# Total organic sulfur (TOS) collected from Niskin bottle samples on R/V Knorr cruise KN210-04 in the Western Atlantic Ocean between Uruguay and Barbados from March to May 2013 (Deep Atlantic DOM project)

**Website**: https://www.bco-dmo.org/dataset/745536
**Data Type**: Cruise Results
**Version**: 1
**Version Date**: 2018-09-04

**Project**
» Dissolved Organic Matter Composition in the Deep Atlantic Ocean (Deep Atlantic DOM)

**Programs**
» Ocean Carbon and Biogeochemistry (OCB)
» Center for Chemical Currencies of a Microbial Planet (C-CoMP)



| Contributors | Affiliation | Role |
|---|---|---|
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**Abstract**
This dataset contains the concentration of total organic sulfur (TOS) in seawater from samples collected during the R/V Knorr cruise KN210-04 between 29 Mar 2013 and 06 May 2013 along the eastern coast of South America.

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## Table of Contents



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## Coverage

**Spatial Extent**: **N**:9.700333 **E**:-28.502444 **S**:-37.998253 **W**:-55.29925
**Temporal Extent**: 2013-03-27 - 2013-05-04

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## Dataset Description

This dataset contains the concentration of total organic sulfur in seawater from samples collected during the R/V Knorr cruise KN210-04 between 29 Mar 2013 and 06 May 2013 along the eastern coast of South America.

**Methods & Sampling**

Whole seawater samples for obtaining the concentration of total organic sulfur (TOS) were collected directly from the Niskin bottles into combusted 40 mL glass vials. The vials were stored frozen (-20°C) until analysis on land.

TOS was determined as described in Cutter et al. In brief, a sample is pumped through three ion exchange cartridges connected in series, a 1 mL Ba (Dionex OnGuard II #057093) to remove most of the sulfate, then through a 2.5 mL Ag (Dionex OnGuard II Ag #057090) to remove chloride, and finally through a 1 mL cartridge packed with BioRad AG 4x4 resin (#143-3341) to remove the remaining sulfate. The resulting sample is then analyzed via ion chromatography to quantify remaining sulfate. Total sulfur is quantitatively converted to H2S by via reductive pyrolysis in pure hydrogen gas and quantified by gas chromatography/flame photometric detection using the trapping /detection system of Radford-Knoery and Cutter. Total organic sulfur is calculated as the difference between total sulfur and residual sulfate. Each step of this analysis has an error attached. The units for TOS are nM; when provided, TOS_sd is the standard deviation of the average for replicate samples. Precision was >10% RSD at/above 200 nM S and the detection limit was 26 nM S.

[ table of contents | back to top ]

## Data Files

| File |
|---|
| **TOS.csv**(Comma Separated Values (.csv), 2.51 KB)<br>MD5:2632ae3e5fac135e0484a2e6d5c3cbfe<br><br>Primary data file for dataset ID 745536 |

[ table of contents | back to top ]

## Related Publications

Cutter, G. A., Cutter, L. S., & Filippino, K. C. (2004). Sources and cycling of carbonyl sulfide in the Sargasso Sea. Limnology and Oceanography, 49(2), 555–565. doi:10.4319/lo.2004.49.2.0555
*Methods*

Radford-Knoery, J., & Cutter, G. A. (1993). Determination of carbonyl sulfide and hydrogen sulfide species in natural waters using specialized collection procedures and gas chromatography with flame photometric detection. Analytical Chemistry, 65(8), 976–982. doi:10.1021/ac00056a005
*Methods*

[ table of contents | back to top ]

## Parameters

| Parameter | Description | Units |
|---|---|---|
| cast | cast number | unitless |
| station | station number | unitless |
| date_utc_YYYYMMDD_start | date, UTC, given as year – month – day | unitless |
| time_utc_HHMM_start | time, UTC, given as hour – minute | unitless |
| event_start | the event number from the ELOG maintained during the cruise | unitless |
| depth_m | depth in meters | meter (m) |
| lat_start | latitude | decimal degrees |
| lon_start | longitude | decimal degrees |
| TOS_nM | total organic sulfur, in nM | nanomolar (nM) |
| TOS_sd | standard deviation for total organic sulfur, from averages of replicates where available | nanomolar (nM) |

[ table of contents | back to top ]

