Cracking the ice code

May 20 2013, by Laura L. Hunt

Geosciences professor John Isbell (left) and postdoctoral researcher Erik Gulbranson look over some of the many samples they have brought back from Antarctica. The two are part of an international team of scientists investigating the last extreme climate shift on Earth, which occurred in the late Paleozoic Era. Credit: Troye Fox

(Phys.org) —What happened the last time a vegetated Earth shifted from an extremely cold climate to desert-like conditions? And what does it tell us about climate change today?

John Isbell is on a quest to coax that information from the geology of the southernmost portions of the Earth. It won't be easy, because the last transition from "icehouse to greenhouse" occurred between 335 and 290 million years ago.

An expert in glaciation from the late Paleozoic Era, Isbell is challenging many assumptions about the way drastic climate change naturally unfolds. The research helps form the all-important baseline needed to predict what the added effects of human activity will bring.

Starting from 'deep freeze'

In the late Paleozoic, the modern continents were fused together into two huge land masses, with what is now the Southern Hemisphere, including Antarctica, called Gondwana. During the span of more than 60 million years, Gondwana shifted from a state of deep freeze into one so hot and dry it supported the appearance of reptiles. The change, however, didn't happen uniformly, Isbell says.

In fact, his research has shaken the common belief that Gondwana was covered by one massive sheet of ice which gradually and steadily melted away as conditions warmed.

Isbell has found that at least 22 individual ice sheets were located in various places over the region. And the state of glaciation during the long warming period was marked by dramatic swings in temperature and atmospheric carbon dioxide (CO2) levels.

"There appears to be a direct association between low CO2 levels and glaciation," he says. "A lot of the changes in greenhouse gases and in a shrinking ice volume then are similar to what we're seeing today."

When the ice finally started disappearing, he says, it did so in the polar regions first and lingered in other parts of Gondwana with higher elevations. He attributes that to different conditions across Gondwana, such as mountain-building events, which would have preserved glaciers longer.

All about the carbon

To get an accurate picture of the range of conditions in the late Paleozoic, Isbell has traveled to Antarctica 16 times and has joined colleagues from around the world as part of an interdisciplinary team funded by the National Science Foundation. They have regularly gone to places where no one has ever walked on the rocks before.

One of his colleagues is paleoecologist Erik Gulbranson, who studies plant communities from the tail end of the Paleozoic and how they evolved in concert with the climatic changes. The information contained in fossil soil and plants, he says, can reveal a lot about carbon cycling, which is so central for applying the work to climate change today.

Documenting the particulars of how the carbon cycle behaved so long ago will allow them to answer questions like, 'What was the main force behind glaciation during the late Paleozoic? Was it mountain-building or climate change?'

Another characteristic of the late Paleozoic shift is that once the climate warmed significantly and atmospheric CO2 levels soared, the Earth's climate remained hot and dry for another 200 million years.

"These natural cycles are very long, and that's an important difference with what we're seeing with the contemporary global climate change," says Gulbranson. "Today, we're seeing change in greenhouse gas concentrations of CO2 on the order of centuries and decades."

Ancient trees and soil

In order to explain today's accelerated warming, Gulbranson's research illustrates that glaciers alone don't tell the whole story.

Many environmental factors leave an imprint on the carbon contained in tree trunks from this period. One of the things Gulbranson hypothesizes from his research in Antarctica is that an increase in deciduous trees occurred in higher latitudes during the late Paleozoic, driven by higher temperatures.

What he doesn't yet know is what the net effect was on the carbon cycle.

While trees soak in CO2 and give off oxygen, there are other environmental processes to consider, says Gulbranson. For example, CO2 emissions also come from soil as microbes speed up their consumption of organic matter with rising temperatures.

"The high latitudes today contain the largest amount of carbon locked up as organic material and permafrost soils on Earth today," he says. "It actually exceeds the amount of carbon you can measure in the rain forests. So what happens to that stockpile of carbon when you warm it and grow a forest over it is completely unknown."

Another unknown is whether the Northern Hemisphere during this time was also glaciated and warming. The pair are about to find out. With UWM backing, they will do field work in northeastern Russia this summer to study glacial deposits from the late Paleozoic.

The two scientists' work is complementary. Dating the rock is essential to pinpointing the rate of change in the carbon cycle, which would be the warning signal we could use today to indicate that nature is becoming dangerously unbalanced.

"If we figure out what happened with the glaciers," says Isbell, "and add it to what we know about other conditions – we will be able to unlock the answers to climate change."

More information: The Carboniferous-Permian Transition Conference, May-2013.

Provided by University of Wisconsin - Milwaukee

Citation: Cracking the ice code (2013, May 20) retrieved 27 April 2024 from https://phys.org/news/2013-05-ice-code.html