

Ramped pyrolysis oxidation (RPO) C isotope values of soils collected in 2014-2015 within Plum Island Ecosystems LTER

Website: <https://www.bco-dmo.org/dataset/827365>

Data Type: Other Field Results

Version: 1

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Project

» [Eutrophication Effects on Sediment Metabolism and Benthic Algal-bacterial Coupling: An Application of Novel Techniques in a LTER Estuary](#) (Benthic_PP_at_TIDE)

Contributors	Affiliation	Role
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Abstract

Ramped pyrolysis oxidation (RPO) C isotope values of soils at Plum Island Ecosystems - LTER. Data were collected 2014-2015.

Table of Contents

- [Coverage](#)
- [Dataset Description](#)
 - [Methods & Sampling](#)
 - [Data Processing Description](#)
- [Data Files](#)
- [Related Publications](#)
- [Parameters](#)
- [Instruments](#)
- [Project Information](#)
- [Funding](#)

Coverage

Spatial Extent: N:42.741354 E:-70.83000142 S:42.73739991 W:-70.84720027

Temporal Extent: 2014-07 - 2015-12

Dataset Description

Bulk soil and elemental properties of marsh and infilled pond soils within Plum Island Ecosystems - LTER. Bulk soil properties of the soils are complemented with Fourier Transform Infrared Spectroscopy and ramped pyrolysis oxidation measurements of the soils. Data were collected during 2014-2015.

Methods & Sampling

Soil cores were collected from three sites within the Plum Island Ecosystems - Long Term Ecological Research (PIE-LTER) domain (MA, USA; 42.74° N, -70.85° W). A core liner was fitted with a gasketed piston and placed on the sediment surface and pushed down into the marsh subsurface, ensuring that the soil column did not compact during collection.

The sites had similar elevations (1.41 - 1.51 m North American Vertical Datum of 1988 [NAVD88]) and salt marsh grass communities, dominated by *Spartina patens*, *S. alterniflora*, and *Distichlis spicata*. Permanently inundated ponds within each site had comparable depths (0.24 - 0.30 m) but varied in size (643 - 7,149 m²)

and age (40 - 53 years) (Spivak et al., 2017; Spivak et al., 2018).

Soil cores were split lengthwise and sectioned into 1, 2, or 5 cm sections, with higher resolution in the top 30 cm. Soil water content (%) and bulk density (g/cm³) were determined gravimetrically after drying to constant mass (60°C). Samples were sieved (1 mm) to remove root material and homogenized with a Retsch Mixer Mill 200.

The thermal reactivity of SOC was characterized through ramped pyrolysis oxidation (RPO). Homogenized soil samples (~6 mg) were exposed to a constant flow of ultra-high purity oxygen and helium gas mixture within a reactor, where temperatures ramped to 1000°C at a constant rate (20°C per min) (Rosenheim et al., 2008). The evolved carbon dioxide (CO₂) was measured by a flow-through infrared gas analyzer and thermograms were constructed by plotting gas concentrations over time. Thermograms were normalized to the expected milligram of carbon evolved per gram of dry soil sample (mg C / g soil). Samples were not acidified as inorganic carbon content was 0.02% - 0.04% of TOC. Analyses were conducted at the National Ocean Sciences Accelerator Mass Spectrometry Facility (NOSAMS, Woods Hole, MA). We further analyzed the $\delta^{13}\text{C}$ and Fm composition of CO₂ evolved from marsh and pond soils at one representative site.

Data Processing Description

Data were processed using the Ramped pyrox python package (Hemingway, Rothman, Rosengard, & Galy, 2017).

BCO-DMO Processing:

- replaced NaN with nd as the missing data identifier;
- renamed fields to conform with BCO-DMO naming conventions (no spaces or special characters).

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

Data Files

File
RPO_carbon.csv (Comma Separated Values (.csv), 2.14 KB) MD5:0d9c2bc55eae4c75e3cc24a4fd81dc09
Primary data file for dataset ID 827365

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

Related Publications

Hemingway, J. D., Galy, V. V., Gagnon, A. R., Grant, K. E., Rosengard, S. Z., Soulet, G., ... McNichol, A. P. (2017). Assessing the Blank Carbon Contribution, Isotope Mass Balance, and Kinetic Isotope Fractionation of the Ramped Pyrolysis/Oxidation Instrument at NOSAMS. *Radiocarbon*, 59(1), 179–193. doi:10.1017/rdc.2017.3 <https://doi.org/10.1017/RDC.2017.3>
Methods

Hemingway, J. D., Rothman, D. H., Rosengard, S. Z., & Galy, V. V. (2017). Technical note: An inverse method to relate organic carbon reactivity to isotope composition from serial oxidation. *Biogeosciences*, 14(22), 5099–5114. doi:10.5194/bg-14-5099-2017
Methods

