Metal analysis of ground- and high matrix waters using ICP-MS

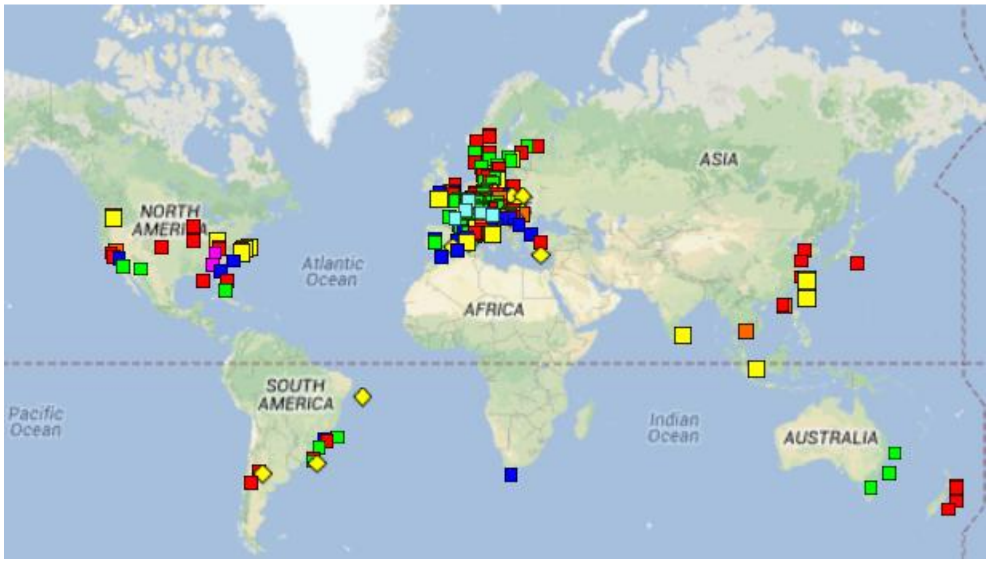
Eurofins Analytico

Wim Proper

Overview of Presentation

- Introduction Eurofins
- Method / Instrument setup
- Instrument performance
- MassHunter software
- Results evaluation (LIMS link)

Eurofins Scientific



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Company Overview

Eurofins Scientific is an international life sciences company which provides a unique range of analytical testing services to clients across multiple industries. The Group is the world leader in food and pharmaceutical products testing. It is also number one in the world in the field of environmental laboratory services, and one of the global market leaders in agroscience, genomics and central laboratory services.

Short History

Eurofins Scientific was founded in 1987 with 10 employees. Today the Eurofins Group is a leading provider of analytical services with:

- an international network of over **180** laboratories across **35** countries in Europe, the USA, Asia and South America
- **over 14,000** staff
- a portfolio of over **100,000** reliable analytical methods
- more than **80 million** assays performed each year.

Eurofins Scientific

Company Overview

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Barneveld (NL)

Environmental samples like water, soil, waste water, …

NEN-EN-ISO 17025

2x ICP-OES and 5x ICP-MS

(Agilent Partnerlab ICP-MS)

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Method / Instrument setup

- Nebulizer choice
- TDS dependency
- Interferences (C, Cl, Ca, …)
- Selectivity
- Method validation (MDL, RSD%, REC%, linearity).

Method / Instrument setup

NEN-EN-ISO 17294-2:

5 Interferences

5.1 General

In certain cases, isobaric and non-isobaric interferences may occur. The most important interferences in this respect are coinciding masses and physical interferences from the sample matrix. For more detailed information, refer to ISO 17294-1.

Common isobaric interferences are given in Table 2 (for additional information see ISO 17294-1). In order to detect these interferences, it is recommended that several different isotopes of an element be determined. All the results should be similar. If they are not, mathematical correction is then necessary if, for a given element, there is no isotope which can be measured without interferences.

Small drifts or variations in intensities should be corrected by the application of the reference-element technique. In general, in order to avoid physical and spectral interferences, the mass concentration of dissolved matter (salt content) shall not exceed 2 g/l.

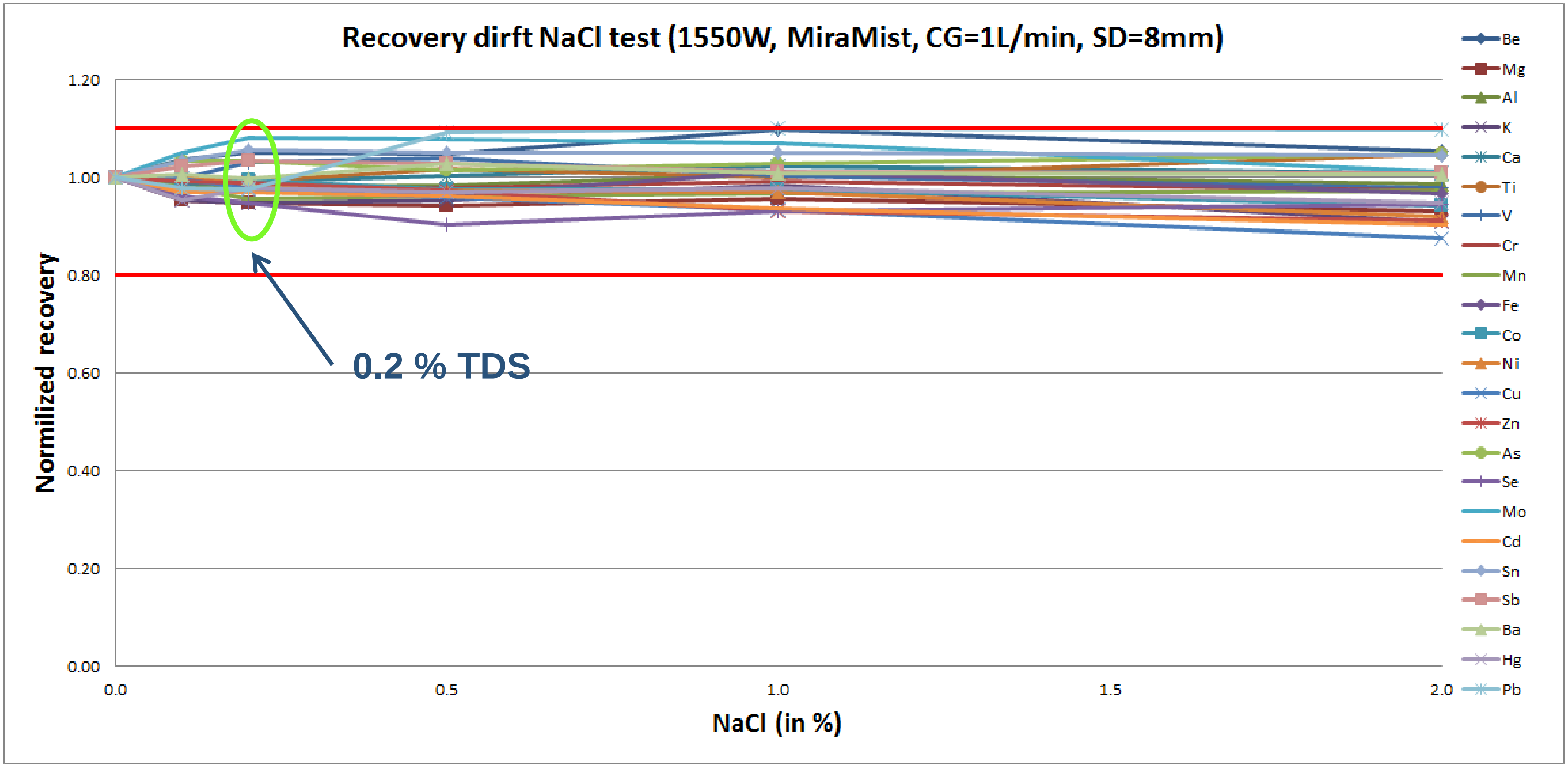
Method / Instrument setup (nebulizer)

Feature ▼ Type ▶	Concentric (std. glass)	Concentric (PFA low flow)	Cross-Flow	High Solids (e.g. Burgener)
Aerosol Efficiency	Good	Excellent	Moderate	Fair
Ability for Ultra-Low Liquid Uptake (<200uL/min)	No	Yes	No	No
Dissolved Solids Tolerance	Moderate	Moderate-poor	Good	Good
Un-dissolved Solids (particulates) Tolerance	Poor	Poor	Moderate	Good
Self-Aspiration	Yes	Yes	Yes	No
HF Resistant	No	Yes	Usually	Yes (typically)
Use for Organic Solvents?	Yes	Most	Yes	No

Standard Micro Mist

Mira Mist

Method / Instrument setup (TDS)



Method / Instrument setup (interference)

Annex A
(informative)

Spectral interferences, choice of isotopes and method detection limits for quadrupole ICP-MS instruments

Table A.1 — Spectral interferences, choice of isotopes and method detection limits for quadrupole ICP-MS instruments

Element	Isotope	Abundance %	Method detection limit[a] µg/l	Theoretical interferences		Interference with practical relevance	Best usable isotopes	
				Inter-element	Polyatomic ions		Preference	Reason
Ag	107	51,8	1	—	ZrO, YO	$^{91}Zr^{18}O$	x	least interference
	109	48,2	1	—	ZrO, ZrOH, NbO	—	—	—
Al	27	100	5	—	BeO, BO, CN, HCN	—	x	—
As	75	100	1	Sm^{2+}, Eu^{2+}, Nd^{2+}	ArCl, CoO, Ar_2H, ArK, CaO_2, NaCAr, CPO_2, CaCl	$^{40}Ar^{35}Cl$	x	—
Au	197	100	0,5	—	HfO, TaO	—	x	—
B	10	19,9	10	—	—	—	x	free of interference, low background
	11	80,1	10	—	BH	—	—	—
Ba	135	6,6	3	—	—	—	—	—
	137	11,2	3	—	—	—	x	highest abundance, least interference
	138	71,7	0,5	La, Ce	—	La, Ce		—
Be	9	100	0,5	—	—	—	x	—
Bi	209	100	0,5	—	—	—	x	—
Ca	43	0,14	100	Sr^{2+}	MgO, BO_2, AlO, CaH, CNO, CO_2	Sr^{2+}	x	low background, least interference
	44	2,1	50	Sr^{2+}	CaH, MgO, AlO, BO_2, CNO, SiO, CO_2, N_2O	Sr^{2+}, $^{12}C^{16}O_2$	x	lowest detection limit
Cd	111	12,8	0,5	—	MoO, MoOH, ZrOH, K_2O_2H	$^{94}Zr^{16}O^{1}H$, $^{95}Mo^{16}O$	—	—
	113	12,2	0,5	In	MoO, ZrOH, Ca_2O_2H, Ar_2O_2H, RuO	In, $^{97}Mo^{16}O$	x	for high Sn
	114	28,7	0,3	Sn	MoO, MoOH, RuO	Sn, $^{98}Mo^{16}O$	x	lowest detection limit, least interference
Ce	140	88,5	0,1	—	—	—	x	—
Co	59	100	0,2	Sn^{2+}	CaO, CaOH, MgCl, ArNa, ArOH, ArF	$^{43}Ca^{16}O$	x	—
Cr	52	83,8	1	—	SO, ArO, ArC, ArN, ClO, HClO, ClN, ArNH	$^{40}Ar^{12}C$	x	for low C and high Cl
	53	9,5	5	—	HSO, ArC, HClO, ClO, ArOH, ArN, ArNH, SO	$^{37}Cl^{16}O$	x	for high C and low Cl
Cs	133	100	0,1	—	RuO_2	—	x	—

continued)

