Spatial and temporal trends of iron and iron isotope cycling in the Peruvian oxygen minimum zone

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Iron (Fe) is a key element in the global ocean's biogeochemical framework because of its essential role in numerous biological processes. A poorly studied link in the oceanic Fe cycle is the reductive release of Fe from sediments in oxygen depleted ocean regions - the oxygen minimum zones (OMZs). Changing rates of Fe release from OMZ sediments may have the potential to modulate ocean fertility which has far-reaching implications considering the high amplitude oxygen fluctuations throughout earth history as well as the ongoing ocean deoxygenation projected for the near future. In order to explore spatial and temporal trends of Fe cycling in OMZs, we present here Fe isotope and speciation data for surface sediments from a transect across the Peruvian upwelling area, one of the most pronounced OMZs of the modern ocean.

Because of continuous dissimilatory Fe reduction and diffusive loss across the benthic boundary, sediments within the OMZ are strongly depleted in reactive Fe components, and the little reactive Fe left behind has a heavy isotope composition. In contrast, surface sediments below the OMZ are enriched in reactive Fe, with the majority being present as Fe oxides with comparably light isotope composition. This lateral pattern of Fe depletion and enrichment indicates that Fe released from sediments within the OMZ is reoxidized and precipitated at the oxycline. First-order calculations suggest that the amount of Fe mobilized within the OMZ and that accumulated at the boundaries are largely balanced. Therefore, benthic Fe fluxes in OMZs should be carefully evaluated prior to incorporation into global models, as much of the initially released Fe may be reprecipitated prior to vertical or offshore transport.

First XRF core scanning results for partly laminated piston cores from the OMZ boundaries reveal downcore oscillations in the content of reactive Fe and redox-sensitive trace metals that are attributed to past changes in OMZ extension. Ongoing work on these cores will focus on their dating and the downcore investigation of Fe and trace metal records in order to better understand past Fe cycling within the Peruvian OMZ and potential interactions with climate variability.