

Context for climate change

Deep ocean sediment research helps put current climate change into context



Professor Stephen Barker, from Cardiff University, has been using deep ocean sediments to learn more about abrupt changes in climate that happened thousands, even hundreds of thousands, of years ago.

Understanding such variability over multiple centuries and millennia provides a context within which recent climate change can be compared and assessed.

Paleoclimate research has provided a critical framework for the **Intergovernmental Panel on Climate Change's (IPCC's)** assessment reports, which support the United Nations Framework Convention on Climate Change.



In the 1980s, it was discovered that there were repeated abrupt changes in Northern Hemisphere climate during the last glacial period (110,000 to 12,000 years ago) - known as Dansgaard-Oeschger (D-O) oscillations; temperatures could have seen an increase of more than 10°C within only a few decades.

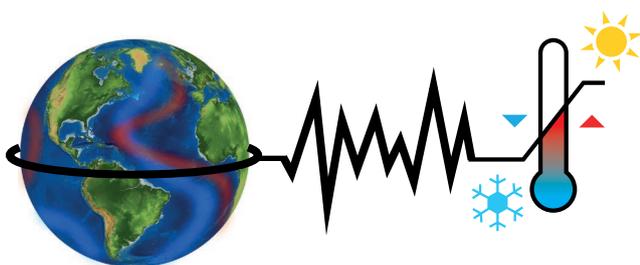
Different hypotheses were put forth to explain this phenomenon and evidence from ice cores, deep ocean sediment cores and terrestrial archives were brought together to try and understand the interactions between ice sheets, ocean and atmosphere. Further debate ensued, raising questions about what this all meant in terms of future climate change.

More than thirty years later, Barker and his colleagues continue to explore this issue.

Using sediment cores extracted through the **International Ocean Discovery Program (IODP)** (and its previous incarnations), the researchers are probing the relationships between abrupt changes in temperature and ocean circulation, freshwater influxes, and internal climate system feedbacks.

Their research has highlighted the global importance of gradual changes in the Southern Hemisphere and Antarctica and provided the first concrete evidence of an oceanographic link between these changes and more rapid variations in the North Atlantic - a mechanism potentially involved in Northern Hemisphere deglaciation.

Barker and his colleagues also used radiocarbon measurements on benthic foraminifera taken from deep ocean sediments from the Southern Ocean to show that **over the last 40,000 years there is a significant link between changes in global ocean circulation and changes in surface temperatures.**



These findings provided the first empirical evidence that at the close of glacial times a weak overturning circulation in the Atlantic was followed by a rapid and deep expansion of North Atlantic waters during deglaciation, which was possibly even more pronounced than during interglacial conditions.



Our results demonstrate the far-reaching impacts of abrupt climate change, providing evidence for direct links between rapid changes in the high latitudes of either hemisphere, both at the surface and in the abyssal ocean. The ubiquitous association we observe between abrupt shifts in ocean circulation and the transitions between glacial and interglacial state adds to mounting evidence for a causal link. This helps us understand these major global climatic changes.”

Professor Stephen Barker

These research findings have contributed to a body of evidence from paleoclimate research that is documenting abrupt climate changes in the past and interrogating plausible theories of the underlying mechanisms driving these changes.

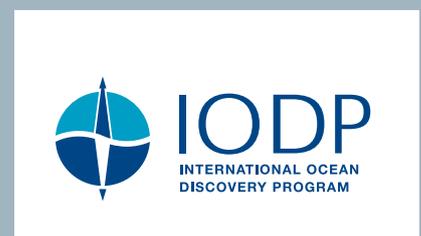
The data generated from this research suggest that existing models used to simulate future climate change may be underestimating change because they typically require much larger disturbances to produce abrupt climate change than paleoclimate data suggest. ■

Additional information

■ This research has been funded by the Natural Environment Research Council (NERC), Leverhulme Trust and the Global Climate Change Foundation.

■ Professor Stephen Barker is Director of Research in the School of Earth and Ocean Sciences at the University of Cardiff. Publications of this research can be viewed at www.cardiff.ac.uk/people/view/81591-barker-stephen

■ The International Ocean Discovery Program is a continuation of over five decades of international collaboration to recover geological data and samples from beneath the ocean floor to study the history and dynamics of Planet Earth. The UK is a member of the IODP as part of the European Consortium for Ocean Research Drilling (ECORD). The UK IODP is a NERC directed research programme that supports UK participation in IODP. www.iodp.rocks





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