

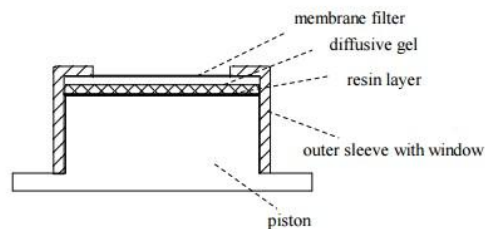


Using passive DGT samplers for integrative measurement of metals in groundwater of industrial sites

S.MAGHE-CHAUVIN



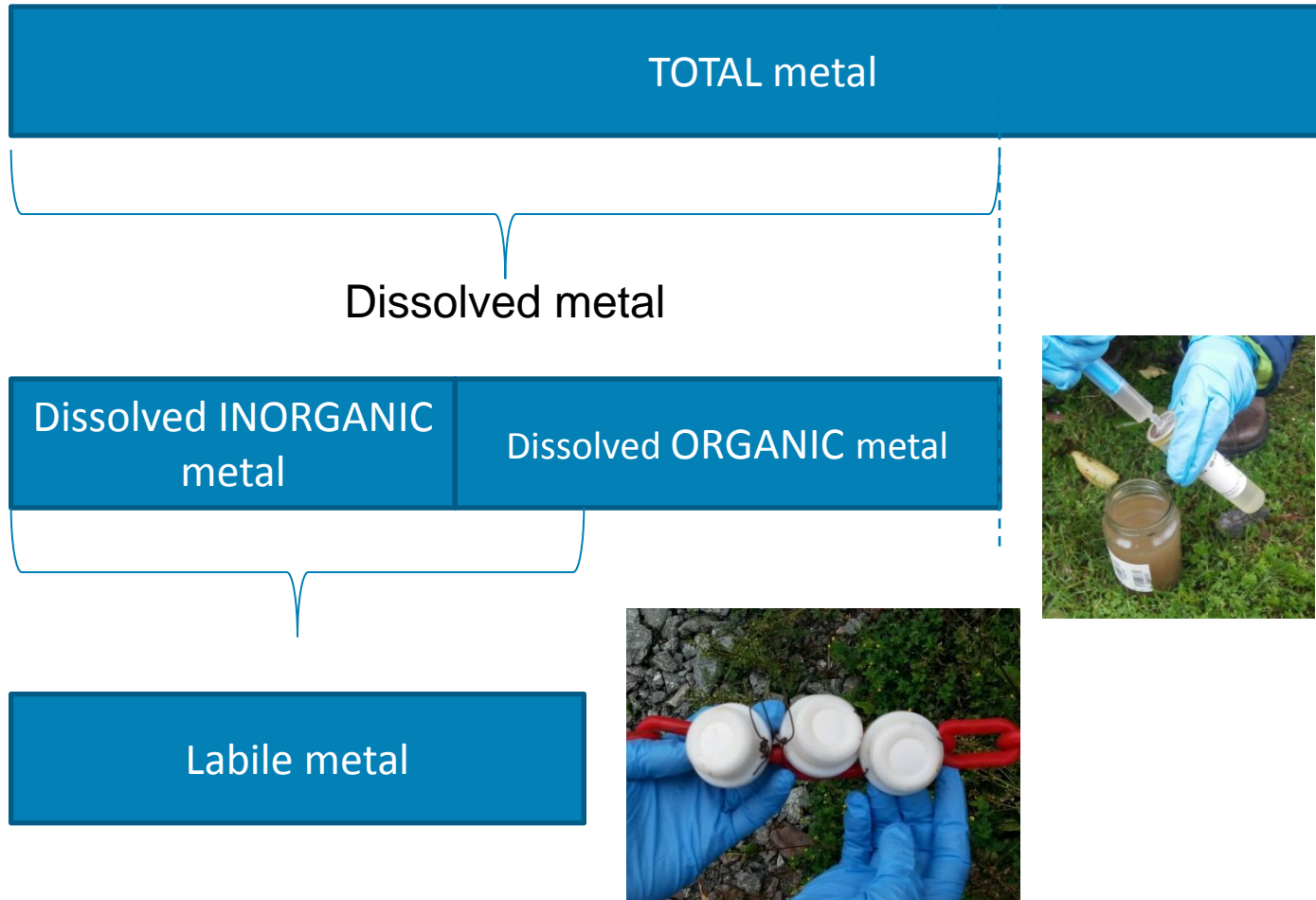
- ◆ DGT (Diffusive Gradient in Thin films)
 - ◇ Passive sampler
 - ◇ Targets: labile solution species (available to biota)
 - cationic metals (Al, As, Cd, Co, Cr, Cu, Fe, Mn, Ni, Pb, Zn),
 - oxyanions (P, As(V), Mo and V),
 - some polar organic compounds (antibiotics, ...).



From DGT Research



0.45 μm filtration



- ◆ Goal of the project: to use DGT as monitoring tools on industrial sites

- ◆ 3 questions:
 - ◇ *Exposition time: how long it could be on contaminated sites?*
 - ◇ Using DGT in groundwater: a relevant tool for vertical stratification study?
 - ◇ DGT and grab sampling: could DGT replace successfully frequent water samples?

- ◆ Two locations with Cd and Zn contamination :
 - ◇ Downstream section of a dump with hydrometallurgical processing residues -> PzA;
 - ◇ Downstream section of a sealed garbage dump (French : ISDD) -> PzB.

