

EVIDENCE OF ^{210}Po BIOMAGNIFICATION IN SARDINE AND ANCHOVY FOODWEBS FROM STABLE NITROGEN ISOTOPE RATIO IN THE GULF OF LION, NORTH WESTERN MEDITERRANEAN SEA

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Abstract

In the Gulf of Lion, a pluridisciplinary project (COSTAS) combining ecology and biogeochemistry of contaminant aims at understanding the trophic transfer of contaminant, including ^{210}Po , a natural radionuclide which induces the highest internal radioactive dose in fishes. Based on ^{210}Po concentrations and $\delta^{15}\text{N}$ measurement on seawater, SPM, five size classes of plankton, anchovy and sardine, we demonstrated for the first time the biomagnification of ^{210}Po among sardine and anchovy foodweb.

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

Introduction The COSTAS project aims at understanding the trophic transfer of metallic and organic contaminants through seawater, phytoplankton, zooplankton, sardine and anchovy populations in the Gulf of Lion (NW Mediterranean Sea). Its originality is to combine the ecology of the trophic web with the biogeochemistry of organic and metallic contaminants. Here we present the evidence of ^{210}Po (natural radionuclide from ^{238}U decay chain) trophic transfer in the foodweb of these fishes in the Gulf of Lion.

Material and method Seawater, SPM and plankton were sampled in May 2010 and February 2011 in the Gulf of Lion at different sampling sites from east to west. Seawater was pumped at the Chl- α maximum and filtered through a $0.45\mu\text{m}$ filter for SPM analysis. Small plankton organisms were sampled by pumping seawater at the Chl- α maximum followed by onboard filtration through $200\mu\text{m}$, $60\mu\text{m}$ and $6\mu\text{m}$ mesh size plankton nets. Two small plankton size fractions were retained [$6-60\mu\text{m}$] and [$60-200\mu\text{m}$]. A trawling system ($200\mu\text{m}$ mesh) was used to get larger plankton organisms. Plankton was collected during 30 min and sieved onboard through three different meshes: $2000\mu\text{m}$, $1000\mu\text{m}$, $500\mu\text{m}$ and $200\mu\text{m}$ to get four large plankton fractions: [$200-500\mu\text{m}$], [$500-1000\mu\text{m}$], [$1000-2000\mu\text{m}$] and [$>2000\mu\text{m}$]. ^{210}Po and $\delta^{15}\text{N}$ analysis and measurement were performed at the CEREGE and MIO laboratories.

Results and discussion A strong spatial structuring of sites based on ^{210}Po concentrations was evidenced by hierarchical clustering, both in spring (May 2010) and winter (February 2011). In May, ^{210}Po concentrations presented values significantly different according to size : the highest concentrations were recorded in SPM and the [$6-60\mu\text{m}$] fraction, and the lowest value in the dissolved phase and the largest size fraction [$>2000\mu\text{m}$], while ^{210}Po concentrations did not differ significantly among plankton fractions from [$60-200\mu\text{m}$] to [$1000-2000\mu\text{m}$]. In February, ^{210}Po concentrations presented homogenous values in particulate matter and plankton fractions in the Gulf of Lion. However, higher ^{210}Po concentrations were observed for each period in the eastern part (Figure 1).

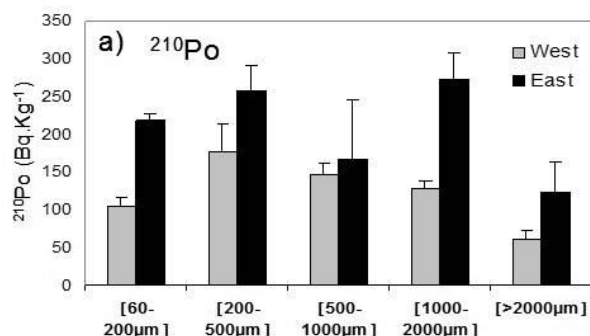


Fig. 1. Figure 1: Mean (+ SE) concentrations of ^{210}Po in the different size

fractions of plankton in the East and West parts of the Gulf of Lions

^{210}Po concentrations in both species decreased in the following order: liver-gonads>fish remains>muscles. Concentrations were significantly different between species, with higher concentrations measured in anchovy (tissues and whole fishes, t-tests, $P<0.01$ for all tissues). In May, $\delta^{15}\text{N}$ was significantly lower in the largest size class [$>2000\mu\text{m}$], while in February, highest $\delta^{15}\text{N}$ was measured in the [$1000-2000\mu\text{m}$] fraction and the lowest in the [$60-200\mu\text{m}$] fraction. Like ^{210}Po , $\delta^{15}\text{N}$ was higher in the East than in the West part of the Gulf of Lion for each period. Significant positive linear relationships were observed between $\text{Log}^{210}\text{Po}$ (y) and $\text{Log}\delta^{15}\text{N}$ (x) in plankton size fractions in May ($y = 1.809x + 1.192$, $R^2 = 0.85$, $P<0.001$) and February ($y = 0.636x + 2.147$, $R^2 = 0.59$, $P<0.01$). However, the slope and accuracy of the relationships were higher in spring than in winter. For investigating a possible biomagnification of ^{210}Po in the food webs of sardine and anchovy, ^{210}Po and $\delta^{15}\text{N}$ values in a whole fish were used¹, along with mean concentrations in plankton fractions from the two sampling dates. Then, a similar significant positive linear relationship between $\text{Log}^{210}\text{Po}$ and $\text{Log}\delta^{15}\text{N}$ was observed from plankton to the two zooplanktivorous fish species (Figure 2). This relationship demonstrates the biomagnification of ^{210}Po along the food webs of these zooplanktivorous fishes, related to the trophic level ($\delta^{15}\text{N}$) of organisms. Such relation is shown here for the first time along the complete foodweb structure.

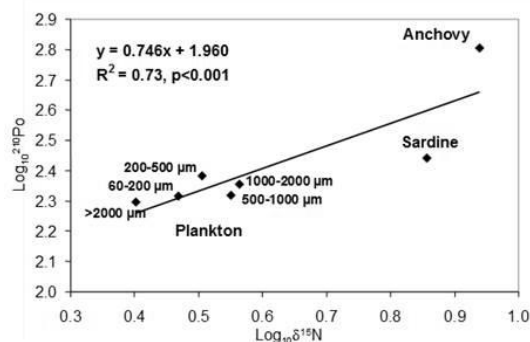


Fig. 2. Figure 2: Biomagnification of ^{210}Po in the food webs of two small pelagic zooplanktivorous fishes, *Sardina pilchardus* (sardine) and *Engraulis encrasicolus* (anchovy) in the Gulf of Lions.

References

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*Frédéric Briand
Directeur Général, CIESM*

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