Benthic trace metal cycling on the Peruvian shelf

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Certain trace metals (e.g. Fe, Co, Zn, Cd) are essential for the growth of marine organisms. Their availability in the oceans can (co-)limit primary productivity and therefore affect the biological pump [e.g. 1]. In the oxygen minimum zone (OMZ) off the coast of Peru, substantial fluxes of reduced Fe and other trace metals across the sediment-bottom water interface have been documented [e.g. 2] or inferred [e.g. 3]. However, the key biogeochemical processes and parameters that control the sedimentary release or burial of trace metals are still poorly constrained.

Here, we present Fe and other trace metal data from in situ benthic chamber incubations, sediment pore waters, and near-bottom water profiles along a transect across the Peruvian OMZ at 12°S. During our sampling campaign in austral autumn 2017, the water column featured steep biogeochemical gradients. While the upper shelf was oxygenated down to around 100 m depth, anoxic conditions prevailed on the deeper shelf and slope, with a nitrogenous OMZ core expanding from around 150 m to 400 m water depth. The highest in-situ benthic fluxes of Fe and the steepest Fe gradients in the bottom water were found close to the upper rim of the OMZ core. In some incubations, the release of Fe coincided with nitrate and nitrite depletion suggesting that reductive processes in the nitrogen cycle exert an important control on the rate of benthic iron release. Moreover, the distribution of mats of sulfide-oxidizing bacteria on the seafloor seems to be important for the observed trace metal concentrations and fluxes, by regulating sulfide concentrations in the surface sediment and, thus, the extent of trace metal retention through their precipitation as sulfides. Our findings can help to predict how benthic trace metal fluxes respond to the currently observed trend of ocean deoxygenation.

[1] Moore et al. (2013). Nature Geoscience, 6(9), 701
[2] Noffke et al. (2012). Limnology and Oceanography, 57(3), 851-867
[3] Hawco et al. (2016). Biogeosciences, 13(20), 5697