

Mapping programme in Sweden: Ensuring the quality and traceability of the geochemical data



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Geochemistry at SGU



Two major activities:

1. Geochemical mapping (till, sediments, topsoil, water, water plants, peat, moss, rocks)
2. SGU Laboratory: ICP MS, pH, accredited earlier for water and till
3. We follow rules for accredited laboratories according to the SWEDAC Authority 'Swedish Board for Accreditation and Conformity Assessment regulations' ([Swedac - En myndighet för kvalitet och säkerhet](#))

At the moment we are 7 staff members:

Anna, Merita, Mateja, Patrick, George, Mattias, Karl-Markus



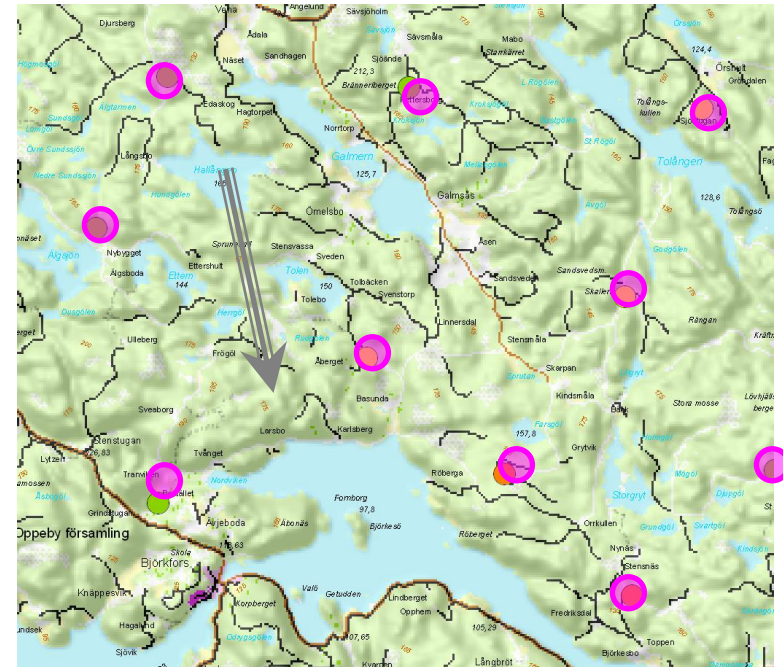
Sampling density 1 sample/7 km²

C-horizon (0.6-1.0 m)

ICP-MS (Aqua Regia): >20 000

ICPMS (7MHNO₃): >24 000

XRF: >28 000



10 km

Ice direction

sediment/soil



- Ongoing 1982 to 2005
- Analytical methods XRF (tot. conc.)
- ICP-MS (7M HNO₃ and AR)

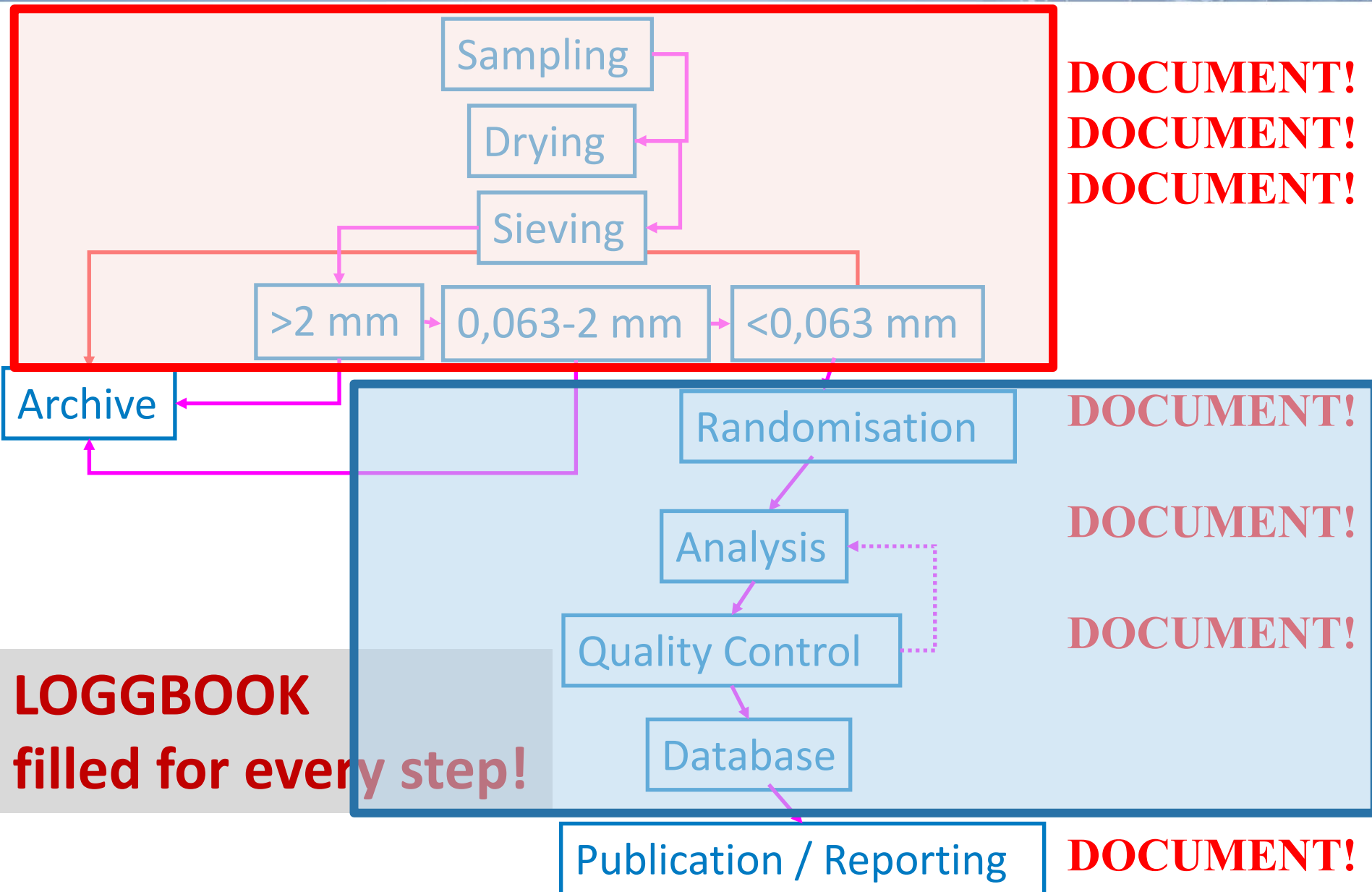
**SGU has ca 35 000
biogeochemical analyses
in database**



*Carex*¹
*Filipendula ulmaria*²
*Fontinalis antipyretica*³

Regional method: 1 sample/6-7 km²

Al, Au, As, Bi, Ba, Co, Cr, Cu, Fe, Hg, K,
Mg, Mn, Mo, Na, Ni, P, Pb, Rb, S, Sb, Cd,
Si, Sr, Se, Ti, U, V, W, Y, Zn, Zr
pH





Provtagningsprotokoll – regional markgeokemisk kartering
Sveriges Geologiska Undersökning, Uppsala. Tel: 018 – 17 9

Serienr: 201849		Löpnr _____		Kartblad _____
Koordinater GPS:		X _(NS) : _____		Y _(EW) : _____
Provdjup _____ cm		B-hor (cm) _____		B/C-hor (cm) _____
Jordart:	–Grusig morän		–Sandig morän (normal)	
	–Siltig morän		– _____	
Egenfärg:	–Grå		–Brungrå	
	–Gråbrun		– _____	
Dränering:	–Dränerat	–Icke dränerat	–Tidvis dränerat	
Bergarter:	–Surt	–Basiskt	– _____	
Jordmån:	–Podsol	–Brunjord	–Kulturljord	
Veget.:	–Barrskog	–Blandskog	–Lövskog	–Öppen mark
	– _____		– _____	
Terräng:	–Platt	–Storlinjerat	–Kuperat	
Blockighet:	–Rik	–Normal	–Fattig	–Fri
Läge:	_____-sluttning	–Backkrön	–Sänka	
Facies:	–Cover moraine	–Hummocky m.	– _____	
Replikat:	Serienr: 10 _____	Löpnr _____	_____	
Övrigt: _____				

Sign: _____

Datum: ____/____/2018

SAMPLING: phone and desktop applications

Samla markgeokemi

Samla markgeokemi

Proposal... Rules and guidelines that teach... statskontoret2024.pdf Sägja 4H-gård transi - Sök på Google Nätverket Renare Mark 2025: KI... Samla markgeokemi

Medarbetarwebben... FutuRaM Project - Global Tailings Portal FutuRaM Project - U... FutuRaM Project - GEM Software Main... Sök Strategisk Mobi... ExchangeAlumiFul... Sveriges geologiska undersökning Optical Mineralogy... Tills SGU

SGU Sveriges geologiska undersökning Samla markgeokemi

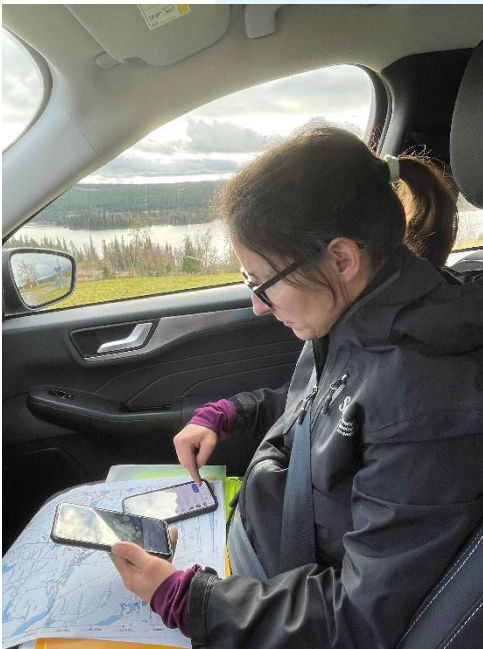
Karta Fält Labb Anna Ladenberger

Provtagningsplatser

Filtrera efter: mm/dd/yyyy mm/dd/yyyy Kartblad Serienummer Löpnummer Provtagare

☐ Silver (Ag) ☐ Guld (Au)

Kartlager



Designing a Teaching Proposal... Rules and guidelines that teacher... statskontoret2024.pdf Sägja 4H-gård transi - Sök på Google

iska... Medarbetarwebben... FutuRaM Project - Global Tailings Portal FutuRaM Project - U... FutuRaM Project - GEM Software Main... Sök Strategisk Mobi... ExchangeAlumiFul...

