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Summary: <p>This survey constitutes a continuation of corresponding surveys undertaken in Finnmark, Troms and Nordland Counties, as well as in North Trøndelag and on Fosen. During the main field work in 2018, and the complementary field work in 2019, mineral soil samples were collected in a grid of 6x6 km in the remaining part of south Trøndelag. In total 462 locations were sampled. The <2 mm dried grain size fraction of these samples were analysed by ICPMS for 53 elements following Aqua Regia digestion.</p> <p>Results are documented with respect to quality of data in tables with descriptive statistics, random plots, X-charts, and correlation plots, in addition to EDA geochemical maps of single elements.</p> <p>The data are briefly compared with previously survey data.</p>					
Keywords:		Till		Aqua Regia	
Geochemistry		Regional mapping		<2 mm soil fraction	

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1. INTRODUCTION

Available till material from Finnmark, Troms and Nordland County, collected with an approximate density of 1 sample/40 km², were re-analysed in 2011, (Reimann et al., 2011). North-Trøndelag with adjacent parts of South-Trøndelag in addition to Fosen were sampled in 2013 with a density of 1 sample/ 36 km² (Finne et al., 2014). During the 2013 sampling campaign also organic soil O-horizon was collected with the same density as the mineral soil (Finne and Eggen, 2015). The data from this sampling campaign have been further interpreted and documented by Reimann et al., 2015, Reimann et al., 2016, Reimann et al., 2019 and others. Based on the large benefit and increased possibility to interpret possible areas of interest for mineral exploration and anthropogenic influence it was decided to continue to sample both organic and bottom soil when completing the sampling of Trøndelag County in 2018.

2. DESCRIPTION OF THE SURVEY AREA

2.1 Bedrock

The north-western part of southern Trøndelag is mainly comprised of basement rock types, such as granites, granitic gneisses and gabbros in the Western Gneiss Region (Figure 1). These gneisses were strongly reworked during the Caledonian orogeny (Tveten et al. 1998). The Møre-Trøndelag Fault Zone (MTFZ), which is a major ENE -WSW feature consisting of faults and folds, can be seen running along the coastline as a series of parallel ductile, compressional shear zones.

The main part of the sampled area, however, comprises supracrustal bedrocks within the Trondheim Nappe complex, which consists of Caledonian nappes belonging to several tectonostratigraphic levels. These were thrust E-SE into several tectonic units, such as the Meråker, Gula and Støren nappes. The Meråker and Støren nappes both contain ophiolite and island arc complexes overlain by sedimentary and volcanic successions of variable metamorphic grade (Corfu et al., 2014).

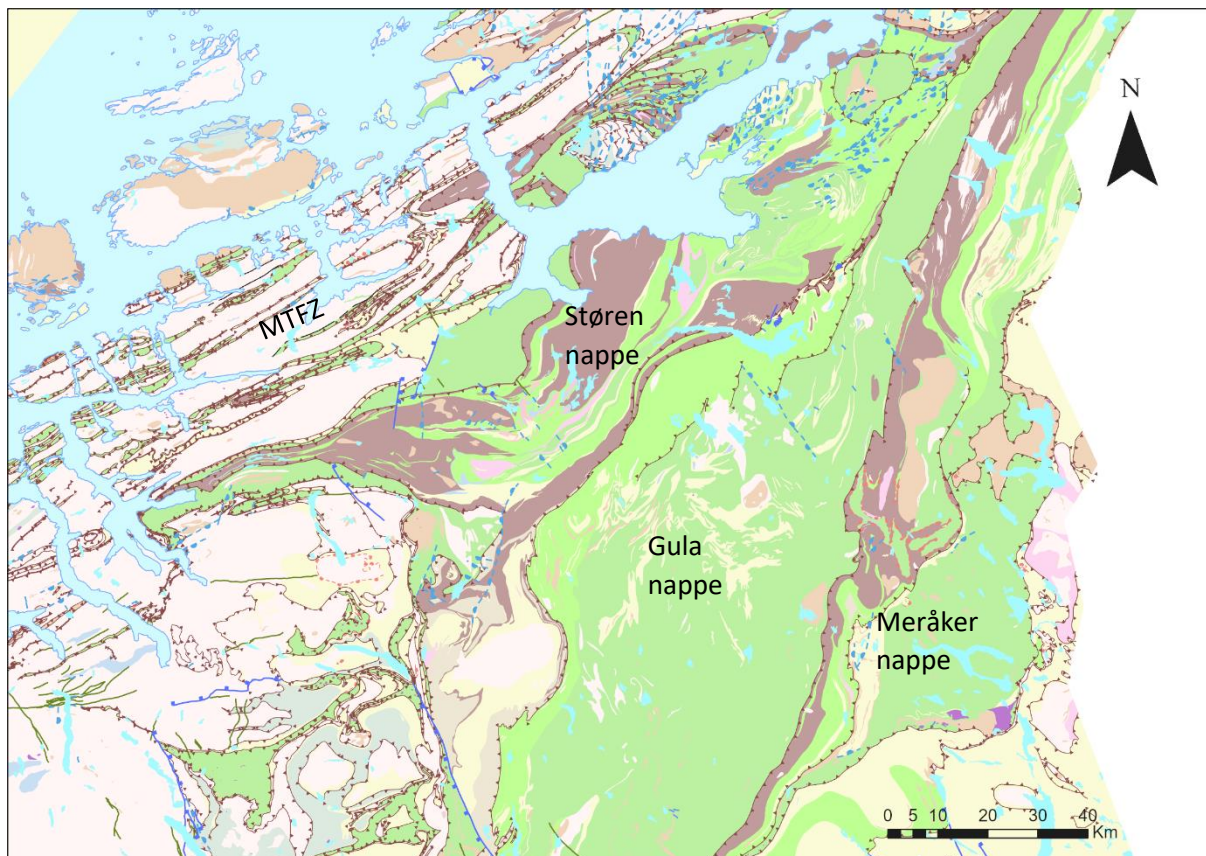


Figure 1. Bedrock map of the sampled area. Bedrock units on the map are merged units from NGU's 1: 250 000 bedrock map. Structural elements in brown represent ductile, compressional shear zones, while brittle structures are represented in blue.

LEGEND

Gangbergarter	Dyke rocks
Mylonitt - breksje	Mylonite - breccia
Tillitt - diamiktitt	Tillite - diamictite
Sandstein - siltstein	Sandstone - siltstone
Leir/glimmerskifer	Clay/mica schists
Karbonatbergart	Carbonates
Pyroklastisk bergart	Pyroclastic rocks
Karbonatitt	Carbonatite
Felsiske vulkansk bergart	Felsic volcanites
Felsisk skifer	Felsic schists
Mafiske vulkansk bergart	Mafic volcanites
Båndet jernmalm	Banded iron ore
Fyllitt	Phyllite
Glimmergneis	Mica gneiss
Granitt - granittisk gneis	Granite - granitic gneiss
Grønnstein	Greenstone
Mangeritt	Mangerite
Amfibolitt	Amphibolite
Anortositt	Anorthosite
Dioritt - gabbro	Diorite - gabbro
Ultramafisk bergart	Ultramafic rocks

2.1 Known mineral resources

Particularly striking, within many of the Palaeozoic volcano-sedimentary successions of the central Caledonides, is the occurrence of major base metal sulphide (VMS) deposits, for example Løkken and Røros (Cu, Zn). The most prominent occurrences are stratiform massive sulphide deposits in metasedimentary successions associated with gabbroic intrusions, such as in Røros (Zn, Cu, Pb). The other most significant deposits within the southern part of Trøndelag are volcanogenic massive sulfide (VMS) ore deposits within metallogenic areas such as Kvikne-Singsås (Cu, Zn, Ni) and Follidal-Meråker (Cu, Zn). These metallic mineral deposits were formed during rifting to subduction and collision within the Caledonian orogeny, during 600–390 Ma (Sandstad et al., 2012). Figure 2 shows the metallogenic areas and deposits identified within southern Trøndelag (Sandstad et al., 2012). In Figure 3 the deposits are further divided into the most prominent elements.