Grab sample	PzA	PzB
Borehole depth (m)	6.1	4
pH	5.6	6.8
Cadmium (µg/L)	3 420	<5
Zinc (µg/L)	378 000	80
Lead (µg/L)	<5	10
Manganese (µg/L)	23 600	7 030

- ◆ How long could a DGT stay in such contaminated water?



1) Speciation simulation

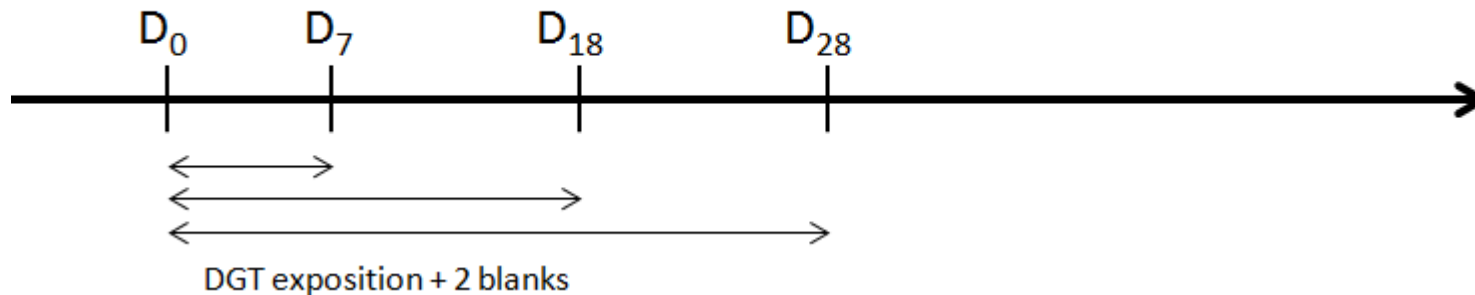
Visual MINTEQ - Species table

Percentage distribution among dissolved and adsorbed species

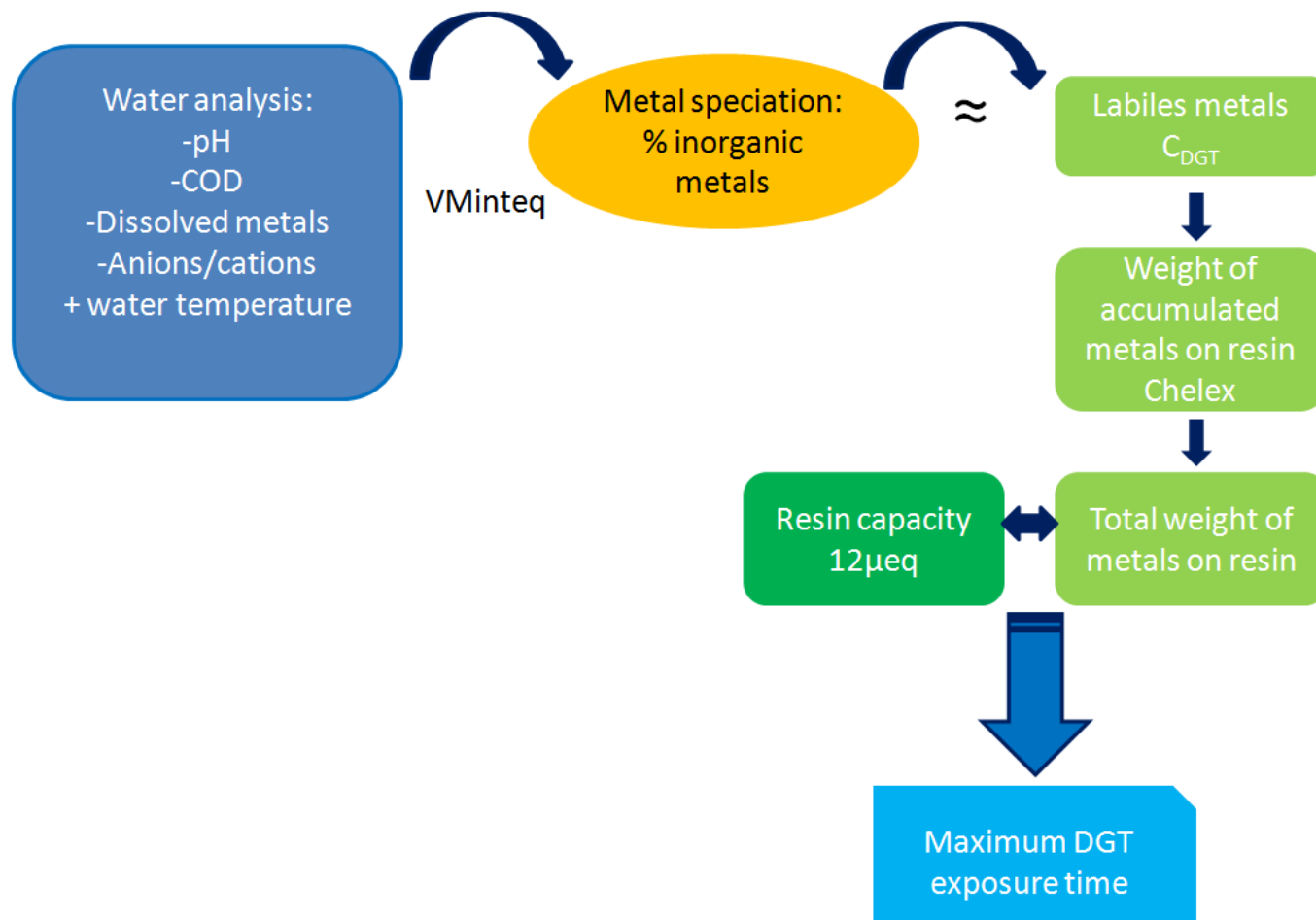
Component	% of total concentration	Species name
Fe+3	0.150	Fe(OH) ₂
	90.136	Fe(OH) ₂ +
	0.149	Fe(OH) ₃ (aq)
	3.784	FA1-Fe(III)(OH) ₂ (aq)
	3.027	FA2-Fe(III)(OH) ₂ (aq)
	0.127	HA1-Fe(III)(OH) ₂ (aq)
	2.616	HA2-Fe(III)(OH) ₂ (aq)
Mg+2	82.270	Mg+2
	0.034	MgF+
	0.039	MgCl+
	17.599	MgSO ₄ (aq)
	0.025	(OH) ₂ Mg+2(OH) ₂ (aq)
Mn+2	83.209	Mn+2
	0.014	MnF+
	0.010	MnCl+
	16.632	MnSO ₄ (aq)
	0.013	Mn(OH) ₂ (aq)