Provtagningsprotokoll

Prov

År	Serienummer (Obligatoriskt)	Löpnummer (Obligatoriskt)	Provtyp (Obligatoriskt)	Provdjup (cm) (Obligatoriskt)	Egenfärg
2024	--	---	Välj	---	Välj

+ Lägg till replikat

+ Lägg till prov

Plats

N (Obligatoriskt) Nord-syd-koordinat	E (Obligatoriskt) Öst-väst-koordinat	Kartblad	B-hor (cm)	B/C-hor (cm)
Sju siffror	Sex siffror		---	---

Dränering	Bergarter	Veget	Jordmån
Välj	Välj	Välj	Välj
Terräng	Blockighet	Läge	Facies
Välj	Välj	Välj	Välj

Bifoga bild

Tillåtna filformat är **JPG, JPEG, PNG**.
Filnamn kan bestå av tecken **a-z, 0-9**.
Inga **mellanrum**, använd **understrek**.
Filer får inte vara större än **20 MB**.

Dra och släpp din fil här eller klicka "Välj fil"

Välj fil

Sample preparation

Temp: 50-60°C



2 fractions: <0.063 mm
 >0.063 mm

3 types of weights:

pH: 6 g

7M HNO₃: 2 g

Aqua Regia: 5 g



Single-use spoons
and containers

	A	B	C	D	E	F	G	H
	Serie	Löpnr	HNO ₃	Kungsvatten - A.R.	pH	Datum	Signatur	Kalktest
			2g	5g	6,00 g		KMA	
1	202357	1	2,00 g	5,00 g	6,00 g	2024-07-31	KMA	-
2	202357	2	2,00 g	5,00 g	6,00 g	2024-07-31	KMA	-
3	202357	3	2,00 g	5,00 g	6,00 g	2024-07-31	KMA	-
4	202357	4	2,00 g	5,00 g	6,00 g	2024-07-31	KMA	-
5	202357	5	2,00 g	5,00 g	6,00 g	2024-07-31	KMA	-
6	202357	6	2,00 g	5,00 g	6,00 g	2024-07-31	KMA	-
7	202357	7	2,00 g	5,00 g	6,00 g	2024-07-31	KMA	-
8	202357	8	2,00 g	5,00 g	6,00 g	2024-07-31	KMA	-
9	202357	9	2,00 g	5,00 g	6,00 g	2024-07-31	KMA	-
10	202357	10	2,00 g	5,00 g	6,00 g	2024-07-31	KMA	-

LOGGBOOK!!!

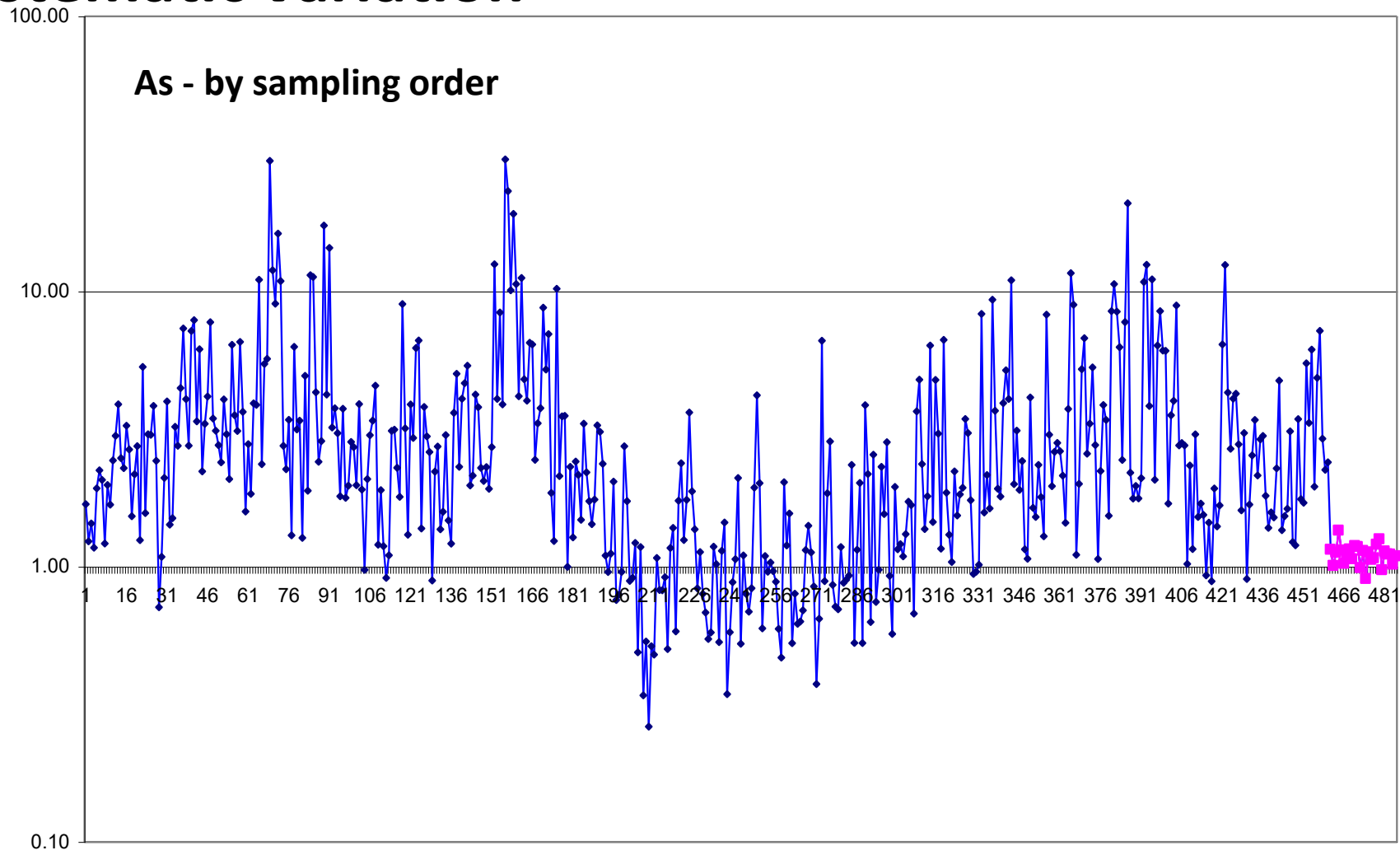


Randomisation for 7M HNO₃
and AR methods, inserting of an
internal standard MP3

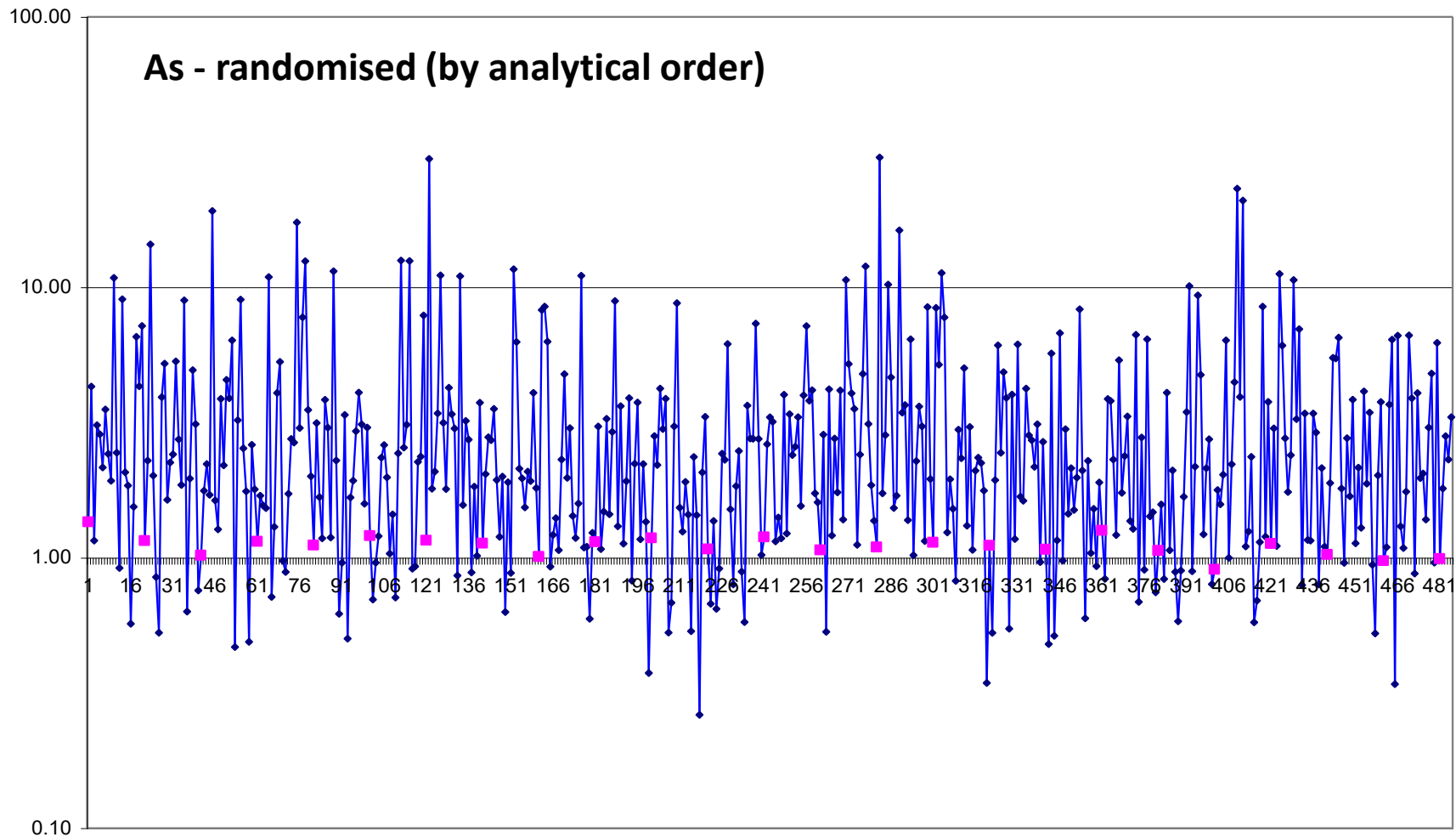




Randomisation to clarify source of systematic variation



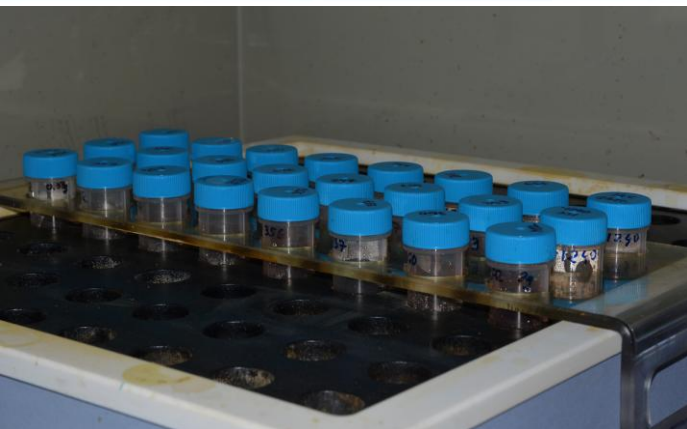
Randomisation to clarify source of systematic variation

