Rapid climate change and the role of the Southern Ocean

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Scientists from Cardiff University and the University of Barcelona have discovered new clues about past rapid climate change.

The research, published this month in the journal *Nature Geoscience*, concludes that oceanographic reorganisations and biological processes are linked to the supply of airborne dust in the Southern Ocean and this connection played a key role in past rapid fluctuations of atmospheric carbon dioxide levels, an important component in the climate system.

The scientists studied a marine sediment core from the Southern Ocean and reconstructed chemical signatures at different water depths using stable isotope ratios in the shells of foraminifera, single–celled marine organisms. They found that the chemical difference between intermediate level and deep waters over the last 300,000 years closely resembled the changes in atmospheric carbon dioxide levels and the input of windblown dust.

Dr Martin Ziegler, School of Earth and Ocean Sciences, explained: "The deep ocean is by far the largest pool of available carbon on short timescales. In the Southern Ocean, water from the deep rises to the sea surface and comes in contact with the atmosphere. These waters will release their carbon to the atmosphere unless marine phytoplankton captures this carbon through photosynthesis and transports it back into the deep when it dies and sinks. The efficiency of this biological activity in the Southern Ocean is thought to depend on the input of nutrients, namely iron, contained in wind blown dust. It is also this efficiency that determines the strength of chemical stratification in the Southern Ocean."

Professor Ian Hall, School of Earth and Ocean Sciences, added: "Our study finds large changes in chemical stratification of the Southern Ocean not only across the shifts from ice ages to warm interglacial conditions, but also on more rapid, millennial timescales. However, changes in dust flux on these short timescales are much smaller. This could suggest that the biological response to a change in dust input is much more sensitive when the dust flux is relatively low such as it is today. This iron fertilization process might be therefore more important than previously thought."

These findings provide an important benchmark for climate modeling studies and more research will be needed to determine the significance and impact of future changes in dust input into the Southern Ocean.

Provided by Cardiff University