Certification Report

Certified Reference Material

BAM-M321

Al-Alloy 2024 AlCu4Mg1

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Summary

This report describes preparation, analysis and certification of the aluminium alloy reference material BAM-M321. The certified reference material (CRM) is available in the form of discs (65 mm diameter and 30 mm height). It is intended for establishing and checking the calibration of optical emission and X-ray spectrometers (excluding micro-analysis) for the analysis of samples of similar matrix composition. It is also suitable for validation and quality control of wet chemical analysis methods.
The following mass fractions and uncertainties have been certified:

Element	Mass fraction [1] in %	Uncertainty [2] in %
Si	0.0490	0.0022
Fe	0.0495	0.0017
Cu	4.38	0.06
Mn	0.808	0.010
Mg	1.51	0.04
Cr	0.0558	0.0013
Ni	0.0504	0.0007
Zn	0.147	0.003
Ti	0.0436	0.0022
Sc	0.0502	0.0020
Sn	0.0286	0.0010
V	0.0105	0.0003
Zr	0.1554	0.0026
	in mg/kg	in mg/kg
Be	4.9	0.2
Bi	323	14
Ca	5.2	0.8
Cd	30	4
Ga	87.9	2.0
Li	5.8	0.4
Na	2.9	0.9
Pb	99	6

1 Unweighted mean value of the means of accepted sets of data (consisting of at least 6 single results), each set being obtained by a different laboratory and/or a different method of measurement.
2 Estimated expanded uncertainty U with a coverage factor of $k = 2$, corresponding to a level of confidence of about 95%, as defined in the ISO/IEC Guide 98-3:2008 [Uncertainty of measurement -- Part 3: Guide to the Expression of Uncertainty in Measurement (GUM:1995)].

This report contains detailed information on the preparation of the CRM as well as on homogeneity investigations and on the analytical methods used for certification analysis.
The certified values are based on the results of eleven laboratories which participated in the certification inter-laboratory comparison.

Content

List of abbreviations
(if not explained elsewhere)

CRM	certified reference material
FAAS	flame atomic absorption spectrometry
ETAAS	Electrothermal atomic absorption spectrometry
ICP-OES	inductively coupled plasma optical emission spectrometry
ICP-MS	inductively coupled plasma mass spectrometry
SOES	spark optical emission spectrometry
XRF	X-ray fluorescence spectrometry
M	mean value
n	number of accepted data sets
s	standard deviation of an individual data set
s_M	standard deviation of laboratory means
s_{rel}	relative standard deviation
$\bar{s}_i$	square root of mean of variances of data sets under repeatability conditions
M_i	single result
I	ICP-OES (Tables 2 – 23)
I(R)	ICP-OES, revised value (Tables 2 – 23)
IMS	ICP-MS (Tables 2 – 23)
A	FAAS (Tables 2 – 23)
EA	ETAAS (Tables 2 – 23)
P	spectrophotometry (Tables 2 – 23)
-s	dissolution in acid (Tables 2 – 23)
-a	dissolution in base (Tables 2 – 23)

1. Introduction

In the metal-producing and metal-working industry mainly spark emission spectrometry (SOES) and X-ray fluorescence spectrometry (XRF) are used for reception inspection of raw materials, e.g. scrap, for quality control of end products and production control. These time-saving analytical techniques require suitable reference materials for calibration and recalibration. The certified reference material BAM-M321 is based on the aluminium alloy AA2024 AlCu4Mg with extra addition of Sc, which is mainly used in the aircraft industry.

The CRM was produced in close cooperation with the working group „Aluminium" of the Committee of Chemists of the Society of Metallurgists und Miners (GDMB). Since all the laboratories participating in this certification project are highly experienced with aluminium analysis and had already participated in earlier inter-laboratory comparisons, there was no preceding round robin for qualification necessary.
Certification was carried out on the basis of ISO 17034 [1] and the relevant ISO-Guides [2, 3].

2. Companies/laboratories involved

Manufacturing of the material:

– Constellium, Centre de Recherches de Voreppe, Voreppe, France

Test for homogeneity:

– Bundesanstalt für Materialforschung und -prüfung (BAM), Berlin, Germany
– Constellium, Centre de Recherches de Voreppe, Voreppe, France

Participants in the certification inter-laboratory comparison:

Aleris Aluminum Duffel BVBA, Duffel, Belgium
Aleris Rolled Products Germany GmbH, Koblenz, Germany
AMAG Austria Metall AG, Ranshofen, Austria
Bundesanstalt für Materialforschung und -prüfung (BAM), Berlin, Germany
Constellium, Centre de Recherches de Voreppe, Voreppe, France
Hydro Aluminium Rolled Products GmbH, R&D, Bonn, Germany
Hydro Aluminium Rolled Products GmbH, Hamburg, Germany
Institute of Non-Ferrous Metals, Gliwice, Poland
Leichtmetall Aluminium Giesserei Hannover GmbH, Hannover, Germany
Otto Fuchs KG, Meinerzhagen, Germany
TRIMET Aluminium SE, Essen, Germany

Statistical evaluation of the data:

– Bundesanstalt für Materialforschung und -prüfung (BAM), Berlin, Germany

3. Candidate material

The candidate material was produced by Constellium, Centre de Recherches de Voreppe, Voreppe, France. About 500 kg of an aluminium melt were doped with the desired elements. The melt was cast into six rods (A – F) with a length of 3775 mm each. 250 mm on both ends of each rod were discarded. The rods were cut into segments of 800 mm length (A1, A2, A3, A4, B1, B2, ..., F3, F4). Between the segments 15-mm discs (AA, AB, AC, AD, AE, BA, BB, ..., FD, FE) were taken for homogeneity testing (see Fig. 1).

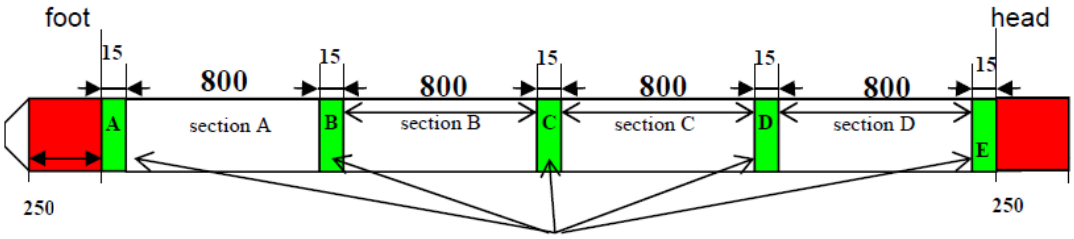


Fig.1: Preparation of the rods cast (all figures in mm)

In total, approx. 500 discs with a diameter of ca. 65 mm and 30 mm height were obtained.

4. Homogeneity testing

Possible reasons for an inhomogeneous distribution of elements in the raw material may be a change of the composition of the melt during the casting procedure because some elements may volatize or because of possible segregation during the solidification of the material. Since the raw material was produced by casting of a rod, concentration gradients can occur over the length of the rod (axial) as well as over the area of the rod (radial, see Figure 2):

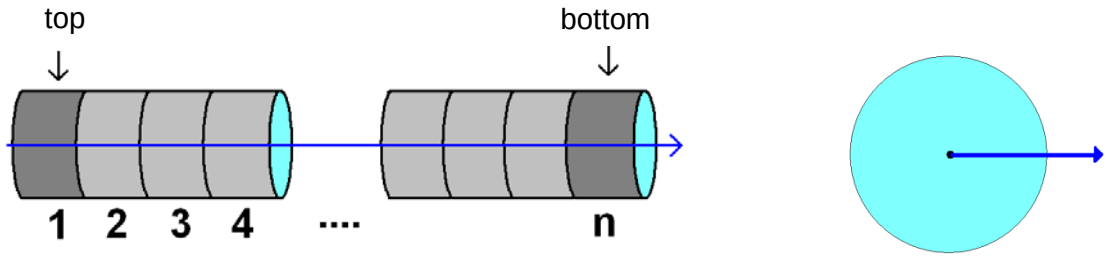


Fig. 2: Axial and radial composition gradient

Therefore, it is necessary to investigate the raw material for both axial and radial inhomogeneities. Radial homogeneity testing of the candidate material using spark emission spectrometry was performed at Constellium, Centre de Recherches de Voreppe on the discs taken from the rods as shown in Fig. 1. In total 30 discs were investigated, this corresponds to 6 % of the whole batch. For the elements Zn and Sc XRF was used to investigate homogeneity. This was done in BAM.
The estimate of analyte-specific inhomogeneity contribution u_{bb} to be included into the total uncertainty budget was calculated according to ISO Guide 35 [3] using Eq. (1) and Eq. (2):

$$s_{bb} = \sqrt{\frac{MS_{among} - MS_{within}}{n}} \qquad (1)$$

$$u^{*}_{bb} = \sqrt{\frac{MS_{within}}{n}} \sqrt[4]{\frac{2}{N(n-1)}} \qquad (2)$$

where:

MS_{among}	mean of squared deviations between discs (from 1-way ANOVA, see Annex 1)
MS_{within}	mean of squared deviations within one disc (from 1-way ANOVA)
n	number of replicate measurements per disc
N	number of discs selected for homogeneity study

s_{bb} signifies the between-discs standard deviation whereas u^{*}_{bb} denotes the maximum heterogeneity that can potentially be hidden by an insufficient repeatability of the applied measurement method (which has to be considered as the minimum uncertainty contribution). In any case the larger of the two values was used as $u_{bb}(1)$. Eq. (1) does not apply if MS_{within} is larger than MS_{among}.

In addition to the tests performed over the length of the rods three discs were tested for homogeneity over the area (possible segregation from the outer part to the centre). To perform this test SOES analysis was carried out in circles (outer circle: 16 sparks, mean circle: 16 sparks, inner circle: 8 sparks; centre: 1 spark). For Sc data from the accompanying spark emission round robin test was used because there was no Sc-channel implemented in the BAM-spectrometer. Calculation was done in the same way as for the other elements while the number of sparks were different (outer circle: 4 sparks, inner circle: 4 sparks; centre: 1 spark).

The analyte-specific within-disc uncertainty component $u_{bb}(2)$ was calculated in the same way as for the total batch. To calculate the necessary data an unbalanced ANOVA was carried out taking into account that the number of single measurements is different for the centre, the inner and the outer circle. For technical reasons, at r_0 (centre) only one measurement is possible. An ANOVA requires a minimum of two measurements per factor value. Thus, the value for r_0 should be replaced by a dummy. This dummy is defined as follows:

The two values replacing the one measured have a mean equal to the value measured, and a standard deviation equal to the average within-variation. This resembles the situation where one could take two independent measurements at the same place, with values deviating by the average standard deviation (non-destructive testing method). A first guess for the average standard deviation may be calculated from the data for r_in (inner circle), r_mean (mean circle) and r_out (outer circle). As results from these calculations an inhomogeneity component for the radius of the disc is obtained. From these values a combined inhomogeneity component is calculated. This component is compared with the within standard deviation calculated from the ANOVA-data. The higher component is used for uncertainty calculation.

Annex 1 and 2 show the results of the homogeneity calculations.

5. Characterisation study

5.1 Analytical methods

Eleven laboratories participated in the certification inter-laboratory comparison. All laboratories were highly experienced in the analysis of aluminium and aluminium alloys and participated successfully in former certification inter-laboratory comparisons. For some elements part of the laboratories used more than one analytical method reporting more than one data set.
The laboratories were asked to analyse six subsamples. They were free to choose any suitable analytical method. Table 1 shows the analytical methods used by the participating laboratories.
For all analytical methods where a calibration was necessary this calibration was performed using liquid standard solutions. All participating laboratories were asked to use only standard solutions prepared from pure metals or stoichiometric compounds or well checked commercial calibration solutions.

Table 1: Analytical procedures used by the participating laboratories

Lab-No.	**Element**	**Sample mass**	**Sample pretreatment**	**Analytical method**
1	Si, Fe, Cu, Mn, Mg, Cr, Ni, Zn, Ti, Sc, Sn, V, Zr	0.5 g	Dissolution with NaOH	ICP-OES, commercial mono-element solutions, matrix matching with pure Al
	B, Be, Bi, Ca, Cd, Ga, Li, Na, Pb	0.5 g	Dissolution with HCl/HNO_3	ICP-OES, commercial mono-element solutions, matrix matching with pure Al
2	Si, Fe, Cu, Mn, Mg, Cr, Ni, Zn, Ti	0.5 g	Dissolution with NaOH	ICP-OES, calibration with pure metals or pure chemicals, matrix matching with pure Al (5N5)
	Sc, Zr, Ca, Li, Na	0.5 g	Dissolution with HNO_3/HF	ICP-OES, calibration with pure metals or chemicals, matrix matching with pure Al (5N5)
	V	0.5 g	Dissolution with HNO_3/HF	ICP-OES, commercial mono-element solution (Merck certipur), matrix matching with pure Al (5N5)
	Sn, B, Bi, Pb	0.5 g	Dissolution with HNO_3/HF	ICP-MS, calibration with pure metals or pure chemicals, matrix matching with pure Al (5N5)
	Be, Cd, Ga	0.5 g	Dissolution with HNO_3/HF	ICP-MS, commercial mono-element solution (Merck certipur), matrix matching with pure Al (5N5)
4	Si	0.5 g	Dissolution with NaOH	Spectrophotometry, commercial mono-element solution, matrix matching with pure Al
	Fe, Cu, Mn, Mg, Cr, Ni, Zn, Ti, Sc, Sn, V, Zr	0.2 g	Dissolution with HNO_3/HCl	ICP-OES, commercial mono-element solutions, matrix matching with pure Al
	B, Be, Bi, Ca, Cd, Ga, Li, Na, Pb	1 g	Dissolution with HNO_3/HCl	ICP-OES, commercial mono-element solutions, matrix matching with pure Al
5	Si, Fe, Cu, Mn, Mg, Cr, Ni, Zn, Ti, Sc, Sn, V, Zr, Bi, Pb	0.5 g	Dissolution with NaOH	ICP-OES, commercial mono-element solutions (NIST)
6	Si, Ti, Be	0.5 g	Dissolution with NaOH	ICP-OES, calibration with pure metals or pure chemicals, matrix matching with pure Al
	Fe, Cu, Mn, Mg, Cr, Ni, Zn, Sc, Sn, V, Zr, Bi, Cd, Ga, Li, Pb	0.5 g	Dissolution with $HCl/HNO_3/H_2O_2$	ICP-OES, calibration with pure metals or pure chemicals, matrix matching with pure Al

Table 1 (cont.): Analytical procedures used by the participating laboratories

Lab-No.	Element	Sample mass	Sample pretreatment	Analytical method
7	Si, Fe, Cu, Mn, Mg, Cr, Ni, Zn, Ti, Sc, Sn, V, Zr, Bi, Cd, Ga, Pb	0.5 g	Dissolution with HNO_3/HCl/HF	ICP-OES, calibration with matrix matched standards, commercial multi-element standard solutions
	Fe, Cr, Zn, Sn, V, Zr, Be, Bi, Cd, Ga, Li, Pb	0.5 g	Dissolution with HNO_3/HCl/HF	ICP-MS, with matrix matched standards, commercial mono-element standard solutions (Perkin Elmer)
8	Si, Fe, Cu, Mn, Mg, Cr, Ni, Zn, Ti, Sc, Sn, V, Zr, B, Be, Bi, Cd, Ga, Li, Pb	0.3 g	Dissolution with NaOH/HNO_3	ICP-OES with matrix matched standards, commercial mono-element solutions (Merck)
	Si, Fe, Cu, Mn, Mg, Cr, Ni, Zn, Ti, Sc, Sn, V, Zr, B, Be, Bi, Cd, Ga, Li, Pb	0.3 g	Dissolution with HCl/H_2O_2	ICP-OES with matrix matched standards, commercial mono-element solutions (Merck)
9	Si, Mn	0.25 g	Dissolution with NaOH	Spectrophotometry, calibration with commercial mono-element solutions (Merck)
	Fe	0.5 g	Dissolution with HCl/H_2O_2	Spectrophotometry, calibration with commercial mono-element solutions (Merck)
	Zr	0.5 g	Dissolution with NaOH,	Spectrophotometry, calibration with commercial mono-element solutions (Merck)
	Fe, Cu, Mn, Mg, Zn	1 g	Dissolution with HCl/H_2O_2	FAAS, calibration with matrix matched standards, calibration with commercial mono-element solutions (Merck)
	Na	0.25 g	Dissolution with HCl/HNO_3/HF	ETAAS, calibration with commercial mono-element solution (Merck)
	Fe, Mn, Mg, Cr, Ni, Ti, Sc, Sn, V, Zr, Be, Ca, Cd, Ga, Li, Na, Pb	1 g	Dissolution with HCl/HNO_3	ICP- OES, calibration with matrix matched standards, commercial mono-element solutions
	Mg	0.25 g	Dissolution with NaOH	ICP-OES, calibration with matrix matched standards, commercial mono-element solution
10	Si, Fe, Cu, Mn, Mg, Cr, Ni, Ti, Sn, V, Zr, Be, Cd, Ga, Pb	0.25 g	Dissolution with NaOH/HNO_3	ICP-OES, calibration with commercial mono-element solutions
12	Si, Fe, Cu, Mn, Mg, Cr, Ni, Ti, Sc, Sn, V, Zr, B, Be, Bi, Cd, Ga, Li, Pb	0.5 g	Dissolution with NaOH/HNO_3	ICP-OES, calibration with matrix matched standards, commercial mono-element solutions (Merck certipur)
15	Si, Fe, Cu, Mn, Mg, Cr, Ni, Ti, Sn, V, Zr, Bi, Cd, Li, Pb	0.5 g	Dissolution with NaOH	ICP-OES, calibration with matrix matched standards, commercial mono-element solutions (Merck certipur)

5.2 Analytical results and statistical evaluation

The analytical results of the inter-laboratory certification comparison are listed in Tables 2 to 23. These tables show the single results (M_i) of each laboratory, the respective laboratories' mean values (M), absolute and relative intra-laboratory standard deviation (s and s_{rel}, respectively), the standard deviation of laboratory means (s_M), and in addition the square root of mean of variances of data sets under repeatability conditions ($\bar{s}_i$) where n is the number of accepted data sets. The continuous line marks the certified value (mean of the laboratories' means), the broken lines mark the standard deviation, calculated from the laboratories' means.
In the related figures for each laboratory its mean value and single standard deviation is given. Outliers which have been excluded are highlighted in yellow.

Table 2: Results for Si

Lab./Meth.	8/I-a(R)	1/I-a	12/I-a	9/P	2/I-a	7/I-s	4/P	8/I-s	5/I-a	15/I-a	6/I-a	10/I-a		
M_i [%]	0.043	0.046	0.045	0.0483	0.0488	0.0492	0.052	0.051	0.051	0.0504	0.0520	0.0517		*n*
	0.042	0.045	0.044	0.0485	0.0485	0.0493	0.050	0.050	0.051	0.0512	0.0529	0.0510		12
	0.043	0.045	0.047	0.0482	0.0489	0.0490	0.051	0.051	0.052	0.0524	0.0519	0.0515		
	0.043	0.045	0.046	0.0482	0.0484	0.0493	0.049	0.051	0.051	0.0520	0.0524	0.0513		
	0.043	0.045	0.046	0.0484	0.0486	0.0496	0.050	0.051	0.051	0.0520	0.0525	0.0544		
	0.042	0.047	0.045	0.0482	0.0486	0.0493	0.049	0.051	0.052	0.0510	0.0522	0.0545		
M [%]	**0.0425**	**0.0455**	**0.0455**	**0.0483**	**0.0486**	**0.0493**	**0.0500**	**0.0505**	**0.0513**	**0.0515**	**0.0523**	**0.0524**		**0.0490**
s [%]	0.0005	0.0008	0.0013	0.0001	0.0002	0.0002	0.0009	0.0004	0.0005	0.0008	0.0004	0.0016	s_M [%]	0.0031
													$\bar{s}_i$ [%]	0.0008
s_{rel}	0.01171	0.01839	0.02760	0.00249	0.00390	0.00394	0.01829	0.00873	0.00961	0.01469	0.00672	0.03063		0.06318

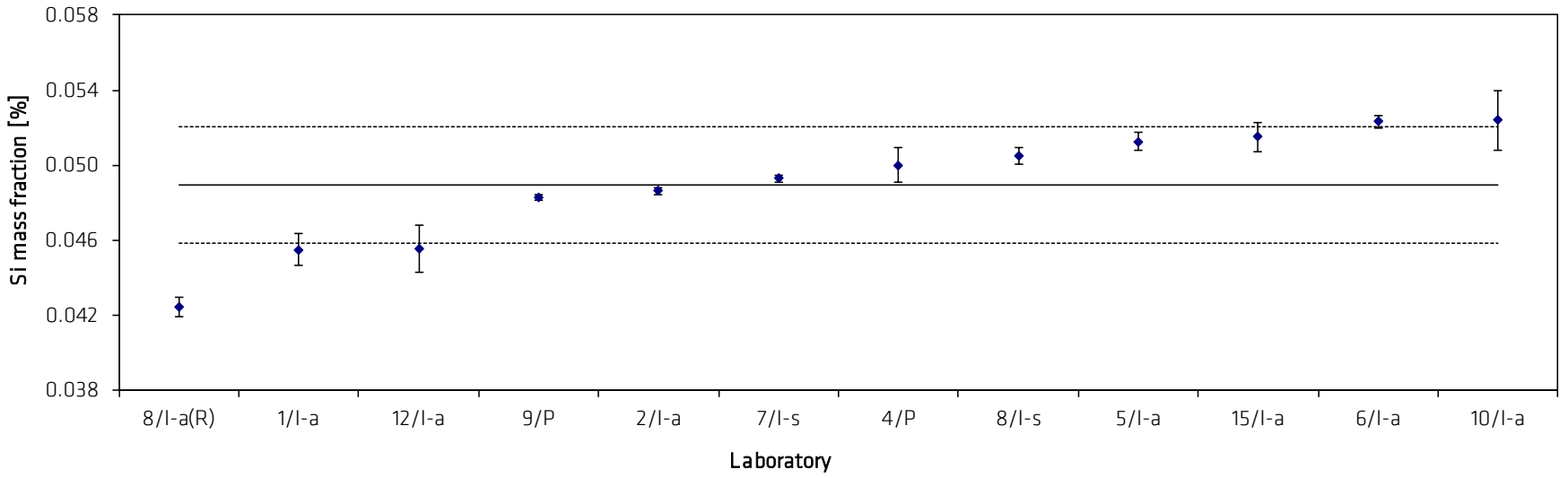


Table 3: Results for Fe

Lab./Meth.	9/I-s	9/A-s	4/I-s	6/I-s	2/I-a	1/I-a	9/P	12/I-a	5/I-a	8/I-s	10/I-a	7/I-s	8/I-a	7/IMS-s	15/I-a		
M_i [%]	0.0472	0.0480	0.0484	0.0481	0.0491	0.0490	0.0494	0.0529	0.0495	0.0500	0.0503	0.0502	0.0504	0.0504	0.0490		n
	0.0474	0.0486	0.0485	0.0504	0.0490	0.0490	0.0493	0.0527	0.0489	0.0502	0.0505	0.0495	0.0511	0.0515	0.0563		15
	0.0471	0.0473	0.0483	0.0481	0.0490	0.0490	0.0492	0.0482	0.0500	0.0498	0.0498	0.0497	0.0511	0.0512	0.0515		
	0.0470	0.0477	0.0487	0.0479	0.0489	0.0490	0.0495	0.0478	0.0499	0.0498	0.0506	0.0513	0.0514	0.0518	0.0505		
	0.0469	0.0469	0.0486	0.0476	0.0490	0.0490	0.0495	0.0488	0.0498	0.0497	0.0498	0.0505	0.0515	0.0508	0.0505		
	0.0467	0.0472	0.0484	0.0502	0.0490	0.0490	0.0490	0.0466	0.0496	0.0493	0.0504	0.0510	0.0514	0.0513	0.0505		
		0.0473					0.0494										
							0.0497										
M [%]	0.0471	0.0476	0.0485	0.0487	0.0490	0.0490	0.0494	0.0495	0.0496	0.0498	0.0502	0.0504	0.0512	0.0512	0.0514		0.0495
s [%]	0.0002	0.0006	0.0001	0.0012	0.0001	0.0000	0.0002	0.0027	0.0004	0.0003	0.0004	0.0007	0.0004	0.0005	0.0025	s_M [%]	0.0013
																$\bar{s}_i$ [%]	0.0011
s_{rel}	0.00519	0.01214	0.00304	0.02522	0.00189	0.00000	0.00453	0.05366	0.00800	0.00609	0.00697	0.01408	0.00789	0.00979	0.04939		0.02547

