

# Sediment trap fluxes of mass, elements and phytoplankton pigments from VERTIGO cruises KM0414, ZHNG09RR from the Hawaiian Islands HOT Site, NW SubArctic Pacific Ocean K2 Site, 2004-2005 (VERTIGO project)

**Website:** <https://www.bco-dmo.org/dataset/2947>

**Version:** final

**Version Date:** 2009-02-06

## Project

» [VERTical Transport In the Global Ocean](#) (VERTIGO)

## Program

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

Contributors	Affiliation	Role
<a href="#">Lamborg, Carl</a>	Woods Hole Oceanographic Institution (WHOI)	Principal Investigator
<a href="#">Buesseler, Kenneth O.</a>	Woods Hole Oceanographic Institution (WHOI)	Co-Principal Investigator
<a href="#">Chandler, Cynthia L.</a>	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

## Table of Contents

- [Dataset Description](#)
  - [Methods & Sampling](#)
  - [Data Processing Description](#)
- [Data Files](#)
- [Parameters](#)
- [Instruments](#)
- [Deployments](#)
- [Project Information](#)
- [Program Information](#)
- [Funding](#)

## Dataset Description

Sediment Trap Fluxes of mass, elements and phytoplankton pigments

## Methods & Sampling

(see platform deployments)

## Data Processing Description

(see platform deployments)

[ [table of contents](#) | [back to top](#) ]

## Data Files

File	
<b>sedtrapflux_KM0414.csv</b>	(Comma Separated Values (.csv), 8.12 KB) MD5:cd36df96fdb7201a57ecd1add0cb9ee3
version: 06 February 2009 Pls: Lamborg, Buesseler Sediment Trap Fluxes of mass, elements and phytoplankton pigments	
<b>sedtrapflux_ZHNG09RR.csv</b>	(Comma Separated Values (.csv), 4.69 KB) MD5:2811fce0d1155765db50f48dcdcd6b91
version: 06 February 2009 Pls: Lamborg, Buesseler " Sediment Trap Fluxes of mass, elements and phytoplankton pigments"	

[ [table of contents](#) | [back to top](#) ]

---

## Parameters

Parameter	Description	Units
Site	ALOHA or K2	text
date	date sampling began (GMT)	YYYYMMDD
event	unique sampling event	dimensionless
ev_code	event code from cruise log	alphanumeric
lon	longitude, negative denotes West	decimal degs
lat	latitude, negative denotes South	decimal degs
Deployment	First or second during cruise	text
Device	Trap type identifier	text
Depth	Depth of sediment trap	meters
Mass_f	Total mass flux	milligrams m-2 day-1
Mass_f_err	Total mass flux error	milligrams m-2 day-1
TC_f	Total Carbon flux	millimoles m-2 day-1

TC_f_err	Total Carbon flux error	millimoles m-2 day-1
N_f	Total Nitrogen flux	millimoles m-2 day-1
N_f_err	Total Nitrogen flux error	millimoles m-2 day-1
PO4_f	Total Phosphate flux	micromoles m-2 day-1
PO4_f_err	Total Phosphate flux error	micromoles m-2 day-1
PIC_f	particulate inorganic carbon flux	micromoles m-2 day-1
PIC_f_err	particulate inorganic carbon flux error	micromoles m-2 day-1
POC_f	particulate organic carbon flux	millimoles m-2 day-1
POC_f_err	particulate organic carbon flux error	millimoles m-2 day-1
bSi_f	biogenic Silica flux	micromoles m-2 day-1
bSi_f_err	biogenic Silica flux error	micromoles m-2 day-1
Th234_f	Thorium 234 flux	dpm m-2 day-1
Th234_f_err	Thorium 234 flux error	dpm m-2 day-1
Ba_f	Barium flux	micrograms m-2 day-1
Ba_f_err	Barium flux error	micrograms m-2 day-1
Al_f	Aluminum flux	micrograms m-2 day-1
Al_f_err	Aluminum flux error	micrograms m-2 day-1
Ca_f	Calcium flux	micrograms m-2 day-1
Ca_f_err	Calcium flux error	micrograms m-2 day-1