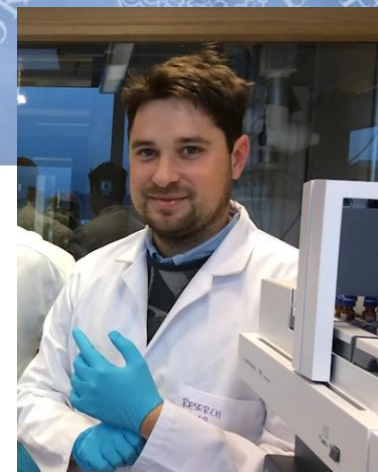




Currently 3 routine methods

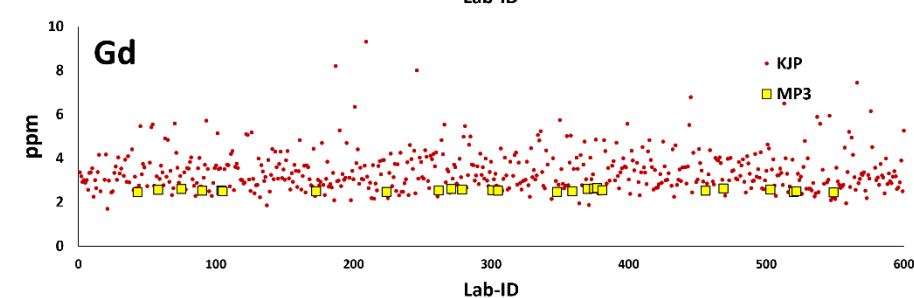
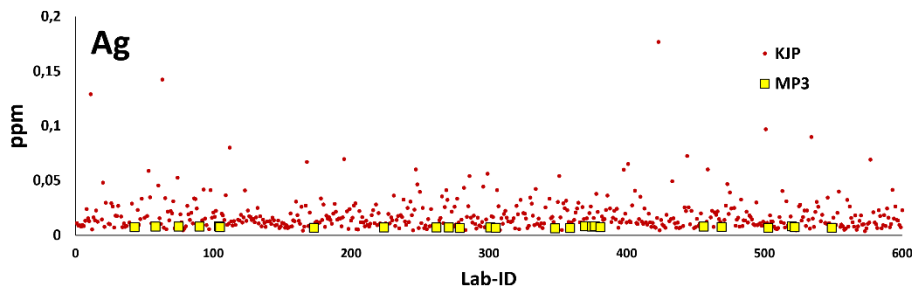
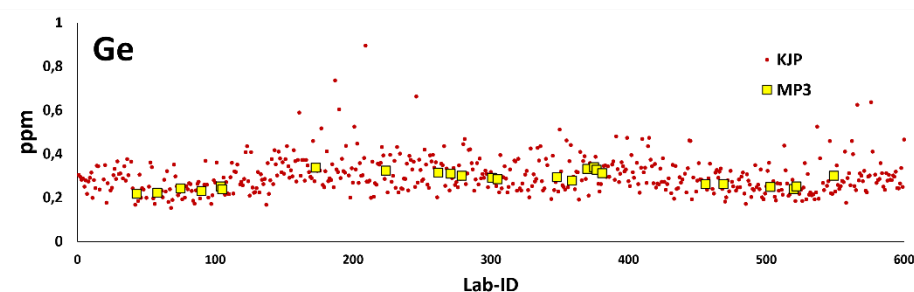
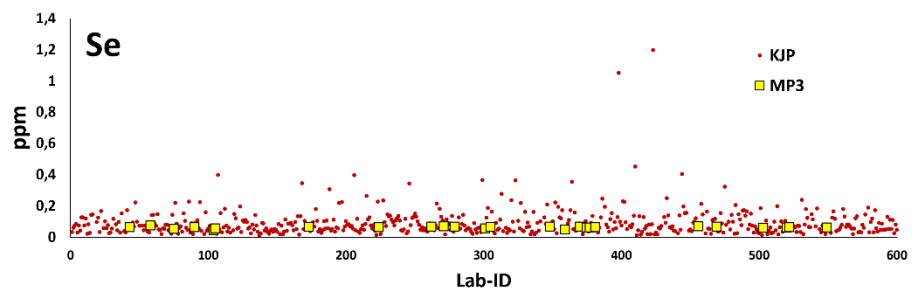
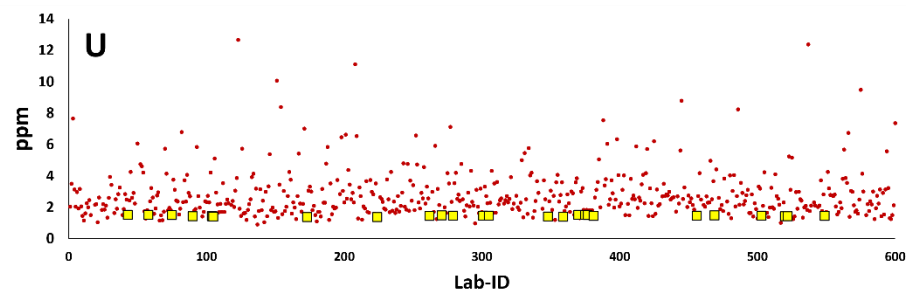
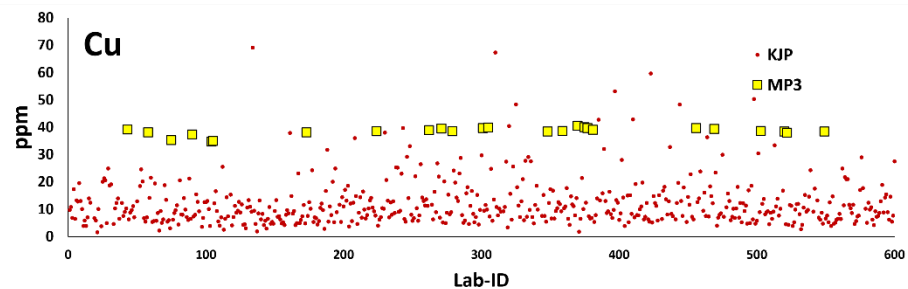
- ☐ 7N Nitric Acid partial leach, till & soil
- ☐ Aqua Regia partial leach, till & soil
- ☐ pH

**LOGGBOOKS!!!**

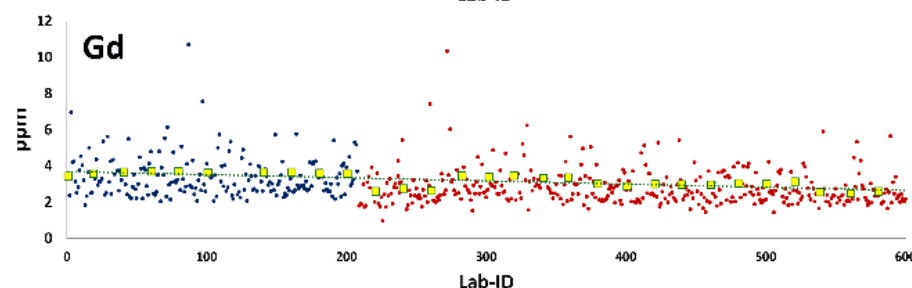
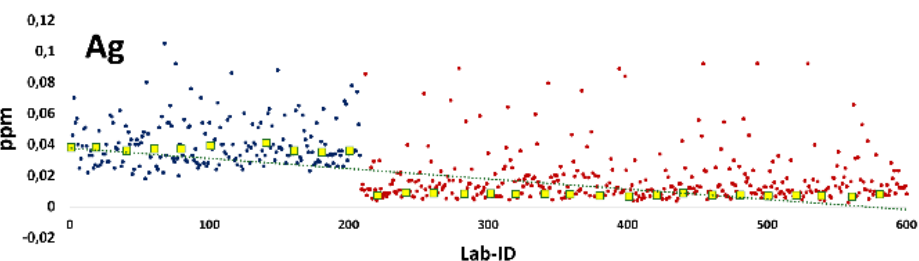
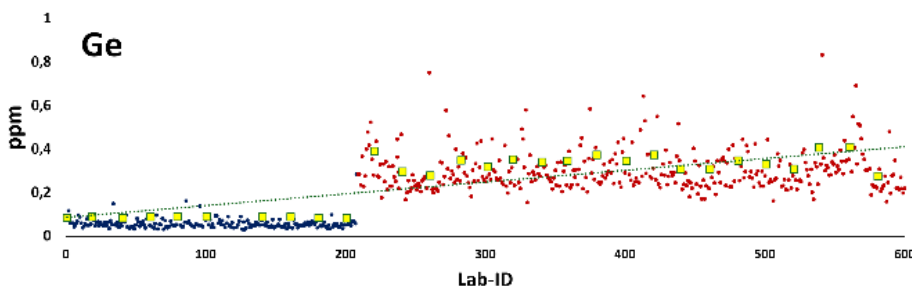
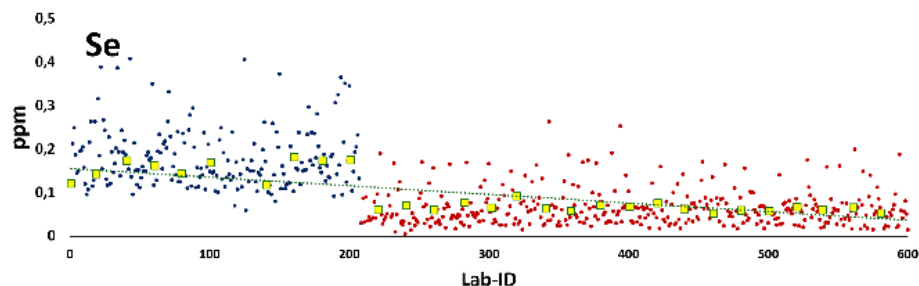
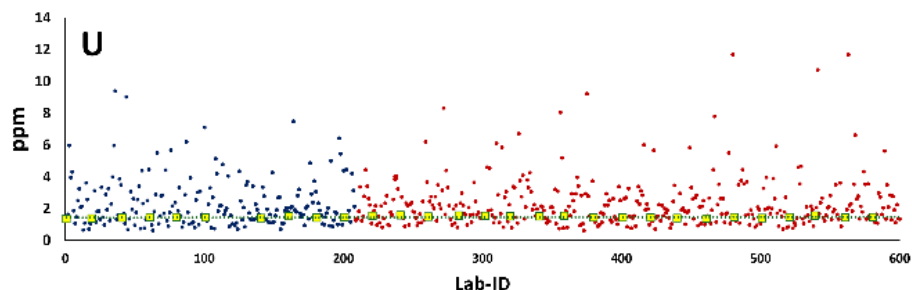
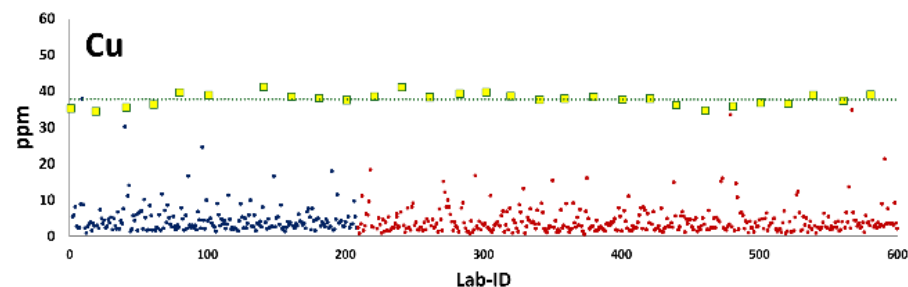


