Arctic's tropical past uncovered

By Rebecca Morelle
Science reporter, BBC News

Fifty-five million years ago the North Pole was an ice-free zone with tropical temperatures, according to research.


The cores contain layers of fossils and minerals

A sediment core excavated from 400m (1,300ft) below the seabed of the Arctic Ocean has enabled scientists to delve far back into the region's past.

An international team has been able to pin-point the changes that occurred as the Arctic transformed from this hot environment to its present cold status.

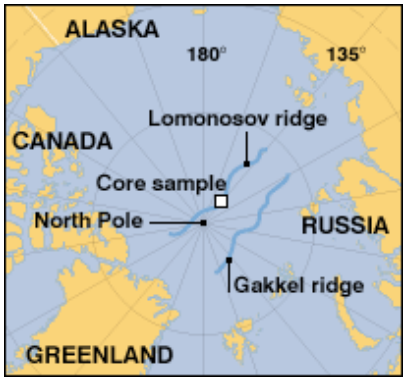
The findings are revealed in a trio of papers published in the journal Nature.

Unlocked secrets

Until now, our understanding of the Arctic's environmental history has been limited because of the difficulties in retrieving material from the harsh, ice-covered region.

But in 2004, the Arctic Coring Expedition (Acex) used ice-breaking ships and a floating drilling rig to remove 400m-long cylinders of sediment from the bottom of the ocean floor.

The cores were taken from the 1,500km-long (930 miles) Lomonosov Ridge, which stretches between Siberia and Greenland.



The core holds layer upon layer of compressed fossils and minerals, which when studied can tell the story of millions of years of Arctic history.

The bottom end of the cylinder helped scientists to uncover what had happened to the Arctic during a dramatic global event known as the Palaeocene-Eocene Thermal Maximum, which occurred about 55 million years ago.

"This time period is associated with a very enhanced greenhouse effect," explained Appy Sluijs, a palaeoecologist

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from Utrecht University in the Netherlands, and the lead author on one of the papers.

"Basically, it looks like the Earth released a gigantic fart of greenhouse gases into the atmosphere - and globally the Earth warmed by about 5C (9F).

"This event is already widely studied over the whole planet - but the one big exception was the Arctic Ocean."

The core revealed that before 55 million years ago, the surface waters of the Arctic Ocean were ice-free and as warm as 18C (64F).

But the sudden increase in greenhouse gases boosted them to a balmy 24C (75F) and the waters suddenly filled with a tropical algae, *Apectodinium*.

When current climate models were applied to this period of the Earth's history, said Dr Sluijs, they predicted North Pole temperatures to be about 15C (27F) lower than the core shows.

Blanket layers

The second of the three papers, led by paleaoecologist Henk Brinkhuis, also from Utrecht University, reports that the Arctic Ocean underwent another transformation about 50 million years ago.

The water changed from salty to fresh, and the ocean became covered with a thick layer of freshwater fern, called *Azolla*.


The water fern *Azolla* covered the ocean in a thick layer

"We assume from climate models from the early Eocene Period that there was lots of fresh water coming into the basin via precipitation and giant Canadian and Siberian river run-offs," said Professor Brinkhuis.

"And, at a certain point, this gave rise to this whopping great growth of *Azolla*."

He believes the prolific growth of this fern, may be linked to the later drops in temperature in the area.

"When you have so much of this plant in this giant sea, you have a mechanism to pump out carbon dioxide from the atmosphere. It is sort of an anti-greenhouse effect," he said.

"We argue that this sits right on the break from the really warm hot house period into the time when the ice house begins."

Future predictions

Further up the core, the first evidence of ice formation emerges.

"Five hundred thousand years above where the *Azolla* was

“ We anticipate that our data will be used by climate

found, we found the first drop stones," explained Professor Brinkhuis, who is also a co-author on the third paper which details Arctic ice-formation.

modellers to give us better information about how climate change occurs

Kate Moran, University of Rhode Island

"These are little stones that come from icebergs, icesheets or sea ice. So it must have been cold enough to have ice.

"Before we did this, it was thought that the ice field in the Northern Hemisphere only began about three million years ago; but now we have pushed that back to 45 million years ago."

Although the data tells us how the world changed from one with greenhouse conditions to one with ice house conditions millions of years ago, it may also help scientists to predict what will result from the present changes in climate.

Appy Sluijs points out that the data reveals that some of the climate models used to detail the Arctic's history got things wrong; and, as they are the same models that predict our future climate, they may need adjusting.

Kate Moran, lead author of one the papers and professor of oceanography and ocean engineering at University of Rhode Island, agrees: "We anticipate that our data will be used by climate modellers to give us better information about how climate change occurs and possibly where global climate might be leading.

"Today's warming of the Arctic can, in all likelihood, be attributed to mankind's impact on the planet; but, as our data suggest, natural processes operating in the past have also resulted in a significant warming and cooling of the Arctic."

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