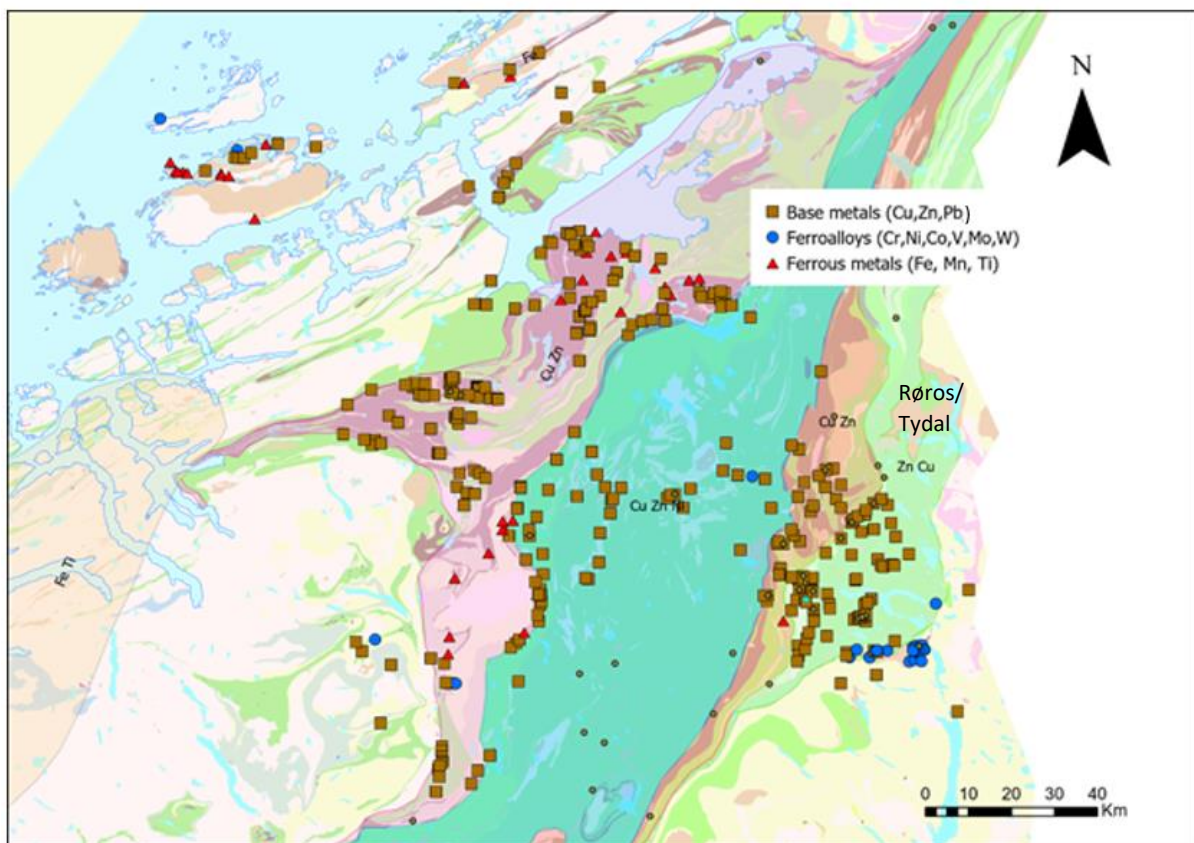


Figure 2. Map of metallic mineral resources within the southern part of Trøndelag. Data from NGU's ore database.

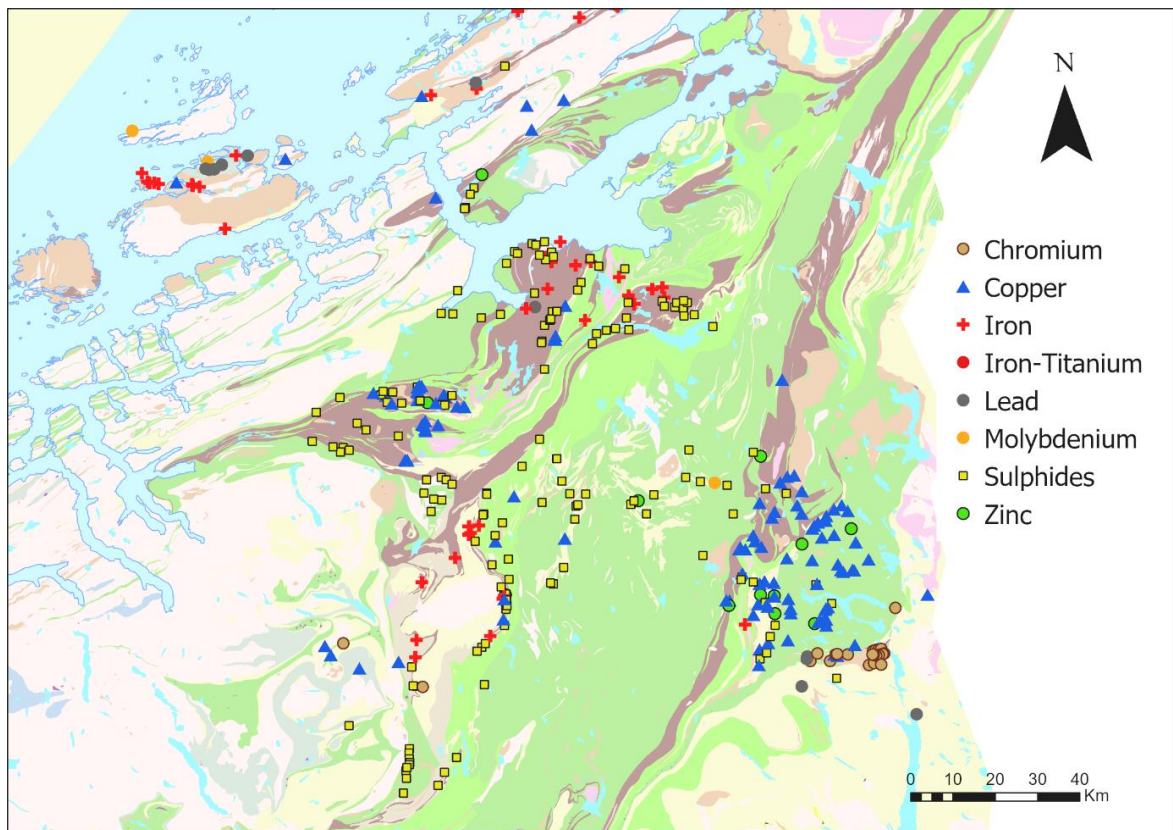


Figure 3. Geological map showing the same mineral resources as in Figure 2 but divided into subsets. Data from NGU's ore database.

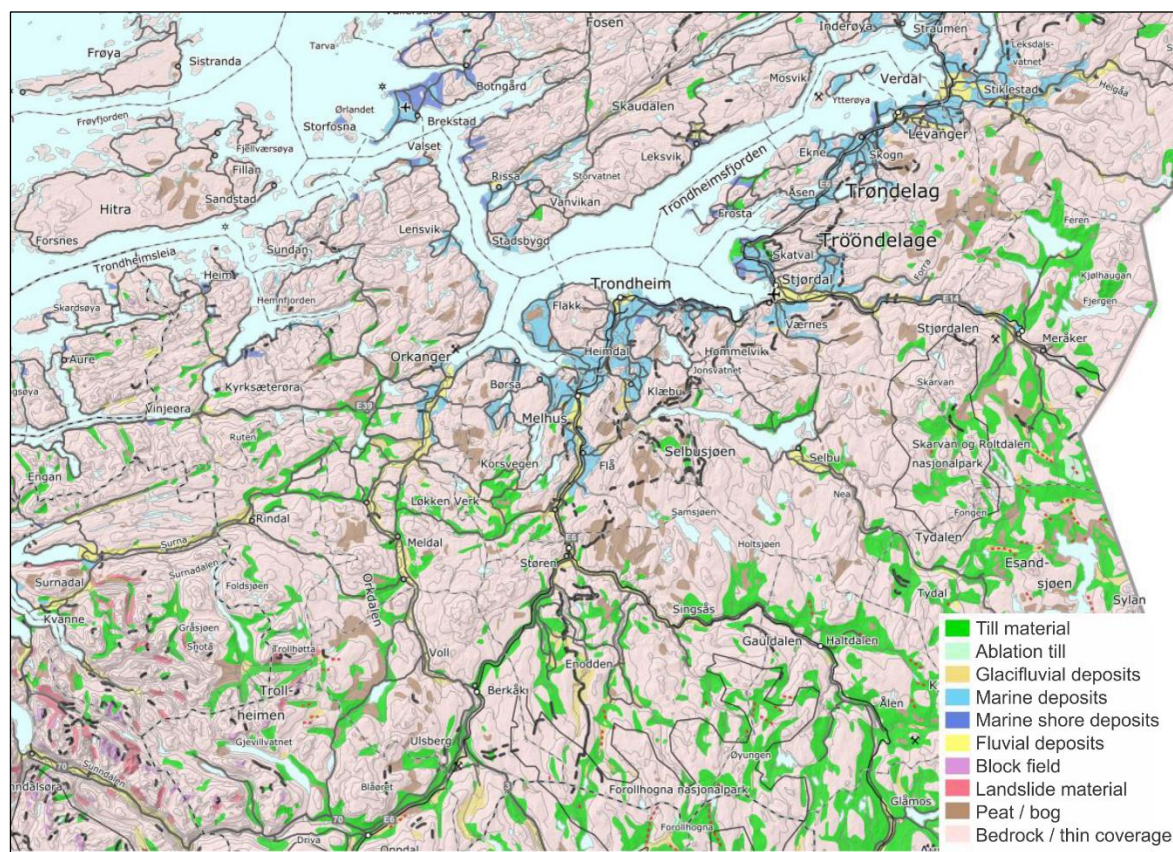


Figure 4. Geological map showing large scale Quaternary deposits. Data from NGU's database.

2.2 Quaternary deposits

The quaternary deposits of the area towards the coastline are dominated by areas of bare bedrock or thin, discontinuous till material, interspersed with weathered rock of local origin. Figure 4 also shows areas of till, mostly confined to lower altitudes in the mountain regions towards the Swedish border.

The area surrounding Trondheim is characterized by marine deposits in the form of clay and fluvial deposits. Rivers discharging into the sea by Trondheim and Orkanger have given rise to substantial fluvial deposits in the river valleys.

3. METHODS

3.1 Field work

As this survey was a continuation of the geochemical soil survey undertaken in North-Trøndelag and Fosen 2013-2014, a similar procedure was adopted in 2018 (Finne et al., 2014). The sample density and sampling procedure were also similar to those used in the three northernmost counties (Reimann et al. 2011). Grids of 6km x 6km were marked on topographical maps along with the highest marine level, polygons delineating glaciofluvial deposits and areas with 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. Figure 5 shows a typical sample pit in podzol, while Figure 6 shows a sample pit where weathered soil has been collected directly from top of bedrock. Sample locations and sample IDs were given numbers in the range 2700 to 3200.

