

Pacific southern-sourced intermediate and mode water variability during the last deglacial atmospheric CO₂ increases

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Southern-sourced Antarctic Intermediate Water (AAIW) and Subantarctic Mode Water (SAMW) form in the Southern Ocean and are currently one of the main sinks of atmospheric CO₂. During the last deglaciation (~21,000-10,000 years before present), atmospheric CO₂ levels increased significantly during two specific time periods, Heinrich stadial 1 (H1) (~18-14.6 ka BP) and the Younger Dryas (YD) ~12.8-11.5 ka BP. This deglacial two-step increase in atmospheric CO₂ resulted from upwelling (and outgassing) of deep and “old” high pCO₂ and nutrient-enriched water masses in the Southern Ocean, close to where AAIW/SAMW is formed. Proxy data studies suggest that AAIW/SAMW was an important conduit of this “old” high pCO₂ waters towards the eastern Pacific tropical upwelling region, but its variability and properties in the Southeast Pacific Ocean are still largely unknown. To fill this gap, we present records of benthic foraminiferal carbon isotopes, Mg/Ca-based water temperatures, paleosalinity reconstructions, and sortable silt mean grain size variations over the last 30 thousand years from Ocean Drilling Program (ODP) Site 1233, in the Southeast Pacific Ocean, which is bathed in AAIW/SAMW. Our proxy data suggest an increased northward circulation of high pCO₂/nutrient-enriched AAIW/SAMW during H1 and YD. Our data provides support for AAIW/SAMW as one of the important conduits for deglacial oceanic outgassing in the eastern equatorial Pacific upwelling.