ANNUAL REPORT ON GEOTRACES ACTIVITIES IN UNITED STATES

May 1st, 2021 to April 30th, 2022

New GEOTRACES or GEOTRACES relevant scientific results

With 70 peer-reviewed publications in the past year (see attached list) there are too many results to describe them all. Therefore, the approach here is to begin by listing the projects from US GEOTRACES that were featured as GEOTRACES science highlights during the reporting period. See: < https://www.geotraces.org/category/science/newsflash/>. Following that we will report briefly on the status of GEOTRACES section GP15, completed in 2018, and planning for GEOTRACES section GP17.

Science highlights, in reverse chronological order, with the name of the lead investigator, include:

Highlight Date	**Lead P.I.**	**Synopsis**
05 Apr. 2022	L. Whitmore	Investigated barium (Ba) cycle in the Arctic Ocean through a unique data set containing dissolved (dBa), particulate (pBa), and stable isotope Ba ratio (δ^{138}Ba) data from four Arctic GEOTRACES expeditions in 2015. Determined that the distribution of dissolved Ba in the upper 500 m of the Arctic Ocean is largely set by a shelf sediment source.
17 Mar. 2022	C. Marsay	Trace element (TE) atmospheric deposition fluxes were assessed during the U.S GEOTRACES GP15 transect by measuring bulk aerosol trace element concentrations and deposition during the low dust season. TE concentrations were the lowest measured during GEOTRACES sections. Deposition rates of TEs on particles to the ocean were calculated from the activity of beryllium-7 (^{7}Be) measured in the same aerosol samples as the TM and in the upper 200 m of the water column.
4 Mar. 2022	J. Bishop	Developed optical sensors for collecting real-time particulate inorganic carbon (PIC) concentration and composition data. The system can be deployed from CTDs and ARGO-style Carbon Flux floats providing PIC concentration vertical profiles. Two prototype sensors had been CTD-deployed during GEOTRACES GP15. After PIC comparison and validation retrieved by other methods, the results show that the sensors can detect PIC concentration variability from 0.01 to > 1 μM in the water column (except in nepheloid layers).
28 Jan. 2022	H. Xu	A data-assimilation model of the dissolved aluminum (Al) cycle was developed using data measured along 11

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		sections and extracted from the GEOTRACES Intermediate Data Product 2017 (IDP2017). The model considers all the processes that might affect the oceanic Al distribution. They determined that 37.2 ± 11.0 Gmol/yr of soluble Al is added to the global ocean, predominantly in the Atlantic Ocean, and that Al fractional solubility varies strongly as a function of atmospheric dust concentration. Based on the soluble Fe:Al ratio of dust, the æolian Fe inputs lie between 3.82 and 9.25 Gmol/yr globally.
28 Jan. 2022	S.-Y. S. Chen	Explore the behavior of thorium-230 (^{230}Th) and protactinium-231 (^{231}Pa) in the benthic nepheloid layers (BNLs) by using hydrographic, optical, and radionuclide data from the western segment of GA03 and a simplified model of particle and radionuclide cycling. Results suggest that the processes of sediment resuspension and lateral transport likely play a significant role in the cycling of ^{230}Th and ^{231}Pa in BNLs near oceanic margins. The study also highlights potential biases introduced by sediment redistribution in regions near oceanic margins where benthic nepheloid layers may be present, complicating the application of ^{230}Th normalization and the interpretation of sediment $^{231}Pa/^{230}Th$ records for deep-ocean cores raised from near continental rises and similar reliefs.
10 Nov. 2021	C. Measures	An examination of the vertical profiles of aluminum (Al), silicic acid (Si), and the Si:Al ratio from the 2015 U.S. Arctic GEOTRACES section (GN01), indicates that the enrichment of dissolved Al in the bottom waters of the Arctic basins can result from the dissolution of amorphous aluminosilicates that are produced within the sedimentary pore waters by reverse weathering processes. The conclusions challenge the paradigm that dissolved Al in bottom waters of the Arctic basins could result from top-down process, i.e., the water column remineralization of vertically transported biological material.
14 Sep. 2021	M. Brzezinski	Report on a comprehensive study of the Arctic Ocean silicic acid ($Si(OH)_4$) concentrations and silicon (Si) isotopic composition based on the analysis of a large set of GEOTRACES GN01 cruise samples together with previous data sets. Anomalously heavy isotopes ($d^{30}Si(OH)_4$ up to +3.2 ‰) together with high $Si(OH)_4$ concentrations characterize the surface waters along the transpolar drift. This reflects the influence of the high silicate content of riverine source waters and the strong

