Large CO2 release speeds up ice age melting

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Foraminifera from the core samples, examined while at sea.

Radiocarbon dating is used to determine the age of everything from ancient artifacts to prehistoric corals on the ocean bottom.

But in a recent study appearing in the Aug. 26 edition of the journal, *Nature,* a Lawrence Livermore scientist and his colleagues used the method to trace the pathway of carbon dioxide released from the deep ocean to the atmosphere at the end of the last ice age.

The team noticed that a rapid increase in atmospheric CO_2 concentrations coincided with a reduced amount of carbon-14 relative to carbon-12 (the two isotopes of carbon that are used for carbon dating and are referred to as radiocarbon) in the atmosphere.

"This suggests that there was a release of very 'old' or low 14/12CO_2 from the deep ocean to the atmosphere during the end of the last ice age," said Tom Guilderson, an author on the paper and a scientist at LLNL's Center for Accelerator Mass Spectrometry.

The study suggests that CO_2 release may speed up the melting following an ice age.

Radiocarbon in the atmosphere is regulated largely by ocean circulation, which controls the sequestration of CO_2 in the deep sea through atmosphere-ocean carbon exchange. During the last ice age (approximately 110,000 to 10,000 years ago), lower atmospheric CO_2 levels were accompanied by increased atmospheric radiocarbon concentrations that have been credited to greater storage of CO_2 in a poorly ventilated abyssal ocean.

"The ocean circulation was significantly different than it is today and carbon was being stored in the deep ocean in a manner that we don't completely understand," Guilderson said.

Using two sediment cores from the sub-Antarctic and subtropic South Pacific near New Zealand, the team dated the cores to be between 13,000 and 19,000 years old. Guilderson was able to use the carbon-14 in the cores as a tracer to determine not only when the large CO_2 release occurred but the ocean pathway by which it escaped.

"In this case, the absence of a signal is telling us something important," Guilderson said. "Deeper waters substantially depleted in carbon-14 were drawn to the upper layers and this is the main source of the CO_2 during deglaciation. Data suggests that the upwelling of this water occurred in the Southern Ocean, near Antarctica. In our cores off New Zealand, which lie in the path of waters which 'turn over' in the Southern Ocean, we don't find anomalously low carbon-14/12 ratios. This implies that either water which upwelled in the Southern Ocean, after 16,500 years ago, had a vigorous exchange with the atmosphere, allowing its 14C-clock to be reset, or the circulation was significantly different than what the current paradigm is. If the paradigm is wrong, then during the glacial and deglaciation, the North Pacific is much more important than we give it credit for," Guilderson said.

The large CO_2 release sped up the melting, he said.

As for CO_2 emissions contributing to recent global warming, Guilderson said the CO_2 release from the last ice age is not relevant.

"We can radiocarbon date the CO_2 in the atmosphere now and what we've found is that the isotopic signature indicates that it is really due to the use of fossil fuels," he said.

The average lifetime of CO_2 in the atmosphere is on the order of 70-100 years.

Provided by Lawrence Livermore National Laboratory