MP3 year 2023

Control diagrams



MP3, control diagrams



The elemental concentrations of Cu, U, Se, Ge, Ag, and Gd across different Lab-ID samples, measured using two instruments: the old instrument (Perkin Elmer, blue dots), the new instrument (red dots). A control sample (MP3, yellow squares) was used.

Internal Standard

MP3

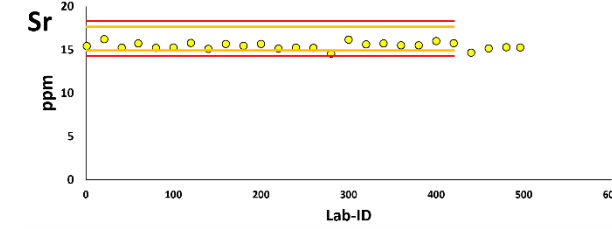
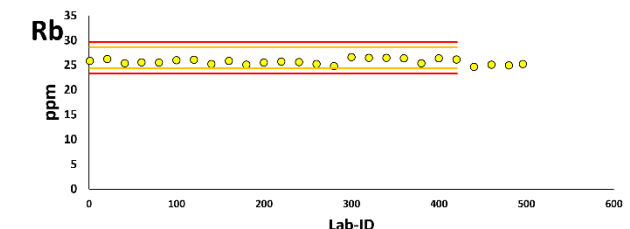
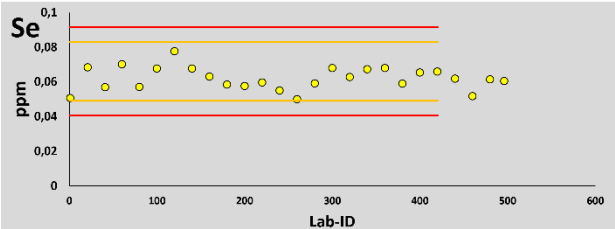
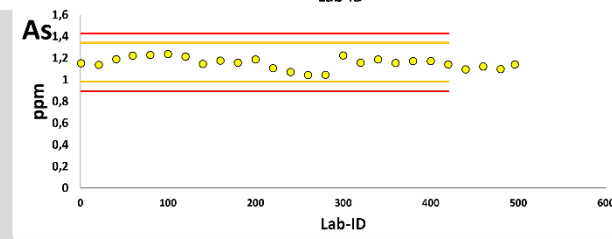
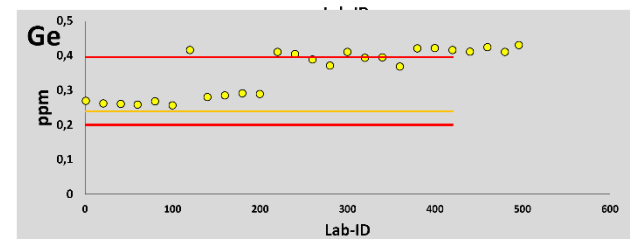
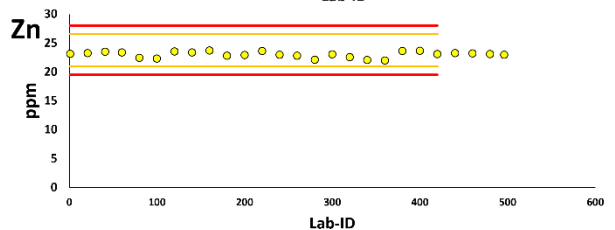
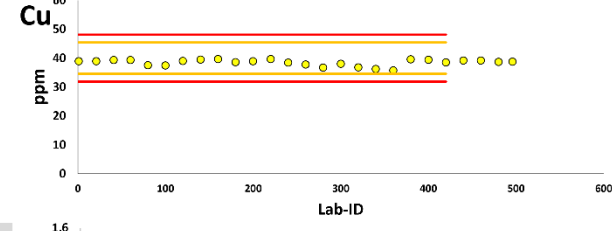
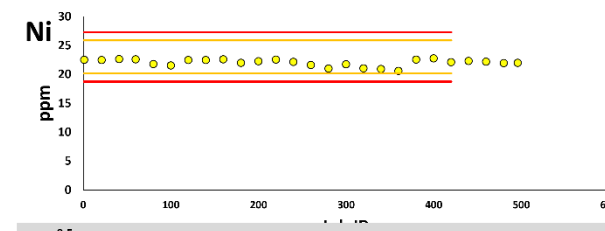
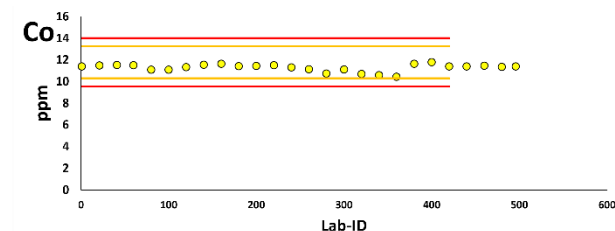
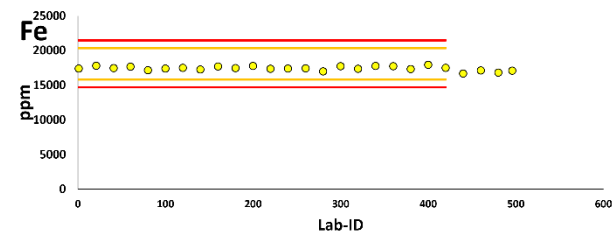
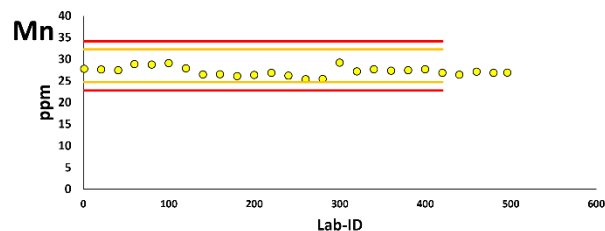
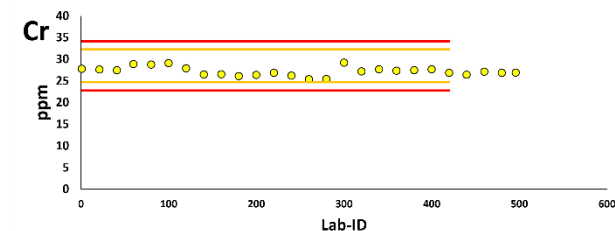
2021

