Constraining the effects of diagenetic alteration on the clumped isotope paleothermometer

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Inherent ambiguities of established carbonate-based paleotemperature proxies, including the need to constrain water composition, have complicated the study of past greenhouse climates. The application of the novel clumped isotope thermometer to foraminifera has the potential to significantly improve climate reconstructions as it is insensitive to the isotopic composition of seawater. However, diagenetic processes can alter the primary clumped isotope signatures of foraminiferal tests, biasing reconstructed temperature signals.

In this study, the clumped isotope compositions of middle Eocene foraminifera from several regions in the Atlantic Ocean (Blake Nose, Demerara Rise, Walvis Ridge, Newfoundland Drifts) are measured. The comparison of contemporaneous benthic foraminifera from similar water depths at each site, but with varying preservational states, allows us to constrain the effects of diagenesis on reconstructed clumped isotope temperature estimates for the deep ocean. Similarly, the analysis of planktonic foraminifera from the same samples exhibiting a range of preservation states helps constrain the sensitivity of clumped isotope-derived sea surface temperatures to diagenetic alteration.

Preliminary results covering a 500 kyr-interval centered at the boundary between magnetochrons C20n and C20r suggest that both clumped and oxygen isotope compositions of benthic foraminifera exhibit relatively little diagenetic effects. In contrast, primary oxygen isotope signatures of planktonic foraminifera appear altered by diagenesis at some sites, whereas the clumped isotope data from planktonic foraminifera suggest a somewhat reduced impact on this proxy compared to oxygen isotope signatures.