

Sediment multicore general organic, inorganic, stable isotope, and bulk radiocarbon data collected from R/V F.G. Walton Smith cruise WS23-139 along the Guianas mudbanks coast in June and July 2023

Website: <https://www.bco-dmo.org/dataset/1009552>

Data Type: Cruise Results

Version: 1

Version Date: 2026-10-12

Project

» [Collaborative Research: What Happens to Terrestrial Organic Matter in the Ocean? Solving the Mystery Behind an Iconic Question](#) (MUDBENCS)

Contributors	Affiliation	Role
Galy, Valier	Woods Hole Oceanographic Institution (WHOI)	Co-Principal Investigator
Rosenheim, Brad	University of South Florida (USF)	Co-Principal Investigator
Colombo, Manuel	Virginia Institute of Marine Science (VIMS)	Scientist
Dunlea, Ann	Woods Hole Oceanographic Institution (WHOI)	Scientist
Eglinton, Timothy I.	ETH-Zurich (ETH)	Scientist
Haghipour, Negar	ETH-Zurich (ETH)	Scientist
Hein, Christopher	Virginia Institute of Marine Science (VIMS)	Scientist
Moura, José Mauro	Federal University of Western Pará (UFOPA)	Scientist
Rauch, Shannon	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract

Multicores from 14 different stations along the Guianas mudbanks coast (NE S. America, Brazil, French Guiana, and Suriname) were extruded and frozen aboard the R/V F.G. Walton Smith in the summer of 2023. Samples were subsequently portioned, with some portions dried, acid-treated, and/or ground. Samples were analyzed in duplicate on an elemental analyzer connected to an isotope ratio mass spectrometer (IRMS) for nitrogen quantity and stable nitrogen isotope values and for carbon quantity, stable carbon isotope values, and carbon:nitrogen ratios. A subset of samples was analyzed for bulk radiocarbon content. A subset of samples was run for surface area, inorganic elemental content, and grain size distribution. These data will be useful for marine chemists interested in particulate-aqueous exchange in a mobile mudbank setting as well as geochemists interested in the exchange of carbon between terrigenous particulate matter, minerals, and the water column in a dynamic shelf sedimentary system with high fluvial inputs. The data were collected by shipboard scientists Brad Rosenheim (chief scientist, co-PI), Christopher Hein, Manuel Colombo, Brenna Boehmann, Evan Flynn, Andrea de Lima Oliveira, Calyn Crawford, Ronmel Rugama-Montenegro, Davide Calvarese, and Jose Moura da Souza Mauro, and land-based scientists Valier Galy (co-PI), Orion Schomber, Theresa King, Devon Firesinger, Ethan Goddard, Ann Dunlea, and Timothy Eglinton. Measurements were made in the Marine Environmental Chemistry Laboratory of the College of Marine Science at the University of South Florida (EA-irMS, Brad Rosenheim), Woods Hole Oceanographic Institution (surface area, inorganic geochemistry), Virginia Institute of Marine Science (grain size), and ETH-Zurich (radiocarbon values).

Table of Contents

- [Coverage](#)
- [Dataset Description](#)
 - [Methods & Sampling](#)
 - [Data Processing Description](#)
 - [BCO-DMO Curation Notes](#)
 - [Problem Description](#)
- [Related Publications](#)
- [Parameters](#)

- [Instruments](#)
 - [Deployments](#)
 - [Project Information](#)
 - [Funding](#)
-

Coverage

Location: Shallow shelf waters along the northeastern coast of South America from the mouth of the Amazon River to the mouth of the Maroni River

Spatial Extent: N:6.0707 E:-49.0968 S:1.1264 W:-53.9354

Temporal Extent: 2023-06-08 - 2023-06-16

Methods & Sampling

Multicores from 14 different stations along the Guianas mudbanks coast (NE S. America, Brazil, French Guiana, and Suriname) were extruded and frozen aboard the R/V F.G. Walton Smith in the summer of 2023. Samples were subsequently portioned, with some portions dried (freeze-drying and oven-drying), acid-treated, and/or ground. Samples were analyzed in duplicate (acid-treated and not acid-treated) on an elemental analyzer connected to an isotope ratio mass spectrometer (IRMS) for nitrogen quantity and stable nitrogen isotope values (not acid-treated) and for carbon quantity, stable carbon isotope values, and carbon:nitrogen ratios (acid-treated).

