

Host-symbiont interaction between the polychaete *Branchipolymoe seepensis* and the vent mussel *Bathymodiolus azoricus* in response to metal accumulation in the Mid-Atlantic Ridge

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INTRODUCTION

Hydrothermal vents are extreme environments rich in biodiversity. The polychaete *Branchipolymoe seepensis* subsists in the pallial cavity of the mussel vent *Bathymodiolus azoricus*. These scale-worms absorb metal particles deposited in mussel gills surface and their presence has been associated with local environmental characteristics.

AIM: The goal of this work was to establish a host-symbiont relationship between these two species using oxidative stress as an endpoint in response to metal accumulation.

MATERIALS & METHODS

Mussels were collected in 2013, in three different hydrothermal vent fields in the Mid-Atlantic Ridge. Mussels and polychaetes, whenever present, (Table 1) were separated, frozen in liquid nitrogen and stored at -80°C.

Table 1 – Samples collected from six different vent sites: MG2, MG3 and MG4 from hydrothermal vent field Menez Gwen (850 m); Monteségur (MS) and Eiffel Tower (ET) from hydrothermal vent field Lucky Strike (1700 m); hydrothermal vent field Rainbow (2300 m). The signs (+) and (-) represent the presence or absence of each specie.

Species	Sampling Sites					
	Menez Gwen			Lucky Strike		Rainbow
	MG2	MG3	MG4	MS	ET	PP37
<i>B. seepensis</i>	-	-	-	+	+	+
<i>B. azoricus</i>	+	+	+	+	+	+

