

How did the Earth enter the Last Glacial Period? Using surface ocean reconstructions to understand ocean carbon uptake during Glacial Inception

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This study examines potential drivers of glacial-interglacial changes in atmospheric CO₂ by examining conditions as the Earth moves into a glacial period, 80-110 ka, when atmospheric CO₂ had decreased by 34-45 ppmv below interglacial values. We use a new compilation of SST data (117 deep-sea cores), polar planktonic oxygen isotope data (19 high-latitude cores), and existing compilations of carbon isotope data from foraminifera. Surface temperature reconstructions show substantial cooling had begun in both the northern and southern high-latitudes between 130 and 100 ka, while low-latitude temperatures had not changed substantially. The largest glacial-interglacial temperature change during glacial inception is observed in the high-latitude North Atlantic Ocean, as evidenced from oxygen isotope records from polar planktonic foraminifera. While this cooling provides support for a North Hemisphere trigger for deep-ocean circulation changes that led to deep-ocean stratification early in the glaciation, evidence for deep-ocean stratification is not strongly detectable in other circulation proxies from deep-sea cores. This suggests that other physical mechanisms (such as sea-ice expansion and surface water stratification) play an early role in reducing atmospheric CO₂ prior to 80-110 ka, with deep-ocean stratification playing a larger role at the onset of Stage 4 (60-70ka).