Table 1: Pb-210, Bi-210, and Po-210 activity measurements in rain, lake water, and dreissenid (Quagga) mussels collected in the Milwaukee Inner Harbor on Lake Michigan, Nov. 2018

Website: https://www.bco-dmo.org/dataset/809807
Data Type: Other Field Results
Version: 1
Version Date: 2020-04-22

Project
» The measurement and use of bismuth-210 as a tracer of particle flux in aquatic systems (Bi 210 measurement)

Contributors	Affiliation	Role
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Abstract
Pb-210, Bi-210, and Po-210 activity measurements in rain, lake water, and dreissenid (Quagga) mussels collected at the School of Freshwater Sciences' slip in the Milwaukee Inner Harbor on Lake Michigan, Nov. 2018. This is table 1 in Waples (2020), Limnol. Oceanogr. Methods.

Table of Contents

Coverage

Spatial Extent: **N**:43.01784 **E**:-87.903 **S**:43.01772 **W**:-87.90352
Temporal Extent: 2018-11-04 - 2018-11-20

Dataset Description

Pb-210, Bi-210, and Po-210 activity measurements in rain, lake water, and dreissenid (Quagga) mussels collected at the School of Freshwater Sciences' slip in the Milwaukee Inner Harbor on Lake Michigan, Nov. 2018. This is table 1 in Waples (2020), Limnol. Oceanogr. Methods.

Methods & Sampling

A detailed description of the methods for determining in situ 210Pb, 210Bi, and 210Po activities is given by Waples (2020).

A second manuscript describing the use of Pb-210, Bi-210, and Po-210 as particle tracers in aquatic systems is currently in review for Limnology and Oceanography (March/2020).

Water samples collected by submersible pump were weighed and filtered through nitrocellulose filters (0.45

um, 293 mm, Millipore) within two hours of sample collection to separate dissolved and particle-bound nuclide fractions of 210Pb, 210Bi, and 210Po. Yield monitors of 207Bi and 209Po (Eckert & Ziegler Isotope Products) were then added to both fractions. No lead monitor was required. Dissolved nuclide fractions (< 0.45 um) of 210Pb, 210Bi, and 210Po were co-precipitated onto newly formed ferric hydroxide and collected by filtration. Both particle-bound and dissolved nuclide fractions were then digested in concentrated nitric acid. Bismuth and polonium were completely separated from lead on EmporeTM anion solid phase extraction (SPE) disks (3M, 47 mm, product number 2252, now manufactured by CDS Analytical). Eluate from the particle-bound fraction was re-spiked with 207Bi and set aside for ~one month for the determination of particle-bound 210Pb (via 210Bi in secular equilibrium with its parent). Anion SPE disks were then counted– first for 210Bi via b-decay on a low background gas-flow proportional detector with anticoincidence circuitry (G542 System, Gamma Products), then for 207Bi via g-emission to determine yield. Polonium was then removed from the SPE disks, plated to copper, and a-counted for 210Po and the yield monitor 209Po. Total 210Pb was determined in a separate water sample via 210Bi that had grown into secular equilibrium with its parent. Activity calculations including uncertainty propagation and decay corrections are all fully described by Waples (2020).

Rainwater was collected at ground level (43.017719, -87.903000) in a large plastic barrel fitted with a funnel (0.216 m2 collection area) over a 40-h period during an extended rain event beginning at 17:20 (CST) on 03 November 2018. The funnel and barrel were rinsed before and after the collection event with a total of 0.4 L of 1 M HCl.

Lake water samples (~ 50 L) for radionuclide analyses were collected from the slip (43.017835, -87.903521) with a submersible pump from a depth of 2 m on 08 November, 15 November, and 20 November 2018.

Quagga mussels (*Dreissena rostriformis bugensis*) were collected from the slip wall (43.017829, -87.904407) on 29 November 2018. Each mussel was measured for shell length and sorted into two groups of large (range: 18–22 mm; geometric mean: 19 mm; n = 10) and small (10–16 mm; geometric mean: 13 mm; n = 20) mussels. Mussel tissue was separated from the shell, pooled by group into two glass beakers, and digested in concentrated HNO3. Shell-free biomass was estimated using the allometric equation m = 0.0018 × L3.11, where m is the tissue dry weight in mg (DW mg) and L is the mussel shell length in mm (Waples et al. 2017).