		biological $Si(OH)_4$ consumption on the Eurasian shelves.
23 Jul. 2021	Y. Shaked	From the analysis of large datasets collected during 3 GEOTRACES and other research cruises, a new approach for quantifying the availability of dissolved iron (dFe) in natural seawater was established. This approach, based on its uptake kinetics by Fe-limited cultured phytoplankton establishes a standardized proxy for dFe bioavailability in low-Fe oceanic regions. The data suggest that dFe species are highly available in low-Fe settings, likely due to photochemical reactions in sunlit waters.
19 Jul. 2021	L. Zheng	Reports basin-scale sectional distributions of cadmium (Cd), nickel (Ni), zinc (Zn), and copper (Cu) in the North Pacific Ocean along three GEOTRACES transects. Based on the analysis of mole ratios of dissolved metal (dM) to phosphate (dM/PO_4) and the enrichment factor of dM, it is proposed that scavenging influences the distribution of these recycled-type metals in the stagnant Pacific Deep Water (PWD). Cu is the most affected by scavenging, while Cd is the least affected, and scavenging plays a significant role on Zn and Ni.
1 Jul. 2021	J. Farmer	Review of geochemical proxies based upon sedimentary isotope ratios of three abundant biologically mediated elements: carbon (C), nitrogen (N), and silicon (Si), commonly used as productivity tracers. Based on GEOTRACES-era data in four key ocean regions there is an evaluation of the processes that lead to changes in the concentration of these elements and their isotopes in the ocean. The study includes a discussion of the uncertainty on interpreting past sedimentary records by these isotopes and examples of representative geochemical reconstructions using sediment records from the last ice age and over the last 70 million years. This paper was a product of the GEOTRACES-PAGES synthesis workshop held in December 2018.
30 Jun. 2021	T. Horner	Review of oceanic distributions, driving processes, and depositional archives of iron, zinc, copper, cadmium, molybdenum, barium, nickel, chromium, and silver based on GEOTRACES-era datasets. The assessment of the overall maturity of each isotope system as a proxy for past ocean productivity reveals that cadmium, barium, nickel and chromium isotopes offer the most promise as tracers of paleoproductivity, whereas iron, zinc, copper, and molybdenum do not. This paper was a

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		product of the GEOTRACES-PAGES synthesis workshop held in December 2018.
23 Jun. 2021	S. Roshan	Used Artificial Neural Network (ANN) mapping to derive a global 3-dimensional climatology of dissolved Cadmium (Cd). Coupled the climatological maps to an Ocean Circulation Inverse Model to diagnose the biogeochemical sources and sinks of Cd and nutrient phosphate (PO_4^{3-}). The dissolved Cd climatology is downloadable and can benefit the calibration of seawater dissolved Cd concentration against core-top foraminiferal Cd/Ca ratio for paleoceanographic applications.
21 May 2021	C. Hayes	Employ a recently compiled global data set of Thorium-normalized fluxes with an updated database of seafloor surface sediment composition to derive atlases of the deep-sea burial flux of calcium carbonate, biogenic opal, total organic carbon (TOC), nonbiogenic material, iron, mercury, and excess barium (Ba_{xs}). New quantitative estimates of major component burial allow evaluations of deep-sea budgets. The new compilation of sedimentary fluxes contributes to the understanding of regional and global sediment preservation. This paper was a product of the GEOTRACES-PAGES synthesis workshop held in December 2018.

We reiterate that the papers by Hayes, Horner and Farmer are products of the GEOTRACES PAGES synthesis workshop held in December 2018.

