Atlantic sediment radiocarbon from mult-corer samples collected in the Amazon Delta and Sierra Leone Rise during R/V Endeavor cruises EN-480 and EN-481 in 2010

Website: https://www.bco-dmo.org/dataset/908387
Data Type: Cruise Results
Version: 1
Version Date: 2023-09-14

Project
» Concentrations and source assessment of black carbon across tropical Atlantic air and sediment (Tropical Atlantic Black Carbon)
» The Black Carbon Cycle: Budget and Fluxes of Black Carbon in South Atlantic Sediments (Black Carbon Cycle)

Contributors	Affiliation	Role
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Abstract
These data include the sediment radiocarbon analysis for Amazon Delta and Sierra Leone Rise Sediments. These data were collected on multiple cruises in throughout the Atlantic; specifically, in the Amazon Delta (EN-480; July 2010) and Sierra Leone Rise (EN-481; August 2010). Sediments were collected using multi-corer and kept frozen until analysis. Radiocarbon was measured for the Amazon Delta and Sierra Leone Rise regions at the National Ocean Sciences-Accelerator Mass Spectrometry (NOSAMS) facility at Woods Hole Oceanographic Institute using the 'reconnaissance' method. These data were published in St.Laurent, et al. (2023).

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Coverage

Spatial Extent: **N**:7.4353 **E**:-21.2436 **S**:4.2828 **W**:-47.4844
Temporal Extent: 2010-07-17 - 2010-08-13

Methods & Sampling

Sediment samples were collected via a 4-barrel multi-corer (R/V Endeavor, segmented into 1-2 cm sections, dried in a drying oven (35°C) and homogenized via mortar and pestle. Sediments were decalcified using 10% hydrochloric acid. Black carbon was isolated using the chemothermal oxidation at 375°C method.

Radiocarbon data were analyzed at the National Ocean Sciences Accelerator Mass Spectrometry Facility

(NOSAMS) at the Woods Hole Oceanic Institute using the “reconnaissance” method as described by Burke et al., 2010 and McIntyre et al., 2011. The blank-corrected fraction modern is also reported as described by Burke et al., 2010. The AMS is a commissioned continuous-flow AMS system.

Instruments:

Both the total organic carbon (~0.10 to 0.35 mgC) and black carbon (~0.15 to 0.80 mgC) samples were combusted into carbon dioxide using a modified elemental analyzer and then converted to graphite using a zinc reduction method before analysis on an Accelerator Mass Spectrometer.

LOCATION:
Amazon Delta (approximately: 4 N, 47 W; 2400-3500m); Sierra Leone Rise (approximately: 7 N, 20 W; 2800-3800m).

BCO-DMO Curation Notes

* Sheet 1 of file "Atlantic Sediment 14C.xlsx" was imported into the BCO-DMO data system.
* * Column names adjusted to conform to BCO-DMO naming conventions designed to support broad re-use by a variety of research tools and scripting languages. [Only numbers, letters, and underscores. Can not start with a number]
* Date format converted to ISO 8601 format.

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Data Files

File
Atlantic Sediment Radiocarbon filename: 908387_v1_atlantic-sediment-radiocarbon.csv (Comma Separated Values (.csv), 2.33 KB) MD5:00377577c09d57e35ef235a359910d87 Primary data table for dataset 908387 version 1.

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Related Publications

Burke, A., Robinson, L. F., McNichol, A. P., Jenkins, W. J., Scanlon, K. M., & Gerlach, D. S. (2010). Reconnaissance dating: A new radiocarbon method applied to assessing the temporal distribution of Southern Ocean deep-sea corals. Deep Sea Research Part I: Oceanographic Research Papers, 57(11), 1510–1520. https://doi.org/10.1016/j.dsr.2010.07.010
Methods

McIntyre, C. P., Roberts, M. L., Burton, J. R., McNichol, A. P., Burke, A., Robinson, L. F., von Reden, K. F., & Jenkins, W. J. (2011). Rapid radiocarbon (14C) analysis of coral and carbonate samples using a continuous-flow accelerator mass spectrometry (CFAMS) system. Paleoceanography, 26(4). Portico. https://doi.org/10.1029/2011pa002174 https://doi.org/10.1029/2011PA002174
Methods

