Impact from zooplankton on the efficiency of the biological carbon pump

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Sequestration of atmospheric carbon dioxide in the world's oceans is still poorly understood despite its important role in the Earth's climate system. Understanding the nature of vertical downward flux of organic matter remains a key goal of oceanography. Large sinking aggregates such as zooplankton fecal pellets and marine snow transport organic matter from the surface to the deep ocean. These aggregates affect nutrient and organic matter distribution in the water column, feed life in the dark ocean, determine deposition rates of surface material in the sediments, and control carbon dioxide removal from the atmosphere. It is still unclear what determines the magnitude of organic matter export to the deep ocean. Recent results have shown that regional and seasonal POC flux variability decreased with increasing depth. This was because high POC fluxes had stronger attenuation compared to low POC fluxes. Since microbial degradation of sinking aggregates mostly varies as a function of temperature, it seems that zooplankton control the magnitude of POC flux from the base of the euphotic zone to the deep sea and, thus, act as the "gatekeepers" of POC flux in the mesopelagic. When testing this hypothesis using direct in situ observations and on-board studies of zooplankton grazing on settling aggregates, we could explain up to 70% of the total POC flux attenuation by zooplankton aggregate feeding. Once the settling organic aggregates are exported into the deep ocean, their turnover is primarily driven by temperature controlled microbial degradation at low rates.