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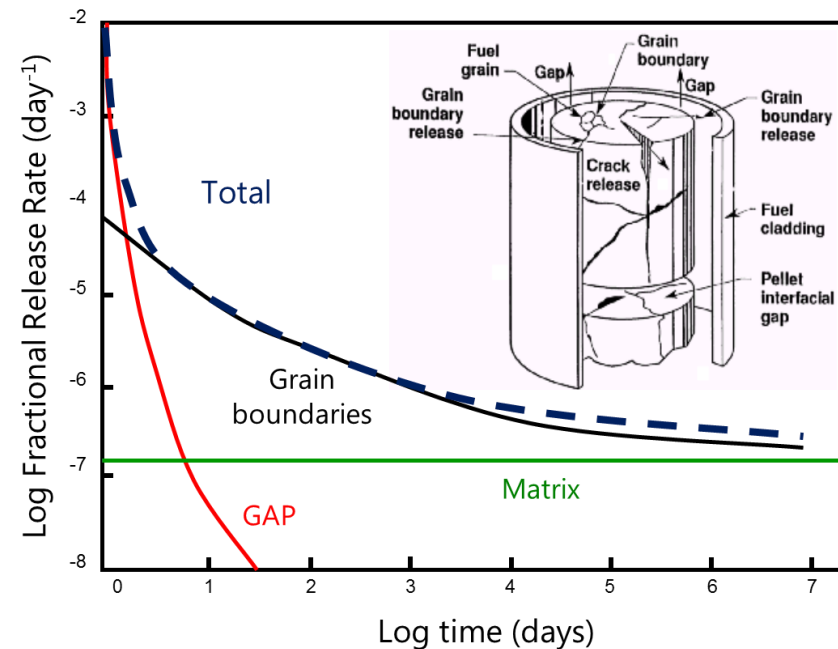
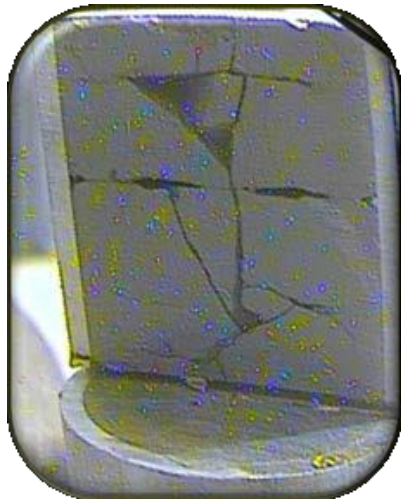
High Burnup Spent Fuel dissolution under highly alkaline conditions

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Objective

- Study the stability of the Spent Nuclear Fuel in highly alkaline conditions
 - **Influence of high pH, Ca and Si**



Experimental

SNF sample

BIC



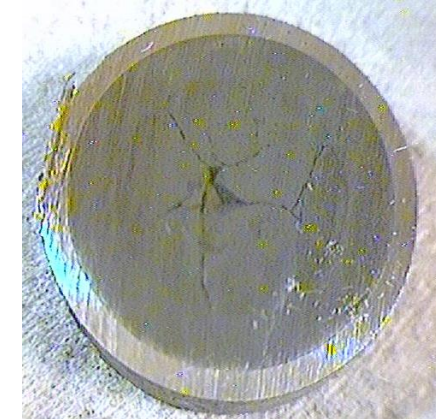
HpH



Ca



Si

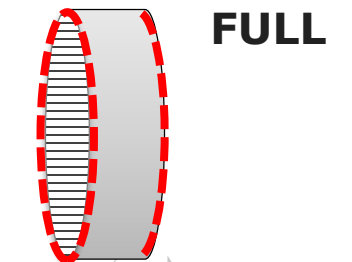
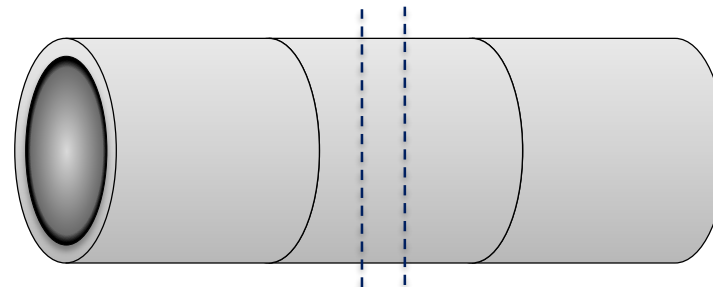
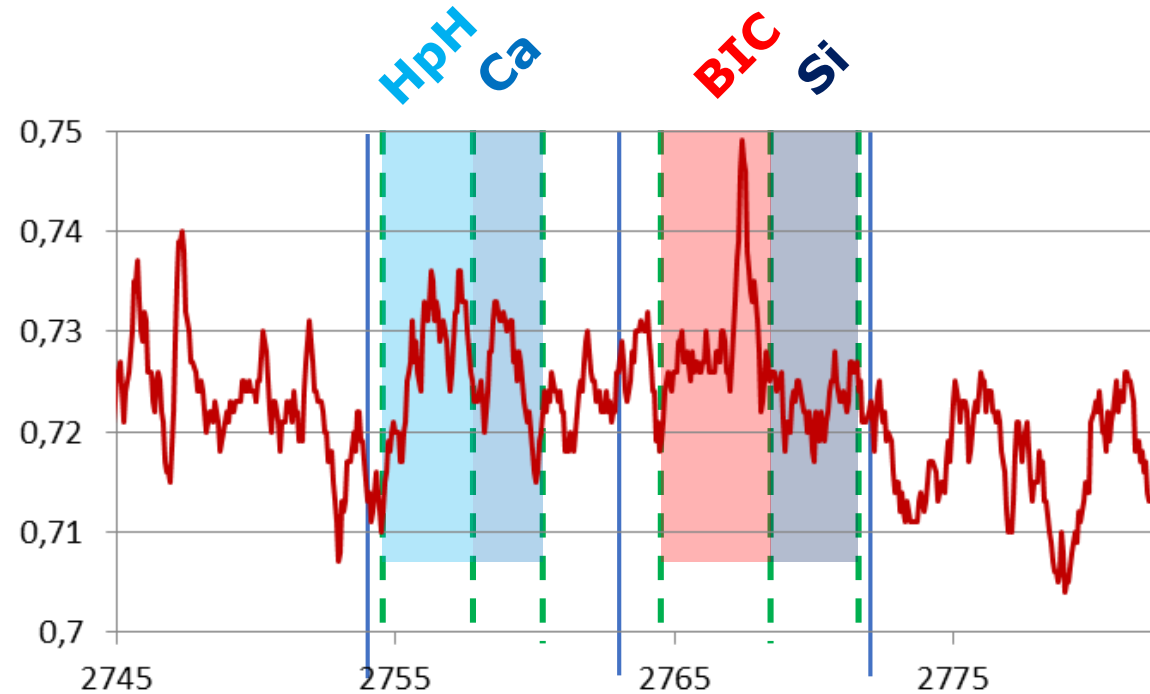
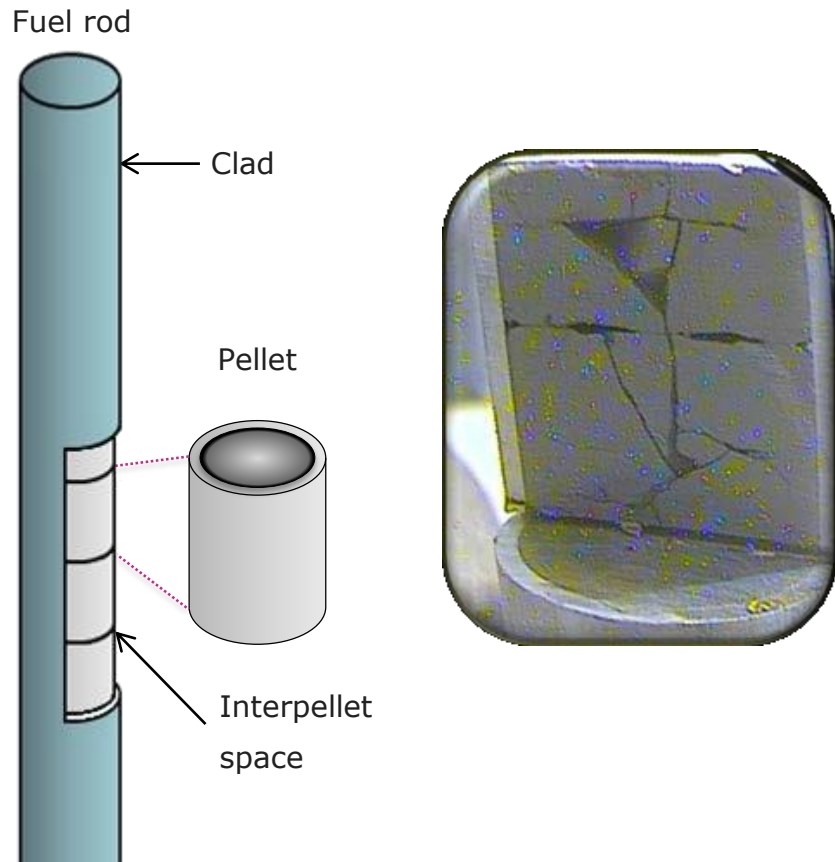


