Surface and hydrocast Cesium isotopes 137 and 134 concentrations from the R/V Ka`imikai-O-Kanaloa KOK1108 cruise in June 2011 in the Northwest Pacific Ocean (Fukushima Radionuclide Levels project)

Website: https://www.bco-dmo.org/dataset/3624
Data Type: Cruise Results
Version: 2
Version Date: 2012-12-17

Project
» Establishing Radionuclide Levels in the Atlantic and Pacific Oceans Originating from the Fukushima Daiichi Nuclear Power Facility (Fukushima Radionuclide Levels)

Contributors	Affiliation	Role
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Abstract
Surface and hydrocast Cesium isotopes 137 and 134 concentrations from the R/V Ka`imikai-O-Kanaloa KOK1108 cruise in June 2011 in the Northwest Pacific Ocean.

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Coverage

Spatial Extent: **N**:38.002 **E**:147.119 **S**:33.982 **W**:141.4
Temporal Extent: 2011-06-06 - 2011-06-17

Dataset Description

Radionuclide results from surface and hydrocast bottle samples were determined from high purity germanium detectors and calibrated against IAEA standards as described in Buesseler et al. (PNAS, 2012).

Concentrations of Cesium isotopes 137Cs and 134Cs are reported in units of Bq (1 Becquerel = one disintegration per second) per unit volume (Bq/meter^3).

Modification History:
Data version 2 (2012-12-17) replaced Data version 1 (2012-10).
Note that updated Cesium data measurements were contributed by Ken Buesseler in October 2012. The online dataset has been revised to include these measurements. A PDF version of these updates is available (See supplemental file WHOI_KOK_Cs_data_Table_S1_Oct_2012_update.pdf). The data are in the same format as Table S1 in the 2012 Buesseler et al. PNAS paper cited below. The net difference in old vs. new is 0.3%, but a few values have changed by 5% or more. The update reflects a second run of the chemical yields measured

for stable Cs by ICPMS.

Methods & Sampling

Water samples were collected in Niskin bottles attached to a CTD Rosette.

Data Processing Description

Method for determination of cesium-134 and -137 in seawater

Surface samples were pumped directly into new, calibrated 20 liter plastic cubitainers. Deeper samples (20-1000 m) were collected by CTD/Rosette. We found that the sample processing improved with 1 micromol prefiltration, presumably due to remove of organic particulates. This will not impact total Cs activities as the measured 137Cs and 134Cs on the 1 µm filters averaged only < 0.04% of the total during this cruise, consistent with the soluble nature of Cs in seawater.

Following collection, samples were acidified to pH 1-2 with JT Baker ultrapure nitric acid (130 mL per 22 L seawater). A stable 133Cs carrier (25 mg per mL standard, 1 mL per sample) was added for calibration of Cs extraction on the resin columns. Samples were allowed to equilibrate for at least 1 hour and an initial aliquot of sample was removed. Samples were extracted onto an ion exchange resin made of the organic polymer polyacrylonitrile, (PAN) and ammonium molybdophosphate (AMP) (1). Precleaned (with 0.1 N nitric acid) biorad glass chromatography columns (1.0x10 cm) were filled with 5 mL AMP-PAN resin in 0.1 N nitric acid. A frit was added above the resin to prevent re-suspension. Resin was allowed to settle for > 1 hour before processing. Samples were pumped directly from cubitainers through the resin column at a flow rate of 30-35 mL per minute. Eluted sample was collected into cleaned cubitainers and a final solution aliquot was taken to determine the column extraction efficiency by measuring stable 133Cs.

AMP-PAN resin was transferred to a vial and gamma counted while still wet for 134Cs and 137Cs isotopes using closed-end coaxial well detectors in the lab. Samples were counted until counting errors on all Cs peaks were generally below 5-10% (depending on sample activity). Samples with low activities were counted for 24-48 hours. Gamma spectrometers were calibrated with a range of 134Cs and 137Cs standards purchased from Eckert and Ziegler. The 137Cs peak at 661 keV and 134Cs peaks at 604 and 795 keV were identified and analyzed with Aptec software.