## Instruments

| | |
|---|---|
| **Dataset-specific Instrument Name** | ion chromatography |
| **Generic Instrument Name** | Ion Chromatograph |
| **Dataset-specific Description** | In brief, a sample is pumped through three ion exchange cartridges connected in series, a 1 mL Ba (Dionex OnGuard II #057093) to remove most of the sulfate, then through a 2.5 mL Ag (Dionex OnGuard II Ag #057090) to remove chloride, and finally through a 1 mL cartridge packed with BioRad AG 4x4 resin (#143-3341) to remove the remaining sulfate. The resulting sample is then analyzed via ion chromatography to quantify remaining sulfate. |
| **Generic Instrument Description** | Ion chromatography is a form of liquid chromatography that measures concentrations of ionic species by separating them based on their interaction with a resin. Ionic species separate differently depending on species type and size. Ion chromatographs are able to measure concentrations of major anions, such as fluoride, chloride, nitrate, nitrite, and sulfate, as well as major cations such as lithium, sodium, ammonium, potassium, calcium, and magnesium in the parts-per-billion (ppb) range. (from http://serc.carleton.edu/microbelife/research_methods/biogeochemical/ic....) |

| | |
|---|---|
| **Dataset-specific Instrument Name** | Niskin bottle |
| **Generic Instrument Name** | Niskin bottle |
| **Dataset-specific Description** | Whole seawater samples for obtaining the concentration of total organic sulfur (TOS) were collected directly from the Niskin bottles into combusted 40 mL glass vials. |
| **Generic Instrument Description** | A Niskin bottle (a next generation water sampler based on the Nansen bottle) is a cylindrical, non-metallic water collection device with stoppers at both ends. The bottles can be attached individually on a hydrowire or deployed in 12, 24, or 36 bottle Rosette systems mounted on a frame and combined with a CTD. Niskin bottles are used to collect discrete water samples for a range of measurements including pigments, nutrients, plankton, etc. |

[ table of contents | back to top ]

## Deployments

**KN210-04**

| | |
|---|---|
| **Website** | https://www.bco-dmo.org/deployment/59057 |
| **Platform** | R/V Knorr |
| **Start Date** | 2013-03-25 |
| **End Date** | 2013-05-09 |
| **Description** | Western Atlantic cruise started at Montevideo, Uruguay and ended at Bridgetown, Barbados. Science Objectives: 1. Characterize deep ocean dissolved organic matter in water masses of western Atlantic Ocean. 2. Characterize microbial community at selected stations and at selected depths. 3. Characterize metabolic capabilities of surface, mesopelagic and bathypelagic microbial consortia vis-a-vis the degradation of organic matter from each zone. 4. Examine metabolic and phylogenetic links between microbes in different marine zones (surface, meso-pelagic and bathypelagic depths). Science Activities: 1. Collection of discrete water samples by Niskin-bottles. 2. Collection of microbial communities from these water samples, by in-situ pumping, or by net-traps and net-tows. 3. Incubation experiments in lab and on deck. 4. Underway mass spectrometry and flow cytometry, from seawater intake. More information is available from the WHOI Cruise Planning Synopsis. Additional cruise information and original data are available from the NSF R2R Data Catalog. |

[ table of contents | back to top ]

## Project Information

### Dissolved Organic Matter Composition in the Deep Atlantic Ocean (Deep Atlantic DOM)

**Coverage**: Western Atlantic Ocean

Transformations of dissolved organic matter (DOM) in the deep ocean have profound impacts on the global carbon cycle due to the sequestration of carbon dioxide ($CO_2$) away from the atmosphere. Although research has been conducted on the high molecular weight component of this material, the same cannot be said for low molecular weight DOM because the needed analytical techniques have not been available to determine its composition and reactivity.

In recent years, a research team at Woods Hole Oceanographic Institution has acquired the necessary analytical capability. As such, in this project, they will carry out the first systematic survey of deep ocean DOM in the western Atlantic Ocean to characterize the low molecular weight fraction of DOM in southward flowing North Atlantic Deep Water (NADW), northward flowing Antarctic Bottom Water (AABW), and Antarctic Intermediate Water (AAIW). Using ultrahigh resolution mass spectrometry and multi-stage fragmentation coupled to liquid chromatography, the scientists will determine the spatial variability in the composition of DOM along the flow path of the water masses, as well as assess the source water, transport, and surface processes that contribute to temporal changes in DOM composition. These results will be augmented with structural elucidation and quantitative assays of unique marker compounds for each water mass. Results will provide important insights into the biogeochemical reactions that govern DOM dynamics in the deep ocean.

[ table of contents | back to top ]

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## Program Information

### Ocean Carbon and Biogeochemistry (OCB)

**Website**: http://us-ocb.org/

**Coverage**: Global

The Ocean Carbon and Biogeochemistry (OCB) program focuses on the ocean's role as a component of the global Earth system, bringing together research in geochemistry, ocean physics, and ecology that inform on and advance our understanding of ocean biogeochemistry. The overall program goals are to promote, plan, and coordinate collaborative, multidisciplinary research opportunities within the U.S. research community and with international partners. Important OCB-related activities currently include: the Ocean Carbon and Climate Change (OCCC) and the North American Carbon Program (NACP); U.S. contributions to IMBER, SOLAS, CARBOOCEAN; and numerous U.S. single-investigator and medium-size research projects funded by U.S. federal agencies including NASA, NOAA, and NSF.

