Sediment pore water and solid phase geochemical analyses from samples collected on R/V Savannah cruise SAV-17-15 in the Gulf of Mexico during July and August 2017

Website: https://www.bco-dmo.org/dataset/806105
Data Type: Cruise Results
Version: 1
Version Date: 2020-03-17

Project
» Source, Composition, and Stability of Soluble Iron Fluxing from Continental Margin Sediments (Soluble Fe Fluxing)

Contributors	Affiliation	Role
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Abstract
Sediment pore water and solid phase geochemical analyses from samples collected on R/V Savannah cruise SAV-17-15 in the Gulf of Mexico during July and August 2017.

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Coverage

Spatial Extent: **N**:28.9476 **E**:-88.8484 **S**:28.2007 **W**:-91.3362
Temporal Extent: 2017-07-26 - 2017-08-06

Methods & Sampling

Sediments were collected and profiled immediately with voltammetric Hg/Au microelectrodes deployed on a computer-controlled micromanipulator (Beckler et al., 2016). Sediment pore waters were then extracted from the same core and either preserved until analysis or analyzed immediately onboard ship. Sampling and analyses were conducted immediately after sediment collection to minimize artifacts from exposure to the atmosphere.

Sediment cores were obtained by a MC-800 multi-corer and profiled within 30 minutes with voltammetric Hg/Au microelectrodes deployed on a computer-controlled micromanipulator. After profiling, sediments were immediately sliced under N_2 atmosphere and pore waters extracted by centrifugation at 3000 rpm under N_2 atmosphere. Finally, pore waters were immediately filtered (0.2 µM PSE Puradisc syringe filters, Whatman) under N_2 atmosphere and either preserved at -20C until analysis (Br^-, NO_2^-, NO_3^-, SO_4^{2-}), preserved at 4C after acidification (NH_4^+), dispensed directly into reagents for analysis (Fe(II), Fed, Mnd, SPO_4^{3-}), or analyzed immediately (DIC, TA). Br^-, NO_2^-, NO_3^-, and SO_4^{2-} were measured by non-suppressed HPLC with UV detection (Beckler et al., 2014). NH_4^+ was measured spectrophopotmetrically by the indophenol blue method (Strickland

and Parsons, 1972), Fed and Fe(II) were measured by the ferrozine method after addition or not of hydroxylamine (Stookey, 1970). Mnd was measured by the porphyrin kinetic spectrophotometric method (Madison et al., 2011) modified to account for dissolved Fe(II) interferences (Owings et al., 2020). SPO_4^{3-} was measured spectrophotometrically using the molybdate-blue method after natural color correction to avoid interferences from dissolved silica and sulfides (Murphy and Riley, 1962). DIC was measured by flow injection analysis with conductivity detection after spiking samples with 10 mM $ZnCl_2$ to prevent dissolved sulfide interferences (Hall and Aller, 1992). Finally, TA was measured by acid titration in an open-cell with continuous pH measurements (Dickson et al., 2007; Rassmann et al., 2016). All errors reported for the electrochemical measurements represent the standard deviation of at least triplicate measurements. Errors of all other parameters represent the analytical error propagated from calibration curves, dilution, and instrumental drift.

Problem report: Some of the data are missing because pore water volumes were too low to make all the measurements.

Data Processing Description

Chromatographic data were processed using Voltint (Bristow and Taillefert, 2008), a Matlab™-based software developed for these applications. Spectrophotometric measurements were processed manually.

BCO-DMO Processing:
- added date column using original year, month, and day columns.

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Data Files

File	
porewater_SAV17-15.csv	(Comma Separated Values (.csv), 35.93 KB) MD5:b535a05764c297d3069d7d42edee29fa
Primary data file for dataset ID 806105	

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Related Publications

Beckler, J. S., Kiriazis, N., Rabouille, C., Stewart, F. J., & Taillefert, M. (2016). Importance of microbial iron reduction in deep sediments of river-dominated continental-margins. Marine Chemistry, 178, 22–34. doi:10.1016/j.marchem.2015.12.003
Methods

Beckler, J. S., Nuzzio, D. B., & Taillefert, M. (2014). Development of single-step liquid chromatography methods with ultraviolet detection for the measurement of inorganic anions in marine waters. Limnology and Oceanography: Methods, 12(8), 563–576. doi:10.4319/lom.2014.12.563
Methods

Bristow, G., & Taillefert, M. (2008). VOLTINT: A Matlab®-based program for semi-automated processing of geochemical data acquired by voltammetry. Computers & Geosciences, 34(2), 153–162. doi:10.1016/j.cageo.2007.01.005
Methods

