Step-wise Cooling in the High North Atlantic Over the Past 17-Million Years

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The response of the global hydrologic cycle to future greenhouse warming is still unclear. The meridional sea-surface temperature gradient, which is linked to Earth's radiative budget and large-scale ocean and atmospheric circulation, and associated polarward heat transport are important for modifying the large-scale atmospheric circulation and the global distribution of precipitation. High-latitude and meridional temperature gradients of the past can help us understand the implications of current and future warming. Certain coccolitophorid algae species produce molecular biomarkers called alkenones or algal biomarkers that can serve as a paleothermometer for sea surface temperature. The relative proportions of $C_{37:2}$ and $C_{37:3}$ methyl ketones provides the $U^{k'}_{37}$ value used to calculate sea surface temperature. Recent work has revealed the magnitude and timing of cooling over the last ~12 million years, but less is known about the Middle-Miocene. Here we reconstructed the sea surface temperature record in the high North Atlantic (ODP Site 985; ~66°N, ~6°W) over the last 17 million years using changes in the unsaturation ratio of long-chain alkenones. Our data reveal that cooling at this site occurred largely in two steps: in the Middle-Miocene alkenone temperatures decreased by 7°C, and in the Late Miocene by an additional 10°C. Existing data from a nearby site in the Nordic Sea (Site 907, ~69°N, ~12°W) displays cooling at similar times and magnitudes, whereas ODP site 982 (~57°N), farther south, shows more gentle, gradual cooling, albeit with a similar total temperature decline. The collective data from sites 907 and 985 suggest that changes in polar circulation may have affected meridional circulation and precipitation patterns.