

**Ocean and Climate Change Institute
2009 ARI Project
Final Report**

Some of the First Seawater Analyses of Cobalt in the Arctic Ocean: a Baseline for Studying the Influence of Climate Change on the Arctic Ocean and Primary Productivity

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What were the primary questions you were trying to address with this research? (Or, if more appropriate, was there a hypothesis or theory that you were trying to prove or disprove?)

We were studying the abundances of the micronutrient cobalt in the Arctic Ocean. This element is very scarce in the oceans, and climate change has the potential to influence its contributions through a variety of mechanisms. Yet there was virtually no previous data to compare with. This study aimed to generate some of the baseline data for future comparison in collaboration with the Canadian GEOTRACES program.

What have you discovered or learned that you didn't know before you started this work?

There are elevated concentrations of cobalt in the subsurface waters, likely due to inflow from the Bering Sea and/or coastal/riverine fluxes.

What is the significance of your findings for others working in this field of inquiry and for the broader scientific community?

This study is important in obtaining a baseline of cobalt abundances in the Arctic Ocean.

What were the most unusual or unexpected results and opportunities in this investigation?

The >100pM upper water column cobalt concentrations are quite high relative to many other oceanic regimes where cobalt can be found 5 to 10 times lower in abundance.

What were the greatest challenges and difficulties?

Access to the Arctic region continues to be a major challenge for research expeditions.

When and where was this investigation conducted? (For instance, did you conduct new field research, or was this a new analysis of existing data?)

This field work was conducted as part of the Canadian GEOTRACES program, where our Canadian colleagues sent samples to us for analysis from their expedition. Specific details about this program are listed in the following text from a recently submitted abstract:

The Canadian IPY-GEOTRACES project is a contribution to the international GEOTRACES program whose goals are to document the processes that control the oceanic distribution of trace

elements and their isotopes and establish their role as regulators or recorders of processes that affect the structure and productivity of marine ecosystems, the dispersion of contaminants in the ocean, the level of greenhouse gases in the atmosphere, and global climate.

Our sampling program took place from August 27, 2009 through September 12, 2009. It was part of Leg 3a of the 2009 CCGS Amundsen Expedition in the Arctic Ocean (ArcticNet 0903). Sampling started in the Mackenzie River delta and continued into the Beaufort Sea (Shelf, slope and deep Canada Basin). We occupied a total of ten stations. Trace elements were sampled with a Trace-Metal CTD/rosette system and marine particles were obtained by filtering seawater in-situ using large volume in-situ pumps. These measurements were complemented by underway sampling of surface water from the ship intake.

Our goals are (1) to document the cycling of key trace elements which act as biological micronutrients (Fe, Cu, Cd, Co, Zn) and their impact on primary production, (2) to establish their sources and sinks, (3) to quantify processes involved in nutrient cycling and carbon sequestration to the deep sea, (4) to elucidate the potential effects of changing ice cover and river discharge on productivity, carbon sequestration and trace gas emission, (5) to record recent changes in ocean circulation, and (6) to develop sedimentary tracers to reconstruct past changes in surface water temperature, salinity and productivity in relation to long term natural climate change. In this poster presentation, we will highlight and integrate some of the main findings that resulted from this program.

What were the key tools or instruments you used to conduct this research?

We use cathodic stripping voltammetry methods for analysis of low level total dissolved cobalt and cobalt speciation in seawater.

Is this research part of a larger project or program?

This was part of the Canadian GEOTRACES program to map trace elements and isotopes in the Canadian Arctic region.

What are your next steps?

Have you published findings or web pages related to this research? Please provide a citation, reprint, and web link (when available).

A general abstract for the cruise:

Canadian IPY-GEOTRACES: Multi-tracer investigation of the effect of climate change on primary production, seawater chemistry and circulation of the Arctic Ocean

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Please provide photographs, illustrations, tables/charts, and web links that can help illustrate your research.

Figure 1. A sectional view of the total dissolved cobalt in seawater on a transect from the western Canadian coastline in the Arctic Ocean showed elevated cobalt in the upper water column and depleted cobalt in intermediate and deeper waters. The large differences in vertical cobalt distributions reflect potential regional sources and limited vertical circulation processes.