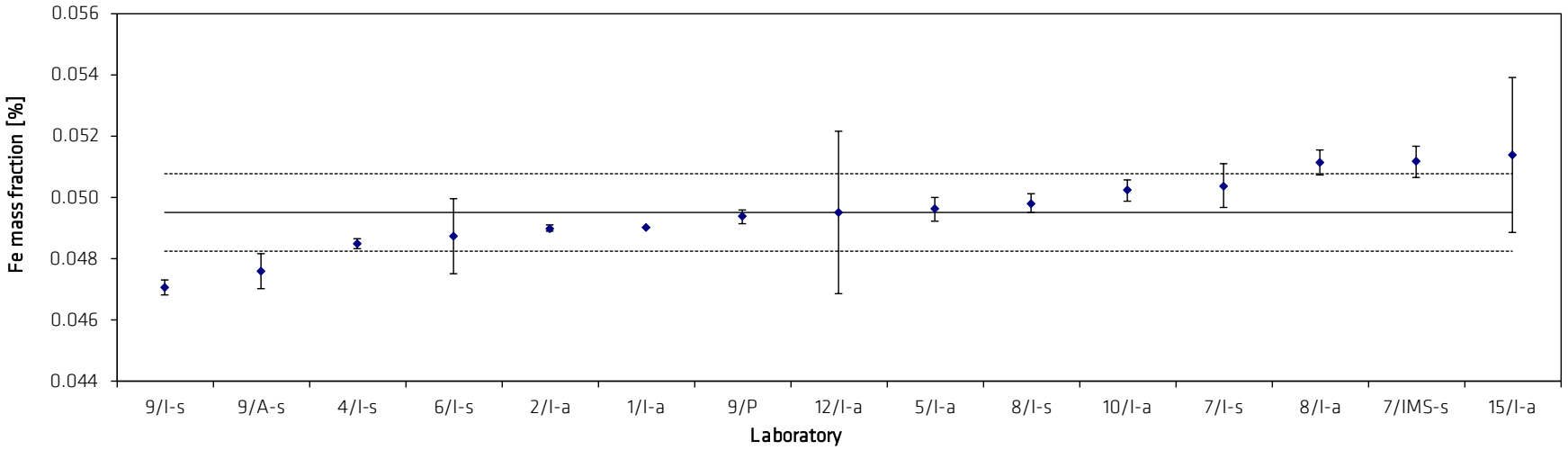


Table 4: Results for Cu

Lab./Meth.	6/I-s	7/I-s	4/I-s	15/I-a	9/A-s	12/I-a	10/I-a	1/I-a	8/I-s	2/I-a	5/I-a		
M_i [%]	4.282	4.305	4.37	4.370	4.375	4.405	4.40	4.43	4.476	4.454	4.448		*n*
	4.305	4.303	4.36	4.385	4.407	4.380	4.39	4.41	4.450	4.440	4.467		11
	4.277	4.304	4.21	4.340	4.372	4.391	4.42	4.40	4.434	4.430	4.462		
	4.260	4.310	4.38	4.388	4.371	4.391	4.40	4.41	4.410	4.449	4.467		
	4.265	4.309	4.23	4.329	4.359	4.380	4.43	4.41	4.406	4.453	4.483		
	4.259	4.301	4.38	4.365	4.386	4.392	4.37	4.41	4.399	4.447	4.486		
					4.389								
M **[%]**	**4.275**	**4.305**	**4.322**	**4.363**	**4.380**	**4.390**	**4.402**	**4.412**	**4.429**	**4.445**	**4.469**		**4.381**
s [%]	0.0174	0.0035	0.0794	0.0239	0.0156	0.0092	0.0214	0.0098	0.0300	0.0091	0.0138	s_M [%]	0.0604
												$\bar{s}_i$ [%]	0.0290
s_{rel}	0.00407	0.00081	0.01836	0.00547	0.00356	0.00210	0.00485	0.00223	0.00678	0.00204	0.00308		0.01379

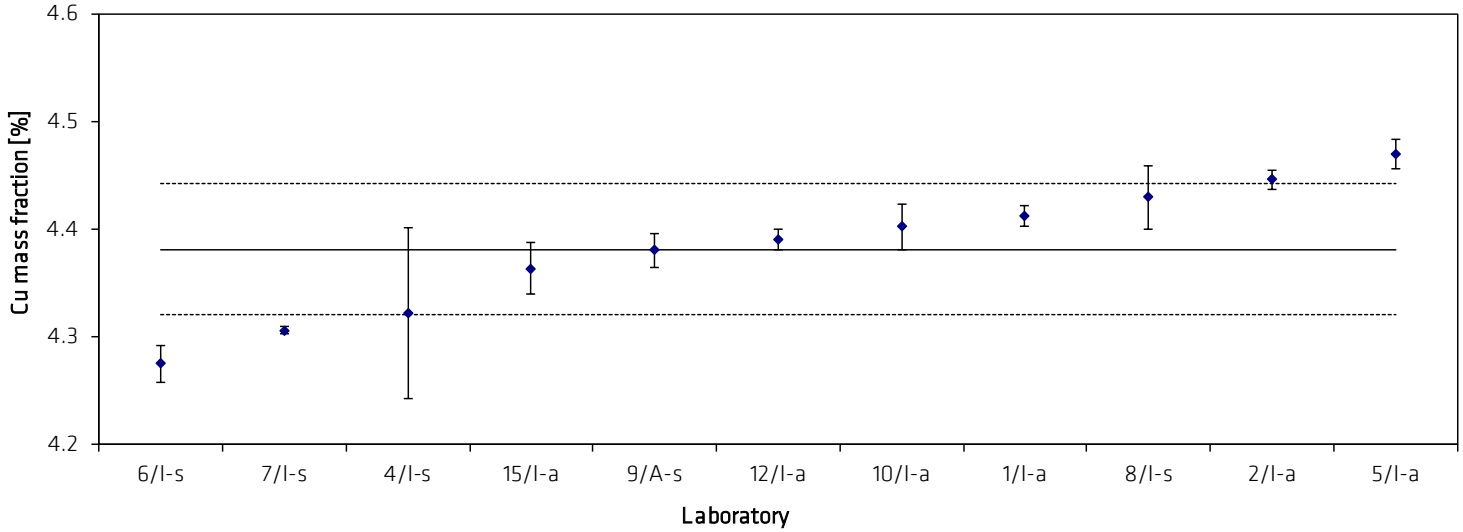


Table 5: Results for Mn

Lab./Meth.	9/I-s	8/I-a(R)	6/I-s	10/I-a	7/I-s	5/I-a	15/I-a	1/I-a	12/I-a	9/P	2/I-a	4/I-s	9/A-s	8/I-s		
M_i [%]	0.7857	0.7922	0.7952	0.792	0.8044	0.8054	0.8050	0.81	0.8179	0.8096	0.8160	0.814	0.826	0.8292		*n*
	0.7904	0.7829	0.7952	0.798	0.8029	0.8048	0.8089	0.81	0.8084	0.8160	0.8157	0.816	0.811	0.8315		14
	0.7956	0.7964	0.7977	0.792	0.8031	0.8063	0.8090	0.81	0.8112	0.8155	0.8131	0.803	0.823	0.8338		
	0.7840	0.7939	0.7918	0.793	0.8028	0.8058	0.8130	0.81	0.8116	0.8123	0.8165	0.824	0.824	0.8329		
	0.7852	0.8031	0.7918	0.797	0.8039	0.8082	0.8090	0.81	0.8098	0.8120	0.8145	0.832	0.825	0.8349		
	0.7769	0.7926	0.7941	0.804	0.8030	0.8082	0.8120	0.81	0.8112	0.8130	0.8166	0.839	0.823	0.8304		
										0.8144			0.831			
***M* [%]**	**0.786**	**0.794**	**0.794**	**0.796**	**0.803**	**0.806**	**0.809**	**0.810**	**0.812**	**0.813**	**0.815**	**0.821**	**0.823**	**0.832**		**0.808**
s [%]	0.0063	0.0066	0.0023	0.0047	0.0006	0.0014	0.0028	0.0000	0.0033	0.0022	0.0014	0.0130	0.0061	0.0021	s_M [%]	0.0128
															$\bar{s}_i$ [%]	0.0050
s_{rel}	0.00804	0.00828	0.00285	0.00589	0.00081	0.00179	0.00348	0.00000	0.00403	0.00275	0.00166	0.01589	0.00738	0.00258		0.01584

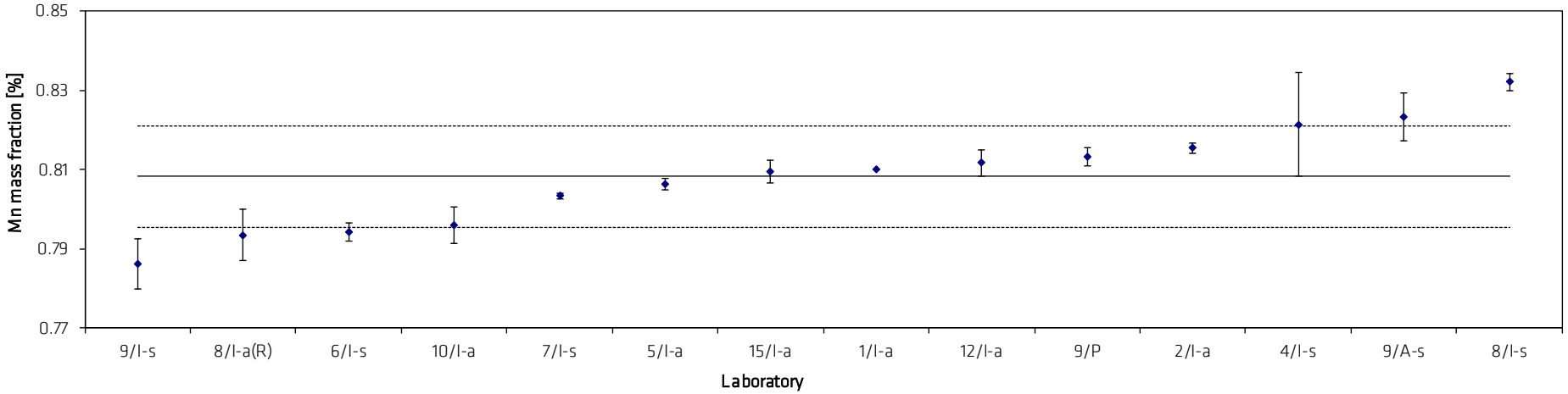


Table 6: Results for Mg

Lab./Meth.	9/I-s	9/I-a	9/A-s	4/I-s	1/I-a	8/I-s	7/I-s	5/I-a	15/I-a	12/I-a	6/I-s	2/I-a	8/I-a	10/I-a		
M_i [%]	1.466	1.489	1.510	1.480	1.50	1.502	1.503	1.501	1.507	1.518	1.516	1.523	1.518	1.54		*n*
	1.471	1.507	1.505	1.490	1.50	1.508	1.507	1.500	1.511	1.499	1.513	1.524	1.533	1.56		14
	1.472	1.496	1.494	1.510	1.49	1.498	1.497	1.501	1.506	1.517	1.517	1.517	1.539	1.55		
	1.469	1.490	1.482	1.480	1.50	1.497	1.503	1.502	1.509	1.505	1.518	1.515	1.546	1.54		
	1.473	1.489	1.484	1.500	1.50	1.496	1.512	1.512	1.498	1.509	1.513	1.515	1.549	1.55		
	1.470	1.476	1.493	1.520	1.50	1.492	1.501	1.511	1.511	1.510	1.518	1.518	1.537	1.53		
		1.487	1.484													
		1.487														
M [%]	**1.470**	**1.490**	**1.493**	**1.497**	**1.498**	**1.499**	**1.504**	**1.504**	**1.507**	**1.510**	**1.516**	**1.519**	**1.537**	**1.545**		**1.506**
s [%]	0.0026	0.0089	0.0109	0.0163	0.0041	0.0056	0.0052	0.0054	0.0049	0.0073	0.0025	0.0036	0.0111	0.0105	s_M [%]	0.0189
															$\bar{s}_i$ [%]	0.0080
s_{rel}	0.00174	0.00597	0.00732	0.01091	0.00272	0.00374	0.00343	0.00362	0.00322	0.00482	0.00167	0.00240	0.00725	0.00679		0.01257

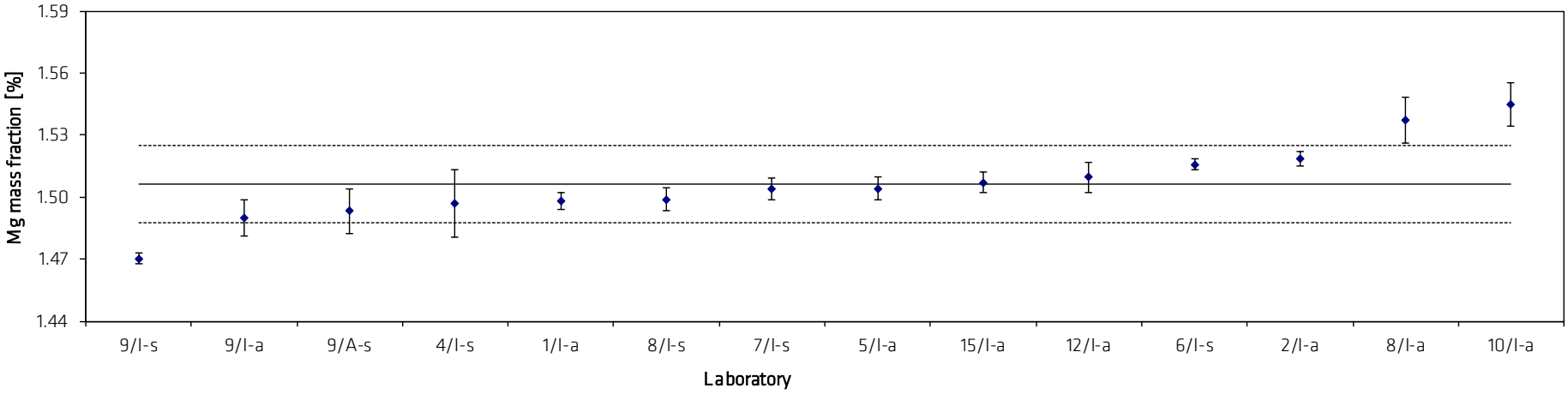


Table 7: Results for Cr

Lab./Meth.	5/I-a	9/I-s	12/I-a	15/I-a	6/I-s	4/I-s	8/I-s	2/I-a	1/I-a	10/I-a	7/I-s(R)	8/I-a	7/IMS-s		
M_i [%]	0.0539	0.0545	0.0549	0.0549	0.0554	0.055	0.0556	0.0563	0.056	0.0567	0.0569	0.0566	0.0563		*n*
	0.0538	0.0543	0.0547	0.0552	0.0549	0.056	0.0563	0.0562	0.056	0.0555	0.0568	0.0571	0.0590		13
	0.0538	0.0545	0.0542	0.0550	0.0554	0.056	0.0562	0.0562	0.056	0.0564	0.0567	0.0574	0.0580		
	0.0540	0.0543	0.0544	0.0555	0.0552	0.055	0.0558	0.0556	0.056	0.0569	0.0573	0.0579	0.0585		
	0.0542	0.0543	0.0552	0.0551	0.0554	0.055	0.0557	0.0558	0.056	0.0566	0.0568	0.0579	0.0571		
	0.0542	0.0543	0.0542	0.0554	0.0553	0.055	0.0557	0.0556	0.056	0.0566	0.0572	0.0579	0.0578		
M **[%]**	**0.0540**	**0.0544**	**0.0546**	**0.0552**	**0.0552**	**0.0554**	**0.0559**	**0.0559**	**0.0560**	**0.0565**	**0.0570**	**0.0575**	**0.0578**		**0.0558**
s [%]	0.0002	0.0001	0.0004	0.0002	0.0002	0.0002	0.0003	0.0003	0.0000	0.0005	0.0002	0.0005	0.0010	s_M [%]	0.0012
														$\bar{s}_i$ [%]	0.0004
s_{rel}	0.00340	0.00193	0.00729	0.00420	0.00369	0.00316	0.00524	0.00586	0.00000	0.00873	0.00427	0.00938	0.01679		0.02083

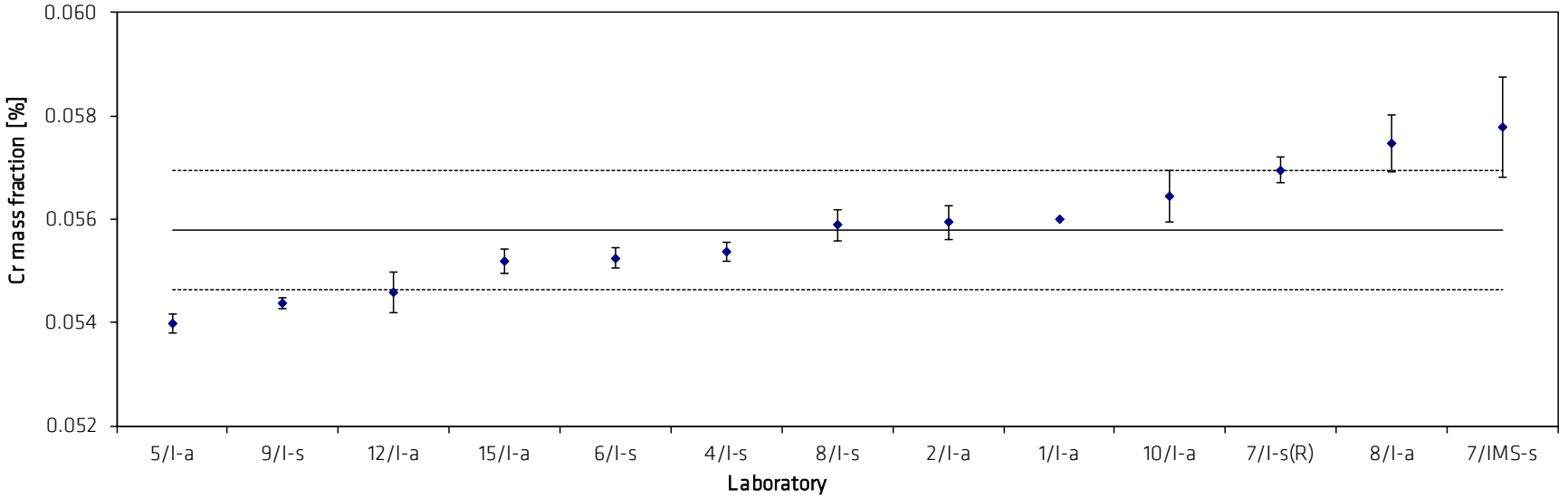


Table 8: Results for Ni

Lab./Meth.	9/I-s	12/I-a	6/I-s	15/I-a	7/I-s	5/I-a	10/I-a	1/I-a	2/I-a	8/I-s	4/I-s	8/I-a		
M_i [%]	0.0473	0.0497	0.0501	0.0496	0.0506	0.0500	0.0505	0.0510	0.0508	0.0510	0.051	0.0507		*n*
	0.0468	0.0493	0.0500	0.0497	0.0499	0.0501	0.0505	0.0500	0.0508	0.0513	0.051	0.0513		11
	0.0473	0.0495	0.0498	0.0498	0.0496	0.0500	0.0503	0.0500	0.0504	0.0506	0.051	0.0513		
	0.0474	0.0490	0.0498	0.0506	0.0492	0.0504	0.0497	0.0510	0.0506	0.0509	0.052	0.0517		
	0.0479	0.0498	0.0499	0.0499	0.0504	0.0506	0.0506	0.0500	0.0508	0.0502	0.051	0.0518		
	0.0477	0.0496	0.0499	0.0505	0.0510	0.0504	0.0504	0.0510	0.0507	0.0502	0.052	0.0515		
M **[%]**	**0.0474**	**0.0495**	**0.0499**	**0.0500**	**0.0501**	**0.0503**	**0.0503**	**0.0505**	**0.0507**	**0.0507**	**0.0512**	**0.0514**		**0.0504**
s [%]	0.0004	0.0003	0.0001	0.0004	0.0007	0.0003	0.0003	0.0005	0.0001	0.0004	0.0004	0.0004	s_M [%]	0.0006
													s_i [%]	0.0004
s_{rel}	0.00797	0.00591	0.00243	0.00852	0.01338	0.00499	0.00649	0.01085	0.00288	0.00882	0.00738	0.00763		0.01098

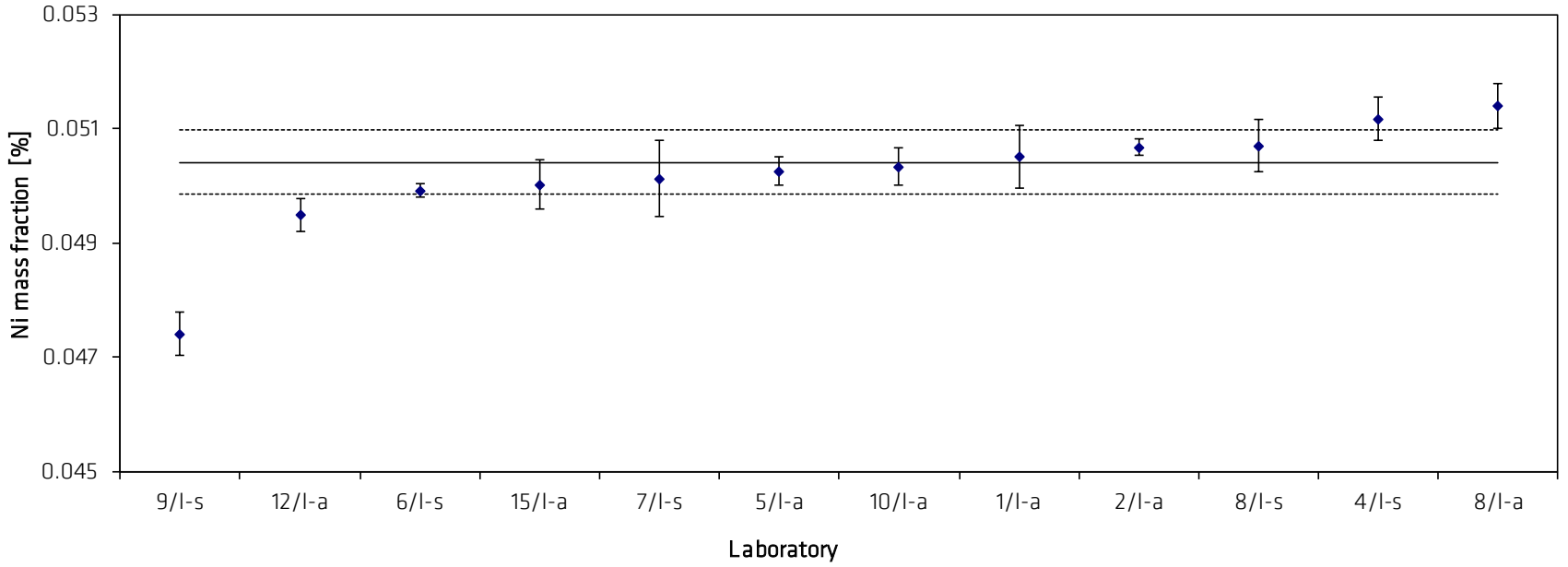


Table 9: Results for Zn

Lab./Meth.	7/A-s	7/I-s	10/I-a	7/IMS-s(R)	4/I-s	6/I-s	12/I-a	1/I-a	9/A-s	2/I-a	8/I-s	15/I-a	8/I-a	5/I-a		
M_i [%]	0.1380	0.1456	0.148	0.1430	0.145	0.1471	0.1463	0.1480	0.147	0.1482	0.1478	0.146	0.1478	0.1526		*n*
	0.1430	0.1428	0.146	0.1470	0.145	0.1457	0.1444	0.1470	0.144	0.1475	0.1491	0.147	0.1489	0.1526		13
	0.1370	0.1459	0.145	0.1450	0.147	0.1463	0.1486	0.1470	0.147	0.1469	0.1486	0.147	0.1491	0.1529		
	0.1430	0.1425	0.145	0.1460	0.148	0.1470	0.1480	0.1470	0.148	0.1485	0.1480	0.150	0.1506	0.1548		
	0.1400	0.1433	0.146	0.1460	0.145	0.1482	0.1466	0.1470	0.149	0.1484	0.1475	0.149	0.1494	0.1557		
	0.1470	0.1421	0.145	0.1490	0.147	0.1467	0.1478	0.1480	0.149	0.1483	0.1471	0.150	0.1505	0.1550		
									0.149							
M **[%]**	**0.1413**	**0.1437**	**0.1458**	**0.1460**	**0.1462**	**0.1468**	**0.1470**	**0.1473**	**0.1476**	**0.1480**	**0.1480**	**0.1482**	**0.1494**	**0.1539**		**0.1466**
s [%]	0.0037	0.0016	0.0012	0.0020	0.0013	0.0009	0.0015	0.0005	0.0018	0.0006	0.0007	0.0016	0.0011	0.0014	s_M [%]	0.0021
															$\bar{s}_i$ [%]	0.0016
s_{rel}	0.02635	0.01140	0.00802	0.01370	0.00909	0.00593	0.01036	0.00350	0.01228	0.00434	0.00494	0.01111	0.00705	0.00902		0.01435

