Relative impacts of upwelling, iron & ocean circulation on the Equatorial Pacific CO_2 source over the last deglaciation

PICHEVIN, L.E.[*1], GANESHRAM, R.S.[1], SADEKOV, A.Y.[2]

[1] University of Edinburgh, Grant Institute, James Hutton Road, Edinburgh EH9 3FE, UK
* Correspondence: laetitia.pichevin@ed.ac.uk
2 University of Cambridge, Department of Earth Sciences, Downing Site, Cambridge CB2 3EQ, UK

The Equatorial Pacific is one of the largest oceanic source of CO_2 to the atmosphere today. This is because biological productivity and the associated fixation of carbon on the sea surface does not efficiently balance the physical efflux of CO_2 via upwelling of subsurface waters. The dearth of biologically available iron, an important micronutrient has widely been held responsible for the inefficiency of the biological carbon pump in the Eastern Equatorial Pacific (EEP) Ocean. As a corrolary, it has been proposed that increased dust-borne Fe supply during glacial stages would enhance nitrate consumption and carbon fixation, and could therefore contribute to the drawdown of atmospheric CO_2 at these times. Recent works based on productivity and nitrate utilisation proxies however have cast doubt on the alledged effect of iron supply on CO_2 efflux in the EEP. However, key information on Fe fertilisation history and nitrate & silicic acid cycling are still missing in this region. Here we present a comprehensive reconstruction of nitrate and silicic acid cycling, Fe availability, upwelling dynamics, subsurface circulation and biogenic accumulation in the EEP in order to determine the relative importance of upwelling, iron availability and ocean circulation on the EEP CO_2 source over the last deglaciation. We show that biological productivity increased during the last glacial period due to iron fertilisation. Despite decreasing Fe supply during the deglaciation, organic carbon export remained high due to high biological productivity sustained by the injection of nutrient-rich water, probably from the Southern Ocean, into the equatorial undercurrent. Moreover, our records suggest that during the deglaciation the biological carbon pump was not more efficient that today and therefore the EEP contributed to the deglacial increase in atmospheric CO_2.