TROPHIC TRANSFER OF METALLIC TRACE ELEMENTS WITHIN A PHYTOPLANKTON-ZOOPLANKTON-ANCHOVY/SARDINE FOOD WEB

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Abstract
The transfer of metallic trace elements through a phytoplankton-zooplankton-anchovy/sardine food web was studied in the Gulf of Lion (GoL), northwestern Mediterranean Sea. Samples of dissolved fraction, suspended particulate matter and of phytoplankton-zooplankton separated in different size classes were collected at different sites during two oceanographic cruises in the GoL. Anchovies and sardines were fished during two other campaigns and dissected to get fish tissue samples of muscles, liver, gonads and the body remains including skin, head and skeleton. MTE (Cu, Cd, Zn, Pb, Hg, CH_3Hg, Ni, Ag) and lead isotopes ratios were determined in water (dissolved), SPM, plankton fractions and in fishes tissues. The metals show different bioaccumulation trends within these entire trophic food webs.

Keywords: Bio-accumulation, Food webs, Metals, Plankton, Gulf of Lyon

The transfer of metallic trace elements (MTE) through a phytoplankton-zooplankton-anchovy/sardine food web was studied in the Gulf of Lion (GoL), northwestern Mediterranean Sea. Samples of dissolved fraction ,suspended particulate matter (SPM) and of phytoplankton-zooplankton separated in different size classes (6-60, 60-200, 200-500, 500-1000, 1000-2000 and >2000 µm) were collected at different sites during two oceanographic cruises (spring and winter) in the GoL (1). Anchovies and sardines were fished during two other campaigns, pooled by fish size and dissected to get fish tissue samples of muscles, liver, gonads and the body remains including skin, head and skeleton. MTE (Cu, Cd, Zn, Pb, Hg, CH_3Hg, Ni, Ag) and lead isotopes ratios were determined in water (dissolved), SPM, plankton fractions and in fishes tissues. C and N stable isotopes were also determined and used as markers of trophic levels for plankton and small pelagic fish and of SPM organic matter origin. Dissolved MTE concentrations were homogeneous in the water column, but spatial differences were found in water surface samples with a distinct enrichment in the eastern GoL, likely due to direct anthropogenic contribution from the Rhone River and the city of Marseille. This pollutant input was also characterized by marked lead isotope imprints. Similar spatial differences were also observed for some MTE in the planktonic fractions, with higher concentrations in the eastern GoL region. The most important variations in MTEs concentrations were observed in their distribution among the different size classes of plankton i.e. from the lowest size fraction (suspended matter plus phytoplankton) up to the >2000 µm of mesozooplankton fraction. Cu, Ni, CH_3Hg and Pb were enriched in the smallest size fraction (suspended matter plus phytoplankton) while Cd, Zn and Ag show highest concentrations in the intermediate fractions (60-200 and 200-500µm), the largest fractions (mesozooplankton >2000 µm) being generally depleted in MET. This latter distribution could be related to the accumulation (targets /mechanisms) of these metals in cell cytoplasm being therefore more mobile compared to the elements primarily adsorbed onto the surface membrane of the plankton cells. Interestingly, MTE displaying low concentrations in zooplankton were also depleted in fishes. MTE and lead isotope ratios generally showed significant shifts between fish tissues suggesting different biochemical distribution, entry pathways and/or sources for the measured metals. No significant spatial differences for both anchovy and sardine contamination were found and MTE levels did not differ between the two species or between the sex. Finally we found that methyl-Hg concentration was effectively higher enriched in the fish tissues, a typical result usually related to Me-Hg chemical speciation and bioaccumulation potential. The proportion of Methyl-Hg vs. total Hg was lower than 1% in the dissolved fraction, and it increased up to 10% in the plankton and exceeded 50% in the fish tissues.

References
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