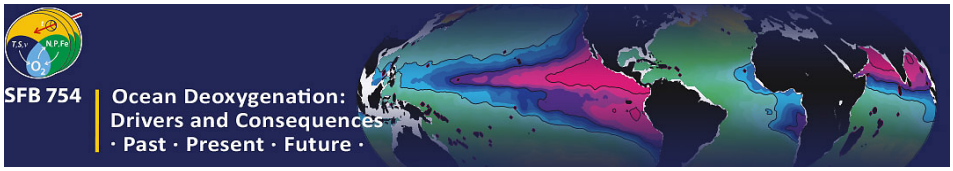

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Understanding the dynamics of OMZs by deliberate Tracer Release Experiments (TREs)

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The dynamics of Oxygen Minimum Zones (OMZs) are influenced by supply and consumption of oxygen through a range of processes. These include the supply of oxygen through diffusive processes across (diapycnal diffusivity, Kz), and along (isopycnal diffusivity, Kx and Ky, for zonal and meridional diffusivity) isopycnals, but also the flow of nutrients from the deeper layers to the photic zone that can fuel biological productivity, and by remineralization of sinking particles that consume oxygen. In order to quantify some of these, hard to measure, processes we have conducted three deliberate Tracer Release Experiments during the SFB754 project. The first experiment, Guinnea Upwelling TRE (GUTRE) focused on the diapycnal flow of oxygen through the upper oxycline of the Eastern Tropical North Atlantic (ETNA). A follow up experiment, the Oxygen Supply TRE (OSTRE) focused on the lateral (isopycnal) supply of oxygen to the core of the OMZ in the ETNA. A third experiment was carried out in the Eastern Tropical South Pacific (ETSP) OMZ off Peru (POSTRE) where the focus was on quantifying the pathway of nutrients released from anoxic sediments through the benthic boundary layer.
During the GUTRE experiment we were able to quantify Kz with high accuracy and noted the importance of bottom topography and density stratification for the diapycnal mixing coefficient and the significance of relating to pressure or density in these calculations. These estimates were refined by the OSTRE experiment and reveal only a small difference in Kz for the two different depth (density) levels of the two experiments. For OSTRE we introduced sampling in a regular grid in a 4×4° control area in order to quantify the amount tracer left in a defined area over time. Initial results suggest a significantly higher Kx compared to Ky, and a significant contribution of mean advection to the model.
The POSTRE experiment was designed differently in that the tracer was released just above the bottom at a fixed position, so that the injection density had a larger variance than a “standard” TRE. The results from a survey 17 months after release clearly indicate a rapid pathway of tracer (i.e. nutrients) from the sediment to reach the top of the OMZ and the photic layer close to the coast. Profiles of tracer advected from the coast indicate a Kz value comparable to the Kz measured in the ETNA.

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