The U.S. GEOTRACES project office paid the open access fees to increase the visibility and availability of the following GEOTRACES synthesis papers:

- Costa, K. M., et al (2020), 230Th Normalization: New Insights on an Essential Tool for Quantifying Sedimentary Fluxes in the Modern and Quaternary Ocean, Paleoceanography and Paleoclimatology, 35(2), e2019PA003820, doi:10.1029/2019PA003820.
- Charette, M. A., et al (2020), The Transpolar Drift as a Source of Riverine and Shelf-Derived Trace Elements to the Central Arctic Ocean, Journal of Geophysical Research: Oceans, 125(5), e2019JC015920, doi:10.1029/2019JC015920.
- Black, E. E., et al (2020), Ironing Out Fe Residence Time in the Dynamic Upper Ocean, Global Biogeochemical Cycles, 34(9), e2020GB006592, doi:10.1029/2020GB006592.
- Hayes, C. T., et al (2021), Global Ocean Sediment Composition and Burial Flux in the Deep Sea, Global Biogeochemical Cycles, 35(4), e2020GB006769, doi:10.1029/2020GB006769.

- Horner, T. J., et al (2021), Bioactive Trace Metals and Their Isotopes as Paleoproductivity Proxies: An Assessment Using GEOTRACES-Era Data, Global Biogeochemical Cycles, 35(11), e2020GB006814, doi: 10.1029/2020GB006814.
- Shaked, Y., et al (2021), Probing the Bioavailability of Dissolved Iron to Marine Eukaryotic Phytoplankton Using In Situ Single Cell Iron Quotas, GLOBAL BIOGEOCHEMICAL CYCLES, 35(8), doi:10.1029/2021GB006979.
- Whitmore, et al (2022), Strong Margin Influence on the Arctic Ocean Barium Cycle Revealed by Pan-Arctic Synthesis, Journal of Geophysical Research: Oceans, 127(4), e2021JC017417, doi: 10.1029/2021JC017417.
- Rahman, S., et al (2022), Dissolved and particulate barium distributions along the US GEOTRACES North Atlantic and East Pacific Zonal Transects (GA03 and GP16): Global implications for the marine barium cycle, Global Biogeochemical Cycles, n/a(n/a), e2022GB007330, doi:10.1029/2022GB007330.

GP15

Papers are starting to be published in greater numbers for GP15, the meridional transect from Alaska to Tahiti, while publication of results continues for GA03, GP16 and GN01 (See the science highlights table above and the appended publication list). Here we highlight two publications presenting results from GP15.

Marsay et al. (*2022*; see publication list for the complete reference) measured trace element (TE) concentrations in aerosols. Combining these TE data with results from the measurement of ^{7}Be in the same aerosol samples, and in the upper ~200 m of seawater, these authors were able to compute atmospheric deposition fluxes of TE along the full extent of the GP15 transect during the low dust season (Figure 1).

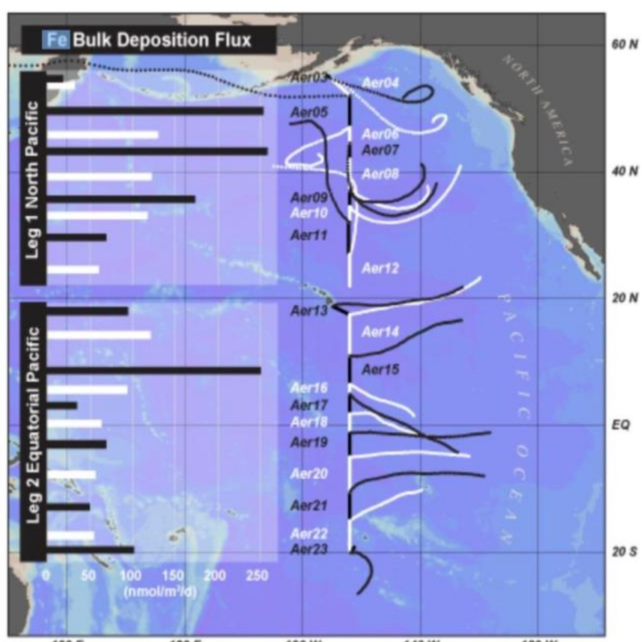

Figure 1. *Map of the GP15 transect with aerosol sampling represented by black (odd number deployments) and white (even deployments) lines spanning between sample deployment and recovery*

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positions. Also shown are 3-day back-trajectories for air masses reaching the start point of each aerosol deployment, and bulk deposition fluxes of Fe for each deployment, based on aerosol Fe concentrations and deposition velocities from [7]Be measurements. Figure from the GEOTRACES website < https://www.geotraces.org/from-alaska-to-tahiti/>.

