists open/close schedules for which all the traps were uniformly programmed during the experiment. An independent monitoring mechanism installed with each trap (Honjo and Doherty, 1988) confirmed that the entire program was executed correctly and on schedule.

TABLE 2

Synchronized Open/Close Schedule for All Traps
at the 34N and 48N, 21W Stations

Period	Mid Date		Open/Close Date		Days Open	Elapsed Days
	JD*	CD*	JD*	CD*		
1	96	04/06/89	93	04/03/89	5	5
2	105	04/15/89	98	04/08/89	14	19
3	119	04/29/89	112	04/22/89	14	33
4	133	05/13/89	126	05/06/89	14	47
5	148	05/29/89	140	05/20/89	17	64
6	164	06/13/89	157	06/06/89	14	78
7	178	06/27/89	171	06/20/89	14	92
8	192	07/11/89	185	07/04/89	14	106
9	206	07/25/89	199	07/18/89	14	120
10	220	08/08/89	213	08/01/89	14	134
11	234	08/22/89	226	08/15/89	14	148
12	248	09/05/89	241	08/29/89	14	162
13	262	09/19/89	255	09/12/89	14	176
14	279	10/06/89	269	09/26/89	20	196 (hiatus)
15	296	10/23/89	289	10/16/89	14	210
16	310	11/06/89	303	10/30/89	14	224
17	324	11/20/89	317	11/13/89	14	238
18	338	12/04/89	331	11/27/89	14	252
19	352	12/18/89	345	12/11/89	14	266
20	1	01/01/90	359	21/25/89	14	280
21	15	01/15/90	8	01/08/90	14	294
22	29	01/29/90	22	01/22/90	14	308
23	43	02/12/90	36	02/05/90	14	322
24	57	02/26/90	50	02/19/90	14	336
25	71	03/12/90	64	03/05/90	14	350

26	85	03/26/90	78	03/19/90	14	364
27	99	04/09/90	92	04/02/90	14	378

*CD = Calendar Date; JD = Julien Date

2. Time-series sediment traps:

   Each sediment trap had an aperture of 0.5 m2, covered by baffles with 25mm diameter cells with the aspect ratio of 2.5. The included cone angle was 42 degrees and the structural frame was built of welded titanium The opening and closing of all 6 traps was synchronized with an error of less than one minute. The sample containers, 13 for each trap, were filled with in situ deep sea water were collected by a 30 liter Niskin bottle prior to the deployment. Analytical grade formalin (S. Wakeham; personal communication, 1988) was added to make a 3% solution buffered with 0.1% sodium borate. Each of the 13 sample containers was completely filled with this sea water solution with preservative before the deployment of a trap. Individual sample containers were mechanically sealed from the ambient water before and after each collecting period (Honjo and Doherty, 1988).

3. Mooring array:

   The mooring design was based on the PARFLUX Sediment Trap Mooring Dynamics Package that has been used by us since 1979 (Honjo et al., 1992). A detailed design, parts listing and tension calculation of the NABE mooring array is available in Manganini and Krishfield, 1992, Cruise Report. The arrays were designed to maintain an average of 180 kg of vertical tension throughout the tautline, with a total buoyancy of 1,114 kg that was balanced with a 1,590 kg (in-water weight) cast-iron anchor. Sediment traps were attached to a mooring in-line with three 1-m polyethylene-jacketed bridles. The automatic collection mechanism (Honjo and Doherty, 1988) of the 6 sediment traps worked flawlessly throughout the duration of the experiment and provided us with a total of 156 samples each of which represents an individual key to the time-space matrix for the NABE experiment.

B. Laboratory Analysis

1. Pre-analysis treatment of samples:

   We measured the pH in supernatant in sample containers immediately after recovery of traps (Manganini and Krishfield, 1992, Cruise Report). Sample containers were then refrigerated on board at approximately 2 to 4 degree C. Particle samples in (original) 250 ml, polyethylene centrifuging sample containers were transported to Woods Hole under refrigeration at approximately 1 to 2 degree C. We identified no swimmers from all samples collected by our experiment. The impact of swimmers, if any, was relatively small; it appears that they were all included with the >1 mm fractions.