Sr_f	Strontium flux	micrograms m-2 day-1
Sr_f_err	Strontium flux error	micrograms m-2 day-1
Sc_f	Scandium flux	nanograms m-2 day-1
Sc_f_err	Scandium flux error	nanograms m-2 day-1
V_f	Vanadium flux	micrograms m-2 day-1
V_f_err	Vanadium flux error	micrograms m-2 day-1
Mn_f	Manganese flux	micrograms m-2 day-1
Mn_f_err	Manganese flux error	micrograms m-2 day-1
Fe_f	Iron flux	micrograms m-2 day-1
Fe_f_err	Iron flux error	micrograms m-2 day-1
Co_f	Cobalt flux	micrograms m-2 day-1
Co_f_err	Cobalt flux error	micrograms m-2 day-1
Cu_f	Copper flux	micrograms m-2 day-1
Cu_f_err	Copper flux error	micrograms m-2 day-1
Zn_f	Zinc flux	micrograms m-2 day-1
Zn_f_err	Zinc flux error	micrograms m-2 day-1
chl_c_f	chlorophyll c flux	micrograms m-2 day-1
chl_c_f_err	chlorophyll c flux error	micrograms m-2 day-1
Per_f	peridinin flux	micrograms m-2 day-1

Per_f_err	peridinin flux error	micrograms m-2 day-1
But_f	19-prime-butanoyloxyfucoxanthin flux	micrograms m-2 day-1
But_f_err	19-prime-butanoyloxyfucoxanthin flux error	micrograms m-2 day-1
Fuco_f	fucoxanthin flux	micrograms m-2 day-1
Fuco_f_err	fucoxanthin flux error	micrograms m-2 day-1
Hex_f	19-prime-hexanoyloxyfucoxanthin flux	micrograms m-2 day-1
Hex_f_err	19-prime-hexanoyloxyfucoxanthin flux error	micrograms m-2 day-1
Viola_f	violaxanthin flux	micrograms m-2 day-1
Viola_f_err	violaxanthin flux error	micrograms m-2 day-1
DDX_f	diadinoxanthin flux	micrograms m-2 day-1
DDX_f_err	diadinoxanthin flux error	micrograms m-2 day-1
Lut_f	lutein flux	micrograms m-2 day-1
Lut_f_err	lutein flux error	micrograms m-2 day-1
Zeax_f	zeaxanthin flux	micrograms m-2 day-1
Zeax_f_err	zeaxanthin flux error	micrograms m-2 day-1
chl_b_mv_f	chlorophyll b, monovinyl flux	micrograms m-2 day-1
chl_b_mv_f_err	chlorophyll b, monovinyl flux error	micrograms m-2 day-1
car_a_f	carotene-alpha flux	micrograms m-2 day-1
car_a_f_err	carotene-alpha flux error	micrograms m-2 day-1

car_b_f	carotene-beta flux	micrograms m-2 day-1
car_b_f_err	carotene-beta flux error	micrograms m-2 day-1
chl_a_dv_f	chlorophyll a, divinyl flux	micrograms m-2 day-1
chl_a_dv_f_err	chlorophyll a, divinyl flux error	micrograms m-2 day-1
chl_a_mv_f	chlorophyll a, monovinyl flux	micrograms m-2 day-1
chl_a_mv_f_err	chlorophyll a, monovinyl flux error	micrograms m-2 day-1
chl_a_tot_f	sum of chlorophyll a like compounds flux	micrograms m-2 day-1
chl_a_f_tot_err	sum of chlorophyll a like compounds flux error	micrograms m-2 day-1

[ [table of contents](#) | [back to top](#) ]

---

## Instruments

<b>Dataset-specific Instrument Name</b>	Neutrally Buoyant Sediment Trap
<b>Generic Instrument Name</b>	Neutrally Buoyant Sediment Trap
<b>Generic Instrument Description</b>	In general, 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. The Neutrally Buoyant Sediment Trap (NBST) was designed by researchers at Woods Hole Oceanographic Institution. The central cylinder of the NBST controls buoyancy and houses a satellite transmitter. The other tubes collect sediment as the trap drifts in currents at a predetermined depth. The samples are collected when the tubes snap shut before the trap returns to the surface. (more: <a href="http://www.whoi.edu/instruments/viewInstrument.do?id=10286">http://www.whoi.edu/instruments/viewInstrument.do?id=10286</a> )