Along the GP15 transect Chmiel et al. (2022 see publication list for the complete reference) measured dissolved Co (dCo) concentrations, including total dissolved and labile Co. In the upper-ocean (sigma-zero <26) dCo was linearly correlated with dissolved phosphate (dPO_4) due to phytoplankton uptake and remineralization (Figure 2). As depth increased, dCo concentrations became increasingly decoupled from dPO_4 due to co-scavenging with Mn oxide particles. Elevated concentrations of dCo within oxygen minimum zones (OMZs) in the equatorial North and South Pacific were consistent with the suppression of oxidative scavenging. In Pacific Deep Water (PDW), a fraction of elevated ligand-bound dCo appeared protected from scavenging by the high biogenic particle flux in the North Pacific basin. This finding is counter to previous expectations of low dCo concentrations in the deep Pacific due to scavenging along the path of thermohaline circulation.

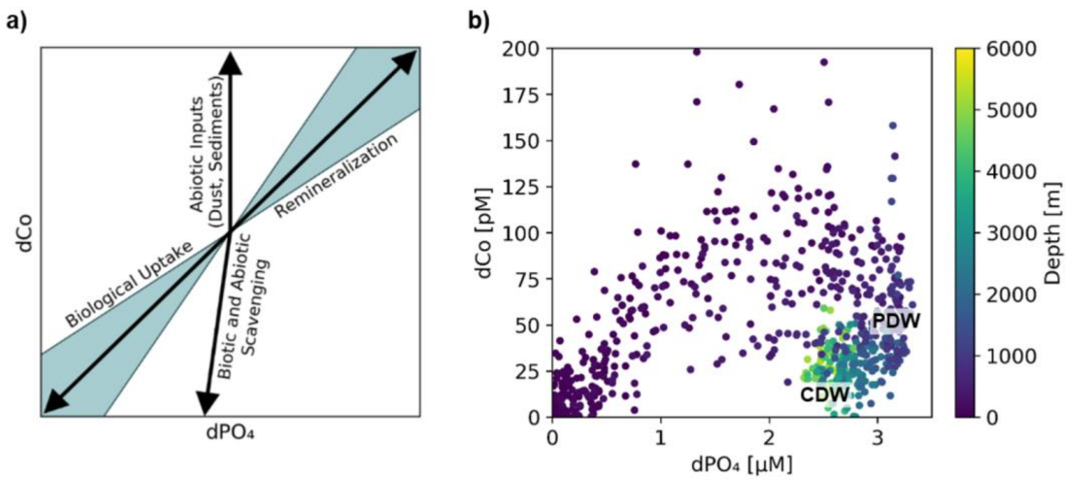

Figure 2. *(a) A vector schematic showing the relationship between dCo and dPO_4 concentrations and the effects of major oceanic processes on nutrient distribution. Biological uptake and remineralization can exhibit a range of stoichiometric relationships, depicted here by the blue shaded region. (b) Observed dCo vs. dPO_4 along the GP15 transect. Approximate positions of Circumpolar Deep Water (CDW) and Pacific Deep Water (PDW) are marked. Figure from Chmiel et al. (2022).*

GEOTRACES or GEOTRACES relevant cruises

There were no US GEOTRACES cruises during the reporting year.

Cruise preparation continues for the two expeditions contributing to GP17: GP17-OCE and GP17-ANT.

U.S. GEOTRACES was originally scheduled to undertake both expeditions (Figure 3) during the current reporting period, but the expeditions were delayed for a year (GP17-OCE) or 2 years (GP17-ANT). The original schedule called for back-to-back cruises with a global class research vessel leaving Tahiti in November 2021 and arriving in Punta Arenas in January 2022. Gear would be immediately transferred to the RVIB Nathaniel B. Palmer and the second cruise would take place from January to March 2022. Currently, the best estimates are that the first cruise will sail from Tahiti at the end of November 2022 while the second cruise will depart from Punta Arenas in late November of 2023. These dates, though recommended, are still subject to change.

The proposed cruise track for each ship is shown below in Figure 3, but as discussed at the GP17-OCE cruise logistics meeting in Norfolk (see below), and subsequently via email, actual planned station locations are still subject to fine tuning. Figure 3 shows the desired station locations for GP17-ANT, with the expectation that actual station locations will be determined by ice conditions at the time of the cruise.

