Sulfur cycling and the effects of deoxygenation on bacterial community structure in the ocean's largest oxygen minimum zone

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Oceanic oxygen minimum zones (OMZs) play a central role in ocean biogeochemical cycles and are expanding as a consequence of climate change, yet how deoxygenation will affect the microbial communities that control these cycles is unclear. Here we sample across dissolved oxygen gradients in the oceans' largest OMZ (the eastern tropical North Pacific ocean or ETNP) and show that bacterial richness displays a unimodal pattern with decreasing dissolved oxygen, reaching maximum values on the edge of the OMZ and decreasing within it. Rare groups on the OMZ margin are abundant at lower dissolved oxygen concentrations, including sulphur-cycling *Chromatiales*. We demonstrate sulfate reduction within the ETNP OMZ, and sulfur oxidation on the OMZ edge, based on patterns of functional gene expression. These data provide potential thresholds for sulfur cycling in OMZs and closely mimic recent model predictions. Our microbial species distribution models (MSDMs) accurately replicate community patterns based on multivariate environmental data, demonstrate likely changes in distributions and diversity in the eastern tropical North Pacific Ocean, and highlight the sensitivity of key bacterial groups to deoxygenation. Through these mechanisms, OMZ expansion may alter microbial composition, competition, diversity and function, all of which have implications for biogeochemical cycling in OMZs.