Ancient glacial melting process similar to existing concerns about Antarctica, Greenland

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An analysis of prehistoric "Heinrich events" that happened many thousands of years ago, creating mass discharges of icebergs into the North Atlantic Ocean, make it clear that very small amounts of subsurface warming of water can trigger a rapid collapse of ice shelves.

The findings, to be published this week in Proceedings of the National Academy of Sciences, provide historical evidence that warming of water by 3-4 degrees was enough to trigger these huge, episodic discharges of ice from the Laurentide Ice Sheet in what is now Canada.

The results are important, researchers say, due to concerns that warmer water could cause a comparatively fast collapse of ice shelves in Antarctica or Greenland, increasing the flow of ice into the ocean and raising sea levels. One of the most vulnerable areas, the West Antarctic Ice Sheet, would raise global sea level by about 11 feet if it were all to melt.

"We don't know whether or not water will warm enough to cause this type of phenomenon," said Shaun Marcott, a postdoctoral researcher at Oregon State University and lead author of the report. "But it would be a serious concern if it did, and this demonstrates that melting of this type has occurred before."

If water were to warm by about 2 degrees under the ice shelves that are

found along the edges of much of the West Antarctic Ice Sheet, Marcott said, it might greatly increase the rate of melting to more than 30 feet a year. This could cause many of the ice shelves to melt in less than a century, he said, and is probably the most likely mechanism that could create such rapid changes of the ice sheet.

To find previous examples of such events, scientists reconstructed past ocean temperatures and used computer simulations to re-create what probably happened at various times during Heinrich events of the distant past. It had been known for some time that such events were associated with major climate changes, but less clear whether the events were a reaction to climate change or helped to cause them.

"There is now better evidence that the climate was getting colder prior to the Heinrich events, causing surface ocean waters to cool but actually causing warmer water in the subsurface," Marcott said. "We tried to demonstrate how this warmer water, at depth, caused the base of the ice shelf to warm and collapse, triggering the Heinrich events."

A present-day concern, Marcott said, is that ocean currents could shift and change direction even before overall ocean water had warmed a significant amount. If currents shifted and warmer water was directed toward ice shelves, more rapid melting might begin, he said.

This study was done by scientists from OSU, the University of Wisconsin, National Center for Atmospheric Research, and the Nanjing University of Information Science and Technology. The lead author was Shaun Marcott, a postdoctoral researcher at OSU. The studies were supported by the National Science Foundation, NASA and other agencies.

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