[OP 3.2]

Bioaccumulation and detoxication of heavy metals in *Bathymodiolus azoricus* (Von Cosel et al., 1998) from Azores hydrothermal vents on Mid-Atlantic Ridge

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Hydrothermal environments are charaterized by high metal concentrations related to interactions of the connective seawater circulation with basaltic rocks inside the crust ocean.They constitute unique natural analogs of hyperpolluted biotopes.

For surviving in such toxic environments, biological communities associated with vents must regulate intracellular metal levels by excretion or accumulation of metal ions in non-toxic forms.

Bioaccumulation and detoxication processes of heavy metals were investigated on the mussel *Bathy-modiolus azoricus* from two hydrothermal vents near Azores. During the DIVA (1994) and AMORES (1997) cruises, samples were collected on two sites : Menez-Gwen 37°50'30''N (800m) and Lucky-Strike 37°17'30''N (1700m), using *in situ* frames.

Global analyses in gill, mantle, digestive gland and kidney were performed using spectrometry (SAEE for Cd and Ag, ICP-AES for as Fe, Zn, Cu, Mn, Sr and Ba. Metals in soluble and insoluble fractions were obtained by spectrometry (SAAE or SAAF) and metallothioneins were quantify by differential pulse polarography (DPP).

Results indicate high concentrations of metals such as Fe, Zn, Cu, Mn, Cd, Ag, Sr and Ba in the mussels of the 2 sites with higher values in Lucky-Strike for Fe, Zn and Ag.

In bivalve molluscs the uptake of metals is mostly done via the gills, as dissolved ions, and via the digestive tract as particles phagocyted by the digestive gland.

In *B. azoricus*, the most abundant metals are Fe (as high as 1500µg g^{-1} DW) in the digestive gland and Zn and Cu in the gill. Metal levels in the mantle are lower, this organ being mostly devoted to reserve storage and secretion of the shell.

In Lucky-Strike mussels, Zn, Cu, Cd and Ag are actively accumulated in the gill and the digestive gland. In Menez-Gwen mussels, levels of Fe, Zn, Cu and Cd are higher in the kidney; compared to others tissues this organ is especially active in storage and excretion. The differences in the mussels from the 2 sites could be explained by local metal concentrations, but also by possible differences in the bioavaibility of the metals depending on their chemical forms.

A variability in results is observed not only in space (depending of sites) but also at the same sites in time (depending on the period of sampling).

After uptake, the metal can be stored in lysosomal systems, or bounded to specific soluble ligand. In the Azores mussel, the distribution of Cu,Zn and Cd between the insoluble and soluble fractions shows some differences between organs and between the 2 sites. The mussel from Lucky-Strike seems to use preferentially immobilization within insoluble fraction, most probably in lysosomes ; this insolubilisation represent the main detoxication mechanism for Zn,Cu and Cd. In Menez-Gwen mussels, the distribution is different and the percentage of Zn and Cd in the soluble fraction is higher, mostly associated with thermolabile forms.

Metallothioneins are specific soluble ligand known to play a major role in metal detoxication, especially in coastal mussels. These proteins are heat-stable and characterized by high cystein content and also a high capacity to complex some metals such as Zn, Cu, Cd and Ag.

Large concentrations of metallothioneins are detected, in mussels of the 2 sites, especially in the gill (as high as 3500µg g^{-1} DW) but low contents of metal were found associated with the thermostable fraction; Zn is the most abundant when low values for Cu and very low ones for Cd are found. Total metallothioneins concentrations in the gill were found high and stable but no relationship with metals levels in this organ was evidenced.

Usually, the metallothioneins complex 7 divalent ions (Zn,Cu^{++},Cd and Hg^{++}) or 12 monovalent ions 5Cu^{+}, Ag^{+}). The data obtained on *B. Azoricus*, indicate an important metal (Zn+Cu+Cd) deficit on these proteins.

The hydrothermal mussel *B. thermophilus* show a great capacity to accumulate heavy metals.The mains targets for bioaccumulation are the gill (soluble components) and the digestive gland (insoluble compo-nents) when the kidney could be active in excretion. The quantitative results vary with the type of environment and the period of sampling.

In this mussel, the main detoxication process seem to be the insolubilisation of metals, probably in lysosomes. The low levels of metals bound to metallothioneins ask questions on the importance of these molecules in detoxication processes of this mussel and on the potential others roles of these molecules.

Further data are needed, in the near environment, about the chemical forms of the metals determining their bioavaibility for the organisms as well as the way the metal is taken.
The two ways of detoxication of metals, insolubilisation in lysosomes and bounding to metallothioneines will be detailed in term of quantitative data and dynamic of the processes using experiments of intoxication.
The hydrotermal activity is an important metal source for the world ocean and the deep biologic pump could play a non-negligible role in oceanic metal cycles. The evaluation of the biological pump will need more quantitative data on bioaccumulation and excretion of metals by animals.