Ice cores store atmospheric bubbles from a million years ago

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Credit: Newcastle University

(Phys.org)—A team of researchers with members from Princeton University, the University of Maine and Oregon State University has found that greenhouse gasses a million years ago, were only slightly higher than they were between 450,000 and 800,000 years ago. In their paper published in *Proceedings of the National Academy of Sciences*, the team describes their study of the newly retrieved ice cores and how it is

helping to better understand the changes to the Earth's ice ages.

The cores were taken from a part of Antarctica known as Allan Hills—there unique geography has caused glaciers sliding down mountains to slide upwards for a bit. Additional erosion due to wind and precipitation has caused very old (blue) ice to lie close enough to the surface to be extracted via core drilling. Dating has shown the ice to be approximately one million years old, which means the air bubbles trapped inside are the same age as well—the oldest found so far. Those air bubbles offer scientists an opportunity to measure the amount of different gasses in the atmosphere from that time period, and it is helping, the team suggests, to gain a better handle on the changes to cyclic ice ages.

Prior study has shown that before a million years ago, the Earth experienced ice ages approximately every 40,000 years, but after that the cycle grew longer, to approximately 100,000 years and scientists want to know why—they suspect it has to do with changes to the ratios of greenhouse gases—most specifically carbon dioxide. That is where the air bubbles in ice core samples come in, they offer direct evidence of carbon dioxide levels. The latest samples show that there were not major swings in greenhouse gas levels at that time, but more ominously, that carbon dioxide levels never rose above 300 ppm over the past million years, until the twentieth century—right now the level is approximately 400 ppm.

The record setting ice cores do not actually answer any real questions about the cyclic nature of ice ages, the researchers acknowledge, but instead add another chapter to a growing body of knowledge—a suggestion that there is indeed a strong correlation between carbon dioxide levels and glacial cycles.

More information: Atmospheric composition 1 million years ago

from blue ice in the Allan Hills, Antarctica John A. Higgins, DOI: 10.1073/pnas.1420232112

Abstract

Here, we present direct measurements of atmospheric composition and Antarctic climate from the mid-Pleistocene (~1 Ma) from ice cores drilled in the Allan Hills blue ice area, Antarctica. The 1-Ma ice is dated from the deficit in 40Ar relative to the modern atmosphere and is present as a stratigraphically disturbed 12-m section at the base of a 126-m ice core. The 1-Ma ice appears to represent most of the amplitude of contemporaneous climate cycles and CO2 and CH4 concentrations in the ice range from 221 to 277 ppm and 411 to 569 parts per billion (ppb), respectively. These concentrations, together with measured δD of the ice, are at the warm end of the field for glacial–interglacial cycles of the last 800 ky and span only about one-half of the range. The highest CO2 values in the 1-Ma ice fall within the range of interglacial values of the last 400 ka but are up to 7 ppm higher than any interglacial values between 450 and 800 ka. The lowest CO2 values are 30 ppm higher than during any glacial period between 450 and 800 ka. This study shows that the coupling of Antarctic temperature and atmospheric CO2 extended into the mid-Pleistocene and demonstrates the feasibility of discontinuously extending the current ice core record beyond 800 ka by shallow coring in Antarctic blue ice areas.