

# Concentrations of deionized water-soluble aerosol major ions from bulk aerosol samples collected on Leg 2 (Hilo, HI to Papeete, French Polynesia) of the US GEOTRACES PMT cruise (GP15, RR1815) on R/V Roger Revelle from Oct-Nov 2018

**Website:** <https://www.bco-dmo.org/dataset/876005>

**Data Type:** Cruise Results

**Version:** 1

**Version Date:** 2022-06-21

## Project

» [US GEOTRACES Pacific Meridional Transect \(GP15\)](#) (U.S. GEOTRACES PMT)

» [Collaborative Research: US GEOTRACES PMT: Quantification of Atmospheric Deposition and Trace Element Fractional Solubility](#) (PMT Aerosol Collection)

## Program

» [U.S. GEOTRACES](#) (U.S. GEOTRACES)

Contributors	Affiliation	Role
<a href="#">Buck, Clifton S.</a>	Skidaway Institute of Oceanography (SKIO)	Principal Investigator
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## Abstract

This dataset reports the concentrations of deionized water-soluble aerosol major ions determined from bulk aerosol samples collected on Leg 2 (Hilo, HI to Papeete, French Polynesia) of the US GEOTRACES Pacific Meridional Transect (PMT) cruise (GP15, RR1815) on R/V Roger Revelle from October to November 2018.

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## Coverage

**Spatial Extent:** N:18.7523 E:-151.238 S:-20 W:-154.899

**Temporal Extent:** 2018-10-25 - 2018-11-23

## Methods & Sampling

A total of 11 48-hour integrated aerosol samples were collected during Leg 2 of the US GEOTRACES Pacific Meridional Transect research cruise (GP15), which took place on the RV Revelle (cruise RR1815) during October-November 2018. The cruise track consisted of a southward transect across the Pacific Ocean between Hawaii and Tahiti. See [attached Supplemental File](#) of sample locations (.png).

Bulk aerosol samples for major ion analyses were collected using one of five Tisch Environmental high-volume ( $\sim 1 \text{ m}^3 \text{ air min}^{-1}$ ) aerosol samplers (model 5170V-BL). For each deployment, 12 replicate 47 mm diameter Whatman 41 filters were loaded on open-face filter holders (Advantec MFS installed on the aerosol sampler on a PVC adaptor plate (Shelley et al., 2015). Filters were acid-washed before use to reduce trace element blanks, following the procedure described by Morton et al. (2013). The samplers were deployed on the forward rail of the ship's 03 deck approximately 16m above sea level, to minimize the influence of sea spray on samples. Samplers were controlled by wind speed and direction, through a Campbell Scientific CR800 data-logger interfaced with an anemometer and wind vane set up in close proximity to the samplers, in order to eliminate contamination from the ship's stack exhaust. This setup was used to restrict sampling to periods when relative wind speed and direction were  $>0.5 \text{ m s}^{-1}$  and from within  $\pm 60^\circ$  of the bow of the ship, respectively, for at least five continuous minutes.

Following sampling, the filters were transfer to pre-labeled petri slides. A set of filters from each deployment were "instantaneously" leached with ultrahigh purity ( $>18 \text{ M}\Omega\cdot\text{cm}$ ; UHP) water according to the methods in previous studies (Buck et al., 2006; Morton et al., 2013). Other filters were transferred to petri-slides and stored frozen until trace element processing back on land. Approximately 30 mL from each leach was collected in an LDPE bottle to serve as a subsample to be analyzed for major ions. This subsample was stored frozen in a commercial freezer until analysis.

The concentration of the major cations and anions were analyzed by ion chromatography (IC) on a Dionex ICS-2100 instrument. The concentrations of the ions were calculated by linear regression of the system response to a series of standards of known concentration. Analytical accuracy was confirmed by regular analysis of check standards. All standards were made with ACS certified salts in UHP. Ion concentrations for each collection were normalized to  $\text{pmol m}^{-3}$  by dividing by the volume of air sampled.