…erferences	Interference with practical relevance	Best usable isotopes	
…lyatomic ions		Preference	Reason
…O, PO_2, ArNa, …, NaCa, CaOH, …NH, NCCl, ClO	$^{47}Ti^{16}O$, $^{40}Ar^{23}Na$	x	for low Na and Ti, lowest detection limit
…O, PO_2, SO_2, …H, ArMg, CaOH, N_2H, S_2 COCl	$^{49}Ti^{16}O$, $^{32}S^{16}O_2{}^{1}H$, $^{40}Ar^{25}Mg$	x	for medium Mg, S and Ti and high Na
NdO, SmO	—	x	—
SmO, NdO	—	x	—
BaO	—	—	—
BaO	—	x	—
…lO, ArO, ArN, …, ArOH, SO, ClO	ArN Cr	x	abundance and background determine choice
…O, ArO, ArOH, …, CaN, CaOH, MgO_2, ArF	$^{40}Ar^{16}O^{1}H$ $^{40}Ca^{16}O^{1}H$	x	
…, ArP, VO, ArS, SO_2, S_2	Ba^{2+}	—	—
ClO_2, ArCl, SO_2, ArS, CrO	—	x	least interference
…, PrO, LaO, BF	—	x	least interference
…O, PrO, NdO	Dy	—	—
…rS, Cl_2, Ar_2	Se	x	—
…O, DyO, ErO		x	—
WO	$^{184}W^{16}O$	—	—
WO	$^{184}W^{17}O$	x	least interference from WO
WO	$^{188}W^{16}O$	—	—
SmO	—	x	—
RuO	Sn	x	—
HfO, LuO		x	—
ArH	—	x	—
—	—	x	—
—	—		—
—	—	x	lowest detection limit
GdO, TbO	Hf	x	—
…O, NaH, C_2	—	x	lowest detection limit, least interference
BeO, C_2, C_2H	—	—	—
BO, CN, C_2H_2, C_2H	—	x	for higher Mg concentrations
…, ArN, ClO, NaS, …H, ArNH, KO, …N, ArO, ArF	ArNH	x	—
ArKO, BrO	—	—	—
BrO, K_2O	Ru	x	lowest detection limit

A.1 (*continued*)

…cal interferences	Interference with practical relevance	Best usable isotopes	
Polyatomic ions		Preference	Reason
UO	—	x	—
BaO, RuO_3	—	x	—
CaO, ArO, CaN, NaCl, MgS, CaOH, Si_2, ArOH	Fe	x	for low Fe
CaO, CaOH, MgCl, NaCl	$^{44}Ca^{16}O$	x	least interference
CaOH, ScO	$^{44}Ca^{16}O^{1}H$, $^{45}Sc^{16}O$		—
SiH, NO, NOH, N_2H, CO, COH	NO	x	—
PtO	—	x	sum of 206, 207 and 208
IrO	—	x	sum of 206, 207 and 208
PtO	—	x	sum of 206, 207 and 208
YO, ArCu	—	—	—
MoO, ZrO	Cd	x	—
—	—	x	—
HfO	—	x	—
—	—	x	—
TmO, ErO	—	x	least interference
TmO, YbO	Os	x	highest abundance
SrO, ArCu, RbO	—	x	—
ArNi, NiCl	—	—	—
SrO	Pd	x	lowest detection limit, least interference
O_2, SH, NOH, O_2H	O_2	x	—
PdO	—	x	least interference
ZrO	Te	—	—
CO_2, SiO, BO_2, AlO, CaH, CHO_2, SiOH, N_2OH	$^{13}C^{16}O_2$, $^{29}Si^{16}O$	x	—
ArCl, Ar_2H, CaCl, $CFNO_2$	$^{40}Ar^{37}Cl$	x	for low Cl
Ar_2, CaCl, ArCa	$^{38}Ar^{40}Ar$	x	for high Cl and Br
Ar_2H, BrH, CCl_2, SO_3, Ar_2H_2, ArCa	Kr, $^{81}Br^{1}H$	x	for low Br
CO, N_2, BO, SiH, AlH, COH, N_2H	—	x	—
RuO_2	—	x	—
MoO, RuO, PdO	—	x	least interference
RuO, PdO	Te	—	—
RbH	—	—	—
—	—	x	lowest detection limit, least interference

1 (*continued*)

…interferences	Interference with practical relevance	Best usable isotopes	
Polyatomic ions		Preference	Reason
NdO, PrO	—	x	—
—	—	x	least interference
PdO	Xe	x	lowest detection limit
—	—	x	—
…O_2, PO, SiO, CCl, …NH, SiOH, SN, N_2, NO_2H	$^{31}P^{16}O$	x	least interference
…rC, CCl, SO, NO_2, PO, SN, NN_2, C_4	Ca, $^{32}S^{16}O$	—	—
SOH	$^{32}S^{16}O^{1}H$	—	—
WO, ReO, WHO	—	—	—
—	—	x	lowest detection limit, least interference
EuO	—	x	—
—	—	x	—
HSO, ClO, ClN, …rNH, ArC, ArN, SN, SO	$^{35}Cl^{16}O$	x	—
HoO, DyO, ErO	—	x	least interference
ErO, YbO	Os	—	—
—	—	x	—
DyO, SmO, GdO	—	x	least interference
DyO, GdO	Hf	—	—
…O, CaO, PO_2, SO_2, …Cl, S_2, PO_2H, ArN_2, ArMg	Ni, $^{48}Ti^{16}O$, $^{32}S^{16}O_2$, $^{40}Ar^{24}Mg$	—	—
…iO, VO, SO_2, PCl, FeC, S_2, SO_2H	$^{50}Ti^{16}O$, $^{34}S^{16}O_2$	x	for medium Ti and S
…O, ClO_2, SO_2, TiO, …rS, FeN, PCl, FeC, S_2, ArN_2, ArSi	Ba^{2+}, $^{40}Ar^{28}Si$	x	for low Ba and Si
—	—	x	—

…ent-dependent spectral interferences and relate to matrix element concentration

…al variation of individual abundances.

Method / Instrument setup (interference)

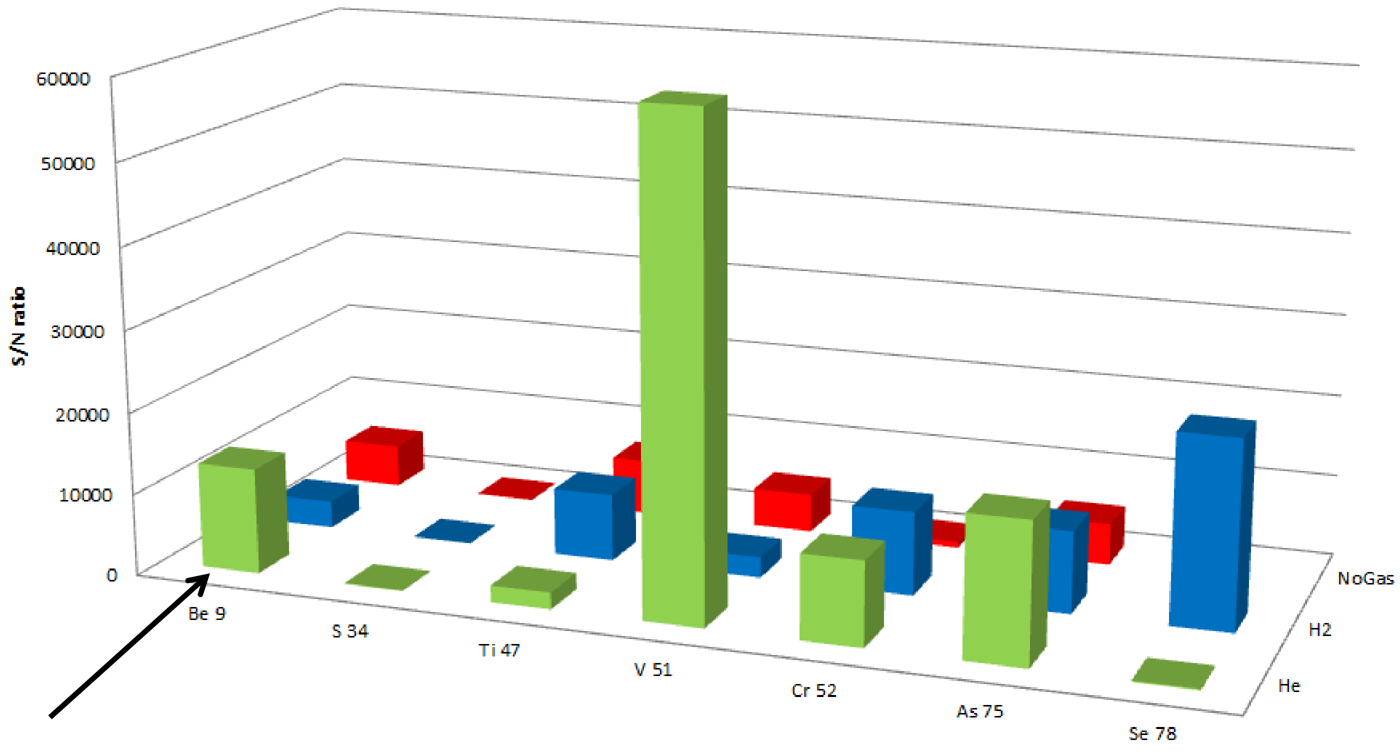
Element	Isotope	Abundance %	Method detection limit[a] µg/l	Theoretical interferences		Interference with practical relevance	Best usable isotopes	
				Inter-element	Polyatomic ions		Preference	Reason
Cu	63	69,2	1	—	TiO, PO_2, ArNa, MgCl, NaCa, CaOH, ArCNH, NCCl, ClO	$^{47}Ti^{16}O$, $^{40}Ar^{23}Na$	x	for low Na and Ti, lowest detection limit
	65	30,8	2	Ba^{2+}	TiO, PO, SO	$^{49}Ti^{16}O$	x	for medium Mg, S

		Cl 10000mg/L (NaCl)						
		Results				Interference?	Lowest	In or decrease %
Element	Unit	Reporting limit	He-mode	H2-mode	Nogas-mode	(ISO17294-2)		
Na / 23	mg/L	0.1	6028.13	6700.05	>			
V / 51	µg/L	1	1.33	40.82	94.02	Y	He	**98.6**
Cr / 53	µg/L	1	3.66	269.34	264.69	Y	He	**98.6**
Cu / 63	µg/L	5	0.52	18.73	87.48	Y	He	**99.4**
As / 75	µg/L	3	0.27	1.26	96.84	Y	He	**99.7**
Se / 77	µg/L	0.5	5.13	0.27	689.48	Y	H2	**100.0**
Se / 78	µg/L	0.5	0.61	0.05	25.26	Y	H2	**99.8**

Reaction gas flow: He 4.0 mL/min and H2 4.0 mL/min

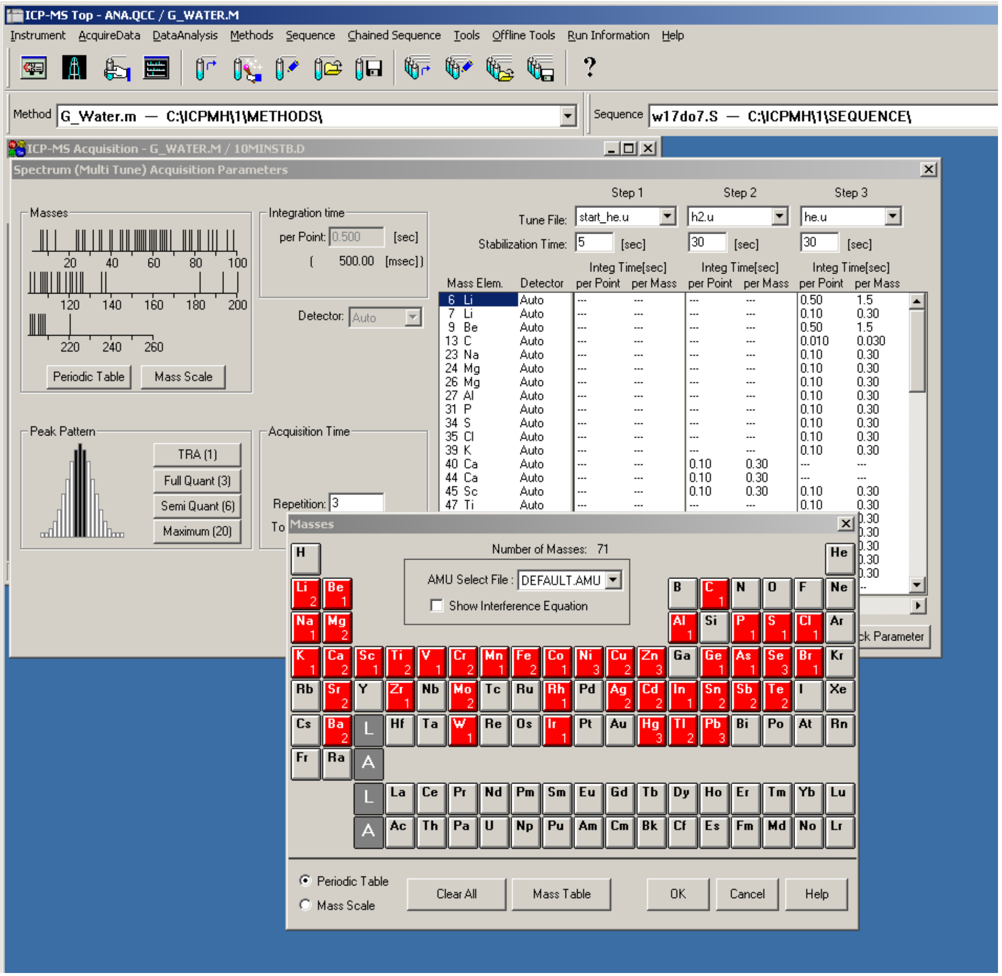
In total 25 interference solutions were measured (like C, Cl, W, … incl mixed)