Back to main output menu Print to Excel

2) *In situ* saturation study with DGT



◆ Speciation simulation using Vminteq



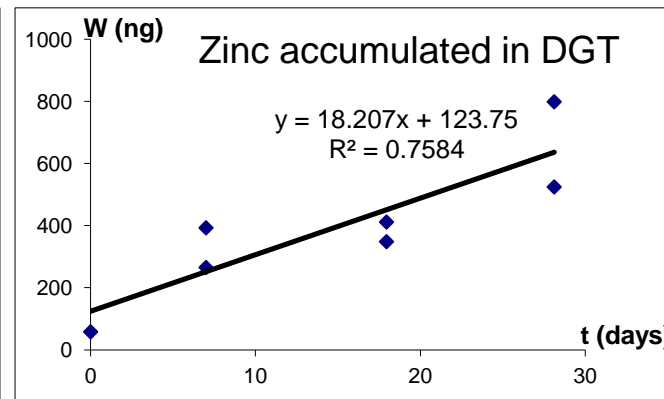
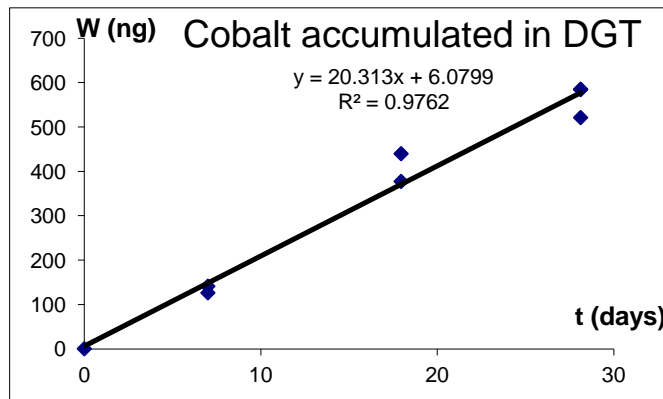
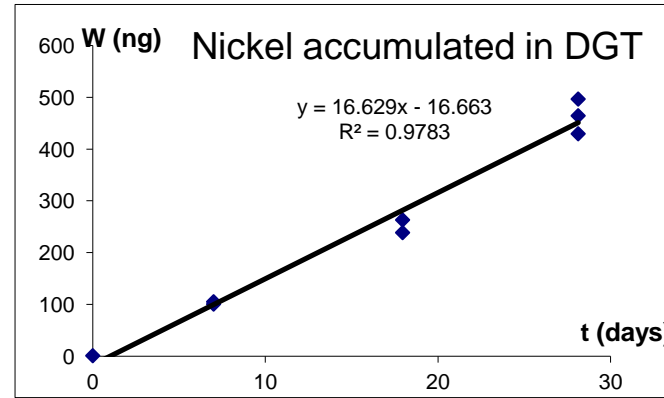
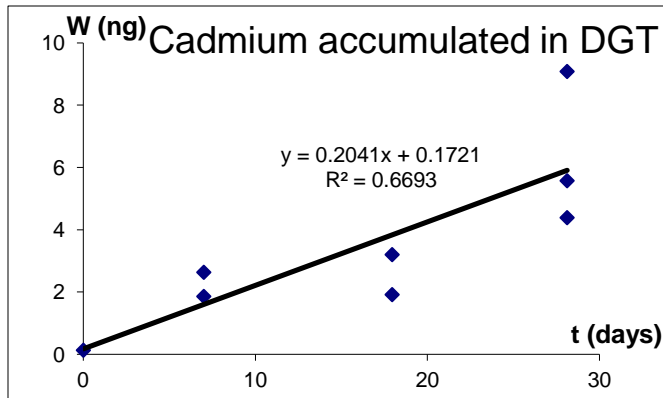
◆ Speciation simulation using software

-> Lead and Copper are more likely to be linked with organic matter : less labile

