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Contrasting abilities of metal bioaccumulation in *Gammarus* populations with different exposure histories

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SequAdapt
PROJECT



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Modélisation
Ecole Doctorale

INTRODUCTION

- Kinetic models are used to link metal exposure to metal contamination in aquatic organisms and enable also the prediction of metal bioaccumulation.
- Kinetic models are characterised by kinetic parameters (uptake and elimination rate constants) which can be determined in controlled conditions.
- “Global” kinetic parameters for Cd, Pb and Ni have been established in five naïve populations of gammarids.
- ➔ BUT gammarids can live in rivers exhibiting metal contamination to which organisms may adapt physiologically.
- Adaptation can result in the modulation of bioaccumulation abilities i.e. kinetic parameters.
- ➔ This may limit the environmental relevance of kinetic models and the reliability of bioaccumulation predictions.

OBJECTIVES

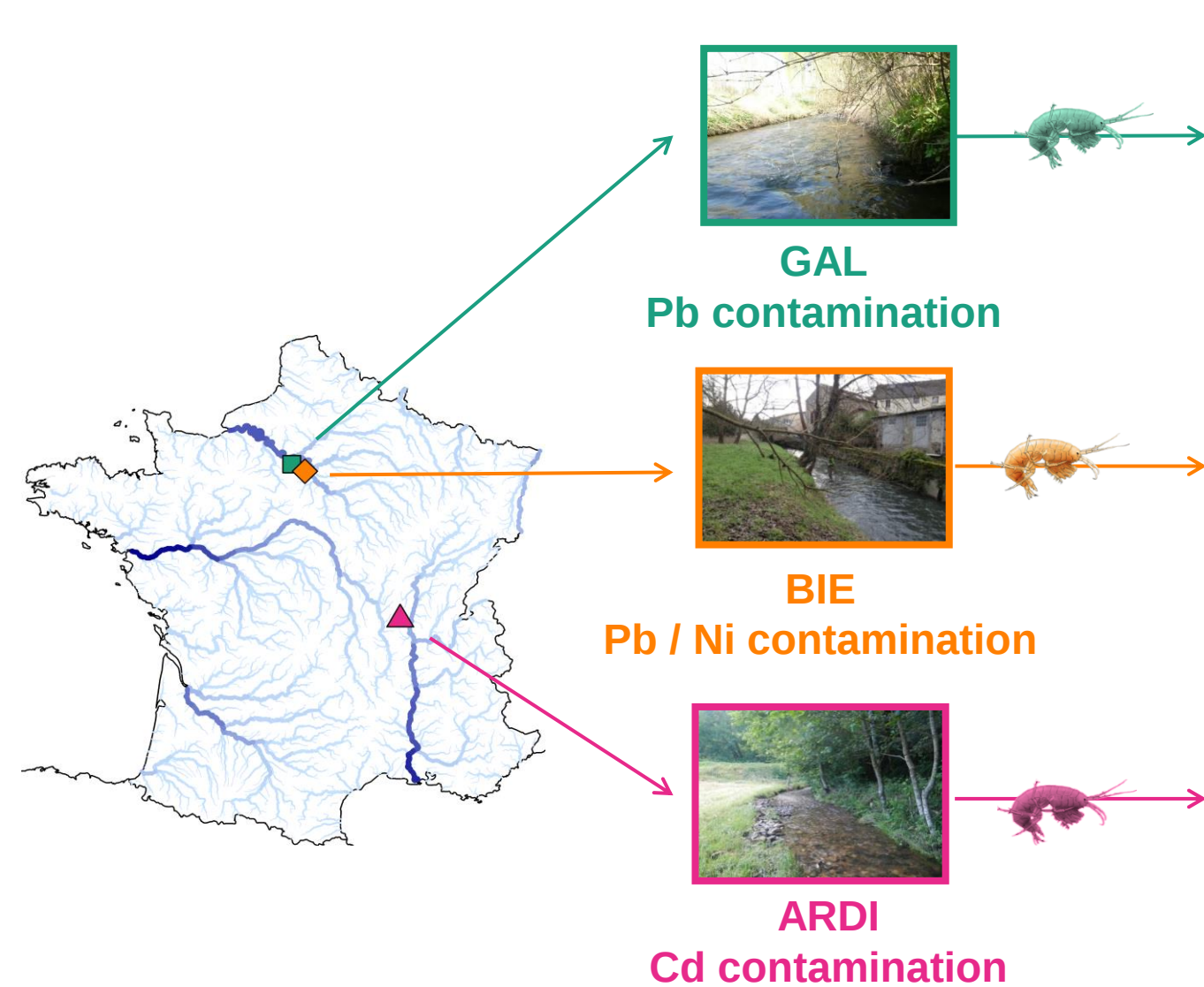
Assess the bioaccumulation abilities of metals in gammarids chronically exposed to metals *in situ*.