Method / Instrument setup (S/N)



	Be 9	S 34	Ti 47	V 51	Cr 52	As 75	Se 78
He	12904	81	2039	59976	10296	17097	161
H2	3317	77	8219	2532	10204	10005	22984
NoGas	5224	82	6829	4727	719	5096	

Method / Instrument setup (Overview)



ICP-MS	**7500ce**
Nebulizer	**Burgener MiraMist**
RF Power	**1550 W**
Sampling Depth	**8.0 mm**
Carrier gas	**1.0 L/min**
KED voltage	**3 V**
He flow rate	**4 mL/min**
H2 flow rate	**4 mL/min**

Calibration ranges:

0 – 2 µg/L Hg

0 – 250 µg/L Ag

0 – 500 µg/L Li, B, Be, Ti, V, Cr, **Mn***, Ni, Co, Cu, Zn, As, **Se***, Sr, Mo, Cd, Sn, Sb, Te, Ba, Tl, Pb

0 – 1 mg/L Br, Zr, W

0 – 50 mg/L Na, **Fe***, K, **Ca***, Al, Mg

0 – 100 mg/L C, Cl, P, S

*) Measured in Hydrogen mode

Method validation

- Method detection limit

  (level between 1 – 3x required reporting limit)

- Reproducibility

  (low level, high level and NIST 1640)

- Recovery

  (same as reproducibility)

- Linearity and working range

Artificial ground water was used

Method validation (MDL)

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Method detection limit according AS3000 regulation

Results in µg/L

Element	GW_MDL_01	GW_MDL_02	GW_MDL_03	GW_MDL_04	GW_MDL_05	GW_MDL_06	GW_MDL_07	GW_MDL_08	GW_MDL_09	GW_MDL_10	Conc	**MDL (3σ)**	MDL_required	x times MDL
Be	0.964	1.083	1.244	1.212	1.015	1.048	0.958	0.900	1.095	0.983	1.050	**0.333**	0.5	0.67
V	3.981	3.928	4.186	3.888	3.732	3.714	3.549	3.610	3.749	3.587	3.792	**0.603**	1	0.60
Cr	3.148	2.822	2.985	3.537	2.934	2.758	2.645	2.802	3.122	3.434	3.019	**0.878**	1	0.88
Co	9.432	9.559	9.873	9.234	9.352	9.495	9.258	9.547	9.197	9.362	9.431	**0.603**	5	0.12
Ni	24.841	28.063	26.222	24.758	25.889	25.733	25.215	25.927	25.169	24.824	25.664	**2.974**	10	0.30
Cu	9.950	10.432	10.638	10.082	10.040	10.299	10.085	10.338	9.708	9.362	10.093	**1.104**	5	0.22
Zn	26.451	28.116	28.189	27.921	27.394	26.922	23.548	28.490	26.860	26.344	27.023	**4.307**	20	0.22
As	5.100	4.934	5.097	5.180	4.934	5.108	4.881	4.951	5.129	5.227	5.054	**0.357**	3	0.12
Se	0.583	0.510	0.677	0.433	0.450	0.387	0.420	0.431	0.471	0.417	0.478	**0.268**	0.5	0.54
Mo	2.761	2.455	2.665	2.362	2.468	2.408	2.322	2.399	2.439	2.374	2.465	**0.419**	1	0.42
Ag	25.198	21.637	21.534	21.388	22.037	21.633	21.531	21.641	21.479	21.129	21.921	**3.522**	20	0.18
Cd	1.991	2.078	2.193	2.047	2.049	2.013	1.962	2.042	2.051	1.490	1.992	**0.560**	0.8	0.70
Sn	2.183	1.983	2.085	1.771	1.494	2.292	1.903	2.134	2.254	1.757	1.986	**0.764**	1	0.76
Sb	0.665	0.501	0.597	0.529	0.515	0.495	0.471	0.509	0.534	0.499	0.531	**0.173**	0.5	0.35
Te	46.098	46.024	49.898	47.826	46.756	47.570	47.339	48.696	48.944	48.465	47.762	**3.788**	40	0.09
Ba	26.826	25.754	27.092	26.842	26.606	26.855	26.691	26.582	25.863	26.368	26.548	**1.308**	15	0.09
Hg	0.107	0.122	0.089	0.103	0.098	0.110	0.121	0.127	0.084	0.091	0.105	**0.045**	0.05	0.90
Tl	24.739	24.169	25.068	23.750	24.122	23.586	23.551	23.523	22.984	23.211	23.870	**1.969**	10	0.20
Pb	24.302	23.958	24.568	23.565	23.701	23.938	23.624	24.162	23.355	23.631	23.880	**1.129**	10	0.11
														0.39

Method validation (MDL)

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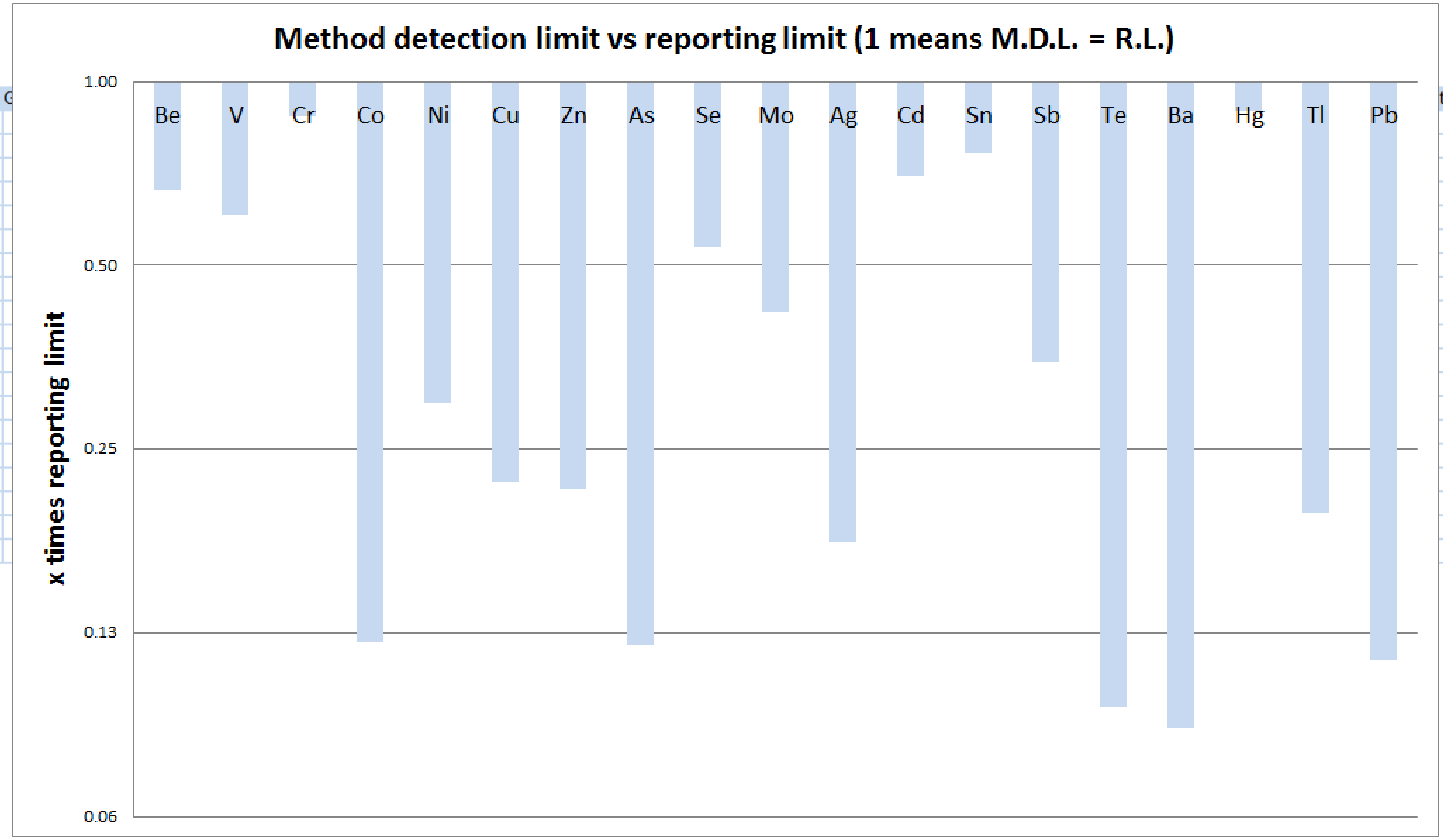
Element	times MDL
Be	0.67
V	0.60
Cr	0.88
Co	0.12
Ni	0.30
Cu	0.22
Zn	0.22
As	0.12
Se	0.54
Mo	0.42
Ag	0.18
Cd	0.70
Sn	0.76
Sb	0.35
Te	0.09
Ba	0.09
Hg	0.90
Tl	0.20
Pb	0.11
	0.39



Method validation (precision and recovery)

