Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.20585

Deglacial CO_2 release from the Southern Ocean during Termination IV

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Abrupt atmospheric CO_2 increases characterise a critical feature of deglaciations. The deglacial CO_2 rise toward Marine Isotope Stage (MIS) 9e (Termination IV) started from 197.1 ppm to 300.7 ppm at 335 ka BP[1], representing the highest natural atmospheric CO_2 recorded in the Antarctic ice cores over the past 800 ka[2]. Oceanic carbon storage changes must be involved in regulating the Pleistocene atmospheric CO_2 variations. However, the mechanisms and pathways of the air-sea carbon exchanges remain elusive partly due to the lack of oceanic carbonate system proxy data with a robust age control beyond Termination I. Here, we present high-resolution carbonate system records for Termination IV from Iberian Margin. We employ a new air-sea CO_2 exchange tracer ($[CO_3^{2-}]_{as}$)[3] to reconstruct carbon transfer between the oceanic and atmospheric reservoirs. An increased $[CO_3^{2-}]_{as}$ would reflect enhanced CO_2 outgassing. At the onset of HS10.1, $[CO_3^{2-}]$ decreased rapidly, likely due to an expansion of southern-sourced Glacial Antarctic Bottom Water (GAABW). During the mid-HS10.1, the lack of any $[CO_3^{2-}]$ decline probably implies an increase in $[CO_3^{2-}]$ associated with the GAABW due to enhanced ventilation via the Southern Ocean. The increased $[CO_3^{2-}]_{as}$ indicated a net release of CO_2 from the Atlantic sector of the Southern Ocean during the mid-HS10.1. The centennial-scale atmospheric CO_2 rise at the end of the HS10.1 is unlikely related to the Atlantic sector of the Southern Ocean, as a $[CO_3^{2-}]_{as}$ the decline was observed. Our results suggested that during the deglacial CO_2 increase toward MIS9e, there was a net release of CO_2 from the Atlantic sector of the Southern Ocean. The net CO_2 release is highly like due to the expansion and ventilation of the GAABW.

References:

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