## Data Processing Description

### Data Processing:

Filter blanks were processed in the same way as samples but were below method detection limits. Reported soluble aerosol major ion concentrations values have been normalized to the volume of air filtered during sample collection. Each sample collection period produced 36 replicate filters. Three of those filters were leached with ultrapure deionized water (DI water) and a subsample from one of these for each deployment was analyzed for major ion concentrations. To assess measurement precision, a subset of samples were analyzed multiple times, from which a relative standard deviation was determined for each major ion species. The standard deviations in the datasheet represent application of these RSDs to all samples. Detection limits are defined as three times the standard deviation from replicate analyses of low concentration samples. Data are marked as described in the datasheet.

### Quality Flags:

Quality flags have been applied with the following definitions:

- 0 = No quality control;
- 1 = Good value;
- 2 = Probably good value;
- 3 = Probably bad value;
- 4 = Bad value;
- 5 = Value changed;
- 6 = Value Below Detection;
- 7 = Value in excess;
- 8 = Interpolated value;
- 9 = Missing value.

### Detection Limits:

Detection limit used is  $3\times\text{SD}$  of triplicate analyses of the lowest measurable sample. All filter blanks were below detection limit for all major ions. Reported detection limits were not normalized by air volume and sample data were evaluated relative to the method detection limit prior to the normalization step in data processing. Data below the detection limit are flagged with code 6 and no value reported ("nd"). Detection limits are reported in the [attached Supplemental File](#) (PDF).

### Note on Standard Deviations:

Only one major ion sample generated per aerosol deployment. A handful of samples were analyzed multiple times, from which a relative standard deviation (%) for each chemical species was determined and this was applied to all values.

### BCO-DMO Processing:

- renamed fields;
- added date/time fields in ISO8601 format and removed original day, month, year, and time columns.

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## Data Files

File
<b>SMLH20_Aerosol_Ions_Leg2.csv</b> (Comma Separated Values (.csv), 2.78 KB) MD5:b25dd30e79a39f4dafacae41a8d5bb80
Primary data file for dataset ID 876005

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## Supplemental Files

File
<b>GP15_SMLH20_Aerosol_Ions_Leg2_Aerosol_Sample_Map.png</b> (Portable Network Graphics (.png), 88.57 KB) MD5:e6d190172b52c35fc75e9b056ea97c45
Map (image) of aerosol sample locations for dataset 876005, "GP15 SMLH20 Aerosol Ions Leg 2".
<b>GP15_SMLH20_Aerosol_Ions_Leg2_Detection_Limits.pdf</b> (Portable Document Format (.pdf), 376.84 KB) MD5:9b63874dcb20d8c2e3529dadd0f57c3c
Table of detection limits for each element reported in Clifton Buck's GP15 SMLH20 Aerosol Ions Leg 2 dataset.

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## Related Publications

Buck, C. S., Landing, W. M., Resing, J. A., & Lebon, G. T. (2006). Aerosol iron and aluminum solubility in the northwest Pacific Ocean: Results from the 2002 IOC cruise. *Geochemistry, Geophysics, Geosystems*, 7(4), n/a-n/a.

doi:10.1029/2005gc000977 <https://doi.org/10.1029/2005GC000977>

*Methods*

Morton, P. L., Landing, W. M., Hsu, S.-C., Milne, A., Aguilar-Islas, A. M., Baker, A. R., ... Zamora, L. M. (2013). Methods for the sampling and analysis of marine aerosols: results from the 2008 GEOTRACES aerosol intercalibration experiment. *Limnology and Oceanography: Methods*, 11(2), 62–78. doi:[10.4319/lom.2013.11.62](https://doi.org/10.4319/lom.2013.11.62)

*Methods*

Shelley, R. U., Morton, P. L., & Landing, W. M. (2015). Elemental ratios and enrichment factors in aerosols from the US-GEOTRACES North Atlantic transects. *Deep Sea Research Part II: Topical Studies in Oceanography*, 116, 262–272.

doi:[10.1016/j.dsr2.2014.12.005](https://doi.org/10.1016/j.dsr2.2014.12.005)