At approximately every twentieth sampling site a field duplicate sample was collected, resulting in 23 field duplicate pairs from the survey area. In total 462 mineral soil samples were collected.



Figure 5 Typical sample pit from a location with till and podzol development. The left photo gives an overview of the pit with a large shovel, sample Rilsan® plastic bag, number tag and ruler. The corner of the photo shows the tarpaulin used for storing the topsoil during sampling. A close-up photo of the pit is given to the right. Photos: Belinda Flem, NGU



Figure 6 Sample location where weathered soil has been sampled. Photo: Malin Andersson, NGU

3.2 Sample preparation/pre-analysis

All samples were returned to NGU by the field workers, who recorded each sample's wet weight before the sample bags were opened and placed in the dryer. The samples were dried at temperatures below 40 °C for more than 3 months. The soil samples were subsequently dry-sieved using a 2 mm nylon mesh. Before returning the < 2mm sieved fraction back into the sample bag for future use, two 50 ml Kautex boxes and one 100 ml Kautex box was filled using a stainless-steel spoon. From each field duplicate sample (23 in number), an analytical split was prepared in an additional 50 ml Kautex box. The >2 mm fraction was thrown away.

All samples, field duplicates, analytical duplicates of the field duplicate and quality control samples were randomized after the procedure described by Eggen et al., 2019. Randomisation numbers from 12001 upwards were used.

3.3 Laboratory analysis

The randomized sample series of the <2-mm fraction was shipped to Acme Labs (now doing business as Bureau Veritas Minerals) 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, HNO₃, and de-mineralized H₂O. 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 Acme Labs home page, <http://acmelab.com/>.

3.4 Quality control

To be able to calculate a practical detection limit (PDL) it was agreed with the laboratory that all instrumental readings had to be reported, independent of detection limit (DL) or quantification limit (QL) set by the laboratory. Reporting limits used by the laboratory are usually set higher than the real quantification limit, as laboratory limits must cover long time operation conditions – possibly years. In addition, the data should not be rounded off, and at least one significant figure containing uncertainty had to be retained.

A PDL for an element can be estimated by using the method first proposed by Thomson and Howarth (1978). The estimation should be based on duplicate analyses on splits of randomly selected samples. A detailed description of the calculation is given in Demetriades (2011).

A project in-house reference material (MINS-project standard, Eggen et al. 2017) was analysed after every 20th sample. In addition, 15 splits of the in-house standard MP3, from the Geological Survey of

Sweden, was analysed in batches of 5 placed in the beginning, middle and end of the randomised sample sequence.

For possible analytical comparison with the previous surveys undertaken in North-Trøndelag and Fosen in 2013-2014 (Finne et al., 2014), and in the three northernmost counties (Reimann et al. 2011), 20 samples from the Nordland/Troms sample collection were evenly distributed into the sample series. The same lab, Bureau Veritas Minerals, Vancouver, Canada, have been used for all three sample collections.

The sampling and analytical design follows the same unbalanced ANOVA design as used in earlier surveys (e.g. Eggen and Finne, 2014; Eggen et al., 2017). The same information can be obtained from a balanced or an unbalanced sampling and analysis design, but an unbalanced design makes a more efficient use of resources (Reimann et al., 2008).

4. RESULTS

4.1 Practical detection limit and precision

Practical detection limits, PDL, were calculated for all elements based on:

- 23 field duplicates and their analytical split pairs
- two randomly selected project standards (MINS-project standard)
- two randomly selected analytical splits of the SGU inhouse standard MP3 (Morris, 2019)
- analytical pairs of the laboratory standards BVGEO01, OREAS26 and DS11
- 16 randomly selected analytical duplicates selected by the laboratory.

In total this gave 4 groups of 11 pairs. The results of the estimated PDL s are given in Table 1. The PDL used is set lower than the laboratory reporting limit for 12 elements while is set higher than the laboratory reporting limit for 2 elements. The PDL for all other elements was either estimated to be similar to the laboratory reporting limit or there were too few analytical pairs above laboratory reporting limit. Overall precision is estimated where the precision versus concentration curve reaches a plateau (Demetriades, 2011).

4.2 Analytical quality control, QC

4.2.1 In-house project standard, MINS

In Appendix 1 the analytical results for all samples; ordinary samples in addition to field duplicates and analytical duplicates, the in-house project standard MINS and MP3 (Morris, 2019) are shown in the order they were analysed in the lab. Negative concentration values reported by the lab are replaced by a low positive value, 0.0000001 mg/kg. The appropriateness of the MINS standard for this survey is good for most elements except Ag, Hg, Nb, and S (too low) and Hf and Zr (too high).

Twenty-three splits of the MINS project standard were analysed along with the samples, one split after approximately every 20th sample. A statistical summary for the project in-house standard is given in Table 2. This includes the minimum, median, and maximum concentration values for all elements. The elements: Ge, Pd, Pt, Re, Ta and Te have concentrations below PDL in all samples. The elements Ag, B, Hg, In, S and Se shows median values below PDL for these elements, and it is thus not possible to calculate the analytical repeatability. Most of the other elements show acceptable analytical repeatability with CVR<15%. The elements Be, Nb, Hf, W, Sn, Cd and Au show a precision (CVR) in growing order from 18 to 110%, mainly due to proximity to PDL (e.g. Be, see Appendix 1) and/or sample inhomogeneity (e.g. Au). For comparison, the summary statistics for the ACME in-house standard DS11 is given in Table 3. This standard has been milled and have thus a more homogenic grain size distribution than the MINS standard that is a <2 mm fraction. In addition, the concentration level of most trace elements is higher in the ACME DS11 standard than in the MINS-standard. Less variation in the analytical results is therefore expected, and, as shown in Table 3, the analytical repeatability (CRV) for all elements are 13% or better.

X-charts of the MINS in-house standard is given in Appendix 2. The analytical results are plotted in the same order as they are analysed. For all elements, the median is indicated by a solid line, dashed lines are drawn at median \pm 1 standard deviation (SD) and dotted lines are drawn at median \pm 2 standard deviations (2SD). The analytical repeatability (CVR), estimated in Table 2, is also reflected in the X-charts, however, no significant analytical trends can be seen.

The MINS in-house standard has been used in one previous survey. The summary statistics of the standard from this survey is given in Table 4 for comparison (Eggen et al. 2017). It should be noted that a different laboratory was used during that study.

4.2.2 Samples re-analysed from previous surveys

Twenty soil samples from the Nordland/Troms sample collection (Reimann et al. 2011) no:2, 4, 7, 10, 15, 17, 40, 45, 47, 48, 49, 50, 62, 63, 66, 68, 73, 76, 77 and 81 were analysed along with the ordinary samples. All of these, except sample no 17, were also analysed along with the North Trøndelag and Fosen samples (Finne et al., 2014). The results from the laboratory analyses for all 54 elements are shown in Appendix 3. Some elements, such as Au, Hf, Sb and Se, generally show poor precision due to nugget effects and low concentrations. All other elements show good precision for most of the 19 samples. However, some samples show poorer precision probably due to grain size distribution which can give large differences between sample splits.

4.3 Precision, locations with field duplicates and analytical duplicates

At approximately every twentieth sample location a field duplicate was collected. After drying and sieving, a split was prepared and analysed with the samples (an analytical duplicate of the field duplicate). Table 5 gives a precision estimate for all elements with concentrations above PDL when it comes to the field and analytical duplicate pairs. In addition, the number of pairs above PDL of the total of 23 pairs analysed are given. The estimated precision (CV) for the field duplicates (ordinary sample compared with the field duplicate) ranges from 17.9% (Na and Sr) to 188% (Au, nugget effects). The analytical duplicate pairs (the duplicate field sample and the analytical duplicate) show a much smaller range and better precision: 1.5% for Al and Mg up to 66.7% for Au. The correlation between ordinary sample and duplicate sample, and the correlation between duplicate sample and analytical duplicate, are shown in Appendix 4. Poor correlation is usually due to few samples (e.g. B), low concentrations (e.g. Be) or due to natural variation.

4.4 Analysis of variance (ANOVA)

The field and analytical duplicates can be used to carry out an unbalanced analysis of variance (ANOVA). By unbalanced it is meant that unequal numbers of analysis occur at each level of design.

In Table 6 the analysis of variance (ANOVA) is given for the 23 duplicate sites giving the distributed percentage variabilities for all elements. The p -value given in Table 6 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, except for Au, B, Ge, In and Te, indicate that the combined sampling and analytical variability is smaller than the between sites regional variability. Silver, Ag, for instance, has an estimated regional variability of 67%, 24% variability at site, and 9 % analytical variability. However, elements such as Au, B, Ge, In and Te shows high local variability or even “negative” variability (by convention set to zero), this mainly reflects the difficulties in determining these elements at low levels.

4.5 Survey data and maps

The survey data, 462 locations in the southern part of Trøndelag county, can be downloaded from the geochemical database at NGU, at [http://geo.ngu.no/kart/Geokjemi mobil/](http://geo.ngu.no/kart/Geokjemi_mobil/). An overview of the data is presented in Table 7 giving the number of samples above PDL, minimum and maximum concentration values measured, and the 2, 5, 10, 25, 50, 75, 90, 95 and 90 % quantiles. In addition, the powers (P) are given as a measure of variation. The powers provide a direct impression of the orders of magnitude each element varies.

EDA (exploratory data analysis) maps of all elements are given in Appendix 5, except for Au, B, Ge, In and Te, due to high local variability compared to regional variability and Pt, Pd, Re and Ta, which have too many samples below PDL . Figure 7 shows the EDA symbols used in Appendix 5 with percentiles for each class.