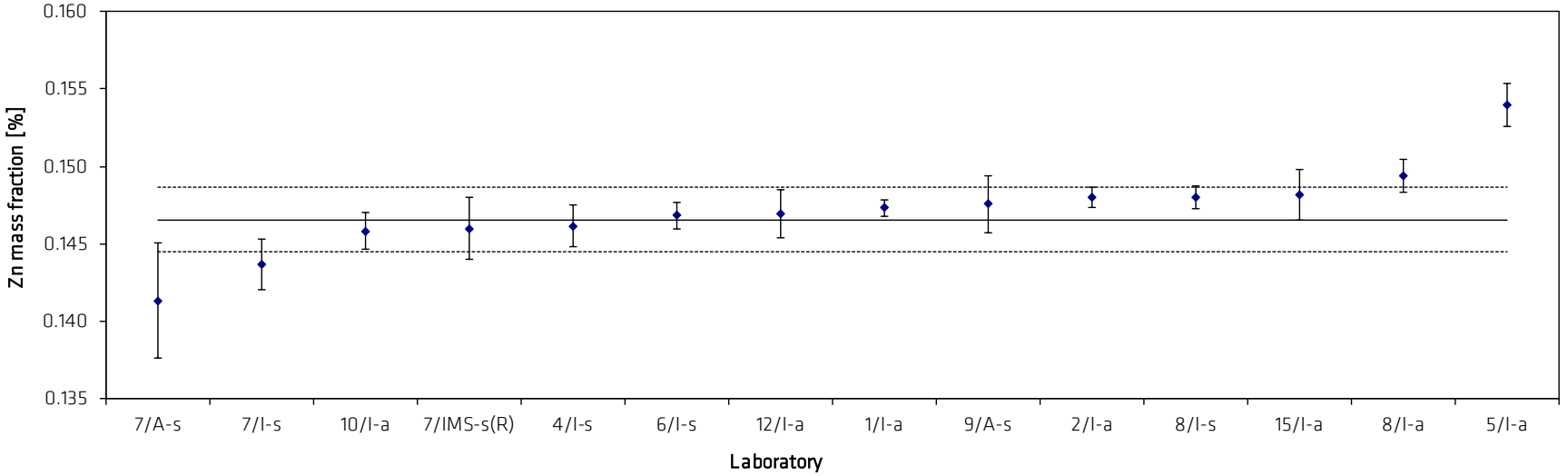


Table 10: Results for Ti

Lab./Meth.	10/I-a	12/I-a	2/I-s	8/I-s	9/P	5/I-a	15/I-a	9/I-s	1/I-a	8/I-a	4/I-s	6/I-a	7/I-s		
M_i [%]	0.0417	0.0430	0.0433	0.0433	0.043	0.0433	0.043	0.0437	0.044	0.0442	0.045	0.052	0.0513		*n*
	0.0420	0.0425	0.0433	0.0433	0.044	0.0432	0.044	0.0431	0.044	0.0445	0.046	0.052	0.0531		11
	0.0419	0.0429	0.0432	0.0433	0.043	0.0434	0.043	0.0438	0.044	0.0447	0.046	0.053	0.0521		
	0.0424	0.0431	0.0431	0.0433	0.043	0.0433	0.044	0.0436	0.044	0.0451	0.045	0.051	0.0527		
	0.0423	0.0426	0.0432	0.0430	0.043	0.0435	0.043	0.0435	0.044	0.0452	0.046	0.052	0.0536		
	0.0424	0.0428	0.0431	0.0431	0.043	0.0434	0.044	0.0436	0.044	0.0450	0.046	0.051	0.0512		
M **[%]**	**0.0421**	**0.0428**	**0.0432**	**0.0432**	**0.0433**	**0.0434**	**0.0434**	**0.0436**	**0.0440**	**0.0448**	**0.0456**	**0.0518**	**0.0523**		**0.0436**
s [%]	0.00029	0.00023	0.00010	0.00013	0.00018	0.00010	0.00008	0.00024	0.00000	0.00039	0.00041	0.00064	0.00097	s_M [%]	0.00093
														$\bar{s}_i$ [%]	0.00023
s_{rel}	0.00695	0.00541	0.00226	0.00308	0.00413	0.00242	0.00188	0.00554	0.00000	0.00864	0.00897	0.01236	0.01859		0.02133

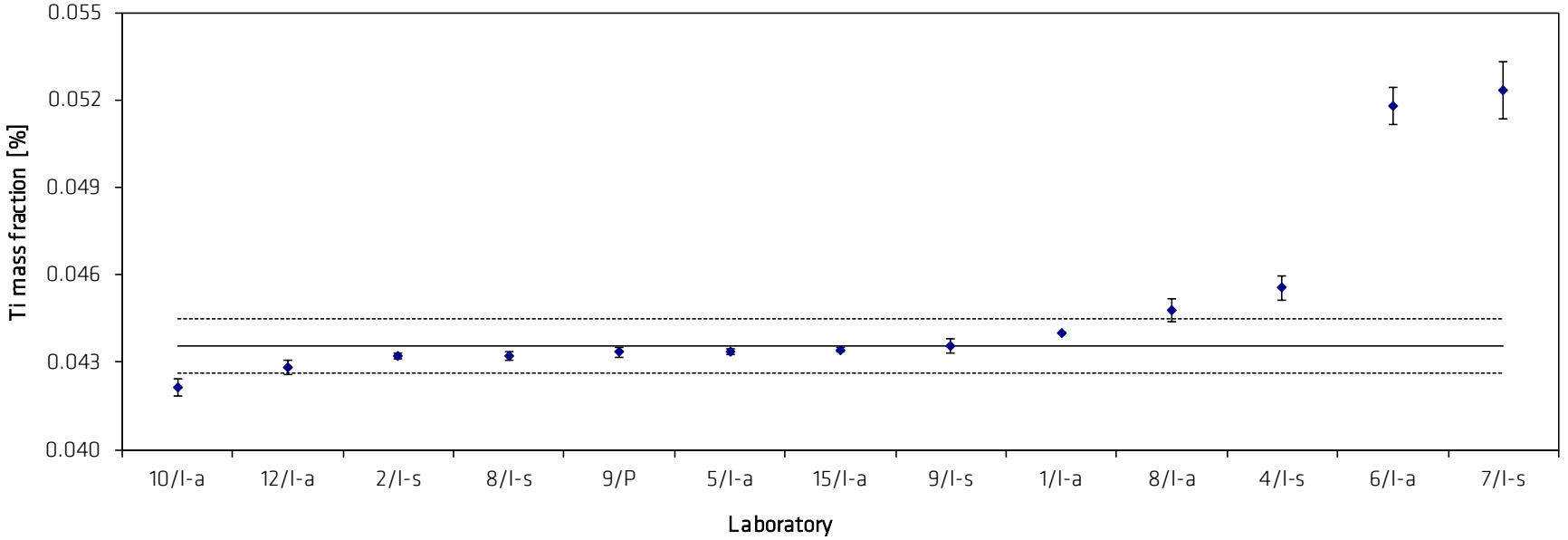


Table 11: Results for Sc

Lab./Meth.	5/I-a	12/I-a	2/I-s	1/I-a	4/I-s	9/I-s	6/I-s	7/I-s		
M_i [%]	0.0489	0.0492	0.0489	0.05	0.0500	0.0506	0.0516	0.0521		*n*
	0.0489	0.0486	0.0489	0.05	0.0504	0.0506	0.0516	0.0515		8
	0.0489	0.0486	0.0490	0.05	0.0506	0.0506	0.0517	0.0522		
	0.0490	0.0491	0.0493	0.05	0.0504	0.0506	0.0516	0.0519		
	0.0489	0.0492	0.0494	0.05	0.0507	0.0506	0.0520	0.0523		
	0.0490	0.0484	0.0493	0.05	0.0511	0.0503	0.0522	0.0514		
M **[%]**	**0.0489**	**0.0489**	**0.0492**	**0.0500**	**0.0505**	**0.0506**	**0.0518**	**0.0519**		**0.0502**
s [%]	0.00005	0.00036	0.00024	0.00000	0.00037	0.00012	0.00023	0.00037	s_M [%]	0.0012
									$\bar{s}_i$ [%]	0.0003
s_{rel}	0.00106	0.00730	0.00481	0.00000	0.00726	0.00237	0.00452	0.00721		0.02397

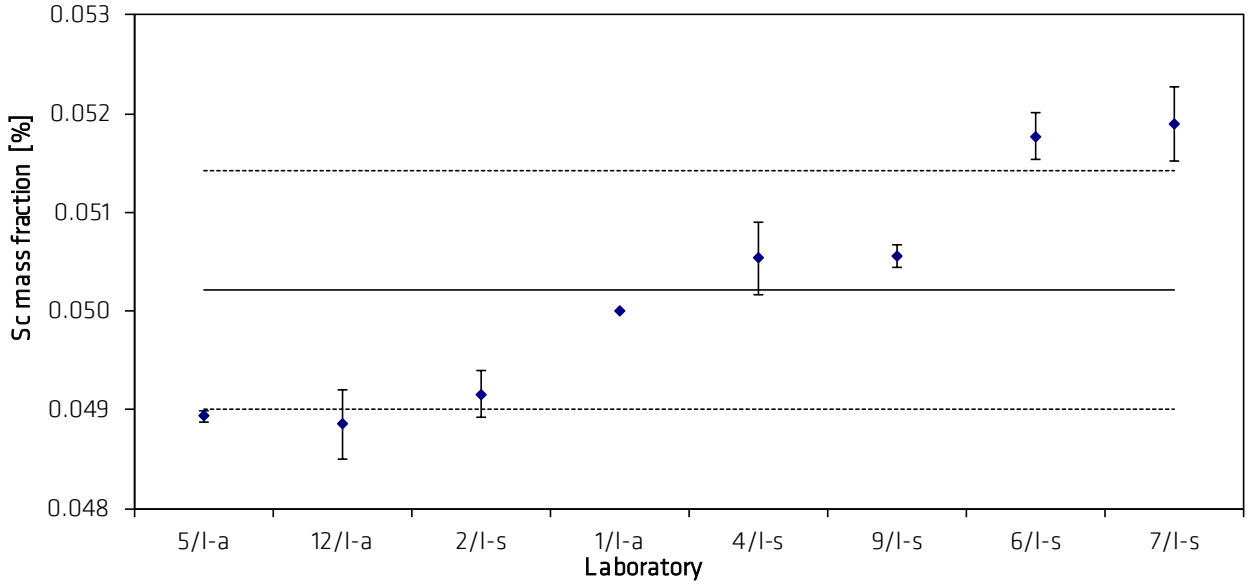


Table 12: Results for Sn

Lab./Meth.	7/IMS-s	7/I-s(R)	10/I-a	6/I-s	12/I-a	9/I-s	2/IMS-s	15/I-a	1/I-a	8/I-s	8/I-a	4/I-s	5/I-a		
M_i [%]	0.0271	0.0278	0.0274	0.0285	0.0285	0.0284	0.0284	0.0287	0.029	0.0291	0.0293	0.0299	0.0299		*n*
	0.0274	0.0270	0.0275	0.0283	0.0284	0.0286	0.0285	0.0290	0.029	0.0295	0.0296	0.0295	0.0296		13
	0.0268	0.0271	0.0272	0.0282	0.0283	0.0286	0.0284	0.0286	0.029	0.0291	0.0294	0.0297	0.0298		
	0.0273	0.0268	0.0274	0.0282	0.0286	0.0285	0.0291	0.0288	0.029	0.0289	0.0297	0.0300	0.0297		
	0.0269	0.0279	0.0276	0.0281	0.0284	0.0286	0.0288	0.0286	0.029	0.0290	0.0296	0.0297	0.0300		
	0.0271	0.0275	0.0274	0.0284	0.0285	0.0285	0.0292	0.0291	0.029	0.0286	0.0297	0.0302	0.0301		
M **[%]**	**0.0271**	**0.0274**	**0.0274**	**0.0283**	**0.0285**	**0.0285**	**0.0287**	**0.0288**	**0.0290**	**0.0290**	**0.0296**	**0.0298**	**0.0299**		**0.0286**
s [%]	0.00023	0.00045	0.00013	0.00015	0.00010	0.00009	0.00035	0.00021	0.00022	0.00029	0.00016	0.00025	0.00019	s_M [%]	0.00090
														$\bar{s}_i$ [%]	0.00024
s_{rel}	0.00841	0.01647	0.00485	0.00531	0.00369	0.00305	0.01233	0.00728	0.00769	0.01014	0.00556	0.00839	0.00627		0.03144

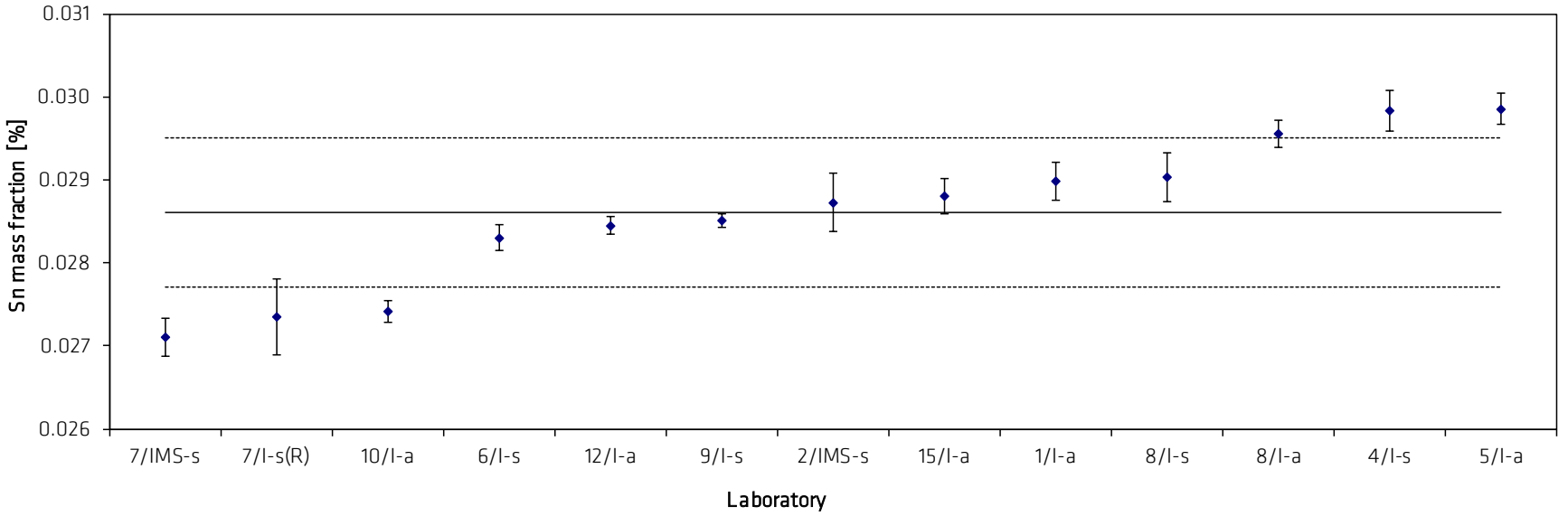


Table 13: Results for V

Lab./Meth.	2/I-s	7/I-s	12/I-a	6/I-s	10/I-a	1/I-a	9/I-s	9/P	8/I-s	15/I-a	5/I-a	8/I-a	7/IMS-s	4/I-s		
M_i [%]	0.0101	0.0102	0.0104	0.0102	0.0106	0.0105	0.0106	0.0106	0.0106	0.0110	0.0107	0.0110	0.0115	0.0119		*n*
	0.0101	0.0101	0.0102	0.0102	0.0104	0.0106	0.0104	0.0105	0.0107	0.0108	0.0107	0.0112	0.0120	0.0120		12
	0.0102	0.0100	0.0101	0.0104	0.0105	0.0105	0.0106	0.0104	0.0107	0.0106	0.0107	0.0111	0.0117	0.0120		
	0.0101	0.0101	0.0102	0.0103	0.0105	0.0105	0.0106	0.0107	0.0107	0.0105	0.0107	0.0113	0.0119	0.0121		
	0.0100	0.0105	0.0104	0.0104	0.0106	0.0105	0.0106	0.0105	0.0106	0.0104	0.0107	0.0112	0.0114	0.0119		
	0.0101	0.0099	0.0102	0.0104	0.0104	0.0106	0.0106	0.0110	0.0106	0.0108	0.0107	0.0112	0.0118	0.0118		
***M* [%]**	**0.0101**	**0.0101**	**0.0103**	**0.0103**	**0.0105**	**0.0105**	**0.0106**	**0.0106**	**0.0107**	**0.0107**	**0.0107**	**0.0112**	**0.0117**	**0.0120**		**0.0105**
s [%]	0.00003	0.00020	0.00012	0.00007	0.00009	0.00005	0.00008	0.00020	0.00005	0.00022	0.00000	0.00010	0.00023	0.00010	s_M [%]	0.00029
															$\bar{s}_i$ [%]	0.00012
s_{rel}	0.00332	0.01999	0.01195	0.00689	0.00852	0.00490	0.00715	0.01845	0.00514	0.02031	0.00000	0.00925	0.01977	0.00878		0.02791

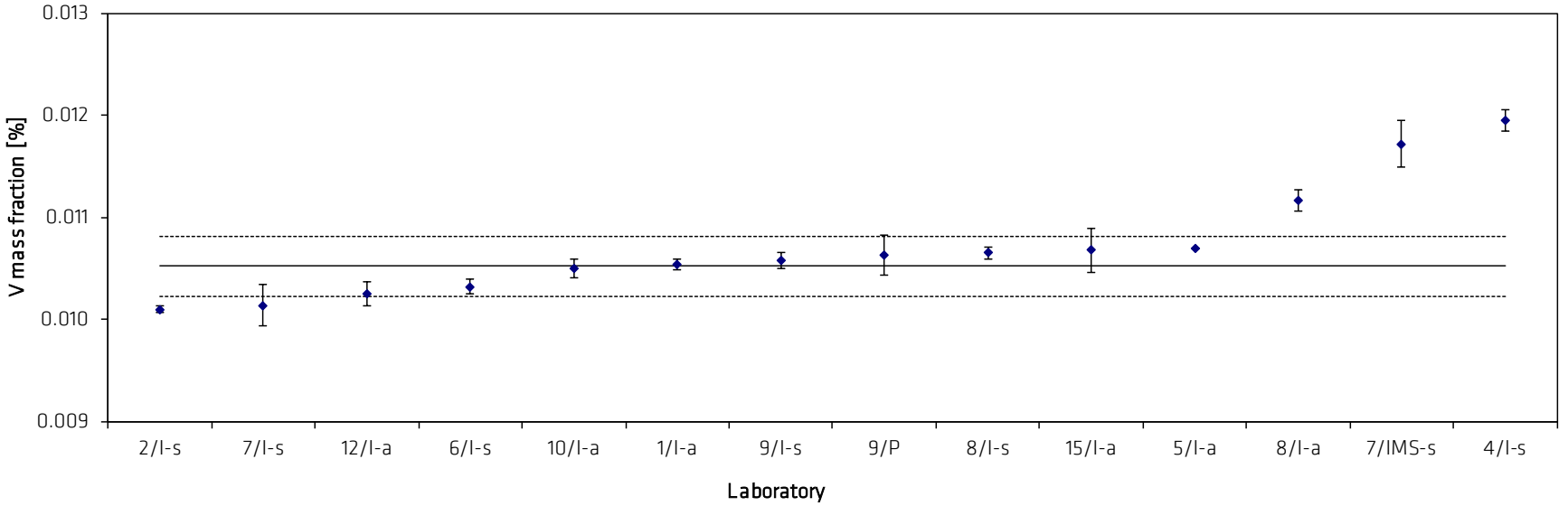


Table 14: Results for Zr

Lab./Meth.	7/I-s	12/I-a	10/I-a	8/I-s	5/I-a	7/IMS-s	15/I-a	6/I-s	9/P	1/I-a	4/I-s	2/I-s	8/I-a	9/I-s		
M_i [%]	0.1510	0.1518	0.149	0.1513	0.1543	0.1550	0.156	0.1561	0.1575	0.157	0.159	0.1587	0.1608	0.1616		*n*
	0.1494	0.1499	0.150	0.1504	0.1541	0.1560	0.156	0.1560	0.1573	0.158	0.156	0.1589	0.1586	0.1594		14
	0.1513	0.1497	0.152	0.1510	0.1543	0.1510	0.156	0.1572	0.1562	0.157	0.157	0.1599	0.1600	0.1615		
	0.1508	0.1506	0.151	0.1523	0.1544	0.1560	0.157	0.1567	0.1572	0.157	0.160	0.1589	0.1635	0.1607		
	0.1493	0.1500	0.153	0.1511	0.1542	0.1550	0.156	0.1572	0.1542	0.157	0.158	0.1583	0.1600	0.1612		
	0.1496	0.1499	0.149	0.1499	0.1539	0.1530	0.157	0.1577	0.1579	0.158	0.160	0.1586	0.1595	0.1604		
									0.1569							
									0.1576							
***M* [%]**	**0.1502**	**0.1503**	**0.1507**	**0.1510**	**0.1542**	**0.1543**	**0.1560**	**0.1568**	**0.1569**	**0.1573**	**0.1583**	**0.1589**	**0.1604**	**0.1608**		**0.1554**
s [%]	0.0009	0.0008	0.0016	0.0008	0.0002	0.0020	0.0005	0.0007	0.0012	0.0005	0.0016	0.0006	0.0017	0.0008	s_M [%]	0.00372
															$\bar{s}_i$ [%]	0.00112
s_{rel}	0.00596	0.00525	0.01084	0.00543	0.00116	0.01274	0.00290	0.00444	0.00754	0.00328	0.01031	0.00348	0.01048	0.00513		0.02394