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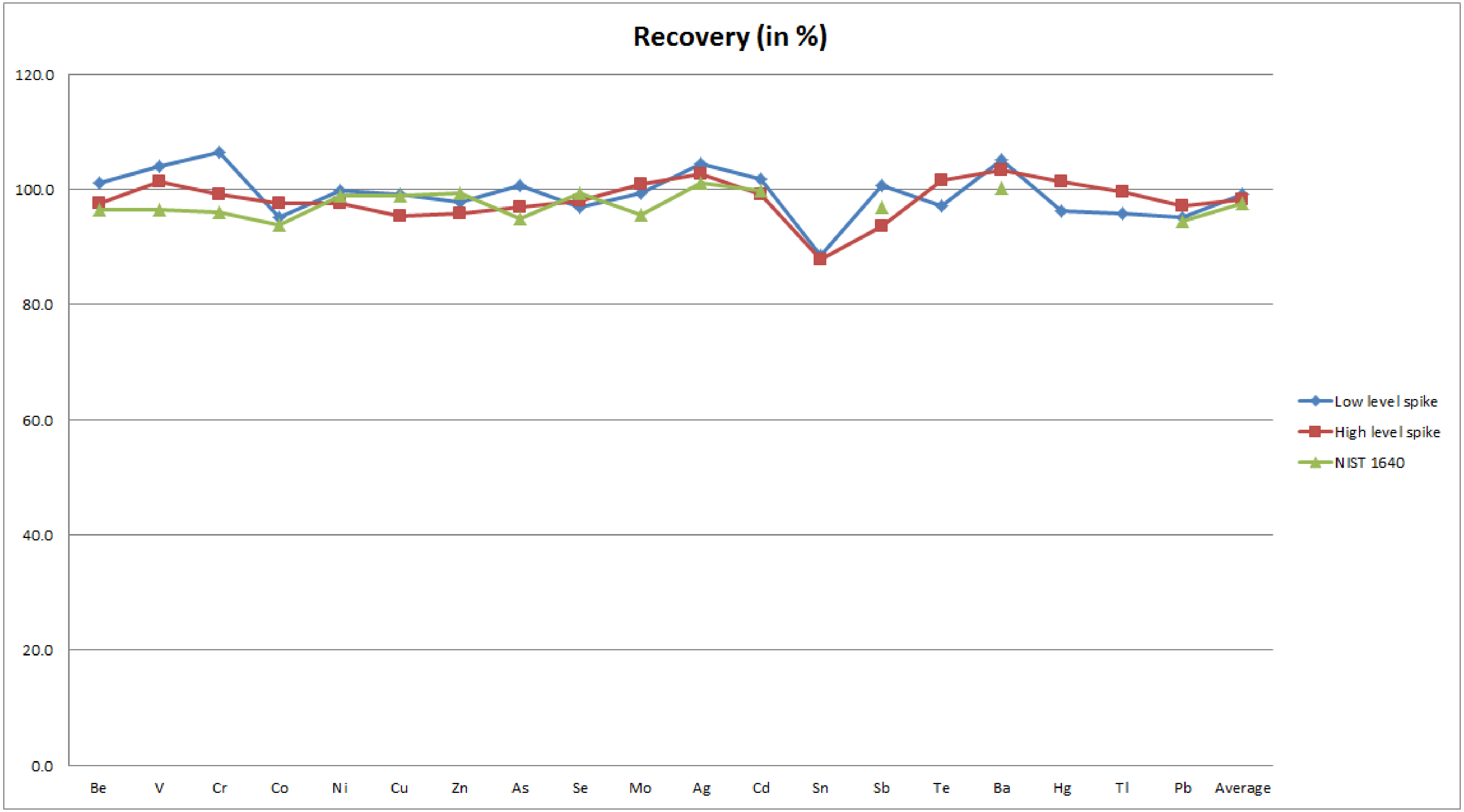
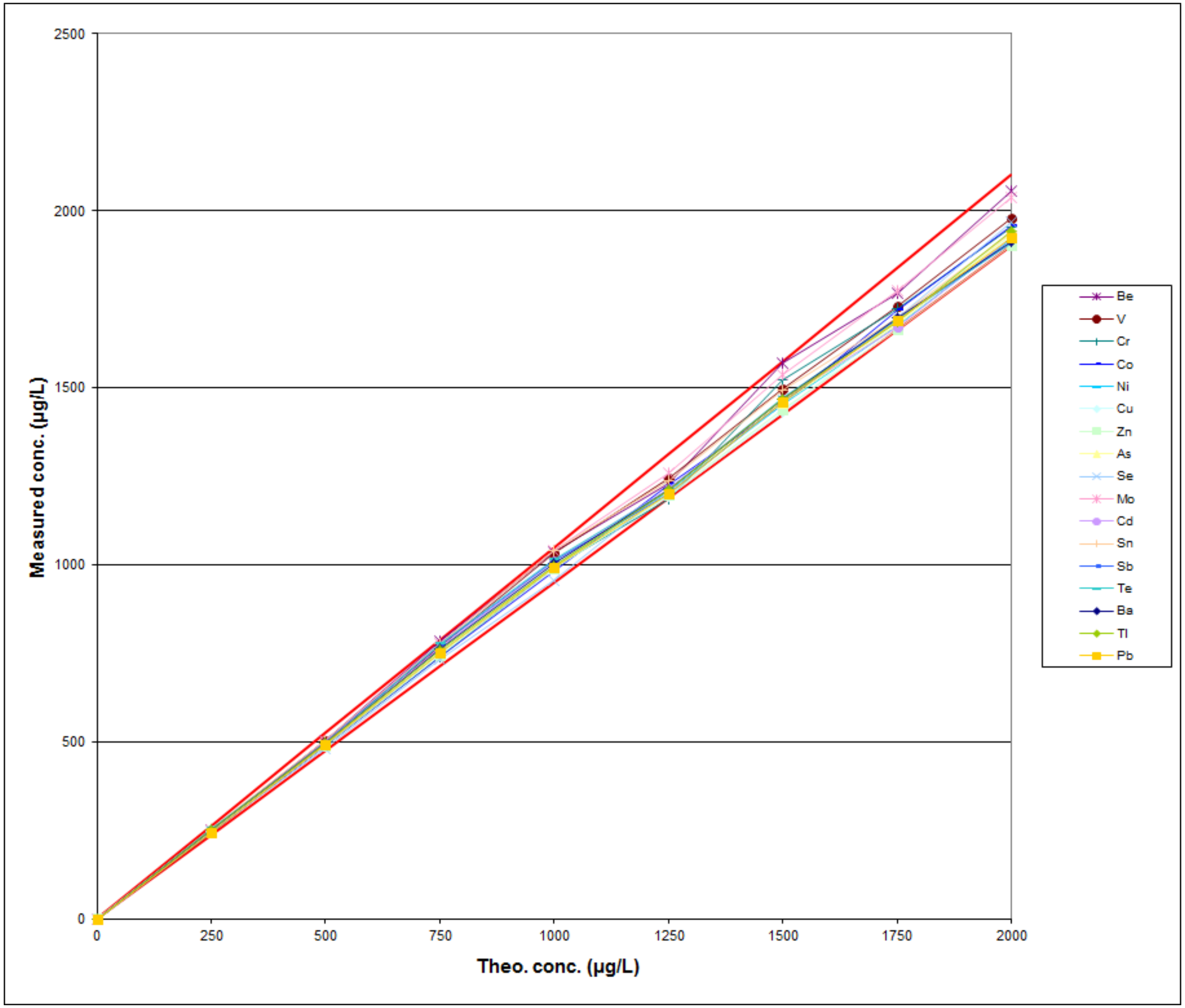
Element	Low level spike			High level spike			NIST 1640		
	Spike added (µg/L)	Reproducibility CV%	Recovery %	Spike added (µg/L)	Reproducibility CV%	Recovery %	Concentration (µg/L)	Reproducibility CV%	Recovery %
Be	20.2	3.3	101.2	97.6	3.7	97.6	33.7	2.9	96.4
V	20.8	2.9	104.0	101.4	3.2	101.4	12.5	2.1	96.5
Cr	21.3	2.5	106.4	99.1	2.5	99.1	37.0	2.0	96.0
Co	19.0	2.5	95.1	975.6	1.8	97.6	19.0	1.5	93.7
Ni	99.8	2.3	99.8	975.5	2.1	97.5	27.1	1.5	98.9
Cu	19.8	2.2	99.2	95.2	2.5	95.2	84.2	1.8	98.8
Zn	97.8	2.0	97.8	958.8	2.5	95.9	52.9	3.1	99.4
As	20.1	2.6	100.7	96.9	1.6	96.9	25.3	1.7	94.9
Se	19.4	4.9	96.9	979.2	3.7	97.9	21.8	3.4	99.2
Mo	19.9	2.3	99.4	1008.1	1.7	100.8	44.7	1.8	95.5
Ag	52.2	2.0	104.4	102.7	1.8	102.7	7.7	2.6	101.2
Cd	20.4	2.3	101.8	99.1	2.3	99.1	22.7	1.7	99.7
Sn	17.7	3.3	88.4	87.9	2.5	87.9			
Sb	20.1	3.1	100.7	93.5	7.3	93.5	13.4	1.4	96.8
Te	97.2	2.3	97.2	1014.9	2.1	101.5			
Ba	105.1	1.7	105.1	1033.2	1.4	103.3	148.2	1.5	100.1
Hg	0.5	7.5	96.3	2.0	7.5	101.3			
Tl	95.7	2.2	95.7	994.9	1.4	99.5			
Pb	95.1	2.0	95.1	972.1	1.4	97.2	26.4	1.8	94.5
Average		**2.8**	**99.2**		**2.8**	**98.2**		**2.0**	**97.4**

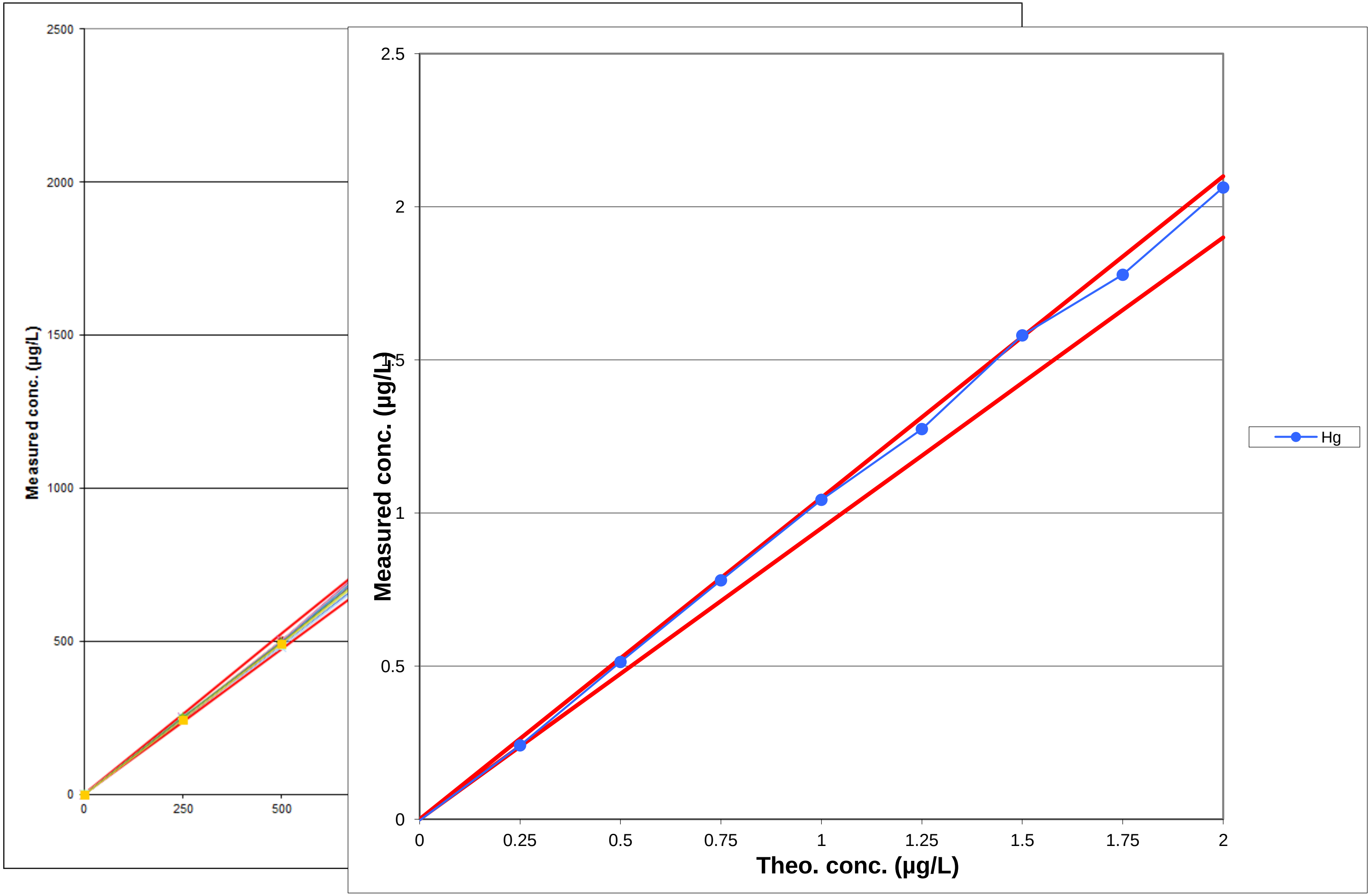
Method validation (precision and recovery)



Method validation (Linearity 5% rule)



Method validation (Linearity 5% rule)



Method validation (Linearity 5% rule)