PzA ($C_{\text{metals}} = \text{mg/L}$)	DGT simulated saturation
0.78 mm diffusive gel	≈ 6 hours
1.96 mm diffusive gel	≈ 12 hours

PzB ($C_{\text{metals}} = \mu\text{g/L}$)	DGT simulated saturation
0.78 mm diffusive gel	14 days
1.96 mm diffusive gel	More than 28 days

- ◆ *In situ* DGT saturation test (1.96mm diffusive gel) in PzB for monitoring

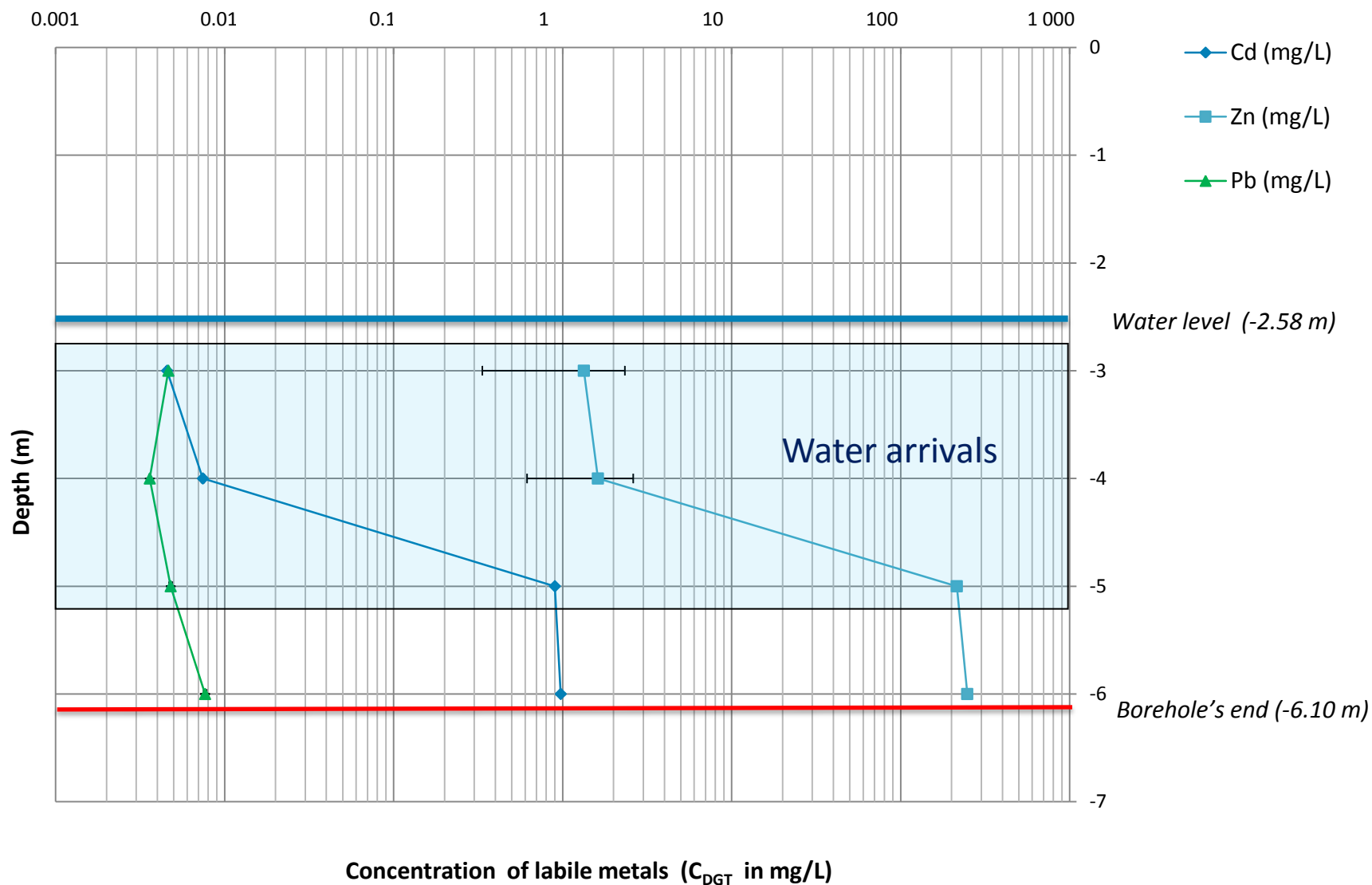


-> NO SATURATION even during 28 days

Conclusions :

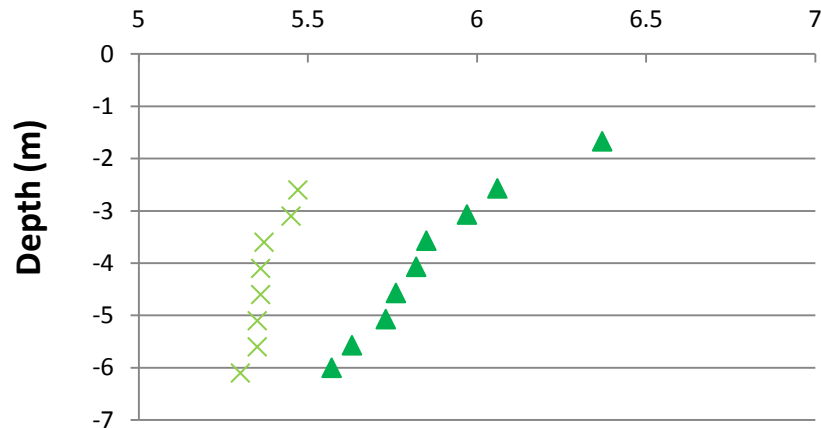
- ◆ The more thicker the diffusive gel is, the longer the DGT could stay into polluted water.
- ◆ Contaminated water with several metals $\approx \text{mg/L}$
-> exposition time for a few hours (PzA)
- ◆ Contaminated waters $\approx \mu\text{g/L}$
-> exposition time for several weeks (PzB)

