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# Bioaccumulation and effect of sediment-associated silver in different forms in two marine deposit feeders

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## Introduction

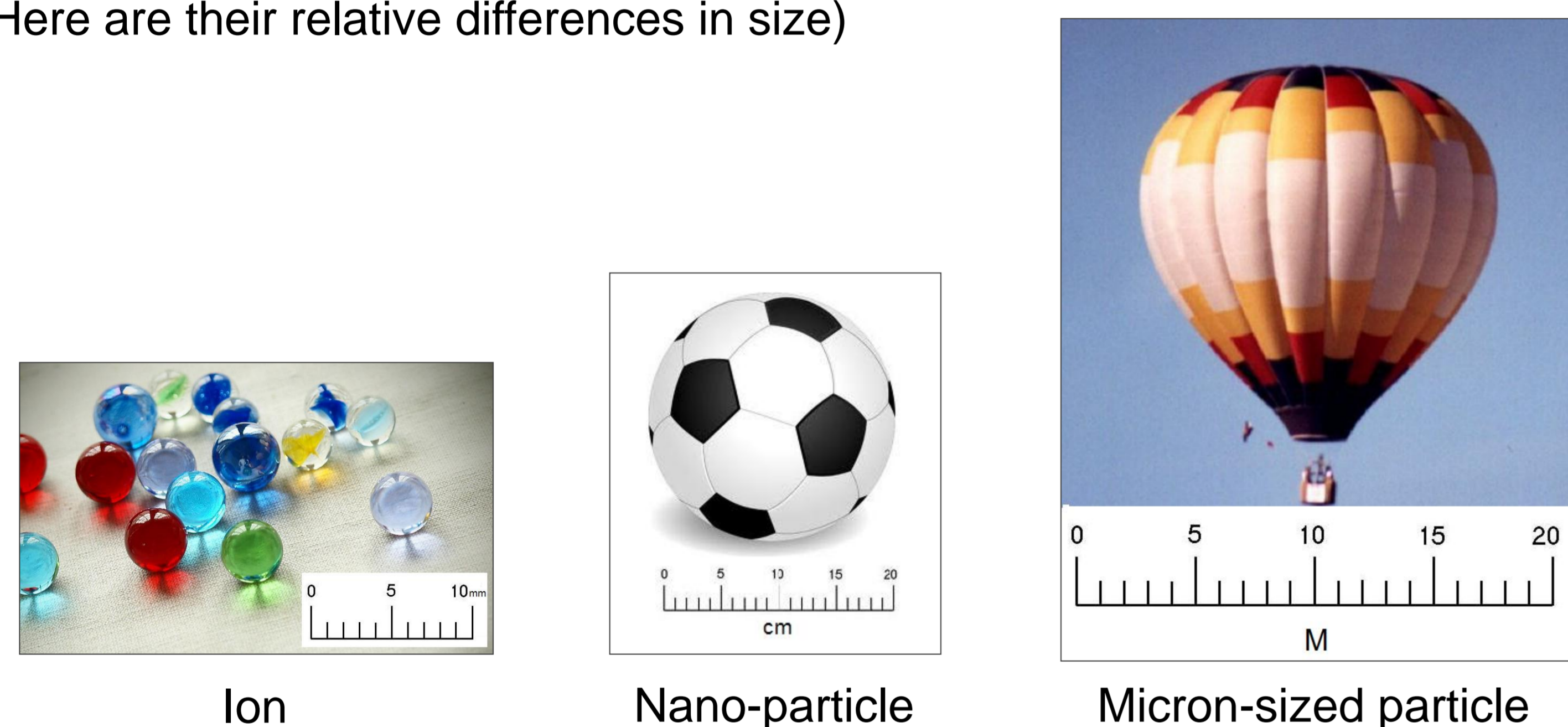
- Different behaviour and effects of metal-bearing nanoparticles (NPs) have been found compared to their corresponding metallic ions [1,2].
- Toxicity of metal-bearing NPs isn't easily predicted when comparing to corresponding ionic form
- It is unclear whether toxicity of metal-bearing NPs is dependent on particle size.

The aim of our study is to exam effects at the individual level by measuring typical endpoints in two organisms (i.e., a marine polychaete, *Capitella teleta* and a marine bivalve, *Macoma balthica*) after exposure to sediment amended with different forms and particle sizes of Ag.

## Hypothesis:

Toxicity and biota is metal form/particle size dependent?

(Here are their relative differences in size)



## Result – *Macoma balthica*

### Toxicity

No negative effects were detected on mortality, condition index or growth of exposed clams for any Ag form (data not shown).

