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Multiproxy record to constrain sea surface temperature cooling across the greenhouse-icehouse transition in the Gulf of Mexico

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Changes in temperature and/or ice volume associated with the Eocene-Oligocene transition (EOT; ca. 34-33.5 Ma) have been controversial. Detailed reconstructions of marine temperatures, particularly subtropical/tropical sea surface temperatures are critical to determine climate forcing mechanisms and response with respect to the establishment of the cryosphere during the EOT. Here we present high-resolution multiproxy sea surface temperature records of foraminiferal Mg/Ca ratios and organic molecular TEX_{86} index. We also reconstructed mean annual air temperatures (MAATs) using the organic molecular MBT/CBT ratio from an expanded succession from St. Stephens Quarry, Alabama. We constrain (sub)tropical sea surface temperatures in the latest Eocene and Oligocene and address the issue of climatic stability during the EOT. These geochemical proxy records are combined with bio-magneto and sequence-stratigraphic studies to constrain the timing and magnitude of temperature and sea level change across the EOT. Both Mg/Ca and TEX_{86}indicate late Eocene sea surface temperatures of $>32^oC$, with a substantial cooling (4-6^{o}C) across the EOT, and minimal temperatures of 27-28^{o}C associated with the early Oligocene glacial maxima (Oi-1 event). There is a significant reduction in sea surface temperatures and MAATs associated with the precursor oxygen isotope shift in the latest Eocene during which MAATs decrease from 28 to 22^{o}C. Our data support that diminishing atmospheric CO_2 levels were a primary mechanism in Paleogene cooling and the expansion of the cryosphere.