	Na (M)	Cl (M)	Ca (M)	Si (M)	CO ₃ ²⁻ (M)	pH
BIC	0.02	19E-03	-	-	1E-03	8.4
HpH*	0.47	-	-	-	1E-03	13.2
Ca*	0.47	-	6E-04	-	1E-03	13.2
Si*	0.47	-	6E-04	3E-04	1E-03	13.2

*Composition based in Young Cement Water agreed with DisCo partners

Experimental

SNF sample preparation



Experimental

SNF characteristics

Cladded Segment	BIC	HpH	Ca	Si 
Length (mm)	4.3 ± 0.1	3.5 ± 0.1	2.3 ± 0.1	2.9 ± 0.1
Segment weight with cladding (g)	3.541 ± 0.001	2.768 ± 0.001	1.727 ± 0.001	2.340 ± 0.001
Segment weight without cladding (g)	2.62 ± 0.05	2.10 ± 0.05	1.31 ± 0.05	1.78 ± 0.05
Diameter without cladding (mm)	9.1 ± 0.1			
Surface area (mm ²)	456 ± 10			
S/V (mm ⁻¹)	9.1 ± 0.2			
Reactor	PWR			
FGR (%)	13.6			
Local burn-up (GWd(THM) ⁻¹)	73			
Av. Linear Power Density (W cm ⁻¹)	255			
Grain size (μm)	6.4			

Experimental

Experimental conditions

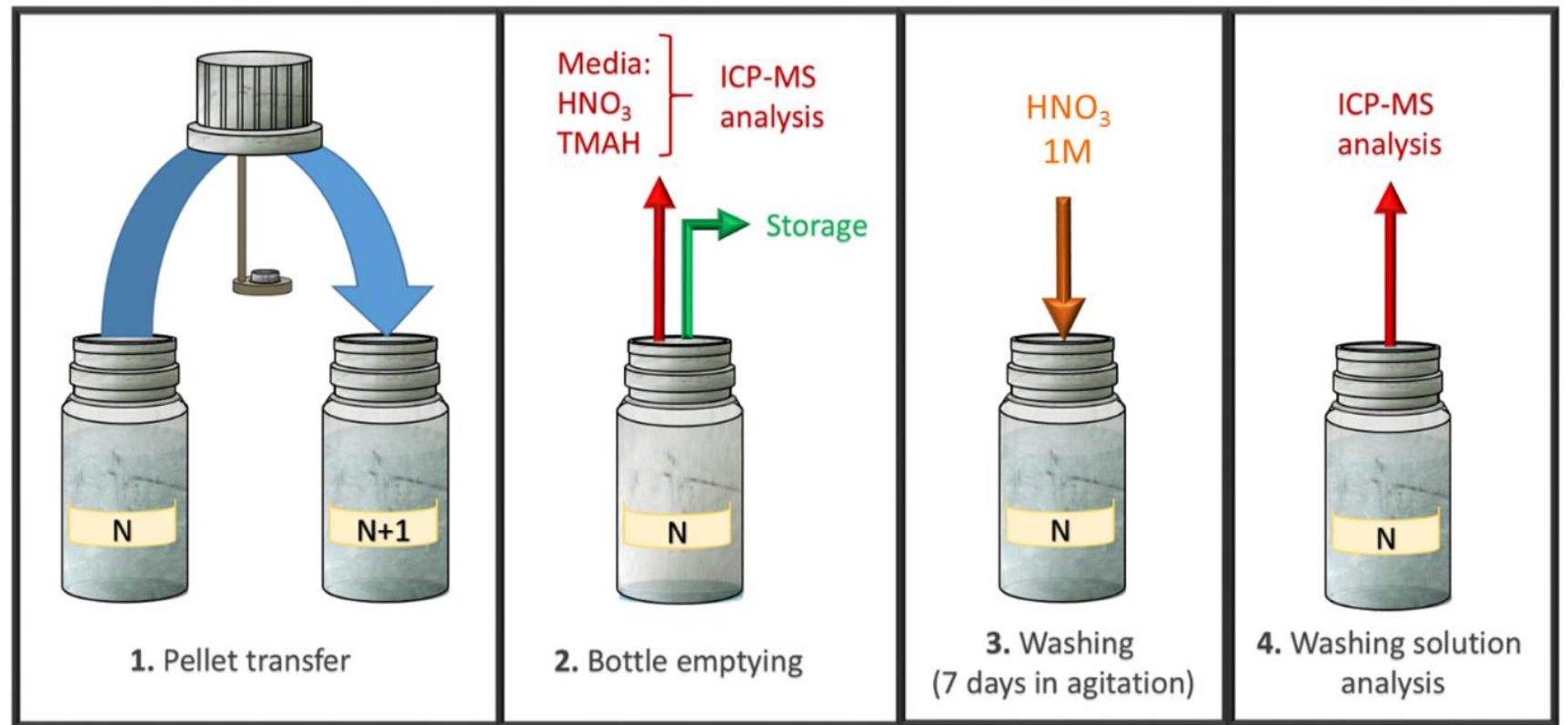
- Volume: 50 ± 1 ml
- T: $25 \pm 5^\circ\text{C}$
- Complete replenishments