### Bioaccumulation

Bioaccumulation of Ag in *M. balthica* decreased significantly with increasing particle size (One-way ANOVA,  $p = 0.03$ ) (Figure 1).

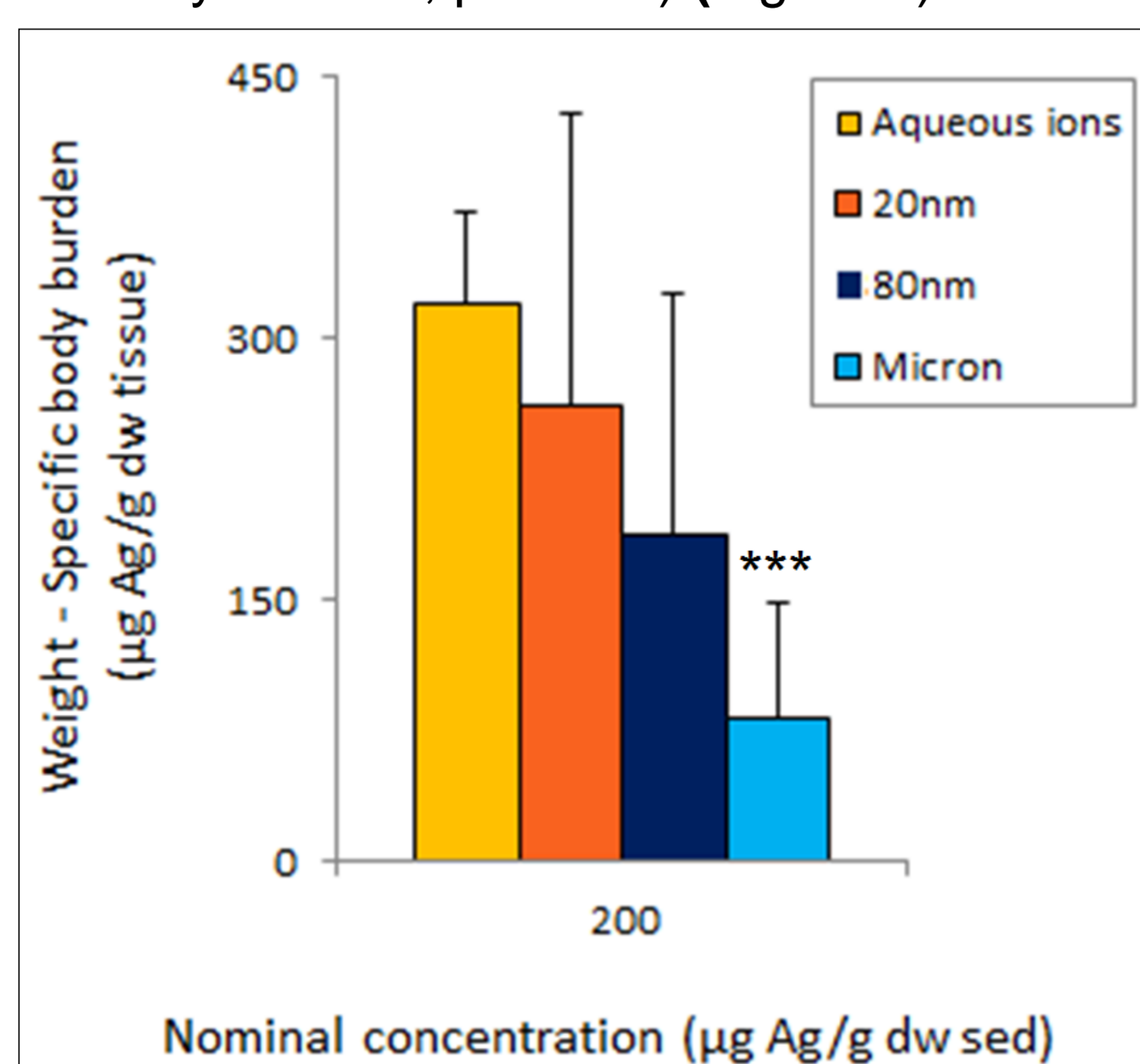
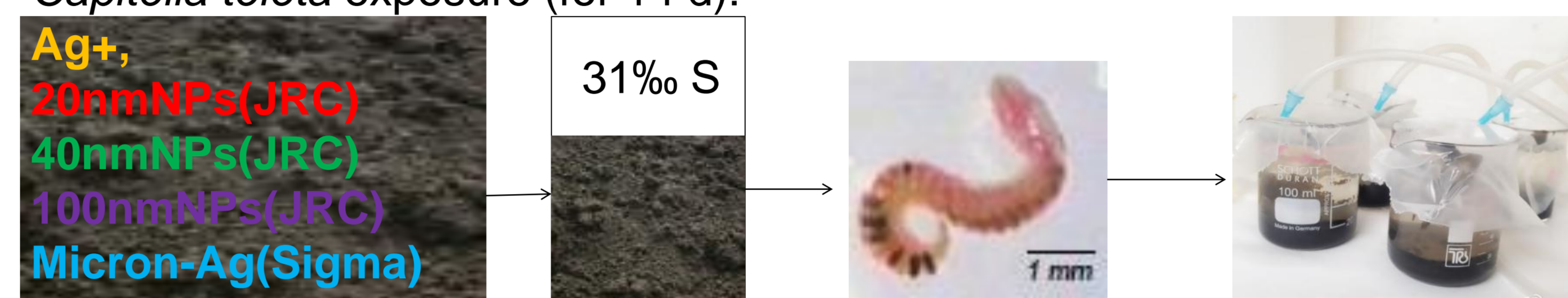