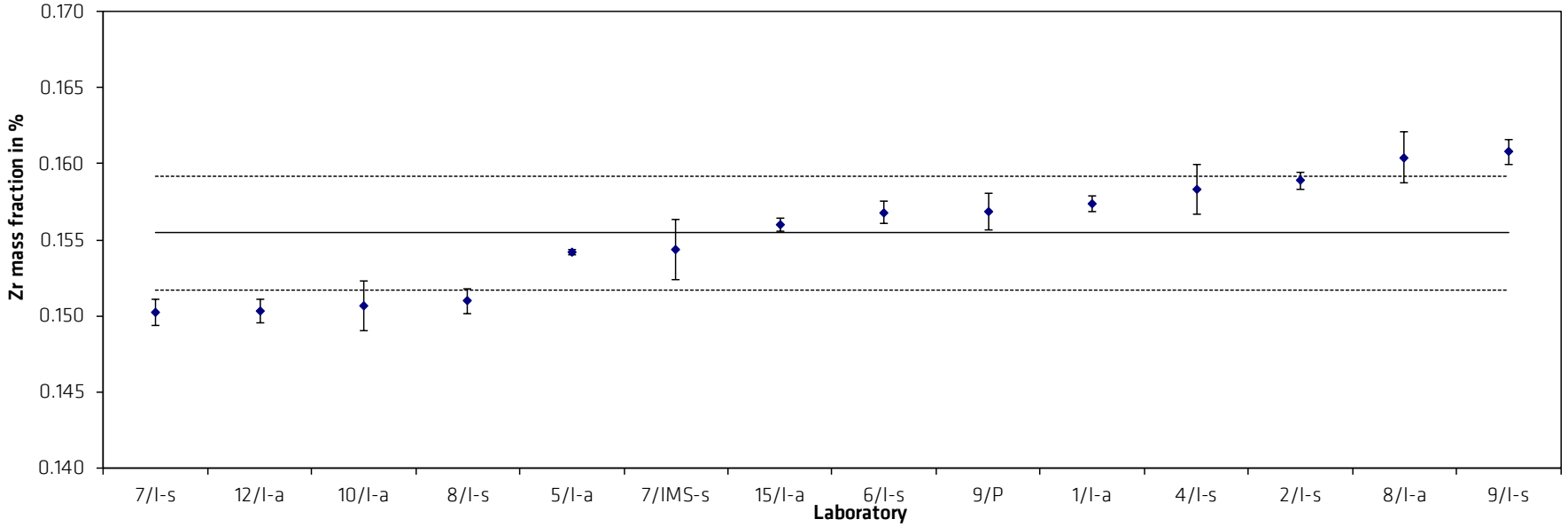


Table 15: Results for B

Lab./Meth.	2/IMS-s	4/I-s	12/I-a	8/I-s	6/I-a	1/I-s		
M_i [mg/kg]	1.02	1.3	2.00	4.0	5.35	<2		*n*
	1.22	1.2	2.50	3.0	5.69	<2		5
	1.11	1.2	7.00	4.0	5.59	<2		
	<1	1.4	4.00	6.0	4.63	<2		
	<1	1.1	5.00	5.0	4.36	<2		
	<1	1.5	2.50	6.0	5.03	<2		
M [mg/kg]	**1.12**	**1.28**	**3.83**	**4.67**	**5.11**	**<2**		**3.20**
s [mg/kg]	0.100	0.147	1.915	1.211	0.533		s_M [mg/kg]	1.885
							$\bar{s}_i$ [mg/kg]	1.044
s_{rel}	0.090	0.115	0.500	0.260	0.104			0.589

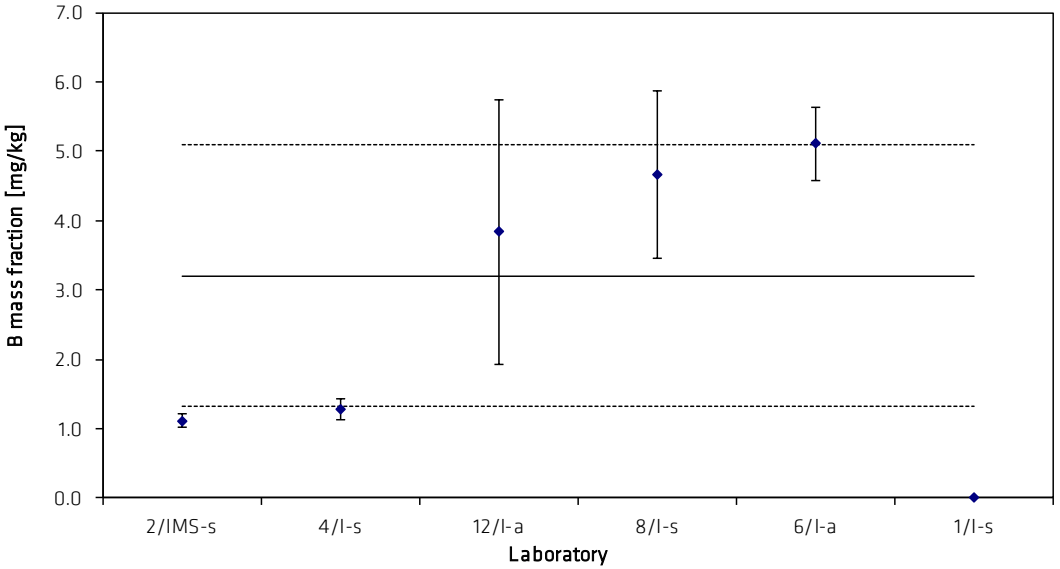


Table 16: Results for Be

Lab./Meth.	7/IMS-s	6/I-a	10/I-a	9/I-s	2/IMS-s	12/I-a	1/I-s	8/I-s	4/I-s		
M_i [mg/kg]	4.6	4.6	4.8	4.87	4.80	4.90	5.0	5.0	5.1		*n*
	4.6	4.6	4.9	4.81	4.78	4.90	4.9	5.0	5.1		7
	4.5	4.6	4.9	4.86	4.75	4.80	4.9	5.0	5.1		
	4.4	4.6	4.7	4.88	5.07	4.90	5.0	5.0	5.1		
	4.4	4.6	4.9	4.91	5.01	4.90	4.9	5.0	5.1		
	4.5	4.6	4.8	4.89	4.83	4.90	4.9	5.0	5.1		
M **[mg/kg]**	**4.50**	**4.61**	**4.83**	**4.87**	**4.87**	**4.88**	**4.93**	**5.00**	**5.10**		**4.93**
s [mg/kg]	0.089	0.013	0.082	0.035	0.134	0.041	0.052	0.000	0.000	s_M [mg/kg]	0.093
										$\bar{s}_i$ [mg/kg]	0.066
s_{rel}	0.020	0.003	0.017	0.007	0.027	0.008	0.010	0.000	0.000		0.019

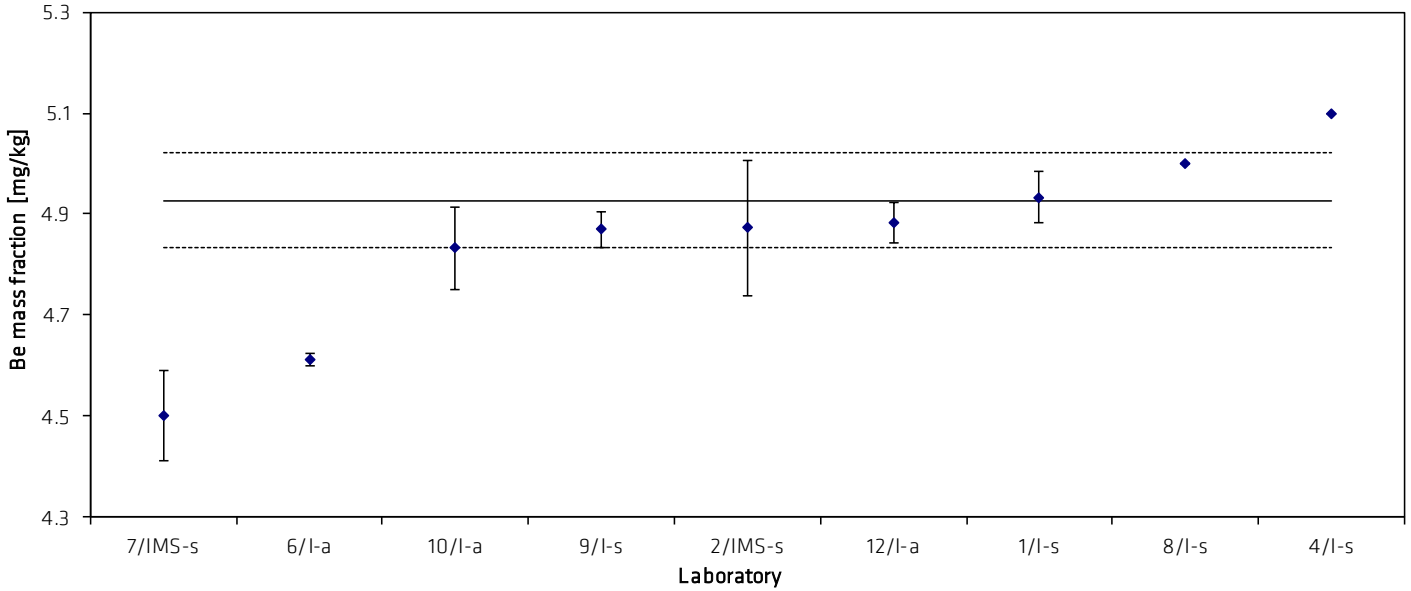


Table 17: Results for Bi

Lab./Meth.	8/I-s	15/I-a	4/I-s	6/I-s	7/I-s	5/I-a	7/IMS-s	12/I-a	1/I-s	2/IMS-s	10/I-a	8/I-a		
M_i [mg/kg]	241	253	308	310.6	325.1	325	329.1	322	325	335.3	342	336		*n*
	240	254	305	309.0	314.5	317	316.5	318	324	334.6	338	342		10
	237	251	305	309.7	316.8	300	329.2	317	324	334.8	344	343		
	239	254	309	309.8	312.5	321	320.9	325	328	331.7	336	344		
	237	256	308	307.4	312.4	324	299.1	324	325	328.5	338	345		
	234	255	309	307.7	317.3	321	319.9	324	327	330.1	337	348		
M **[mg/kg]**	**238**	**254**	**307**	**309**	**316**	**318**	**319**	**322**	**326**	**332**	**339**	**343**		**323**
s [mg/kg]	2.53	1.72	1.86	1.25	4.72	9.25	11.07	3.39	1.64	2.84	3.13	4.00	s_M [mg/kg]	11.94
													$\bar{s}_i$ [mg/kg]	5.32
s_{rel}	0.011	0.007	0.006	0.004	0.015	0.029	0.035	0.011	0.005	0.009	0.009	0.012		0.037

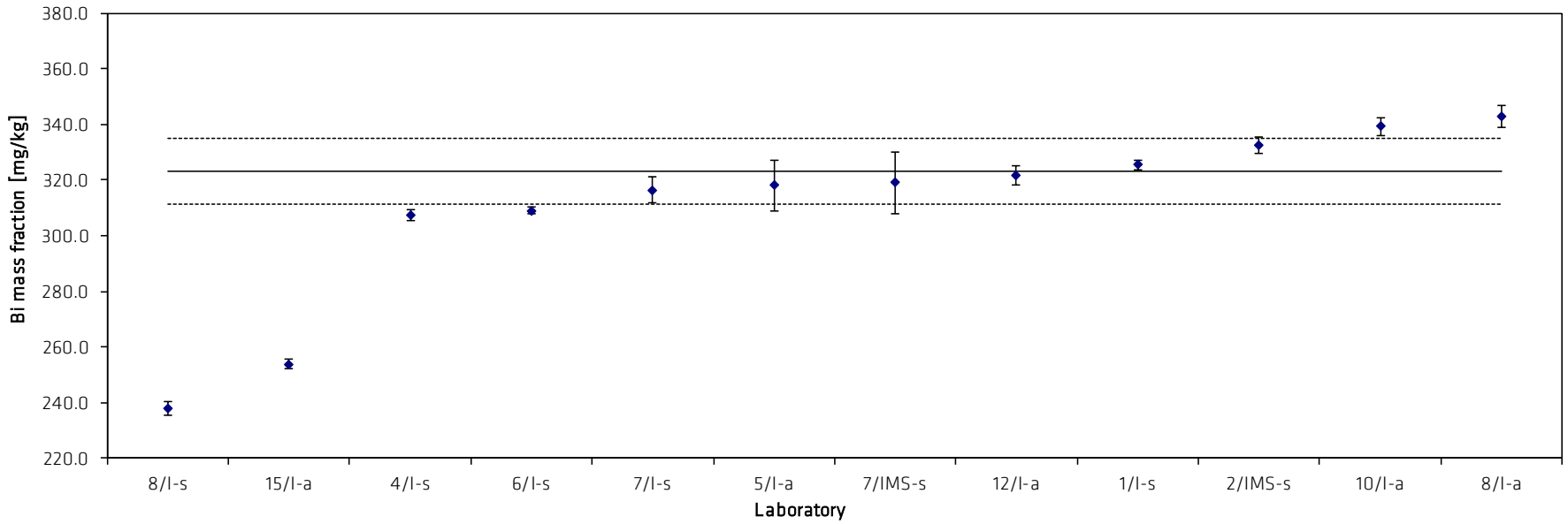


Table 18: Results for Ca

Lab./Meth.	4/l-s	12/l-a	9/l-s	2/l-s	1/l-s		
M_i [mg/kg]	4.5	4.7	4.51	5.8	5.0		*n*
	4.4	4.6	4.80	5.5	6.0		5
	4.4	4.7	5.14	5.7	8.0		
	4.5	4.8	4.97	5.6	7.0		
	4.4	4.8	5.20	5.6	7.0		
	4.4	4.7		5.7	6.0		
M [mg/kg]	**4.43**	**4.69**	**4.92**	**5.65**	**6.50**		**5.24**
s [mg/kg]	0.052	0.083	0.278	0.094	1.049	s_M [mg/kg]	0.838
						$\bar{s}_i$ [mg/kg]	0.489
s_{rel}	0.012	0.018	0.056	0.017	0.161		0.160

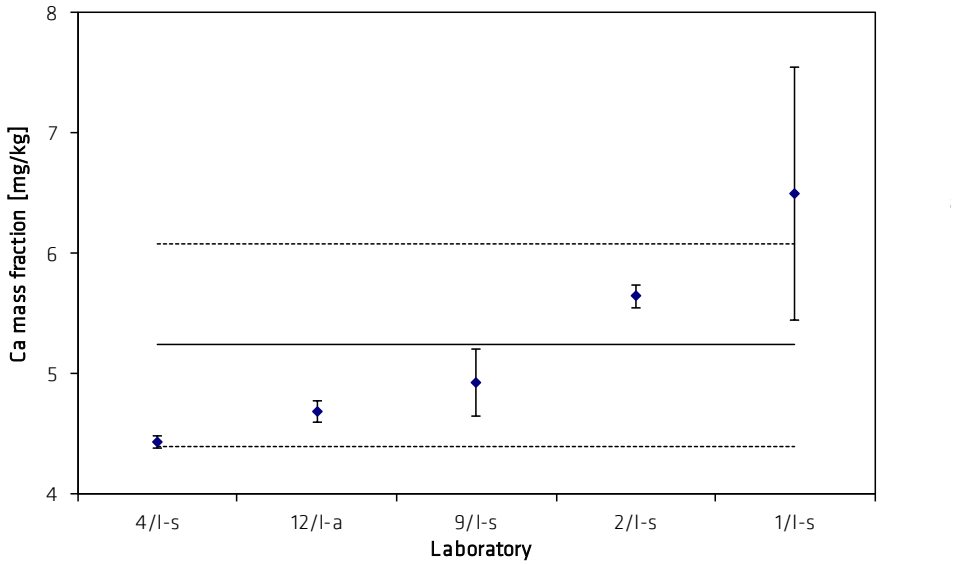


Table 19: Results for Cd

Lab./Meth.	8/I-s	9/I-s	8/I-a	7/IMS-s	7/I-s	4/I-s	15/I-a	6/I-s	2/IMS-s	12/I-a	1/I-s	10/I-a(R)		
M_i [mg/kg]	28.0	28.5	29.0	29.4	30.3	30.4	30.9	30.9	30.7	32.0	33.0	33.0		*n*
	28.0	28.2	29.0	29.5	29.9	30.4	30.8	30.8	30.0	31.6	32.0	33.0		12
	29.0	28.4	29.0	28.5	29.9	30.2	30.3	30.7	31.3	31.6	32.0	32.0		
	29.0	28.6	29.0	29.2	30.2	30.2	30.7	30.8	31.1	32.2	33.0	34.0		
	28.0	28.7	29.0	28.8	30.2	30.0	30.5	30.8	30.6	32.0	32.0	32.0		
	28.0	28.5	29.0	29.0	30.0	29.8	30.8	30.9	31.2	31.6	32.0	33.0		
M **[mg/kg]**	**28.3**	**28.5**	**29.0**	**29.1**	**30.1**	**30.2**	**30.7**	**30.8**	**30.8**	**31.8**	**32.3**	**32.8**		**30.4**
s [mg/kg]	0.5	0.2	0.0	0.4	0.2	0.2	0.2	0.1	0.5	0.3	0.5	0.8	s_M [mg/kg]	1.48
													$\bar{s}_i$ [mg/kg]	0.38
s_{rel}	0.0182	0.0061	0.0000	0.0130	0.0056	0.0078	0.0073	0.0027	0.0155	0.0084	0.0160	0.0229		0.0486

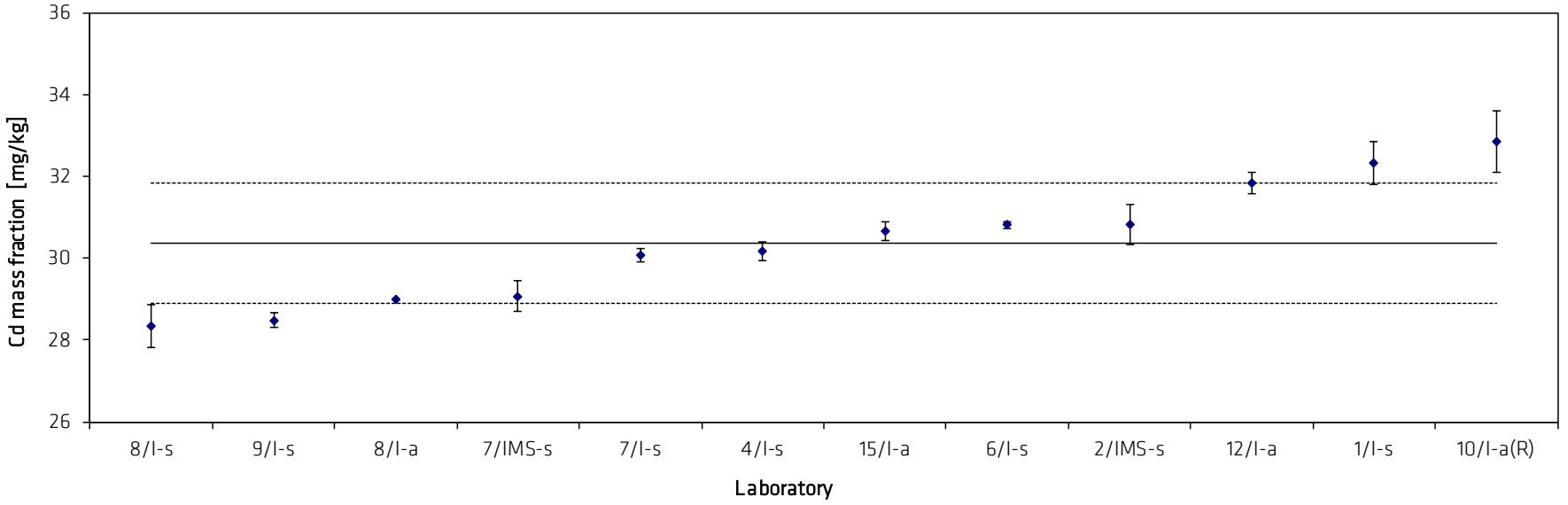


Table 20: Results for Ga

Lab./Meth.	7/IMS-s	10/I-a	8/I-s	6/I-a	8/I-a	7/I-s	9/I-s	12/I-a	2/IMS-s	1/I-s	4/I-s		
M_i [mg/kg]	86.7	86.8	87.0	87.3	87.0	88.2	89.3	89.9	89.4	90	93.6		*n*
	87.3	84.9	86.0	86.8	88.0	89.3	88.0	88.8	88.5	90	93.1		10
	83.8	84.6	87.0	87.2	90.0	89.2	89.3	87.3	89.7	90	93.3		
	85.2	88.7	87.0	86.2	89.0	87.8	88.9	89.4	90.7	90	93.9		
	85.4	85.9	86.0	86.1	88.0	89.1	88.8	88.8	90.1	89	93.0		
	86.1	87.0	86.0	86.6	88.0	87.9	88.6	89.0	90.0	90	93.4		
M [mg/kg]	**85.8**	**86.3**	**86.5**	**86.7**	**88.3**	**88.6**	**88.8**	**88.9**	**89.7**	**89.8**	**93.4**		**87.9**
s [mg/kg]	1.24	1.52	0.55	0.51	1.03	0.70	0.49	0.88	0.77	0.41	0.33	s_M [mg/kg]	1.49
												$\bar{s}_i$ [mg/kg]	0.88
s_{rel}	0.014	0.018	0.006	0.006	0.012	0.008	0.006	0.010	0.009	0.005	0.004		0.017

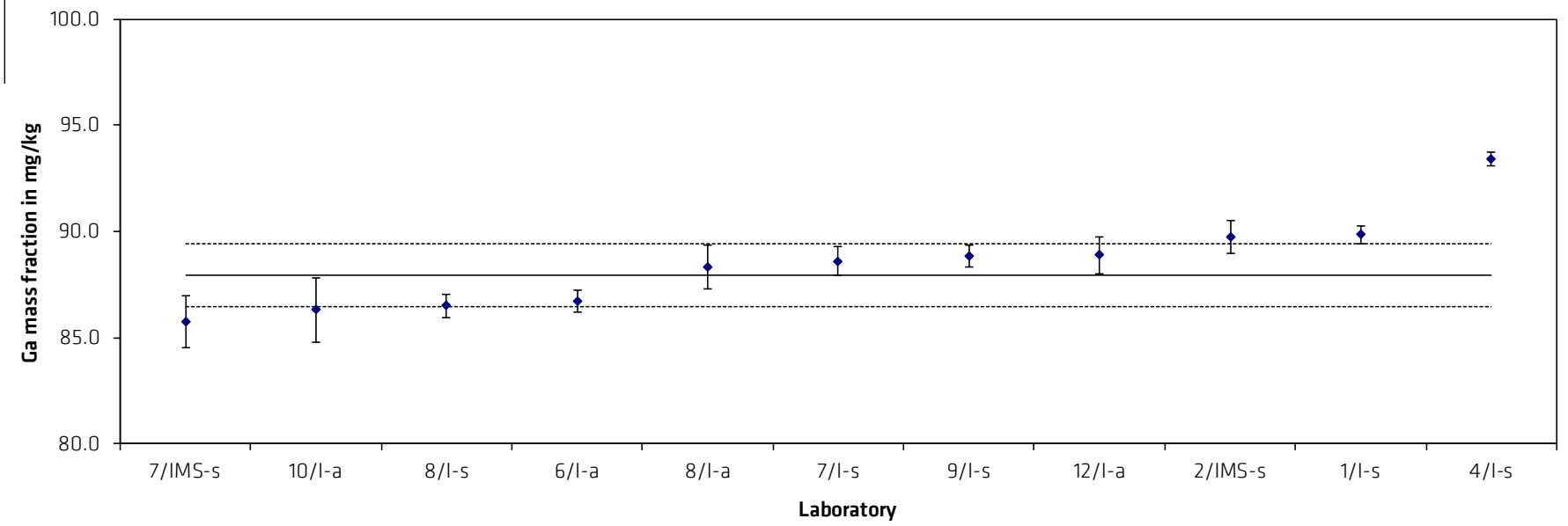


Table 21: Results for Li

Lab./Meth.	8/l-s	7/IMS-s	9/l-s	4/l-s	12/l-a	15/l-a	8/l-a	2/l-s	6/l-s	1/l-s		
M_i [mg/kg]	5	5.5	5.8	5.8	5.9	6.2	6	6.2	6.1	6		*n*
	5	5.6	5.7	5.8	5.8	5.8	6	6.3	6.1	6		10
	5	5.2	5.8	5.8	5.7	5.9	6	6.3	6.1	6		
	6	5.2	5.7	5.8	5.8	5.9	6	5.9	6.1	6		
	5	5.1	5.7	5.8	5.9	5.9	6	5.9	6.1	6		
	6	5.6	5.7	5.8	5.8	5.9	6	6.0	6.2	7		
M [mg/kg]	**5.3**	**5.4**	**5.7**	**5.8**	**5.8**	**5.9**	**6.0**	**6.1**	**6.1**	**6.2**		**5.8**
s [mg/kg]	0.516	0.225	0.030	0.000	0.075	0.137	0.000	0.204	0.031	0.408	s_M [mg/kg]	0.297
											$\bar{s}_i$ [mg/kg]	0.235
s_{rel}	0.097	0.042	0.005	0.000	0.013	0.023	0.000	0.033	0.005	0.066		0.051