PEEK sample holder

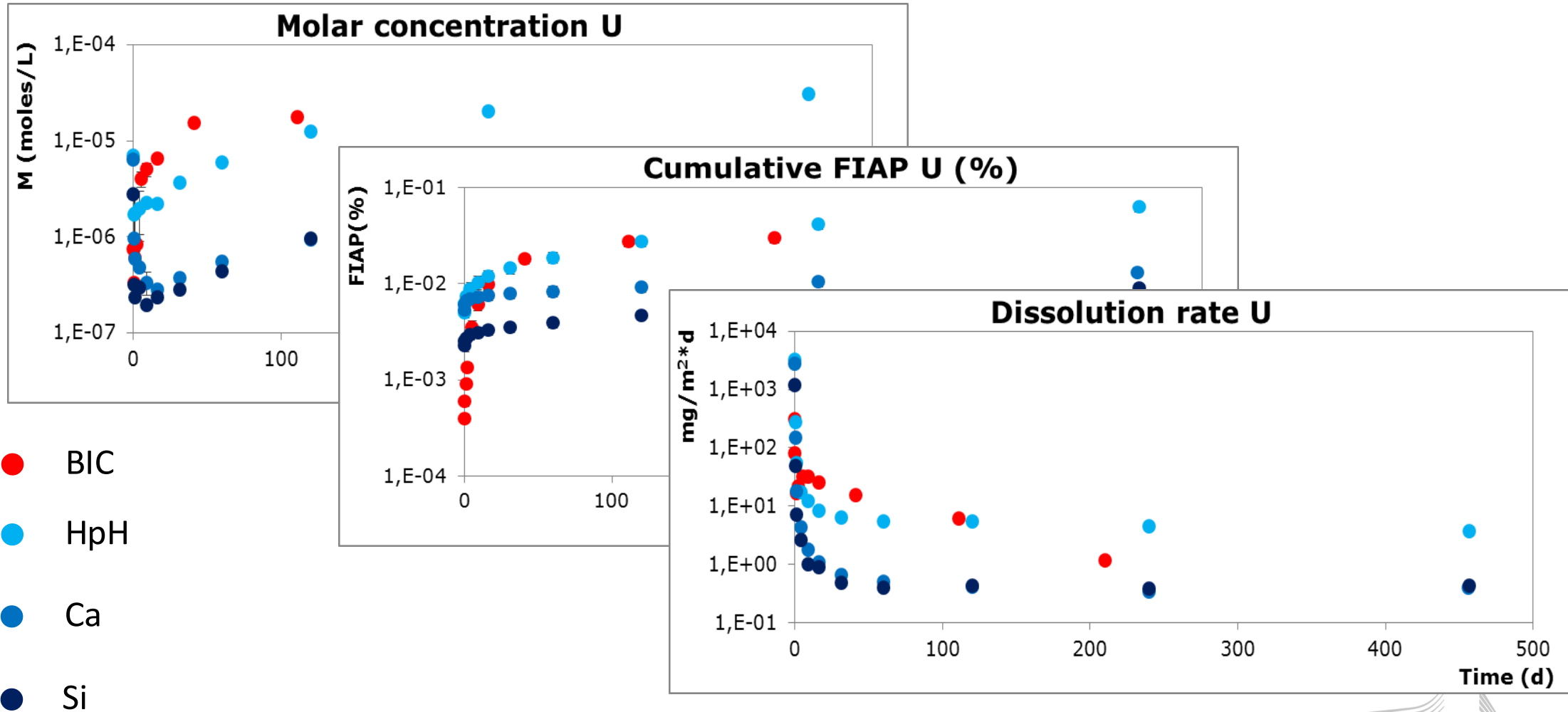


Orbital stirrer



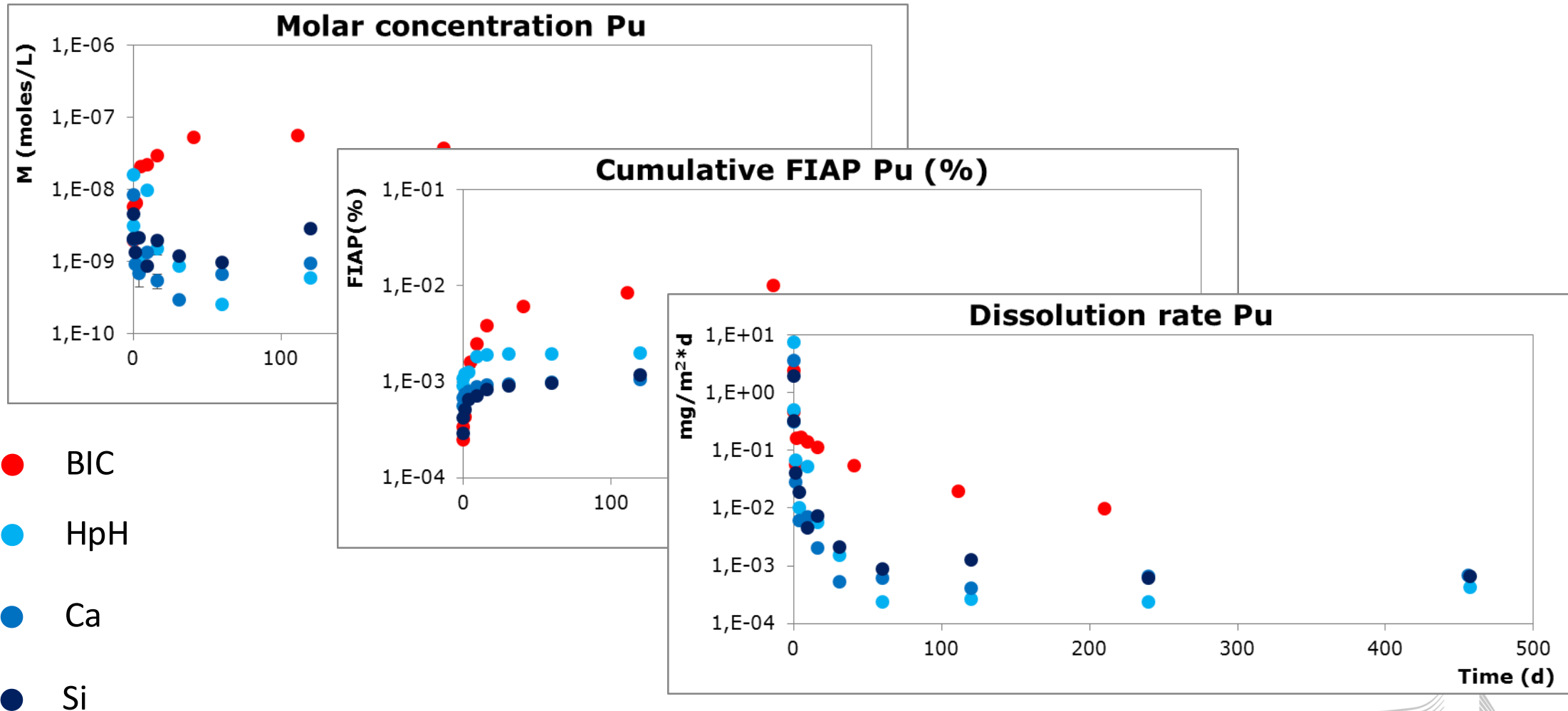
Results

Uranium



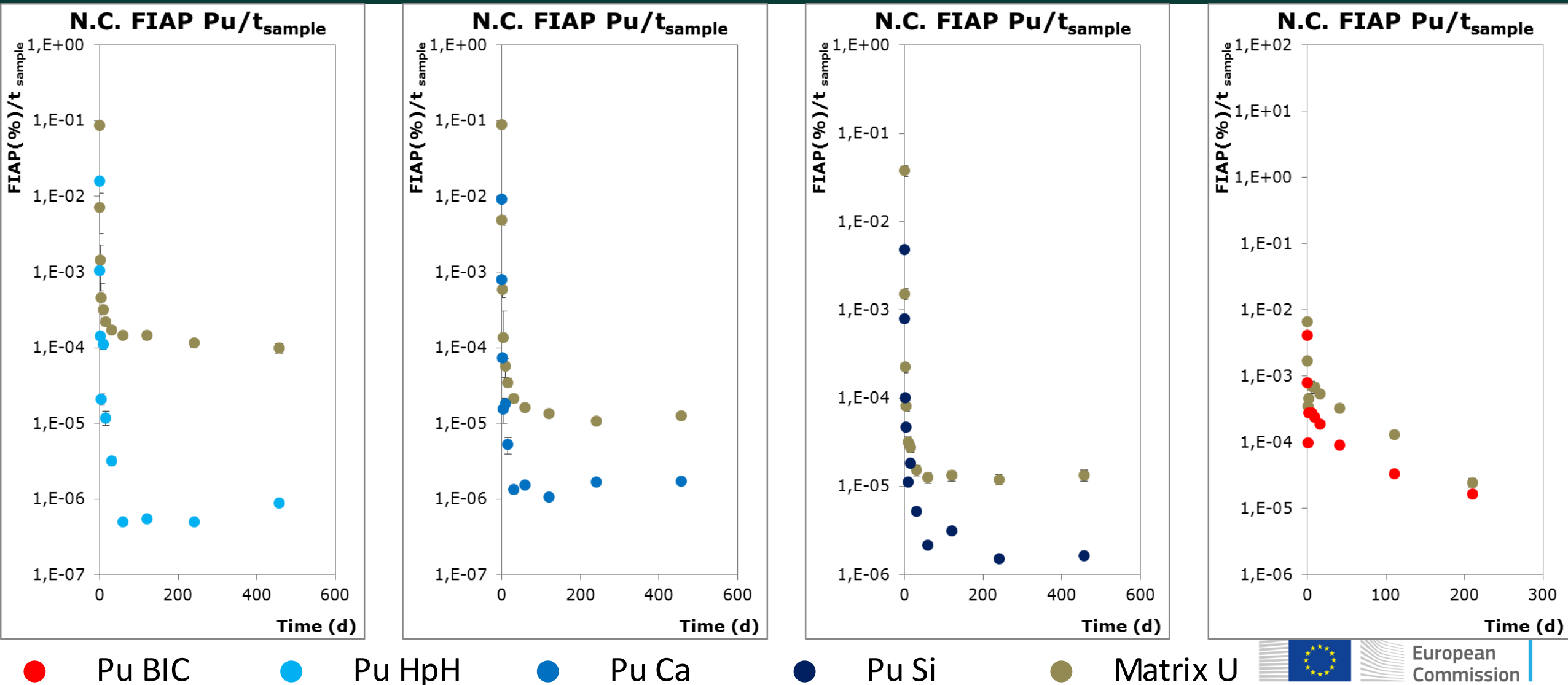
Results

Plutonium (Ln /An)



