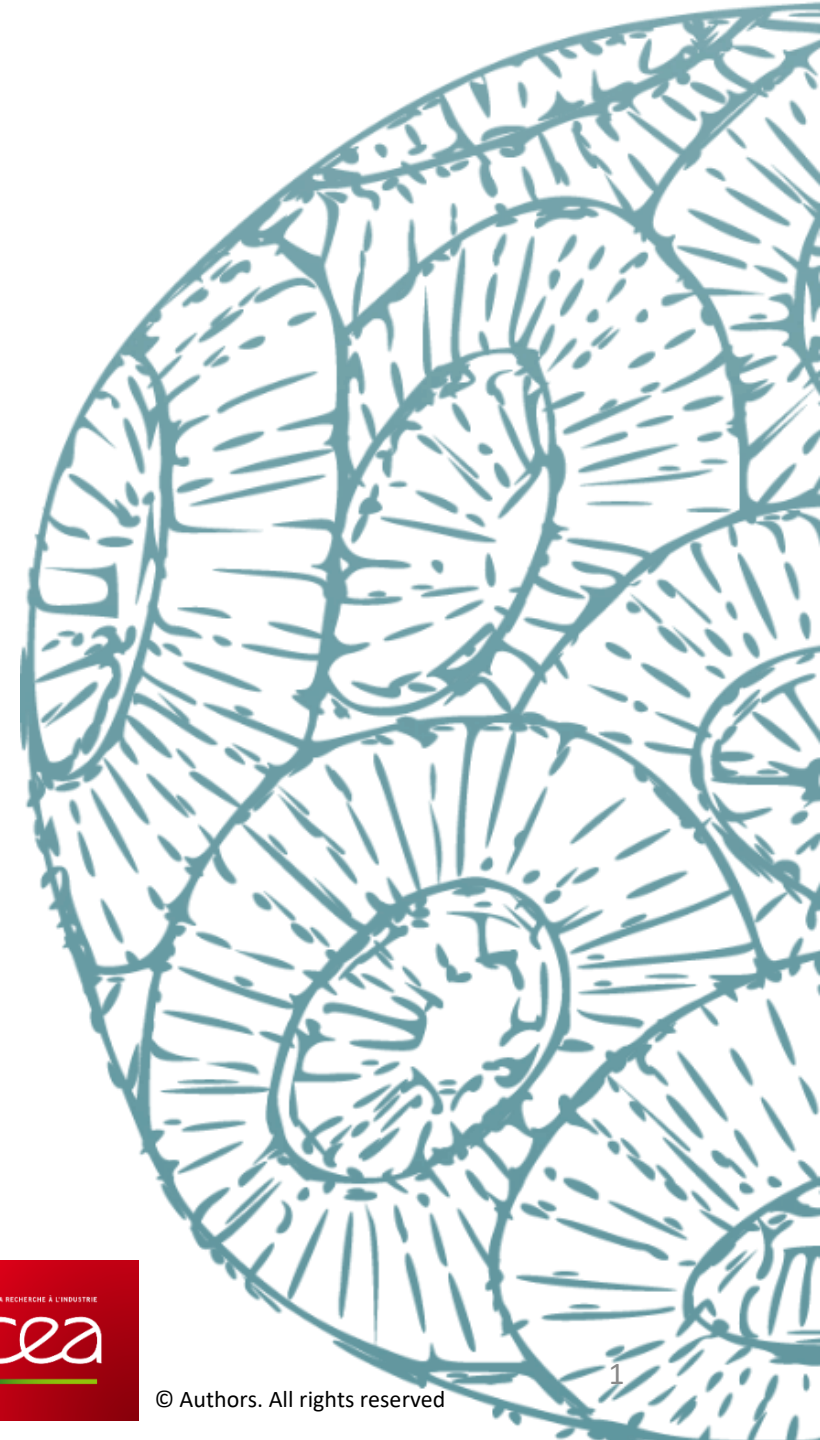


Variations of the Carbonate Counter Pump in the Southern Ocean during the Mid-Brunhes event and their contribution to the global biospheric productivity

