

# Water column Th-234 activity determined using a 4-L technique from samples collected on R/V Melville cruise MV1008 in the Costa Rica Dome in 2010 (CRD FLUZIE project)

**Website:** <https://www.bco-dmo.org/dataset/516062>

**Data Type:** Cruise Results

**Version:** 1

**Version Date:** 2014-05-28

## Project

» [Costa Rica Dome FLUX and Zinc Experiments](#) (CRD FLUZIE)

## Programs

» [Integrated Marine Biogeochemistry and Ecosystem Research -US](#) (IMBER-US)

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

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## Abstract

Water column Thorium-234 and Uranium-238 measured on the MV1008 cruise in the Costa Rica Dome (CRD) region of the Eastern Tropical Pacific Ocean.

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## Coverage

**Spatial Extent:** N:10.33 E:-86.76 S:8.37 W:-92.92

**Temporal Extent:** 2010-06-27 - 2010-07-23

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## Dataset Description

Water column Thorium-234 and Uranium-238 measured on the MV1008 cruise in the Costa Rica Dome (CRD) region of the Eastern Tropical Pacific Ocean.

## Acquisition Description

4-L samples for analysis of water column  $^{234}\text{Th}$  concentrations were typically taken at 12 depths spanning the upper 150 m on two casts per experimental cycle. On two cycles in the core of the CRD, an additional set of 8 samples was taken to assess  $^{234}\text{Th}$  deficiency down to 500-m depth. Samples were analyzed by standard small volume procedures (Benitez-Nelson et al. 2001, Buesseler et al. 2001, Pike et al. 2005). Immediately after collection, samples were acidified to a pH < 2 with concentrated  $\text{HNO}_3$ , spiked with 1 mL  $^{230}\text{Th}$  tracer (0.17 Bq mL<sup>-1</sup>), shaken vigorously, and allowed to equilibrate for 4-9 hours. Samples were then basified to a pH of 8-9 with  $\text{NH}_4\text{OH}$ . 100  $\mu\text{L}$  each of  $\text{KMnO}_4$  (7.5 g L<sup>-1</sup>) and  $\text{MnCl}_2$  (33 g L<sup>-1</sup>) were added and samples were shaken then allowed to sit for >8 hours as Th co-precipitated with manganese oxide. Samples were then filtered at high pressure onto a quartz microfiber (QMA) filter, dried in a drying oven, and mounted into RISO sample holders for beta counting.

Samples were beta counted at the University of South Carolina on a RISO low-level beta multi-counter within two months of the collection date. After an additional 8 months, samples were recounted to determine background beta emissions. Detector efficiency was calibrated using four samples taken from 2000-m depth (in water columns exceeding 3000-m depth), which were assumed to be at equilibrium with respect to  $^{234}\text{Th}$  and  $^{238}\text{U}$ . After background counts yield analyses were conducted as follows. Manganese oxide precipitate was dissolved from filters in 10 mL 8M  $\text{HNO}_3$ /10%  $\text{H}_2\text{O}_2$ . 1 mL of  $^{229}\text{Th}$  (1.66 Bq g<sup>-1</sup>) tracer was then added gravimetrically, and the sample was sonicated for 20 minutes and allowed to sit for >6 hours. An aliquot of this solution was then filtered through a 0.1-mm syringe filter and diluted with 2.2M  $\text{HNO}_3$ /1%HF for mass spec analysis of the  $^{229}\text{Th}$ : $^{230}\text{Th}$  tracer ratio at the Woods Hole Oceanographic Institution Analytical Facility.

