Are polluted sediments a source of contaminants for the water column?

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Context

- **Many aquatic ecosystems may be threatened by a possible remobilisation of pollutants accumulated in sediments.**

- **Any disruptive event of water/sediment equilibrium may induce a contaminant release in the water column.**

- **Re-deposition following re-suspension of initially anoxic sediment in oxic water is then a potential episode of increasing mobility of pollutants.**

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Objective

- **A laboratory experiment was performed to understand the sediment ability to release metals in solution during re-deposition following re-suspension in oxic condition.**

- **Special care was given to the kinetics of the phenomena involved by coupling physical and chemical mechanisms.**

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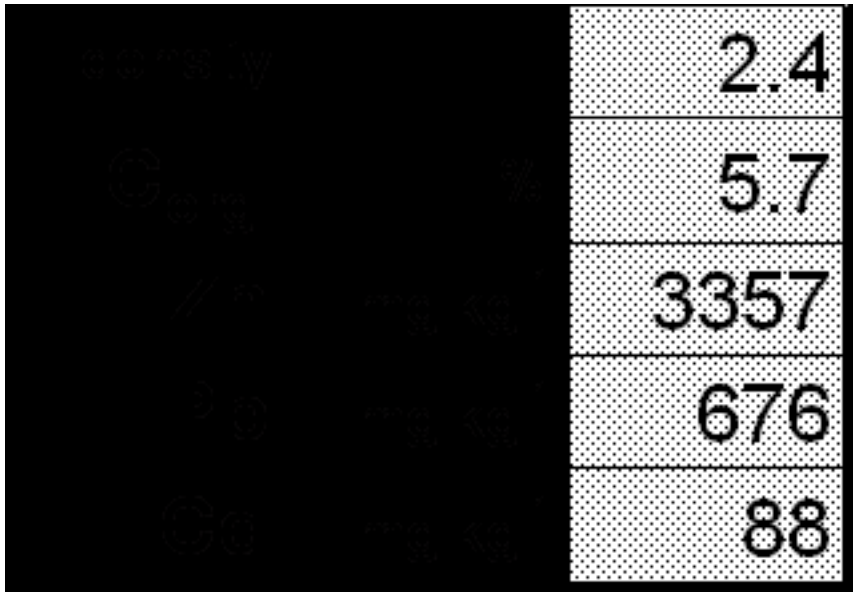
Material : *Sediment characteristics*

Material originating from the Scarpe river in the North of France



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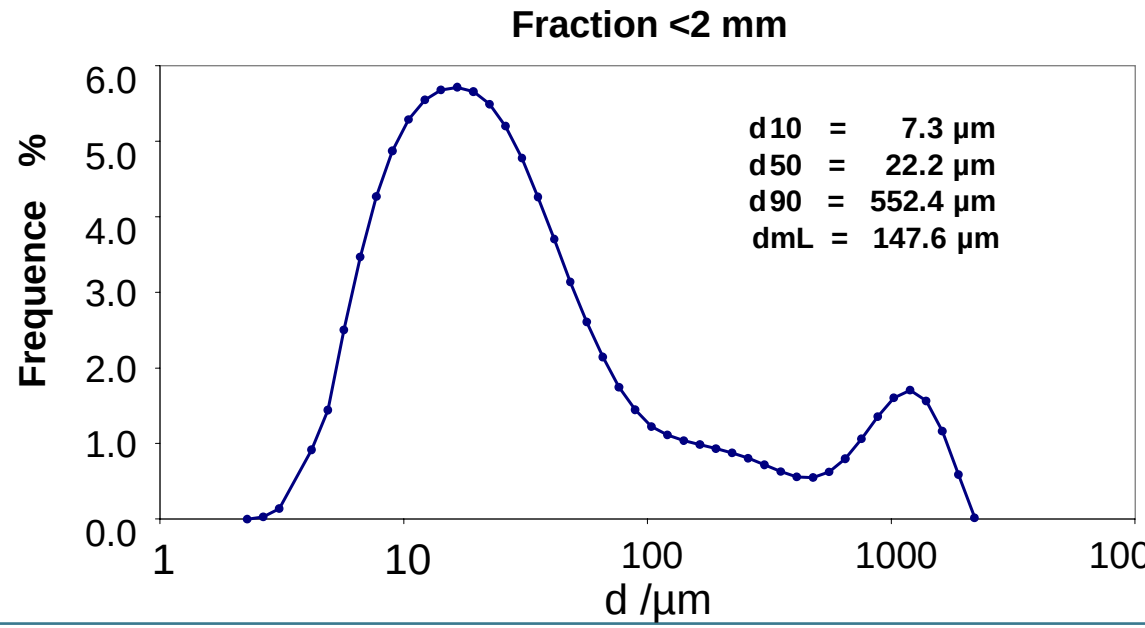
Material : *Sediment characteristics*

semi-quantitative mineralogy :

- Quartz ~ 40% , Calcite ~ 15% , Microline , Plagioclase and clay ;

with :
- Interstratified smectite/illite ~ 47% ;
- Kaolinite ~ 30% ;
- Illite and/or mica ~ 20% ;
- Chlorite ~ 3%.

