From beneath Antarctica's Ross Sea, scientists retrieve pristine record of the continent's climate cycles

April 16 2007

Frequent climate fluctuations on the world's southernmost continent have been so extreme over the past 5 million years that Antarctica's Ross Ice Shelf, a floating slab of ice the size of France, oscillated in size dramatically, and perhaps even disappeared for periods of time when the West Antarctic Ice Sheet may have been smaller, according to scientists engaged in an unprecedented international geologic drilling project.

Researchers with the Antarctic Geological Drilling (ANDRILL) Program, which concluded its first field season in January, say long cores of sedimentary rocks that they recovered from below the bed of the Ross Sea beneath the ice shelf allow them to peer deeply into the past to a time when Antarctica was a warmer, more inviting place.

They were surprised, for example, to find such large volumes of fossil diatoms—microscopic single-celled algae that live in surface or shallow waters—in the cores. The presence of the fossilized one-cell creatures, some of them previously unknown to science, confirms that large areas of the Ross Ice Shelf have previously melted and were replaced with highly productive open waters.

Studies of the cores may provide scientists with glimpses into the planet's future if predictions of global temperature increases are accurate. Either way, they say, data from the cores will help create more accurate climate models for predicting future trends.

“We recovered a superb, unique geologic record that scientists will be using as a benchmark for decades to come as we wrestle with trying to predict how global warming will impact the world’s oceans and our lives,” said Ross Powell, a Northern Illinois University geologist.

Powell and Tim Naish, of New Zealand’s Victoria University of Wellington, served as co-chief scientists for the first season of the $30-million ANDRILL Program. A second drilling operation will begin at another location next fall (during the Antarctic spring).

Filled with an abundance of information about Antarctica’s ice sheet and climate history, the newly recovered rock core stretches more than a kilometer (three-quarters of a mile) in length. It tells the story of episodic changes of the Ross Ice Shelf and the ice sheets feeding it, with more than 50 oscillations in the ice margin over the last 10 million years.

Some intervals when the ice shelf disappeared were probably during past times when our planet was 2 to 3 degrees Celsius (3.6 to 5.4 degrees Fahrenheit) warmer than it is today—“much like it is predicted to be in the next 50 to 100 years by many climate models,” Naish said.

“If we’re going through this 2- to 3-degree (Celsius) warming in the next century, as has been predicted, we want to get a sense of how the ice sheet will react—and how fast it will react—by looking at what it has done in the past,” Powell added. “The world was only about 5 to 6 degrees warmer (Celsius)on average when there was no ice on the Antarctic at all. A couple degrees change can lead to quite dramatic changes across the world.”

Antarctica New Zealand, which develops, manages and administers the country’s Antarctic activities, ran the on-ice drilling operations and logistics on behalf of the ANDRILL partner nations—the United States, New Zealand, Italy and Germany.

The ANDRILL Science Management Office at the University of Nebraska-Lincoln coordinated U.S. science planning. The National Science Foundation, which manages the U.S. Antarctic Program, is providing about $20 million in support of the $30 million (U.S.) project, which is a focal point during International Polar Year (IPY), a worldwide campaign of polar education, field research and analyses.

“ANDRILL is one of the crown jewels of our International Polar Year portfolio,” said Thomas Wagner, program director for the U.S. Antarctic Program’s geology and geophysics program. “It embodies the spirit of IPY with its international partnerships and scientific focus on the role of Antarctica in the global system of climate.”

At a site on the Ross Ice Shelf, ANDRILL operators melted an access hole through 85 meters (278 feet) of ice and dropped the drill bit through another 840 meters (2,755 feet) of seawater, before coring 1,285 meters (eight-tenths of a mile) below the seabed on the continental shelf.

The core will reveal information about water temperatures and ice-sheet and ice-shelf dynamics over about the past 10 million years.

A massive ice sheet covers Antarctica today, while ice shelves, fed by fast-flowing streams of ice within the ice sheet, are large floating bodies of ice. Ice shelves are extremely sensitive early indicators of climate change. The Ross Ice Shelf is the world’s largest ice shelf and is prone to increased melting from warming oceans. Scientists believe its demise would be an important precursor to eventual collapse of the entire West Antarctic Ice Sheet.

About 90 percent of the world's ice volume is in the Antarctic. The disappearance of even its smaller West Antarctic Ice Sheet could raise worldwide sea levels by an estimated six meters (20 feet).

“By studying the core, our scientists can tell when ice was grounded and sitting directly on the seabed, when the Ross Ice Shelf was fully over the site and floating in the water, when there was open water with icebergs, and when there were no icebergs,” Powell said. The greatest detail in the core covers a period from 1 million to 5 million years ago.

“By integrating this critical new climate information from the core into ice sheet computer models, we should be able to say just how extensive was the loss of ice in West Antarctica during warmer times in the past,” Naish added.

Scientists were surprised by the wealth of diatoms, which evolved rapidly and were eventually deposited on the ocean floor. The variety of diatoms, which leave behind glass-like shells that accumulate over time in layers, is a key indicator of past water temperatures. About one-third of the upper 600 meters (almost 2,000 feet) of core, which covers a time period going back roughly 5 million years, is rich in diatoms.

It will take years for scientists, post-doctoral researchers and students from across the world to unravel the many mysteries of the core, which will be stored at Florida State University’s Antarctic Marine Geology Research Facility. They are now working to correlate the new information to what was occurring in the climate in other parts of the world. Other climate records include deep-ocean geologic cores, which provide climate information from other parts of the world, and global sea-level records, which can be inferred from sedimentary deposits and erosion surfaces on continental shelves.

Source: Northern Illinois University

climate cycles (2007, April 16) retrieved 17 April 2024 from https://phys.org/news/2007-04-beneath-antarctica-ross-sea-scientists.html