A subset (n=35) of acid-treated samples was analyzed for bulk radiocarbon content. A subset (n=25) of non-acid-treated, unground samples was run for surface area, and all non-acid-treated and unground samples were measured for inorganic elemental content and grain size distribution. Sample names in this dataset include the code for the seagoing expedition (WS23-139), the multicore number, and the extrusion depth (in centimeters) from the multicore. Columns are provided with station numbers, latitude, longitude, and station name. The 14 stations aligned in sets of 3 cross-shelf transects (inner, middle, and outer) at 6 different locations along this coast.

Sediment samples were extruded on board the ship after cores were recovered. Extruded intervals were measured using a rotating core table on a calibrated threaded rod (Schwing et al., 2016). Extruded samples were placed in pre-combusted glass jars with pre-combusted foil covers and threaded lids, and they were frozen on board the ship. Upon return to the laboratories at the University of South Florida, samples were thawed and separated into three aliquots: acid treatment, no acid treatment, and archive.

Archive aliquots were refrozen.

Acid treatment consisted of rinsing with 1N HCl in pre-combusted glass beakers and rinsing with distilled water until pH testing strips rose to a stable pH when contacted with siphoned rinse water from the sediments. The sediments were dried at 50 degrees Celsius and ground. This aliquot was used for carbon isotopes, %TOC, C:N ratios, and radiocarbon measurements.

The non-acid-treated samples were divided for grain size analysis, surface area analysis, and inorganic geochemistry (undried, unground) and for nitrogen isotope, %C, and %N analyses (dried and ground). The %CaCO₃ of the samples was calculated using the difference between %C and %TOC measurements, the latter of which had carbonate minerals removed by acid treatment, and the %TOC values were corrected for the missing mass of CaCO₃ by multiplying the measured values by the term (1-%CaCO₃). Both corrected and measured %TOC values are provided.

Data Processing Description

Stable isotope data were transferred to the international stable isotope scales of PDB (carbon isotopes) and AIR (nitrogen isotopes) by measuring laboratory reference materials that were calibrated to those scales. Radiocarbon data were transferred to fraction modern values using standards offered by the International Atomic Energy Association. Nitrogen and carbon composition of the organic matter was calculated from...

Calculation of the amount of CaCO₃ and correction of %TOC are explained under the methods section. Data from different sources were merged using the pandas package (v. 2.2.2) of Python (v. 3.14.0) and output as a

single .csv file.

BCO-DMO Curation Notes

This section documents curation actions performed prior to publication review with the submitter, and additional information relevant to understanding and reusing this dataset. It distinguishes changes made to the submitted (meta)data from unresolved issues and/or enhancements that improve future reuse and interoperability.

CURATION ACTIONS PERFORMED ON DATA

- Imported original file "MUDBENCs_MC_data_repository.csv" into the BCO-DMO data processing system.
- Deleted the unnamed column containing row numbers.
- Renamed columns to comply with BCO-DMO naming conventions.
- Replaced a non-standard character in the station_name value "Uaça Outer" with "Uaca Outer".
- Converted format and renamed column "on_station_time" to "on_station_time_local" (no timezone conversion, format change of %Y-%m-%d %H:%M:%S to %Y-%m-%dT%H:%M:%S).
- Converted "off_station_time" to local datetime "off_station_time_local" similarly.
- Converted "on_station_time" with input timezone of UTC-3 to UTC and named the new column "on_station_time_UTC".
- Converted "off_station_time" with input timezone of UTC-3 to UTC and named the new column "off_station_time_UTC".
- Deleted original on_station_time and off_station_time columns after creating local/UTC variants.
- Saved the final file as "1009552_v1_guiana_mudbanks_multicore.csv".

CURATION ACTIONS PERFORMED ON METADATA

- BCO-DMO's standard metadata entry and text formatting steps were performed. See: <https://www.bco-dmo.org/how-to/standard-curation-edits>

ISSUES POTENTIALLY IMPACTING REUSE

- The "Data Processing" section is incomplete.
- C to N mass ratio appears twice in the dataset as columns "C_to_N_mass_ratio" and "C_to_N_mass_ratio2". It is not known if or how these differ.