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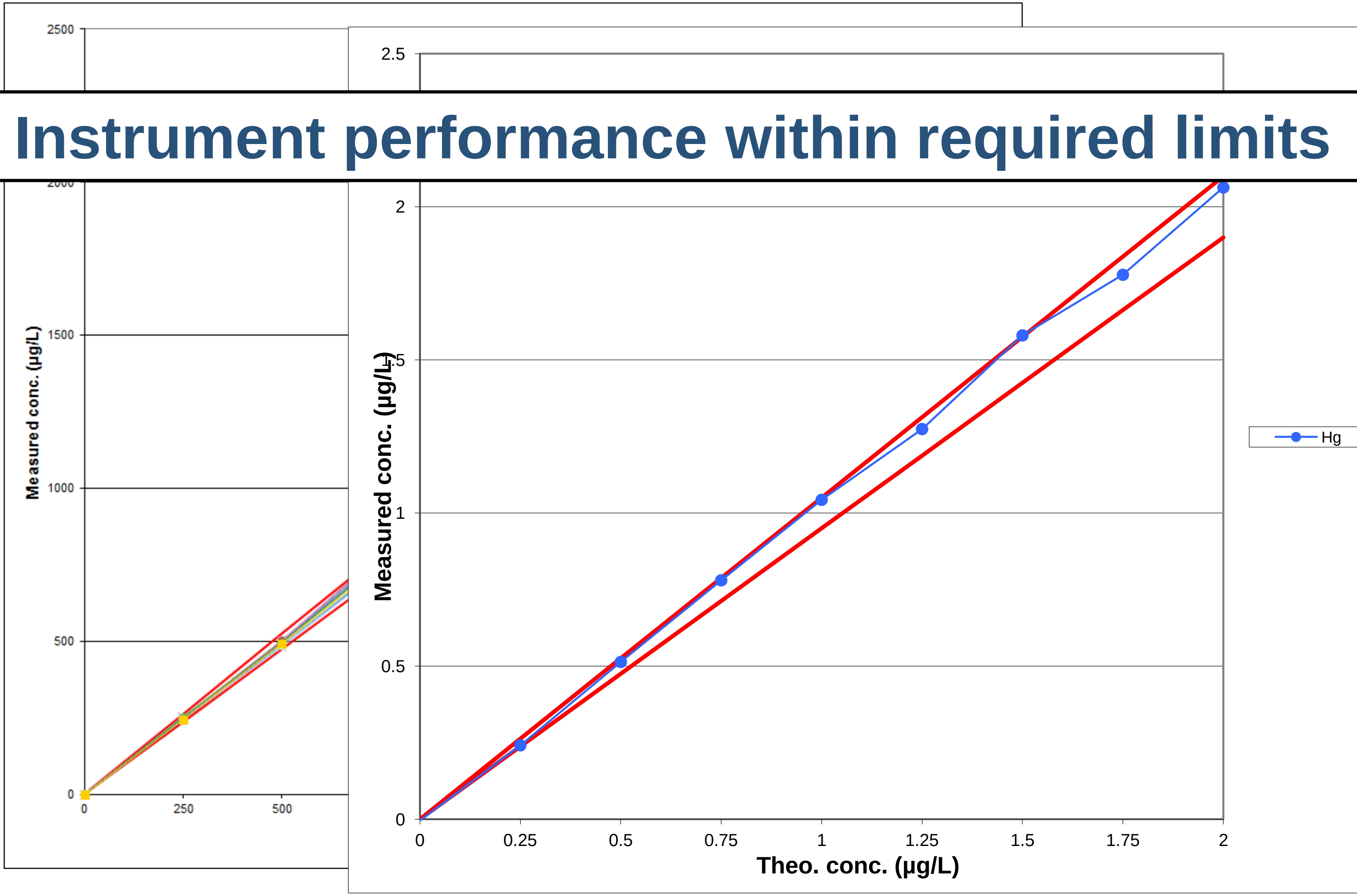
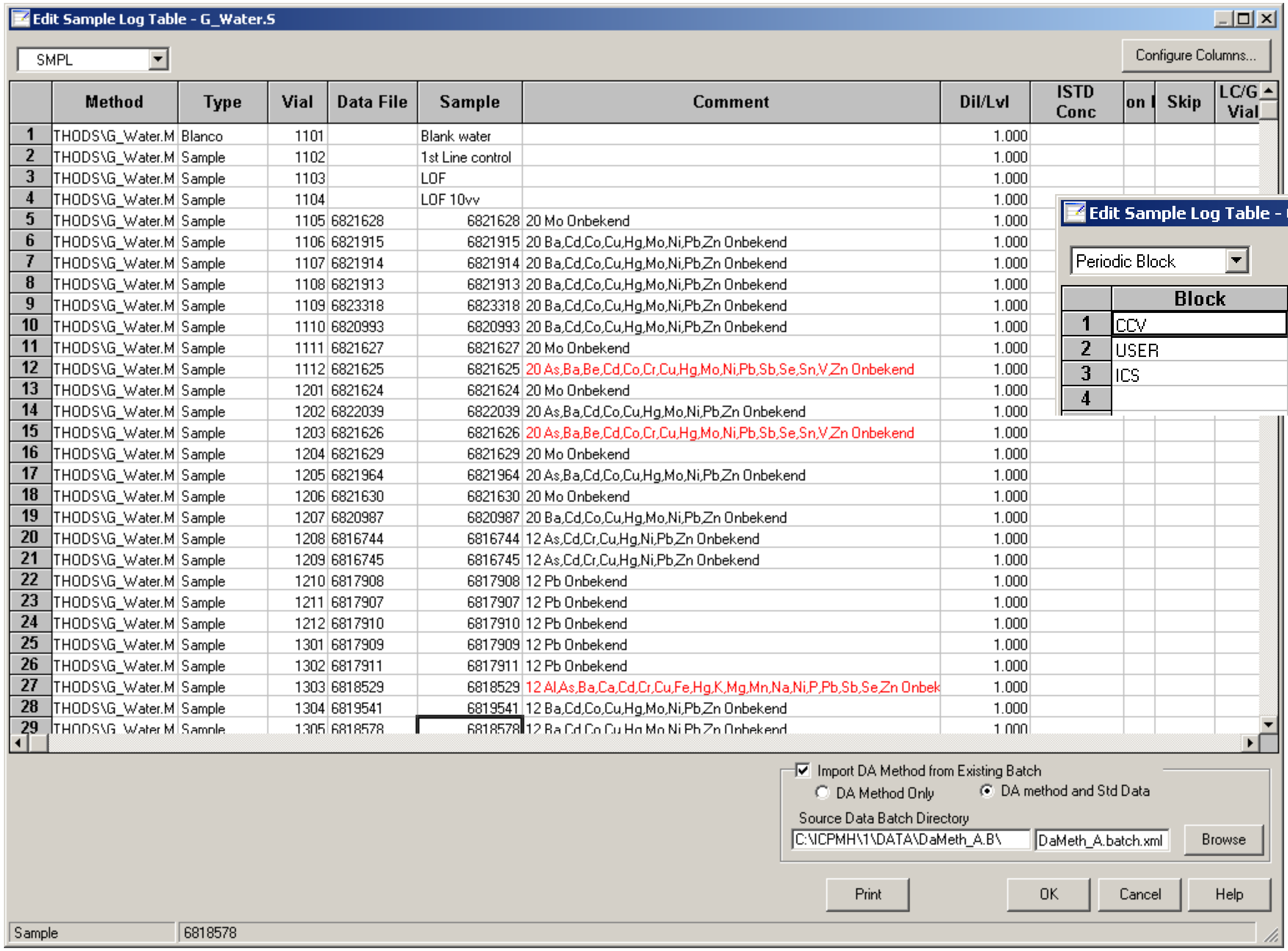
Instrument performance within required limits



Running samples (sequence)



Edit Sample Log Table - G_Water.S

SMPL

Configure Columns...

	Method	Type	Vial	Data File	Sample	Comment	Dil/Lvl	ISTD Conc	on l	Skip	LC/G Vial
1	THODS\G_Water.M	Blanco	1101		Blank water		1.000				
2	THODS\G_Water.M	Sample	1102		1st Line control		1.000				
3	THODS\G_Water.M	Sample	1103		LOF		1.000				
4	THODS\G_Water.M	Sample	1104		LOF 10vv		1.000				
5	THODS\G_Water.M	Sample	1105	6821628	6821628	20 Mo Onbekend	1.000				
6	THODS\G_Water.M	Sample	1106	6821915	6821915	20 Ba,Cd,Co,Cu,Hg,Mo,Ni,Pb,Zn Onbekend	1.000				
7	THODS\G_Water.M	Sample	1107	6821914	6821914	20 Ba,Cd,Co,Cu,Hg,Mo,Ni,Pb,Zn Onbekend	1.000				
8	THODS\G_Water.M	Sample	1108	6821913	6821913	20 Ba,Cd,Co,Cu,Hg,Mo,Ni,Pb,Zn Onbekend	1.000				
9	THODS\G_Water.M	Sample	1109	6823318	6823318	20 Ba,Cd,Co,Cu,Hg,Mo,Ni,Pb,Zn Onbekend	1.000				
10	THODS\G_Water.M	Sample	1110	6820993	6820993	20 Ba,Cd,Co,Cu,Hg,Mo,Ni,Pb,Zn Onbekend	1.000				
11	THODS\G_Water.M	Sample	1111	6821627	6821627	20 Mo Onbekend	1.000				
12	THODS\G_Water.M	Sample	1112	6821625	6821625	20 As,Ba,Be,Cd,Co,Cr,Cu,Hg,Mo,Ni,Pb,Sb,Se,Sn,V,Zn Onbekend	1.000				
13	THODS\G_Water.M	Sample	1201	6821624	6821624	20 Mo Onbekend	1.000				
14	THODS\G_Water.M	Sample	1202	6822039	6822039	20 As,Ba,Cd,Co,Cu,Hg,Mo,Ni,Pb,Zn Onbekend	1.000				
15	THODS\G_Water.M	Sample	1203	6821626	6821626	20 As,Ba,Be,Cd,Co,Cr,Cu,Hg,Mo,Ni,Pb,Sb,Se,Sn,V,Zn Onbekend	1.000				
16	THODS\G_Water.M	Sample	1204	6821629	6821629	20 Mo Onbekend	1.000				
17	THODS\G_Water.M	Sample	1205	6821964	6821964	20 As,Ba,Cd,Co,Cu,Hg,Mo,Ni,Pb,Zn Onbekend	1.000				
18	THODS\G_Water.M	Sample	1206	6821630	6821630	20 Mo Onbekend	1.000				
19	THODS\G_Water.M	Sample	1207	6820987	6820987	20 Ba,Cd,Co,Cu,Hg,Mo,Ni,Pb,Zn Onbekend	1.000				
20	THODS\G_Water.M	Sample	1208	6816744	6816744	12 As,Cd,Cr,Cu,Hg,Ni,Pb,Zn Onbekend	1.000				
21	THODS\G_Water.M	Sample	1209	6816745	6816745	12 As,Cd,Cr,Cu,Hg,Ni,Pb,Zn Onbekend	1.000				
22	THODS\G_Water.M	Sample	1210	6817908	6817908	12 Pb Onbekend	1.000				
23	THODS\G_Water.M	Sample	1211	6817907	6817907	12 Pb Onbekend	1.000				
24	THODS\G_Water.M	Sample	1212	6817910	6817910	12 Pb Onbekend	1.000				
25	THODS\G_Water.M	Sample	1301	6817909	6817909	12 Pb Onbekend	1.000				
26	THODS\G_Water.M	Sample	1302	6817911	6817911	12 Pb Onbekend	1.000				
27	THODS\G_Water.M	Sample	1303	6818529	6818529	12 Al,As,Ba,Ca,Cd,Cr,Cu,Fe,Hg,K,Mg,Mn,Na,Ni,P,Pb,Sb,Se,Zn Onbek	1.000				
28	THODS\G_Water.M	Sample	1304	6819541	6819541	12 Ba,Cd,Co,Cu,Hg,Mo,Ni,Pb,Zn Onbekend	1.000				
29	THODS\G_Water.M	Sample	1305	6818578	6818578	12 Ba,Cd,Co,Cu,Hg,Mo,Ni,Pb,Zn Onbekend	1.000				

☑ Import DA Method from Existing Batch

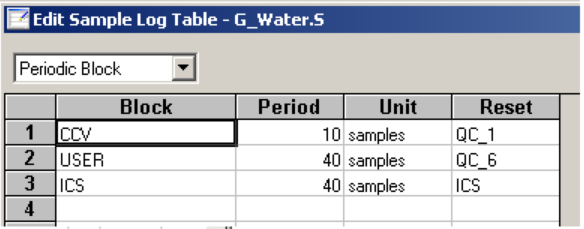
○ DA Method Only ◉ DA method and Std Data

Source Data Batch Directory

C:\ICPMH\1\DATA\DaMeth_A.B\ DaMeth_A.batch.xml Browse

Print OK Cancel Help

Sample 6818578



Edit Sample Log Table - G_Water.S

Periodic Block

	Block	Period	Unit	Reset
1	CCV	10	samples	QC_1
2	USER	40	samples	QC_6
3	ICS	40	samples	ICS
4				

Water samples are filtered in the field and acidified with 0.5% HNO_3.
In the lab 0.6% HCl will be added to stabilize mercury.