*Methods*

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## Related Datasets

### Continues

Buck, C. S., Landing, W. M., Marsay, C., Umstead, D. (2022) **Concentrations of deionized water-soluble aerosol major ions from bulk aerosol samples collected on Leg 1 (Seattle, WA to Hilo, HI) of the US GEOTRACES Pacific Meridional Transect (PMT) cruise (GP15, RR1814) on R/V Roger Revelle from Sept-Oct 2018.** Biological and Chemical Oceanography Data Management Office (BCO-DMO). (Version 1) Version Date 2022-06-21

doi:10.26008/1912/bco-dmo.875955.1 [[view at BCO-DMO](#)]

*Relationship Description: GP15 was made up of two cruise legs, RR1814 (Leg 1) and RR1815 (Leg 2)*

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## Parameters

Parameter	Description	Units
Cruise_id	Cruise identifier	unitless

GEOTRC_EVENTNO	GEOTRACES Event Number	unitless
GEOTRC_SAMPNO	GEOTRACES Sample Number	unitless
Aerosol_deployment_number	Aerosols-specific sample number (see included map)	unitless
Julian_Day	Date and time (UTC) at start of sample collection; formatted to ISO8601 standard: YYYY-MM-DDThh:mmZ	unitless
Start_ISO_DateTime_UTC	Sampling start Julian day	unitless
Start_Lat	Latitude at start of sample collection	degrees North
Start_Long	Longitude at start of sample collection	degrees East
End_ISO_DateTime_UTC	Date and time (UTC) at end of sample collection; formatted to ISO8601 standard: YYYY-MM-DDThh:mmZ	unitless
End_Lat	Latitude at end of sample collection	degrees North
End_Long	Longitude at end of sample collection	degrees East
Air_Vol_Total	Total volume of air sampled per filter	cubic meters (m <sup>3</sup> )
Na_A_SMLH2O_CONC_HIVOL_uihbk6	Deionized water soluble aerosol Na concentration	picomoles per cubic meter (pmol/m <sup>3</sup> )
SD1_Na_A_SMLH2O_CONC_HIVOL_uihbk6	Relative standard deviation of Na_A_SMLH2O_CONC_HIVOL_uihbk6	picomoles per cubic meter (pmol/m <sup>3</sup> )
Flag_Na_A_SMLH2O_CONC_HIVOL_uihbk6	Quality flag for Na_A_SMLH2O_CONC_HIVOL_uihbk6	unitless
Mg_A_SMLH2O_CONC_HIVOL_gsrmmom	Deionized water soluble aerosol Mg concentration	picomoles per cubic meter (pmol/m <sup>3</sup> )
SD1_Mg_A_SMLH2O_CONC_HIVOL_gsrmmom	Relative standard deviation of Mg_A_SMLH2O_CONC_HIVOL_gsrmmom	picomoles per cubic meter (pmol/m <sup>3</sup> )
Flag_Mg_A_SMLH2O_CONC_HIVOL_gsrmmom	Quality flag for Mg_A_SMLH2O_CONC_HIVOL_gsrmmom	unitless
K_A_SMLH2O_CONC_HIVOL_zistzq	Deionized water soluble aerosol K concentration	picomoles per cubic meter (pmol/m <sup>3</sup> )
SD1_K_A_SMLH2O_CONC_HIVOL_zistzq	Relative standard deviation of K_A_SMLH2O_CONC_HIVOL_zistzq	picomoles per cubic meter (pmol/m <sup>3</sup> )
Flag_K_A_SMLH2O_CONC_HIVOL_zistzq	Quality flag for K_A_SMLH2O_CONC_HIVOL_zistzq	unitless
Ca_A_SMLH2O_CONC_HIVOL_w5ikws	Deionized water soluble aerosol Ca concentration	picomoles per cubic meter (pmol/m <sup>3</sup> )
SD1_Ca_A_SMLH2O_CONC_HIVOL_w5ikws	Relative standard deviation of Ca_A_SMLH2O_CONC_HIVOL_w5ikws	picomoles per cubic meter (pmol/m <sup>3</sup> )
Flag_Ca_A_SMLH2O_CONC_HIVOL_w5ikws	Quality flag for Ca_A_SMLH2O_CONC_HIVOL_w5ikws	unitless
Cl_A_SMLH2O_CONC_HIVOL_unpcbh	Deionized water soluble aerosol Cl concentration	picomoles per cubic meter (pmol/m <sup>3</sup> )
SD1_Cl_A_SMLH2O_CONC_HIVOL_unpcbh	Relative standard deviation of Cl_A_SMLH2O_CONC_HIVOL_unpcbh	picomoles per cubic meter (pmol/m <sup>3</sup> )