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## Parameters

Parameter	Description	Units
event	Number referring to the particular deployment activity (event) on the FluZiE cruise.	integer
cast	CTD Cast number from the FluZiE cruise.	integer
niskin	Niskin bottle that the sample was taken from.	integer
cycle	Refers to the 4-day Lagrangian experiment during which the sample was taken.	integer
sample	Refers to a specific <sup>234</sup> Th measurement.	unitless
lat	Latitude (in degrees North) where the sample was collected.	decimal degrees
lon	Longitude (in degrees East) where the sample was collected.	decimal degrees
depth	Depth (in meters) that the sample was taken from as determined by CTD.	meters
sal	Salinity determined by CTD.	practical salinity units (PSU)
density	Density determined by CTD.	kilograms per cubic meter (kg m <sup>-3</sup> )
U238_activity	The activity of Uranium-238 ( <sup>238</sup> U) estimated from salinity using the equation of Owens et al. (2011).	decays per minute per liter (dpm L <sup>-1</sup> )
Th234_activity	The activity of Thorium-234 ( <sup>234</sup> Th).	decays per minute per liter (dpm L <sup>-1</sup> )
uncertainty	The uncertainty in <sup>234</sup> Th activity determined by propagating our measurement uncertainty.	decays per minute per liter (dpm L <sup>-1</sup> )
ISO_DateTime_UTC	Date and time (UTC) of CTD cast from which the water was drawn formatted to ISO 8601 standard. format: YYYY-mm-ddTHH:MM:SS.xx	unitless

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## Instruments

<b>Dataset-specific Instrument Name</b>	Mass Spec
<b>Generic Instrument Name</b>	Mass Spectrometer
<b>Dataset-specific Description</b>	Mass spec analysis of the 229:230Th tracer ratio took place at the Woods Hole Oceanographic Institution Analytical Facility.
<b>Generic Instrument Description</b>	General term for instruments used to measure the mass-to-charge ratio of ions; generally used to find the composition of a sample by generating a mass spectrum representing the masses of sample components.

<b>Dataset-specific Instrument Name</b>	RISO low-level beta multi-counter
<b>Generic Instrument Name</b>	Riso Laboratory Anti-coincidence Beta Counters
<b>Dataset-specific Description</b>	Samples were beta counted at the University of South Carolina on a RISO low-level beta multi-counter within two months of the collection date.
<b>Generic Instrument Description</b>	Low-level beta detectors manufactured by Riso (now Nutech) in Denmark. These instruments accept samples that can be mounted on a 25mm filter holder. These detectors have very low backgrounds, 0.17 counts per minute, and can have counting efficiencies as high as 55%. See: <a href="http://cafethorium.whoi.edu/website/about/services_radioanalytical_facil...">http://cafethorium.whoi.edu/website/about/services_radioanalytical_facil...</a> and <a href="http://www.nutech.dtu.dk/Produkter/Dosimetri/NUK_instruments/GM_multicou...">http://www.nutech.dtu.dk/Produkter/Dosimetri/NUK_instruments/GM_multicou...</a>

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## Deployments

MV1008

<b>Website</b>	<a href="https://www.bco-dmo.org/deployment/58834">https://www.bco-dmo.org/deployment/58834</a>
<b>Platform</b>	R/V Melville
<b>Report</b>	<a href="http://dmoserv3.whoj.edu/data_docs/CRD_FLUZiE/CRUISE_REPORT_Melville1008.pdf">http://dmoserv3.whoj.edu/data_docs/CRD_FLUZiE/CRUISE_REPORT_Melville1008.pdf</a>
<b>Start Date</b>	2010-06-22
<b>End Date</b>	2010-07-25
<b>Description</b>	<p>Research on the cruise was aimed at acquiring a better understanding of plankton dynamics, carbon and nutrient fluxes, and potential trace element limitation in the Costa Rica Dome region of the eastern tropical Pacific. The specific science objectives were: 1) to assess grazing and trace metal/nutrient controls on primary production and phytoplankton standing stocks; 2) to quantify carbon and elemental fluxes and export rates from the euphotic zone; and 3) to measure microbial population, processes, stable isotope abundances associated with the OMZ and nitrite maxima. Operations included: 4-day sediment trap deployments, daily process experiments conducted on satellite-tracked drifters, CTD and trace-metal rosette sampling, shipboard grow-out experiments, net sampling for zooplankton biomass and grazing assessments, and MOCNESS stratified tows to 1000 m. BCO-DMO Note: March 2013 (GLC): The original CTD profile data (85 casts) have been submitted by R2R to NODC. Jim Moffett (USC) was a participant on this cruise and is interested in getting a copy of the full set of CTD cast data (deep and shallow casts). He plans to contact SIO ODF group or Mike Landry (Chief Scientist). Original cruise data are available from the NSF R2R data catalog.</p>

