Intensification of Antarctic Ocean stratification at the end of the mid-Pleistocene transition

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The causes of the mid-Pleistocene transition (MPT; ~1.2 to 0.7 million years ago), when the climate cycles shifted from 41- to ~100-kyr periodicities, are not fully understood. Many of the proposed hypotheses involve global cooling and an associated decline in glacial atmospheric CO_2. Whereas evidence suggests that the ice ages prior to the transition were characterised by atmospheric CO_2 concentrations 30−40 ppmv higher than today, the mechanisms accounting for the CO_2 drawdown remain unclear. Here we use surface- and bottom-dwelling foraminifera from the Antarctic Ocean to reconstruct the vertical density gradient of the past 1.5 million years, a process crucial in controlling the partitioning of CO_2 between the ocean interior and the atmosphere. We found that an abrupt increase in glacial stratification occurred towards the end of the MPT, coinciding with the emergence of the dominant high-amplitude 100-kyr glacial cycles. While iron fertilization in the Subantarctic Ocean likely played a major role in enhancing oceanic carbon sequestration, we propose that the reconstructed changes in the Antarctic Ocean were instrumental in finalising the transition to more prolonged and severe ice ages, allowing Northern Hemisphere ice sheets to survive periods of obliquity-paced summer insolation maxima.

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