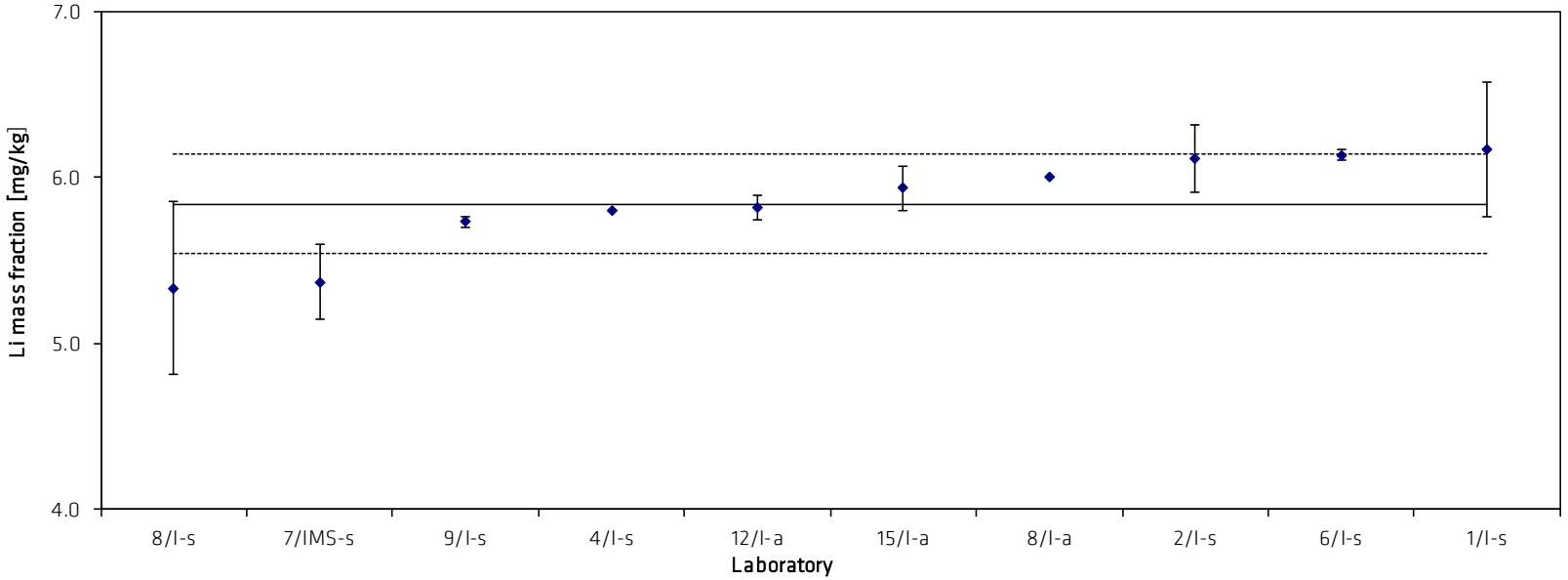


Table 22: Results for Na

Lab./Meth.	9/EA-s	9/I-s	2/I-s	1/I-s	4/I-s		
M_i [mg/kg]	2.4	2.6	2.3	3.5	3.5		*n*
	2.5	2.2	2.4	3.4	4.0		5
	2.5	2.5	2.4	3.4	3.7		
	2.5	2.6	2.7	3.6	4.0		
	2.5		2.7	3.3	3.9		
	2.4		2.7	3.4	3.7		
M [mg/kg]	**2.44**	**2.47**	**2.55**	**3.43**	**3.80**		**2.94**
s [mg/kg]	0.037	0.192	0.187	0.103	0.200	s_M [mg/kg]	0.633
						$\bar{s}_i$ [mg/kg]	0.157
s_{rel}	0.015	0.078	0.073	0.030	0.053		0.215

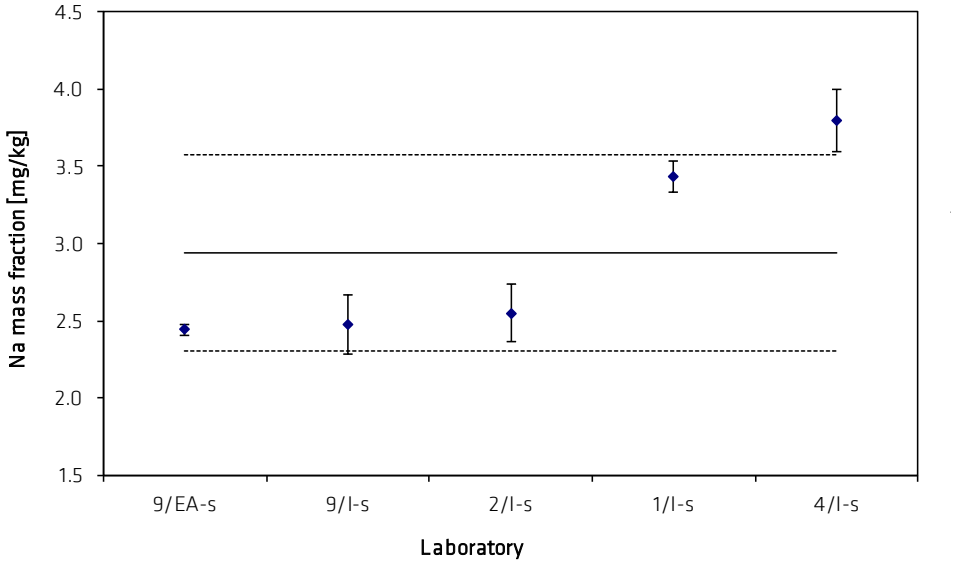
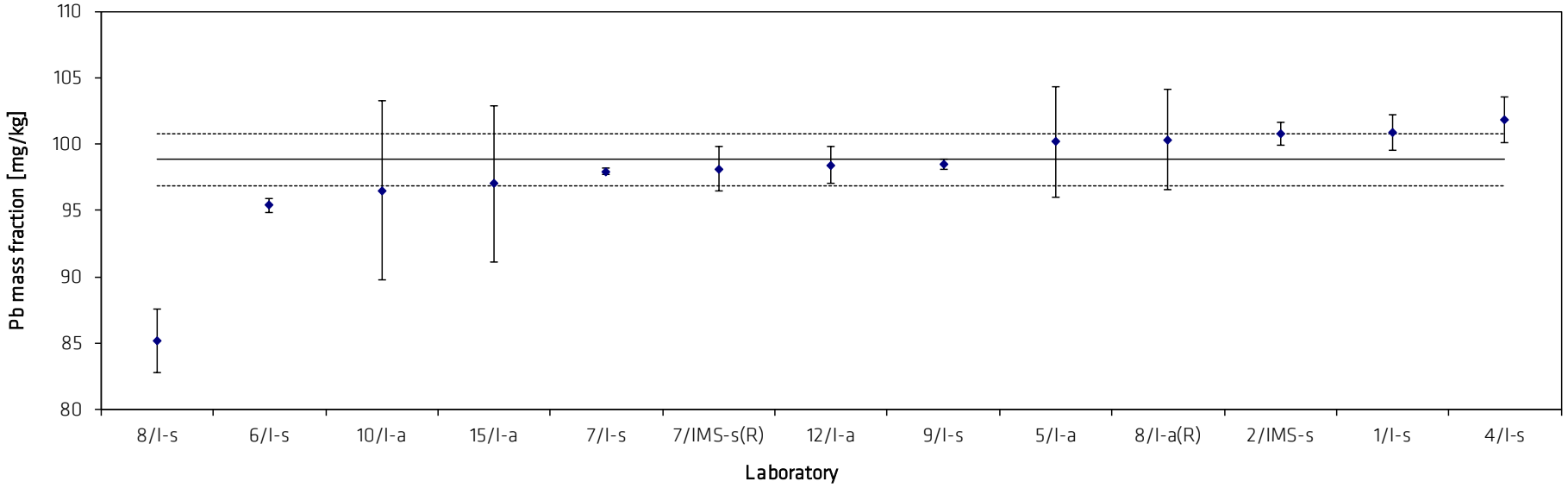


Table 23: Results for Pb

Lab./Meth.	8/I-s	6/I-s	10/I-a	15/I-a	7/I-s	7/IMS-s(R)	12/I-a	9/I-s	5/I-a	8/I-a(R)	2/IMS-s	1/I-s	4/I-s		
M_i [mg/kg]	85	96	99	101	97.8	97.1	96.8	98.7	98	94	101.1	103	103		*n*
	89	95	107	97	98.0	98.3	97.6	98.0	106	99	100.8	101	102		12
	87	95	100	106	98.1	96.2	100.9	98.9	97	105	100.1	101	101		
	83	95	93	89	97.8	97.1	98.6	98.0	95	103	102.3	101	99		
	84	96	89	95	97.6	99.6	98.8	98.6	103	101	100.0	100	102		
	83	95	91	94	98.2	100.5	97.8	98.4	102	100	100.4	99	104		
M **[mg/kg]**	**85.2**	**95.4**	**96.5**	**97.0**	**97.9**	**98.1**	**98.4**	**98.4**	**100.2**	**100.3**	**100.8**	**100.8**	**101.8**		**98.8**
s [mg/kg]	2.401	0.529	6.745	5.899	0.226	1.652	1.415	0.379	4.167	3.777	0.856	1.329	1.722	s_M [mg/kg]	1.978
														$\bar{s}_i$ [mg/kg]	3.196
s_{rel}	0.0282	0.0055	0.0699	0.0608	0.0023	0.0168	0.0144	0.0039	0.0416	0.0376	0.0085	0.0132	0.0169		0.020



The statistical evaluation of the data was performed using the software program BAM-ecerto [4]. The Cochran-test was only performed once. The following results were obtained:

Tab. 24: Outcome of statistical tests on the results obtained for Si and Fe

	Si	Fe
Number of data sets	12	15
Scheffe's test (data compatible?)	yes	yes
Snedecor-F-Test and Bartlett-Test	Pooling not allowed	Pooling not allowed
Dixon (α = 0.05)	---	---
Dixon (α = 0.01)	---	---
Nalimov (α = 0.05)	Lab. 8/I-a	---
Nalimov (α = 0.01)	---	---
Grubbs (α = 0.05)	---	---
Grubbs (α = 0.01)	---	---
Grubbs Pair (α = 0.05)	---	---
Grubbs Pair (α = 0.01)	---	---
Cochran (α = 0.01)	Lab. 10	Lab. 15
Kolmogorov-Smirnov-Lilliefors Test	Distribution: normal	Distribution: normal

The outliers were not removed.

Tab. 25: Outcome of statistical tests on the results obtained for Mn and Cu

	Mn	Cu
Number of data sets	14	11
Scheffe's test (data compatible?)	yes	yes
Snedecor-F-Test and Bartlett-Test	Pooling not allowed	Pooling not allowed
Dixon (α = 0.05)	---	---
Dixon (α = 0.01)	---	---
Nalimov (α = 0.05)	Lab. 8/I-a	---
Nalimov (α = 0.01)	---	---
Grubbs (α = 0.05)	---	---
Grubbs (α = 0.01)	---	---
Grubbs Pair (α = 0.05)	---	---
Grubbs Pair (α = 0.01)	---	---
Cochran (α = 0.01)	Lab. 4	Lab. 4
Kolmogorov-Smirnov-Lilliefors Test	Distribution: normal	Distribution: normal

The outliers were not removed.

Tab. 26: Outcome of statistical tests on the results obtained for Mg and Cr

	Mg	Cr
Number of data sets	14	13
Scheffe's test (data compatible?)	yes	yes
Snedecor-F-Test and Bartlett-Test	Pooling not allowed	Pooling not allowed
Dixon (α = 0.05)	---	---
Dixon (α = 0.01)	---	---
Nalimov (α = 0.05)	Labs. 9/I-s and 10	---
Nalimov (α = 0.01)	---	---
Grubbs (α = 0.05)	---	---
Grubbs (α = 0.01)	---	---
Grubbs Pair (α = 0.05)	---	---
Grubbs Pair (α = 0.01)	---	---
Cochran (α = 0.01)	Lab. 4	Lab. 7/IMS
Kolmogorov-Smirnov-Lilliefors Test	Distribution: normal	Distribution: normal

The outliers were not removed.

Tab. 27: Outcome of statistical tests on the results obtained for Ni

	1st run	2nd run
Number of data sets	12	11
Scheffe's test (data compatible?)	yes	yes
Snedecor-F-Test and Bartlett-Test	Pooling not allowed	Pooling not allowed
Dixon (α = 0.05)	Lab. 9/I-s	---
Dixon (α = 0.01)	Lab. 9/I-s	---
Nalimov (α = 0.05)	Lab. 9/I-s	---
Nalimov (α = 0.01)	Lab. 9/I-s	---
Grubbs (α = 0.05)	Lab. 9/I-s	---
Grubbs (α = 0.01)	Lab. 9/I-s	---
Grubbs Pair (α = 0.05)	---	---
Grubbs Pair (α = 0.01)	---	---
Cochran (α = 0.01)	---	---
Kolmogorov-Smirnov-Lilliefors Test	Distribution: normal	Distribution: normal

The outlier (Lab. 9, 1st run) was removed.

Tab. 28: Outcome of statistical tests on the results obtained for Zn

	1st run	2nd run
Number of data sets	14	13
Scheffe's test (data compatible?)	yes	yes
Snedecor-F-Test and Bartlett-Test	Pooling not allowed	Pooling not allowed
Dixon (α = 0.05)	Labs. 7/A-s and 5	Labs. 7/A-s
Dixon (α = 0.01)	Labs. 7/A-s and 5	Labs. 7/A-s
Nalimov (α = 0.05)	Labs. 7/A-s and 5	Labs. 7/A-s
Nalimov (α = 0.01)	Lab. 5	---
Grubbs (α = 0.05)	Lab. 5	---
Grubbs (α = 0.01)	---	---
Grubbs Pair (α = 0.05)	---	---
Grubbs Pair (α = 0.01)	---	---
Cochran (α = 0.01)	Lab. 7/A-s	Lab. 7/A-s
Kolmogorov-Smirnov-Lilliefors Test	Distribution: normal	Distribution: normal

The outlier (Lab. 5) was removed, Lab. 7/A-s was not removed.

Tab. 29: Outcome of statistical tests on the results obtained for Ti

	1st run	2nd run
Number of data sets	13	11
Scheffe's test (data compatible?)	yes	yes
Snedecor-F-Test and Bartlett-Test	Pooling not allowed	Pooling not allowed
Dixon (α = 0.05)	Lab. 7/I-s	---
Dixon (α = 0.01)	Lab. 7/I-s	---
Nalimov (α = 0.05)	Lab. 7/I-s	---
Nalimov (α = 0.01)	Lab. 7/I-s	---
Grubbs (α = 0.05)	Lab. 7/I-s	---
Grubbs (α = 0.01)	Lab. 7/I-s	---
Grubbs Pair (α = 0.05)	Labs. 7/I-s and 6	---
Grubbs Pair (α = 0.01)	Labs. 7/I-s and 6	---
Cochran (α = 0.01)	---	---
Kolmogorov-Smirnov-Lilliefors Test	Distribution: normal	Distribution: normal

The outliers (Labs. 6 and 7, 1st run) were removed.

Tab. 30: Outcome of statistical tests on the results obtained for Sc and Sn

	Sc	Sn
Number of data sets	8	13
Scheffe's test (data compatible?)	yes	yes
Snedecor-F-Test and Bartlett-Test	Pooling not allowed	Pooling not allowed
Dixon (α = 0.05)	---	---
Dixon (α = 0.01)	---	---
Nalimov (α = 0.05)	---	---
Nalimov (α = 0.01)	---	---
Grubbs (α = 0.05)	---	---
Grubbs (α = 0.01)	---	---
Grubbs Pair (α = 0.05)	---	---
Grubbs Pair (α = 0.01)	---	---
Cochran (α = 0.01)	---	---
Kolmogorov-Smirnov-Lilliefors Test	Distribution: normal	Distribution: normal

Tab. 31: Outcome of statistical tests on the results obtained for V

	1st run	2nd run
Number of data sets	14	12
Scheffe's test (data compatible?)	yes	yes
Snedecor-F-Test and Bartlett-Test	Pooling not allowed	Pooling not allowed
Dixon (α = 0.05)	---	---
Dixon (α = 0.01)	---	---
Nalimov (α = 0.05)	Lab. 4	---
Nalimov (α = 0.01)	---	---
Grubbs (α = 0.05)	---	---
Grubbs (α = 0.01)	---	---
Grubbs Pair (α = 0.05)	Labs. 7/IMS-s and 4	---
Grubbs Pair (α = 0.01)	Labs. 7/IMS-s and 4	---
Cochran (α = 0.01)	---	---
Kolmogorov-Smirnov-Lilliefors Test	Distribution: normal	Distribution: normal

The outliers (Labs. 7/IMS and 4, 1st run) were removed.

Tab. 32: Outcome of statistical tests on the results obtained for Zr and Ca

	Zr	Ca
Number of data sets	14	5
Scheffe's test (data compatible?)	yes	yes
Snedecor-F-Test and Bartlett-Test	Pooling not allowed	Pooling not allowed
Dixon (α = 0.05)	---	---
Dixon (α = 0.01)	---	---
Nalimov (α = 0.05)	---	---
Nalimov (α = 0.01)	---	---
Grubbs (α = 0.05)	---	---
Grubbs (α = 0.01)	---	---
Grubbs Pair (α = 0.05)	---	---
Grubbs Pair (α = 0.01)	---	---
Cochran (α = 0.01)	---	Lab. 1
Kolmogorov-Smirnov-Lilliefors Test	Distribution: normal	Distribution: normal

The outlier was not removed.

Tab. 33: Outcome of statistical tests on the results obtained for Be

	1st run	2nd run
Number of data sets	9	7
Scheffe's test (data compatible?)	yes	yes
Snedecor-F-Test and Bartlett-Test	Pooling not allowed	Pooling not allowed
Dixon (α = 0.05)	---	---
Dixon (α = 0.01)	---	---
Nalimov (α = 0.05)	Lab. 7/IMS	---
Nalimov (α = 0.01)	---	---
Grubbs (α = 0.05)	---	---
Grubbs (α = 0.01)	---	---
Grubbs Pair (α = 0.05)	Labs. 7/IMS and 6	---
Grubbs Pair (α = 0.01)	Labs. 7/IMS and 6	---
Cochran (α = 0.01)	Lab. 2	Lab. 2
Kolmogorov-Smirnov-Lilliefors Test	Distribution: normal	Distribution: normal

The outliers (Lab. 7/IMS and 6) were removed.

Tab. 34: Outcome of statistical tests on the results obtained for Bi

	1st run	2nd run
Number of data sets	12	10
Scheffe's test (data compatible?)	yes	yes
Snedecor-F-Test and Bartlett-Test	Pooling not allowed	Pooling not allowed
Dixon (α = 0.05)	Lab. 8/I-s	---
Dixon (α = 0.01)	Lab. 8/I-s	---
Nalimov (α = 0.05)	Lab. 8/I-s	---
Nalimov (α = 0.01)	Lab. 8/I-s	---
Grubbs (α = 0.05)	---	---
Grubbs (α = 0.01)	---	---
Grubbs Pair (α = 0.05)	Labs. 8/I-s and 15	---
Grubbs Pair (α = 0.01)	Labs. 8/I-s and 15	---
Cochran (α = 0.01)	Lab. 7/IMS	Lab. 7/IMS
Kolmogorov-Smirnov-Lilliefors Test	Distribution: not normal	Distribution: normal

The outliers (Lab. 8/I-s and 15) were removed.

Tab. 35: Outcome of statistical tests on the results obtained for Cd and Li

	Cd	Li
Number of data sets	12	10
Scheffe's test (data compatible?)	yes	yes
Snedecor-F-Test and Bartlett-Test	Pooling not allowed	Pooling not allowed
Dixon (α = 0.05)	---	---
Dixon (α = 0.01)	---	---
Nalimov (α = 0.05)	---	---
Nalimov (α = 0.01)	---	---
Grubbs (α = 0.05)	---	---
Grubbs (α = 0.01)	---	---
Grubbs Pair (α = 0.05)	---	---
Grubbs Pair (α = 0.01)	---	---
Cochran (α = 0.01)	Lab. 10	Lab. 8/I-s
Kolmogorov-Smirnov-Lilliefors Test	Distribution: normal	Distribution: normal

The outliers (Lab. 10, Cd and Lab. 8, Li) were not removed.

Tab. 36: Outcome of statistical tests on the results obtained for Ga

	1st run	2nd run
Number of data sets	11	10
Scheffe's test (data compatible?)	yes	yes
Snedecor-F-Test and Bartlett-Test	Pooling not allowed	Pooling not allowed
Dixon (α = 0.05)	---	---
Dixon (α = 0.01)	---	---
Nalimov (α = 0.05)	Lab. 4	---
Nalimov (α = 0.01)	Lab. 4	---
Grubbs (α = 0.05)	Lab. 4	---
Grubbs (α = 0.01)	---	---
Grubbs Pair (α = 0.05)	---	---
Grubbs Pair (α = 0.01)	---	---
Cochran (α = 0.01)	---	---
Kolmogorov-Smirnov-Lilliefors Test	Distribution: normal	Distribution: normal

The outlier (Lab. 4) was removed.

Tab. 37: Outcome of statistical tests on the results obtained for Pb

	1st run	2nd run
Number of data sets	13	12
Scheffe's test (data compatible?)	yes	yes
Snedecor-F-Test and Bartlett-Test	Pooling not allowed	Pooling not allowed
Dixon (α = 0.05)	Lab. 8/I-s	---
Dixon (α = 0.01)	Lab. 8/I-s	---
Nalimov (α = 0.05)	Lab. 8/I-s	---
Nalimov (α = 0.01)	Lab. 8/I-s	---
Grubbs (α = 0.05)	Lab. 8/I-s	---
Grubbs (α = 0.01)	Lab. 8/I-s	---
Grubbs Pair (α = 0.05)	Labs. 8/I-s and 6/I-s	---
Grubbs Pair (α = 0.01)	Labs. 8/I-s and 6/I-s	---
Cochran (α = 0.01)	Lab. 10	Lab. 10
Kolmogorov-Smirnov-Lilliefors Test	Distribution: normal	Distribution: normal

The outlier (Lab. 8/I-s) was removed.

Tab. 38: Outcome of statistical tests on the results obtained for Na

	Na
Number of data sets	5
Scheffe's test (data compatible?)	yes
Snedecor-F-Test and Bartlett-Test	Pooling not allowed
Dixon (α = 0.05)	---
Dixon (α = 0.01)	---
Nalimov (α = 0.05)	---
Nalimov (α = 0.01)	---
Grubbs (α = 0.05)	---
Grubbs (α = 0.01)	---
Grubbs Pair (α = 0.05)	Labs. 1 and 4
Grubbs Pair (α = 0.01)	Labs. 1 and 4
Cochran (α = 0.01)	---
Kolmogorov-Smirnov-Lilliefors Test	Distribution: normal

The outliers were not removed.

