When palm trees gave way to spruce trees

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New research reveals the demise of an ancient forest. These are dawn redwood stumps on Axel Heiberg Island, Nunavut. Credit: David Greenwood

For climatologists, part of the challenge in predicting the future is figuring out exactly what happened during previous periods of global climate change.

One long-standing climate puzzle relates to a sequence of events 33.5 million years ago in the Late Eocene and Early Oligocene. Profound changes were underway. Globally, carbon dioxide levels were falling and the hothouse warmth of the dinosaur age and Eocene Period was waning. In Antarctica, ice sheets had formed and covered much of the southern polar continent.

But what exactly was happening on land, in northern latitudes? When and how did Northern glaciation begin, and what does this knowledge

add to the understanding of the relationship between carbon dioxide levels and today's climate?

An international team that included Dr. David Greenwood, an NSERC-funded researcher at Brandon University, now provides some of the very first detailed answers, and they come from an unusual source.

"Fossils of land plants are excellent indicators of past climates," said Dr. Greenwood. "But the fossil plant localities from the Canadian Arctic and Greenland don't appear to record this major climate change, and pose problems for precisely dating their age, so we needed to look elsewhere."

The "where" was in marine sediments entombed when the North Atlantic Ocean was beginning to open, and lying now at the bottom of today's Norwegian-Greenland Sea. Sediment cores taken from there contained a record of ancient spores and pollen blown from the continent to the west.

"These marine sediment cores give us a very precise chronology of the changes in the dominant land plants," said Dr. Greenwood "and since many of these species have modern relatives, we can assume that the temperatures and environments they lived in were very similar."

To arrive at a holistic picture of the climate of the transition, the researchers merged the plant data with physical information about the state of the atmosphere and ocean taken from chemical and isotopic information in the same sediments, and compared this to computer modelling of climate in the period.

"We can see that summer temperatures on land remained relatively warm throughout the Eocene/Oligocene transition, but that the period was marked by increasing seasonality," said Dr. Greenwood.

"Mean temperatures during the coldest month dropped by five degrees

Celsius, to just above freezing," he said.

"This was probably not enough to create much in the way of continental ice on East Greenland," he said, "but it did wipe out palms and other subtropical trees such as swamp cypress. They were replaced by temperate climate trees such as spruces and hemlock."

The researcher said that, nonetheless, the middle period of the transition remained fairly warm. "Hickory and walnut were still present, but these became rare in the final stages," he said.

Although the march to a cooler world was gradual in northern latitudes, it was inevitable according to Dr. Greenwood.

"Changes in the earth's position in its orbit were leading a much greater seasonal range in radiation for polar regions and, overall, heat was becoming more concentrated in the tropics, largely due to a global drop in carbon dioxide levels in the atmosphere" he said.

Source: Natural Sciences and Engineering Research Council