TRACE METAL SPECIATION? AN ESSENTIAL ASPECT OF BIOMONITORING TO AVOID HASARDOUS CONCLUSIONS

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Introduction

The Mediterranean mussel *Mytilus galloprovincialis* (**Fig. 1**) is widely used as a bioindicator species in active monitoring surveys. As a filter feeder artificially maintained in the water column, it bioaccumulates trace metals from the surrounding water in their dissolved and particulate forms. However, most monitoring surveys don't take into account that speciation aspect when studying trace metal accumulation kinetics in mussels. In the framework of the STARECAPMED project, we monitored trace metal concentrations in the flesh of mussels together with their "most bioavailable" dissolved and particulate fractions in the water column for almost 5 months (February-June 2011).

Fig. 1. *Mytilus galloprovincialis.*

Fig. 2. Map of Corsica (France) and Google Earth picture of the Calvi Bay. The Stareso station is reported on the picture.

Material and methods

Mussels were placed in several pouches to allow regular sampling, and immerged near the Oceanographic Research Station Stareso in the Calvi Bay (**Figs. 2, 3**). Mussels and water samples were collected every week to 2 weeks, as were deployed DGTs. Seawater samples were filtered through 47 mm hydrophilic PTFE membrane filters with a 0.45 µm pore size until clogging. Mussel flesh and filters were digested (HNO_3/H_2O_2) in a microwave digestion lab station. DGT resins were eluted for 24h in 1.0 M HNO_3. Cr, Mn, Co, Ni, Cu, Zn, Ag, Cd and Pb were measured by DRC-ICP-MS.

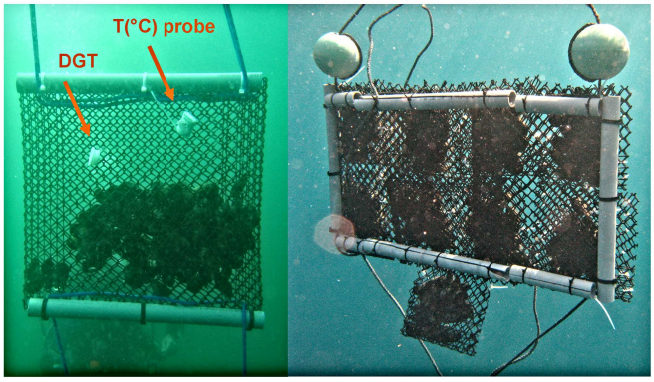

Fig. 3. Conchylicultural pouches for regular sampling.

Results and discussion

All the studied metals except Pb and Zn were present in the water column to over 80% in their dissolved form. The contribution of the dissolved pathway was likely to be predominant in the oligotrophic Calvi Bay. Dissolved trace metals showed little temporal variability of their levels, likely resulting from their integration over time in the DGT probes and the lack of seasonality of this fraction. In contrast, Zn showed great variability of its particulate fraction during the survey. Such temporal variability was also observed for Cr, more abundant in its particulate form at the end of the survey, and for Mn and Pb that conversely tended to decrease (**Table 1**, **Fig. 4**).

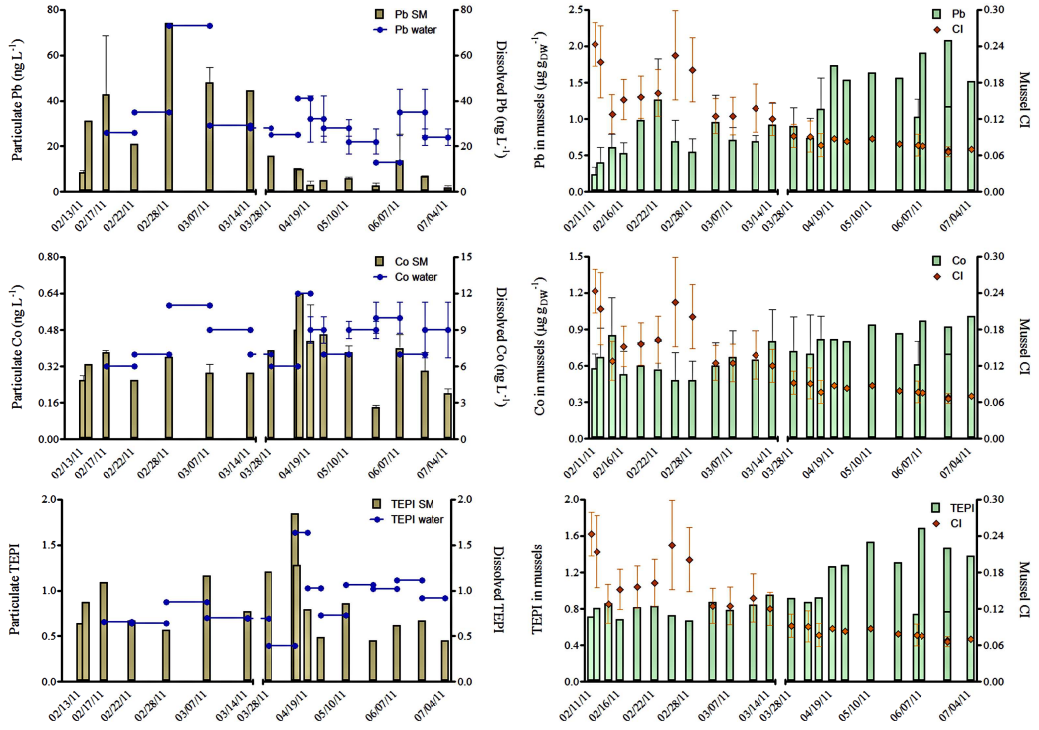

Fig. 4. Temporal evolution of dissolved and particulate Pb and Co concentrations (ng L^{-1}) and Trace Element Pollution Index values (TEPI = overall metal contamination levels, no unit) in the water column of the monitored station Stareso, and Pb and Co concentrations (µg g_{DW}^{-1}) and TEPI values in the mussel flesh given together with their Condition Index values (CI, no unit).

metal	water	SM	ratio
Cr	53 (56)	4.9 (6.1)	9%
Mn	190 (36)	23 (14)	11%
Co	8.39 (1.8)	0.35 (0.12)	4%
Ni	223 (48)	2.9 (1.1)	1%
Cu	76 (32)	8.7 (4.0)	10%
Zn	519 (412)	2130 (3315)	80%
Ag	1.2 (0.7)	0.24 (0.20)	17%
Cd	7.7 (2.6)	0.22 (0.11)	3%
Pb	32 (14)	20 (21)	39%

Table 1. Dissolved (water) and particulate (SM) mean (SD) trace metal concentrations (ng L^{-1}) and concentration ratios.

Results and discussion

The dynamic of trace metals in the mussel flesh is regulated by the environmental bioavailability of dissolved and particulate metals, the ecophysiological status of mussels and the trophic conditions of the water body. In the oligotrophic Calvi Bay, showing background contamination levels by metals, the trophic conditions played a major role once out of the spring plankton bloom. It led to the increase of some metal concentrations (*e.g.* Cd) in the flesh of mussels undergoing starvation. Conversely, Cu and Co displayed only little temporal variations of their concentrations, these essential micronutrients being well regulated (**Fig. 4**).

Conclusion

The combined study of trace metal bioavailability and mussel ecophysiology in defined environmental conditions allows discriminating against biotic and abiotic factors regulating metal uptake in mussels, thus avoiding wrong conclusions about the observed dynamics of the studied contaminants. Mussels are a good proxy of coastal water quality, but their proper use notably requires adjustment of raw contaminant concentrations with trophic status of monitored sites.

References:

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