1. Determine the kinetic parameters describing Cd, Pb and Ni bioaccumulation in populations of gammarids chronically exposed to metals *in situ*.

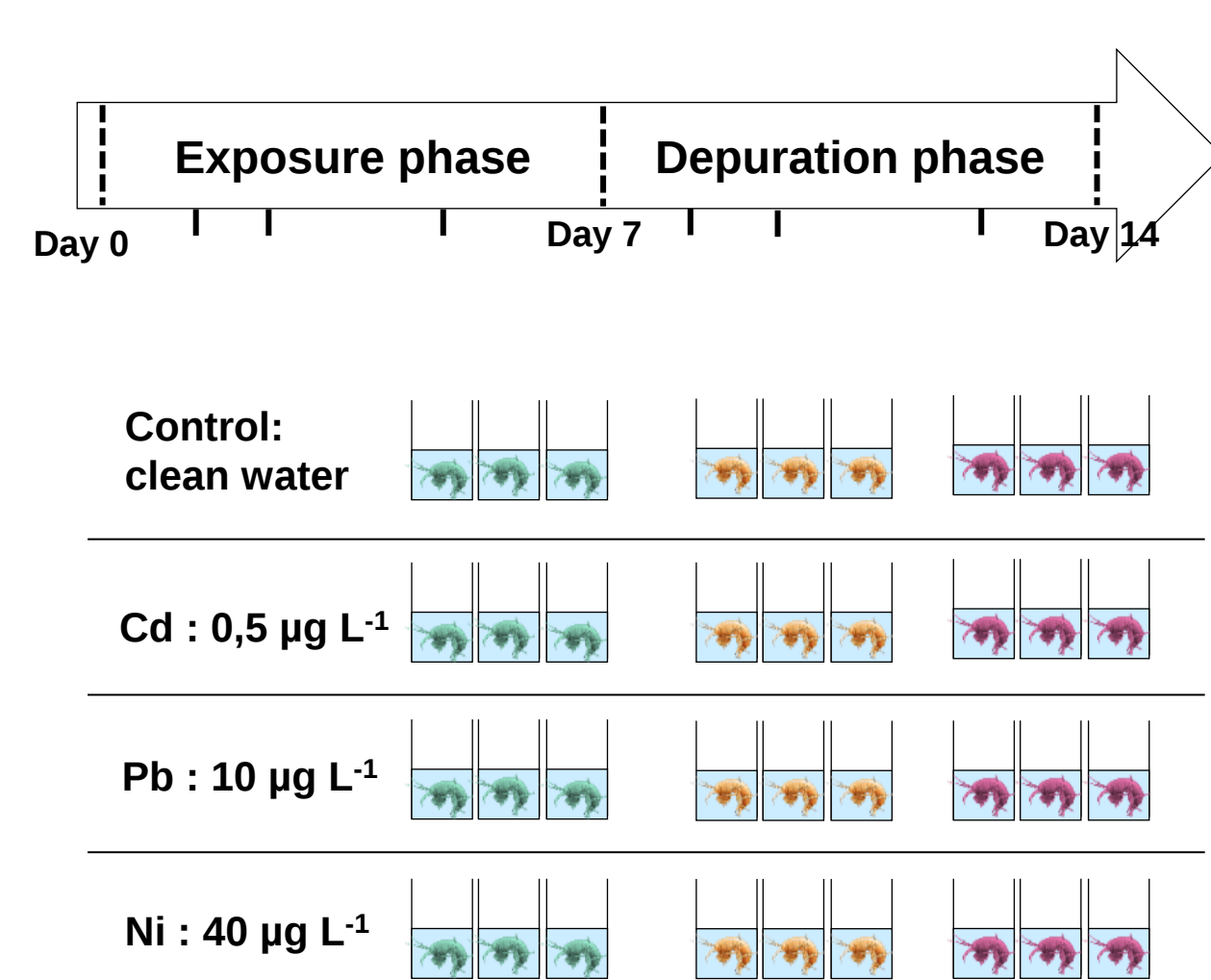
2. Compare the kinetic parameters with “global” kinetic parameters already determined in five naïve populations of gammarids.

