Niskin bottle basic hydrographic data, thorium-234, pigments and nutrients 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/2966
Version: 8 December 2008
Version Date: 2008-12-08

Project
» VERtical Transport In the Global Ocean (VERTIGO)

Program
» Ocean Carbon and Biogeochemistry (OCB)

Contributors	Affiliation	Role
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Dataset Description

Niskin bottle summary product; basic hydrography, thorium-234, pigments and nutrients

Methods & Sampling

see cruise specific documentation

Data Processing Description

see cruise specific documentation

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Parameters

Parameter	Description	Units

cast	CTD cast number	dimensionless
type	cast type; B=Niskin bottle	character
event	unique sampling event number composite of date and time (GMT)	YYyday_hhmm
lon	longitude, negative denotes West	decimal degrees
lat	latitude, negative denotes South	decimal degrees
date	date sampling began (GMT)	YYYYMMDD
bot	Niskin bottle number	dimensionless
time	time sampling began (GMT)	hhmm
yrday	decimal day of year sampling began (GMT) (T0 is 1/1/2004 00:00)	ddd.xx
bot_QC	bottle quality flag 0 = good; -1 = suspect	dimensionless
press	pressure, from CTD	decibars
temp	temperature, from CTD, ITS-90	degrees Celsius
salinity	salinity, from CTD, PSS-78 (PSU)	dimensionless
O2_umol_kg	oxygen, dissolved	micromol/kilogram
sigma_0	sigma-theta (potential density)	kilograms/meter^3
fluor	fluorescence, uncalibrated	micrograms/liter
turb	turbidity, Seapoint	volts
beam	beam attenuation (raw data in volts)	volts
NH4	ammonium	micromolar
PO4	phosphate	micromolar
NO3_NO2	nitrate plus nitrite	micromolar
Th234	Thorium 234	dpm/liter
Th234_err	Th234 error; measurement uncertainty	dpm/liter
chl_da	chlorophyllide a	nanograms/liter
chl_c	chlorophyll c	nanograms/liter
peridinin	peridinin	nanograms/liter
fucox_but	19-prime-butanoyloxyfucoxanthin	nanograms/liter
fucox	fucoxanthin	nanograms/liter
fucox_hex	19-prime-hexanoyloxyfucoxanthin	nanograms/liter
prasinox	prasinox	nanograms/liter
violax	violaxanthin	nanograms/liter
diadinox	diadinoxanthin	nanograms/liter
allox	alloxanthin	nanograms/liter
lutein	lutein	nanograms/liter
zeax	zeaxanthin	nanograms/liter
chl_b_mv	chlorophyll b, monovinyl	nanograms/liter
carotene_a	alpha carotene	nanograms/liter
carotene_b	beta carotene	nanograms/liter
chl_a_dv	chlorophyll a, divinyl	nanograms/liter
chl_a_mv	chlorophyll a, monovinyl	nanograms/liter
chl_a_tot	sum of chlorophyll a like compounds	nanograms/liter

comments	notes regarding sampling event	dimensionless
T_local	local time (GMT +11)	hhmm
Pmax	maximum pressure recorded	decibars
depth_n	depth, nominal target sampling depth	meters
depth	depth, calculated from CTD pressure	meters
potemp	potential temperature, ITS-90 (from primary T0,C0 sensors)	degrees Celsius
sal	salinity, from CTD, PSS-78 (PSU) (from primary T0,C0 sensors)	dimensionless
O2_satP	oxygen saturation	percent
trans	transmissivity	voltage
PIC	Particulate Inorganic Carbon as measured by transmissometer	voltage
SiO2	silicate	micromolar
NO2	nitrite	micromolar
chl_a_fluor	chlorophyll-a by Fluorometric methods	milligrams/meter^3

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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.

