ICEBERGS FERTILIZE THE SOUTHERN OCEAN

Giant icebergs breaking off of glaciers and plunging into the ocean is an iconic image associated with climate change. But according to a new study, the icebergs' role is more than just symbolic. By fertilizing phytoplankton, those icebergs may play a key part in the drawdown of carbon dioxide from the atmosphere — thus helping to offset warming.

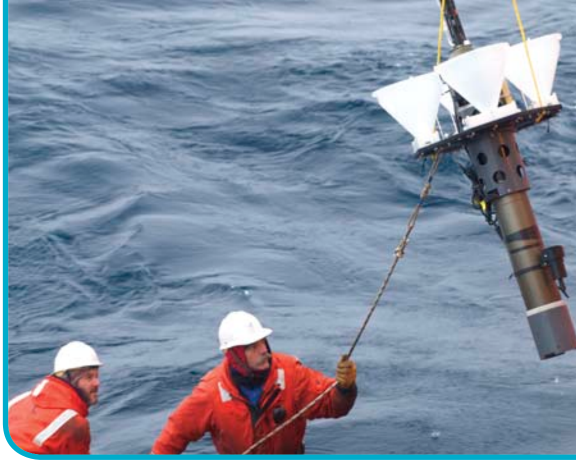
Phytoplankton, tiny plant-like organisms that feed on sunlight and carbon dioxide, are a major food source for marine life in the Southern Ocean around Antarctica. And, they play a vital role in sequestering carbon dioxide. The carbon dioxide that phytoplankton pump from the air ends up in the deep ocean as marine life eat and then excrete the phytoplankton as waste, and also as the phytoplankton themselves die and sink. Just how much carbon dioxide this process pulls out of the atmosphere "is what we are trying to determine," says Timothy Shaw, an oceanographer at the University of South Carolina and a co-author of the new study, published in the journal Deep-Sea Research II.

Researchers led by Monterey Bay Aquarium Research Institute (MBARI) marine biologist Ken Smith recently carried out three cruises to the Southern Ocean to investigate how the phytoplankton grow in that region, and thus how they affect carbon dioxide levels as an agent of storage and transfer in the carbon cycle.

The team found that although the phytoplankton population in the Southern Ocean is smaller than in other oceans, populations are thriving. Where the phytoplankton were getting a key nutrient — iron — that they need to survive, however, was the surprising part. Iron usually comes from sediments carried out to sea by rivers, but this is an unlikely source in Antarctica. "Only a few islands in Antarctica have high iron sediments," says Alejandro Orsi, an oceanographer at Texas A&M University who is not affiliated with the project. Furthermore, he says, "many places in Antarctica with high iron content have no contact with the ocean." Thus, the iron must come from elsewhere.

Smith, Shaw and their team figured that iron in the Southern Ocean must be supplied by icebergs. Testing their hypothesis meant sampling the water near icebergs. "The danger of sampling close to a large iceberg is a major issue," Shaw says. Calving icebergs create waves that can reach more than 10 meters high and possibly wash over a boat's deck or in some cases cause a boat to capsize into frigid seas.

The impact of iceberg fertilization and associated carbon dioxide drawdown is the primary driver for this work.
— Timothy Shaw, University of South Carolina



Researchers programmed this sediment trap to sink 600 meters below the ocean surface as a large iceberg drifted over it. After three days, the team pulled up the trap and analyzed the sediments; they found that icebergs are providing the necessary nutrients for phytoplankton blooms in the Southern Ocean.

Researchers launch a small remotely operated vehicle to collect video and water samples from beneath Antarctic icebergs.

Both: Debbie Nail Meyer ©2009 MBARI

To help collect data and minimize risk, MBARI engineers built a small remotely operated vehicle that could gather water samples from around and beneath icebergs, as well as take underwater photographs. Researchers tested the water samples for phytoplankton growth, carbon concentration and iron content. The underwater photographs, combined with GPS data and satellite images, allowed researchers to track icebergs and measure their size.

Antarctic glaciers entrain iron-bearing sediments as they grind their way toward the shoreline, where icebergs calve off into the ocean. The icebergs melt as they are carried along ocean currents, releasing their sediment payload and providing phytoplankton with nutritious iron, the team found.

As the ocean continues to warm, the rate of ice calving will likely increase, but how associated phytoplankton growth will affect the atmosphere is less certain, Shaw says. "The impact of iceberg fertilization and associated carbon dioxide drawdown is the primary driver for this work."

George Hale