MATERIALS & METHODS

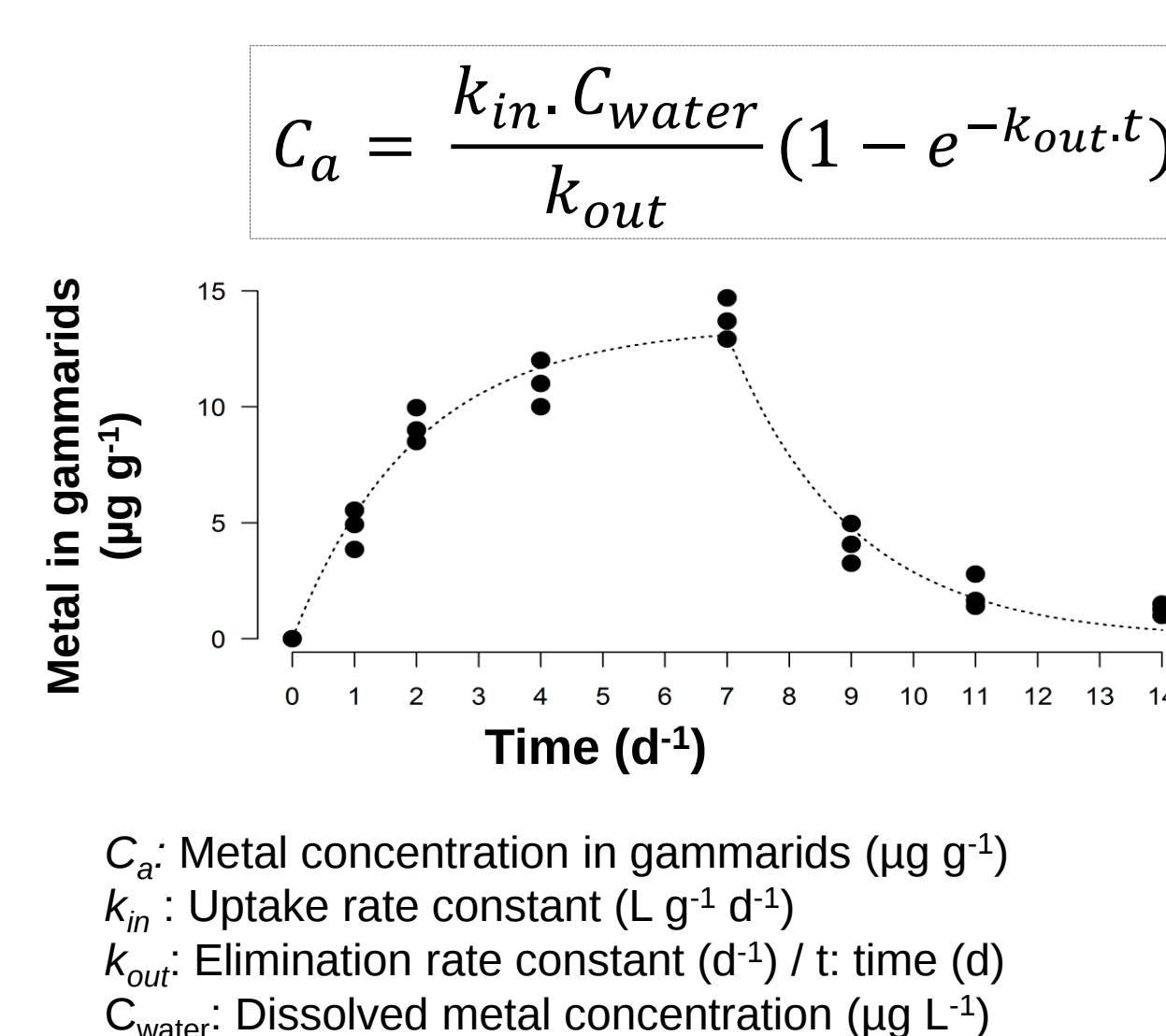
① Collection of 3 gammarids populations from metal-contaminated sites