RESULTS & DISCUSSION

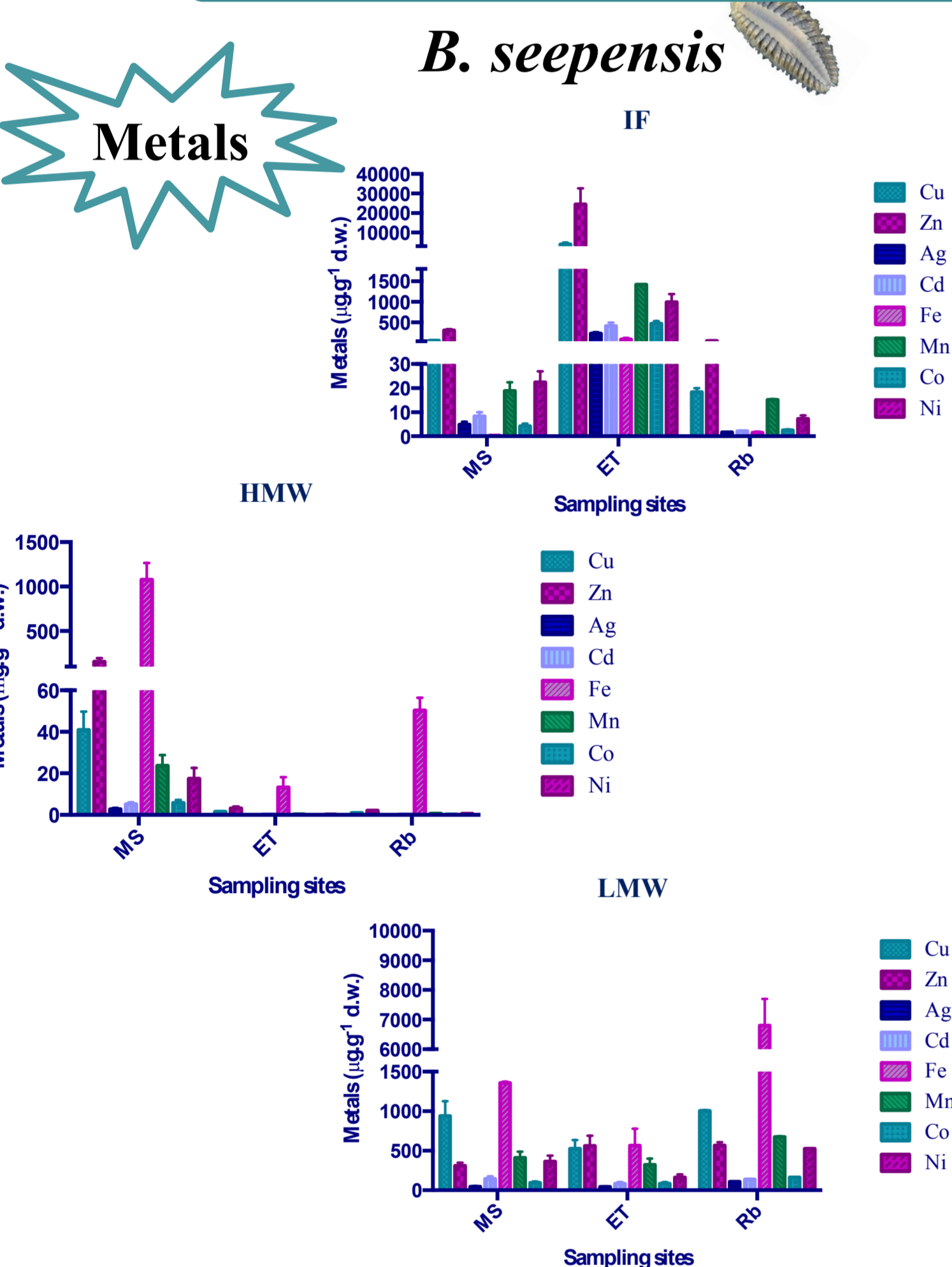


Table 2 – Metal concentrations (Cu, Zn, Fe, and Mn) in *B. azoricus* tissues (G, DG and M) from Lucky Strike (MS and ET) and Rainbow hydrothermal vent sites: insoluble fraction (IF), high molecular weight (HMW) and low molecular weight (LMW).

IF	Tissue	Metals (µg·g ⁻¹ d.w.)			
		Cu	Zn	Fe	Mn
MS	G	9.2	42.8	33.4	8.2
	DG	843.3	499.4	5198.4	526.6
	M	199.4	93.0	2054.3	53.8
ET	G	645.4	4300.3	530.6	30.2
	DG	212.5	1702.6	643.9	24.9
	M	18.3	77.7	316.1	101.3
Rb	G	36.8	67.5	387.7	9.4
	DG	78.6	145.1	6921.5	17.1
	M	4.4	16.9	382.2	4.7

HMW	Tissue	Metals (µg·g ⁻¹ d.w.)			
		Cu	Zn	Fe	Mn
MS	G	56.1	111.8	36.2	43.2
	DG	342.5	343.8	1075.0	386.7
	M	1454.4	2287.8	9201.0	913.8
ET	G	49.6	358.5	178.3	17.7
	DG	463.8	804.9	1729.3	475.5
	M	102.1	651.3	359.2	26.7
Rb	G	75.3	158.3	5169.1	87.6
	DG	855.7	1642.0	51715.2	496.5
	M	3807.5	7241.1	18531.7	888.9

LMW	Tissue	Metals (µg·g ⁻¹ d.w.)			
		Cu	Zn	Fe	Mn
MS	G	11434.6	2839.1	6068.1	129.7
	DG	143.3	337.6	2649.0	63.8
	M	4428.8	3600.8	34614.0	1084.3
ET	G	23.9	39.9	77.9	25.6
	DG	53.5	57.7	247.7	27.0
	M	956.3	1109.9	1684.5	250.7
Rb	G	13591.9	9400.9	325835.7	1587.9
	DG	56.2	95.9	2722.1	22.1
	M	56.4	48.0	678.7	27.2

Figure 4 –Metal concentrations (Cu, Zn, Ag, Cd, Fe, Mn, Co and Ni) in whole body of *B. seepensis* from Lucky Strike and Rainbow hydrothermal vent sites: insoluble fraction (IF), high molecular weight (HMW) and low molecular weight (LMW).

