Ice age thermostat prevented extreme climate cooling

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A composite image of the Western hemisphere of the Earth. Credit: NASA

During the ice ages, an unidentified regulatory mechanism prevented atmospheric CO2 concentrations from falling below a level that could have led to runaway cooling, reports a study conducted by researchers of the ICTA-UAB and published online in *Nature Geoscience* this week. The study suggests the mechanism may have involved the biosphere, as plants and plankton struggled to grow under very low CO2 levels.

Atmospheric CO2 concentrations swung over a range of 100 ppm (parts per million, by volume) during the ice ages. The exact processes behind this variation have been difficult to pinpoint, but it is known that changes in the storage of carbon by photosynthetic organisms played an important role.

"When we took a close look at measurements from ice cores, we noticed that atmospheric CO2 concentrations hovered close to 190 ppm during much of the past 800,000 years, but very rarely fell any lower," said Sarah Eggleston, a researcher at the Institut of Environmental Science and Technology (ICTA-UAB) and co-author of the study. "This was surprising, because it suggests that these very low CO2 concentrations were quite stable. What's more, we know that CO2 was often very high in the distant geological past, but we have no evidence that CO2 concentrations were ever lower than 190 ppm."

"We know that, over hundreds of thousands of years, CO2 is regulated by slowly reacting with exposed rocks" explained Eric Galbraith, lead author of the study and an ICREA professor at ICTA-UAB. "But this would be too slow to explain the stability during periods of only a few thousand years, as we see in the ice cores. So it must have been some other mechanism that kicked in at very low CO2."

The authors suggest that it was most likely the biosphere that maintained habitable temperatures, since at very low CO2 levels, plants and phytoplankton struggle to photosynthesize. Slower growth of these

organisms would have meant less carbon in the soils and deep ocean leaving more in the atmosphere, and preventing CO2 concentrations from falling further. This might have prevented extreme cooling that would have led to Earth freezing over as a 'snowball'.

However, the study did not reveal a corresponding regulation during the warm portions of the ice age cycles, suggesting that the Earth does not have a similar mechanism to prevent rapid warming.

More information: E. D. Galbraith et al. A lower limit to atmospheric CO2 concentrations over the past 800,000 years, *Nature Geoscience* (2017). DOI: 10.1038/ngeo2914

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