First Compilation of Tropical Ice Cores Shows Abrupt Global Climate Shift

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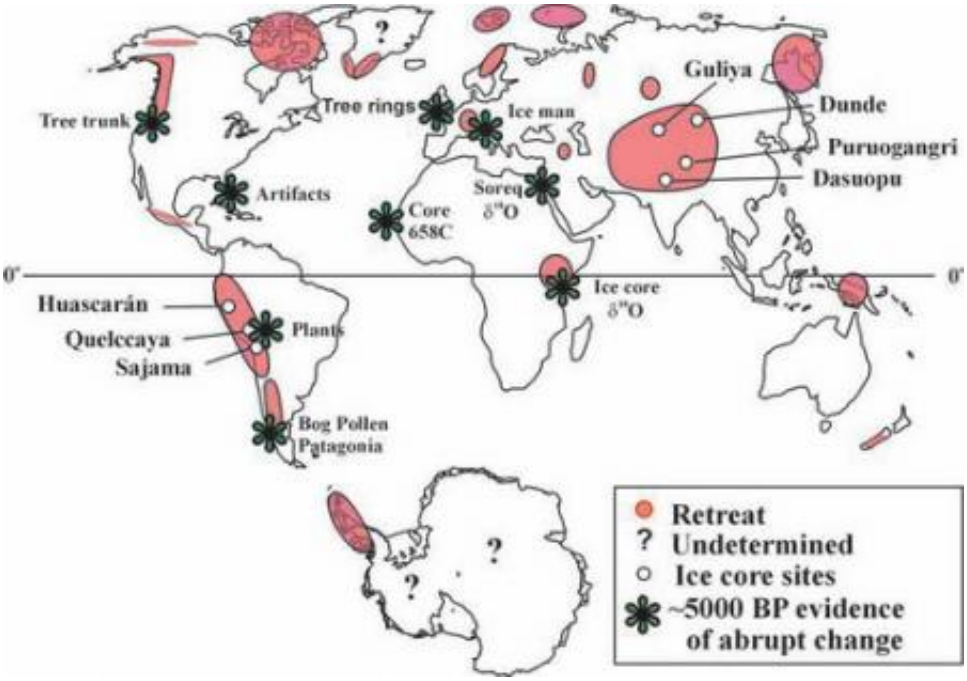

The locations of ice cores and evidence for abrupt climate change approximately 5,000 years ago discussed in the research are shown, along with areas of large-scale ice retreat. Courtesy of Lonnie Thompson, Ohio State University

For the first time, glaciologists have combined and compared sets of ancient climate records trapped in ice cores from the South American Andes and the Asian Himalayas to paint a picture of how climate has changed – and is still changing – in the tropics.

Their conclusions mark a massive climate shift to a cooler regime that occurred just over 5,000 years ago, and a more recent reversal to a much warmer world within the last 50 years.

The evidence also suggests that most of the high-altitude glaciers in the planet's tropical regions will disappear in the near future. The paper was included in the current issue of the journal *Proceedings of the National Academy of Science*.

Lastly, the research shows that in most of the world, glaciers and ice caps are rapidly retreating, even in areas where precipitation increases are documented. This implicates increasing temperatures and not decreasing precipitation as the most likely culprit.

The researchers from Ohio State University's Byrd Polar Research Center and three other universities combined the chronological climate records retrieved from seven remote locations north and south of the equator. Cores drilled through ice caps and glaciers there have captured a climate history of each region, in some cases, providing annual records and in others decadal averages.

"Approximately 70 percent of the world's population now lives in the tropics so when climate changes there, the impacts are likely to be enormous," explains Lonnie Thompson, professor of geological sciences at Ohio State.

For the last three decades, Thompson has led nearly 50 expeditions to remote ice caps and glaciers to drill cores through them and retrieve climate records. This study includes cores taken from the Huascaran and Quelccaya ice caps in Peru; the Sajama ice cap in Bolivia; the Dunde, Guliya, Puruogangri and Dasuopu ice caps in China.

For each of these cores, the team -- including research partner Ellen

Mosley-Thompson, professor of geography at Ohio State – extracted chronological measurements of the ratio of two oxygen isotopes -- O18 and O16 -- whose ratio serves as an indicator of air temperature at the time the ice was formed. All seven cores provided clear annual records of the isotope ratios for the last 400 years and decadally averaged records dating back 2000 years.

“We have a record going back 2,000 years and when you plot it out, you can see the Medieval Warm Period (MWP) and the Little Ice Age (LIA),” Thompson said. During the MWP, 70O to 1000 years ago, the climate warmed in some parts of the world. The MWP was followed by the LIA, a sudden onset of colder temperatures marked by advancing glaciers in Europe and North America.

“And in that same record, you can clearly see the 20th Century and the thing that stands out – whether you look at individual cores or the composite of all seven – is how unusually warm the last 50 years have been.

“There hasn’t been anything in the record like it – not even the MWP,” Thompson said.

“The fact that the isotope values in the last 50 years have been so unusual means that things are dramatically changing. That’s the real story here.”

While the isotope evidence is clear throughout all of the cores, Thompson says that the more dramatic evidence is the emergence of unfossilized wetland plants around the margin of the Quelccaya ice cap, uncovered as the ice retreated in recent years.

First discovered in 2002, the researchers have since identified 28 separate sites near the margin of the ice cap where these ancient plants have been exposed. Carbon-dating revealed that the plants range in age

from 5,000 to 6,500 years old.

“This means that the climate at the ice cap hasn’t been warmer than it is today in the last 5,000 years or more,” Thompson said. “If it had been, then the plants would have decayed.”

The researchers say a major climate shift around 5,000 years ago in the tropics had to have cooled the region since the ice cap quickly expanded and covered the plants. The fact that they are now being exposed indicates that the opposite has occurred – the region has warmed dramatically, causing the ice cap to quickly melt.

The role of precipitation in the global retreat of alpine glaciers may have been clarified by this study. Some researchers, convinced that a reduction in local precipitation is causing their retreat, have been skeptical about the role of rising temperatures.

“While all the glaciers we have measured throughout the tropics are retreating, the local precipitation at all of these sites but one, has increased over the last century,” Thompson said. “That means that the retreat of the ice is driven mainly by rising temperatures.”

Changes in the oxygen isotope ratios over the past 100 years have also pointed to temperature, rather than precipitation, as the engine driving glacial retreat, he said.

“Tropical glaciers are the ‘canaries in the coal mine’ for our global climate system,” he says, “as they integrate and respond to most of the key climatological variables – temperature, precipitation, cloudiness, humidity and radiation.”

Thompson said that the evidence arising from the tropics is particularly important. “The uniformity of the climate in the tropics makes these

kinds of records so critical since they tell us what is happening to global temperatures.

“What this is really telling us is that our climate system is sensitive, it can change abruptly due to either natural or to human forces,” he said. “If what happened 5,000 years ago were to happen today, it would have far-reaching social and economic implications for the entire planet.

“The take-home message is that global climate can change abruptly, and with 6.5 billion people inhabiting the planet, that’s serious.”

Working along with Thompson and Mosley-Thompson on the project were Henry Brecher, Mary Davis, Ping-Nan Lin and Tracy Mashiotta, all with the Byrd Center; Blanca Leon of the University of Texas; Don Les of the University of Connecticut, and Keith Mountain of the University of Louisville.

Source: Ohio State University