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Mineral soil geochemistry in Møre and Romsdal
county, Q-C report

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Summary:

This report describes the mineral soil geochemistry results from two areas: 1) the entire Møre and Romsdal county (*n*= 430), and 2) the Ålesund municipality (Møre and Romsdal county; *n*= 284). The former is a continuation of previous surveys carried out in the Finnmark, Troms, Nordland, and Trøndelag counties. During the main field work in 2019 and 2020, and complementary field work in 2021, 714 locations were sampled. The Møre and Romsdal county was systematically mapped (i.e., regional survey), whereas targeted urban geochemical mapping was done in the Ålesund municipalitiy. For the regional survey, samples were collected based on a loose 6x6 km grid. Conversely, for the urban soil sampling surveys 5 to 30 samples were collected per km^2. For both surveys, the <2 mm grain size fraction was analyzed by IC-PMS for 53 elements following Aqua Regia digestion.

Results are documented with respect to quality of data in tables with descriptive statistics, random plots, X-charts, and correlation plots. In addition, we report magnetic susceptibility measurements carried out on the regional geochemical mapping survey.

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1. INTRODUCTION

As part of the national geochemical mapping program of soil, mineral soil, mainly till, were collected in Møre and Romsdal county during the field seasons 2021-2022 at a density of 1 sample/ 36 km^2. An overview of the mapping progress is given in Table 1.1. In addition, urban geochemistry surveys were carried out in Ålesund (Møre and Romsdal county) and Kristiansand (Agder county) with a varying sampling density ranging from approximately 5 to 30 samples per km^2.

Table 1. ***Progress in the national geochemical mapping program of Norway.***

Survey	Year	Sampling density	Soil	Analysed Fraction	Lab
Finnmark and Troms[1)]	2011	1/40 km^2	Till	<0.063mm	ACME[*)]
Nordland[1)]	2011	1/40 km^2	Till	<2mm	ACME[*)]
North-Trøndelag and Fosen[2, 3)]	2013	1/36 km^2	Till Humus	<2mm	ACME[*)]
Southern Trøndelag[4, 5)]	2018/ 2019	1/36 km^2	Till Humus	<2mm	ACME[*)]
Hedmark[6]	2020/ 2021	1/36 km^2	Till Humus	<2mm	Bureau Veritas
Møre and Romsdal[7]	2021/ 2022	1/36 km^2	Till Humus	<2mm	Bureau Veritas

[1)]Reimann et al., 2011
[2)]Finne et al., 2014
[3)]Finne and Eggen, 2015
[4)]Flem et al., 2020
[5)]Flem et al., 2021
[6)]Flem et al. 2022
[7)]Acosta-Góngora et al. (2024)
[*)] At present, operating as Bureau Veritas Commodities Canada Ltd.

This report describes the quality of the mineral soil samples and their analysis. In the case of the regional survey, it represents a continuation of a national scale survey which has already covered the Trøndelag and Hedmark counties (Reimann et al., 2011; Finne et al., 2014; Finne and Eggen, 2015; Flem et al., 2022). Sampling and geochemical analysis of humus in the Møre and Romsdal county survey will be presented in a separate quality control report (Acosta-Góngora et al. 2024). The analytical data is available at https://www.ngu.no/.

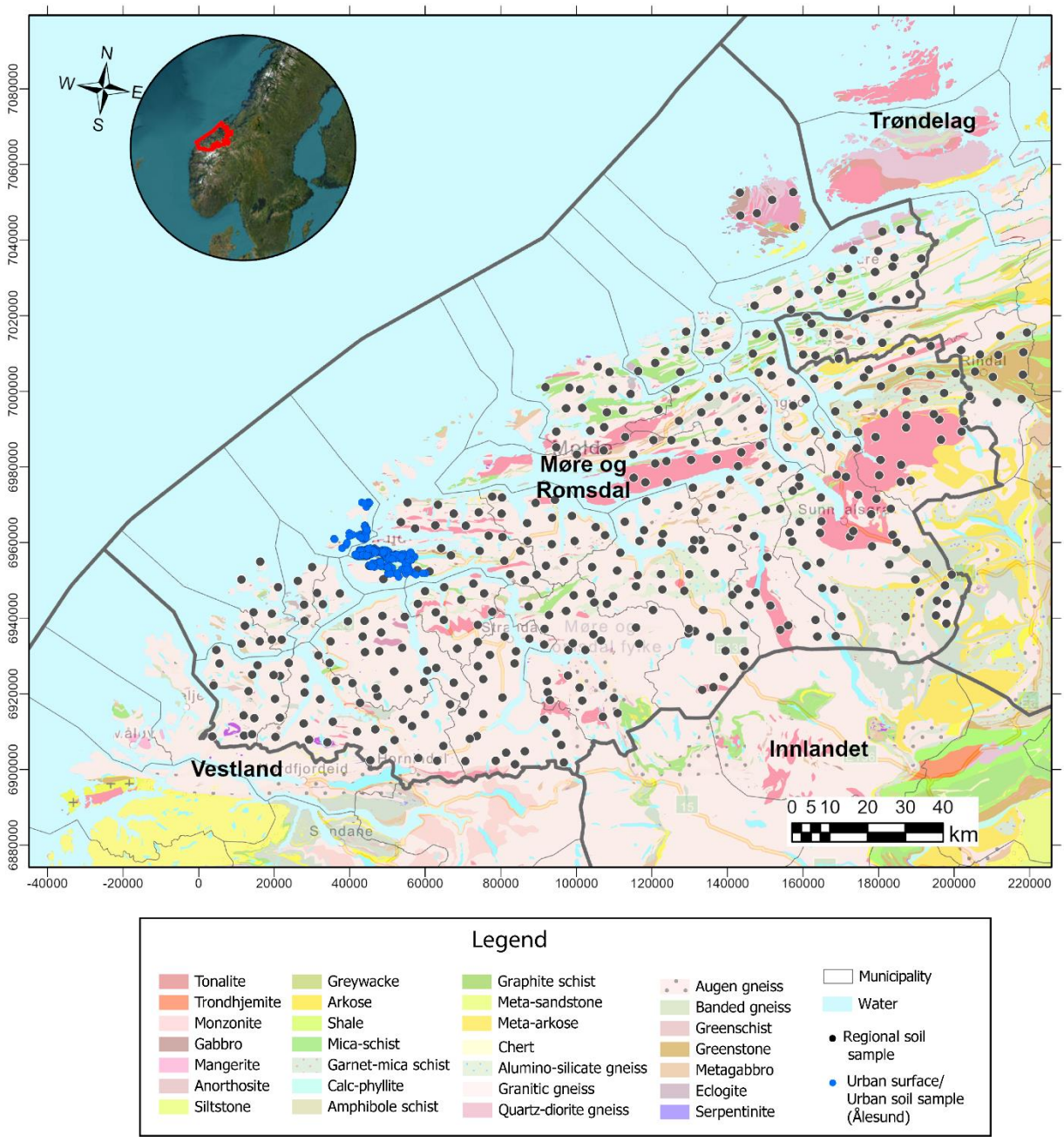

Figure 1. *Bedrock of survey area. The Møre and Romsdal county is marked with a black line. Bedrock units are from NGUs 1:1 350 000 scale bedrock map of Norway (Geological Survey of Norway, 2021).*

2. DESCRIPTION OF THE SURVEY AREA

2.1 Regional geology

2.1.1 Møre and Romsdal county

Møre og Romsdal County is mainly characterized by granitic gneisses, which is comprised by the area known as the Western Gneiss Region (WGR). The granitic gneisses from the WGR were formed between 1700 and 1600 Ma and have an igneous origin. These were strongly deformed and metamorphosed during the Caledonian Orogeny (ca. 420–390 Ma).

During Caledonian continent-continent collision with Laurentia (Greenland), the WGR was subducted to mantle depths, locally at more than 100 km, and this resulted in the widespread occurrence of high-pressure eclogite lenses, particularly along the western parts that were subjected to the highest pressures (Cuthbert et al., 2000; Hacker and Gans, 2005). The subduction also resulted in fragments of this mantle getting stuck to the down going continental slab –found as lenses of olivine-rich mantle peridotite.

During the Caledonian Orogeny, the WGR was overthrust by nappes, which comprise of schists, amphibolites and marbles and continued deformation led to in-folding of the nappes into the gneissic substrate (Terry et al., 2000; Tucker et al., 2004).

The various rocks therefore represent diverse mineral resources, including marble (allochthonous nappes) and olivine (mantle peridotite fragments). Historically, mining for Fe and Ti was undertaken from mafic rocks associated with the gneisses. Figure 1 shows the bedrock map of Møre and Romsdal county based on the NGU bedrock map of Norway with scale 1:1 350 000 (Geological Survey of Norway, 2021).

3.METHODS

3.1 Field work

3.1.1 Regional sampling

A grid of 6 km x 6 km was marked on topographical maps along with the highest marine level, and polygons delineating areas containing glaciofluvial deposits and marine deposits. These areas were excluded from sampling. In addition, national parks and protected areas were marked to remind the field workers to take extra precautions and, if possible, avoid these areas as there may be special rules for thoroughfare and sampling. Field workers were free to find a suitable location within each grid cell with a minimum distance of 10-100 m from abandoned to high traffic roads. Sample pits were dug by paint-free steel shovels down to the mineral soil layer, preferably to C-horizon in podzols. If till was not available, weathered soil was collected. Samples were transferred into Rilsan® plastic bags using a small steel shovel (Flem et al., 2020). Sample locations and sample IDs were given numbers in the range 4001 to 4420.

At approximately every twentieth sampling site a field duplicate sample was collected, resulting in 21 field duplicate pairs from the survey area. In total 430 mineral soil samples (not including field duplicate samples) were collected.

3.1.2 Urban soil sampling

To aid the field workers, a grid of 1x1 km was established within the urban/habited areas. In these areas, approximately 5-30 samples were taken within each grid cell to keep the sampling relatively systematic. The dense sampling was conducted in the city centres. Samples were collected from playgrounds and parks and other open spaces, avoiding private gardens. Sample pits were dug by paint-free steel shovels, and the material was collected in Rilsan® plastic bags. The samples were taken from 0-2 cm depth. Ålesund is largely covered with asphalt and stone, and thus, it was not always possible to find open spaces with uncovered soil. Hence, some samples were taken from the soil material collected on top of the permanent covers, gutters and roadsides (herein urban surface soil sample). A total of 284 samples were collected in the Ålesund municipality. No duplicates were taken for urban soil. A small set of 32 urban soil samples from the Kristiansand municipality were also sent along with those from Ålesund. Although the Kristiansand data were included for the QC evaluation (i.e., QC plots) as they belong to the same analytical batch, these samples are not discussed in this report.

3.2 Sample preparation and quality control

The regional sample procedure and equipment as reported for the southern Trøndelag survey (Flem et al. 2020) were used during the field work. Sampling was conducted by digging soil pits at representative sites (regional soil samples). To avoid contamination pit walls were cleaned and samples retrieved into labelled sample bags. The urban surface soil samples taken in Ålesund and Kristiansand, were taken from topsoil (0-2 cm depth) using the same type of labelled sample bags. Sample preparation and analysis described below were equivalent for the regional, and urban surface soil samples. After collection, their wet weight was recorded and then these were air-dried at temperatures of 20 - 40 °C for more than 3 months. The soil samples were subsequently dry-sieved using a 2 mm nylon mesh. For each sample two 50 ml Kautex boxes and one 100 ml Kautex box was filled using a stainless-steel spoon. The remaining < 2mm sieved fraction was filled back into the sample bag and stored for future use. From each field duplicate sample (n = 21), an analytical split was prepared in an additional 50 ml Kautex box. The >2 mm fraction was discarded. To enable comparison with the previous surveys from northern and mid-Norway (Reimann et al. 2011; Finne et al., 2014; Flem et al., 2020; Flem et al. 2022), 36 samples of the MINS in-house project standard were included as well as previously analysed samples from other regional surveys. The sampling and analytical design followed the same unbalanced ANOVA design as used in earlier surveys (e.g., Eggen et al., 2017; Flem et al 2020). All samples, field duplicates, analytical duplicates of the field duplicate, and quality

control samples (MINS standards and re-analyses) from the regional and urban surveys were randomized together after the procedure described by Eggen et al. (2019). Randomisation numbers from 15001 upwards were used.

3.3 Laboratory analyses

The randomized sample series of the <2-mm fraction was shipped to Bureau Veritas Minerals (previously ACME Labs) in Vancouver Canada. The mineral soil samples were analysed using the laboratory standard package 'AQ251-EXT 53 element 15g', which uses a sample split of 15 g for the extraction. The analytical package involves a modified aqua regia digestion, which consists of 1:1:1 v/v concentrated ACS grade HCl, HNO_3, and de-mineralized H_2O. The analyses were performed by using a Spectro Ciros Vision emission spectrometer (ICP-AES) and a Perkin Elmer Elan 6000/9000 inductively coupled plasma mass spectrometer (ICP-MS) for 53 elements. Details on the analytical procedure can be found on Bureau Veritas home page, https://commodities.bureauveritas.com/metals-minerals. Results reported by the laboratory Bureau Veritas Minerals include measurements below detection limit, DL (Table 1), blank measurements, and measurements of in-house reference materials.

Table 1. *Bureau Veritas official DL*

Element	mg/kg	Element	mg/kg	Element	mg/kg	Element	mg/kg
Ag	0.002	Cu	0.01	Nb	0.02	Ta	0.05
Al	100	Fe	100	Ni	0.1	Te	0.02
As	0.1	Ga	0.1	P	10	Th	0.1
Au	0.0002	Ge	0.1	Pb	0.01	Ti	10
B	1	Hf	0.02	Pd	0.01	Tl	0.02
Ba	0.5	Hg	0.005	Pt	0.002	U	0.05
Be	0.1	In	0.02	Rb	0.1	V	1
Bi	0.02	K	100	Re	0.001	W	0.05
Ca	100	La	0.5	S	200	Y	0.01
Cd	0.01	Li	0.1	Sb	0.02	Zn	0.1
Ce	0.1	Mg	100	Sc	0.1	Zr	0.1
Co	0.1	Mn	1	Se	0.1		
Cr	0.5	Mo	0.01	Sn	0.1		
Cs	0.02	Na	10	Sr	0.5		

3.4 Magnetic susceptibility

The magnetic susceptibility measurements were carried out only for soil samples of the Møre and Romsdal regional survey with a Bartington MS3/MS2K system (Bartington Instruments, 1995), which has a resolution (lowest measurement capable of recording) of 1 x 10-6 SI. This sensor is designed to take measurements on flat and smooth surface and has a surface of integration (spot size) of ca. 25.4 mm diameter. The measurements were made at NGU's laboratory facilities directly on the sieved soil material contained in the Kautex boxes. Amplitude changes of a low-frequency magnetic field measured by the MS3 with a magnetic susceptibility (MS) achieve a resolution of 2 µSI (Deng, 2015). Each sample measurement was conducted as follows. One analysis of a disk-shaped MS reference material was performed every ten samples, then, 1 successive analysis of the sample lasting 0.1 s each were bracketed by two 0.1 s analyses of blank (gun targeting the air) for instrument drift correction. Magnetic susceptibility analyses of the reference material yield average and median values of 404 x 10-5 µSI (standard deviation of 2.3 x 10-5 µSI; only 1.2% offset from manufacturer reference

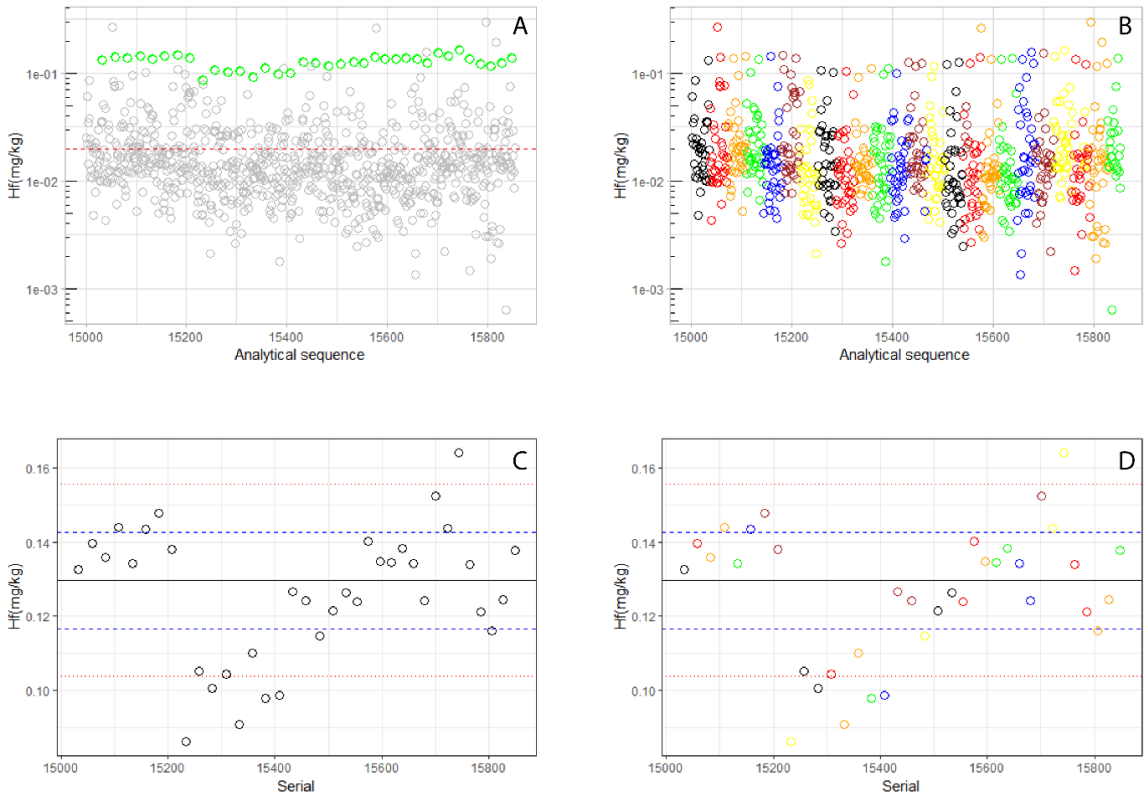

Figure 2. *Random (A, B) and X-plots (C, D) plots for Hf displaying instrumental racks in different colours. Negative laboratory concentration values are set to a low positive value to fit the log scale. In A, the MINS standard is represented by the green circles.*

value). The data spreads over three orders of magnitude indicating significant variability associated with compositional changes of the soil.

4. RESULTS

Random plots for all elements are given in Appendix 1. In general, most analytical sequences for elements having concentrations well above detection limits follow a relatively regular flat trend. On the other hand, Hf and Zr have a pronounced break at the beginning of their sequences followed by slightly positive trend indicating a potential analytical artifact (Figure 3).

4.1 Analytical quality control, QC

4.1.1 NGU project standard, MINS

The in-house NGU project standard, hereafter referred to as MINS standard, has previously been used during the Oppdal survey (Eggen et al., 2017) and later for external quality control (QC) for the south Trøndelag (Flem et al., 2020) and Hedmark (Flem et al., 2022) surveys. The MINS standard is a suitable QC parameter for most elements except Ag, Ge, Hg, S, and Se (too low) (Table A1; Appendix 2**)**. Thirty-six splits of the MINS standard were analysed along with the samples, one split after approximately every 20th sample. X-charts for all elements of the MINS standard are given in Appendix 2. The analytical results are plotted in the same order as they were analysed. For all elements, the median is indicated by a solid line, whereas dashed lines are drawn at ± 10% and ± 20% relative to the median. The analytical repeatability expressed by the robust coefficient of variation (CVR; Reimann et al., 2008) is shown in Table A1 which is reflected in the X-charts. As noted in the random charts, Hf and Zr show a rough analytical break followed by a positive trend (Figs. 3C, D).

The statistical summary for the MINS standard is given in Table A1. This includes the minimum, median, and maximum concentration values for all elements. The elements: Ag, B, Ge, In, Pd, Pt, Re, S, Ta, and W show many measurements below DL, which constrain the possibility to calculate the analytical repeatability. Most of the other elements show acceptable analytical repeatability with CVR<15%. The elements Hg, Sb, Be, and Au show a low precision (i.e., high CVR) in growing order from 21.2 to 29.7, and it is mainly due to proximity to their DL and/or sample inhomogeneity (e.g., Au).

4.1.2 Samples re-analysed from previous surveys

In addition to the MINS standard, quality control was further facilitated by including soil samples from previous surveys. Nineteen soil samples from the Nordland/Troms sample collection (Reimann et al. 2011), no:2, 4, 7, 10, 15, 40, 45, 47, 48, 49, 50, 62, 63, 66, 68, 73, 76, 77, and 81 were analysed along with the ordinary sample batch. The results from the laboratory analyses for all 53 elements are shown in Appendix 3 for all mineral soil surveys conducted in the national geochemical mapping program. The elements Au, B, Be, Bi, Ca, Ge, Hf, Hg, In, Nd, Pd, Pt, Re, S, Sb, Se, Sn, Ta, Te, and W show a generally low precision probably due to nugget effects, grain size distribution, low concentrations, and/or laboratory batch effects. The elements, Ag, Al, As, Ba, Cd, Ce, Co, Cr, Cs, Cu, Fe, Ga, K, La, Li, Mg, Mn, Mo, Na, Ni, P, Pb, Rb, Sc, Th, Ti, Tl, U, V, Y, Zn, and Zr, show a generally high repeatability. However, one must nevertheless be careful when combining the data sets from various surveys also for these elements.

4.2 Precision and Analysis of variance (ANOVA)

Only for the regional survey, a field duplicate was collected at approximately every twentieth sample location. The field duplicates are used to estimate the variation introduced by sampling and to answer the question of whether a comparable result would be obtained if the survey was undertaken a second time at approximately the same sampling sites. Analytical precision is estimated via splits of samples. In this survey splits of the field duplicates are used (an analytical duplicate of the field duplicate). Table A2 gives a precision estimate for all elements with concentrations above DL for the field and analytical duplicate pairs. The estimated precision, given by the coefficient of variation (CV), for the field duplicates (ordinary sample compared with the field duplicate) ranges from 10.9% (Hf) to 110.5% (Au).

The correlation between ordinary sample and duplicate sample and the correlation between field duplicate sample and analytical duplicate are shown in Appendices 4 and 5. Poor correlation is usually due to the influence from a few samples (e.g., Sr), low concentrations (e.g., Au) or due to natural variation.

The field and analytical duplicates can be used to carry out an unbalanced analysis of variance (ANOVA) for those elements with more than five duplicate pairs above DL. By “unbalanced”, it is meant that unequal numbers of analysis occur at each level of design. In Table A3 the analysis of variance (ANOVA) is given for the 21 sites with a duplicate sample giving the distributed percentage variabilities for all elements. The *p*-value given in Table A3 is for the F-

test to determine if the variance at the "between" level are equal for the field and analytical duplicates. The field duplicate ANOVA indicate that the combined sampling and analytical variability is smaller than the between sites regional variability. Lanthanum, La, for instance, has an estimated regional variability of 90.1%, and 8.5% variability at site (local variability) and 1.4% analytical variability. However, elements such as Fe, Al, Nb, Cd, Ag, Ca, S, Se, W and Hg show higher local variability (>20%). For some elements this mainly reflects the difficulties in determining their concentrations at low levels.

4.3 Data distribution

The geochemical distribution of each element is presented in plots of the empirical cumulative distribution function, ECDF, for the regional and urban mineral soil samples (Appendices 6 and 7). The concentration is plotted along the X-axis and the cumulative probability is plotted along the Y-axis. These plots allow the direct visual recognition of breaks in the curve which may indicate different geochemical processes. Breaks in the uppermost 5-10 percentiles of the distribution are often used as thresholds for anomaly identification. All laboratory readings are shown including those below detection limit. Negative results were replaced by a low positive value. A statistical summary for the regional (Møre and Romsdal county) and urban (Ålesund) data is provided in Tables A4.1 and A4.2.

5. SUMMARY

This report gives an evaluation of the quality of the data from the Møre and Romsdal mineral soil survey. Few data are available for B, S, Ta, Pd, Pt, Re, and Te due to too high detection limits. Sequence distribution trends detected for Hf and Zr indicate the presence of analytical artifacts for those elements. Despite the later, these achieved relatively low CVR in the MINS standard. Re-analysed samples from the Nordland/Troms sample collection (Reimann et al., 2011) show that 32 out of 52 elements have a good repeatability between batches. However, one must nevertheless be careful when combining the data sets from the various surveys also for these elements. With careful use, and working preferentially with quantiles, many elements in the national mapping program datasets (that do not have detection limit issues) can be merged. However, it is the user's responsibility to consider if the batch effects are within acceptable limits. The quality and variability of magnetic susceptibility soil sample measurements can complement to the geochemical suite presented here. This new dataset is now merged into the existing data and is available for further usage. Finally, the only objective

of this report is to assess QC parameters, so it is up to the user to carry out any exploratory data analysis (EDA) of the geochemical analyses and magnetic susceptibility measurements.

6. ACKNOWLEDGMENTS

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TABLES

TABLE A1 THE MINS PROJECT STANDARD.

Summary statistics for the MINS project standard. The minimum (MIN), median, maximum (MAX) is given. In addition, the interquartile range (IQR) and the robust coefficient of variation (CVR) is given as a measure of precision

Element	>DL	Min	Median	Mean	Max	CVR	IQR
Mo	36	0.2	0.3	0.3	0.3	11.9	0.03
Cu	36	21.58	24.88	24.82	26.81	3.8	1.10
Pb	36	3.89	4.57	4.52	4.83	5.2	0.33
Zn	36	26.6	28.8	28.81	30.6	3.9	1.45
Ag	0	<0.002	–	–	–	–	–
Ni	36	35.6	39.65	39.51	42.9	4.9	2.70
Co	36	7.9	9	8.96	9.8	4.9	0.55
Mn	36	237	268	267	282	3.3	11.50
Fe	36	14508	16527	16403	17414	4.9	1096
As	36	2.1	2.55	2.55	2.9	8.7	0.30
U	36	0.46	0.56	0.55	0.60	4.0	0.03
Au	27	<0.0002	0.0005	0.0009	0.0083	29.7	0.00
Th	36	3.6	4.1	4.1	4.4	3.6	0.20
Sr	36	6.8	8.2	8.3	9.7	9.0	0.97
Cd	21	<0.01	0.03	0.03	0.03	0.0	0.01
Sb	36	0.04	0.06	0.06	0.08	24.7	0.01
Bi	36	0.05	0.06	0.06	0.07	0.0	0.00
V	36	22	25	25	27	5.9	2.00
Ca	36	1542	1729	1717	1869	4.2	90.50
P	36	413	498	492	552	11.6	70.25
La	36	13.1	14.7	14.6	15.9	5.0	0.88
Cr	36	40	46	45	50	3.7	2.33
Mg	36	6583	7304	7313	7736	3.9	292
Ba	36	26.1	30.3	30.2	34.7	5.9	2.40
Ti	36	573	697	696	778	7.8	71.75
B	0	<1	–	–		–	–
Al	36	11017	12260	12252	13288	3.8	607
Na	36	66	83	82	97	9.0	8.75
K	36	972	1144	1156	1380	7.3	99.25
W	5	<0.05	0.06	0.06	0.06	0.0	0.00
Sc	36	2.7	2.9	3.0	3.2	5.1	0.20
Tl	36	0.08	0.09	0.090	0.1	0.0	0.00
S	0	<200	–	–	–	–	–
Hg	8	<0.005	0.007	0.007	0.009	21.2	0.00
Se	15	0.2	0.2	0.2	0.2	0.0	0.00
Te	1	<0.02	0.03	0.03	0.03	0.0	0.00
Ga	36	2.8	3.15	3.14	3.5	7.1	0.30
Cs	36	0.68	0.73	0.742	0.810	4.1	0.04
Ge	0	<0.1	–	–	–	–	–
Hf	36	0.09	0.13	0.13	0.16	11.4	0.02
Nb	36	0.29	0.35	0.35	0.44	10.7	0.05
Rb	36	7.4	8.1	8.15	9	5.5	0.50

Element	>DL	Min	Median	Mean	Max	CVR	IQR
Sn	36	0.2	0.2	0.2	0.3	0.0	0.00
Ta	0	<0.05	–	–	–	–	–
Zr	36	5.3	6.9	6.7	7.9	8.6	0.90
Y	36	6.75	7.49	7.42	8.23	5.2	0.51
Ce	36	29.2	32.2	32.1	33.9	4.4	1.85
In	0	<0.02	–	–	–	–	–
Re	0	<0.001	–	–	–	–	–
Be	36	0.2	0.25	0.25	0.3	29.7	0.10
Li	36	8.9	10.8	10.7	11.8	6.2	0.92
Pd	0	<0.01	–	–	–	–	–
Pt	1	<0.002	0.003	0.003	0.003	0.0	–

TABLE A2 PRECISION OF DUPLICATES

The precision for analytical duplicates is presented in the tale only for elements that have >4 pairs above DL. Abbreviations: CV, covariation coefficient; No. Pair. Number of pairs above DL.

	Field duplicate		Analytical duplicate	
Element	No. Pair	CV (%)	No. Pair	CV (%)
Mo	21	61.9	21	8
Cu	21	27.3	21	6.1
Pb	21	34.1	21	4.9
Zn	21	16.5	21	5.2
Ag	18	79.3	20	13
Ni	21	35.6	21	4.8
Co	21	24.1	21	5.8
Mn	21	18.6	21	5.2
Fe	21	18.5	21	4.3
U	21	74.7	21	42.6
Au	10	110.5	11	122.9
Th	21	17.2	21	15.4
Sr	21	63.5	21	7.8
Cd	11	34.2	11	13.6
Bi	9	25	10	8
V	21	21.4	21	4.3
Ca	20	44.5	21	6.5
P	21	21	21	7.5
La	21	16.4	21	8.1
Cr	21	21.9	21	3.7
Mg	21	24.1	21	4.7
Ba	21	13.2	21	4.3
Ti	21	24.6	21	3.9
Al	21	37.7	21	3.7
Na	21	16	21	6.8
K	21	16.9	21	4.3
W	8	42.2	8	9.7
Sc	21	13.9	21	4.2
Tl	20	20.4	20	5.3
S	4	32.2	6	1.2
Hg	15	44.6	15	12.9
Se	16	41.1	16	7.7
Ga	21	28.3	21	4.8
Cs	21	17.8	21	6
Hf	6	10.9	7	10.3
Nb	21	55.9	21	10.6
Rb	21	20.2	21	5.5
Sn	21	45.2	21	7.9
Zr	21	21.7	21	6.5
Y	21	17.3	21	9.1
Ce	21	21.2	21	6.9

Be	15	44.2	17	5.9
Li	21	24	21	5.6

TABLE A3 ANOVA

Analysis of variance table (ANOVA) for the 21 duplicate sites giving the distributed percentage variabilities for all elements with >4 pairs above DL. The p-value is for the F-test. All variables were log-transformed prior to the calculation.

Element	Regional (%)	Site (%)	Analytical (%)	p-value
Mo	88.5	11.2	0.4	0.3
Cu	85.9	13.4	0.7	0.3
Pb	86.9	12.4	0.7	0.3
Zn	89.3	8.9	1.7	0.4
Ag	67.0	30.3	2.7	0.1
Ni	78.9	19.7	1.5	0.4
Co	83.2	15.3	1.4	0.2
Mn	87.5	11.3	1.3	0.3
Fe	77.4	21.6	1.1	0.1
U	68.3	19.2	12.6	0.2
Au	10.5	16.6	72.9	1.0
Th	89.1	6.9	4.0	0.5
Sr	79.7	19.3	1.0	0.5
Cd	59.1	28.2	12.7	0.3
Bi	85.2	10.8	4.1	0.4
V	86.6	12.2	1.2	0.4
Ca	68.7	30.7	0.6	0.0
P	90.0	9.6	0.4	0.4
La	90.1	8.5	1.4	0.3
Cr	89.1	9.5	1.4	0.6
Mg	82.8	15.9	1.3	0.4
Ba	94.9	4.5	0.6	0.4
Ti	84.6	14.3	1.1	0.3
Al	76.6	22.2	1.2	0.4
Na	85.3	13.3	1.4	0.4
K	90.6	8.8	0.7	0.4
W	52.9	41.4	5.7	0.7
Sc	89.4	9.1	1.5	0.5
Tl	85.2	12.9	2.0	0.4
S	63.8	36.1	0.1	0.3
Hg	49.5	44.3	6.1	0.2
Se	58.8	38.8	2.4	0.2
Ga	88.3	10.8	0.9	0.4
Cs	86.9	11.2	1.9	0.4
Hf	91.6	3.7	4.7	0.6
Nb	70.2	26.5	3.3	0.1
Rb	84.4	14.3	1.3	0.3
Sn	83.8	14.1	2.1	0.2
Zr	92.9	5.5	1.6	0.4

Element	Regional (%)	Site (%)	Analytical (%)	p-value
Y	85.1	11.6	3.4	0.3
Ce	89.1	10.0	0.9	0.4
Be	82.1	17.1	0.8	0.7
Li	82.8	15.7	1.6	0.2

TABLE A4 SURVEY DATA

A4.1 Regional data

Summary statistics for the regional survey data (n=430) giving the number of samples above the methodical detection limit (DL), median, mean, minimum (Min) and maximum (Max) concentration values, and the measured concentration at the 5, 25, 50, 75% quantiles. In addition, the standard deviation (Stdev) is given as a measure of variation. A summary of the magnetic susceptibility (MS) measurements is given at the end of the Table.

Element	>DL	Min	Median	Mean	Stdev	Q5	Q25	Q50	Q75	Max
Mo	416	<0.01	0.17	0.39	1.02	0.03	0.07	0.19	0.38	16.71
Cu	430	0.03	19.41	22.43	16.48	2.54	12.05	20.85	29.37	156.12
Pb	430	0.71	2.50	9.11	120.93	1.18	1.82	2.79	4.09	2510.57
Zn	430	0.4	25.7	28.7	17.9	8.1	17.7	27.8	36.3	195.9
Ag	399	<0.002	0.015	0.026	0.035	0.004	0.008	0.016	0.032	0.358
Ni	429	0.5	14.2	25.5	69.2	3.9	8.2	15.4	23.1	1139.8
Co	429	0.2	6.6	7.9	6.2	1.8	4.4	7.2	9.8	73.2
Mn	430	8	222	270	293	67	154	238	309	5184
Fe	430	623	17034	18462	9264	6999	12298	18124	22766	86921
As	117	<0.1	0.3	0.8	0.9	0.2	0.2	0.4	0.8	4.9
U	430	0.07	0.65	1.13	2.42	0.20	0.44	0.70	1.01	30.33
Au	253	<0.0002	0.0005	0.0006	0.0004	0.0003	0.0003	0.0005	0.0007	0.0038
Th	427	0.2	4.2	4.2	2.4	0.6	2.5	4.5	5.7	13.3
Sr	430	0.9	12.0	14.4	11.4	3.6	8.1	12.5	16.8	99.2
Cd	187	<0.01	0.03	0.03	0.02	0.02	0.02	0.03	0.04	0.10
Sb	77	<0.02	0.04	0.50	3.98	0.03	0.03	0.04	0.05	34.96
Bi	255	<0.02	0.04	0.06	0.04	0.03	0.03	0.05	0.06	0.36
V	430	5	37	39	19	16	27	39	48	135
Ca	426	<100	2666	2827	1710	605	1705	2797	3574	12599
P	430	16	588	667	535	99	375	639	814	4634
La	428	<0.5	16.9	18.1	10.4	3.1	11.7	17.8	22.4	89.2
Cr	430	0.5	20.5	28.4	25.2	6.6	13.4	22.9	34.0	216.6
Mg	429	<100	4825	6017	6484	1439	3163	5141	7696	108030
Ba	430	2.3	43.9	59.0	55.6	10.6	24.6	50.7	75.0	457.9
Ti	430	240	1199	1308	672	500	836	1262	1602	6081
B	8	<1	2	2	0	2	2	2	2	3
Al	430	697	11610	12631	6113	4539	8515	12262	15710	46439
Na	430	26	171	183	131	61	111	180	224	2129
K	428	<100	2137	2700	2167	496	1203	2310	3559	15852
W	240	<0.05	0.09	0.18	0.87	0.06	0.07	0.09	0.13	13.41
Sc	429	<0.2	2.8	2.9	1.4	0.9	1.9	3.0	3.7	8.4
Tl	416	<0.02	0.11	0.13	0.09	0.04	0.07	0.12	0.17	0.51
S	86	<200	345	451	381	210	279	363	454	2956
Hg	285	<0.005	0.016	0.025	0.025	0.006	0.010	0.019	0.031	0.176
Se	330	<0.1	0.3	0.5	0.5	0.2	0.2	0.4	0.6	4.1
Te	80	<0.02	0.03	0.04	0.02	0.03	0.03	0.03	0.04	0.19

Element	>DL	Min	Median	Mean	Stdev	Q5	Q25	Q50	Q75	Max
Ga	430	0.8	4.4	5.0	2.7	1.9	3.1	4.7	6.1	27.7
Cs	430	0.2	0.9	1.1	0.8	0.3	0.6	1.0	1.4	5.7
Ge	8	<0.1	0.2	0.2	0.0	0.2	0.2	0.2	0.2	0.3
Hf	93	<0.02	0.04	0.05	0.04	0.03	0.03	0.04	0.05	0.30
Nb	430	0.1	1.2	1.5	1.1	0.4	0.8	1.2	1.9	8.8
Rb	430	0.6	17.6	21.4	16.4	3.9	10.4	18.9	27.1	102.4
Sn	418	0.1	0.4	0.5	0.3	0.2	0.3	0.4	0.6	1.5
Ta	1	<0.05	0.06	0.06	NA	0.06	0.06	0.06	0.06	0.06
Zr	423	<0.1	0.6	0.9	1.1	0.2	0.4	0.6	0.9	11.1
Y	430	0.21	5.41	5.56	2.83	1.86	4.07	5.63	6.64	36.51
Ce	430	1.2	39.6	42.8	27.0	6.8	26.3	41.5	52.5	191.8
In	35	<0.02	0.03	0.04	0.01	0.03	0.03	0.03	0.04	0.11
Re	2	<0.001	0.004	0.004	0.001	0.003	0.004	0.004	0.005	0.005
Be	336	<0.1	0.3	0.3	0.2	0.2	0.2	0.3	0.3	1.8
Li	429	0.3	6.8	8.0	5.1	1.6	4.9	7.3	10.3	39.9
Pd	1	<0.01	0.02	0.02	NA	0.02	0.02	0.02	0.02	0.02
Pt	2	<0.002	0.020	0.020	0.023	0.006	0.012	0.022	0.028	0.036
MS	430	0.00002	0.0028	0.0042	0.0047	0.0001	0.0008	0.0034	0.0060	0.0336

A4.2 Urban data

Summary statistics for the urban survey data (n=280) giving the number of samples above the methodical detection limit (DL), median, mean, minimum (Min) and maximum (Max) concentration values, and the measured concentration at the 5, 25, 50, 75% quantiles. In addition, the standard deviation (Stdev) is given as a measure on variation.

Element	>DL	Min	Median	Mean	Stdev	Q5	Q25	Q50	Q75	Max
Mo	316	0.08	0.69	1.09	1.35	0.21	0.43	0.76	1.29	10.47
Cu	316	2.3	28.49	49.43	113.96	9.12	21.91	30.5	42.7	1615.68
Pb	316	1.18	6.35	13.73	18.86	2.17	3.77	7.34	14.38	133.32
Zn	316	11.3	74.9	119.5	144.8	27.4	53.5	82.3	129.9	1316.2
Ag	316	0.004	0.033	0.09	0.406	0.014	0.023	0.036	0.063	7.055
Ni	316	2.3	18.6	27.4	101.3	8.8	15.9	19.1	22.7	1795.1
Co	316	1.4	7.4	7.8	5	2.9	6.1	7.5	8.7	80
Mn	316	25	278	291	122	113	226	284	338	891
Fe	316	4955	15492	16790	6303	11113	13772	16022	17728	61933
As	257	<0.1	0.5	0.9	1.4	0.1	0.2	0.6	0.9	9.9
U	316	0.09	0.69	0.93	1.31	0.44	0.57	0.72	0.85	20.3
Au	300	<0.0002	0.001	0.0069	0.0337	0.0003	0.0006	0.0011	0.0022	0.5276
Th	316	0.5	3.7	4.3	5.7	1.1	2.5	3.9	4.7	94.2
Sr	316	1.1	21.3	22.1	11.6	2.7	17.1	22.4	27.1	85.6
Cd	250	<0.01	0.04	0.08	0.18	0.01	0.02	0.05	0.1	2.65
Sb	313	0.02	0.35	0.64	1.38	0.04	0.14	0.39	0.7	21.98
Bi	300	<0.02	0.13	0.31	1.11	0.03	0.07	0.16	0.27	14.86

Element	>DL	Min	Median	Mean	Stdev	Q5	Q25	Q50	Q75	Max
V	316	6	32	34.8	12.1	21	29	33	38	114
Ca	316	184	3944	4086	2069	637	3135	4172	4917	16479
P	316	109	612	652	289	234	492	628	742	1876
La	316	2.4	17.7	18.3	6.3	8.9	15.6	18.3	20.9	71.2
Cr	316	3.6	25.3	28.6	21.9	13	21	26	29.7	320.4
Mg	316	384	5156	5919	10768	1866	4354	5296	6036	193014
Ba	316	4.7	55.1	59.8	31.3	20.4	43.8	57.8	72.2	342.8
Ti	316	143	893	1002	451	534	752	919	1105	3791
B	131	<1	1	1	1	1	1	1	2	7
Al	316	1528	8728	9670	5005	5761	7354	8988	10613	53102
Na	316	43	307	355	223	78	233	317	421	1588
K	316	230	2717	2909	1646	621	2059	2863	3393	12965
W	308	0.05	1.58	2.77	4.21	0.08	0.31	1.81	3.44	37.51
Sc	316	0.4	2.4	2.5	1.3	1.3	2	2.4	2.8	14.4
Tl	315	<0.02	0.13	0.15	0.1	0.08	0.11	0.13	0.16	1.07
S	255	<200	397	440	252	200	263	421	542	2422
Hg	217	<0.005	0.013	0.045	0.178	0.005	0.005	0.015	0.043	2.839
Se	240	<0.1	0.2	0.4	0.5	0.1	0.2	0.2	0.4	3.8
Te	27	<0.02	0.02	0.02	0.01	0.02	0.02	0.02	0.02	0.09
Ga	316	0.6	3.4	4	1.9	2.3	3	3.5	4.2	14.5
Cs	316	0.16	1.04	1.25	0.82	0.64	0.85	1.07	1.33	7.49
Ge	3	<0.1	0.1	0.1	0	0.1	0.1	0.1	0.1	0.2
Hf	44	<0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.27
Nb	315	<0.02	1	1.3	1	0.5	0.8	1.1	1.5	8.6
Rb	316	3	21.6	23.7	13	8	17.1	22.7	27.1	135.3
Sn	316	0.2	1.7	2.4	2.3	0.5	1	1.8	2.7	17.6
Ta	0	<0.05	0.1	0.1	0	0.1	0.1	0.1	0.1	0.1
Zr	313	<0.1	0.6	0.8	0.8	0.2	0.4	0.6	0.8	8.2
Y	316	0.62	5.12	5.67	4.06	3.25	4.43	5.27	5.84	64.88
Ce	316	5.3	36.5	40.4	52.8	21.6	31.8	37.6	42.9	954.2
In	42	<0.02	0.02	0.03	0.02	0.02	0.02	0.02	0.02	0.37
Re	10	<0.001	0.001	0.001	0	0.001	0.001	0.001	0.001	0.001
Be	178	<0.1	0.2	0.2	0.3	0.1	0.1	0.2	0.2	4.6
Li	316	0.2	7.3	8	4.4	4.1	6	7.5	8.6	51.2
Pd	18	<0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.19
Pt	67	<0.002	0.002	0.003	0.004	0.002	0.002	0.002	0.002	0.039

Møre and Romsdal soil geochemistry

Appendices

APPENDIX 1: RANDOM PLOTS

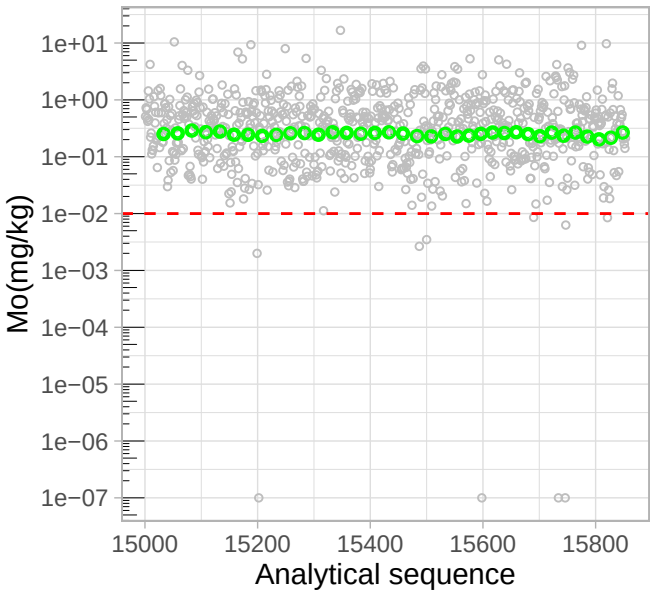
Random plots of all samples with field and analytical duplicates in addition to the in-house standard MINS and re-analyzed samples from Nordland/Troms.

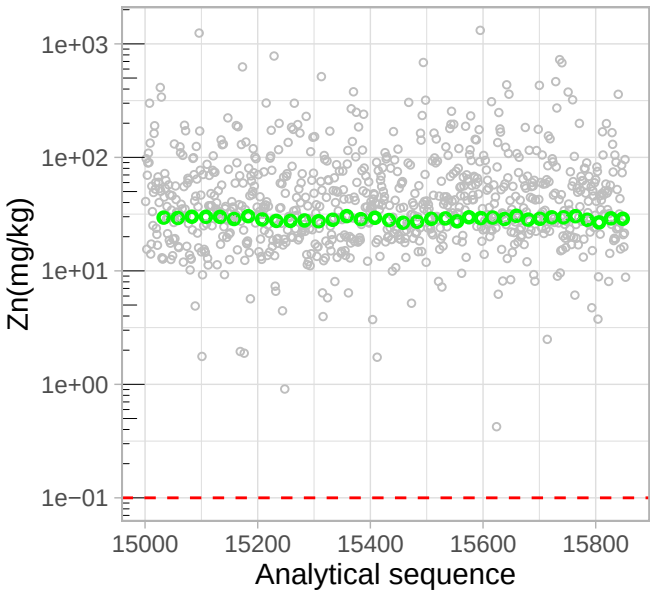
The laboratory method detection limit (DL) is indicated by a **red dotted line**.

Samples from the MINS standard are coloured in **green**.

Negative laboratory concentration values were set to a low positive value (1×10^{-7}) to fit the log scale.

In grey are plotted the rest of the samples which correspond to: ordinary sample, field duplicate, analytical duplicate and re-analyzed samples from Nordland/Troms.


Mo(mg/kg)
1e+01
1e+00
1e−01
1e−02
1e−03
1e−04
1e−05
1e−06
1e−07
15000
15200
15400
15600
15800
Analytical sequence


Zn(mg/kg)
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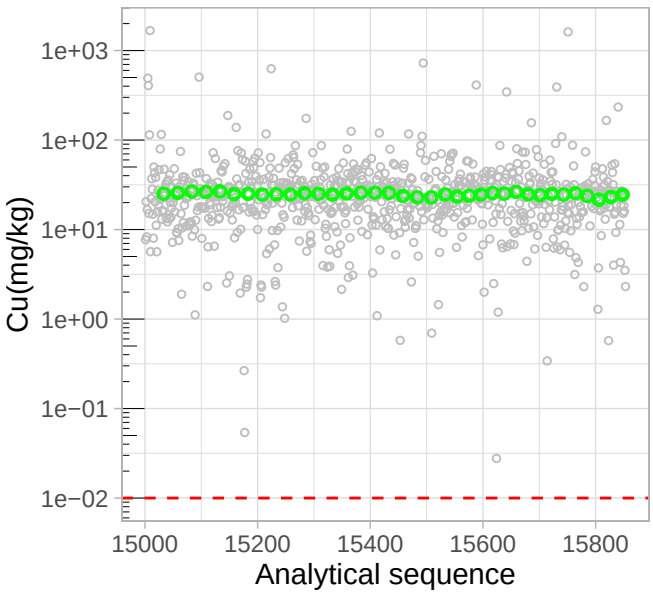
1e+01
1e+00
1e−01
15000
15200
15400
15600
15800
Analytical sequence


Cu(mg/kg)
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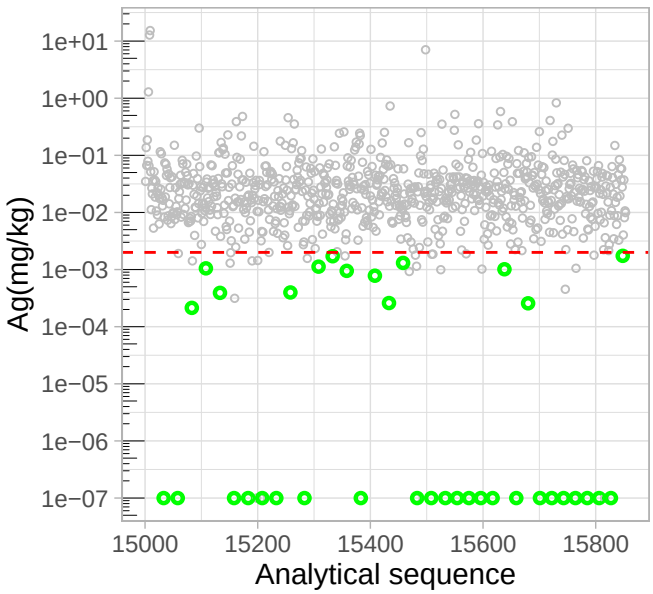
1e+01
1e+00
1e−01
1e−02
15000
15200
15400
15600
15800
Analytical sequence


Ag(mg/kg)
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1e−01
1e−02
1e−03
1e−04
1e−05
1e−06
1e−07
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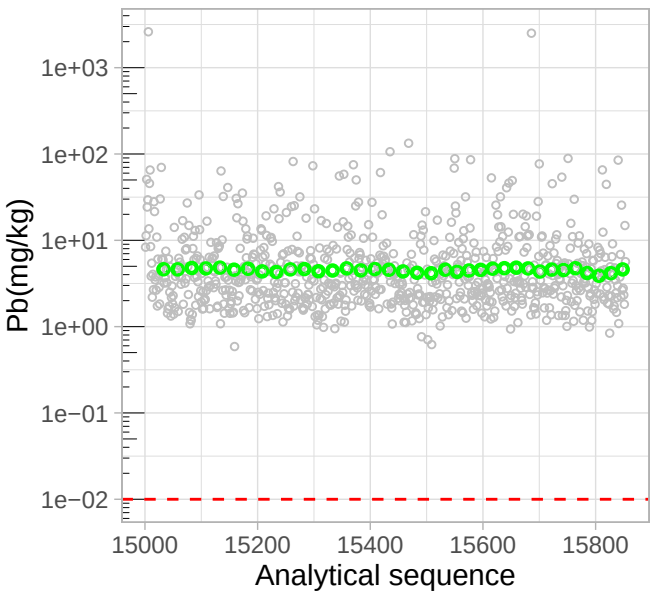
15200
15400
15600
15800
Analytical sequence


Pb(mg/kg)
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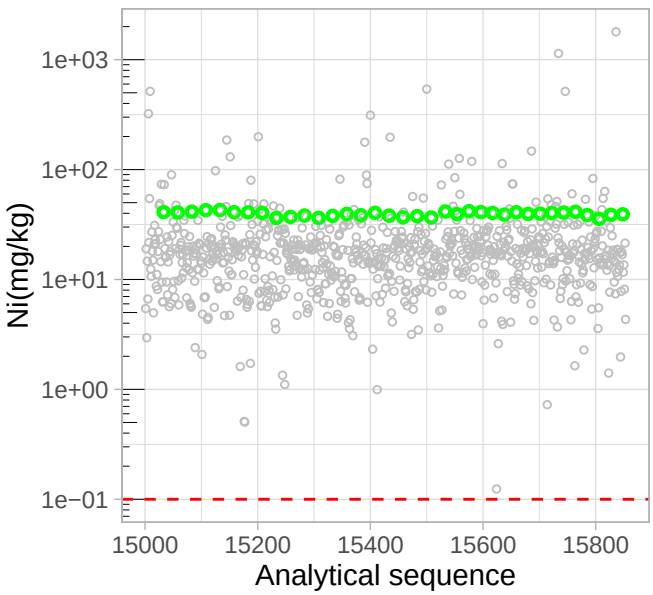
1e+01
1e+00
1e−01
1e−02
15000
15200
15400
15600
15800
Analytical sequence


Ni(mg/kg)
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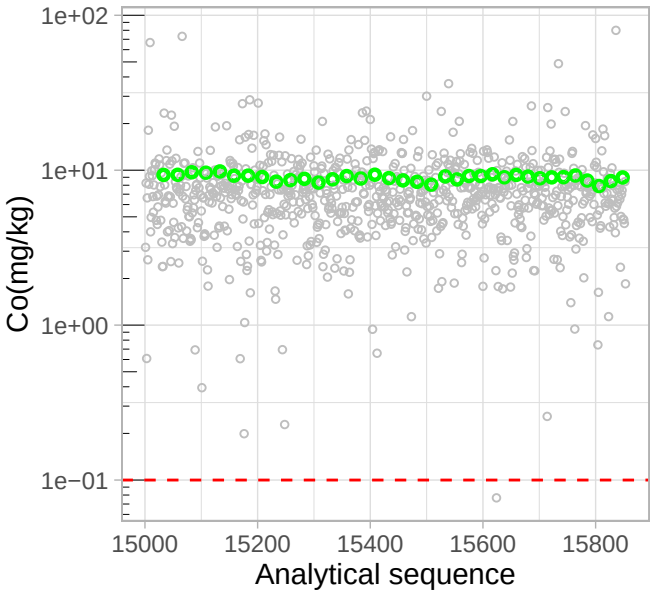
1e+01
1e+00
1e−01
15000
15200
15400
15600
15800
Analytical sequence


Co(mg/kg)
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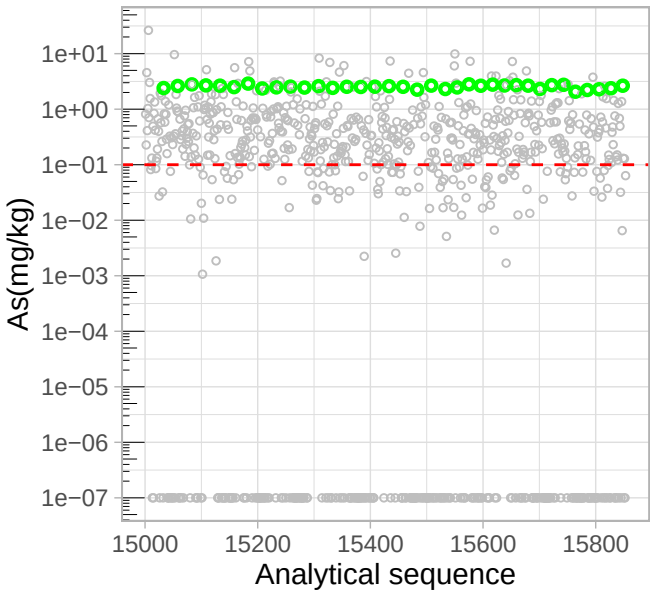
1e+01
1e+00
1e−01
15000
15200
15400
15600
15800
Analytical sequence


As(mg/kg)
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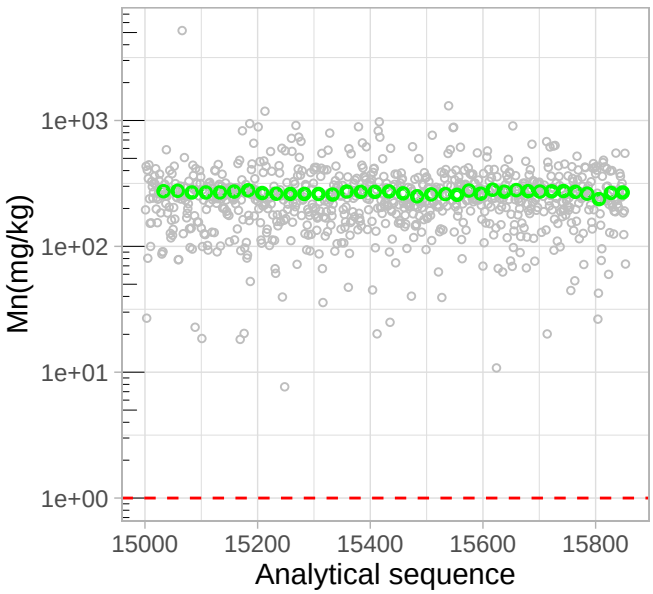
1e+00
1e−01
1e−02
1e−03
1e−04
1e−05
1e−06
1e−07
15000
15200
15400
15600
15800
Analytical sequence


Mn(mg/kg)
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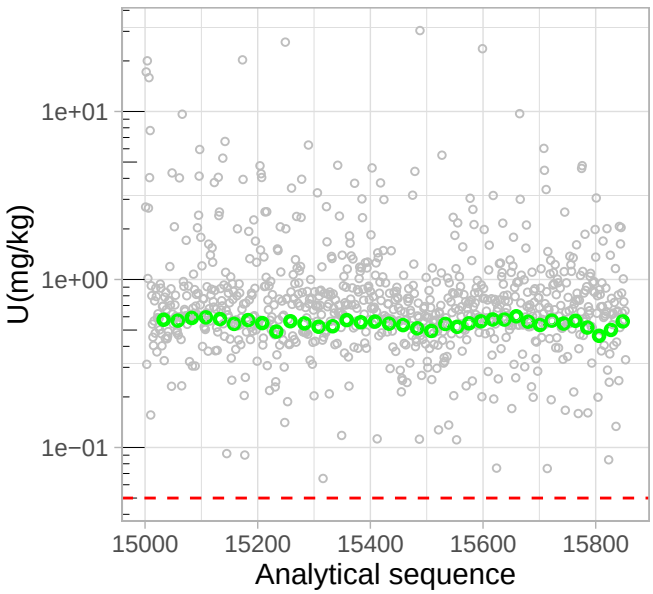
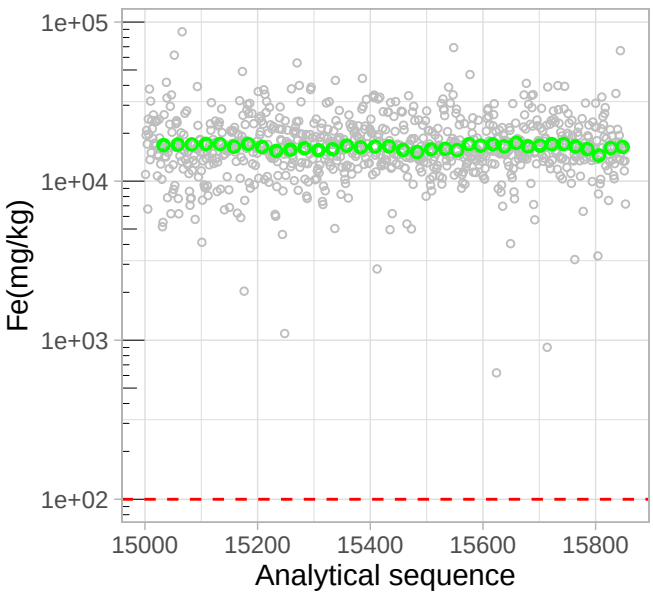
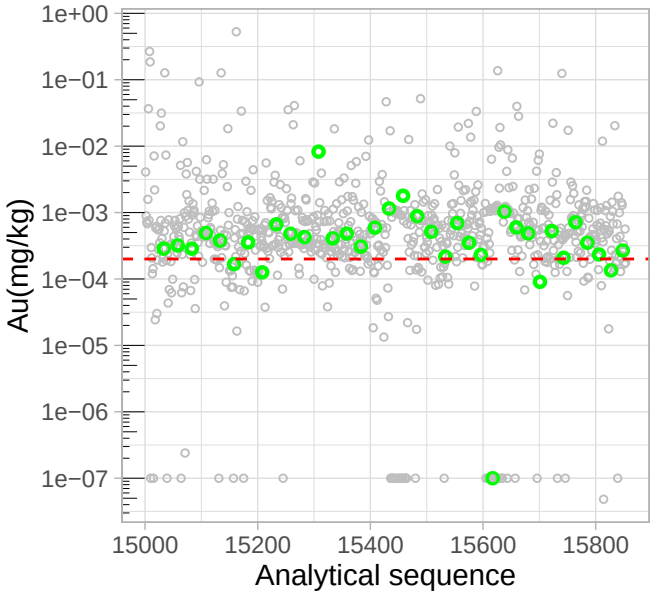
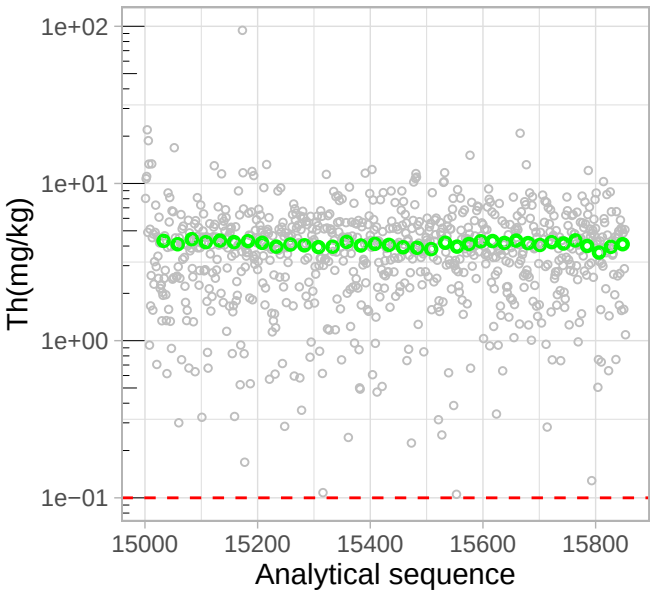
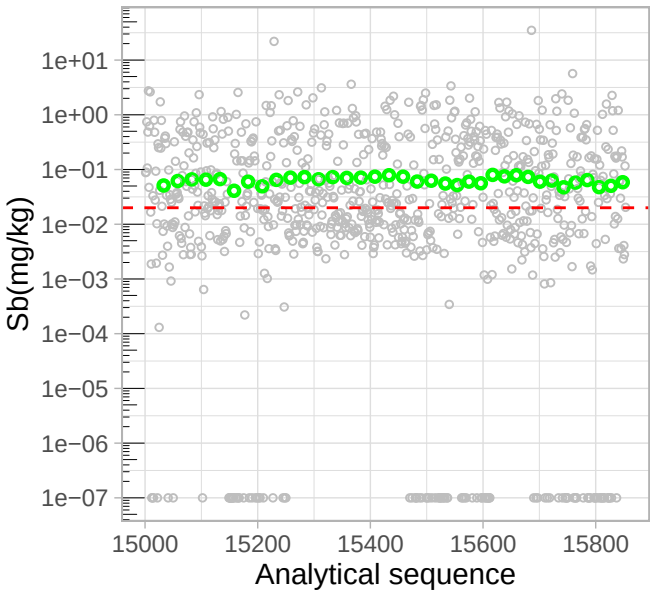
1e+02
1e+01
1e+00
15000
15200
15400
15600
15800
Analytical sequence

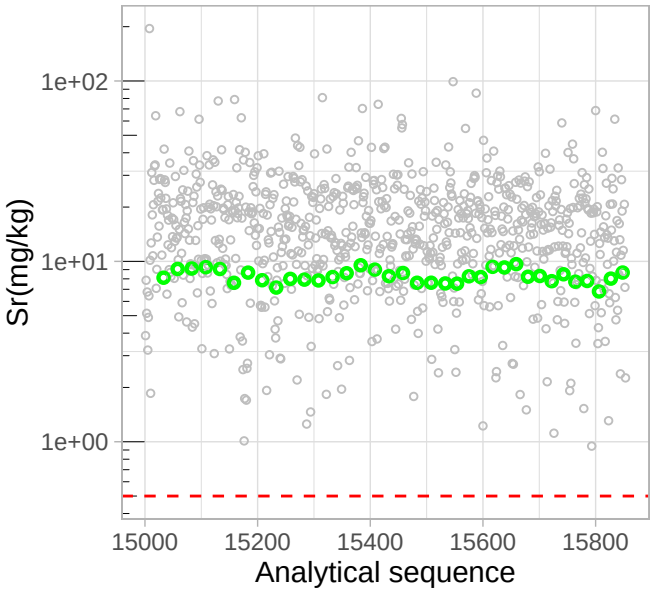

U(mg/kg)
1e+01
1e+00
1e−01
15000
15200
15400
15600
15800
Analytical sequence

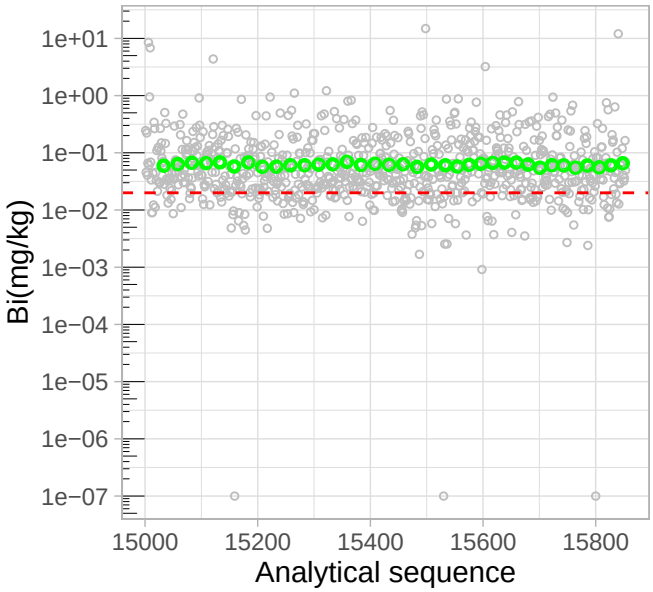

Fe(mg/kg)
1e+05
1e+04
1e+03
1e+02
15000
15200
15400
15600
15800
Analytical sequence

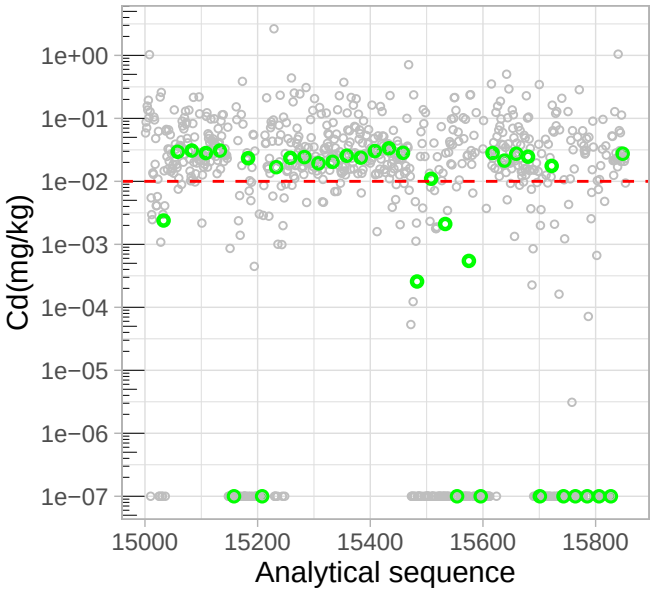

Au(mg/kg)
1e+00
1e−01
1e−02
1e−03
1e−04
1e−05
1e−06
1e−07
15000
15200
15400
15600
15800
Analytical sequence