Problem Description

Not all analyses were performed on all samples. Quality control flags pertain to the analysis of general organic geochemistry variables (C, N, d15N, d13C, and derived quantities) by elemental analyzer isotope ratio mass spectrometer. Flags are for samples where the unacidified sample N content was near the instrument detection limits, and therefore both the nitrogen quantity and isotope values may be inaccurate.

[[table of contents](#) | [back to top](#)]

Related Publications

Schwing, P. T., Romero, I. C., Larson, R. A., O'Malley, B. J., Fridrik, E. E., Goddard, E. A., Brooks, G. R., Hastings, D. W., Rosenheim, B. E., Hollander, D. J., Grant, G., & Mulhollan, J. (2016). Sediment Core Extrusion Method at Millimeter Resolution Using a Calibrated, Threaded-rod. *Journal of Visualized Experiments*, (114). <https://doi.org/10.3791/54363>
Methods

[[table of contents](#) | [back to top](#)]

Parameters

Parameter	Description	Units
sample_ID	sample identification including ship abbreviation, year of expedition, sequential number of expedition, multicore number, depth range of sample in centimeters, and suffix for duplicate analyses	unitless
mass_mg	mass of sample analyzed for organic geochemistry (stable carbon isotopes, carbon and nitrogen content, derived values)	milligrams
d15N	stable nitrogen isotope value from non-acidified sample normalized to AIR standard scale	permille
d13C	stable carbon isotope value from acidified sample normalized to PDB standard scale	permille
pct_N	weight percent of nitrogen in acidified sample	percent
pct_C	weight percent of carbon in acidified sample	percent
micromols_N	number of micromoles of nitrogen measured in mass of acidified sample	micromoles
micromols_C	number of micromoles of carbon measured in mass of acidified sample	micromoles
Fm	fraction modern radiocarbon value	proportion activity ratio of the measured sample relative to activity ratio of 1950 wood
Si_wt_pct	weight percent of silicon	percent
Al_wt_pct	weight percent of aluminum	percent
Ti_wt_pct	weight percent of titanium	percent
Fe_wt_pct	weight percent of iron	percent
Mn_wt_pct	weight percent of manganese	percent
Ca_wt_pct	weight percent of calcium	percent

Mg_wt_pct	weight percent of magnesium	percent
Na_wt_pct	weight percent of sodium	percent
K_wt_pct	weight percent of potassium	percent
Ba_microg_per_g	barium content, micrograms per gram	micrograms Ba per gram sediment
Cr_microg_per_g	chromium content, micrograms per gram	micrograms Cr per gram sediment
Sc_microg_per_g	scandium content, micrograms per gram	micrograms Sc per gram sediment
Sr_microg_per_g	strontium content, micrograms per gram	micrograms Sr per gram sediment
V_microg_per_g	vanadium content, micrograms per gram	micrograms V per gram sediment
Y_microg_per_g	yttrium content, micrograms per gram	micrograms Y per gram sediment
Zn_microg_per_g	zinc content, micrograms per gram	micrograms Zn per gram sediment
Zr_microg_per_g	zirconium content, micrograms per gram	micrograms Zr per gram sediment
pct_clay	percent clay	percent
pct_silt	percent silt	percent
pct_vfn	percent very fine	percent
pct_fine	percent fine	percent
pct_med	percent medium	percent
pct_crs	percent coarse	percent
pct_vcrs	percent very coarse	percent
d10	grain diameter at the 10th percentile	micrometers

d50	grain diameter at the 50th percentile	micrometers
d90	grain diameter at the 90th percentile	micrometers
mean	mean grain diameter	micrometers
sorting	statistic for variability in grain size	dimensionless
skewness	moment coefficient of skewness of grain size distribution	dimensionless
kurtosis	moment coefficient of kurtosis of grain size distribution	dimensionless
mass_mg_N	mass of unacidified sample analyzed for organic geochemistry (stable nitrogen isotopes, derived values)	milligrams
d15N_N	stable nitrogen isotope value from unacidified samples relative to AIR standard scale	permille
pct_C_N	weight percent of carbon in unacidified sample	percent
C_to_N_mass_ratio	mass ratio of carbon to nitrogen in acidified sample	dimensionless
flags	Flags/comments	unitless
top_depth	depth at the top of the multicore	centimeters (cm)
bottom_depth	depth at the bottom of the multicore	centimeters (cm)
core	sequential core number	unitless
pct_CaCO3	percent calcium carbon calculated from different in C_pct between acidified and unacidified samples	percent
C_pct_corrected	carbon content of acidified sample corrected for missing mass of CaCO3 removed by acidification	percent
C_to_N_mass_ratio2	mass ratio of carbon to nitrogen in acidified sample	dimensionless
C_to_N_mass_corrected	mass ratio of carbon to nitrogen in acidified samples using the C_pct_corrected variable	dimensionless

