Reassessment of the latitudinal temperature gradient across the Pacific during the EECO using a novel combination of instrumentation

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The early Eocene Climatic Optimum (EECO; ~ 53.3 to 49.1 Ma) was a period of the warmest sustained temperatures of the Cenozoic caused by perturbations to the global carbon cycle. Deep sea sediment cores and the microfossils preserved within them are the primary sources of information for these changes in climate and global carbon cycling but are subject to diagenetic alteration after deposition. One of the great challenges in paleoclimate research is determining how to accurately interpreting the proxy record by identifying the amount of chemical alteration of the isotopic and elemental compositions locked within microfossils such as foraminifera. The planktic foraminifera record has been biased by digenesis, provoking questions about the strength of the latitudinal temperature gradient throughout the EECO, specifically with respect to mismatches between proxy data and climate model simulations that remain unresolved. To investigate this question, we selected three deep sea sites that span across the Pacific Ocean, ODP Sites 865, 1209 and DSDP Site 207. From these sediments we extracted carefully screened planktic foraminifera and conducted analysis by two independent approaches on splits of the same individual foraminiferal shells. We measured the δ18O composition by conventional analysis (gas source mass spectrometry), and Mg/Ca ratios on fragments of the same shells by LA-ICP-MS that allows for a careful diagenetic screening. We then independently estimate sea surface temperatures and compare records to quantify the extent of bias in the planktonic foraminifera record. This approach helps to reassess the latitudinal temperature gradients across the EECO.

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