Late Oligocene warming: Constraints from TEX_{86}-derived sea surface temperature proxy records

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Paleo-proxy reconstructions for the late Oligocene indicate a decoupling of temperature and pCO_2. Specifically, benthic oxygen isotope data indicate warming in the late Oligocene (~26-24 Ma), whereas alkenone-based pCO_2 estimates indicate a decline from ~700 to 400 ppm. Sea surface temperature (SST) proxy estimates for this interval are of low resolution (>500 kyr) and geographically sparse, so that the appearance of decoupling could be fallacious. Using middle Oligocene to lowermost Miocene (30-22 Ma) marine sediments sampled at ~100 kyr resolution from the western equatorial Atlantic, ODP Hole 929A (5°N), and the southwestern Atlantic, DSDP Hole 516F (30°S), we apply the TEX_{86} paleothermometer to provide improved constraints on late Oligocene warming.

Our TEX_{86} data indicate that during the middle-late Oligocene (30-23 Ma) SSTs ranged between 26°C and 33°C at 929A, and between 28°C and 31°C at 516F. In the earliest Miocene (23-22 Ma), TEX_{86}-derived SSTs varied between 23°C and 32°C at 929A, and between 27°C and 30°C at 516F. TEX_{86}-SSTs indicate cooling from ~30.0-27.5 Ma at both sites, followed by a warming trend until ~25 Ma. SSTs then remained fairly stable, decreasing by ~2°C for ~0.5 Myr, around the Oligocene-Miocene boundary, ~23 Ma. These patterns are similar to those observed in benthic oxygen isotopes records of comparable age from ODP Site 1264 (southeastern Atlantic), and ODP Site 1218 (equatorial Pacific). Specifically, our TEX_{86} records show the late Oligocene warming trend as seen in the benthic oxygen isotope data (~26.3-23.7 Ma), confirming that deep-sea (thus high latitude surface) warming was a feature of the global surface ocean. Together with the benthic oxygen isotope data, our TEX_{86}-SST records are not easily reconciled with declining pCO_2 during the period ~28-24 Ma. This suggests that other warming factors, e.g., increased northward ocean heat transport and reduced Arctic sea ice, both related to opening of the Arctic Ocean, may be involved.