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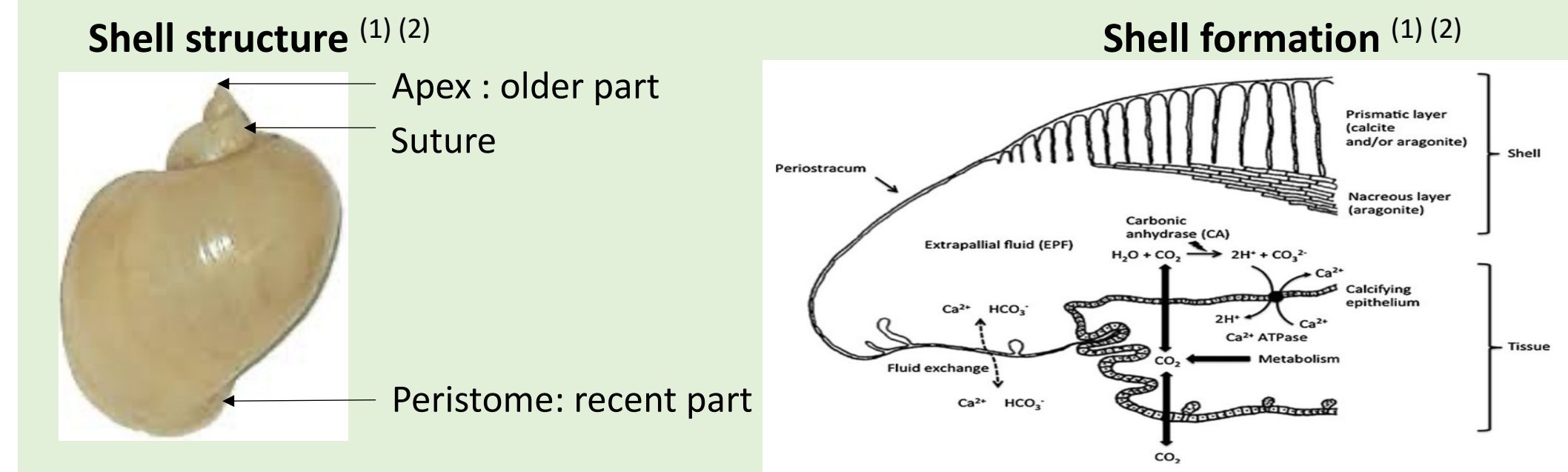
Accumulation and chronic effects of cobalt on the gastropod *Radix balthica*

Maëva Marimoutou¹, G. Bareille¹, M. Milhe-Poutingon¹, P. Baldoni-Andrey², A. Boulemant³, C. Courrèges¹, C. Gelber², S. Mounicou¹, H. Tabouret¹, S. Le Faucheur¹

¹Université de Pau et des Pays de l'Adour, E2S-UPPA, CNRS, IPREM, Chaire Ecotox, Pau, France; ²TotalEnergies, Pole d'Études et de Recherche de Lacq, France; ³Rio Tinto Closure, France (Email: maeva.marimoutou@univ-pau.fr)

INTRODUCTION

Gastropods are widespread mollusks living at the bottom and in shallow water of freshwater systems. First consumers of periphyton and plants, they represent an important source of food for large crustacean and fish. Toxic effects due to contamination such as an increase in metal would thus impede food sustainability of ecosystems. Gastropod shells have the interesting feature of growing throughout their life by integrating some of the chemical elements present in their environment, including metals.



In this study, cobalt (Co) is the metal of interest due to its increasing use in recent technologies of transport or energy storage⁽³⁾. Laser Ablation Inductively Coupled Plasma Mass Spectrometry (LA-ICP-MS - micrometer scale) was used to explore the variability of metals in shells with two objectives :

- 1) To study Co effects towards gastropod growth and reproduction during 28 days in outdoor mesocosms
- 2) To examine the relationships between ambient Co concentrations and Co accumulation in shell gastropods

MATERIALS AND METHODS



Exposure conditions

- 28 days in June 2021
- 4 studied Co concentrations : $0.7 \pm 0.2 \mu\text{g}\cdot\text{L}^{-1}$ (control), $2.4 \pm 0.8 \mu\text{g}\cdot\text{L}^{-1}$, $24.1 \pm 0.8 \mu\text{g}\cdot\text{L}^{-1}$ and $56 \pm 17 \mu\text{g}\cdot\text{L}^{-1}$
- 3 boxes of 32 organisms of *Radix balthica* collected *in situ* placed in each artificial stream
- Sampling at D0, D7, D14, D21 and D28