2. Supernatant analysis:

   In the shore laboratory, first the liquid in a sample container was decanted and then filtered through a 0.45 um pore size Nucleopore filter leaving approximately 1/3 of the original volume. About 50 ml of filtered liquid was then analyzed for total N, NO2, NO3, NH4, P, PO4 and SiO2 using an automatic nutrient analyzer (e.g. Grasshoff et al. 1983). We regarded all excess quantities above the ambient concentration as being dissolved from the trapped particles while stored in situ before the recovery and added to the particle fluxes after being stochastically converted to solids. The remaining liquid in the sampling containers was used as rinse water in the processing

of the particulate portion in each specific sample. When additional rinse water was required during the course of analysis, for example, for sample splitting we used filtered and buffered deep Sargasso Sea water containing 3% formalin.

3. Water sieving:

   Particle samples were water-sieved through a 1-mm Nitex mesh. This was necessary to maintain precision during splitting of the major portion of the sediment that was 1
   mm fraction were large aggregates and fragmented gelatinous zooplankton. A sample caught in the 1 mm mesh was then re-suspended in the original seawater, stirred gently and poured onto a grid-printed, 47-mm Nucleopore filter with 2-um pore size, while applying gentle vacuum suction. While a sample on a filter was wet, the filter with the >1 mm fraction was cut into 4 equal pieces along the printed grid by a Teflon-coated blade; each aliquot was then immediately put back into the filtered original water for storage. When a >1 mm sample was too small to split, it was dried and homogenized by pulverization.

   Sediment that passed through the 1 mm mesh was further water- sieved through a 62-um Nitex sieve. Each fraction was split into 1/4 aliquots and then into 1/40 aliquots by a rotating wet- sediment splitter with 4 and 10 splitting heads (Honjo, 1980). The average error during the splitting of NABE samples into 4 or 10 aliquots was 3.7% for the mm fraction. Wet splitting of the trap-collected sample is justified
   for multi-disciplinary research including biocoenosis studies. Once particle samples are dried, each becomes inseparable and unidentifiable. Consequently, biocoenosis research such as picking up foraminifera tests or identifying diatom frustules becomes impossible.

4. Total dry mass measurement:

   Dry mass was determined by weighing two 1/4 aliquots of >1 mm (whose flux was usually insignificant) and three 1/10 aliquots of on pre-weighed 47 mm, 0.45 um Nucleopore filters. Before weighing,
   the samples were rinsed 3 times with distilled water, dried in an oven at 60 deg. C for 24 hours and cooled in a desiccator for 4 hours. Total flux was calculated from dry weight of the above aliquots divided by aperture area of the trap and the time it was opened.

5. Sedimentary component analyses:

   The dried sample was pulverized and homogenized, then the two size fractions were recombined proportionally and analyzed with respect to concentrations of:

   a) Carbonate: as $CaCO_3$
   b) Biogenic Opal
   c) Organic carbon, nitrogen and hydrogen in the decalcified fraction
   d) Phosphorus

   a) Carbonate content was determined by a method based on a vacuum-gasometric technique developed by Ostermann, et al. (1989). A preweighed sample is introduced into a sealed reaction vessel containing concentrated phosphoric acid. The pressure due to the evolution of CO_2 gas is proportional to the carbonate content when calibrated with appropriate standards and was recorded by a transducer. The results were calculated and reported as carbonate percent in the total sample.

   b) Biogenic opal was estimated from particulate, reactive Si, selectively

leaching decalcified samples in a sodium carbonate solution (Eggimann, et al., 1980) and converting the Si content to SiO_2 fluxes. A preweighed sample of approximately 10 mg along with 10 ml of 1 M Na_2CO_3 was sealed in a Teflon container. The samples were placed in a shaker bath at 90 deg. C for 3 hours and then filtered through a 47-mm-diameter, 0.45 um pore size Nucleopore filter using an all-plastic filtering apparatus. The filtrate at room temperature was neutralized with 0.2 N HCl using methyl orange as an indicator. After appropriate dilution, content of Si was determined spectrophotometrically (Strickland and Parsons, 1972). The Si content was then converted to SiO_2 and reported as particulate opal flux.

c) Organic carbon, nitrogen and hydrogen were analyzed using a Perkin-Elmer Elemental Analyzer Model 240C. Preweighed samples on precombusted glass fiber filters were decalcified using 1N phosphoric acid.

d) Reactive (biogenic) phosphorus content was determined by the Solorzano and Sharp method that was based on the dissolution of phosphorus by an acid after ashing, using $MgSO_4$ as an oxidant. A preweighed sample was placed into a glass centrifuge tube along with 2 ml of 0.017 M $MgSO_4$ and was dried at 90 degree C. The centrifuge tube containing the sample was ashed at 500 deg. C for 2 hours. After cooling, 5 ml of 0.2 M HCl was added and, with the centrifuge tube capped, was heated at 80 deg. C for 30 min. At room temperature, 5 ml of distilled H_2O with one ml of reagent (Strickland and Parsons, 1972) was added and the centrifuge tube was shaken in a vortex shaker, then centrifuged. The concentration of phosphorus was determined spectrophotometrically in the supernatant and the results were reported as particulate phosphorus flux.

