



Open oceanic productivity changes at mid-latitudes during interglacials and its relation to the Atlantic Meridional Overturning Circulation

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Variations in the interactions between marine ecosystems, thermohaline circulation, external forcing and atmospheric greenhouse gases concentrations are not yet fully represented in detailed models of the glacial-interglacial transitions.

Most of the research on past productivity changes has been focused so far on high-productivity areas such as upwelling areas (i.e. equatorial or coastal upwelling areas) even though those regions appraise only a little part of the ocean. Accordingly, the importance of oceanic productivity changes over glacial/interglacial cycles should be better known, as it may also play an important role on the loss of photosynthetically generated carbon as a central mechanism in the global carbon cycle. Its understanding will help quantifying the parameters needed to run comprehensive climate models, and subsequently help to better predict climate change for the near future.

A high-resolution study of oceanic productivity, bottom water flow speed, surface and deep-water mass, bottom water ventilation, and terrestrial input changes during two interglacials (Holocene and Marine Isotope Stage [MIS] 5), at an open ocean site approximately 300 km west off Portugal [IMAGES core MD01-2446: 39°03'N, 12°37'W, 3547 m water depth] was conducted within the AMOCINT project (ESF-EUROCORES programme, 06-EuroMARC-FP-008).

Even though siliceous productivity is expectedly low for oceanic regions, it shows a robust and consistent pattern with increased values during cold phases of MIS 5, and during the glacial stages 4 and 6 suggesting higher nutrient availability, during these periods. The same pattern is observed for MIS2 and the last deglaciation. The opal record is fully supported by the organic carbon content and to the estimated productivity using foraminifera based FA20 and SIMMAX.28 transfer functions for a near location.

The benthic $\delta^{13}\text{C}$ record suggests less North Atlantic Deep Water (NADW) coincident with periods of higher productivity. The grain-size variations and magnetic properties, suggests stronger/faster bottom currents during cold phases, in agreement with a stronger component of Antarctic sourced Bottom Water (AABW) at the Eastern Atlantic Margin. The probable enhancement of AABW during these periods may also account for a higher preservation of siliceous biogenic particles at the ocean floor sediment/water interface.

Given that MD01-2446 is placed far from the continent, productivity records should mainly reflect local conditions. Still, we should not fully discard the preservation of punctual influence of coastal processes derived from upwelling filament plumes at the Estremadura Plateau. Lebreiro et al., 1997 [Paleoceanography, 12, 718-727] reported for a near location, the dominance of pre-upwelling and post-upwelling related foraminifera species during MIS 6 implying less intense or persistent upwelling during MIS 6 than MIS 4. On the contrary, opal and organic carbon data reveals a clear increase in productivity also during MIS 6, reinforcing the idea that productivity variations are likely related to open ocean conditions and therefore, nutrients availability associated to the Atlantic Meridional Oceanic Circulation.