- ◆ 3 questions:
 - ◇ Exposition time: how long it could be on contaminated sites?
 - ◇ ***Using DGT in groundwater: a relevant tool for vertical stratification study?***
 - ◇ DGT and grab sampling: could DGT replace successfully frequent water samples?

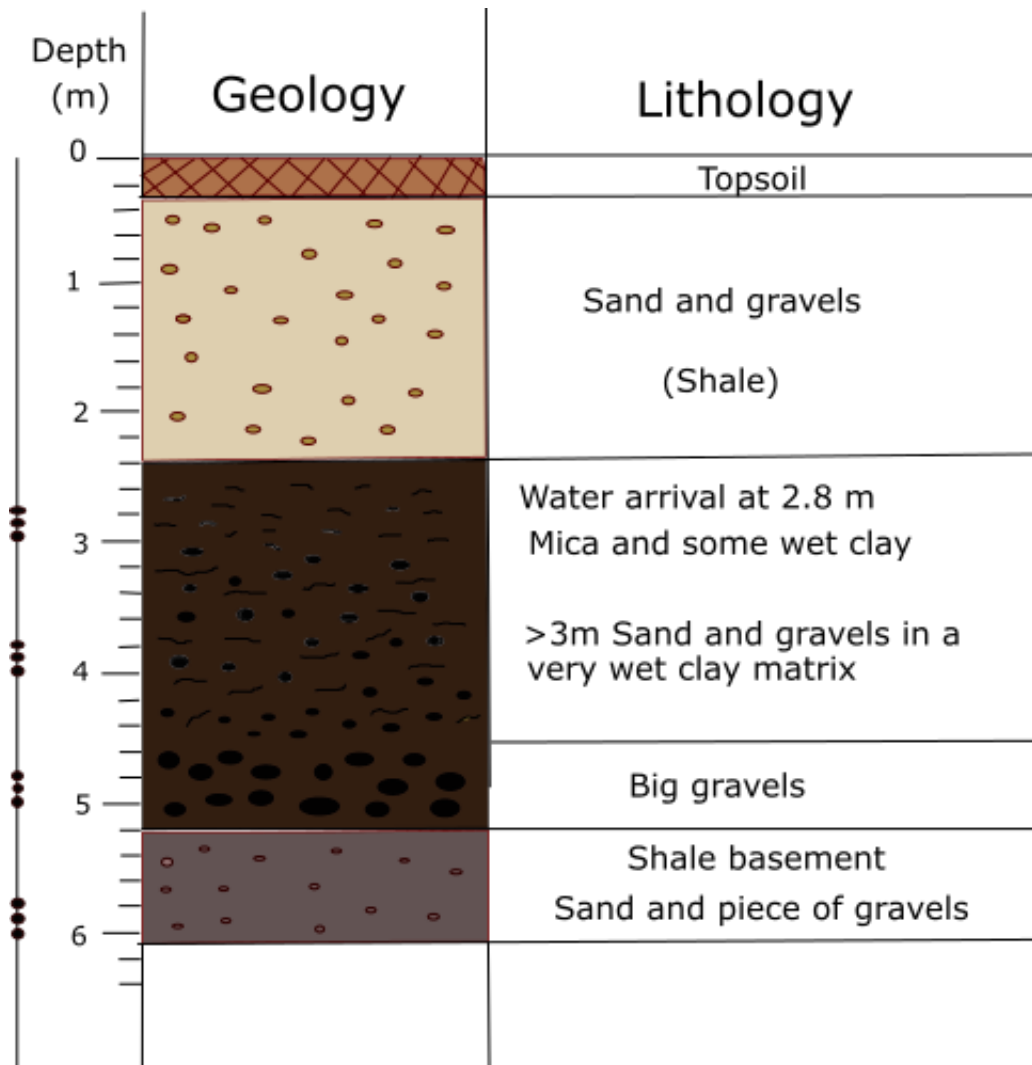