McNichol, A. P., Jones, G. A., Hutton, D. L., Gagnon, A. R., & Key, R. M. (1994). The Rapid Preparation of Seawater ΣCO_2 for Radiocarbon Analysis at the National Ocean Sciences Ams Facility. *Radiocarbon*, 36(2), 237–246. doi:10.1017/s0033822200040522 <https://doi.org/10.1017/S0033822200040522>
Methods

Spivak, A. C., Gosselin, K. M., & Sylva, S. P. (2018). Shallow ponds are biogeochemically distinct habitats in salt marsh ecosystems. *Limnology and Oceanography*. doi:10.1002/lno.10797
Methods

Spivak, A. C., Gosselin, K., Howard, E., Mariotti, G., Forbrich, I., Stanley, R., & Sylva, S. P. (2017). Shallow ponds are heterogeneous habitats within a temperate salt marsh ecosystem. *Journal of Geophysical Research: Biogeosciences*, 122(6), 1371–1384. doi:10.1002/2017jg003780 <https://doi.org/10.1002/2017JG003780>
Methods

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

Parameters

Parameter	Description	Units
Site	Site number (1, 2, or 3); three high marsh sites were cored in PIE-LTER	unitless
Location	Location within each site (HIGH MARSH or POND); at each of the three sites, two high marsh cores and one inundated pond core were collected	unitless
Core_ID	Core identifier (1 or 2); the two marsh cores were labeled 1 and 2	unitless
Depth_into_Core	Depth of horizon relative to surface of the marsh	centimeters (cm)
Fraction	Fraction identifier; Five fractions were collected for each soil horizon	unitless
Start_Temp	Starting temperature of fraction collection	degrees Celsius
End_Temp	Ending temperature of fraction collection	degrees Celsius
Carbon_Mass	Mass of carbon within fraction	micrograms
d13C	Stable carbon isotopic value of fraction	per mil
C14	Radioisotopic carbon value of fraction	fraction modern
Ea	Activation energy of fraction	kilojoules per mol

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

Instruments

Dataset-specific Instrument Name	infrared gas analyzer
Generic Instrument Name	Gas Analyzer
Dataset-specific Description	The evolved carbon dioxide (CO ₂) was measured by a flow-through infrared gas analyzer.
Generic Instrument Description	Gas Analyzers - Instruments for determining the qualitative and quantitative composition of gas mixtures.

Dataset-specific Instrument Name	Retsch Mixer Mill 200
Generic Instrument Name	Homogenizer
Dataset-specific Description	Retsch Mixer Mill 200 was used for homogenization.
Generic Instrument Description	A homogenizer is a piece of laboratory equipment used for the homogenization of various types of material, such as tissue, plant, food, soil, and many others.

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

Project Information

Eutrophication Effects on Sediment Metabolism and Benthic Algal-bacterial Coupling: An Application of Novel Techniques in a LTER Estuary (Benthic_PP_at_TIDE)

Coverage: Plum Island Estuary, Rowley Massachusetts

Extracted from the NSF award abstract:

This project will address how rates of benthic microalgal production respond to eutrophication and geomorphological changes in human-impacted tidal creeks. Excess nutrient loading increases benthic algal biomass and likely stimulates production rates but the magnitude of nutrient and geomorphological effects on rates of production is unknown. Will changes in benthic algal productivity affect algal-bacterial coupling? Furthermore, how is algal-bacterial coupling affected by geomorphological changes, which may be exacerbated by excess nutrient loading but can also occur in pristine marshes?

This project will take advantage of the infrastructure of the TIDE project, a long-term saltmarsh eutrophication experiment at the Plum Island Ecosystem - Long Term Ecological Research site in Northeastern Massachusetts. Specifically, the PIs will measure benthic metabolism and examine algal- bacterial coupling in fertilized and ambient nutrient tidal creeks in the first field season. The following field season, they will compare sediment metabolism and carbon dynamics on slumped tidal creek walls (i.e. areas where low marsh has collapsed into the tidal creek) to that on the bottom of tidal creeks. In both years, gross and net production will be determined using an innovative triple oxygen isotope technique and traditional dissolved oxygen and inorganic carbon flux measurements. Comparisons between these methods will be useful in informing studies of sediment metabolism. Lipid biomarkers will be used to characterize the sources of organic matter to creek sediments, and stable isotope analysis of bacterial specific biomarkers to identify the sources of organic carbon utilized by sediment bacteria. The biomarkers will reveal whether sediment bacteria use organic matter substrates, such as benthic microalgal carbon, selectively or in proportion to availability. Overall, results from the proposed study will provide important information about how sediment carbon dynamics in shallow tidal creeks respond to long term eutrophication. Furthermore, findings will enhance understanding of the role of tidal creeks in coastal biogeochemistry.

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

Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1233678

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