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Latitudinal variations in efficiency of biological pump and bioactive transport of POM to deep ocean in the central North Pacific

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Based upon chlorophyll distribution in surface ocean water the high latitude oceans are characterized to be more productive than their low latitude counterparts. In this study we show that the higher productivity of high latitude oceans is also reflected in the deep ocean, and is further enhanced by active movements of large zooplankton and/or nektons. Settling particles were collected by sediment traps deployed for about one year during 1993-94 at different water depths (between 1342 and 4588 m) at 4 sampling sites along 175 E longitude in the central North Pacific Ocean. The samples were analyzed for amino acids (AA) and amino sugars (or hexosamines), and the data were interpreted together with already published data on their carbon and nitrogen contents and total mass flux (Kawahata, 2002). AA and hexosamines accounted for about 12.5 to 27.9% of particulate organic carbon flux to the deep ocean. Biogeochemical indicator parameters based upon these two groups of compounds varied in the range comparable with that observed in similar studies conducted at other sites in the world ocean. Correlations between non-protein AA (beta-alanine and gama-aminobutyric acid) and flux parameters clearly showed that higher particle flux supplied relatively less degraded particulate organic matter (POM) to the deep ocean. Such correlations were non-existent in the case of relatively shallow water depth traps, although higher mass fluxes in the relatively deep water depth traps correlate well with those in the shallow water depth traps. Moreover, mean values of the indicator parameters in relatively shallow water depth traps differed significantly (students t-Test; p below 0.03) from those in relatively deep water depth traps at the same site. Simultaneous interpretation of oceanographic properties and indicator parameters revealed that the shallow water depth traps, located just below the oxygen minimum zone, received microbially degraded POM. On the other hand, a repackaging of settling POM above oxygen minimum zone and its transport by some large zooplankton and nektons to deep ocean led to deposition of relatively less degraded POM. The organisms involved in this repackaging feed excessively in surface waters and migrate vertically to deeper waters (to avoid predation) and defecate rather less digested food (high in labile contents) below the shallow water depth traps. High tyrosine content at one trap site also suggested predominantly planktonic origin rather than bacterial origin of POM at the deep water depth trap. Latitudinal trends in POM flux and its labile composition suggest that relatively fresh POM is being deposited at a higher rate in the subarctic area of the Pacific Ocean. However, this trend is not so clear in the deep traps probably due to influence of bioactive transport and deposition of laterally advected particles in these traps. Total mass and particulate organic carbon fluxes normalized to primary productivity estimates show a sharp rise in efficiency of biological pump towards subarctic area which is responsible for enhanced fluxes of high labile content particles to the deep ocean in this part of the Pacific.