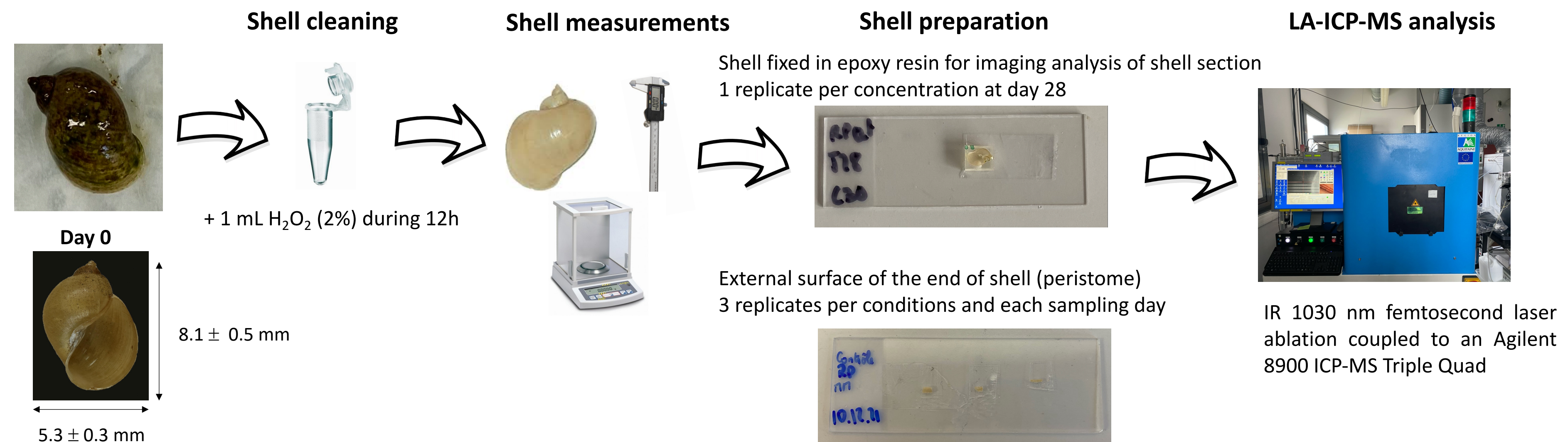


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Once a week

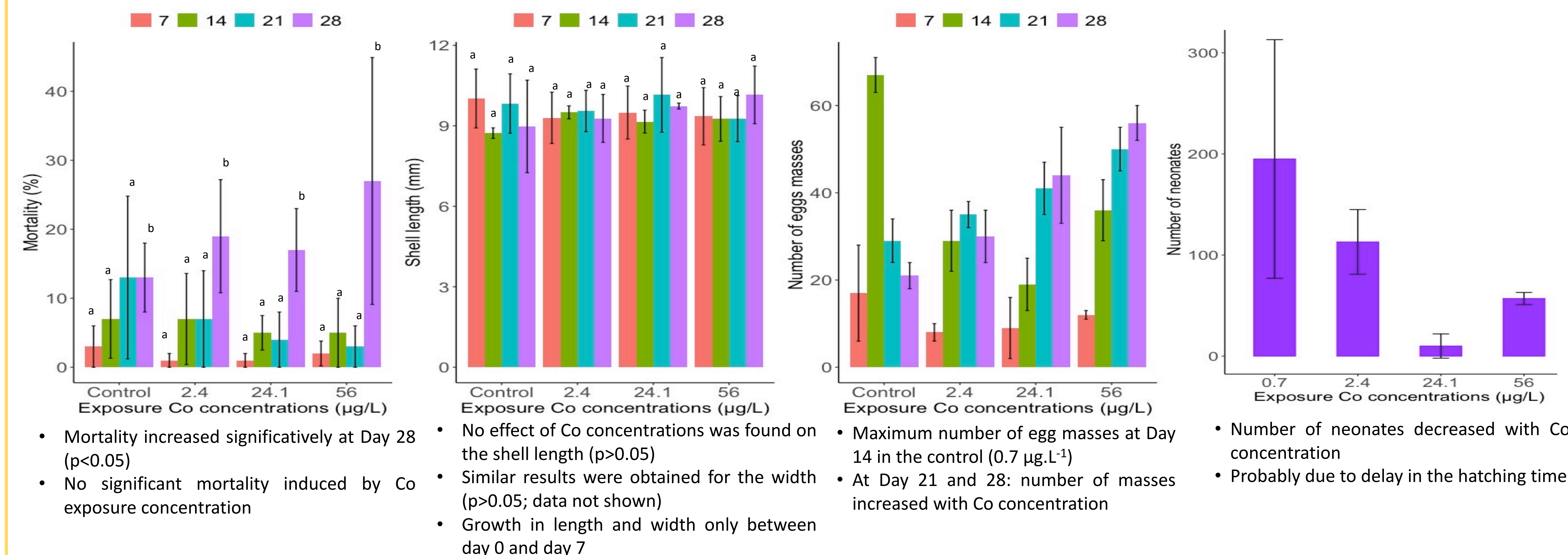
- *Physicochemical parameters* : Conductivity, pH, oxygen and turbidity
- *Water analysis* : Anion, cation and dissolved organic matter concentrations
- *Organism analysis* : Shell measurements (length and width) and number of egg masses
- *Shell analysis* : Microchemical analyses of metals in the shells performed using LA-ICP-MS

