Water column profiles of dissolved Actinium-227 (227Ac) from the U.S. GEOTRACES Arctic cruise (HLY1502; GN01) on USCGC Healy from August to October 2015

Website: https://www.bco-dmo.org/dataset/825984
Data Type: Cruise Results
Version: 1
Version Date: 2020-10-02

Project
» U.S. Arctic GEOTRACES Study (GN01) (U.S. GEOTRACES Arctic)
» GEOTRACES Arctic Section: Actinium-227 as a Naturally-occurring Tracer of Dissolved Material Transport in the Arctic Ocean (GT Arctic 227Ac)

Program
» U.S. GEOTRACES (U.S. GEOTRACES)

Contributors	Affiliation	Role
Hammond, Douglas E.	University of Southern California (USC)	Principal Investigator
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Coverage

Spatial Extent: **N**:89.989 **E**:174.817 **S**:60.224 **W**:-180
Temporal Extent: 2015-08-12 - 2015-10-08

Methods & Sampling

In summary: Filtered water from McLane submersible pumps was passed through acetate filter cartridges impregnated with MnO2. Ac, along with Ra and Th, were sorbed to the cartridges. These were returned to USC and analyzed.

See Methodology Supplemental File (BCO-DMO_227Ac_Methods_for_Arctic_Geotraces_GN01.pdf) for details.

Problem report: Some pump deployments failed to deliver sufficient water (nd).

Data Processing Description

BCO-DMO Processing:
- renamed fields to conform with BCO-DMO parameter naming conventions.

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Supplemental Files

File
227Ac Methods for Arctic GEOTRACES filename: BCO-DMO_227Ac_Methods_for_Arctic_Geotraces_GN01.pdf (Portable Document Format (.pdf), 497.75 KB) MD5:62e89f7d29f57e5d7d339eee9d9f2b1e Detailed methods for Arctic GEOTRACES 227Ac dataset contributed by PI D. Hammond.

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Parameters

Parameter	Description	Units
Cruise_ID	Cruise identifier	unitless
GEOTRC_CASTNO	Cast number	unitless
GEOTRC_INSTR	Instrument	unitless
Station_ID	Station number	unitless
Start_Date_UTC	Start date; format: MM/DD/YYYY	unitless
Start_Time_UTC	Start time; format: hh:mm	unitless
Start_ISO_DateTime_UTC	Start date and time (UTC) formatted to ISO8601 standard: YYYY-MM-DDThh:mmZ	unitless
End_Date_UTC	End date; format: MM/DD/YYYY	unitless
End_Time_UTC	End time; format: hh:mm	unitless
End_ISO_DateTime_UTC	End date and time (UTC) formatted to ISO8601 standard: YYYY-MM-DDThh:mmZ	unitless
Start_Latitude	Start latitude	degrees North
Start_Longitude	Start longitude	degrees East
End_Latitude	End latitude	degrees North

End_Longitude	End longitude	degrees East
Event_ID	Event number	unitless
Sample_ID	GEOTRACES sample number	unitless
Sample_Depth	Sample depth	meters (m)
Vol_Flag	Volume flag: 1=320-1500L; 2=200-320L; 3= <200L.	unitless
Ac227	Actinium-227	disintegrations per minute per cubic meter (dpm/m3)
sig_ex227Ac	?	disintegrations per minute per cubic meter (dpm/m3)
Ac_Flag	Ac Flag = Calc method: 1=a; 2=b; 3=c; 4=d.	unitless
Excess_227Ac	Excess Actinium-227	disintegrations per minute per cubic meter (dpm/m3)
sig_ex227Ac_2	?	disintegrations per minute per cubic meter (dpm/m3)
Excess_Ac_Flag	Excess Ac Flag: 1=Use meas Pa; 2=estimated Pa.	unitless

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Instruments

Dataset-specific Instrument Name	
Generic Instrument Name	McLane Pump
Generic Instrument Description	McLane pumps sample large volumes of seawater at depth. They are attached to a wire and lowered to different depths in the ocean. As the water is pumped through the filter, particles suspended in the ocean are collected on the filters. The pumps are then retrieved and the contents of the filters are analyzed in a lab.

Dataset-specific Instrument Name	RaDeCC
Generic Instrument Name	Radium Delayed Coincidence Counter
Dataset-specific Description	RaDeCC manufactured by Scientific Computing, Inc (Columbia, SC)
Generic Instrument Description	The RaDeCC is an alpha scintillation counter that distinguishes decay events of short-lived radium daughter products based on their contrasting half-lives. This system was pioneered by Giffin et al. (1963) and adapted for radium measurements by Moore and Arnold (1996). References: Giffin, C., A. Kaufman, W.S. Broecker (1963). Delayed coincidence counter for the assay of actinon and thoron. J. Geophys. Res., 68, pp. 1749-1757. Moore, W.S., R. Arnold (1996). Measurement of 223Ra and 224Ra in coastal waters using a delayed coincidence counter. J. Geophys. Res., 101 (1996), pp. 1321-1329. Charette, Matthew A.; Dulaiova, Henrieta; Gonneea, Meagan E.; Henderson, Paul B.; Moore, Willard S.; Scholten, Jan C.; Pham, M. K. (2012). GEOTRACES radium isotopes interlaboratory comparison experiment. Limnology and Oceanography - Methods, vol 10, pg 451.

