The International Polar Year ANDRILL Offshore New Harbor Project

The Offshore New Harbor Project: Investigating the Tipping Point from the Greenhouse to Icehouse World of the Past in Antarctica

Introduction

Today, the climate is changing faster than any time of the last 65 million years, with rising temperatures occurring at an alarming rate. Warmer ocean sea surface temperatures are feeding ever more powerful hurricanes, while heat waves and droughts are occurring in record numbers. Moreover, thawing glaciers and melting of the sea ice are shrinking at rates that are far quicker than what even the most pessimistic climate models have predicted.

There is a growing body of knowledge indicating these changes are due to increased concentrations of greenhouse gases such as CO_2 in our atmosphere. Predictions of future atmospheric CO_2 levels expected to occur by the end of this century range from 500 to 900 ppm. The last time that atmospheric CO_2 levels were this high occurred between 25 and 34 million years ago. During this time, the Antarctic ice sheet was far more dynamic, retreating hundreds of miles inland during warm periods, which resulted in sea level to rise over a hundred feet, while during colder periods, the ice sheet expanded across the Antarctic shelf and grew, in some case, larger than today. Additionally, it was also during this period (~34 million years ago) that one of the most dramatic and permanent climatic changes of the last 100 million years occurred: the abrupt change from greenhouse world conditions in which ice sheets were either absent of ephemeral in nature to an icehouse world in which large continental sized ice sheets expanded across Antarctica. Scientists are still struggling to understand what were the causal mechanisms that resulted in this tipping point that switched the climate in Antarctica so dramatically. As this time interval is the last time that atmospheric CO_2 was as high as what is predicted for this century and was considerably warmer than today, studying this period may be able to provide us with a glimpse of our future.

Although a wealth of data from deep sea and terrestrial records provide a detailed story of climate changes at low and mid latitudes, first-order questions remain about how climate and the ice sheet changed in Antarctica. This is due in part to the difficulty in conducting an expedition in this cold harsh region. In fact, many scientists now agree that the key to the climate puzzle lies literally at the bottom of the Earth: Antarctica. However, so far no one has recovered a continuous record during this time interval on the Antarctic continent or on its shelf.

From K. Miller, Rutgers University

If all of the world's ice sheets melted, sea level would rise by approximately 230 feet. This is a representation of how New York Harbor would look in an ice-free world.

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The Offshore New Harbor Project: Exploring Undiscovered Country

Starting last fall and continuing until the spring of 2009, the International Polar Year (IPY) will mark a global effort to understand how patterns of present and past climate change at high latitudes can help scientists better

understand and forecast future climate conditions. This fall, an IPY expedition led by Queens College Professor, Dr. Pekar, will travel to Antarctica to collect seismic and gravity data that will image and constrain the geometry of the sediments below the sea floor in the offshore New Harbor (ONH) area of the Ross Sea. These sediments were deposited during the Greenhouse World (45-34 million years ago) as well as across the transition from the Greenhouse to Icehouse World (34-25 million years ago). The goal of the project will to evaluate the geometry of these Greenhouse World sediments to provide a better understanding of the depositional history in the western Ross Sea and then to develop a drilling project to recover these sediments. This expedition is part of the ANDRILL Program (ANtarctic DRILLing, www.andrill.org), which "is a multinational initiative with the objective to recover stratigraphic core records for the use of interpreting Antarctic's climatic, glacial, and tectonic history for the past 50 Ma".

In early October, the ONH team will fly from Christchurch, New Zealand to McMurdo Station, the largest base in Antarctica. This is the early spring in Antarctica and temperatures typically are in the minus 20's Fahrenheit (plus wind chill). After they are given training on how to survive on the sea ice, they will traverse by vehicles across the sea ice of McMurdo Sound to offshore of New Harbor. There they will conduct the seismic and gravity survey, while living on the sea ice and sleep in unheated tents. It is planned that we will be on the sea ice for about 35 to 40 days. The team will include Dr. Pekar (lead PI), a professor at Queens College (CUNY), Marvin Speece (Co-PI from Montana Tech), Ms. Brown, a teacher at the Promise Academy, which is part of the Harlem Children's Zone, as well as three students from Queens College.

As the storm ebbs….
This is a scene from the 2005 ANDRILL expedition in which Dr. Pekar was a participant. In the background are the Trans-Antarctic Mountains, which soar over 12,000 feet above McMurdo Sound. It is anticipated that we will also experience similar conditions during our upcoming expedition.

Results of the Expedition: Developing a Strategy to Drill One of Antarctic's "Holy Grails"

After the expedition, the seismic and gravity data will be processed, analyzed, and then interpreted to reconstruct the geometry of these greenhouse world sediments. This will provide clues about the depositional history of the area and most importantly will permit us to develop a proposal to drill these sediments in the near future. Such a drilling project would represent a first time that cores from this time interval and region would be recovered. These sedimentary archives have the potential to allow us to unlock many of the secrets of Antarctica's climatic and cryospheric evolution during times when the Earth was a Greenhouse World. In fact, for many Antarctic scientists, these sediments are considered to be one of "Antarctic's Holy Grails".

For more information contact:
Dr. Stephen Pekar (Principal Investigator)
School of Earth and Environmental Sciences
Queens College
65-30 Kissena Blvd.
Flushing, NY 11367
http://qcpages.qc.edu/EES/pep/pekar.html
Email: stephen.pekar@qc.cuny.edu