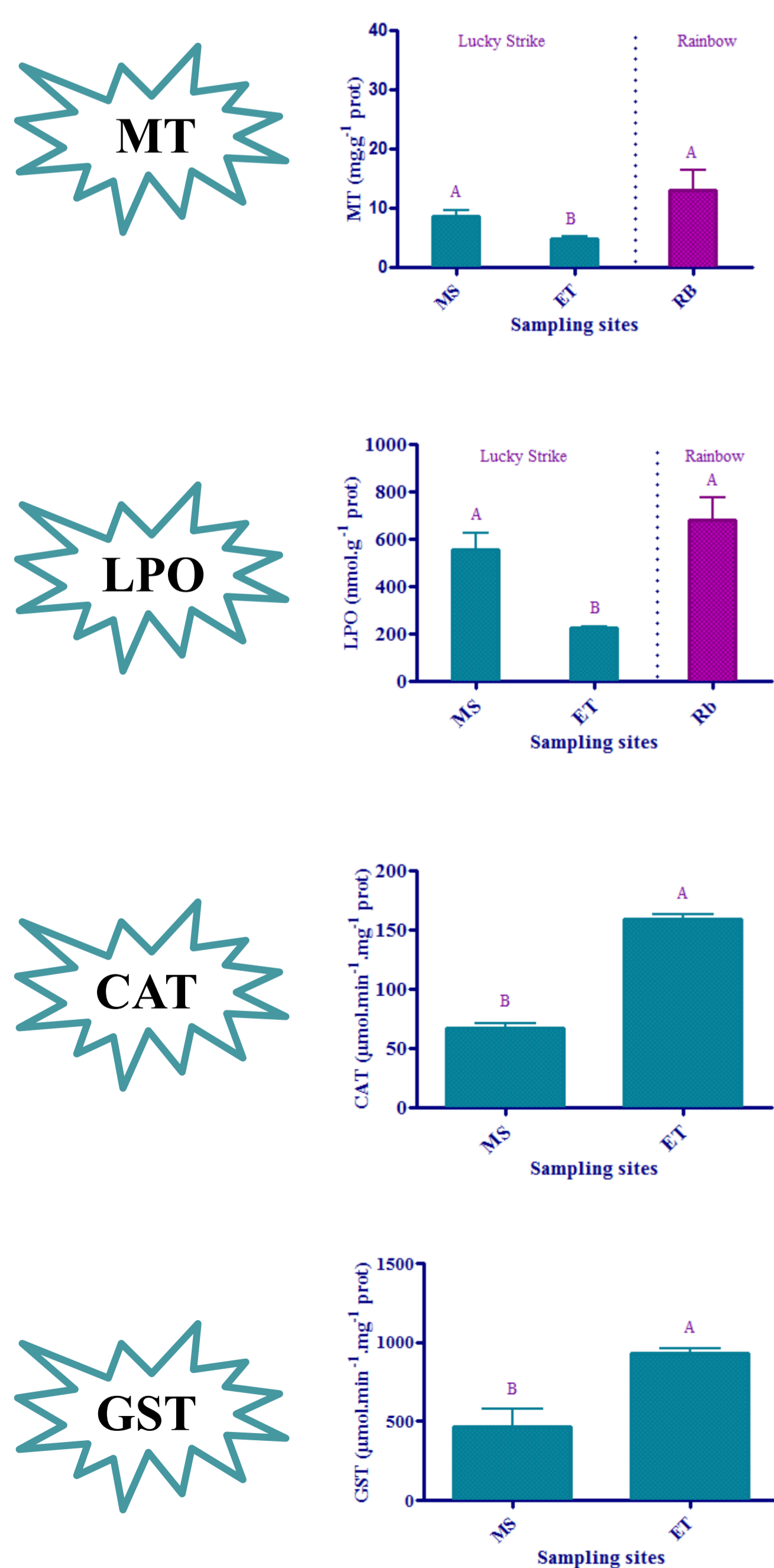


Figure 2 –MT, LPO, CAT and GST in whole body of *B. seepensis* from Lucky Strike and Rainbow hydrothermal vent sites, except for CAT and GST from Rainbow hydrothermal vent. Different letters represent significant differences ($p < 0.05$).

