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Beaufort Gyre Exploration Project: Dispatch 20: Geochemistry of the Canada Basin

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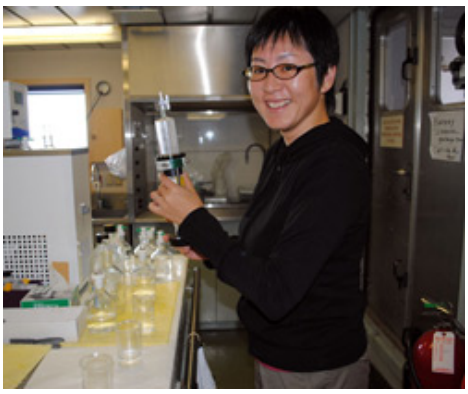

August 9 photos

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Geochemist Michiyo Kawai (TUMSAT) has been busy in the main science lab of the *Louis S. St-Laurent* analyzing water samples to understand the geochemistry of the Arctic Ocean.

Michiyo's analyses relate to understanding the composition and origin of relatively fresh water in the Canada Basin. Michiyo and her colleagues analyze the distribution of nutrients to trace the pathways of water of Pacific Ocean origin, which is high in nutrients. Pacific Water is the major source of nutrients to the Arctic Ocean. They use an isotope of oxygen (18O) to differentiate surface fresh water that results from sea-ice melt from fresh water that originates from rivers; river water is low in this oxygen isotope. Alkalinity is another valuable tracer that Michiyo uses to understand further where the river water originates. North American rivers, with pathways to the ocean through rocks, exhibit higher alkalinity than Siberian rivers that flow predominantly over tundra to reach the Arctic Ocean.

Michiyo and colleagues are also investigating Arctic Ocean acidification. For this, they measure three properties of the water column – alkalinity, pH and dissolved inorganic carbon (DIC). These geochemical attributes are used to provide an estimate of the saturation state of seawater with respect to calcium carbonate, which tells us whether seawater is corrosive to calcium carbonate (of great importance to organisms with shells, for example). Since 2008, Michiyo and colleagues have found that the surface ocean in the central Canada Basin has become corrosive to the aragonite type of calcium carbonate, which may be harmful to some types of plankton. There are two reasons for this change in the surface-ocean layer: an increase in atmospheric carbon dioxide, and melting sea ice. Melting sea ice leads to a greater open-water region for more efficient absorption of atmospheric CO2 by the ocean. Melting ice also changes the chemistry of seawater through the addition of melt water, which leads to a lower saturation state with respect to calcium carbonate.

The Arctic Ocean's Canada Basin is the first deep-ocean region in the world to exhibit under saturation with respect to calcium carbonate in the surface layer (although this is observed in coastal regions elsewhere). The impact of increasing atmospheric CO2 is observed sooner in the Arctic because of sea-ice melt. The geochemical analyses taking place on our cruise this year are a critical element of the unfolding story.

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