The certified mass fractions of all elements were calculated as mean of the accepted data sets. These values are given in Table 39.
The resp. combined uncertainties were calculated from the spread resulting from the certification inter-laboratory comparison (u_{ilc}) and the uncertainty contributions from possible inhomogeneity over the length ($u_{bb}(1)$) and over area ($u_{bb}(2)$) of the material using Equation 3.

$$u_{\text{combined}} = \sqrt{u_{ilc}^2 + u_{bb}^2(1) + u_{bb}^2(2)} \qquad (3)$$

with

$u_{ilc} = \sqrt{\frac{s_M^2}{n}}$: uncertainty contribution resulting from inter-laboratory comparison

n : number of data sets used for calculating the certified mass fraction of each element

Table 39: Uncertainty calculation (u_{bb}(rel) was calculated with the data from the homogeneity test (see Annex 1 and 2) and used for the calculation of u_{bb}(2) and u_{bb}(2) by multiplication with *M*)

	uncertainty contribution from									u_{bb} (rel)		
	M	n	s_M	u_{ilc}	u_{bb} (1) Length	u_{bb} (2) Area	u (comb)	U		Length		Area
	%		%	%	%	%	%	%				
Si	0.0490	12	0.0031	0.0009	0.0001	0.0006	0.0011	0.00216		0.1971		1.2216
Fe	0.0495	15	0.0013	0.0003	0.0000	0.0008	0.0008	0.00166		0.0926		1.5327
Cu	4.3810	10	0.0604	0.0191	0.0005	0.0193	0.0272	0.05432		0.0114		0.4406
Mn	0.8080	14	0.0128	0.0034	0.0005	0.0032	0.0047	0.00936		0.0618		0.3901
Mg	1.5060	14	0.0189	0.0051	0.0089	0.0130	0.0165	0.03306		0.5933		0.8605
Cr	0.0558	13	0.0012	0.0003	0.0003	0.0004	0.0006	0.00124		0.5956		0.7232
Ni	0.0504	11	0.0006	0.0002	0.0002	0.0002	0.0003	0.00069		0.4851		0.3543
Zn	0.1466	13	0.0021	0.0006	0.0004	0.0012	0.0014	0.00280		0.2487		0.8332
Ti	0.0436	11	0.0009	0.0003	0.0002	0.0010	0.0011	0.00219		0.5009		2.3780
Sc	0.0502	8	0.0012	0.0004	0.0004	0.0008	0.0010	0.00192		0.8000	*	1.5197
Sn	0.0286	13	0.0009	0.0002	0.0001	0.0004	0.0005	0.00099		0.4851		1.4199
V	0.0105	12	0.0003	0.0001	0.0001	0.0000	0.0001	0.00021		0.4851		0.3008
Zr	0.1554	14	0.0037	0.0010	0.0005	0.0007	0.0013	0.00259		0.2991		0.4436
	mg/kg		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg				
Be	4.93	7	0.09	0.0352	0.0093	0.0928	0.0997	0.1993		0.1897		1.8822
Bi	323.20	10	11.94	3.7758	1.6521	5.4538	6.8359	13.6718		0.5112		1.6874
Ca	5.24	5	0.84	0.3748	0.0796	0.0856	0.3926	0.7852		1.5194		1.6341
Cd	30.40	12	1.48	0.4272	1.5233	0.4702	1.6504	3.3009		5.0107		1.5467
Ga	87.95	10	1.50	0.4728	0.1188	0.8520	0.9816	1.9632		0.1351		0.9688
Li	5.84	10	0.30	0.0939	0.1178	0.0582	0.1615	0.3229		2.0164		0.9963
Na	2.94	5	0.63	0.2831	0.2843	0.0159	0.4016	0.8031		9.6716		0.5424
Pb	98.8	12	1.98	0.5710	0.7750	2.5180	2.6957	5.3914		0.7844		2.5486
										*estimated		

The expanded uncertainties *U* are calculated by multiplication of $u_{combined}$ with a coverage factor of $k = 2$ using Equation 4.

$$U = k \cdot u_{combined} \qquad (4)$$

The calculated mass fractions and their resp. expanded uncertainties are given on Page 3 of this report. Rounding was done according to DIN 1333 [5].

In addition to the wet chemical characterisation an accompanying inter-laboratory comparison with spark emission was performed to check if there is agreement between SOES and wet chemistry. Tab. 40 shows the mean values of wet chemical and spark emission results as well as their standard deviations. The data of wet chemistry and SOES are consistent for all elements considering their uncertainties. The data from the spark emission inter-laboratory comparison was not used for the calculation of the certified values.

Tab. 40: Comparison wet chemistry vs. SOES

Element	Wet chemical analysis			Spark emission		
	Mass fraction in %	**Std.-dev.** in %	***n***	**Mass fraction** in %	**Std.-dev.** in %	***n***
Si	0.0490	0.0031	12	0.0504	0.0044	14
Fe	0.0495	0.0013	15	0.505	0.0045	14
Cu	4.38	0.07	11	4.36	0.07	15
Mn	0.808	0.013	14	0.797	0.021	15
Mg	1.506	0.019	14	1.509	0.038	15
Cr	0.0558	0.0012	13	0.0567	0.0022	15
Ni	0.0504	0.0006	11	0.0513	0.0021	14
Zn	0.1466	0.0021	13	0.150	0.006	15
Ti	0.0436	0.0010	11	0.0443	0.0022	15
Sc	0.0502	0.0012	8	0.0518	0.0062	8
Sn	0.0286	0.0009	13	0.0273	0.0030	15
V	0.0105	0.0003	12	0.0117	0.0018	14
Zr	0.1554	0.0038	14	0.152	0.013	14
	in mg/kg	in mg/kg		in mg/kg	in mg/kg	
Be	4.93	0.10	7	4.88	0.62	14
Bi	323	12	10	326	20	14
Ca	5.2	0.9	5	6.4	1.3	14
Cd	30.4	1.5	12	32.5	4.7	12
Ga	87.9	1.5	10	94.0	10.2	12
Li	5.8	0.3	10	6.8	2.0	15
Na	2.9	0.7	5	3.7	1.8	15
Pb	98.8	2.0	12	104.8	6.3	14

6. Instructions for users and stability

The certified reference material BAM-M321 is intended for the calibration and quality control of spark emission and X-ray fluorescence spectrometers used for the analysis of similar materials. It is also suitable for validation and quality control of wet chemical analysis methods.
The surface of the material should be cleaned by turning or milling before analysis.
An area 8mm in diameter in the centre of the discs should be avoided for spark optical emission spectrometry.
If chips prepared from the compact material are used for wet chemical analysis, a minimum sample intake of 0.2 g has to be used.
The material will remain stable provided that it is not subjected to excessive heat (eg, during preparation of the working surface).

7. Metrological Traceability

To ensure traceability of the certified mass fractions to the SI (Système International d'Unités) calibration was performed using standard solutions prepared from pure metals or stoichiometric compounds or well checked commercial calibration solutions.

8. Information on and purchase of the CRM

Certified reference material BAM-M321 is supplied by

Bundesanstalt für Materialforschung und -prüfung (BAM)
Division 1.6 „Inorganic Reference Materials“
Richard-Willstätter-Str. 11, D-12489 Berlin, Germany
Phone +49 (0)30 - 8104 2061
Fax: +49 (0)30 – 8104 72061
E-Mail: sales.crm@bam.de

Each disc of BAM-M321 will be distributed together with a detailed certificate containing the certified values and their uncertainties, the mean values and standard deviations of all accepted data sets and information on the analytical methods used and the names of the participating laboratories.
Information on certified reference materials can be obtained from BAM:
https://www.bam.de.
Tel. +49 30 8104 1111.

9. References

[1] DIN EN ISO 17034, General requirements for the competence of reference material producers, 2016

[2] ISO Guide 31, Reference materials - Contents of certificates, labels and accompanying documentation, 2015

[3] ISO Guide 35, Reference materials - Guidance for characterization and assessment of homogeneity and stability, 2017

[4] Lisec, J.: BAM ecerto Softwaretool (BAM 2019)

[5] DIN 1333:1992-02 Zahlenangaben

Annex 1: Calculation of uncertainty contribution of potential inhomogeneity (length), SOES Silicon:

Sample	*Number*	*Sum*	*Mean*	*Variance*		
A1	5	0.2670	0.0534	3E-07		
A2	5	0.2650	0.0530	6.0185E-35		
A3	5	0.2650	0.0530	6.0185E-35		
A4	5	0.2640	0.0528	0.0000002		
A5	5	0.2650	0.0530	6.0185E-35		
B1	5	0.2650	0.0530	6.0185E-35		
B2	5	0.2650	0.0530	6.0185E-35		
B3	5	0.2640	0.0528	0.0000002		
B4	5	0.2640	0.0528	0.0000002		
B5	5	0.2640	0.0528	0.0000002		
C1	5	0.2650	0.0530	6.0185E-35		
C2	5	0.2650	0.0530	6.0185E-35		
C3	5	0.2650	0.0530	6.0185E-35		
C4	5	0.2650	0.0530	6.0185E-35		
C5	5	0.2650	0.0530	6.0185E-35		
D1	5	0.2650	0.0530	6.0185E-35		
D2	5	0.2650	0.0530	6.0185E-35		
D3	5	0.2640	0.0528	0.0000002		
D4	5	0.2650	0.0530	6.0185E-35		
D5	5	0.2640	0.0528	0.0000002		
E1	5	0.2650	0.0530	6.0185E-35		
E2	5	0.2650	0.0530	6.0185E-35		
E3	5	0.2650	0.0530	6.0185E-35		
E4	5	0.2630	0.0526	3E-07		
E5	5	0.2660	0.0532	0.0000002		
F1	5	0.2660	0.0532	0.0000002		
F2	5	0.2650	0.0530	6.0185E-35		
F3	5	0.2630	0.0526	3E-07		
F4	5	0.2650	0.0530	6.0185E-35		
F5	5	0.2640	0.0528	0.0000002		
			0.0530			
ANOVA						
Source of variation	*sums of squares (SS)*	*degrees of freedom (df)*	*Mean squares (MS)*	*F-value*	*P-value*	*critical F-value*
Between groups	3.8733E-06	29	1.3356E-07	1.48403576	0.07269046	1.56207098
Within groups	0.0000108	120	9E-08			
Total	1.4673E-05	149				
within-sd	0.0003					
effective n	4.00					
s_bb	0.000104					
s_bb_min	5.39E-05					
u_bb	0.000104					
u_bb(rel.)	0.19707733					

Iron:

Sample	*Number*	*Sum*	*Mean*	*Variance*		
A1	5	0.2595	0.0519	9.5E-08		
A2	5	0.2599	0.0520	5.2E-08		
A3	5	0.2599	0.0520	6.7E-08		
A4	5	0.2591	0.0518	1.02E-07		
A5	5	0.2598	0.0520	7.3E-08		
B1	5	0.2592	0.0518	2.3E-08		
B2	5	0.2597	0.0519	8.8E-08		
B3	5	0.2603	0.0521	1.48E-07		
B4	5	0.2593	0.0519	5.8E-08		
B5	5	0.2602	0.0520	1.23E-07		
C1	5	0.2601	0.0520	6.7E-08		
C2	5	0.2600	0.0520	8.5E-08		
C3	5	0.2611	0.0522	3.2E-08		
C4	5	0.2601	0.0520	1.27E-07		
C5	5	0.2595	0.0519	5.5E-08		
D1	5	0.2598	0.0520	4.8E-08		
D2	5	0.2604	0.0521	9.7E-08		
D3	5	0.2600	0.0520	8E-08		
D4	5	0.2598	0.0520	5.3E-08		
D5	5	0.2592	0.0518	2.3E-08		
E1	5	0.2599	0.0520	9.7E-08		
E2	5	0.2594	0.0519	4.7E-08		
E3	5	0.2600	0.0520	3E-08		
E4	5	0.2598	0.0520	3.3E-08		
E5	5	0.2609	0.0522	6.2E-08		
F1	5	0.2597	0.0519	7.3E-08		
F2	5	0.2603	0.0521	2.8E-08		
F3	5	0.2598	0.0520	1.08E-07		
F4	5	0.2602	0.0520	8.3E-08		
F5	5	0.2597	0.0519	9.8E-08		
			0.0520			
ANOVA						
Source of variation	*sums of squares (SS)*	*degrees of freedom (df)*	*Mean squares (MS)*	*F-value*	*P-value*	*critical F-value*
Between groups	1.2029E-06	29	4.148E-08	0.5774542	0.95583536	1.56207098
Within groups	0.00000862	120	7.1833E-08			
Total	9.8229E-06	149				
within-sd	0.000268					
effective n	4.00					
s_bb	0					
s_bb_min	4.81E-05					
u_bb	4.81E-05					
u_bb(rel.)	0.0926363					

Copper:

Sample	*Number*	*Sum*	*Mean*	*Variance*		
A1	5	21.5950	4.3190	9.5E-06		
A2	5	21.6010	4.3202	6.2E-06		
A3	5	21.6020	4.3204	8.8E-06		
A4	5	21.5940	4.3188	1.47E-05		
A5	5	21.6020	4.3204	1.13E-05		
B1	5	21.5920	4.3184	2.3E-06		
B2	5	21.5950	4.3190	9E-06		
B3	5	21.6030	4.3206	1.48E-05		
B4	5	21.5920	4.3184	5.3E-06		
B5	5	21.6020	4.3204	1.23E-05		
C1	5	21.6060	4.3212	3.7E-06		
C2	5	21.6000	4.3200	8.5E-06		
C3	5	21.6110	4.3222	3.2E-06		
C4	5	21.6010	4.3202	1.27E-05		
C5	5	21.5950	4.3190	5.5E-06		
D1	5	21.5980	4.3196	4.8E-06		
D2	5	21.6040	4.3208	9.7E-06		
D3	5	21.6000	4.3200	8E-06		
D4	5	21.5980	4.3196	5.3E-06		
D5	5	21.5920	4.3184	2.3E-06		
E1	5	21.5990	4.3198	9.7E-06		
E2	5	21.5940	4.3188	4.7E-06		
E3	5	21.6000	4.3200	3E-06		
E4	5	21.5980	4.3196	3.3E-06		
E5	5	21.6090	4.3218	6.2E-06		
F1	5	21.5970	4.3194	7.3E-06		
F2	5	21.6030	4.3206	2.8E-06		
F3	5	21.5970	4.3194	1.13E-05		
F4	5	21.6020	4.3204	8.3E-06		
F5	5	21.5960	4.3192	9.7E-06		
			4.3199			

ANOVA

Source of variation	*sums of squares (SS)*	*degrees of freedom (df)*	*Mean squares (MS)*	*F-value*	*P-value*	*critical F-value*
Between groups	0.00013197	29	4.5508E-06	0.60893906	0.93856211	1.56207098
Within groups	0.0008968	120	7.4733E-06			
Total	0.00102877	149				

within-sd	0.002734
effective n	4.00
s_bb	0
s_bb_min	0.000491
u_bb	0.000491
u_bb(rel.)	0.01136895

Manganese:

Sample	*Number*	*Sum*	*Mean*	*Variance*		
A1	5	3.9950	0.7990	9.5E-06		
A2	5	4.0010	0.8002	6.2E-06		
A3	5	4.0020	0.8004	8.8E-06		
A4	5	3.9940	0.7988	0.0000147		
A5	5	4.0020	0.8004	0.0000113		
B1	5	3.9920	0.7984	0.0000023		
B2	5	3.9950	0.7990	9E-06		
B3	5	4.0030	0.8006	0.0000148		
B4	5	3.9920	0.7984	5.3E-06		
B5	5	4.0020	0.8004	0.0000123		
C1	5	4.0010	0.8002	6.7E-06		
C2	5	4.0000	0.8000	8.5E-06		
C3	5	4.0110	0.8022	3.2E-06		
C4	5	4.0010	0.8002	0.0000127		
C5	5	3.9950	0.7990	5.5E-06		
D1	5	3.9980	0.7996	4.8E-06		
D2	5	4.0040	0.8008	9.7E-06		
D3	5	4.0000	0.8000	8E-06		
D4	5	3.9980	0.7996	5.3E-06		
D5	5	3.9920	0.7984	0.0000023		
E1	5	3.9990	0.7998	9.7E-06		
E2	5	3.9940	0.7988	4.7E-06		
E3	5	4.0000	0.8000	3E-06		
E4	5	3.9980	0.7996	3.3E-06		
E5	5	4.0090	0.8018	6.2E-06		
F1	5	3.9970	0.7994	7.3E-06		
F2	5	4.0030	0.8006	0.0000028		
F3	5	3.9970	0.7994	0.0000113		
F4	5	4.0020	0.8004	8.3E-06		
F5	5	3.9960	0.7992	9.7E-06		
			0.7998			
ANOVA						
Source of variation	*sums of squares (SS)*	*degrees of freedom (df)*	*Mean squares (MS)*	*F-value*	*P-value*	*critical F-value*
Between groups	0.00012334	29	4.2531E-06	0.56158936	0.96313133	1.56207098
Within groups	0.0009088	120	7.5733E-06			
Total	0.00103214	149				
within-sd	0.002752					
effective n	4.00					
s_bb	0					
s_bb_min	0.000494					
u_bb	0.000494					
u_bb(rel.)	0.06181352					

Magnesium:

Sample	*Number*	*Sum*	*Mean*	*Variance*		
A1	5	7.2800	1.4560	3E-05		
A2	5	7.2300	1.4460	3E-05		
A3	5	7.2100	1.4420	0.00002		
A4	5	7.1900	1.4380	0.00012		
A5	5	7.2200	1.4440	8E-05		
B1	5	7.2300	1.4460	3E-05		
B2	5	7.3100	1.4620	7E-05		
B3	5	7.2200	1.4440	3E-05		
B4	5	7.2300	1.4460	0.00013		
B5	5	7.1900	1.4380	7E-05		
C1	5	7.2200	1.4440	3E-05		
C2	5	7.2300	1.4460	8E-05		
C3	5	7.1900	1.4380	0.00002		
C4	5	7.2600	1.4520	0.00002		
C5	5	7.2400	1.4480	0.00002		
D1	5	7.2400	1.4480	0.00002		
D2	5	7.2200	1.4440	0.00013		
D3	5	7.1900	1.4380	0.00002		
D4	5	7.2600	1.4520	7E-05		
D5	5	7.2200	1.4440	3E-05		
E1	5	7.3100	1.4620	0.00002		
E2	5	7.2100	1.4420	7E-05		
E3	5	7.2100	1.4420	7E-05		
E4	5	7.1700	1.4340	3E-05		
E5	5	7.3200	1.4640	8E-05		
F1	5	7.2600	1.4520	7E-05		
F2	5	7.3000	1.4600	5E-05		
F3	5	7.1500	1.4300	0.0001		
F4	5	7.2000	1.4400	5E-05		
F5	5	7.2000	1.4400	0.00015		
			1.4461			
ANOVA						
Source of variation	*sums of squares (SS)*	*degrees of freedom (df)*	*Mean squares (MS)*	*F-value*	*P-value*	*critical F-value*
Between groups	0.01021933	29	0.00035239	6.07570353	6.0414E-13	1.56207098
Within groups	0.00696	120	5.8E-05			
Total	0.01717933	149				
within-sd	0.007616					
effective n	4.00					
s_bb	0.008579					
s_bb_min	0.001368					
u_bb	0.008579					
u_bb(rel.)	0.59325828					

Chromium:

Sample	*Number*	*Sum*	*Mean*	*Variance*		
A1	5	0.2760	0.0552	0.0000002		
A2	5	0.2740	0.0548	0.0000002		
A3	5	0.2710	0.0542	0.0000002		
A4	5	0.2720	0.0544	3E-07		
A5	5	0.2730	0.0546	3E-07		
B1	5	0.2740	0.0548	0.0000002		
B2	5	0.2740	0.0548	7E-07		
B3	5	0.2720	0.0544	3E-07		
B4	5	0.2720	0.0544	3E-07		
B5	5	0.2710	0.0542	0.0000002		
C1	5	0.2730	0.0546	3E-07		
C2	5	0.2740	0.0548	0.0000002		
C3	5	0.2710	0.0542	0.0000002		
C4	5	0.2750	0.0550	6.0185E-35		
C5	5	0.2730	0.0546	3E-07		
D1	5	0.2740	0.0548	0.0000002		
D2	5	0.2730	0.0546	3E-07		
D3	5	0.2700	0.0540	6.0185E-35		
D4	5	0.2740	0.0548	0.0000002		
D5	5	0.2730	0.0546	3E-07		
E1	5	0.2750	0.0550	6.0185E-35		
E2	5	0.2730	0.0546	3E-07		
E3	5	0.2720	0.0544	3E-07		
E4	5	0.2700	0.0540	6.0185E-35		
E5	5	0.2760	0.0552	0.0000002		
F1	5	0.2740	0.0548	0.0000002		
F2	5	0.2760	0.0552	0.0000002		
F3	5	0.2700	0.0540	6.0185E-35		
F4	5	0.2710	0.0542	0.0000002		
F5	5	0.2710	0.0542	0.0000002		
			0.0546			
ANOVA						
Source of variation	*sums of squares (SS)*	*degrees of freedom (df)*	*Mean squares (MS)*	*F-value*	*P-value*	*critical F-value*
Between groups	0.00001854	29	6.3931E-07	2.95066313	1.9486E-05	1.56207098
Within groups	2.6E-05	120	2.1667E-07			
Total	4.454E-05	149				
within-sd	0.000465					
effective n	4.00					
s_bb	0.000325					
s_bb_min	8.36E-05					
u_bb	0.000325					
u_bb(rel.)	0.59555745					

Nickel:

Sample	*Number*	*Sum*	*Mean*	*Variance*		
A1	5	5.9425	1.1885	5.9966E-06		
A2	5	5.9064	1.1813	2.7665E-05		
A3	5	5.9058	1.1812	1.6073E-05		
A4	5	5.9131	1.1826	2.3714E-06		
A5	5	5.9206	1.1841	2.3404E-05		
B1	5	5.9187	1.1837	9.1637E-06		
B2	5	5.9094	1.1819	8.4629E-06		
B3	5	5.9061	1.1812	8.9719E-06		
B4	5	5.9616	1.1923	9.0903E-06		
B5	5	5.8954	1.1791	3.0223E-06		
C1	5	5.9073	1.1815	3.0321E-06		
C2	5	5.9146	1.1829	3.2914E-06		
C3	5	5.9928	1.1986	5.3076E-06		
C4	5	5.9322	1.1864	8.1576E-06		
C5	5	5.9135	1.1827	3.5155E-06		
D1	5	5.9733	1.1947	2.4536E-05		
D2	5	5.9125	1.1825	9.5767E-06		
D3	5	5.9213	1.1843	2.7881E-05		
D4	5	5.9066	1.1813	1.1683E-05		
D5	5	5.9096	1.1819	6.7844E-06		
E1	5	5.9462	1.1892	3.5009E-06		
E2	5	5.9373	1.1875	1.4668E-05		
E3	5	5.9328	1.1866	7.7876E-06		
E4	5	5.9211	1.1842	2.9218E-05		
E5	5	5.9190	1.1838	3.618E-05		
F1	5	5.9116	1.1823	4.399E-05		
F2	5	5.9144	1.1829	3.4333E-05		
F3	5	5.9142	1.1828	9.3399E-06		
F4	5	5.9132	1.1826	3.3358E-05		
F5	5	6.0135	1.2027	2.0853E-05		
			1.1852			
ANOVA						
Source of variation	*sums of squares (SS)*	*degrees of freedom (df)*	*Mean squares (MS)*	*F-value*	*P-value*	*critical F-value*
Between groups	0.0042707	29	0.00014727	9.7912584	4.4419E-20	1.56207098
Within groups	0.00180486	120	1.5041E-05			
Total	0.00607557	149				
within-sd	0.003878					
effective n	4.00					
s_bb	0.005749					
s_bb_min	0.000697					
u_bb	0.005749					
u_bb(rel.)	0.48508641					

Zinc:

Sample	*Number*	*Sum*	*Mean*	*Variance*		
A1	5	0.7120	0.1424	8E-07		
A2	5	0.7090	0.1418	0.0000002		
A3	5	0.7120	0.1424	3E-07		
A4	5	0.7130	0.1426	8E-07		
A5	5	0.7120	0.1424	8E-07		
B1	5	0.7100	0.1420	5E-07		
B2	5	0.7160	0.1432	7E-07		
B3	5	0.7110	0.1422	7E-07		
B4	5	0.7120	0.1424	0.0000013		
B5	5	0.7090	0.1418	7E-07		
C1	5	0.7170	0.1434	3E-07		
C2	5	0.7140	0.1428	0.0000002		
C3	5	0.7150	0.1430	5E-07		
C4	5	0.7120	0.1424	3E-07		
C5	5	0.7110	0.1422	7E-07		
D1	5	0.7110	0.1422	0.0000002		
D2	5	0.7120	0.1424	3E-07		
D3	5	0.7130	0.1426	8E-07		
D4	5	0.7100	0.1420	0.000001		
D5	5	0.7090	0.1418	7E-07		
E1	5	0.7140	0.1428	0.0000002		
E2	5	0.7190	0.1438	0.0000002		
E3	5	0.7150	0.1430	0.000001		
E4	5	0.7120	0.1424	3E-07		
E5	5	0.7150	0.1430	0.0000015		
F1	5	0.7140	0.1428	0.0000012		
F2	5	0.7140	0.1428	7E-07		
F3	5	0.7130	0.1426	3E-07		
F4	5	0.7140	0.1428	7E-07		
F5	5	0.7140	0.1428	7E-07		
			0.1426			
ANOVA						
Source of variation	*sums of squares (SS)*	*degrees of freedom (df)*	*Mean squares (MS)*	*F-value*	*P-value*	*critical F-value*
Between groups	3.256E-05	29	1.1228E-06	1.810901	0.0139532	1.56207098
Within groups	7.44E-05	120	6.2E-07			
Total	0.00010696	149				
within-sd	0.000787					
effective n	4.00					
s_bb	0.000355					
s_bb_min	0.000141					
u_bb	0.000355					
u_bb(rel.)	0.24868643					

Titanium:

Sample	*Number*	*Sum*	*Mean*	*Variance*		
A1	5	0.2250	0.0450	0		
A2	5	0.2200	0.0440	0		
A3	5	0.2200	0.0440	0		
A4	5	0.2200	0.0440	0		
A5	5	0.2200	0.0440	0		
B1	5	0.2220	0.0444	3E-07		
B2	5	0.2200	0.0440	0		
B3	5	0.2200	0.0440	0		
B4	5	0.2200	0.0440	0		
B5	5	0.2200	0.0440	0		
C1	5	0.2200	0.0440	0		
C2	5	0.2200	0.0440	0		
C3	5	0.2200	0.0440	0		
C4	5	0.2200	0.0440	0		
C5	5	0.2200	0.0440	0		
D1	5	0.2200	0.0440	0		
D2	5	0.2210	0.0442	0.0000002		
D3	5	0.2200	0.0440	0		
D4	5	0.2210	0.0442	0.0000002		
D5	5	0.2210	0.0442	0.0000002		
E1	5	0.2230	0.0446	3E-07		
E2	5	0.2200	0.0440	0		
E3	5	0.2210	0.0442	0.0000002		
E4	5	0.2200	0.0440	0		
E5	5	0.2220	0.0444	3E-07		
F1	5	0.2220	0.0444	3E-07		
F2	5	0.2210	0.0442	0.0000002		
F3	5	0.2200	0.0440	0		
F4	5	0.2200	0.0440	0		
F5	5	0.2200	0.0440	0		
			0.0441			
ANOVA						
Source of variation	*sums of squares (SS)*	*degrees of freedom (df)*	*Mean squares (MS)*	*F-value*	*P-value*	*critical F-value*
Between groups	7.7933E-06	29	2.6874E-07	3.6645768	2.908E-07	1.56207098
Within groups	8.8E-06	120	7.3333E-08			
Total	1.6593E-05	149				
within-sd	0.000271					
effective n	4.00					
s_bb	0.000221					
s_bb_min	4.87E-05					
u_bb	0.000221					
u_bb(rel.)	0.50088003					

Tin:

Sample	*Number*	*Sum*	*Mean*	*Variance*		
A1	5	5.9425	1.1885	5.9966E-06		
A2	5	5.9064	1.1813	2.7665E-05		
A3	5	5.9058	1.1812	1.6073E-05		
A4	5	5.9131	1.1826	2.3714E-06		
A5	5	5.9206	1.1841	2.3404E-05		
B1	5	5.9187	1.1837	9.1637E-06		
B2	5	5.9094	1.1819	8.4629E-06		
B3	5	5.9061	1.1812	8.9719E-06		
B4	5	5.9616	1.1923	9.0903E-06		
B5	5	5.8954	1.1791	3.0223E-06		
C1	5	5.9073	1.1815	3.0321E-06		
C2	5	5.9146	1.1829	3.2914E-06		
C3	5	5.9928	1.1986	5.3076E-06		
C4	5	5.9322	1.1864	8.1576E-06		
C5	5	5.9135	1.1827	3.5155E-06		
D1	5	5.9733	1.1947	2.4536E-05		
D2	5	5.9125	1.1825	9.5767E-06		
D3	5	5.9213	1.1843	2.7881E-05		
D4	5	5.9066	1.1813	1.1683E-05		
D5	5	5.9096	1.1819	6.7844E-06		
E1	5	5.9462	1.1892	3.5009E-06		
E2	5	5.9373	1.1875	1.4668E-05		
E3	5	5.9328	1.1866	7.7876E-06		
E4	5	5.9211	1.1842	2.9218E-05		
E5	5	5.9190	1.1838	3.618E-05		
F1	5	5.9116	1.1823	4.399E-05		
F2	5	5.9144	1.1829	3.4333E-05		
F3	5	5.9142	1.1828	9.3399E-06		
F4	5	5.9132	1.1826	3.3358E-05		
F5	5	6.0135	1.2027	2.0853E-05		
			1.1852			
ANOVA						
Source of variation	*sums of squares (SS)*	*degrees of freedom (df)*	*Mean squares (MS)*	*F-value*	*P-value*	*critical F-value*
Between groups	0.0042707	29	0.00014727	9.7912584	4.4419E-20	1.56207098
Within groups	0.00180486	120	1.5041E-05			
Total	0.00607557	149				
within-sd	0.003878					
effective n	4.00					
s_bb	0.005749					
s_bb_min	0.000697					
u_bb	0.005749					
u_bb(rel.)	0.48508641					

Vanadium:

Sample	*Number*	*Sum*	*Mean*	*Variance*		
A1	5	5.9425	1.1885	5.9966E-06		
A2	5	5.9064	1.1813	2.7665E-05		
A3	5	5.9058	1.1812	1.6073E-05		
A4	5	5.9131	1.1826	2.3714E-06		
A5	5	5.9206	1.1841	2.3404E-05		
B1	5	5.9187	1.1837	9.1637E-06		
B2	5	5.9094	1.1819	8.4629E-06		
B3	5	5.9061	1.1812	8.9719E-06		
B4	5	5.9616	1.1923	9.0903E-06		
B5	5	5.8954	1.1791	3.0223E-06		
C1	5	5.9073	1.1815	3.0321E-06		
C2	5	5.9146	1.1829	3.2914E-06		
C3	5	5.9928	1.1986	5.3076E-06		
C4	5	5.9322	1.1864	8.1576E-06		
C5	5	5.9135	1.1827	3.5155E-06		
D1	5	5.9733	1.1947	2.4536E-05		
D2	5	5.9125	1.1825	9.5767E-06		
D3	5	5.9213	1.1843	2.7881E-05		
D4	5	5.9066	1.1813	1.1683E-05		
D5	5	5.9096	1.1819	6.7844E-06		
E1	5	5.9462	1.1892	3.5009E-06		
E2	5	5.9373	1.1875	1.4668E-05		
E3	5	5.9328	1.1866	7.7876E-06		
E4	5	5.9211	1.1842	2.9218E-05		
E5	5	5.9190	1.1838	3.618E-05		
F1	5	5.9116	1.1823	4.399E-05		
F2	5	5.9144	1.1829	3.4333E-05		
F3	5	5.9142	1.1828	9.3399E-06		
F4	5	5.9132	1.1826	3.3358E-05		
F5	5	6.0135	1.2027	2.0853E-05		
			1.1852			
ANOVA						
Source of variation	*sums of squares (SS)*	*degrees of freedom (df)*	*Mean squares (MS)*	*F-value*	*P-value*	*critical F-value*
Between groups	0.0042707	29	0.00014727	9.7912584	4.4419E-20	1.56207098
Within groups	0.00180486	120	1.5041E-05			
Total	0.00607557	149				
within-sd	0.003878					
effective n	4.00					
s_bb	0.005749					
s_bb_min	0.000697					
u_bb	0.005749					
u_bb(rel.)	0.48508641					

Zirconium:

Sample	*Number*	*Sum*	*Mean*	*Variance*		
A1	5	0.7700	0.1540	0		
A2	5	0.7660	0.1532	7E-07		
A3	5	0.7670	0.1534	8E-07		
A4	5	0.7630	0.1526	3E-07		
A5	5	0.7660	0.1532	0.0000002		
B1	5	0.7690	0.1538	7E-07		
B2	5	0.7700	0.1540	0		
B3	5	0.7680	0.1536	3E-07		
B4	5	0.7660	0.1532	0.0000002		
B5	5	0.7660	0.1532	0.0000002		
C1	5	0.7660	0.1532	0.0000002		
C2	5	0.7680	0.1536	3E-07		
C3	5	0.7640	0.1528	0.0000002		
C4	5	0.7690	0.1538	0.0000002		
C5	5	0.7660	0.1532	0.0000002		
D1	5	0.7660	0.1532	0.0000002		
D2	5	0.7660	0.1532	7E-07		
D3	5	0.7630	0.1526	3E-07		
D4	5	0.7690	0.1538	0.0000002		
D5	5	0.7670	0.1534	3E-07		
E1	5	0.7700	0.1540	5E-07		
E2	5	0.7660	0.1532	7E-07		
E3	5	0.7660	0.1532	7E-07		
E4	5	0.7650	0.1530	5E-07		
E5	5	0.7720	0.1544	3E-07		
F1	5	0.7700	0.1540	0		
F2	5	0.7700	0.1540	0		
F3	5	0.7650	0.1530	0		
F4	5	0.7640	0.1528	0.0000002		
F5	5	0.7630	0.1526	3E-07		
			0.1534			
ANOVA						
Source of variation	*sums of squares (SS)*	*degrees of freedom (df)*	*Mean squares (MS)*	*F-value*	*P-value*	*critical F-value*
Between groups	3.3493E-05	29	1.1549E-06	3.68598679	2.5674E-07	1.56207098
Within groups	3.76E-05	120	3.1333E-07			
Total	7.1093E-05	149				
within-sd	0.00056					
effective n	4.00					
s_bb	0.000459					
s_bb_min	0.000101					
u_bb	0.000459					
u_bb(rel.)	0.29907174					

Beryllium:

Sample	*Number*	*Sum*	*Mean*	*Variance*		
A1	5	26.8000	5.3600	0.003		
A2	5	26.9000	5.3800	0.002		
A3	5	26.9000	5.3800	0.002		
A4	5	27.0000	5.4000	0		
A5	5	26.9000	5.3800	0.002		
B1	5	26.7000	5.3400	0.003		
B2	5	26.8000	5.3600	0.003		
B3	5	26.7000	5.3400	0.003		
B4	5	26.8000	5.3600	0.003		
B5	5	26.6000	5.3200	0.002		
C1	5	27.0000	5.4000	0		
C2	5	26.8000	5.3600	0.003		
C3	5	26.9000	5.3800	0.002		
C4	5	26.7000	5.3400	0.003		
C5	5	27.0000	5.4000	0		
D1	5	27.0000	5.4000	0		
D2	5	26.7000	5.3400	0.003		
D3	5	26.9000	5.3800	0.002		
D4	5	26.9000	5.3800	0.002		
D5	5	26.8000	5.3600	0.003		
E1	5	26.9000	5.3800	0.002		
E2	5	26.9000	5.3800	0.002		
E3	5	26.8000	5.3600	0.003		
E4	5	26.7000	5.3400	0.003		
E5	5	26.9000	5.3800	0.002		
F1	5	27.0000	5.4000	0		
F2	5	26.8000	5.3600	0.003		
F3	5	26.8000	5.3600	0.003		
F4	5	27.0000	5.4000	0		
F5	5	26.9000	5.3800	0.002		
			5.3700			
ANOVA						
Source of variation	*sums of squares (SS)*	*degrees of freedom (df)*	*Mean squares (MS)*	*F-value*	*P-value*	*critical F-value*
Between groups	0.071	29	0.00244828	1.2040701	0.24086516	1.56207098
Within groups	0.244	120	0.00203333			
Total	0.315	149				
within-sd	0.045092					
effective n	4.00					
s_bb	0.010185					
s_bb_min	0.008101					
u_bb	0.010185					
u_bb(rel.)	0.18966609					

Bismuth:

Sample	*Number*	*Sum*	*Mean*	*Variance*		
A1	5	1610.0000	322.0000	15.5		
A2	5	1624.0000	324.8000	5.2		
A3	5	1646.0000	329.2000	3.7		
A4	5	1638.0000	327.6000	2.8		
A5	5	1630.0000	326.0000	5		
B1	5	1615.0000	323.0000	7		
B2	5	1626.0000	325.2000	15.2		
B3	5	1613.0000	322.6000	2.3		
B4	5	1628.0000	325.6000	9.8		
B5	5	1612.0000	322.4000	4.3		
C1	5	1637.0000	327.4000	5.3		
C2	5	1631.0000	326.2000	9.7		
C3	5	1636.0000	327.2000	3.2		
C4	5	1635.0000	327.0000	17.5		
C5	5	1639.0000	327.8000	5.2		
D1	5	1634.0000	326.8000	6.7		
D2	5	1632.0000	326.4000	6.3		
D3	5	1634.0000	326.8000	7.7		
D4	5	1628.0000	325.6000	2.3		
D5	5	1629.0000	325.8000	6.2		
E1	5	1636.0000	327.2000	16.7		
E2	5	1642.0000	328.4000	18.8		
E3	5	1638.0000	327.6000	11.3		
E4	5	1622.0000	324.4000	11.3		
E5	5	1629.0000	325.8000	26.7		
F1	5	1622.0000	324.4000	10.3		
F2	5	1638.0000	327.6000	7.3		
F3	5	1633.0000	326.6000	4.3		
F4	5	1651.0000	330.2000	6.2		
F5	5	1642.0000	328.4000	1.8		
			326.2000			
ANOVA						
Source of variation	*sums of squares (SS)*	*degrees of freedom (df)*	*Mean squares (MS)*	*F-value*	*P-value*	*critical F-value*
Between groups	569.6	29	19.6413793	2.30532621	0.00087319	1.56207098
Within groups	1022.4	120	8.52			
Total	1592	149				
within-sd	2.918904					
effective n	4.00					
s_bb	1.667437					
s_bb_min	0.524387					
u_bb	1.667437					
u_bb(rel.)	0.51117002					

Calcium:

Sample	*Number*	*Sum*	*Mean*	*Variance*		
A1	5	23.3000	4.6600	0.173		
A2	5	22.2000	4.4400	0.003		
A3	5	23.1000	4.6200	0.077		
A4	5	22.4000	4.4800	0.017		
A5	5	22.2000	4.4400	0.008		
B1	5	22.3000	4.4600	0.003		
B2	5	22.1000	4.4200	0.002		
B3	5	21.9000	4.3800	0.002		
B4	5	21.9000	4.3800	0.002		
B5	5	21.9000	4.3800	0.007		
C1	5	22.5000	4.5000	0.005		
C2	5	23.1000	4.6200	0.017		
C3	5	22.7000	4.5400	0.003		
C4	5	21.9000	4.3800	0.002		
C5	5	22.2000	4.4400	0.003		
D1	5	22.7000	4.5400	0.008		
D2	5	22.5000	4.5000	0.015		
D3	5	22.3000	4.4600	0.003		
D4	5	22.3000	4.4600	0.023		
D5	5	21.9000	4.3800	0.007		
E1	5	22.3000	4.4600	0.003		
E2	5	22.7000	4.5400	0.013		
E3	5	22.6000	4.5200	0.012		
E4	5	22.5000	4.5000	0.01		
E5	5	22.0000	4.4000	0.01		
F1	5	23.2000	4.6400	0.048		
F2	5	22.1000	4.4200	0.002		
F3	5	22.6000	4.5200	0.012		
F4	5	23.1000	4.6200	0.012		
F5	5	22.1000	4.4200	0.002		
			4.4840			
ANOVA						
Source of variation	*sums of squares (SS)*	*degrees of freedom (df)*	*Mean squares (MS)*	*F-value*	*P-value*	*critical F-value*
Between groups	1.0256	29	0.03536552	2.10509031	0.00275311	1.56207098
Within groups	2.016	120	0.0168			
Total	3.0416	149				
within-sd	0.129615					
effective n	4.00					
s_bb	0.068128					
s_bb_min	0.023286					
u_bb	0.068128					
u_bb(rel.)	1.51935034					

Cadmium:

Sample	*Number*	*Sum*	*Mean*	*Variance*		
A1	5	150.0000	30.0000	0		
A2	5	145.0000	29.0000	0		
A3	5	140.0000	28.0000	0		
A4	5	138.0000	27.6000	0.3		
A5	5	133.0000	26.6000	0.3		
B1	5	150.0000	30.0000	0		
B2	5	146.0000	29.2000	0.2		
B3	5	141.0000	28.2000	0.2		
B4	5	138.0000	27.6000	0.3		
B5	5	132.0000	26.4000	0.3		
C1	5	150.0000	30.0000	0		
C2	5	144.0000	28.8000	0.2		
C3	5	140.0000	28.0000	0		
C4	5	138.0000	27.6000	0.3		
C5	5	131.0000	26.2000	0.2		
D1	5	150.0000	30.0000	0		
D2	5	145.0000	29.0000	0		
D3	5	140.0000	28.0000	0		
D4	5	138.0000	27.6000	0.3		
D5	5	130.0000	26.0000	0		
E1	5	150.0000	30.0000	0		
E2	5	145.0000	29.0000	0		
E3	5	140.0000	28.0000	0		
E4	5	136.0000	27.2000	0.2		
E5	5	134.0000	26.8000	0.2		
F1	5	150.0000	30.0000	0		
F2	5	145.0000	29.0000	0		
F3	5	140.0000	28.0000	0		
F4	5	138.0000	27.6000	0.3		
F5	5	131.0000	26.2000	0.2		
			28.1867			

ANOVA

Source of variation	*sums of squares (SS)*	*degrees of freedom (df)*	*Mean squares (MS)*	*F-value*	*P-value*	*critical F-value*
Between groups	234.773333	29	8.09563218	69.391133	9.6868E-62	1.56207098
Within groups	14	120	0.11666667			
Total	248.773333	149				

within-sd	0.341565
effective n	4.00
s_bb	1.412353
s_bb_min	0.061363
u_bb	1.412353
u_bb(rel.)	5.01071358

Gallium:

Sample	*Number*	*Sum*	*Mean*	*Variance*		
A1	5	450.0000	90.0000	1		
A2	5	450.0000	90.0000	0.5		
A3	5	448.0000	89.6000	0.3		
A4	5	451.0000	90.2000	0.7		
A5	5	453.0000	90.6000	0.3		
B1	5	449.0000	89.8000	0.7		
B2	5	451.0000	90.2000	0.7		
B3	5	447.0000	89.4000	0.3		
B4	5	451.0000	90.2000	0.7		
B5	5	450.0000	90.0000	0.5		
C1	5	452.0000	90.4000	0.3		
C2	5	452.0000	90.4000	0.3		
C3	5	451.0000	90.2000	0.7		
C4	5	451.0000	90.2000	0.2		
C5	5	451.0000	90.2000	0.7		
D1	5	451.0000	90.2000	0.2		
D2	5	451.0000	90.2000	0.7		
D3	5	450.0000	90.0000	0		
D4	5	451.0000	90.2000	0.2		
D5	5	452.0000	90.4000	0.3		
E1	5	451.0000	90.2000	0.2		
E2	5	455.0000	91.0000	0		
E3	5	452.0000	90.4000	0.3		
E4	5	451.0000	90.2000	0.7		
E5	5	452.0000	90.4000	0.8		
F1	5	451.0000	90.2000	0.7		
F2	5	452.0000	90.4000	0.3		
F3	5	450.0000	90.0000	0		
F4	5	453.0000	90.6000	0.8		
F5	5	454.0000	90.8000	0.7		
			90.2200			
ANOVA						
Source of variation	*sums of squares (SS)*	*degrees of freedom (df)*	*Mean squares (MS)*	*F-value*	*P-value*	*critical F-value*
Between groups	14.54	29	0.50137931	1.08995502	0.36114374	1.56207098
Within groups	55.2	120	0.46			
Total	69.74	149				
within-sd	0.678233					
effective n	4.00					
s_bb	0.10171					
s_bb_min	0.121846					
u_bb	0.121846					
u_bb(rel.)	0.13505426					

Lithium:

Sample	*Number*	*Sum*	*Mean*	*Variance*		
A1	5	27.8000	5.5600	0.003		
A2	5	27.4000	5.4800	0.007		
A3	5	27.1000	5.4200	0.002		
A4	5	26.6000	5.3200	0.007		
A5	5	26.6000	5.3200	0.007		
B1	5	27.8000	5.5600	0.003		
B2	5	27.2000	5.4400	0.003		
B3	5	26.7000	5.3400	0.003		
B4	5	27.0000	5.4000	0.01		
B5	5	26.3000	5.2600	0.003		
C1	5	28.0000	5.6000	0.005		
C2	5	27.4000	5.4800	0.002		
C3	5	27.2000	5.4400	0.003		
C4	5	26.7000	5.3400	0.003		
C5	5	26.4000	5.2800	0.002		
D1	5	27.7000	5.5400	0.003		
D2	5	27.4000	5.4800	0.002		
D3	5	27.2000	5.4400	0.003		
D4	5	26.7000	5.3400	0.003		
D5	5	26.5000	5.3000	0.005		
E1	5	27.9000	5.5800	0.002		
E2	5	27.8000	5.5600	0.003		
E3	5	27.1000	5.4200	0.002		
E4	5	26.8000	5.3600	0.003		
E5	5	26.6000	5.3200	0.012		
F1	5	27.9000	5.5800	0.002		
F2	5	27.5000	5.5000	0.01		
F3	5	27.0000	5.4000	0.005		
F4	5	26.6000	5.3200	0.002		
F5	5	26.8000	5.3600	0.003		
			5.4247			
ANOVA						
Source of variation	*sums of squares (SS)*	*degrees of freedom (df)*	*Mean squares (MS)*	*F-value*	*P-value*	*critical F-value*
Between groups	1.50673333	29	0.05195632	12.6722736	1.4087E-24	1.56207098
Within groups	0.492	120	0.0041			
Total	1.99873333	149				
within-sd	0.064031					
effective n	4.00					
s_bb	0.10938					
s_bb_min	0.011503					
u_bb	0.10938					
u_bb(rel.)	2.01635319					

Sodium:

Sample	*Number*	*Sum*	*Mean*	*Variance*		
A1	5	16.5000	3.3000	0.02		
A2	5	15.2000	3.0400	0.008		
A3	5	14.7000	2.9400	0.003		
A4	5	13.9000	2.7800	0.002		
A5	5	12.9000	2.5800	0.007		
B1	5	16.6000	3.3200	0.002		
B2	5	15.3000	3.0600	0.003		
B3	5	14.2000	2.8400	0.013		
B4	5	13.7000	2.7400	0.003		
B5	5	12.7000	2.5400	0.003		
C1	5	16.6000	3.3200	0.007		
C2	5	15.1000	3.0200	0.002		
C3	5	14.7000	2.9400	0.003		
C4	5	13.7000	2.7400	0.003		
C5	5	13.1000	2.6200	0.002		
D1	5	16.5000	3.3000	0.005		
D2	5	15.1000	3.0200	0.007		
D3	5	14.8000	2.9600	0.003		
D4	5	13.7000	2.7400	0.003		
D5	5	12.8000	2.5600	0.003		
E1	5	16.4000	3.2800	0.012		
E2	5	15.7000	3.1400	0.008		
E3	5	14.6000	2.9200	0.007		
E4	5	13.7000	2.7400	0.003		
E5	5	13.1000	2.6200	0.012		
F1	5	16.7000	3.3400	0.008		
F2	5	15.5000	3.1000	0.01		
F3	5	14.6000	2.9200	0.002		
F4	5	13.8000	2.7600	0.003		
F5	5	13.1000	2.6200	0.002		
			2.9267			
ANOVA						
Source of variation	*sums of squares (SS)*	*degrees of freedom (df)*	*Mean squares (MS)*	*F-value*	*P-value*	*critical F-value*
Between groups	9.45733333	29	0.32611494	57.8902265	2.2613E-57	1.56207098
Within groups	0.676	120	0.00563333			
Total	10.1333333	149				
within-sd	0.075056					
effective n	4.00					
s_bb	0.283055					
s_bb_min	0.013484					
u_bb	0.283055					
u_bb(rel.)	9.6715994					