Particle size distribution :



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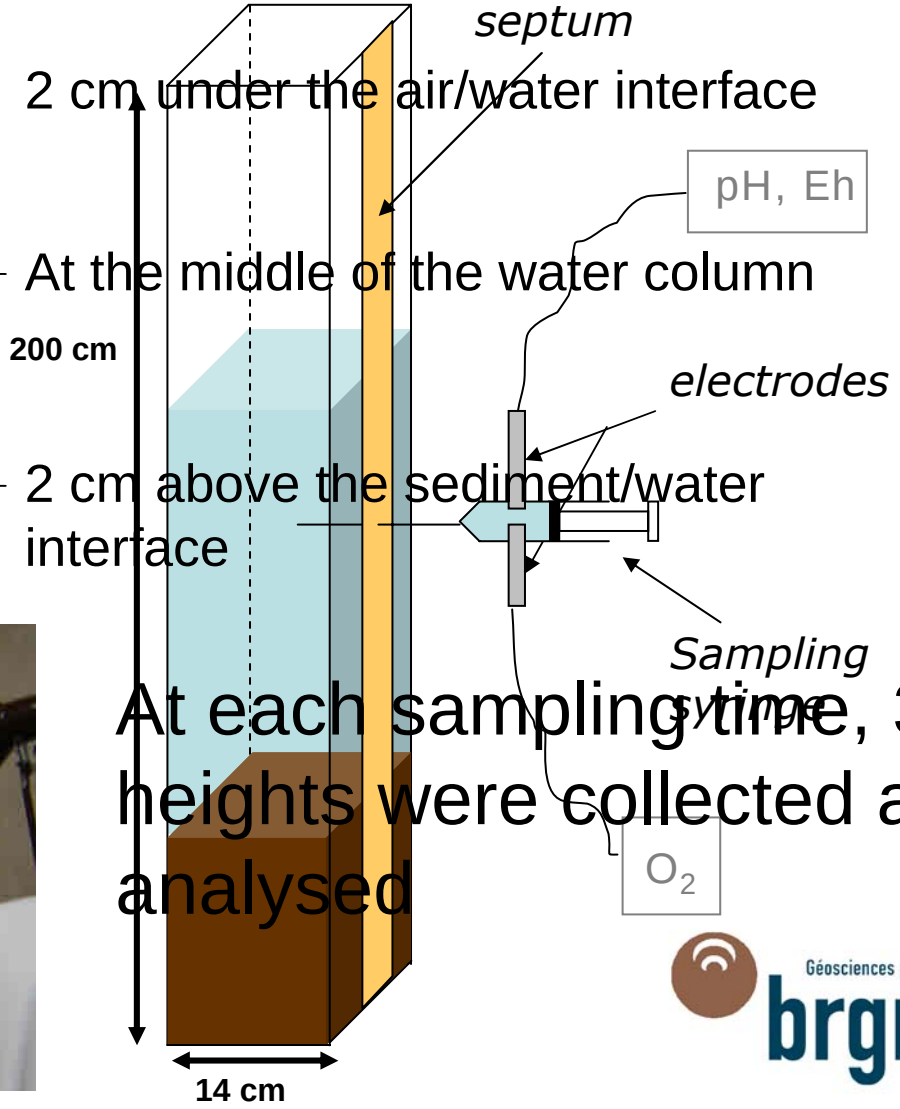
Method : *Experimental devices*

> overview of column set and sampling operation



At each sampling time, 3 heights were collected and analysed

Method : *Experimental devices*

> overview of column set for density measurement

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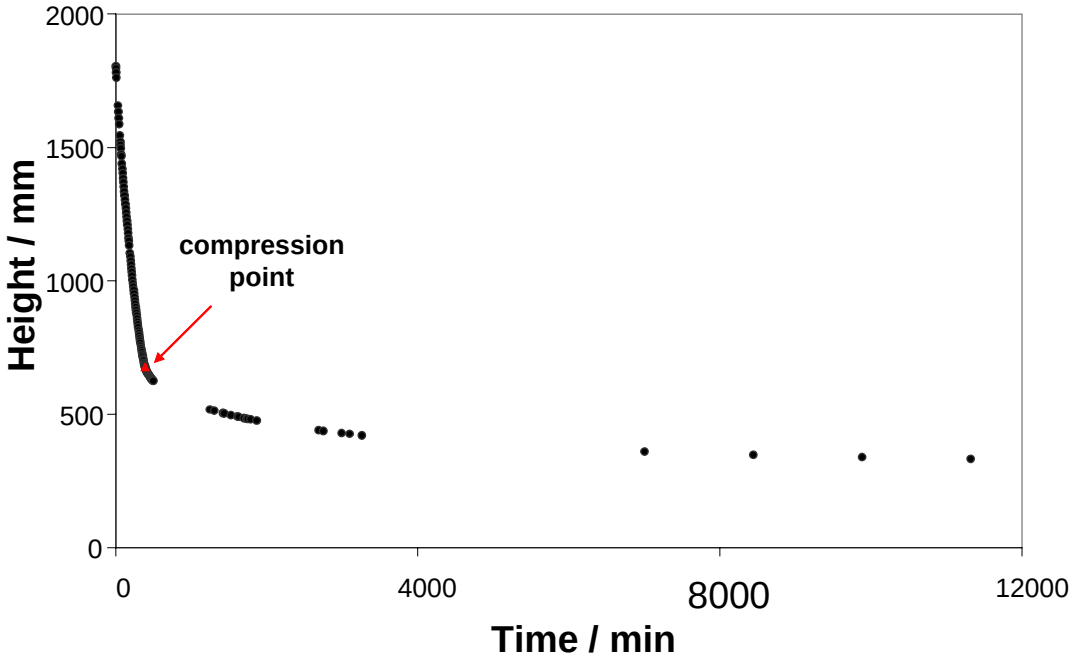
Results : *Settling kinetic*

