Reconstructing Neogene climate evolution from a benthic foraminiferal perspective

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Benthic foraminifers inhabit all marine environments in water depths ranging from the intertidal zone to the deep ocean and their distribution is closely related to the export flux of particulate organic matter to the sea floor, bottom water ventilation and carbonate ion concentrations. Their isotope and geochemical signals still provide the most robust climate proxy data beyond the Quaternary, allowing tracking of temperature/salinity, ice volume, deep and intermediate water circulation and ventilation at orbital and suborbital resolution. Benthic foraminiferal isotopes provide the backbone of the Cenozoic chronology and recent syntheses have led to a better understanding of climate-carbon cycle and cryosphere dynamics. Over the past decades, ODP and IODP sites in the Pacific, Indian and Southern Oceans have recovered exceptionally well-preserved sediment archives that capture Neogene climate evolution in unprecedented resolution. Here we focus on the interval 17 to 4 Ma, which was marked by major climatic reversals, as the Earth entered into the warmest climate phase of the Neogene period (Miocene Climate Optimum), then transitioned to a much colder mode with stepwise growth of high-latitude ice sheets. We integrate high-resolution benthic foraminiferal isotope records with paired isotope and Mg/Ca-derived temperature records of mixed layer foraminifers, carbonate accumulation estimates and XRF-scanning elemental data to better understand the pacing of events and the processes driving long- and short-term climate variability. This long-term perspective underlines the crucial role of the marine carbon cycle and low latitude processes in driving climate change on a warmer Earth.