Iodine 129 levels from R/V Ka`imikai-O-Kanaloa KOK1108 from June 2011 (Fukushima Radionuclide Levels project)

Website: https://www.bco-dmo.org/dataset/716480
Data Type: Cruise Results
Version: 1
Version Date: 2017-09-29

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
Iodine 129 data collected using paired Niskin-CTD rosette from R/V Ka`imikai-O-Kanaloa KOK1108 in June 2011

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Coverage

Spatial Extent: **N**:38.002 **E**:147.119 **S**:33.982 **W**:141.399
Temporal Extent: 2011-06-06 - 2011-06-17

Dataset Description

Iodine 129 data collected from paired Niskin-CTD rosette.

Methods & Sampling

Sampling onboard the KOK was conducted using paired Niskin bottles on a CTD/rosette. Sample bottles (HDPE, acid-cleaned with 2% nitric acid) were rinsed several times with sample water prior to filling. Bottles were filled, sealed, and taped, and stored in the dark.

129I analyses were made on total inorganic iodine. Iodine was extracted from seawater in a dedicated low-level 129I preparation laboratory, using an adapted version (Tumey et al. 2013) of a commonly-used solvent extraction procedure (Fehn et al., 1992; Michel et al., 2012; Moran et al., 1998; Schnabel et al., 2007; Suzuki et

al., 2008). Briefly, 0.5 mg of a very low 129I iodine carrier (Woodward Iodine Corporation; ~2x10-14 129I/127I) was added to a 250ml aliquot of each seawater sample: i.e., a carrier to sample ratio of ~40:1. Through the addition of sodium sulfite and hydroxylamine hydrochloride dissolved inorganic iodine was reduce to iodide. The procedure calls for the addition of nitric acid following the sulfite and hydroxylamine additions. This addition reduces the pH and enables the reduction of iodate to iodide. The resulting iodide was oxidized to molecular iodine by the addition of nitric acid and sodium nitrite. Molecular iodine was extracted into chloroform and then back-extracted into an aqueous solution of sodium sulfite and potassium hydroxide. 129I analyses were made on silver iodide precipitated by the addition of silver nitrate. The precipitated silver iodide was rinsed with MQ water (3X), dried, and mechanically mixed with niobium powder prior to being loaded into individual stainless steel target holders.

Accelerator mass spectrometric analyses were made at the Center for Accelerator Mass Spectrometry (CAMS), Lawrence Livermore National Laboratory. Targets were analyzed in a sequence similar to that for 14C at CAMS (e.g., Guilderson et al., 2003) and normalized against an in-house prepared dilution of NIST SRM 4949C with Woodward Iodide. Targets were analyzed such that samples with a 129I/127I ratio of ≥1 x 10-11 were counted to ~3% counting statistics. 129I/127I ratios for process blanks, prepared by running MQ water run through the full extraction procedure, averaged 3.8 x 10-14 and were not subtracted from unknowns (ie., consistent with how data are reported in the literature).

In much of the open ocean, total dissolved iodine (speciated between iodate and iodide) is constant to a few percent of a concentration of ~60 ugI- l-1 (Barkley and Thompson, 1960; Elderfield and Truesdale, 1980; Nakayama et al., 1989). Such a value is consistent with iodine concentrations in waters off Japan with salinities > 30 psu (Zheng et al., 2012). Salinities observed in the R/V KOK hydrocasts had a limited range: 33.5-34.8 psu. For the data reported here, the salinity was 34.18 ± 0.29 psu (1-sigma sd). We expect a limited range in total dissolved iodine concentrations and use 60ugI-l l-1 estimated uncertainty of 2ugI-l-1 (1-sigma sd) in calculating the 129I/127I ratios derived from our measurements of seawater samples. All uncertainties during dilution and processing are considered independent and added in quadrature.

Individual replicates (n=15) were made on random samples spanning the range of values and analyzed across ~8 months of time. The average relative difference for all of the pairs was -0.3 percent.