latitude	latitude	decimal degrees
longitude	longitude	decimal degrees
station_number	sequential station number	unitless
station_name	station name	unitless
on_station_time_local	date and time that over-the-side work began on station, local time zone of UTC-3	unitless
off_station_time_local	date and time that over-the-side work ended on station, local time zone of UTC-3	unitless
on_station_time_UTC	date and time that over-the-side work began on station, UTC time zone	unitless
off_station_time_UTC	date and time that over-the-side work ended on station, UTC time zone	unitless

[[table of contents](#) | [back to top](#)]

Instruments

Dataset-specific Instrument Name	IonPlus Micadas Accelerator Mass Spectrometer
Generic Instrument Name	Accelerator Mass Spectrometer
Dataset-specific Description	Radiocarbon: IonPlus Micadas 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 1×10^{15} (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	NOVA 4000e SA analyzer
Generic Instrument Name	BET surface area analyzer
Dataset-specific Description	Surface Area: Quantachrome Surface Area Analyzer (NOVA 4000e SA analyzer; Quantachrome Instruments, USA)
Generic Instrument Description	Also called a "Gas Adsorption Surface Area Analyzer". A BET surface area analyzer is a laboratory instrument used to determine the specific surface area of solid materials using gas adsorption techniques, typically based on the Brunauer-Emmett-Teller (BET) method. The instrument measures the quantity of gas, commonly nitrogen, adsorbed onto the surface of a solid sample at different pressures. Depending on the model, it may also be used to determine pore volume and pore size distribution.

Dataset-specific Instrument Name	Carlo Erba CHN 1108
Generic Instrument Name	Carlo-Erba EA-1108 elemental analyzer
Dataset-specific Description	Stable isotopes and elemental content, organic matter: ThermoFinnigan Delta+XL IRMS, Carlo Erba CHN 1108
Generic Instrument Description	An elemental analyzer that simultaneously determines the total carbon, hydrogen, nitrogen, and sulfur in a small solid or liquid sample. A sample is put into a tin capsule that is placed in the combustion tube. Here, the sample is in an oxygen-rich gas stream, which causes flash combustion of the tin capsule, and in turn, the sample is rapidly combusted. The resulting gases are separated on a packed gas chromatography column and quantified using a thermal conductivity detector. The instrument was originally manufactured by Carlo-Erba, which has since been replaced by Thermo Scientific (part of Thermo Fisher Scientific). This model is no longer in production. It is also possible to determine oxygen with a modification to the systems configuration. Analysis times: CHN in 7 min, S in 5 min and O in 6 min. Range: 10 ppm to 100%.

Dataset-specific Instrument Name	ThermoFisher iCAP
Generic Instrument Name	Inductively Coupled Plasma Mass Spectrometer
Dataset-specific Description	Inorganic elemental content: ThermoFisher iCAP inductively coupled plasma mass spectrometer
Generic Instrument Description	An ICP Mass Spec is an instrument that passes nebulized samples into an inductively-coupled gas plasma (8-10000 K) where they are atomized and ionized. Ions of specific mass-to-charge ratios are quantified in a quadrupole mass spectrometer.

Dataset-specific Instrument Name	ThermoFinnigan Delta+XL
Generic Instrument Name	Isotope-ratio Mass Spectrometer
Dataset-specific Description	Stable isotopes and elemental content, organic matter: ThermoFinnigan Delta+XL IRMS, Carlo Erba CHN 1108
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	Beckman Coulter Laser Diffraction Particle Size Analyzer
Generic Instrument Name	Laser Diffraction Particle Size Analyzer
Dataset-specific Description	Grain size: Beckman Coulter Laser Diffraction Particle Size Analyzer
Generic Instrument Description	Laser diffraction is particle sizing technique for materials ranging from hundreds of nanometers up to several millimeters in size. Laser diffraction measures particle size distributions by measuring the angular variation in intensity of light scattered as a laser beam passes through a dispersed particulate sample. One example is the Beckman Coulter LS200.