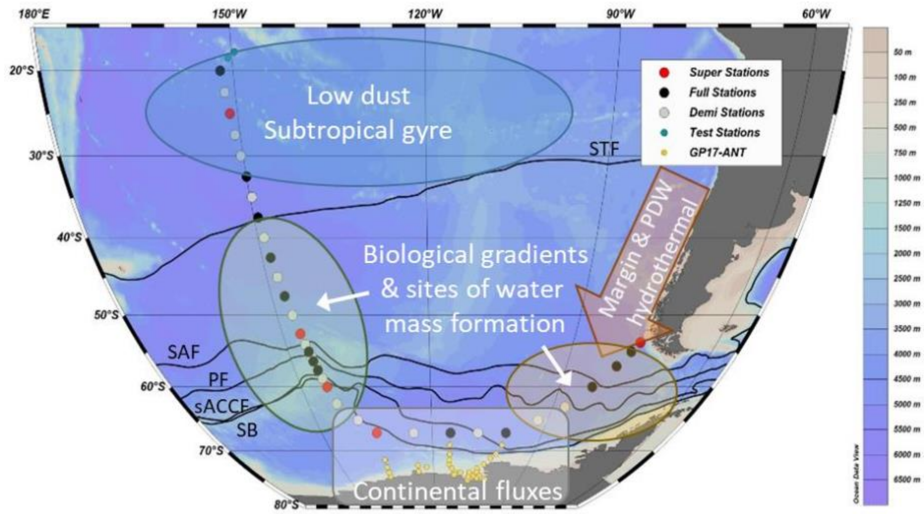

Figure 3. *Station locations for the proposed two-ship operation constituting GEOTRACES section GP17. The legend shows the different types of stations to be sampled from the global class research vessel. In yellow near the coast of Antarctica are the proposed stations for the icebreaker. The principal oceanographic features targeted for study are also indicated. The transits to and from the Amundsen Sea on the icebreaker are not shown in this map.*

Principal investigators for the voyage from Tahiti to Antarctica and then to Chile are Ben Twining (chief scientist), Jessica Fitzsimmons, and Greg Cutter. Principal investigators for the cruise into the Amundsen Sea are Pete Sedwick (chief scientist), Phoebe Lam, and Rob Sherrell.

New projects and/or funding

As of the close of this reporting period, 11 research projects have been funded to participate in GP17-OCE, 3 projects to participate in GP17-ANT, and 11 projects to participate in both. Funding decisions for some proposals are still pending at the time this report was written.

GEOTRACES workshops and meetings organized

U.S. GEOTRACES SSC held a virtual meeting on 7 June 2021. The 8-hour meeting included news from the US NSF, which funds US GEOTRACES research, status reports on GN01 (Arctic Ocean) and GP15 (northern Pacific meridional transect), and the status of plans for GP17-OCE (Tahiti to Antarctica and then to Chile) and GP17-ANT (coastal Antarctica in the

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Amundsen Sea). There was also a discussion of GEOTRACES data management, of the use of ROMS models in GEOTRACES, and of the need to replace/renew GEOTRACES seawater standards. The meeting concluded with a discussion of priorities for GEOTRACES after completion of GP17, anticipating that this would be the primary topic of discussion at the annual SSC meeting in 2022.

A synthesis workshop for GEOTRACES Section GP15 was held in Norfolk Virginia, 14-16 March 2022, at Old Dominion University. Greg Cutter served as the local host. The meeting was held in a hybrid format with approximately 70 total participants. This was the first opportunity for US GEOTRACES investigators to see each other in person since the beginning of the pandemic in early 2020. The meeting began with a plenary review and discussion of 6 existing synthesis topics (Alaskan Margin Processes; Hydrothermal Sources; Near-bottom features in TEIs; Atmospheric inputs; Biological uptake, particle flux, regeneration, scavenging; and Water masses, end member composition, circulation). Workshop participants then broke into working groups to flesh out these topics and to identify new ones. The workshop concluded with a list of potential publications that would pursue these synthesis topics.