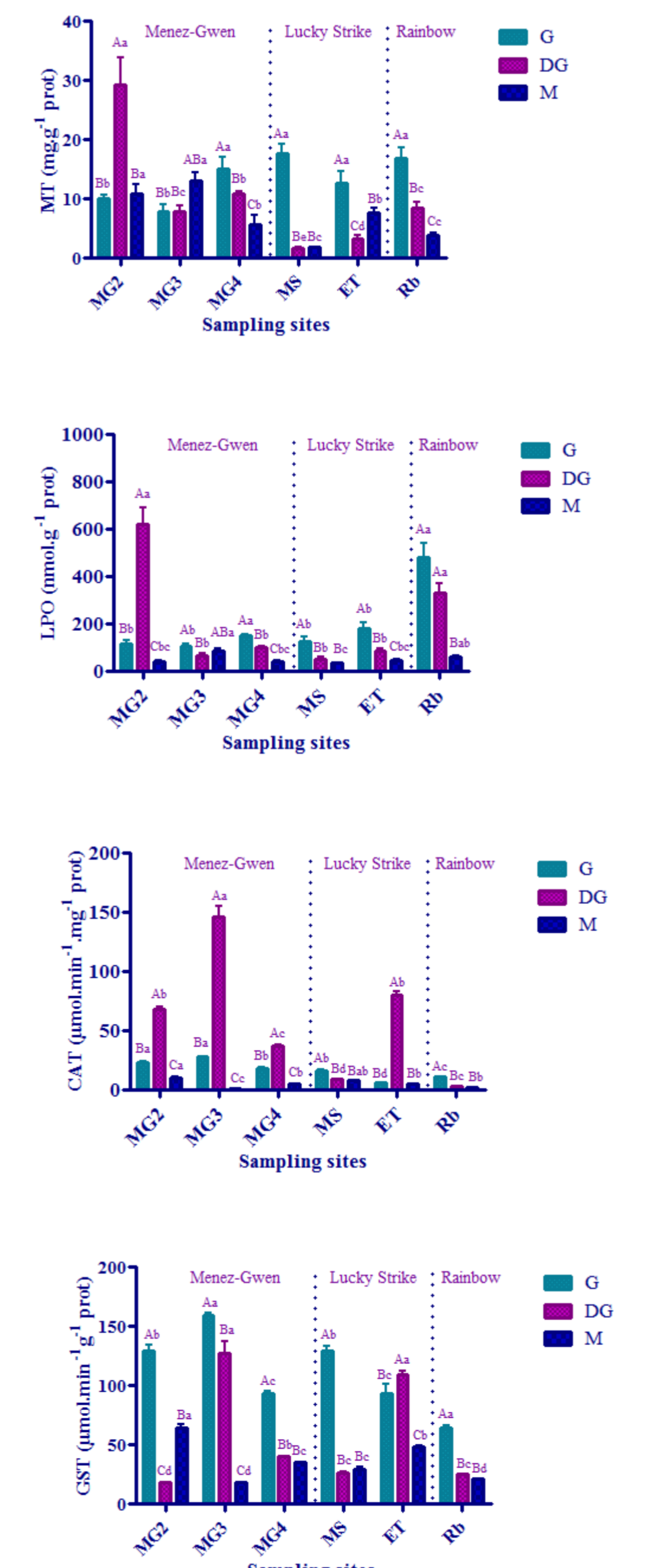


Figure 3 – MT, LPO, CAT and GST in gills (G), digestive gland (DG) and mantle (M) tissues of *B. azoricus* from Menez Gwen, Lucky Strike and Rainbow hydrothermal vent sites. Different letters represent significant differences ($p < 0.05$).