Dataset-specific Instrument Name	Sediment multicores
Generic Instrument Name	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.

[[table of contents](#) | [back to top](#)]

Deployments

WS23139

Website	https://www.bco-dmo.org/deployment/1009741
Platform	R/V F.G. Walton Smith
Start Date	2023-05-13
End Date	2023-07-18
Description	See more information at R2R: https://www.rvdata.us/search/cruise/WS23139

Project Information

Collaborative Research: What Happens to Terrestrial Organic Matter in the Ocean? Solving the Mystery Behind an Iconic Question (MUDBENCs)

Coverage: Atlantic Ocean coastal waters, Brazil, French Guiana, Suriname

NSF Award Abstract:

The Amazon River is one of the largest and most important rivers in the world. It not only carries water through the Amazon rain forests, it also carries mud - lots of mud. This mud settles when the river joins the ocean, forming the Amazon delta. Waves and wind re-suspend some of this mud, which forms mud banks that slowly move from the coast of Brazil, to French Guiana, Suriname, and Guyana. Not only do these mud banks shape the coastlines of these areas, but they also serve as a storage for carbon that had been removed from the atmosphere by the Amazon rainforest, dropped to the forest floor and washed into the river, ultimately transported on particles of mud into the Amazon delta. Normally, this represents a transfer of carbon from the atmosphere to the sediment and rock record, hiding it away for thousands to millions of years and participating in the natural regulation of atmospheric carbon dioxide concentration. However, the Amazon's special case of mud banks that travel hundreds of miles along the coast has long been believed to stir up this carbon and release most of it back to the atmosphere. This idea has held for decades, but if wrong, may have a large impact on our understanding of the ocean's carbon cycle. This research will use new science and technology to change the way we look at river carbon cycling in the ocean by sampling the mud banks, ocean waters, and Amazon River waters more thoroughly than has been previously done, with the aim to understand and quantify the storage of land-derived carbon in marine mudbank sediments offshore the Amazon River. This research will serve as the core of two Ph.D. dissertations and will interface with the Woods Hole Partnership Educational Program (PEP) to provide under-represented minority college students an opportunity to gain practical experience in marine and environmental sciences. The project will also be incorporated into the Saint Petersburg Science Fest, an event that brings several thousand school children to University of South Florida campus during one weekend every autumn to showcase different research projects and initiatives.

Twenty years ago, John Hedges posed a seminal question pertaining to the role of the ocean in the carbon cycle: "what happens to terrestrial organic matter in the oceans?" That question was set upon a conundrum - because riverine organic matter is highly degraded, it should be expected to suffer minimal respiration in the ocean, yet by most accounts continental margins seem to be incinerators of terrestrial organic matter. However, much of this paradigm was originally built upon biogeochemical studies of the Amazon sub-aqueous delta and the mobile fluidized mudbanks along the Guianas coast. However, preliminary state of the art characterizations of organic carbon in Amazon River and mudbank sediments suggest that a fraction of terrestrial organic carbon is actually not refractory and as such is rapidly and efficiently oxidized in the ocean, whereas another fraction is refractory and is in fact quantitatively preserved in marine sediments. Overall, the data suggest an underestimation of burial efficiency in the realm of 50-100%. This proposal focuses on gaining a transformative mechanistic and quantitative understanding of the fate of terrestrial organic carbon in the coastal ocean offshore of the Amazon River. This will be done through i) sampling the marine province offshore of the Guianas coast (the Guianas mudbanks) as well as the Amazon River delta, using a shallow-draft research vessel and ii) using novel state of the art geochemical analysis of organic carbon - in particular ramped oxidation and compound specific radiocarbon analysis - and elemental composition to demonstrate the selective nature of terrestrial organic carbon oxidation and provide new estimates of burial efficiency of this system - with implications for the global inventory of terrestrial organic carbon in the ocean.

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.

Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1851494

[[table of contents](#) | [back to top](#)]