To check for column recoveries, initial and final sample aliquots containing stable cesium were diluted with 5% ultrapure nitric acid and analyzed on an Element 2 ICP-MS (Thermo Fisher Scientific, WHOI plasma facility) equipped with PFA MicroFlow nebulizer, quartz spray chamber and regular cones. Recovery corrections were applied to measured 134Cs and 137Cs activities with an average recovery of 93 plus/minus 5% standard deviation.

Calibration standards were run using this new AMP-PAN method for 137Cs. We found good agreement between archived water from the Sargasso Sea collected in 1978 (internal WHOI lab standard 137Cs = 3.4 ± 0.4 Bq m-3) and results of triplicate samples analyzed here (3.7 plus/minus 0.2 Bq m-3). Similarly, we measured a 137Cs activity in a single 5 L sample of 369 plus/minus 8 Bq m-3 in an IAEA Irish Sea water reference material, IAEA-443, which has a 95% confidence limit of 340-370 Bq m-3 (2).

The concentration of cesium isotopes in water is reported in units of Bq (1 Becquerel = one disintegration per second) per unit volume (Bq m-3). All activities are decay corrected to April 6th, the date of the maximum direct radioactivity discharge into the ocean (3).

Surface Cs measured by underway system is reported with the casts as the shallowest measurement and assigned a depth and pressure of 2.0.

BCO-DMO notes: Codes (parameter name WHOI_Cs_codes) were assigned to identify bottle sample type:

uw = underway Cs sample ns = not sample ind = Cs sample was drawn from a single bottle cb_X_X = Cs sample was drawn from multiple bottle identified by X and X

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Data Files

File
hydrocast_Cs.csv (Comma Separated Values (.csv), 97.46 KB) MD5:45d3253b002c86a41007ef34f53440d4 Primary data file for dataset ID 3624

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Supplemental Files

File
Oct 2012 version of updated Cesium data filename: WHOI_KOK_Cs_data_Table_S1_Oct_2012_update.pdf (Portable Document Format (.pdf), 69.73 KB) MD5:9bd704523f78eae5e6c20152f85daee9 Oct 2012 version of updated Cesium data

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Related Publications

Buesseler, K. O., Jayne, S. R., Fisher, N. S., Rypina, I. I., Baumann, H., Baumann, Z., ... Yoshida, S. (2012). Fukushima-derived radionuclides in the ocean and biota off Japan. Proceedings of the National Academy of Sciences, 109(16), 5984–5988. doi:10.1073/pnas.1120794109
General

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Parameters

Parameter	Description	Units
sta	CTS station number	dimensionless
cast	CTD cast number	dimensionless
event	Cruise event identifier	dimensionless
date	Date of sample in YYYYMMDD format	unitless
longitude	longitude	decimal degrees
latitude	latitude	decimal degrees
bot_Nis	sample bottle number	dimensionless
time_local	localtime of cast	hhmm

press	sampling pressure	decibars
depth	sampling depth	meters
temp	Temperature	degrees Celsius
potemp	Potential Temperature	degrees Celsius
sigma_0	Potential Density	kilograms/meter^3
sal_cal	Salinity calibrated to water sample salinity	PSU
O2_cal	dissolved oxygen concentration calibrated to water sample oxygen	milliliters/liter
sal_nis	Salinity from water samples	PSU
O2_nis	dissolved oxygen concentration from water samples	milliliters/liter
Cs137	Cesium-137	Bq/meter^3
err_Cs137	standard error for 137Cs measurement	Bq/meter^3
Cs134	Cesium-134	Bq/meter^3
err_Cs134	standard error for 137Cs measurement	Bq/meter^3
Cs134_Cs137	Ratio of Cesium-134 to Cesium-137	Bq/meter^3
err_Cs134_Cs137	standard error for measurement of 134Cs to 137Cs ratio	Bq/meter^3
WHOI_Cs_Code	WHOI Cs code	dim
time		unitless
date_local	local date in YYYYMMDD format.	unitless