Initial MES = 56 g/l
Settling speed: V = 0.3 m/h
Compression starts after about 6 hours



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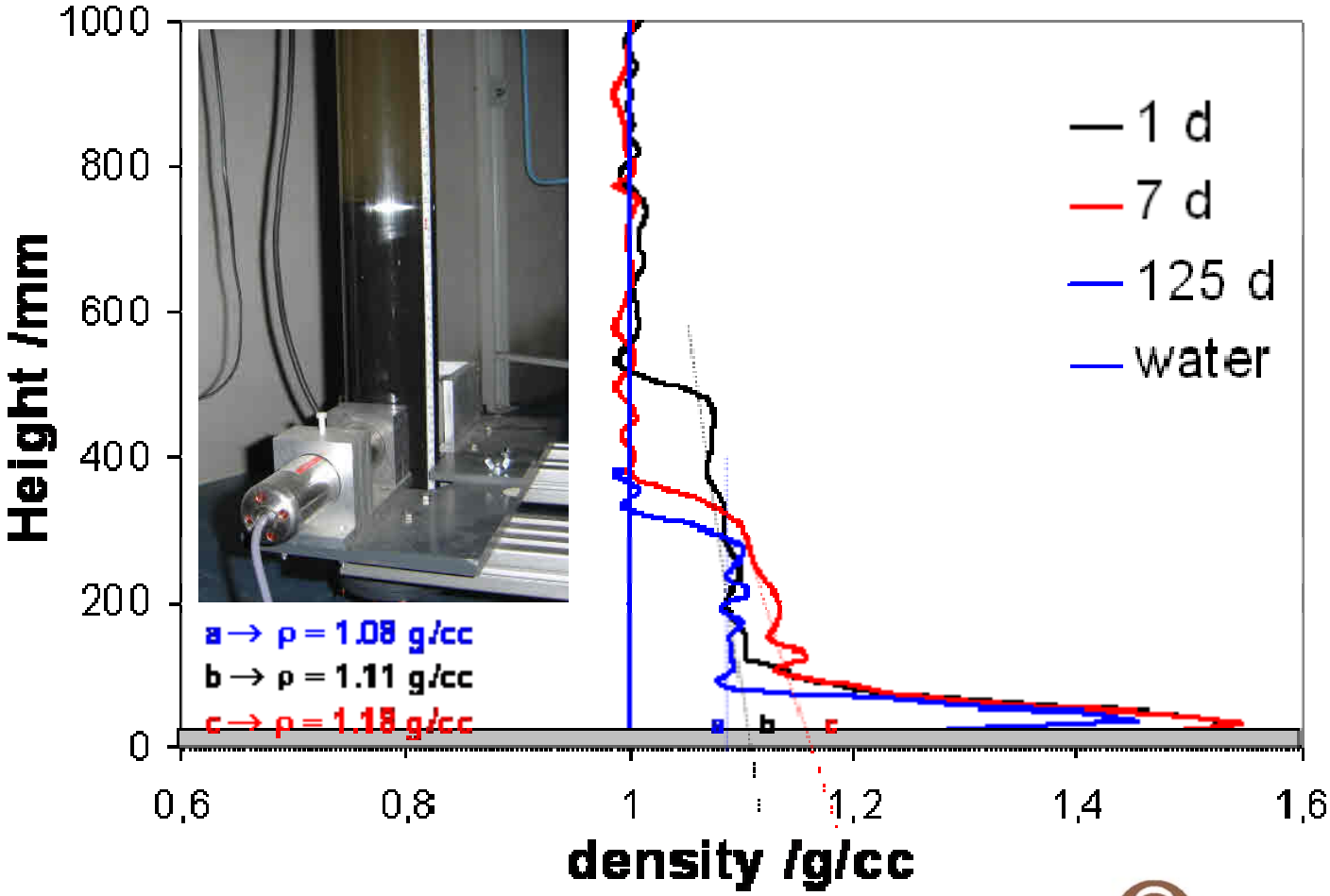
Gamma densimetric profile