	EDA symbol set	Percentiles used
Highest concentration values	■	95-100%
Higher concentration values	+	75-95%
Inner concentration values	•	25-75%
Lower concentration values	○	5-25%
Lowest concentration values	○	0-5%

Figure 7. The EDA (exploratory data analysis) map symbol set used in this report (Appendix 5).

5. FIRST IMPRESSION OF DATA

The aim of this report is to describe the soil sampling, analysis, and the quality of the data. However, a few first impressions of the data are considered necessary to state.

The shape of the survey area gives large contrasts as several lithological units are present (see Figure 1). Some elements, such as Se and Na, might be influenced by distance to the ocean, elevation, and main precipitation direction.

Parts of the bedrock of the Oppdal, Rennebu and Orkanger municipalities are dominated by overlying rocks from Cambrian and Ordovician (e.g. Nilsen and Wolff 1989). In practice, this means a lot of relatively carbonate-rich bedrock, which often provides the basis for a lush and species-rich vegetation. This is particularly noticeable in the Southwestern part of the area, and e.g. around the Nerskogen, where there are a lot of calcite bearing phyllite. This South-North oriented lithological unit is reflected in high concentrations of Ca, P and Sr (Appendix 5). In the SW-part of the sampled area an elongated multi-element anomaly can be seen, which was also documented by Andersson et al. (2018). This anomaly is present in the area with occurrences of rhyolitic as well as andesitic to basaltic rock types lying along a series of faults. Beryllium, Ca, Cs, P, Pb, Rb, Sn, Sr, Th, Tl, U and W mark the fault zone.

Locations of multi-element anomalies (MEAA) in the soil from the survey area are presented in Figure 8. The colour intensity from grey to black and the size of the dots is related to the number of elements that have concentrations above its 75th percentile (left Figure 8) and above the 90th percentile in the dataset (right Figure 8) at a given sample site. The darker and bigger the dot are, the more elements have concentrations above their 75th percentile (left Figure 8) or above the 90th percentile at that location. In the areas with a red circle marked “A” and “B”, several samples show a high number of elements above the 75th percentile in the MEAA-map, Figure 8. These areas are known to have several occurrences of base metals, Figure 2. The maximum total number of elements enriched in a single sample is 38 at the 75th percentile, this sample was collected in the south end of the area marked with a “C”, south of Selbusjøen, Figure 8. The same area also shows multi-element anomalies above the 90th percentile, Figure 8-left. Area “C” have few registrations in NGUs ore database.

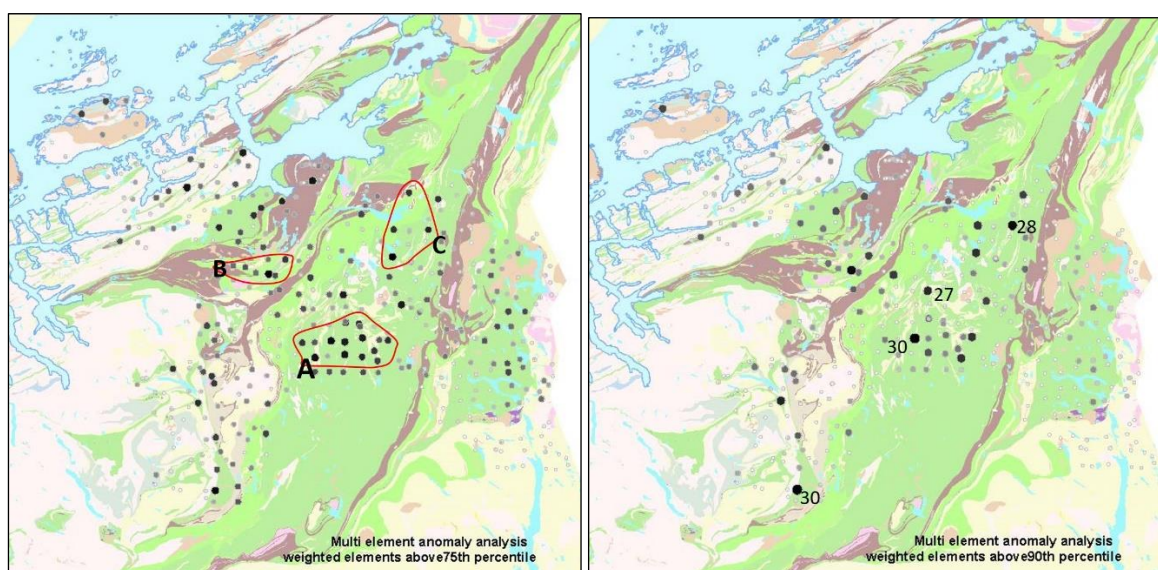


Figure 8. Multi element anomaly analysis (MEAA). Locations of multi-element anomalies in the soil from the survey area. The dots intensity of grey to black colour increases in relation to the number of elements with a concentration > the 75th percentile (left) and >90th percentile in the dataset (right) at any given sample site. The letters A, B and C represent areas with clusters of sample locations that revealed multi-element anomalies. See text for explanations. Sample locations with the highest number of anomal concentrations are marked with the number of elements with concentrations above their 90th percentile (right hand figure).

Trøndelag county has a long history of Cu-Zn mining, e.g at Løkken, Røros, Meråker and Skorovass. These areas are also highlighted in the contour maps for Cu and Zn in Figure 9. However, also the area south of Selbusjøen show relatively high values of Cu and Zn and represents an unexplained geochemical anomaly.

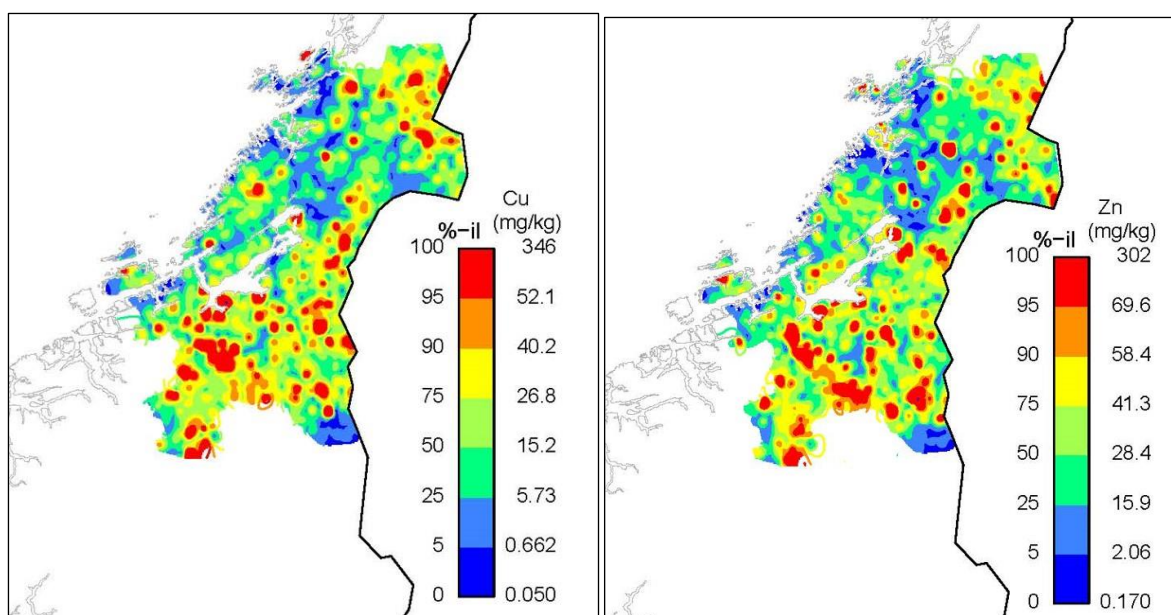


Figure 9 Contour/colour maps of Cu and Zn in Trøndelag County. Data from this survey and Finne et al., 2014.

6. CONCLUSIONS

The quality of the data reported from this survey is acceptable for most elements, with a few exceptions; Ge, Pd, Pt, Re, Ta and Te have poor detection limits, and Au, B and In shows high local variability or even “negative” variability which mainly reflects the difficulties in determining these elements at low levels. Re-analysed samples from the Nordland/Troms sample collection (Reimann et al. 2011) which were also analysed along with the North Trøndelag and Fosen samples (Finne et al., 2014), show good precision for most elements. The exceptions are Au, Hf, Sb and Se which show generally poor precision due to nugget effects and low concentrations. With careful use or working with quantiles, most elements in the three datasets can be merged and used as one dataset.

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TABLES

Table 1: Practical detection limits (PDL).

All elements analysed given with laboratory reported detection limits (Lab DL), estimated practical detection limit (PDL Cal.), overall precision and practical detection limit (PDL) used. Elements with PDL<Lab DL is shown in green while PDL>Lab DL is shown in red.