[ [table of contents](#) | [back to top](#) ]

---

## Deployments

**KM0414**

<b>Website</b>	<a href="https://www.bco-dmo.org/deployment/57847">https://www.bco-dmo.org/deployment/57847</a>
<b>Platform</b>	R/V Kilo Moana
<b>Start Date</b>	2004-06-20
<b>End Date</b>	2004-07-10
<b>Description</b>	<p>VERTIGO project expedition to the U.S. Hawaii Ocean Time-series (HOT) site, near the deep-water Station ALOHA (A Long-Term Oligotrophic Habitat Assessment; 22° 45'N, 158° 00'W) located 100 km north of Oahu, Hawaii. Funded by: NSF OCE-0301139 Related information: VERTIGO cruise information from the VERTIGO Project site: <a href="https://cafethorium.whoi.edu/projects/vertigo/vertigo-hi/">https://cafethorium.whoi.edu/projects/vertigo/vertigo-hi/</a> HOT Web site: <a href="https://hahana.soest.hawaii.edu/index.html">https://hahana.soest.hawaii.edu/index.html</a> Original cruise data are available from the NSF R2R data catalog: <a href="http://www.rvdata.us/catalog/KM0414">http://www.rvdata.us/catalog/KM0414</a></p> <p><b>Methods &amp; Sampling</b></p> <p>Methodology: Methodology Change history: YYYYMMDD 080710: contributed by Carl Lamborg 081114: date, event, ev_code, lon, lat from cruise logs merged with original data 081114: added to OCB database; Steve Gegg (<a href="mailto:sgegg@whoi.edu">sgegg@whoi.edu</a>), BCO DMO 090206: minor edits to some parameter names to conform to OCB convention DMO Note: Used common "device" id from these data to determine sample position, date and event code for sed trap data KM0414 event log</p>

## ZHNG09RR

<b>Website</b>	<a href="https://www.bco-dmo.org/deployment/57848">https://www.bco-dmo.org/deployment/57848</a>
<b>Platform</b>	R/V Roger Revelle
<b>Start Date</b>	2005-07-21
<b>End Date</b>	2005-08-27
<b>Description</b>	<p>VERTIGO 2005 expedition to the K2site in the NW Pacific near 45° N and 160° E Funded by: NSF OCE-0301139 Cruise information from the VERTIGO project site: <a href="https://cafethorium.whoi.edu/projects/vertigo/vertigo-k2/">https://cafethorium.whoi.edu/projects/vertigo/vertigo-k2/</a> Original cruise data for the Revelle are available from the NSF R2R data catalog: <a href="http://www.rvdata.us/catalog/ZHNG09RR">http://www.rvdata.us/catalog/ZHNG09RR</a></p> <p><b>Methods &amp; Sampling</b></p> <p>Methodology: Methodology Change history: YYYYMMDD 080710: contributed by Carl Lamborg 081114: date, event, ev_code, lon, lat from cruise logs merged with original data 081114: added to OCB database; Steve Gegg (<a href="mailto:sgegg@whoi.edu">sgegg@whoi.edu</a>), BCO DMO 090206: minor edits to some parameter names to conform to OCB convention DMO Note: Used common "device" id from these data to determine sample position, date and event code for sed trap data RR_K2 event log</p>

[ [table of contents](#) | [back to top](#) ]

## Project Information

### VERTical Transport In the Global Ocean (VERTIGO)

**Website:** <https://cafethorium.whoi.edu/projects/vertigo/>

**Coverage:** HOT site and subarctic NW Pacific

#### NSF Award Abstract:

In this study, researchers at the Woods Hole Oceanographic Institution, Virginia Institute of Marine Science, University of California - Santa Cruz, University of California - Santa Barbara, University of Tasmania, and NIWA-Australia will work collaboratively to answer a difficult question in marine biogeochemistry: What controls

the efficiency of particle transport between the surface and deep ocean? More specifically, what is the fate of sinking particles leaving the upper ocean and what factors influence remineralization length scales for different sinking particle classes? Knowing the efficiency of particle transport is important for an accurate assessment of the ocean carbon sink. Globally, the magnitude and efficiency of the biological pump will in part modulate levels of atmospheric carbon dioxide.

