

Antarctic Meltwater and Southern Ocean Variability During the Last Interglacial

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The Antarctic Ice Sheet (AIS) plays a central role in regulating global sea-level change and climate stability. Its mass loss is strongly influenced by the intrusion of warm Circumpolar Deep Water (CDW) onto the Antarctic continental shelf, which enhances basal melting and ice-sheet retreat. Meltwater discharge from the AIS can alter Southern Ocean stratification and deep-water formation, with potential impacts on global ocean circulation through changes in Antarctic Bottom Water production and the Atlantic Meridional Overturning Circulation (AMOC). Despite its significance, the relationship among CDW intensification, freshwater input, and surface ocean variability during past warm periods remains insufficiently understood.

The Last Interglacial (LIG; ~130–115 ka) provides a valuable analogue for near-future warming conditions, yet the feedbacks linking AIS meltwater fluxes and Southern Ocean dynamics are still unclear. To address this gap, we present high-resolution (~170-year) multiproxy records from IODP Expedition 382 Sites U1536 and U1537 in the Scotia Sea. Our reconstruction integrates compound-specific hydrogen isotope ratios (δD) of C₁₈ fatty acids as an indicator of meltwater input, glycerol dialkyl glycerol tetraether (GDGT)-based sea surface temperature estimates, and radiolarian assemblages reflecting water-mass structure and CDW influence.

Preliminary results reveal intervals in the early LIG when enhanced CDW intrusion occurred simultaneously with increased meltwater discharge and abrupt surface ocean cooling. This coupling suggests that AIS freshwater input and CDW dynamics interacted closely over centennial timescales. Such changes may have influenced Antarctic Bottom Water formation and are potentially linked to the subsequent weakening of the AMOC.

Keywords: Southern Ocean, Antarctic ice sheet