◆ Multiparameters probe

pH



Stratification in groundwater

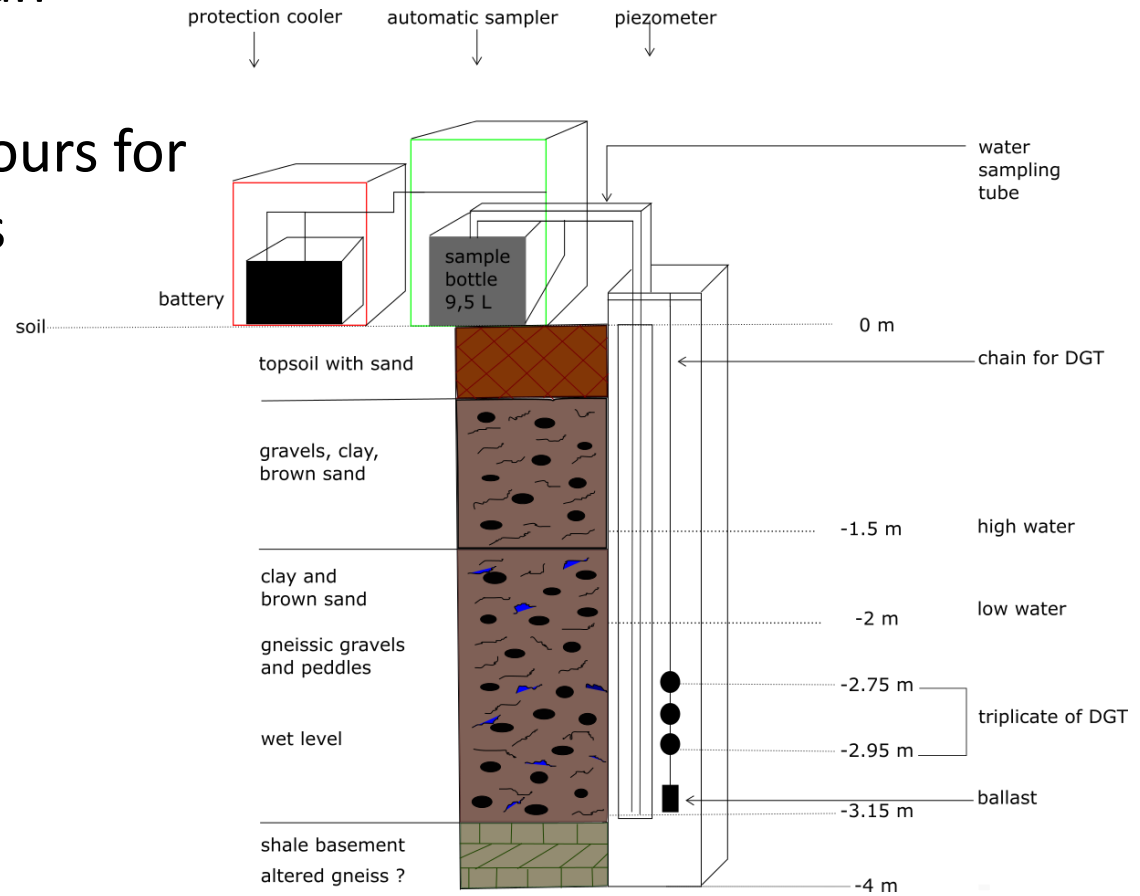


Conclusions :

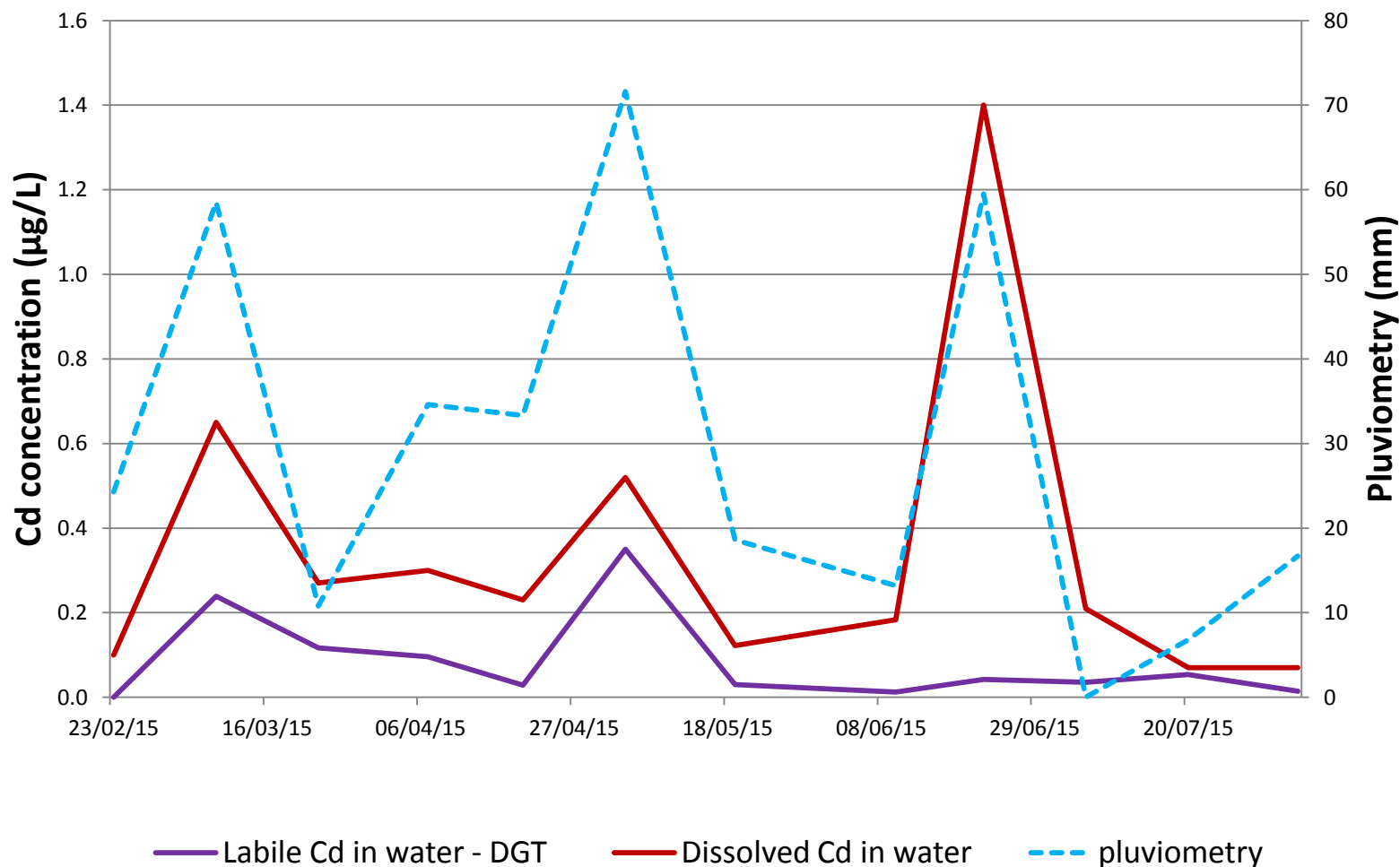
- ◆ Cohence with vertical variations of pH and conductivity measured by multi parameters probe
- ◆ Relevant vertical profile of metals using DGTs

