Goldschmidt 2026 Abstract
https://doi.org/10.46427/gold2026.37373

Late Miocene cooling in the South Atlantic Subtropical Gyre

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The end of the Miocene and the onset of the Pliocene were marked by major environmental and oceanographic reorganizations, including the Late Miocene–Early Pliocene "biogenic bloom" (BB). This event is characterized by enhanced accumulation of biogenic components in marine sediments and has been documented across all major ocean basins, particularly in high-productivity upwelling systems. Here, we reconstruct mixed-layer temperatures and paleo–export productivity at Deep Sea Drilling Project (DSDP) Site 516, located within the South Atlantic Subtropical Gyre (SASG). As subtropical gyres are vast oligotrophic regions and important sinks for atmospheric CO_2, Site 516 provides a valuable opportunity to investigate the expression of the BB in a low-productivity open-ocean setting. Our objectives are to constrain the onset and characteristics of the BB in the western SASG and to evaluate the mechanisms driving regional paleoproductivity changes. We analyzed sedimentary elemental composition, benthic and planktonic foraminiferal stable carbon ($\delta^{13}C$) and oxygen ($\delta^{18}O$) isotopes, Mg/Ca ratios from the planktonic foraminifer *Trilobatus trilobus* (used to reconstruct mixed-layer temperatures), and conducted a quantitative assessment of benthic foraminiferal assemblages. Our results indicate that enhanced surface productivity in the western SASG began at ~7.8 Ma, broadly coincident with the onset of the Late Miocene Carbon Isotopic Shift (LMCIS), which persisted for approximately 0.8 Myr. Mg/Ca-derived mixed-layer temperatures from *T. trilobus* reveal a long-term cooling trend between 10.7 and 7.5 Ma, with mixed-layer temperatures decreasing gradually from ~28°C to ~22°C. The main cooling step predates both the BB and the LMCIS by ~1.0 Myr. After 7.5 Ma, surface temperatures show a gradual recovery, stabilizing at ~25°C. This observation suggests that increased productivity during the BB occurred within the SASG, and was not related to the northward migration of the frontal boundary. Enhanced dust flux, depicted by the Site 516 log(Zr/Rb) record, likely fertilized surface waters and stimulated regional primary productivity, contributing to the development and maintenance of the BB in this oligotrophic gyre setting.