Speciation of I129 and I127 from water samples collected from cruise KOK1108 in the Western Equatorial Pacific and Kuroshio Extension (Fukushima Radionuclide Levels project)

Website: https://www.bco-dmo.org/dataset/3967
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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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Dataset Description

Speciation of the radionuclide Iodine-129 (I129) and Iodine-127 (I127)

Relevant References:

Iodine-129 in Seawater Offshore Fukushima: Distribution, Inorganic Speciation, Sources, and Budget

Methods & Sampling

Seawater samples were collected at multiples depths in Niskin bottles at 4 stations ranging in distance from 40 to 530 km from Fukushima Dai-ichi nuclear power plant to be analyzed for levels of I129 and I127. The samples were stored in dark at ambient temperature before analysis.

0.5-1 L filtered seawater was transferred to a beaker; 125I solution (about 100 Bq, in NaI form) was added to the seawater. The prepared solution was then loaded to an anion exchange column (AG1-×4 resin, NO3- form, 1.0 cm in diameter and 15 cm length), the column was washed with 50 mL 0.2 mol/L NaNO3, the effluent and wash were combined for iodate separation. The column was then eluted with 150 mL 5% NaClO and then 50 mL of 3M HNO3, and the eluate was combined for iodide separation.

1.0 mL of solution of iodide fraction, iodate fraction and original seawater were taken into a vial for 127I measurement using ICP-MS. The remaining solution of iodate fraction (Efluent + washes of 0.2 mol/L NaNO3) or 200-500 mL of original seawater samples (for total 129I) was transferred to a beaker; 125I tracer (200 Bq), 0.5 mg 127I carrier, and 1M NaHSO3 solution were added. The solution was adjusted to pH 1-2 using 3 mol/L HNO3 to convert all iodine to iodide. The solution was then transferred to a separation funnel, 50 mL CHCl3 was added and then 1.0 mol/L NaNO2 solution was added to oxidize iodide to I2 to be extracted to CHCl3 phase by shaking. I2 is then back-extracted to the water phase by add 5 mmol/L NaHSO3 solution. This extraction and back-extraction steps were repeated once. The back-extracted aqueous phase was used for

preparation of AgI target.

The remaining solution of iodide fraction was transferred to a separatory funnel. After addition of 0.5 mg of 127I carrier, 3.0 mol/L HNO3 was added to adjust pH1-2. 50 mL of CHCl3 and 5 mL of 1 mol/L NH2OH×HCl solution were added to reduce iodate to I2 to be extracted to CHCl3 phase by shaking. I2 in CHCl3 phase was then back-extracted using 5mM NaHSO3 solution.

0.5 mL of 1.0 mol/L AgNO3 solution was added to the back-extracted aqueous phases to precipitate iodide as AgI, which was separated using a centrifuge. The resulting AgI precipitate was dried at 70 °C and used for AMS measurement of 129I. 125I in the precipitate was counted using a NaI gamma-detector to monitor the chemical yield of iodine in the separation. Before extraction, the eluate of iodide from the anion exchange column was also measured for 125I by gamma-detector to monitor chemical recovery of iodide during column separation. This is used to correct 127Iodide and 129Iodide concentrations in seawater.

An ICP-MS system (X Series II, Thermo, Waltham, MA) equipped with an Xs- skimmer cone and standard concentric nebulizer was used for the measurement 127I. 1.0 mL of the separated fractions or the original seawater was diluted to 20 mL using 1% ammonium solution, and spiked with Cs+ (to 2.0 ppb) as internal standard. The detection limit of the method for 127I was calculated as 3 SD of the procedure blank to be 0.03 ng/mL.

The 129I/127I ratios in total iodine samples were determined by AMS at the Vienna Environmental Research Accelerator (VERA) and the University of Arizona AMS Laboratory, both using a 3MV National Electrostatics Corporation AMS. The 129I/127I ratios in iodide and iodate samples were measured using the 3 MV AMS facility at the Xi'an AMS center. The machine backgrounds of the 129I/127I ratio are around (2-4)×10-14. The blanks using the same procedure as the samples were also prepared; the highest measured 129I/127I ratio is 1´10-13, which is significantly lower than measured 129I/127I ratios in the samples.

Data Processing Description

Anion exchange chromatography was used for separation of iodide, iodate, and total inorganic iodine from seawater.

Data flagged as "nd" indicates “not measured”, because not enough sample water was available.>

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Data Files

File
I129_I127.csv (Comma Separated Values (.csv), 3.20 KB) MD5:18aa0c9d457d7f0f7158bba492a675fc Primary data file for dataset ID 3967

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Parameters

Parameter	Description	Units
sta	station id	integer
event	event-id	dimensionless
longitude	longitude	decimal degrees
latitude	latitude	decimal degrees
date	Date of sample	YYYYMMDD
date_local	Date (local) of sample	YYYYMMDD
time_local	time (local) of cast	hhmm
bot_Nis	Niskin bottle number	integer
depth	depth	meters
press	pressure	decibars
temp	temperature	degrees C
potemp	potential temperature	degrees C
sigma_0	potential density	kilograms/meter^3
sal_cal	salinity calibrated to water sample salinity	PSU
O2_cal	dissolved oxygen concentration calibrated to water samples of O2	milliliters/liter
sal_nis	salinity from water samples	PSU
O2_nis	dissolved oxygen concentration from water samples	milliliters/liter
I129_e07atL	Iodine-129 total concentration	10^7 atoms/liter
I129_e07atL_err	Iodine-129 standard error	10^7 atoms/liter
I127_ugL	Iodine-127	micrograms/liter
I127_ugL_err	Iodine-127 error	micrograms/liter
I127_Iide_ugL	Iodide in Iodine-127	micrograms/liter
I127_Iide_ugL_err	Iodide in Iodine-127 error	micrograms/liter
I129_Iide_e07atL	Iodide in Iodine-129	10^7 atoms/liter
I129_Iide_e07atL_err	Iodide in Iodine-129 error	10^7 atoms/liter
I127_IO3_ugL	Iodate in Iodine-127	micrograms/liter
I127_IO3_ugL_err	Iodate in Iodine-127	micrograms/liter
I129_IO3_e07atL	Iodate in Iodine-129	10^7 atoms/liter
I129_IO3_e07atL_err	Iodate in Iodine-127 error	10^7 atoms/liter

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Instruments

Dataset-specific Instrument Name	Mass Spectrometer
Generic Instrument Name	Mass Spectrometer
Generic Instrument Description	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.

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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