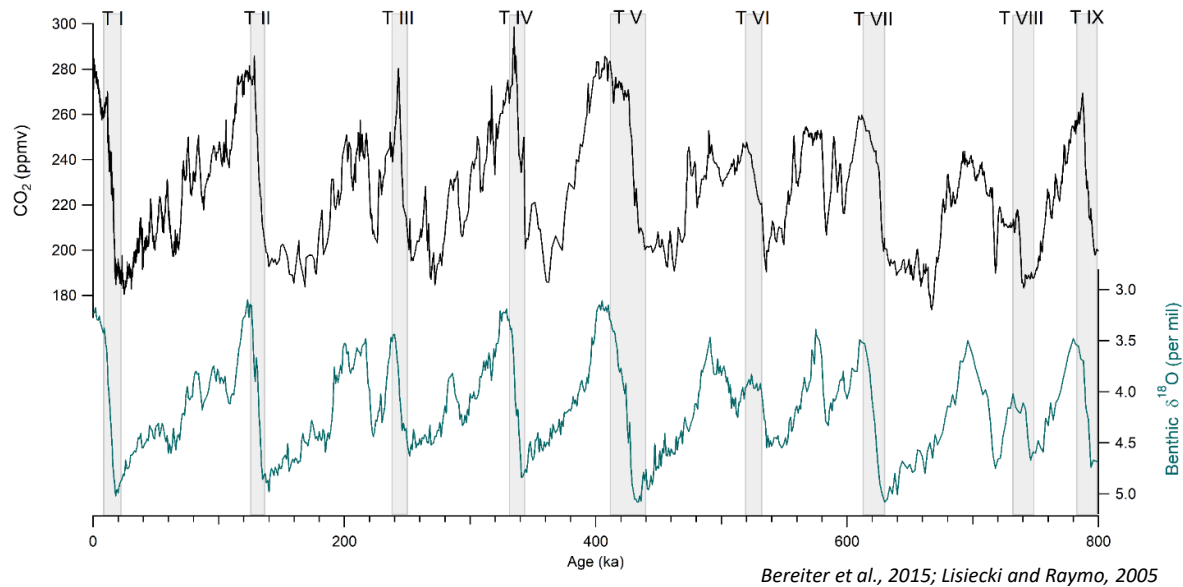
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How to explain the increases in CO₂ during terminations?



Possible forcing factors impacting atmospheric CO₂ :

- ✓ Temperature changes
- ✓ Sea ice extent
- ✓ Oceanic circulation dynamic
- ✓ Biosphere productivity (terrestrial and oceanic)



