Expected changes in delivery of trace nutrients may affect ocean phytoplankton

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By Lauren Frisch

Rob Rember and Ana Aguilar-Islas sample sea ice in the Arctic Ocean. U.S. Coast Guard photo by Petty Officer 2nd Class Cory J. Mendenhall.

Phytoplankton and sea ice algae, the tiny photosynthetic organisms that make up the base of the food web, rely on trace elements for nutrients. Projected sea ice changes could affect the distribution of these trace elements in ocean water.

Trace metals (metals found in very low levels in the environment) tend to be concentrated in sea ice. They can be nutritious or toxic to organisms, depending on how much the organism consumes. Knowing how these elements cycle through the ocean is important, because small changes in their distributions can alter the species composition of phytoplankton and ice algae, which could affect the rest of the food web.

In the Arctic Ocean, ice algae and phytoplankton help sustain all larger organisms. Reduction in or changes in the species composition of these organisms can have repercussions for the organisms higher up in the food web that depend on ice algae and plankton as a source of food.

Little is known about the distribution of trace metals in the Arctic Ocean.

Vincent Domena, a master's student at the University of Alaska Fairbanks School of Fisheries and Ocean Sciences, explains that sea ice is expected to have higher concentrations of trace elements than the ocean water underneath. "This is especially true for sea ice that once was landfast, or anchored to the land. This sea ice typically forms in shallow areas where it can trap metal-rich sediments," Domena said.

Landfast ice can thus become an important source of trace elements for the surface waters of the Arctic Basin. As sea ice breaks from the land late in the spring, it carries the trace element–rich sediment out to the open ocean.

Domena works with SFOS assistant professor Ana Aguilar-Islas and International Arctic Research Center assistant professor Robert Rember to study the distribution of certain trace metals—aluminum, manganese, iron, nickel, copper, zinc and lead—in landfast ice and pack ice (free-floating ice). The researchers measure concentrations of trace elements using an inductively coupled plasma mass spectrometer, an instrument that is

capable of detecting trace elements in very low concentrations in melted sea ice.

The landfast ice samples were taken in May 2015 off the coast of Oliktok Point on the North Slope, west of Prudhoe Bay. The pack ice samples were collected in September 2015 close to the North Pole.

Funding for the Oliktok Point research comes from the Coastal Marine Institute. The pack ice study is part of the international GEOTRACES program, which is funded in part by the National Science Foundation. The goal of GEOTRACES is to map the concentration of trace elements and their isotopes around the globe over the next decade. In the Arctic, where trace metal data is lacking, scientists aim to establish baseline trace element concentrations via a series of international expeditions that took place in summer 2015.

As sea ice formations and melting cycles change, the amount of sediment that is carried out to the open ocean is likely to be altered. In addition, longer ice-free periods in the summer will increase the length of time before trace elements are transported.

“As long as we have winters with temperatures below freezing in the Arctic, there will be ice of some sort over the Arctic Ocean during winter months,” said Domena. “However, as temperatures get warmer, we’ll likely continue to see less multiyear old ice and longer ice-free periods.”

Because sediment on ice can have a unique ratio of trace elements based on the geology of its location, the data that Domena and others are collecting also can be used to help geolocate ice masses and infer their movement.

This research, along with the data being collected by other Arctic GEOTRACES expeditions, will help scientists determine how distributions of various elements are changing and predict how distributions are likely to change in the future.

Visit the GEOTRACES website: http://geotraces.org/ , for more information