Software used:
- Maestro software (v. 6.04 and 6.06, Advanced Measurement Technology)
- SigmaPlot (v. 11, Systat Software)
- Excel (v. 2002, Microsoft)

Data Processing Description

BCO-DMO Processing Notes:

- added conventional header with dataset name, PI name, version date
- modified parameter names to conform with BCO-DMO naming conventions
- re-formatted date-time from m/d/yy H:M to yyyy-mm-ddTHH:MM:SS
- added column for ISO_DateTime_UTC
- split standard deviations into separate columns
- added columns for calculation method which were originally indicated by italic values

[table of contents | back to top]

Data Files

File
Table1.csv (Comma Separated Values (.csv), 1.78 KB) MD5:ebc2169b609820aa79224d204b7753e4 Primary data file for dataset ID 809807

[table of contents | back to top]

Related Publications

Waples, J. T. (2020). Measuring bismuth-210, its parent, and daughter in aquatic systems. Limnology and Oceanography: Methods, 18(4), 148–162. doi:10.1002/lom3.10352
Results
,
Methods

[table of contents | back to top]

Parameters

Parameter	Description	Units
sample	sample identifier	unitless
type	fraction of sample: T = total; D = dissolved (< 0.45um); P = particulate	unitless
ISO_DateTime_Local	sample collection local date and time; ISO formatted yyyy-mm-ddTHH:MM:SS (UTC- 6 hr)	unitless
ISO_DateTime_UTC	sample collection date and time; ISO formatted yyyy-mm-ddTHH:MM:SSZ (converted to UTC from local: UTC- 6 hr)	unitless
latitude	latitude; north is positive	decimal degrees
longitude	longitude; east is positive	decimal degrees
depth	sample depth	meters
Pb_dpm	Lead 210Pb activity in total (T); dissolved (D); or particulate (P) fraction of sample	disintegrations/minute/minute^3 (DPM m-3)
Pb_stdev	standard deviation of 210Pb activity	disintegrations/minute/minute^3 (DPM m-3)
Pb_calc_method	c = comment that 210Pb values were calculated by difference or sum (errors propagated)	unitless
Bi_dpm	Bismuth 210Bi activity in total (T); dissolved (D); or particulate (P) fraction of sample	disintegrations/minute/minute^3 (DPM m-3)
Bi_stdev	standard deviation of 210Bi activity	disintegrations/minute/minute^3 (DPM m-3)
Bi_calc_method	c = comment that 210Bi values were calculated by difference or sum (errors propagated)	unitless
Po_dpm	Polonium 210Po activity in total (T); dissolved (D); or particulate (P) fraction of sample	disintegrations/minute/minute^3 (DPM m-3)
Po_stdev	standard deviation of 210Po activity	disintegrations/minute/minute^3 (DPM m-3)
Po_calc_method	c = comment that 210Po values were calculated by difference or sum (errors propagated)	unitless

[table of contents | back to top]

Instruments

Dataset-specific Instrument Name	low background gas-flow proportional detector with anticoincidence circuitry (G542 System, Gamma Products)
Generic Instrument Name	Gamma Ray Spectrometer
Generic Instrument Description	Instruments measuring the relative levels of electromagnetic radiation of different wavelengths in the gamma-ray waveband.

[table of contents | back to top]

Project Information

The measurement and use of bismuth-210 as a tracer of particle flux in aquatic systems (Bi 210 measurement)

Coverage: Lake Michigan 43.0 N 87.9 W

Naturally occurring radioactive nuclides provide invaluable "clocks" with which to investigate a wide range of processes in earth and environmental sciences. Nuclides with shorter half-lives are well suited to studying rapid processes, but are often present at very low concentrations and are particularly difficult to measure. The goal of this Early Concept Grant for Exploratory Research (EAGER) is to develop and demonstrate a new analytical method for measuring bismuth-210 (half life, 5 days) in lake water, seawater, and associated particles. Because bismuth tends to become associated with particles more than its parent isotope lead-210 (half life, 22 years), the bismuth-210/lead-210 daughter/parent pair can potentially be used to investigate very short time-scale processes associated with particle (sediment) formation and cycling in lakes and the coastal ocean. Knowledge about such processes is important to understanding carbon and nutrient cycling in these productive and dynamic areas.

The specific goals of this exploratory project are to 1) demonstrate an improved method for measuring the lead-210/bismuth-210/polonium-210 trio in aquatic system samples; 2) measure lead-210/bismuth-210/polonium-210 in Lake Michigan; and 3) explore the feasibility of using bismuth-210/lead-210 disequilibrium as a proxy for particle flux. The project would support an undergraduate student researcher for the summer.

[table of contents | back to top]

Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1639865

[table of contents | back to top]