Element	Lab DL mg/kg	PDL Cal. mg/kg	Overall* Precision %	Comments	PDL used mg/kg
Ag	0.002	0.001	1.21		0.001
Al	100	250	2.83	Comparatively high PDL because all analytical pair values are well above the DL.	100
As	0.1	0.1	0.46		0.1
Au	0.0002	0.0001	5.89		0.0001
B	1	0.06	22.65	Poor precision, too many analytical pair values near DL., and notable differences between some replicates	1
Ba	0.5	0.7	4.72		1
Be	0.1	0.03	16.19	Poor precision, too many analytical pair values near DL., and notable differences between some replicates	0.1
Bi	0.02	0.003	0.12		0.02
Ca	100	10	2.11		20
Cd	0.01	0.004	1.88		0.005
Ce	0.1	0.9	5.56	Somewhat high PDL, because there are no analytical pair values near the detection limit	0.1
Co	0.1	0.2	4.08	Comparatively high PDL, because most analytical pair values are well above the DL.	0.1
Cr	0.5	2	6.12	Somewhat high PDL, because there are no analytical pair values near the detection limit	0.5
Cs	0.02	0.06	5.82	Comparatively high PDL, because most analytical pair values are well above the DL.	0.02
Cu	0.01	0.2	0.47	Comparatively high PDL, because all analytical pair values are well above the DL.	0.01
Fe	100	100	2.12		100
Ga	0.1	0.1	3.53		0.1
Ge	0.1	0.01	40.83	Too few analytical pair values above detection limit to estimate reliable values	0.1
Hf	0.02	0.001	9.41	Poor precision, too many analytical pair values near D.L., and notable differences between some replicates	0.02
Hg	0.005	0.001	13.12	Poor precision, too many analytical pair values near D.L., and notable differences between some replicates	0.005
In	0.02	0.0001	8.81	Too few analytical pair values above detection limit to estimate reliable values	0.02
K	100	50	5.13	Comparatively high PDL, because most analytical pair values are well above the DL.	100
La	0.5	0.5	8.39	Comparatively high PDL, because all analytical pair values are well above the DL.	0.5
Li	0.1	0.2	1.78	Comparatively high PDL, because all analytical pair values are well above the DL.	0.1
Mg	100	2	1.40		10
Mn	1	4	4.38	Comparatively high PDL, because all analytical pair values are well above the DL.	1
Mo	0.01	0.003	0.74		0.005

Element	Lab DL mg/kg	PDL Cal. mg/kg	Overall* Precision %	Comments	PDL used mg/kg
Na	10	1	3.54	Comparatively high PDL, because all analytical pair values are well above the DL.	5
Nb	0.02	0.005	3.26		0.02
Ni	0.1	0.1	2.47		0.1
P	10	14	7.62	Poor precision and elevated PDL	15
Pb	0.01	0.04	0.88	Comparatively high PDL, because all analytical pair values are well above the DL.	0.01
Pd	0.01	0.001	4.17	Too few analytical pair values above detection limit to estimate reliable values	0.01
Pt	0.002	0.0001	3.55	Too few analytical pair values above detection limit to estimate reliable values	0.002
Rb	0.1	0.1	1.61		0.1
Re	0.001	0.0001	7.66	Too few analytical pair values above detection limit to estimate reliable values	0.001
S	200	0.04	3.00		5
Sb	0.02	0.001	0.19		0.001
Sc	0.1	0.1	6.87		0.1
Se	0.1	0.03	5.35		0.05
Sn	0.1	0.01	2.96		0.05
Sr	0.5	0.1	3.44	Comparatively high PDL, because all analytical pair values are well above the DL.	0.5
Ta	0.05	0.0002	13.96	Too few analytical pair values above detection limit to estimate reliable values	0.05
Te	0.02	0.001	1.83	Too few analytical pair values above detection limit to estimate reliable values	0.02
Th	0.1	0.1	10.38		0.1
Ti	10	4	1.92		5
Tl	0.02	0.001	4.74		0.01
U	0.05	0.02	5.70		0.05
V	1	1	5.71		1
W	0.05	0.005	1.79		0.01
Y	0.01	0.06	3.10	Comparatively high PDL, because all analytical pair values are well above the DL.	0.01
Zn	0.1	0.1	0.61		0.1
Zr	0.1	0.01	3.76		0.1

Table 2: The MINS project standard (Sagelva).

Summary statistics for the MINS project standard (Sagelva). 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.

MINS project standard (n=23)						Sorted by precision	
Element	MIN mg/kg	MEDIAN mg/kg	MAX mg/kg	IQR mg/kg	CVR %	Element	CVR %
Ag	<0.001	<0.001	0.0035	-	-	Ni	2.3
Al	11210	12550	13940	498	4.3	Mg	3.3
As	2.35	2.65	3.25	0.110	4.6	Fe	3.6
Au	<0.0001	0.0004	0.0018	0.0005	110	Li	3.8
B	<1	<1	1.82	-	-	Mn	4.1
Ba	28.1	33.5	35.5	2.97	7.6	Al	4.3
Be	0.134	0.244	0.435	0.06	18	As	4.6
Bi	0.052	0.060	0.108	0.006	8.3	Ga	4.6
Ca	1380	1680	1860	126	5.3	Co	4.8
Cd	0.01	0.02	0.04	0.01	27	V	4.8
Ce	30.1	34.3	38.1	2.49	5.3	Mo	5.0
Co	8.32	9.17	9.93	0.41	4.8	Cu	5.2
Cr	42.5	47.6	50.6	2.48	5.3	Ca	5.3
Cs	0.668	0.734	0.820	0.04	6.0	Ce	5.3
Cu	24.0	26.7	28.3	1.47	5.2	Cr	5.3
Fe	15130	16530	17240	580	3.6	Zn	5.4
Ga	2.80	3.26	3.47	0.147	4.6	Tl	5.8
Ge	<0.1	<0.1	<0.1	-	-	Cs	6.0
Hf	0.07	0.106	0.207	0.02	21	Rb	6.1
Hg	<0.005	<0.005	0.009	0.0004	-	P	6.6
In	<0.02	<0.02	0.03	-	-	Pb	7.2
K	1020	1150	1370	94.4	8.9	Sc	7.3
La	13.5	15.9	17.3	1.34	7.9	Th	7.3
Li	10.7	11.6	12.2	0.582	3.8	Ba	7.6
Mg	6760	7430	7700	255	3.3	La	7.9
Mn	250	269	289	10.6	4.1	Bi	8.3
Mo	0.244	0.270	0.303	0.01	5.0	K	8.9
Na	65.2	82.4	149	9.20	13	Y	8.9
Nb	0.246	0.313	0.419	0.05	18	U	10
Ni	36.9	40.9	43.5	0.90	2.3	Ti	11
P	478	527	598	34	6.6	Sb	12
Pb	4.27	4.84	5.37	0.33	7.2	Na	13
Pd	<0.01	<0.01	<0.01	-	-	Sr	13
Pt	<0.002	<0.002	<0.002	-	-	Zr	15
Rb	7.17	8.33	9.22	0.594	6.1	Be	18
Re	<0.001	<0.001	<0.001	-	-	Nb	18
S	<5	<5	12.3	-	-	Hf	21
Sb	0.053	0.066	0.109	0.01	12	W	23

MINS project standard (n=23)						Sorted by precision	
Element	MIN mg/kg	MEDIAN mg/kg	MAX mg/kg	IQR mg/kg	CVR %	Element	CVR %
Sc	2.59	3.17	3.59	0.276	7.3	Sn	24
Se	<0.05	<0.05	0.141	-	-	Cd	27
Sn	0.104	0.218	0.345	0.05	24	Au	110
Sr	6.93	9.18	10.4	1.21	13	Ag	-
Ta	<0.05	<0.05	<0.05	-	-	B	-
Te	<0.02	<0.02	<0.02364	-	-	Ge	-
Th	3.71	4.77	5.50	0.401	7.3	Hg	-
Ti	545	699	777	87.7	11	In	-
Tl	0.08	0.09	0.101	0.004	5.8	Pd	-
U	0.490	0.619	0.684	0.06	10	Pt	-
V	22.1	24.7	26.2	1.34	4.8	Re	-
W	0.03	0.05	0.07	0.01	23	S	-
Y	6.31	7.37	8.10	0.603	8.9	Se	-
Zn	26.4	29.0	31.7	1.59	5.4	Ta	-
Zr	3.74	5.66	6.94	0.758	15	Te	-

Table 3: The ACME in-house standard DS11

Summary statistics for the ACME in-house standard DS11. 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.

ACME standard DS11 (n=11)						Sorted by precision	
Element	MIN mg/kg	MEDIAN mg/kg	MAX mg/kg	IQR mg/kg	CVR %	Element	CVR %
Ag	1.6	1.7	1.7	0.053	1.9	Mn	1.0
Al	10700	11400	12100	594	6.6	As	1.8
As	39	42	44	0.61	1.8	Ag	1.9
Au	0.061	0.068	0.084	0.0062	11	Te	1.9
B	6.3	6.7	8.3	0.53	6.4	Cr	2.0
Ba	320	340	380	15	4.2	Mg	2.0
Be	0.53	0.64	0.79	0.072	10	S	2.1
Bi	9.7	12	12	0.42	3.4	Ca	2.6
Ca	9810	10300	10700	254	2.6	Zn	2.6
Cd	2.0	2.3	2.5	0.082	4.1	Ni	2.9
Ce	32	36	42	2.6	8.8	W	2.9
Co	13	13	14	0.47	4.6	V	3.1
Cr	55	59	60	2.4	2.0	Sb	3.3
Cs	2.6	2.9	3.0	0.11	3.8	Bi	3.4
Cu	140	150	160	9.0	6.3	Fe	3.4
Fe	29200	30600	32000	882	3.4	Tl	3.4
Ga	4.6	4.9	5.1	0.23	4.4	Rb	3.5
Ge	<0.1	<0.1	<0.1	-	-	Se	3.7
Hf	0.053	0.063	0.079	0.0065	13	Cs	3.8
Hg	0.23	0.25	0.28	0.012	5.6	Re	3.9
In	0.21	0.24	0.27	0.019	6.7	K	4.0
K	3760	3940	4140	142	4.0	Cd	4.1
La	16	18	21	1.9	11	Ba	4.2
Li	21	22	24	1.1	5.2	Ga	4.4
Mg	7980	8240	8530	139	2.0	Co	4.6
Mn	961	1000	1050	10.1	1.0	Pb	4.6
Mo	13	14	15	1.1	8.2	U	4.6
Na	670	720	800	42	5.8	Li	5.2
Nb	1.2	1.5	1.7	0.18	11	Pd	5.3
Ni	73	78	80	2.1	2.9	Sn	5.5
P	630	710	770	39	6.3	Hg	5.6
Pb	130	130	140	4.2	4.6	Pt	5.7
Pd	0.092	0.11	0.11	0.0072	5.3	Na	5.8
Pt	0.16	0.17	0.18	0.0082	5.7	Sr	5.8
Rb	31	34	35	0.98	3.5	Y	6.0
Re	0.038	0.043	0.050	0.0017	3.9	Cu	6.3
S	2400	2600	2800	85	2.1	P	6.3
Sb	7.4	8.7	9.1	0.34	3.3	B	6.4
Sc	2.9	3.2	3.5	0.19	6.4	Sc	6.4