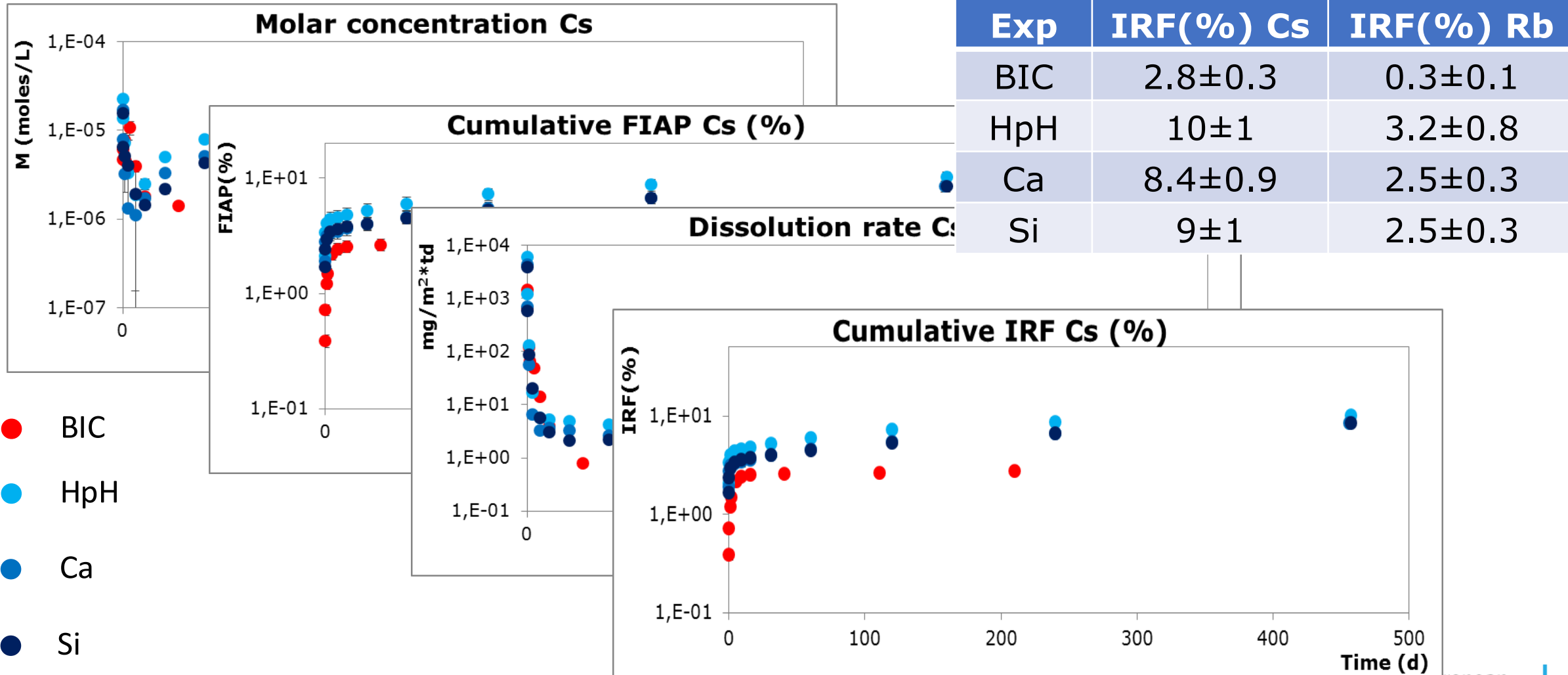
Results

Plutonium (Ln /An)



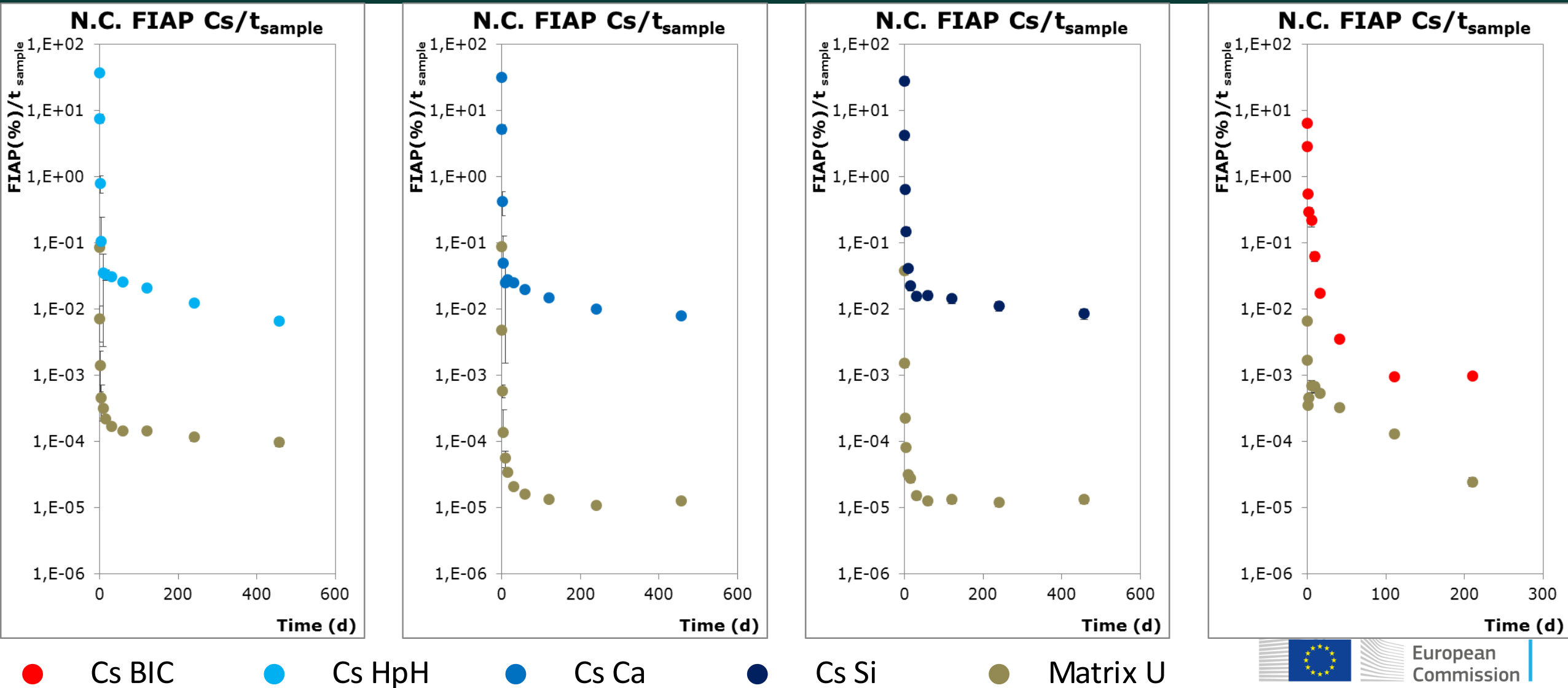
Results

Cesium (Rubidium)