- ◆ 3 questions:
 - ◇ Exposition time: how long it could be on contaminated sites?
 - ◇ Using DGT in groundwaters: a relevant tool for vertical stratification study?
 - ◇ ***DGT and grab sampling: could DGT replace successfully frequent water sampler?***

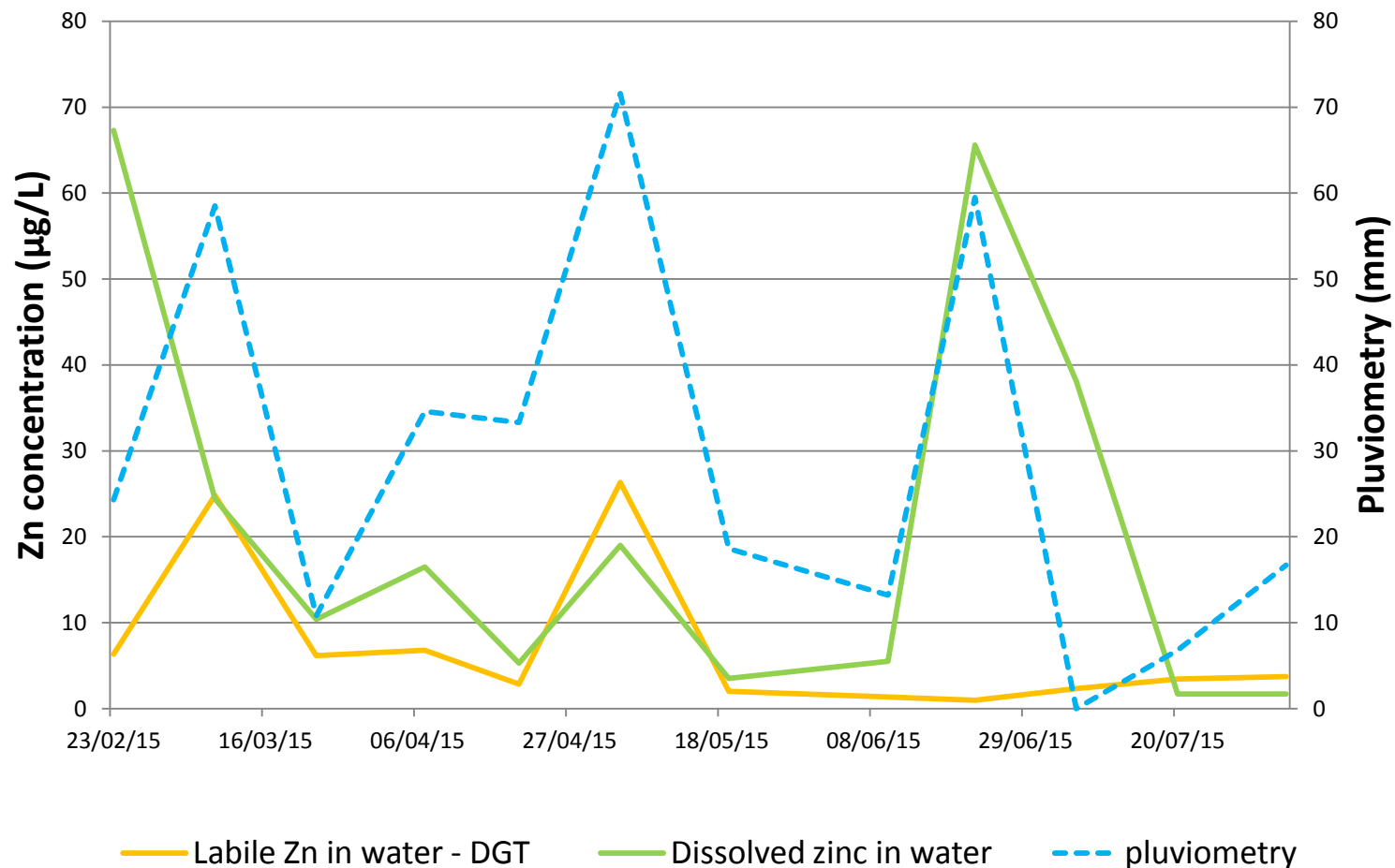
DGTs and installation of an automatic sampler :
water samples every 6 hours for 2 weeks during 6 months



