

Radiocarbon data from R/V Blue Heron cruise BH10-03 on Lake Superior in May 2010 (Lake Superior Radiocarbon project)

Website: <https://www.bco-dmo.org/dataset/3511>

Version: 19 July 2013

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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% H₃PO₄ (by weight) in a CO₂-free closed reaction vessel, and the CO₂ 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 $43.9 \pm 3.9 \mu\text{M}$ ($n = 5$), 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 $\leq 2.5\%$, 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 (SigmaUltra; 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 "May2010cruise_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" removed. 19July2013, srg
- Data for Accession # OS-82071 corrected. 19July2013, srg

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Data Files

| File |
|--|
| May2010_Radiocarbon.csv (Comma Separated Values (.csv), 15.97 KB) MD5:60e7f6d9f8ca88d01096e16ed327091a |
| Primary data file for dataset ID 3511 |

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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) | hhmm |
| lat | Latitude (South is negative) | decimal degrees |
| lon | Longitude (West is negative) | decimal degrees |
| depth_of_sample | depth of sample | meters |
| Submitter_Identification | Submitter Identification | text |
| Type | Type | text |
| Process | Process type | text |
| Accession_Number | Accession Number (OS-xxxxx) | dimensionless |
| 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 |
| d13C | $\delta^{13}\text{C}$ <i>Note: Values in parentheses are average deviation from replicate analyses of the sample.</i> | per mille |
| d13C_Source | $\delta^{13}\text{C}$ Source | text |
| D14C | $\Delta^{14}\text{C}$ | per mille |

| | | |
|------------------|---|------------|
| C_conc | C conc | umol/L |
| weight_percent_C | weight percent C <i>Note: Values in parentheses are average deviation from replicate analyses of the sample.</i> | percentage |
| DIC_Conc | DIC Conc | mmol/kg |
| DOC_Conc | DOC Conc | um/kg |
| CtoN_MolarRatio | C/N Molar Ratio <i>Note 1: 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.</i> <i>Note 2: Values in parentheses are average deviation from replicate analyses of the sample.</i> | 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 (SigmaUltra; 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 (SigmaUltra; 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

BH10-03

| | |
|--------------------|--|
| Website | https://www.bco-dmo.org/deployment/58719 |
| Platform | R/V Blue Heron |
| Start Date | 2010-05-28 |
| End Date | 2010-06-03 |
| Description | Cruise pictures and info (for a general audience)Original data are available from the NSF R2R data catalog |

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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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