Clues on Pacific Ocean carbon cycle & circulation dynamics since the last Glacial Maximum from Southern Hemisphere depth transects

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Ocean circulation plays a key role in regulating atmospheric CO_2 concentrations. During the Last Glacial Maximum (LGM), shoaling of northern-sourced waters likely contributed to the reduction of atmospheric CO_2. We compared vertical transects of $\delta^{13}C$ and $\delta^{18}O$ based on *Cibicidoides spp.* in sediment cores from the Southwest Pacific (660-3800 m) and Southwest Atlantic (440-3900 m) basins. These data show that glacial water mass properties and boundaries in the South Atlantic and Pacific were more distinct than present. The $\delta^{13}C$ between ~1100 and 2500 m in the Pacific was >1 ‰ more depleted than the Atlantic and Pacific $\delta^{18}O$ below 2500 m was ~0.5 ‰ more depleted than the Atlantic, implying independent deep water sources. We attribute this to a 'deep gateway' effect whereby northern-sourced waters shallower than the Drake Passage sill were unable to enter the Southern Ocean because net meridional geostrophic transport cannot be supported in the absence of a net zonal circumpolar pressure gradient above the sill depth. Calculations of $\delta^{18}O$ and $\delta^{13}C$ vertical differences ($\Delta\delta^{18}O$ and $\Delta\delta^{13}C$) relative to 660 m in the Pacific show enhanced $\Delta\delta^{13}C$ and reduced $\Delta\delta^{18}O$ gradients below 1100 m at the LGM. Glacial $\Delta\delta^{18}O$ suggest that stratification in the Pacific was ~500 m shallower than present. Both Pacific isotopic gradients shifted rapidly at 16.5 ka (the middle of Heinrich 1), coincident with evidence for the onset of wind-driven upwelling in the Southern Ocean. Waters above 1.6 km became more enriched in $\delta^{13}C$ and depleted in $\delta^{18}O$; this shallow water change was coincident with deeper Pacific $\delta^{13}C$ enrichment and leads deep Atlantic $\delta^{18}O$ and $\delta^{13}C$. Evidence from other tracers (e.g., ε_{Nd}) also support invigorated deep flow in the Pacific. During Heinrich Stadial 1, shoaled northern-sourced waters were unable to escape the Atlantic and contribute to deep waters in the Southern Ocean. From this, we infer that Pacific Southern Ocean dynamics contributed to the early deglacial release of CO_2.