② Exposure of gammarids to metals in controlled conditions



③ Fitting of the kinetic model to the bioaccumulation data



④ Determination of kinetic parameters for each contaminated population

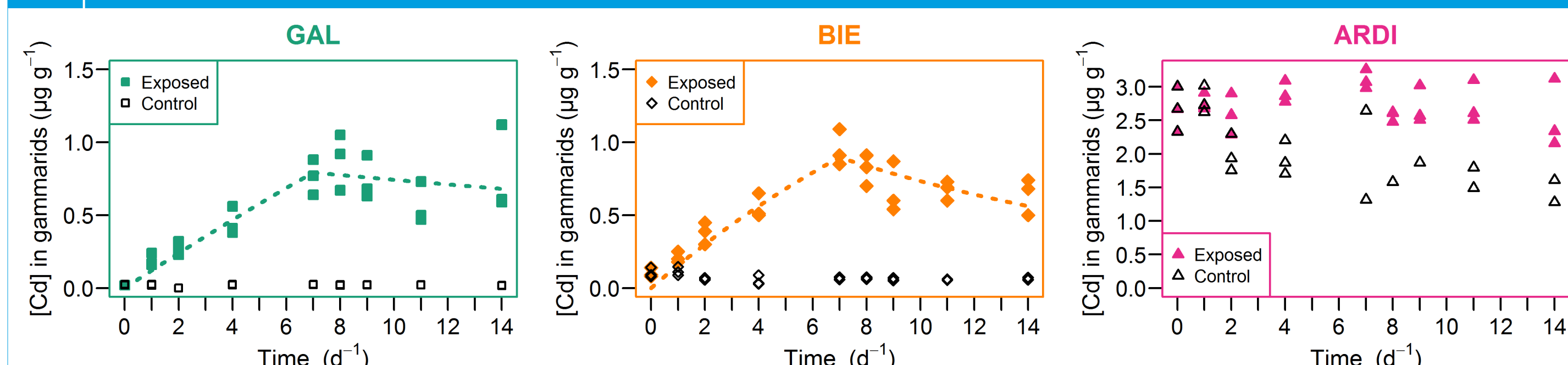
➔ k_{in} and k_{out}

⑤ Comparison with the “global” kinetic parameters already established in five naïve populations living in pristine sites but exhibiting contrasted geochemical parameters

(See Plateform: «Between-population variability of waterborne metal bioaccumulation in *Gammarus* sp. from uncontaminated freshwaters», at 2:30 PM, ID 149, room 131/132)