LA-ICP-MS analysis



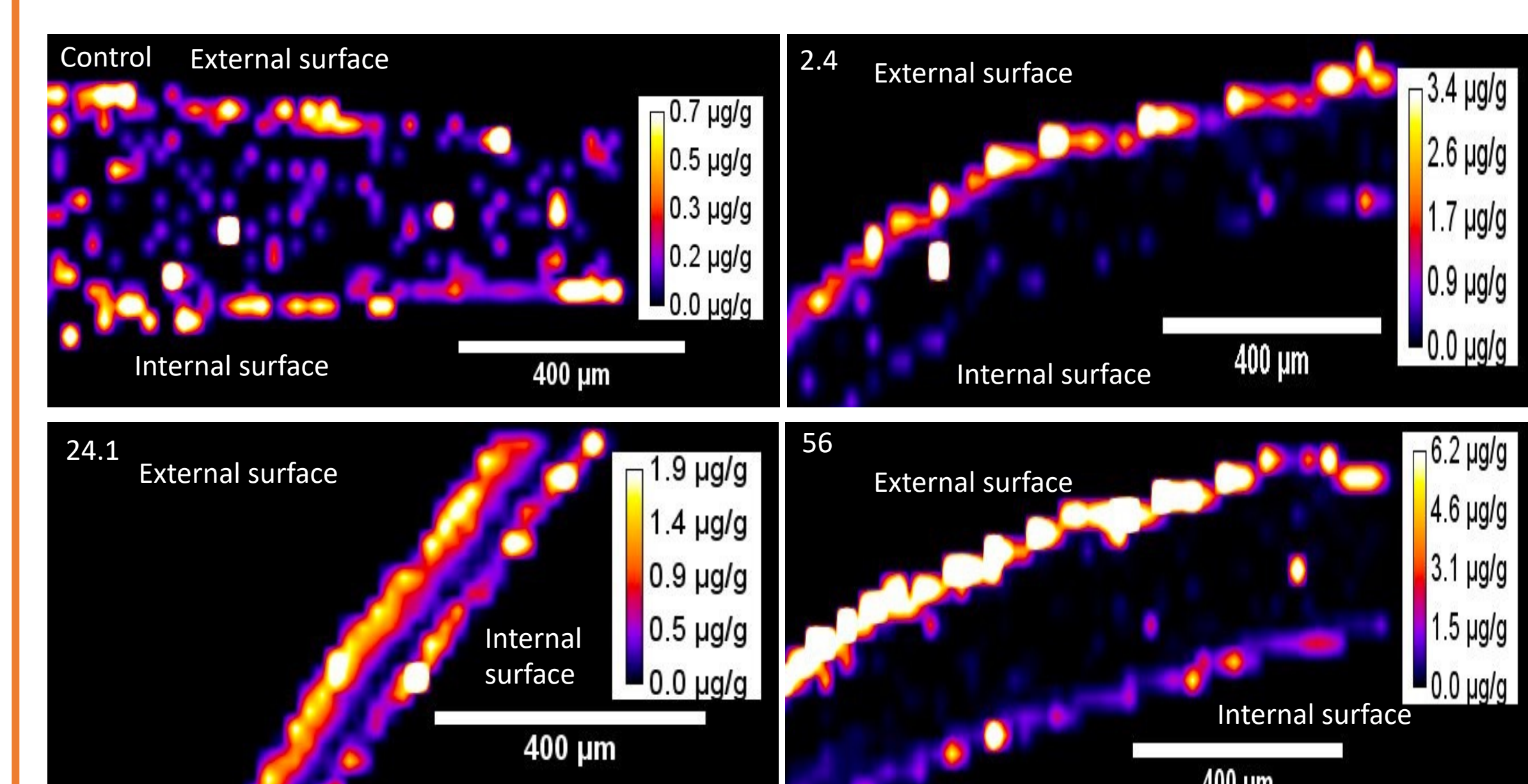
RESULTS

1) Co effects towards gastropods

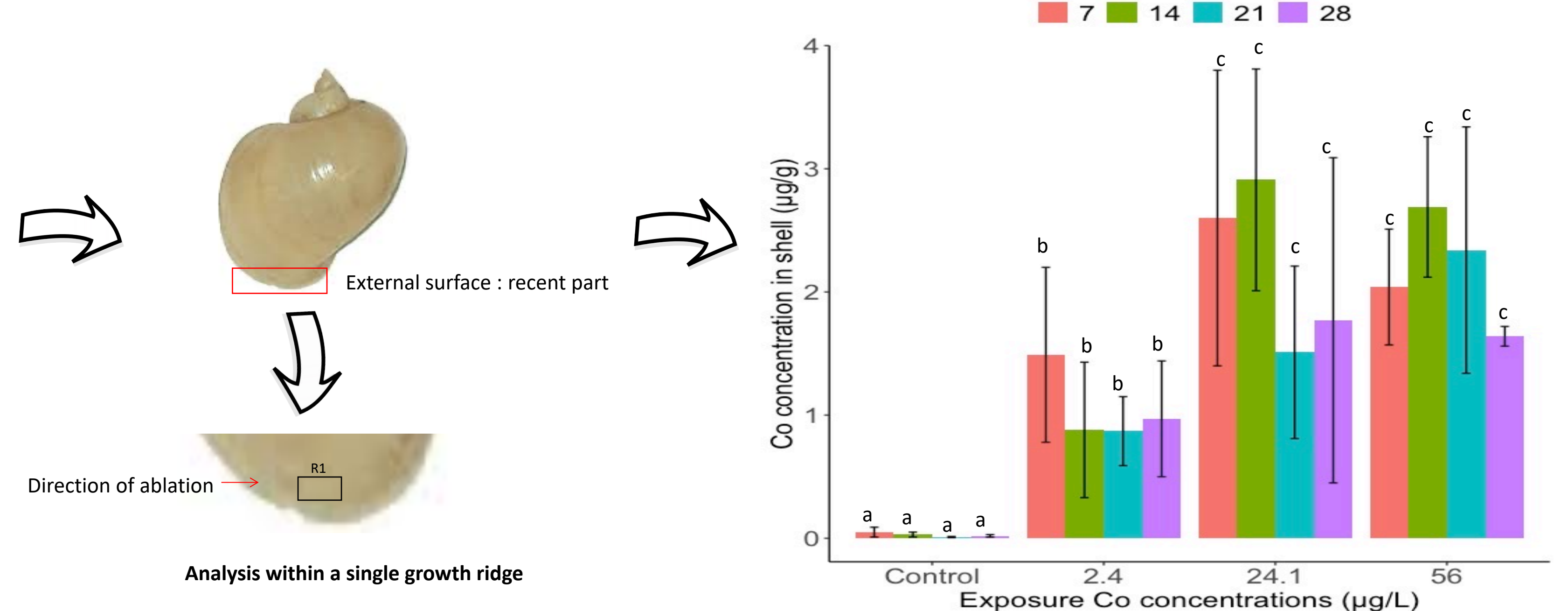


2) Cobalt distribution in shell

A) Co distribution in shell by mass-spectrometry imaging at Day 28



B) Co concentrations in external shell surface as a function of exposure time



- In control, Co distributed evenly in the shell at very low concentration ($< 1 \mu\text{g/g}$)
- At all exposure concentrations, higher Co concentration mainly found on the shell external surface
- At the 24.1 and 56 $\mu\text{g/L}$, shell Co concentrations were high at both internal and external surfaces

- Significant increase in shell Co concentration was observed from 2.4 $\mu\text{g/L}$ Co at Day 7
- No further increase was observed at longer exposure time
- Shell Co concentration further increased at 24.1 $\mu\text{g/L}$. A plateau was measured at 56 $\mu\text{g/L}$ Co

CONCLUSION

- The present study demonstrates the impact of Co on the reproduction of *R. Balthica*. A delay in hatching was observed in Co-exposed gastropods. This delay is dependent of exposure Co concentration with a minimum effect at higher Co concentrations. The number of neonates is much lower at the higher Co concentrations.
- Co did not show a negative impact on the shell growth at the micrometer level.
- Co mainly distributes in the external shell surfaces. Shell Co accumulation was already measured at the end of the first week of exposure and no further increase was observed with longer exposure time. Future analysis of Co accumulation in the gastropod soft bodies as a function of time will allow us to better understand Co pathway from water to the shell and to assess the potential use of gastropod shells as bioindicator of metal contamination.

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