

## ANNUAL REPORT ON GEOTRACES ACTIVITIES IN CANADA

May 1st, 2023 to April 30th, 2024

### *New GEOTRACES or GEOTRACES relevant scientific results*

- Erin Bertrand's group found that hydroxycobalamin is the dominant form of cobalamin (vitamin B12- a cobalt-containing micronutrient) and thus that many of the dissolved marine cobalamin measurements in the literature appear to be chemically inconsistent with this finding. This reconciles some longstanding confusion in the literature and highlights the need for interconnecting trace element analytical methodologies with the developing field of marine metabolite quantification. See Bannon et al 2024 Limnology and Oceanography Letters.
- Erin Bertrand's group continues collaboration with Rob Middag's group at NIOZ to use proteomic methodologies to examine particulate metal use in iron-limited regions of the North Atlantic and Southern Ocean, suggesting that iron limitation profoundly shapes Mn use in diatoms.

### *GEOTRACES or GEOTRACES relevant cruises*

- Jean-Eric Tremblay (ULaval) and Jay Cullen (UVic) conducted trace element and isotope sampling in the Canadian Arctic as part of the ArcticNet supported NTRAIN program (<https://arcticnet.ulaval.ca/project/nutrient-fluxes-and-living-marine-resources-in-the-inuit-nunangat/>) in the eastern, central and western Arctic Ocean in summer 2023.
- Jay Cullen (UVic), Maite Maldonado (UBC), Andrew Ross (DFO) Samples for trace elements and copper ligand measurement were collected using GEOTRACES protocols during Line P cruises in 2021 and 2022 as part of the Line P Iron Program, a GEOTRACES Process Study (GPpr07). Samples for Fukushima derived radionuclides were collected in collaboration with John N. Smith (DFO).

### *New projects and/or funding*

- Summer and Fall 2024 [REFUGE-Arctic](#) and [Transforming Climate Action](#) research programs aboard CCGS Amundsen will explore trace element cycling in the Inuit Nunangat Ocean. Contacts: Mathieu Ardyna, Jean-Eric Tremblay, Jay Cullen, Erin Bertrand
  - REFUGE-ARCTIC is a large international consortium of researchers studying lead by France and including collaborations with the USA, Denmark and Canada that will study how changing sea ice and the hydrological cycle in the Arctic will affect physical, chemical and biological fields (<https://refuge-arctic.ulaval.ca/team.html>). First field work planned for summer and fall 2024
  - The Transforming Climate Action Canada First Research Excellence ([TCA-CFREE](#)) program will examine the roles of metals in carbon cycling in the North Atlantic and Arctic Gateway as part of its efforts to reduce uncertainty in the North Atlantic and Arctic Gateway carbon sink from 2024-2029. Contacts: Jean-Éric Tremblay, Erin Bertrand

### ***Other GEOTRACES activities***

- All 2012-2020 Line P data and intercalibration reports, for oxygen, nutrients and metadata (on behalf of Andrew Ross- Fisheries and Oceans Canada), as well as trace metals (on behalf of Jay Cullen and Robyn Taves, University of Victoria) was submitted by Racquelle Mangahas and Maite Maldonado, University of British Columbia