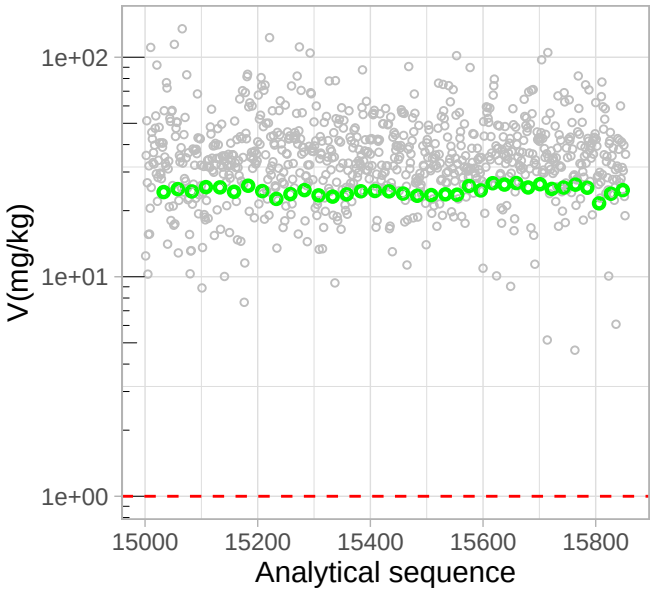

Th(mg/kg)
1e+02
1e+01
1e+00
1e−01
15000
15200
15400
15600
15800
Analytical sequence

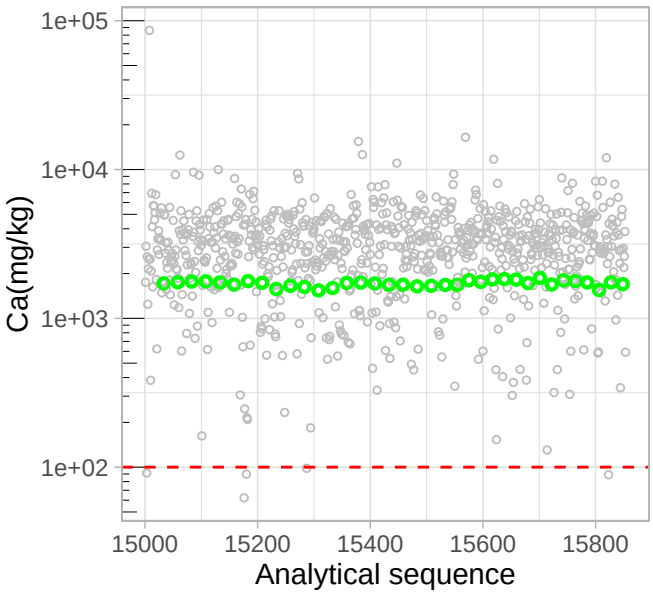

Sb(mg/kg)
1e+01
1e+00
1e−01
1e−02
1e−03
1e−04
1e−05
1e−06
1e−07
15000
15200
15400
15600
15800
Analytical sequence

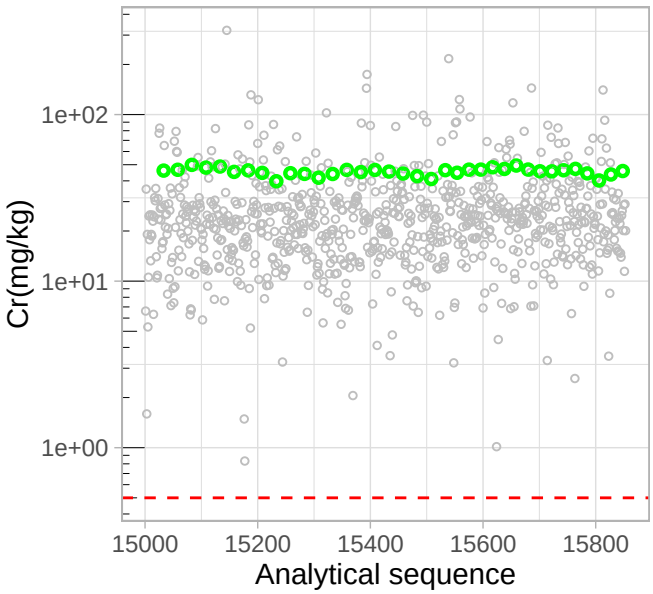

Sr(mg/kg)
1e+02
1e+01
1e+00
15000
15200
15400
15600
15800
Analytical sequence

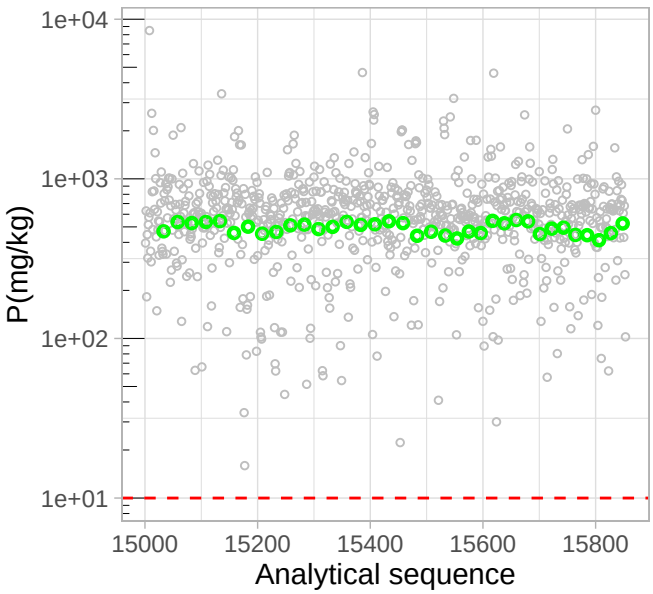

Bi(mg/kg)
1e+01
1e+00
1e−01
1e−02
1e−03
1e−04
1e−05
1e−06
1e−07
15000
15200
15400
15600
15800
Analytical sequence

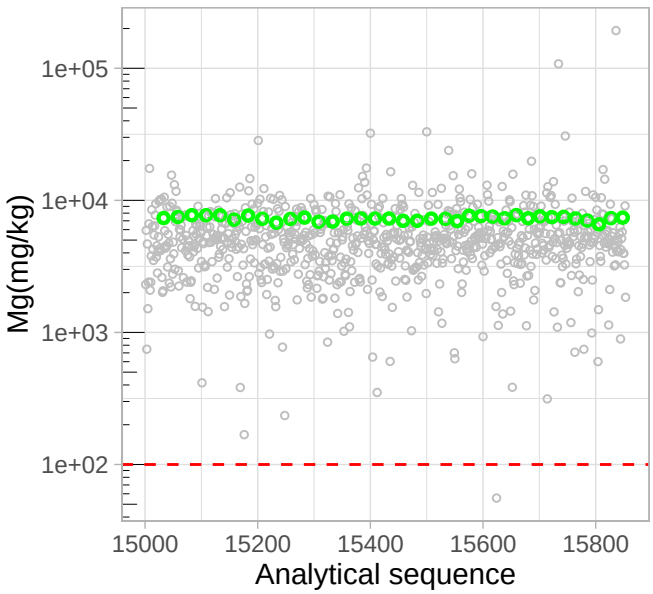

Cd(mg/kg)
1e+00
1e−01
1e−02
1e−03
1e−04
1e−05
1e−06
1e−07
15000
15200
15400
15600
15800
Analytical sequence

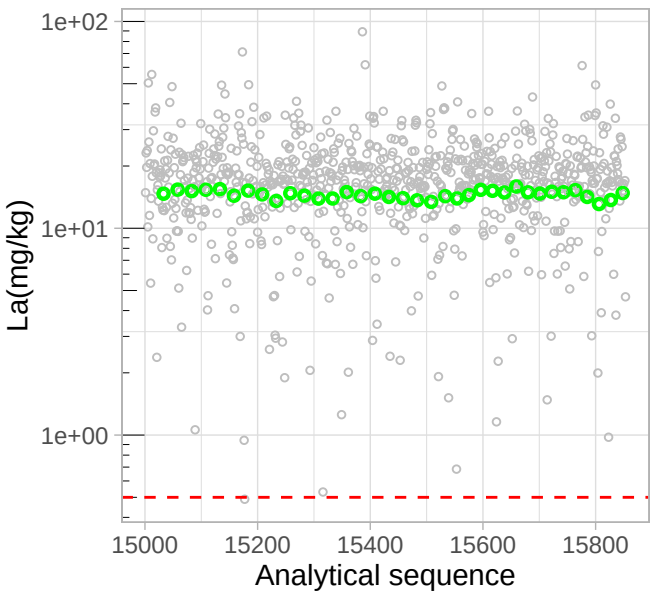

V(mg/kg)
1e+02
1e+01
1e+00
15000
15200
15400
15600
15800
Analytical sequence

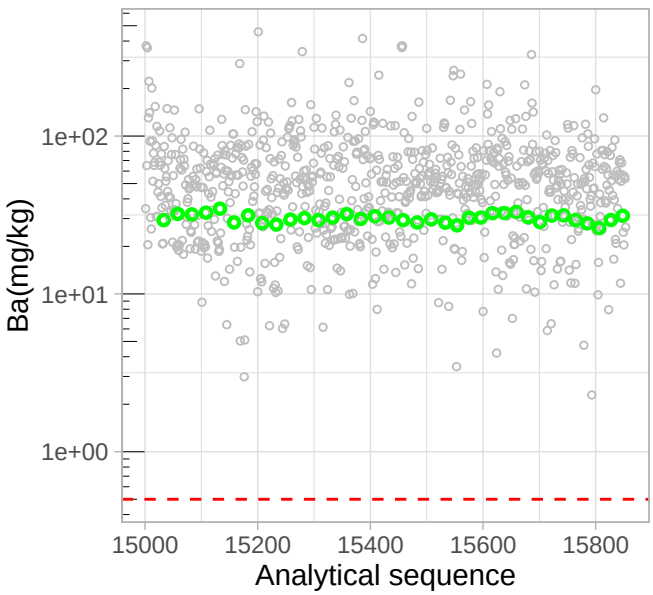

Ca(mg/kg)
1e+05
1e+04
1e+03
1e+02
15000
15200
15400
15600
15800
Analytical sequence

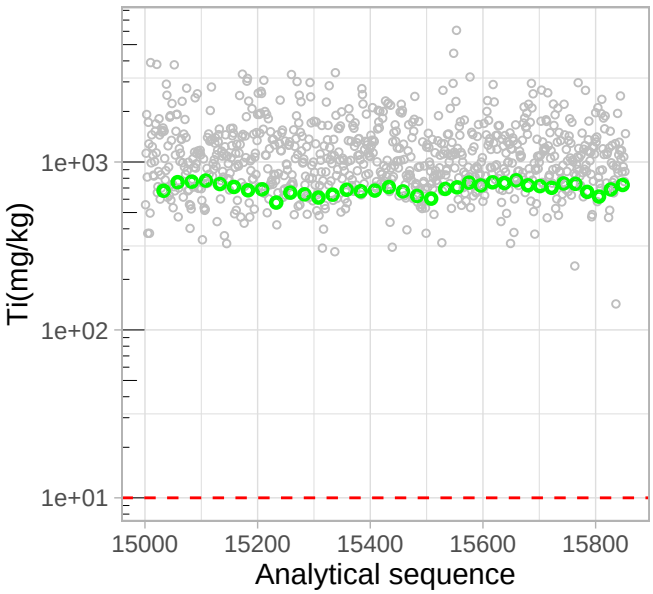

Cr(mg/kg)
1e+02
1e+01
1e+00
15000
15200
15400
15600
15800
Analytical sequence

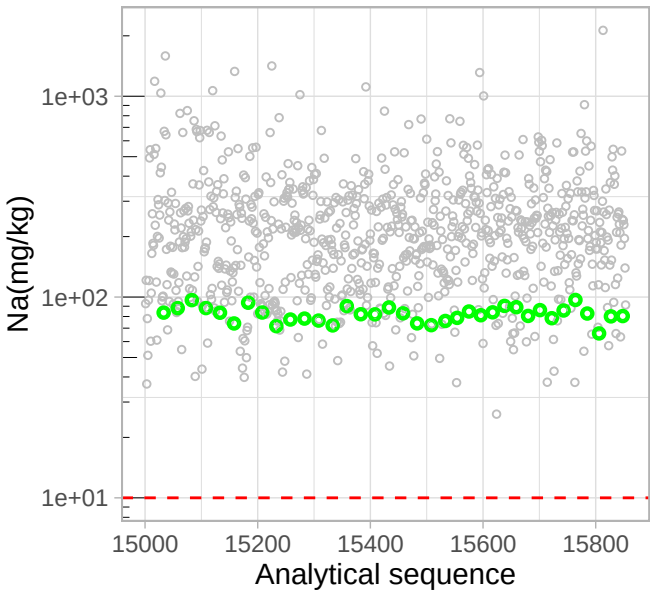

P(mg/kg)
1e+04
1e+03
1e+02
1e+01
15000
15200
15400
15600
15800
Analytical sequence

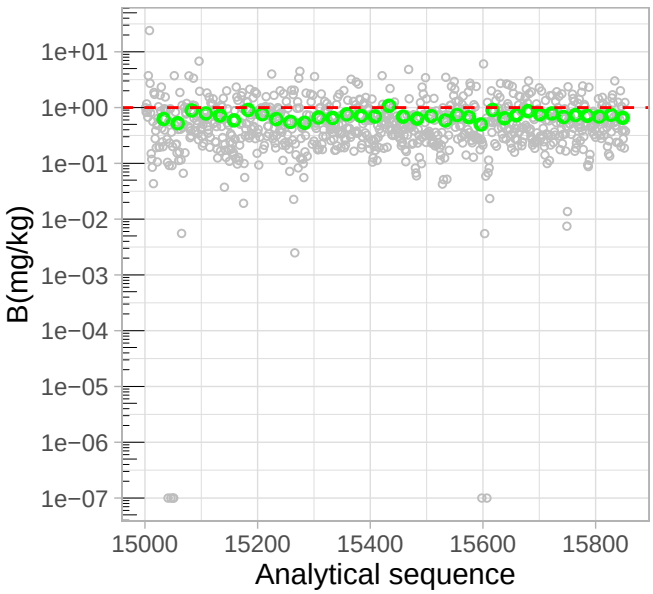

Mg(mg/kg)
1e+05
1e+04
1e+03
1e+02
15000
15200
15400
15600
15800
Analytical sequence

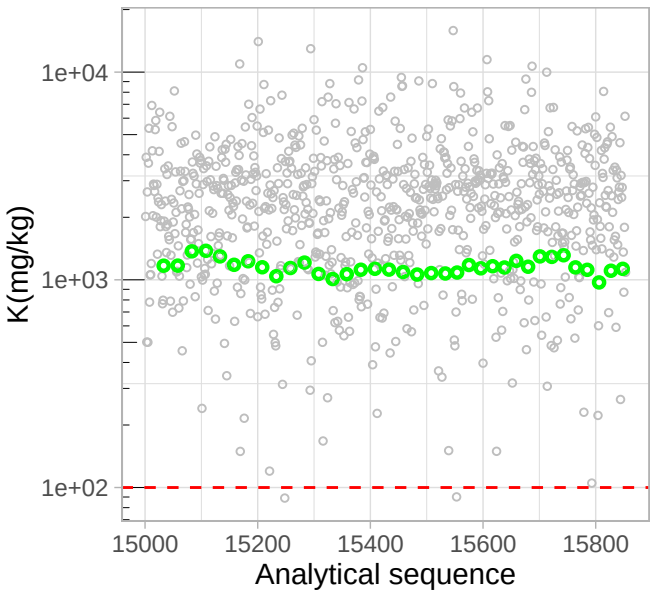

La(mg/kg)
1e+02
1e+01
1e+00
15000
15200
15400
15600
15800
Analytical sequence

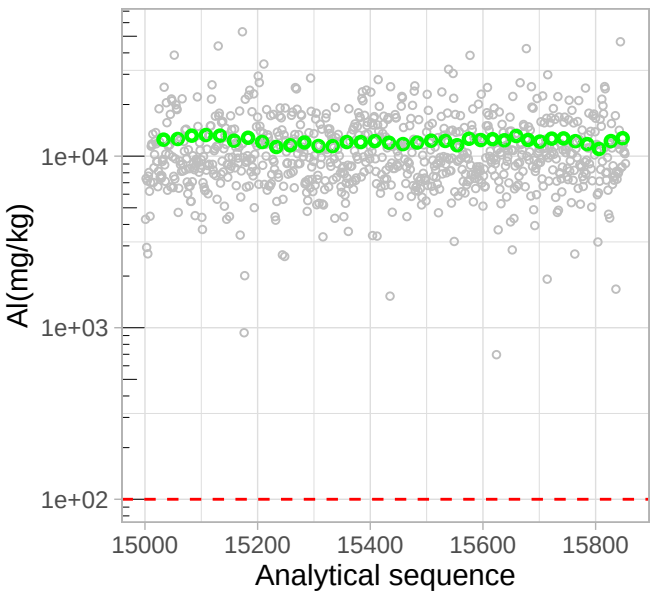

Ba(mg/kg)
1e+02
1e+01
1e+00
15000
15200
15400
15600
15800
Analytical sequence

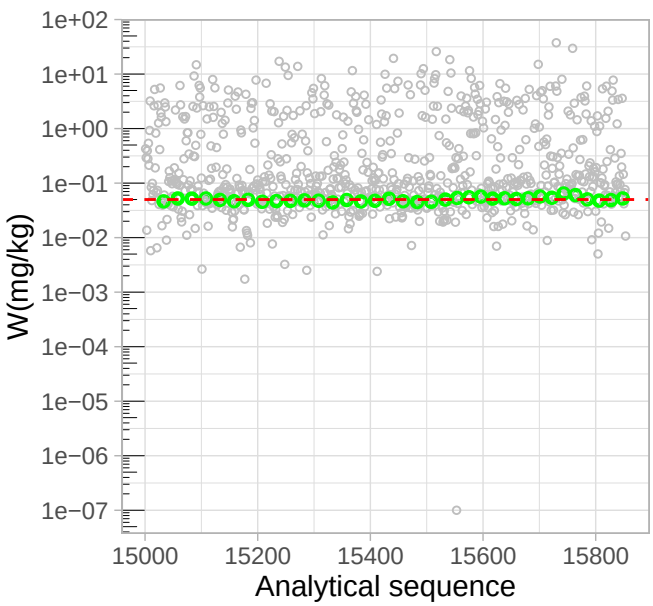

Ti(mg/kg)
1e+03
1e+02
1e+01
15000
15200
15400
15600
15800
Analytical sequence

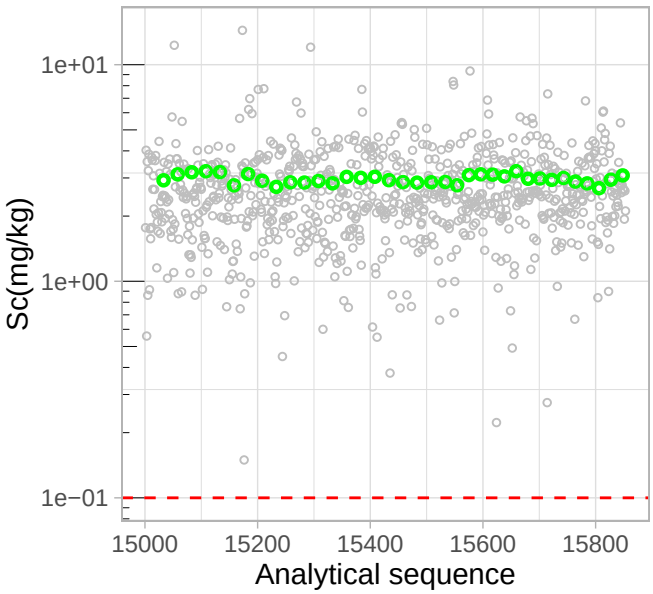

Na(mg/kg)
1e+03
1e+02
1e+01
15000
15200
15400
15600
15800
Analytical sequence

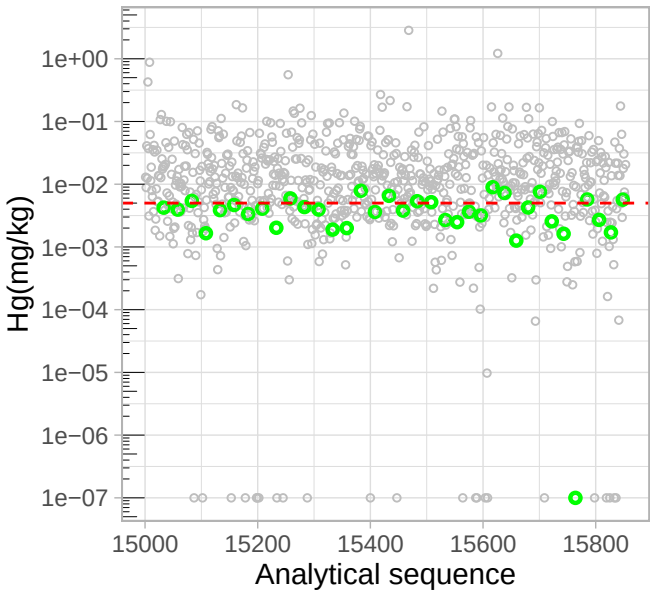

B(mg/kg)
1e+01
1e+00
1e−01
1e−02
1e−03
1e−04
1e−05
1e−06
1e−07
15000
15200
15400
15600
15800
Analytical sequence

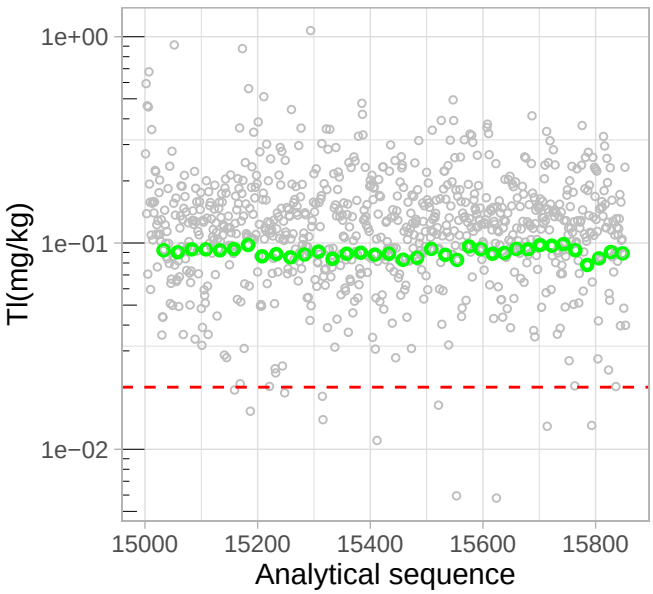

K(mg/kg)
1e+04
1e+03
1e+02
15000
15200
15400
15600
15800
Analytical sequence

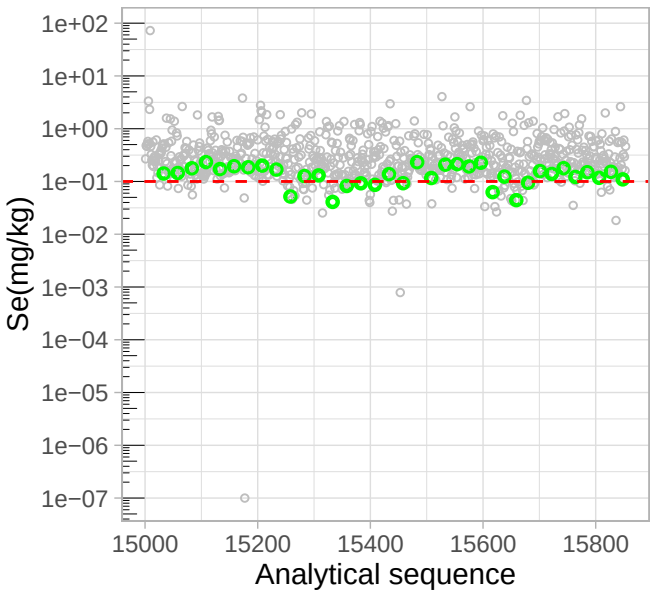

Al(mg/kg)
1e+04
1e+03
1e+02
15000
15200
15400
15600
15800
Analytical sequence

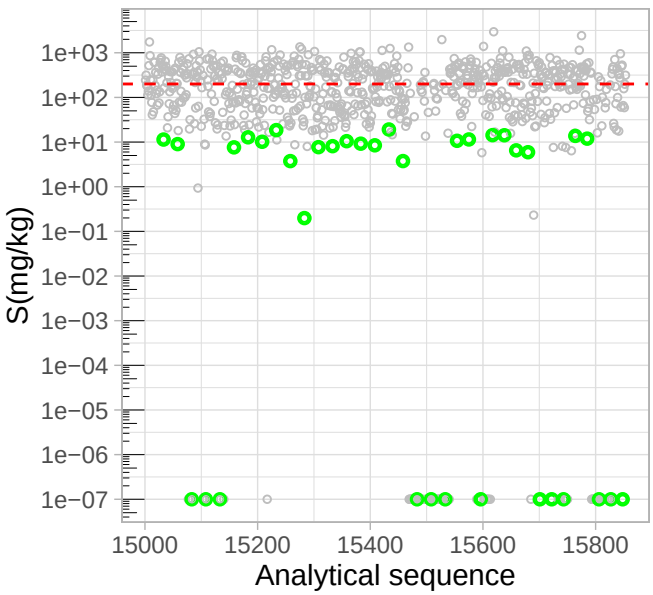

W(mg/kg)
1e+02
1e+01
1e+00
1e−01
1e−02
1e−03
1e−04
1e−05
1e−06
1e−07
15000
15200
15400
15600
15800
Analytical sequence

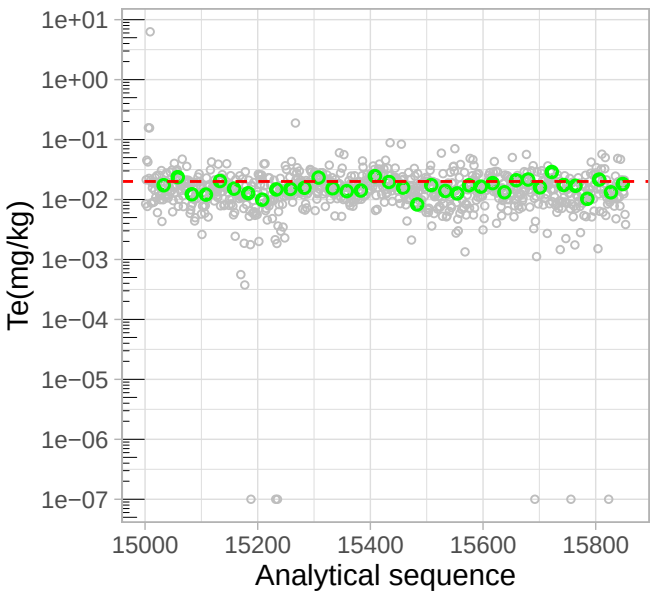

Sc(mg/kg)
1e+01
1e+00
1e−01
15000
15200
15400
15600
15800
Analytical sequence

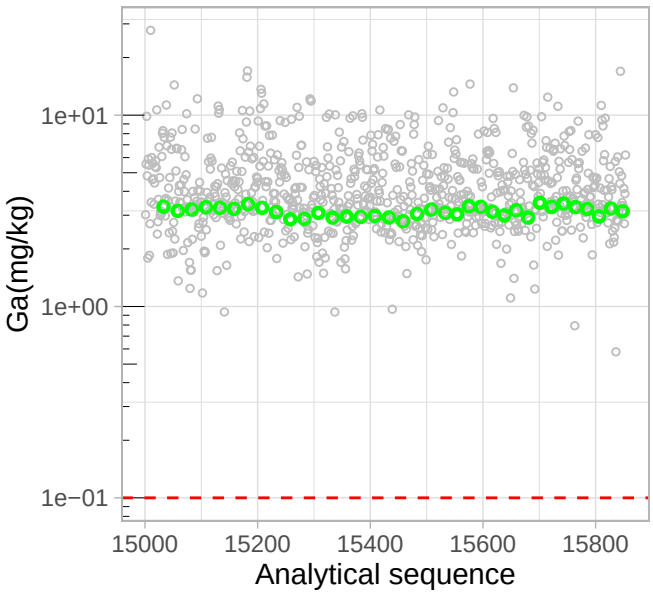

Hg(mg/kg)
1e+00
1e−01
1e−02
1e−03
1e−04
1e−05
1e−06
1e−07
15000
15200
15400
15600
15800
Analytical sequence

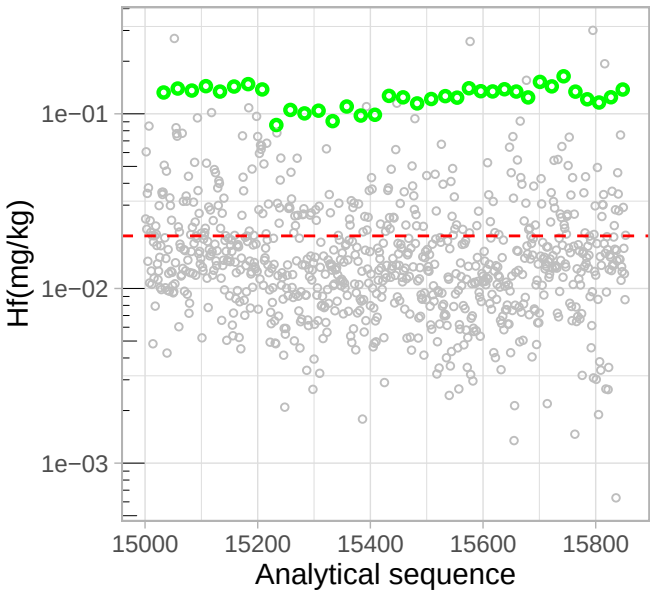

Tl(mg/kg)
1e+00
1e−01
1e−02
15000
15200
15400
15600
15800
Analytical sequence

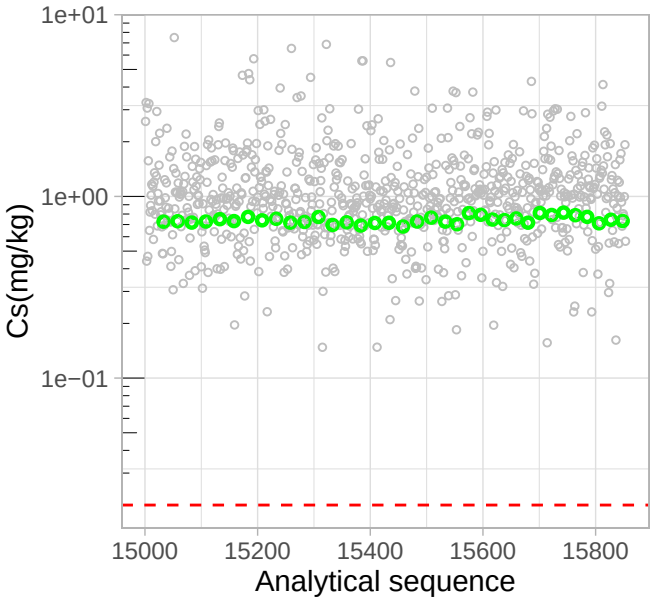

Se(mg/kg)
1e+02
1e+01
1e+00
1e−01
1e−02
1e−03
1e−04
1e−05
1e−06
1e−07
15000
15200
15400
15600
15800
Analytical sequence

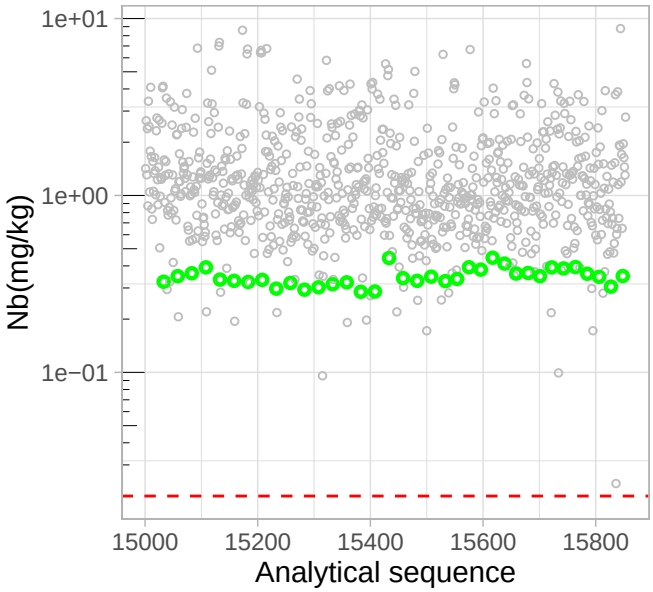

S(mg/kg)
1e+03
1e+02
1e+01
1e+00
1e−01
1e−02
1e−03
1e−04
1e−05
1e−06
1e−07
15000
15200
15400
15600
15800
Analytical sequence

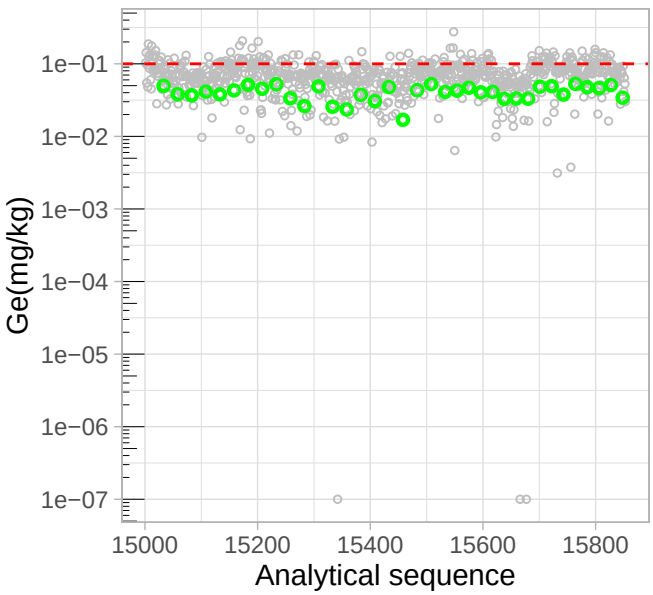

Te(mg/kg)
1e+01
1e+00
1e−01
1e−02
1e−03
1e−04
1e−05
1e−06
1e−07
15000
15200
15400
15600
15800
Analytical sequence

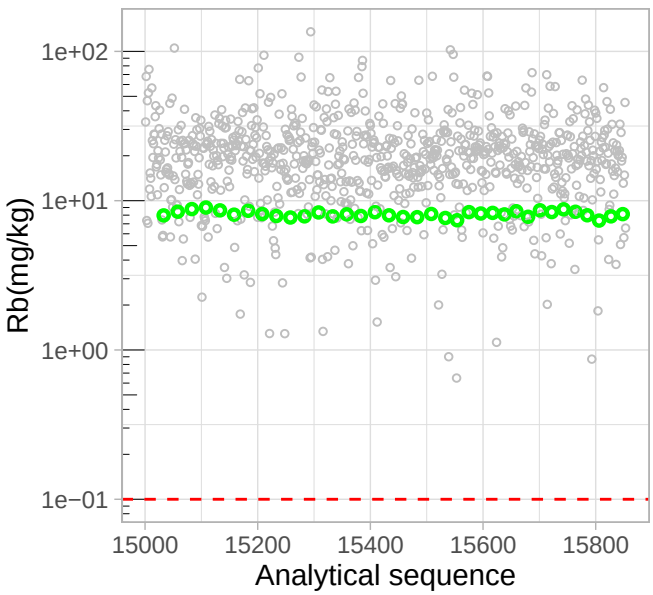

Ga(mg/kg)
1e+01
1e+00
1e−01
15000
15200
15400
15600
15800
Analytical sequence

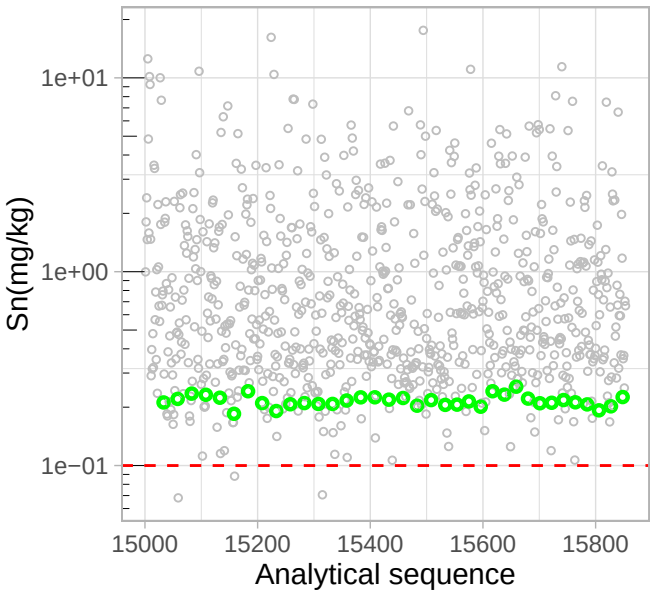

Hf(mg/kg)
1e−01
1e−02
1e−03
15000
15200
15400
15600
15800
Analytical sequence

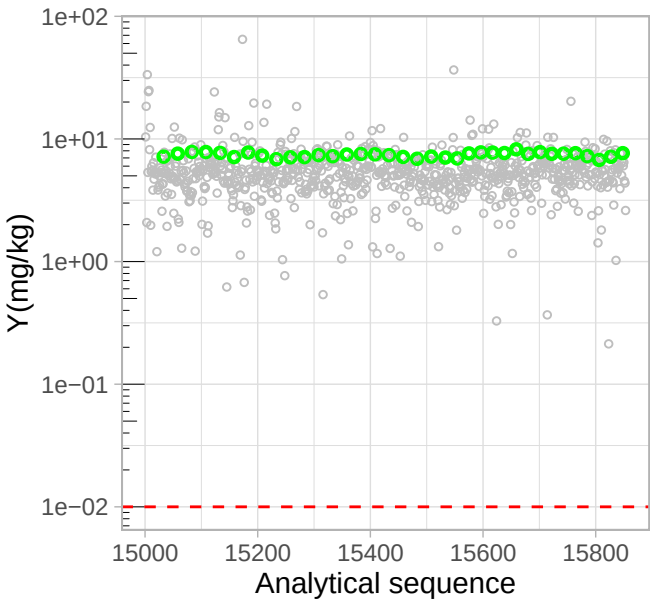

Cs(mg/kg)
1e+01
1e+00
1e−01
15000
15200
15400
15600
15800
Analytical sequence

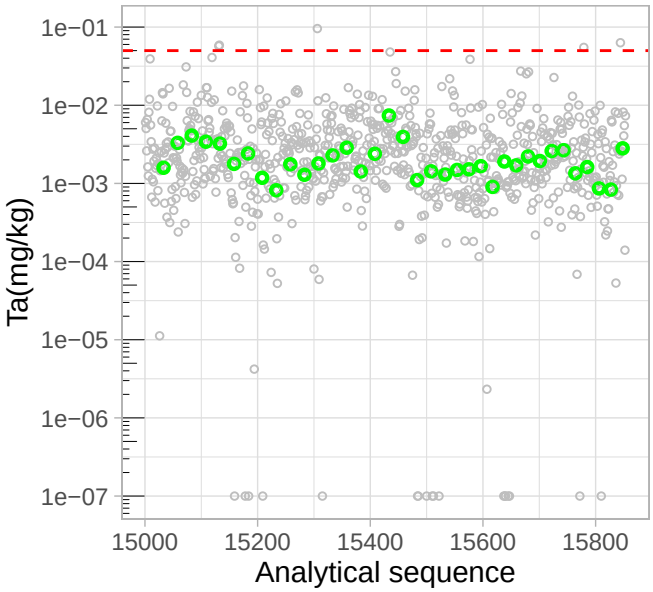

Nb(mg/kg)
1e+01
1e+00
1e−01
15000
15200
15400
15600
15800
Analytical sequence

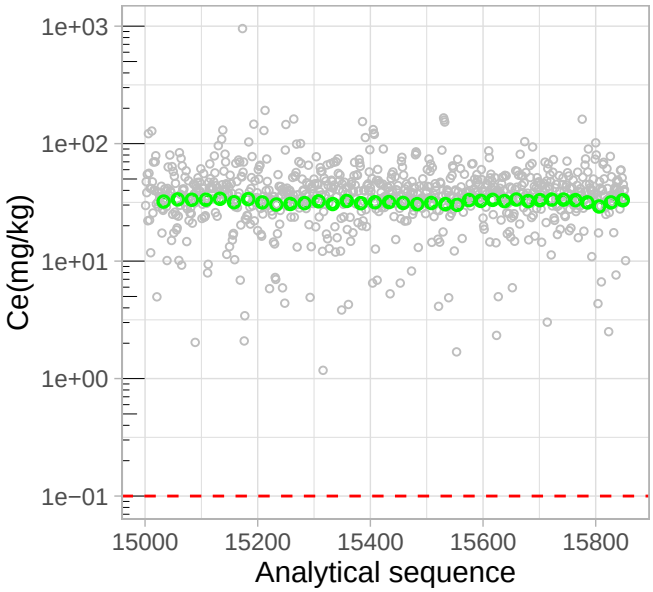

Ge(mg/kg)
1e−01
1e−02
1e−03
1e−04
1e−05
1e−06
1e−07
15000
15200
15400
15600
15800
Analytical sequence

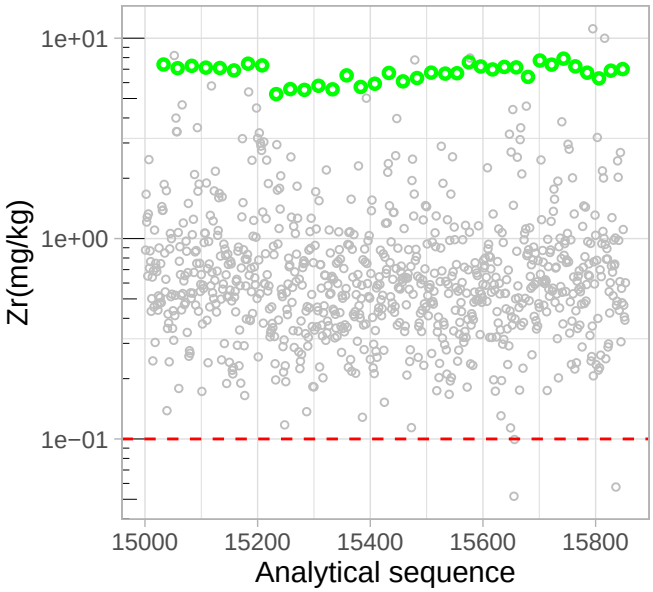

Rb(mg/kg)
1e+02
1e+01
1e+00
1e−01
15000
15200
15400
15600
15800
Analytical sequence

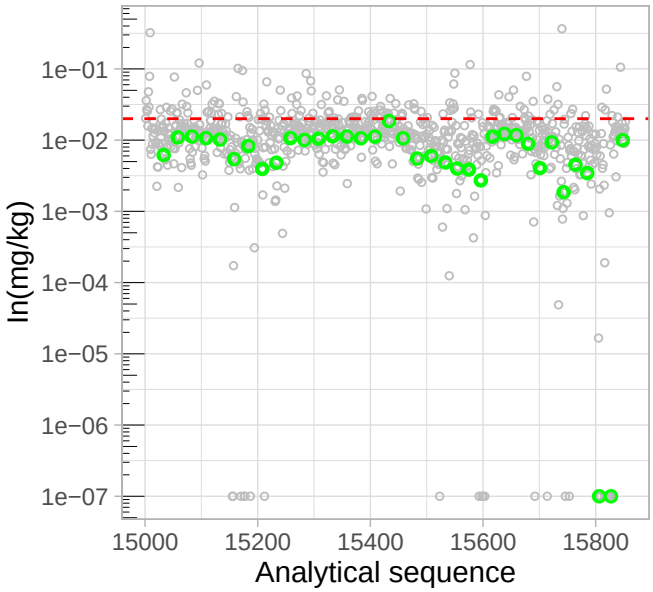

Sn(mg/kg)
1e+01
1e+00
1e−01
15000
15200
15400
15600
15800
Analytical sequence

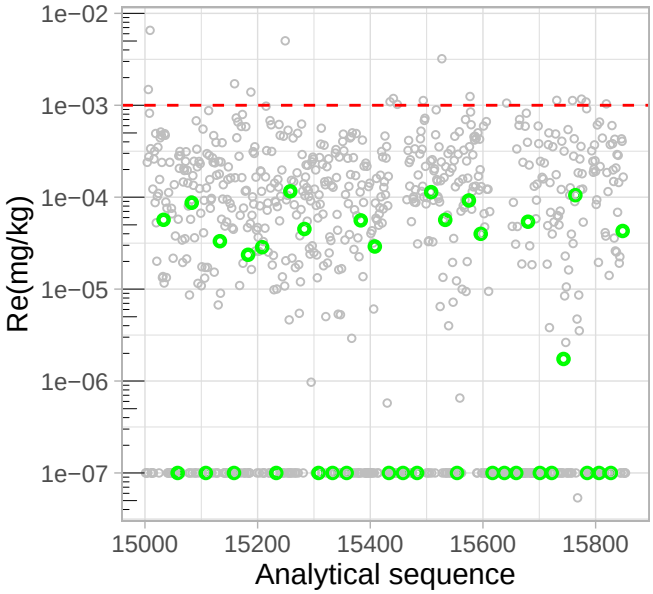

Y(mg/kg)
1e+02
1e+01
1e+00
1e−01
1e−02
15000
15200
15400
15600
15800
Analytical sequence

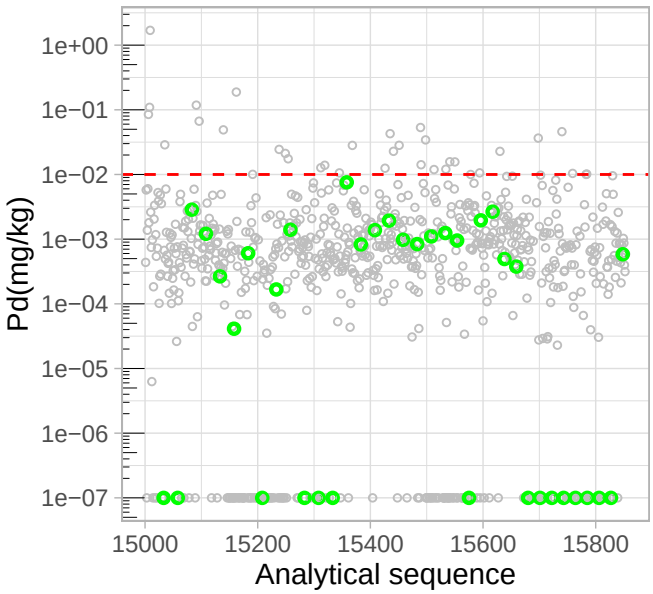

Ta(mg/kg)
1e−01
1e−02
1e−03
1e−04
1e−05
1e−06
1e−07
15000
15200
15400
15600
15800
Analytical sequence

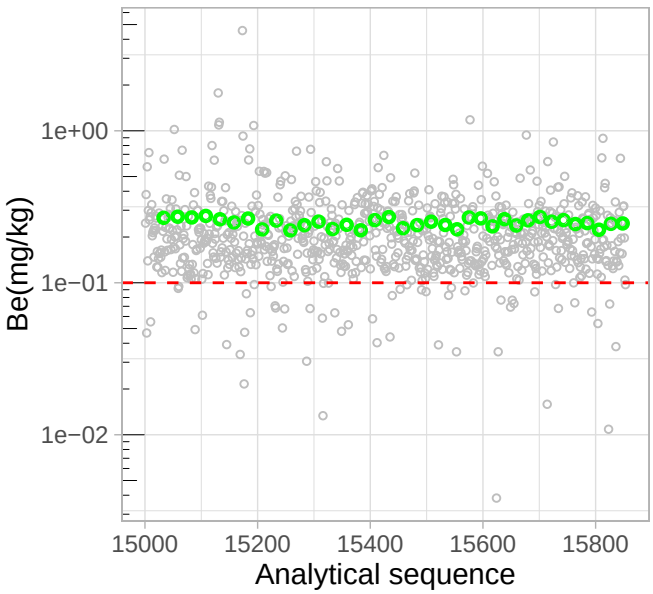

Ce(mg/kg)
1e+03
1e+02
1e+01
1e+00
1e−01
15000
15200
15400
15600
15800
Analytical sequence

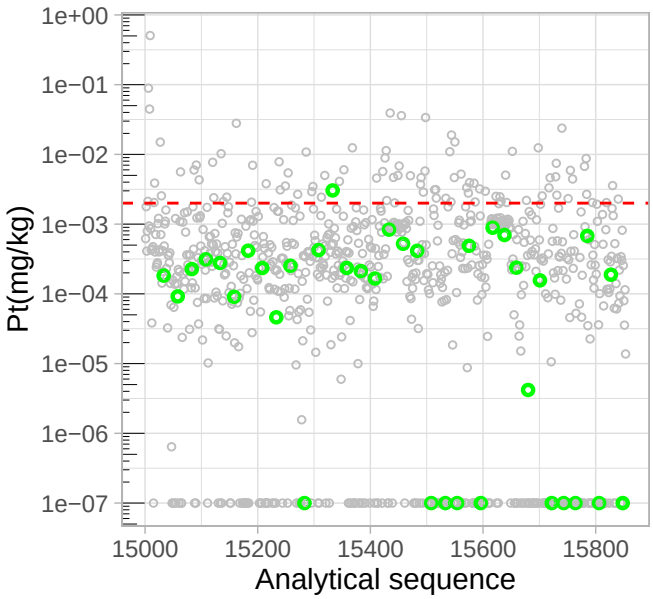

Zr(mg/kg)
1e+01
1e+00
1e−01
15000
15200
15400
15600
15800
Analytical sequence

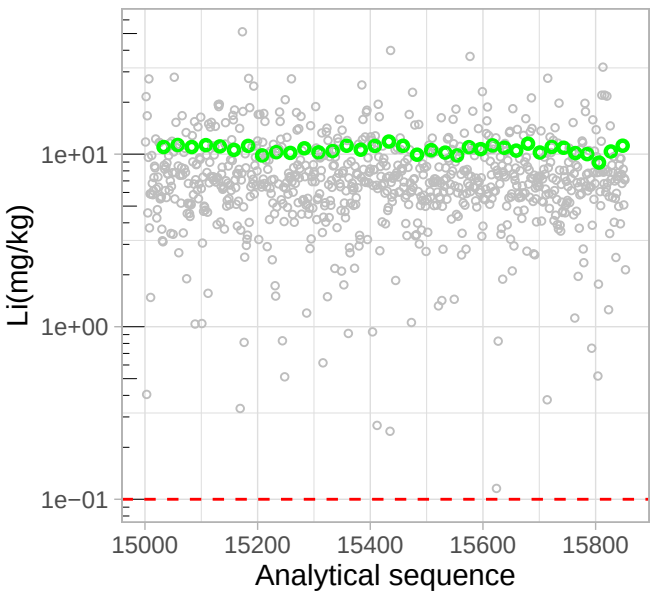

In(mg/kg)
1e−01
1e−02
1e−03
1e−04
1e−05
1e−06
1e−07
15000
15200
15400
15600
15800
Analytical sequence


Re(mg/kg)
1e−02
1e−03
1e−04
1e−05
1e−06
1e−07
15000
15200
15400
15600
15800
Analytical sequence


Pd(mg/kg)
1e+00
1e−01
1e−02
1e−03
1e−04
1e−05
1e−06
1e−07
15000
15200
15400
15600
15800
Analytical sequence


Be(mg/kg)
1e+00
1e−01
1e−02
15000
15200
15400
15600
15800
Analytical sequence


Pt(mg/kg)
1e+00
1e−01
1e−02
1e−03
1e−04
1e−05
1e−06
1e−07
15000
15200
15400
15600
15800
Analytical sequence

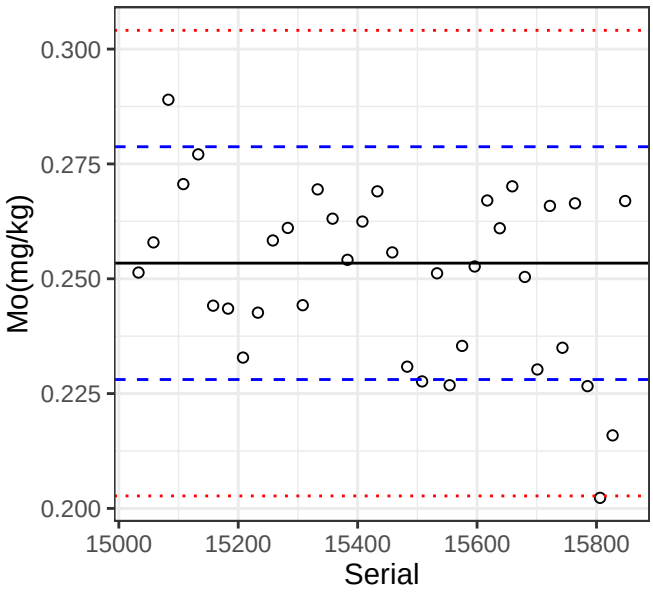

Li(mg/kg)
1e+01
1e+00
1e−01
15000
15200
15400
15600
15800
Analytical sequence

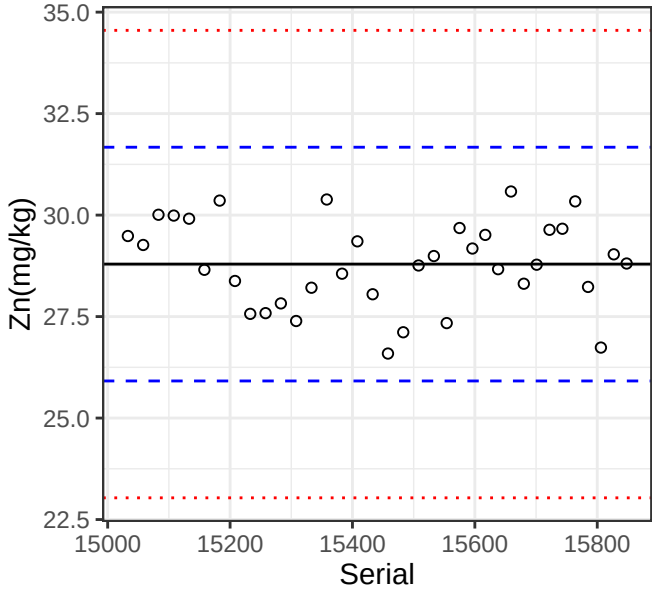
APPENDIX 2: X-CHARTS

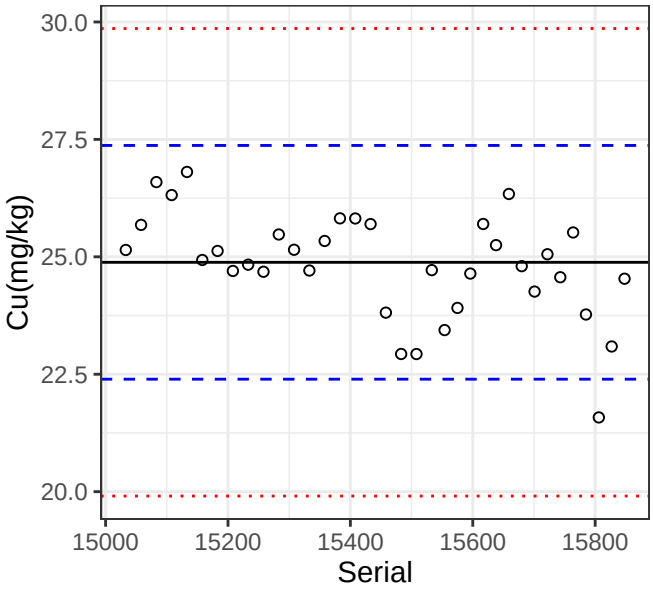
X-charts comprising splits of the MINS in-house standard.

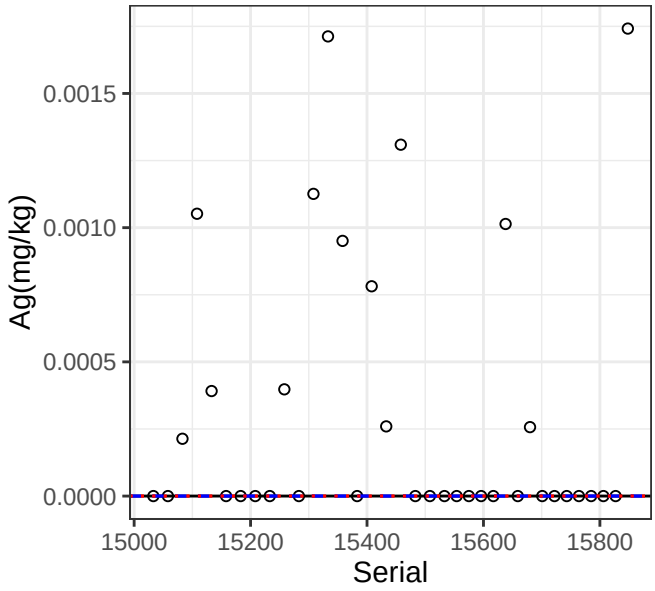
Analyses are plotted in the same order as the analytical sequence in the laboratory.

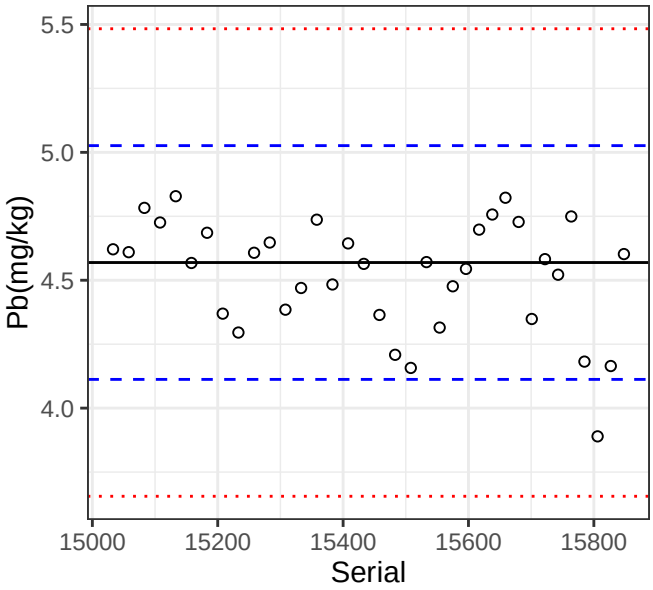
The median is indicated by a solid line, dashed lines are drawn at ±10% (**blue**) and ±20% (**red**) relative to the median.