A cruise logistics meeting for GEOTRACES Section GP17-OCE was held immediately following the GP15 workshop, 17-18 March 2022, also at Old Dominion University. Holding these meetings back-to-back saved on the transportation cost because many investigators are involved in both sections. The meeting was held in a hybrid format with approximately 70 total participants. With more than 20 funded individual projects, involving a much larger number of investigators, the meeting was designed to identify and meet the research needs of all investigators to the extent possible given the constraints of the cruise logistics. The cruise track and station locations were discussed in plenary after which participants met in breakout groups to sort out the sample requirements for the three principle sampling systems: the standard rosette, used for parameters not prone to contamination; the trace metal-clean rosette, used for parameters prone to contamination; and the in situ pumping system, used to collect size fractionated particles and samples for selected radionuclides that are recovered from large volumes of seawater by sorption onto cartridges.

Early career presence: There were no early career participants at the SSC meeting. There were about 70 participants attending each the Norfolk meetings. Neither meeting compiled a participant list; although there were a number of early career scientists involved in each meeting, it is impossible to determine the number of early career investigators that participated online.

Outreach activities conducted

Outreach activities during the past year were impeded by the pandemic and by the focus on completing GP15. Nevertheless, US GEOTRACES has several outreach activities to report.

Alan Shiller gave a keynote talk at the Research Day of the University of Southern Mississippi in November 2021. The talk was titled "Trace Elements Dissolved in Natural Waters: How the small picture matters for the big picture" and highlighted aspects of GEOTRACES work. The talk was designed for a general audience.

Jennifer Kenyon (WHOI) combined her PhD thesis research that included ^{234}Th on GEOTRACES sections with artwork to help produce a graphic comic book designed to explain through art some of the key scientific concepts featured in GEOTRACES. She helped run a program while still in graduate school called "Synergy II," which is the host name of the website below. Students and scientists at WHOI were partnered with artists who were affiliated with Art League Rhode Island. Kenyon paired up with artist Laurie Kaplowitz, a Boston-based artist and formerly a professor of fine arts at the University of Massachusetts Dartmouth, to produce the comic. The program participation was all voluntary, and Kenyon wrote the proposals to fund the production of the artwork. One can learn more about the comic book here: https://www.synergyexperience.org/pursuit-and-decay.

Investigators at US institutions contributed to several activities related to the release of IDP2021 that were designed to make GEOTRACES data more accessible to users. The principal example is the video of the launch of IDP2021:

https://www.geotraces.org/geotraces-intermediate-data-product-2021-launch-webinar-eventvideos/

Phoebe Lam (University of California at Santa Cruz) described the GEOTRACES program in a US-NSF sponsored video/webinar on NSF-supported programs that observe the ocean:

https://www.geotraces.org/webinar-recording-available-learn-about-geotraces-and-other-nsffunded-projects/ or https://www.nsf.gov/geo/oce/ocean-obs/ocean-observing-webinar-video.mp4

A related post, written by Chris Parsons and edited by Elena Masferrer and Bob Anderson, can be found on the NSF "Science Matters" website:

https://beta.nsf.gov/science-matters/geotraces-research-voyages-studying-rare-substancesoceans

Other GEOTRACES activities

U.S. GEOTRACES has a new website <https://usgeotraces.ldeo.columbia.edu>. Among the new features that will make this website a valuable resource to the oceanographic community are numerous links to relevant information on the international GEOTRACES website and a searchable database of U.S. GEOTRACES publications. Cruise leaders identified as their first priority for the new website that it contains the publications associated with each US GEOTRACES section. This priority has been incorporated into the search features, along with the ability to search by keyword or by each of the following categories: Synthesis, Methods (including intercalibration), International efforts, and Related publications. Work on the website is currently ongoing, but it is sufficiently complete that the website has been opened to public access.

New GEOTRACES or GEOTRACES-relevant publications (published or in press)

A list of 70 US GEOTRACES peer-reviewed papers that were published during the 12-month reporting period is appended at the end of this report.

The number of publications and the number of authors is so large that it is impossible to track all of the early career investigators involved in these publications, or to check each publication

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to see if it acknowledges SCOR support. However, US GEOTRACES investigators have been asked to include SCOR support in their acknowledgements.

Completed GEOTRACES PhD or Master theses (please include the URL link to the pdf file of the thesis, if available)

A list of dissertations is included in the list of publications appended at the end of this report.

GEOTRACES presentations in international conferences

The number of US GEOTRACES presentations at international meetings and conferences is too large to track.