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Deployments

HLY1502

Website	https://www.bco-dmo.org/deployment/638807
Platform	USCGC Healy
Report	https://datadocs.bco-dmo.org/docs/302/geotraces/GEOTRACES_ARCTIC/data_docs/cruise_reports/healy1502.pdf
Start Date	2015-08-09
End Date	2015-10-12
Description	Arctic transect encompassing Bering and Chukchi Shelves and the Canadian, Makarov and Amundsen sub-basins of the Arctic Ocean. The transect started in the Bering Sea (60°N) and traveled northward across the Bering Shelf, through the Bering Strait and across the Chukchi shelf, then traversing along 170-180°W across the Alpha-Mendeleev and Lomonosov Ridges to the North Pole (Amundsen basin, 90°N), and then back southward along ~150°W to terminate on the Chukchi Shelf (72°N). Additional cruise information is available in the GO-SHIP Cruise Report (PDF) and from the Rolling Deck to Repository (R2R): https://www.rvdata.us/search/cruise/HLY1502

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Project Information

U.S. Arctic GEOTRACES Study (GN01) (U.S. GEOTRACES Arctic)

Website: https://www.geotraces.org/

Coverage: Arctic Ocean; Sailing from Dutch Harbor to Dutch Harbor (GN01)

Description from NSF award abstract:

In pursuit of its goal "to identify processes and quantify fluxes that control the distributions of key trace elements and isotopes in the ocean, and to establish the sensitivity of these distributions to changing environmental conditions", in 2015 the International GEOTRACES Program will embark on several years of research in the Arctic Ocean. In a region where climate warming and general environmental change are occurring at amazing speed, research such as this is important for understanding the current state of Arctic Ocean geochemistry and for developing predictive capability as the regional ecosystem continues to warm and influence global oceanic and climatic conditions. The three investigators funded on this award, will manage a large team of U.S.scientists who will compete through the regular NSF proposal process to contribute their own unique expertise in marine trace metal, isotopic, and carbon cycle geochemistry to the U.S. effort. The three managers will be responsible for arranging and overseeing at-sea technical services such as hydrographic measurements, nutrient analyses, and around-the-clock management of on-deck sampling activites upon which all participants depend, and for organizing all pre- and post-cruise technical support and scientific meetings. The management team will also lead educational outreach activities for the general public in Nome and Barrow, Alaska, to explain the significance of the study to these communities and to learn from residents' insights on observed changes in the marine system. The project itself will provide for the support and training of a number of pre-doctoral students and post-doctoral researchers. Inasmuch as the Arctic Ocean is an epicenter of global climate change, findings of this study are expected to advance present capability to forecast changes in regional and globlal ecosystem and climate system functioning.

As the United States' contribution to the International GEOTRACES Arctic Ocean initiative, this project will be part of an ongoing multi-national effort to further scientific knowledge about trace elements and isotopes in the world ocean. This U.S. expedition will focus on the western Arctic Ocean in the boreal summer of 2015. The scientific team will consist of the management team funded through this award plus a team of scientists from U.S. academic institutions who will have successfully competed for and received NSF funds for specific science projects in time to participate in the final stages of cruise planning. The cruise track segments will include the Bering Strait, Chukchi shelf, and the deep Canada Basin. Several stations will be designated as so-called super stations for intense study of atmospheric aerosols, sea ice, and sediment chemistry as well as water-column processes. In total, the set of coordinated international expeditions will involve the deployment of ice-capable research ships from 6 nations (US, Canada, Germany, Sweden, UK, and Russia) across different parts of the Arctic Ocean, and application of state-of-the-art methods to unravel the complex dynamics of trace metals and isotopes that are important as oceanographic and biogeochemical tracers in the sea.

GEOTRACES Arctic Section: Actinium-227 as a Naturally-occurring Tracer of Dissolved Material Transport in the Arctic Ocean (GT Arctic 227Ac)

Coverage: Bering Sea to North Pole

NSF Award Abstract:
In this project, a group of investigators participating in the 2015 U.S. GEOTRACES Arctic expedition will measure profiles of actinium-227, a naturally-occurring radioisotope that can be used as a tracer of oceanic water movement, in the Arctic Ocean. In common with other multinational initiatives in the International GEOTRACES Program, the goals of the U.S. Arctic expedition are to identify processes and quantify fluxes that control the distributions of key trace elements and isotopes in the ocean, and to establish the sensitivity of these distributions to changing environmental conditions. Some trace elements are essential to life, others are known biological toxins, and still others are important because they can be used as tracers of a variety of physical, chemical, and biological processes in the sea. The isotope measured as part of this study, actinium-227, has a 22 year half-life, making it well-suited as a tracer of mixing and solute transport in the Arctic Ocean. This study will involve educational opportunities in scientific research for high school and undergraduate students.

Quantifying the biogeochemical dynamics of the deep sea is necessary to understand the ocean carbon cycle. Despite having a half-life that is well suited for the study of both vertical and lateral transport in the deep ocean, few actinium-227 measurements have been made in the deep sea. Recent advances in instrumentation facilitate this analysis, and the synergy provided by the GEOTRACES program will provide an ideal opportunity to obtain additional data that will serve two purposes. The measurements of actinium-227 from this study will aid in defining the rates of boundary exchange, particularly when combined with estimates based on radium-228 (measured as part of a separate award) and will be useful for deducing the transport and the dynamics of other solutes measured by GEOTRACES in deep waters. By using multiple tracers with different half-lives, the separate roles of these processes may be distinguished, allowing a more complete understanding of the

dynamics of solute behaviors.

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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
NSF Division of Ocean Sciences (NSF OCE)	OCE-1436958

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