Factors influencing the distribution of epibenthic megafauna across the Peruvian oxygen minimum zone

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Abstract
De-oxygenation of the oceans is progressing and is associated with severe habitat loss and distinct changes in the species composition of bentho-pelagic communities. Distributions of epibenthic organisms across the Peruvian OMZ are investigated along a latitudinal depth transect at 11 °S from ~ 80 to 1000 m water depth using sea floor images. Likely controls of their distribution were investigated by combining abundances of major groups with geochemical parameters and sea floor topography. In addition to bottom water oxygen levels and organic carbon availability, particular emphasis is laid on the effects of local hydrodynamics. Beside the occurrence of microbial mats at the shelf and upper slope, distinct zones of highly abundant epibenthic metazoan communities amongst which gastropods (900 ind. m$^{-2}$), ophiuroids (140 ind. m$^{-2}$), and pennatulaceans (20 ind. m$^{-2}$) were dominant, were observed at the lower boundary of the OMZ. Their distribution extended from 460 m water depth with O$_2$ levels < 2 µM, where gastropods occurred, to 680 m (O$_2$ ~ 6 µM) where epifaunal abundances declined sharply. Bottom water O$_2$ represents a major factor that limits the ability of metazoans to invade deeply into the OMZ where they could have access to labile organic carbon. However, depending on their feeding mode, the distribution of organisms appeared to be related to local hydrodynamics caused by the energy dissipation of incipient internal M2 tides affecting suspension, transport and deposition of food particles. This was particularly evident in certain sections of the investigated transect. At these potentially critical sites, energy dissipation of internal tides is associated with high bottom shear stress and high turbulences and coincides with elevated turbidity levels in the benthic boundary layer, increased Zr/Al-ratios, low sedimentation rates as well as a shift in the grain size towards coarser particles. In or near such areas, abundant suspension feeding organisms such as ophiuroids, pennatulaceans, and tunicates were present whereas deposit feeding gastropods were absent. The influence of local hydrodynamic conditions on the distribution of epibenthic organisms has been neglected in OMZ studies, although it has been considered in other settings.

Key words: oxygen minimum zone; epibenthic megafauna; bacterial mats; internal tides; video imaging, Peruvian margin