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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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During the last 800,000 years, atmospheric CO_2 concentrations have varied with an amplitude of more than 100 ppm, with the fastest increases registered during deglaciations. The mechanisms behind the increases of CO_2 are still discussed since several parameters are involved. Biological productivity on land and in the ocean played a major role in the variations of atmospheric CO_2. Particularly, productivity variations in the Southern Ocean along deglaciations are key because changes in the efficiency of the Soft Tissue Pump (STP) and the Carbonate Counter Pump (CCP) in the Subantarctic Zone significantly impact the exchanges between ocean and atmospheric reservoirs. As calcifying organisms, coccolithophores and planktonic foraminifera represent the major producers of $CaCO_3$ and are therefore good tools to reconstruct past variations of CCP.

Among the last 9 deglaciations, Termination V registers the strongest global productivity (20% higher) compared to the other 8 interglacial periods. Associated with the Mid-Brunhes event, it is followed by the warm MIS 11, the longest interglacial (~ 30 ka). MIS 11 also registers a strong carbonate production in the ocean, most probably favoured by the low eccentricity during this period. Studying the variations of the CCP during this specific period of time is therefore important to better understand its relation with biospheric productivity changes and its impact on atmospheric CO_2.

Here we present micropaleontological (coccoliths and foraminifera) and geochemical ($CaCO_3$) data from marine core MD04-2718, located in the Indian sector of the Southern Ocean (48°53 S; 65°57 E) throughout Termination V and MIS 11, that we compared with other productivity data from the Southern Ocean as well as reconstruction of global biospheric productivity data ($\Delta^{17}O$ of O_2).

Results show that coccolith and foraminifera abundances and masses increase during Termination V and MIS 11. The good correlation between variations of $CaCO_3$ in the sediment and calcite mass from coccoliths and foraminifera shells proves that exported $CaCO_3$ is essentially of planktonic origin and reveals that CCP significantly increases over this period.

We suggest that the strengthening of CCP through the increase in production and export of calcite associated to coccolith and foraminifera in the Southern Ocean may have contributed to increase the atmospheric CO_2 during Termination V and MIS 11, while the strong biological productivity registered during this period would have permitted to maintain the CO_2 level relatively low

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