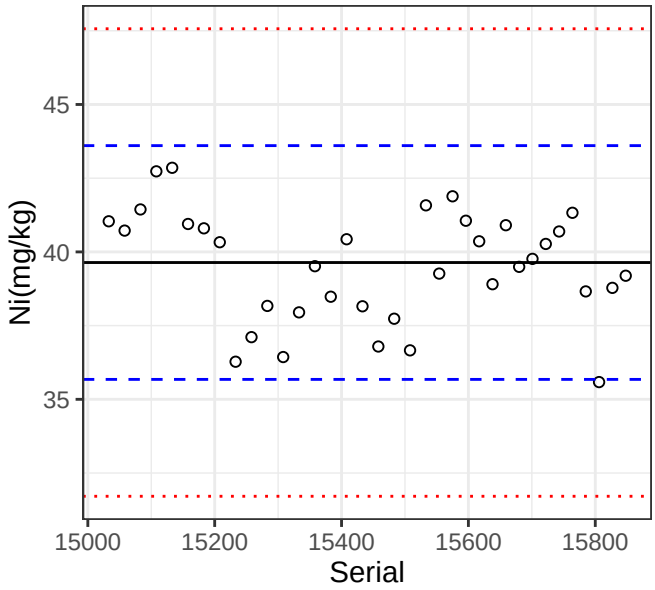

Mo(mg/kg)
0.300
0.275
0.250
0.225
0.200
15000
15200
15400
15600
15800
Serial

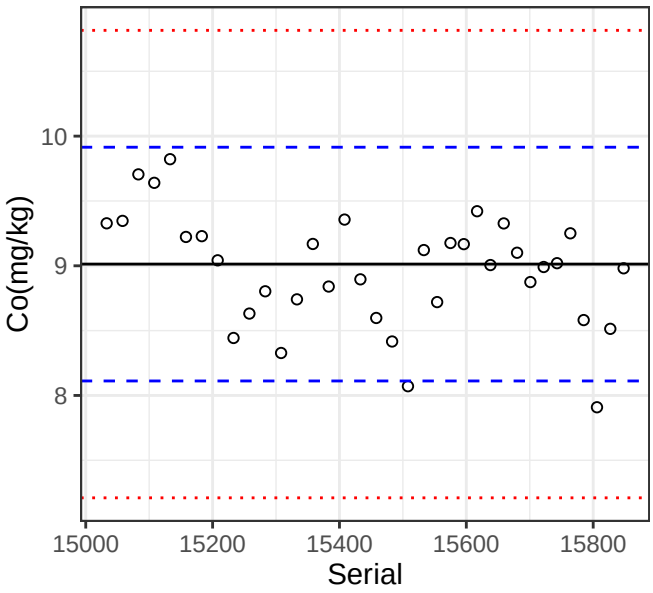

Zn(mg/kg)
35.0
32.5
30.0
27.5
25.0
22.5
15000
15200
15400
15600
15800
Serial

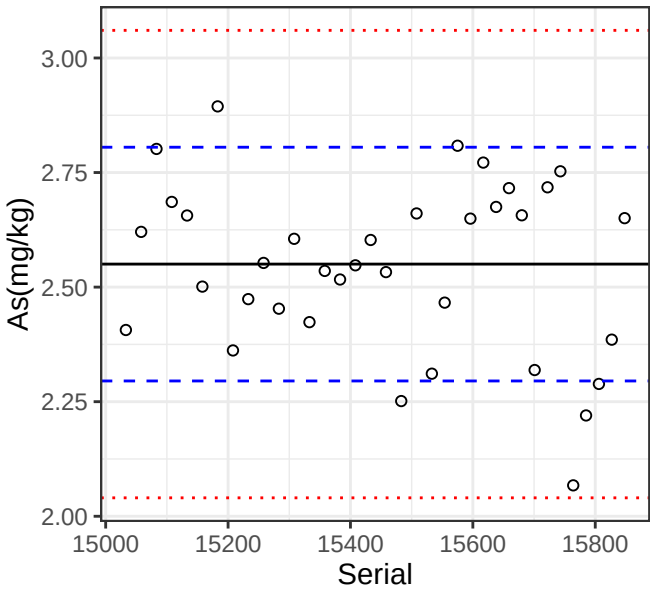

Cu(mg/kg)
30.0
27.5
25.0
22.5
20.0
15000
15200
15400
15600
15800
Serial

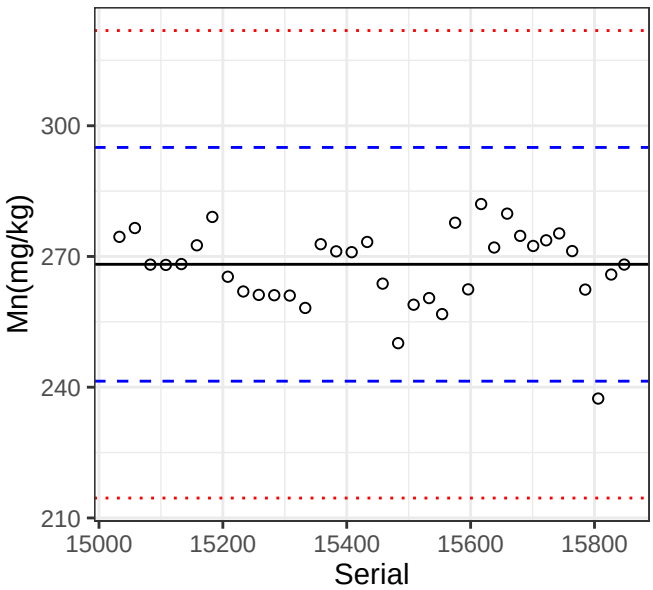

Ag(mg/kg)
0.0015
0.0010
0.0005
0.0000
15000
15200
15400
15600
15800
Serial

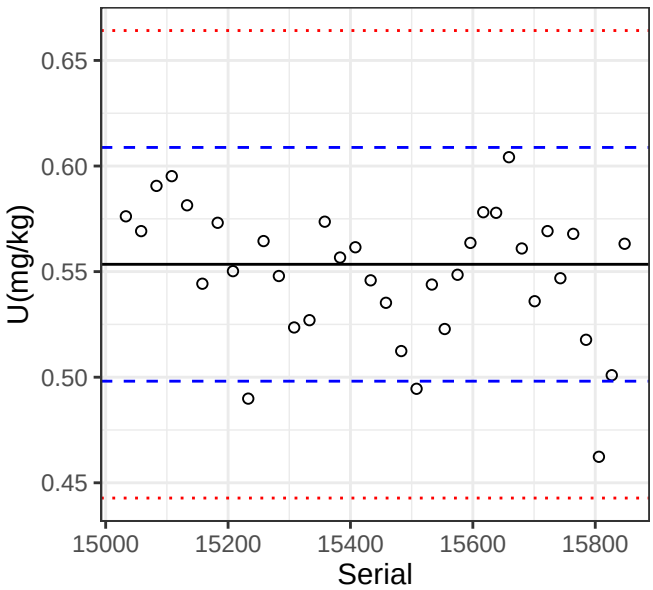

Pb(mg/kg)
5.5
5.0
4.5
4.0
15000
15200
15400
15600
15800
Serial

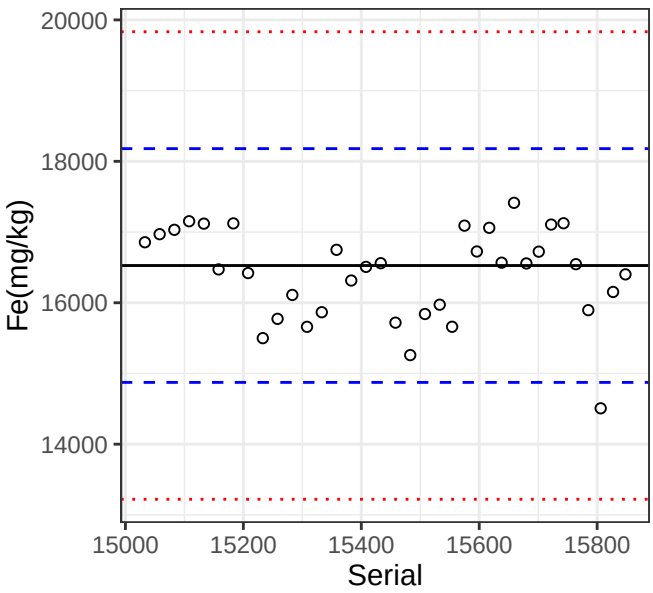

Ni(mg/kg)
45
40
35
15000
15200
15400
15600
15800
Serial

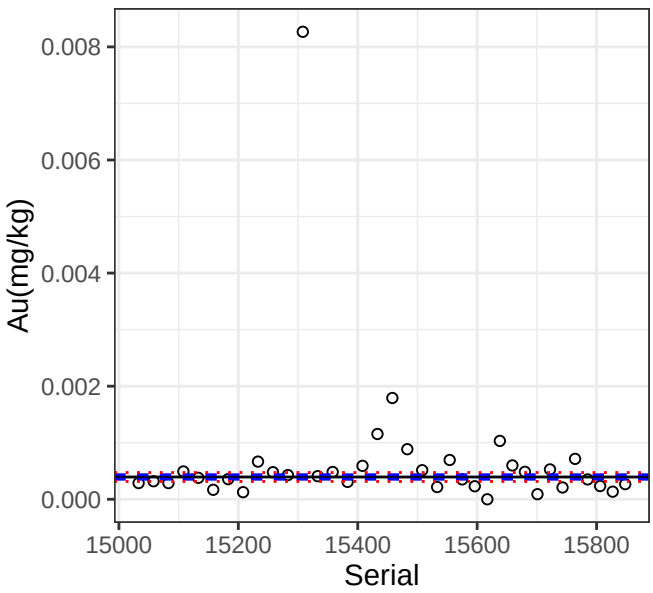

Co(mg/kg)
10
9
8
15000
15200
15400
15600
15800
Serial

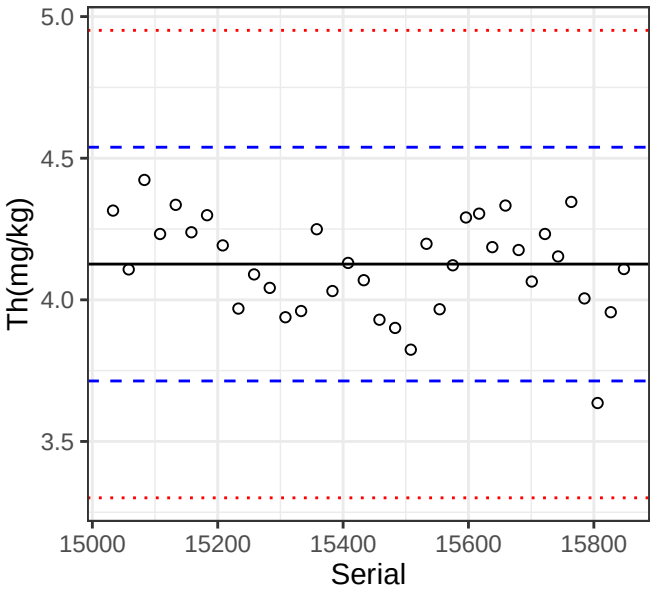

As(mg/kg)
3.00
2.75
2.50
2.25
2.00
15000
15200
15400
15600
15800
Serial

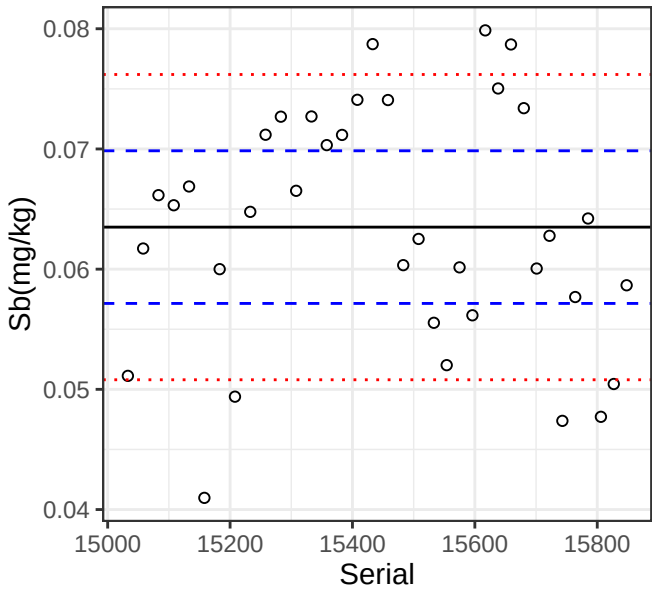

Mn(mg/kg)
300
270
240
210
15000
15200
15400
15600
15800
Serial

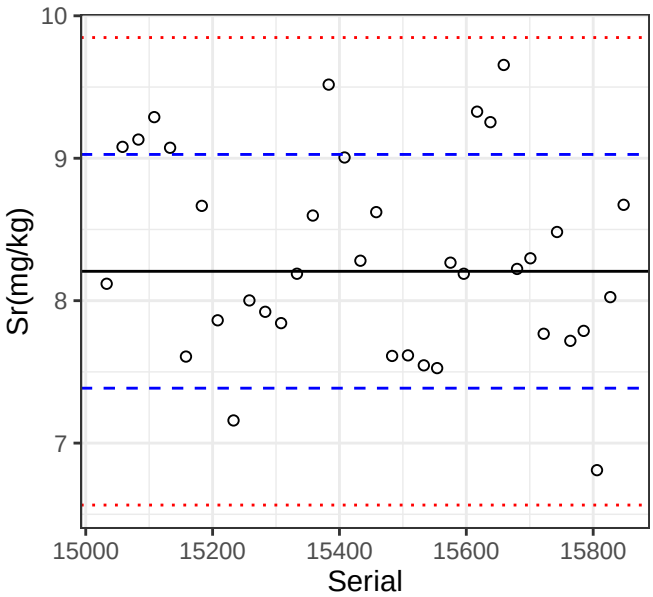

U(mg/kg)
0.65
0.60
0.55
0.50
0.45
15000
15200
15400
15600
15800
Serial

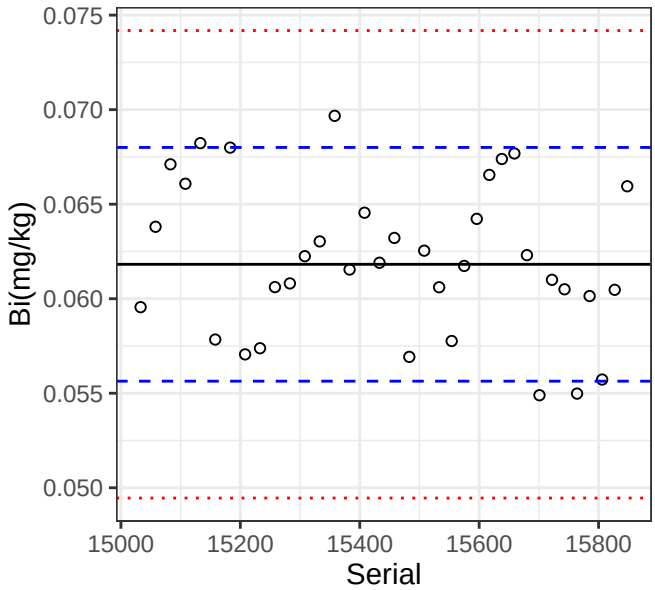

Fe(mg/kg)
20000
18000
16000
14000
15000
15200
15400
15600
15800
Serial

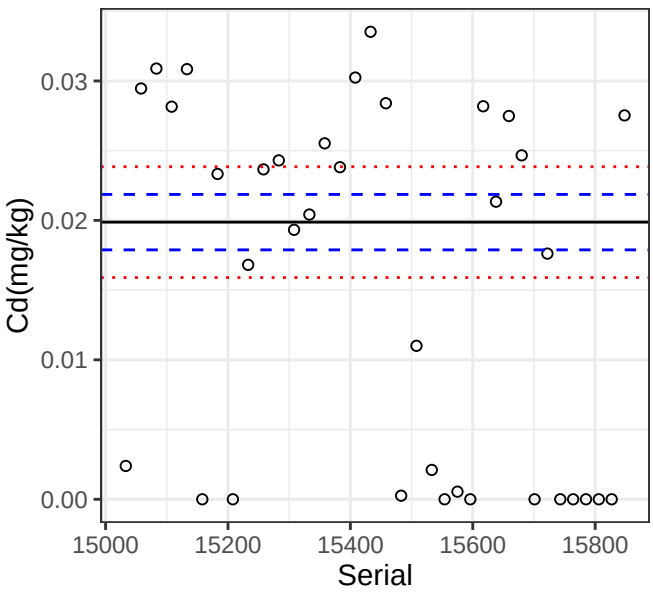

Au(mg/kg)
0.008
0.006
0.004
0.002
0.000
15000
15200
15400
15600
15800
Serial

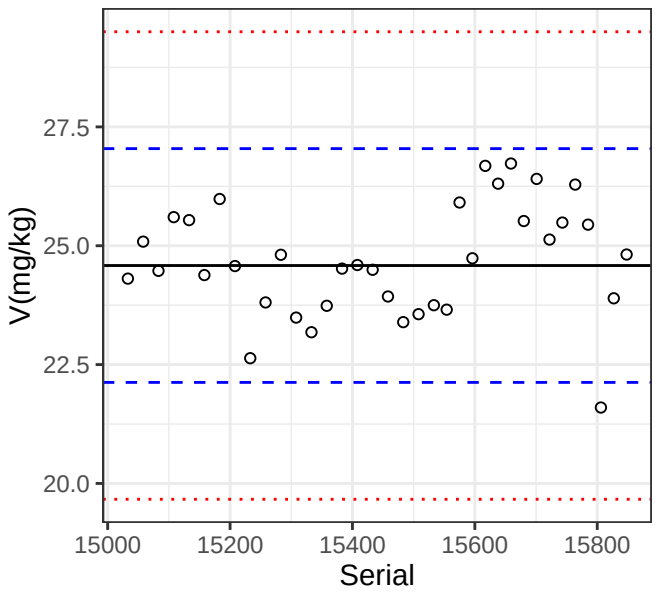

Th(mg/kg)
5.0
4.5
4.0
3.5
15000
15200
15400
15600
15800
Serial

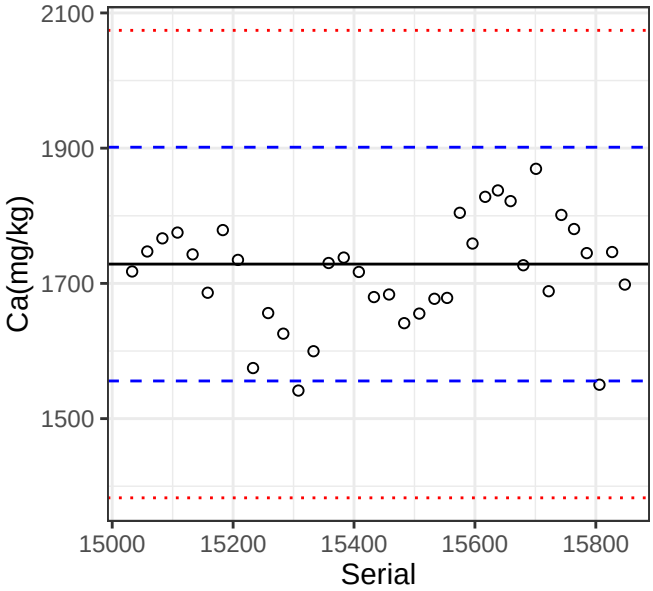

Sb(mg/kg)
0.08
0.07
0.06
0.05
0.04
15000
15200
15400
15600
15800
Serial

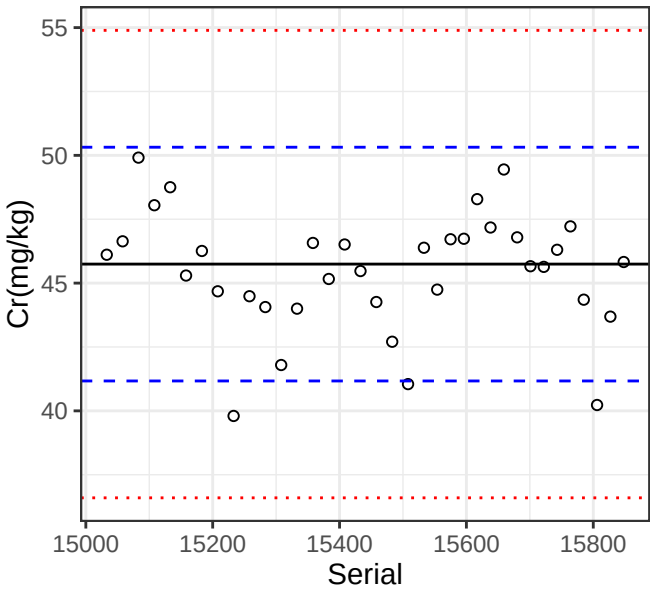

Sr(mg/kg)
10
9
8
7
15000
15200
15400
15600
15800
Serial

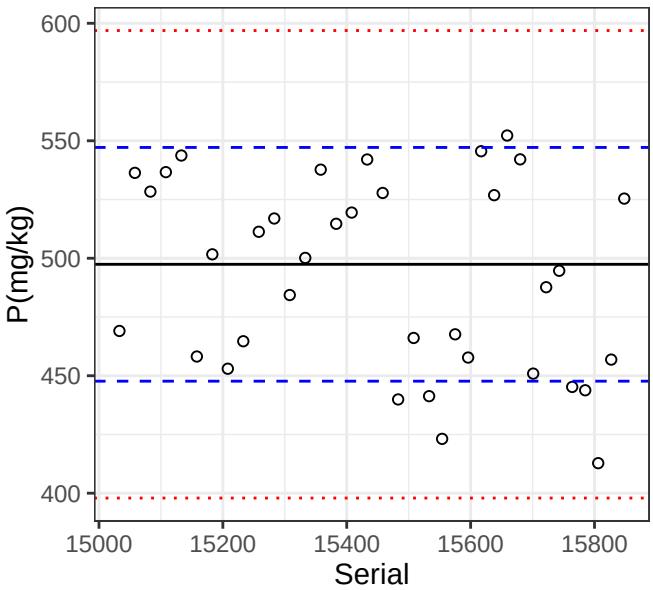

Bi(mg/kg)
0.075
0.070
0.065
0.060
0.055
0.050
15000
15200
15400
15600
15800
Serial

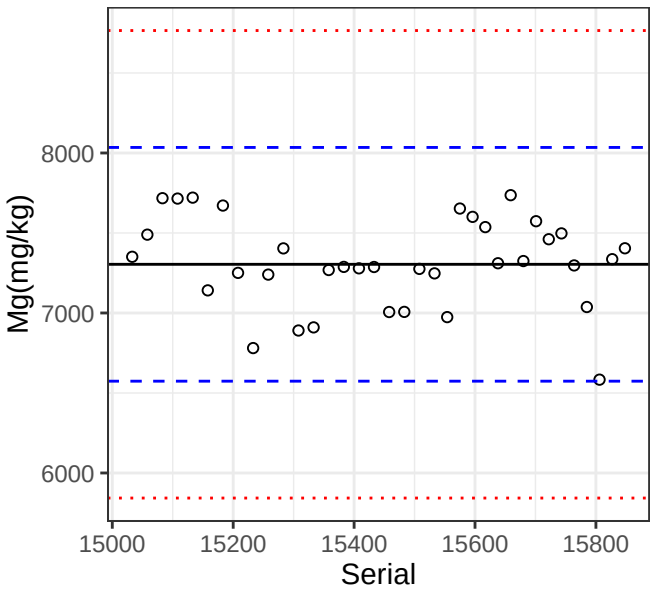

Cd(mg/kg)
0.03
0.02
0.01
0.00
15000
15200
15400
15600
15800
Serial

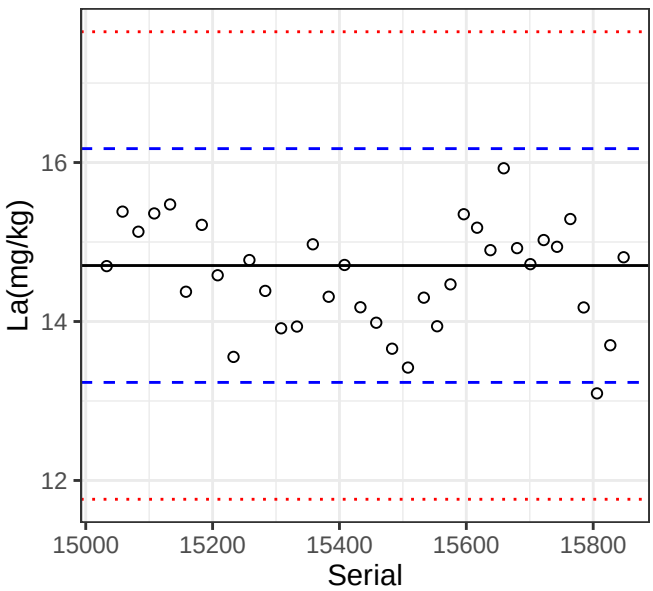

V(mg/kg)
27.5
25.0
22.5
20.0
15000
15200
15400
15600
15800
Serial

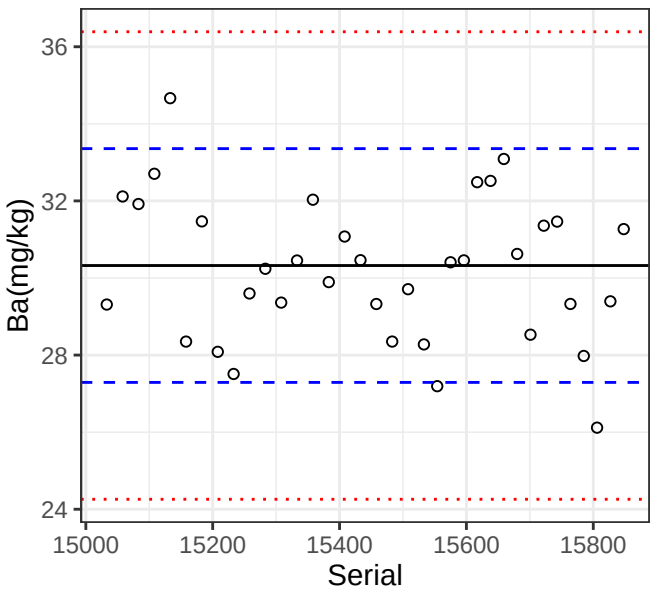

Ca(mg/kg)
2100
1900
1700
1500
15000
15200
15400
15600
15800
Serial

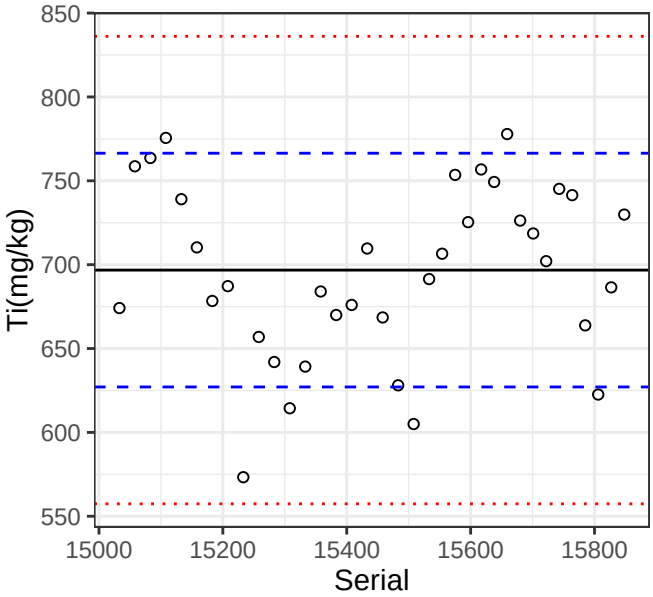

Cr(mg/kg)
55
50
45
40
15000
15200
15400
15600
15800
Serial

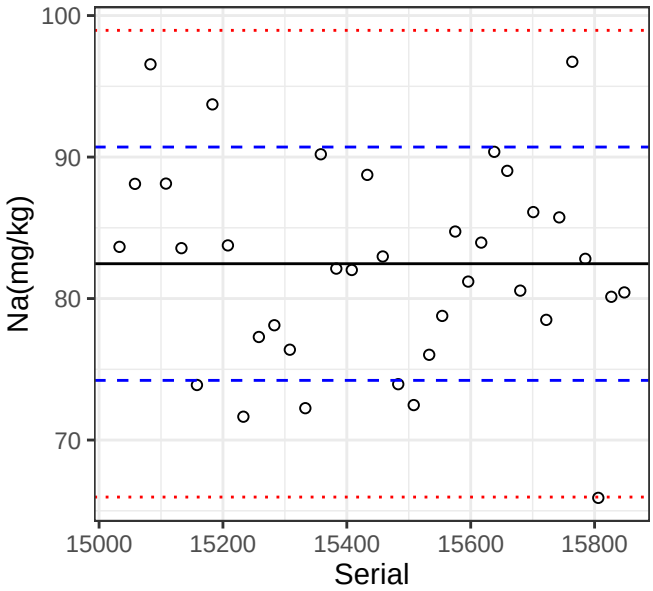

P(mg/kg)
600
550
500
450
400
15000
15200
15400
15600
15800
Serial

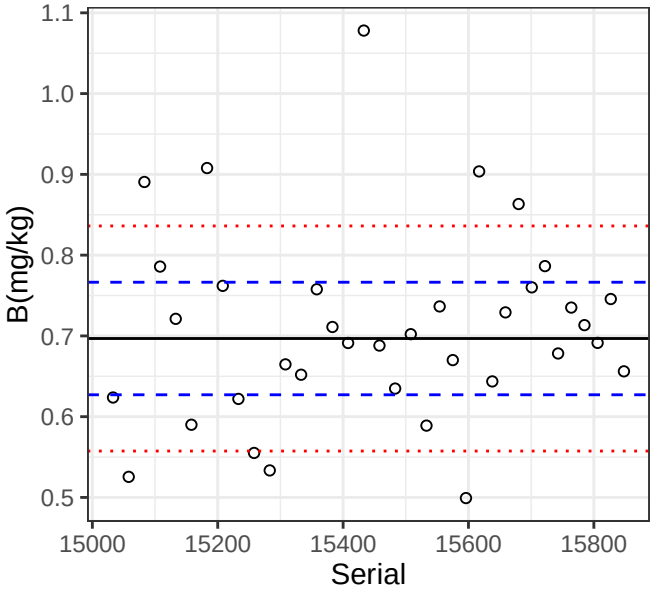

Mg(mg/kg)
8000
7000
6000
15000
15200
15400
15600
15800
Serial

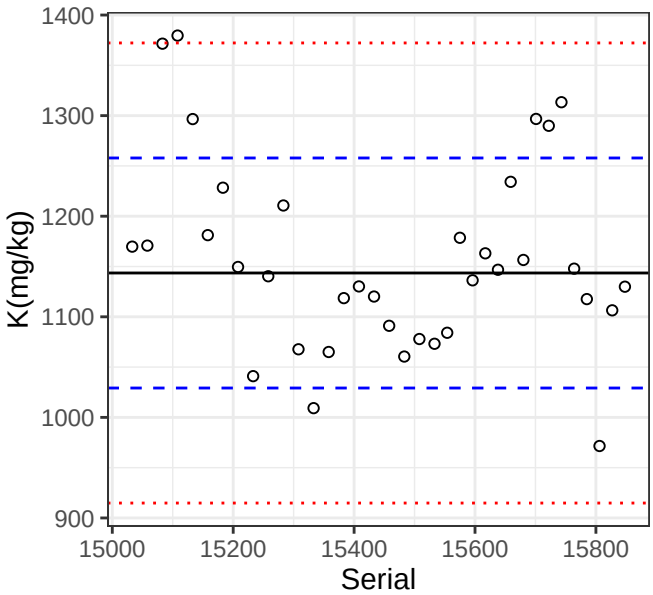

La(mg/kg)
16
14
12
15000
15200
15400
15600
15800
Serial

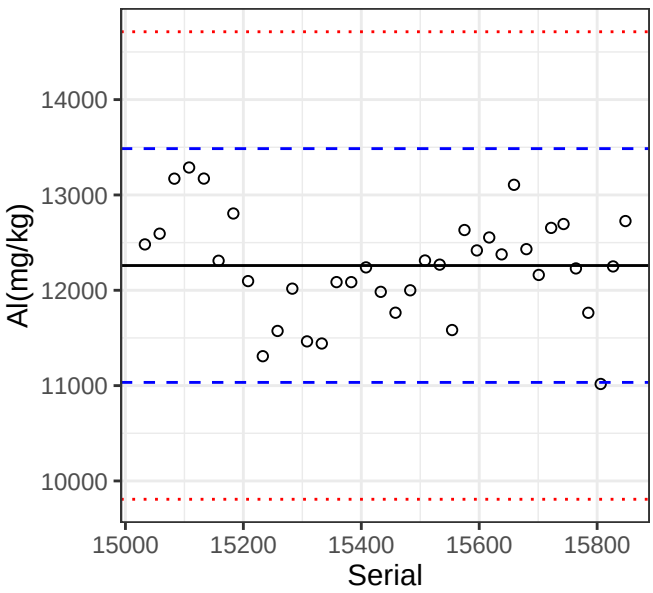

Ba(mg/kg)
36
32
28
24
15000
15200
15400
15600
15800
Serial

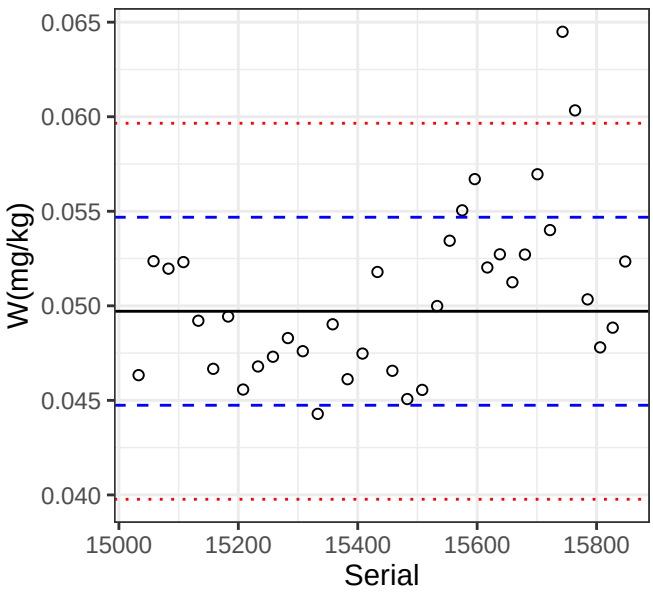

Ti(mg/kg)
850
800
750
700
650
600
550
15000
15200
15400
15600
15800
Serial

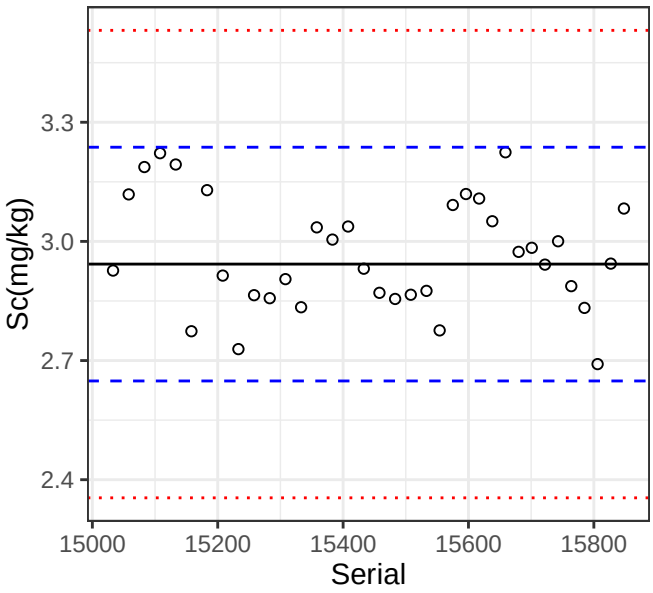

Na(mg/kg)
100
90
80
70
15000
15200
15400
15600
15800
Serial

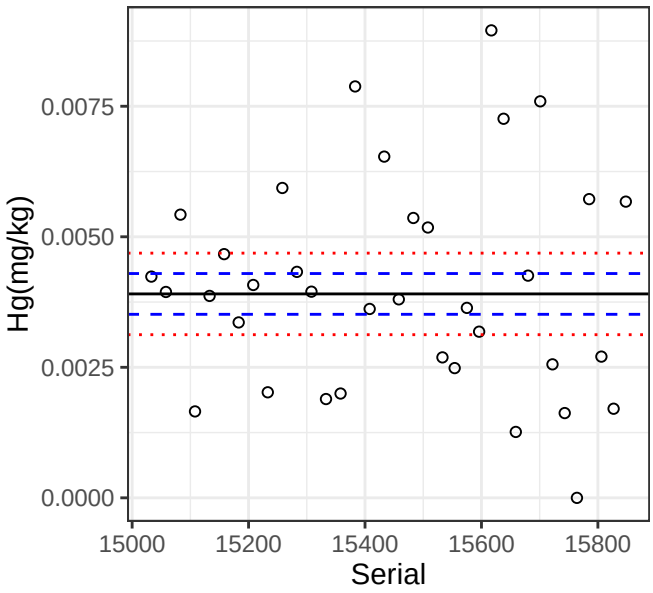

B(mg/kg)
1.1
1.0
0.9
0.8
0.7
0.6
0.5
15000
15200
15400
15600
15800
Serial

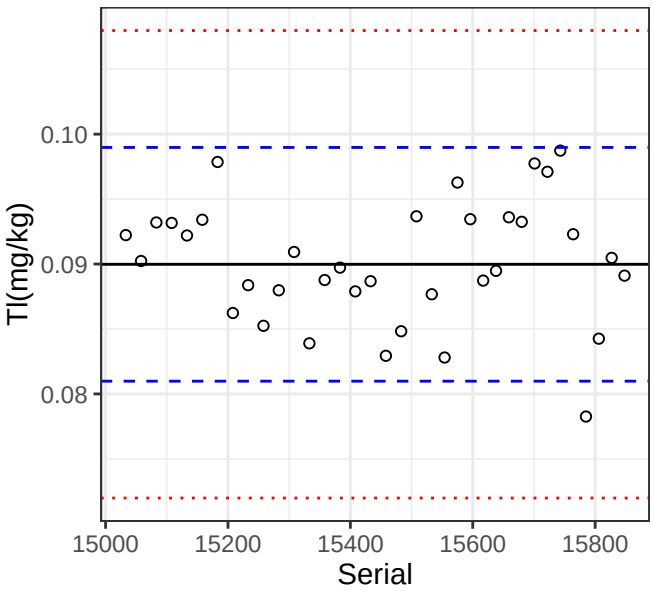

K(mg/kg)
1400
1300
1200
1100
1000
900
15000
15200
15400
15600
15800
Serial

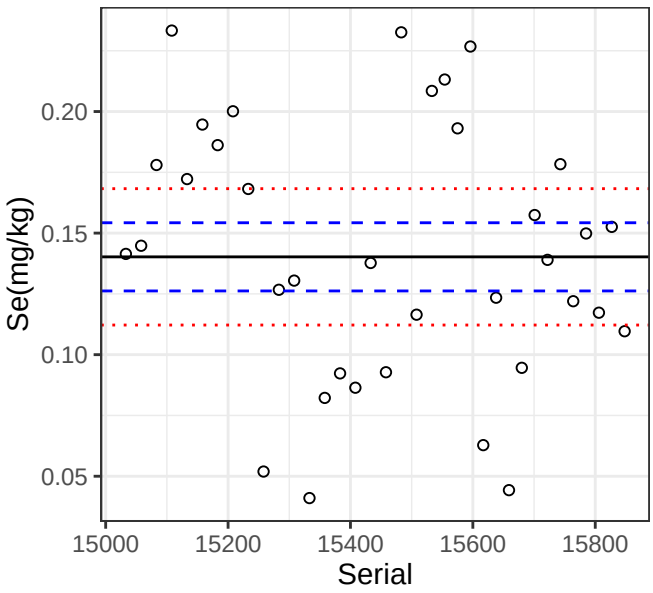

Al(mg/kg)
14000
13000
12000
11000
10000
15000
15200
15400
15600
15800
Serial

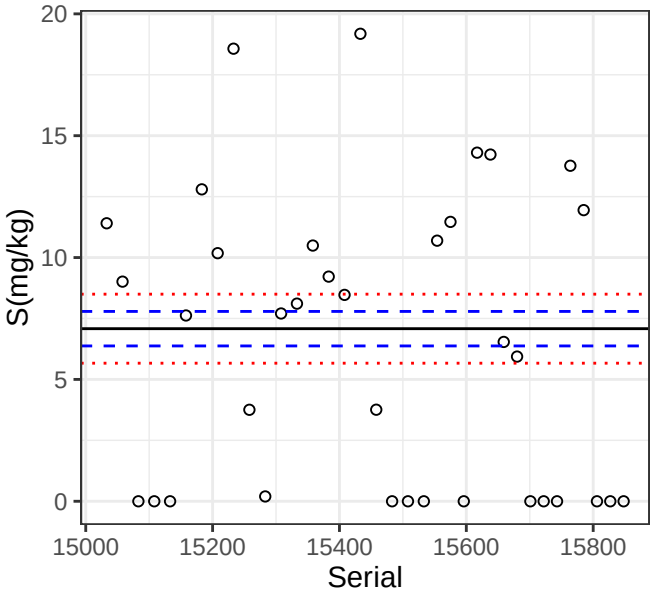

W(mg/kg)
0.065
0.060
0.055
0.050
0.045
0.040
15000
15200
15400
15600
15800
Serial

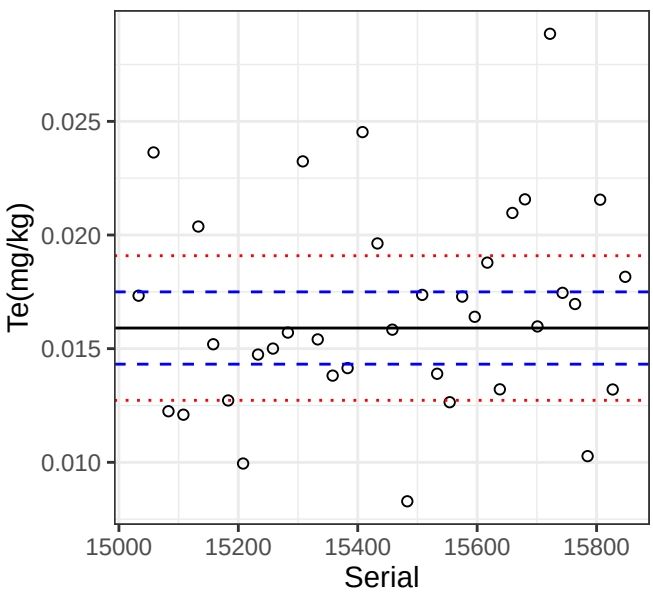

Sc(mg/kg)
3.3
3.0
2.7
2.4
15000
15200
15400
15600
15800
Serial

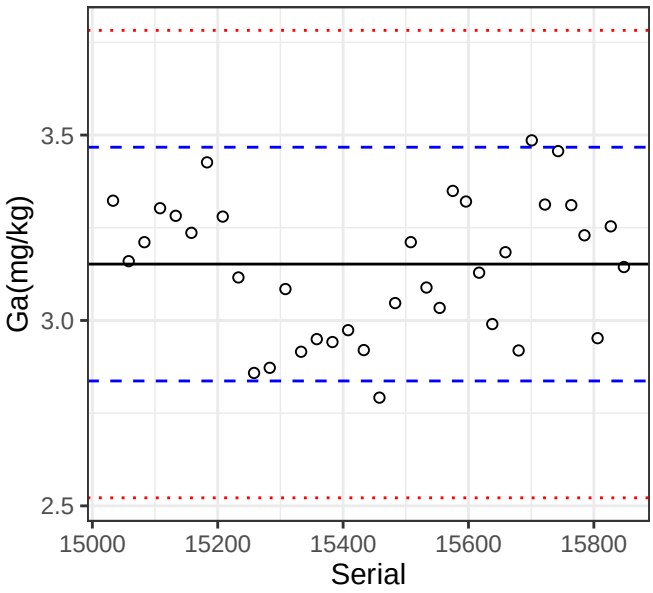

Hg(mg/kg)
0.0075
0.0050
0.0025
0.0000
15000
15200
15400
15600
15800
Serial

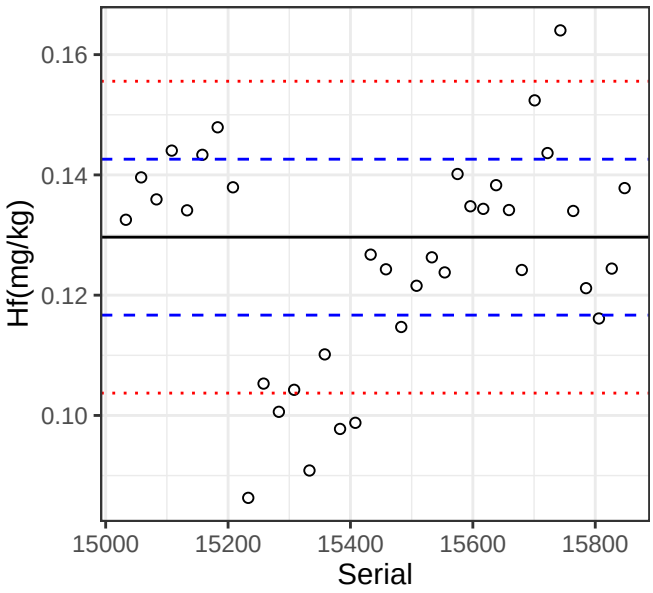

Tl(mg/kg)
0.10
0.09
0.08
15000
15200
15400
15600
15800
Serial

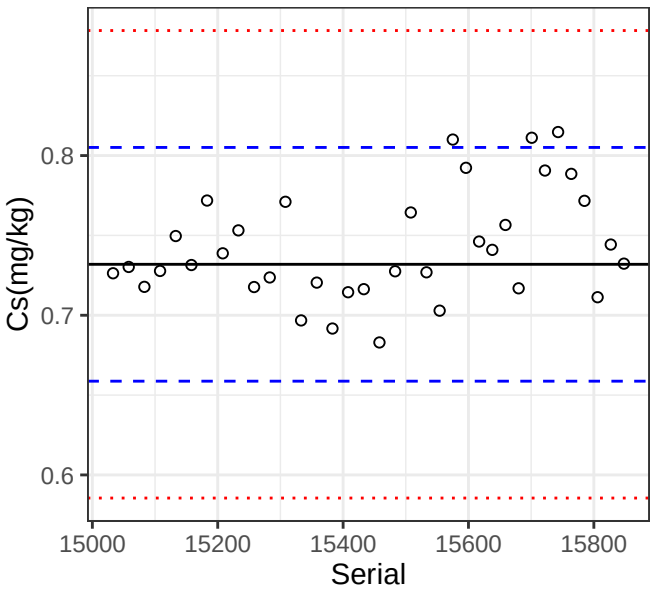

Se(mg/kg)
0.20
0.15
0.10
0.05
15000
15200
15400
15600
15800
Serial

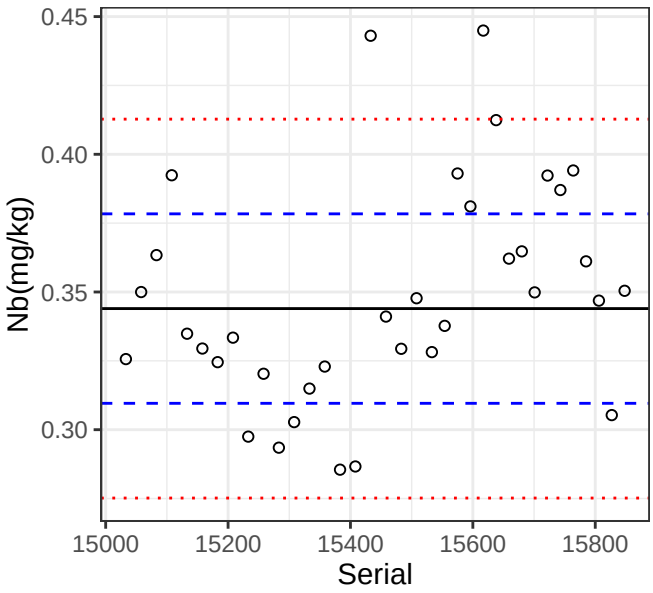

S(mg/kg)
20
15
10
5
0
15000
15200
15400
15600
15800
Serial

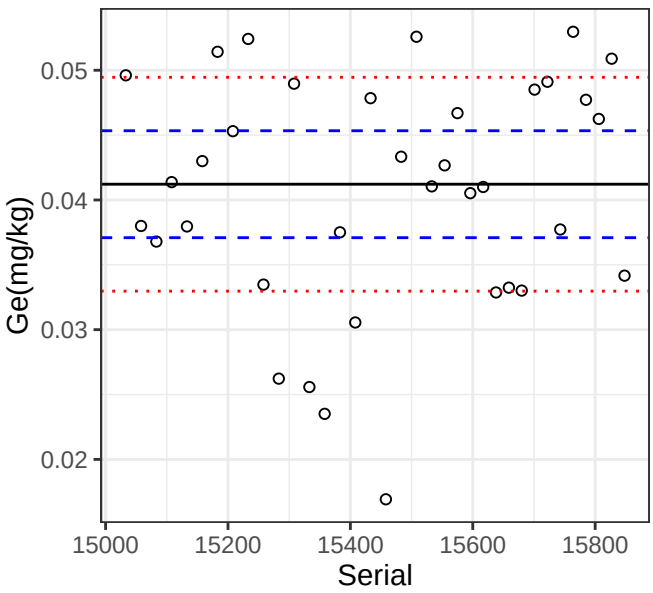

Te(mg/kg)
0.025
0.020
0.015
0.010
15000
15200
15400
15600
15800
Serial

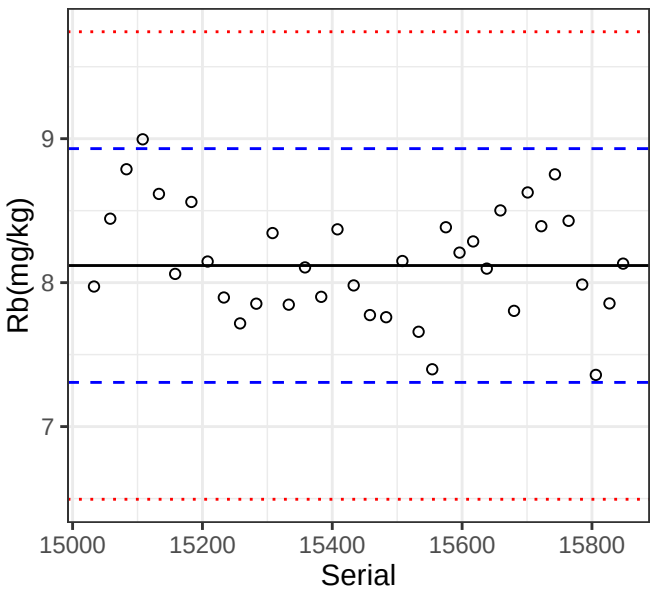

Ga(mg/kg)
3.5
3.0
2.5
15000
15200
15400
15600
15800
Serial

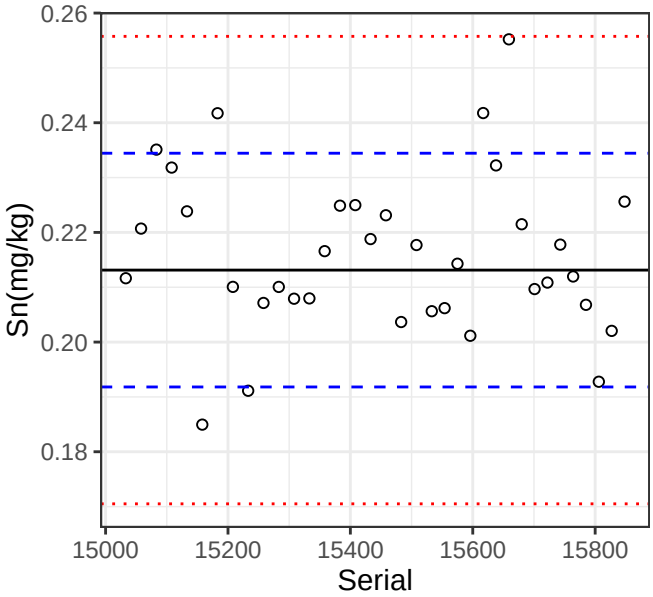

Hf(mg/kg)
0.16
0.14
0.12
0.10
15000
15200
15400
15600
15800
Serial

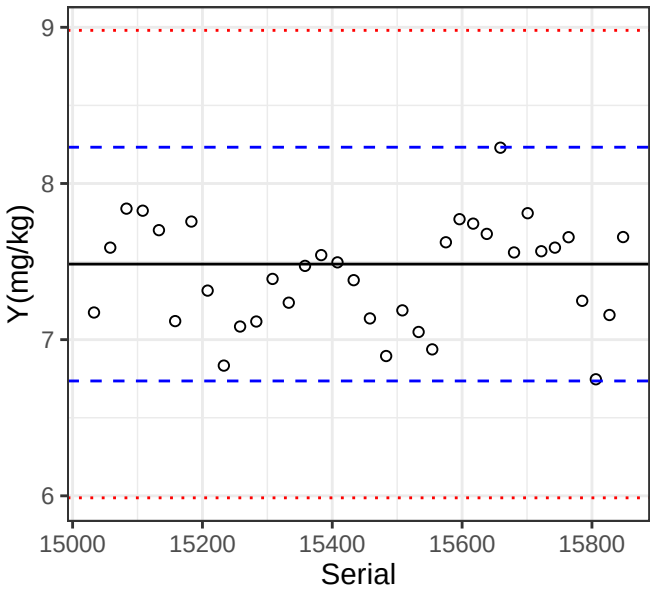

Cs(mg/kg)
0.8
0.7
0.6
15000
15200
15400
15600
15800
Serial

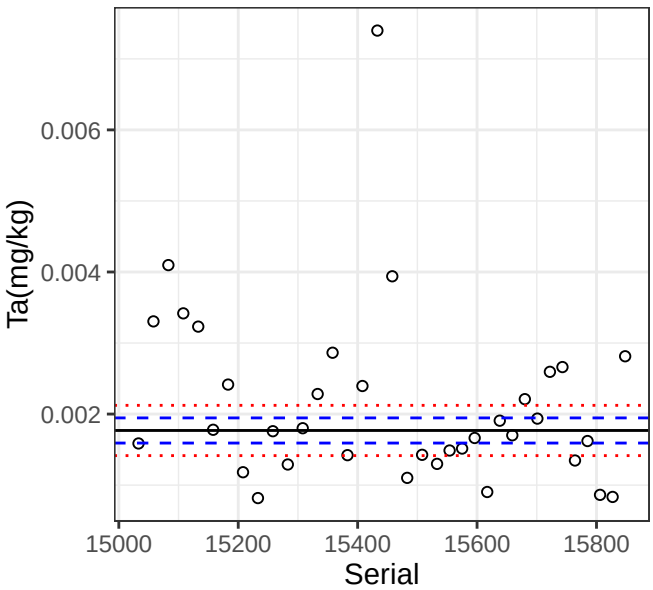

Nb(mg/kg)
0.45
0.40
0.35
0.30
15000
15200
15400
15600
15800
Serial

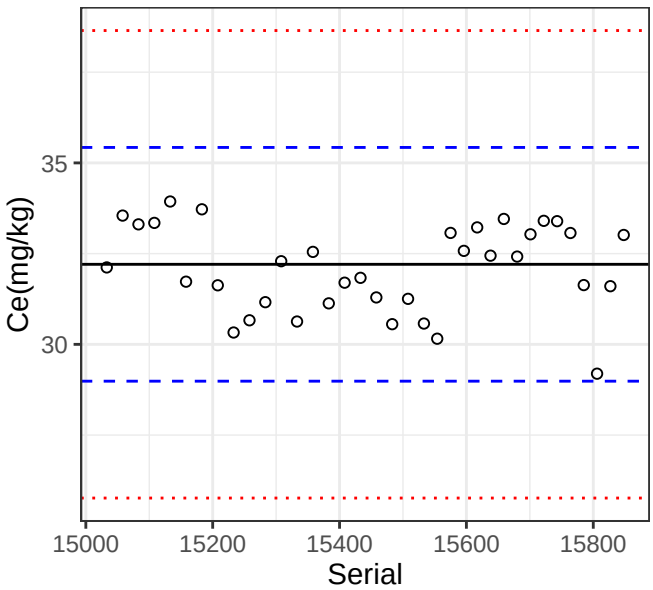

Ge(mg/kg)
0.05
0.04
0.03
0.02
15000
15200
15400
15600
15800
Serial

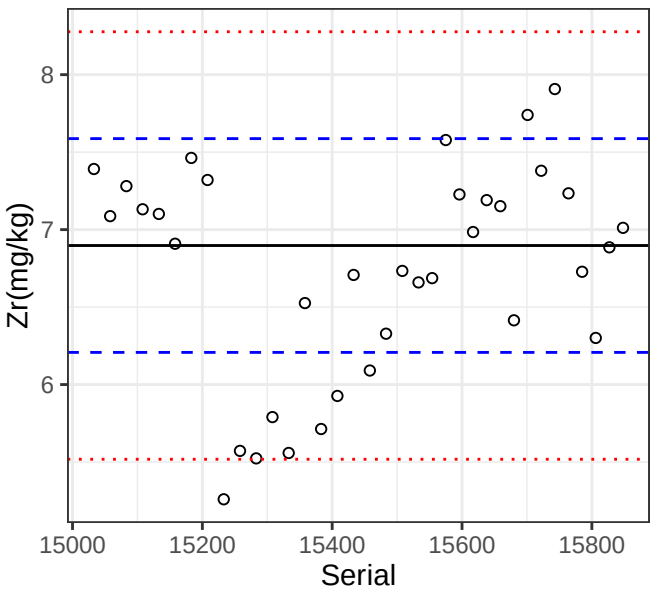

Rb(mg/kg)
9
8
7
15000
15200
15400
15600
15800
Serial

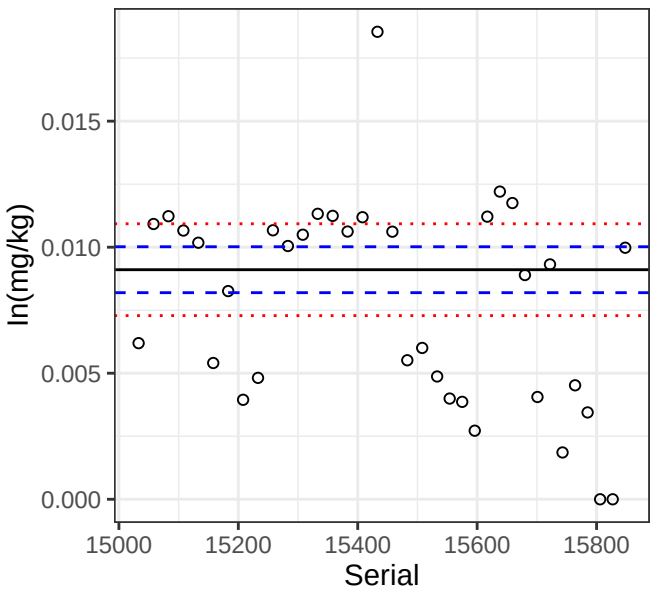

Sn(mg/kg)
0.26
0.24
0.22
0.20
0.18
15000
15200
15400
15600
15800
Serial

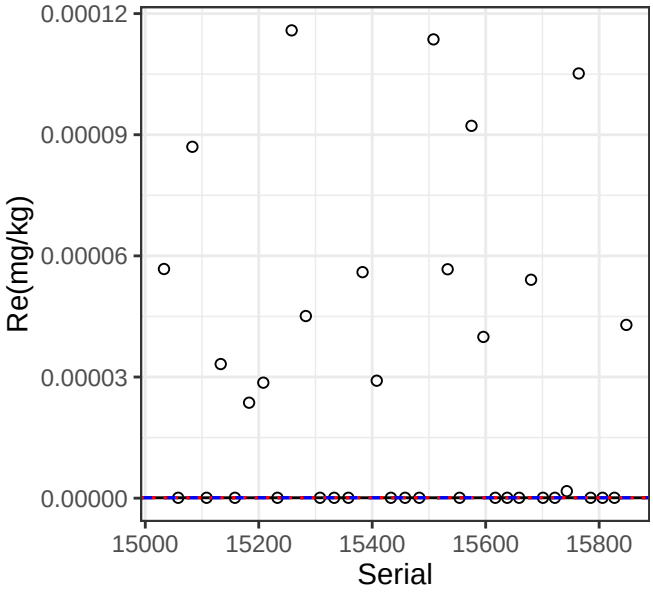

Y(mg/kg)
9
8
7
6
15000
15200
15400
15600
15800
Serial

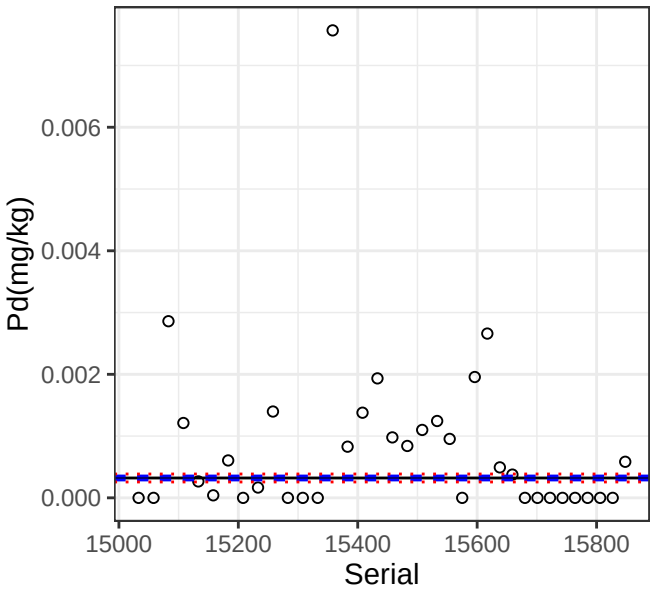

Ta(mg/kg)
0.006
0.004
0.002
15000
15200
15400
15600
15800
Serial

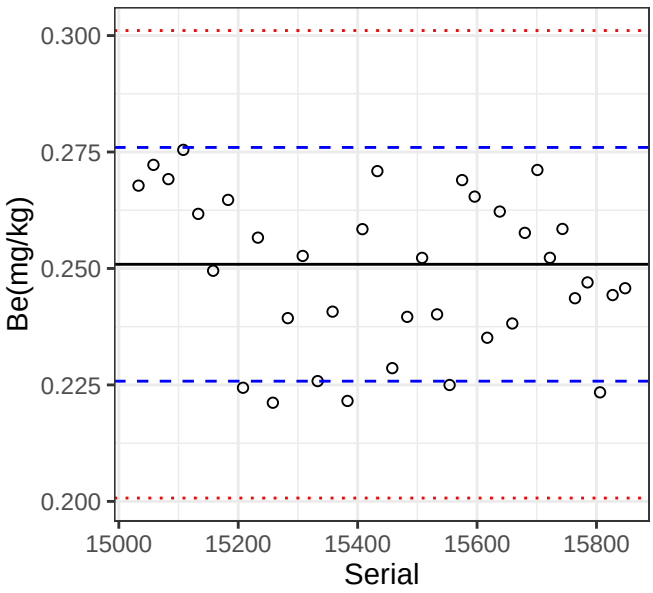

Ce(mg/kg)
35
30
15000
15200
15400
15600
15800
Serial

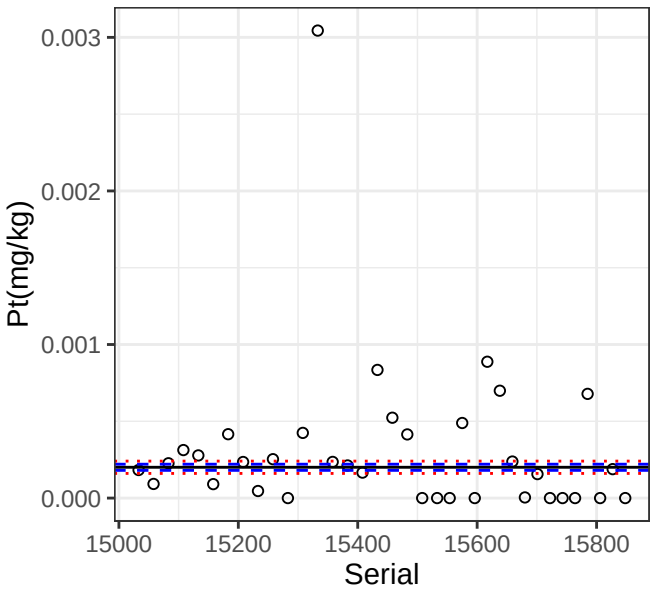

Zr(mg/kg)
8
7
6
15000
15200
15400
15600
15800
Serial

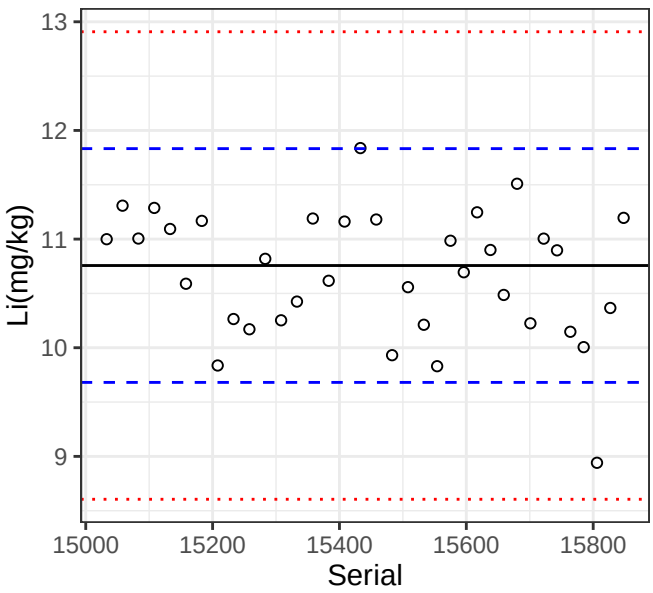

In(mg/kg)
0.015
0.010
0.005
0.000
15000
15200
15400
15600
15800
Serial


0.00012
0.00009
0.00006
0.00003
0.00000
Re(mg/kg)
15000
15200
15400
15600
15800
Serial


0.006
0.004
0.002
0.000
Pd(mg/kg)
15000
15200
15400
15600
15800
Serial


0.300
0.275
0.250
0.225
0.200
Be(mg/kg)
15000
15200
15400
15600
15800
Serial

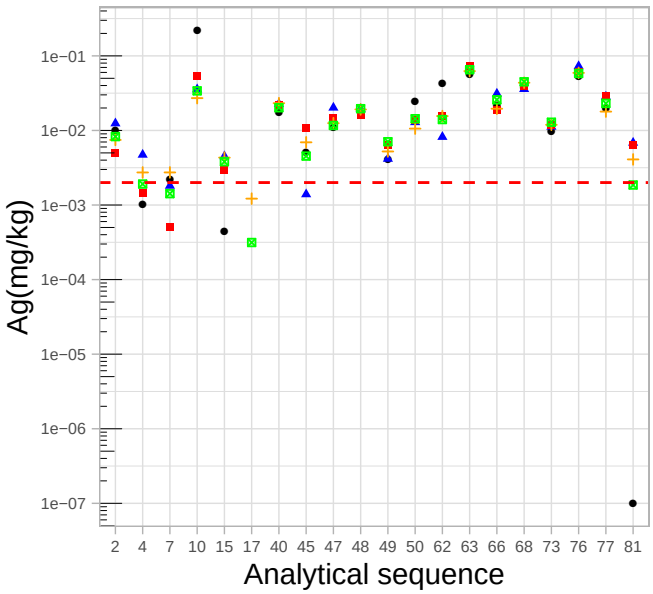

0.003
0.002
0.001
0.000
Pt(mg/kg)
15000
15200
15400
15600
15800
Serial

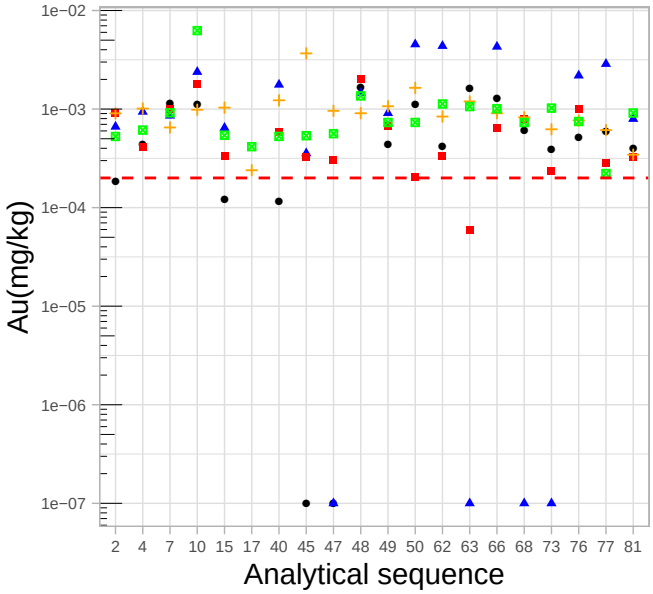

13
12
11
10
9
Li(mg/kg)
15000
15200
15400
15600
15800
Serial

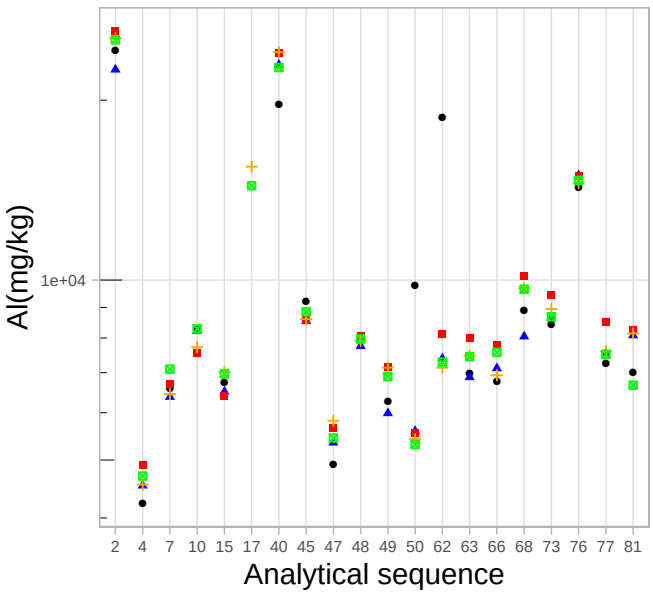
APPENDIX 3: Re-analysed samples from previous surveys

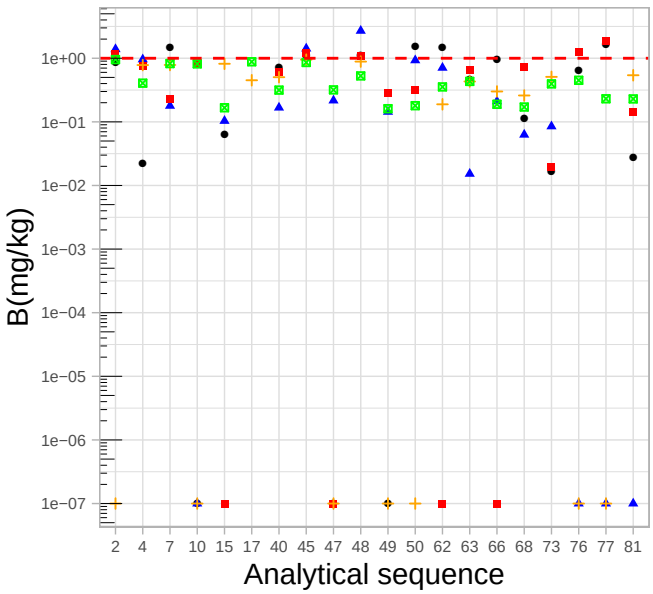
Samples re-analysed from previous surveys (n = 19; no:2, 4, 7, 10, 15, 17, 40, 45, 47, 48, 49, 50, 62, 63, 66, 68, 73, 76, 77, and 81) from the Nordland/Troms collection (Reimann et al., 2011) which were reanalysed along with the North-Trøndelag and Fosen (Finne et al., 2014), South-Trøndelag (Flem et al., 2020) and Hedmark surveys (Flem et al. 2022), and now for the fifth time with the present survey. The same laboratory, Bureau Veritas Minerals, Vancouver, Canada, has been used for the five re-analyses.