7N HNO₃

Control diagrams

+/- 2σ : alert level

+/- 3σ : fail level

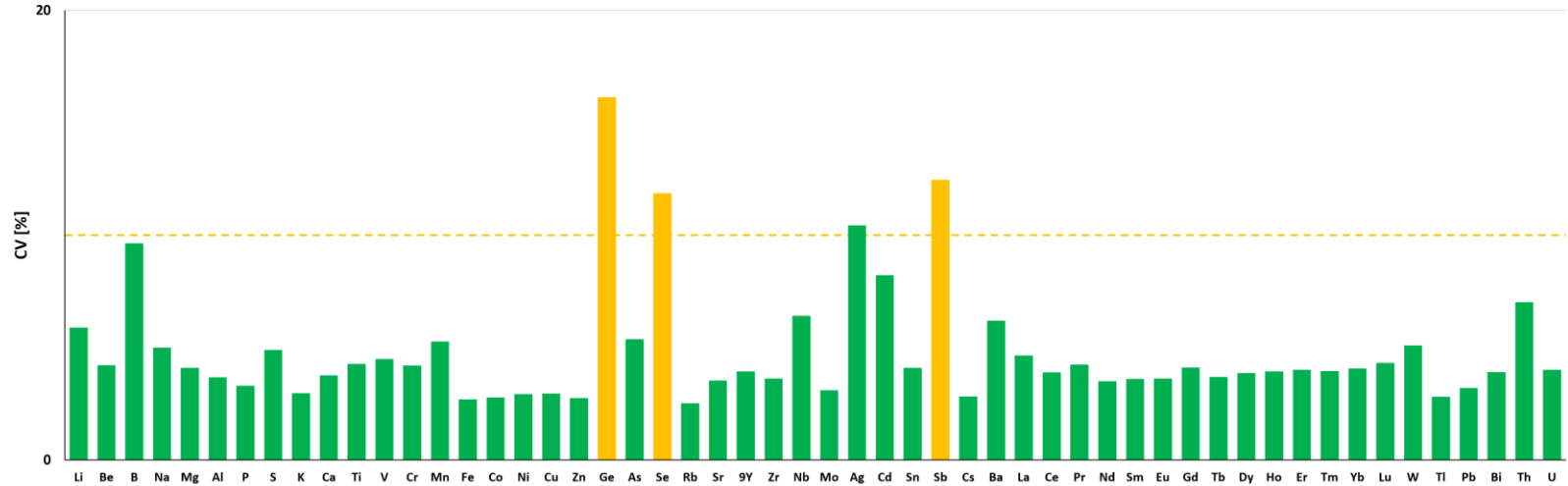


Internal Standard

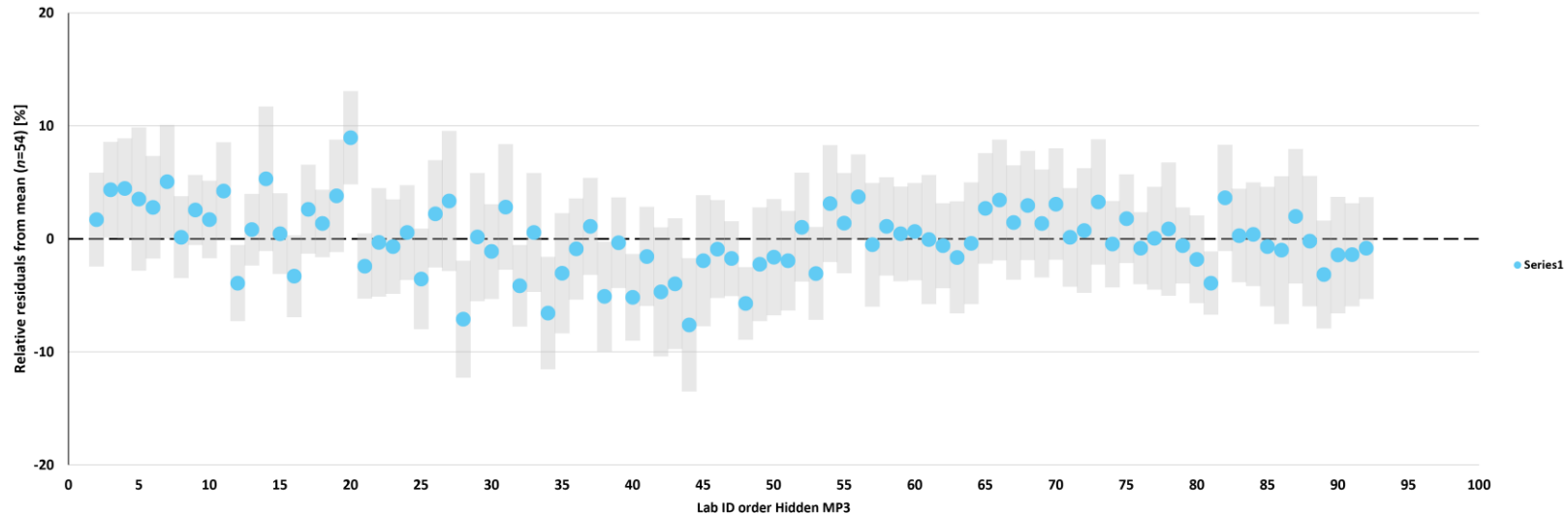
MP3

7N HNO₃

hidden MP3 2021

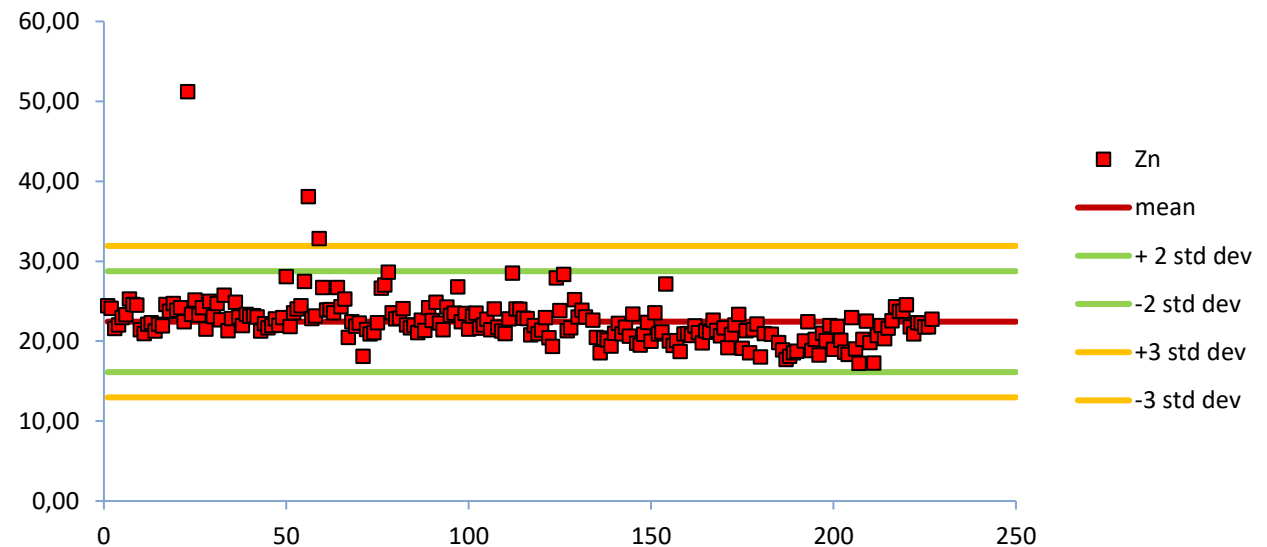
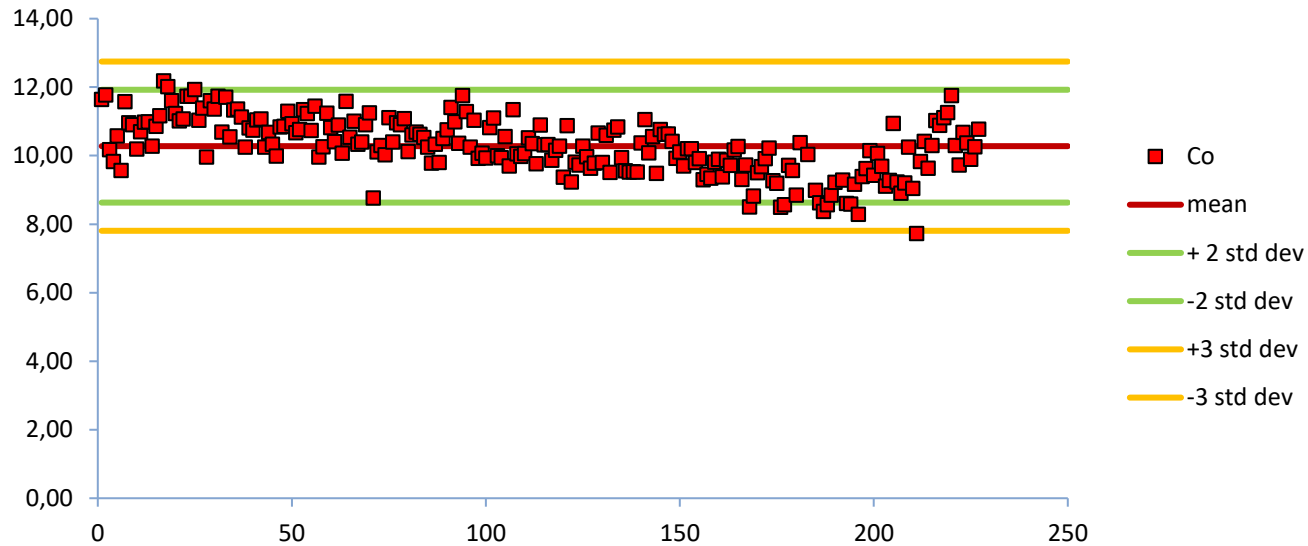