Aim of this study

Unravel the impact of Southern Ocean biological productivity on atmospheric CO₂

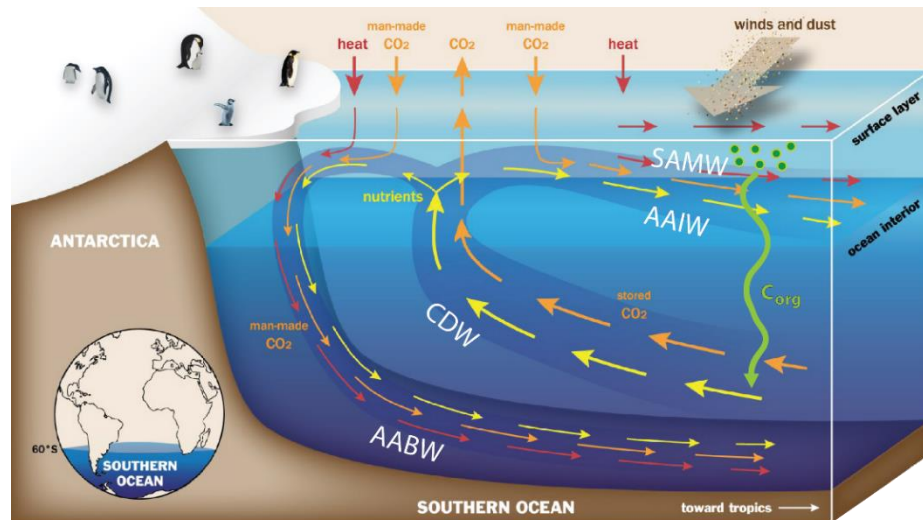
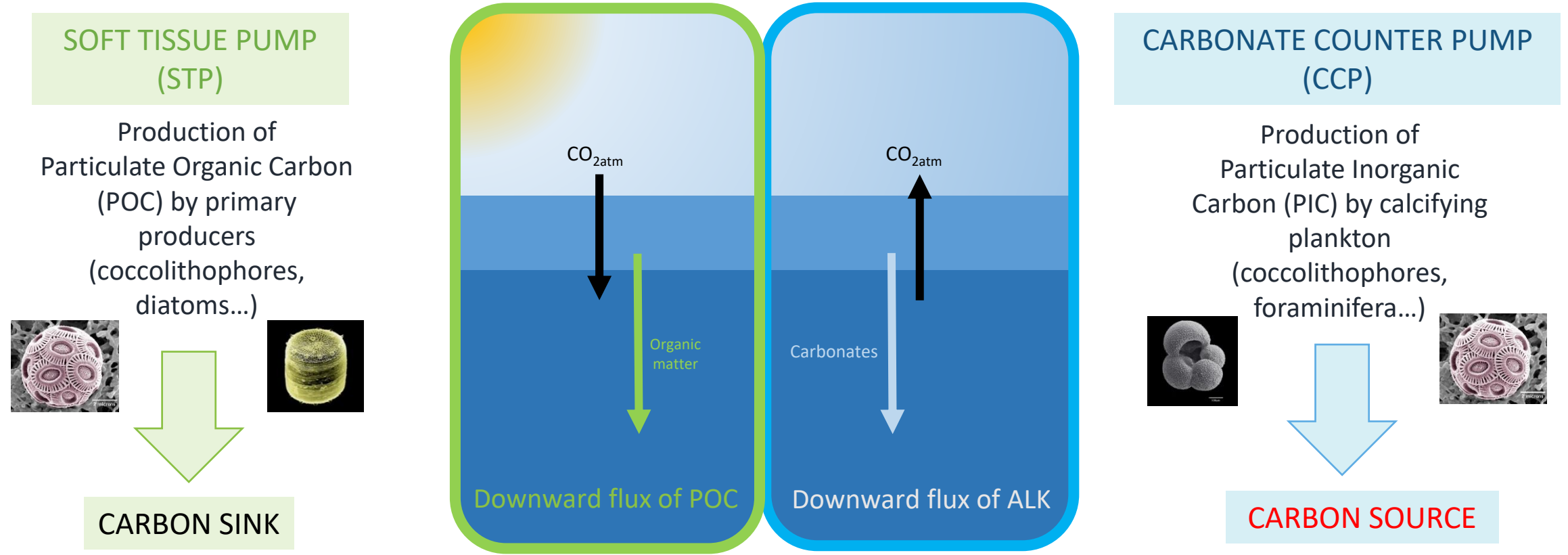


