Surprises in iron cycling at the Peru Margin

P. J. LAM[1]*, M. I. HELLER[1,o], J. W. MOFFETT[2], C. P. TILL[3], S.G. JOHN[2], V. SANIAL[4], M. A. CHARETTE[4], J-M. LEE[1], B. M. TONER[4], AND M. A. MARCUS[6]

[1]UCSC, Santa Cruz, CA 95064 USA (*correspondence: pjlam@ucsc.edu)
[2]USC, Los Angeles, CA 90089 USA
[3]Humboldt State University, Arcata, CA 95521 USA
[4]WHOI, Woods Hole, MA 02543 USA
[5]University of Minnesota, St. Paul, MN 55108 USA
[6]ALS, LBNL, Berkeley, CA 94720 USA
[o]now at IFREMER, Plouzané, France

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) in the eastern half of the transect and the East Pacific Rise hydrothermal plume in the western half. Both features were expected to be important sources of dissolved iron into the ocean interior. The EPR hydrothermal iron plume was found to extend for several thousands of kilometers around 2500 m [1, 2], greatly exceeding prior expectations. In contrast, 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.

In this talk, we examine 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, indicating rapid redox cycling of Fe, even in anoxic waters, that is trapping Fe near the coast. 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. The long-lived ^{228}Ra isotope shows high activity at the deeper slope, also consistent with strong sediment resuspension. The presence of light Fe isotopes, however, suggests an influence of particles from the ODZ. We examine mechanims for the strong sediment resuspension in the deep slope, as well as reversible exchange mechanisms, that explain the deep Fe plume.

[1] Resing *et al*. (2015) *Nature* **523**, 200. [2] Fitzsimmons *et al*. (2017) *Nature Geosci* **10**, 195.