Geophysical Research Abstracts,
Vol. 11, EGU2009-2464-1, 2009
EGU General Assembly 2009

High sea-surface temperatures in the Early Cretaceous (Berriasian – Barremian): a problem for ice?

K. Littler (1), S. Robinson (1), P. Bown (1), A. Nederbragt (1), and R. Pancost (2)

(1) Department of Earth Sciences, University College London, England (kate.littler@ucl.ac.uk), (2) Organic Chemistry Unit, Bristol Biogeochemistry Research Centre, University of Bristol, England

The Early Cretaceous (∼145 – 125 million years ago) is thought to have been a period of elevated atmospheric CO_2 and warm average global temperatures. Some sedimentological evidence, such as the presence of high latitude glendonites, seems to suggest transient glaciations despite the inferred high CO_2 conditions. Previous geochemical studies of Early Cretaceous palaeotemperatures have relied upon oxygen-isotopes and Mg/Ca ratios of belemnites. However, species-specific responses and uncertainty relating to the original isotopic and elemental-ratio composition of Cretaceous seawater remain problematic. In this study, we apply the TEX^{86} organic palaeothermometer to Early Cretaceous marine sediments from DSDP/ODP sites, thereby producing sea-surface temperature estimates which are independent of the original seawater chemistry. Our results show extremely high average annual temperatures in the tropical Proto-North Atlantic of at least ∼35˚C, far in excess of modern values of ∼25˚C at the same latitude. The temperature record in this region remained essentially constant (∼1.5˚C variation), over a time period greater than 10Ma. In addition to the tropical sites, a high-latitude site (∼60˚S palaeolatitude) yields a minimum average temperature of ∼25˚C, which is also far above modern values for this latitude. The temperature range at this site (∼2.5˚C) is slightly more variable than at the low-latitude sites.

The TEX^{86} temperature record demonstrates that tropical regions are not limited to modern temperature maximums, as has been suggested by some previous oxygen-isotope studies. The global temperature gradient constructed from these records suggests excessively warm temperatures at higher latitudes, which it is difficult to reconcile with the existence of large ice sheets. The small range in temperatures recorded at these sites also suggests a high degree of long-term temperature stability in the tropics, which is interesting in light of the large positive carbon-isotope excursion in the late Valanginian (∼137Ma). This event, which is well documented in Tethyan, North Atlantic and Pacific sections, is often attributed to large volcanically induced changes in temperature and weathering rates. The lack of significant changes in our temperature record suggests that any temperature perturbations during the Valanginian carbon-isotope event were either spatially variable or shorter in duration than the resolution of our record. In either case, it may be that the proposed model for the Valanginian event needs reassessment.