



Abstract ID : 280

How and why does CO₂ change? Oceanic records of carbon storage and pCO₂ within and beyond the (current) reach of the ice cores

Content

CO₂ records from Antarctic ice cores lay down two fundamental challenges to the paleoceanographic community. First, can CO₂ reconstructions be found in the ocean that mirror the atmosphere, reflecting glacial-interglacial carbon storage and release? Secondly, can oceanic reconstructions be used to extend the record of CO₂ change beyond the reach of the oldest ice?

Here I present recent efforts by our group to address these challenges using the boron isotope proxy for paleo pH and CO₂. With boron and trace element records spanning a range of oceanic depths, we show how the structure of glacial carbon storage evolved over the last glacial cycle, highlighting likely causal mechanisms. We find that the structure of deep ocean circulation changed systematically in different glacial stages, proving an architecture into which carbon can be sequestered by the biological pump. We also show how this glacial carbon storage broke down during intervals of rapid climate change, with CO₂ released back to the atmosphere from each high latitude ocean basin at different times. Finally, we show new reconstructions of CO₂ beyond the current reach of the ice cores, illuminating the role of the carbon cycle in the intensification of the ice ages.

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Track Classification: Biogeochemical Cycles in the Earth system – data and models