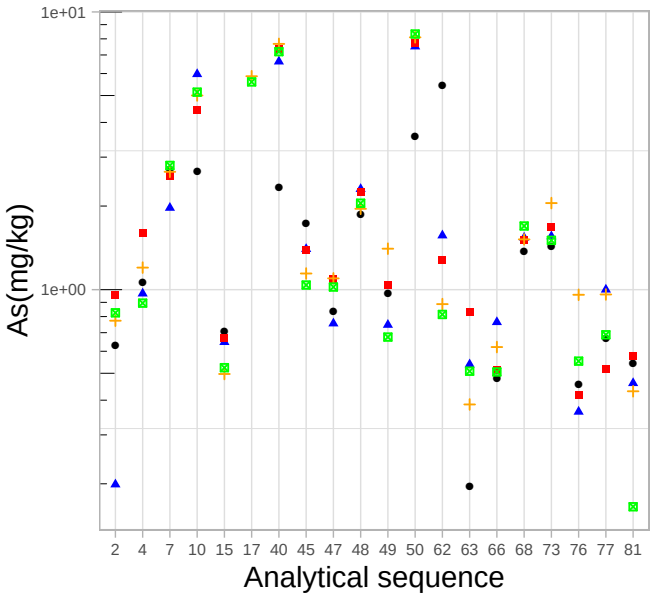
Year	Survey
● 2012	Nordland/Troms
▲ 2014	Nord-Trøndelag and Fosen
■ 2019	South-Trøndelag
+ 2022	Hedmark
⊠ 2023	More og Romsdal

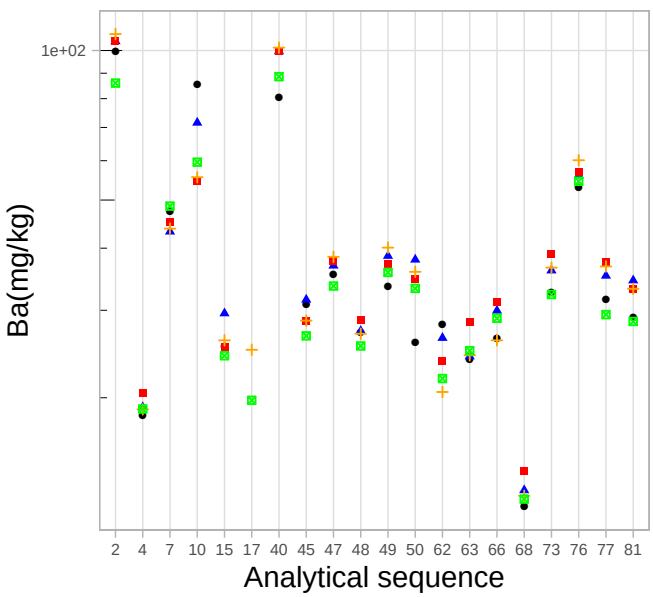

Ag(mg/kg)
1e−01
1e−02
1e−03
1e−04
1e−05
1e−06
1e−07
2 4 7 10 15 17 40 45 47 48 49 50 62 63 66 68 73 76 77 81
Analytical sequence

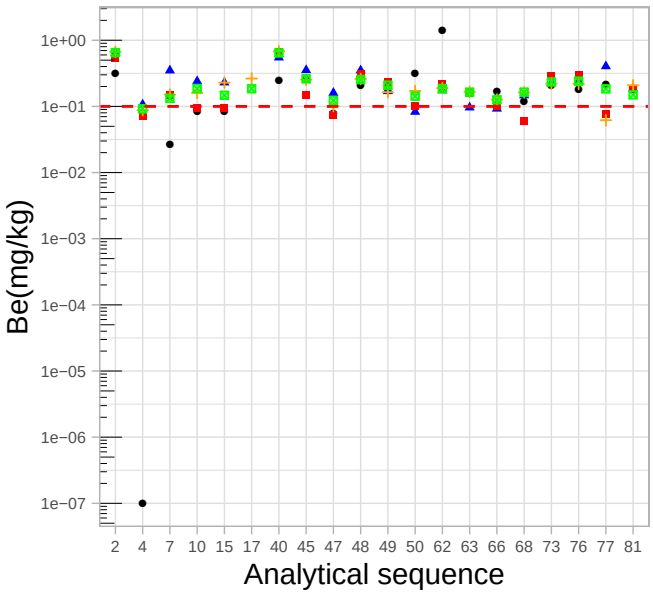

Au(mg/kg)
1e−02
1e−03
1e−04
1e−05
1e−06
1e−07
2 4 7 10 15 17 40 45 47 48 49 50 62 63 66 68 73 76 77 81
Analytical sequence

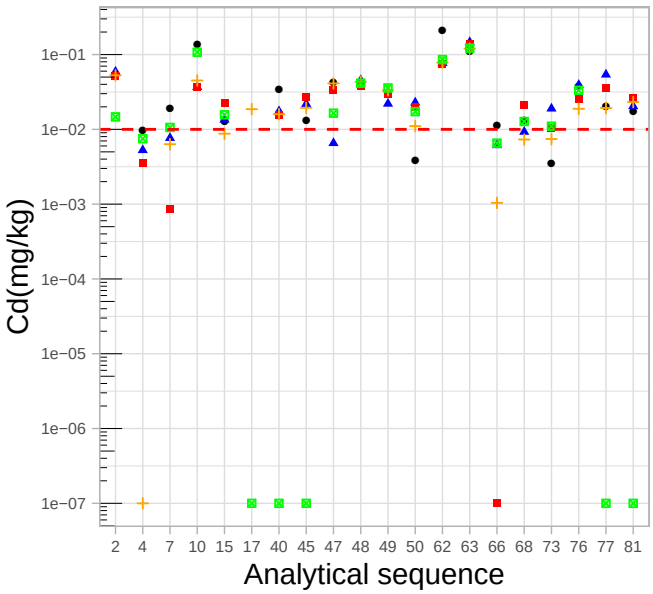

Al(mg/kg)
1e+04
2 4 7 10 15 17 40 45 47 48 49 50 62 63 66 68 73 76 77 81
Analytical sequence

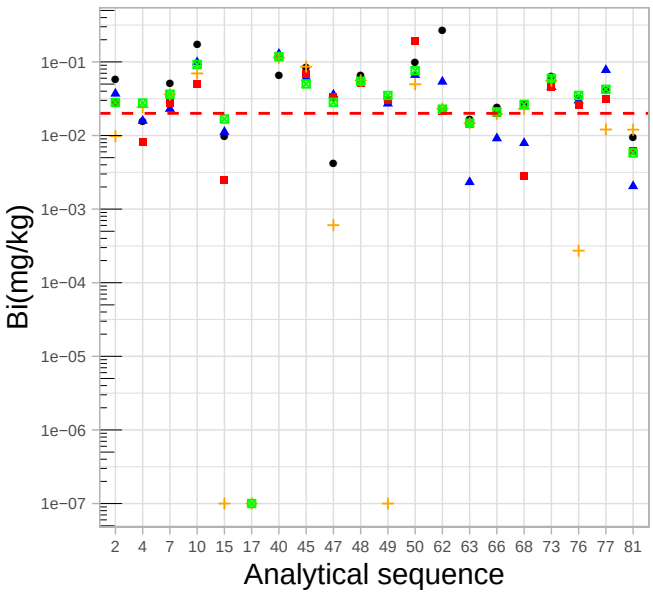

B(mg/kg)
1e+00
1e−01
1e−02
1e−03
1e−04
1e−05
1e−06
1e−07
2 4 7 10 15 17 40 45 47 48 49 50 62 63 66 68 73 76 77 81
Analytical sequence

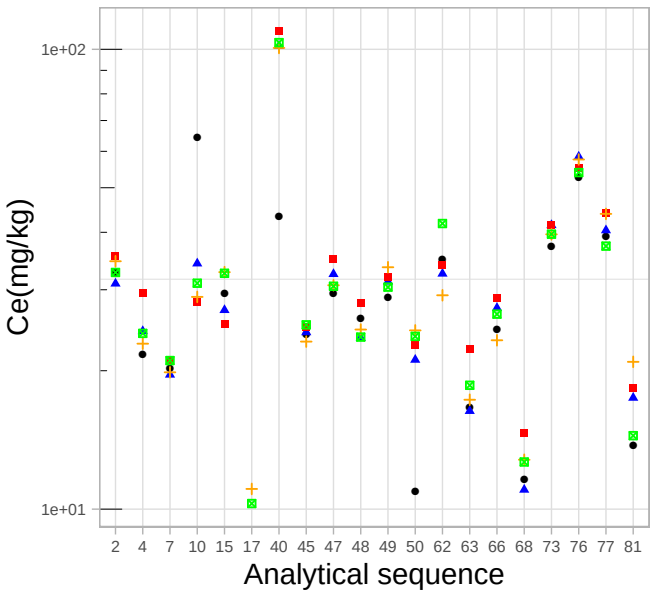

As(mg/kg)
1e+01
1e+00
2 4 7 10 15 17 40 45 47 48 49 50 62 63 66 68 73 76 77 81
Analytical sequence

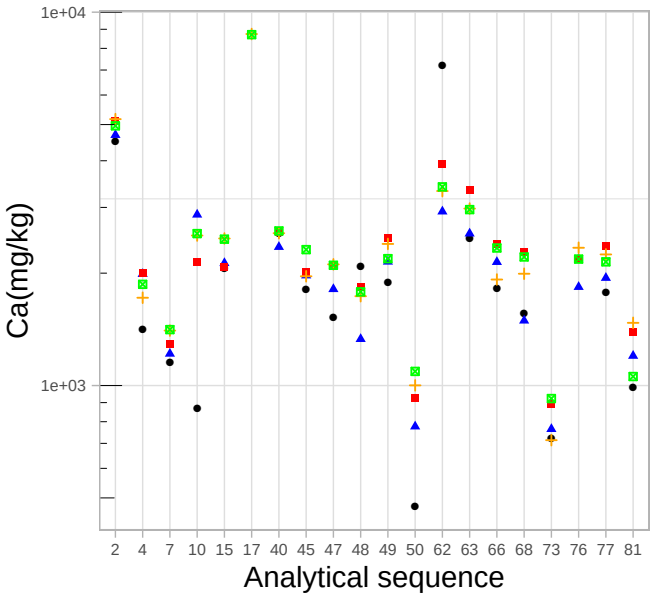

Ba(mg/kg)
1e+02
2 4 7 10 15 17 40 45 47 48 49 50 62 63 66 68 73 76 77 81
Analytical sequence

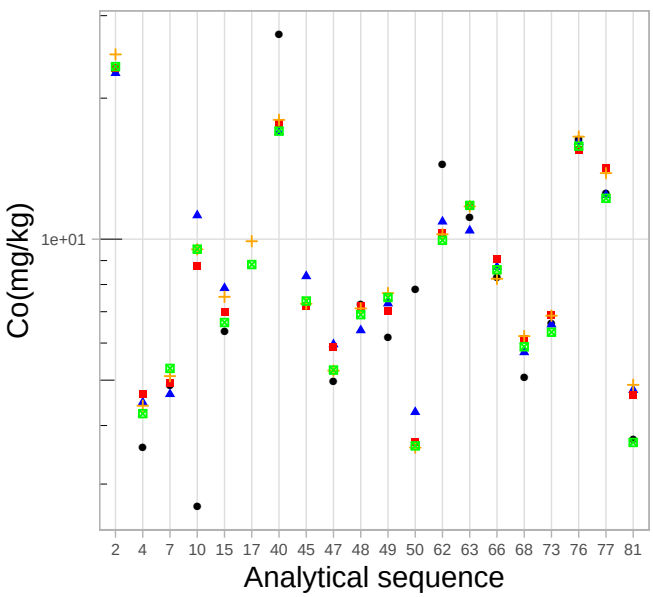

Be(mg/kg)
1e+00
1e−01
1e−02
1e−03
1e−04
1e−05
1e−06
1e−07
2 4 7 10 15 17 40 45 47 48 49 50 62 63 66 68 73 76 77 81
Analytical sequence

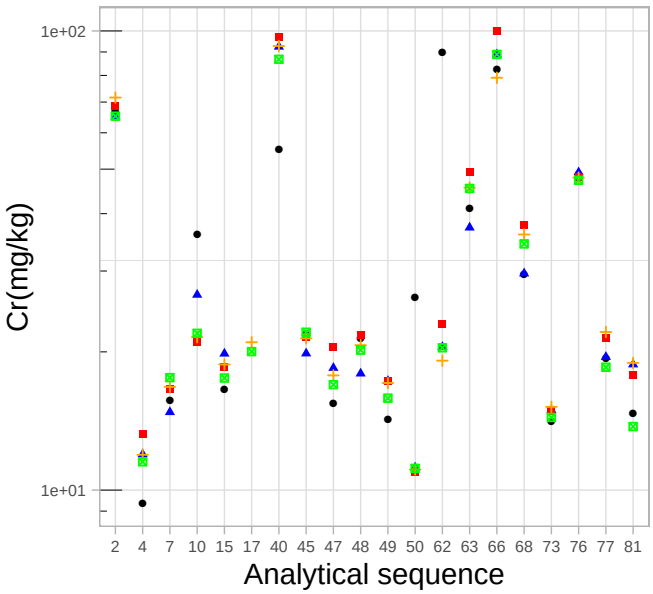

Cd(mg/kg)
1e−01
1e−02
1e−03
1e−04
1e−05
1e−06
1e−07
2 4 7 10 15 17 40 45 47 48 49 50 62 63 66 68 73 76 77 81
Analytical sequence

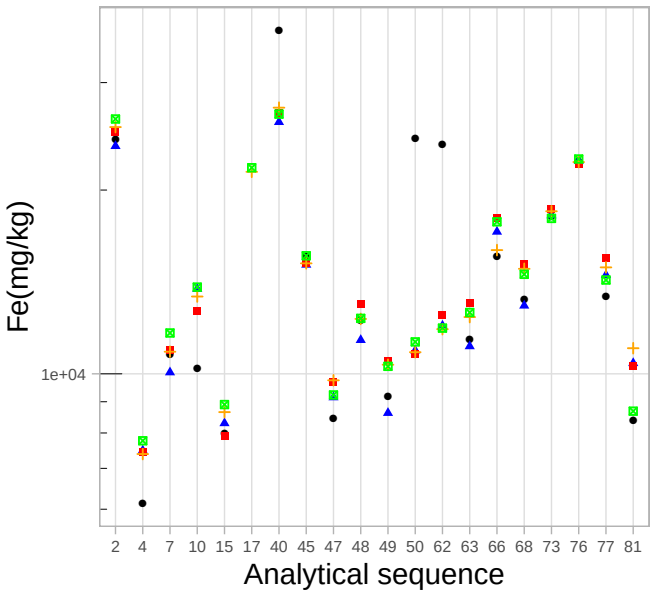

Bi(mg/kg)
1e−01
1e−02
1e−03
1e−04
1e−05
1e−06
1e−07
2 4 7 10 15 17 40 45 47 48 49 50 62 63 66 68 73 76 77 81
Analytical sequence

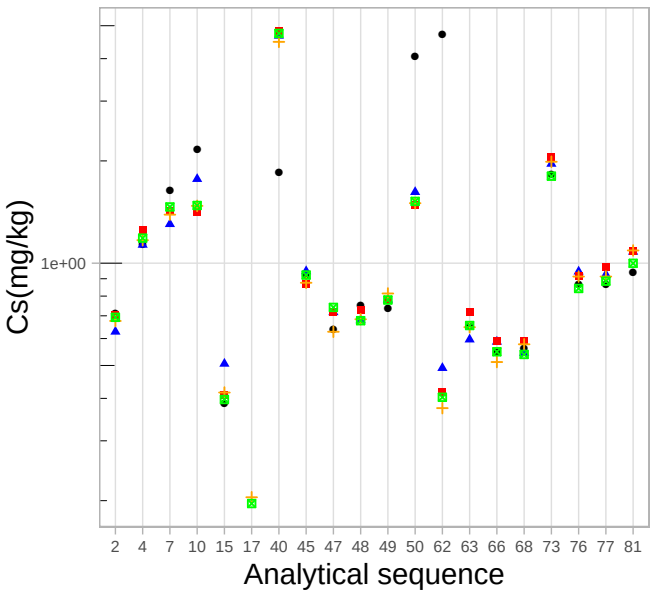

Ce(mg/kg)
1e+02
1e+01
2 4 7 10 15 17 40 45 47 48 49 50 62 63 66 68 73 76 77 81
Analytical sequence

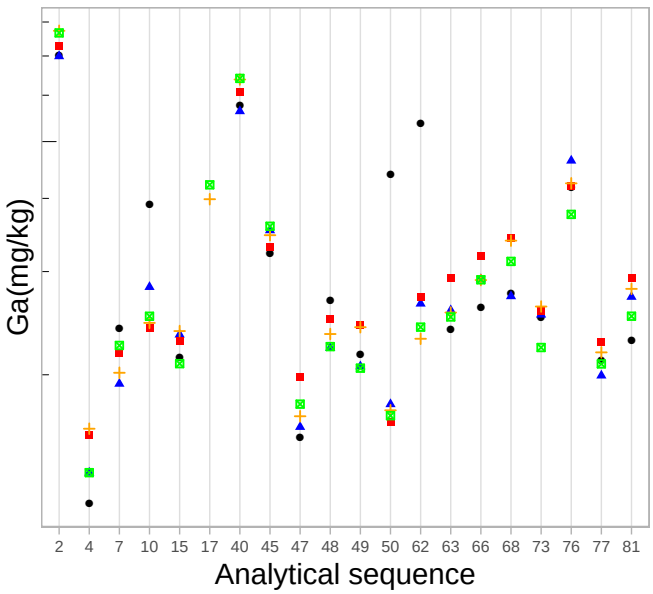

Ca(mg/kg)
1e+04
1e+03
2 4 7 10 15 17 40 45 47 48 49 50 62 63 66 68 73 76 77 81
Analytical sequence

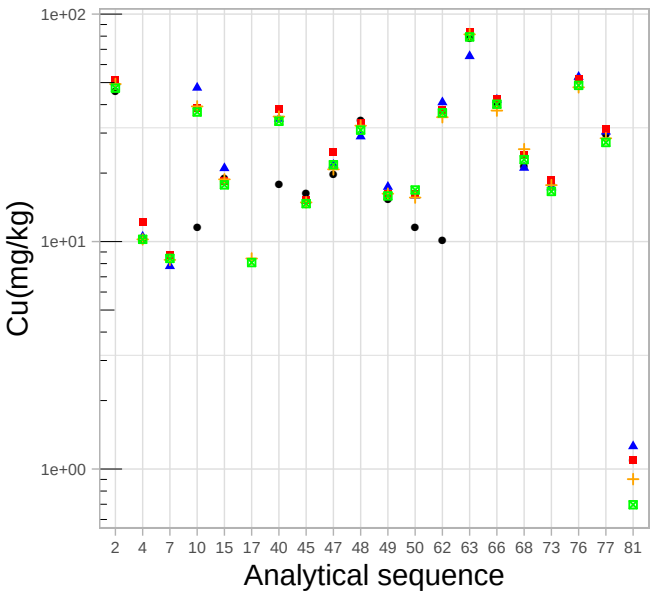

Co(mg/kg)
1e+01
2 4 7 10 15 17 40 45 47 48 49 50 62 63 66 68 73 76 77 81
Analytical sequence

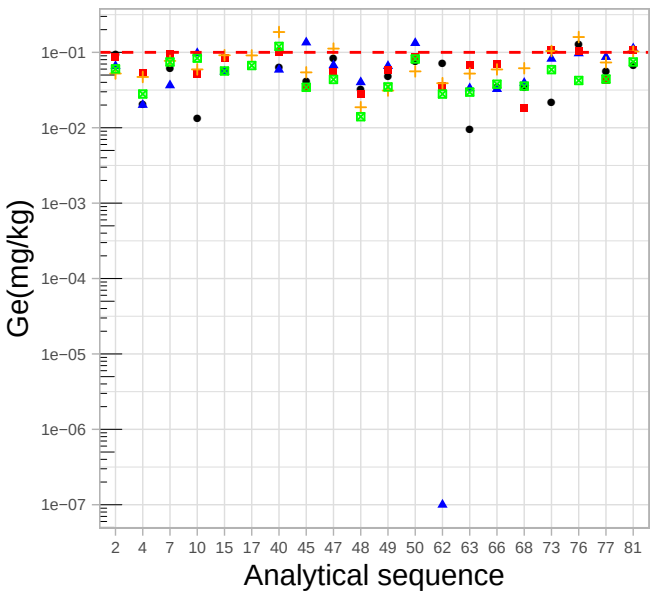

Cr(mg/kg)
1e+02
1e+01
2 4 7 10 15 17 40 45 47 48 49 50 62 63 66 68 73 76 77 81
Analytical sequence

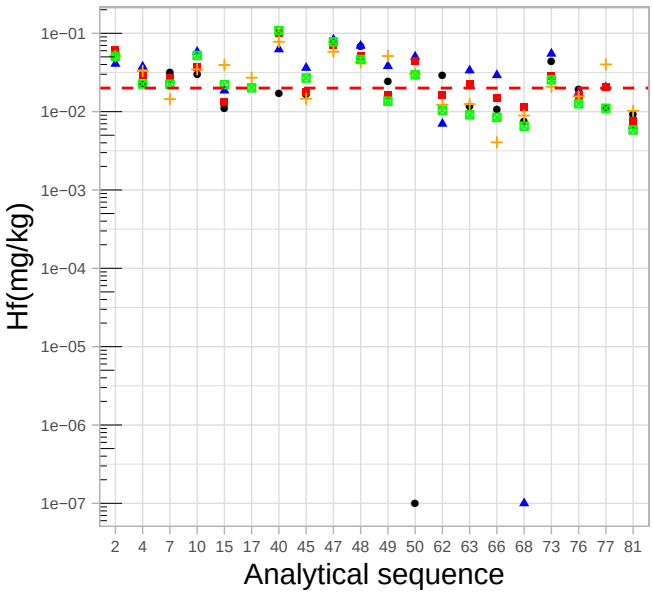

Fe(mg/kg)
1e+04
2 4 7 10 15 17 40 45 47 48 49 50 62 63 66 68 73 76 77 81
Analytical sequence

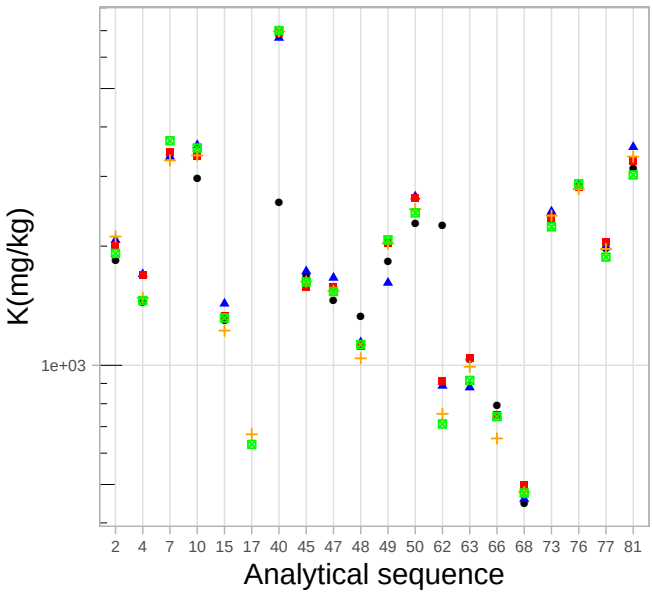

Cs(mg/kg)
1e+00
2 4 7 10 15 17 40 45 47 48 49 50 62 63 66 68 73 76 77 81
Analytical sequence

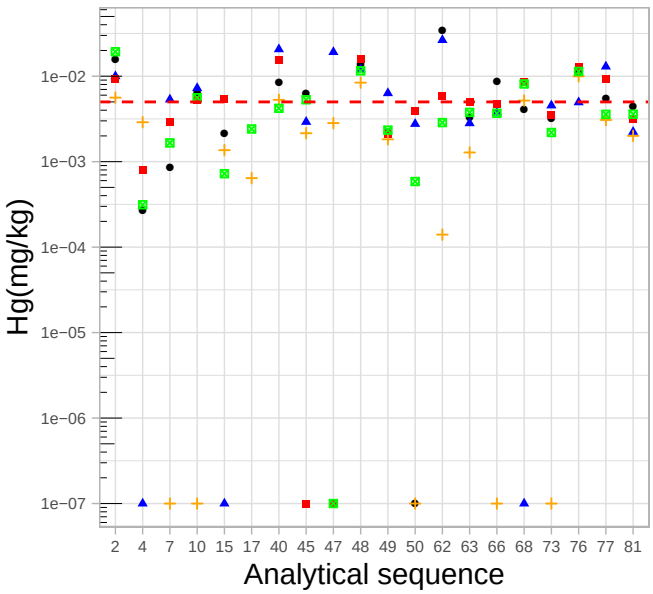

Ga(mg/kg)
2 4 7 10 15 17 40 45 47 48 49 50 62 63 66 68 73 76 77 81
Analytical sequence

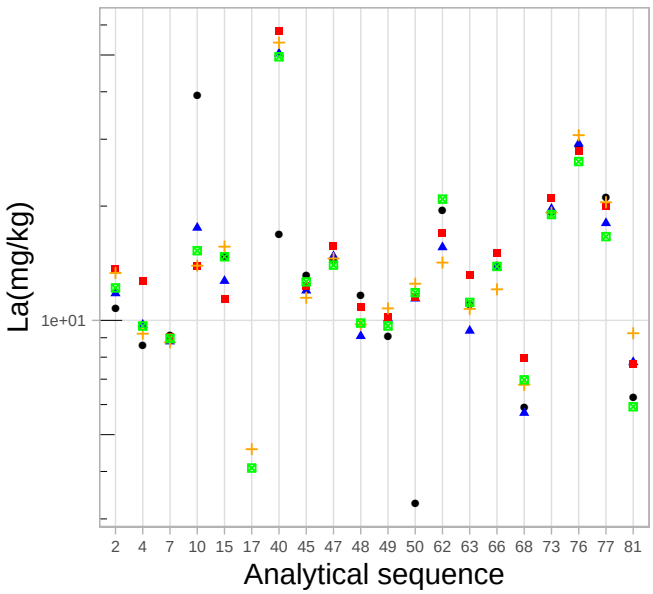

Cu(mg/kg)
1e+02
1e+01
1e+00
2 4 7 10 15 17 40 45 47 48 49 50 62 63 66 68 73 76 77 81
Analytical sequence

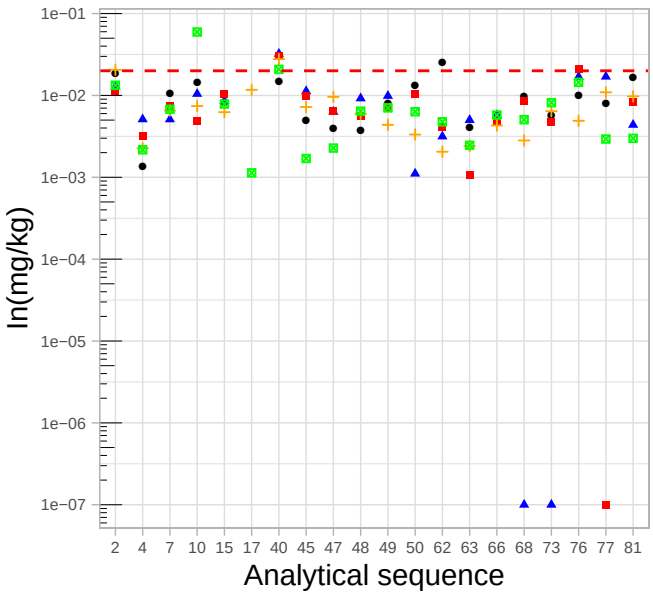

Ge(mg/kg)
1e−01
1e−02
1e−03
1e−04
1e−05
1e−06
1e−07
2 4 7 10 15 17 40 45 47 48 49 50 62 63 66 68 73 76 77 81
Analytical sequence

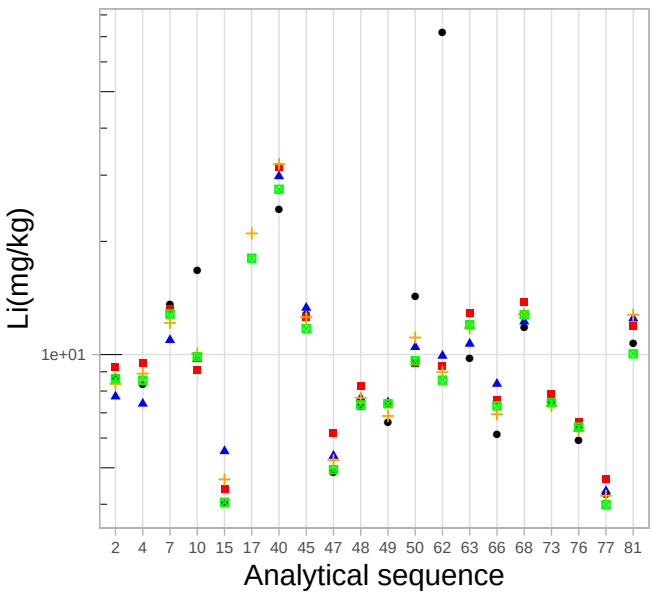

Hf(mg/kg)
1e−01
1e−02
1e−03
1e−04
1e−05
1e−06
1e−07
2 4 7 10 15 17 40 45 47 48 49 50 62 63 66 68 73 76 77 81
Analytical sequence

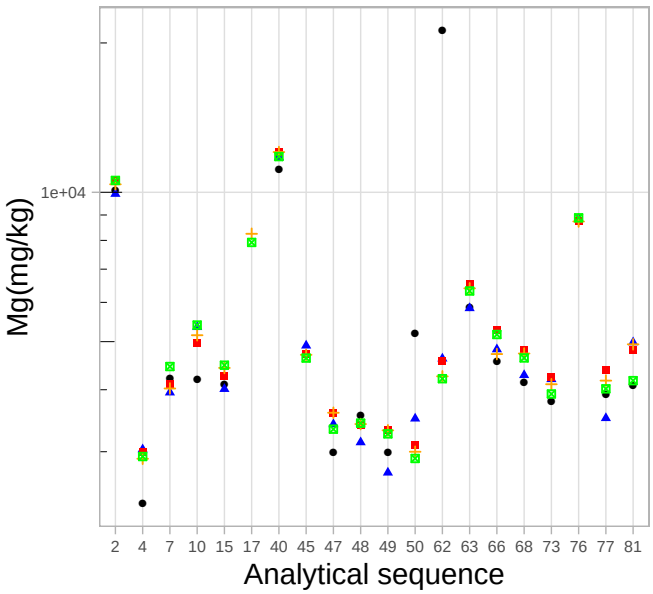

K(mg/kg)
1e+03
2 4 7 10 15 17 40 45 47 48 49 50 62 63 66 68 73 76 77 81
Analytical sequence

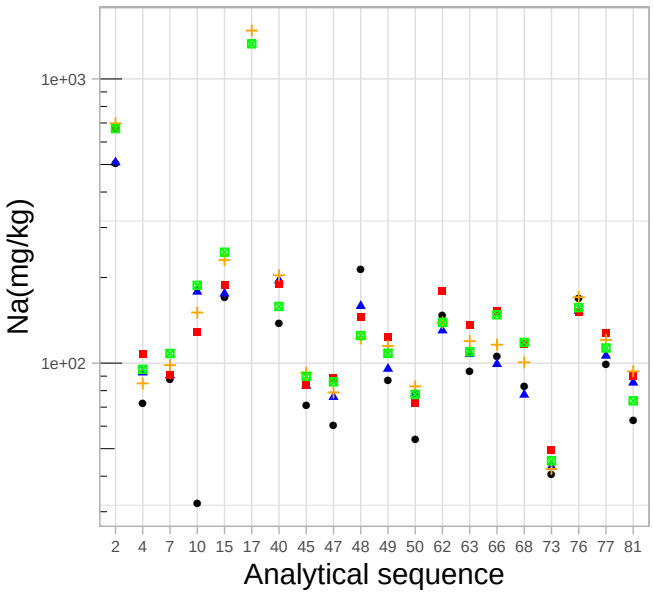

Hg(mg/kg)
1e−02
1e−03
1e−04
1e−05
1e−06
1e−07
2 4 7 10 15 17 40 45 47 48 49 50 62 63 66 68 73 76 77 81
Analytical sequence

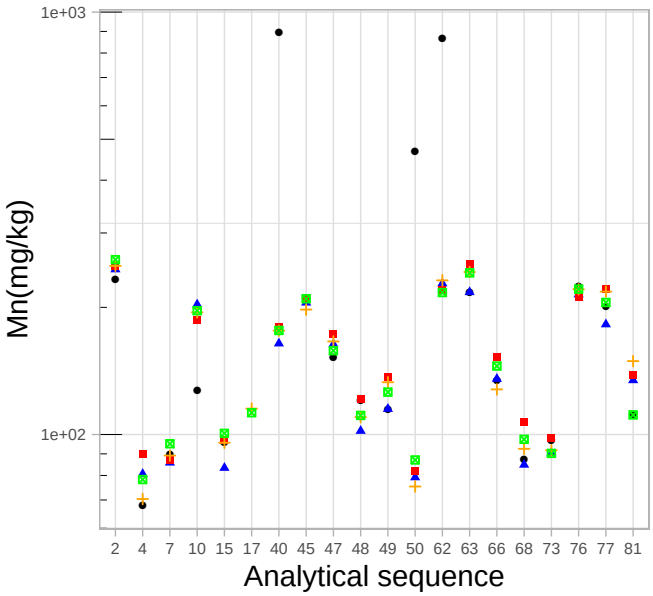

La(mg/kg)
1e+01
2 4 7 10 15 17 40 45 47 48 49 50 62 63 66 68 73 76 77 81
Analytical sequence

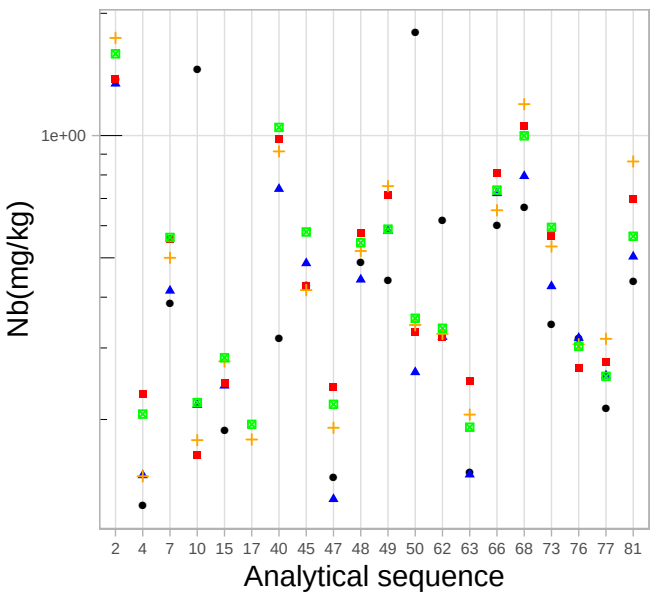

In(mg/kg)
1e−01
1e−02
1e−03
1e−04
1e−05
1e−06
1e−07
2 4 7 10 15 17 40 45 47 48 49 50 62 63 66 68 73 76 77 81
Analytical sequence

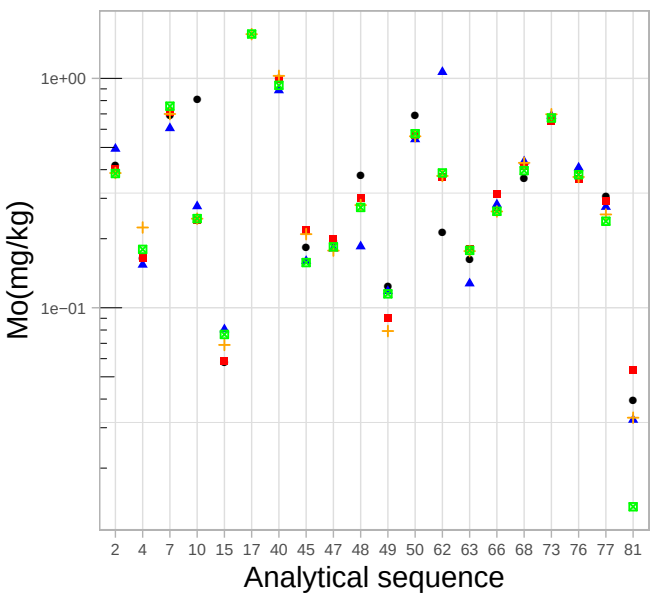

Li(mg/kg)
1e+01
2 4 7 10 15 17 40 45 47 48 49 50 62 63 66 68 73 76 77 81
Analytical sequence

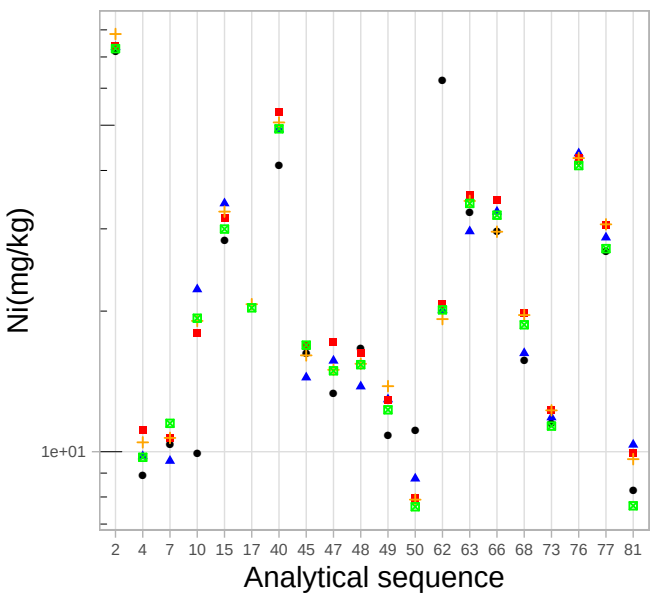

Mg(mg/kg)
1e+04
2 4 7 10 15 17 40 45 47 48 49 50 62 63 66 68 73 76 77 81
Analytical sequence

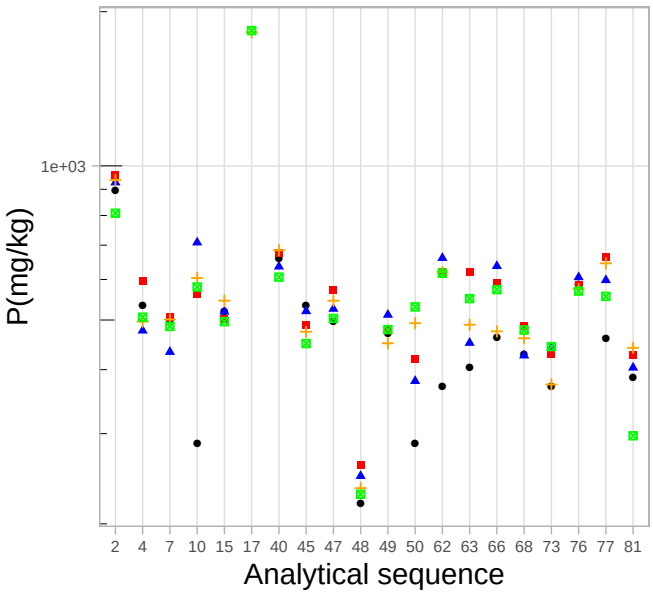

Na(mg/kg)
1e+03
1e+02
2 4 7 10 15 17 40 45 47 48 49 50 62 63 66 68 73 76 77 81
Analytical sequence

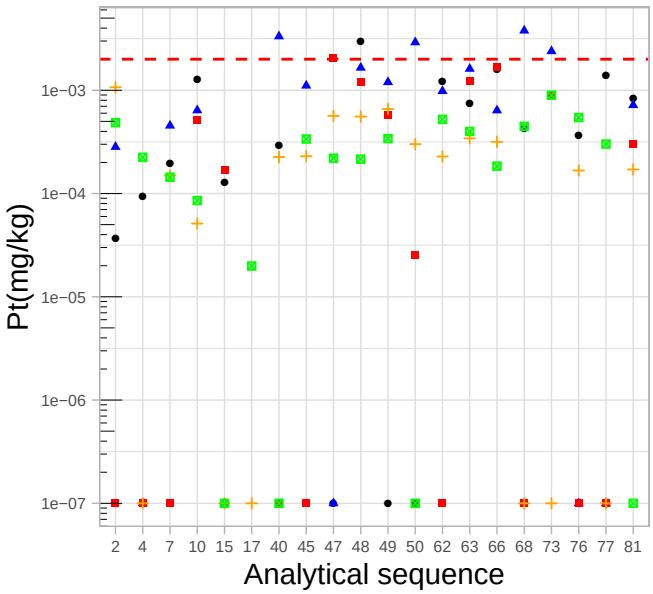

Mn(mg/kg)
1e+03
1e+02
2 4 7 10 15 17 40 45 47 48 49 50 62 63 66 68 73 76 77 81
Analytical sequence

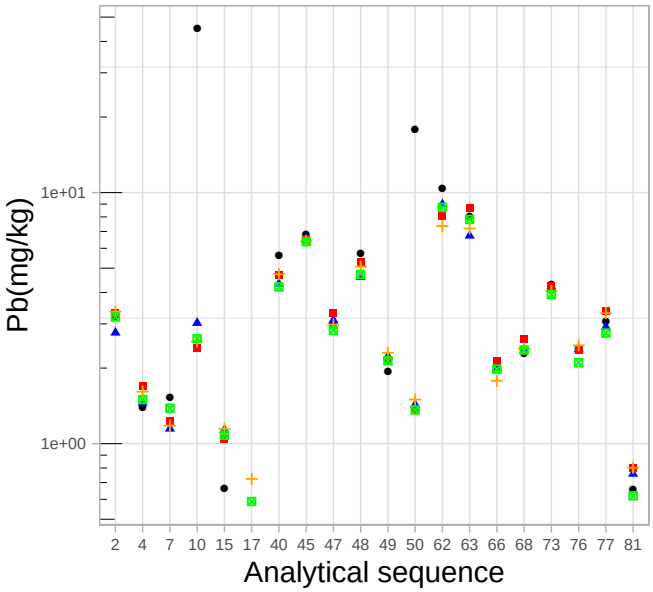

Nb(mg/kg)
1e+00
2 4 7 10 15 17 40 45 47 48 49 50 62 63 66 68 73 76 77 81
Analytical sequence

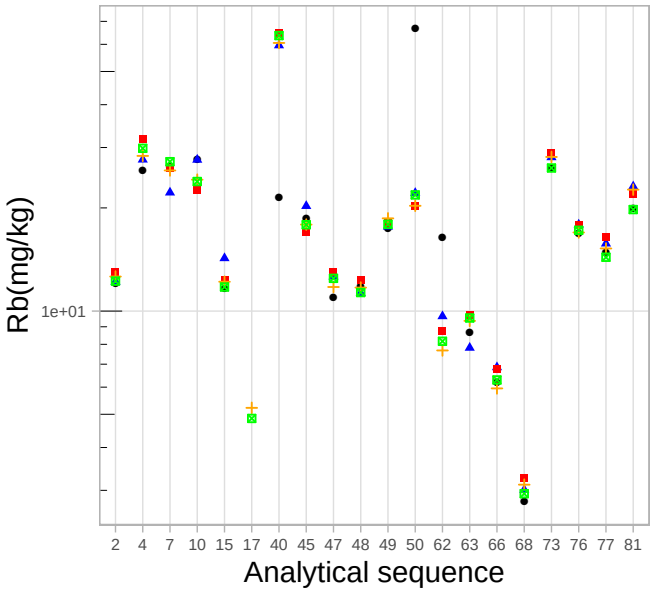

Mo(mg/kg)
1e+00
1e−01
2 4 7 10 15 17 40 45 47 48 49 50 62 63 66 68 73 76 77 81
Analytical sequence

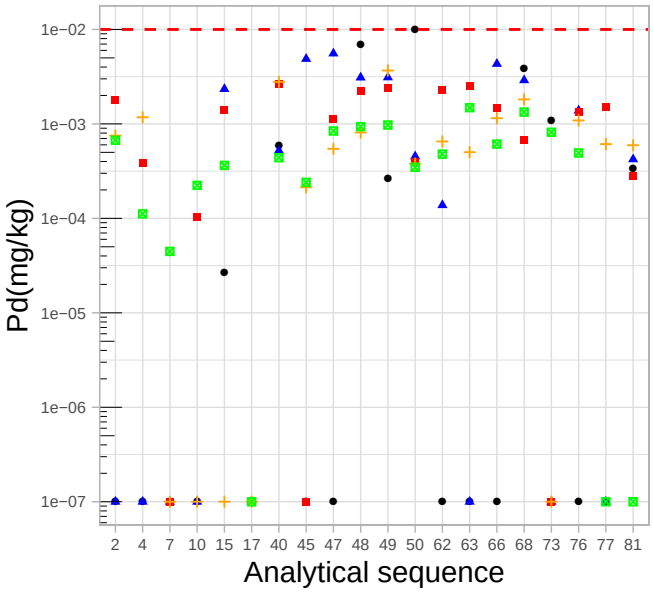

Ni(mg/kg)
1e+01
2 4 7 10 15 17 40 45 47 48 49 50 62 63 66 68 73 76 77 81
Analytical sequence

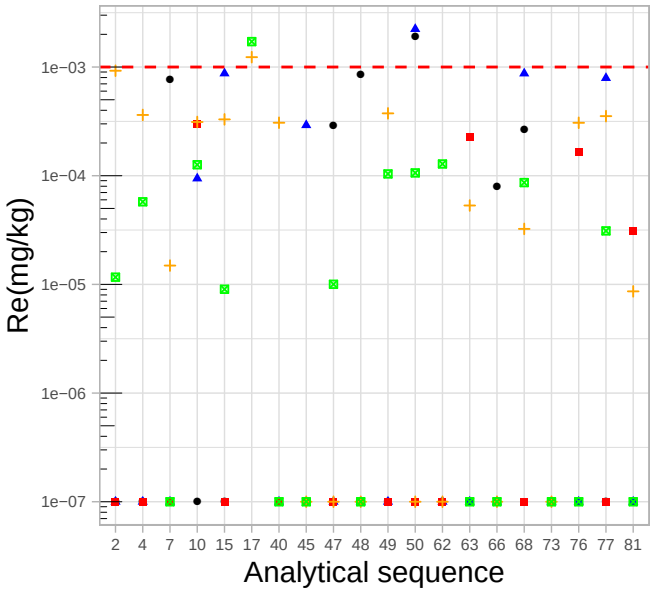

P(mg/kg)
1e+03
2 4 7 10 15 17 40 45 47 48 49 50 62 63 66 68 73 76 77 81
Analytical sequence

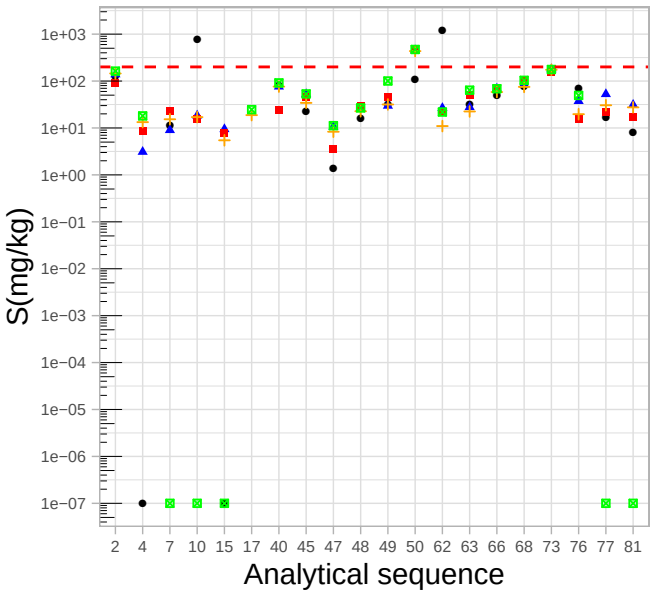

Pt(mg/kg)
1e−03
1e−04
1e−05
1e−06
1e−07
2 4 7 10 15 17 40 45 47 48 49 50 62 63 66 68 73 76 77 81
Analytical sequence

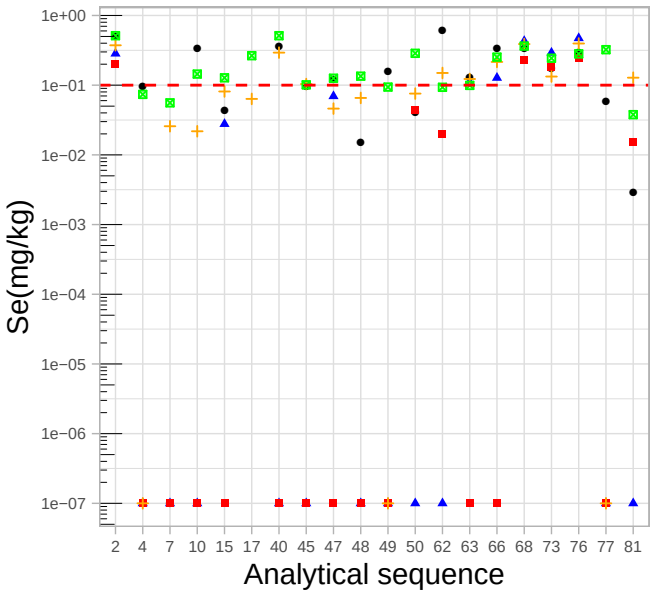

Pb(mg/kg)
1e+01
1e+00
2 4 7 10 15 17 40 45 47 48 49 50 62 63 66 68 73 76 77 81
Analytical sequence

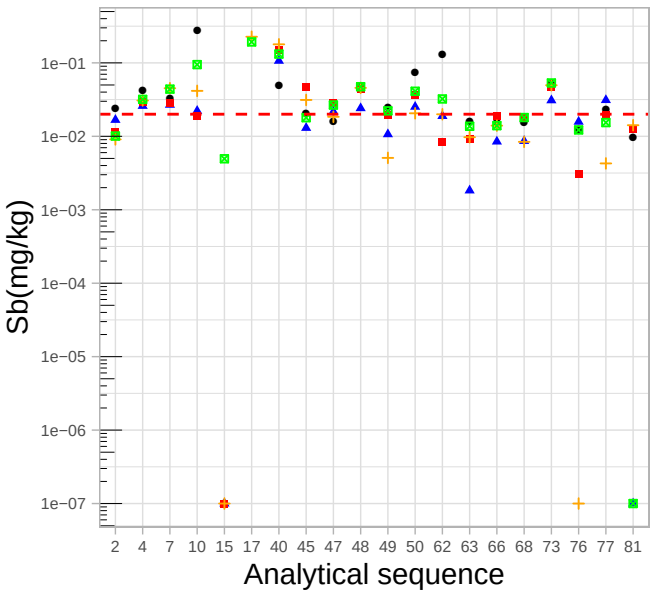

Rb(mg/kg)
1e+01
2 4 7 10 15 17 40 45 47 48 49 50 62 63 66 68 73 76 77 81
Analytical sequence

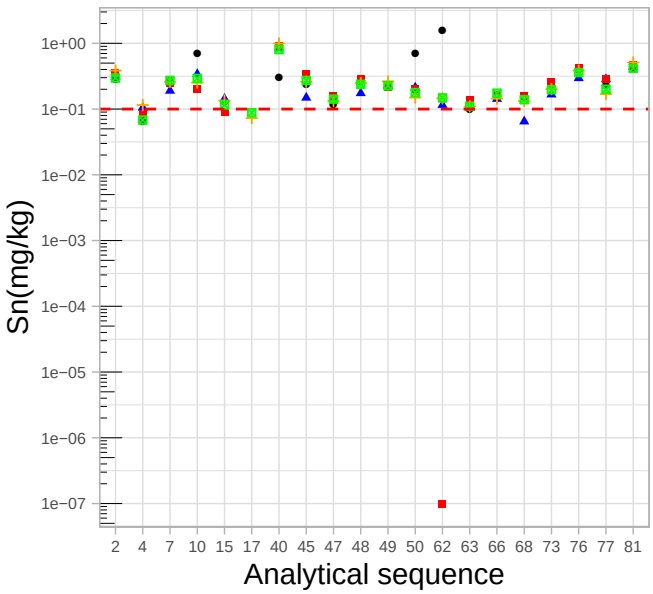

Pd(mg/kg)
1e−02
1e−03
1e−04
1e−05
1e−06
1e−07
2 4 7 10 15 17 40 45 47 48 49 50 62 63 66 68 73 76 77 81
Analytical sequence

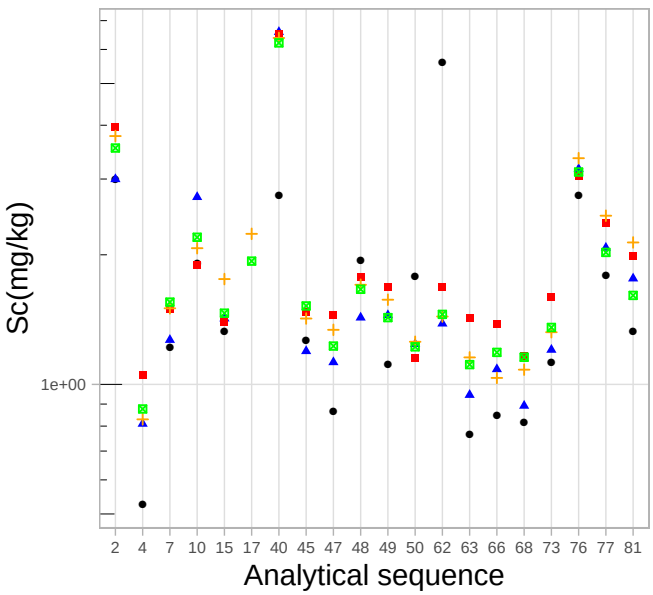

Re(mg/kg)
1e−03
1e−04
1e−05
1e−06
1e−07
2 4 7 10 15 17 40 45 47 48 49 50 62 63 66 68 73 76 77 81
Analytical sequence

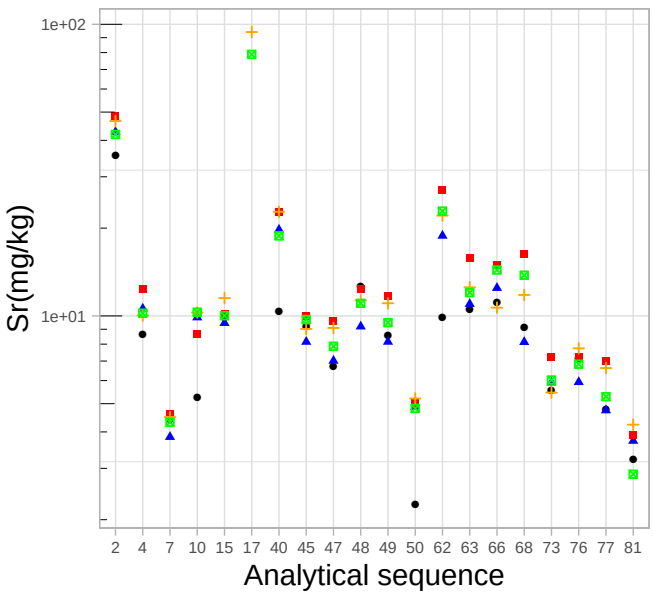

S(mg/kg)
1e+03
1e+02
1e+01
1e+00
1e−01
1e−02
1e−03
1e−04
1e−05
1e−06
1e−07
2 4 7 10 15 17 40 45 47 48 49 50 62 63 66 68 73 76 77 81
Analytical sequence

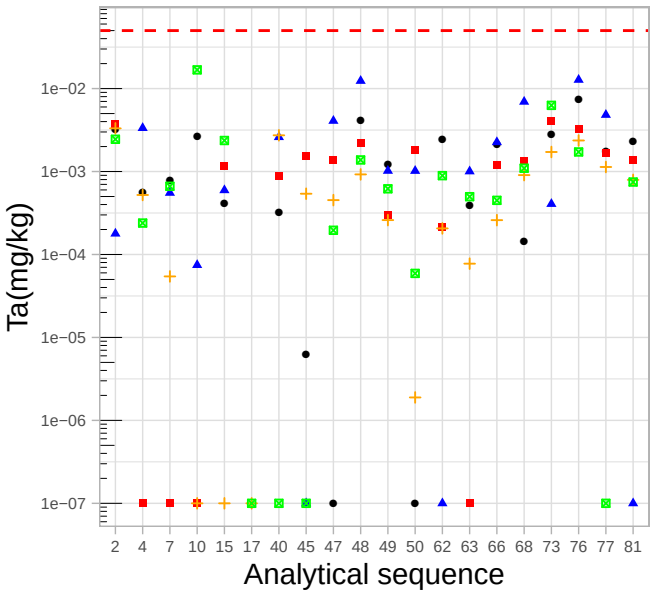

Se(mg/kg)
1e+00
1e−01
1e−02
1e−03
1e−04
1e−05
1e−06
1e−07
2 4 7 10 15 17 40 45 47 48 49 50 62 63 66 68 73 76 77 81
Analytical sequence

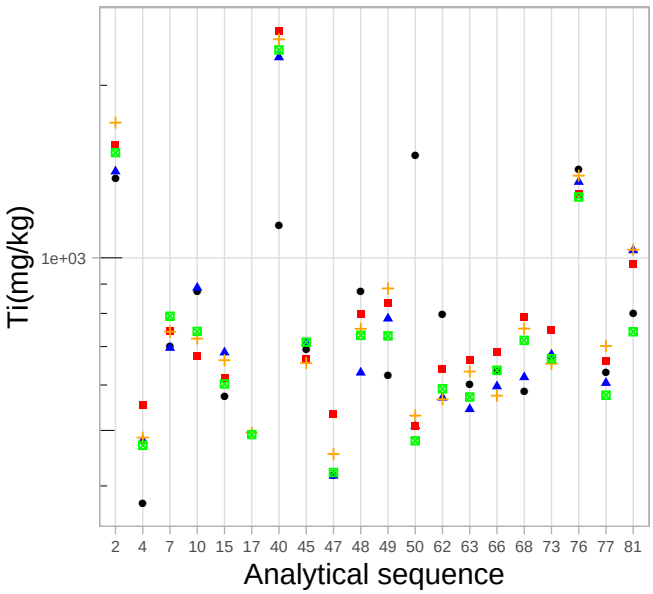

Sb(mg/kg)
1e−01
1e−02
1e−03
1e−04
1e−05
1e−06
1e−07
2 4 7 10 15 17 40 45 47 48 49 50 62 63 66 68 73 76 77 81
Analytical sequence

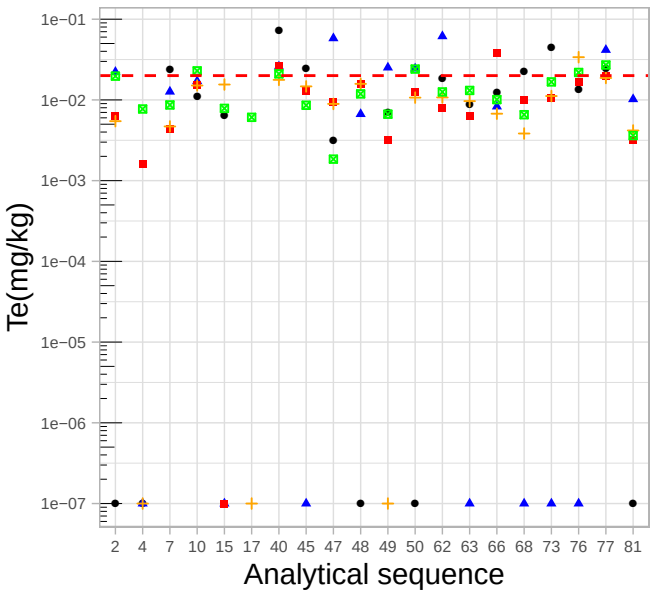

Sn(mg/kg)
1e+00
1e−01
1e−02
1e−03
1e−04
1e−05
1e−06
1e−07
2 4 7 10 15 17 40 45 47 48 49 50 62 63 66 68 73 76 77 81
Analytical sequence

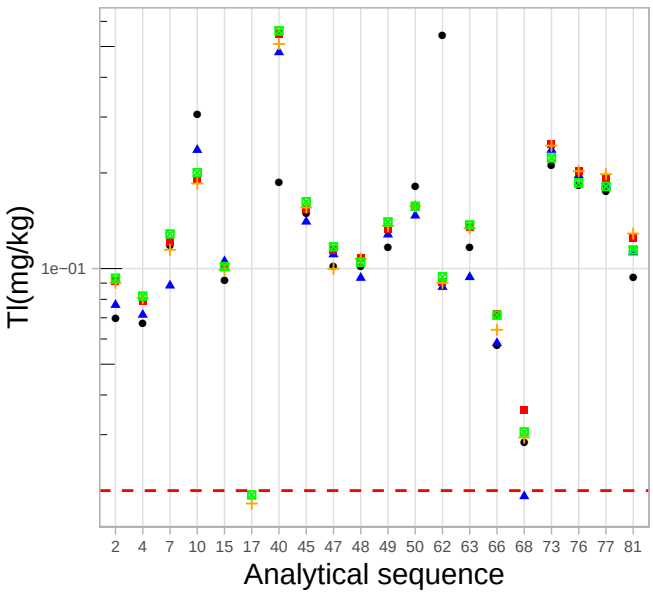

Sc(mg/kg)
1e+00
2 4 7 10 15 17 40 45 47 48 49 50 62 63 66 68 73 76 77 81
Analytical sequence

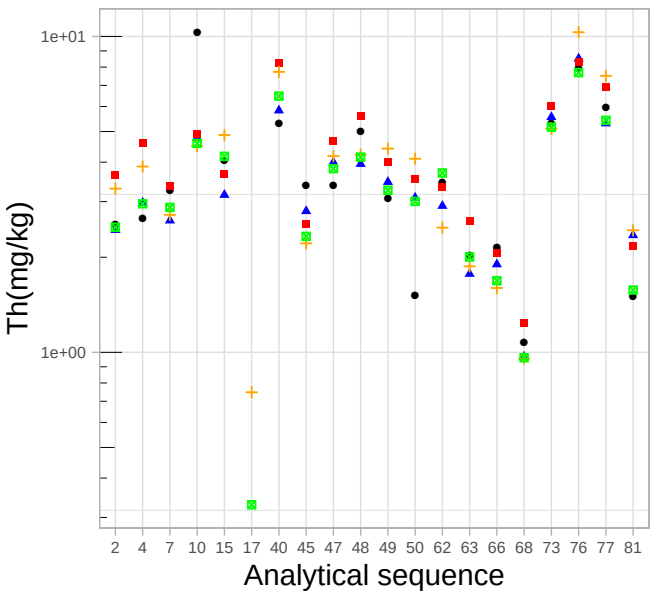

Sr(mg/kg)
1e+02
1e+01
2 4 7 10 15 17 40 45 47 48 49 50 62 63 66 68 73 76 77 81
Analytical sequence

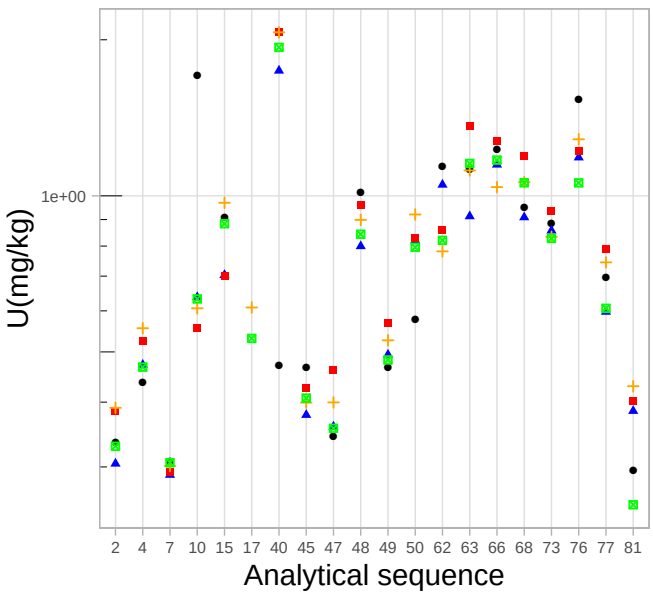

Ta(mg/kg)
1e−02
1e−03
1e−04
1e−05
1e−06
1e−07
2 4 7 10 15 17 40 45 47 48 49 50 62 63 66 68 73 76 77 81
Analytical sequence

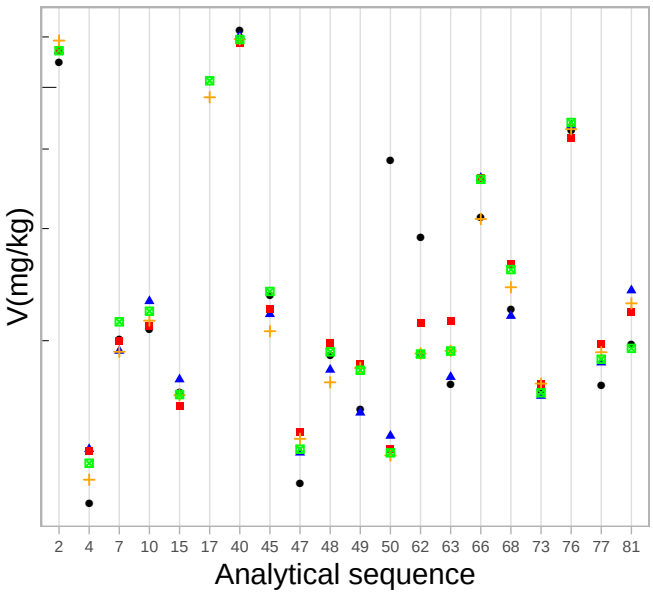

Ti(mg/kg)
1e+03
2 4 7 10 15 17 40 45 47 48 49 50 62 63 66 68 73 76 77 81
Analytical sequence

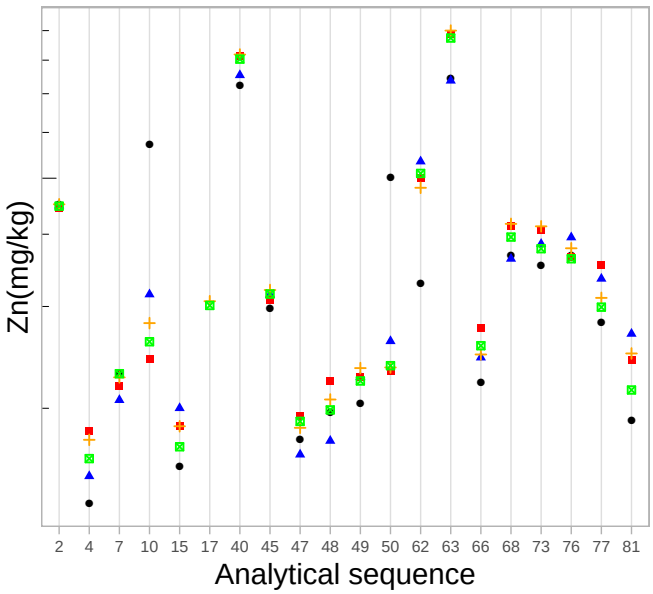

Te(mg/kg)
1e−01
1e−02
1e−03
1e−04
1e−05
1e−06
1e−07
2 4 7 10 15 17 40 45 47 48 49 50 62 63 66 68 73 76 77 81
Analytical sequence

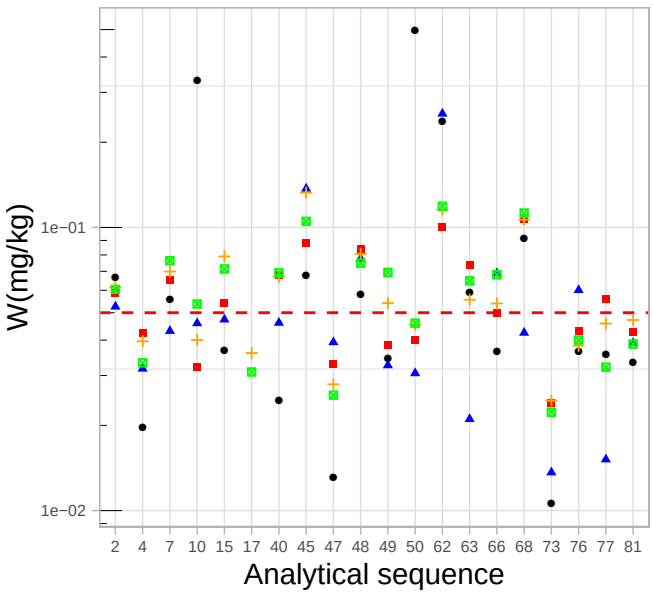

Tl(mg/kg)
1e−01
2 4 7 10 15 17 40 45 47 48 49 50 62 63 66 68 73 76 77 81
Analytical sequence

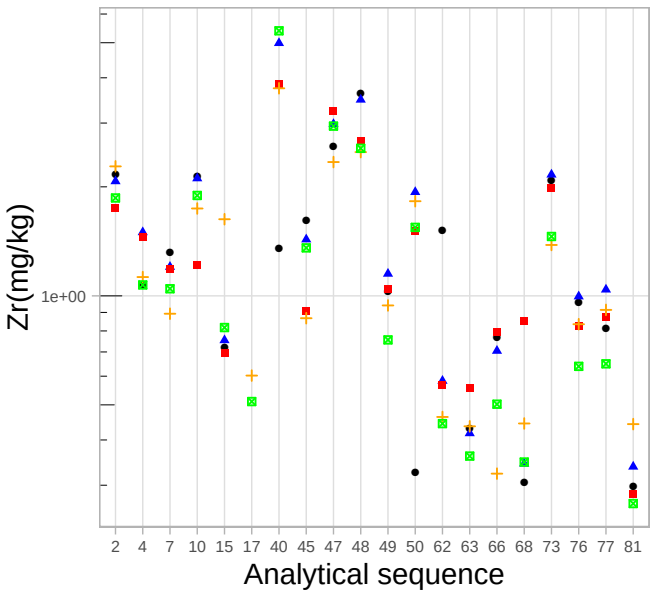

Th(mg/kg)
1e+01
1e+00
2 4 7 10 15 17 40 45 47 48 49 50 62 63 66 68 73 76 77 81
Analytical sequence

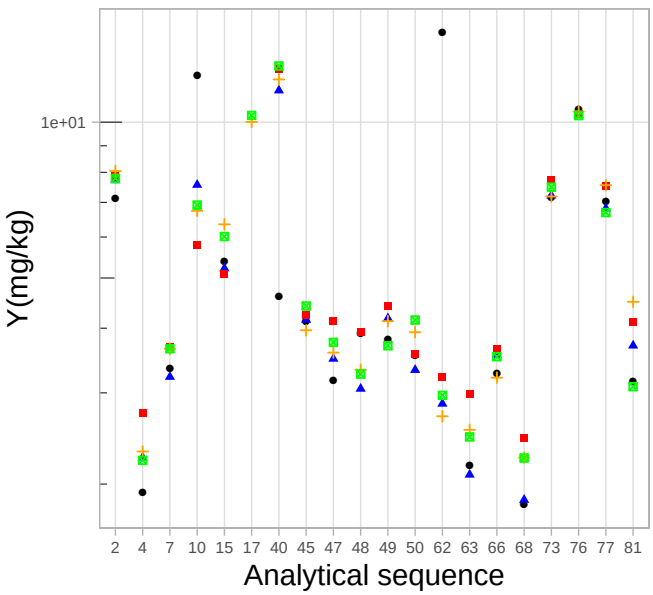

U(mg/kg)
1e+00
2 4 7 10 15 17 40 45 47 48 49 50 62 63 66 68 73 76 77 81
Analytical sequence


V(mg/kg)
2 4 7 10 15 17 40 45 47 48 49 50 62 63 66 68 73 76 77 81
Analytical sequence


Zn(mg/kg)
2 4 7 10 15 17 40 45 47 48 49 50 62 63 66 68 73 76 77 81
Analytical sequence

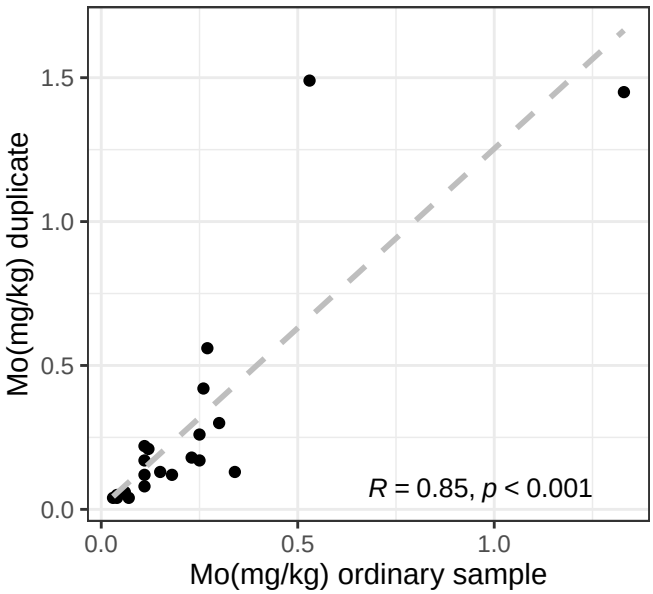

W(mg/kg)
1e−01
1e−02
2 4 7 10 15 17 40 45 47 48 49 50 62 63 66 68 73 76 77 81
Analytical sequence

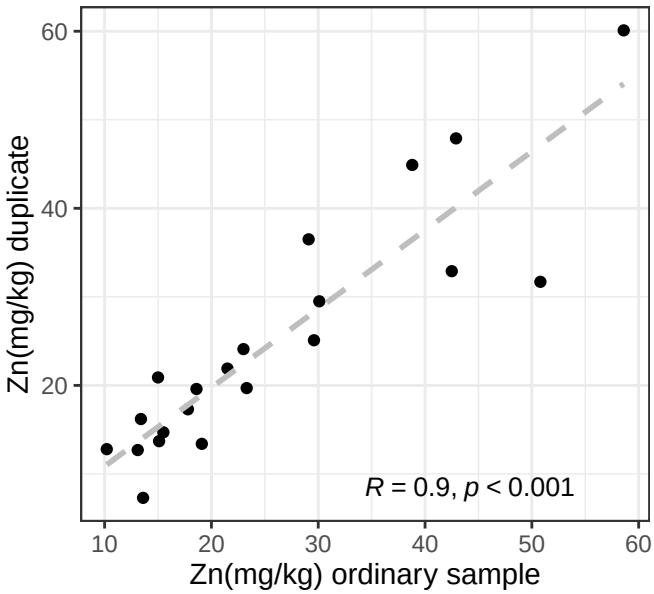

Zr(mg/kg)
1e+00
2 4 7 10 15 17 40 45 47 48 49 50 62 63 66 68 73 76 77 81
Analytical sequence

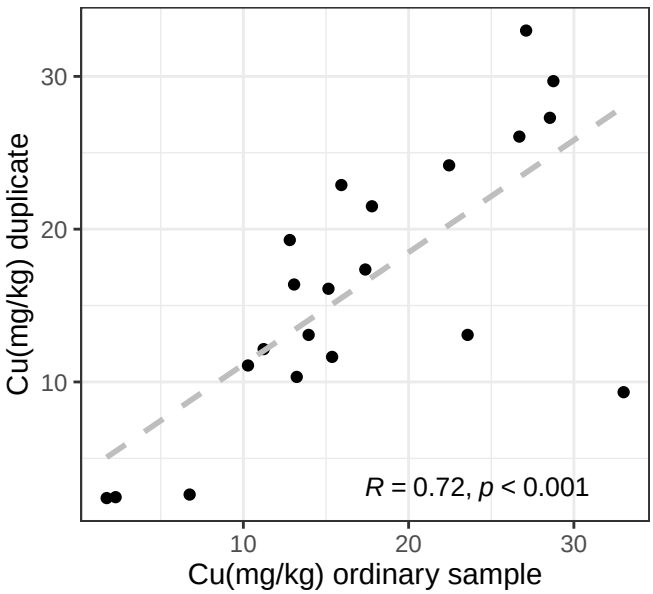

Y(mg/kg)
1e+01
2 4 7 10 15 17 40 45 47 48 49 50 62 63 66 68 73 76 77 81
Analytical sequence

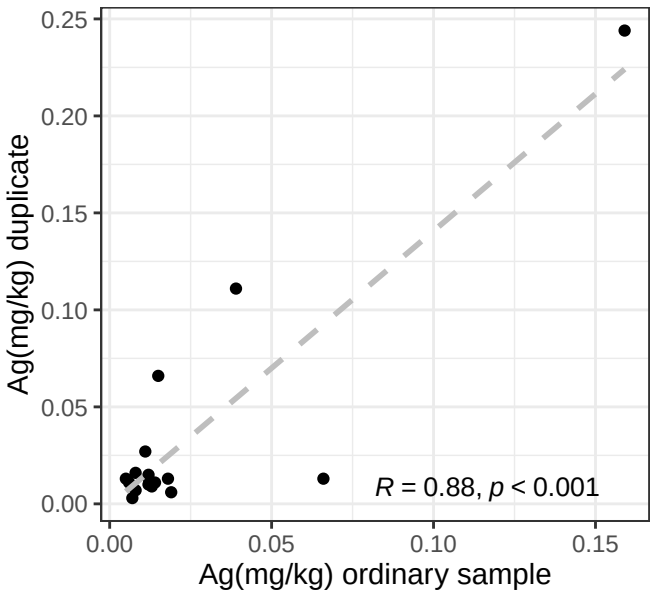
APPENDIX 4: Correlation plots, field duplicates

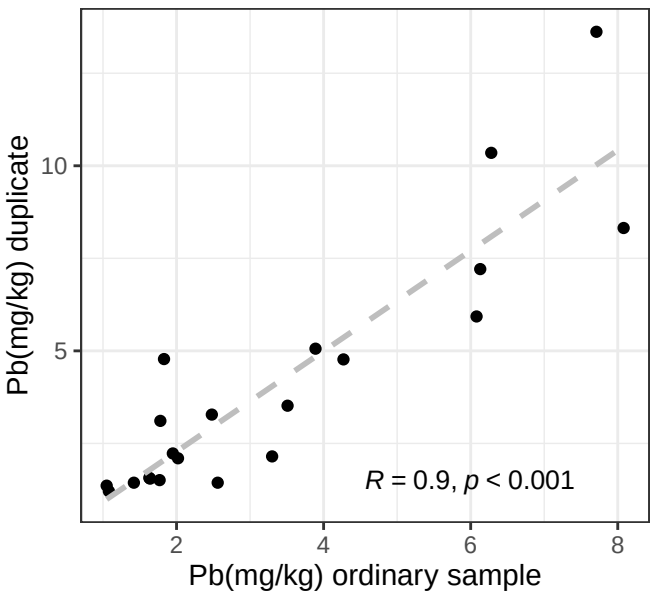
The correlation between ordinary and field duplicate samples shown for all elements that have at least five duplicate pairs above detection limits. Each plot includes the covariance or correlation coefficient.