All Elements



Longterm Monitoring of Internal Standard

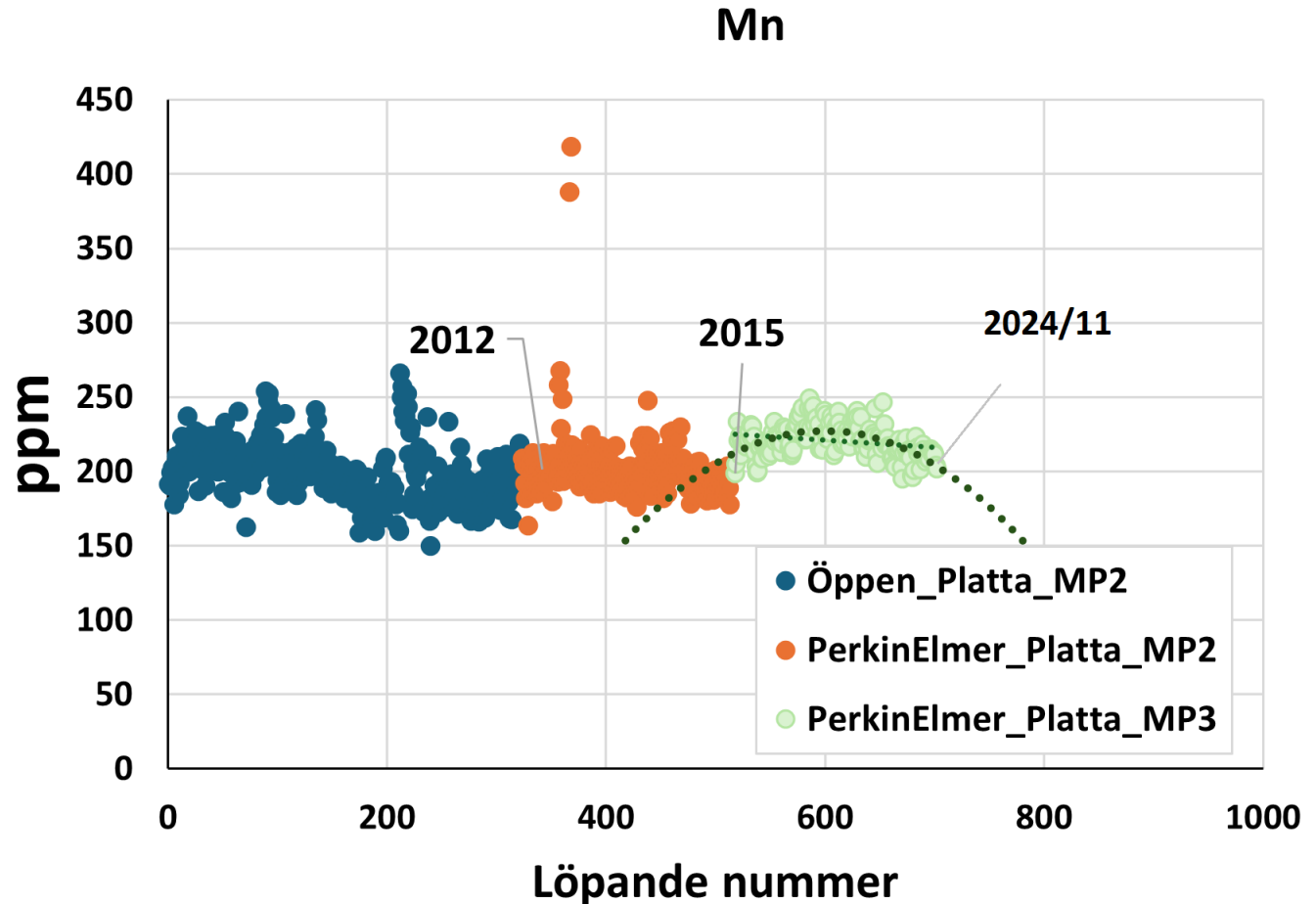
MP2 in 7N HNO₃
2009 - 2014

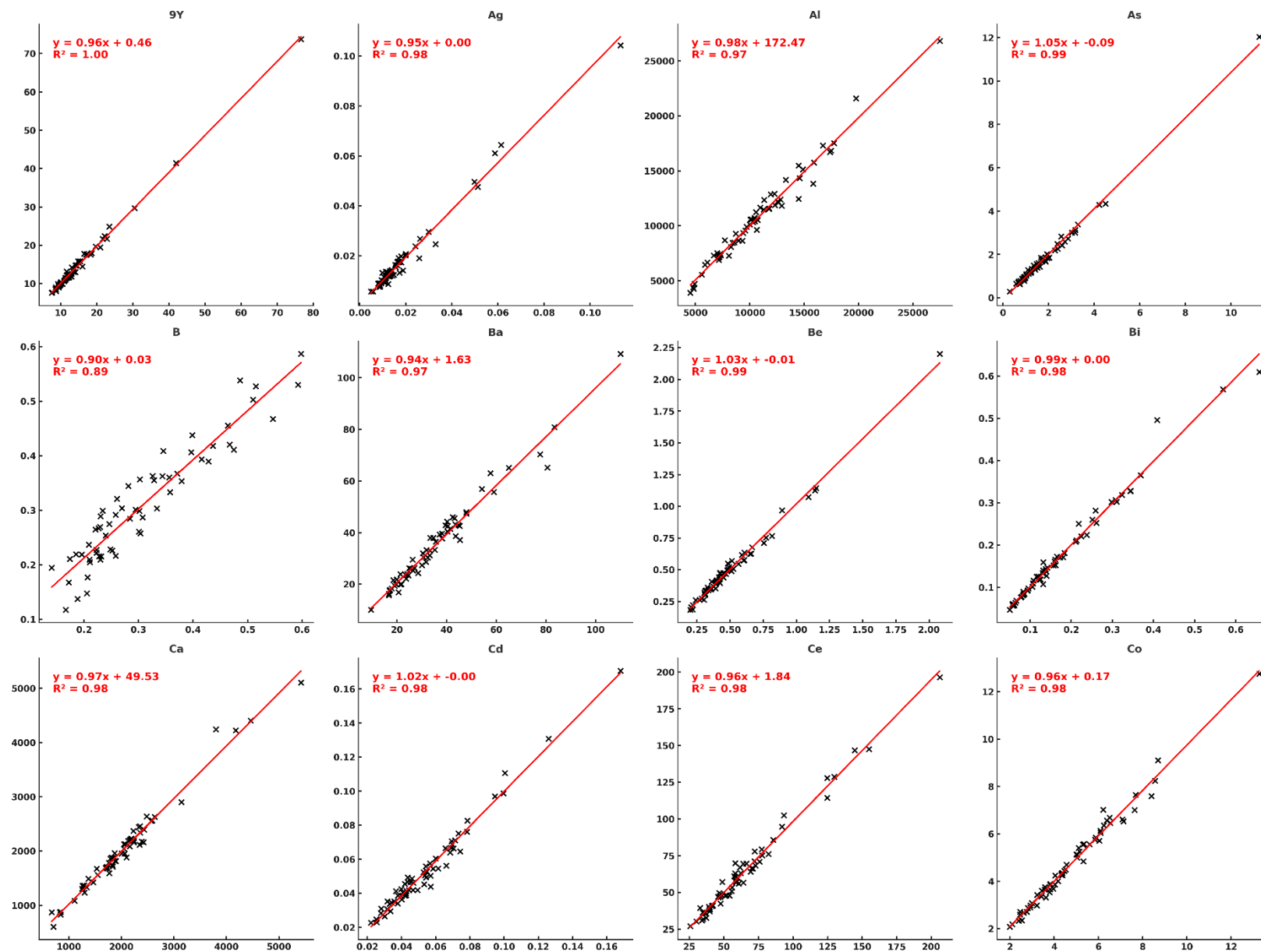


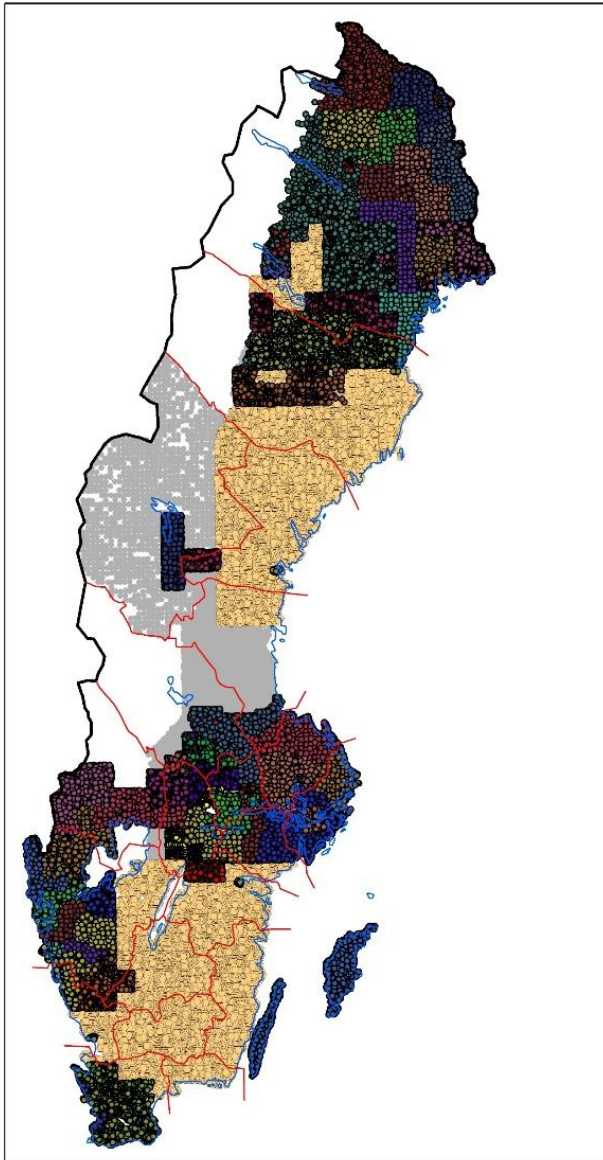
Testing new hotplate

Longterm
Monitoring
of
Internal Standard
MP2/MP3

7N HNO₃

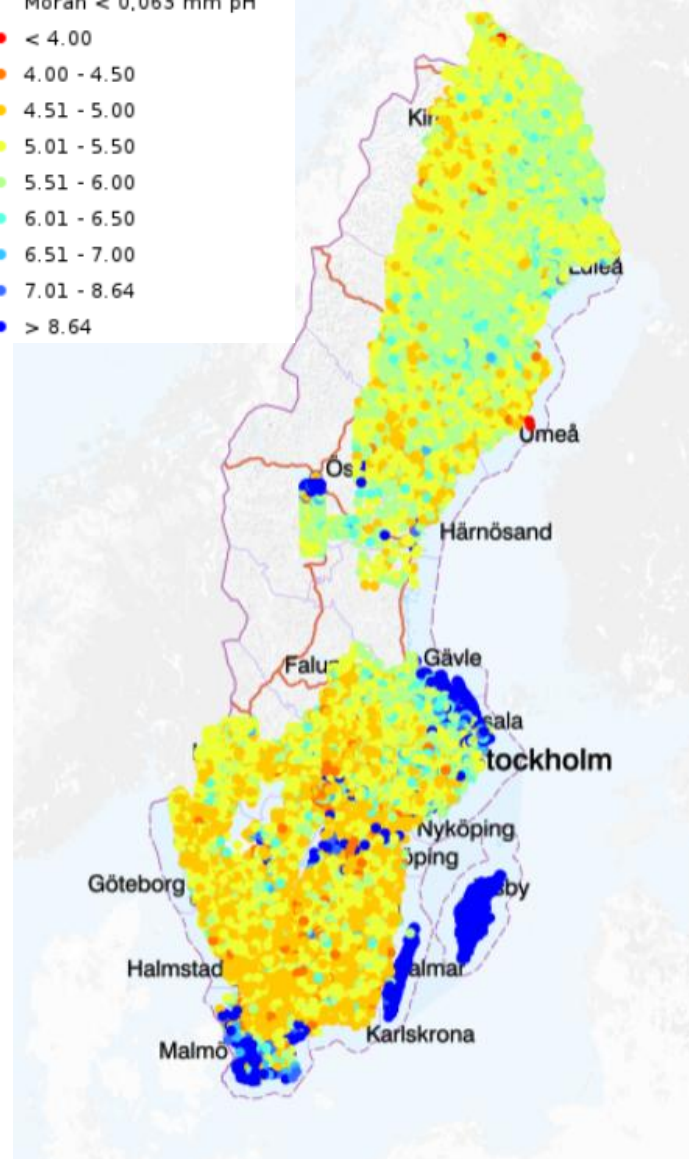




[SGUs Kartvisare](#)**Morän < 0.063 mm pH**

Morän < 0,063 mm pH

- < 4.00
- 4.00 - 4.50
- 4.51 - 5.00
- 5.01 - 5.50
- 5.51 - 6.00
- 6.01 - 6.50
- 6.51 - 7.00
- 7.01 - 8.64
- > 8.64



