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Pathways of gravitational particle export in the peruvian OMZ

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Oxygen minimum zones (OMZs) may expand in the future with important consequence on biogeochemical cycles. In well-oxygenated waters, temperature and plankton community structure are known as the main factors affecting the magnitude of the biological carbon pump, an ecosystem service that buffers the atmospheric CO_2 concentration. In oxygen deficient waters, observations suggest that the efficiency with which the POC is transported to depth is larger relative to oxygenated waters regardless of the temperature or the plankton community. The expansion of OMZ could therefore increase the global magnitude of the biological carbon pump. The underlying mechanisms by which low O_2 concentrations enhance the flux of POC are however poorly understood or partially demonstrated. Several explanations were proposed: (1) the absence of zooplankton leading to less consumption on particles and a limited presence of fast sinking carbon rich fecal; (2) the quality of the organic matter exported as particles differs in OMZ; (3) the reduced efficiency with which heterotrophic prokaryotes respire organic matter (OM) and (4) the potential addition of OM produced from dissolved inorganic carbon by chemoautotrophic prokaryotes attached to sinking particles. Although all the above mechanisms do enhance the flux of POC in O_2 deficient regions, they were only established and tested individually in various OMZ. This prevents the unequivocal identification of the prevailing mechanism. Moreover, the extent to which empirical relationships between temperature and flux attenuation remains valid in low O_2 regions is unknown. Recently, (Cisternas-Novoa et al., companion paper) made extensive measurements of mesopelagic POC fluxes in the Peruvian OMZ. Locally, flux attenuation coefficients yielded to a wide range of values (from 0.3 to 1.0) despite the small ranges of top 500m median temperatures and O_2 concentrations (from 11 to 14℃ and 2.0 to 2.4 µmol kg^{-1} respectively). This suggests that other factors may shape the variability of the flux attenuation in this region. We will further examine this pattern by examining and quantifying the carbon fluxes carried by various ecological routes (phytodetritical aggregates vs fecal pellets) using polyacrylamide gels placed in two drifting sediment traps. We couple this novel approach to traditional information on the biogeochemical quality/quantity of the particle flux. In essence, we are looking at which gravitational downward export pathway dominates the particle flux from the euphotic zone and through the (partly anoxic) mesopelagic zone. We further confront our results to proposed mechanisms as to why fluxes of C are larger in OMZs.

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