St.Laurent, K., Cantwell, M., & Lohmann, R. (2023). New insights on black carbon in pelagic Atlantic sediments. Marine Chemistry, 104312. https://doi.org/10.1016/j.marchem.2023.104312
Results

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Related Datasets

IsRelatedTo

Lohmann, R., St. Laurent, K. A. (2023) **Atlantic sediment black carbon, total organic carbon, and stable carbon ratio (13C) values from samples collected using a multi-corer and box corer from multiple cruises throughout the Atlantic between 1994 and 2010.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2023-09-14 doi:10.26008/1912/bco-dmo.908373.1 [view at BCO-DMO]
Relationship Description: Datasets from the same cruises published as part of the same study "New insights on black carbon in pelagic Atlantic sediments." published in St. Laurent, et al. (2023).

Lohmann, R., St. Laurent, K. A. (2023) **Atlantic sediment petrography analysis data from mult-corer samples collected in the Amazon Delta and Sierra Leone Rise during R/V Endeavor cruises EN-480 and EN-481 in 2010.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2023-10-02 doi:10.26008/1912/bco-dmo.908380.1 [view at BCO-DMO]
Relationship Description: Datasets from the same cruises published as part of the same study "New insights on black carbon in pelagic Atlantic sediments." published in St. Laurent, et al. (2023).

Lohmann, R., St. Laurent, K. A. (2023) **Atlantic sediment polycyclic aromatic hydrocarbon (PAH) concentrations from samples collected using a multi-corer and box corer from multiple cruises throughout the Atlantic between 1994 and 2010.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2023-09-14 doi:10.26008/1912/bco-dmo.908357.1 [view at BCO-DMO]
Relationship Description: Datasets from the same cruises published as part of the same study "New insights on black carbon in pelagic Atlantic sediments." published in St. Laurent, et al. (2023).

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Parameters

Parameter	Description	Units
Site	Numerical sediment core name	unitless
Depth_Interval	sediment depth interval	cenitmeters below seafloor (cmbsf)
Date	Core date	unitless
Lat	Core sample location latitude	decimal degrees
Lon	Core sample location longitude	decmial degrees
Carbon_Fraction	The fraction of carbon measured (Total Organic Carbon or Black Carbon)	unitless
Fm_Measured	The measured 14C fraction modern	14C years
Norm_del13C	The normalized stable carbon isotope ratio	per mil (0/00)
Fm_Stdev	Standard deviation of the 14C fraction modern	14C years
Fm_Corrected	The blank corrected 14C fraction modern	14C years
Fmc_Stdev	Standard deviation of the blank corrected 14C fraction modern	14C years

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Instruments

Dataset-specific Instrument Name	continuous-flow AMS system
Generic Instrument Name	Accelerator Mass Spectrometer
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	4-barrel multi-corer
Generic Instrument Name	Multi Corer
Dataset-specific Description	Sediment samples were collected via a 4-barrel multi-corer
Generic Instrument Description	The Multi Corer is a benthic coring device used to collect multiple, simultaneous, undisturbed sediment/water samples from the seafloor. Multiple coring tubes with varying sampling capacity depending on tube dimensions are mounted in a frame designed to sample the deep ocean seafloor. For more information, see Barnett et al. (1984) in Oceanologica Acta, 7, pp. 399-408.

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Deployments

EN480

Website	https://www.bco-dmo.org/deployment/910748
Platform	R/V Endeavor
Start Date	2010-07-13
End Date	2010-07-23

EN481

Website	https://www.bco-dmo.org/deployment/910750
Platform	R/V Endeavor
Start Date	2010-07-25
End Date	2010-08-19

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Project Information

Concentrations and source assessment of black carbon across tropical Atlantic air and sediment (Tropical Atlantic Black Carbon)

Coverage: Tropical North Atlantic Ocean

NSF Award Abstract:
Black carbon is formed during the incomplete burning of fuels (e.g., the black clouds of smoke emitted by buses and trucks). Black carbon does not degrade easily in the environment and can be transported long distances, even reaching the seafloor. Yet the fluxes of black carbon in the environment are not well known, particularly in the oceans. Rivers are considered the dominant source of black carbon to the oceans. However, recent results suggest that there may be regions of the ocean where the atmospheric delivery of black carbon may be important. This study investigates whether biomass burning (e.g., wildfires) in Africa is a source of black carbon to the tropical Atlantic Ocean. The unique molecular and isotopic properties of black carbon will be used to identify black carbon in the atmosphere, water and sediment in the study region. Sediment, water

column and atmospheric particles will be collected during a 3-week research cruise across the tropical Atlantic Ocean. Two different approaches will be used to quantify black carbon in the environment. The research is relevant and timely for our understanding of the carbon cycle, a key component of our ability to forecast climate and its change. The project supports a graduate student and provide opportunities for high school students participating in the SMILE Program (Science and Math Investigative Learning Experiences). This project is jointly funded by the Chemical Oceanography Program and the Established Program to Stimulate Competitive Research (EPSCoR).