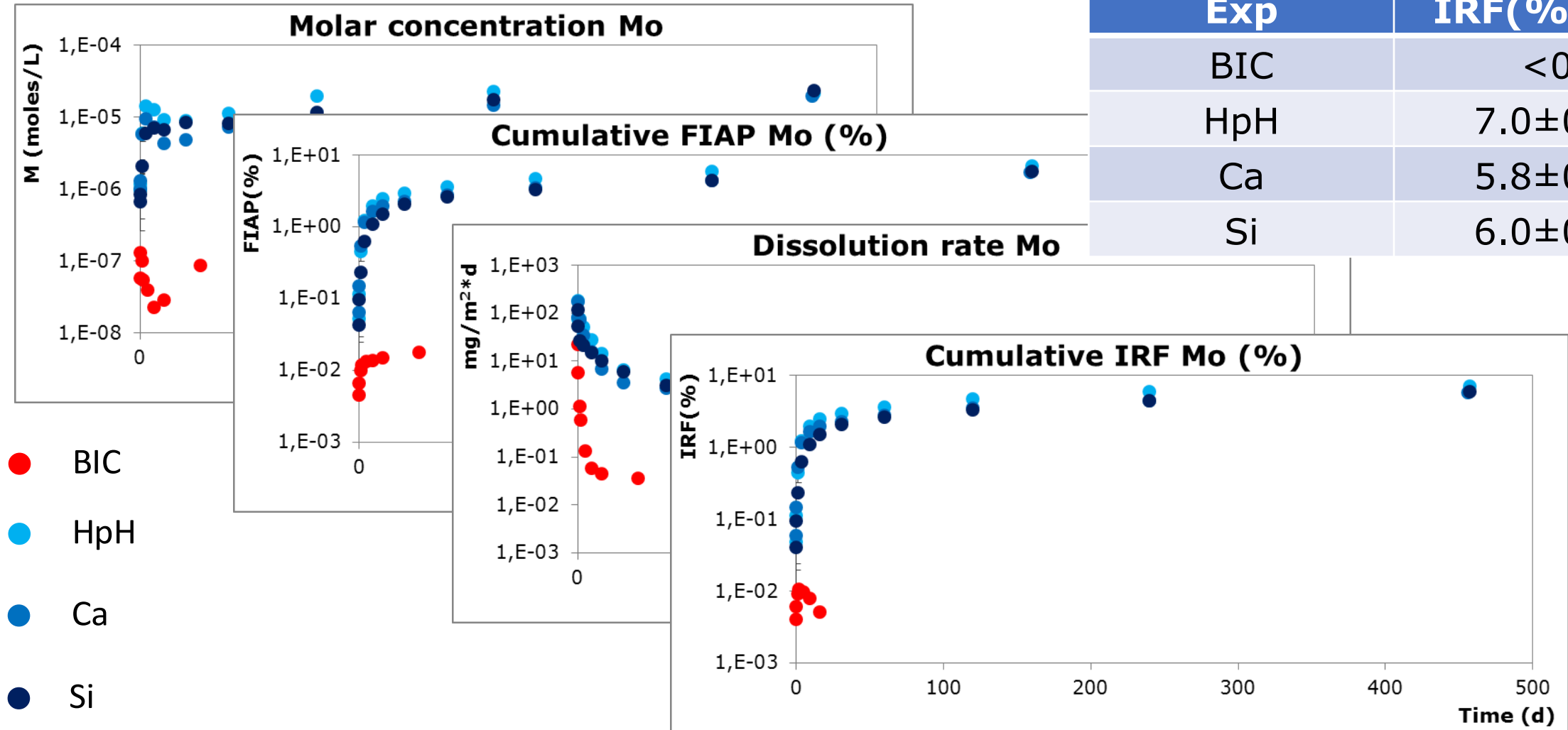
Results

Cesium (Rubidium)