The scientific mission of OCB is to study the evolving role of the ocean in the global carbon cycle, in the face of environmental variability and change through studies of marine biogeochemical cycles and associated ecosystems.

The overarching OCB science themes include improved understanding and prediction of: 1) oceanic uptake and release of atmospheric CO2 and other greenhouse gases and 2) environmental sensitivities of biogeochemical cycles, marine ecosystems, and interactions between the two.

The OCB Research Priorities (updated January 2012) include: ocean acidification; terrestrial/coastal carbon fluxes and exchanges; climate sensitivities of and change in ecosystem structure and associated impacts on biogeochemical cycles; mesopelagic ecological and biogeochemical interactions; benthic-pelagic feedbacks on biogeochemical cycles; ocean carbon uptake and storage; and expanding low-oxygen conditions in the coastal and open oceans.

### Center for Chemical Currencies of a Microbial Planet (C-CoMP)

**Website**: https://ccomp-stc.org/

**Coverage**: North Atlantic, BATS, global/other

Functions carried out by microscopic inhabitants of the surface ocean affect every aspect of life on our planet, regardless of distance from the coast. Ocean phytoplankton are responsible for half of the photosynthesis on Earth, the first step in a complex system that annually withdraws 50 billion metric tons of carbon from the atmosphere to sustain their growth. Of this, 25 billion metric tons participate in a rapid cycle in which biologically reactive material is released into seawater and converted back into carbon dioxide by marine bacteria within hours to days. The chemical-microbe network at the heart of this fast cycle remains poorly constrained; consequently, its primary currencies and controls remain elusive; its sensitivities to changing ocean conditions are unknown; and its responses to future climate scenarios are not predictable. The Center for Chemical Currencies of a Microbial Planet (C-CoMP) integrates research, education and knowledge transfer activities to develop a mechanistic understanding of surface ocean carbon flux within the context of a changing ocean and through increased participation in ocean sciences. C-CoMP supports science teams that merge biology, chemistry, modeling, and informatics to close long-standing knowledge gaps in the identities and dynamics of organic molecules that serve as the currencies of elemental transfer between the ocean and atmosphere. C-CoMP fosters education, outreach, and knowledge transfer activities that engage students of all ages, broaden participation in the next generation of ocean scientists, and extend novel open-science approaches into complementary academic and industrial communities. The Center framework is critical to this mission, uniquely facilitating an open exchange of experimental and computational science, methodological and conceptual challenges, and collaborations that establish integrated science and education partnerships. With expanded participation in ocean science research and ocean literacy across the US society, the next generation of ocean scientists will better reflect the diverse US population.

Climate-carbon feedbacks on the marine carbon reservoir are major uncertainties for future climate projections, and the trajectory and rate of ocean changes depend directly on microbial responses to temperature increases, ocean acidification, and other perturbations driven by climate change. C-CoMP research closes an urgent knowledge gap in the mechanisms driving carbon flow between ocean and atmosphere, with global implications for predictive climate models. The Center supports interdisciplinary science teams following open and reproducible science practices to address: (1) the chemical currencies of surface ocean carbon flux; (2) the structure and regulation of the chemical-microbe network that mediates this flux; and (3) sensitivity of the network and its feedbacks on climate. C-CoMP leverages emerging tools and technologies to tackle critical challenges in these themes, in synergy with existing ocean programs and consistent with NSF’s Big Ideas. C-CoMP education and outreach activities seek to overcome barriers to ocean literacy and diversify participation in ocean research. The Center is developing (1) initiatives to expand ocean literacy in K-12 and the broader public, (2) ocean sciences undergraduate curricula and research opportunities that provide multiple entry points into research experiences, (3) post-baccalaureate programs to transition undergraduates into graduate education and careers in ocean science, and (4) interdisciplinary graduate student and postdoctoral programs that prepare the next generation of ocean scientists. The C-CoMP team includes education faculty who evaluate the impacts of education and outreach activities and export successful STEM initiatives to the education community. C-CoMP is revolutionizing the technologies for studying chemical transformations in microbial systems to build understanding of the outsized impact of microbes on elemental cycles. Open science, cross-disciplinary collaborations, community engagement, and inclusive practices foster strategic advances in critical science problems and STEM initiatives. C-CoMP science, education, and knowledge-transfer themes are efficiently addressed through a sustained network of scientists addressing critical research challenges while broadening the workforce that will tackle multi-disciplinary problems with academic, industrial and policy partners.

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 Program's Data Management Plan (DMP) is available as a PDF document.

[ table of contents | back to top ]

## Funding

| Funding Source | Award |
| --- | --- |
| NSF Division of Ocean Sciences (NSF OCE) | OCE-1154320 |

[ table of contents | back to top ]