Flag_CI_A_SMLH2O_CONC_HIVOL_unpcbh	Quality flag for CI_A_SMLH2O_CONC_HIVOL_unpcbh	unitless
SO4_A_SMLH2O_CONC_HIVOL_gxqblx	Deionized water soluble aerosol SO4 concentration	picomoles per cubic meter (pmol/m <sup>3</sup> )
SD1_SO4_A_SMLH2O_CONC_HIVOL_gxqblx	Relative standard deviation of SO4_A_SMLH2O_CONC_HIVOL_gxqblx	picomoles per cubic meter (pmol/m <sup>3</sup> )
Flag_SO4_A_SMLH2O_CONC_HIVOL_gxqblx	Quality flag for SO4_A_SMLH2O_CONC_HIVOL_gxqblx	unitless
NO3_A_SMLH2O_CONC_HIVOL_kup3gq	Deionized water soluble aerosol NO3 concentration	picomoles per cubic meter (pmol/m <sup>3</sup> )
SD1_NO3_A_SMLH2O_CONC_HIVOL_kup3gq	Relative standard deviation of NO3_A_SMLH2O_CONC_HIVOL_kup3gq	picomoles per cubic meter (pmol/m <sup>3</sup> )
Flag_NO3_A_SMLH2O_CONC_HIVOL_kup3gq	Quality flag for NO3_A_SMLH2O_CONC_HIVOL_kup3gq	unitless

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## Instruments

<b>Dataset-specific Instrument Name</b>	Tisch Environmental high-volume (~1 m <sup>3</sup> air min <sup>-1</sup> ) aerosol samplers (model 5170V-BL)
<b>Generic Instrument Name</b>	Aerosol Sampler
<b>Generic Instrument Description</b>	A device that collects a sample of aerosol (dry particles or liquid droplets) from the atmosphere.

<b>Dataset-specific Instrument Name</b>	anemometer
<b>Generic Instrument Name</b>	Anemometer
<b>Generic Instrument Description</b>	An anemometer is a device for measuring the velocity or the pressure of the wind. It is commonly used to measure wind speed. Aboard research vessels, it is often mounted with other meteorological instruments and sensors.

<b>Dataset-specific Instrument Name</b>	Campbell Scientific CR800 data-logger
<b>Generic Instrument Name</b>	Data Logger
<b>Generic Instrument Description</b>	Electronic devices that record data over time or in relation to location either with a built-in instrument or sensor or via external instruments and sensors.

<b>Dataset-specific Instrument Name</b>	Dionex ICS-2100 ion chromatography system
<b>Generic Instrument Name</b>	Ion Chromatograph
<b>Generic Instrument Description</b>	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 <a href="http://serc.carleton.edu/microbelife/research_methods/biogeochemical/ic...">http://serc.carleton.edu/microbelife/research_methods/biogeochemical/ic...</a> )

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## Deployments

### RR1815

<b>Website</b>	<a href="https://www.bco-dmo.org/deployment/776917">https://www.bco-dmo.org/deployment/776917</a>
<b>Platform</b>	R/V Roger Revelle
<b>Report</b>	<a href="https://datadocs.bco-dmo.org/docs/geotraces/GEOTRACES_PMT/casciotti/data_docs/GP15_Cruise_Report_with_ODF_Report.pdf">https://datadocs.bco-dmo.org/docs/geotraces/GEOTRACES_PMT/casciotti/data_docs/GP15_Cruise_Report_with_ODF_Report.pdf</a>
<b>Start Date</b>	2018-10-24
<b>End Date</b>	2018-11-24
<b>Description</b>	Additional cruise information is available from the Rolling Deck to Repository (R2R): <a href="https://www.rvdata.us/search/cruise/RR1815">https://www.rvdata.us/search/cruise/RR1815</a>