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## Project Information

### Costa Rica Dome FLUX and Zinc Experiments (CRD FLUZiE)

**Coverage:** Costa Rica Dome, Eastern Tropical Pacific Ocean

Research was aimed at improved understanding of plankton dynamics, carbon and nutrient fluxes, and potential trace element limitation in the Costa Rica Dome region of the eastern tropical Pacific. The specific science objectives of the 2010 R/V Melville cruise (MV1008) were: 1) to assess grazing and trace metal/nutrient controls on primary production and phytoplankton standing stocks; 2) to quantify carbon and elemental fluxes and export rates from the euphotic zone; and 3) to measure microbial population, processes, stable isotope abundances associated with the OMZ and nitrite maxima. Additional information about MV1008 can be found in the cruise report (PDF). NOTE: The original proposal and award abstract are not relevant. The project was originally funded by NSF as experimental tests of phytoplankton controls in the Arabian Sea. Piracy concerns in the region led to

the cancellation of the research cruise in 2009, and a Change of Scope request was approved to focus the project on related issues in the Costa Rica Dome (CRD). Though this project is not formally affiliated with any large program, it aligns with IMBER's emphasis on community ecology and biogeochemistry, and the OCB focus on carbon-based measurements of production, grazing and export processes.

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## Program Information

### Integrated Marine Biogeochemistry and Ecosystem Research -US (IMBER-US)

**Website:** <http://www.imber.info/>

**Coverage:** global

The BCO-DMO database includes data from IMBER endorsed projects lead by US funded investigators. There is no dedicated US IMBER project or data management office. Those functions are provided by US-OCB and BCO-DMO respectively. The information in this program description pertains to the Internationally coordinated IMBER research program. The projects contributing data to the BCO-DMO database are those funded by US NSF only. The full IMBER data catalog is hosted at the Global Change Master Directory (GCMD). IMBER Data Portal: The IMBER project has chosen to create a metadata portal hosted by the NASA's Global Change Master Directory (GCMD). The GCMD IMBER data catalog provides an overview of all IMBER endorsed and related projects and links to datasets, and can be found at URL <http://gcmd.nasa.gov/portals/imber/>. IMBER research will seek to identify the mechanisms by which marine life influences marine biogeochemical cycles, and how these, in turn, influence marine ecosystems. Central to the IMBER goal is the development of a predictive understanding of how marine biogeochemical cycles and ecosystems respond to complex forcings, such as large-scale climatic variations, changing physical dynamics, carbon cycle chemistry and nutrient fluxes, and the impacts of marine harvesting. Changes in marine biogeochemical cycles and ecosystems due to global change will also have consequences for the broader Earth System. An even greater challenge will be drawing together the natural and social science communities to study some of the key impacts and feedbacks between the marine and human systems. To address the IMBER goal, four scientific themes, each including several issues, have been identified for the IMBER project: Theme 1 - Interactions between Biogeochemical Cycles and Marine Food Webs; Theme 2 - Sensitivity to Global Change: How will key marine biogeochemical cycles, ecosystems and their interactions, respond to global change?; Theme 3 - Feedback to the Earth System: What are the roles of the ocean biogeochemistry and ecosystems in regulating climate?; and Theme 4 - Responses of Society: What are the relationships between marine biogeochemical cycles, ecosystems, and the human system?

## 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.

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## Funding

Funding Source	Award
<a href="#">NSF Division of Ocean Sciences (NSF OCE)</a>	<a href="#">OCE-0826626</a>

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