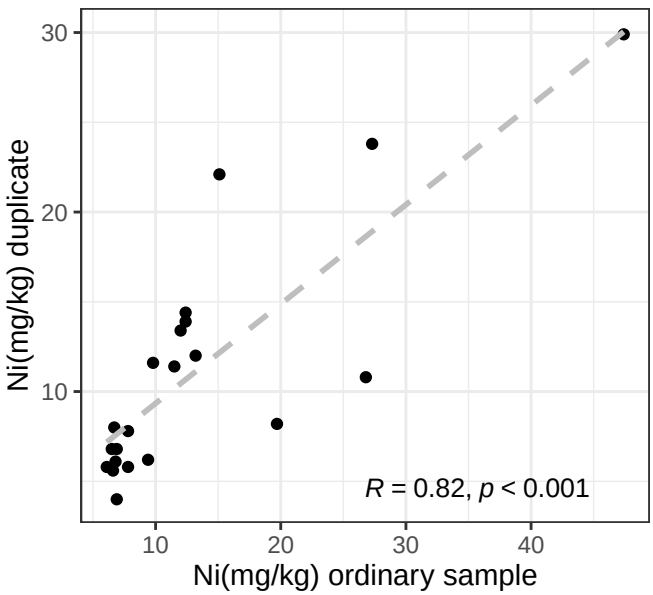

Mo(mg/kg) duplicate
Mo(mg/kg) ordinary sample
R = 0.85, p < 0.001

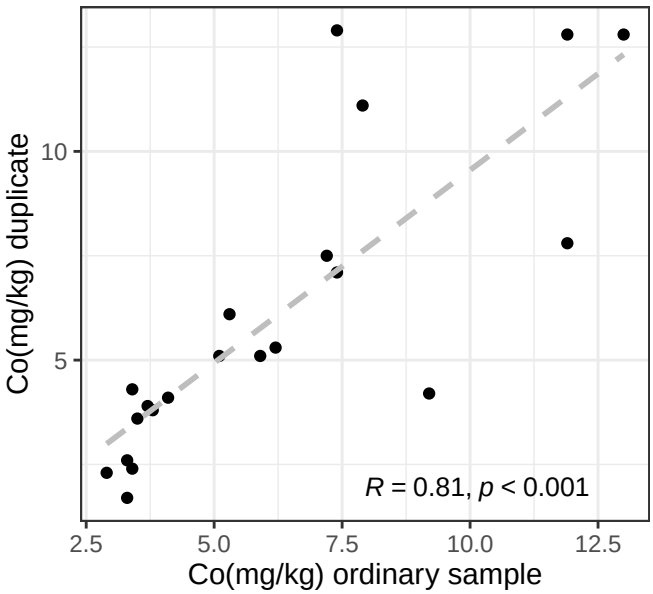

Zn(mg/kg) duplicate
Zn(mg/kg) ordinary sample
R = 0.9, p < 0.001

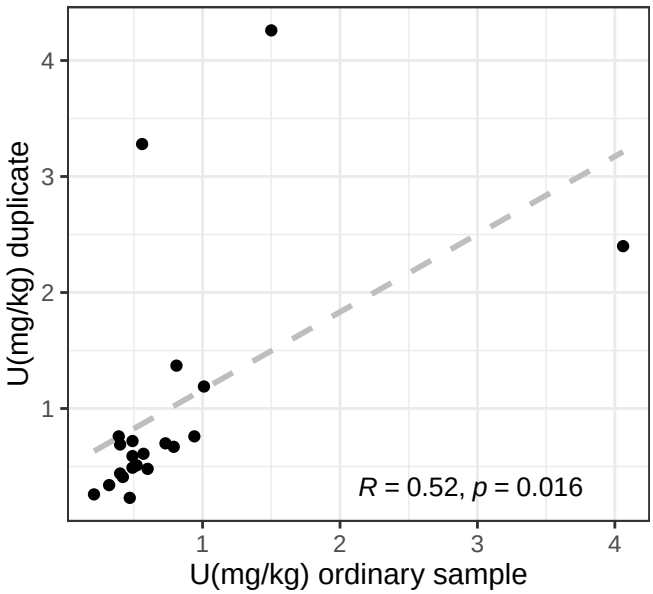

Cu(mg/kg) duplicate
Cu(mg/kg) ordinary sample
R = 0.72, p < 0.001

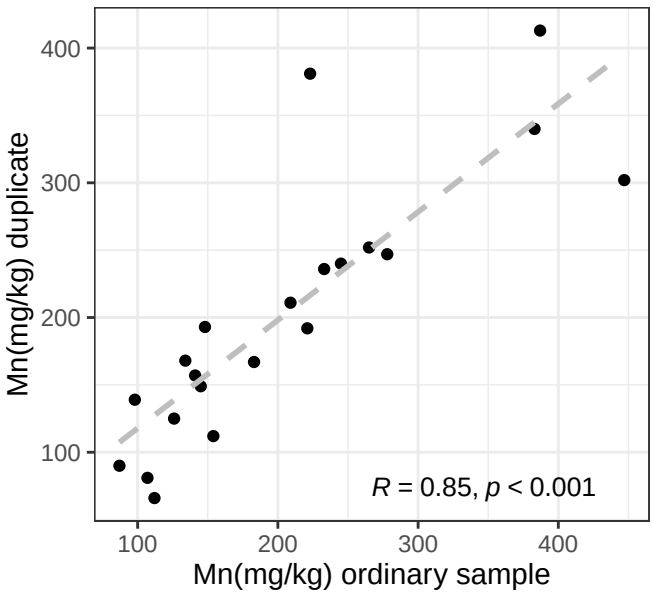

Ag(mg/kg) duplicate
Ag(mg/kg) ordinary sample
R = 0.88, p < 0.001

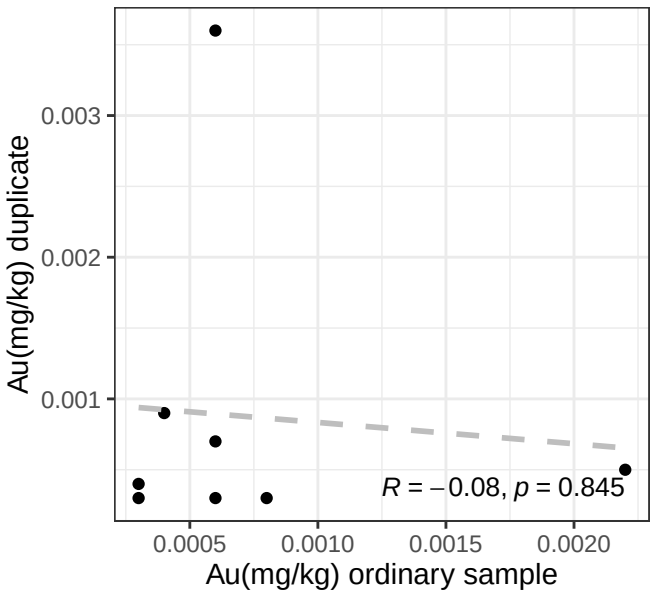

Pb(mg/kg) duplicate
Pb(mg/kg) ordinary sample
R = 0.9, p < 0.001

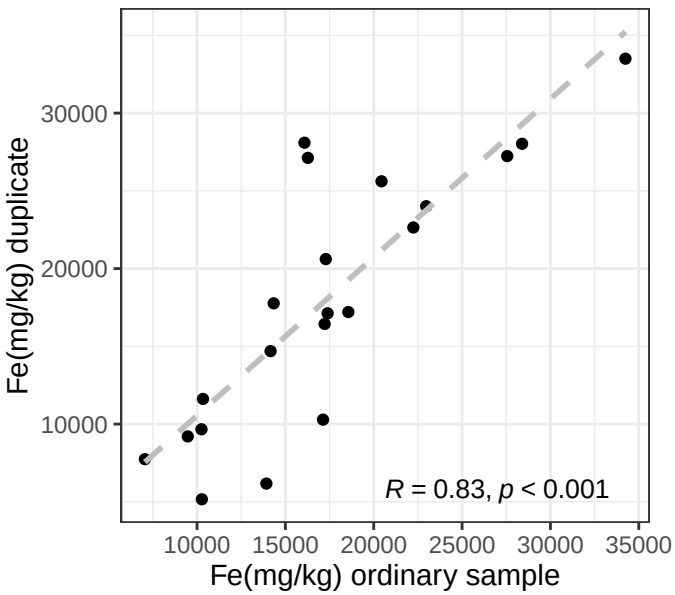

Ni(mg/kg) duplicate
Ni(mg/kg) ordinary sample
R = 0.82, p < 0.001

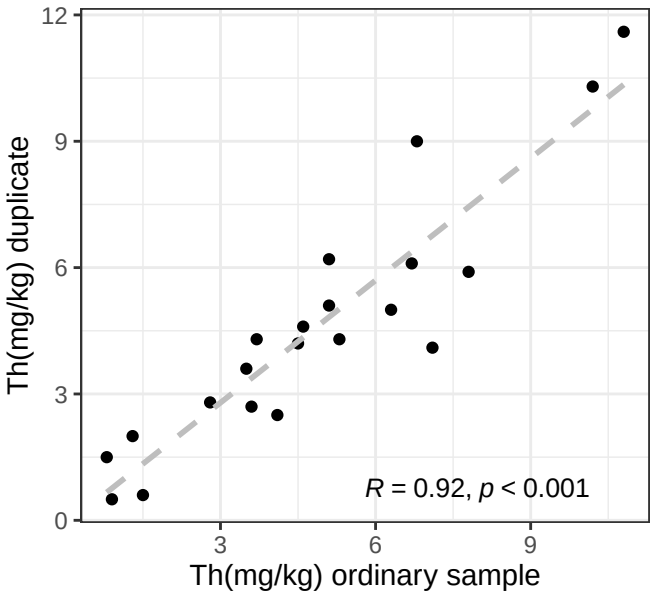

Co(mg/kg) duplicate
Co(mg/kg) ordinary sample
R = 0.81, p < 0.001

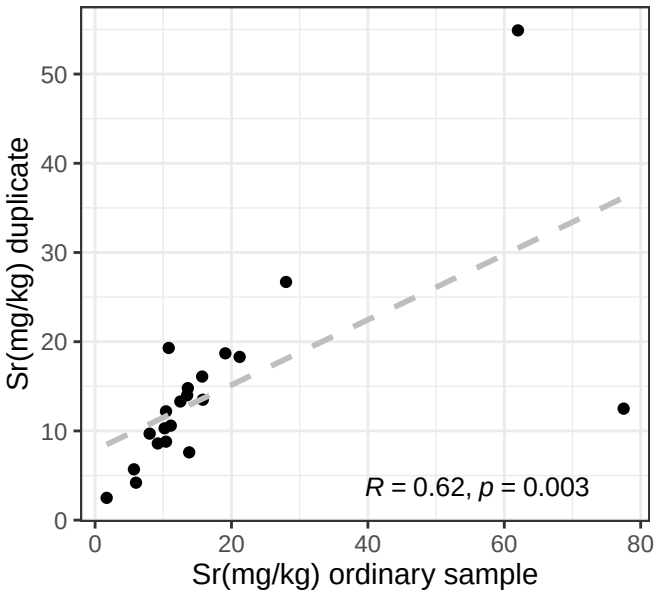

U(mg/kg) duplicate
U(mg/kg) ordinary sample
R = 0.52, p = 0.016

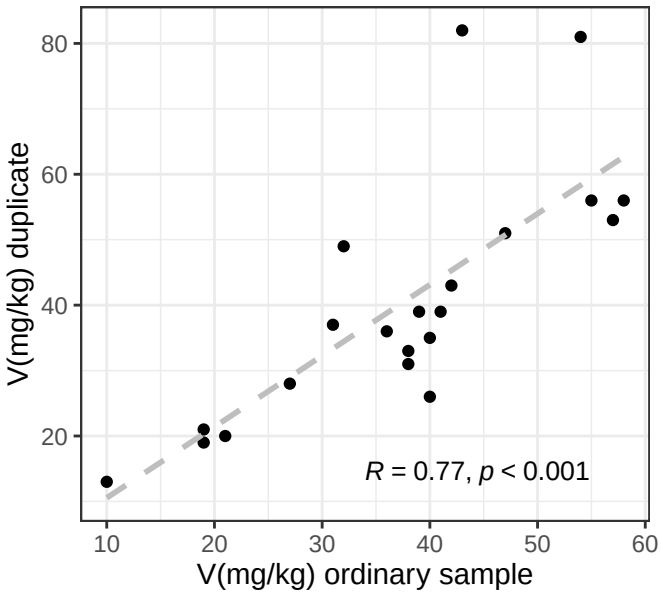

Mn(mg/kg) duplicate
Mn(mg/kg) ordinary sample
R = 0.85, p < 0.001

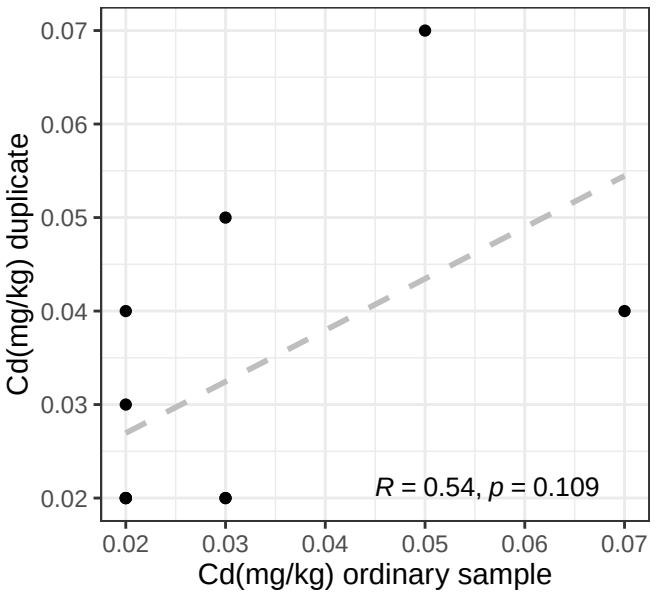

Au(mg/kg) duplicate
Au(mg/kg) ordinary sample
R = −0.08, p = 0.845

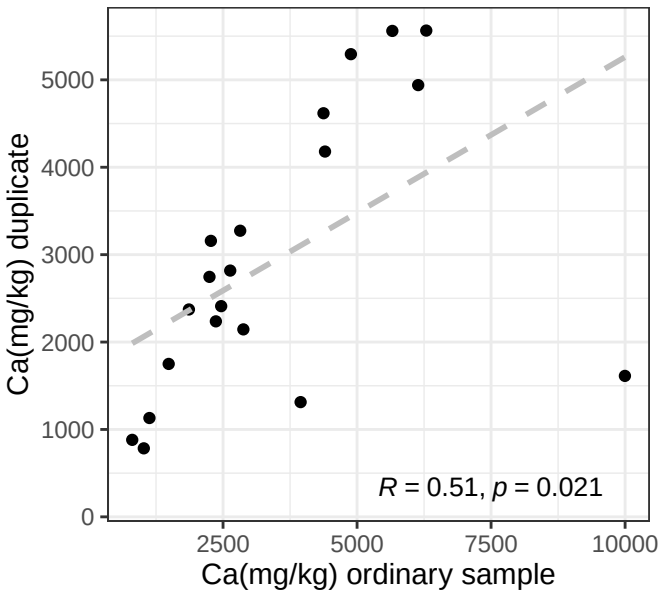

Fe(mg/kg) duplicate
Fe(mg/kg) ordinary sample
R = 0.83, p < 0.001

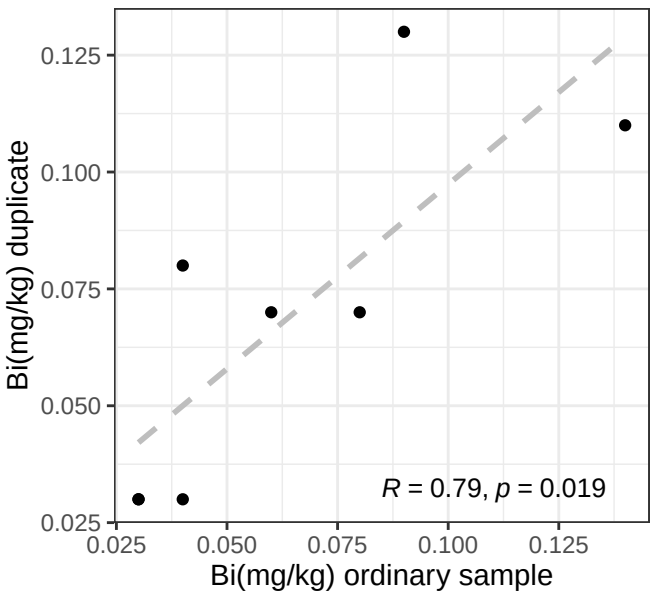

Th(mg/kg) duplicate
Th(mg/kg) ordinary sample
R = 0.92, p < 0.001

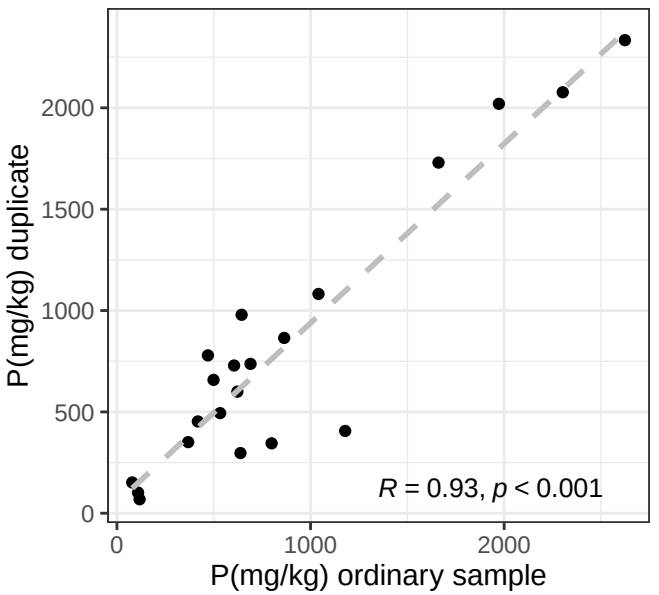

Sr(mg/kg) duplicate
Sr(mg/kg) ordinary sample
R = 0.62, p = 0.003

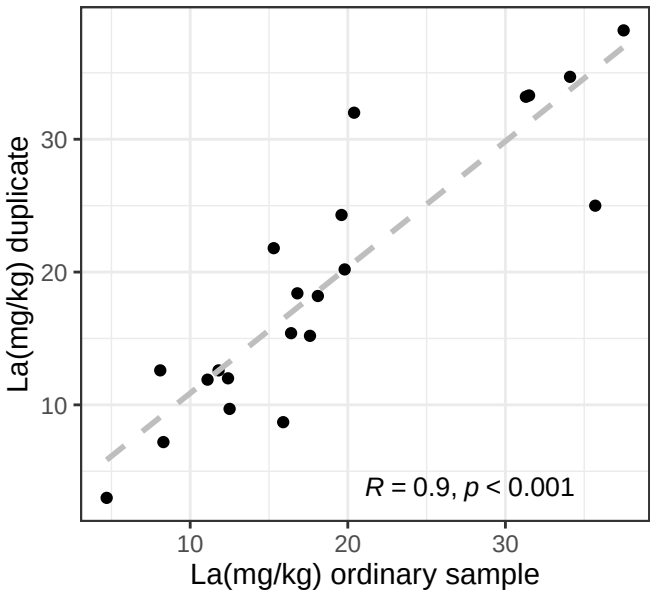

V(mg/kg) duplicate
V(mg/kg) ordinary sample
R = 0.77, p < 0.001

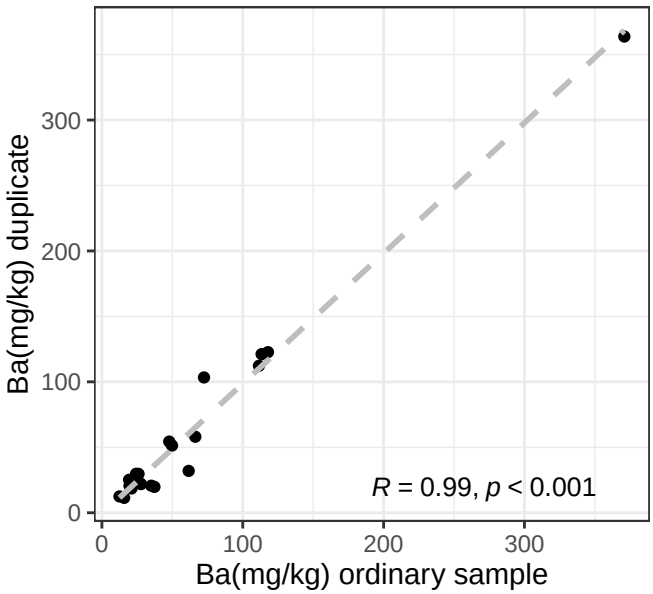

Cd(mg/kg) duplicate
Cd(mg/kg) ordinary sample
R = 0.54, p = 0.109

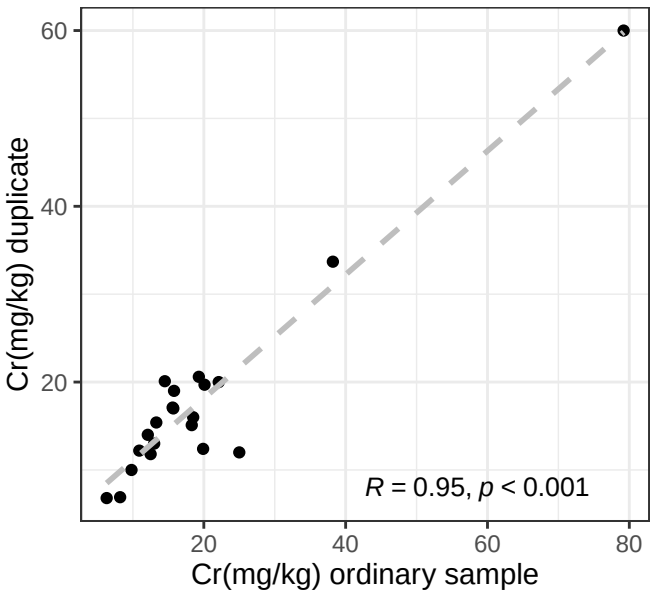

Ca(mg/kg) duplicate
Ca(mg/kg) ordinary sample
R = 0.51, p = 0.021

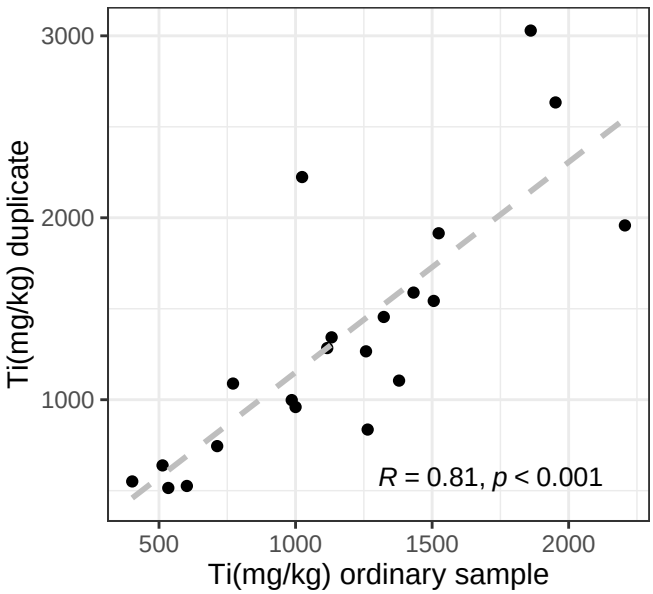

Bi(mg/kg) duplicate
Bi(mg/kg) ordinary sample
R = 0.79, p = 0.019

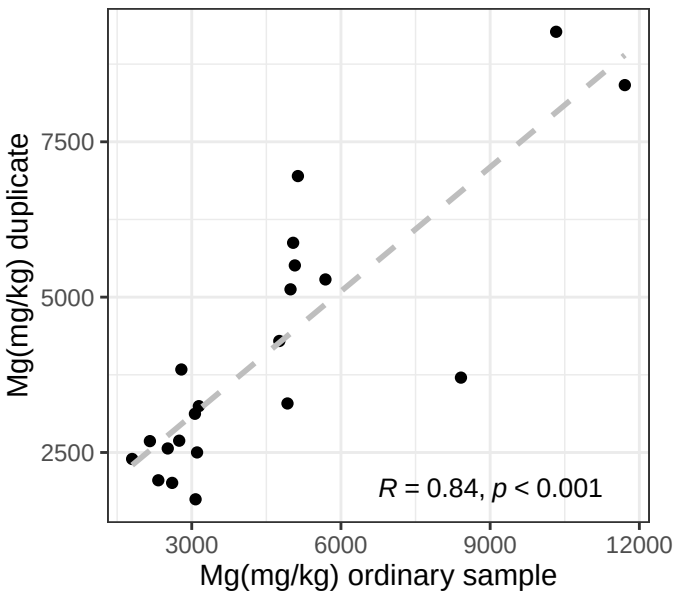

P(mg/kg) duplicate
P(mg/kg) ordinary sample
R = 0.93, p < 0.001

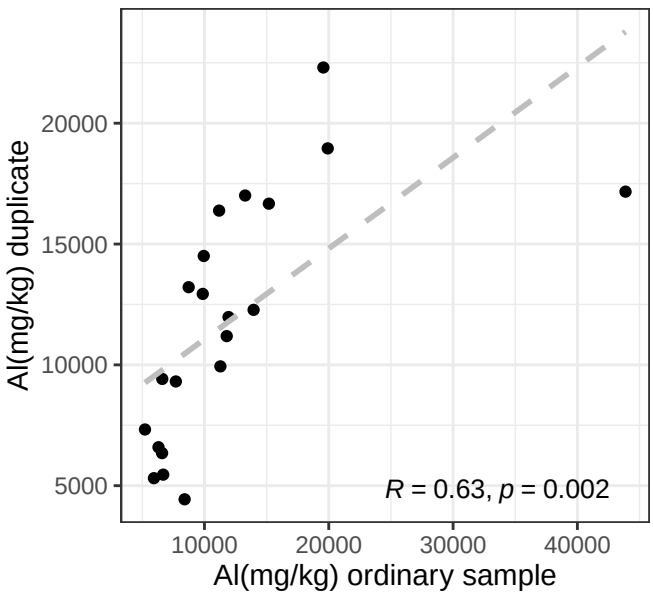

La(mg/kg) duplicate
La(mg/kg) ordinary sample
R = 0.9, p < 0.001

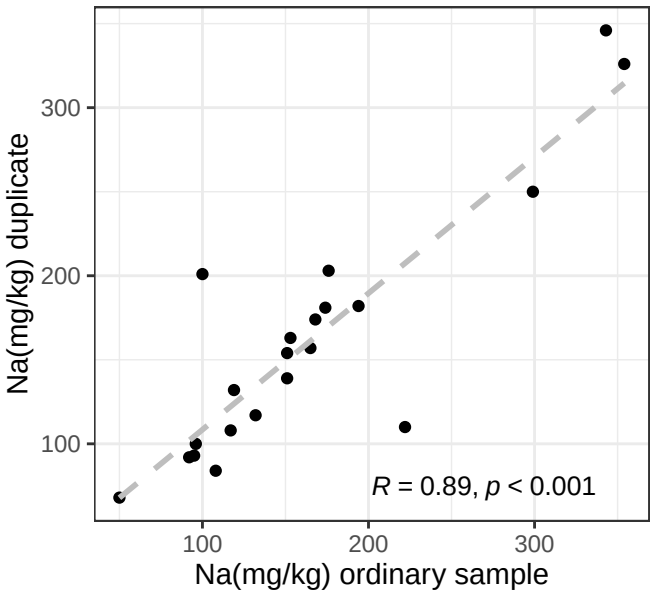

Ba(mg/kg) duplicate
Ba(mg/kg) ordinary sample
R = 0.99, p < 0.001

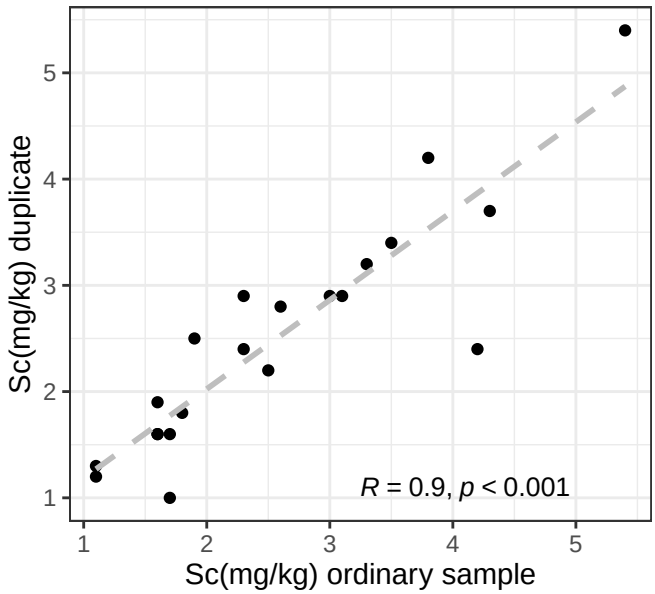

Cr(mg/kg) duplicate
Cr(mg/kg) ordinary sample
R = 0.95, p < 0.001

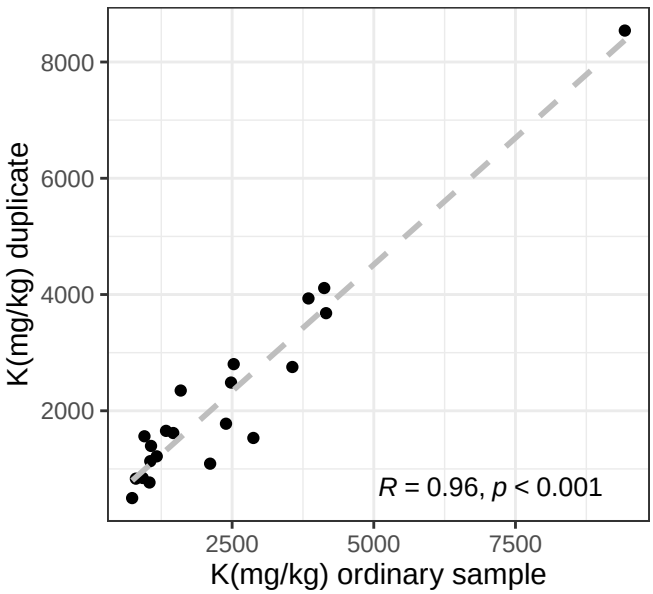

Ti(mg/kg) duplicate
Ti(mg/kg) ordinary sample
R = 0.81, p < 0.001

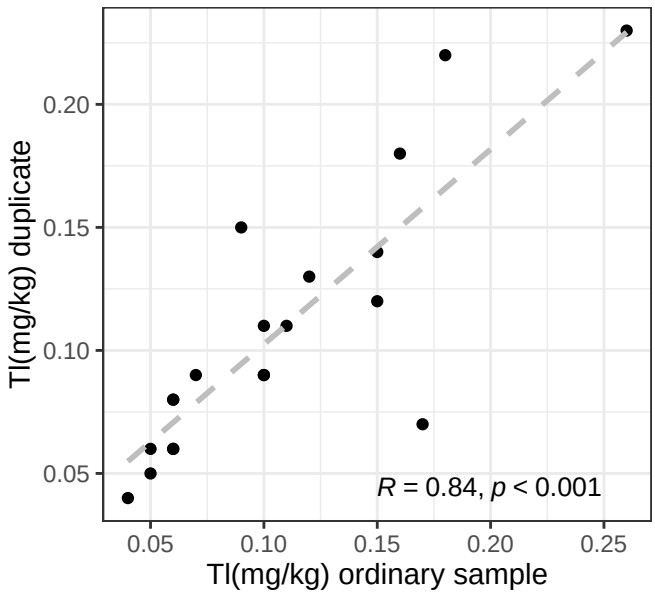

Mg(mg/kg) duplicate
Mg(mg/kg) ordinary sample
R = 0.84, p < 0.001

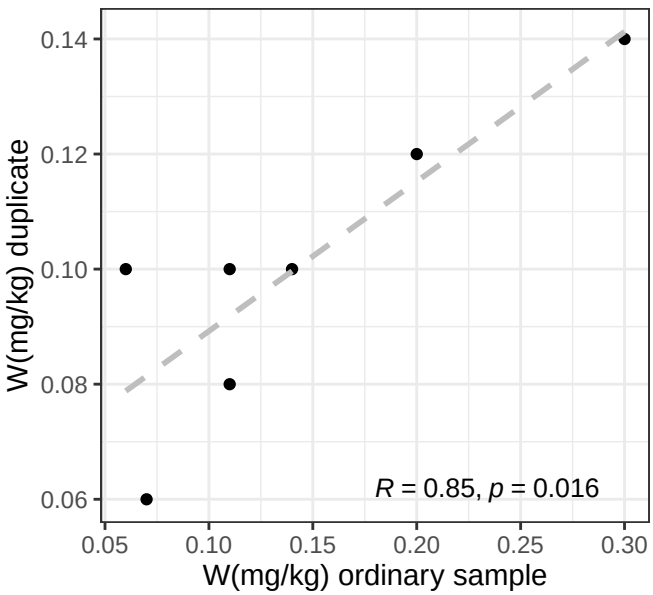

Al(mg/kg) duplicate
Al(mg/kg) ordinary sample
R = 0.63, p = 0.002

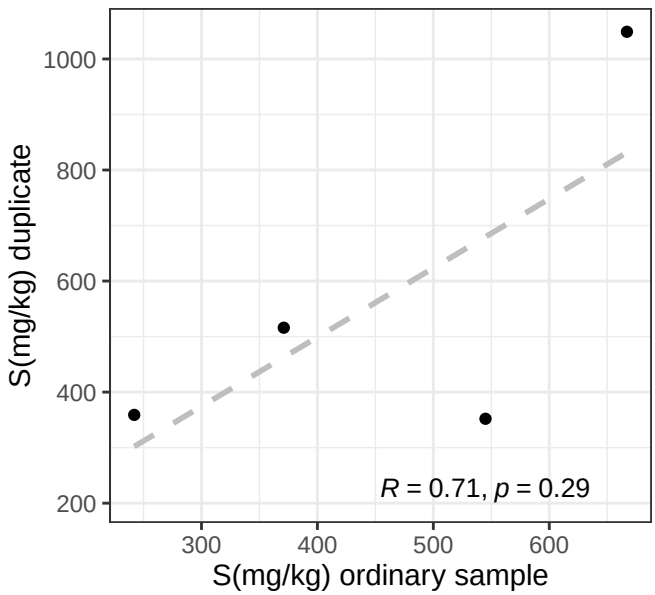

Na(mg/kg) duplicate
Na(mg/kg) ordinary sample
R = 0.89, p < 0.001

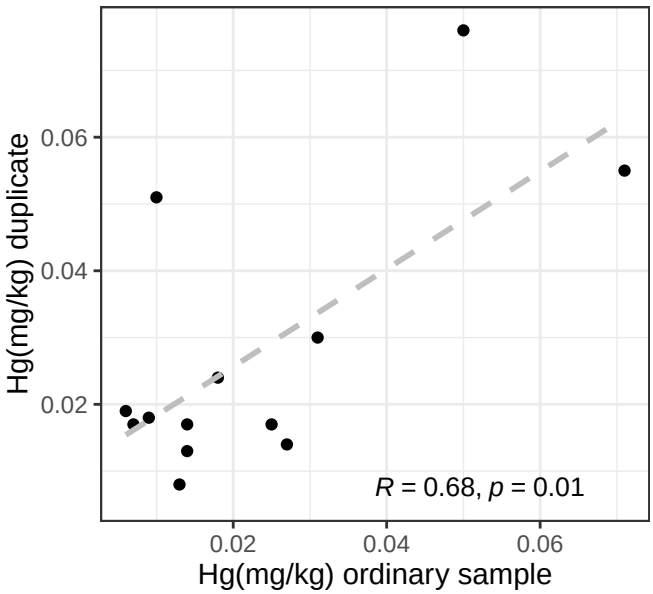

Sc(mg/kg) duplicate
Sc(mg/kg) ordinary sample
R = 0.9, p < 0.001

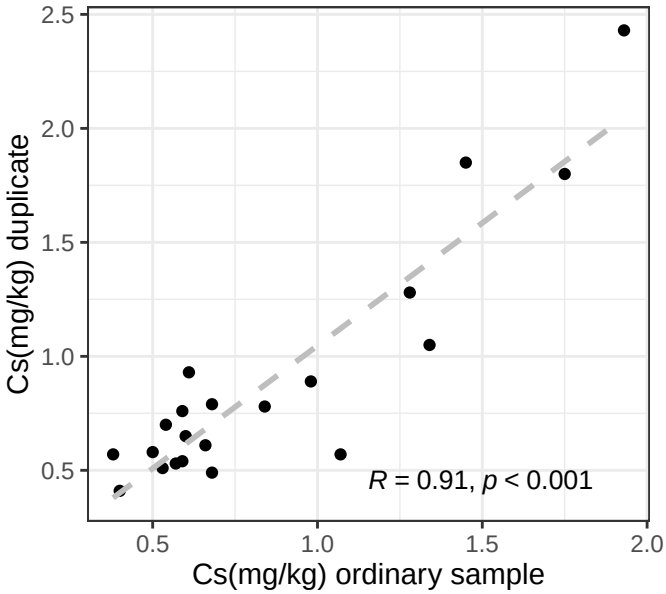

K(mg/kg) duplicate
K(mg/kg) ordinary sample
R = 0.96, p < 0.001

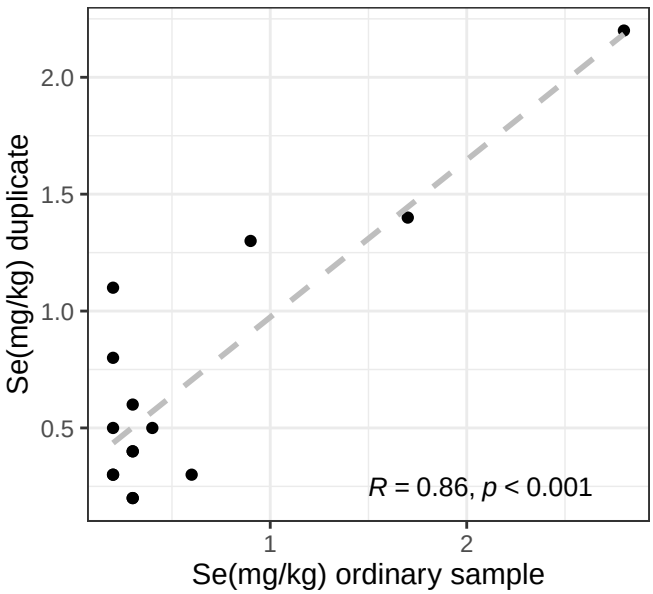

Tl(mg/kg) duplicate
Tl(mg/kg) ordinary sample
R = 0.84, p < 0.001

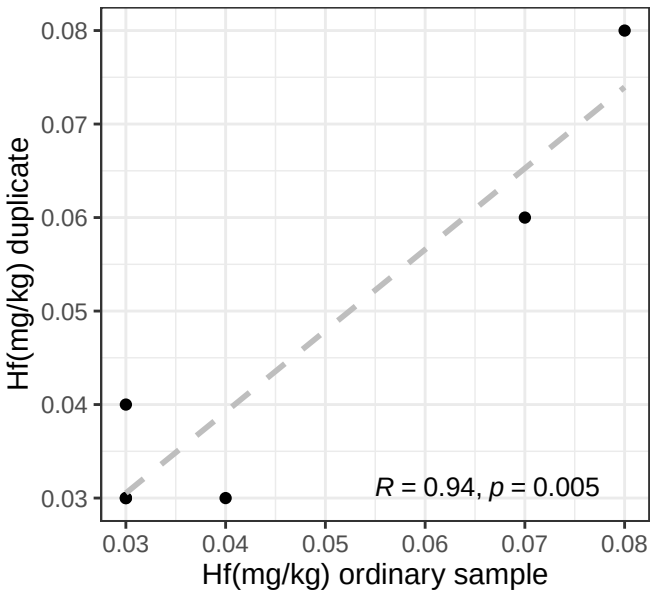

W(mg/kg) duplicate
W(mg/kg) ordinary sample
R = 0.85, p = 0.016

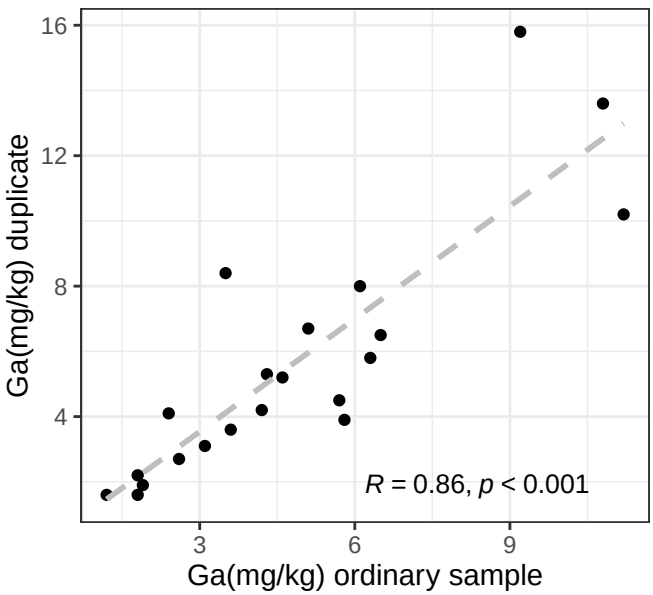

S(mg/kg) duplicate
S(mg/kg) ordinary sample
R = 0.71, p = 0.29

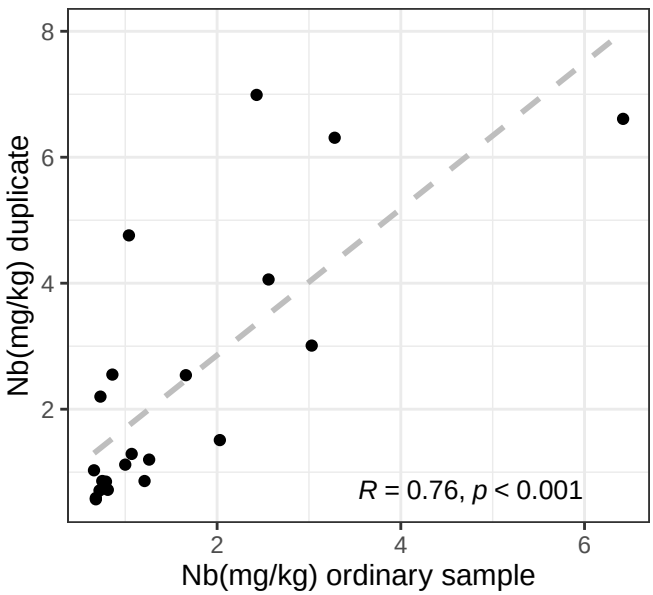

Hg(mg/kg) duplicate
Hg(mg/kg) ordinary sample
R = 0.68, p = 0.01

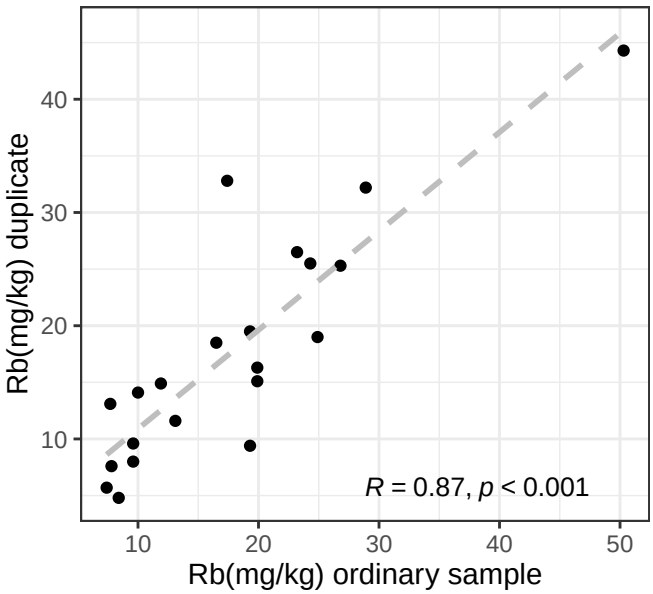

Cs(mg/kg) duplicate
Cs(mg/kg) ordinary sample
R = 0.91, p < 0.001

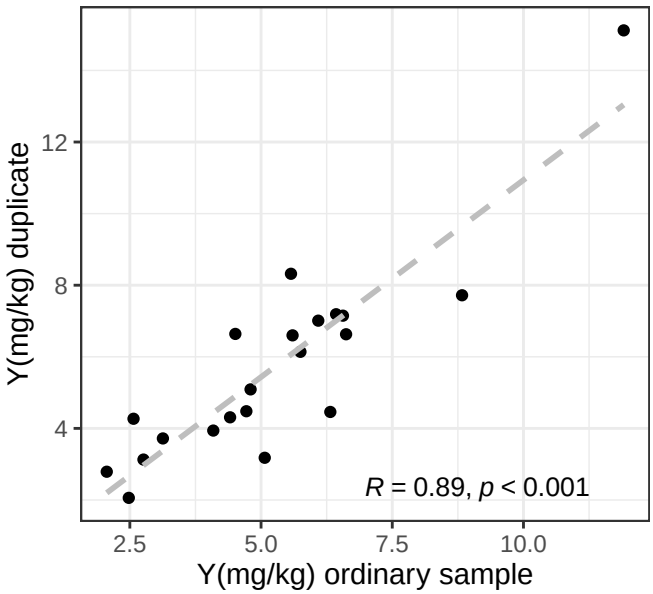

Se(mg/kg) duplicate
Se(mg/kg) ordinary sample
R = 0.86, p < 0.001

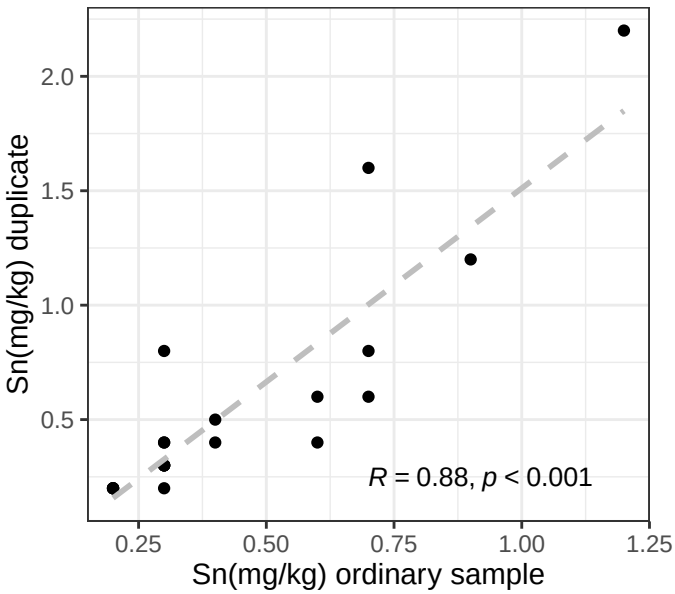

Hf(mg/kg) duplicate
Hf(mg/kg) ordinary sample
R = 0.94, p = 0.005

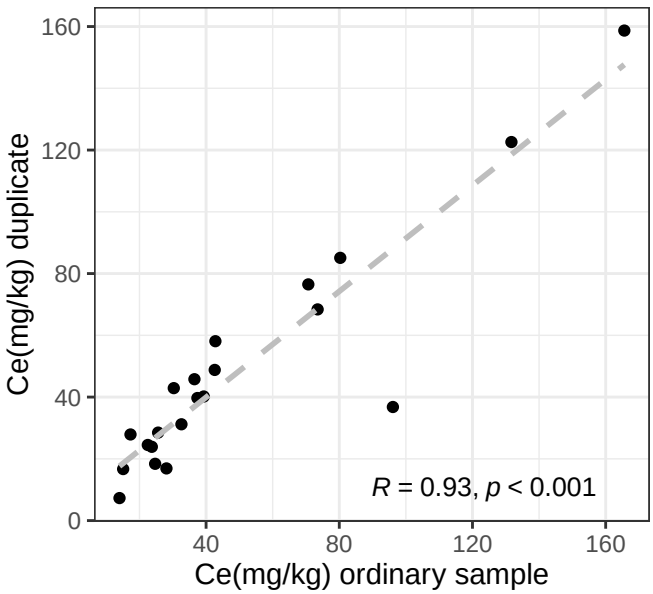

Ga(mg/kg) duplicate
Ga(mg/kg) ordinary sample
R = 0.86, p < 0.001

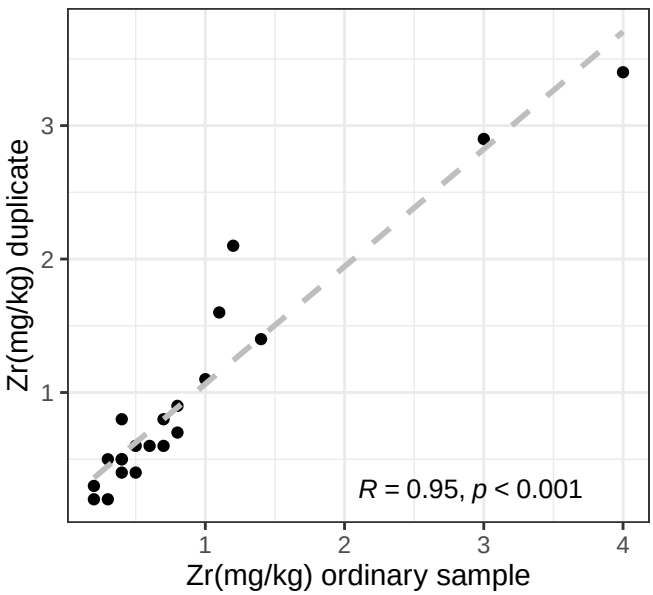

Nb(mg/kg) duplicate
Nb(mg/kg) ordinary sample
R = 0.76, p < 0.001

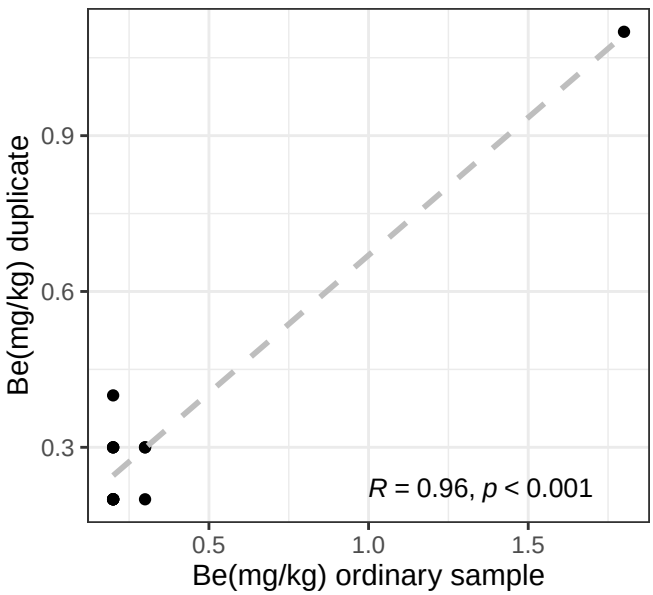

Rb(mg/kg) duplicate
Rb(mg/kg) ordinary sample
R = 0.87, p < 0.001

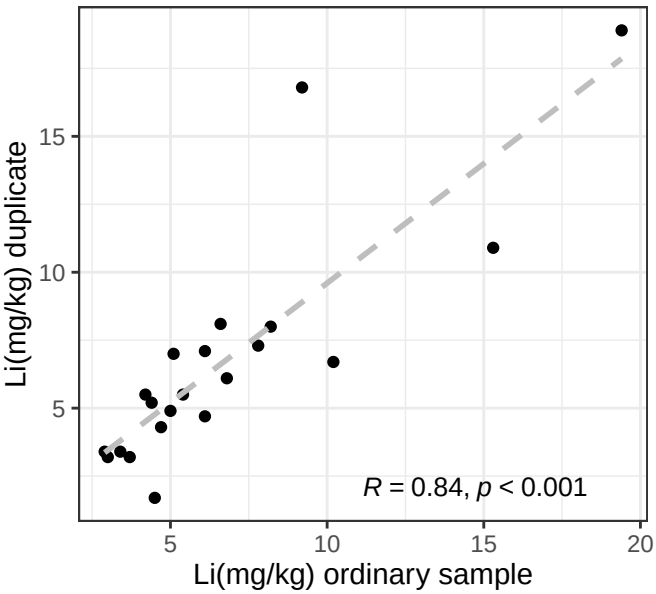

Y(mg/kg) duplicate
Y(mg/kg) ordinary sample
R = 0.89, p < 0.001


Sn(mg/kg) duplicate
Sn(mg/kg) ordinary sample
R = 0.88, p < 0.001


Ce(mg/kg) duplicate
Ce(mg/kg) ordinary sample
R = 0.93, p < 0.001

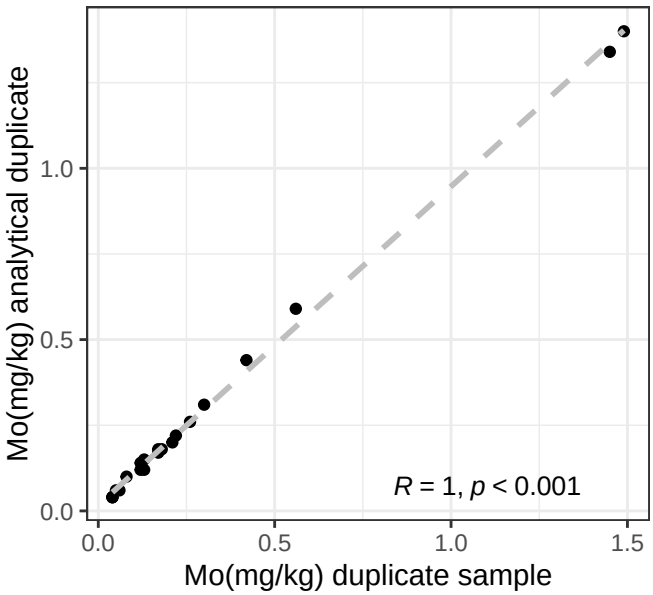

Zr(mg/kg) duplicate
Zr(mg/kg) ordinary sample
R = 0.95, p < 0.001

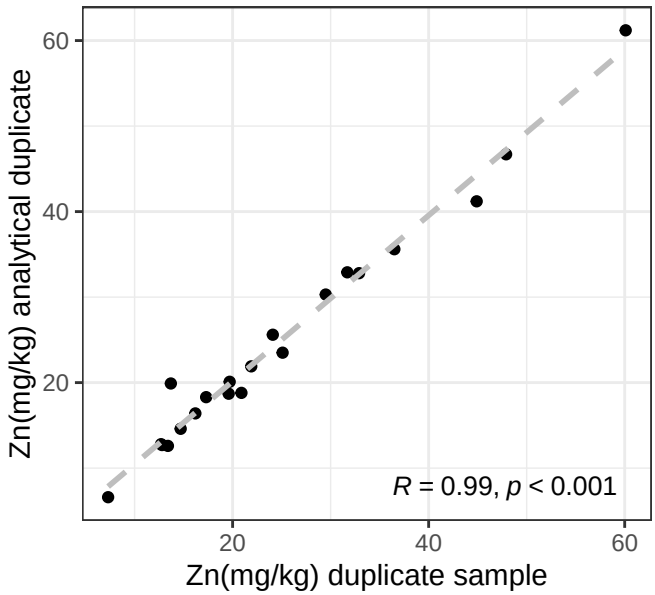

Be(mg/kg) duplicate
Be(mg/kg) ordinary sample
R = 0.96, p < 0.001

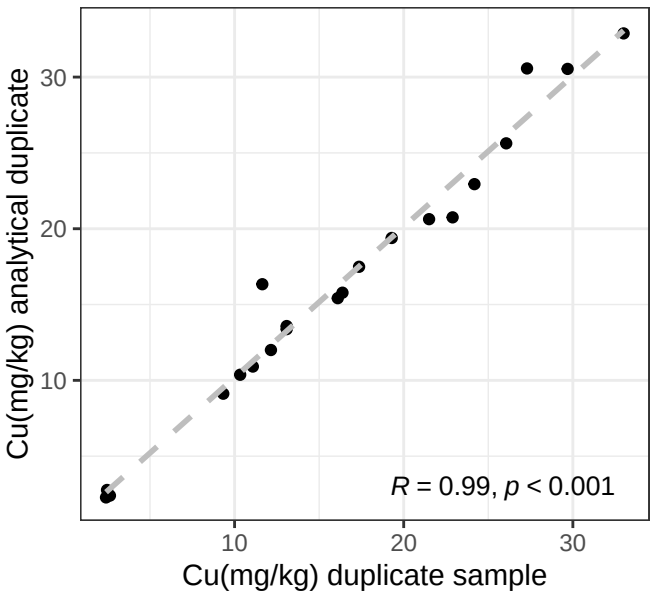

Li(mg/kg) duplicate
15
10
5
R = 0.84, p < 0.001
5
10
15
20
Li(mg/kg) ordinary sample

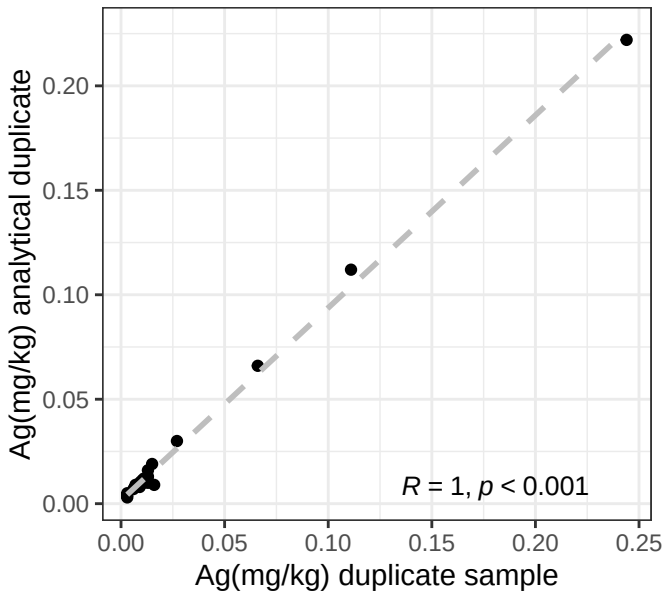
APPENDIX 5: Correlation plots, Analytical duplicates

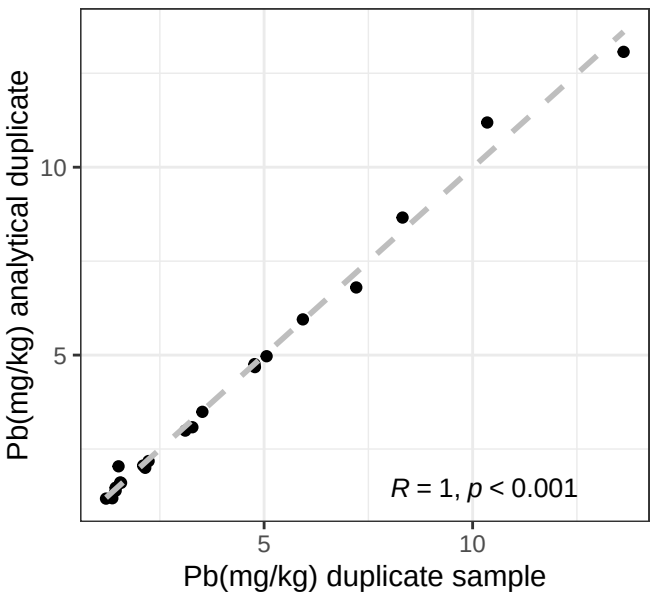
The correlation between duplicate and analytical duplicate samples shown for all elements that have at least four duplicate pairs above detection limit. Each plot includes the covariance or correlation coefficient.