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Deployments

KM0414

Website	https://www.bco-dmo.org/deployment/57847
Platform	R/V Kilo Moana
Start Date	2004-06-20
End Date	2004-07-10
Description	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: https://cafethorium.whoi.edu/projects/vertigo/vertigo-hi/ HOT Web site: https://hahana.soest.hawaii.edu/index.html Original cruise data are available from the NSF R2R data catalog: http://www.rvdata.us/catalog/KM0414 **Methods & Sampling** Methodology: please see Buesseler at al. 2001 and Pike et al. 2005 Buesseler, K. O., C. Benitez-Nelson, Rutgers van der Loeff, M., Andrews, J., Ball, L., Crossin, G., and M. Charette (2001). An intercomparison of small- and large-volume techniques for thorium-234 in seawater. Marine Chemistry, 74, 15-28. (PDF) Pike, S.M., K.O. Buesseler, J. Andrews and N. Savoye (2005). Quantification of 234Th recovery in small volume sea water samples by inductively coupled plasma mass spectrometry. Journal of Radioanalytical and Nuclear Chemistry, 263(2): 355-360. (PDF) Change history: YYMMDD 060928: contributed by Ken Buesseler 061003: added to OCB database; Cyndy Chandler (cchandler@whoi.edu), OCB CDMO 061122: add metadata from event log; cchandler@whoi.edu 061206: original data included a column called seafloor; removed 071129: add pigment data 080103: add bot_QC per PI request. 080707: remove bad NO3_NO2 values per PI request; correct misaligned data columns for P>1000 081202: remove suspect deepwater Thorium data from casts 29 (B1,2,3) and cast 90 (bottles 1,2,3,4,5) PI note: a negative bot_QC quality flag indicates that at least the nitrite plus nitrate data are suspect, and possibly other data from that bottle as well; 0 indicates good. In July 2008 after reviewing data, PI requested removal of suspect DIN values; remaining data values from these suspect bottle samples were not removed. cast bot bot_QC press NO2_NO3 17 20 -1 59.324 2.5 17 16 -1 124.259 1.6 19 4 -1 304.730 4.5 19 1 -1 1011.760 32.2 27 10 -1 73.481 1.7 29 3 -1 3045.735 18.5 29 2 -1 3047.211 22.1 29 1 -1 3045.820 18.9 46 2 -1 177.491 8.4 46 1 -1 296.281 32.1

ZHNG09RR

Website	https://www.bco-dmo.org/deployment/57848
Platform	R/V Roger Revelle
Start Date	2005-07-21
End Date	2005-08-27
Description	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: https://cafethorium.whoi.edu/projects/vertigo/vertigo-k2/ Original cruise data for the Revelle are available from the NSF R2R data catalog: http://www.rvdata.us/catalog/ZHNG09RR **Methods & Sampling** Methodology: basic hydrographic data; thorium-234, please see published references: Buesseler at al. 2001 and Pike et al. 2005 Buesseler, K. O., C. Benitez-Nelson, Rutgers van der Loeff, M., Andrews, J., Ball, L., Crossin, G., and M. Charette (2001). An intercomparison of small- and large-volume techniques for thorium-234 in seawater. Marine Chemistry, 74, 15-28. (PDF) Pike, S.M., K.O. Buesseler, J. Andrews and N. Savoye (2005). Quantification of 234Th recovery in small volume sea water samples by inductively coupled plasma mass spectrometry. Journal of Radioanalytical and Nuclear Chemistry, 263(2): 355-360. (PDF) Change history: YYMMDD 060123: Added by Cyndy Chandler (cchandler@whoi.edu), OCB CDMO; basic hydrographic data from Niskin bottles contributed by Dave Siegel 060905: remove O2, T, C and derived params from station 20 per Chief Scientist request; sensor caps left on during deployment 080707: niskin data updated with nutrient and HPLC pigment data from Ken Buesseler 081202: uncalibrated PAR and derived fucox/chla_total ratio removed 081208: fluorometric chlorophyll a contributed by Sei-ichi Saitoh DMO note: Thorium 234 data from Niskin bottle samples are available for VERTIGO participants (restricted access). event, date, time, latitude and longitude are from the CTD cast NMEA header lines; T_local (local time at study area) was computed by adjusting GMT time by +11 As of January 2006, oxygen, fluorescence, turbidity, transmissivity and PAR had not yet been compared with in-situ data and should be used by others with caution until finalized. PIC sensor: voltage 0 - 5: WET Labs PIC 001 (4th build) POC sensor: voltage 0 - 5: WET Labs CST-DR 391 - tranmsissometer scattering sensor: voltage 0 - 5: Seapoint scattering sensor Fluorometric chlorophyll-a data (acquired using standard Turner method) were contributed by Se-ichi Saitoh (Hokkaido Univ., Japan) with target (nominal) depths but no Niskin bottle numbers. DMO staff were able to determine most of the Niskin bottle numbers by checking the chl-a sampling records as entered on the orignal sample log sheets. Exceptions and comments are noted below: cast bot depth_n chl_a comments 6 12 5 0.29 bottles 12 and 14 6 3 200 0.01 originally reported as cast 8 18 21 5 0.44 bottles 21 and 24 28 12 10 0.50 bottle 12 is a guess for 10 m sample 31 21 5 0.35 bottles 21 and 24 36 12 10 0.42 bottle 12 is a guess for 10 m sample 39 22 5 0.33 bottles 22 and 24 62 21 5 0.30 bottles 21 and 24 and for many casts, according to original paper sample log sheets: deepest chl-a sample noted was at 50 m (e.g. deeper samples reported in data file not recorded on sample log sheet) casts 23 and 76 sample log sheet noted that sample also taken from bottle 24 at **Processing Description** http://ocb.whoi.edu/jg/info/OCB/VERTIGO/RR_K2/bottle_summ.html0">Info file for Niskin bottle summary data

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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; 47oN 160oE). 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; 47oN 160oE) - 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 CO2. 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.

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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.

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