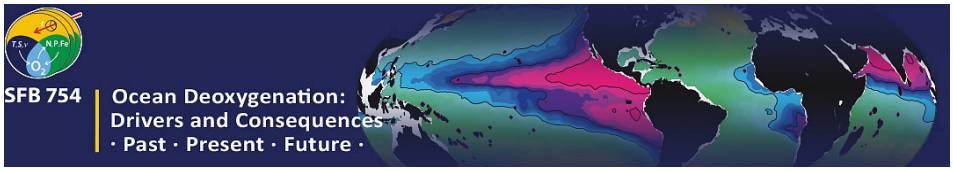

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Surprises in the westward penetration of iron and its redox cycling at the Peru Margin

The GP16 Eastern Pacific Zonal Transect cruise from Peru to Tahiti in 2013 along 12-15°S crossed the large eastern tropical South Pacific oxygen deficient zone (ODZ), which was expected to be an important source of dissolved iron into the ocean interior. We however found, there was no significant iron plume in the heart of the ODZ around 300 m that extended beyond the coastal margin, despite the ODZ penetrating several thousand of kilometers into the interior. Surprisingly, a deep coastal iron plume in oxygenated waters centered around 2000 m was observed to penetrate >1000 km into the interior.
We examine here the reasons behind the most significant surprise in iron cycling at the Peru Margin: the unexpected high Fe from the oxygenated deep slope relative to the more reducing ODZ above. We find high particulate Fe in the ODZ and show that this is present as Fe(III)- oxyhydroxides whereas most dissolved Fe is in the Fe(II) redox state. This strongly indicates rapid redox cycling of Fe, even in anoxic waters where the two major oxidants of Fe were proven to be absent, which results in trapping of Fe near the coast. Because these long known oxidants for dFe(II), oxygen and Hydrogen Peroxide, are absent in ODZs alternative oxidants must be considered. We found that the highest concentrations of pFe and nitrite (NO2-) are co-located, suggesting that nitrogen species may play a key role in the oxidation of dFe(II) in the ODZ. By contrast, particulate iron in the deep Fe plume has more unweathered, Fe(II)-containing crystalline silicate minerals, consistent with the strong lithogenic particle signal observed. We examine mechanisms for the strong sediment resuspension in the deep slope, as well as reversible exchange mechanisms, that potentially can explain the deep Fe plume.

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