Goldschmidt 2021 Abstract
https://doi.org/10.7185/gold2021.7483

Deglacial CO_2 release and ventilation in the Indian Ocean sector attributed to a Southern Ocean deep gateway effect

ELISABETH L SIKES[1], RYAN GLAUBKE[1], NATALIE E. UMLING[2], THOMAS J. WILIAMS[3], AIDAN STARR[4] AND ELLEN MARTIN[3]

[1]Rutgers University
[2]American Museum of Natural History
[3]University of Florida
[4]Cardiff University

Presenting Author: sikes@marine.rutgers.edu

The Southern Ocean exerts a profound control on ocean mixing and water mass exchange between the major oceanic basins, and is thought to play a critical role in glacial-interglacial circulation changes and ocean-atmosphere carbon exchange. Shoaling of north Atlantic-sourced waters (NSW) during the Last Glacial Maximum (LGM) contributed to the observed reduction of glacial atmospheric CO_2, in part due to the resulting reconfiguration of Southern Ocean circulation caused by the deep gateway effect. This effect is produced by the absence of a net zonal circumpolar pressure gradient above the Drake Passage sill that prevents southward geostrophic transport of intermediate depth NSW across the Antarctic Circumpolar Current; this gateway closed to shoaled NSW during the LGM. The lack of NSW allowed the expansion of a lower circulation cell with an increased component of Pacific and Indian Deep Water higher in remineralized carbon, thereby increasing the oceanic carbon store. We present here data from two Southeast Indian Ocean cores; TT1811-34GGC (41.718°S, 80.163°W, 3167 m. water depth) bathed in Circumpolar Deep Water (CDW) and TT1811-50GGC (38.334°S, 77.715°W, 1118 m.) bathed in Antarctic Intermediate Water (AAIW). In our deep core, Holocene–LGM $\delta^{13}C$ differences of ~ 1‰ based on *Cibicidoides spp.* indicate increased respired CO_2 in the LGM, while neodymium isotopes (ε_{Nd}) measured on uncleaned planktic foraminifera, decreased from -6.5 in the LGM to -8.6 in the Holocene, recording significantly reduced NSW. Sortable silt (SS) records from both cores suggest reduced flow speeds throughout the water column while AAIW $\delta^{13}C$ records no change. CDW $\delta^{13}C$ increased early in Heinrich Stadial 1, indicating early CDW ventilation, whereas SS and εNd shift later in the deglaciation, suggesting the return of NSW and reinvigorated deep water flow occurred later in the deglaciation. This sequence is consistent with the idea that shoaled NSW was unable to escape the Atlantic and contribute to deep flow in the Southern Indian Ocean until/after the Antarctic Cold Reversal, similar to observations from the Southern Pacific. From these data, we infer that Southern Ocean dynamics, rather than Atlantic overturning circulation, controlled the timing of early deglaciation and CO_2 release from the Southern Hemisphere