RESULTS & DISCUSSION

1. Bioaccumulation kinetics

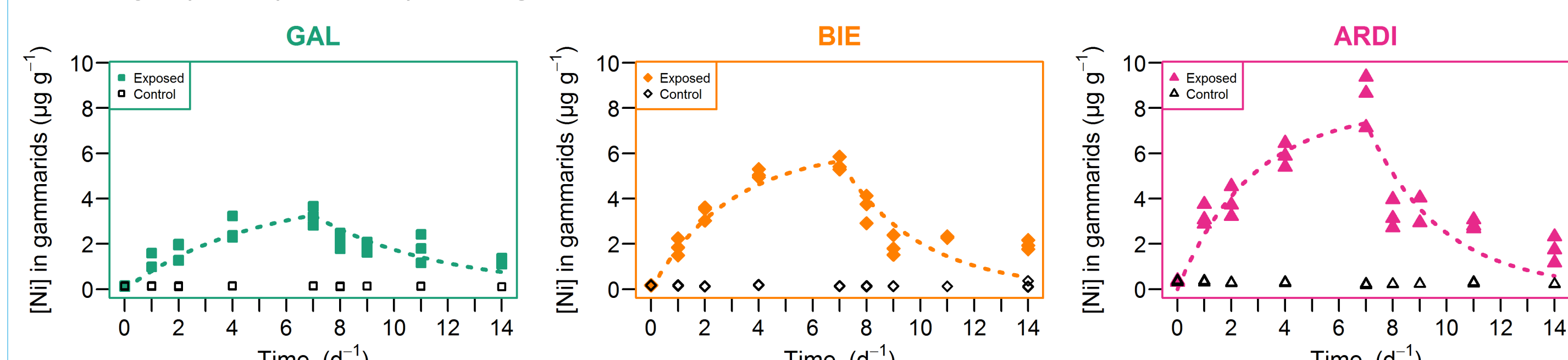
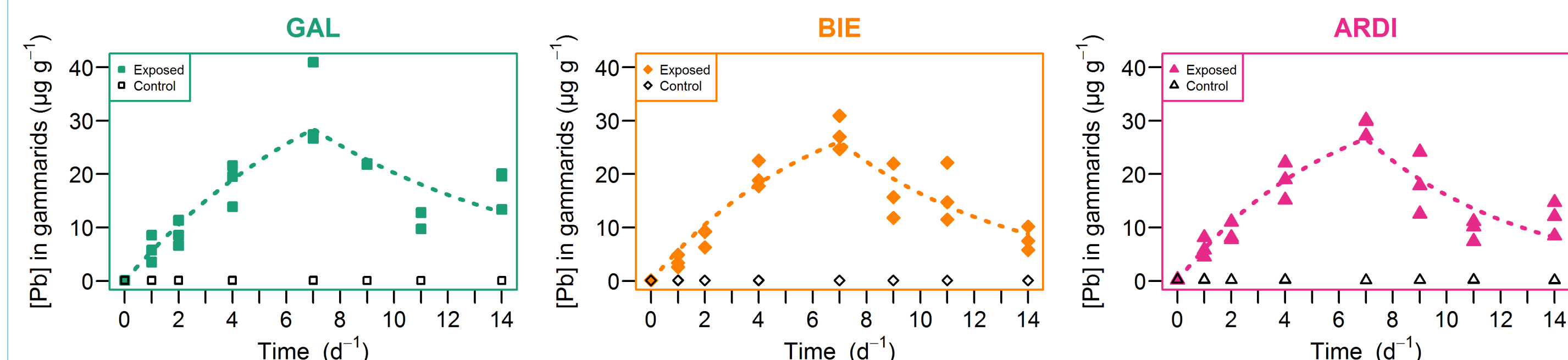


For GAL and BIE:

- k_{in} was successfully determined for Cd.
- k_{out} was not determined because of the high variability between replicates and the inadequate elimination phase length.

For ARDI:

- High basal Cd content
- No new accumulation
- No kinetic parameters

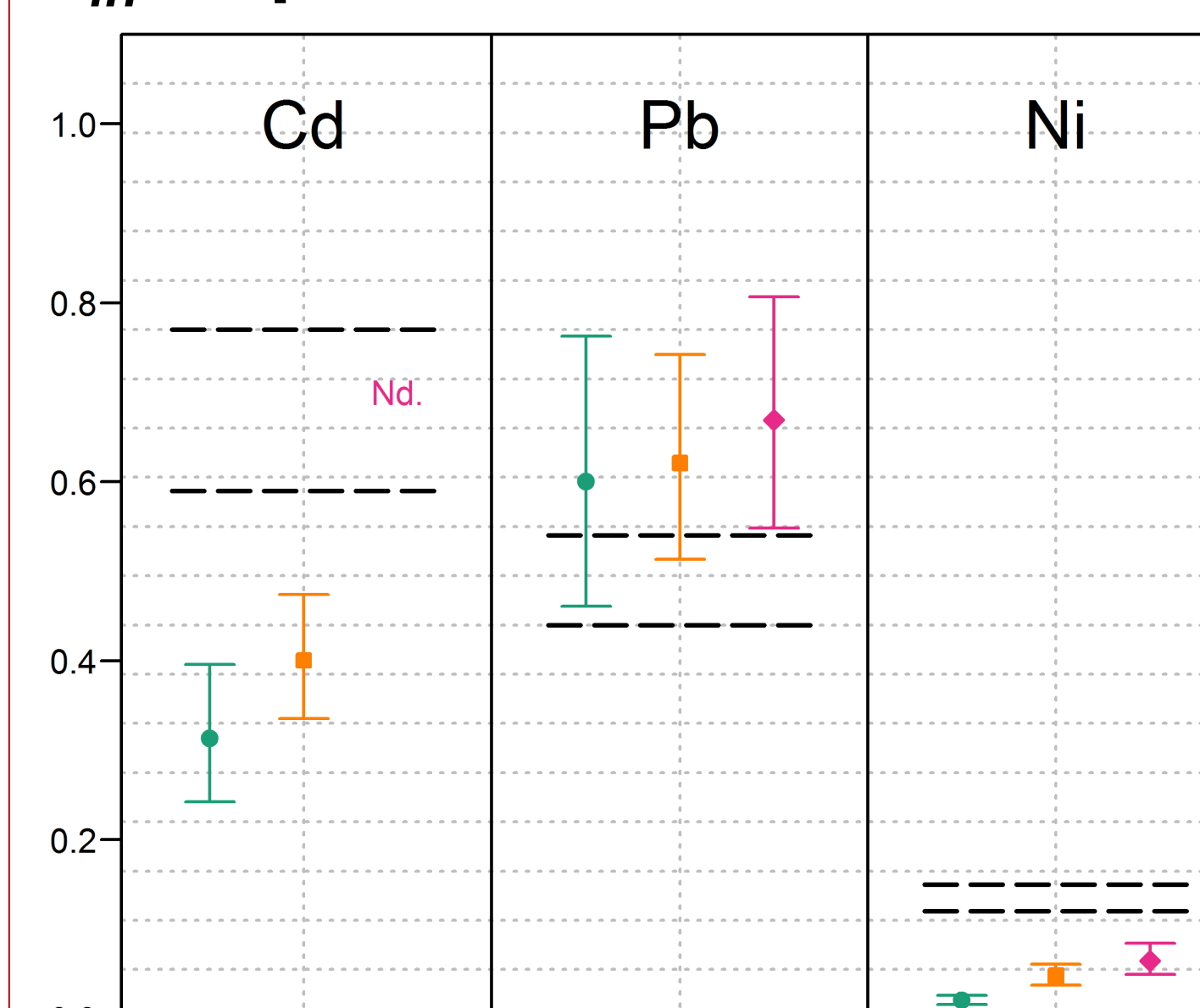


For GAL, BIE and ARDI:

