An intense Northeast Pacific oxygen-minimum zone during the Bølling-Allerød

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A high-resolution record has shown that oscillations in bottom-water oxygenation in the Santa Barbara basin off central California were synchronous with indications of rapid climate change observed in Greenland ice cores and North Atlantic sediments over the past 60 kyr (Kennett and Ingram, 1995; Behl and Kennett, 1996). The mechanism behind this teleconnection has been difficult to establish because oxygen depletion in the Santa Barbara basin is locally enhanced by productivity and restricted circulation relative to oxygen levels in northeast Pacific source waters. On the basis of the preservation of fine laminations and the concentrations of Mo and Cd in two cores on the open California margin, we demonstrate that the oxygen content of northeast Pacific waters at 800 m depth during the Bølling-Allerød warm period (15–13 ka) was at least as low as it is within the Santa Barbara basin today. Because oxygen isotopic data for benthic and planktonic foraminifera throughout the far North Pacific suggest increased stratification during this episode, we attribute the reduction in the oxygen content of intermediate water in the northeast Pacific to suppressed ventilation at higher latitudes.

We believe that the tropics ultimately need to be invoked in order to explain (1) the remarkable synchroneity between rapid climate change in the North Atlantic and the North Pacific regions over the course of deglaciation and, (2) the anti-phased pattern of changes in thermohaline circulation of the North Atlantic and North Pacific Oceans, whereby ventilation of the North Atlantic shoaled during the Last Glacial Maximum and Younger Dryas as it deepened in the North Pacific, and vice versa during the Bølling-Allerød and Holocene. The greater density of deep water formed at high latitude in the North Atlantic, compared to the Pacific, is maintained, in part, by excess evaporation in the North Atlantic and transport of water vapour across Central America to the Pacific by the Trade Winds. We therefore propose that changes in the flux of water vapour transported from the North Atlantic to the North Pacific determined by changes in tropical Atlantic sea surface temperature controlled the inverse pattern of ventilation depth inthe two basins during climatic fluctuations associated with the transition from the Last Glacial Maximum to the Holocene.

References

Kennett, J.P. and Ingram, B.L. (1995) *Nature*, **377**, 510–3.

Behl, R.J. and Kennett, J.P. (1996) *Nature*, **379**, 243–6.