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

- Ardyna, M. et al (in review) The vital significance of the Arctic's Last Ice Area in a warming world. *Nature Geoscience*.
- Bannon, C., Mudge, E., Bertrand, E.M. (2024) Shedding light on cobalamin photodegradation in the ocean. *Limnology and Oceanography Letters*. 9,2. <https://doi.org/10.1002/lol2.10371>
- Colombo, M., LaRoche, J., Desai, D., Li, J., & Maldonado, M. T. (2023). Control of particulate manganese (Mn) cycling in halocline Arctic Ocean waters by putative Mn-oxidizing bacterial dynamics. *Limnology and Oceanography*, 68(9), 2070-2087. <https://doi.org/10.1002/lno.12407>
- Meyer, A.C.S, J.T. Cullen, D.S. Grundle. (2023). Nitrous oxide distributions in the Oxygenated water column of the Sargasso Sea. *Atmosphere-Ocean*. 61(3), 173-185 <https://doi.org/10.1080/07055900.2022.2153325>
- Rogalla, B., Allen, S. E., Colombo, M., Myers, P. G., & Orians, K. J. (2023). Continental and glacial runoff fingerprints in the Canadian Arctic Archipelago, the Inuit Nunangat Ocean. *Journal of Geophysical Research: Biogeosciences*, 128, e2022JG007072. <https://doi.org/10.1029/2022JG007072>
- Brent M Robicheau, Jennifer Tolman, Sonja Rose, Dhvani Desai, Julie LaRoche, Marine nitrogen-fixers in the Canadian Arctic Gateway are dominated by biogeographically distinct noncyanobacterial communities, *FEMS Microbiology Ecology*, Volume 99, Issue 12, December 2023, fiad122, <https://doi.org/10.1093/femsec/fiad122>
- S. A. Rose, B. M. Robicheau, J. Tolman, D. Fonseca-Batista, E. Rowland, D. Desai, J. M. Ratten, E. J. H. Kantor, A. M. Comeau, M. I. G. Langille, J. Jerlström-Hultqvist, E. Devred, G. Sarthou, E. M. Bertrand, J. LaRoche. Nitrogen-fixation in the widely distributed novel marine  $\gamma$ -proteobacterial diazotroph *Candidatus Thalassolituus haligoni*. *Science Advances* (in press, 2024)
- Saito, M. A., Alexander, H., Benway, H. M., Boyd, P. W., Gledhill, M., Kujawinski, E. B., Levine, N. M., Maheigan, M., Marchetti, A., Obernosterer, I., Santoro, A. E., Shi, D., Suzuki, K., Tagliabue, A., Twining, B. S., & Maldonado, M. T. (2024). The Dawn of the BioGeoSCAPES Program: OCEAN METABOLISM AND NUTRIENT CYCLES ON A CHANGING PLANET. *Oceanography*, 37(2), 162–166. <https://www.jstor.org/stable/27309831>

### ***Completed GEOTRACES PhD or Master theses***

- Zee, M. (2024) A Chemical Characterization of the Endeavour Neutrally Buoyant Plume, Juan de Fuca Ridge. University of Victoria

### ***GEOTRACES presentations in international conferences***

- 2024 Bannon, C, Mudge, E, Bertrand E. Cobalamin cycling in the Northwest Atlantic Ocean Sciences Meeting 2024, Feb. 18-23, New Orleans LA, USA.
- 2024 Onak, C., \*\*A.C.S. Meyer, H. Hunt, R.C. Hamme, J.T. Cullen and T. Conway. Iron Isotope Fractionation Associated with Spatial and Temporal Changes in Redox Conditions - A Time Series Analysis of Saanich Inlet, Ocean Sciences Meeting 2024, Feb. 18-23, New Orleans LA, USA.
- 2023 Cullen, J.T. Monitoring contamination from the Fukushima-Daiichi nuclear power plant in the subarctic northeast Pacific using a community science approach. Gordon Research Conference: Chemical Oceanography, July 16-23, Manchester NH, USA.
- 2023 Zee, M. and J.T. Cullen. Characterizing the trace element chemistry of the Endeavour Ridge neutrally buoyant hydrothermal plume. Chapman Conference on Hydrothermal Circulation and Seawater Chemistry, May 15-19, Argos Cyprus.
- 2023 Cullen, J.T. and \*\*T. Anderlini. Variability in the Distributions of Dissolved Trace Metals in Surface Waters of Baffin Bay. Canadian Chemistry Conference and Exhibition 2023, June 4-8, Vancouver BC, Canada.
- 2023 Anderlini, T. and J.T. Cullen. The British Columbian Shelf as a Source of Trace Metals to the Subarctic Northeast Pacific Ocean. Canadian Chemistry Conference and Exhibition 2023, June 4-8, Vancouver BC, Canada.
- 2023 Zee, M. and J.T. Cullen. Characterizing the trace element chemistry of the Endeavour Ridge neutrally buoyant hydrothermal plume. Canadian Chemistry Conference and Exhibition 2023, June 4-8, Vancouver BC, Canada.

### ***GEOTRACES relevant infrastructure***

With funding from NSERC and in collaboration and with funding from Amundsen Science new trace element sampling infrastructure was installed on the CCGS Amundsen, a science capable icebreaker tasked with Arctic research. A 12 x 10L trace element rosette equipped with trace element clean OTE sampling bottles, a SBE CTD, oxygen sensor, altimeter and transmissometer will be deployed with a winch (2500 m synthetic sea cable) through the ship's moon pool. A trace element clean sampling laboratory was constructed in the moon pool. This infrastructure is now available to Amundsen users.

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