ACME standard DS11 (n=11)						Sorted by precision	
Element	MIN mg/kg	MEDIAN mg/kg	MAX mg/kg	IQR mg/kg	CVR %	Element	CVR %
Se	2.0	2.2	2.3	0.085	3.7	Al	6.6
Sn	1.5	1.8	2.0	0.10	5.4	In	6.7
Sr	59	66	71	3.5	5.8	Ti	7.8
Ta	<0.05	<0.05	<0.05	-	-	Mo	8.3
Te	4.4	4.5	4.8	0.074	1.9	Ce	8.8
Th	6.4	8.1	9.2	0.89	12	Be	10
Ti	790	910	970	78	7.8	Au	11
Tl	4.7	4.9	5.1	0.17	3.4	Nb	11
U	2.2	2.5	2.8	0.11	4.6	La	12
V	45	48	51	1.4	3.1	Th	12
W	2.8	3.0	3.1	0.10	2.9	Hf	13
Y	6.9	7.7	8.6	0.48	6.0	Zr	13
Zn	320	330	350	7.1	2.5	Ge	-
Zr	2.5	2.7	4.3	0.54	12	Ta	-

Table 4: The MINS project inhouse standard, previous analysis

Summary statistics for the MINS project inhouse standard (Sagelva) from the Oppdal and Rennebu survey, Eggen et al. 2017.

Sagelva standard (n=23) alphabetical									Sorted by precision				
Min	Q50	Max	CVR		Min	Q50	Max	CVR		CVR		CVR	
mg/kg	mg/kg	mg/kg	%		mg/kg	mg/kg	mg/kg	%		%		%	
Ag	<0.01	<0.01	<0.01	-	Mo	0.27	0.29	0.35	5.1	Ge	25	Ni	3.2
Al	11300	11900	12300	3.7	Na	50	100	100	0.0	In	14	P	2.8
As	2.4	2.7	2.9	5.5	Nb	0.20	0.26	0.30	5.7	Ca	10	U	2.7
Au	<0.001	<0.001	0.001	-	Ni	35.6	37.7	40.0	3.2	Ti	7.7	Mn	2.4
B	<10	<10	10	-	P	500	530	550	2.8	Sr	7.6	Mg	2.1
Ba	30	30	30	-	Pb	4.2	4.6	4.9	3.2	V	6.5	Co	1.7
Be	0.2	0.2	0.3	6.2	Rb	7.3	7.9	8.5	3.8	Be	6.2	Au	-
Bi	0.06	0.07	0.07	-	Re	<0.001	<0.001	<0.001	-	Nb	5.7	Ag	-
Ca	1300	1500	1600	9.9	S	<100	<100	100	-	Zn	5.7	B	-
Cd	0.01	0.03	0.03	-	Sb	0.06	0.07	0.08	-	As	5.5	Ba	-
Ce	31.2	33.0	36.3	4.0	Sc	2.8	3.0	3.4	4.9	Li	5.1	Bi	-
Co	8.2	8.6	9.3	1.7	Se	0.1	0.1	0.2	-	Mo	5.1	Cd	-
Cr	40	42	43	3.5	Sn	0.2	0.2	0.2	-	Sc	4.9	Hf	-
Cs	0.68	0.72	0.80	4.1	Sr	7.0	7.8	8.7	7.6	Y	4.6	Hg	-
Cu	21.9	24.8	26.7	3.6	Ta	<0.01	<0.01	<0.01	0.0	Cs	4.1	K	-
Fe	15000	15800	16500	3.8	Te	<0.01	0.02	0.03	0.0	Ce	4.0	Na	-
Ga	3.06	3.20	3.44	3.2	Th	4.1	4.5	4.8	3.3	La	4.0	Re	-
Ge	0.05	0.06	0.08	24.7	Ti	530	580	640	7.7	Fe	3.8	S	-
Hf	0.06	0.07	0.07	-	Tl	0.08	0.09	0.09	-	Rb	3.8	Sb	-
Hg	<0.01	<0.01	0.01	-	U	0.51	0.55	0.59	2.7	Al	3.7	Se	-
In	0.010	0.011	0.012	13.5	V	22	23	24	6.5	Zr	3.7	Sn	-
K	900	1000	1000	-	W	0.05	0.05	0.06	-	Cu	3.6	Ta	-
La	14.1	14.9	15.9	4.0	Y	6.70	7.13	7.66	4.6	Cr	3.5	Te	-
Li	10.2	11.6	12.8	5.1	Zn	25	26	27	5.7	Th	3.3	Tl	-
Mg	6600	7000	7300	2.1	Zr	3.9	4.0	4.4	3.7	Ga	3.2	W	-
Mn	230	243	251	2.4						Pb	3.2		

Table 5. Precision of duplicates

Precision estimate of field and analytical duplicates. The no. pair >PDL gives the number of field duplicate pairs or analytical duplicate pairs that shows concentrations above the practical detection limit.

Field duplicates (23 pairs)						Analytical duplicates (23 pairs)					
Alphabetical			Sorted			Alphabetical			Sorted		
Element	No. pair >PDL	Precision (CV) %	Element	No. pair >PDL	Precision (CV) %	Element	No. pair >PDL	Precision (CV) %	Element	No. pair >PDL	Precision (CV) %
Ag	21	60.5	Na	23	17.9	Ag	21	8.2	Al	23	1.5
Al	23	25.9	Sr	23	17.9	Al	23	1.5	Mg	23	1.5
As	19	86.4	B	5	19.9	As	18	14.2	V	23	1.6
Au	13	188	Co	23	20.2	Au	13	66.7	Fe	23	1.7
B	5	19.9	Zn	23	23	B	5	15.5	Y	23	2
Ba	23	41.6	P	23	23.2	Ba	23	7.2	Pb	23	2.6
Be	18	31.6	Ce	23	24.7	Be	20	25.1	Sr	23	2.7
Bi	20	28.9	Sb	22	25.1	Bi	20	4.6	Ti	23	2.7
Ca	23	26.3	Al	23	25.9	Ca	23	2.8	Ca	23	2.8
Cd	21	59.8	Ca	23	26.3	Cd	22	10.7	Mn	23	2.8
Ce	23	24.7	S	20	26.9	Ce	23	3.3	Ni	23	2.8
Co	23	20.2	Fe	23	28.1	Co	23	3.4	Cr	23	2.9
Cr	23	66.8	Bi	20	28.9	Cr	23	2.9	Ga	23	2.9
Cs	23	37.1	Ni	23	29.1	Cs	23	3.2	Mo	23	2.9
Cu	23	52.5	Hg	19	29.7	Cu	23	3.1	Cu	23	3.1
Fe	23	28.1	W	22	30.7	Fe	23	1.7	Rb	23	3.1
Ga	23	31.5	Ga	23	31.5	Ga	23	2.9	Cs	23	3.2
Ge	1	-	Be	18	31.6	Ge	5	27.8	Ce	23	3.3
Hf	17	53.6	Zr	22	32	Hf	18	15.5	Tl	23	3.3
Hg	19	29.7	Pb	23	32.7	Hg	19	11.2	Co	23	3.4
In	4	-	La	23	33.9	In	5	13.3	K	23	3.7
K	23	57.7	Mn	23	34	K	23	3.7	Na	23	3.9
La	23	33.9	V	23	34.2	La	23	4.2	La	23	4.2
Li	23	39.3	Te	5	34.3	Li	23	4.7	P	23	4.2
Mg	23	37.6	Cs	23	37.1	Mg	23	1.5	Sc	23	4.2
Mn	23	34	Mg	23	37.6	Mn	23	2.8	Zn	23	4.5
Mo	23	42	Th	23	38.5	Mo	23	2.9	Bi	20	4.6
Na	23	17.9	Li	23	39.3	Na	23	3.9	U	23	4.6
Nb	23	49	Rb	23	40.6	Nb	23	5.4	Li	23	4.7
Ni	23	29.1	Sc	23	40.6	Ni	23	2.8	Sn	23	5.1
P	23	23.2	Ba	23	41.6	P	23	4.2	Nb	23	5.4
Pb	23	32.7	Mo	23	42	Pb	23	2.6	Zr	22	6.5
Pd	0	-	Ti	23	42.1	Pd	0	-	S	21	6.8
Pt	0	-	U	23	46.4	Pt	0	-	Ba	23	7.2
Rb	23	40.6	Sn	23	48.2	Rb	23	3.1	Ag	21	8.2
Re	1	-	Nb	23	49	Re	1	-	Th	23	10.2
S	20	26.9	Cu	23	52.5	S	21	6.8	Cd	22	10.7