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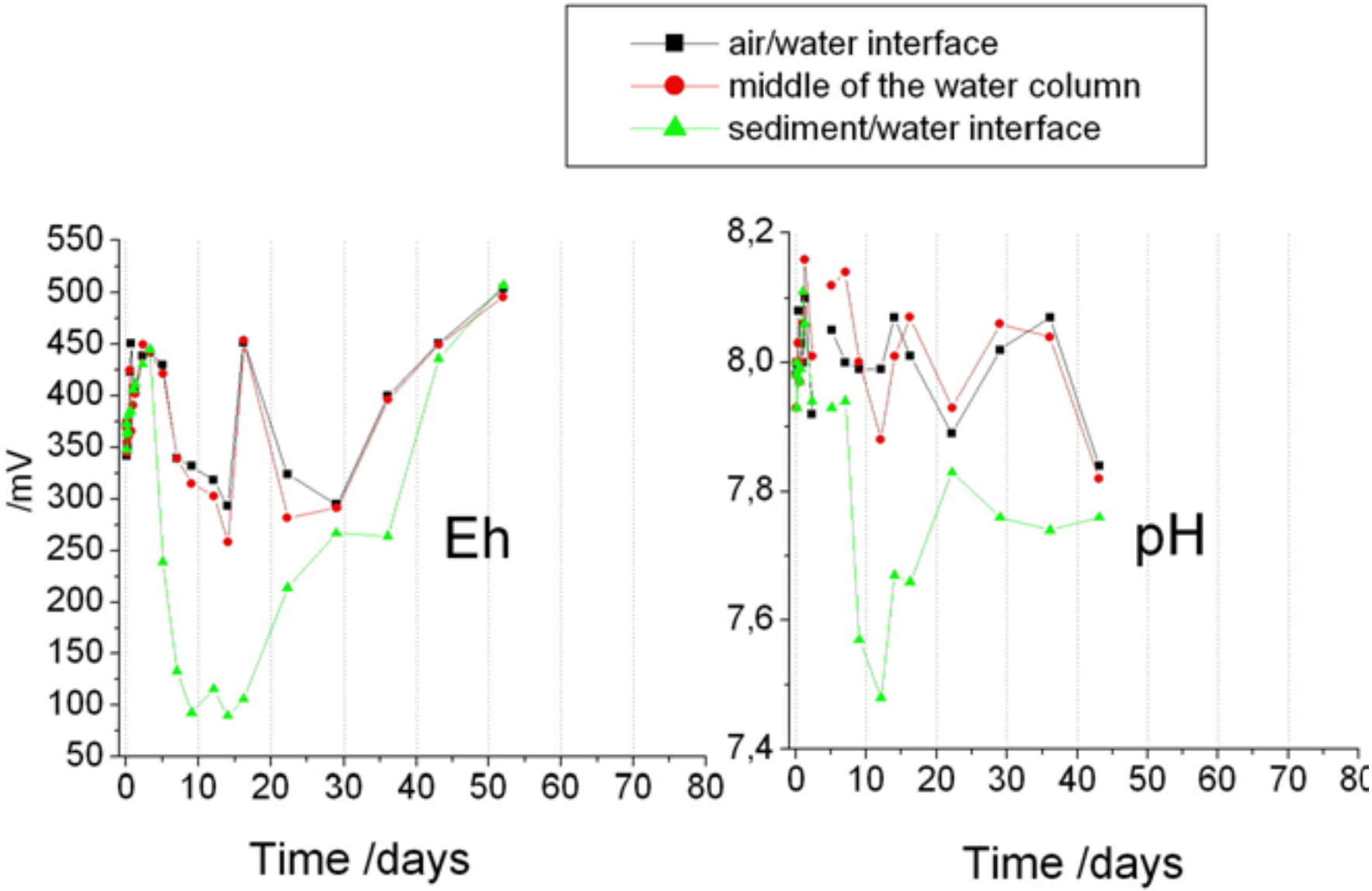
