

Southern Ocean abyssal oxygenation linked to the air-sea partitioning of carbon throughout the last glacial cycle

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It is believed that no single mechanism can account for the full amplitude of past CO₂ variability over glacial interglacial cycles [1]. But although multiple synergistic processes may be involved, a build-up of biologically-stored carbon in deep water masses has emerged as a central mechanisms for low CO₂ during the last glacial maximum [2] [3]. However, the mechanisms by which this deeply sequestered carbon was released, and its history prior to the glacial maximum, remain subjects of debate. Here, we present redox-sensitive trace metal records from the Antarctic Zone of the Southern Ocean to reconstruct changes in deep ocean oxygenation – and, by inference, respired carbon storage - across the last glacial cycle. Our results show a greater amount of remineralized carbon in the abyssal Southern Ocean during the last glacial maximum, which was removed during the northern hemisphere cold phases of the deglaciation, when atmospheric CO₂ rose rapidly [4]. Furthermore, our new records show that the same relationship between atmospheric CO₂ and abyssal Southern Ocean oxygenation was maintained throughout most of the prior 60 kyrs, consistent with a unifying role of the Southern Ocean through a coupled control on deep ocean ventilation and iron fertilization.

[1] Hain, M.P., Sigman, D.M., Haug, G.H. (2010) *GBC*, **24**, 10.1029/2010GB003790 [2] Sigman, D.M., Hain, M.P., Haug, G.H. (2010) *Nature*, **466**, 47-55 [3] Skinner, L.C., et al. (2010) *Science*, **328**, 1147-1151 [4] Marcott, S.A., et al. (2014) *Nature*, **514**, 616-619