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Instruments

Dataset-specific Instrument Name	CTD Sea-Bird 911
Generic Instrument Name	CTD Sea-Bird 911
Generic Instrument Description	The Sea-Bird SBE 911 is a type of CTD instrument package. The SBE 911 includes the SBE 9 Underwater Unit and the SBE 11 Deck Unit (for real-time readout using conductive wire) for deployment from a vessel. The combination of the SBE 9 and SBE 11 is called a SBE 911. The SBE 9 uses Sea-Bird's standard modular temperature and conductivity sensors (SBE 3 and SBE 4). The SBE 9 CTD can be configured with auxiliary sensors to measure other parameters including dissolved oxygen, pH, turbidity, fluorescence, light (PAR), light transmission, etc.). More information from Sea-Bird Electronics.

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

KOK1108

Website	https://www.bco-dmo.org/deployment/58727
Platform	R/V Ka`imikai-O-Kanaloa
Report	http://bcodata.whoi.edu/Fukushima/Fukushima_KOK1108_dailyBlog.pdf
Start Date	2011-06-04
End Date	2011-06-19
Description	The purpose of the 16 day KOK1108 cruise aboard the University of Hawaii research vessel Ka'imikai-o-Kanaloa was to study the fate of radiation released into the ocean from the Fukushima Daiichi nuclear power plant that was badly damaged by a tsunami on March 11, 2011.

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Project Information

Establishing Radionuclide Levels in the Atlantic and Pacific Oceans Originating from the Fukushima Daiichi Nuclear Power Facility (Fukushima Radionuclide Levels)

Website: http://www.whoi.edu/page.do?pid=67796

Coverage: Northwest Pacific Ocean

The March 11, 2011 earthquake in Japan and the subsequent tsunami damaged and disrupted cooling systems at the Fukushima Daiichi nuclear power facility causing contamination of land and seas surrounding the site, as well as food supplies and drinking water. Small but measurable quantities of radioactivity have been detected in the atmosphere over the United States, including aerosol samples collected at the Woods Hole Oceanographic Institution, where I-131 was seen to increase to detectable levels as of March 21-22, 2011.

With major funding from the Moore Foundation, as well as a contribution from the National Science Foundation through a 2011 Grant for Rapid Response Research (RAPID) and support from the Woods Hole Oceanographic Institution, collaborating investigators from the United States, Japan, Spain, Monaco, and the United Kingdom were able to obtain samples off Japan for an early assessment of impacts.

From June 4 through June 19, 2011, a research cruise was carried out aboard the RV Kaimikai-O-Kanaloa, a research vessel operated by the University of Hawaii. During the cruise, hundreds of samples were collected in an area off the coast of Japan as close as 30 kilometers from the Fukushima Nuclear Power Plant and extending as far out as 600 kilometers off shore. The essential components of the program include: radionuclide measurements of water and particles; a radioecological study of biota, especially species at the base of the food chain and key fish species and a physical oceanographic study to characterize transport and water masses. A baseline radionuclide data set for the Atlantic and Pacific was obtained along an east to west network of sampling stations. Three hundred sampling events took place at thirty major stations for a total of more than 1500 samples. Along with 41 CTD stations, bottle samples of salinity, oxygen, radionuclides, and particulates were taken to depths of about 1000 meters. A list of the radionuclides sampled and a sampling summary map is available. One hundred net tows resulted in approximately fifty pounds of biological samples, including plankton and small fish. Daily samples of aerosol were also taken.

Early investigation following an accidental release of man-made radionuclides is key to understanding the magnitude of the release and the relationship to public health issues The research results also set the stage for the use of the longer lived radionuclides as tracers in subsequent studies by the community to understand ocean processes.

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Funding

Funding Source	Award
Gordon and Betty Moore Foundation (GBMF)	GBMF3007
NSF Division of Ocean Sciences (NSF OCE)	OCE-1136693

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