Dickson, A.G., Sabine, C.L. and Christian, J.R. (Eds.) 2007. Guide to best practices for ocean CO2 measurements. PICES Special Publication 3, 191 pp. ISBN: 1-897176-07-4. URL: https://www.nodc.noaa.gov/ocads/oceans/Handbook_2007.html https://hdl.handle.net/11329/249
Methods

Eitel, E. M., Owings, S. M., Belli, K. M., Beckler, J. S., Williams, A., Fields, B. P., … Taillefert, M. (2020). Variations in sediment production of dissolved iron across a continental margin not dominated by major upwelling or riverine inputs. Marine Chemistry, 220, 103750. doi:10.1016/j.marchem.2020.103750
Results

Hall, P. . J., & Aller, R. C. (1992). Rapid, small-volume, flow injection analysis for total CO2, and NH4+ in marine and freshwaters. Limnology and Oceanography, 37(5), 1113–1119. doi:10.4319/lo.1992.37.5.1113
Methods

Madison, A. S., Tebo, B. M., & Luther, G. W. (2011). Simultaneous determination of soluble manganese(III), manganese(II) and total manganese in natural (pore)waters. Talanta, 84(2), 374–381. doi:10.1016/j.talanta.2011.01.025
Methods

Murphy, J., & Riley, J. P. (1962). A modified single solution method for the determination of phosphate in natural waters. Analytica Chimica Acta, 27, 31–36. doi:10.1016/s0003-2670(00)88444-5
Methods

Rassmann, J., Lansard, B., Pozzato, L., & Rabouille, C. (2016). Carbonate chemistry in sediment porewaters of the Rhone River delta driven by early diagenesis (northwestern Mediterranean). Biogeosciences, 13(18), 5379–5394. doi:10.5194/bg-13-5379-2016
Methods

Stookey, L. L. (1970). Ferrozine---a new spectrophotometric reagent for iron. Analytical Chemistry, 42(7), 779–781. doi:10.1021/ac60289a016
Methods

Strickland, J. D. H. and Parsons, T. R. (1972). A Practical Hand Book of Seawater Analysis. Fisheries Research Board of Canada Bulletin 157, 2nd Edition, 310 p.
Methods

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Parameters

Parameter	Description	Units
Year	Year	unitless
Month	Month	unitless
Day	Day	unitless
Collection_Type	Type of collection	unitless
Station	Station number	unitless
Lon	Longitude	decimal degrees East
Lat	Latitude	decimal degrees North
sample_ID	Sample ID number	unitless
Sediment_depth	Sediment depth	centimeters (cm)
Fe_II	Dissolved ferrous iron	micromolar (uM)

sdFe_II	Standard deviation of Fe_II	micromolar (uM)
Fed	Total dissolved iron	micromolar (uM)
sdFed	Standard deviation of Fed	micromolar (uM)
Fe_III_d	Dissolved ferric iron	micromolar (uM)
sdFe_III_d	Standard deviation of Fe_III_d	micromolar (uM)
DIC	Dissolved inorganic carbon	millimolar (mM)
sdDIC	Standard deviation of DIC	millimolar (mM)
PO4	Dissolved orthophosphate	micromolar (uM)
sdPO4	Standard deviation of PO4	micromolar (uM)
Mnd	Total dissolved manganese	micromolar (uM)
sdMnd	Standard deviation of Mnd	micromolar (uM)
NH4	Dissolved ammonium	micromolar (uM)
sdNH4	Standard deviation of NH4	micromolar (uM)
NO2	Dissolved nitrite	micromolar (uM)
sdNO2	Standard deviation of NO2	micromolar (uM)
Br	Dissolved bromide	micromolar (uM)
sdBr	Standard deviation of Br	micromolar (uM)
NO3	Dissolved nitrate	micromolar (uM)
sdNO3	Standard deviation of NO3	micromolar (uM)

Cl	Dissolved chloride	millimolar (mM)
sdCl	Standard deviation of Cl	millimolar (mM)
SO42	Sulfate	millimolar (mM)
sdSO42	Standard deviation of SO42	millimolar (mM)
TA	Total Alkalinity	millimolar (mM)
sdTA	Standard deviation of TA	millimolar (mM)
date	Date; format: yyyy-mm-dd	unitless

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Instruments

Dataset-specific Instrument Name	Flow Injection Analysis
Generic Instrument Name	Flow Injection Analyzer
Dataset-specific Description	Flow Injection Analysis with peristaltic pump (Gilson), conductivity detector (Fisher Scientific), and integrator with LC-100 software (Analytical Systems, Inc.)
Generic Instrument Description	An instrument that performs flow injection analysis. Flow injection analysis (FIA) is an approach to chemical analysis that is accomplished by injecting a plug of sample into a flowing carrier stream. FIA is an automated method in which a sample is injected into a continuous flow of a carrier solution that mixes with other continuously flowing solutions before reaching a detector. Precision is dramatically increased when FIA is used instead of manual injections and as a result very specific FIA systems have been developed for a wide array of analytical techniques.