Data Processing Description

We believe that Station 18, taken right after inclement weather with two aborted stations, had sample collection issues.
The bottles had two sets of labels on them. The 129I data imply that there are at least one pair of mislabeled bottles.
We recommend not using data from Station 18.
Station 32, bottle 16 - bad target. Anomalously low current. Redone

BCO-DMO Processing:
* Converted data to BCO-DMO standardized file format
* Created applicable BCO-DMO header.
* Mapped appropriate terms to BCO-DMO terminology

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Data Files

File	
FukushimaRadionuclideLevels.csv	(Comma Separated Values (.csv), 22.04 KB) MD5:d461bcdf05f08751670c8b9704f8a1a0
Primary data file for dataset ID 716480	

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Related Publications

Barkley, R. A., & Thompson, T. G. (1960). The total Iodine and Iodate-iodine content of sea-water. Deep Sea Research (1953), 7(1), 24–34. doi:10.1016/0146-6313(60)90004-6
Methods

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

Elderfield, H., & Truesdale, V. W. (1980). On the biophilic nature of iodine in seawater. Earth and Planetary Science Letters, 50(1), 105–114. doi:10.1016/0012-821x(80)90122-3 https://doi.org/10.1016/0012-821X(80)90122-3
Methods

Fehn, U., Peters, E. ., Tullai-Fitzpatrick, S., Kubik, P. ., Sharma, P., Teng, R. T. ., … Elmore, D. (1992). 129I and 36Cl concentrations in waters of the eastern Clear Lake area, California: Residence times and source ages of hydrothermal fluids. Geochimica et Cosmochimica Acta, 56(5), 2069–2079. doi:10.1016/0016-7037(92)90330-l https://doi.org/10.1016/0016-7037(92)90330-L
Methods

Guilderson, T. P., Southon, J. R., & Brown, T. A. (2003). High-Precision AMS 14C Results on TIRI/FIRI Turbidite. Radiocarbon, 45(01), 75–80. doi:10.1017/s0033822200032409 https://doi.org/10.1017/S0033822200032409
Methods

Guilderson, T. P., Tumey, S. J., Brown, T. A., & Buesseler, K. O. (2014). The 129-iodine content of subtropical Pacific waters: impact of Fukushima and other anthropogenic 129-iodine sources. Biogeosciences, 11(17), 4839–4852. doi:10.5194/bg-11-4839-2014
Results

Michel, C. J., Ammann, A. J., Chapman, E. D., Sandstrom, P. T., Fish, H. E., Thomas, M. J., … MacFarlane, R. B. (2012). The effects of environmental factors on the migratory movement patterns of Sacramento River yearling late-fall run Chinook salmon (Oncorhynchus tshawytscha). Environmental Biology of Fishes, 96(2-3), 257–271. doi:10.1007/s10641-012-9990-8
Methods

Moran, J. E., Fehn, U., & Teng, R. T. D. (1998). Variations in 129I/127I ratios in recent marine sediments: evidence for a fossil organic component. Chemical Geology, 152(1-2), 193–203. doi:10.1016/s0009-2541(98)00106-5 https://doi.org/10.1016/S0009-2541(98)00106-5
Methods

NAKAYAMA, E., SUZUKI, Y., FUJIWARA, K., & KITANO, Y. (1989). Chemical analyses of seawater for trace elements recent progress in Japan on clean sampling and chemical speciation of trace elements. A review. Analytical Sciences, 5(2), 129–139. doi:10.2116/analsci.5.129
Methods

Rypina, I. I., Jayne, S. R., Yoshida, S., Macdonald, A. M., Douglass, E., & Buesseler, K. (2013). Short-term dispersal of Fukushima-derived radionuclides off Japan: modeling efforts and model-data intercomparison. Biogeosciences, 10(7), 4973–4990. doi:10.5194/bg-10-4973-2013
General

Schnabel, C., Olive, V., Atarashi-Andoh, M., Dougans, A., Ellam, R. M., Freeman, S., … Xu, S. (2007). 129I/127I ratios in Scottish coastal surface sea water: Geographical and temporal responses to changing emissions. Applied Geochemistry, 22(3), 619–627. doi:10.1016/j.apgeochem.2006.12.007
Methods

Suzuki, T., Kabuto, S., Amano, H., & Togawa, O. (2008). Measurement of iodine-129 in seawater samples collected from the Japan Sea area using accelerator mass spectrometry: Contribution of nuclear fuel reprocessing plants. Quaternary Geochronology, 3(3), 268–275. doi:10.1016/j.quageo.2007.12.004
Methods

