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Dramatic high latitude sea surface temperature change during the Paleogene: New multi-proxy records from New Zealand

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Recent work on exceptionally preserved foraminifera and organic matter from tropical (Tanzanian) sediments has challenged our understanding of how sea surface temperatures changed during the Paleogene. Those data suggest that although deep sea temperatures changed significantly - warming from the Paleocene to the Early Eocene Climatic Optimum followed by significantly cooling - tropical SSTs were relatively constant. To obtain comparable records from high latitudes, we determined SSTs for well preserved New Zealand sediments using a combination of TEX_{86} indices and foraminiferal $\delta^{18}O$ values and Mg/Ca ratios. Over 50 TEX_{86} analyses clearly show that from 65 to 40 million years ago, the coolest temperatures (ca. 17 to 22˚C) occurred during the Paleocene and specifically during the Paleocene Carbon Isotope Maximum (PCIM). SSTs then dramatically increased to 30 to 35˚C during the Early Eocene Climatic Optimum, then cooled from 50 to 40Ma to values < 25˚C. In general, planktic foraminiferal Mg/Ca ratios agree with these estimates, although their $\delta^{18}O$ values suggest somewhat lower and more variable temperatures, consistent with diagenetic alteration. Our records document extensive changes in high latitude SST during the Paleogene and, when compared with the Tanzanian records, reveal extensive changes in the latitudinal SST gradient. Strikingly, we see almost no evidence

for a SST gradient during the EECO, highlighting the unusual nature of this interval. However, SST gradients do develop during the Eocene, possibly associated with decreasing pCO_2.