Latitudinal variations in intermediate depth ventilation and export production over the northeastern Pacific Oxygen Minimum Zones during the last glacial period

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Résumé

Intensity and extension of the Oxygen Minimum Zone (OMZ) in Eastern Tropical North Pacific are modulated by both oceanic oxygen supply from Northern and Southern Pacific intermediate water, and oxygen consumption through organic matter degradation. During the last glacial period, OMZ within the northeastern Pacific strengthened and weakened on a millennial timescale, demonstrating a tight linkage with northern high latitude climate, although the precise mechanisms and its geographical extension remain undetermined. We analyzed cores MD02-2508 and MD02-2524, retrieved respectively off Baja California (23°N) and Nicaragua margin (12°N), for major and trace elements (Br, Ca, Ti, Fe, Mn, and Sr) using a XRF scanner and redox-sensitive trace elements (Cu, Ni, Cd, As, V, Cr, Mo, and U) using ICP-MS. At the northern site, better oxygenation was suggested for millennial-scale cold events (Cartapanis et al. in press). The southern core shows high content of redox sensitive elements during H1 event and Younger Dryas (YD), whereas no clear pattern was identified for the last glacial period. The XRF Ca-based carbonate content shows lower values during stadials and H events. The trace element enrichment observed in the Nicaragua Basin indicates enhanced OMZ during H1 and YD that contrasts with better oxygenation

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at the northern core. This suggests that a physical boundary separated well-oxygenated northern intermediate water from southern oxygen-depleted water between 23◦N and 12◦N. For the southern site, the previously reported opal concentration indicates opposite trend of millennial-scale variability with carbonates. From an analogy to modern seasonal productivity cycle linked to the coastal upwelling and possible silicic acid leakage during the last glacial period, we propose increased opal production during stadial and H events, when the coastal upwelling was active in the Nicaragua Basin. This led to more organic matter accumulation that favors carbonates dissolution. Both northern and southern forcing seems to have contributed to OMZ variability in the Nicaragua Basin.