Lead:

Sample	*Number*	*Sum*	*Mean*	*Variance*		
A1	5	537.0000	107.4000	1.3		
A2	5	545.0000	109.0000	0.5		
A3	5	543.0000	108.6000	1.3		
A4	5	551.0000	110.2000	1.7		
A5	5	545.0000	109.0000	2.5		
B1	5	539.0000	107.8000	2.7		
B2	5	542.0000	108.4000	1.8		
B3	5	541.0000	108.2000	1.2		
B4	5	547.0000	109.4000	1.8		
B5	5	544.0000	108.8000	1.7		
C1	5	553.0000	110.6000	0.8		
C2	5	548.0000	109.6000	3.8		
C3	5	549.0000	109.8000	4.7		
C4	5	549.0000	109.8000	2.2		
C5	5	554.0000	110.8000	6.2		
D1	5	551.0000	110.2000	1.7		
D2	5	548.0000	109.6000	1.8		
D3	5	550.0000	110.0000	0.5		
D4	5	547.0000	109.4000	1.8		
D5	5	547.0000	109.4000	3.8		
E1	5	541.0000	108.2000	0.7		
E2	5	557.0000	111.4000	1.3		
E3	5	554.0000	110.8000	1.2		
E4	5	546.0000	109.2000	0.2		
E5	5	544.0000	108.8000	3.7		
F1	5	547.0000	109.4000	3.3		
F2	5	545.0000	109.0000	1.5		
F3	5	551.0000	110.2000	0.2		
F4	5	552.0000	110.4000	2.3		
F5	5	557.0000	111.4000	3.8		
			109.4933			
ANOVA						
Source of variation	*sums of squares (SS)*	*degrees of freedom (df)*	*Mean squares (MS)*	*F-value*	*P-value*	*critical F-value*
Between groups	145.493333	29	5.01701149	2.42758621	0.00042839	1.56207098
Within groups	248	120	2.06666667			
Total	393.493333	149				
within-sd	1.437591					
effective n	4.00					
s_bb	0.858828					
s_bb_min	0.258266					
u_bb	0.858828					
u_bb(rel.)	0.78436592					

Annex 2: Calculation of uncertainty contribution of potential inhomogeneity (area)

Silicon:

r_0	0.0503777	0.0536223														
r_in	0.0523	0.0521	0.0528	0.0521	0.0524	0.0519	0.0516	0.053								
r_middle	0.0531	0.0533	0.0534	0.0527	0.053	0.0522	0.0528	0.0526	0.0529	0.0533	0.0531	0.0532	0.0529	0.0534	0.0532	0.0538
r_out	0.0512	0.0519	0.052	0.0523	0.0517	0.0525	0.0523	0.0526	0.0515	0.0513	0.0518	0.052	0.052	0.051	0.0519	0.0513

Source of variation	*sums of squares (SS)*	*degrees of freedom (df)*	*Mean squares (MS)*	*F-value*	*P-value*	*critical F-value*
Between groups	1.25074E-05	3	4.16915E-06	12.95140339	5.63129E-06	2.851741336
Within groups	1.22325E-05	38	3.21907E-07			
Total	2.47399E-05	41				

within-sd	0.000567368
effective n	9.40
s_bb	0.000639859
s_bb_min	8.86515E-05
u_bb	0.000639859
u_bb(rel.)	1.221584284

Iron:

r_0	0.056118304	0.059281696														
r_in	0.0592	0.059	0.0588	0.0597	0.0591	0.0589	0.0595	0.0595								
r_middle	0.06	0.059	0.0601	0.06	0.0596	0.06	0.0601	0.0601	0.0601	0.0598	0.0596	0.0598	0.0594	0.0601	0.0595	0.0598
r_out	0.059	0.0588	0.0581	0.058	0.058	0.0586	0.0577	0.0582	0.0579	0.0575	0.0575	0.0584	0.0591	0.0577	0.0586	0.0585

Source of variation	*sums of squares (SS)*	*degrees of freedom (df)*	*Mean squares (MS)*	*F-value*	*P-value*	*critical F-value*
Between groups	2.39116E-05	3	7.97054E-06	27.09181441	1.52536E-09	2.851741336
Within groups	1.11798E-05	38	2.94205E-07			
Total	3.50914E-05	41				

within-sd	0.000542406
effective n	9.40
s_bb	0.000903829
s_bb_min	8.47512E-05
u_bb	0.000903829
u_bb(rel.)	1.532677606

Copper:

r_0	4.220719929	4.394680071														
r_in	4.3963	4.3599	4.3528	4.4034	4.3816	4.3874	4.3513	4.4058								
r_middle	4.3015	4.2828	4.3626	4.3273	4.3484	4.4092	4.3447	4.3853	4.3726	4.3536	4.3125	4.346	4.3239	4.3087	4.3407	4.3689
r_out	4.3098	4.3069	4.3339	4.3522	4.3165	4.3115	4.3018	4.3477	4.3074	4.3179	4.3665	4.3531	4.3338	4.3551	4.377	4.3799

Source of variation	*sums of squares (SS)*	*degrees of freedom (df)*	*Mean squares (MS)*	*F-value*	*P-value*	*critical F-value*
Between groups	0.013913393	3	0.004637798	3.882536961	0.016261993	2.851741336
Within groups	0.045392051	38	0.001194528			
Total	0.059305445	41				

within-sd	0.03456194
effective n	9.40
s_bb	0.019142338
s_bb_min	0.005400315
u_bb	0.019142338
u_bb(rel.)	0.440573249

Manganese:

r_0	0.776629137	0.825770863														
r_in	0.8046	0.8056	0.8027	0.8028	0.7996	0.7924	0.7979	0.8013								
r_middle	0.8009	0.8027	0.8018	0.8014	0.8028	0.7965	0.8004	0.7961	0.802	0.8015	0.798	0.797	0.7921	0.794	0.8023	0.7962
r_out	0.8287	0.8123	0.8069	0.8053	0.8089	0.7979	0.8045	0.8098	0.8071	0.8084	0.7903	0.8118	0.8072	0.7989	0.8052	0.802

Source of variation	*sums of squares (SS)*	*degrees of freedom (df)*	*Mean squares (MS)*	*F-value*	*P-value*	*critical F-value*
Between groups	0.000474253	3	0.000158084	2.399205235	0.082975899	2.851741336
Within groups	0.002503833	38	6.58903E-05			
Total	0.002978086	41				

within-sd	0.008117286
effective n	9.40
s_bb	0.003132283
s_bb_min	0.001268329
u_bb	0.003132283
u_bb(rel.)	0.390068311

Magnesium:

r_0	1.450856735	1.521943265														
r_in	1.4748	1.4895	1.4876	1.4773	1.4882	1.4761	1.4822	1.4929								
r_middle	1.499	1.5089	1.5139	1.5049	1.518	1.4998	1.5006	1.5133	1.5081	1.5058	1.5023	1.5125	1.5191	1.5143	1.4882	1.5179
r_out	1.4714	1.488	1.4775	1.4808	1.483	1.4927	1.5007	1.4993	1.5119	1.4673	1.4849	1.4761	1.4927	1.4806	1.4792	1.4888

Source of variation	*sums of squares (SS)*	*degrees of freedom (df)*	*Mean squares (MS)*	*F-value*	*P-value*	*critical F-value*
Between groups	0.005122944	3	0.001707648	10.89084183	2.66061E-05	2.851741336
Within groups	0.005958274	38	0.000156797			
Total	0.011081218	41				

within-sd	0.012521848
effective n	9.40
s_bb	0.012846786
s_bb_min	0.001956543
u_bb	0.012846786
u_bb(rel.)	0.860466231

Chromium:

r_0	0.057434443	0.059765557														
r_in	0.0594	0.059	0.0584	0.0592	0.0586	0.0588	0.0593	0.0585								
r_middle	0.0588	0.0586	0.0585	0.0584	0.0582	0.0584	0.0587	0.0585	0.0581	0.0583	0.0579	0.0586	0.0581	0.0588	0.0579	0.0577
r_out	0.059	0.0594	0.0595	0.0595	0.0591	0.0596	0.059	0.0592	0.0587	0.0593	0.0588	0.0592	0.0594	0.0591	0.0594	0.0585

Source of variation	*sums of squares (SS)*	*degrees of freedom (df)*	*Mean squares (MS)*	*F-value*	*P-value*	*critical F-value*
Between groups	5.64244E-06	3	1.88081E-06	10.40212748	3.91828E-05	2.851741336
Within groups	6.8708E-06	38	1.8081E-07			
Total	1.25132E-05	41				

within-sd	0.000425218
effective n	9.40
s_bb	0.000425338
s_bb_min	6.64405E-05
u_bb	0.000425338
u_bb(rel.)	0.723183218

Nickel:

r_0	0.047946096	0.050053904														
r_in	0.0493	0.0497	0.0492	0.049	0.0493	0.0494	0.0491	0.0496								
r_middle	0.049	0.049	0.0487	0.0489	0.049	0.0482	0.0488	0.0489	0.0489	0.0492	0.0487	0.0495	0.0495	0.0495	0.0487	0.0491
r_out	0.0494	0.0492	0.0497	0.0494	0.0493	0.0497	0.0494	0.0501	0.0495	0.0493	0.0493	0.0491	0.0495	0.0489	0.0489	0.0488

Source of variation	*sums of squares (SS)*	*degrees of freedom (df)*	*Mean squares (MS)*	*F-value*	*P-value*	*critical F-value*
Between groups	1.33396E-06	3	4.44653E-07	2.794798964	0.053269389	2.851741336
Within groups	6.0458E-06	38	1.591E-07			
Total	7.37976E-06	41				

within-sd	0.000398874
effective n	9.40
s_bb	0.000174322
s_bb_min	6.23241E-05
u_bb	0.000174322
u_bb(rel.)	0.354313289

Zinc:

r_0	0.153730374	0.163269626														
r_in	0.1589	0.159	0.1597	0.1579	0.1596	0.1577	0.1566	0.1608								
r_middle	0.1582	0.1596	0.1604	0.1586	0.1582	0.1567	0.1571	0.1578	0.1585	0.1596	0.1589	0.1593	0.1602	0.1612	0.1595	0.1613
r_out	0.1547	0.1572	0.1563	0.1589	0.1567	0.1578	0.1576	0.157	0.1554	0.1531	0.1572	0.1567	0.1569	0.1554	0.1578	0.1559

Source of variation	*sums of squares (SS)*	*degrees of freedom (df)*	*Mean squares (MS)*	*F-value*	*P-value*	*critical F-value*
Between groups	5.77838E-05	3	1.92613E-05	6.430267058	0.001247933	2.851741336
Within groups	0.000113826	38	2.99541E-06			
Total	0.000171609	41				

within-sd	0.001730725
effective n	9.40
s_bb	0.001315673
s_bb_min	0.000270426
u_bb	0.001315673
u_bb(rel.)	0.833216498

Titanium:

r_0	0.041478144	0.043521856														
r_in	0.0424	0.0423	0.0424	0.0421	0.0423	0.0422	0.0423	0.0422								
r_middle	0.0426	0.0429	0.0426	0.0427	0.0428	0.0426	0.0423	0.0423	0.0423	0.0424	0.0425	0.0421	0.0423	0.0422	0.0423	0.0424
r_out	0.0439	0.044	0.0445	0.0441	0.0449	0.0442	0.0445	0.0443	0.0442	0.0443	0.0444	0.0441	0.0437	0.0438	0.0438	0.0435

Source of variation	*sums of squares (SS)*	*degrees of freedom (df)*	*Mean squares (MS)*	*F-value*	*P-value*	*critical F-value*
Between groups	2.99646E-05	3	9.98818E-06	79.06891126	2.14825E-16	2.851741336
Within groups	4.80026E-06	38	1.26323E-07			
Total	3.47648E-05	41				

within-sd	0.000355419
effective n	9.40
s_bb	0.001024446
s_bb_min	5.55343E-05
u_bb	0.001024446
u_bb(rel.)	2.378039791

Scandium:

r_0	0.041050924	0.043349076					
r_in	0.04438	0.04404	0.04291	0.04275			
r_out	0.04409	0.044	0.04386	0.04383			

Source of variation	*sums of squares (SS)*	*degrees of freedom (df)*	*Mean squares (MS)*	*F-value*	*P-value*	*critical F-value*
Between groups	4.11894E-06	2	2.05947E-06	3.093458505	0.108978715	4.737414128
Within groups	4.66025E-06	7	6.6575E-07			
Total	8.77919E-06	9				

within-sd	0.000815935					
effective n	3.20					
s_bb	0.000659953					
s_bb_min	0.000333475					
u_bb	0.000659953			0.043426		
u_bb(rel.)	1.519717795					

Tin:

r_0	207.296474	227.503526														
r_in	219.6	219.9	223.5	218.5	220	218.6	218	215								
r_middle	221.6	223.7	224.1	224.6	225.2	225.6	221.7	226.2	220.4	220	228.8	216.9	221.1	221.5	224.7	226.2
r_out	220.5	215.7	215.9	211.4	219.9	214.5	218.6	213	219.1	212.3	220.8	221.2	218.8	215.8	218.7	218.9

Source of variation	*sums of squares (SS)*	*degrees of freedom (df)*	*Mean squares (MS)*	*F-value*	*P-value*	*critical F-value*
Between groups	315.9015476	3	105.3005159	7.593907641	0.000425092	2.851741336
Within groups	526.9249762	38	13.86644674			
Total	842.8265238	41				

within-sd	3.723767815
effective n	9.40
s_bb	3.11934525
s_bb_min	0.581840054
u_bb	3.11934525
u_bb(rel.)	1.419858339

			219.6941176	

Vanadium:

r_0	125.456908	140.143092														
r_in	137.1	135.4	131.9	135.8	133.7	134.5	136.5	133.8								
r_middle	135.2	135.3	133.5	132.9	131.6	132.6	134.6	136.3	134.1	132.4	134.3	132.8	134.9	137.7	134.7	131
r_out	133.2	133.8	138.2	135.2	134	139.9	130.4	134.1	133.8	135	132.1	132.8	134.7	133.6	136.8	133.4

Source of variation	*sums of squares (SS)*	*degrees of freedom (df)*	*Mean squares (MS)*	*F-value*	*P-value*	*critical F-value*
Between groups	8.567708333	3	2.855902778	0.428023357	0.734068027	2.851741336
Within groups	253.547625	38	6.672305921			
Total	262.1153333	41				

within-sd	2.583080704
effective n	9.40
s_bb	0
s_bb_min	0.403607285
u_bb	0.403607285
u_bb(rel.)	0.300776952

			134.1882353	

Zirconium:

r_0	1574.45407	1646.74593															
r_in	1621.8	1612.3	1593.8	1608.8	1600.1	1596	1605.3	1591									
r_middle	1593.8	1590.9	1594.8	1590.2	1587.4	1588	1596.5	1601.4	1584.5	1587.2	1572.7	1594.8	1579	1603.5	1572.7	1566.7	
r_out	1574.8	1600.3	1609.2	1607.1	1590.3	1609.6	1586.5	1600.9	1587.7	1601.3	1585.5	1597.5	1603.5	1598.3	1602.6	1581.1	

Source of variation	*sums of squares (SS)*	*degrees of freedom (df)*	*Mean squares (MS)*	*F-value*	*P-value*	*critical F-value*
Between groups	1939.515804	3	646.5052679	3.691544604	0.019953456	2.851741336
Within groups	6654.992101	38	175.1313711			
Total	8594.507905	41				

within-sd	13.23372098
effective n	9.40
s_bb	7.082591369
s_bb_min	2.067773642
u_bb	7.082591369
u_bb(rel.)	0.443614427

Beryllium:

r_0	4.534559823	4.785440177															
r_in	4.69	4.71	4.69	4.67	4.66	4.68	4.71	4.69									
r_middle	4.88	4.84	4.86	4.85	4.87	4.8	4.84	4.85	4.87	4.81	4.82	4.84	4.86	4.85	4.79	4.82	
r_out	4.92	4.9	4.9	4.88	4.88	4.89	4.89	4.92	4.91	4.86	4.89	4.85	4.83	4.82	4.79	4.79	

Source of variation	*sums of squares (SS)*	*degrees of freedom (df)*	*Mean squares (MS)*	*F-value*	*P-value*	*critical F-value*
Between groups	0.236968155	3	0.078989385	42.20810361	3.53992E-12	2.851741336
Within groups	0.071114226	38	0.001871427			
Total	0.308082381	41				

within-sd	0.043259993
effective n	9.40
s_bb	0.090591444
s_bb_min	0.006759389
u_bb	0.090591444
u_bb(rel.)	1.882247063

Bismuth:

r_0	318.8431777	362.1568223														
r_in	347.4	346.9	348.2	353.8	356.2	344.7	354.6	349.3								
r_middle	350.5	354.8	351.1	351.1	351.2	354.6	353.1	359.5	354.2	345	361.5	340.2	357.7	364.4	356.9	353.6
r_out	347.3	339.9	348.4	331.4	339.8	346.1	331.4	335.8	340.5	339	337.5	346.6	345.1	344	358.8	348.8

Source of variation	*sums of squares (SS)*	*degrees of freedom (df)*	*Mean squares (MS)*	*F-value*	*P-value*	*critical F-value*
Between groups	1149.95494	3	383.3183135	6.239433574	0.001497189	2.851741336
Within groups	2334.522155	38	61.43479355			
Total	3484.477095	41				

within-sd	7.838035056
effective n	9.40
s_bb	5.85273408
s_bb_min	1.224695784
u_bb	5.85273408
u_bb(rel.)	1.687439231

Calcium:

r_0	6.38115469	7.69884531														
r_in	6.9	7.27	7	7.01	7.06	6.96	6.95	6.94								
r_middle	7	7.06	6.98	6.81	6.96	6.94	6.97	6.97	6.95	6.9	6.84	7.03	7.02	7.11	6.89	6.96
r_out	7.26	6.55	7.08	6.77	6.56	6.69	7.1	6.77	6.91	6.67	6.49	6.67	6.74	6.66	6.58	6.71

Source of variation	*sums of squares (SS)*	*degrees of freedom (df)*	*Mean squares (MS)*	*F-value*	*P-value*	*critical F-value*
Between groups	0.499203571	3	0.16640119	3.583734009	0.02241235	2.851741336
Within groups	1.764429286	38	0.04643235			
Total	2.263632857	41				

within-sd	0.215481669
effective n	9.40
s_bb	0.112990948
s_bb_min	0.033669088
u_bb	0.112990948
u_bb(rel.)	1.634067305

Cadmium:

r_0	21.09234882	36.90765118														
r_in	24.38	30.53	31.06	27.8	26.95	29.92	27.57	32.65								
r_middle	27.18	33.62	29.81	28.9	28.65	28.13	29.05	31.95	30.82	27.73	30.16	27.87	23.67	30.67	25.89	30.27
r_out	31	28.29	33.1	28.55	34.43	29.24	31.52	29.28	29.7	25.46	28.97	30.19	29.99	28.34	30.22	28.85

Source of variation	*sums of squares (SS)*	*degrees of freedom (df)*	*Mean squares (MS)*	*F-value*	*P-value*	*critical F-value*
Between groups	7.308441071	3	2.436147024	0.285992568	0.835199008	2.851741336
Within groups	323.6922818	38	8.518217942			
Total	331.0007229	41				

within-sd	2.918598626
effective n	9.40
s_bb	0
s_bb_min	0.45603208
u_bb	0.45603208
u_bb(rel.)	1.546704181

Gallium:

r_0	84.37914445	88.42085555														
r_in	85.6	87	86	87.1	86.8	87	86.5	86.4								
r_middle	88.3	87.6	88.1	88.5	88	88.7	88.3	88.9	88.8	88.1	89.2	87.9	88.1	88	88	88.5
r_out	89	87.7	87.3	87.3	88.2	87.5	88	87.2	88.2	87.8	87.9	88.4	88.7	88	88.8	89.1

Source of variation	*sums of squares (SS)*	*degrees of freedom (df)*	*Mean squares (MS)*	*F-value*	*P-value*	*critical F-value*
Between groups	21.77598214	3	7.258660714	15.00735968	1.34116E-06	2.851741336
Within groups	18.37958929	38	0.483673402			
Total	40.15557143	41				

within-sd	0.69546632
effective n	9.40
s_bb	0.849109431
s_bb_min	0.108666861
u_bb	0.849109431
u_bb(rel.)	0.968750064

Lithium:

r_0	4.895152917	5.204847083														
r_in	5.05	5.01	5.09	5.09	5.11	5.11	5.09	5.12								
r_middle	5.2	5.14	5.25	5.2	5.13	5.18	5.08	5.2	5.12	5.2	5.11	5.19	5.16	5.14	5.2	5.25
r_out	5.14	5.15	5.18	5.21	5.26	5.13	5.15	5.12	5.14	5.23	5.15	5.25	5.25	5.23	5.22	5.19

Source of variation	*sums of squares (SS)*	*degrees of freedom (df)*	*Mean squares (MS)*	*F-value*	*P-value*	*critical F-value*
Between groups	0.084116369	3	0.02803879	8.344453856	0.000218491	2.851741336
Within groups	0.127686488	38	0.003360171			
Total	0.211802857	41				

within-sd	0.05796698
effective n	9.40
s_bb	0.051247165
s_bb_min	0.009057361
u_bb	0.051247165
u_bb(rel.)	0.996342417

Sodium:

r_0	6.865912826	7.174087174														
r_in	6.99	7.02	7.11	7.07	7.11	7.07	7.07	6.98								
r_middle	7.06	7.1	7.17	7.1	7.09	7.08	7.15	7.15	7.47	7.11	7.13	7.04	7.17	7.15	7.12	7.14
r_out	7.04	7.09	7.08	7.07	7.02	7.07	7.06	7.05	7.1	7.06	7.05	7.1	7.11	7.14	7.19	7.09

Source of variation	*sums of squares (SS)*	*degrees of freedom (df)*	*Mean squares (MS)*	*F-value*	*P-value*	*critical F-value*
Between groups	0.059696726	3	0.019898909	3.304463147	0.030357827	2.851741336
Within groups	0.228829464	38	0.006021828			
Total	0.28852619	41				

within-sd	0.077600438
effective n	9.40
s_bb	0.038428946
s_bb_min	0.012125096
u_bb	0.038428946
u_bb(rel.)	0.542376165

Lead:

r_0	94.03690237	101.9630976														
r_in	99.1	99.4	100.2	98	96.8	100.5	98.6	99.6								
r_middle	105.5	107.6	104.9	103.6	102.3	102.5	102.9	105.1	103.2	102.9	103.5	105.1	104.7	104.9	102.6	104.5
r_out	103	102.9	103.5	105.1	102.9	104.1	106	105.1	104.8	104.1	104	102.5	103.2	102.2	102.5	103

Source of variation	*sums of squares (SS)*	*degrees of freedom (df)*	*Mean squares (MS)*	*F-value*	*P-value*	*critical F-value*
Between groups	199.5471726	3	66.51572421	27.93259988	1.02952E-09	2.851741336
Within groups	90.48916071	38	2.381293703			
Total	290.0363333	41				

within-sd	1.543144097
effective n	9.40
s_bb	2.612492442
s_bb_min	0.241116818
u_bb	2.612492442
u_bb(rel.)	2.548553726