Running samples (DA method)

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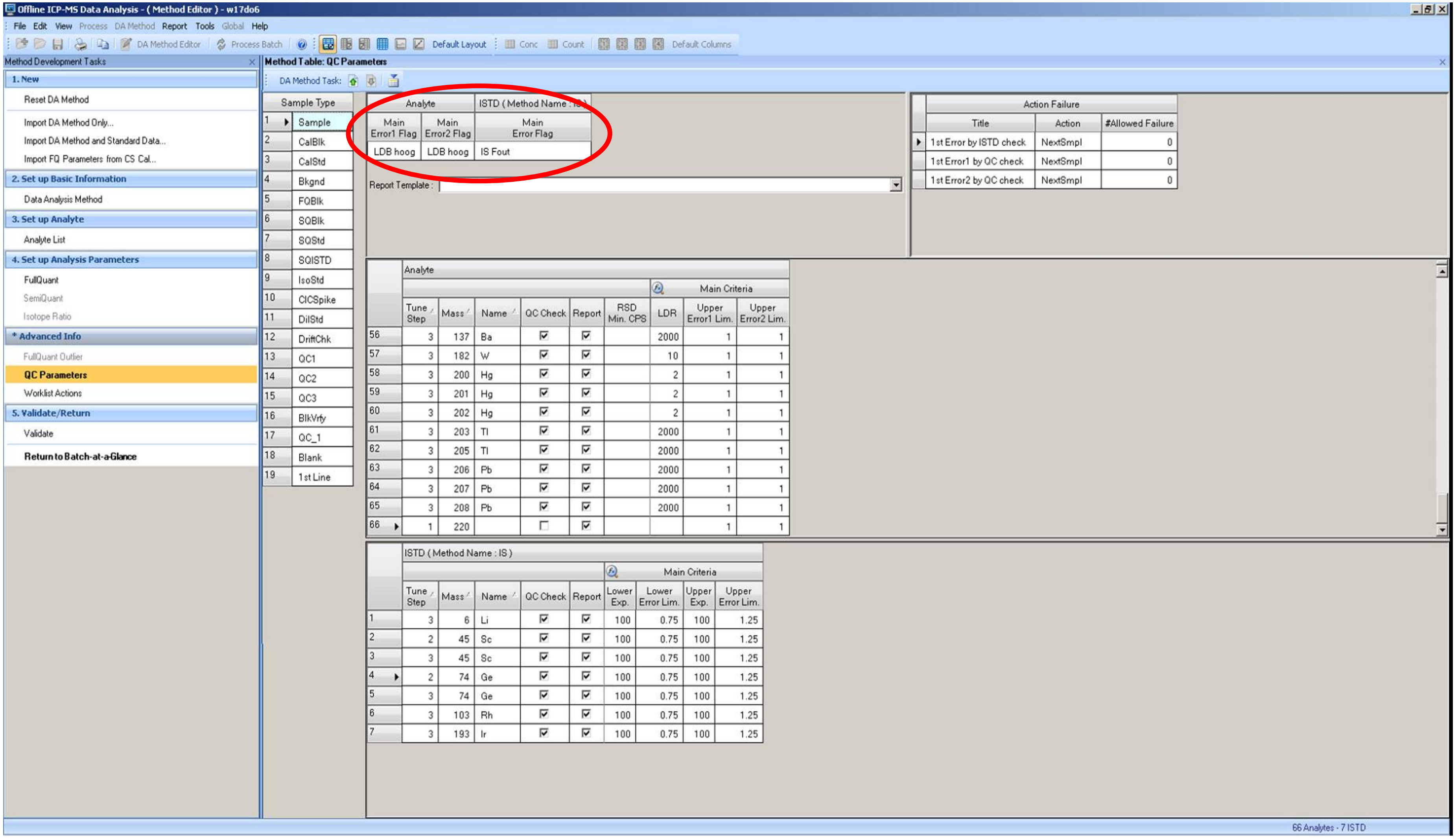


	Sample Type
1	Sample
2	CalBlk
3	CalStd
4	Bkgnd
5	FQBlk
6	SQBlk
7	SQStd
8	SQISTD
9	IsoStd
10	CICSpike
11	DilStd
12	DriftChk
13	QC1
14	QC2
15	QC3
16	BlkVrfy
17	QC_1
18	Blank
19	1st Line

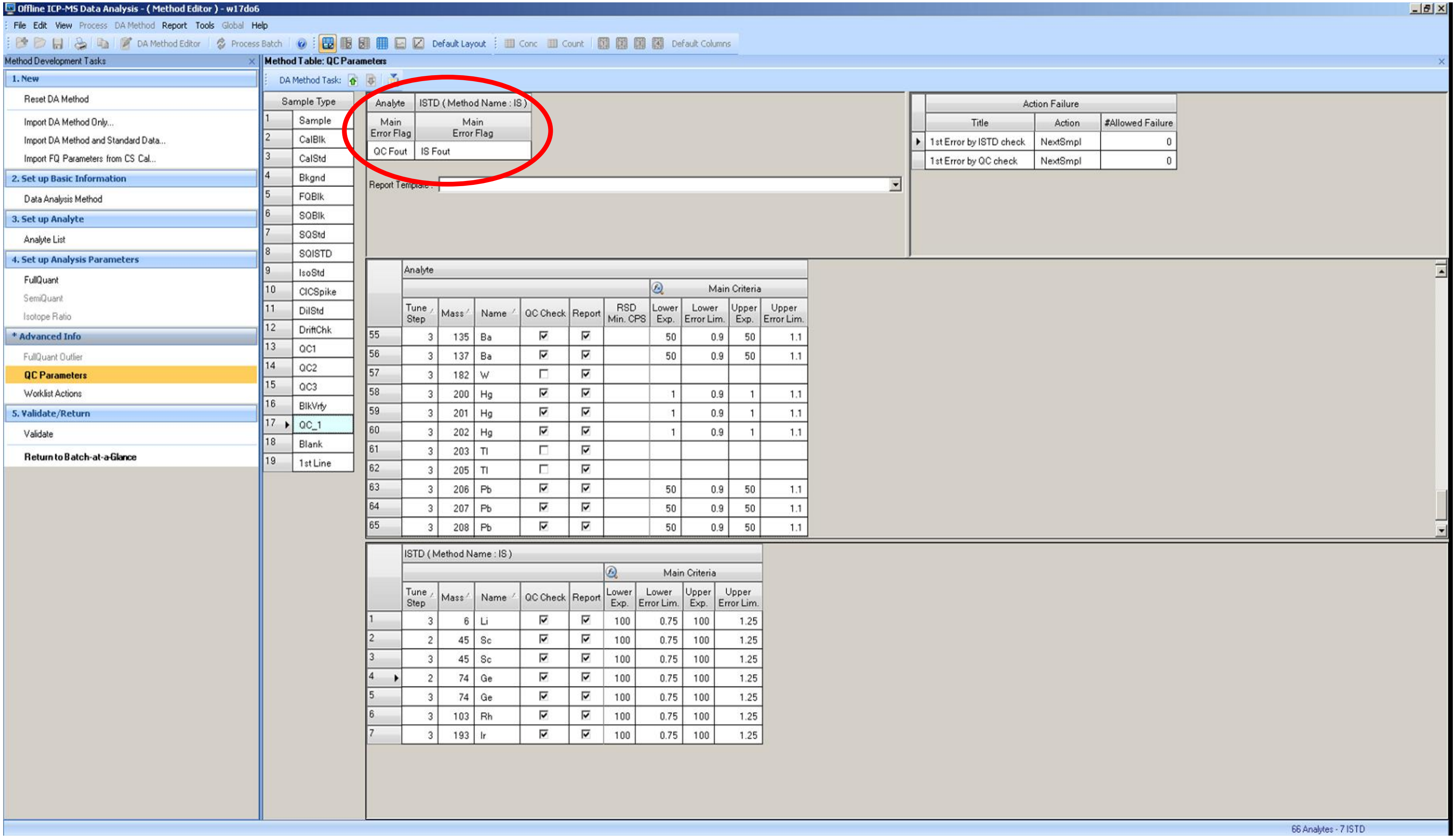
Analyte		ISTD (Method Name : IS)
Main Error1 Flag	Main Error2 Flag	Main Error Flag
LDB hoog	LDB hoog	IS Fout

Action Failure		
Title	Action	#Allowed Failure
1st Error by ISTD check	NextSmpl	0
1st Error1 by QC check	NextSmpl	0
1st Error2 by QC check	NextSmpl	0

	Analyte					Main Criteria			
	Tune Step	Mass	Name	QC Check	Report	RSD Min. CPS	LDR	Upper Error1 Lim.	Upper Error2 Lim.
56	3	137	Ba	☑	☑		2000	1	1
57	3	182	W	☑	☑		10	1	1
58	3	200	Hg	☑	☑		2	1	1
59	3	201	Hg	☑	☑		2	1	1
60	3	202	Hg	☑	☑		2	1	1
61	3	203	Tl	☑	☑		2000	1	1
62	3	205	Tl	☑	☑		2000	1	1
63	3	206	Pb	☑	☑		2000	1	1
64	3	207	Pb	☑	☑		2000	1	1
65	3	208	Pb	☑	☑		2000	1	1
66	1	220		☐	☑			1	1

	ISTD (Method Name : IS)					Main Criteria			
	Tune Step	Mass	Name	QC Check	Report	Lower Exp.	Lower Error Lim.	Upper Exp.	Upper Error Lim.
1	3	6	Li	☑	☑	100	0.75	100	1.25
2	2	45	Sc	☑	☑	100	0.75	100	1.25
3	3	45	Sc	☑	☑	100	0.75	100	1.25
4	2	74	Ge	☑	☑	100	0.75	100	1.25
5	3	74	Ge	☑	☑	100	0.75	100	1.25
6	3	103	Rh	☑	☑	100	0.75	100	1.25
7	3	193	Ir	☑	☑	100	0.75	100	1.25

Running samples (DA method)



Running samples (results)

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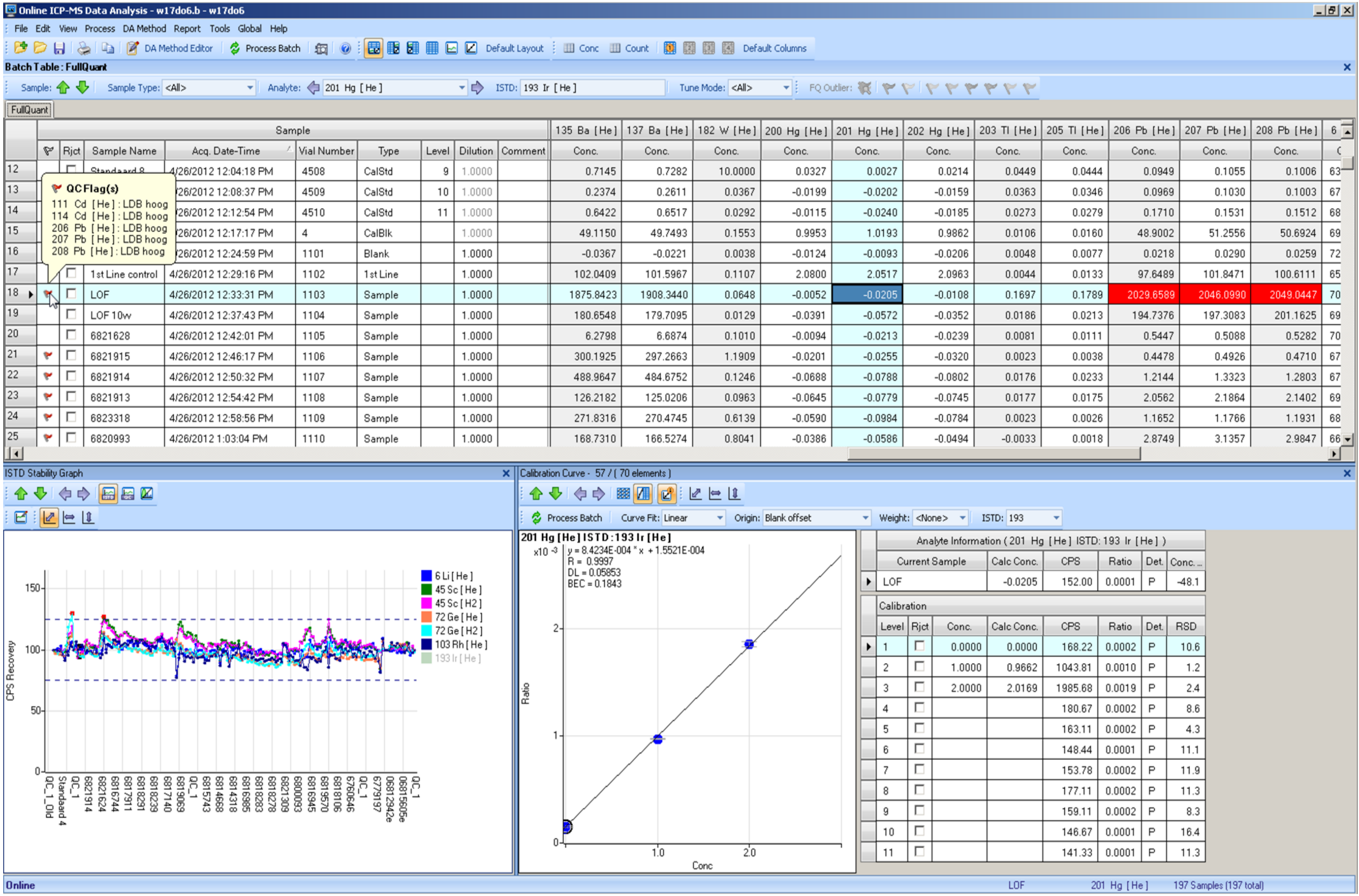

