Scientist Uses Tracer to Predict Ancient Ocean Circulation

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(PhysOrg.com) -- Even though the Cretaceous Period ended more than 65 million years ago, clues remain about how the ocean water circulated at that time. Measuring a chemical tracer in samples of ancient fish scales, bones and teeth, University of Missouri and University of Florida researchers have studied circulation in the Late Cretaceous North Atlantic Ocean.

The Late Cretaceous was a time with high atmospheric levels of carbon dioxide and warm temperatures. Understanding such ancient greenhouse climates is important for predicting what may happen in the future. The new findings contradict some previous models.

Water masses are naturally imprinted with a chemical signature that reflects the geology in the land masses surrounding the area where they form. They carry this signature with them as they travel through the oceans, and the signature is recorded by fish skeletal material. If this fish debris is fossilized, so is the signature. MU and UF researchers collected 45 samples of 95- to 65- million-year-old fish debris from the Demerara Rise in the tropical western North Atlantic Ocean. They measured the chemical signature of these samples to estimate the source and circulation of intermediate waters during the Cretaceous Period.

“This technique allows us to track how water flowed in the Cretaceous oceans better than has been possible previously,” said Ken MacLeod, a professor of geological sciences in the MU College of Arts and Science. “Constraining ocean circulation patterns during greenhouse times,

especially across the very large changes in the global carbon cycle that occurred during the interval we studied, is giving us a better understanding of how greenhouse oceans behave."

Late Cretaceous atmospheric carbon dioxide levels were two to four times higher than today, which resulted in a greenhouse climate with tropical sea-surface temperatures rising to more than 34 degrees Celsius, 4 to 7 degrees Celsius (7 to 12 degrees Fahrenheit) warmer than today.

"The chemical signatures we measured presented two surprising findings. Values were extremely low for open-ocean sites for most of the time between 95 and 65 million years ago, but they were interrupted by a shift that was larger and more rapid than anything previously documented in marine sediments. This shift happened precisely at the time of the largest disturbance to the global carbon cycle of the past 200 million years," MacLeod said.

Based on the results, the researchers proposed the Late Cretaceous North Atlantic was characterized by sinking of warm, salty, equatorial waters, and that circulation became more vigorous or a new source of the chemical signature was introduced at the time of the disturbance to the carbon cycle. Both the persistent formation of warm, saline intermediate waters and enhanced mixing contradict leading paleoceanographic models for these times.

Provided by University of Missouri