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## Carbonate counter pump strength and its impact on atmospheric pCO<sub>2</sub> over the past 800 ka: evidence from Southern Ocean micropaleontological and geochemical data

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During the glacial-interglacial transitions of the past 800 000 years (800 ka), commonly referred to as “glacial terminations”, atmospheric CO<sub>2</sub> concentrations (pCO<sub>2</sub>) rose by 50-100 ppm. Biological productivity from the Southern Ocean (SO) significantly impacted these variations through changes in the Biological Carbon Pump strength, which includes the Soft Tissue Pump (STP) i.e., the net downward flux of phytoplanktonic organic carbon, and the Carbonate Counter Pump (CCP) i.e., the export of planktonic calcium carbonates increasing the surface-to-depth alkalinity gradient. Both modulate ocean-atmosphere exchanges as they respectively decrease and increase CO<sub>2</sub> concentrations in the surface ocean and hence the atmosphere. Paleoclimate studies focusing on the SO highlight decreasing STP from the Subantarctic as a potential driver of increasing pCO<sub>2</sub> during glacial terminations. A few studies have demonstrated the probable impact of CCP on pCO<sub>2</sub> over specific glacial terminations (Duchamp-Alphonse et al., 2018; Brandon et al., 2022; Anderson et al., 2024) but very little is known about CCP patterns over the past 800 ka.

This study aims to reconstruct changes in CCP strength over the past 800 ka and assess their impacts on pCO<sub>2</sub>. Following the exact same strategy as the one developed by Brandon et al., (2022), we performed micropaleontological (coccolith and foraminifera abundances and morphometrics) and geochemical analyses (CaCO<sub>3</sub>, Ca<sub>XRF</sub>, d<sup>13</sup>C<sub>N. pachyderma</sub>, d<sup>18</sup>O<sub>N. pachyderma</sub>) on sediment core MD97-2115 (43°10,84S, 171°48,55W), retrieved in the Pacific sector of the Subantarctic Zone. Preliminary results show that the carbonate fine fraction (< 20µm) of the sediment is mainly composed of coccoliths (*Emiliania huxleyi* and *Gephyrocapsa* morphotypes; *Coccolithus pelagicus*; *Calcidiscus leptoporus*) and might be used as a CCP signal.

Anderson, H. J. *et al.* Millennial-Scale Carbon Flux Variability in the Subantarctic Pacific During Marine Isotope Stage 3 (57–29 ka). *Paleoceanography and Paleoclimatology* 39, e2023PA004776

(2024).

Brandon, M. *et al.* Enhanced Carbonate Counter Pump and upwelling strengths in the Indian sector of the Southern Ocean during MIS 11. *Quaternary Science Reviews* 287, 107556 (2022).

Duchamp-Alphonse, S. *et al.* Enhanced ocean-atmosphere carbon partitioning via the carbonate counter pump during the last deglacial. *Nature Communications* 9, 1–10 (2018).