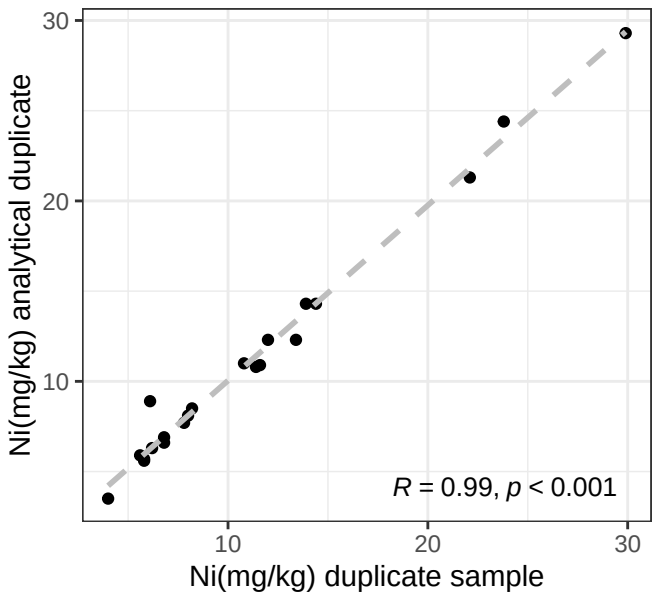

Mo(mg/kg) analytical duplicate
Mo(mg/kg) duplicate sample
R = 1, p < 0.001
0.0
0.5
1.0
1.5

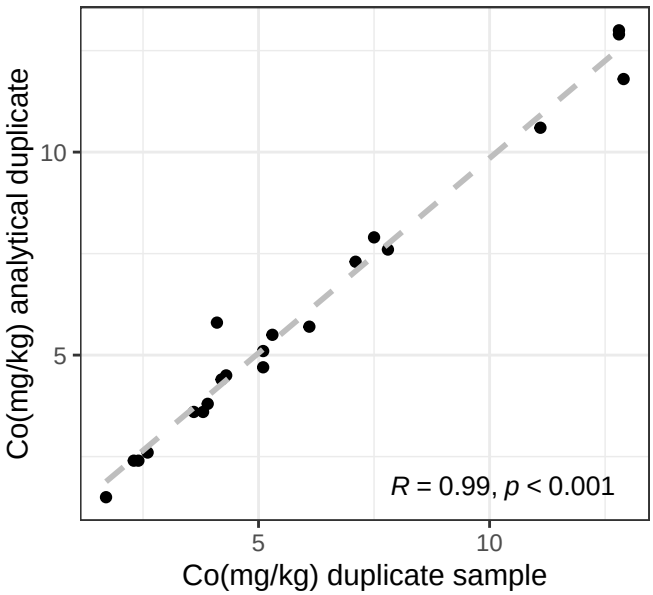

Zn(mg/kg) analytical duplicate
Zn(mg/kg) duplicate sample
R = 0.99, p < 0.001
20
40
60

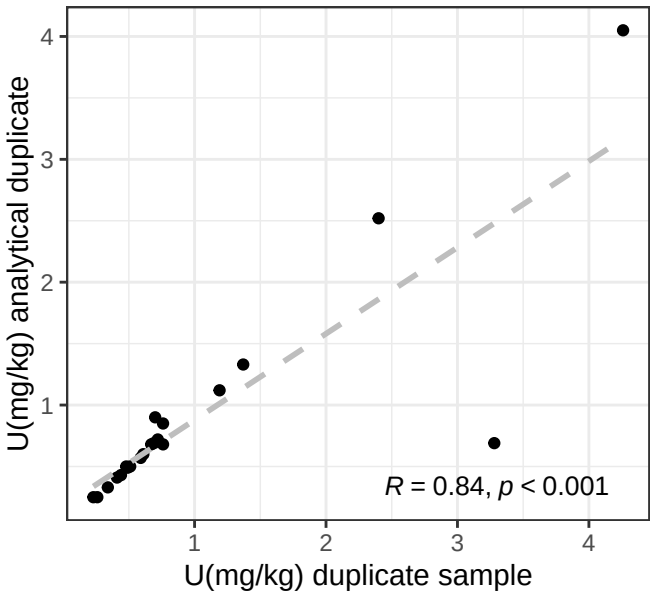

Cu(mg/kg) analytical duplicate
Cu(mg/kg) duplicate sample
R = 0.99, p < 0.001
10
20
30

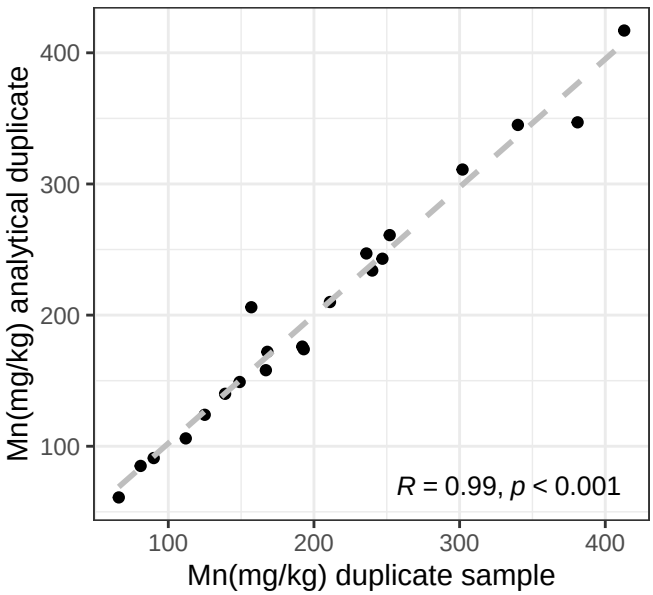

Ag(mg/kg) analytical duplicate
Ag(mg/kg) duplicate sample
R = 1, p < 0.001
0.00
0.05
0.10
0.15
0.20
0.25

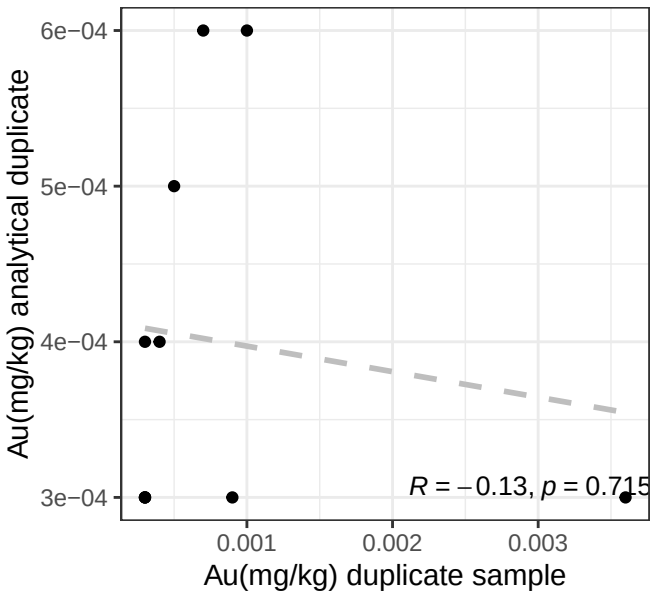

Pb(mg/kg) analytical duplicate
Pb(mg/kg) duplicate sample
R = 1, p < 0.001
5
10

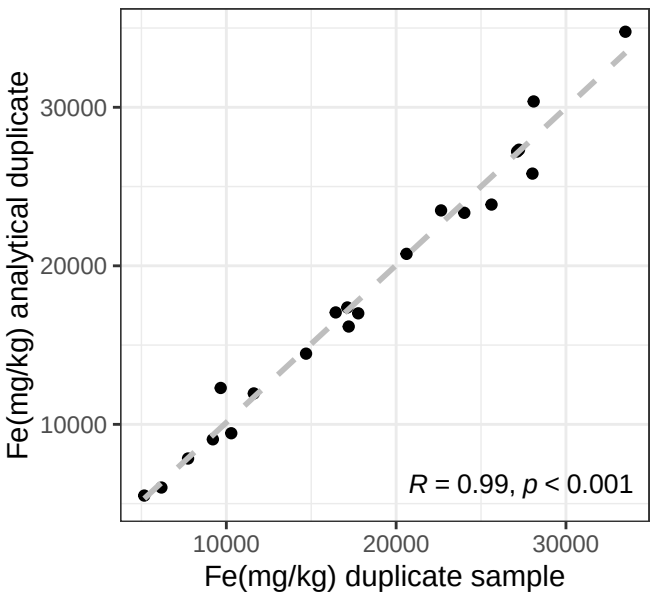

Ni(mg/kg) analytical duplicate
Ni(mg/kg) duplicate sample
R = 0.99, p < 0.001
10
20
30

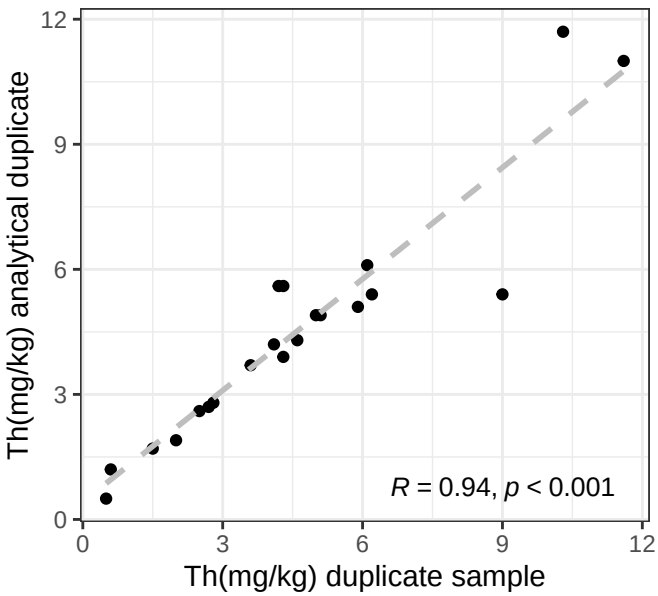

Co(mg/kg) analytical duplicate
Co(mg/kg) duplicate sample
R = 0.99, p < 0.001

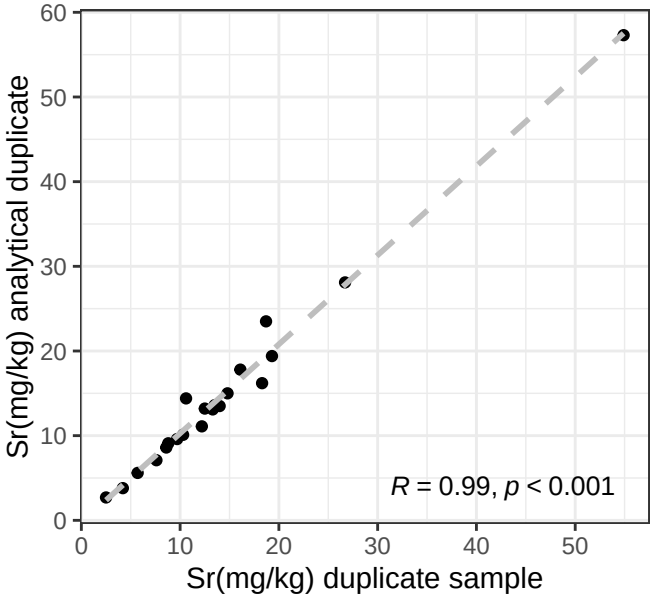

U(mg/kg) analytical duplicate
U(mg/kg) duplicate sample
R = 0.84, p < 0.001

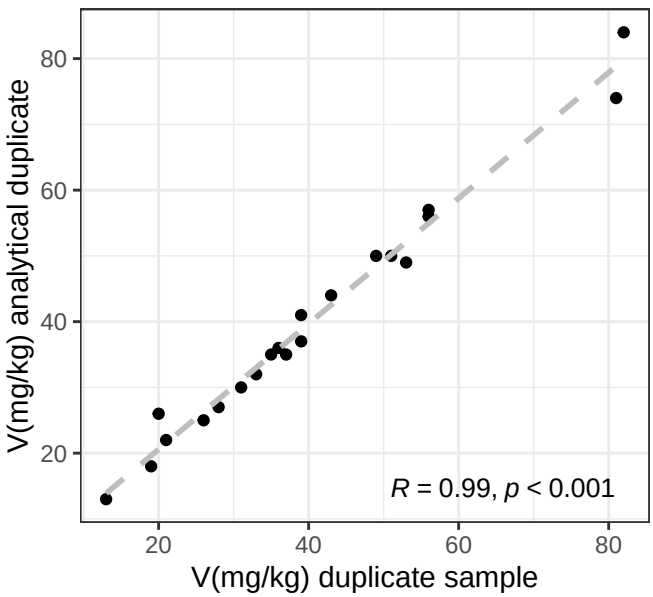

Mn(mg/kg) analytical duplicate
Mn(mg/kg) duplicate sample
R = 0.99, p < 0.001

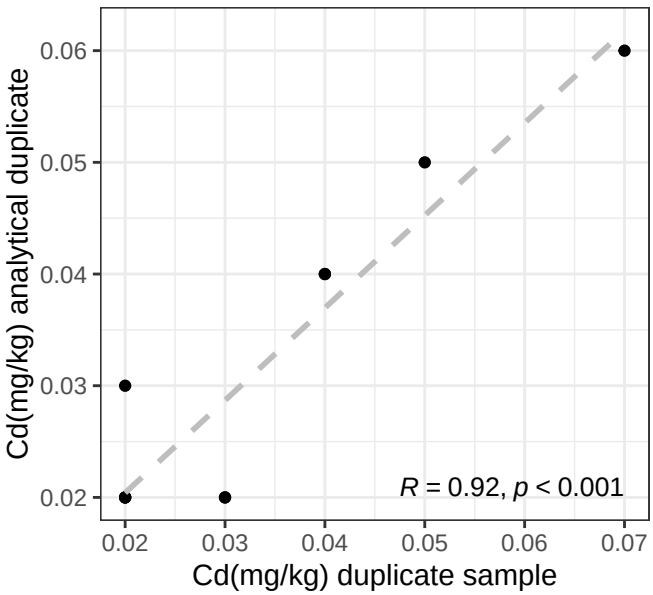

Au(mg/kg) analytical duplicate
Au(mg/kg) duplicate sample
R = −0.13, p = 0.715

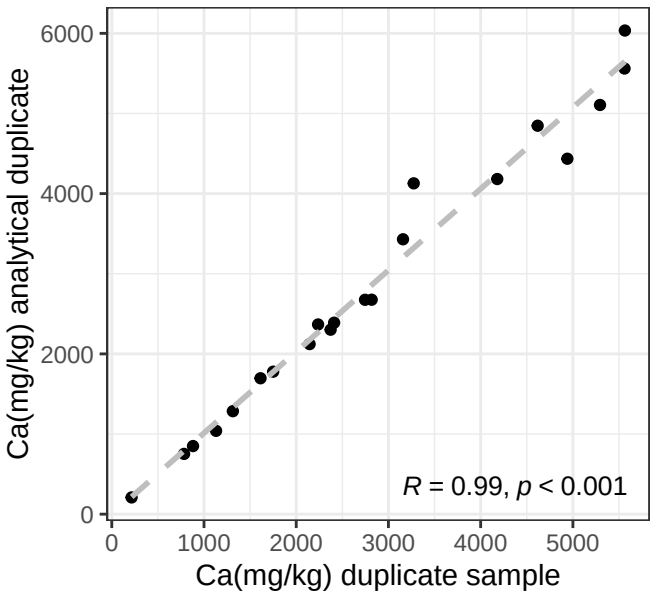

Fe(mg/kg) analytical duplicate
Fe(mg/kg) duplicate sample
R = 0.99, p < 0.001

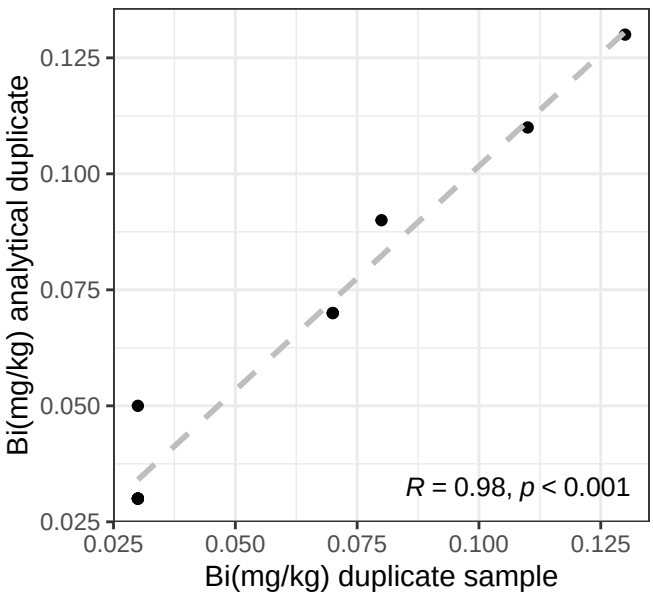

Th(mg/kg) analytical duplicate
Th(mg/kg) duplicate sample
R = 0.94, p < 0.001

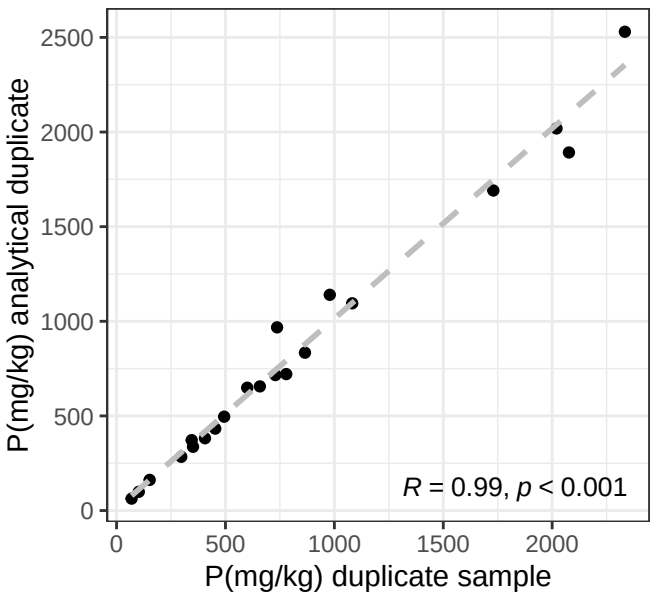

Sr(mg/kg) analytical duplicate
Sr(mg/kg) duplicate sample
R = 0.99, p < 0.001

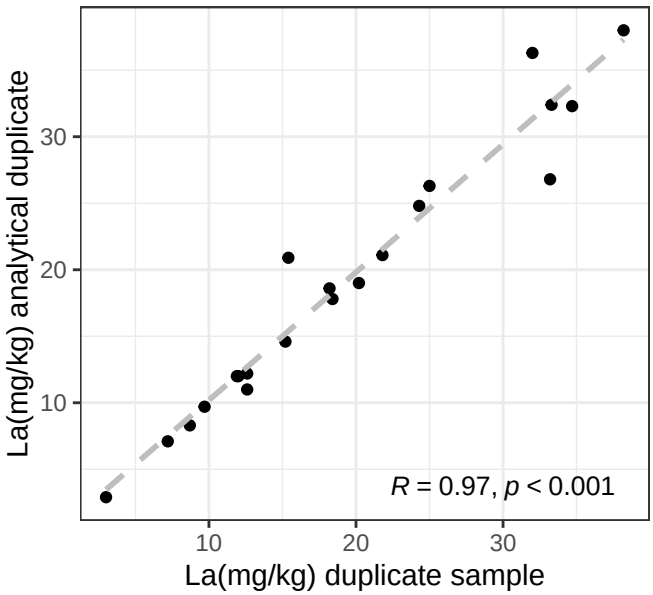

V(mg/kg) analytical duplicate
V(mg/kg) duplicate sample
R = 0.99, p < 0.001

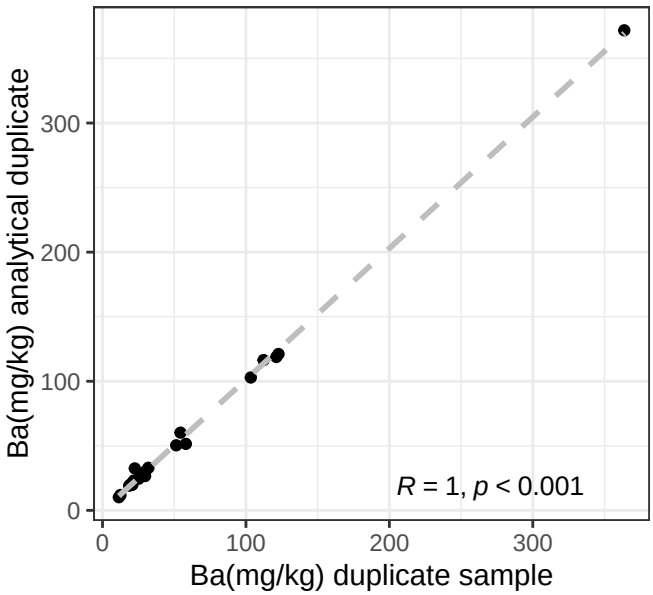

Cd(mg/kg) analytical duplicate
Cd(mg/kg) duplicate sample
R = 0.92, p < 0.001

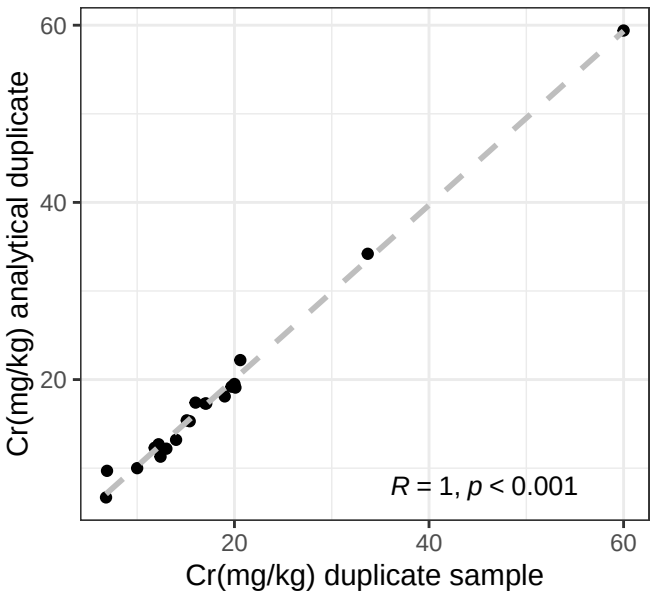

Ca(mg/kg) analytical duplicate
Ca(mg/kg) duplicate sample
R = 0.99, p < 0.001

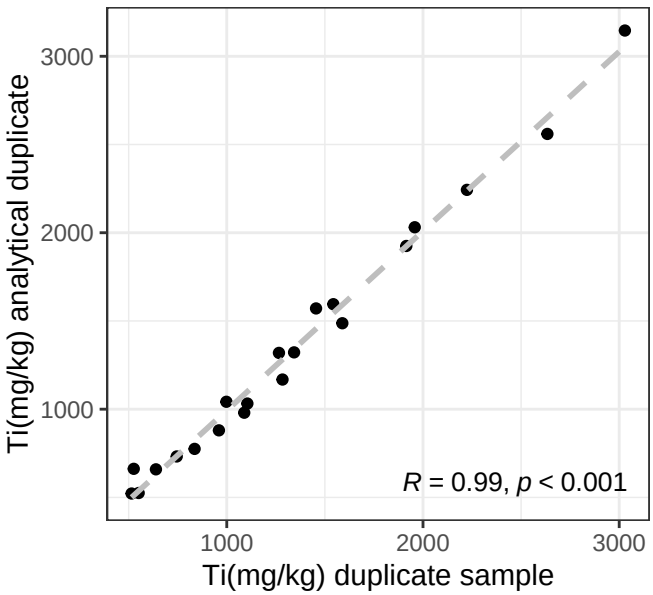

Bi(mg/kg) analytical duplicate
Bi(mg/kg) duplicate sample
R = 0.98, p < 0.001

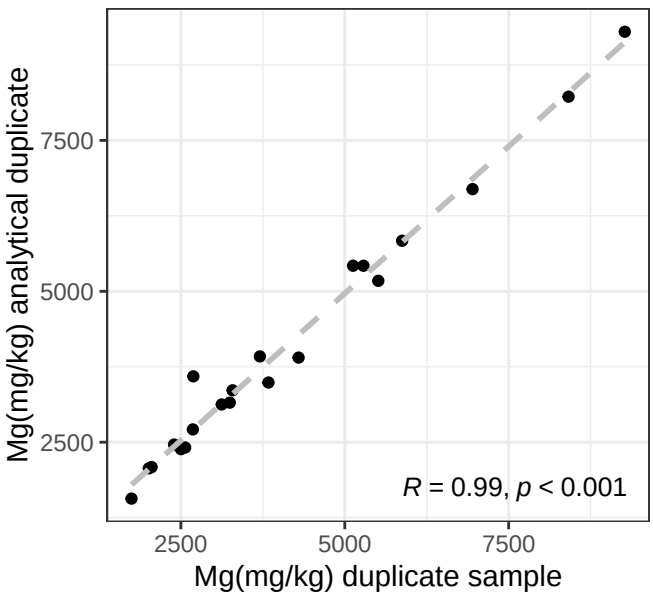

P(mg/kg) analytical duplicate
P(mg/kg) duplicate sample
R = 0.99, p < 0.001

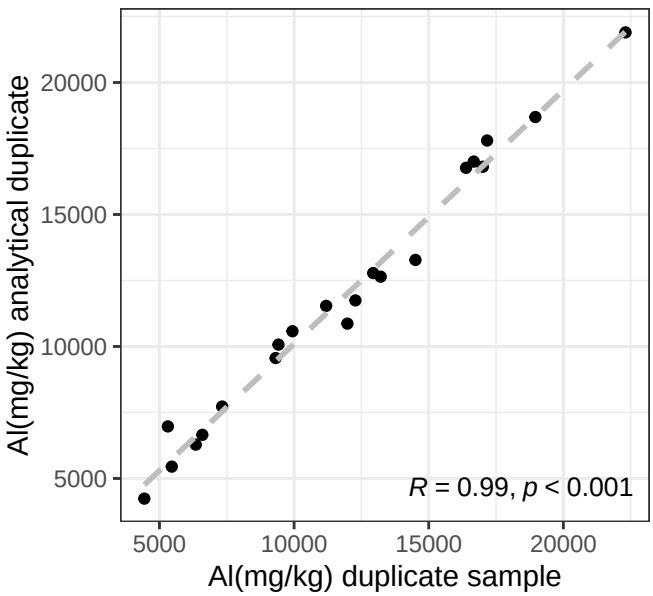

La(mg/kg) analytical duplicate
La(mg/kg) duplicate sample
R = 0.97, p < 0.001

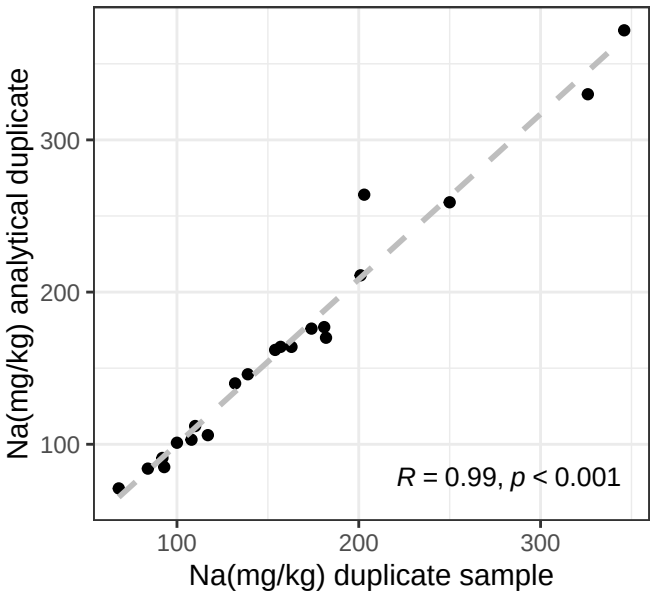

Ba(mg/kg) analytical duplicate
Ba(mg/kg) duplicate sample
R = 1, p < 0.001

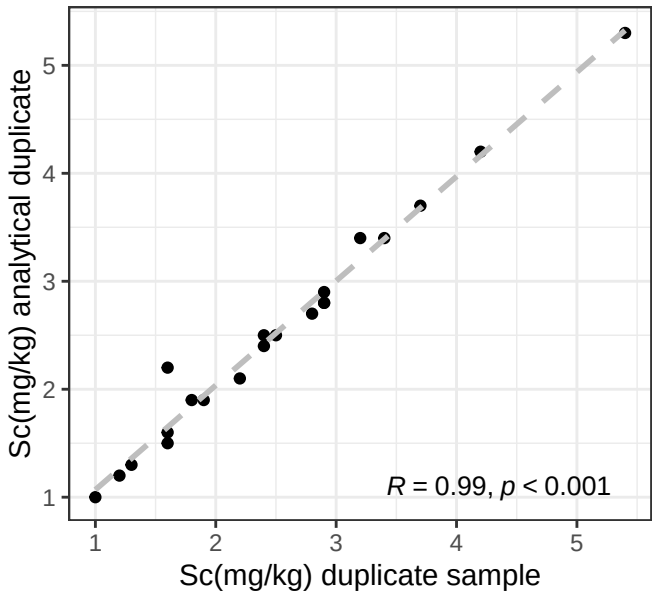

Cr(mg/kg) analytical duplicate
Cr(mg/kg) duplicate sample
R = 1, p < 0.001

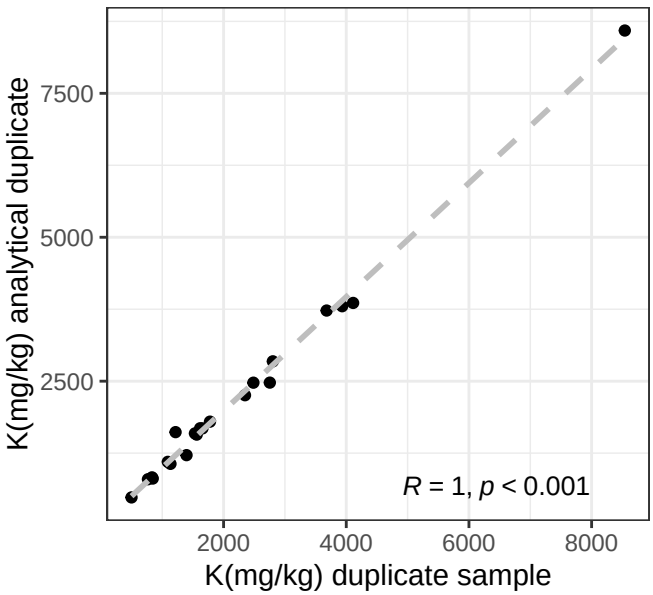

Ti(mg/kg) analytical duplicate
Ti(mg/kg) duplicate sample
R = 0.99, p < 0.001

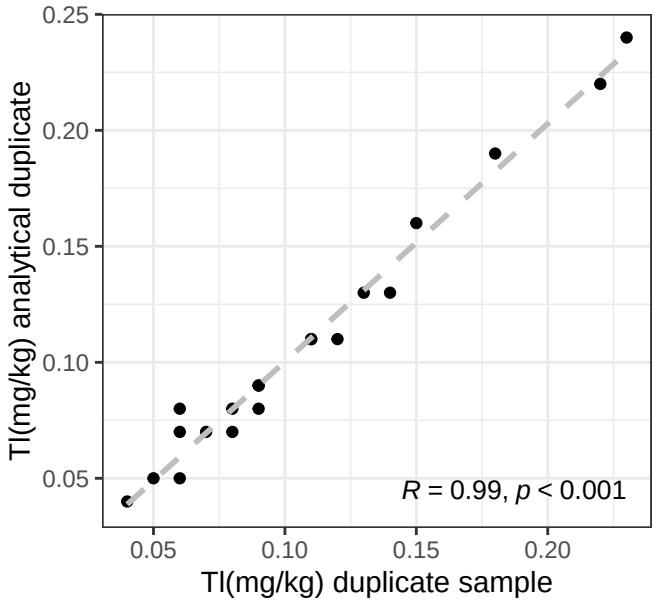

Mg(mg/kg) analytical duplicate
Mg(mg/kg) duplicate sample
R = 0.99, p < 0.001

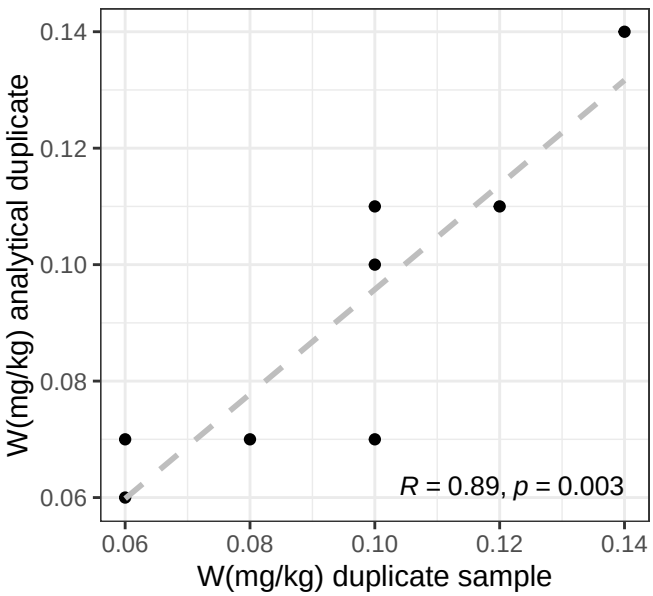

Al(mg/kg) analytical duplicate
Al(mg/kg) duplicate sample
R = 0.99, p < 0.001

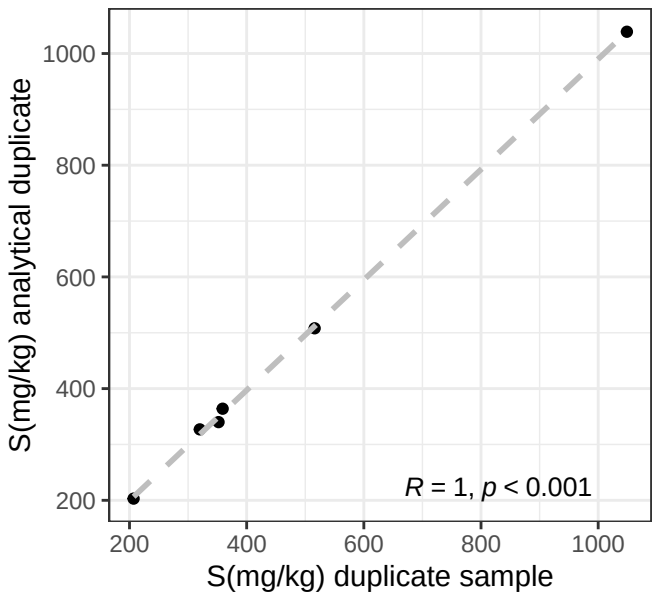

Na(mg/kg) analytical duplicate
Na(mg/kg) duplicate sample
R = 0.99, p < 0.001

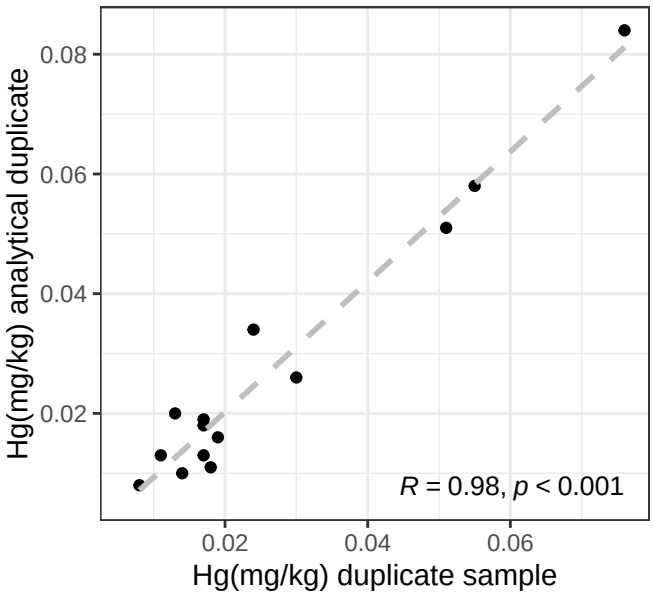

Sc(mg/kg) analytical duplicate
Sc(mg/kg) duplicate sample
R = 0.99, p < 0.001

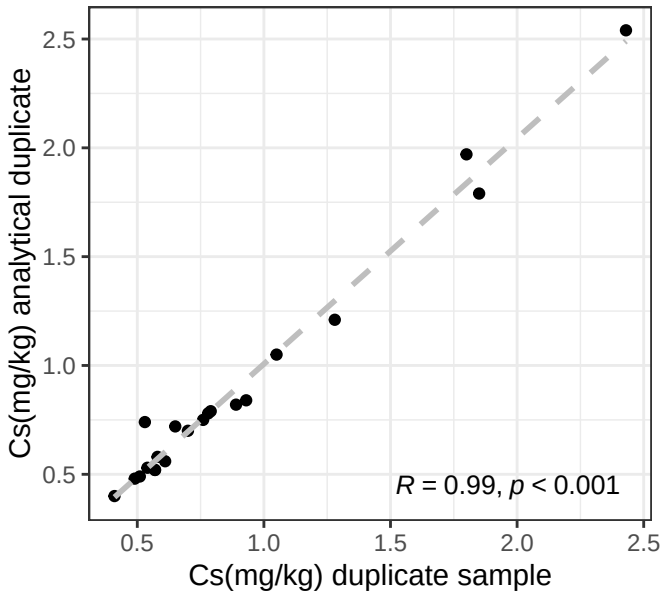

K(mg/kg) analytical duplicate
K(mg/kg) duplicate sample
R = 1, p < 0.001

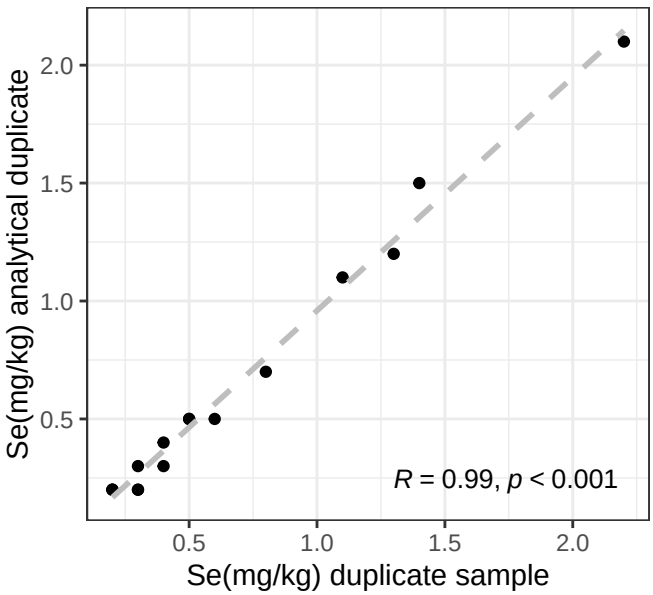

Tl(mg/kg) analytical duplicate
Tl(mg/kg) duplicate sample
R = 0.99, p < 0.001

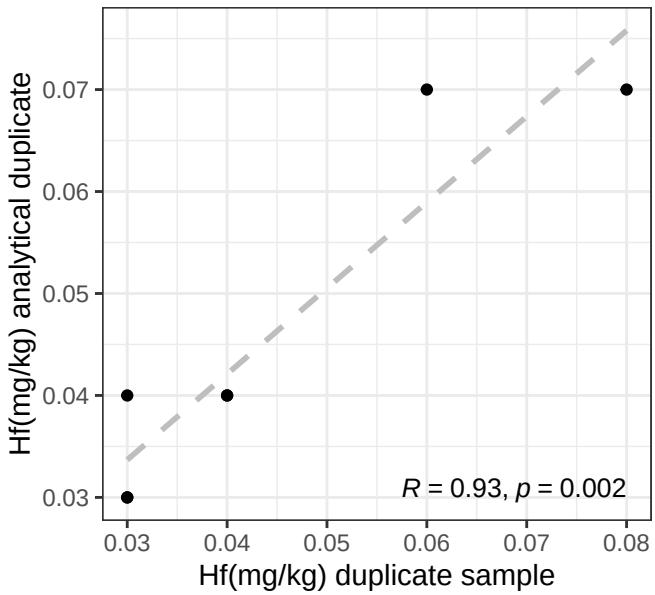

W(mg/kg) analytical duplicate
W(mg/kg) duplicate sample
R = 0.89, p = 0.003

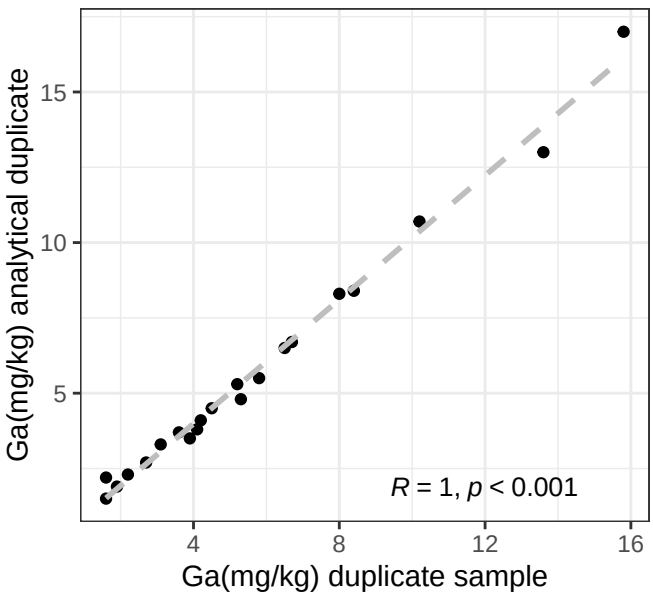

S(mg/kg) analytical duplicate
S(mg/kg) duplicate sample
R = 1, p < 0.001

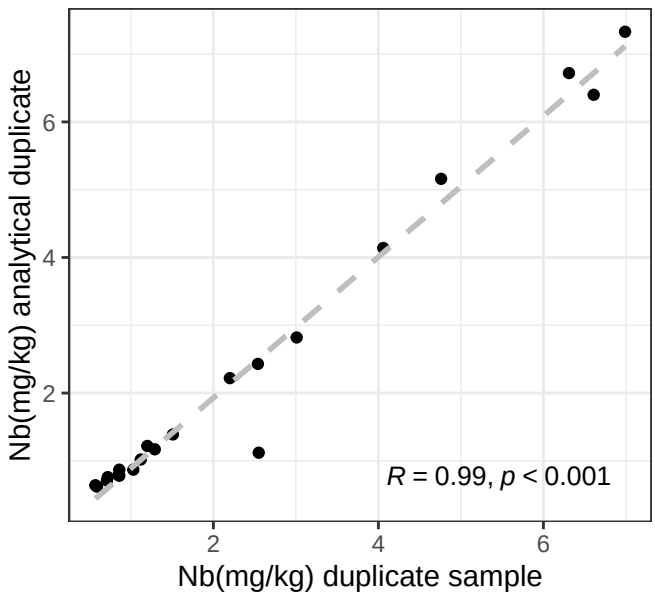

Hg(mg/kg) analytical duplicate
Hg(mg/kg) duplicate sample
R = 0.98, p < 0.001

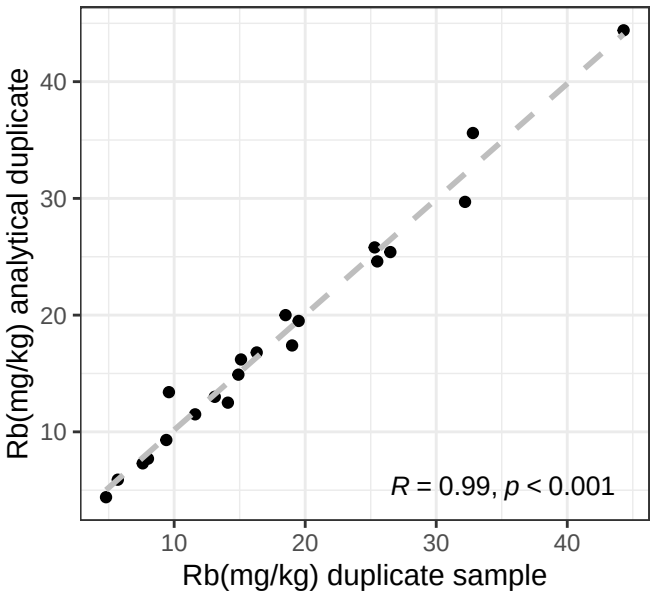

Cs(mg/kg) analytical duplicate
Cs(mg/kg) duplicate sample
R = 0.99, p < 0.001

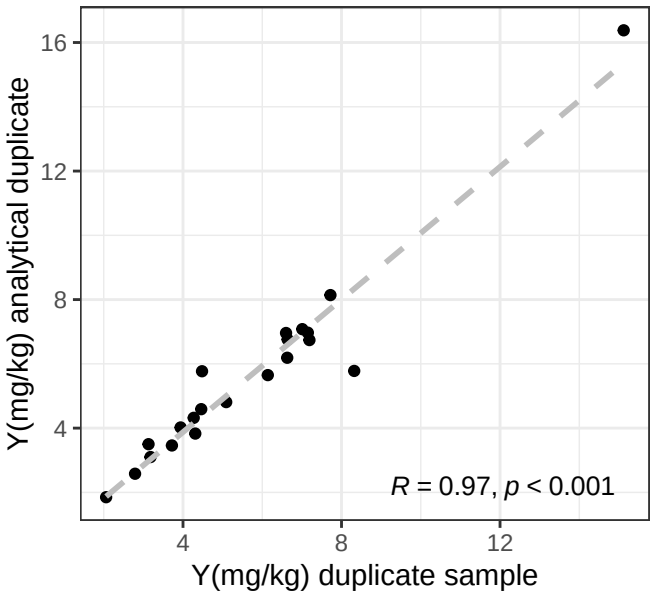

Se(mg/kg) analytical duplicate
Se(mg/kg) duplicate sample
R = 0.99, p < 0.001

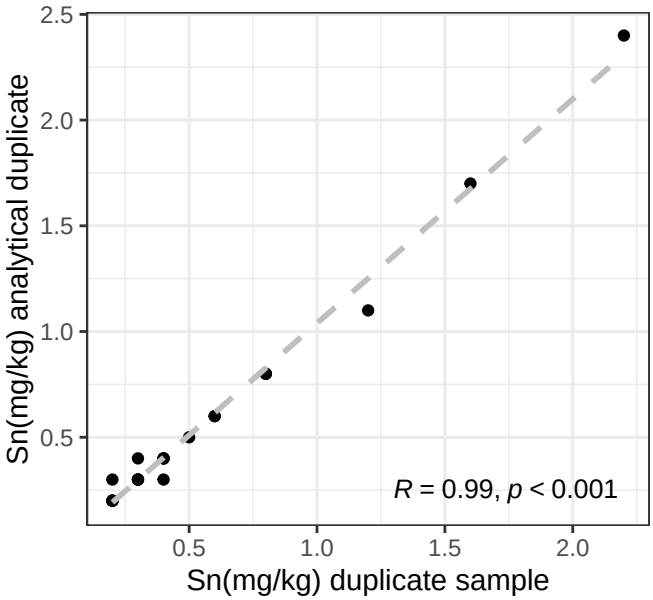

Hf(mg/kg) analytical duplicate
Hf(mg/kg) duplicate sample
R = 0.93, p = 0.002

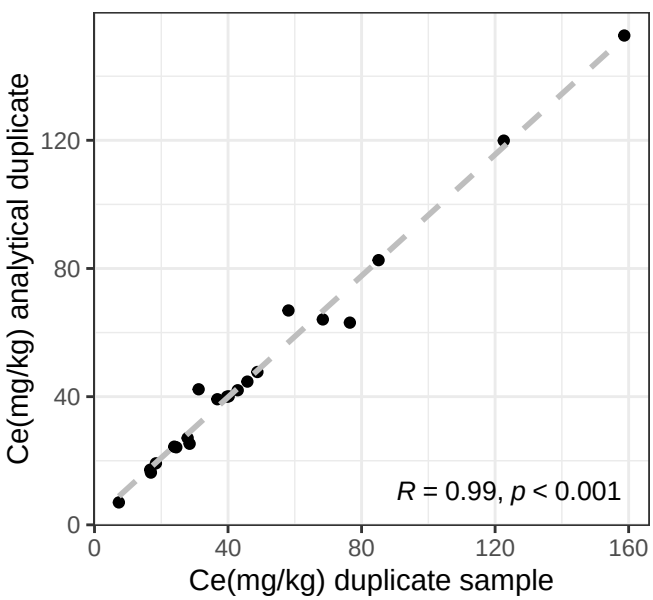

Ga(mg/kg) analytical duplicate
Ga(mg/kg) duplicate sample
R = 1, p < 0.001

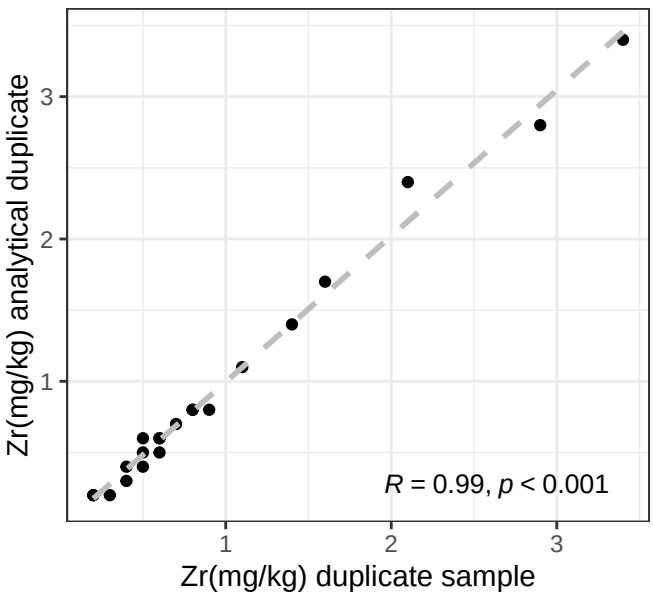

Nb(mg/kg) analytical duplicate
Nb(mg/kg) duplicate sample
R = 0.99, p < 0.001

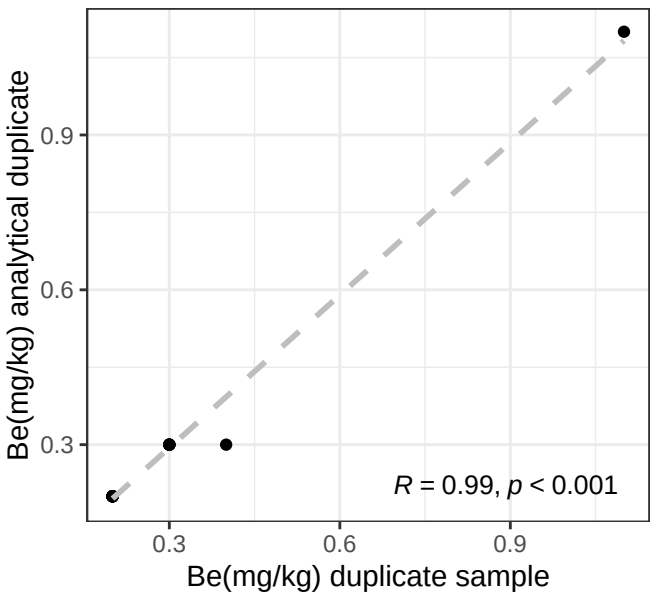

Rb(mg/kg) analytical duplicate
Rb(mg/kg) duplicate sample
R = 0.99, p < 0.001

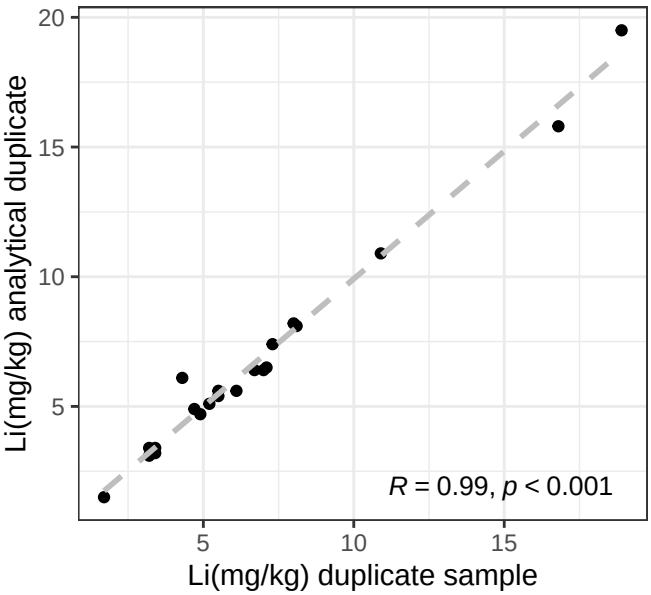

Y(mg/kg) analytical duplicate
Y(mg/kg) duplicate sample
R = 0.97, p < 0.001


Sn(mg/kg) analytical duplicate
Sn(mg/kg) duplicate sample
R = 0.99, p < 0.001


Ce(mg/kg) analytical duplicate
Ce(mg/kg) duplicate sample
R = 0.99, p < 0.001


Zr(mg/kg) analytical duplicate
Zr(mg/kg) duplicate sample
R = 0.99, p < 0.001


Be(mg/kg) analytical duplicate
Be(mg/kg) duplicate sample
R = 0.99, p < 0.001

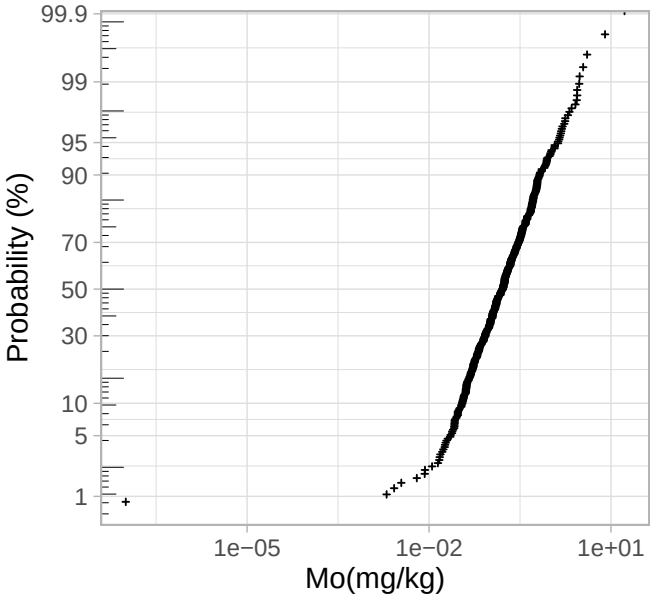

20
15
10
5
Li(mg/kg) analytical duplicate
R = 0.99, p < 0.001
5
10
15
Li(mg/kg) duplicate sample

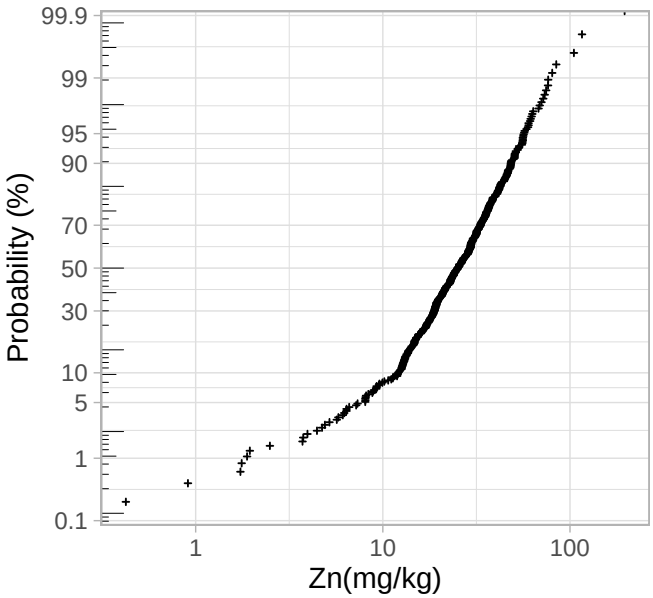
APPENDIX 6: ECDF-plots regional data

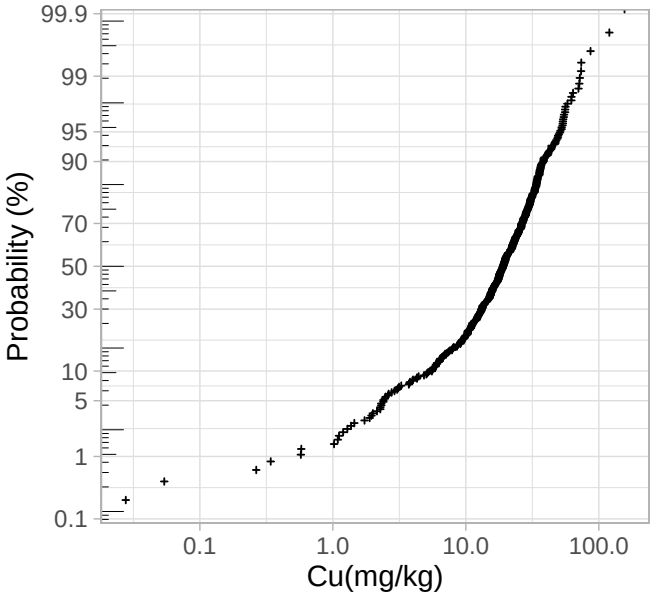
Plots of the empirical cumulative distribution function (ECDF-plots) for all 53 elements analysed.

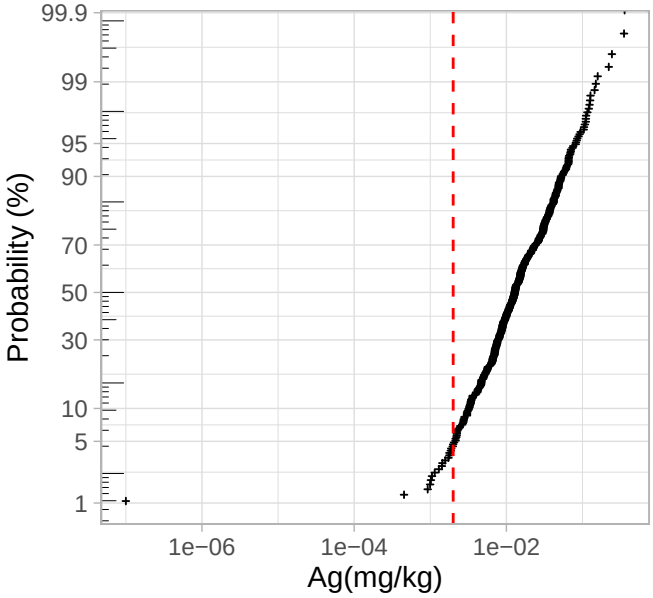
All laboratory readings are shown also those below detection limit, negative reading is however replaced by a low positive value (1×10^{-7}).

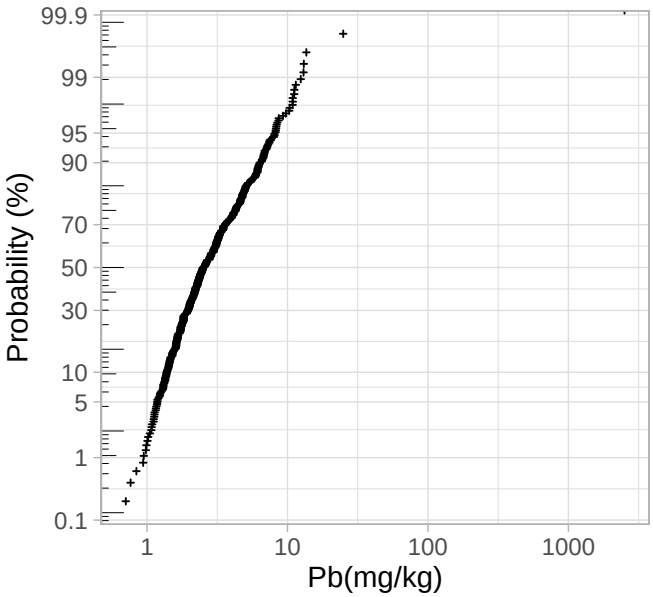
The laboratory detection limit (DL) is indicated by a red dotted for elements having concentrations close to or below DL.

