Climate Change Alters Ocean Chemistry

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(PhysOrg.com) -- Researchers have discovered that the ocean's chemical makeup is less stable and more greatly affected by climate change than previously believed. The researchers report in the December 12, 2008 issue of *Science* that during a time of climate change 13 million years ago the chemical makeup of the oceans changed dramatically. The researchers warn that the chemical composition of the ocean today could be similarly affected by climate changes now underway – with potentially far-reaching consequences for marine ecosystems.

"As CO2 increases and weather patterns shift, the chemical composition of our rivers will change, and this will affect the oceans," says co-author Ken Caldeira of the Carnegie Institution's Department of Global Ecology. "This will change the amount of calcium and other elements in ocean salts."

The research team, which included Caldeira, Elizabeth M. Griffith and Adina Paytan of the University of California, Santa Cruz, plus two other colleagues, studied core samples of deep oceanic sediment recovered from the Pacific Ocean Basin. By analyzing the calcium isotopes in grains of the mineral barite in different layers, they determined that between 13 and 8 million years ago the ocean's calcium levels shifted dramatically. The shift corresponds to the growth of the Antarctic ice sheets during the same time interval. Because of the huge volume of water that became locked up in the ice cap, sea level also dropped.

"The climate got colder, ice sheets expanded, sea level dropped, and the intensity, type, and extent of weathering on land changed," explains

Griffith.

"This caused changes in ocean circulation and in the amount and composition of what rivers delivered to the ocean," adds Paytan. "This in turn impacted the biology and chemistry of the ocean."

Calcium-bearing rocks such as limestone are the largest storehouse of carbon in the Earth's carbon cycle because they are primarily made up of calcium carbonate. "The ocean's calcium cycle is closely linked to atmospheric carbon dioxide and the processes that control seawater's acidity," says Caldeira. Acidification of seawater is already a growing threat to coral reefs and other marine life.

"What we learned from this work is that the ocean system is much more sensitive to climate change than we have previously appreciated," says Griffith. "We thought that the concentration of calcium, which is a major element in seawater, would change slowly and gradually over tens of millions of years. But what our data suggests is that there could be a more dynamic relationship between climate and ocean chemistry, which can sometimes result in rapid biogeochemical reorganization."

"We see here how dynamic the climate-ocean system is and that the responses to change are not always what we would expect" says Paytan. "We need to keep this in mind when considering future climate and other anthropogenic changes, like ocean acidification, and their impact on the ocean and ocean resources."

Article: A dynamic marine calcium cycle during the past 28 million years. Elizabeth M. Griffith, Adina Paytan, Ken Caldeira, Thomas D. Bullen and Ellen Thomas. *Science* (December 12, 2008)

Source: Carnegie Institution