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## Project Information

### US GEOTRACES Pacific Meridional Transect (GP15) (U.S. GEOTRACES PMT)

**Website:** <http://www.geotraces.org/>

**Coverage:** Pacific Meridional Transect along 152W (GP15)

A 60-day research cruise took place in 2018 along a transect from Alaska to Tahiti at 152° W. A description of the project titled "*Collaborative Research: Management and implementation of the US GEOTRACES Pacific Meridional Transect*", funded by NSF, is below. Further project information is available on the [US GEOTRACES website](#) and on the [cruise blog](#). A detailed [cruise report is also available](#) as a PDF.

*Description from NSF award abstract:*

GEOTRACES is a global effort in the field of Chemical Oceanography in which the United States plays a major role. The goal of the GEOTRACES program is to understand the distributions of many elements and their isotopes in the ocean. Until quite recently, these elements could not be measured at a global scale. Understanding the distributions of these elements and isotopes will increase the understanding of processes that shape their distributions and also the processes that depend on these elements. For example, many "trace elements" (elements that are present in very low amounts) are also important for life, and their presence or absence can play a vital role in the population of marine ecosystems. This project will launch the next major U.S. GEOTRACES expedition in the Pacific Ocean between Alaska and Tahiti. The award made here would support all of the major infrastructure for this expedition, including the research vessel, the sampling equipment, and some of the core oceanographic measurements. This project will also support the personnel needed to lead the expedition and collect the samples.

This project would support the essential sampling operations and infrastructure for the U.S. GEOTRACES Pacific Meridional Transect along 152° W to support a large variety of individual science projects on trace element and isotope

(TEI) biogeochemistry that will follow. Thus, the major objectives of this management proposal are: (1) plan and coordinate a 60 day research cruise in 2018; (2) obtain representative samples for a wide variety of TEIs using a conventional CTD/rosette, GEOTRACES Trace Element Sampling Systems, and in situ pumps; (3) acquire conventional CTD hydrographic data along with discrete samples for salinity, dissolved oxygen, algal pigments, and dissolved nutrients at micro- and nanomolar levels; (4) ensure that proper QA/QC protocols are followed and reported, as well as fulfilling all GEOTRACES intercalibration protocols; (5) prepare and deliver all hydrographic data to the GEOTRACES Data Assembly Centre (via the US BCO-DMO data center); and (6) coordinate all cruise communications between investigators, including preparation of a hydrographic report/publication. This project would also provide baseline measurements of TEIs in the Clarion-Clipperton fracture zone (~7.5°N-17°N, ~155°W-115°W) where large-scale deep sea mining is planned. Environmental impact assessments are underway in partnership with the mining industry, but the effect of mining activities on TEIs in the water column is one that could be uniquely assessed by the GEOTRACES community. In support of efforts to communicate the science to a wide audience the investigators will recruit an early career freelance science journalist with interests in marine science and oceanography to participate on the cruise and do public outreach, photography and/or videography, and social media from the ship, as well as to submit articles about the research to national media. The project would also support several graduate students.

