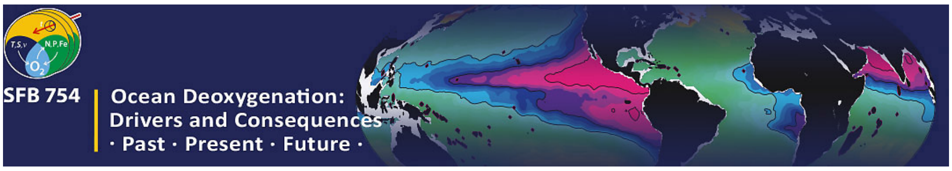

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Drivers of Anoxia in a Large Embayment of an Eastern Boundary Upwelling System: St Helena Bay

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St Helena Bay is located in the southern Benguela and is a large, highly productive open bay formed by the Cape Columbine promontory. Here we show oxygen depletion to be a function of local drawdown at seasonal and episodic scales. We investigated plankton community metabolism through estimates of net community production [NCP] and respiration [R] as determined by oxygen fluxes in the water column, providing information on the balance of autotrophy and heterotrophy within the Bay. Rates of NCP and gross community production [GCP] were typically shown to be appreciably higher near surface, despite the regular presence of subsurface biomass maxima. Characteristically, NCP was a significant fraction of GCP in the surface waters, but declined sharply with depth, and in most cases the community compensation depth [where NCP=0] was <10 m. Autotrophic communities, where organic matter is produced in excess of respiratory demand, were therefore typically confined to the upper 10 m of the water column, and often excluded the bulk of the phytoplankton community, where light limitation is considered to lead to heterotrophic community metabolism. Little consumption of oxygen was observed in the bottom mixed layer of the water column. With increasingly stratified conditions a seasonal decline in oxygen was achieved in near bottom waters through sub-seasonal events of hypoxia and ultimately anoxia linked to periodic deposition of senescent phytoplankton blooms as indicated by spikes in bottom chlorophyll a concentrations. A seasonal shift in phytoplankton composition during the upwelling season from diatom to dinoflagellate dominance was demonstrated with regular development of nearshore blooms termed red tides. Our estimates of NCP and R within these blooms are among the highest values recorded. Ratios of R to GCP were particularly high [0.6–0.73] and are considered a function of the inherently high cellular respiration rates of dinoflagellates. Night time R in surface waters under these bloom conditions far exceeded oxygen replenishment via air-water exchange leading overnight to conditions of anoxia. Under these conditions oxygen may be stripped from the entire water column of shallow nearshore environments. We conclude increasing relevance of biological as opposed to hydrophysical drivers of low oxygen at the episodic scale.

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