Suzuki, T., Otosaka, S., Kuwabara, J., Kawamura, H., & Kobayashi, T. (2013). Iodine-129 concentration in seawater near Fukushima before and after the accident at the Fukushima Daiichi Nuclear Power Plant. Biogeosciences, 10(6), 3839–3847. doi:10.5194/bg-10-3839-2013
General

Tumey, S. J., Guilderson, T. P., Brown, T. A., Broek, T., & Buesseler, K. O. (2013). Input of 129I into the western Pacific Ocean resulting from the Fukushima nuclear event. Journal of Radioanalytical and Nuclear Chemistry, 296(2), 957–962. doi:10.1007/s10967-012-2217-9
Methods

,
Results

Zheng, J., Takata, H., Tagami, K., Aono, T., Fujita, K., & Uchida, S. (2012). Rapid determination of total iodine in Japanese coastal seawater using SF-ICP-MS. Microchemical Journal, 100, 42–47. doi:10.1016/j.microc.2011.08.007
Methods

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Parameters

Parameter	Description	Units
Station_num	Station ID	unitless
Cast	Hydrocast ID	unitless
Event	Unique event identifier	unitless
Date	Date of sample collection in YYYYMMDD format	unitless
Lat	Latitude of station (North is positive)	Decimal Degrees
Lon	Longitude of station (West is positive)	Decimal Degrees
Bottle	Niskin bottle number	unitless
Depth	Depth when niskin fired	meters (m)
Pressure	Pressure in db when niskin fired	decibars (db)
Temp_in_situ_ctd	In-situ temperature from CTD.	degrees Celsius (C)
Potemp_ctd	Potential temperature (0db)	degrees Celsius (C)
sigma_t0	potential density (0db)	kilograms per meter cubed (kg/m^3)
PSU_ctd	Practical salinity from CTD.	practical salinity units (psu)
atom_ratio_129I_127I	Atom Ratio 129I/127I in atom per atom	unitless
std_dev_129_127I	one-sigma standard deviation uncertainty in atom per atom	unitless

atom_129I	Atoms 129I per liter seawater	atom per liter (atom/L)
std_dev_129Iatom	one-sigma standard deviation uncertainty	atom per Liter (atom/L)
FLAG	Alphanumeric flag regarding sample collection or data acquistion Flag Definitions: collection - @sea bottle labelling issue; do not use bad target - do not use na - no flag, not applicable	unitless
Note	Description of the flag	unitless

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Instruments

Dataset-specific Instrument Name	Accelerator mass spectrometric analyses
Generic Instrument Name	Accelerator Mass Spectrometer
Dataset-specific Description	Accelerator mass spectrometric analyses were made at the Center for Accelerator Mass Spectrometry (CAMS), Lawrence Livermore National Laboratory.
Generic Instrument Description	An AMS measures "long-lived radionuclides that occur naturally in our environment. AMS uses a particle accelerator in conjunction with ion sources, large magnets, and detectors to separate out interferences and count single atoms in the presence of 1x1015 (a thousand million million) stable atoms, measuring the mass-to-charge ratio of the products of sample molecule disassociation, atom ionization and ion acceleration." AMS permits ultra low-level measurement of compound concentrations and isotope ratios that traditional alpha-spectrometry cannot provide. More from Purdue University: http://www.physics.purdue.edu/primelab/introduction/ams.html

Dataset-specific Instrument Name	CTD/rosette
Generic Instrument Name	CTD - profiler
Dataset-specific Description	Sampling onboard the KOK was conducted using paired Niskin bottles on a CTD/rosette.
Generic Instrument Description	The Conductivity, Temperature, Depth (CTD) unit is an integrated instrument package designed to measure the conductivity, temperature, and pressure (depth) of the water column. The instrument is lowered via cable through the water column. It permits scientists to observe the physical properties in real-time via a conducting cable, which is typically connected to a CTD to a deck unit and computer on a ship. The CTD is often configured with additional optional sensors including fluorometers, transmissometers and/or radiometers. It is often combined with a Rosette of water sampling bottles (e.g. Niskin, GO-FLO) for collecting discrete water samples during the cast. This term applies to profiling CTDs. For fixed CTDs, see https://www.bco-dmo.org/instrument/869934.

Dataset-specific Instrument Name	Niskin bottles
Generic Instrument Name	Niskin bottle
Dataset-specific Description	Sampling onboard the KOK was conducted using paired Niskin bottles on a CTD/rosette.
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

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