The research team intends to test two basic hypotheses about remineralization control, namely: (1) particle source characteristics are the dominant control on the efficiency of particle transport; and/or that (2) mid-water processing, either by zooplankton or bacteria, controls transport efficiency. To do so, they will conduct process studies at sea focused on particle flux and composition changes in the upper 500-1000m of the ocean. The basic approach is to examine changes in particle composition and flux with depth within a given source region using a combination of approaches, many of which are new to the field. These include neutrally buoyant sediment traps, particle pumps, settling columns and respiration chambers, along with the development of new biological and geochemical tools for an integrated biogeochemical assessment of the biological pump. Two sites will be studied extensively on three-week process study cruises: the Hawaii Ocean Time-series site (HOT) and a new moored time-series site in the subarctic NW Pacific (Japanese site K2; 47°N 160°E). There are strong contrasts between these sites in rates of production, export, particle composition and expected remineralization length scales.

Evidence for variability in the flux vs. depth relationship of sinking particles is not in dispute, but the controls on particle transport efficiency through the twilight zone remain poorly understood. A lack of reliable flux and particle characterization data within the twilight zone has hampered our ability to make progress in this area, and no single approach is likely to resolve these issues. The proposed study will apply quantitative modeling to determine the net effects of the individual particle processes on the effective transport of carbon and other elements and to place the shipboard observations in the context of spatial and temporal variations in these processes

Besides the obvious contributions to the study of the oceanic and planetary carbon cycles, there are broader outcomes and impacts forthcoming from this project. Graduate and undergraduate students will be included in all aspects of the research, and the involvement of non-US PIs will encourage exchange of students and post-docs between labs in different countries. In addition, the component groups will continue to maintain science web sites designed for both public and scientific exchange where the broader and specific goals and outcomes of this work can be communicated.

*Original PI-provided project description:*

The main goal of VERTIGO is the investigation of the mechanisms that control the efficiency of particle transport through the mesopelagic portion of the water column.

Question: What controls the efficiency of particle transport between the surface and deep ocean? More specifically, what is the fate of sinking particles leaving the upper ocean and what factors influence remineralization length scales for different sinking particle classes? VERTIGO researchers have set out to test two basic hypotheses regarding remineralization control, namely:

1. particle source characteristics are the dominant control on the efficiency of particle transport; and/or that
2. mid-water processing, either by zooplankton or bacteria, controls transport efficiency.

To test their hypotheses, they will conduct process studies in the field focused on particle flux and composition changes in the upper 500-1000m of the ocean. The basic approach is to examine changes in particle composition and flux with depth within a given source region using a combination of approaches, many of which are new to the field. These include neutrally buoyant sediment traps, particle pumps, settling columns and respiration chambers, along with the development of new biological and geochemical tools for an integrated biogeochemical assessment of the biological pump. Three week process study cruises have been planned at two sites - the Hawaii Ocean Time-series site (HOT) and a new moored time-series site in the subarctic NW Pacific (Japanese site K2; 47°N 160°E) - where there are strong contrasts in rates of production, export, particle composition and expected remineralization length scales.

Evidence for variability in the flux vs. depth relationship of sinking particles is not in dispute but the controls on particle transport efficiency through the twilight zone remain poorly understood. A lack of reliable flux and particle characterization data within the twilight zone has hampered our ability to make progress in this area, and no single approach is likely to resolve these issues. The proposed study will apply quantitative modeling to determine the net effects of the individual particle processes on the effective transport of carbon and other elements, and to place the shipboard observations in the context of spatial and temporal variations in these processes. For rapid progress in this area, we have organized this effort as a group proposal taking advantage of expertise in the US and international community.