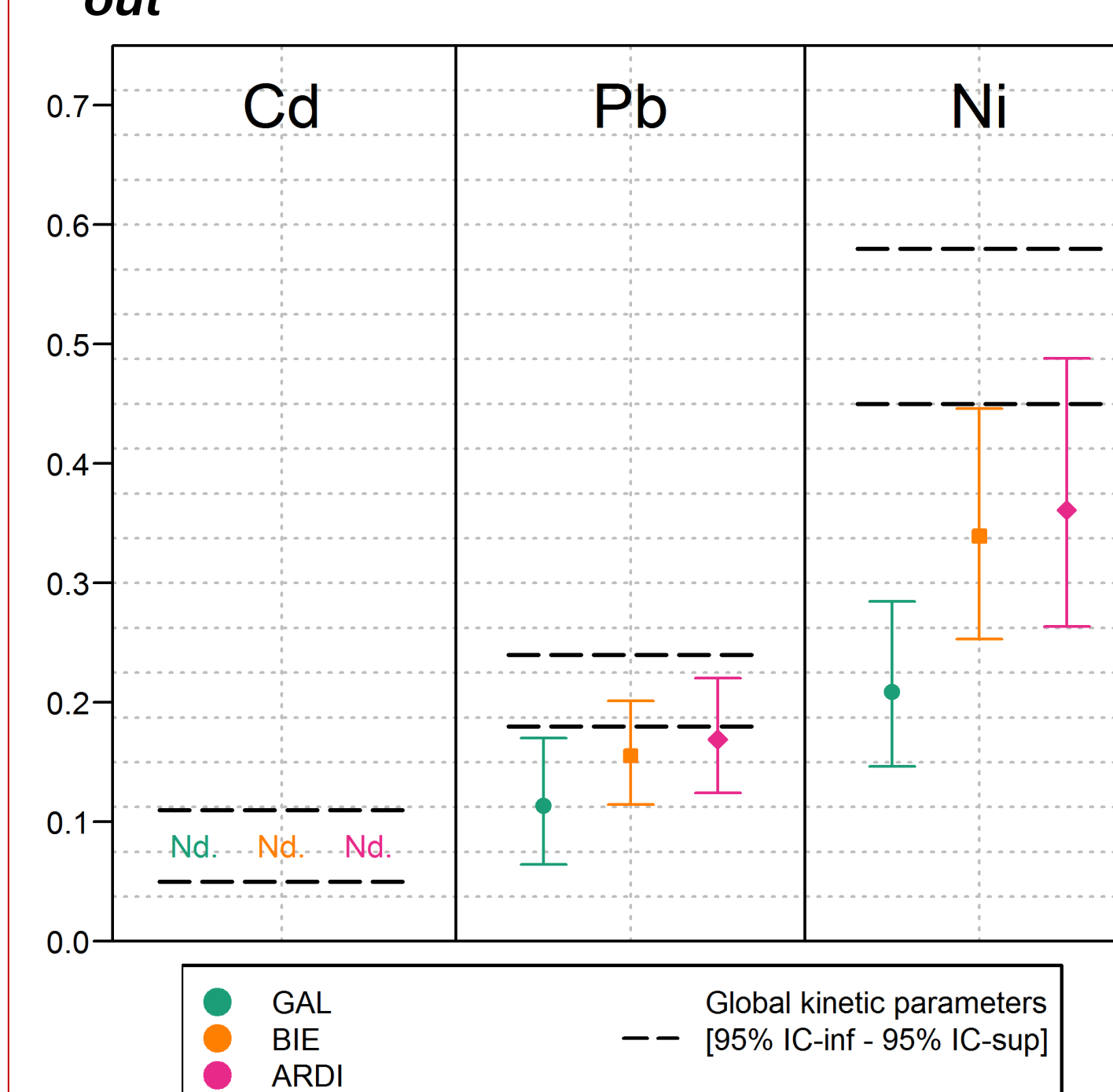
- k_{in} and k_{out} were successfully determined for Pb and Ni.

2. Comparison with the “global” kinetic parameters

k_{in} - Uptake rate constant



k_{out} - Elimination rate constant



Cd:

- $k_{in} < k_{in}$ in naïve populations

GAL and BIE: Populations chronically exposed to metals *in situ* decrease their Cd uptake compared to naïve populations.

➔ Physiological adaptation

ARDI: High basal Cd content in organisms chronically exposure to Cd *in situ*.

➔ Storage under detoxified forms

Pb:

- $k_{in} > k_{in}$ in naïve populations
- $k_{out} < k_{out}$ in naïve populations

GAL, BIE, ARDI: Population chronically exposed to metals *in situ* tend to accumulate more Pb and to eliminate less Pb compared to naïve populations.

➔ Storage abilities

Ni:

- $k_{in} < k_{in}$ in naïve populations
- $k_{out} < k_{out}$ in naïve populations

GAL, BIE, ARDI: Populations chronically exposed to metals *in situ* accumulate and eliminate less Ni compared to naïve populations.

➔ Regulation abilities

These results suggest that tolerance mechanisms occur in chronically contaminated populations with metals.

CONCLUSION

- Bioaccumulation strategies are specific to the metal considered.
- Populations chronically exposed to metals *in situ* modulate their metal bioaccumulation abilities compared to naïve populations.
- The modulation of metal bioaccumulation does not seem to be specific to the type of metal encountered *in situ* but to a global metallic pressure.

- Predictive models require to well defined the population used to determined k_{in} and k_{out} and, thus, to calibrate models.
- Further studies are needed to assess the physiological mechanisms involved in the modulation of metal bioaccumulation.