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Sediment release of dissolved organic matter in the oxygen minimum zone off Peru

Alexandra Loginova (1), Andrew Dale (1), Frederic LeMoigne (1,2), Sören Thomsen (1,3), Stefan Sommer (1), Klaus Wallmann (1), and Anja Engel (1)

(1) GEOMAR Helmholtz-Centre for Ocean Research Kiel, Düsternbrooker Weg 20, 24105 Kiel, Germany, (2) Mediterranean Institute of Oceanography, UM 110, Aix Marseille Univ., Universite´ 6 de Toulon, CNRS, IRD, 13288, Marseille, France, (3) LOCEAN-IPSL, IRD/CNRS/Sorbonnes Universites (UPMC)/MNHN, UMR 7159, Paris, France

In combination to sluggish ventilation by ocean currents, the nutrient upwelling and high surface productivity, followed by organic matter remineralization, leads to a pronounced oxygen minimum zone (OMZ) in the eastern tropical South Pacific (ETSP). There, oxygen concentrations drop below 1 μmol/kg at a water depth <80 m. The high productivity results in the supply of organic matter (OM) to the anoxic sediments and its utilization by heterotrophic communities. The microbial utilization of OM under anoxia leads to nitrogen loss processes, and an accumulation of sulphide and methane. The proximity of the OMZ to the ocean surface in the ETSP may lead to an active outgassing of climate relevant products of the anoxic OM remineralization.
The degradation of OM in sediments is associated with production of dissolved organic matter (DOM) from organic particles (POM) that is further remineralized into inorganic nutrients and dissolved inorganic carbon, which then can be released back to the water column, fuelling productivity. Part of the DOM pool may be released to the overlying water column and serve as ligands for micronutrients, such as iron, or provide an additional substrate for microbial communities to respire, affecting overlying water column biogeochemistry. Despite the potential relevance for biogeochemical processes, the quality of the DOM in the pore waters that may be released to the overlying water column has been barely studied in the ETSP off Peru.
High spatial resolution measurements of DOM fluorescence (FDOM) during the research cruise M93 (Feb-March 2013) indicated elevated intensities near the sediments in the ETSP off Peru. Those intensities were interpreted as a sediment release of DOM, the quantification of dissolved organic carbon (DOC) flux, however, was not possible at the time.
To estimate DOM fluxes and DOM quality, DOC and FDOM samples were collected from the sediment pore waters and from benthic incubation chambers from six stations along the 12°S transect in the Peruvian upwelling in 2017 (cruises M136, M137). Samples were collected using a multiple-corer and by Biogeochemical Observatories, respectively. Here, we evaluate DOC fluxes from the sediments and relate them to the measurements of FDOM. We evaluate the quality of DOM by Excitation Emission spectroscopy, followed by parallel factor analysis. The possible implications of the DOM release for water column biogeochemistry are discussed.