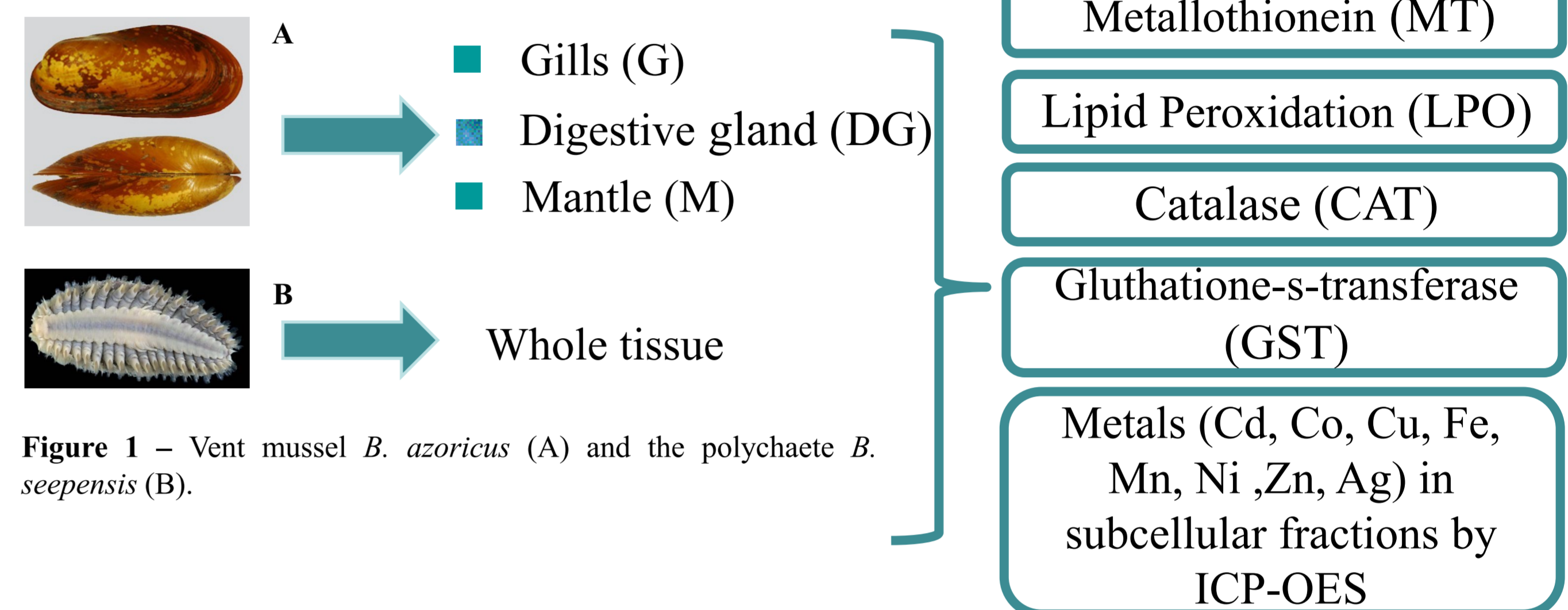


Figure 1 – Vent mussel *B. azoricus* (A) and the polychaete *B. seepensis* (B).

POINT OUT

≠ sites → ≠ chemical gradient environments of microhabitats of each vent site → Rainbow > Lucky Strike > Menez-Gwen.
 ≠ tissues in mussels → ≠ uptake, tissue-specific detoxification functions and redox requirements.

Metal concentrations:

✓ Insoluble fraction → > polychaetes from ET than in mussels
 → ET for G and in MS for DG and M

✓ Soluble fraction:

Polychaetes

Thermolabile

> MS, especially Zn, Fe and Cu

Heat-stable

> Rb and MS for Fe and Cu

Mussels

> Rb and MS for M and DG tissues

> MS for all tissues

POINT OUT

Polychaetes → MT and LPO levels > MS and Rb.
 → CAT and GST activity > ET

Mussels → MT, LPO levels and GST > G
 → CAT > DG, between sites

The small size of the polychaetes in MS and the less frequency in Rb is inversely proportional to the metals concentration and degradation of the mussel tissues.

CONCLUSIONS

- ✓ MT, LPO levels and CAT, GST activity are associated with oxidative stress caused by the enrichment of metals in hydrothermal ecosystems.
- ✓ The differences of metal chemistry between sites shows intra and inter vent fields.
- ✓ Presence of polychaetes and their accumulation and detoxification behaviour reinforces the theory of adaptation of both species to high metals characteristic of Rainbow and Lucky Strike that influence metal bioavailability in tissues.

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