Figure 1. Silver concentration measured in *M. balthica* exposed to a nominal conc. of 200µg/g dw sed. \*\*\* refers to a significant difference from ionic Ag. Error bars indicated 1 standard deviation (n=5).

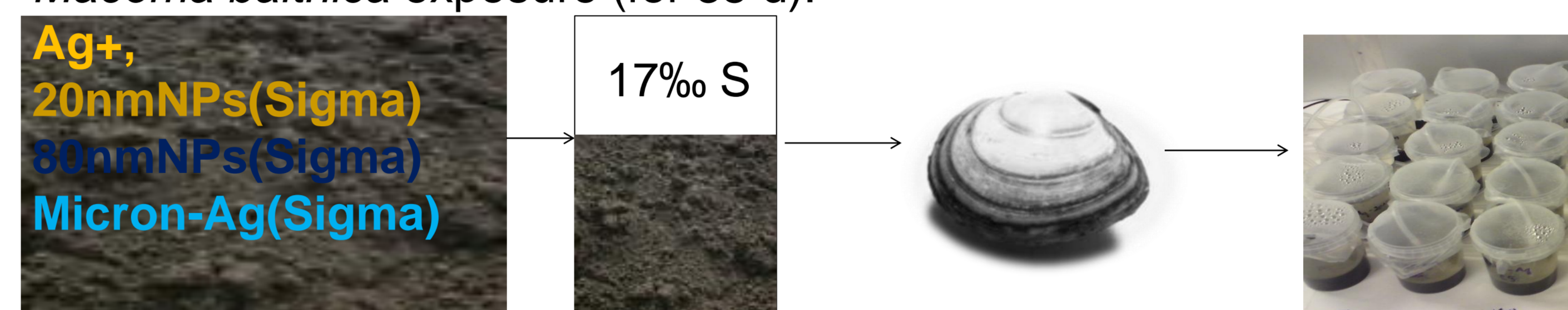
Reference  
 [1] Garcia-Alonso J, Khan FR, Misra SK, Turmaine M, Smith BD, Rainbow PS, Luoma SN, Valsami-Jones E. 2011. Cellular Internalization of Silver Nanoparticles in Gut Epithelia of the Estuarine Polychaete *Nereis diversicolor*. *Environ Sci Technol* 45:4630-4636. [2] Cong Y, Banta GT, Selck H, Berhanu D, Valsami-Jones E, Forbes VE. 2011. Toxic effects and bioaccumulation of nano-, micron- and ionic-Ag in the polychaete, *Nereis diversicolor*. *Aquatic Toxicology* 105:403-411. [3] Cong Y. 2011. PhD thesis of 'Toxic effects and bioaccumulation of nano-, micron- and aqueous-Ag in the estuarine polychaete, *Nereis (Hediste) diversicolor*', Roskilde University.

## Experimental design

*Capitella teleta* exposure (for 14 d):



*Macoma balthica* exposure (for 35 d):



Endpoints • Mortality • Growth • Health condition • Body burden

## Result – *Capitella teleta*

### Toxicity

No significant effects on either mortality or specific growth rate were detected for any Ag form or nominal concentration (data not shown).

### Bioaccumulation

There was no significant effect of Ag form on Ag accumulation in *C. teleta*, although body burden increased significantly as a function of nominal concentration (One-way ANOVA,  $p < 0.001$ ) (Figure 2).