Using the reported method, the lithogenic particles were too small to detect and were usually within the analytical error.

C. Restoration of dissolved components to particulate flux

The dissolution of collected particles in a bottle may occur as soon as particles arrive in the bottle while it is open, or later when it is sealed. Assuming that all dissolved portions remained in the recovered bottle, we restored the dissolved components of Si, P and N by analyzing the supernatants in sample bottles. We assumed that the elevated concentration above the sea water initially used to fill the bottles was caused by dissolved components. During the deployment of a trap, the sample bottles were open to the water column only for the duration of collecting periods. While a bottle was open, the bottle water which was placed in the bottle before deployment is exchanged with ambient water. In case the nutrient concentration of the initial bottle water is not equal to that of the ambient water, a correction had to be made; we assumed that one half of the initial water was diluted by the ambient water while the bottle was open. In practice, the effect on calculating particle flux by the difference of nutrients in the initial sea water was within analytical error.

References:

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Method of Sea-Water Analysis. Weinheim, Verlag Chemie.

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Large Aperture Time-series Sediment Traps; Design Objectives, Construction and Application. Deep-Sea Research, 35(1): 133-149.

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Manganini, S.J. and Krishfield, R., (in preparation)
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Strickland, J.D.H. and Parsons, T.R., 1972.
A Practical Handbook of Seaweater Analysis. Fisheries Research Board of Canada, Bulletin 169, 2nd edition, Ottawa, Canada.

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Data Files

File
sediment.csv (Comma Separated Values (.csv), 18.48 KB) MD5:60501fa18af439c36bb067e4bbb3481b Primary data file for dataset ID 2598

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Parameters

Parameter	Description	Units
mooring	sediment trap mooring array identifer	
trap	sediment trap number	
lat_n	nominal latitude of sediment trap mooring	whole degrees N
lon_n	nominal longitude of sediment trap mooring	whole degrees W
depth_n	nominal depth of sediment trap	meters
period	originator created sample ID, identifies a specific sampling period during the trap deployment	
date_open	date sediment trap opened reported as yyyymmdd	
days	number of days sediment trap open	
mass_f	mass particulate flux	mg/m2/day
mass_f_gt1	mass particulate flux, grain size greater than 1mm	mg/m2/day
mass_f_lt1	mass particulate flux, grain size less than 1mm	mg/m2/day
CO3_f	total carbonate flux	mg/m2/day
Ca_CO3_f	calcium in carbonate flux	mg/m2/day
pic_f	particulate inorganic carbon flux	mg/m2/day
pon_f	particulate organic nitrogen flux	mg/m2/day
poc_f	particulate organic carbon flux	mg/m2/day
SiO2_f_tot	total silicate (SiO2) flux	mg/m2/day
SiO2_p_f	particulate silicate flux	mg/m2/day
SiO2_diss_f	dissolved silicate flux	mg/m2/day
Si_opal_f	Silica flux in opal	mg/m2/day
P_f_tot	total phosphorus flux	ug/m2/day
P_p_f	particulate phosphorus flux	ug/m2/day
P_diss_f	dissolved phosphorus flux	ug/m2/day

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Instruments

Dataset-specific Instrument Name	Sediment Trap
Generic Instrument Name	Sediment Trap
Generic Instrument Description	Sediment traps are specially designed containers deployed in the water column for periods of time to collect particles from the water column falling toward the sea floor. In general a sediment trap has a jar at the bottom to collect the sample and a broad funnel-shaped opening at the top with baffles to keep out very large objects and help prevent the funnel from clogging. This designation is used when the specific type of sediment trap was not specified by the contributing investigator.

