Radiocarbon data from R/V Blue Heron cruise BH09-05 on Lake Superior, June 2009 (Lake Superior Radiocarbon project)

Website: https://www.bco-dmo.org/dataset/3502
Version: 19 July 2013
Version Date: 2013-07-19

Project
» How important is quote old unquote Carbon in Lake Superior. A Radiocarbon Investigation (Lake Superior Radiocarbon)

Contributors	Affiliation	Role
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Dataset Description

DIC, DOC, POC, Zoopl Carbon concentration & isotopic data.
For POC and zooplankton C/N ratios also included.

Related files and references:
Sampling procedures, instrumentation, discussion of blanks, etc, included in Zigah, P.K., E.C. Minor, J.P. Werne, and S. L. McCallister, 2011. Radiocarbon and stable carbon isotopic insights into provenance and cycling of carbon in Lake Superior. *Limnology and Oceanography* 56(3), 867-886.

Methods & Sampling

Because the samples are initially processed on deck and radiocarbon is being measured, the engines of the R/V Blue Heron are shut down during this time allowing the vessel to drift (engines not going and thus less possibility for contamination from the stack), until the processing of the samples has been completed.

Related files and references:
Sampling procedures, instrumentation, discussion of blanks, etc, included in Zigah, P.K., E.C. Minor, J.P. Werne, and S. L. McCallister, 2011. Radiocarbon and stable carbon isotopic insights into provenance and cycling of carbon in Lake Superior. *Limnology and Oceanography* 56(3), 867-886.

Isotopic data were processed as described in Radiocarbon Data & Calculations.

Concentration data for DOC and DIC are from a Shimadzu TOC-Vcsh Analyzer.

For DIC, the analyzer was calibrated using primary standard grade sodium carbonate and ACS reagent grade sodium bicarbonate. The inorganic carbon in the sample was volatilized with 25% H_3PO_4 (by weight) in a CO_2-free closed reaction vessel, and the CO_2 evolved was measured by a non-dispersive infrared (NDIR) gas

detector.

For DOC, the samples were acidified to pH 2 with ACS reagent grade HCl at the time of sampling. The TOC analyzer was run in NPOC mode and calibrated with potassium hydrogen phthalate (KHP). Deep seawater from Florida Strait at 700 m (Batch-8 2008) reference waters obtained from the DOC Consensus Reference Program (Hansell laboratory, University of Miami, USA) and additional KHP standards were interspersed and analyzed along with the samples to assess instrumental performance.

Our mean DOC value of the external reference sample was 43.9 ± 3.9 µM (n = 5), and agrees with the consensus value of 41-43 µM. For each sample and standard, three injections were performed. If the standard deviation was not ≤ 2.5%, two more injections were performed and the closest three of the five injections were averaged to yield sample concentration.

Particulate organic samples (on GF/F filters) were fumigated with HCl, dried, then loaded into tin capsules and analyzed for particulate organic carbon (POC) and particulate organic nitrogen (PON) concentrations using a Costech ECS 4010 elemental analyzer (EA) coupled to Finnigan Delta Plus XP isotope ratio mass spectrometer (IRMS). The EA was calibrated with acetanilide (Costech Analytical Technologies Inc., Valencia, CA, USA) and caffeine (SigmalUltra; Wheaton Science Products, NJ, USA) reference standard materials; C and N were quantified using the IRMS. Typical instrumental precisions for POC and PON measurements were respectively, 0.2% and 0.4% of the measured concentrations.

Data Processing Description

BCO-DMO Processing Notes
Generated from original .xls file "June09cruise_collatedC14_OC.xls" contributed by Elizabeth Minor

BCO-DMO Edits
- Column inserted with cruise_id
- Location values split into separate Lat/Lon values
- Lat/Lon values converted to decimal degrees
- Date converted to YYYYMMDD
- Time converted to HHMM
- "time_range" column inserted to preserve start/end time range in time cell ("nd" if no range)
- "time" contains the start time of the time range
- "nd" (no data) value inserted in blank cells
- Commas in various fields converted to semicolons
- "<" symbol changed to "lt"
- ">" symbol changed to "gt"
- Parameter names modified to conform to BCO-DMO convention
- Misc leading and trailing spaces and tabs in various fields removed
- Blank lines removed
- Data column and parameter "error_calc_1" removed. 19July2013, srg

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Data Files

File
June2009_Radiocarbon.csv (Comma Separated Values (.csv), 10.63 KB) MD5:1d7e5a694a38902d0cd71d5502042528 Primary data file for dataset ID 3502

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Parameters

Parameter	Description	Units

cruise_id	cruise id	text
date	date	yyyymmdd
time	time (CDST)	hhmm
time_range	time range (CDST)	hh:mm
lat	Latitude (South is negative)	decimal degrees
lon	Longitude (West is negative)	decimal degrees
depth_of_sample	depth of sample	meters
Kind	Kind	text
Type	Type	text
Submitter_Identification	Submitter Identification	text
Description	Description	text
d13C	delta^{13}C	permille
F_Modern	fraction modern	Unitless
Fm_Error	the error in fraction modern (as determined by NOSAMS)	Unitless
Age	Age	Radiocarbon years
Age_Error	Age Error	Radiocarbon years
D14C_NOSAMS	DELTA^{14}C NOSAMS	per mille
D14C_Minor	DELTA^{14}C Minor	per mille
Carbon_content	Carbon content	uM/L

std_dec_C_content	std dec C content	umol C per L
N_content	N content	uM/L
CtoN_MolarRatio	C/N Molar Ratio *Note: The C/N data for the POC samples is from POC2 rather than POC1 (where the radiocarbon and stable carbon numbers come from). In other words, one filter was analyzed by NOSAMS; the other was analyzed by us using an elemental analyzer hooked up to an isotope-ratio mass spec.*	ratio