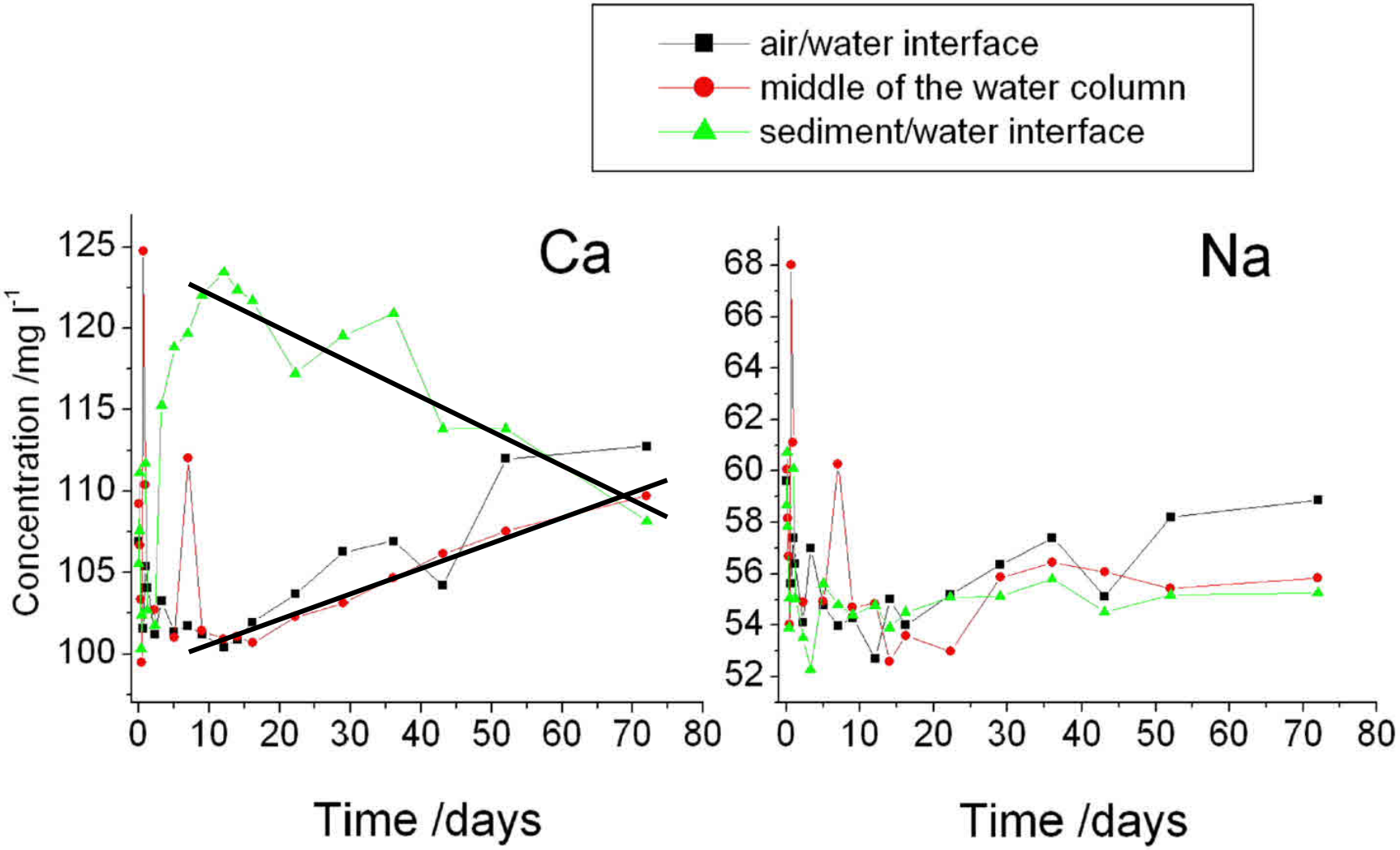
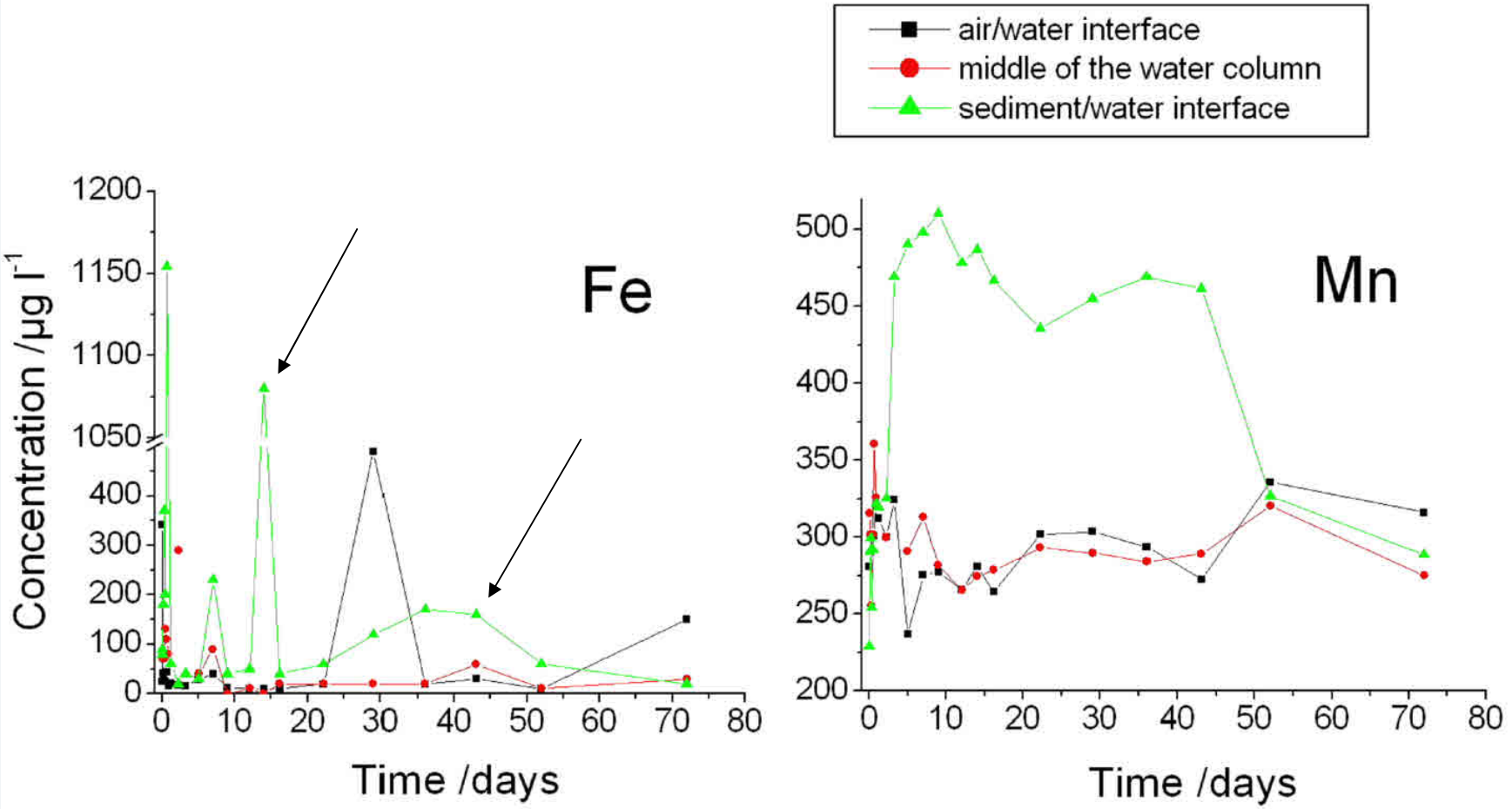
Results: E_H *and pH*