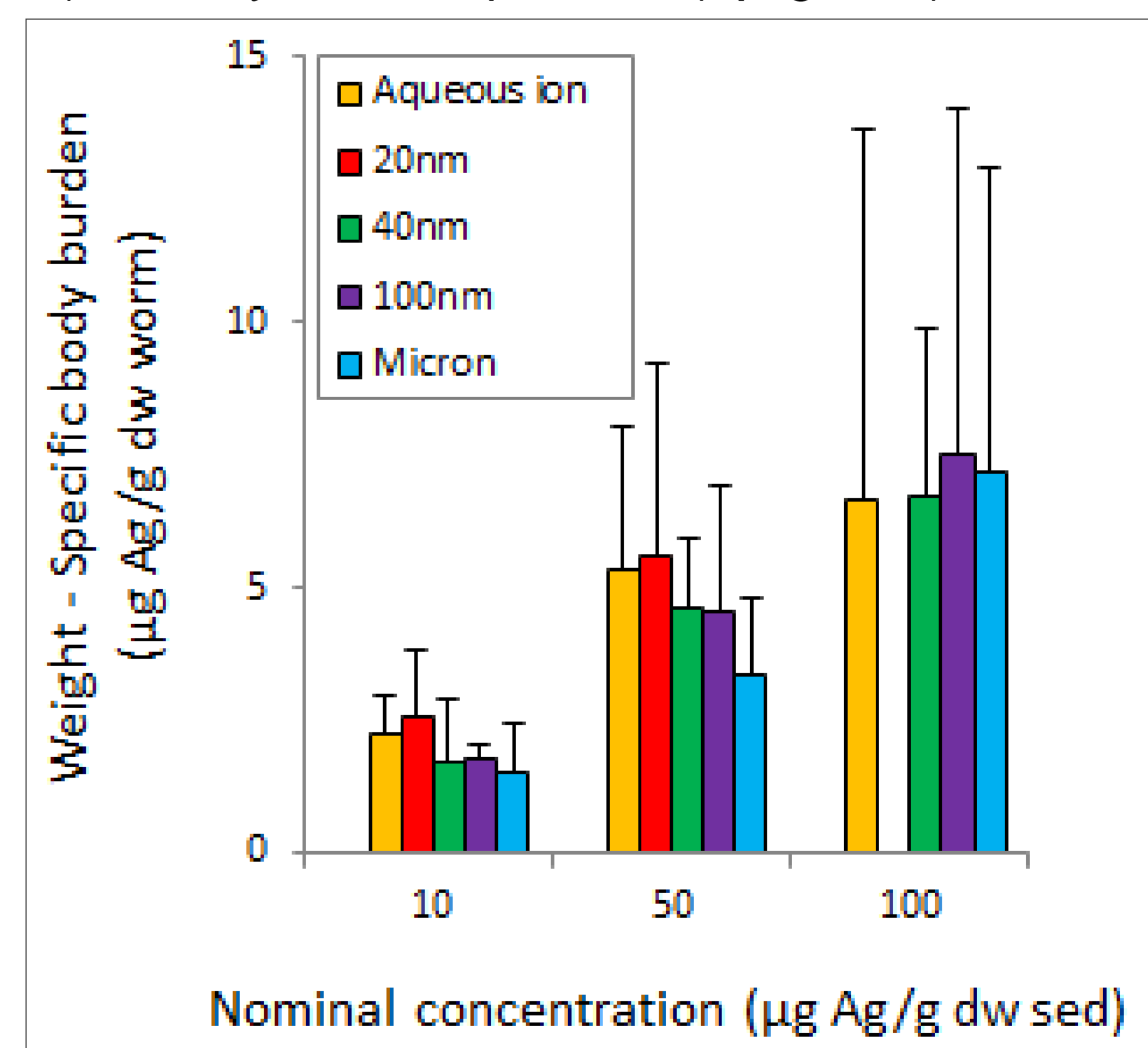


Figure 2. Silver concentration measured in *Capitella teleta* exposed to nominal concentration of 10, 50 and 100 µg/g dw sed. Error bars indicated 1 standard deviation (n=4). 20 nm-nanoparticle at 100µg/g dw sed nominal concentration was removed due to a significant difference in initial measured Ag concentration from the other treatments with the same nominal concentration at day 0.

## Conclusions

- No significant effects on mortality and growth of *C. teleta* and *M. balthica*.
- All Ag forms are bioavailable to both organisms.
- Metal form/particle size dependence of bioavailability is species specific, possibly due to differences in:
  - gut structure, thus
  - particle sorting mechanisms

Such differences in the bioavailability of metal-bearing particles warrant further investigation and consideration in terms of the impact of them in sediment environments.