Results

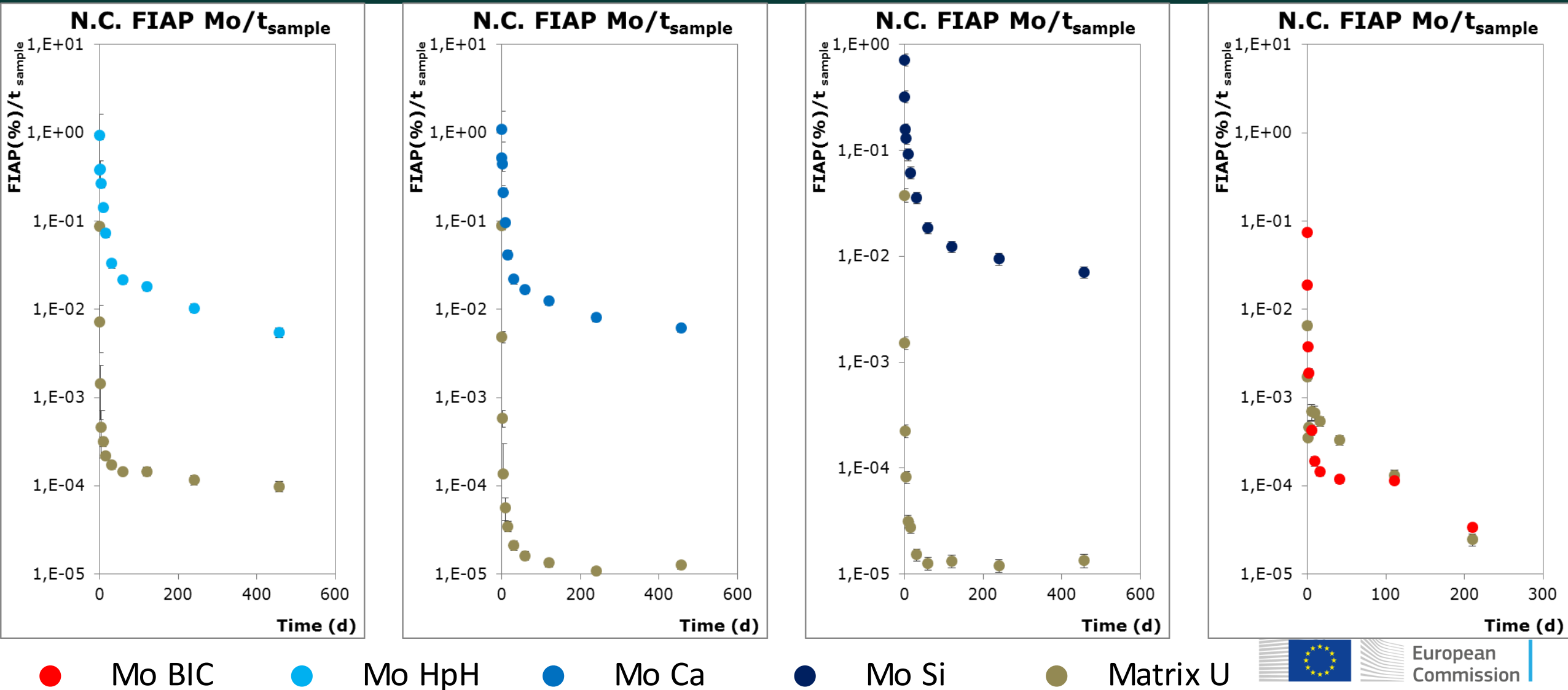
Molybdenum



Exp	IRF(%) Mo
BIC	<0
HpH	7.0 ± 0.3
Ca	5.8 ± 0.2
Si	6.0 ± 0.3

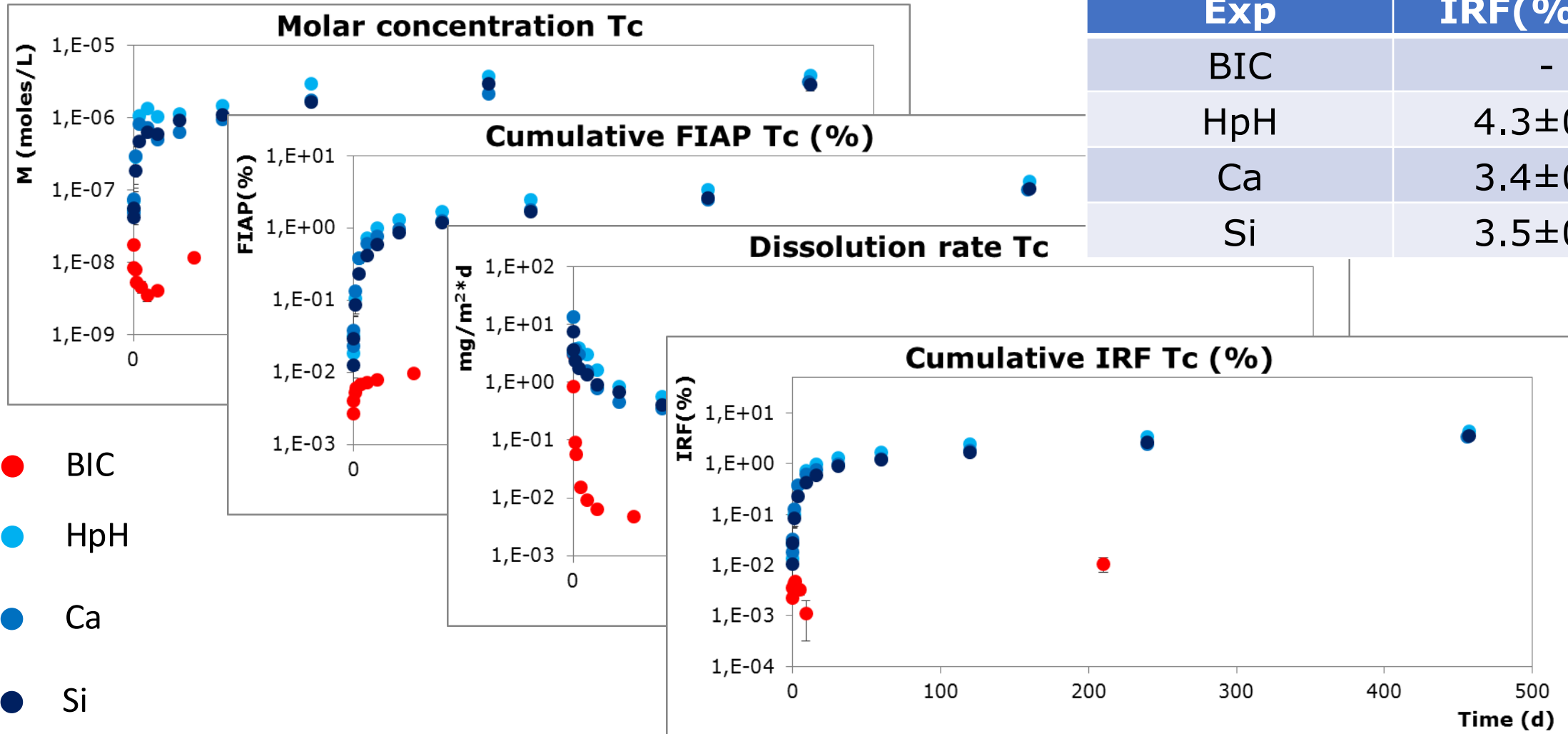
Results

Molybdenum



Results

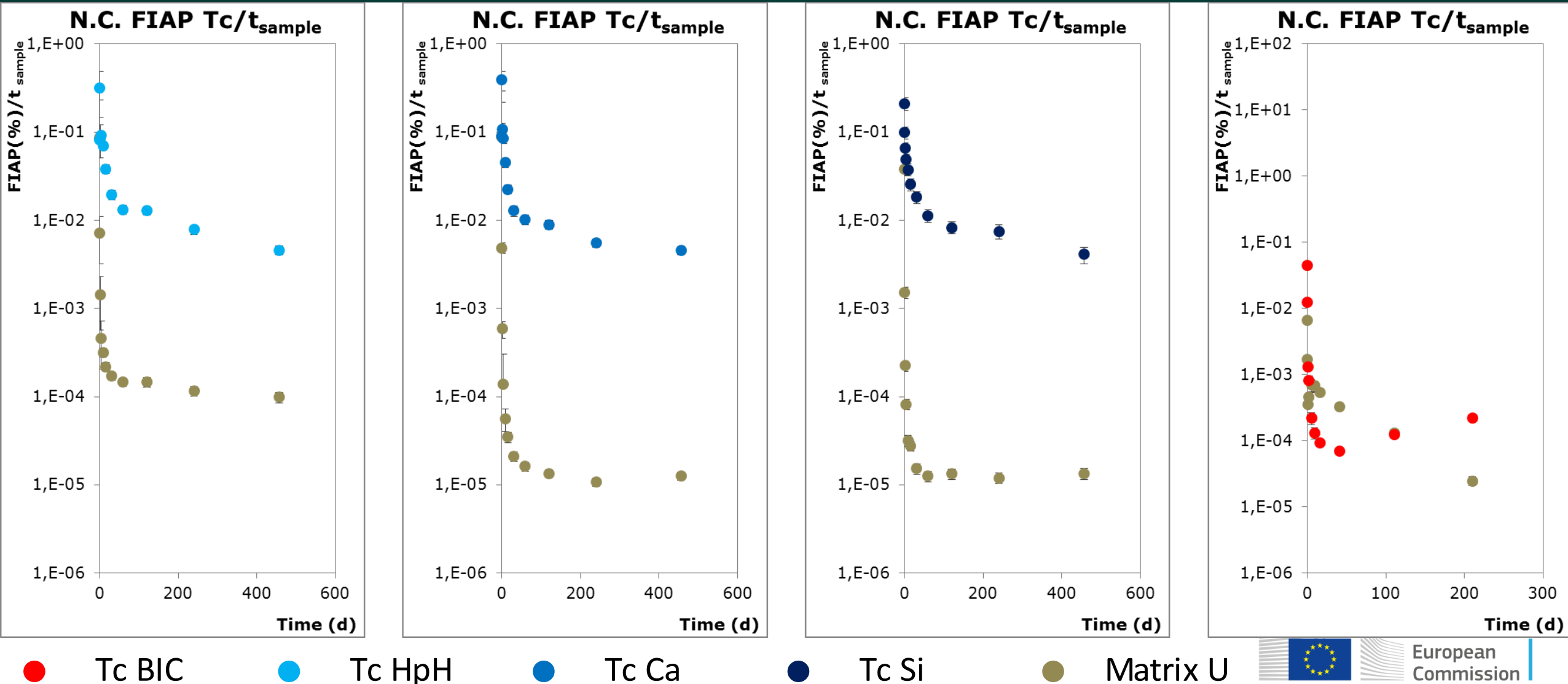
Technetium



Exp	IRF(%) Tc
BIC	-
HpH	4.3±0.2