Valj område för pdf

Om kartvisaren

Visa position

Sök ort

☒ Morän < 0.063 mm pH☐ Morän <0,063 mm totalhalt XRF☒ Morän <0,063 mm
salpetersyralakning ICP-MS☒ Morän <0,063 mm kungsvattenlakning
ICP-MS☒ Morän <0,063 mm kungsvattenlakning
ICP-AAS☒ Morän <0,063 mm kungsvattenlakning
ICP-AES☒ Morän < 0,063 mm
kungsvattenlakning (NSG-SGAB)☐ Höjdsuggning (Lantmäteriet)☒ Topografi (Lantmäteriet)

7M HNO₃
ICP MS

Koppar (Cu), ppm

Koppar (Cu), ppm

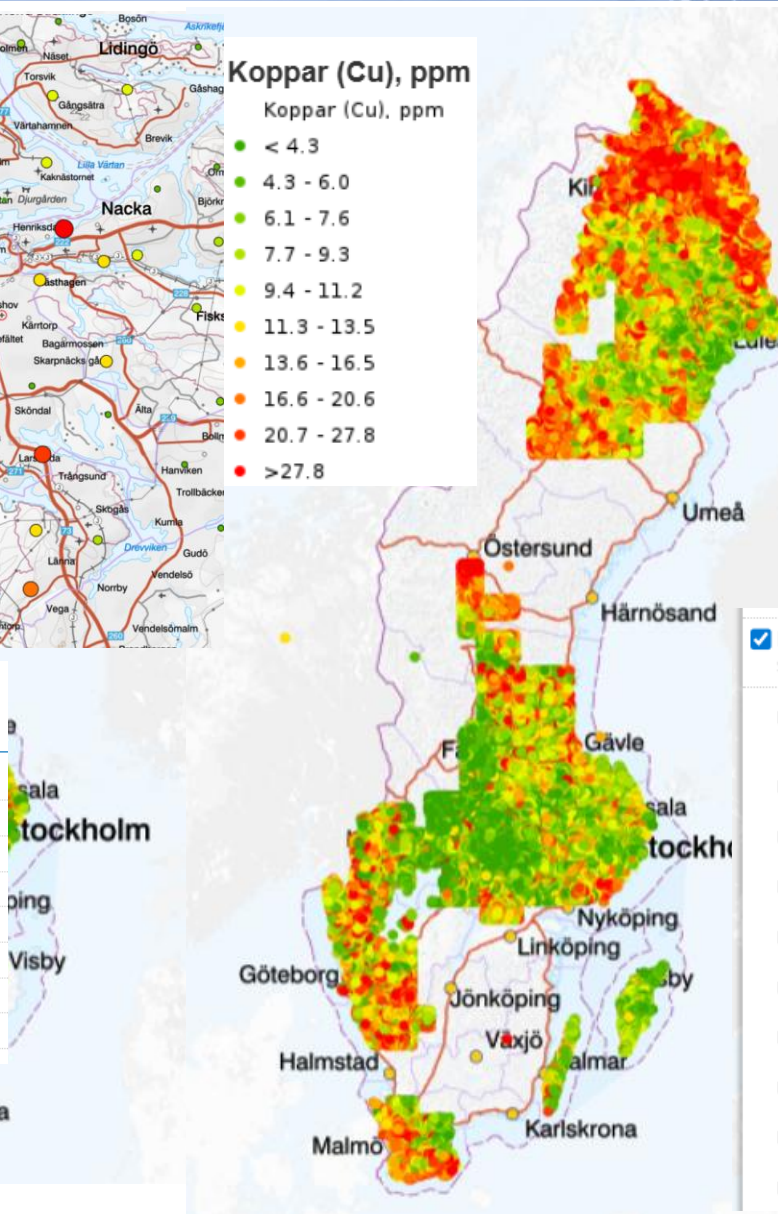
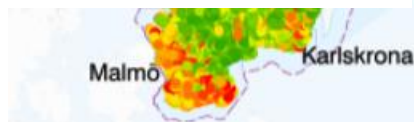
- < 4.3
- 4.3 - 6.0
- 6.1 - 7.6
- 7.7 - 9.3
- 9.4 - 11.2
- 11.3 - 13.5
- 13.6 - 16.5
- 16.6 - 20.6
- 20.7 - 27.8
- > 27.8



Resultat

Koppar (Cu), ppm - Träff: 1

idkod	XX05
idnr	33103
prov_artal	2005
provtyp	Morän finfraktion (< 0,063 mm)
typmetod	Salpetersyralakning ICP-MS
ns	6577241
ew	667217
cu_ppm	21.9



☒ Morän < 0,063 mm
salpetersyralakning ICP-MS

- ☐ Provpunkter, morän < 0,063 mm
salpetersyralakning ICP-MS
- ☐ Silver (Ag), ppm
- ☐ Arsenik (As), ppm
- ☐ Barium (Ba), ppm
- ☐ Vismut (Bi), ppm
- ☐ Kadmium (Cd), ppm
- ☐ Kobolt (Co), ppm
- ☐ Krom (Cr), ppm
- ☒ Koppar (Cu), ppm
- ☐ Järn (Fe), ppm

☒ Morän <0,063 mm kungsvattenlakning ICP-MS

☐ Provpunkter, morän < 0.063 mm kungsvattenlakning ICP-MS

☒ Guld (Au), ppb

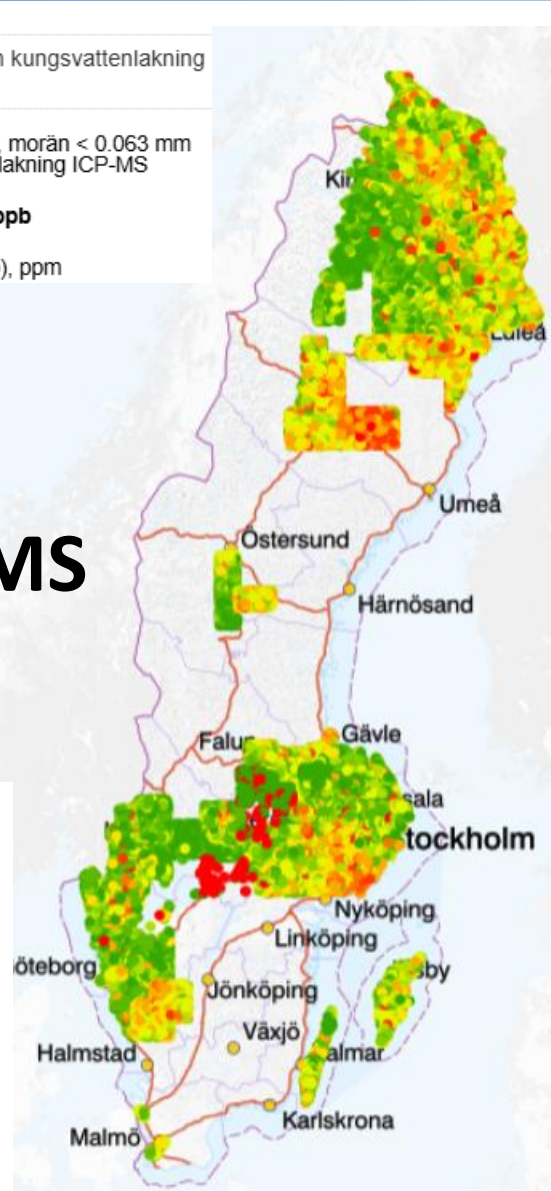
☐ Antimon (Sb), ppm

AR
ICP MS

Guld (Au), ppb

Guld (Au), ppb

• < 0.2
 • 0.2 - 0.4
 • 0.5
 • 0.6 - 0.7
 • 0.8 - 1.1
 • 1.2 - 1.4
 • 1.5 - 2.2
 • 2.3 - 3.4
 • 3.5 - 10.1
 • > 10.1