Surface sediment samples will be collected at ten sites across the tropical Atlantic Ocean in a region known to be impacted by biomass burning events (wildfires) in Africa. Appropriate locations for sediment sampling will be identified using state-of-the-art ship equipment to ensure a successful coring operation. Once collected, the black carbon and organic carbon fractions of the sediment will be isolated and measured. A range of isotopic and molecular marker approaches will be used to identify the likely source of these carbon fractions. The central hypothesis is that the black carbon residing in the sediment of the tropical Atlantic Ocean is derived from biomass burning and delivered through atmospheric deposition. Carbon derived from recent biomass burning contains C-14 isotopes that indicate 'young' (or recently produced) carbon, while carbon from fossil fuels ('old carbon') has no C-14 due to radioactive decay. To further assess the origin of the black carbon in the region, water column and atmospheric particles will be collected during the research cruise. The origin of the atmospheric black carbon particles (biomass burning or fossil fuel emissions) will be established through a collaboration with colleagues in Sweden. The broader impacts of this research include the engagement of high school students through The SMILE Program (Science and Math Investigative Learning Experiences) at the University of Rhode Island. The project also provides training opportunities for graduate and undergraduate students, with a focus on recruitment of students from under-represented groups.

This award reflects NSF's statutory mission and has been deemed worthy of support through evaluation using the Foundation's intellectual merit and broader impacts review criteria.

The Black Carbon Cycle: Budget and Fluxes of Black Carbon in South Atlantic Sediments (Black Carbon Cycle)

Coverage: South Atlantic

NSF abstract:
This award is funded under the American Recovery and Reinvestment Act of 2009 (Public Law 111-5).

In this study, researchers at the University of Rhode Island will attempt to determine the origin and fluxes of black carbon (BC) in marine sediments from the South Atlantic. Black carbon in the atmosphere is a key driver of global climate change; it is second only to CO2 in its contribution to global warming. The proposed work is thus relevant and timely for our understanding of the carbon cycle, a key component of our ability to forecast climate and its change. The major sources of BC on the global scale are fossil fuel and biomass burning, which are both prominent in Africa and South America. Hence, it is proposed to account for soot BC, char and charcoal residing in sediments from the South Atlantic by combining thermal, chemical and petrographic isolation methods.

This project has three main hypotheses: (1) Soot BC constitutes a significant fraction of the total organic carbon in deep sea sediments of the South Atlantic, and dominates total BC in those sediments; (2) Biomass burning is the dominant source of the soot BC present in deep sea sediments of the South Atlantic; and (3) For the South Atlantic, atmospheric deposition of soot BC is as important as riverine inputs.

This study represents a first attempt to account for BC sinks on an Ocean scale. It thus holds promise to make a major step forward towards being able to mass balance sources and sinks of BC. Previous studies suggest that BC reaches the oceans predominantly from riverine sources. In the case of the South Atlantic, the research team hypothesizes that atmospheric transport and deposition is at least as important. The proposed research will compare different BC determination procedures for deep sea sediments, thereby improving our understanding of the different constituents of the BC cycle. Similarly, organic marker molecules are often used for source apportionment. This study will explore if this still holds true for deep sea sediment samples, as preliminary data found discrepancies arising from molecular marker analysis and isotopic analysis. Lastly, accounting for soot BC in deep sea sediments will also aid in identifying more of the uncharacterized sedimentary OC .

Broader Impacts: The results of this work are expected to aid atmospheric and earth system science modelers in refining their atmospheric and oceanic transport models for BC, including its relation to global climate change. The project will enhance infrastructure for research and education by establishing research collaboration between URI and international partners at the University of Bremen, the MPI for Meteorology, Hamburg, and the University of Tuebingen.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1924191
NSF Division of Ocean Sciences (NSF OCE)	OCE-0851044

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