Closing Remark

We close this annual report by remembering **David Kadko**, Chief Scientist of GN01, who passed away during the current reporting period. The original plan of US GEOTRACES field activities did not include work in the Arctic Ocean. David led the charge to insert an Arctic expedition into the US GEOTRACES cruise schedule. He organized and led the expedition as well as research that combined data from different investigators to derive fluxes and residence times of trace elements in the surface waters of the Arctic Ocean. He led similar synthesis research in the southern Equatorial Pacific Ocean and one of his last efforts was to derive a method of estimating aerosol settling rates globally from satellite data. His research was a model for GEOTRACES and he will be sorely missed.

A tribute to Dr. David Kadko is posted on the GEOTRACES website:

https://www.geotraces.org/a-tribute-to-dr-david-kadko/

Submitted by

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Publication appendix follows.

2021-2022 US GEOTRACES and GEOTRACES-related Publications and other products

References 1 May 2021 – 30 April 2022 plus papers missed in previous reports

70 publications, 6 Dissertations and one Data Product (listed after journal publications)

U.S. GEOTRACES and Related Publications

Related Publications include:

1) U.S. GEOTRACES PIs publishing results that support the GEOTRACES mission but the results are not from GEOTRACES cruises,
2) Papers that use data from U.S. GEOTRACES cruises but do not include US GEOTRACES PIs as co-authors, and
3) Papers describing international collaboration on which U.S. GEOTRACES PIs appear as co-authors.

- Bam, W., K. Maiti, and M. Baskaran (2021), 210Po and 210Pb as Tracers of Particle Cycling and Export in the Western Arctic Ocean, Frontiers in Marine Science, 8, 1041.
- Baskaran, M., and K. Krupp (2021), Novel Application of 210Po-210Pb Disequilibria to Date Snow, Melt Pond, Ice Core, and Ice-Rafted Sediments in the Arctic Ocean, Frontiers in Marine Science, 8, 892.
- Baskaran, M., K. Krupp, W. Bam, and K. Maiti (2022), Climate Change Impacts to the Arctic Ocean Revealed from High Resolution GEOTRACES Po-210-Pb-210-Ra-226 Disequilibria Studies, Journal of Geophysical Research-Oceans, 127(5), doi:10.1029/2021JC018359.
- Bishop, J. K. B., V. J. Amaral, P. J. Lam, T. J. Wood, J.-M. Lee, A. Laubach, A. Barnard, A. Derr, and C. Orrico (2022), Transmitted Cross-Polarized Light Detection of Particulate Inorganic Carbon Concentrations and Fluxes in the Ocean Water Column: Ships to ARGO Floats, Frontiers in Remote Sensing, 3.
- Brzezinski, M. A., I. Closset, J. L. Jones, G. F. de Souza, and C. Maden (2021), New Constraints on the Physical and Biological Controls on the Silicon Isotopic Composition of the Arctic Ocean, Frontiers in Marine Science, 8, 931.
- Buck, N. J., P. M. Barrett, P. L. Morton, W. M. Landing, and J. A. Resing (2021), Energy dispersive X-ray fluorescence methodology and analysis of suspended particulate matter in seawater for trace element compositions and an intercomparison with high-resolution inductively coupled plasma-mass spectrometry, Limnology and Oceanography: Methods, 19(6), doi: 10.1002/lom3.10433.
- Carter, T. S., E. E. Joyce, and M. G. Hastings (2021), Quantifying Nitrate Formation Pathways in the Equatorial Pacific Atmosphere from the GEOTRACES Peru-Tahiti Transect, ACS Earth and Space Chemistry, 5(10), 2638-2651, doi:10.1021/acsearthspacechem.1c00072.
- Chamizo, E., M. Christl, M. López-Lora, N. Casacuberta, A. M. Wefing, and T. C. Kenna (2022), The Potential of 233U/236U as a Water Mass Tracer in the Arctic Ocean, Journal of Geophysical Research: Oceans, 127(3), e2021JC017790, doi: 10.1029/2021JC017790.

