Carbon Isotopes Support Atlantic Meridional Overturning Circulation Decline as a Trigger for Early Deglacial CO_2 Rise

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Abstract

The mechanism for the observed initial rise of atmospheric CO_2 during the last deglaciation remains unknown. Most recent hypotheses invoke southern hemisphere processes such as shifts in mid-latitude westerly winds. Here we compare simulations from a global, coupled climate-biogeochemistry model including carbon isotopes ($\delta^{13}C$) with a synthesis of high-resolution deep sea $\delta^{13}C$ reconstructions as well as ice core data. The reconstructions from Heinrich Stadial Event 1 (HS1, ~19-15 ka BP) are constistent with model simulations of a large multi-millennial reduction of the Atlantic Meridional Overturning Circulation (AMOC). Our results suggest that the rise in atmospheric CO_2 and decrease in its $\delta^{13}C$ composition ($\delta^{13}C_{CO2}$) observed during the early deglacial may have been caused by an AMOC induced decline of the ocean's biologically sequestered carbon storage without the need to invoke changes in southern hemisphere winds.