Global cooling as significant as global warming, research shows

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A "cold snap" 116 million years ago triggered a similar marine ecosystem crisis to those witnessed in the past as a result of global warming, according to research published today in *Nature Geoscience*.

The international study involving experts from the universities of Newcastle, UK, Cologne, Frankfurt and GEOMAR-Kiel, confirms the link between global cooling and a crash in the marine ecosystem during the mid-Cretaceous greenhouse period.

It also quantifies for the first time the amplitude and duration of the temperature change. Analysing the geochemistry and micropaleontology of a marine sediment core taken from the North Atlantic Ocean, the

team show that a global temperature drop of up to 5oC resulted in a major shift in the global carbon cycle over a period of 2.5 million years.

Occurring during a time of high tectonic activity that drove the breaking up of the super-continent Pangaea, the research explains how the opening and widening of new ocean basins around Africa, South America and Europe created additional space where large amounts of atmospheric CO2 was fixed by photosynthetic organisms like marine algae. The dead organisms were then buried in the sediments on the sea bed, producing organic, carbon rich shale in these new basins, locking away the carbon that was previously in the atmosphere.

The result of this massive carbon fixing mechanism was a drop in the levels of atmospheric CO2, reducing the greenhouse effect and lowering global temperature.

This period of global cooling came to an end after about 2 million years following the onset of a period of intense local volcanic activity in the Indian Ocean. Producing huge volumes of volcanic gas, carbon that had been removed from the atmosphere when it was locked away in the shale was replaced with CO2 from the Earth's interior, re-instating a greenhouse effect which led to warmer climate and an end to the "cold snap".

The research team say this study highlights how global climate is intrinsically linked to processes taking place in the earth's interior at million year time scales and that these processes can modify ecospace for marine life, driving evolution.

Current research efforts tend to concentrate on global warming and the impact that a rise of a few degrees might have on past and present day ecosystems. This study shows that if global temperatures swing the other way by a similar amount, the result can be just as severe, at least for

marine life.

However, the research team emphasise that the observed changes of the earth system in the Cretaceous happened over millions of years, rather than decades or centennial, which cannot easily be related to our rapidly changing modern climate conditions.

"As always it's a question of fine balance and scale," explains Thomas Wagner, Professor of Earth Systems Science at Newcastle University, and one of the leaders of this study.

"All earth system processes are operating all the time and at different temporal and spatial scales; but when something upsets the balance – be it a large scale but long term natural phenomenon or a short and massive change to global greenhouse gases due to anthropogenic activity – there are multiple, potential knock-on effects on the whole system.

"The trick is to identify and quantify the initial drivers and consequences, which remains an ongoing challenge in climate research."

More information: 'Atlantic cooling associated with a marine biotic crisis during the mid-Cretaceous period'. A McAnena, S Flogel, P Hofmann, JO Herrle, A Griesand, J Pross, HM Talbot, J Rethemeyer, K Wallmann and T Wagner. *Nature Geoscience*, DOI: 10.1038/NGEO1850

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