Field duplicates (23 pairs)						Analytical duplicates (23 pairs)					
Alphabetical			Sorted			Alphabetical			Sorted		
Element	No. pair >PDL	Precision (CV) %	Element	No. pair >PDL	Precision (CV) %	Element	No. pair >PDL	Precision (CV) %	Element	No. pair >PDL	Precision (CV) %
Sb	22	25.1	Hf	17	53.6	Sb	23	19.5	Hg	19	11.2
Sc	23	40.6	Tl	22	55.4	Sc	23	4.2	In	5	13.3
Se	17	74.5	K	23	57.7	Se	17	18.4	W	23	13.7
Sn	23	48.2	Cd	21	59.8	Sn	23	5.1	As	18	14.2
Sr	23	17.9	Ag	21	60.5	Sr	23	2.7	Te	9	14.9
Ta	1	-	Y	23	60.9	Ta	1	-	B	5	15.5
Te	5	34.3	Cr	23	66.8	Te	9	14.9	Hf	18	15.5
Th	23	38.5	Se	17	74.5	Th	23	10.2	Se	17	18.4
Ti	23	42.1	As	19	86.4	Ti	23	2.7	Sb	23	19.5
Tl	22	55.4	Au	13	188	Tl	23	3.3	Be	20	25.1
U	23	46.4	Ge	1	-	U	23	4.6	Ge	5	27.8
V	23	34.2	In	4	-	V	23	1.6	Au	13	66.7
W	22	30.7	Pd	0	-	W	23	13.7	Pd	0	-
Y	23	60.9	Pt	0	-	Y	23	2	Pt	0	-
Zn	23	23	Re	1	-	Zn	23	4.5	Re	1	-
Zr	22	32	Ta	1	-	Zr	22	6.5	Ta	1	-

Table 6: Analysis of variance table (ANOVA)

Analysis of variance table (ANOVA) for the 23 duplicate sites giving the distributed percentage variabilities for all elements. The p -value is for the F-test. All variables were log-transformed prior to the calculation.

Element	Regional %	Site %	Analytical %	p -value	Element	Regional %	Site %	Analytical %	p -value
Ag	67.35	23.58	9.07	0.19	Mn	63.88	35.95	0.18	0.37
Al	77.34	22.60	0.06	0.44	Mo	77.70	21.75	0.55	0.25
As	88.51	9.28	2.21	0.31	Na	94.85	3.91	1.24	0.43
Au	24.45	19.32	56.23	0.14	Nb	59.83	39.90	0.27	0.08
B	77.48	0.00	22.52	0.85	Ni	89.10	10.84	0.05	0.34
Ba	86.87	12.92	0.21	0.40	P	77.80	21.80	0.40	0.19
Be	76.95	11.72	11.33	0.45	Pb	64.04	35.78	0.18	0.10
Bi	57.85	40.93	1.22	0.06	Rb	68.85	31.03	0.12	0.31
Ca	80.63	19.25	0.13	0.33	S	69.11	30.74	0.15	0.17
Cd	75.28	21.13	3.59	0.31	Sb	91.93	1.18	6.89	0.79
Ce	77.93	21.93	0.14	0.39	Sc	78.73	20.86	0.40	0.49
Co	87.80	12.02	0.18	0.46	Se	72.08	25.98	1.94	0.15
Cr	77.23	22.69	0.08	0.22	Sn	80.16	18.53	1.31	0.27
Cs	58.57	41.34	0.10	0.40	Sr	89.90	9.95	0.15	0.34
Cu	77.75	22.11	0.13	0.16	Te	24.46	50.84	24.71	0.00
Fe	68.14	31.78	0.08	0.34	Th	79.67	19.25	1.09	0.27
Ga	74.58	24.95	0.47	0.31	Ti	67.06	32.83	0.11	0.14
Ge	75.31	0.00	24.69	0.42	Tl	66.81	32.91	0.28	0.28
Hf	65.75	25.37	8.88	0.13	U	92.43	7.39	0.18	0.45
Hg	74.51	24.02	1.48	0.19	V	72.69	27.25	0.06	0.22
In	47.52	42.93	9.55	0.72	W	62.08	31.08	6.84	0.20
K	79.94	19.98	0.08	0.25	Y	90.88	9.04	0.08	0.33
La	80.28	19.53	0.19	0.31	Zn	87.78	11.82	0.40	0.47
Li	65.04	34.79	0.17	0.38	Zr	89.97	9.43	0.61	0.32
Mg	75.34	24.60	0.06	0.41					

Table 7: The survey data

Summary statistics for the survey data (n=462) giving the number of samples above the practical detection limit (PDL), minimum (Min), maximum (Max) concentration value measured and the 2, 5, 10, 25, 50, 75, 90, 95 and 90 % quantiles. In addition, the powers (P) are given as a measure on variation.