Running samples (DA results)

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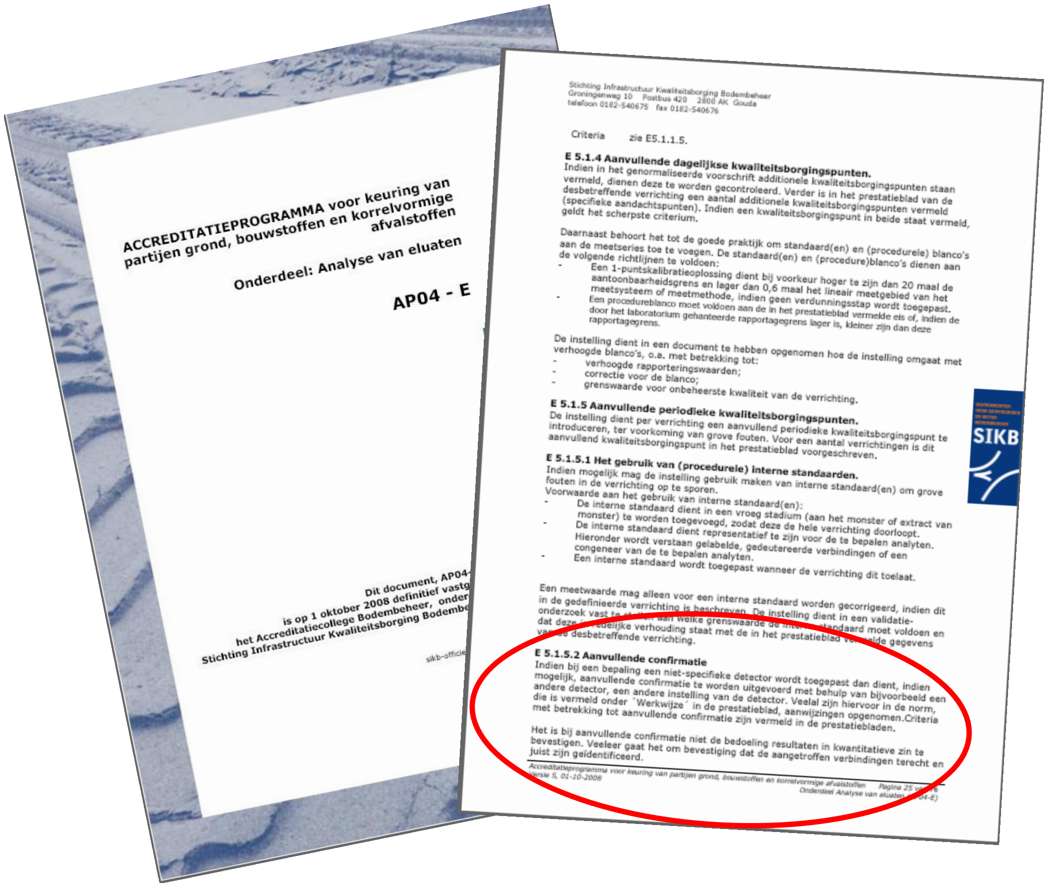


Dutch accreditation program AP-04 - regulated methods for soils and other materials

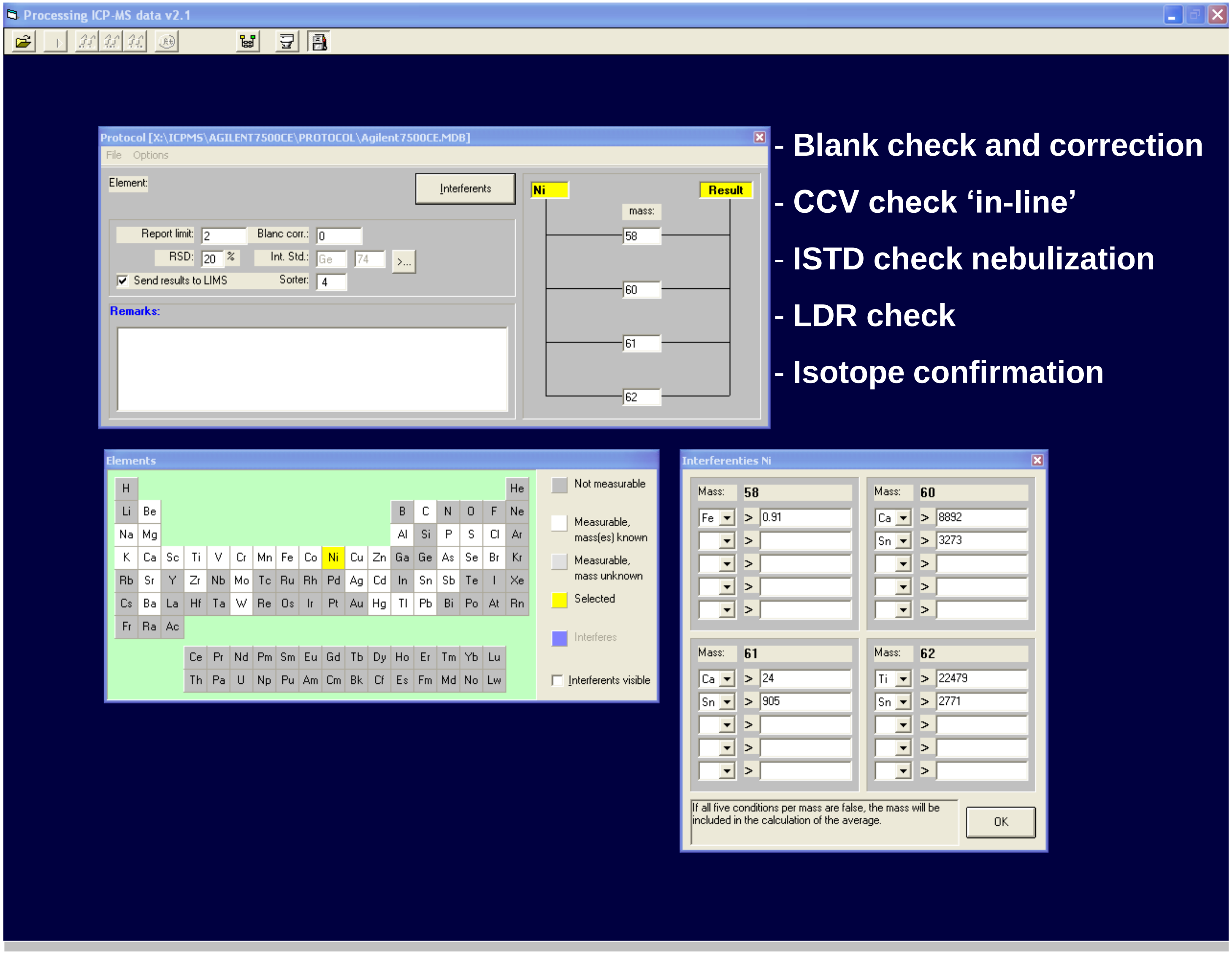
Section E 5.1.5.2: Aanvullende confirmatie (Additional confirmation)

"If a non-specific detector is used, the result should, if possible, be confirmed using another detector, or a different setting of the detector."

"Non-specific" refers to the fact that more than 1 ion may be present at each mass – i.e. the analyte measurement may be affected by the presence of interferences

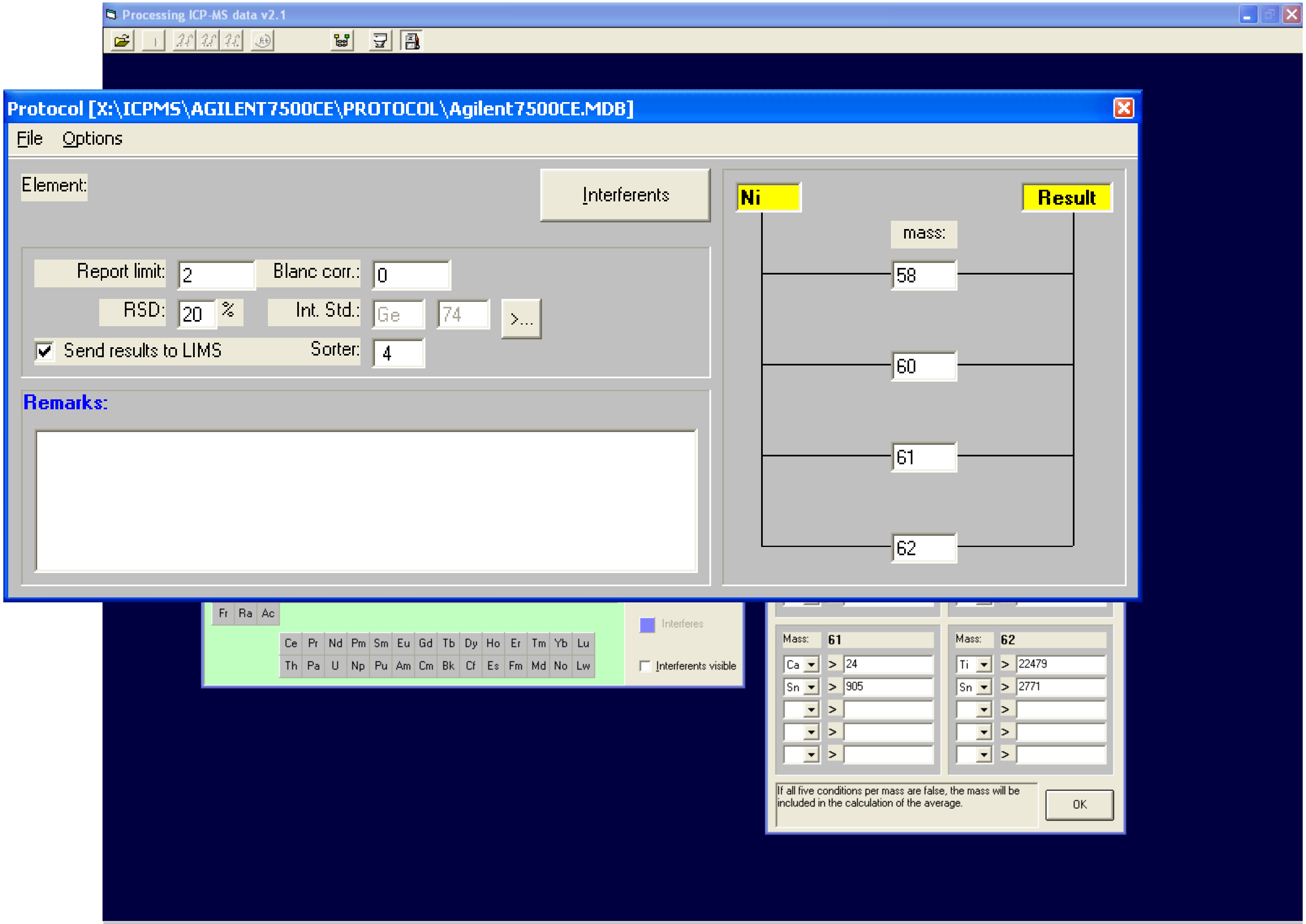
"This additional confirmation is not intended to provide a second quantitative result. ***Rather it is confirmation that the compounds detected using the first measurement are correctly identified.***"

