Can trace element/Ca data be used to infer Eocene planktonic foraminiferal palaeoecology?

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Planktonic foraminiferal ecology, such as depth of calcification, causes species to have differences in their geochemical signatures. Since geochemical proxy data are used to infer deep-time palaeoceanographic conditions, it is important to constrain species palaeobiology in order to improve our understanding of the validity of proxy signals.

The palaeoecology and photosymbiotic associations of many extinct Cenozoic planktonic foraminiferal species has not been determined. The data obtained using these analyses can help identify and interpret the influences of vital effects on foraminiferal geochemistry Eocene sediments containing extremely well preserved, glassy planktonic foraminifera were recovered from Ocean Drilling Program Leg 174AX, Bass River, western North Atlantic. This study focuses on the interval from 56 – 40 Ma, covering a time of dramatic climatic change from peak warmth during the early Eocene climatic optimum and subsequent temperature decline. These changes are evident from bulk sediment $\delta^{13}C$ and fluctuations in $\%CaCO_3$ data. The diverse foraminiferal assemblages allow for multispecies geochemical analyses in order to reconstruct marine temperatures and water column $\delta^{13}C$ gradients.

Trace element/Ca ratios of individual chambers of various species of surface and deep dwelling planktonic foraminifera were obtained by slow depth profiling, utilising laser ablation inductively coupled plasma mass spectrometry (LA-ICPMS) as an analytical technique capable of achieving (sub)μm vertical spatial resolution. Results show minor differences in element/Ca ratios (2 – 5% in Mg/Ca and 2 – 4% in Sr/Ca) between species and between each foraminiferal chamber. Changes in trace element/Ca ratios with size are also evident, showing the importance of using a narrow size fraction for geochemical analyses of foraminifera. Data obtained in this study will be useful to compare to other sites of exceptional preservation, and for reconstructing sea surface temperature gradients in the Eocene greenhouse.