Changes in thermocline oxygen concentrations occurring over many timescales: Eastern subTropical North Pacific

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Oxygen Fluctuations on Monthly and Annual Scale

A time series of oxygen concentration has been measured for a SPOT (San Pedro Ocean Time series) between Los Angeles and Catalina Island since 1998. Monthly measurements reveal a decline in thermocline oxygen content defining a slope of 3.5 μM per year. While CalCoFI work has identified a similar trend in O_2 in S. California waters, this rate is faster than that previously published and, extended another 10-20 years, places hypoxic waters on the shelf. We have investigated this trend both in terms of changes in water mass and in relations to changes in productivity. To this end, we have been measuring oxygen consumption (BOD) in waters from 100 m in the presence and absence of nutrient ammendments. During certain parts of the year, the additon of inorganic N and P increases BOD. Fluctuations in unammended BOD are large and seem to correlate with productivity. In the spring, BOD is largest, 0.15 μM/hr and in early winter BOD is smallest, < 0.03 μM/hr. BOD is scaled to seasonal measurements of POC export.

Oxygen Fluctuations on Centennial Scale

We have analyzed a time series of sedimentary $\delta^{15}N$ isotope profiles, from 1900 to the present using laminated sediments collected off Baja California and in Santa Monica Basin. The past 20 years has been a period of increasing denitrification intensity in ETNP OMZ. However, from 1900 to 1990 the sediments provide evidence that the OMZ has been shrinking, not expanding. Historical climate data and Earth system model simulations reveals changes in the ocean's largest anoxic zone over the 20th century were driven by tropical winds, and are likely to shrink as the climate warms. We further investigated decadal variability in the difference between the sedimentary $\delta^{15}N$ signal off Mexico and off S. California and find a reasonable coherence in this metric and the PDO index. We propose that this metric is an index of mixing between southern and northern end-members in $\delta^{15}N$ nitrate. The sediments deposited in Santa Monica Basin are sensitive to the nitrate isotope values of these end-members and also recording the degree of water-mass mixing.