Running samples (LIMS link)

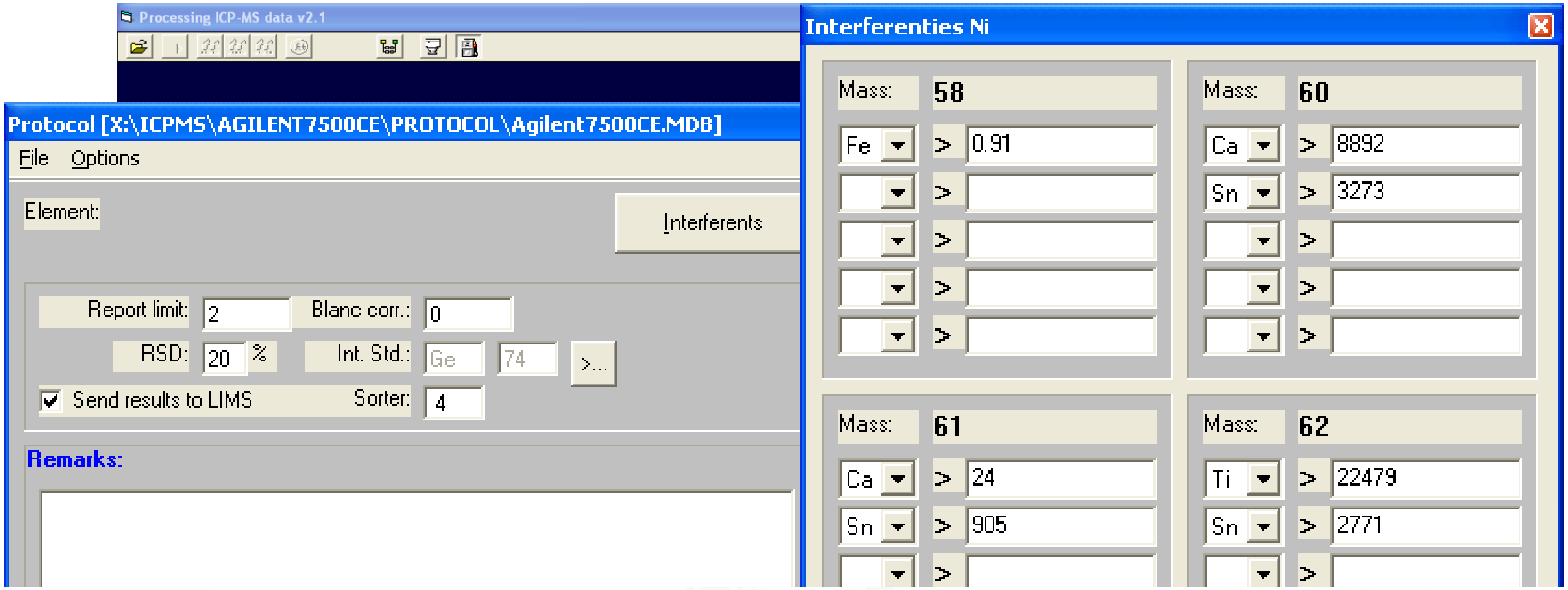


- Blank check and correction
- CCV check ‘in-line’
- ISTD check nebulization
- LDR check
- Isotope confirmation

Running samples (LIMS link)



Running samples (LIMS link)



Element	Isotope	Abundance %	Method detection limit[a] µg/l	Theoretical interferences		Interference with practical relevance	Best usable isotopes	
				Inter-element	Polyatomic ions		Preference	Reason
Ni	58	68,1	1	Fe	CaO, ArO, CaN, NaCl, MgS, CaOH, Si_2, ArOH	Fe	x	for low Fe
	60	26,2	3	—	CaO, CaOH, MgCl, NaCl	$^{44}Ca^{16}O$	x	least interference
	61	1,1	5	—	CaOH, ScO	$^{44}Ca^{16}O^{1}H$, $^{45}Sc^{16}O$		—

Running samples (LIMS link)

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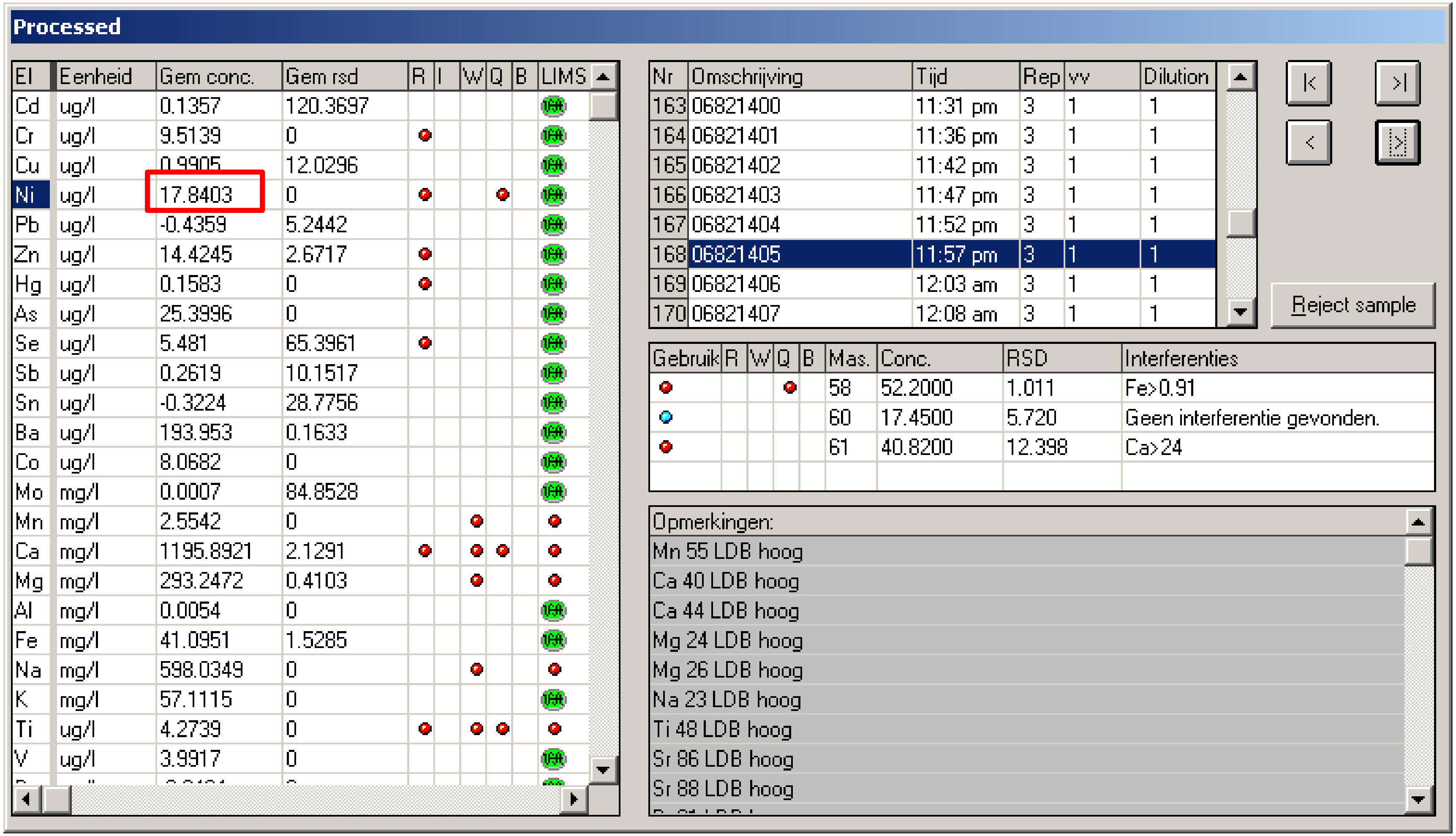
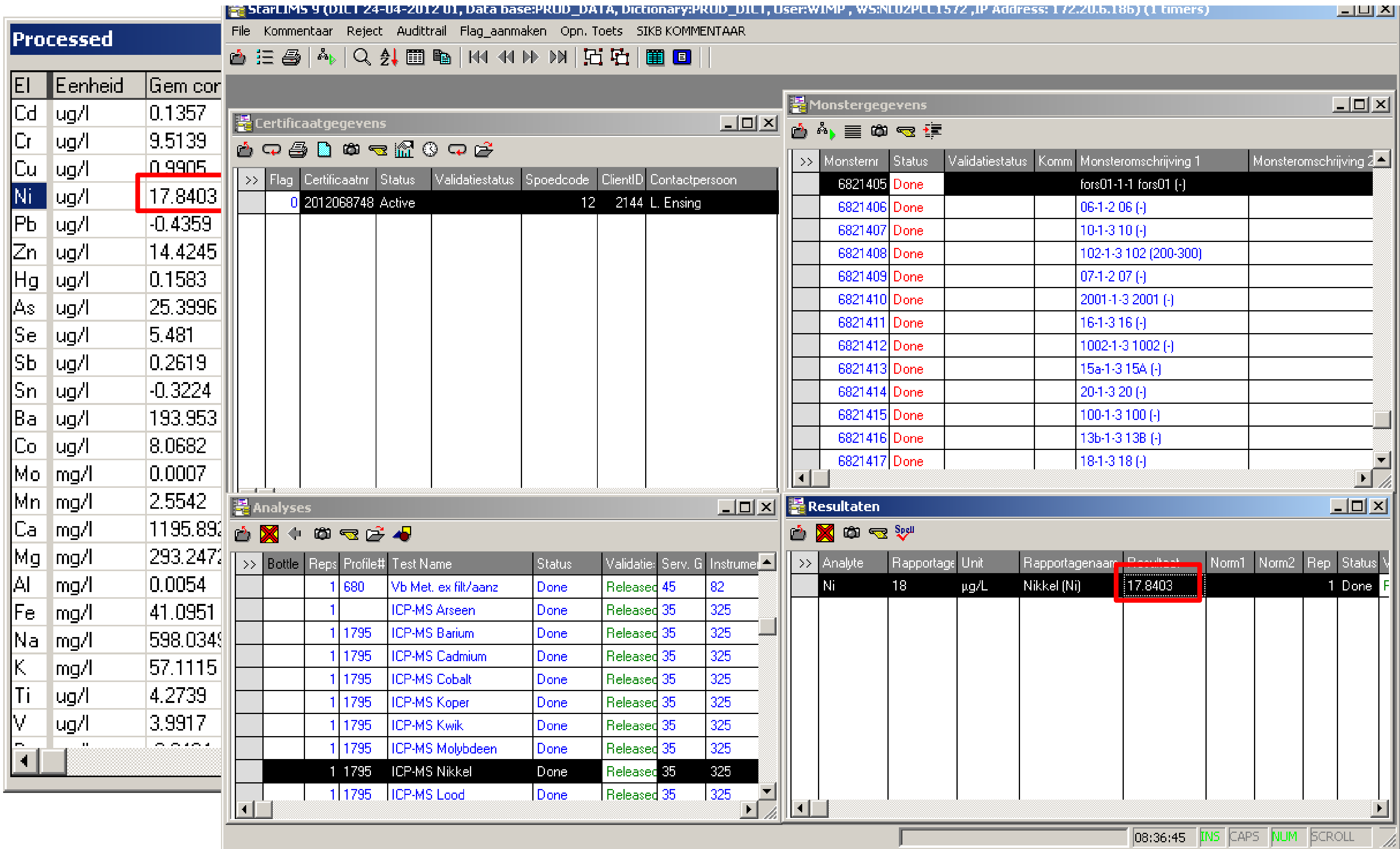


Running samples (LIMS link)



Conclusions

- Proven method since 2004.
- Tuned with robust settings, high matrix samples can be measured.
- No need to correct for interferences, only isobaric overlay.
- Instrument performance within required limits (He / H_2 mode).
- Replaced ICP-OES + AAS + Hg analyzer.
- Fully implemented in the lab.

Excellent work horse!