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- Chen, S.-Y. S., O. Marchal, P. E. Lerner, D. C. McCorkle, and M. M. Rutgers van der Loeff (2021), On the cycling of 231Pa and 230Th in benthic nepheloid layers, Deep Sea Research Part I: Oceanographic Research Papers, 177, 103627, doi: 10.1016/j.dsr.2021.103627.
- Chmiel, R., N. Lanning, A. Laubach, J. M. Lee, J. Fitzsimmons, M. Hatta, W. Jenkins, P. Lam, M. McIlvin, A. Tagliabue, and M. Saito (2022), Major processes of the dissolved cobalt cycle in the North and equatorial Pacific Ocean, Biogeosciences, 19(9), 2365-2395, doi:10.5194/bg-19-2365-2022.
- Close, H. G., P. J. Lam, and B. N. Popp (2021), Marine Particle Chemistry: Influence on Biogeochemical Cycles and Particle Export, ACS Earth and Space Chemistry, 5(5), 12101211, doi:10.1021/acsearthspacechem.1c00091.
- Cohen, N. R., M. R. McIlvin, D. M. Moran, N. A. Held, J. K. Saunders, N. J. Hawco, M. Brosnahan, G. R. DiTullio, C. Lamborg, J. P. McCrow, C. L. Dupont, A. E. Allen, and M. A. Saito (2021a), Dinoflagellates alter their carbon and nutrient metabolic strategies across environmental gradients in the central Pacific Ocean, Nature Microbiology, 6(2), 173-186, doi:10.1038/s41564-020-00814-7.
- Cohen, N. R., A. E. Noble, D. M. Moran, M. R. McIlvin, T. J. Goepfert, N. J. Hawco, C. R. German, T. J. Horner, C. H. Lamborg, J. P. McCrow, A. E. Allen, and M. A. Saito (2021b), Hydrothermal trace metal release and microbial metabolism in the northeastern Lau Basin of the South Pacific Ocean, Biogeosciences, 18(19), 5397-5422, doi:10.5194/bg-18-53972021.
- Conway, T. M., T. J. Horner, Y. Plancherel, and A. G. González (2021), A decade of progress in understanding cycles of trace elements and their isotopes in the oceans, Chemical Geology, 580, 120381, doi: 10.1016/j.chemgeo.2021.120381.
- Crusius, J. (2021), Dissolved Fe Supply to the Central Gulf of Alaska Is Inferred to Be Derived from Alaskan Glacial Dust That Is Not Resolved by Dust Transport Models, Journal of Geophysical Research: Biogeosciences, 126(6), e2021JG006323, doi: 10.1029/2021JG006323.
- Cui, X., C. H. Lamborg, C. R. Hammerschmidt, Y. Xiang, and P. J. Lam (2021), The Effect of Particle Composition and Concentration on the Partitioning Coefficient for Mercury in Three Ocean Basins, Frontiers in Environmental Chemistry, 2, 6.
- Dabrowski, J. S., R. S. Pickart, D. A. Stockwell, P. Lin, and M. A. Charette (2022), Physical drivers of sediment-water interaction on the Beaufort Sea shelf, Deep Sea Research Part I: Oceanographic Research Papers, 181, 103700, doi: 10.1016/j.dsr.2022.103700.
- de Souza, G. F., D. Vance, M. Sieber, T. M. Conway, and S. H. Little (2022), Re-assessing the influence of particle-hosted sulphide precipitation on the marine cadmium cycle, Geochimica et Cosmochimica Acta, 322, 274-296, doi: 10.1016/j.gca.2022.02.009.
- De Vera, J., P. Chandan, W. M. Landing, G. W. Stupple, A. Steffen, and B. A. Bergquist (2021a), Amount, Sources, and Dissolution of Aerosol Trace Elements in the Canadian Arctic, ACS Earth and Space Chemistry, 5(10), 2686-2699, doi:10.1021/acsearthspacechem.1c00132.
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Dissertations

PhD Dissertations

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- Babcock-Adams, Lydia (2022). Molecular Characterization of Organically Bound Copper in the Marine Environment. Ph.D. Thesis, MIT–WHOI Joint Program in Chemical Oceanography, Woods Hole, MA. • Fan, Songyun (2022). Characterization of Aerosol Trace Elements over the Polar Regions. PhD dissertation. Rutgers University Newark, NJ USA
- Kelly, Rachel (2022). Investigations on marine metal cycling through a global expedition, a wildfire survey, and a viral infection. PhD dissertation. University of Southern California.

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Other Products

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