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Instruments

Dataset-specific Instrument Name	CHN Elemental Analyzer
Generic Instrument Name	CHN Elemental Analyzer
Dataset-specific Description	Costech ECS 4010 elemental analyzer (EA) Finnigan Delta Plus XP isotope ratio mass spectrometer (IRMS) Particulate organic samples (on GF/F filters) were fumigated with HCl, dried, then loaded into tin capsules and analyzed for particulate organic carbon (POC) and particulate organic nitrogen (PON) concentrations using a Costech ECS 4010 elemental analyzer (EA) coupled to Finnigan Delta Plus XP isotope ratio mass spectrometer (IRMS). The EA was calibrated with acetanilide (Costech Analytical Technologies Inc., Valencia, CA, USA) and caffeine (SigmalUltra; Wheaton Science Products, NJ, USA) reference standard materials; C and N were quantified using the IRMS. Typical instrumental precisions for POC and PON measurements were respectively, 0.2% and 0.4% of the measured concentrations.
Generic Instrument Description	A CHN Elemental Analyzer is used for the determination of carbon, hydrogen, and nitrogen content in organic and other types of materials, including solids, liquids, volatile, and viscous samples.

Dataset-specific Instrument Name	Isotope-ratio Mass Spectrometer
Generic Instrument Name	Isotope-ratio Mass Spectrometer
Dataset-specific Description	Costech ECS 4010 elemental analyzer (EA) Finnigan Delta Plus XP isotope ratio mass spectrometer (IRMS) Particulate organic samples (on GF/F filters) were fumigated with HCl, dried, then loaded into tin capsules and analyzed for particulate organic carbon (POC) and particulate organic nitrogen (PON) concentrations using a Costech ECS 4010 elemental analyzer (EA) coupled to Finnigan Delta Plus XP isotope ratio mass spectrometer (IRMS). The EA was calibrated with acetanilide (Costech Analytical Technologies Inc., Valencia, CA, USA) and caffeine (SigmalUltra; Wheaton Science Products, NJ, USA) reference standard materials; C and N were quantified using the IRMS. Typical instrumental precisions for POC and PON measurements were respectively, 0.2% and 0.4% of the measured concentrations.
Generic Instrument Description	The Isotope-ratio Mass Spectrometer is a particular type of mass spectrometer used to measure the relative abundance of isotopes in a given sample (e.g. VG Prism II Isotope Ratio Mass-Spectrometer).

Dataset-specific Instrument Name	Shimadzu TOC-V Analyzer
Generic Instrument Name	Shimadzu TOC-V Analyzer
Dataset-specific Description	Concentration data for DOC and DIC are from a Shimadzu TOC-Vcsh Analyzer.
Generic Instrument Description	A Shimadzu TOC-V Analyzer measures DOC by high temperature combustion method.

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Deployments

BH09-05

Website	https://www.bco-dmo.org/deployment/58713
Platform	R/V Blue Heron
Start Date	2009-06-12
End Date	2009-06-21

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Project Information

How important is quote old unquote Carbon in Lake Superior. A Radiocarbon Investigation (Lake Superior Radiocarbon)

Coverage: Lake Superior

Organic carbon present in aquatic ecosystems has the potential to either be sequestered by sedimentary organic matter or recycled and contributed to the atmosphere through microbial respiration. Ultimately, the fate of organic matter is dependant upon its source, as well as the physical transport mechanisms and biogeochemical transformations it is exposed to in the water column. Because these processes vary

significantly within aquatic systems, such as the ocean, it is difficult to assess the biogeochemical importance of organic carbon; however, it is a problem of critical importance whose results could be utilized to resolve key issues in global biogeochemical carbon cycles and to determine the net heterotrophy of most aquatic environments.

Scientists from the University of Minnesota-Duluth and Virginia Commonwealth University would address this problem by studying organic carbon dynamics in Lake Superior because its biogeochemistry is similar to that of the world ocean. Using Lake Superior as a natural laboratory, the researchers plan to carry out radiocarbon measurements of particulate organic carbon (POC), dissolved organic carbon (DOC), dissolved inorganic carbon (DIC), and bacterially-respired CO2, as well as obtain the chemical composition of DOC and POC during stratified and non-stratified periods. Results would be used to identify the sources of carbon in the lake and determined transformations of carbon between POC, DOC, DIC, and bacterially-respired CO2.

Educational impacts include workshops and presentation for K-12 audiences as well as research and training opportunities for graduate and undergraduate students in Water Resources Science and Biochemistry classes.

Cruise pictures and info (for a general audience)

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-0825600

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