Dataset-specific Instrument Name	HPLC
Generic Instrument Name	High-Performance Liquid Chromatograph
Dataset-specific Description	Br^-, NO_2^-, NO_3^-, and SO_4^{2-} were measured by non-suppressed HPLC with UV detection
Generic Instrument Description	A High-performance liquid chromatograph (HPLC) is a type of liquid chromatography used to separate compounds that are dissolved in solution. HPLC instruments consist of a reservoir of the mobile phase, a pump, an injector, a separation column, and a detector. Compounds are separated by high pressure pumping of the sample mixture onto a column packed with microspheres coated with the stationary phase. The different components in the mixture pass through the column at different rates due to differences in their partitioning behavior between the mobile liquid phase and the stationary phase.

Dataset-specific Instrument Name	MC-800 multi-corer
Generic Instrument Name	Multi Corer
Dataset-specific Description	Sediment cores were obtained by a MC-800 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.

Dataset-specific Instrument Name	spectrophopotmeter
Generic Instrument Name	Spectrophotometer
Dataset-specific Description	NH_4^+ was measured spectrophopotmetrically
Generic Instrument Description	An instrument used to measure the relative absorption of electromagnetic radiation of different wavelengths in the near infra-red, visible and ultraviolet wavebands by samples.

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Deployments

SAV-17-15

Website	https://www.bco-dmo.org/deployment/806108
Platform	R/V Savannah
Start Date	2017-07-19
End Date	2017-08-13
Description	More cruise information from the Rolling Deck to Repository (R2R): https://www.rvdata.us/search/cruise/SAV-17-15

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Project Information

Source, Composition, and Stability of Soluble Iron Fluxing from Continental Margin Sediments (Soluble Fe Fluxing)

Coverage: Northern South Atlantic Bight (Cape Lookout, NC) and Northern Gulf of Mexico

NSF Award Abstract:
Iron is a limiting nutrient in the world's oceans and plays a key role in regulating the growth of phytoplankton. The main sources of iron to the open ocean are the atmosphere, through wind-blown terrestrial dust, and the seafloor, through input from continental shelf sediments. While atmospheric inputs have been well-studied, the oceanic input of iron from sediments has only sparsely been measured and, as a result, the relative importance of the sediment-derived iron to the iron pool and, ultimately, primary productivity in the oceans is poorly understood. In this study, researchers will examine the chemical properties of sediment-derived iron in the oceans to assess its contribution to the iron used by phytoplankton. Results from this study will further our understanding of iron inputs to the ocean and their importance to ocean primary productivity. The project will contribute to the training of graduate students, as well as provide educational opportunities such as a day at sea for undergraduate students in engineering and physical science.

The atmosphere and continental margin sediments are the main source of the limiting nutrient iron (Fe) to the open ocean. Yet, the chemical form of iron from sediments has not been well examined and only quantified as reduced iron or the dissolved iron passing through 0.45 µm filters. The kinetics of iron oxygenation suggests it should precipitate rapidly in the overlying waters, challenging the view that sediments are important sources of iron for primary production. To establish whether the flux of iron from sediments has important implications for primary productivity, possibly rivaling atmospheric inputs, it is necessary to demonstrate that ferric iron originating in sediments is under the form of stable iron species with potential for a high residence time in the water column. The overall objective of this project is to test the hypotheses that iron fluxing across the sediment-water interface in continental margin sediments is dissolved under the form of organic-Fe(III) complexes and that the magnitude of the iron flux is influenced by the redox conditions in the overlying waters, the composition of the complexes, and the biogeochemical processes in the underlying sediments. To test these hypotheses, the flux and speciation of dissolved Fe(III) will be quantified in the sediments of the Carolina depocenter and the Gulf of Mexico, and the biogeochemical processes regulating the production and the flux of iron as a function of the redox regime of the environment will be determined using in situ measurements and state-of-the-art voltammetric and chromatographic techniques.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1438648

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