The efficiency of particle transport is important for an accurate assessment of the ocean C sink. Globally, the magnitude and efficiency of the biological pump will in part modulate levels of atmospheric CO<sub>2</sub>. We maintain that to understand present day ocean C sequestration and to evaluate potential strategies for enhancing sequestration, we need to assess possible changes in the efficiency of particle transport due to climate variability or via purposeful manipulations of C uptake, such as via iron fertilization.

*VERTIGO Acknowledgments:* (from K.O. Buesseler, et al / Deep-Sea Research II 55 (2008) 1522-1539) We thank the officers, crew and shore-based support teams for the R/V Kilo Moana (2004) and R/V Roger Revelle (2005). Funding for VERTIGO was provided primarily by research grants from the US National Science Foundation Programs in Chemical and Biological Oceanography (KOB, CHL, MWS, DKS, DAS). Additional US and non-US grants included: US Department of Energy, Office of Science, Biological and Environmental Research Program (JKBB); the Gordon and Betty Moore Foundation (DMK); the Australian Cooperative Research Centre program and Australian Antarctic Division (TWT); Chinese NSFC and MOST programs (NZJ); Research Foundation Flanders and Vrije Universiteit Brussel (FD, ME); JAMSTEC (MCH); New Zealand Public Good Science Foundation (PWB); and internal WHOI sources and a contribution from the John Aure and Cathryn Ann Hansen Buesseler Foundation (KOB). A number of individuals at sea and on shore, helped make the VERTIGO project a success, including: J. Andrews, C. Bertrand, R. Bidigare III, S. Bray, K. Casciotti, M. Charette, R. Condon, J. Cope, E. Fields, M. Gall, M. Gonneea, P. Henderson, T. Kobari, D. Kunz, S. Saitoh, S. Manganini, C. Moy, S. Okamoto, S. Pike, L. Robertson, D. Ruddick and Y. Zhang. Suggestions by three anonymous reviewers and help by the editor, R. Lampitt, are also greatly appreciated.

[ [table of contents](#) | [back to top](#) ]

---

## **Program Information**

### **Ocean Carbon and Biogeochemistry (OCB)**

**Website:** <http://us-ocb.org/>

**Coverage:** Global

The Ocean Carbon and Biogeochemistry (OCB) program focuses on the ocean's role as a component of the global Earth system, bringing together research in geochemistry, ocean physics, and ecology that inform on and advance our understanding of ocean biogeochemistry. The overall program goals are to promote, plan, and coordinate collaborative, multidisciplinary research opportunities within the U.S. research community and with international partners. Important OCB-related activities currently include: the Ocean Carbon and Climate Change (OCCC) and the North American Carbon Program (NACP); U.S. contributions to IMBER, SOLAS, CARBOOCEAN; and numerous U.S. single-investigator and medium-size research projects funded by U.S. federal agencies including NASA, NOAA, and NSF.

The scientific mission of OCB is to study the evolving role of the ocean in the global carbon cycle, in the face of environmental variability and change through studies of marine biogeochemical cycles and associated ecosystems.

The overarching OCB science themes include improved understanding and prediction of: 1) oceanic uptake and release of atmospheric CO<sub>2</sub> and other greenhouse gases and 2) environmental sensitivities of biogeochemical cycles, marine ecosystems, and interactions between the two.

The OCB Research Priorities (updated January 2012) include: ocean acidification; terrestrial/coastal carbon fluxes and exchanges; climate sensitivities of and change in ecosystem structure and associated impacts on biogeochemical cycles; mesopelagic ecological and biogeochemical interactions; benthic-pelagic feedbacks on biogeochemical cycles; ocean carbon uptake and storage; and expanding low-oxygen conditions in the coastal and open oceans.

[ [table of contents](#) | [back to top](#) ]

---

## Funding

Funding Source	Award
<a href="#">NSF Division of Ocean Sciences (NSF OCE)</a>	<a href="#">OCE-0301139</a>

[ [table of contents](#) | [back to top](#) ]