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Deployments

NABE_N34

Website	https://www.bco-dmo.org/deployment/57747
Platform	JGOFS Sediment Trap
Start Date	1989-04-04
End Date	1990-04-17

NABE_N48

Website	https://www.bco-dmo.org/deployment/57748
Platform	JGOFS Sediment Trap
Start Date	1989-04-04
End Date	1990-04-17

EN203

Website	https://www.bco-dmo.org/deployment/57741
Platform	R/V Endeavor
Start Date	1989-10-04
End Date	1989-10-17
Description	Sediment trap deployment and recovery cruises: R/V Endeavor cruise EN 203 Dates: October 4 - 17, 1989 Chief Scientist: S. Manganini Purpose: recover and redeploy both sediment trap arrays see sediment trap datasets reported from US JGOFS NABE North Atlantic Bloom Experiment sediment **Methods & Sampling** recovery and redeployment of sediment traps

AII-119-2

Website	https://www.bco-dmo.org/deployment/57740
Platform	R/V Atlantis II
Start Date	1989-03-28
End Date	1989-04-06
Description	R/V Atlantis II cruise 119 leg 2 (also called JGOFS leg 1) Dates: March 28 - April 6, 1989 Chief Scientist: S. Honjo Purpose: deploy both sediment trap mooring arrays **Methods & Sampling** Sediment trap deployment and recovery cruises: R/V Atlantis II cruise 119 leg 2 (also called JGOFS leg 1) Dates: March 28 - April 6, 1989 Chief Scientist: S. Honjo Purpose: deploy both sediment trap mooring arrays

Darwin_45B

Website	https://www.bco-dmo.org/deployment/57742
Platform	RRS Charles Darwin
Start Date	1990-04-01
End Date	1990-04-30
Description	RRS Charles Darwin cruise 45B Dates: April 1990 Chief Scientist: S. Manganini Purpose: final recovery of both US JGOFS NABE sediment trap arrays **Methods & Sampling** RRS Charles Darwin cruise 45B Dates: April 1990 Chief Scientist: S. Manganini Purpose: final recovery of both sediment trap arrays

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Project Information

U.S. JGOFS North Atlantic Bloom Experiment (NABE)

Website: http://usjgofs.whoi.edu/research/nabe.html

Coverage: North Atlantic

One of the first major activities of JGOFS was a multinational pilot project, North Atlantic Bloom Experiment (NABE), carried out along longitude 20° West in 1989 through 1991. The United States participated in 1989 only, with the April deployment of two sediment trap arrays at 48° and 34° North. Three process-oriented cruises where conducted, April through July 1989, from R/V *Atlantis II* and R/V *Endeavor* focusing on sites at 46° and 59° North. Coordination of the NABE process-study cruises was supported by NSF-OCE award # 8814229. Ancillary sea surface mapping and AXBT profiling data were collected from NASA's P3 aircraft for a series of one day flights, April through June 1989.

A detailed description of NABE and the initial synthesis of the complete program data collection efforts appear in: Topical Studies in Oceanography, JGOFS: The North Atlantic Bloom Experiment (1993), Deep-Sea Research II, Volume 40 No. 1/2.

The U.S. JGOFS Data management office compiled a preliminary NABE data report of U.S. activities: Slagle, R. and G. Heimerdinger, 1991. U.S. Joint Global Ocean Flux Study, North Atlantic Bloom Experiment, Process Study Data Report P-1, April-July 1989. NODC/U.S. JGOFS Data Management Office, Woods Hole Oceanographic Institution, 315 pp. (out of print).

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Program Information

U.S. Joint Global Ocean Flux Study (U.S. JGOFS)

Website: http://usjgofs.whoi.edu/

Coverage: Global

The United States Joint Global Ocean Flux Study was a national component of international JGOFS and an integral part of global climate change research.

The U.S. launched the Joint Global Ocean Flux Study (JGOFS) in the late 1980s to study the ocean carbon cycle.

An ambitious goal was set to understand the controls on the concentrations and fluxes of carbon and associated nutrients in the ocean. A new field of ocean biogeochemistry emerged with an emphasis on quality measurements of carbon system parameters and interdisciplinary field studies of the biological, chemical and physical process which control the ocean carbon cycle. As we studied ocean biogeochemistry, we learned that our simple views of carbon uptake and transport were severely limited, and a new "wave" of ocean science was born. U.S. JGOFS has been supported primarily by the U.S. National Science Foundation in collaboration with the National Oceanic and Atmospheric Administration, the National Aeronautics and Space Administration, the Department of Energy and the Office of Naval Research. U.S. JGOFS, ended in 2005 with the conclusion of the Synthesis and Modeling Project (SMP).

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Funding

Funding Source	Award
National Science Foundation (NSF)	unknown NABE NSF

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