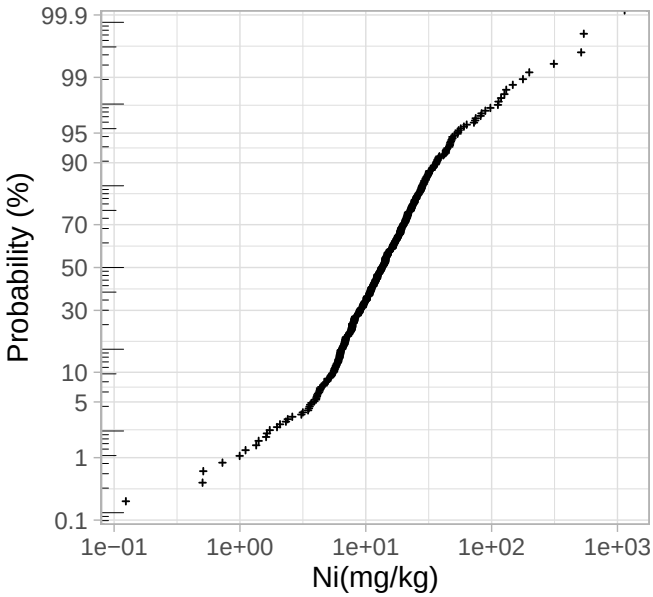

Probability (%)
99.9
99
95
90
70
50
30
10
5
1
1e−05
1e−02
1e+01
Mo(mg/kg)

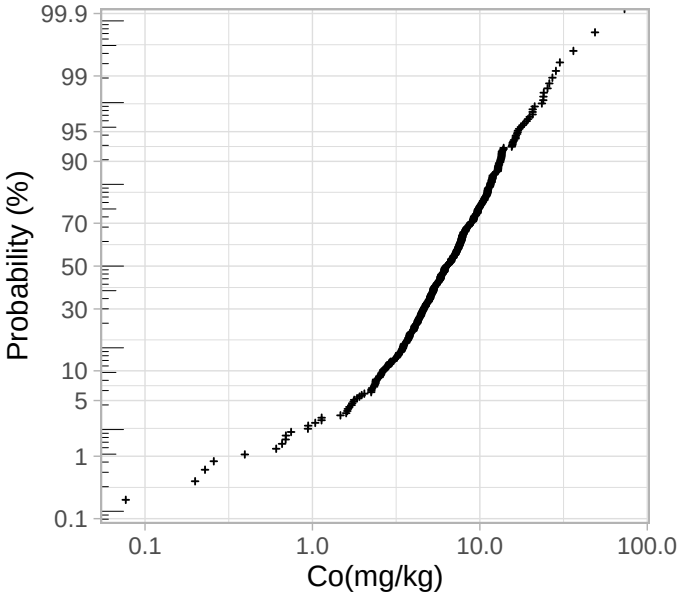

Probability (%)
99.9
99
95
90
70
50
30
10
5
1
0.1
1
10
100
Zn(mg/kg)

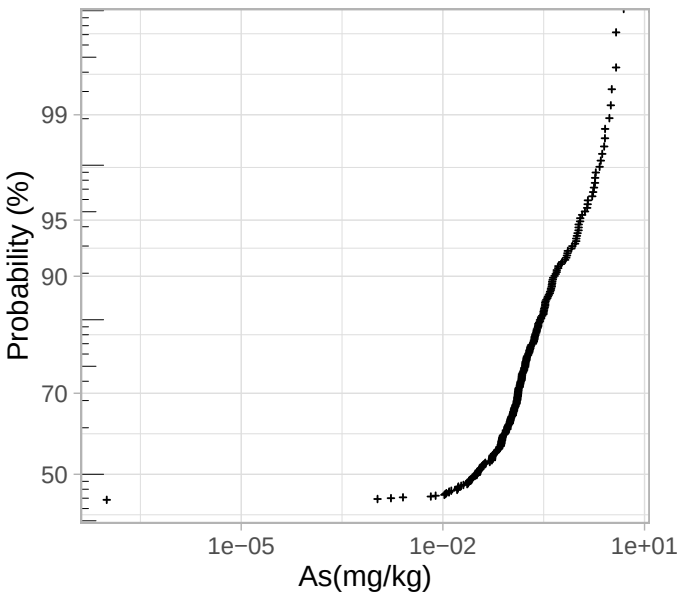

Probability (%)
99.9
99
95
90
70
50
30
10
5
1
0.1
0.1
1.0
10.0
100.0
Cu(mg/kg)

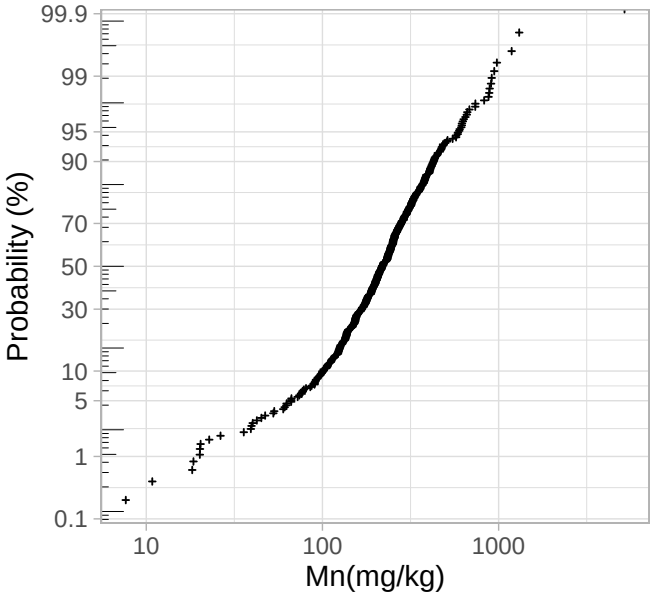

Probability (%)
99.9
99
95
90
70
50
30
10
5
1
1e−06
1e−04
1e−02
Ag(mg/kg)

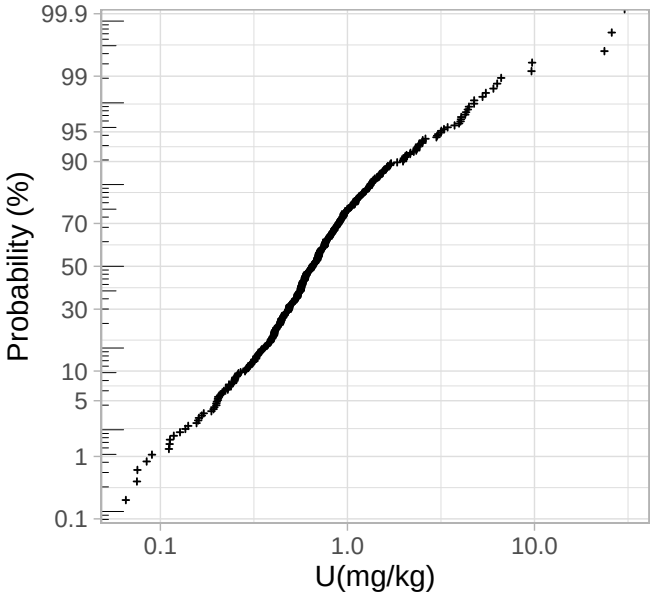

Probability (%)
99.9
99
95
90
70
50
30
10
5
1
0.1
1
10
100
1000
Pb(mg/kg)

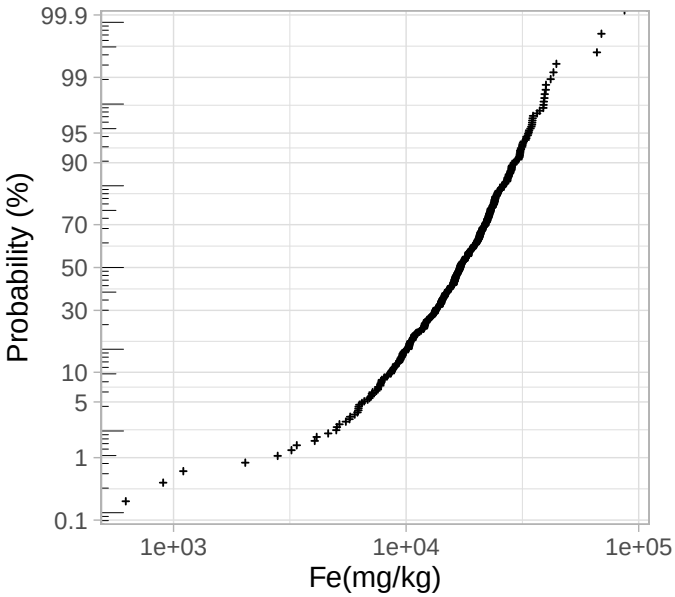

Probability (%)
99.9
99
95
90
70
50
30
10
5
1
0.1
1e−01
1e+00
1e+01
1e+02
1e+03
Ni(mg/kg)

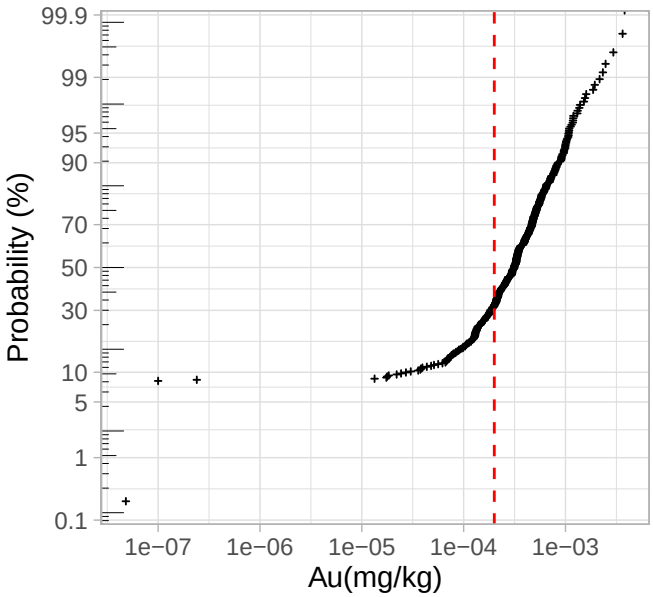

Probability (%)
99.9
99
95
90
70
50
30
10
5
1
0.1
0.1
1.0
10.0
100.0
Co(mg/kg)

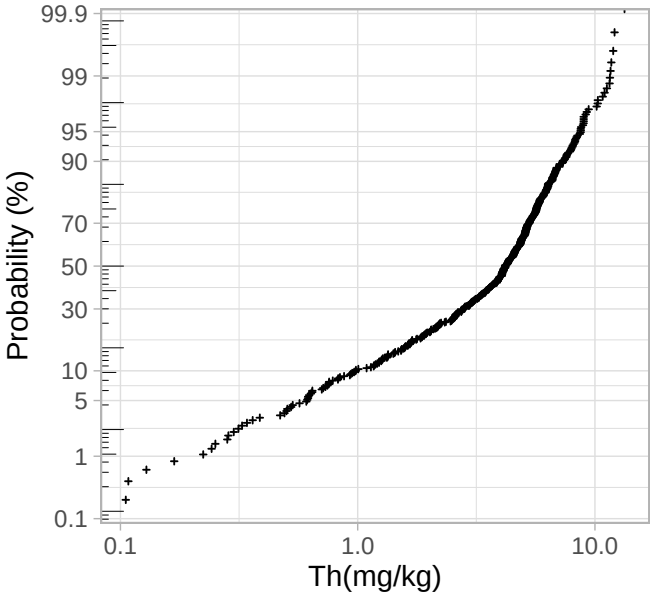

Probability (%)
99
95
90
70
50
1e−05
1e−02
1e+01
As(mg/kg)

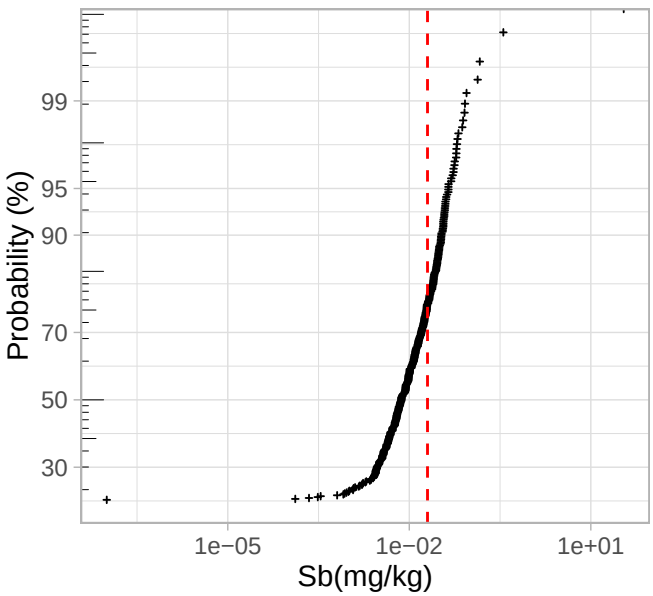

Probability (%)
99.9
99
95
90
70
50
30
10
5
1
0.1
10
100
1000
Mn(mg/kg)

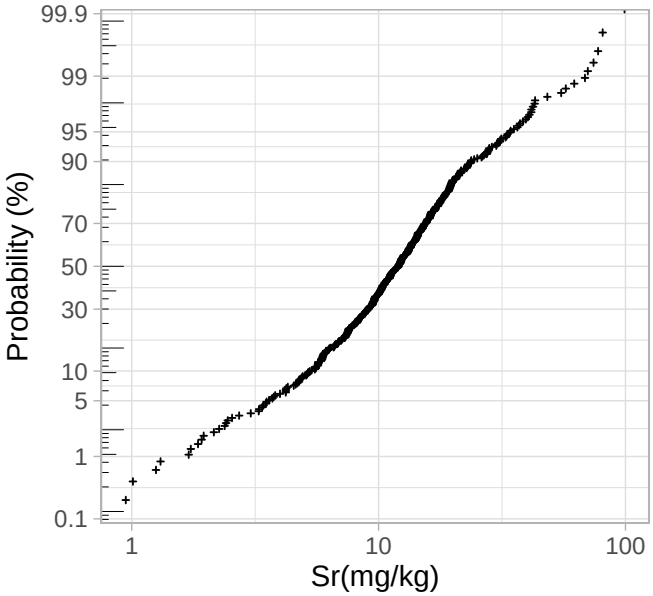

Probability (%)
99.9
99
95
90
70
50
30
10
5
1
0.1
0.1
1.0
10.0
U(mg/kg)

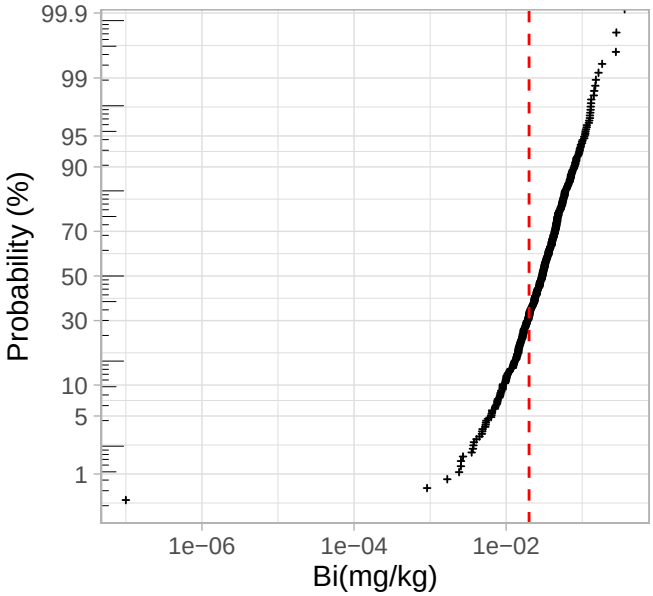

Probability (%)
99.9
99
95
90
70
50
30
10
5
1
0.1
1e+03
1e+04
1e+05
Fe(mg/kg)

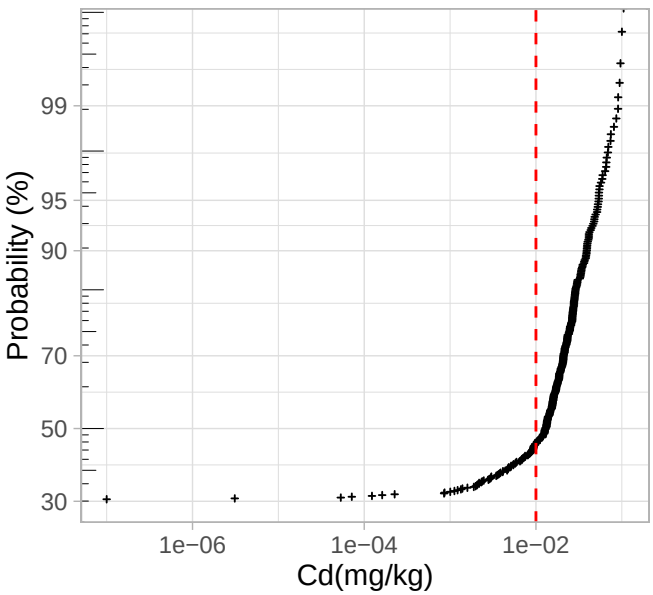

Probability (%)
99.9
99
95
90
70
50
30
10
5
1
0.1
1e−07
1e−06
1e−05
1e−04
1e−03
Au(mg/kg)

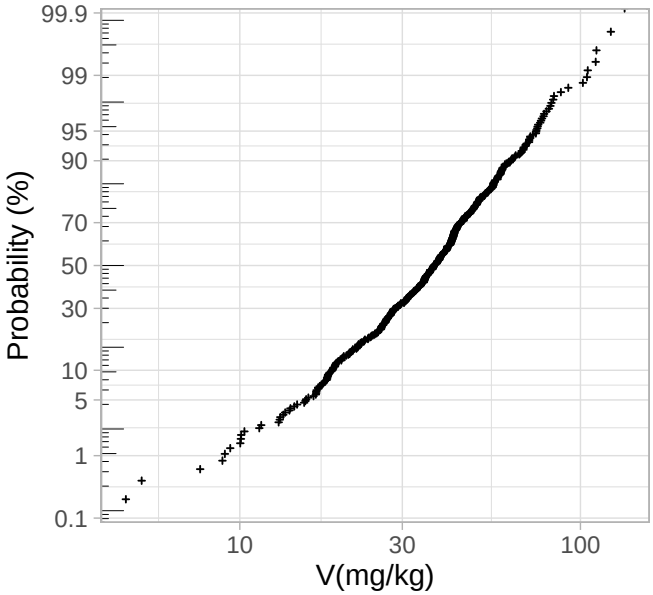

Probability (%)
99.9
99
95
90
70
50
30
10
5
1
0.1
0.1
1.0
10.0
Th(mg/kg)

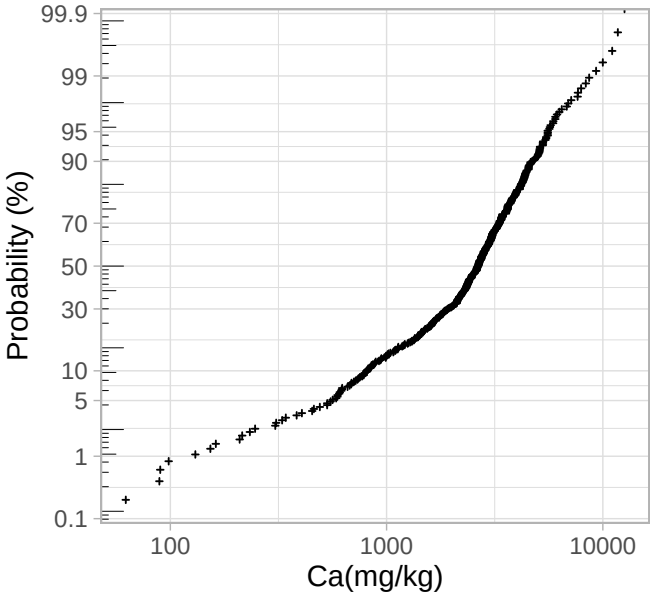

Probability (%)
99
95
90
70
50
30
1e−05
1e−02
1e+01
Sb(mg/kg)

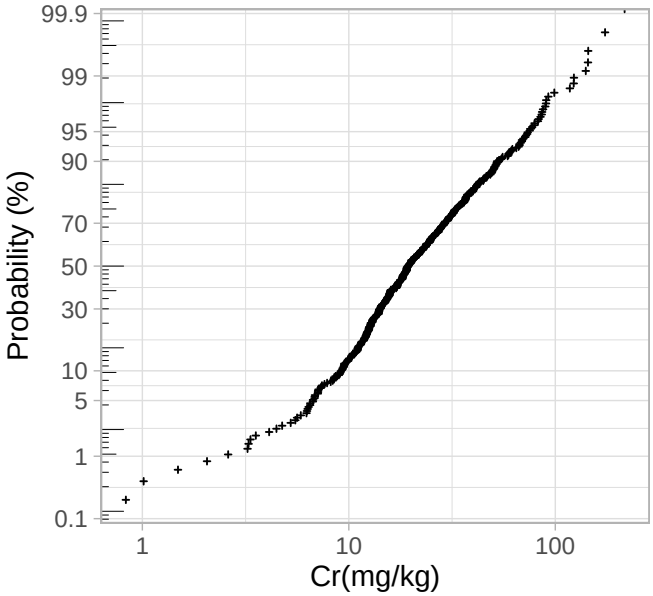

Probability (%)
99.9
99
95
90
70
50
30
10
5
1
0.1
1
10
100
Sr(mg/kg)

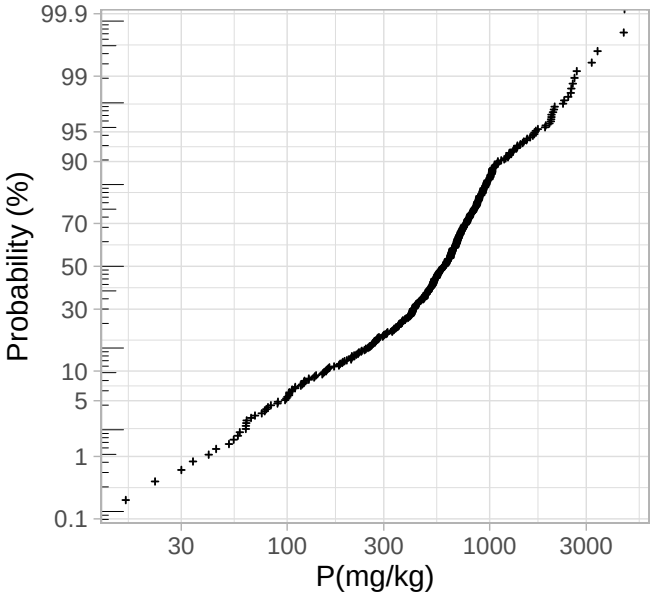

Probability (%)
99.9
99
95
90
70
50
30
10
5
1
1e−06
1e−04
1e−02
Bi(mg/kg)

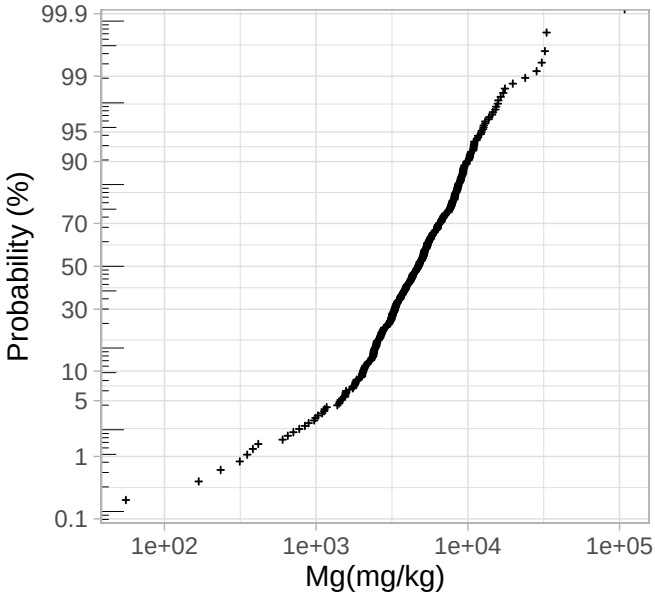

Probability (%)
99
95
90
70
50
30
1e−06
1e−04
1e−02
Cd(mg/kg)

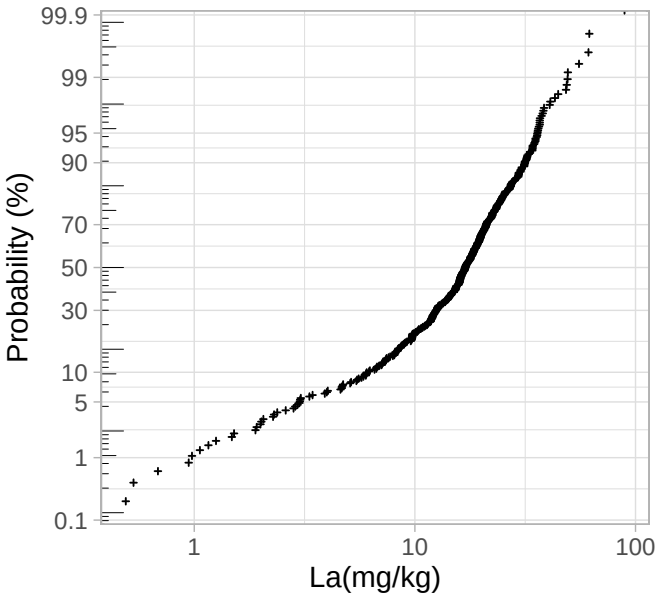

Probability (%)
99.9
99
95
90
70
50
30
10
5
1
0.1
10
30
100
V(mg/kg)

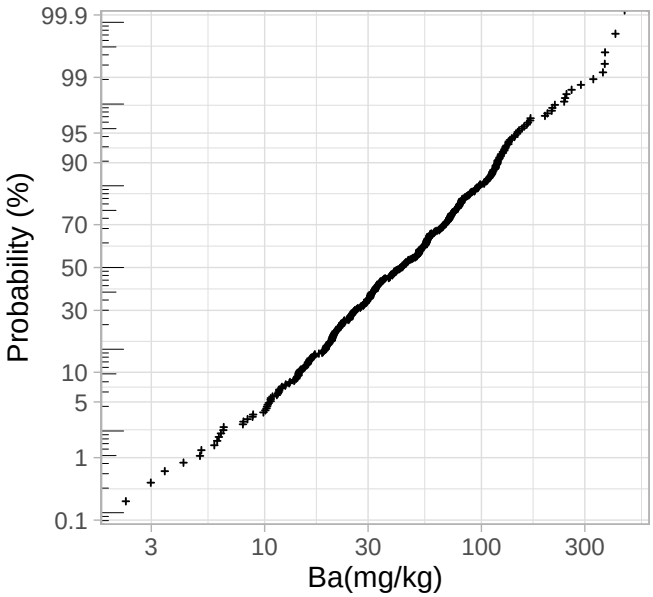

Probability (%)
99.9
99
95
90
70
50
30
10
5
1
0.1
100
1000
10000
Ca(mg/kg)

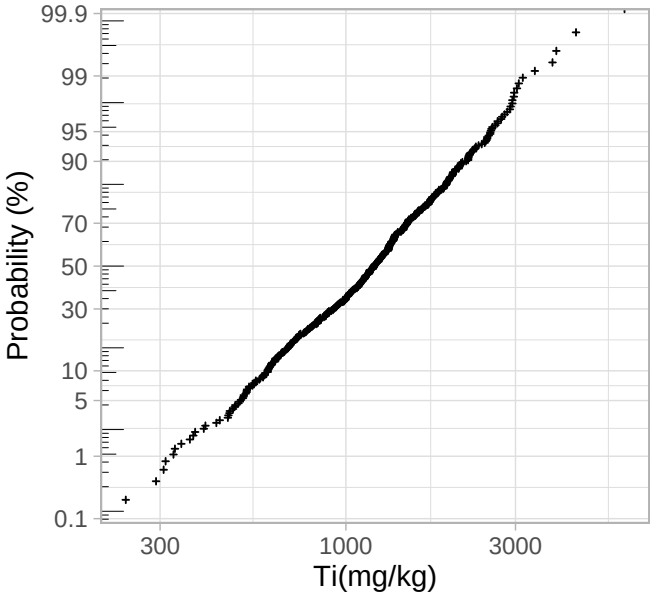

Probability (%)
99.9
99
95
90
70
50
30
10
5
1
0.1
1
10
100
Cr(mg/kg)

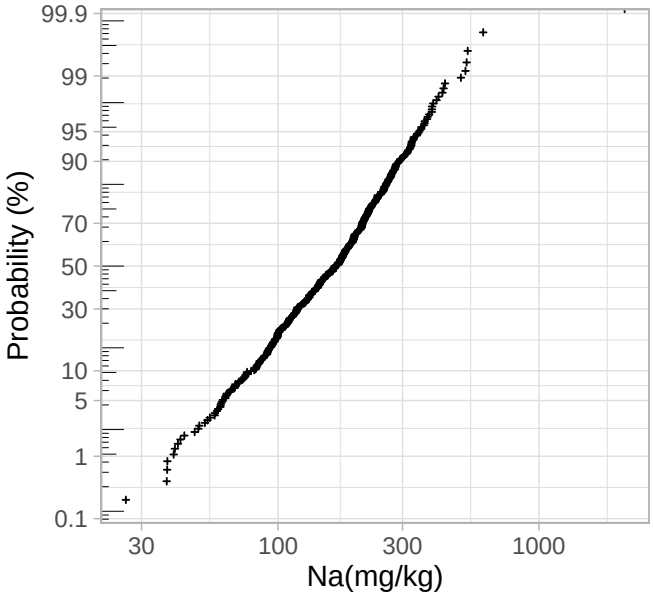

Probability (%)
99.9
99
95
90
70
50
30
10
5
1
0.1
30
100
300
1000
3000
P(mg/kg)

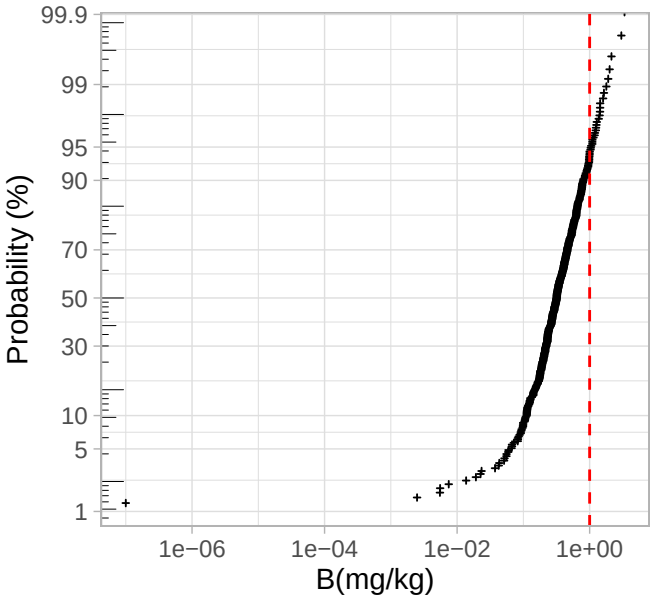

Probability (%)
99.9
99
95
90
70
50
30
10
5
1
0.1
1e+02
1e+03
1e+04
1e+05
Mg(mg/kg)

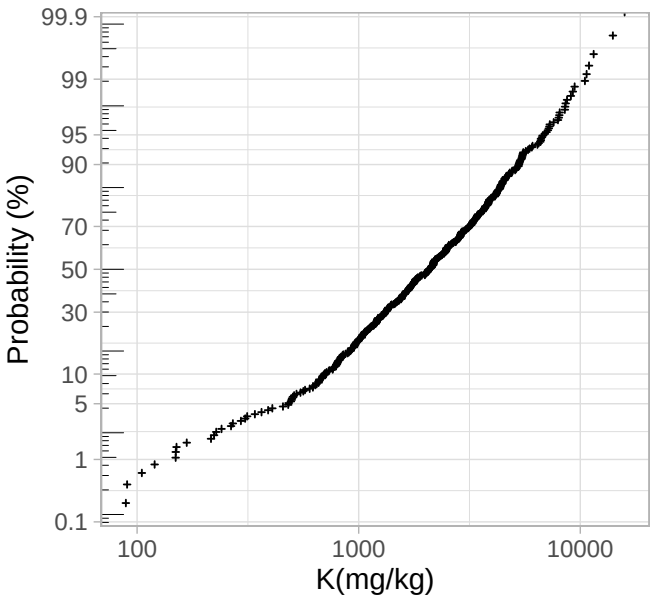

Probability (%)
99.9
99
95
90
70
50
30
10
5
1
0.1
1
10
100
La(mg/kg)

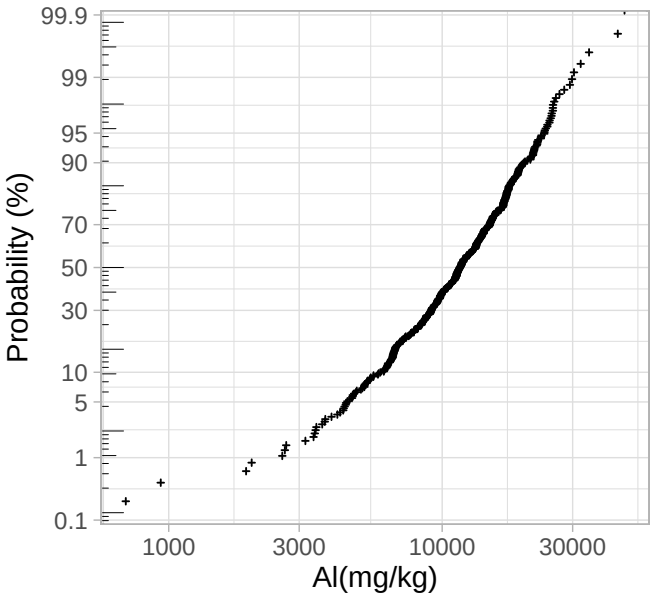

Probability (%)
99.9
99
95
90
70
50
30
10
5
1
0.1
3
10
30
100
300
Ba(mg/kg)

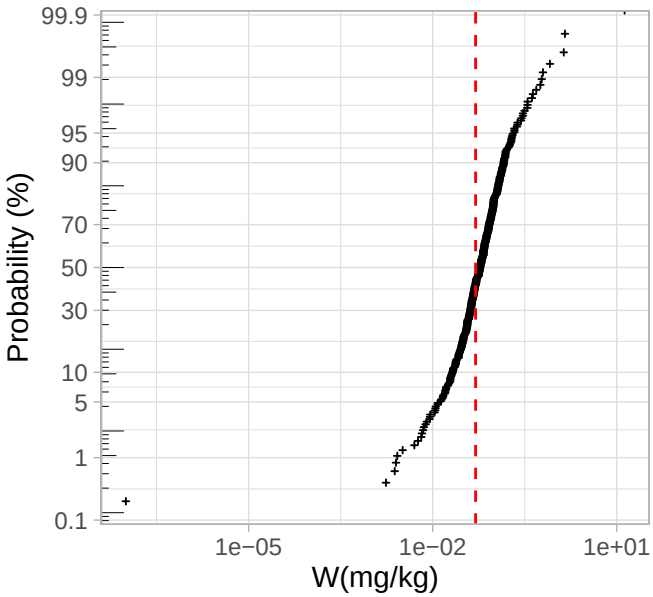

Probability (%)
99.9
99
95
90
70
50
30
10
5
1
0.1
300
1000
3000
Ti(mg/kg)

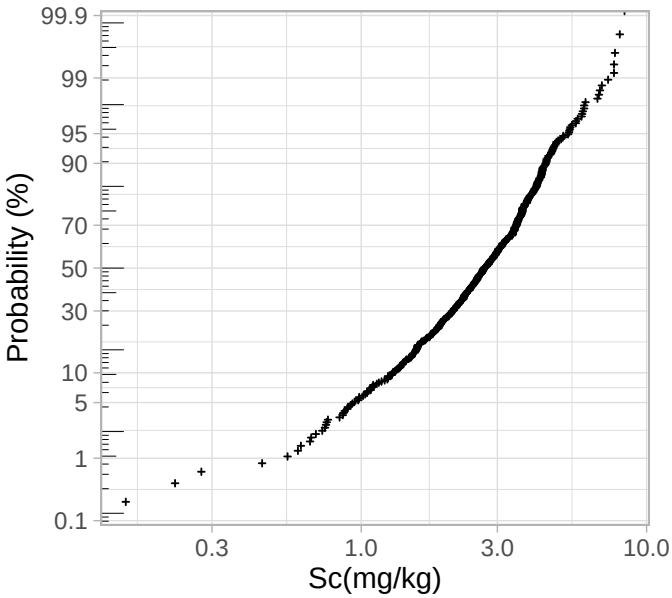

Probability (%)
99.9
99
95
90
70
50
30
10
5
1
0.1
30
100
300
1000
Na(mg/kg)

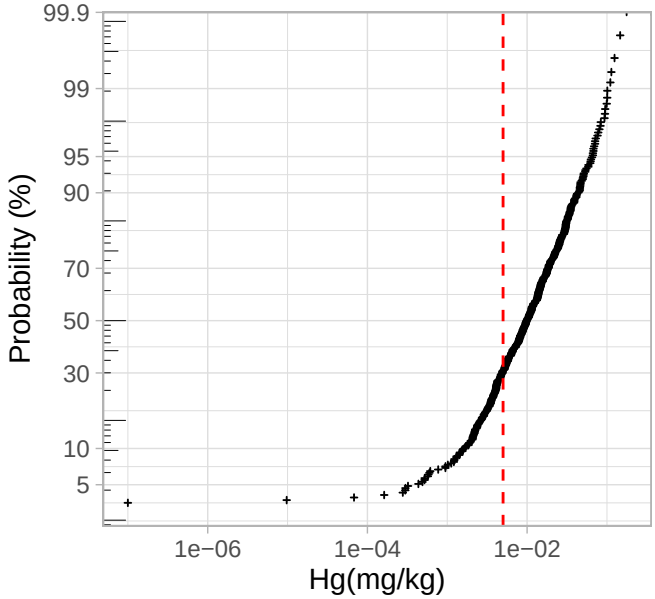

Probability (%)
99.9
99
95
90
70
50
30
10
5
1
1e−06
1e−04
1e−02
1e+00
B(mg/kg)

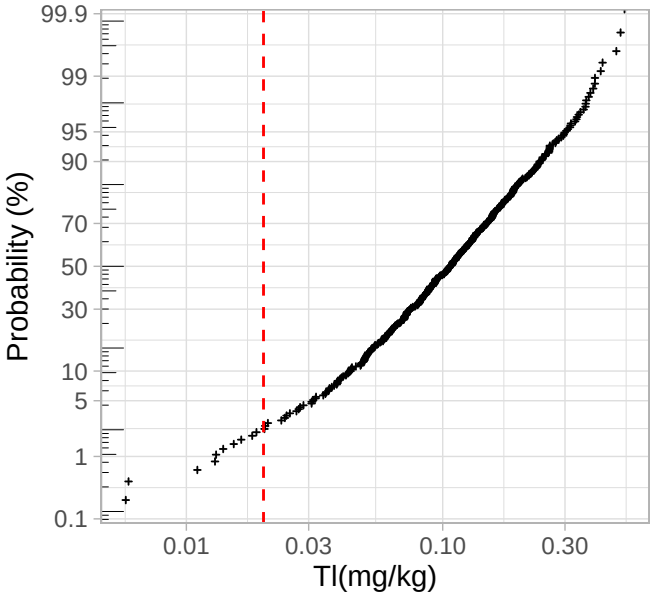

Probability (%)
99.9
99
95
90
70
50
30
10
5
1
0.1
100
1000
10000
K(mg/kg)

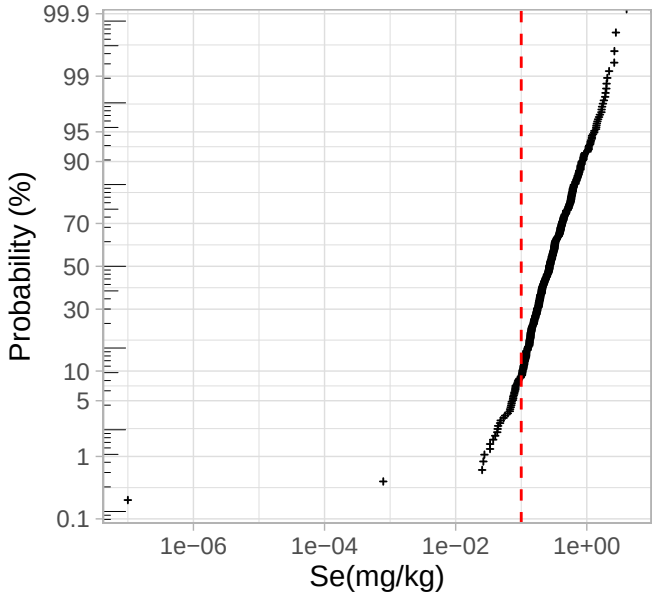

Probability (%)
99.9
99
95
90
70
50
30
10
5
1
0.1
1000
3000
10000
30000
Al(mg/kg)

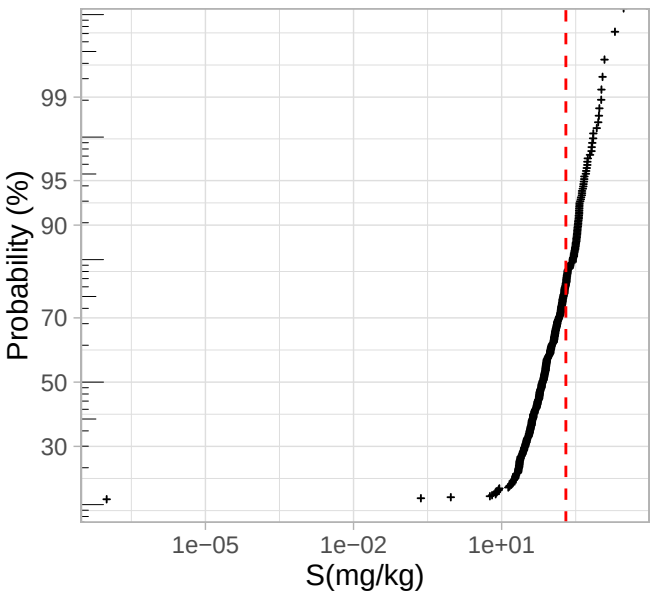

Probability (%)
99.9
99
95
90
70
50
30
10
5
1
0.1
1e−05
1e−02
1e+01
W(mg/kg)

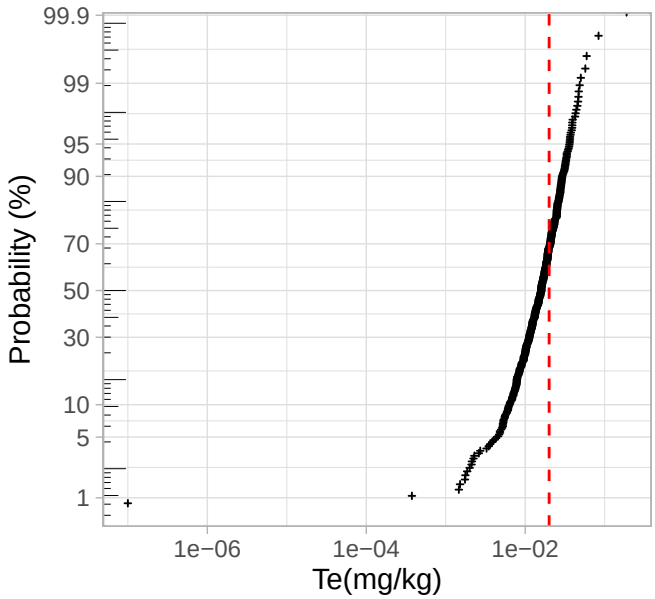

Probability (%)
99.9
99
95
90
70
50
30
10
5
1
0.1
0.3
1.0
3.0
10.0
Sc(mg/kg)

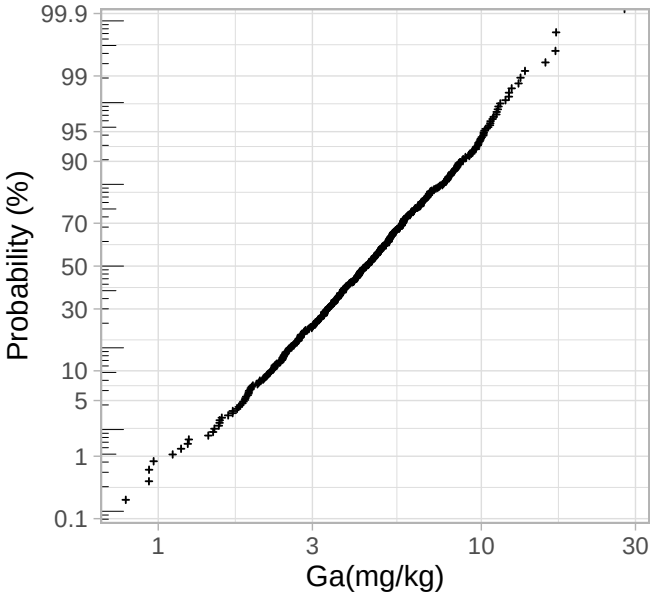

Probability (%)
99.9
99
95
90
70
50
30
10
5
1e−06
1e−04
1e−02
Hg(mg/kg)

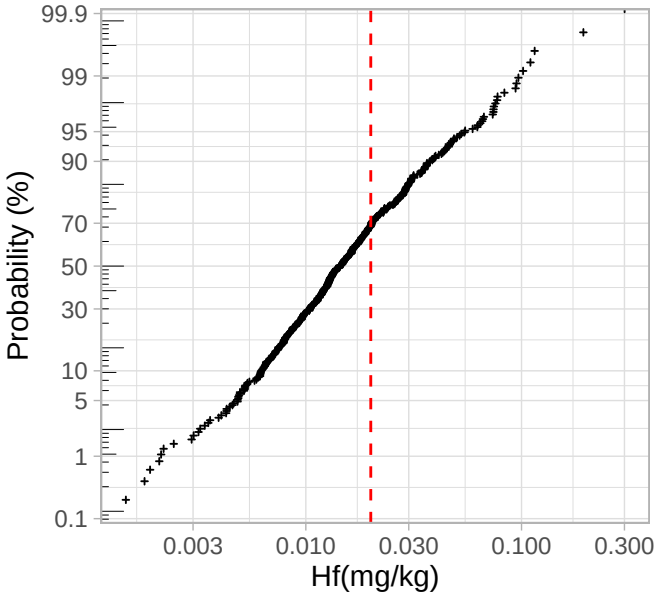

Probability (%)
99.9
99
95
90
70
50
30
10
5
1
0.1
0.01
0.03
0.10
0.30
Tl(mg/kg)

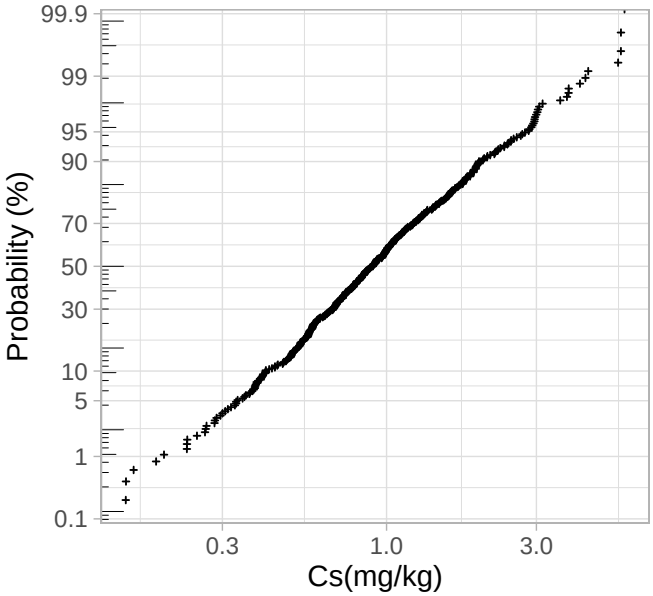

Probability (%)
99.9
99
95
90
70
50
30
10
5
1
0.1
1e−06
1e−04
1e−02
1e+00
Se(mg/kg)

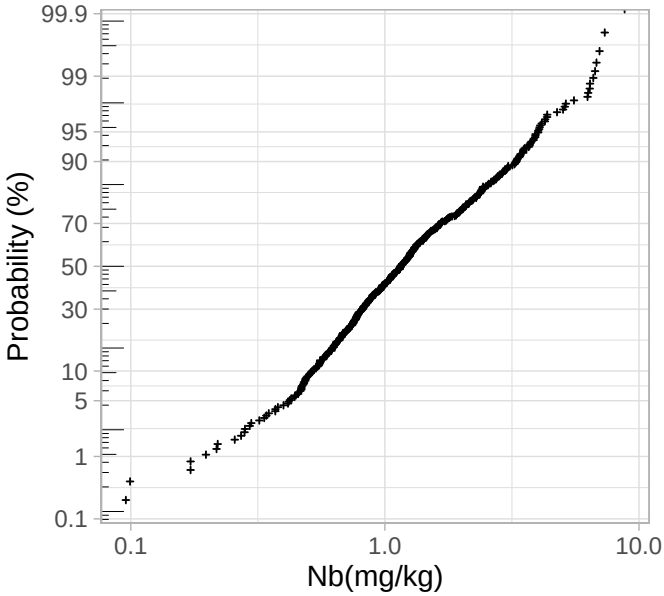

Probability (%)
99
95
90
70
50
30
1e−05
1e−02
1e+01
S(mg/kg)

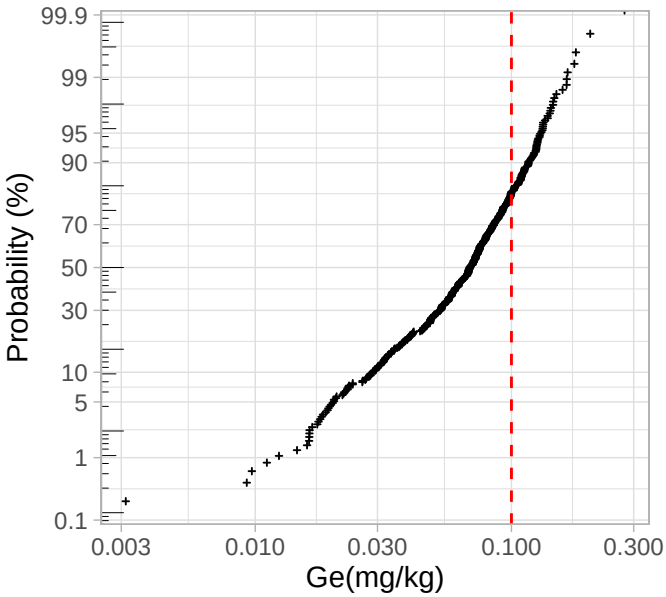

Probability (%)
99.9
99
95
90
70
50
30
10
5
1
1e−06
1e−04
1e−02
Te(mg/kg)

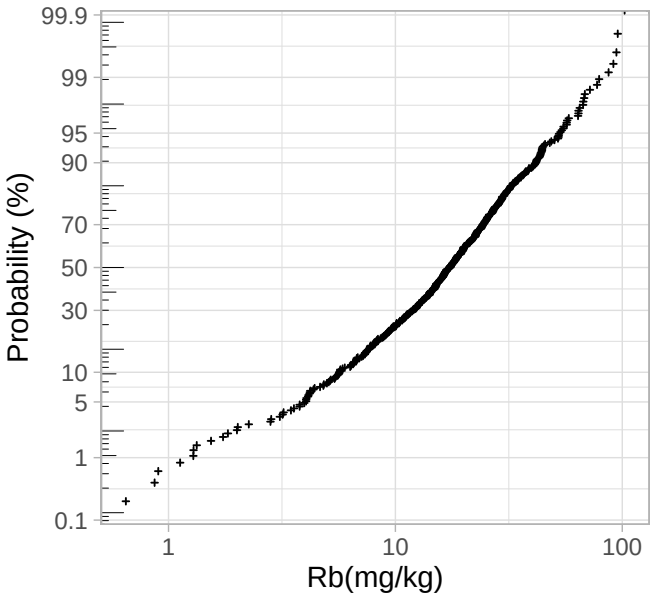

Probability (%)
99.9
99
95
90
70
50
30
10
5
1
0.1
1
3
10
30
Ga(mg/kg)

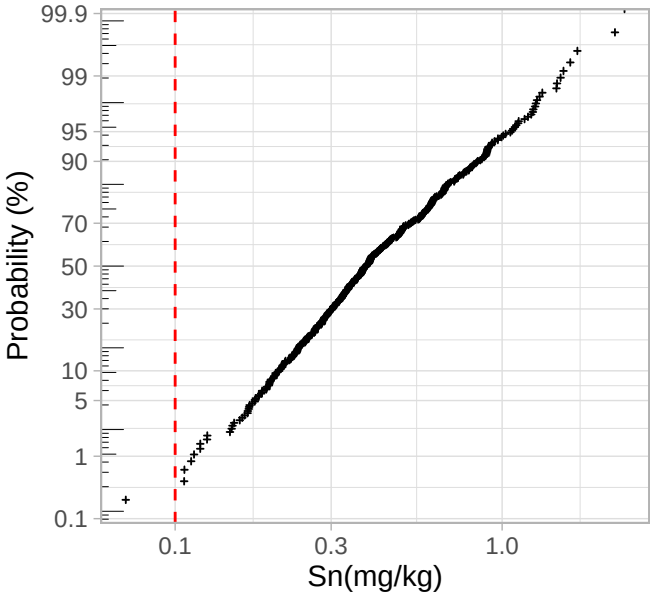

Probability (%)
99.9
99
95
90
70
50
30
10
5
1
0.1
0.003
0.010
0.030
0.100
0.300
Hf(mg/kg)

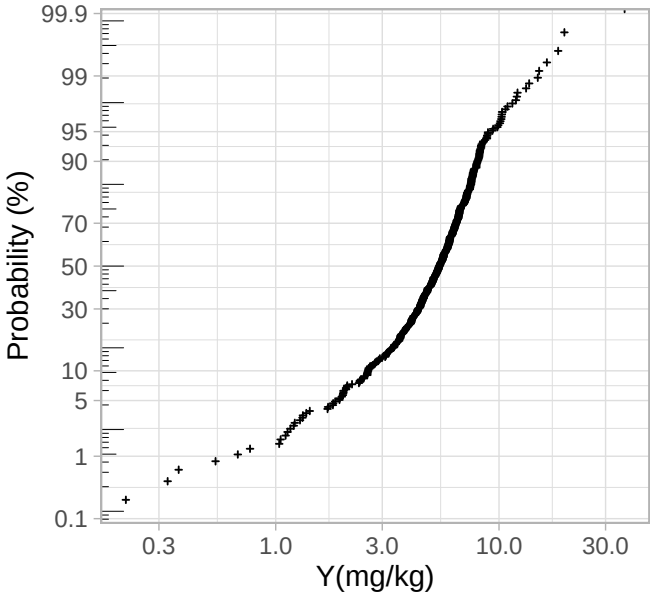

Probability (%)
99.9
99
95
90
70
50
30
10
5
1
0.1
0.3
1.0
3.0
Cs(mg/kg)

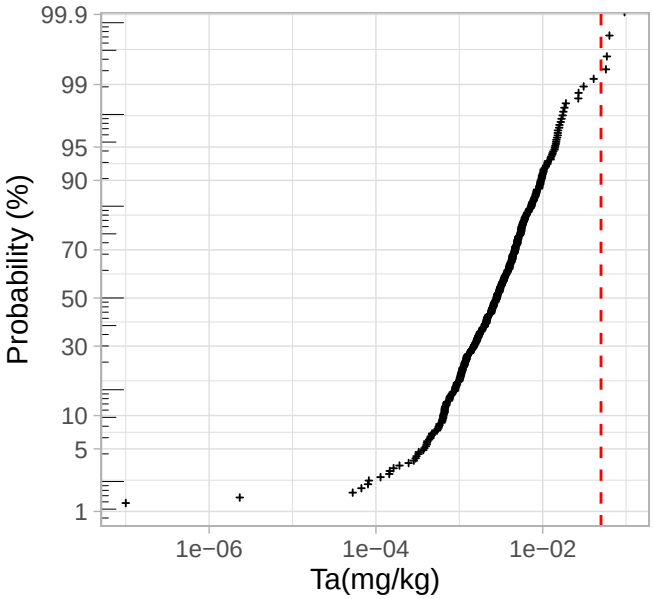

Probability (%)
99.9
99
95
90
70
50
30
10
5
1
0.1
0.1
1.0
10.0
Nb(mg/kg)

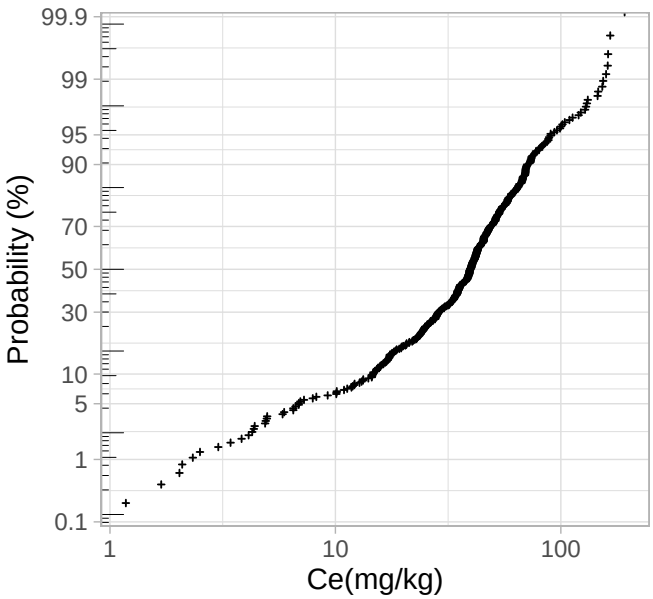

Probability (%)
99.9
99
95
90
70
50
30
10
5
1
0.1
0.003
0.010
0.030
0.100
0.300
Ge(mg/kg)

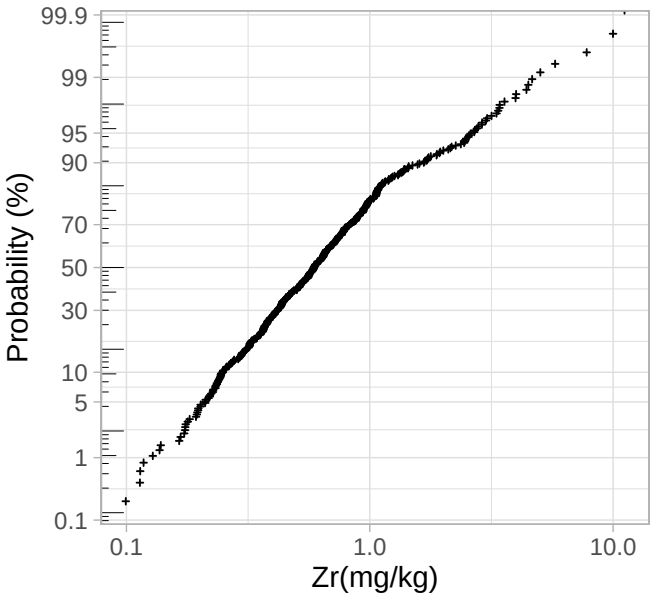

Probability (%)
99.9
99
95
90
70
50
30
10
5
1
0.1
1
10
100
Rb(mg/kg)

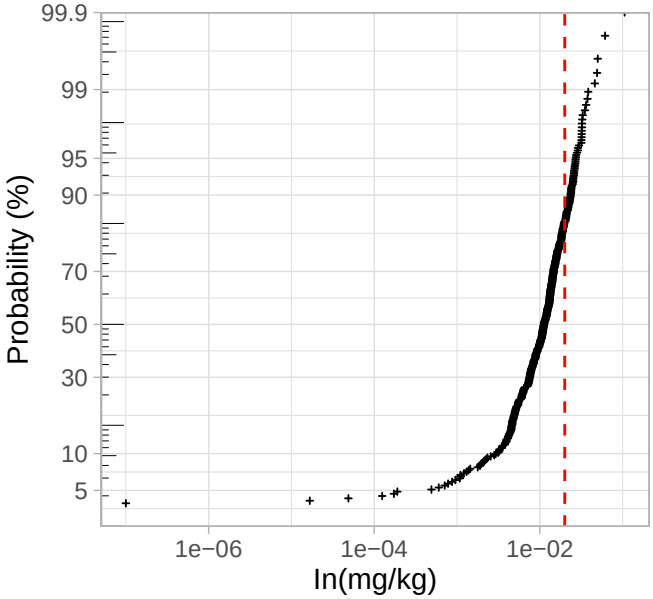

Probability (%)
99.9
99
95
90
70
50
30
10
5
1
0.1
0.1
0.3
1.0
Sn(mg/kg)

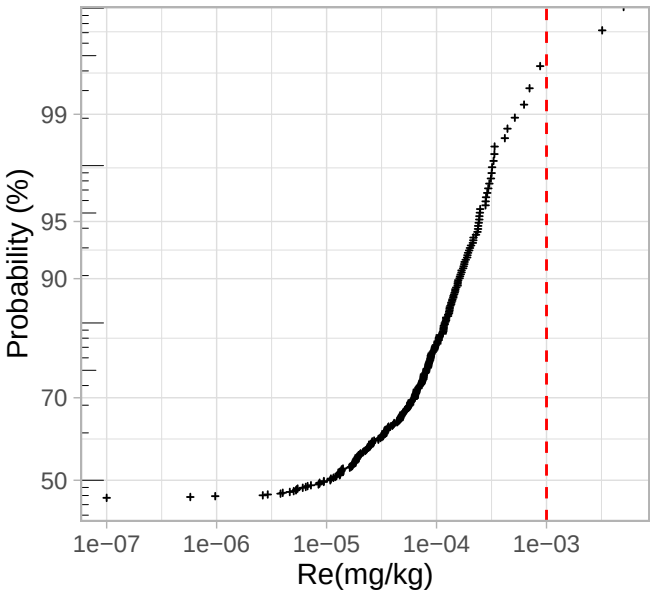

Probability (%)
99.9
99
95
90
70
50
30
10
5
1
0.1
0.3
1.0
3.0
10.0
30.0
Y(mg/kg)

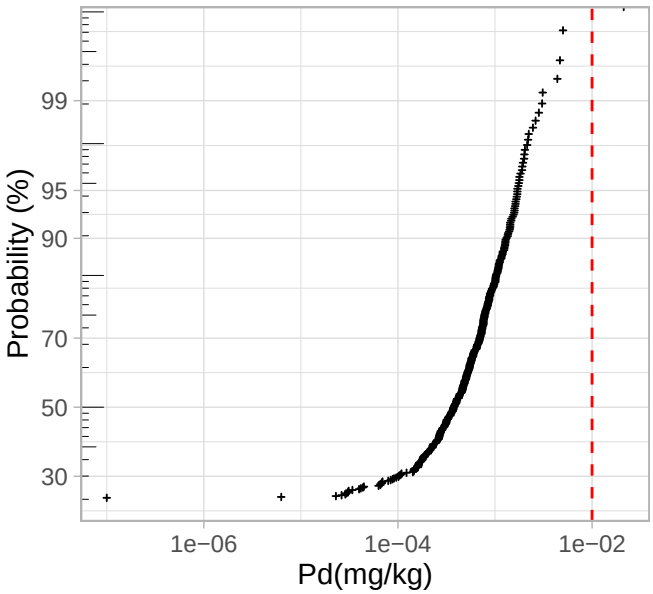

Probability (%)
99.9
99
95
90
70
50
30
10
5
1
1e−06
1e−04
1e−02
Ta(mg/kg)

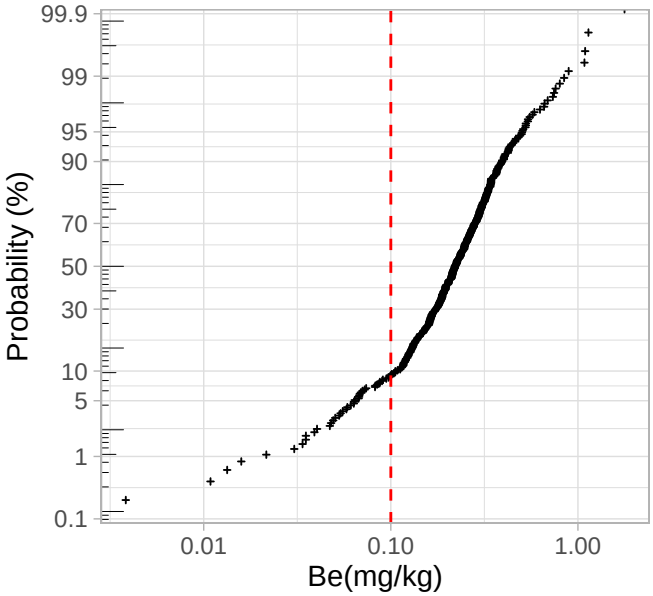

Probability (%)
99.9
99
95
90
70
50
30
10
5
1
0.1
1
10
100
Ce(mg/kg)

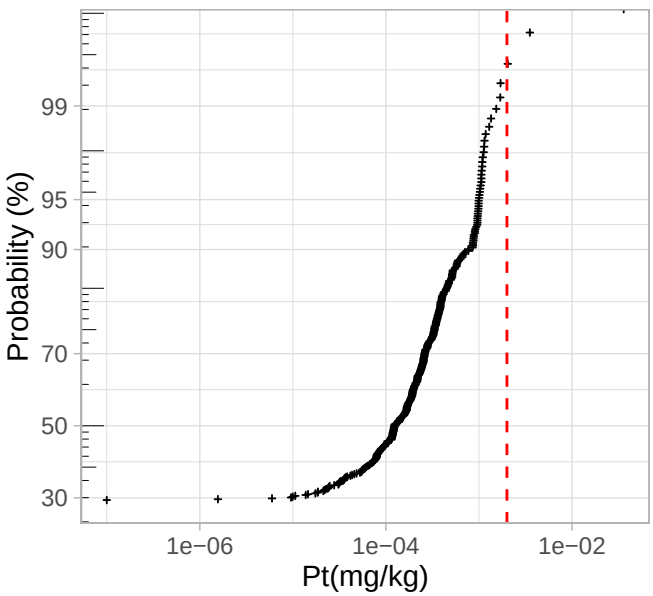

Probability (%)
99.9
99
95
90
70
50
30
10
5
1
0.1
0.1
1.0
10.0
Zr(mg/kg)

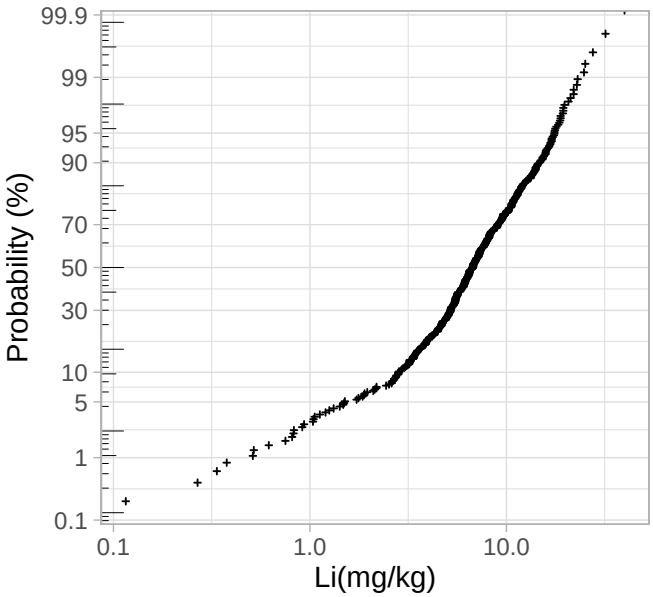

Probability (%)
99.9
99
95
90
70
50
30
10
5
1e−06
1e−04
1e−02
In(mg/kg)


Probability (%)
99
95
90
70
50
1e−07
1e−06
1e−05
1e−04
1e−03
Re(mg/kg)


Probability (%)
99
95
90
70
50
30
1e−06
1e−04
1e−02
Pd(mg/kg)


Probability (%)
99.9
99
95
90
70
50
30
10
5
1
0.1
0.01
0.10
1.00
Be(mg/kg)


Probability (%)
99
95
90
70
50
30
1e−06
1e−04
1e−02
Pt(mg/kg)

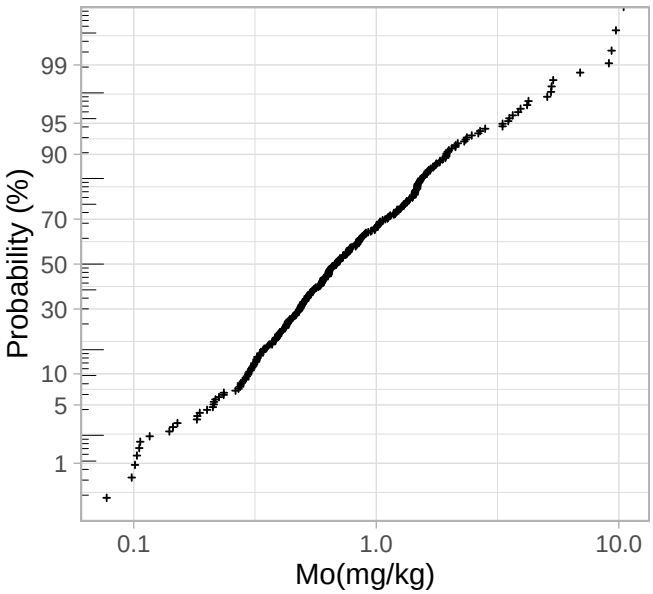

Probability (%)
99.9
99
95
90
70
50
30
10
5
1
0.1
0.1
1.0
10.0
Li(mg/kg)

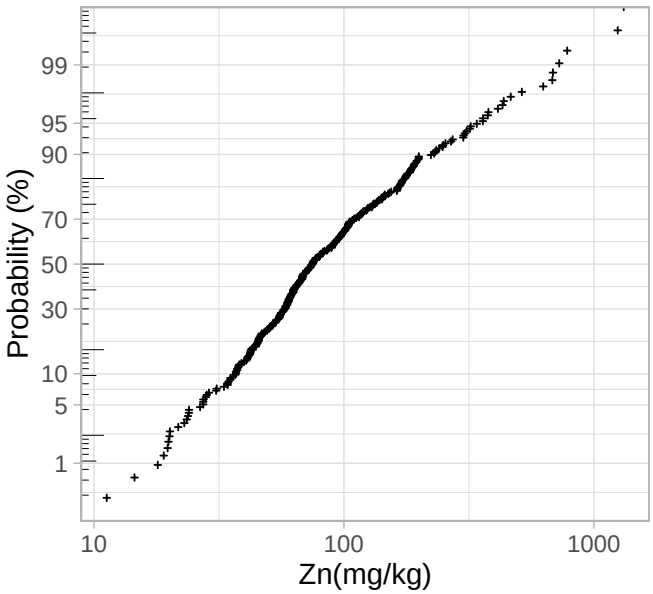
APPENDIX 7: ECDF-PLOTs urban data

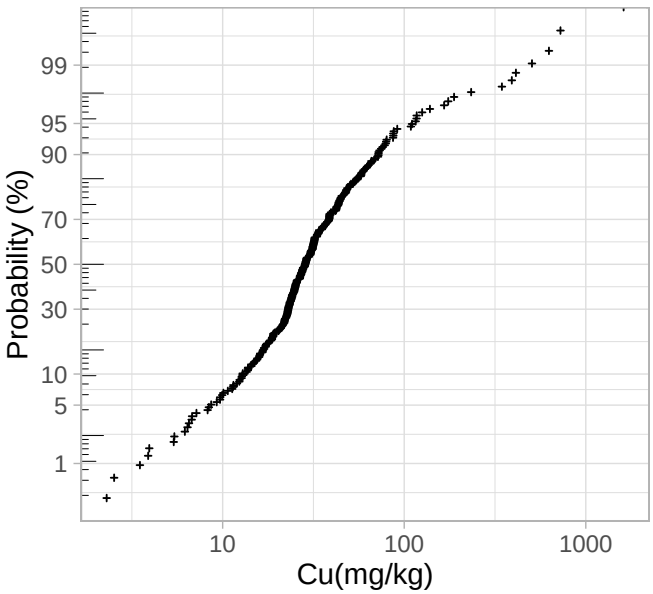
Plots of the empirical cumulative distribution function (ECDF-plots) for all 53 elements analysed.

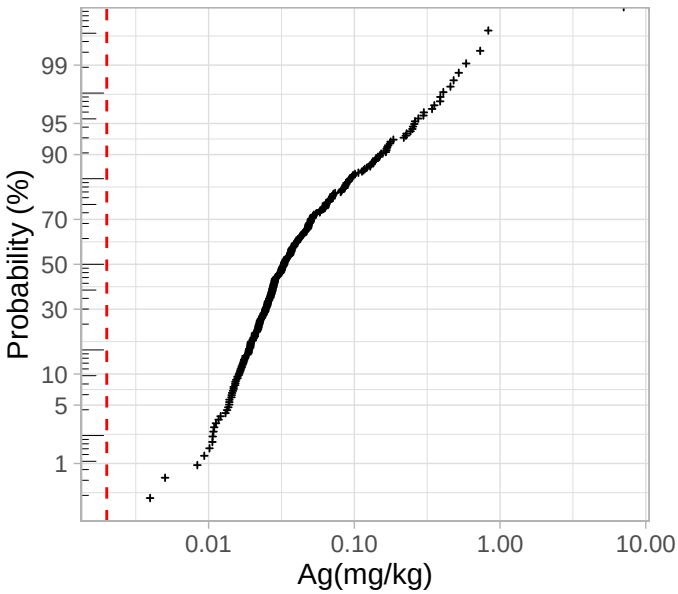
All laboratory readings are shown also those below detection limit, negative reading is however replaced by a low positive value (1 x 10^{-7}).

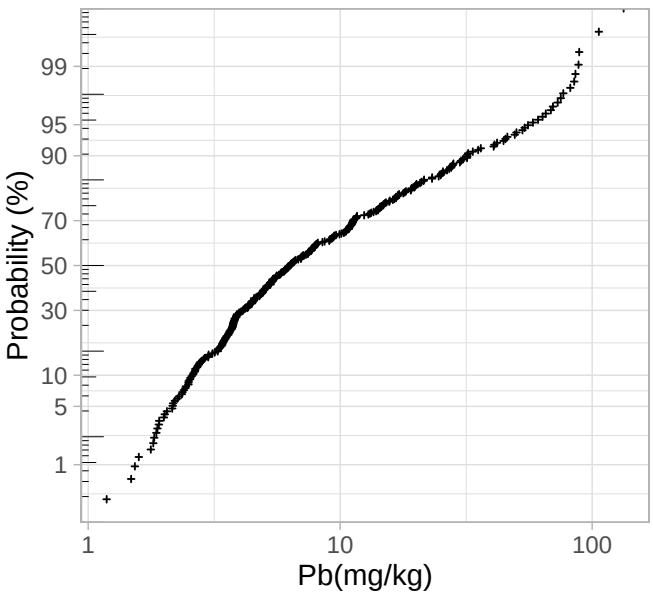
The laboratory detection limit (DL) is indicated by a red dotted for elements having concentrations close to or below DL.

