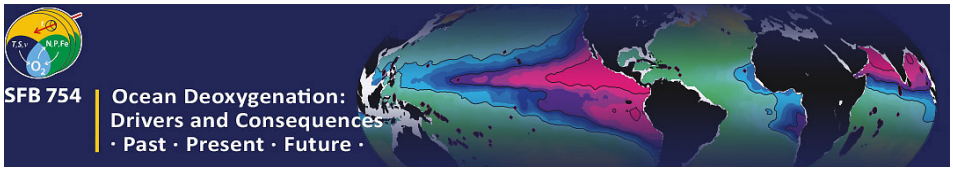

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The Regulation of Oxygen to Low Concentrations in the Bay of Bengal

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The Bay of Bengal (BoB) is a peculiar oxygen minimum zone (OMZ). With traditional oxygen sensing techniques, mid-level water oxygen concentrations are below detection, yet, geochemical analysis have provided little evidence for N2 production as might be expected in the absence of oxygen. New, ultra-high sensitivity STOX oxygen measurements show, in contrast, that low, sub-micron, levels of oxygen are a persistent feature of BoB OMZ waters. Molecular genetic analyses show that these waters contain a suite of anaerobic bacteria capable of producing N2 (both anammox bacteria and the denitrifiers), as well as nitrifying bacteria and archaea, as typical for OMZs. Thus, microbes capable of a completely coupled anaerobic/aerobic nitrogen cycle are present. Despite these microbial populations, our geochemical analyses confirm that rates of N2 production within the BoB OMZ are very low. Thus, extremely low-oxygen conditions, but with occasional anoxia allowing limited N2 production, seem to have been a long-term feature of the BoB OMZ. This persistence of low oxygen conditions is remarkable. Simple modeling shows that such a situation is extremely unstable without an active stabilizing mechanism. In this talk, we review our current understanding of BoB biogeochemistry and microbial ecology. We also propose biological feedback mechanisms, in the context of a simple box model, that may act to stabilize oxygen in the BoB to low sub-micromolar concentrations. Such feedback mechanisms could well operate elsewhere, but they cannot keep an OMZ from becoming anoxic if the carbon flux to OMZ waters is high enough.

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