### **Collaborative Research: US GEOTRACES PMT: Quantification of Atmospheric Deposition and Trace Element Fractional Solubility (PMT Aerosol Collection)**

**Coverage:** Pacific Ocean along 152 W

#### *NSF Award Abstract:*

The goal of the international GEOTRACES program is to understand the distributions of trace chemical elements and their isotopes in the oceans. An essential part of this effort is determining the sources of trace elements to the oceans, one of which is from the atmosphere: dust falling from the air, and rain, both deliver elements to the sea surface. This project would collect and analyze samples of rainwater and of particles from the atmosphere, along a U.S. GEOTRACES expedition from Alaska to Tahiti in the fall of 2018. The timing of the expedition corresponds to the part of the year with the highest atmospheric dust concentrations in the Gulf of Alaska and may also capture the tail end of peak fire season in Asia. In contrast, the southern end of the proposed ship track is known to have very low atmospheric dust. Aerosols will be influenced by human activity in Asia as well. The anticipated differences in atmospheric deposition along the ship track will allow the assessment of the role of this process on trace element and isotope cycling. The project will support a postdoctoral investigator. The relevance of ocean-atmosphere studies to the public will be communicated at campus open house events and in online forums in collaboration with the GEOTRACES management team.

In alignment with the mission of GEOTRACES, the proposed research will address the following biogeochemical and oceanographic questions: 1) What is the magnitude of atmospheric aerosol deposition (wet and dry) to the surface of the Pacific Ocean? 2) What is the chemical composition of these aerosols and how does composition vary based on source (e.g. Alaskan glacial flour, Asian mineral dust, emissions from biomass burning, anthropogenic emissions)? 3) What is the fractional solubility of trace elements in Pacific aerosols and does solubility vary based on aerosol source? 4) What is the potential bioavailability of soluble aerosol Fe? 5) How is the soluble fraction of aerosol trace elements distributed across operationally defined size classes? 6) How does atmospheric deposition impact distributions of other GEOTRACES parameters? Atmospheric aerosol and precipitation samples will be collected over the 70-day expedition and the investigators will provide sub-samples to collaborators and other interested scientists. These samples will be analyzed for a suite of key trace elements from bulk and size-fractionated aerosol samples, aerosol leachates, and rain samples. A sequential extraction scheme designed to solubilize aerosol Fe as a function of its FeOx morphology and particle size will be used on selected samples because an understanding of aerosol trace element fractional solubility is fundamental to future work to assess the bioavailability of aerosol derived trace elements. The proposed work will provide data that directly contribute to the GEOTRACES objectives related to atmospheric deposition and will help to address temporal variability as this cruise section follows the CLIVAR/Repeat Hydrography P16N line.

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.

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## **Program Information**

### **U.S. GEOTRACES (U.S. GEOTRACES)**

**Website:** <http://www.geotraces.org/>

**Coverage:** Global

**GEOTRACES** is a [SCOR](#) sponsored program; and funding for program infrastructure development is provided by the [U.S. National Science Foundation](#).

GEOTRACES gained momentum following a special symposium, S02: Biogeochemical cycling of trace elements and isotopes in the ocean and applications to constrain contemporary marine processes (GEOSECS II), at a 2003 Goldschmidt meeting convened in Japan. The GEOSECS II acronym referred to the Geochemical Ocean Section Studies. To determine full water column distributions of selected trace elements and isotopes, including their concentration, chemical speciation, and physical form, along a sufficient number of sections in each ocean basin to establish the principal relationships between these distributions and with more traditional hydrographic parameters;

- \* To evaluate the sources, sinks, and internal cycling of these species and thereby characterize more completely the physical, chemical and biological processes regulating their distributions, and the sensitivity of these processes to global change; and

- \* To understand the processes that control the concentrations of geochemical species used for proxies of the past environment, both in the water column and in the substrates that reflect the water column.

GEOTRACES will be global in scope, consisting of ocean sections complemented by regional process studies. Sections and process studies will combine fieldwork, laboratory experiments and modelling. Beyond realizing the scientific objectives identified above, a natural outcome of this work will be to build a community of marine scientists who understand the processes regulating trace element cycles sufficiently well to exploit this knowledge reliably in future interdisciplinary studies.

Expand "Projects" below for information about and data resulting from individual US GEOTRACES research projects.

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## Funding

Funding Source	Award
<a href="#">NSF Division of Ocean Sciences (NSF OCE)</a>	<a href="#">OCE-1756103</a>
<a href="#">NSF Division of Ocean Sciences (NSF OCE)</a>	<a href="#">OCE-1756104</a>

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