Dramatic ocean circulation changes revealed

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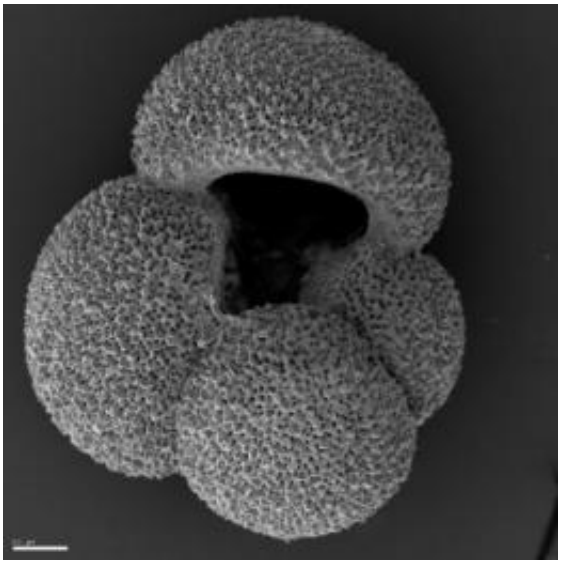

These are shells of a type of foraminifers used in this study. Credit: Cardiff University

The unusually cold weather this winter has been caused by a change in the winds. Instead of the typical westerly winds warmed by Atlantic surface ocean currents, cold northerly Arctic winds are influencing much of Europe.

However, scientists have long suspected that far more severe and longer-lasting cold intervals have been caused by changes to the circulation of the warm Atlantic ocean currents themselves.

Now new research led by Cardiff University, with scientists in the UK

and US, reveals that these ocean circulation changes may have been more dramatic than previously thought.

The findings, published today (14 January 2011) in the journal *Science*, show that as the last Ice Age came to an end (10,000 - 20,000 years ago) the formation of deep water in the North-East Atlantic repeatedly switched on and off. This caused the climate to warm and cool for centuries at a time.

The circulation of the world's ocean helps to regulate the global climate. One way it does this is through the transport of heat carried by vast ocean currents, which together form the 'Great ocean conveyor'. Key to this conveyor is the sinking of water in the North-East Atlantic, a process that causes warm tropical waters to flow northwards in order to replace the sinking water. Europe is kept warmer by this circulation, so that a strong reduction in the rate at which deep water forms can cause widespread cooling of up to 10 degrees Celsius.

This is a picture from the research ship. Credit: Cardiff University

Lead author Dr David Thornalley, Cardiff School of Earth and Ocean

Sciences, explains how the scientists studied changes in ocean circulation: "We retrieved ocean sediment cores from the seafloor of the Northeast Atlantic which contained the shells of small organisms. We used these shells to examine the past distribution of radiocarbon in the ocean. Radiocarbon is a radioactive form of carbon that acts like a natural stopwatch, timing how long it has been since water was last at the sea surface. This allows us to determine how quickly deep water was forming in the Northeast Atlantic at different times in the past."

The team of scientists found that each time deep water formation switched off, the Northeast Atlantic did not fill with water that sank locally. Instead it became inundated with water that had originally formed near Antarctica and then spread rapidly northwards. The new results suggest that the Atlantic ocean is capable of radical changes in how it circulates on timescales as short as a few decades.

Dr Thornalley said: "These insights highlight just how dynamic and sensitive ocean circulation can be. Whilst the circulation of the modern ocean is probably much more stable than it was at the end of the last Ice Age, and therefore much less likely to undergo such dramatic changes, it is important that we keep developing our understanding of the climate system and how it responds when given a push."

More information: The *Science* paper 'The Deglacial Evolution of North Atlantic Deep Convection' can be read online at: www.sciencemag.org/journals

Provided by Cardiff University