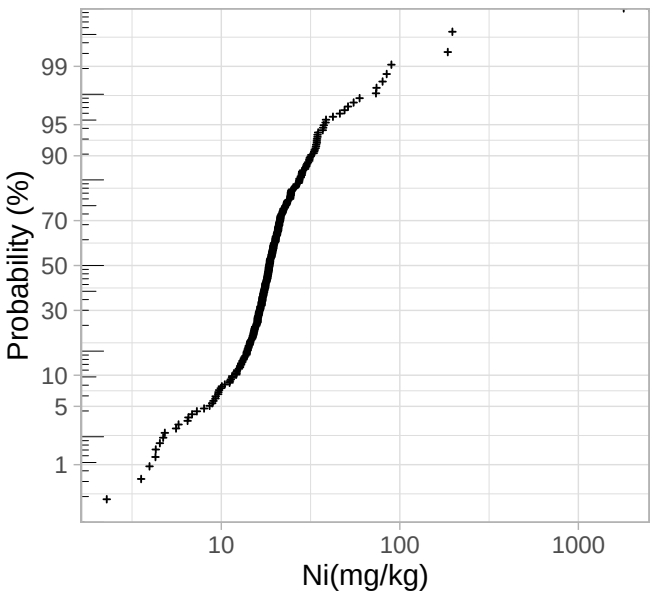

Probability (%)
99
95
90
70
50
30
10
5
1
0.1
1.0
10.0
Mo(mg/kg)

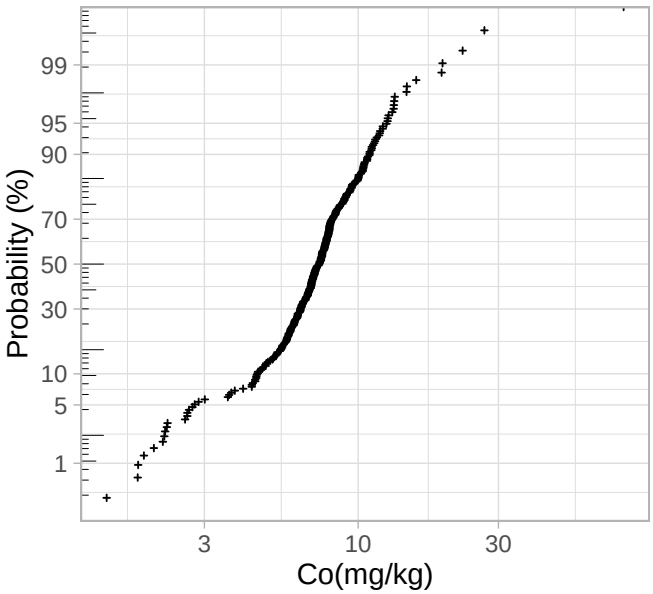

Probability (%)
99
95
90
70
50
30
10
5
1
10
100
1000
Zn(mg/kg)

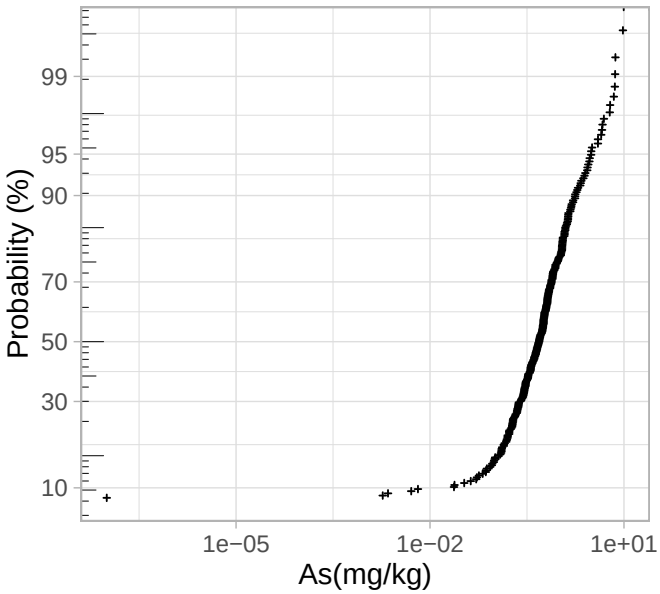

Probability (%)
99
95
90
70
50
30
10
5
1
10
100
1000
Cu(mg/kg)

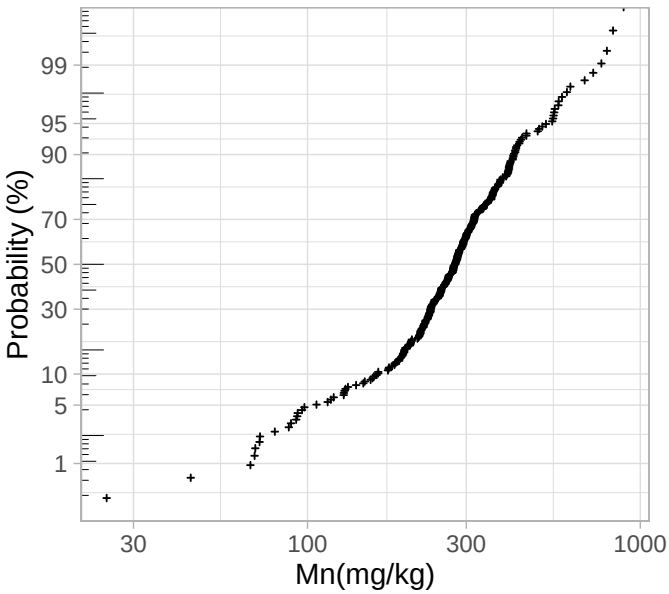

Probability (%)
99
95
90
70
50
30
10
5
1
0.01
0.10
1.00
10.00
Ag(mg/kg)

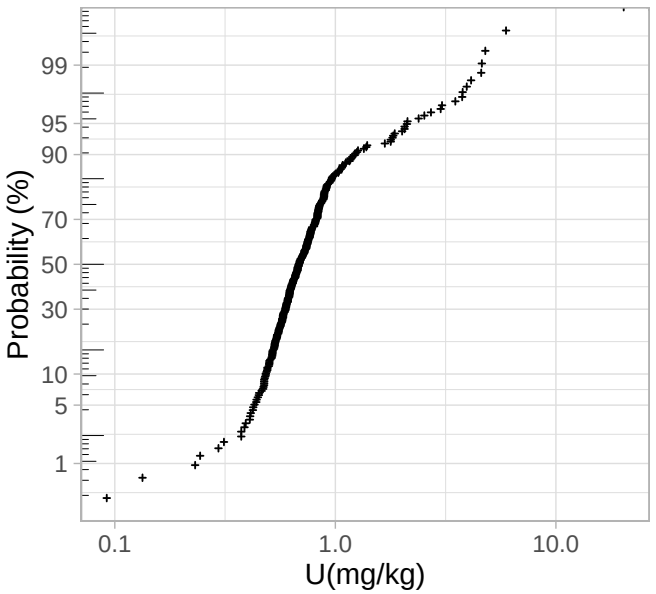

Probability (%)
99
95
90
70
50
30
10
5
1
1
10
100
Pb(mg/kg)

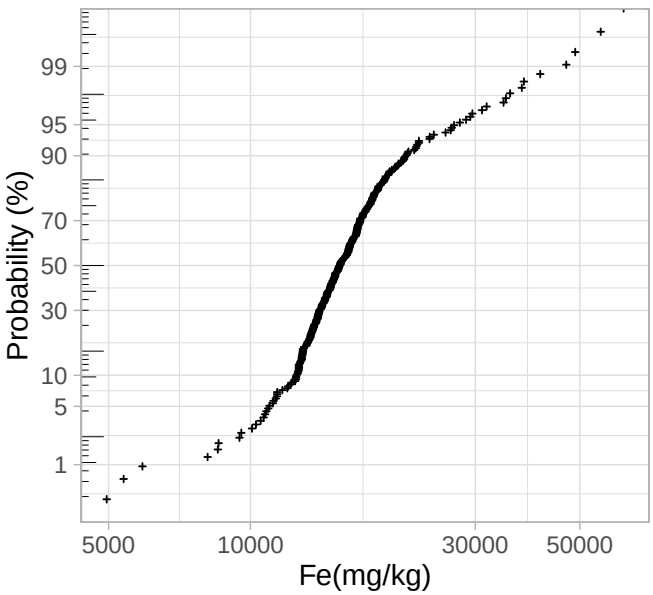

Probability (%)
99
95
90
70
50
30
10
5
1
10
100
1000
Ni(mg/kg)

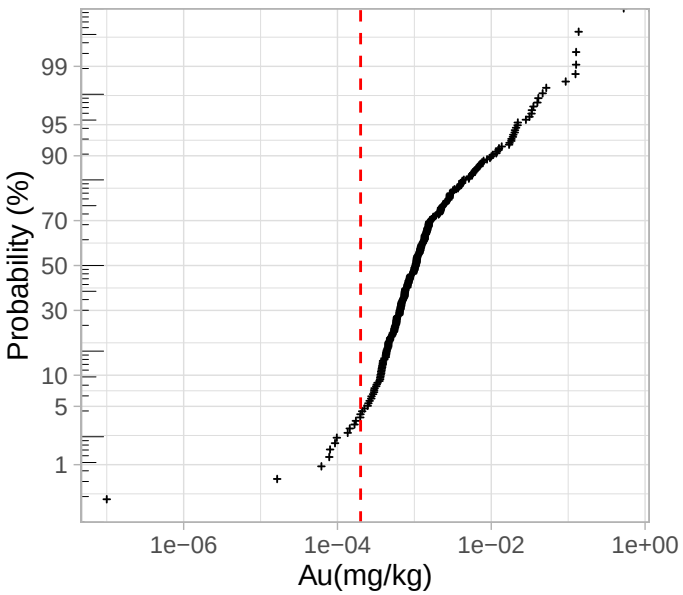

Probability (%)
99
95
90
70
50
30
10
5
1
3
10
30
Co(mg/kg)

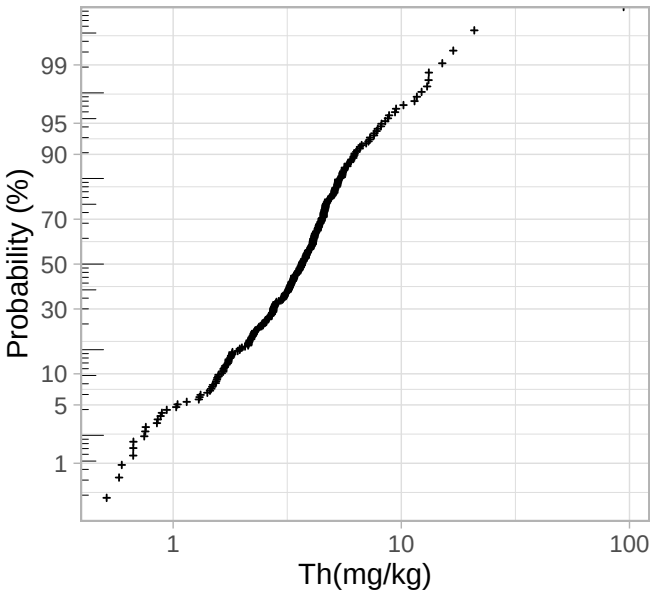

Probability (%)
99
95
90
70
50
30
10
1e−05
1e−02
1e+01
As(mg/kg)

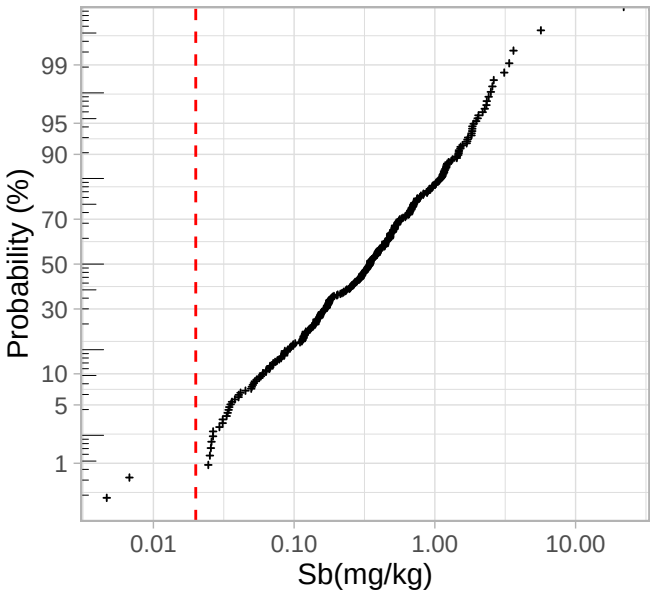

Probability (%)
99
95
90
70
50
30
10
5
1
30
100
300
1000
Mn(mg/kg)

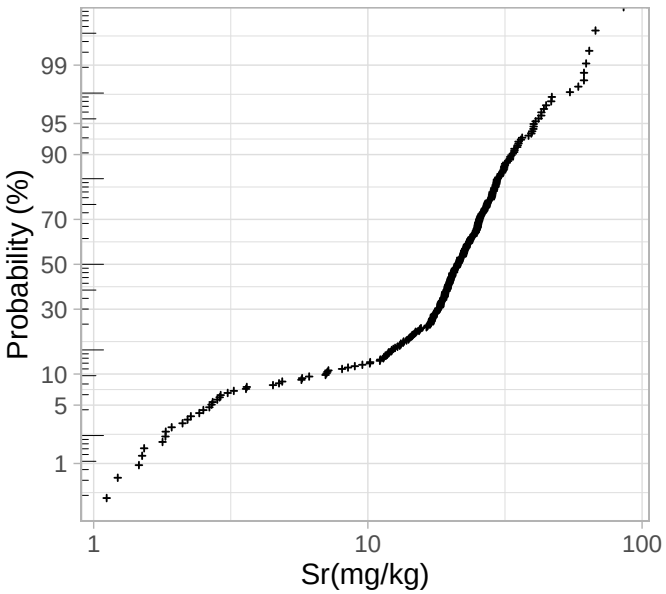

Probability (%)
99
95
90
70
50
30
10
5
1
0.1
1.0
10.0
U(mg/kg)

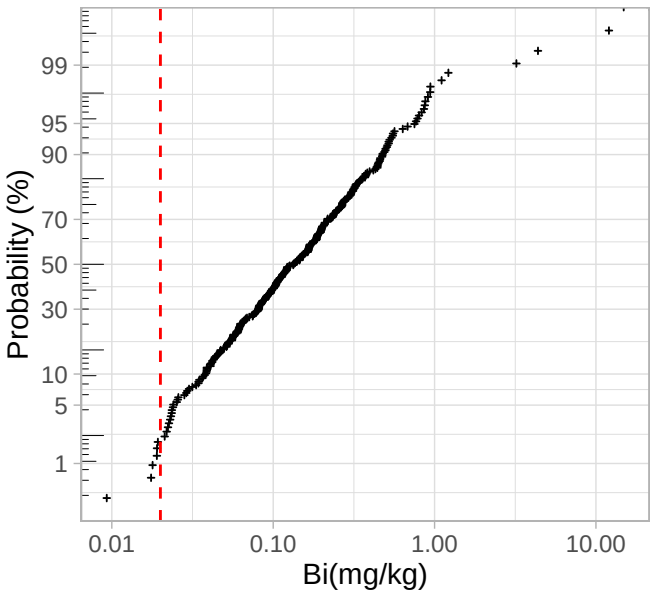

Probability (%)
99
95
90
70
50
30
10
5
1
5000
10000
30000
50000
Fe(mg/kg)

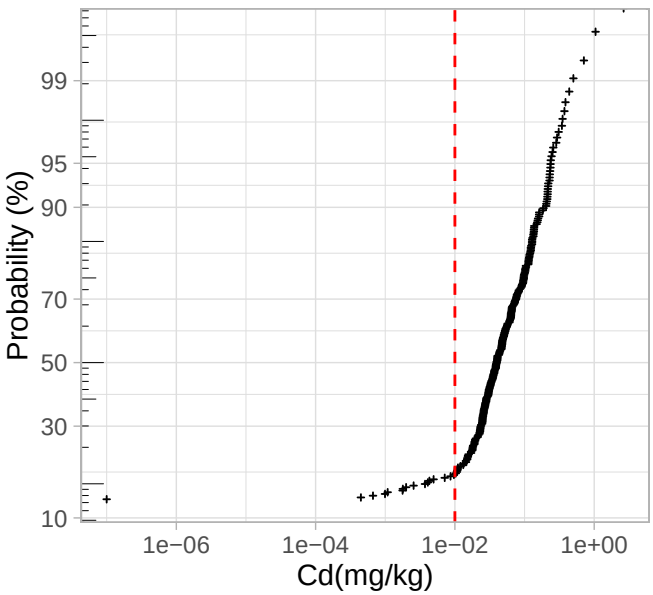

Probability (%)
99
95
90
70
50
30
10
5
1
1e−06
1e−04
1e−02
1e+00
Au(mg/kg)

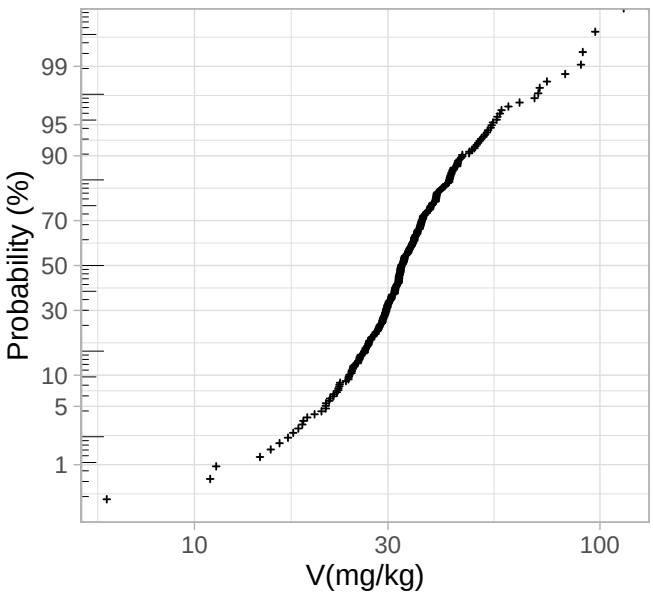

Probability (%)
99
95
90
70
50
30
10
5
1
1
10
100
Th(mg/kg)

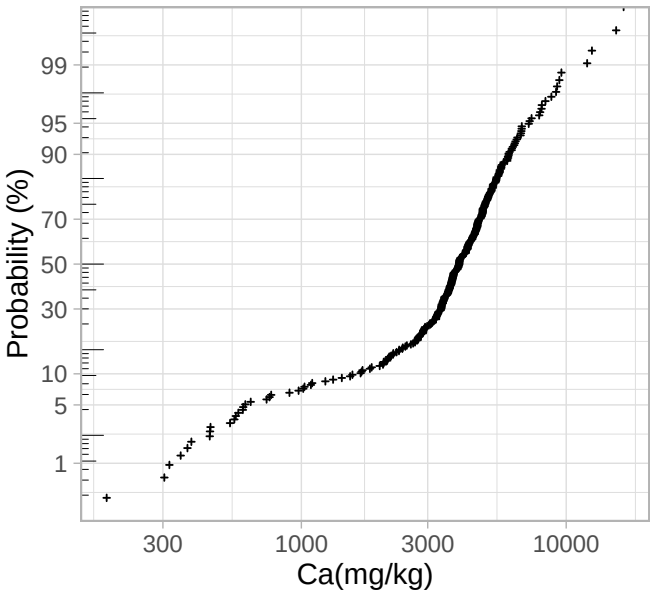

Probability (%)
99
95
90
70
50
30
10
5
1
0.01
0.10
1.00
10.00
Sb(mg/kg)

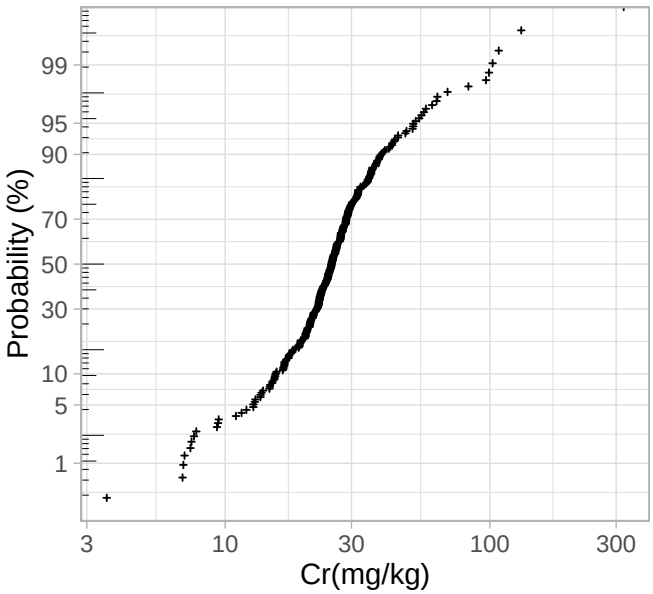

Probability (%)
99
95
90
70
50
30
10
5
1
1
10
100
Sr(mg/kg)

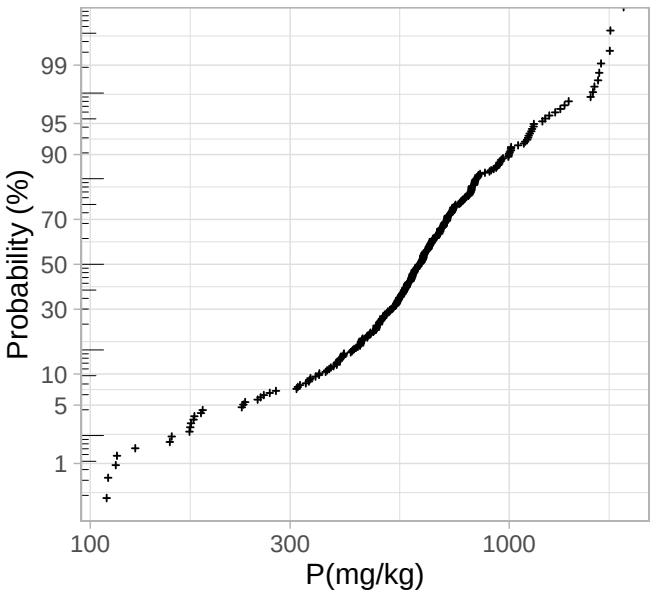

Probability (%)
99
95
90
70
50
30
10
5
1
0.01
0.10
1.00
10.00
Bi(mg/kg)

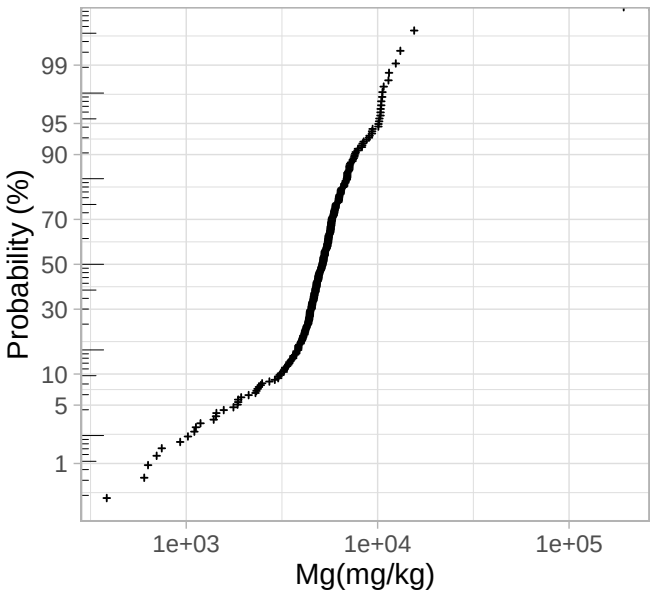

Probability (%)
99
95
90
70
50
30
10
1e−06
1e−04
1e−02
1e+00
Cd(mg/kg)

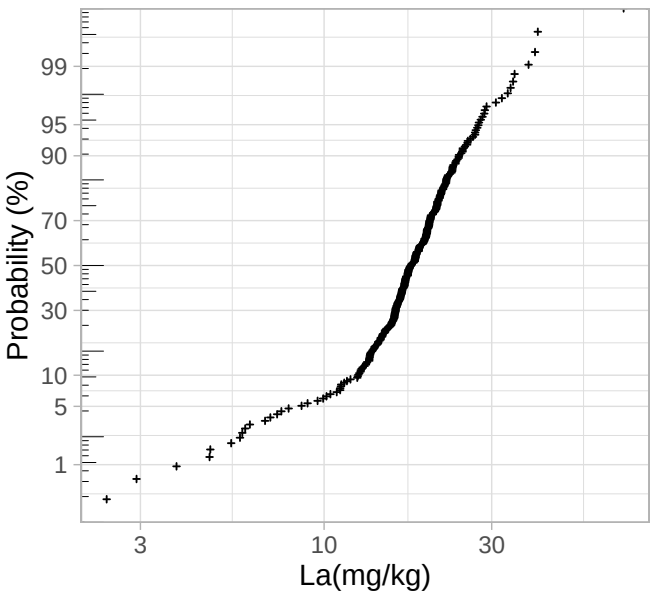

Probability (%)
99
95
90
70
50
30
10
5
1
10
30
100
V(mg/kg)

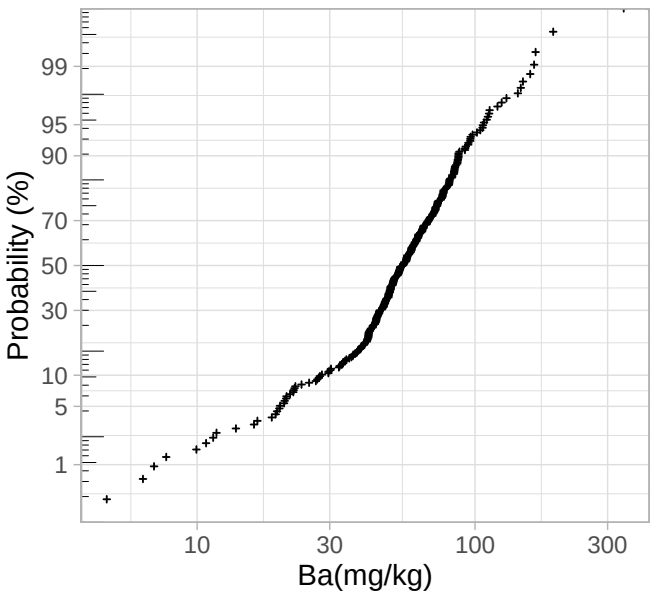

Probability (%)
99
95
90
70
50
30
10
5
1
300
1000
3000
10000
Ca(mg/kg)

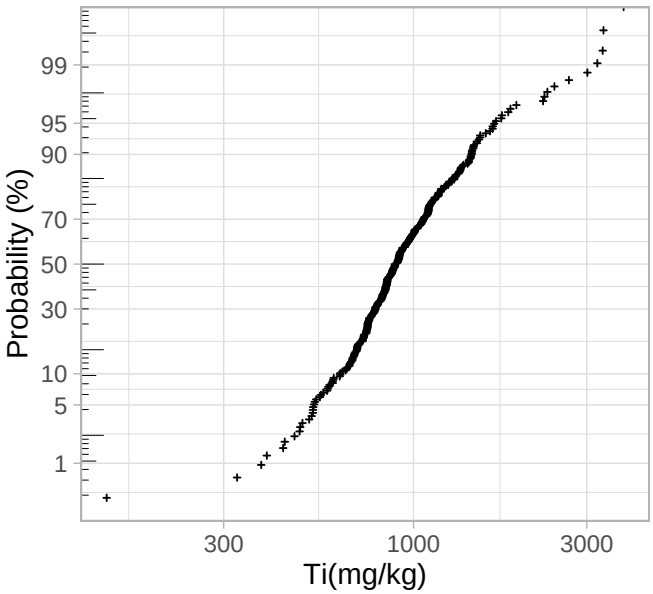

Probability (%)
99
95
90
70
50
30
10
5
1
3
10
30
100
300
Cr(mg/kg)

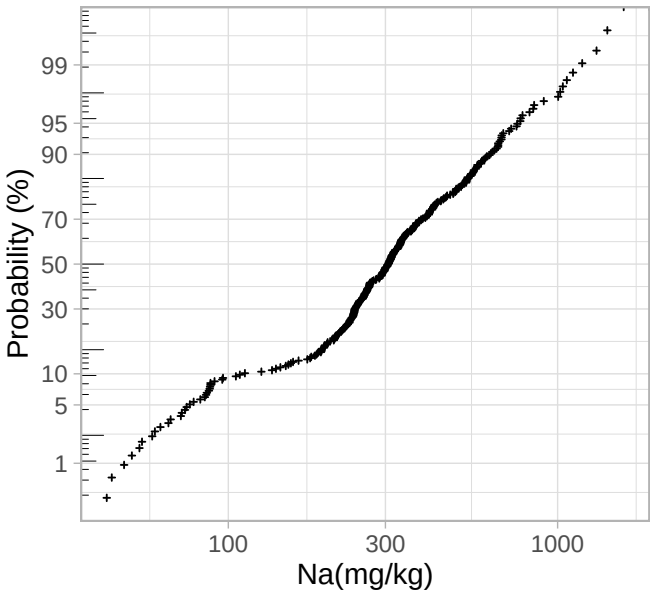

Probability (%)
99
95
90
70
50
30
10
5
1
100
300
1000
P(mg/kg)

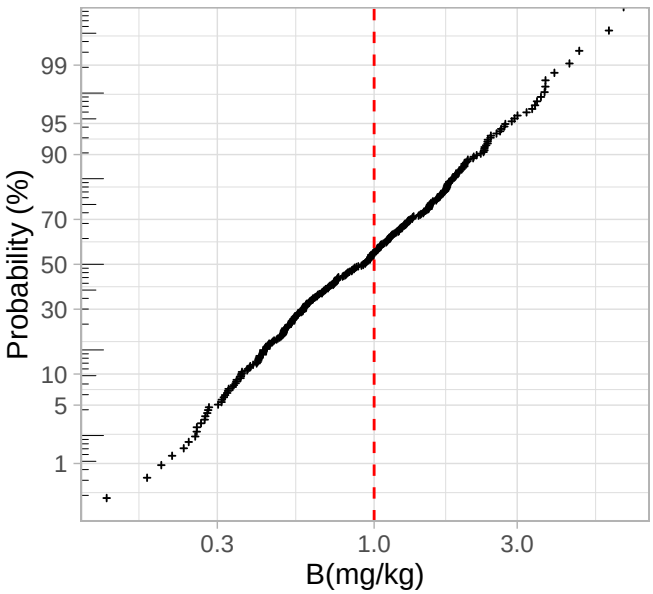

Probability (%)
99
95
90
70
50
30
10
5
1
1e+03
1e+04
1e+05
Mg(mg/kg)

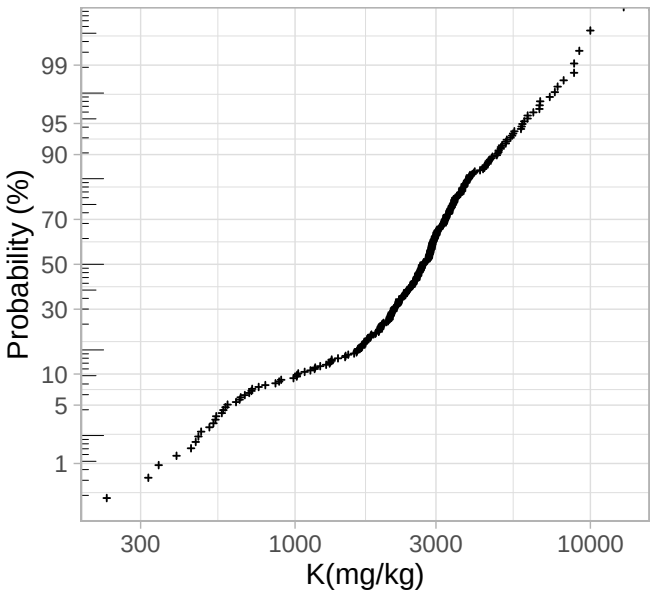

Probability (%)
99
95
90
70
50
30
10
5
1
3
10
30
La(mg/kg)

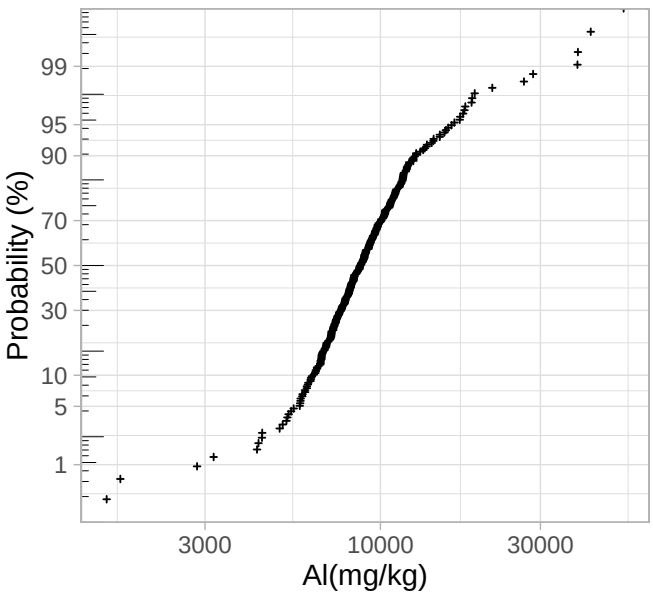

Probability (%)
99
95
90
70
50
30
10
5
1
10
30
100
300
Ba(mg/kg)

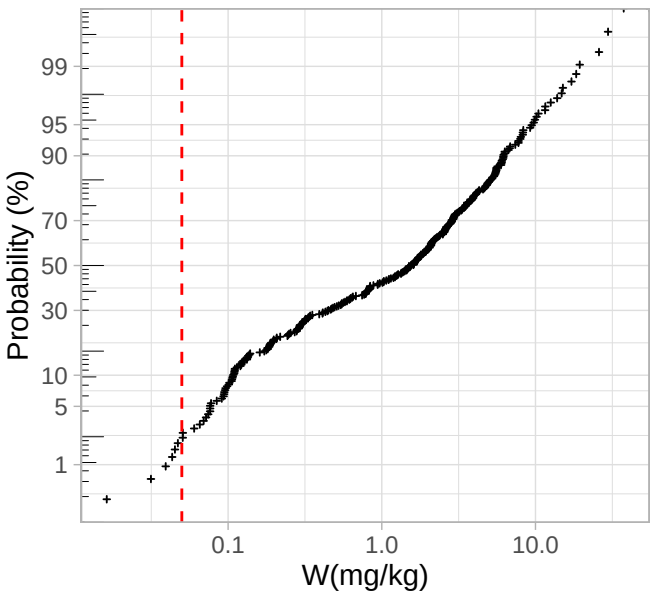

Probability (%)
99
95
90
70
50
30
10
5
1
300
1000
3000
Ti(mg/kg)

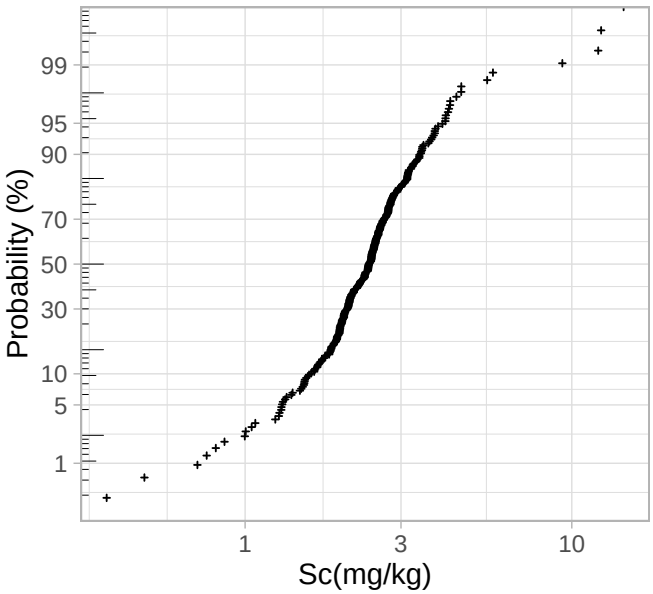

Probability (%)
99
95
90
70
50
30
10
5
1
100
300
1000
Na(mg/kg)

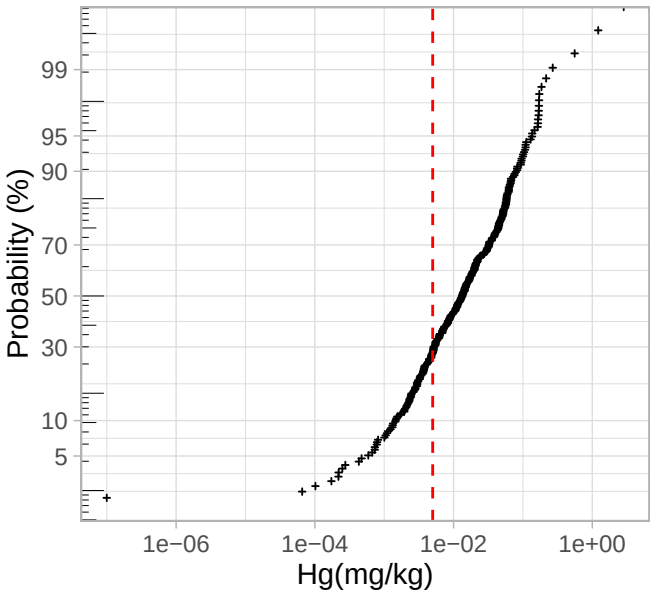

Probability (%)
99
95
90
70
50
30
10
5
1
0.3
1.0
3.0
B(mg/kg)

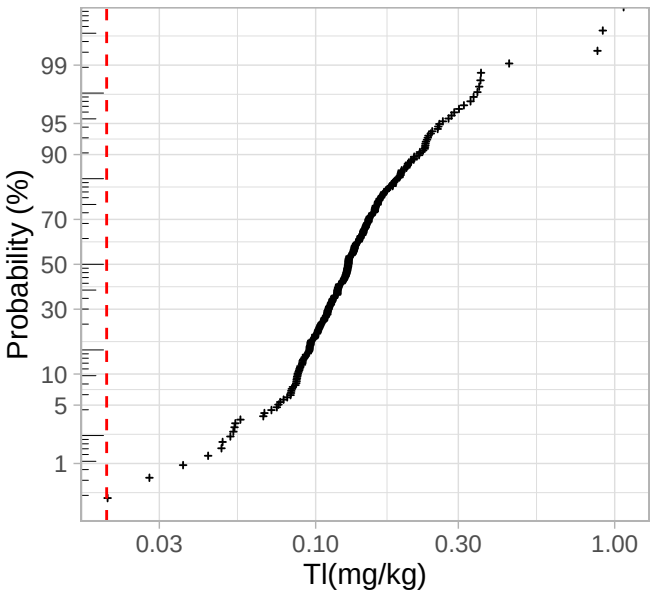

Probability (%)
99
95
90
70
50
30
10
5
1
300
1000
3000
10000
K(mg/kg)

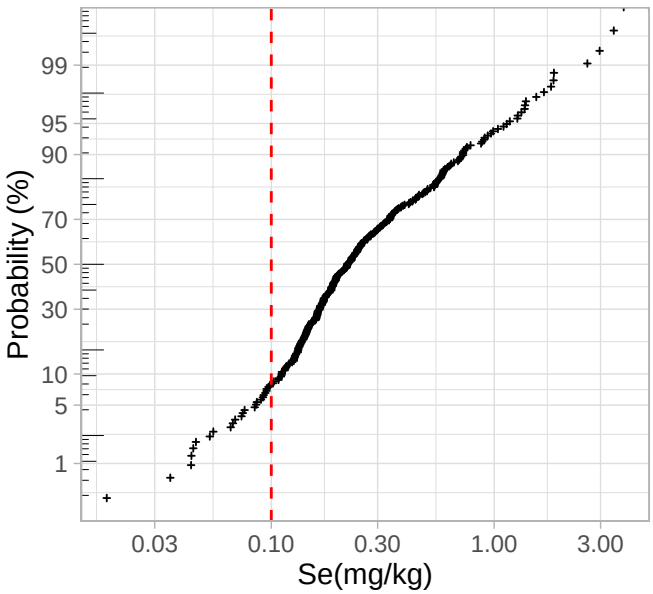

Probability (%)
99
95
90
70
50
30
10
5
1
3000
10000
30000
Al(mg/kg)

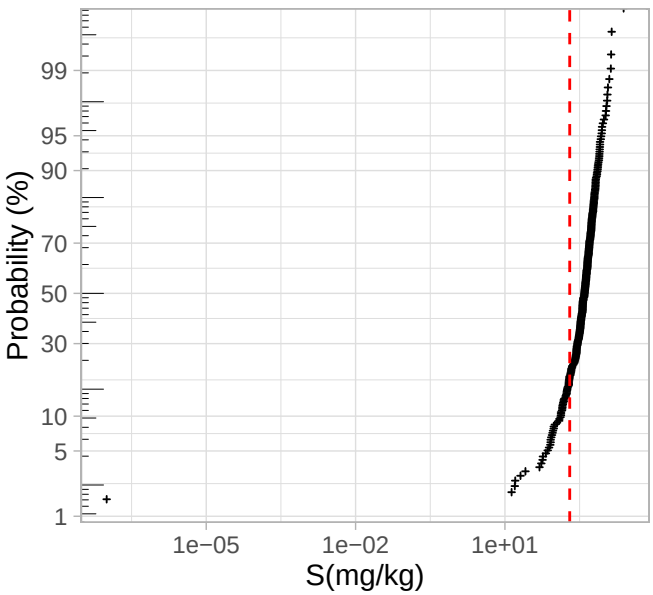

Probability (%)
99
95
90
70
50
30
10
5
1
0.1
1.0
10.0
W(mg/kg)

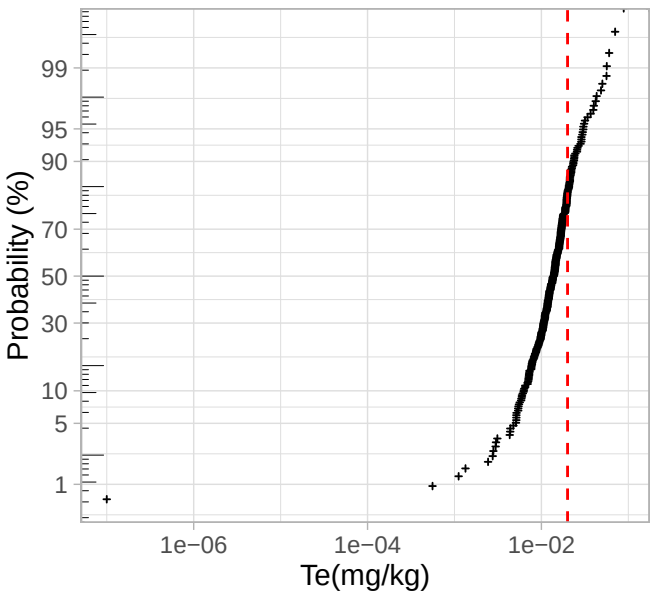

Probability (%)
99
95
90
70
50
30
10
5
1
1
3
10
Sc(mg/kg)

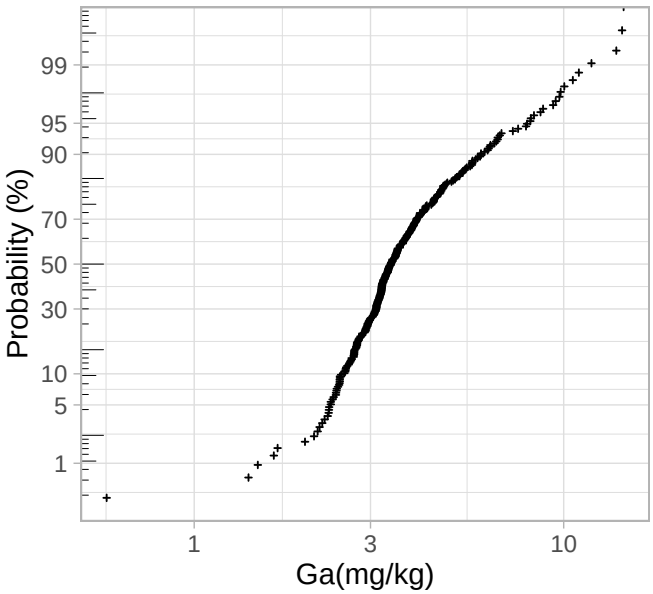

Probability (%)
99
95
90
70
50
30
10
5
1e−06
1e−04
1e−02
1e+00
Hg(mg/kg)

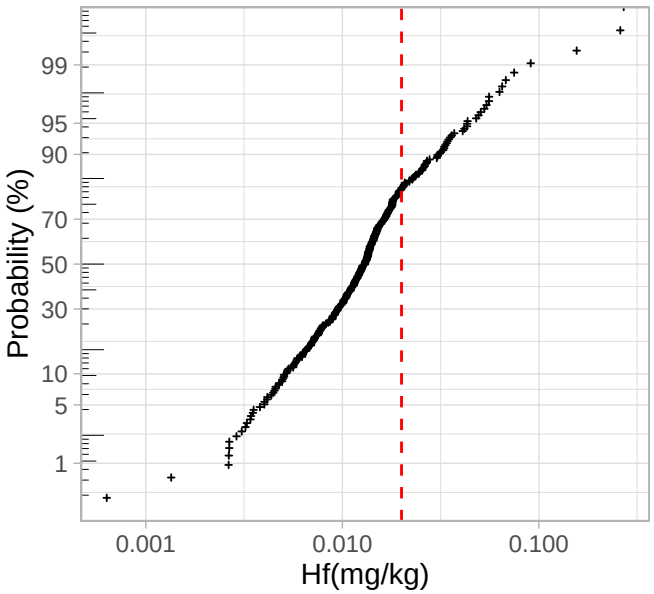

Probability (%)
99
95
90
70
50
30
10
5
1
0.03
0.10
0.30
1.00
Tl(mg/kg)

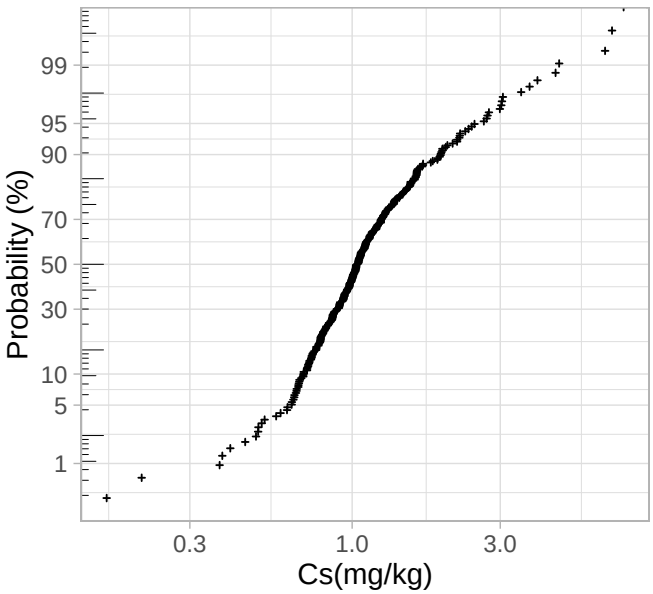

Probability (%)
99
95
90
70
50
30
10
5
1
0.03
0.10
0.30
1.00
3.00
Se(mg/kg)

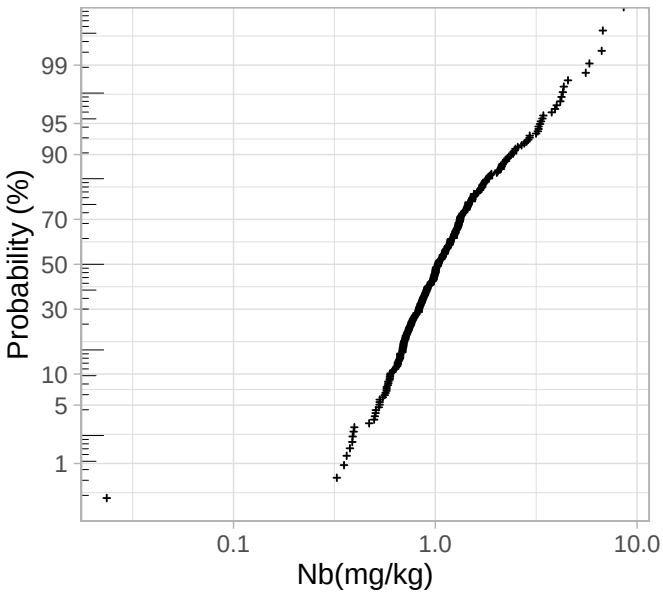

Probability (%)
99
95
90
70
50
30
10
5
1
1e−05
1e−02
1e+01
S(mg/kg)

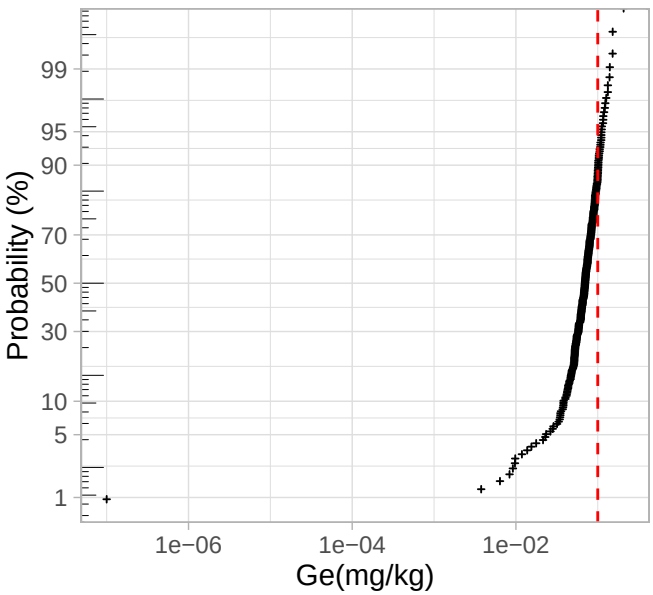

Probability (%)
99
95
90
70
50
30
10
5
1
1e−06
1e−04
1e−02
Te(mg/kg)

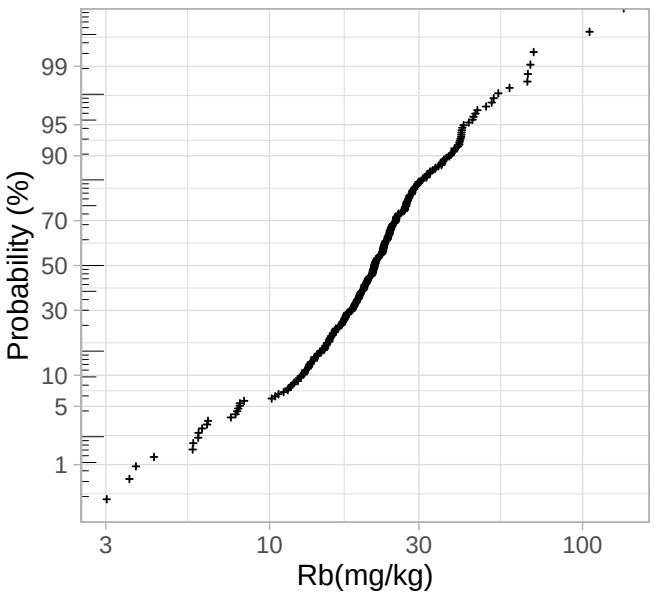

Probability (%)
99
95
90
70
50
30
10
5
1
1
3
10
Ga(mg/kg)

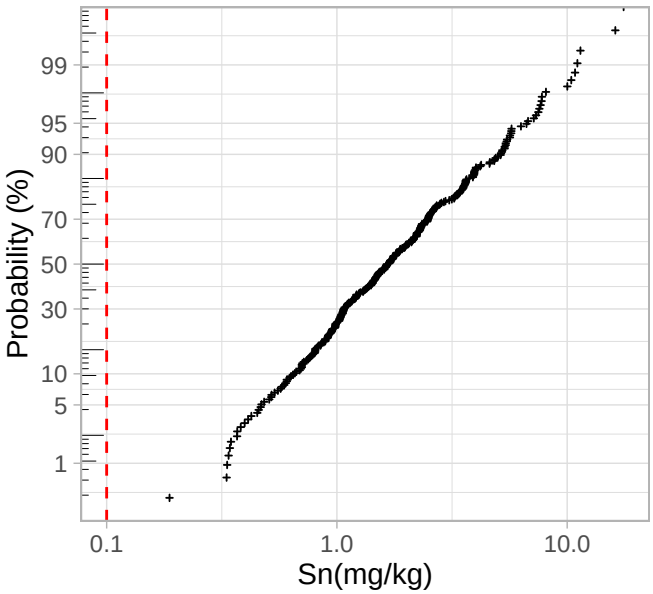

Probability (%)
99
95
90
70
50
30
10
5
1
0.001
0.010
0.100
Hf(mg/kg)

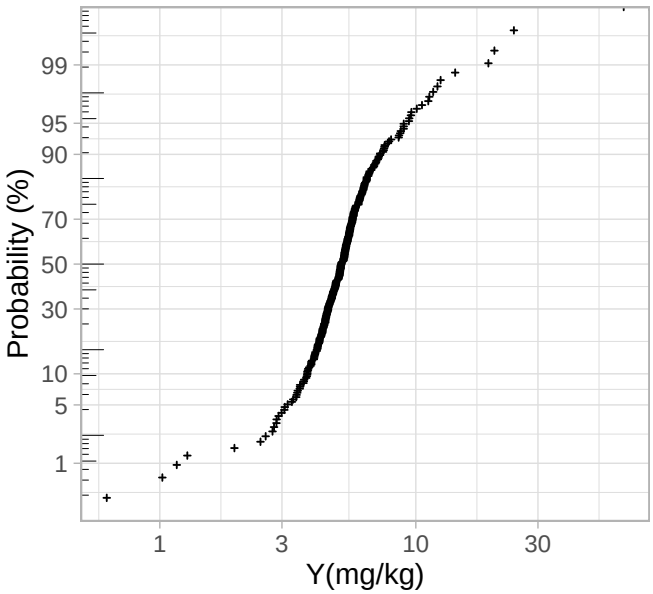

Probability (%)
99
95
90
70
50
30
10
5
1
0.3
1.0
3.0
Cs(mg/kg)

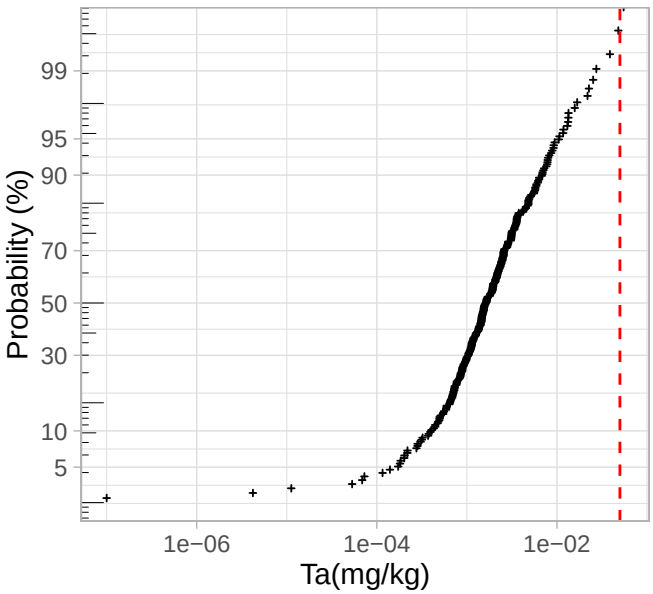

Probability (%)
99
95
90
70
50
30
10
5
1
0.1
1.0
10.0
Nb(mg/kg)

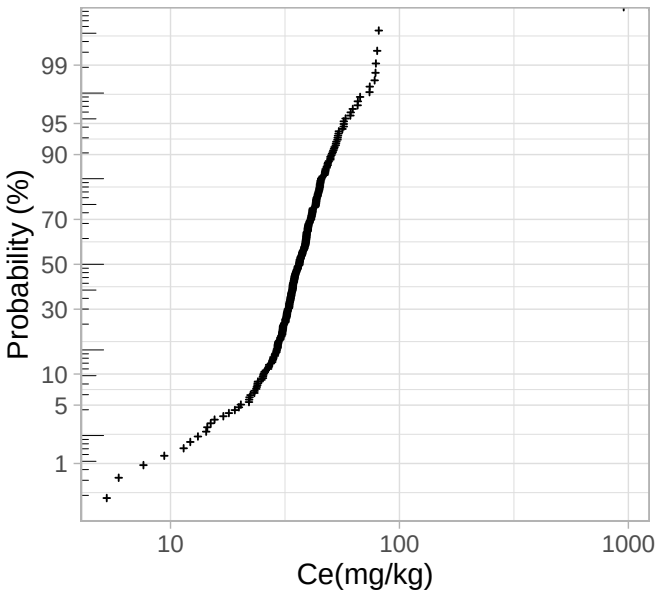

Probability (%)
99
95
90
70
50
30
10
5
1
1e−06
1e−04
1e−02
Ge(mg/kg)

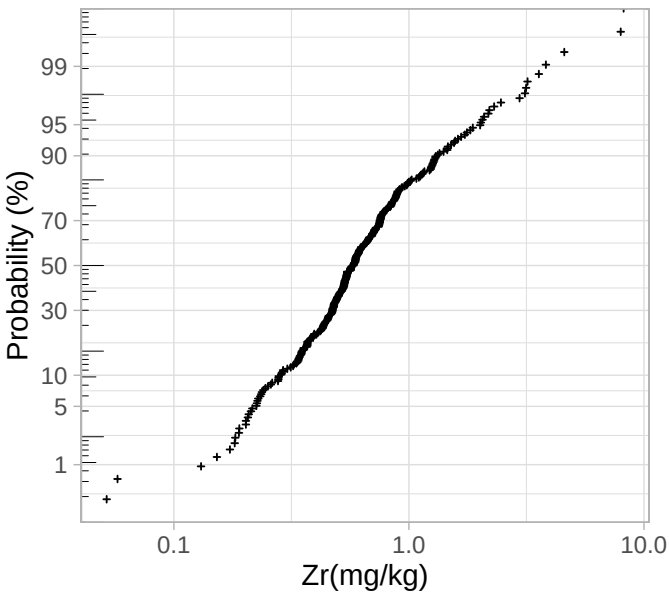

Probability (%)
99
95
90
70
50
30
10
5
1
3
10
30
100
Rb(mg/kg)

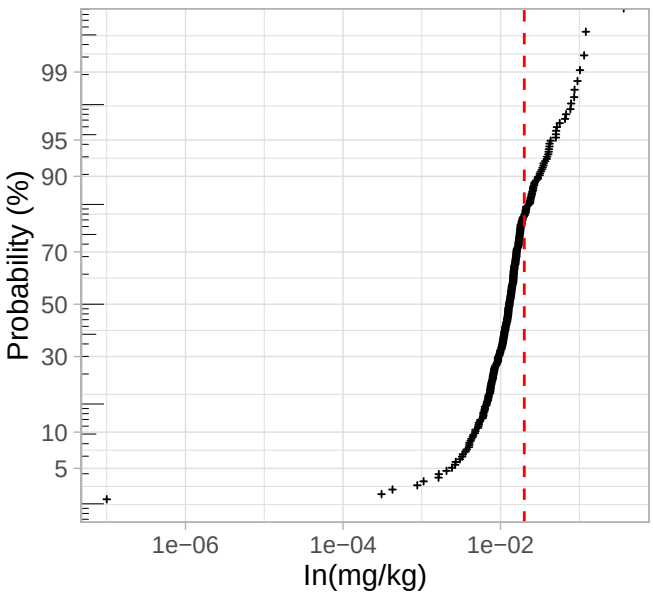

Probability (%)
99
95
90
70
50
30
10
5
1
0.1
1.0
10.0
Sn(mg/kg)

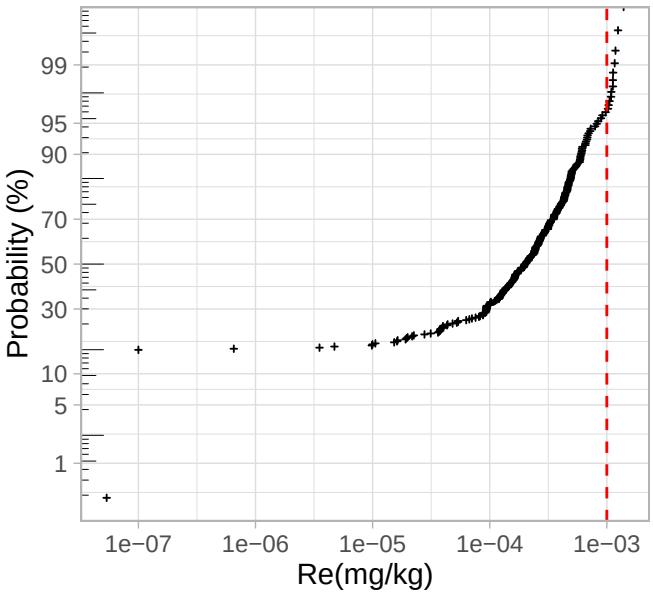

Probability (%)
99
95
90
70
50
30
10
5
1
1
3
10
30
Y(mg/kg)

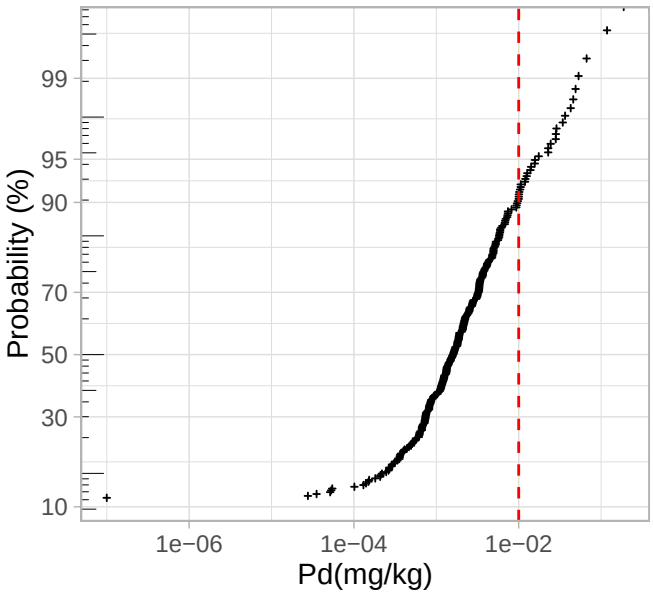

Probability (%)
99
95
90
70
50
30
10
5
1e−06
1e−04
1e−02
Ta(mg/kg)

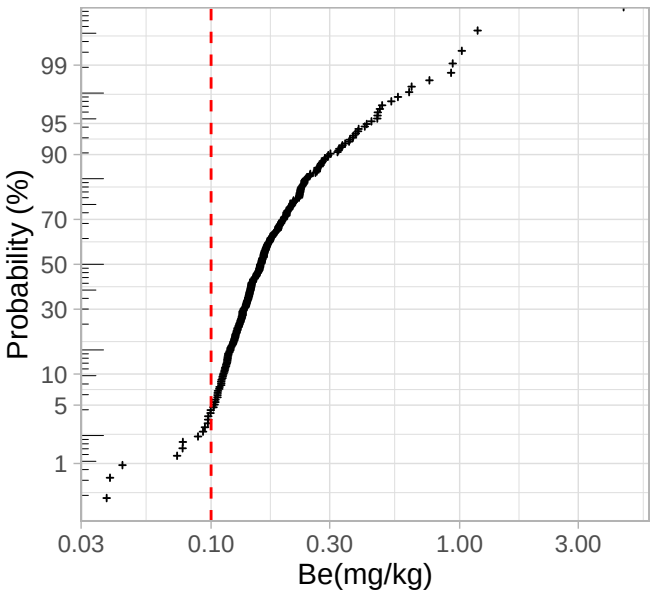

Probability (%)
99
95
90
70
50
30
10
5
1
10
100
1000
Ce(mg/kg)

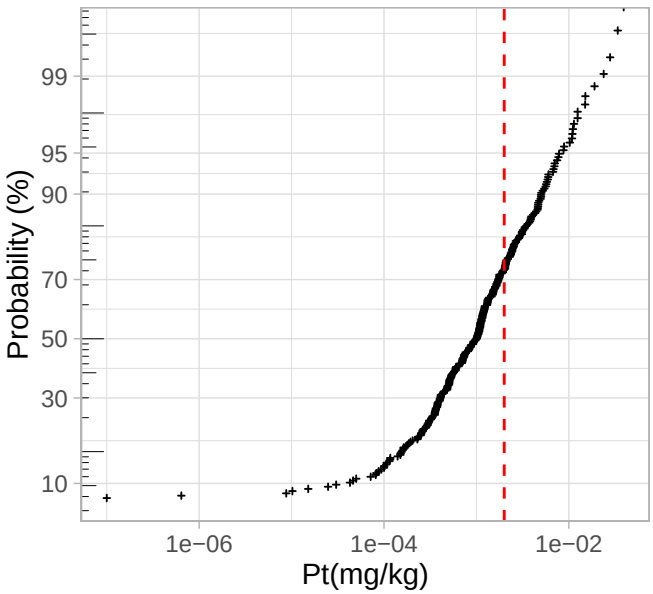

Probability (%)
99
95
90
70
50
30
10
5
1
0.1
1.0
10.0
Zr(mg/kg)

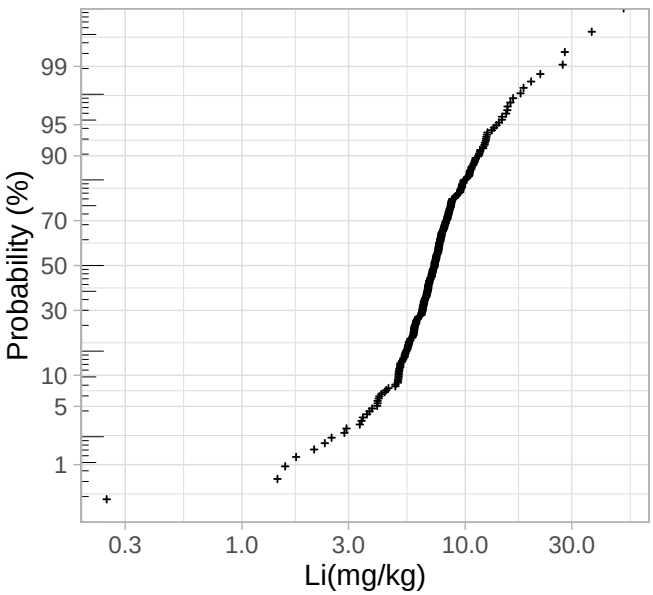

Probability (%)
99
95
90
70
50
30
10
5
1e−06
1e−04
1e−02
In(mg/kg)


Probability (%)
99
95
90
70
50
30
10
5
1
1e−07
1e−06
1e−05
1e−04
1e−03
Re(mg/kg)


Probability (%)
99
95
90
70
50
30
10
1e−06
1e−04
1e−02
Pd(mg/kg)


Probability (%)
99
95
90
70
50
30
10
5
1
0.03
0.10
0.30
1.00
3.00
Be(mg/kg)


Probability (%)
99
95
90
70
50
30
10
1e−06
1e−04
1e−02
Pt(mg/kg)


Probability (%)
99
95
90
70
50
30
10
5
1
0.3
1.0
3.0
10.0
30.0
Li(mg/kg)

GEOLOGICAL
SURVEY OF
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