Results: *Ca and Na*



Results: *Fe and Mn*



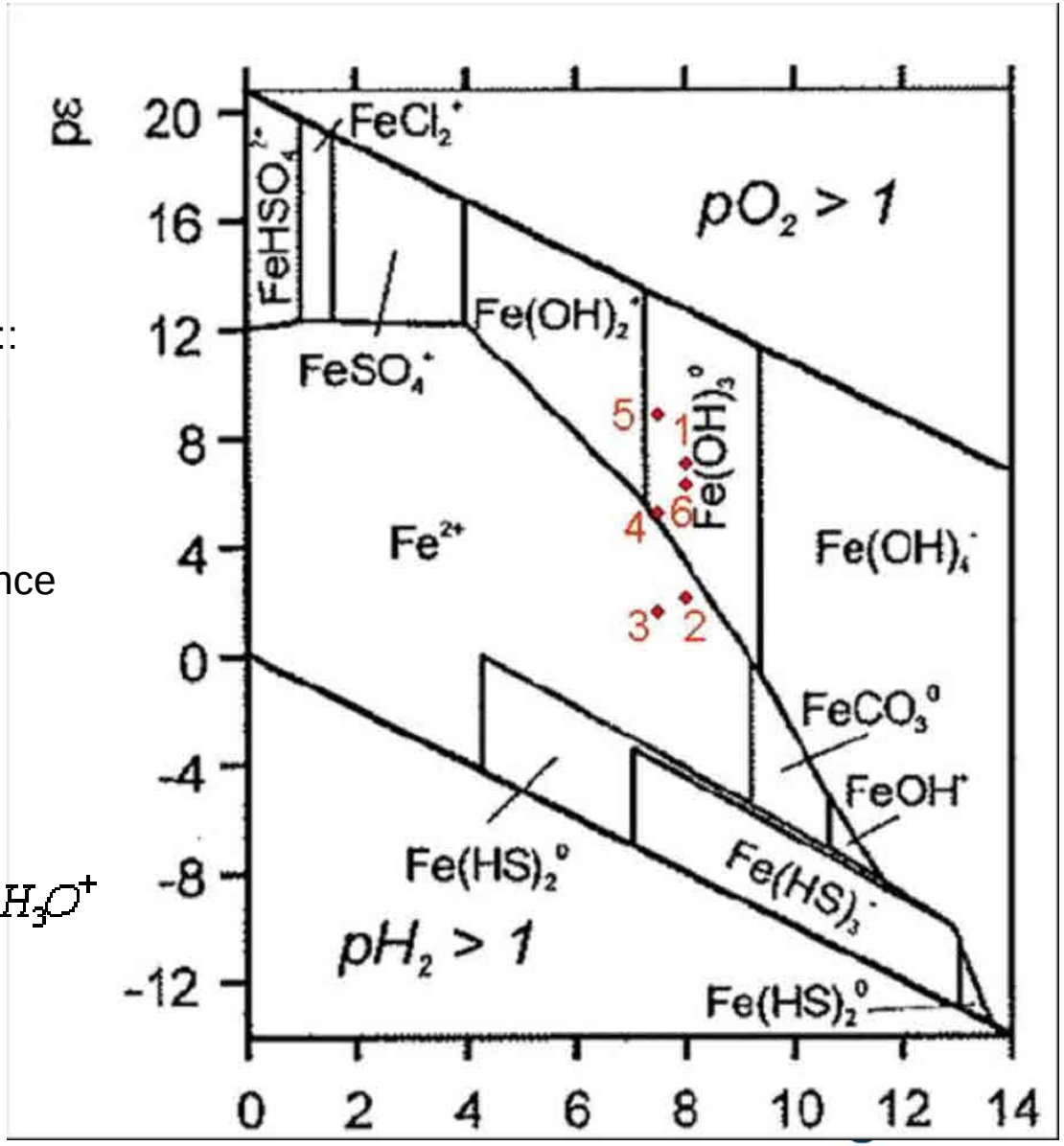
Results: *Fe*

Six samples are plotted in a pE/pH stability diagram for aqueous iron species (Kölling *et al.*, 1999).

At the sediment/water interface::
1, after 3,3 days
2, after 7 days
3, after 12 days
4, after 36 days
5, after 72 days jours d'expérience