Illustration by Ilissa Ocko, modified

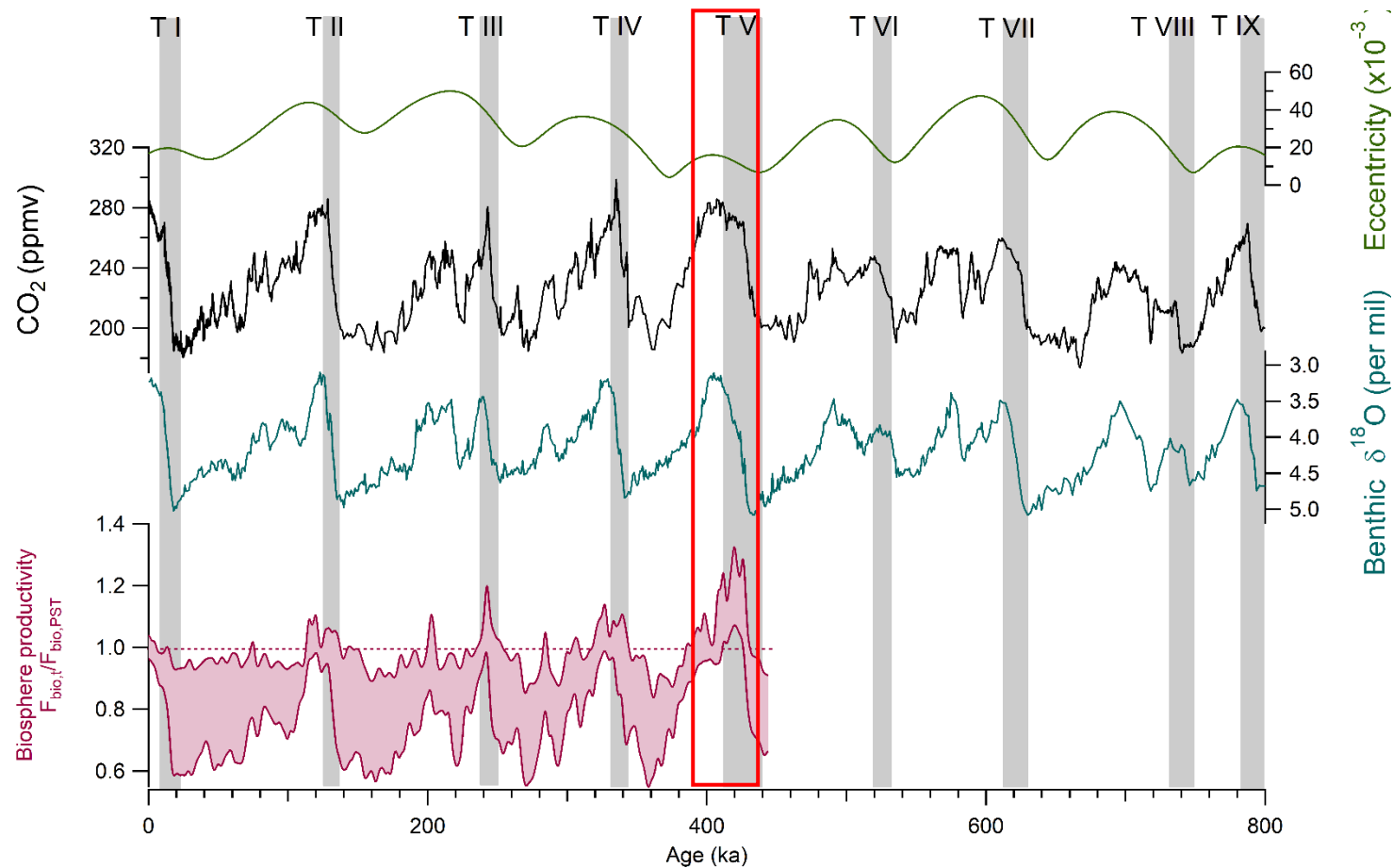
The Biological Pump

Sequestration of carbon in the deep ocean at the expense of surface ocean and atmosphere through biological processes



✓ As calcifying phytoplankton and primary producers, coccolithophores are good tools to reconstruct the past variations of both STP and CCP in the ocean

The unique feature of Mid-Brunhes event



Laskar et al., 2004; Bereiter et al., 2015; Lisiecki and Raymo, 2005; Brandon et al., 2020

Termination V : First Termination associated with 100 ka-cycles

Minimum of eccentricity

Strong Glacial Period (MIS 12)

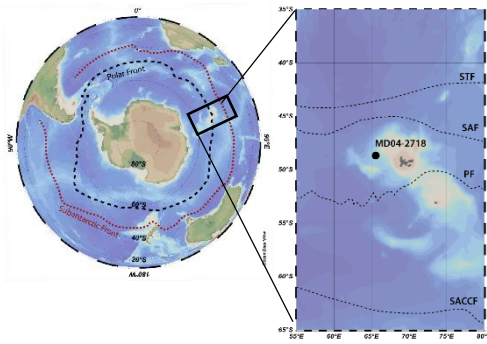
Long Interglacial – 30 ka (MIS 11)

Strong biosphere productivity (10-30% superior to PST)
Brandon et al., 2020, Nat. Comms

Strong carbonate production
Barker et al., 2006, QSR

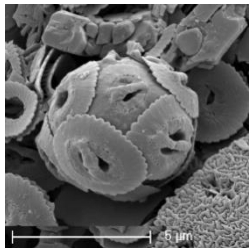
Reconstruction of the CCP in the Indian sector of the Southern Ocean

Objective: Reconstruct the variation of the CCP in the Southern Ocean to better understand its impact on atmospheric CO₂ over Mid-Bruhnes event

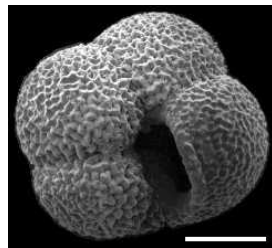


MD04-2718 sediment core

- ✓ 48°53,30 S; 65°57,42 E
- ✓ 1428 m water depth
- ✓ Indian sector of the Southern Ocean
- ✓ Age model based on AICC2012

