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How far off is the next ice age?

By Carolyn Fry

With global warming taking centre stage in the climate change debate, the idea that Earth might be heading towards an ice age seems outdated.

We still have a lot to learn about cycles of ice advance and retreat

Yet scientists studying microfossils from deep-sea cores have discovered that we may still have much to learn about the cycles of ice advance and retreat that have affected Earth for a million years.

Periods of ice advance are known as glacials, while the warm periods are known as interglacials.

In the past, it was thought all interglacial periods lasted for around 11,000 years, in line with Earth's natural orbital cycle around the Sun, but new findings show events on the planet's surface may also influence the timing of ice advances and retreats.

It is important that we understand these natural climatic rhythms as our current interglacial has lasted 11,500 years and could potentially end at any time.

> **It's possible that our pumping greenhouse gases into the atmosphere could somehow lubricate the flipping from one state to another**
>
> Chronis Tzedakis, University of Leeds

Although the current human-induced high levels of carbon dioxide (CO_2) in our atmosphere are thought to be unprecedented in the recent geological record, some scientists argue that it's possible the changes we are making by pumping CO_2 into the atmosphere could ultimately help usher in the next ice age.

"There are operations within the climate system that we still don't fully understand," explains Professor Chronis Tzedakis, from Leeds University, UK.

"It's possible that our pumping greenhouse gases into the atmosphere could somehow lubricate the flipping from one

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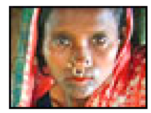

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state to another."

Core value

Professor Tzedakis and colleagues studied tree pollen and tiny fossilised marine creatures called foraminifera from a sediment core taken close to the Tagus river estuary off the coast of Portugal.

Sea water contains two major isotopes, or types, of oxygen, O16 and O18. The O16 isotope is lighter and evaporates more readily than the heavier type.

When this happens during an ice age, O16 ends up being locked away in ice on land and the remaining seawater becomes enriched with the heavier O18 isotope.

Fluctuations show up in the chemical composition of foraminifera, which means they can be used to deduce the amount of ice volume that was around at the time they were alive.

Meanwhile, preserved pollen discharged into the sea by rivers reflects the extent of forest cover, which is known to increase and decrease with warming and cooling.

Extracting both sets of data from a single core provides scientists with a picture of changes occurring both on land and the sea.

Advance and retreat

In the 1990s, researchers had investigated the interglacial prior to the one we are in now, which began 132,000 years ago. So Professor Tzedakis' team opted to look farther back in time to the interglacials that started 240,000 and 340,000 years ago respectively.

They expected to see a similar pattern to the last interglacial findings, which had revealed the warm period lasted 16,000 years and that there was a 5,000-year time lag between the ice retreating and the appearance of forests, and again between the ice advancing and the trees disappearing.

However, the new findings showed up a completely different cycle of events.

"Much to our surprise we found that pattern was not replicated," said Professor Tzedakis.

"We didn't have a big lag between the onset of the interglacial and establishment of trees plus there wasn't the persistence of forests into the period of ice growth."

Of particular interest was the pollen data from the interglacial beginning 240,000 years ago as this showed the opposite sequence of events.

The cores yielded many types of pollen, including oak (pictured)

Here, the forests seem to have disappeared after 6,000 years of warmth, despite there being no detectable change in the amount of ice cover.

The decline mirrored reductions in atmospheric methane observed in ice cores from Antarctica, suggesting it was a global rather than local event that prompted their demise. Following the disappearance of the trees, the ice sheets then gradually advanced.

The scientists believe this shows that different mechanisms operating within Earth's climate system can impinge on the underlying orbital controls of glacial-interglacial cycles.

In the case of the trees disappearing from Portugal before the advance in ice they believe an unknown global event, which may have also caused lower atmospheric methane levels, prompted them to die back.

Global impact

If vast areas of heat-absorbing forests in Siberia were also affected and replaced by tundra, this would have increased the solar energy reflected back into the atmosphere, in turn cooling the planet's surface temperature and encouraging ice growth.

It is this unusual turn of events which has got the scientists thinking that our impact on global climate could yet prompt the return of another ice age, despite the fact that global temperatures are currently increasing.

They now plan to extend their research to look back at one more interglacial, which began 400,000 years ago. This has the best potential to shed light on future climate change as the natural geometry of the Earth's orbit was the same at that time as it is today.

"It's a fascinating period," says Professor Tzedakis. "It appears to have been quite warm and wet and to have lasted a long time; possibly 30,000 years. Within the context of our present study it will be important to see how the forest reacted within the ice-free period."

> **Both [man-made] and natural changes in forest cover have a significant effect on climate**
>
> Chris Jones, Hadley Centre

Although today's unnaturally CO2-rich atmosphere is not replicated in climatic records of the recent past, the information gleaned from cores provides a means for scientists to test the accuracy of models designed to predict future climate changes.

At the Met Office's Hadley Centre for Climate Prediction and Research, scientists are finding that land cover has an important role in influencing climate.

"We're increasingly finding that we have to include the effects of changes in land cover in our models," said carbon cycle research scientist Chris Jones.

"Both [man-made] and natural changes in forest cover have a significant effect on climate, so being able to understand how changes in cover worked in ancient climates is extremely useful."

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