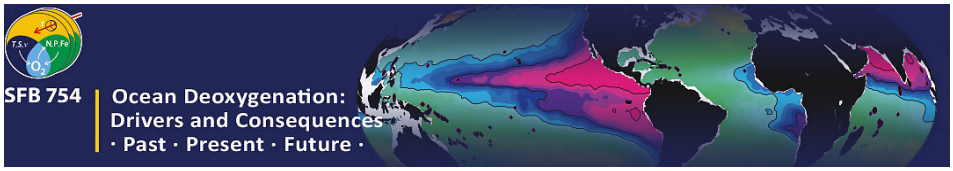

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Nitrogen fixation in the coastal Peruvian upwelling zone following a simulated upwelling event

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The oxygen minimum zone (OMZ) in the eastern tropical South Pacific (ETSP) promotes the microbial loss of nitrogen from the water column accompanied by release of sediment bound phosphate. Consequently, subsurface water masses depleted in dissolved inorganic nitrogen and enriched in dissolved inorganic phosphorus (low N:P ratio) are upwelled to the surface layer off Peru. Geochemical tracer studies and biogeochemical models suggest the excess of phosphate (P*) in the upwelled waters provides a niche for marine nitrogen fixation in surface waters above the oxygen depleted layers. Two mechanisms have been suggested as to how nitrogen fixation in the surface waters could be stimulated by the upwelled waters: 1) Redfield nutrient assimilation by phytoplankton which leaves behind P* that could be consumed by diazotrophs (nitrogen fixers); 2) non- Redfield nutrient uptake by non-diazotrophs where surplus P from biomass is released as dissolved organic phosphorus (DOP). DOP may provide an additional source of phosphorus that could enhance nitrogen fixation. These two mechanisms could also act simultaneously to stimulate nitrogen fixation. However, in addition to mixed evidence on nitrogen fixation, scarcity of data on nitrogen fixation rates in the surface waters of the Peruvian upwelling zone provide a challenge. To better understand the impact of upwelled waters with OMZ influenced N:P ratios and corresponding feedbacks on nitrogen fixation, we measured nitrogen fixation rates during an offshore mesocosm study conducted in the coastal upwelling zone off Peru from February to April 2017. An upwelling event featuring two water masses of different OMZ influenced N:P ratios was simulated to the surface of the mesocosms. Stable isotope incubations of the surface (oxic) and bottom (anoxic) mesocosm waters were used to quantify nitrogen fixation rates. We present the temporal development of nitrogen fixation rates from this study and relate this to inorganic nutrient concentrations, stoichiometry and other relevant biogeochemical parameters. These results will contribute to nitrogen fixation measurements and help shed light on biogeochemical controls and associated feedbacks on nitrogen fixation in the Peruvian upwelling system.

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