☒ Morän <0,063 mm kungsvattenlakning ICP-AAS

☐ Provpunkter, morän < 0.063 mm kungsvattenlakning AAS

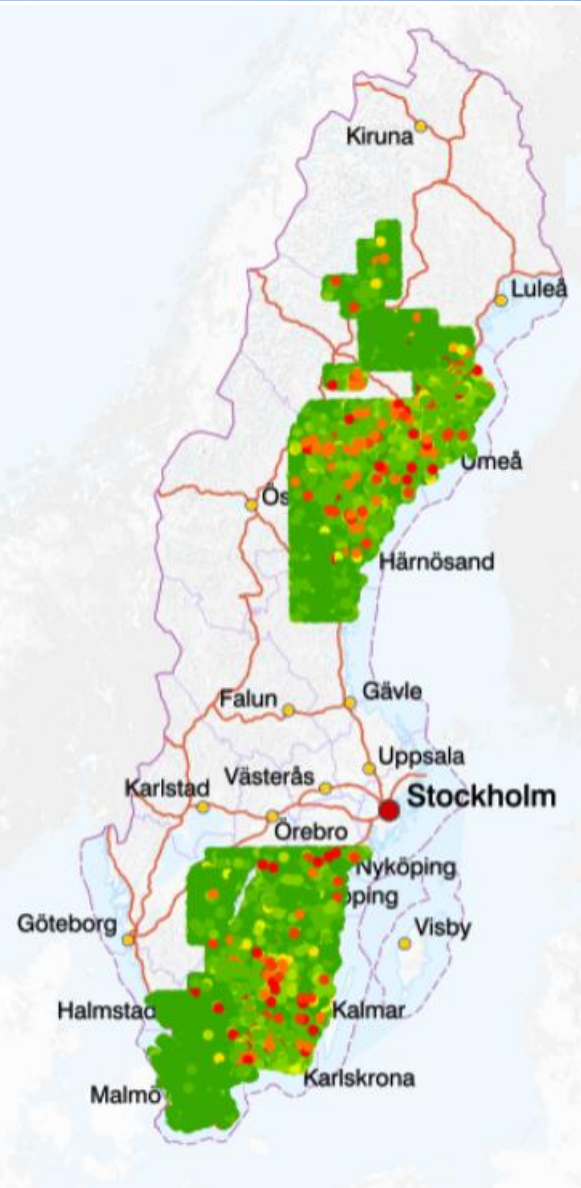
☒ Guld (Au), ppb

AR
AAS

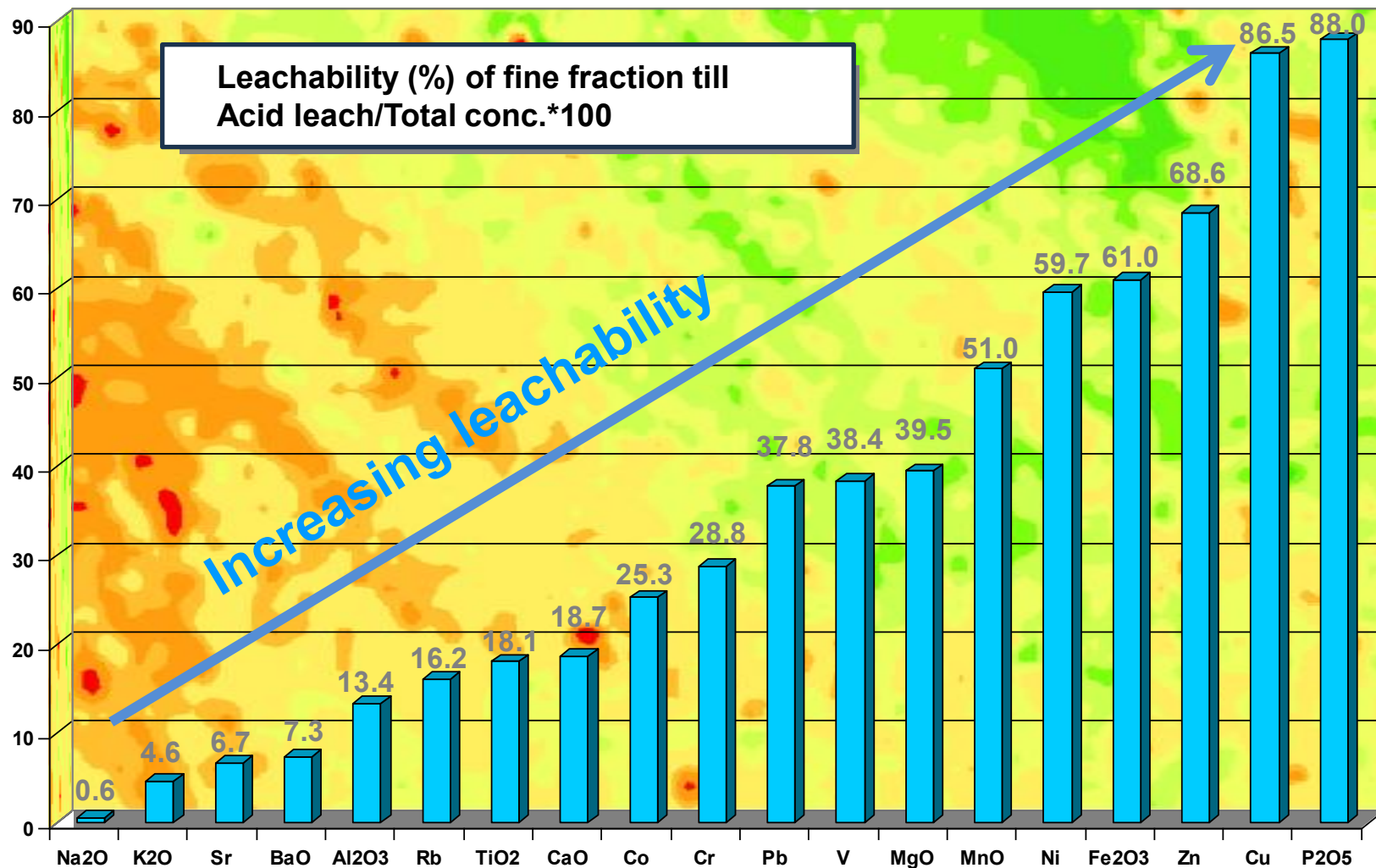
Guld (Au), ppb

Guld (Au), ppb

• < 1
 • 1
 • 2
 • 3
 • 4
 • 5
 • 6
 • 7 - 8
 • 9 - 14
 • > 14

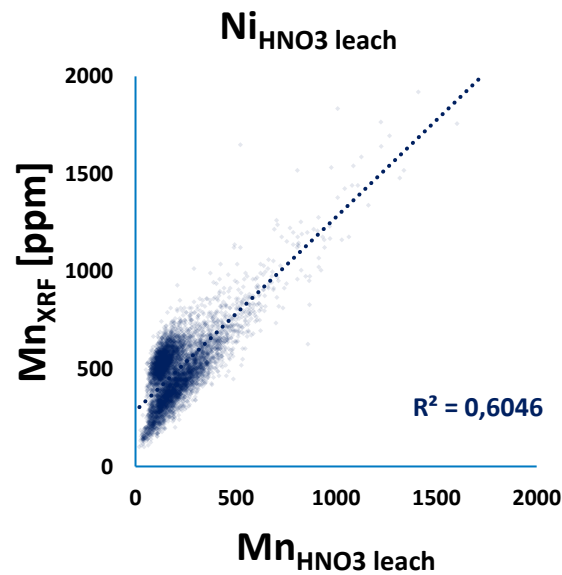
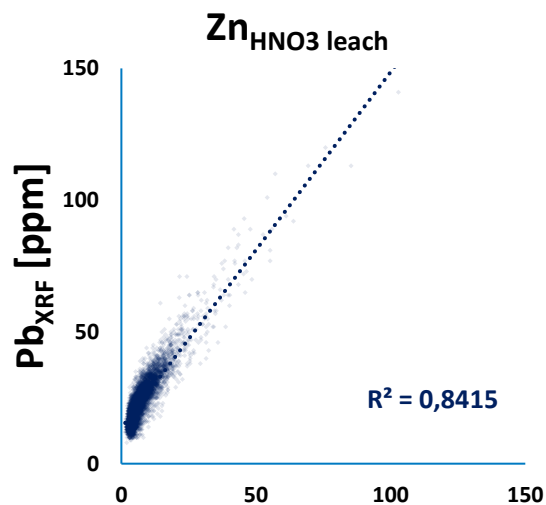
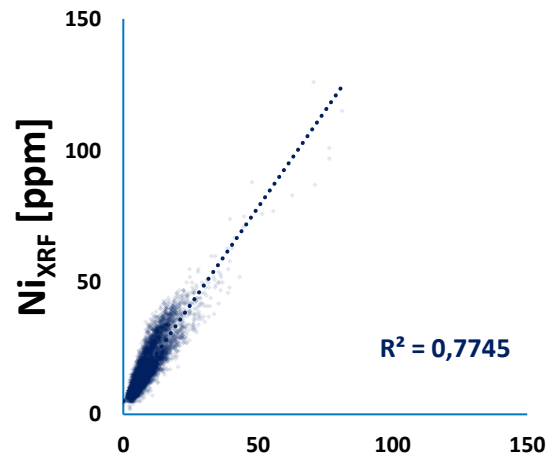
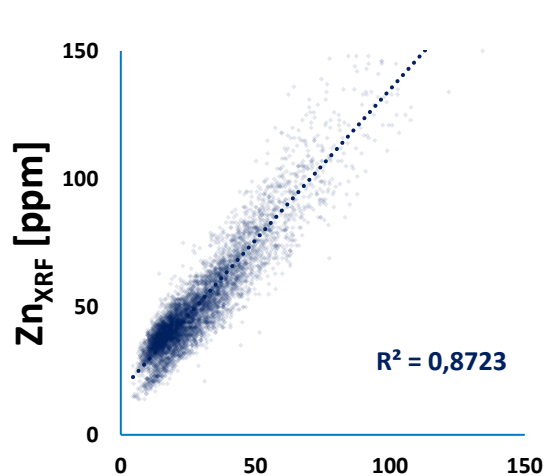


Leachability



Median values, upp till 22 400 analyser

Acid leach vs XRF



What affects leachability?

- Leachability is strongly controlled by mineralogy.
- Common minerals such as carbonates and biotite

Table 7

Leachability of iron from hornblende, epidote, chlorite, biotite and ilmenite

Snäll & Liljefors 2000

Mineral	Fe		Leachability (% of total wt%) in					
	Fraction	Total (wt%)	1 M HCl, 2 h	4 M HCl, 0.5 h	1 M HNO ₃	7 M HNO ₃	SS 028150	Aqua regia
<i>Hornblende</i>	<2 mm	11.4	5.4	6.3	1.3	2.4	3.6	4
	<63 µm	11.4	21	16	5.1	5.7	13	14
	Powder	11.4	34	31	10	29	35	26
<i>Epidote</i>	<2 mm	10.4			0.5	1.4	1.6	1.6
	<63 µm	10.4			1	4.7	5.1	5.5
	Powder	10.4			15	31	36	32
<i>Mg-Chlorite</i>	0.5–2 mm	6.0	32	18	6	63	40	50
	Powder	6.0	75	74	57	75	76	81
<i>Fe-Chlorite</i>	30–500 µm	10.4	70	64	59	83	89	77
	Powder	10.4	73	68	72	87	88	80
<i>Biotite</i>	0.5–2 mm	20.6	104	98	25	54	54	82
	Powder	20.6	96	97	90	94	99	90
<i>Ilmenite</i>	Powder	9.1				17	n.d.	57

Interna revisioner och ledningens genomgång – Vägledning för laboratorier och kontrollorgan

- ☐ Frequency: at least once per year
- ☐ Purpose
- ☐ Criteria
- ☐ Planning

Horizontal revision

Vertical revision

Report

Follow-up of corrections

THANK YOU FOR
YOUR ATTENTION!