In the middle of the column :
6, after 36 days

$$Fe^{2+} + O_2 + H_2O \rightarrow Fe(OH)_3^0 + 2H_3O^+$$



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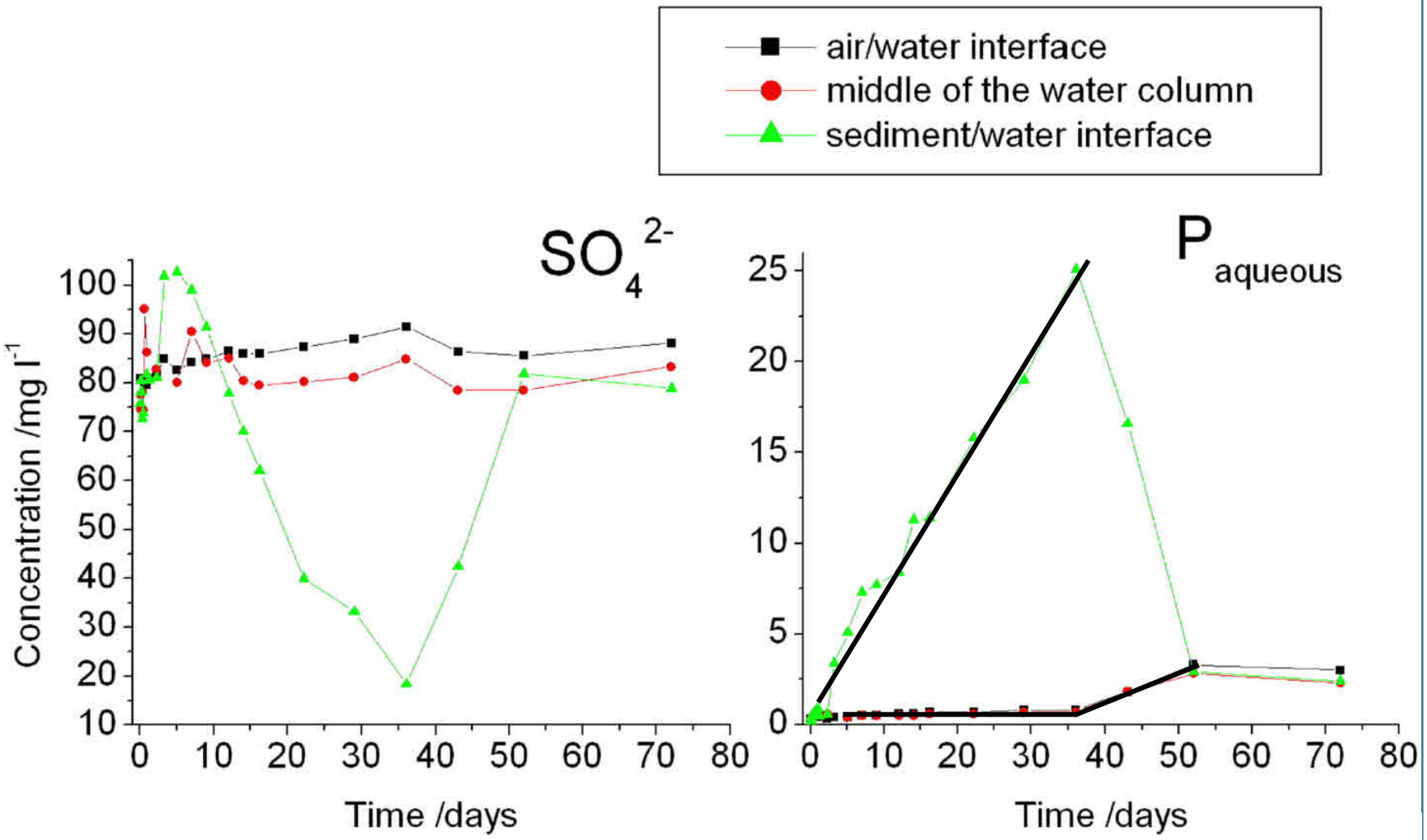
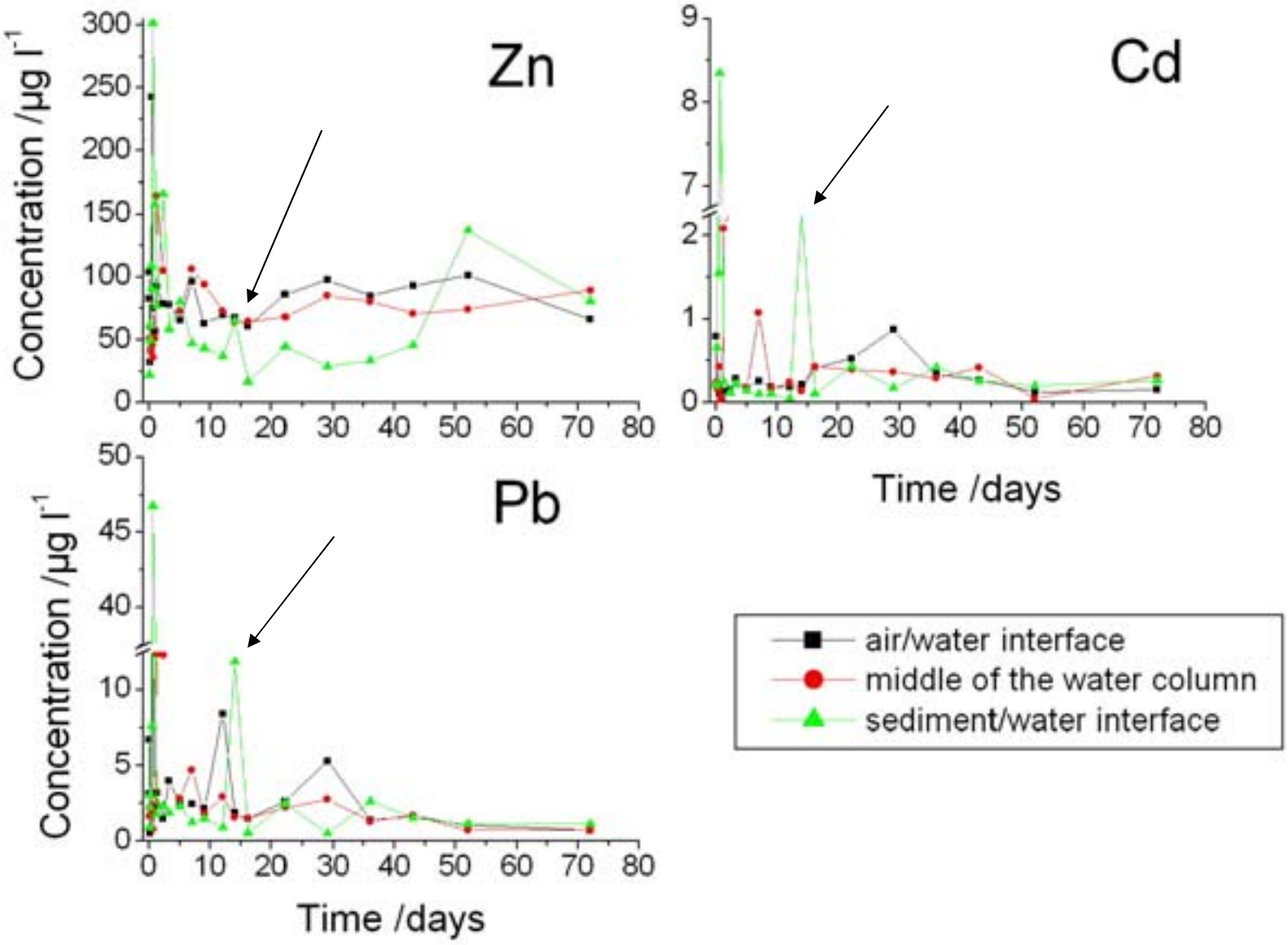
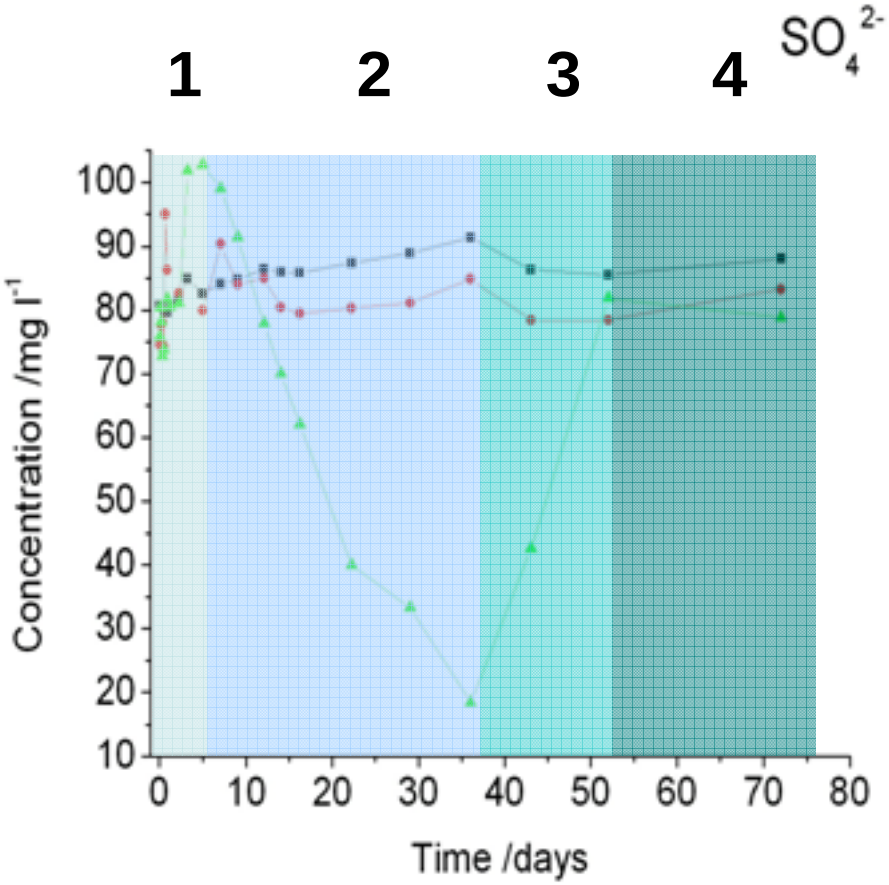
Results: SO_4^{2-} and aqueous P



Results: metals



Results: synthesis



1. Settling and compression, release of oxidation products (SO_4^{2-}, H^+, Ca^{2+}, Mg^{2+}, Mn^{2+})

2. Degazing and compression, release of reduction and mineralization products (Fe^{2+}, $P_{aqueous}$) – possible release of pollutants in colloïdal form

3. Dispersion of solutes probably due to colloids destabilisation due to iron hydroxides precipitation

4. Equilibrium: 2 systems with opposite redox co-exist.

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Conclusion

- **Equilibrium of both water and sediment is not reached before 50 days of experiment,**
- **During the first 30 days following re-deposition, release of metals may occur. It is probably link to the mechanical release of colloids due to bubbling,**
- **This source of contaminants for the water column is difficult to quantify,**
- **Is it a significant source of pollutants for the biocenose ?**

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Perspectives

> **What is the behavior of other pollutants ?**
  - As, which may compete with P ?
  - Organics, which are mainly linked to organic matter in sediment ?

> **GedSet, a new Interreg 4 research project, has been accepted and should bring some answers.**

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