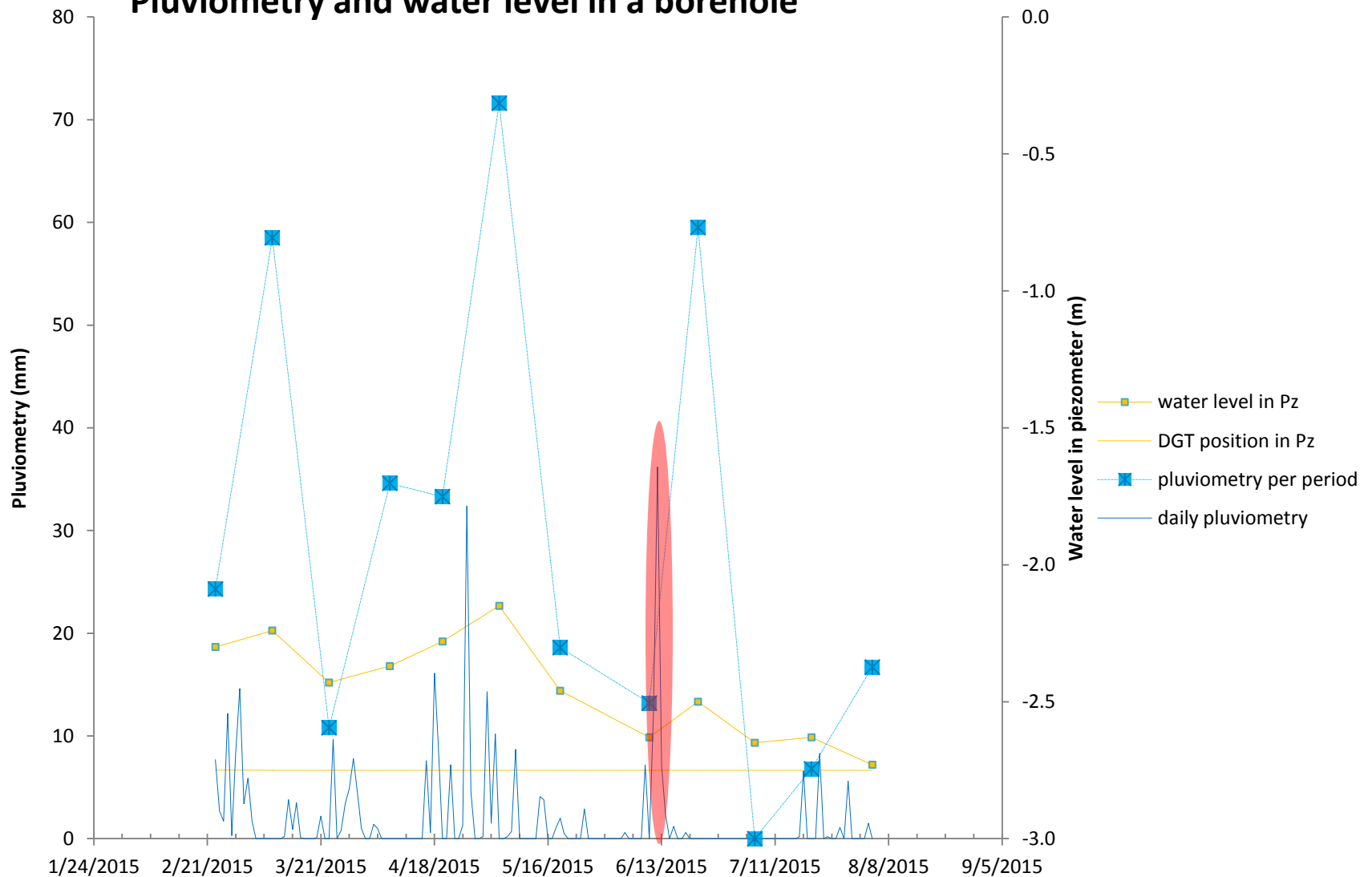
Cadmium evolution in a borehole



Zinc evolution in a borehole



Pluviometry and water level in a borehole



Conclusions :

- ◆ Global good correlation between labile metals concentration with DGT and dissolved metals by analysis
- ◆ Specific reaction during short rainfall: metals are dissolved but not labiles (hypothesis to be confirmed)
- ◆ Advantage of DGT: the LOQ is lower for DGT (integrative samplers)

- ◆ Recall of the 3 questions:
 - ◇ Exposition time: how long it could be on contaminated sites?
 - > weeks in contaminated waters ($\mu\text{g/L}$) versus hours in very high contaminated water (mg/L)
 - ◇ Using DGT in groundwater: a relevant tool for vertical stratification study?
 - > Stratification study : good vertical correlation with multi parameters log



- ◇ DGT and grab sampling: could DGT replace successfully frequent water samples?
 - > DGT versus water analysis : coherent results between dissolved metals and labiles metals concentrations but maybe different reactions when short and intense rainfall.



-> The DGT is a useful integrative sampler which can be used for vertical profile in underground water or monitoring even on contaminated sites!



Contact: MINELIS – Ségolène MAGHE-CHAUVIN

segolene.chauvin@minelis.com

☎ 05.61.16.54.71