Ca	3.4±0.2
Si	3.5±0.3

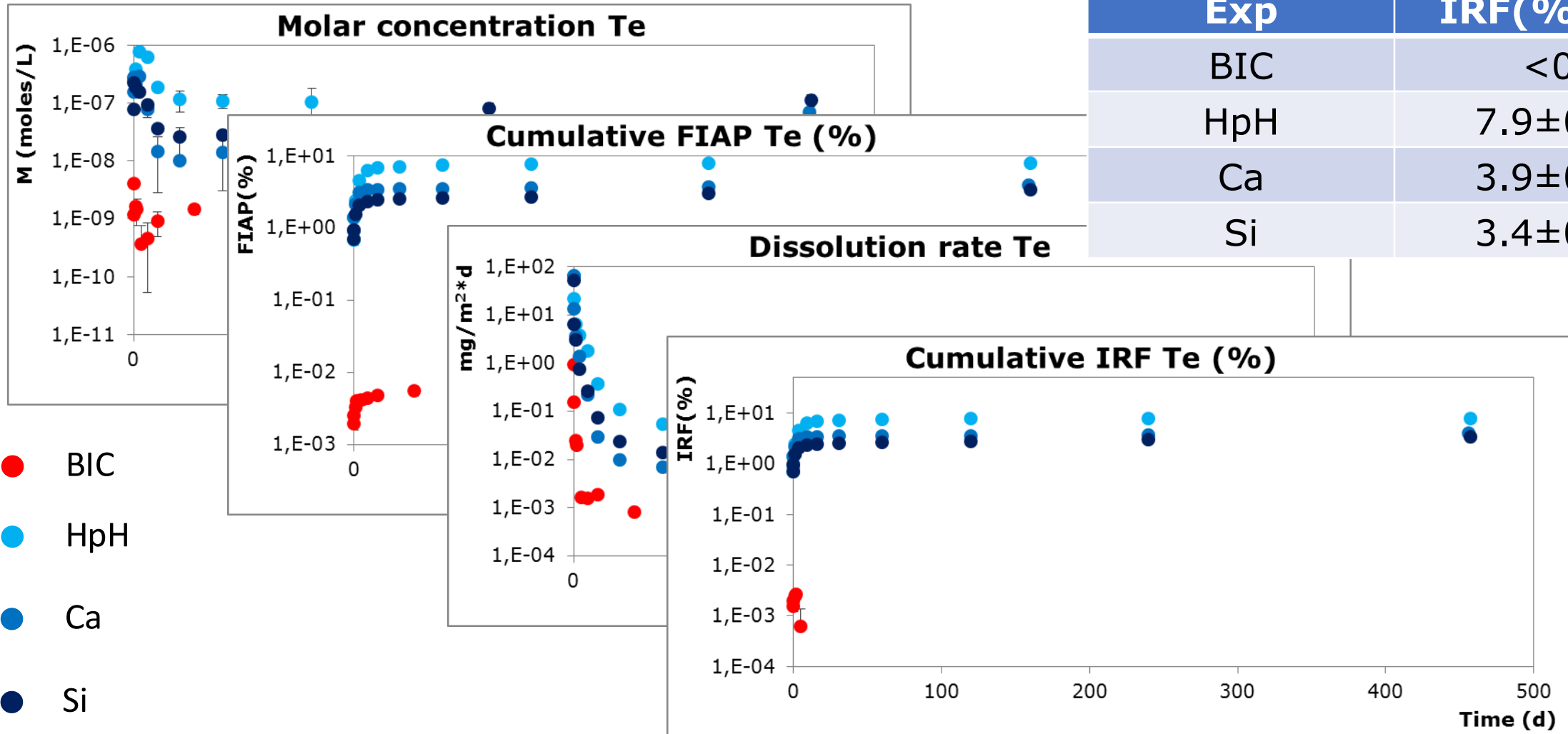
Results

Technetium



Results –Tellurium

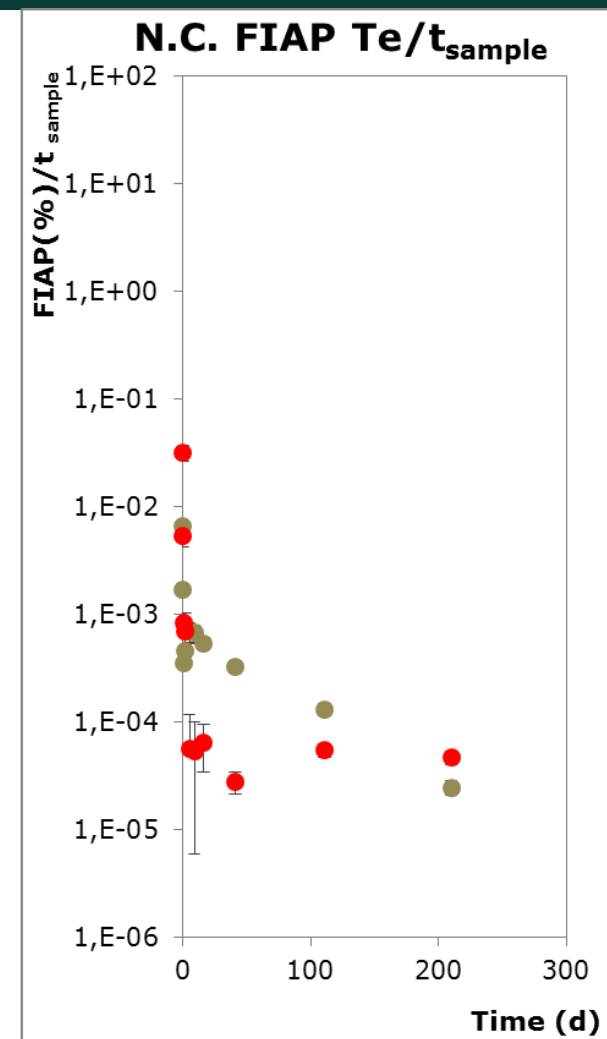
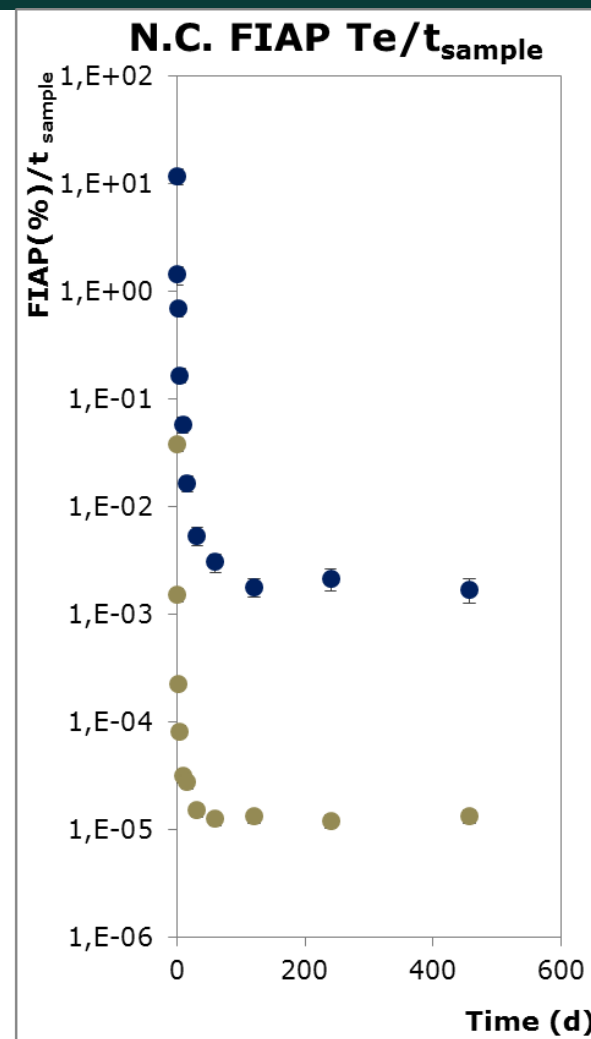
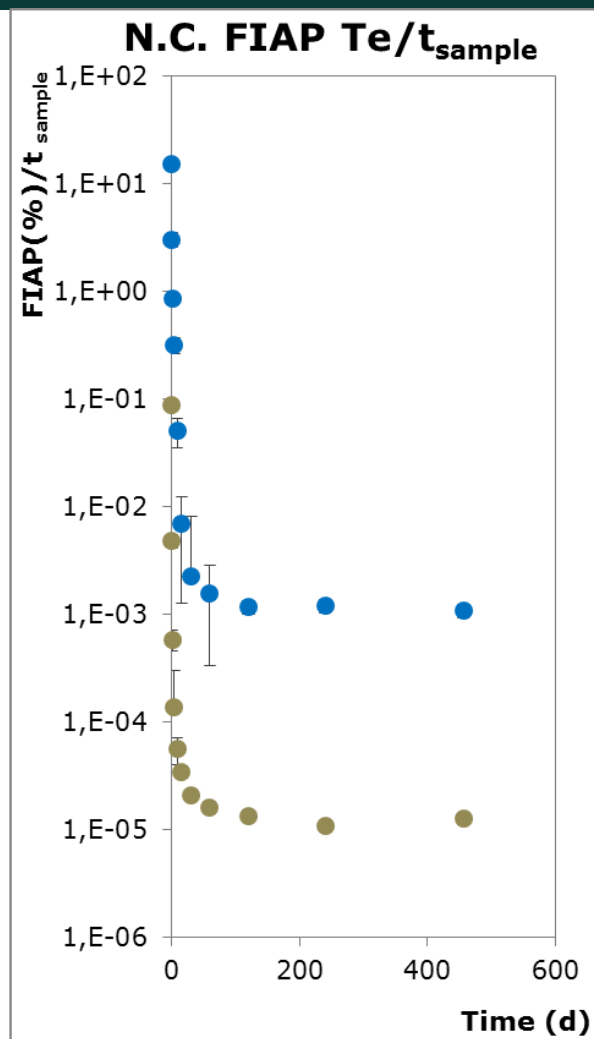
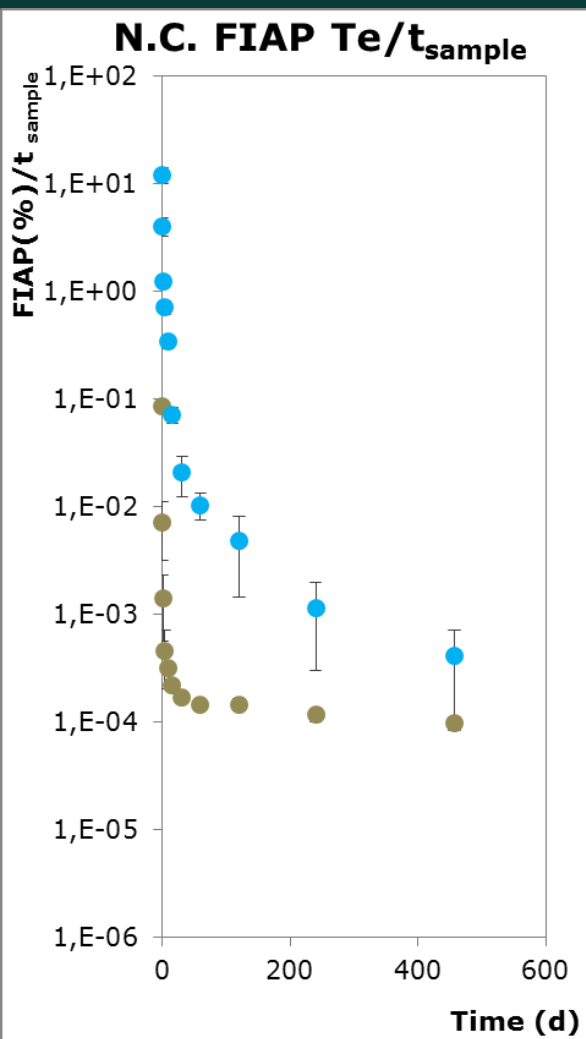
Tellurium