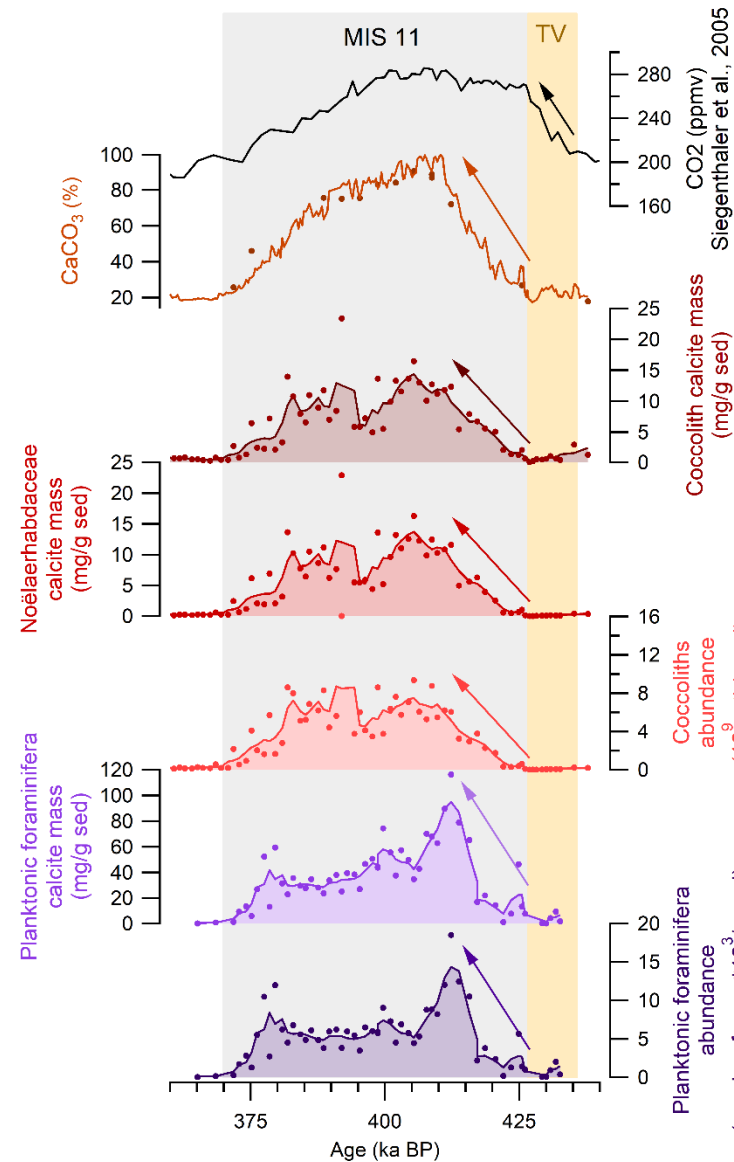


mikrotax.org



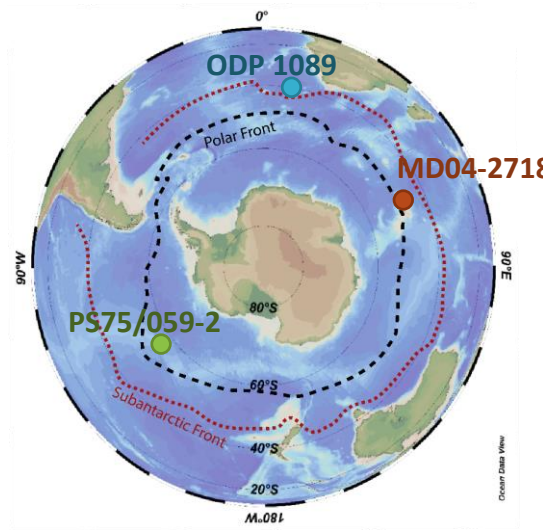
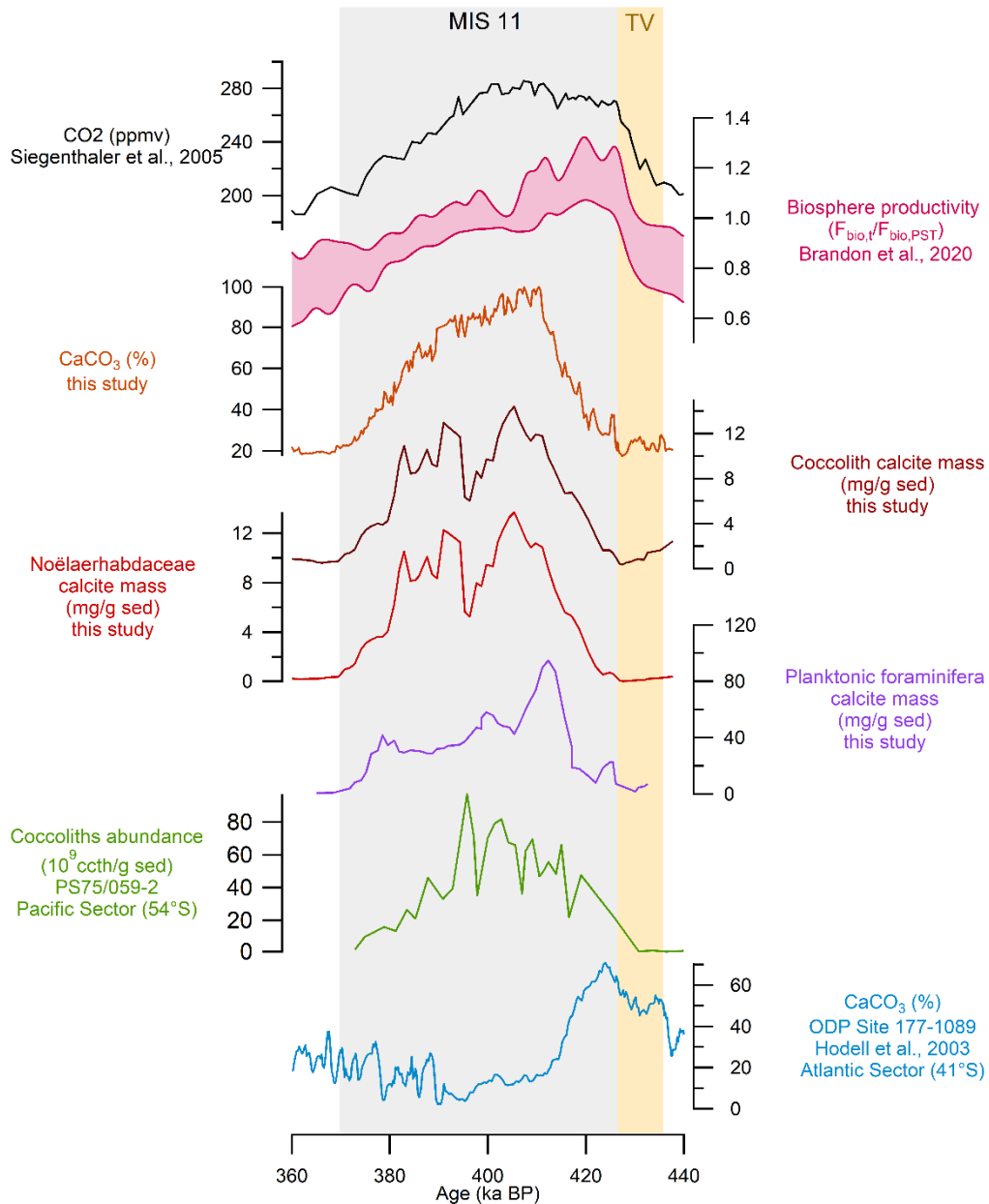
byrd.osu.edu

- ✓ Abundance of coccolithophores and foraminifera
- ✓ Mass of calcite produced by coccolithophores and foraminifera
- ✓ Percentage of CaCO₃ in the sediments



Increase of the Carbonate Counter Pump in the Indian sector of the Southern Ocean due to an increase in coccolith and foraminifera abundances

Increase in the CCP over the Southern Ocean during MIS 11



- ✓ Atlantic sector (blue): increase in CaCO₃ production during T5
- ✓ Pacific (green) and Indian sector : high CaCO₃ productivity during second part of MIS 11.

Increase in coccolith and foraminifera productivity in the Southern Ocean



Increase in Carbonate Counter Pump



Increase in CO₂ flux in the surface ocean and in the atmosphere



Contribution to the high atmospheric CO₂ plateau during MIS 11

Increase in CO₂ flux from the ocean counterbalanced by the high biosphere productivity due to increased terrestrial productivity (Brandon et al., 2020 and this study)₆

Take-home messages

Coccolith and foraminifera productivity reconstruction over Mid-Brunhes event in the Indian sector of the SO

Strong increase in CCP during second part of MIS 11

Implication of the increase in CCP in the Southern Ocean on atmospheric CO₂