EVALUATION OF SEDIMENT GENOTOXICITY AND TOXICITY OF THE BERRE LAGOON SEDIMENTS

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Abstract

Trace metals and organic contaminants were analyzed in surface sediments of four sites of the Berre lagoon to determine their potential toxicity and genotoxicity for the benthic fauna. Bioavailable trace metals determined by chemical extractions were compared with bioassimilated contents in Hediste diversicolor as well as with the metallothioneine induction in these organisms. Genotoxic effects were observed for both trace metals and organic contaminants.

Keywords: Metals, Pah, Bio-Indicators, Annelida, Ecotoxicology

In the last decade, numerous assays or indicators were proposed to define the toxicity or genotoxicity of contaminated sediments. They are mostly based on in vitro bioassays and generally refer to one type of contaminant: metal or PAHs. If some tests have been shown to be representative, it is still difficult to evaluate the toxicity associated to a multi-contamination combining organic and inorganic pollutants, and the in situ relationships between these mixtures and their effects on benthic organisms are still unknown.

To better understand such relationships, we conducted a preliminary work using a multi-tool approach on sediments from the Berre lagoon (south of France). This lagoon was impacted in the last century by industrial and urban development introducing large amounts of trace metals and organic contaminants. Their contents decreased in the surface of the sediments since the 1980's but large contents have been accumulated below the surface. These contents in the most impacted area (Vaine lagoon) are up to 160 µg.Kg-1 for total PCBs, 2500 ppm for total PAHs, 80 ppm for Cr, 70 ppm for Ni, 45 ppm de Cu and 140 ppm for Zn.

Four sites characterized by various contaminants contents were sampled and surface sediments were analyzed for trace metals (Cr, Cu, Ni, Pb, Cd, Zn), 16 PAH's and 7 PCB's. The trace metal bioavailibility was studied in more details by comparing labile fractions obtained from Diffusive Gradient Technique (DGT) devices and from several chemical extractions including EDTA 0.1 M, or pH4 and pH6 as physiological pH prevailing in the digestive tract of organisms. In order to show if these various labile pools of metals are representative of the bioavailable form of metals for benthic organisms, we compared their concentrations to the bioassimilated metals contents in the deposit-feeder polychaete Hediste diversicolor (characteristic of coastal sediment) as well as to a metal specific stress marker: the metallothionein (MT) content in cells of the intestinal walls of these organisms. MTs (analyzed by ELISA method) were evidenced in only one site and no relation between MTs and trace metals in the sediment was observed (except for Cd extracted by EDTA). It confirms the rather large variation previously observed for MT induction that can be due to environmental parameters or supplementary detoxification processes [1].

Detection of acting genotoxic and mutagenic pollutants in sediment was tested by the vitro comet assay, the micronucleus assay and the Salmonella mutagenicity test (Ames test) performed on both organic and inorganic extracts of the sediment. The assays performed on organic extracts were conducted with and without metabolic activation (S9 mix) for the detection of both indirect and direct acting genotoxins. The two sites with the highest PAHs and PCBs contents revealed genotoxic and mutagenic effects with a positive dose-response relationship, but only when S9 metabolic activation was added. Furthermore, the strongest genotoxicity was not observed for the most contaminated site. Genotoxic effects associated to trace metals extracts were also observed for the two most contaminated sites, but as for MT there is no direct relationships with total or labile metal extractions.

The responses to the toxicity tests realized in this preliminary work are in rather good agreement with the multi-contaminants contents measured in the sediment. However, information on in situ xenobiotic effects onto organisms and their potential variations with time have to be gained from a future project that will be briefly presented.

References

1 - Amiard J.C., Amiard-triquet C., Barka S., Pellerin J., Rainbow P.S., 2006. Metallothioneins in aquatic invertebrates: Their role in metal detoxification and their use as biomarkers . *Aquatic toxicology*. 76, 160-202.