Compound-specific isotope analyses reveal varying seasonal zooplankton-particle interactions

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The use of compound-specific isotope analyses (CSIA) in food web studies has expanded widely over the last decade. Here we show how results of CSIA can resolve links between metazoan food webs and microbial or detrital food sources. We evaluated midwater (~200-1500m) zooplankton seasonal trophic dynamics in the North Pacific Subtropical Gyre (NPSG) using amino acid CSIA. Midwater zooplankton are a major link between marine food webs and biogeochemical cycling in the open ocean, but their diets and activity remain poorly known. We find that midwater zooplankton respond strongly to seasonal changes in particle export in the NPSG. In summer, when export from the euphotic zone is high, results of CSIA indicate that large particles (>53μm) dominate the food web base for meso- and upper bathypelagic zooplankton. In winter, when particle export is low, zooplankton in the mid-mesopelagic zone continue to rely on large particle basal resources; however resident zooplankton in the lower mesopelagic and upper bathypelagic zones switch to include bacterially-degraded smaller particles (0.3 – 53μm) or a subset of the small particle pool in their food web base. Diverse feeding strategies therefore make zooplankton important biogeochemical agents in NPSG midwaters. For example, small oncaeid and oithonid copepods are able to access small particle resources at depth and may be an important trophic link between the microbial loop and deep dwelling micronekton species that also rely on small particle-based food webs. This zooplankton response to seasonal variations in particle size and export flux has important implications for calculating midwater metabolism and the export of organic matter to the deep sea.