Exp	IRF(%) Te
BIC	<0
HpH	7.9 ± 0.5
Ca	3.9 ± 0.3
Si	3.4 ± 0.2

Results –Tellurium

Tellurium



Te BIC



Te HpH



Te Ca



Te Si



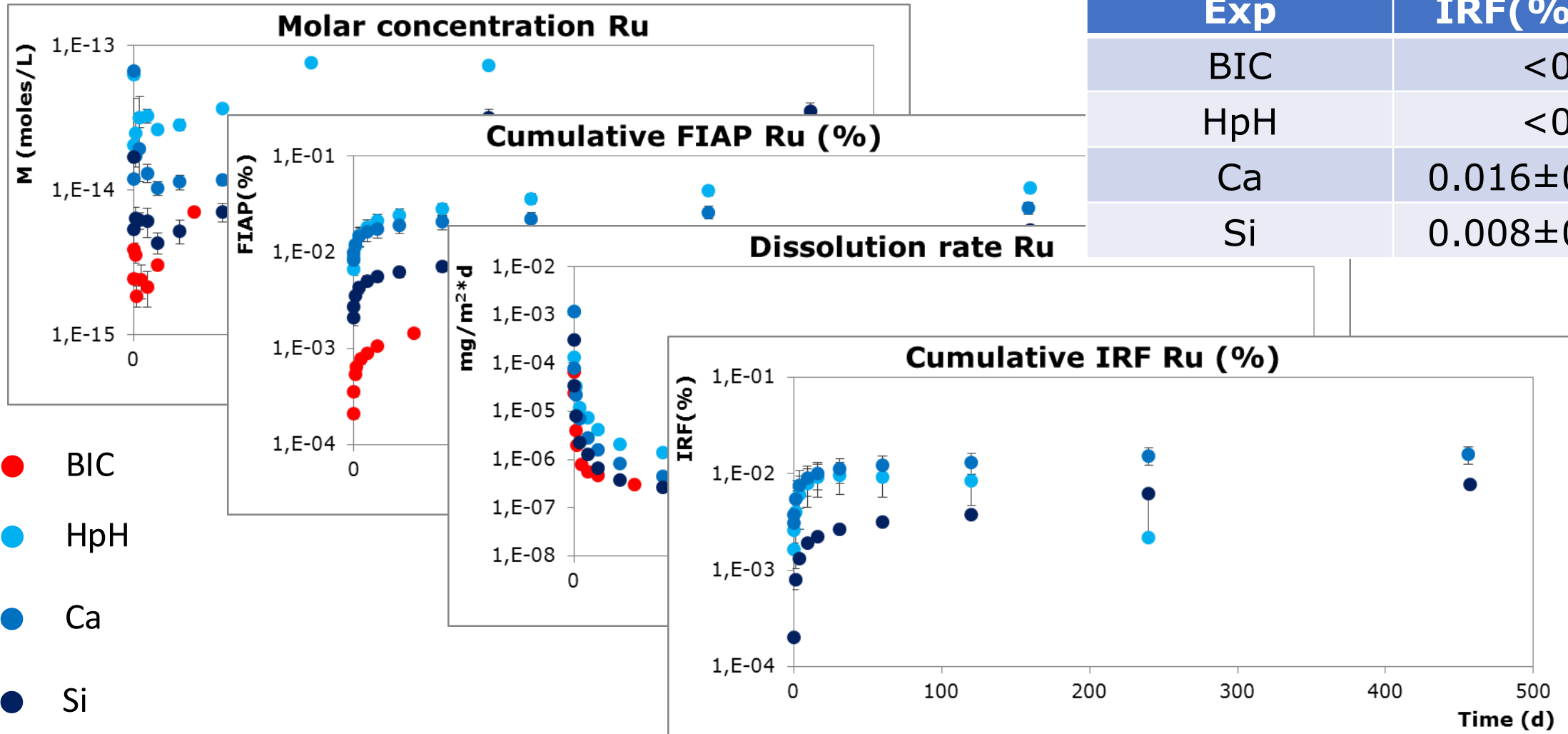
Matrix U



European
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Results – Ruthenium

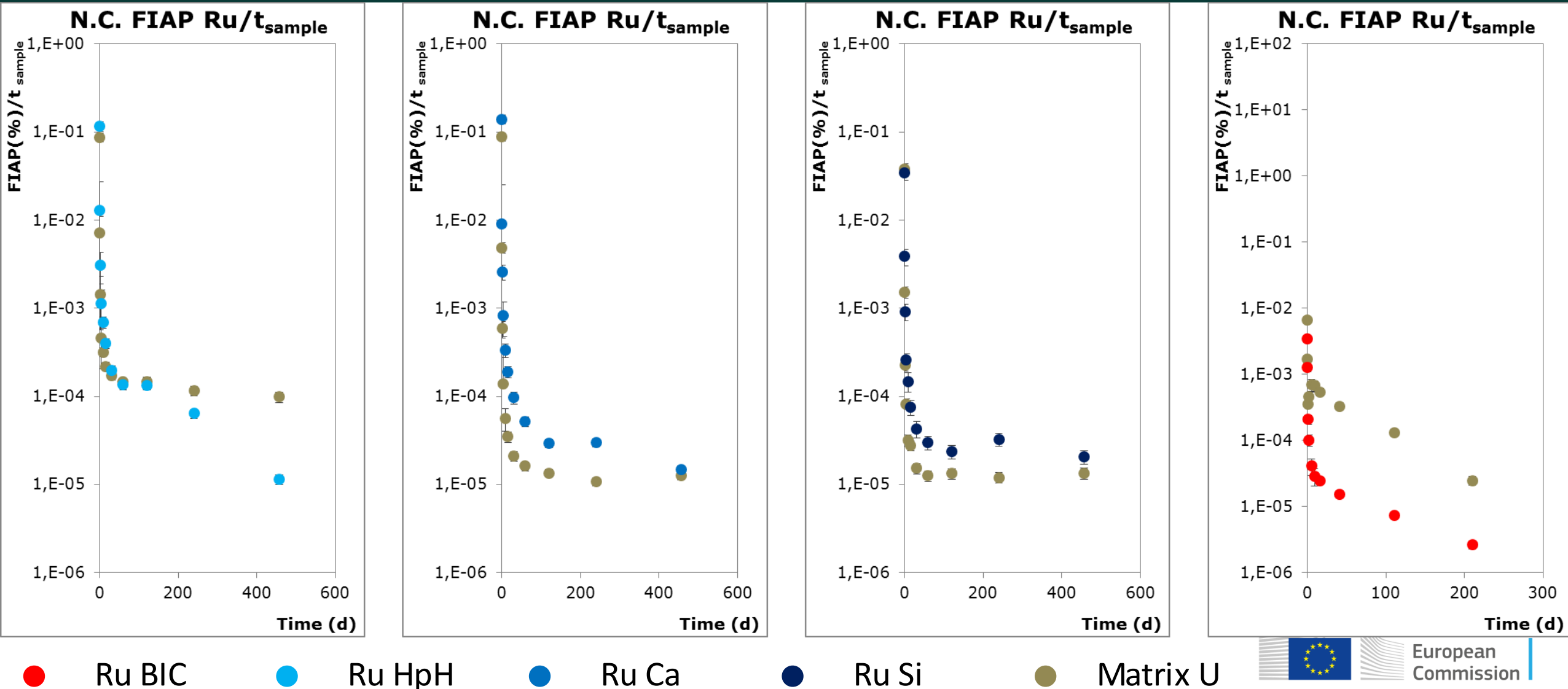
Ruthenium



Exp	IRF(%) Ru
BIC	<0
HpH	<0
Ca	0.016 ± 0.003
Si	0.008 ± 0.001

Results – Ruthenium

Ruthenium



Conclusions and Outlook

- In comparison to results in ground water, the presence of Ca and Si significantly reduces U release, supporting previously reported passivation effects [1]
- The higher pH also reduces actinide and lanthanide release
- The higher pH enhances Mo, Tc, Te and Ru release
- Complementary speciation analysis, SEM, Raman and modelling
- Experiments under reducing conditions



[1] PhD Alexandra Espriu (Chapter 3): *Study of 3% at. doped SIMFUEL corrosion at hyper-alkaline conditions in contact with silicate and calcium*



Any questions?

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