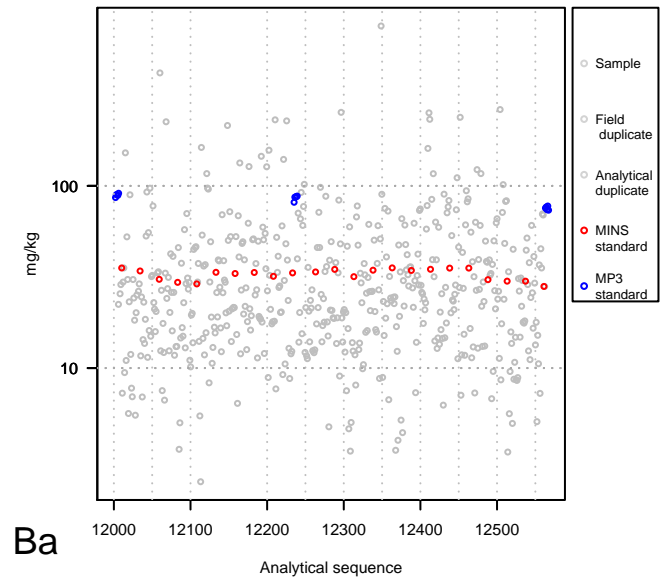
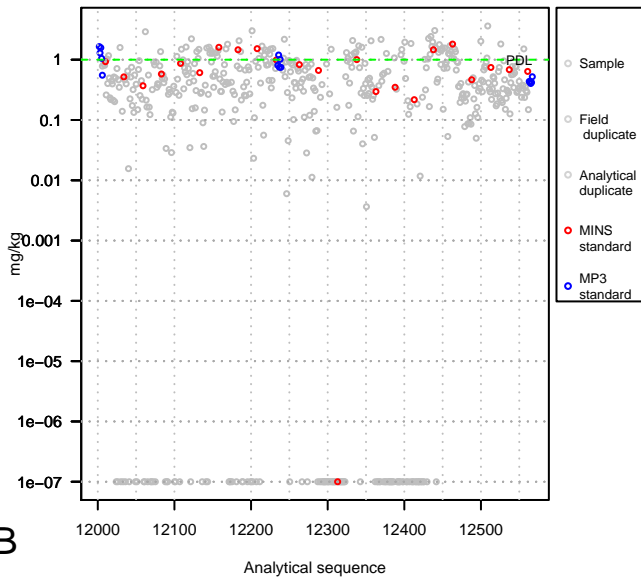
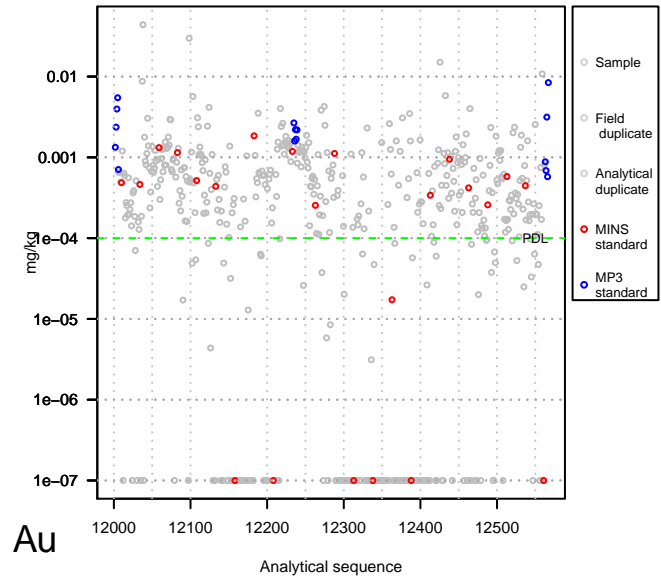
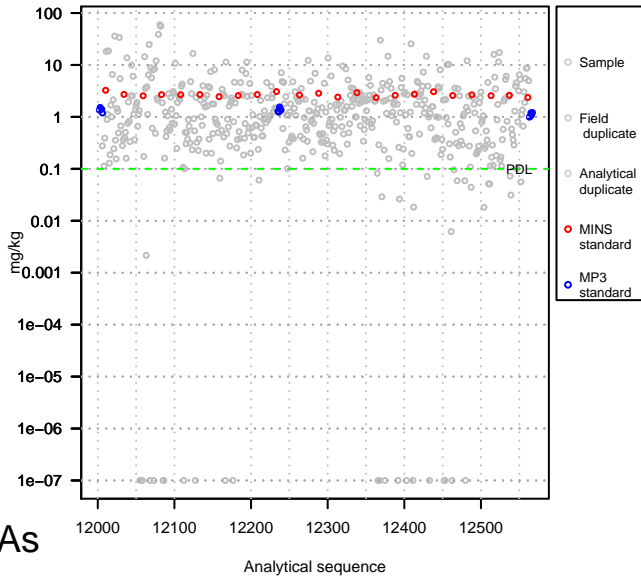
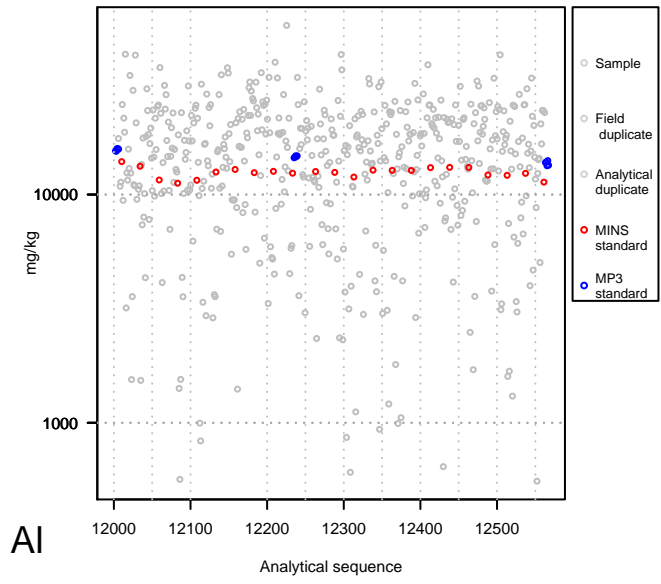
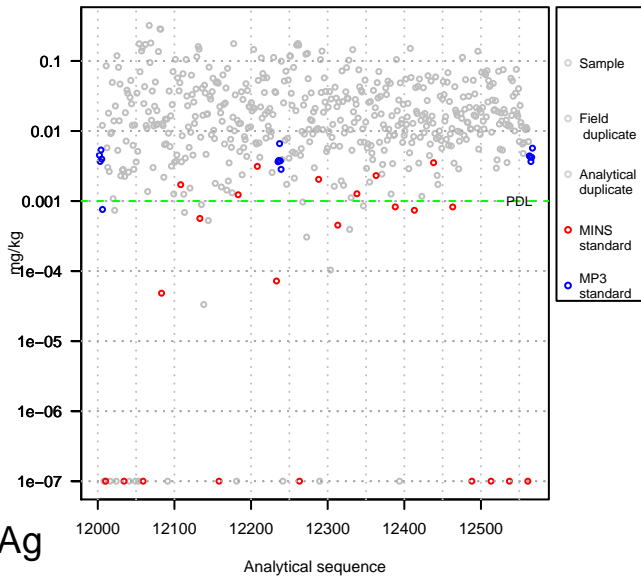
Ele	n>PDL	Min mg/kg	Q2 mg/kg	Q5 mg/kg	Q10 mg/kg	Q25 mg/kg	Q50 mg/kg	Q75 mg/kg	Q90 mg/kg	Q95 mg/kg	Q98 mg/kg	Max mg/kg	P
Ag	443	<0.001	<0.001	0.00126	0.00259	0.00684	0.0148	0.0347	0.0679	0.105	0.138	0.322	2.5
Al	462	555	1067	2341	3754	9447	15492	21345	25913	31049	34977	55094	2
As	429	<0.1	<0.1	<0.1	0.16	0.388	1.08	2.62	5.71	10.2	16.4	38.7	2.6
Au	306	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.000273	0.000812	0.00145	0.00239	0.00398	0.0439	2.6
B	70	<1	<1	<1	<1	<1	<1	<1	1.32	1.61	2.08	3.63	0.6
Ba	462	2.38	4.98	6.94	9.23	14.7	25.2	42.3	72.7	102	162	755	2.5
Be	393	<0.1	<0.1	<0.1	<0.1	0.166	0.256	0.409	0.553	0.705	0.987	3.62	1.6
Bi	430	<0.02	<0.02	<0.02	0.0276	0.0504	0.0785	0.119	0.181	0.234	0.318	0.613	1.5
Ca	459	<20	103	258	403	801	1450	2260	3118	4186	5664	9992	2.7
Cd	433	<0.005	<0.005	<0.005	0.00886	0.0186	0.0341	0.0569	0.0891	0.118	0.181	1.17	2.4
Ce	462	0.869	3.16	5.26	9.89	17.6	29.1	43	62.5	81.6	108	193	2.3
Co	455	<0.1	0.117	0.675	1.39	5.43	8.91	14.7	20.3	25.8	34.3	55.6	2.7
Cr	461	<0.5	1.31	3.21	8.00	25.9	45.8	69.6	104	138	210	421	2.9
Cs	462	0.0505	0.218	0.3	0.463	0.79	1.28	1.98	3	3.85	4.97	11.3	2.4
Cu	462	0.0619	0.252	0.861	2.3	8.37	19.4	31.1	46.2	56.4	74.1	110	3.2
Fe	461	<100	787	2441	5657	13454	21795	30019	38524	46307	56124	79587	2.9
Ga	462	0.359	0.59	1	1.75	3.02	4.59	6.2	8.07	9.89	11.6	15.6	1.6
Ge	61	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.112	0.147	0.209	1.29	1.1
Hf	397	<0.02	<0.02	<0.02	<0.02	0.0267	0.0473	0.0772	0.114	0.15	0.211	0.619	1.5
Hg	396	<0.005	<0.005	<0.005	<0.005	0.00761	0.0143	0.0262	0.0469	0.0581	0.071	0.121	1.4
In	145	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.0225	0.0322	0.0402	0.053	0.0882	0.6
K	459	<100	168	221	296	538	998	2215	3982	5597	9655	23825	2.4
La	461	<0.5	1.61	2.62	4.52	7.4	12.1	17.1	24.8	31.4	44.8	112	2.3
Li	458	<0.1	0.23	0.795	1.76	6.39	13.1	20.6	28.6	35.6	43.4	58.1	2.8
Mg	462	26	86.1	491	1069	4081	6959	10752	14753	18396	21996	36928	3.2
Mn	462	1.44	14.3	25	49.2	128	217	358	512	779	1225	3440	3.4
Mo	458	<0.005	0.0253	0.0517	0.0903	0.177	0.316	0.618	1.07	1.5	2.05	15.6	3.5
Na	461	<5	9.37	14.1	26	44.9	73	111	166	220	308	1024	2.3
Nb	461	<0.02	0.146	0.246	0.324	0.468	0.792	1.44	2.7	3.51	4.53	6.5	2.5
Ni	461	<0.1	0.382	1.46	3.27	12.7	28.6	47.4	69.1	96.6	125	235	3.4
P	462	15.1	37.2	61.7	103	215	370	531	693	786	1111	2648	2.2
Pb	462	0.263	1.07	1.8	2.46	4	5.34	7.54	10.4	14.7	22.8	48.8	2.3
Pd	0	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
Pt	5	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	0.002	0.00508	0.4
Rb	462	0.415	1.78	2.45	3.65	6.03	10.2	18.7	32.5	39.2	57	166	2.6
Re	6	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	0.00761	0.9
S	434	<5	<5	<5	15.7	40.5	85.2	175	291	407	535	1834	2.6
Sb	413	<0.001	<0.001	<0.001	<0.001	0.00967	0.0243	0.043	0.0789	0.128	0.26	6.9	3.8
Sc	459	<0.1	0.192	0.426	0.766	1.77	2.89	3.94	5.39	6.53	9.36	17.8	2.2

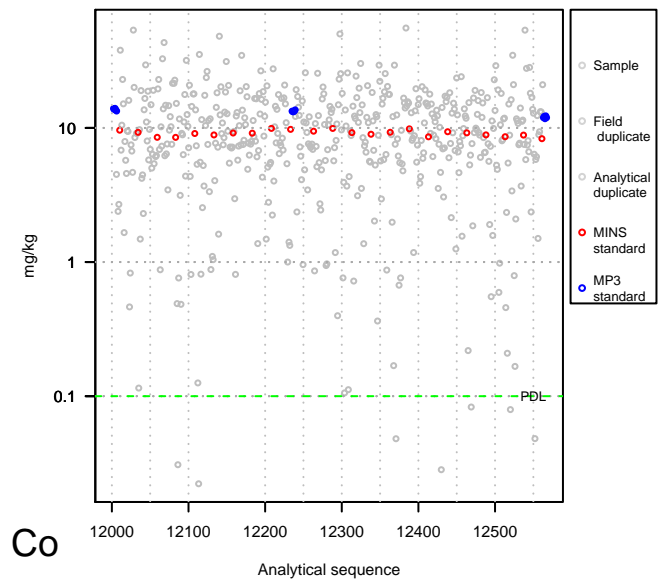
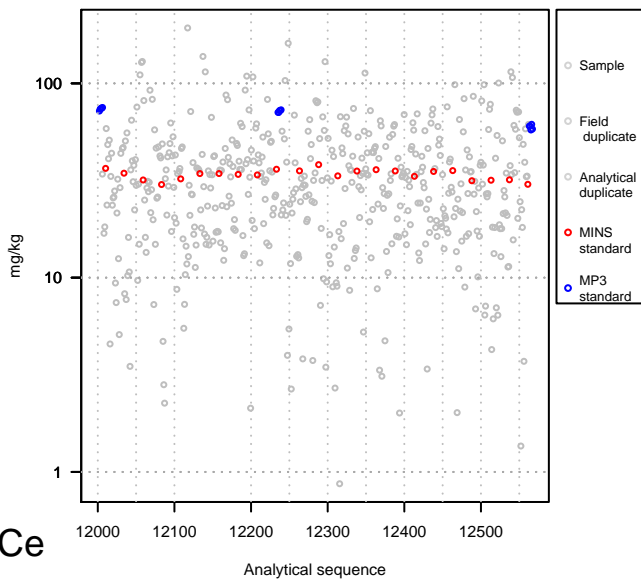
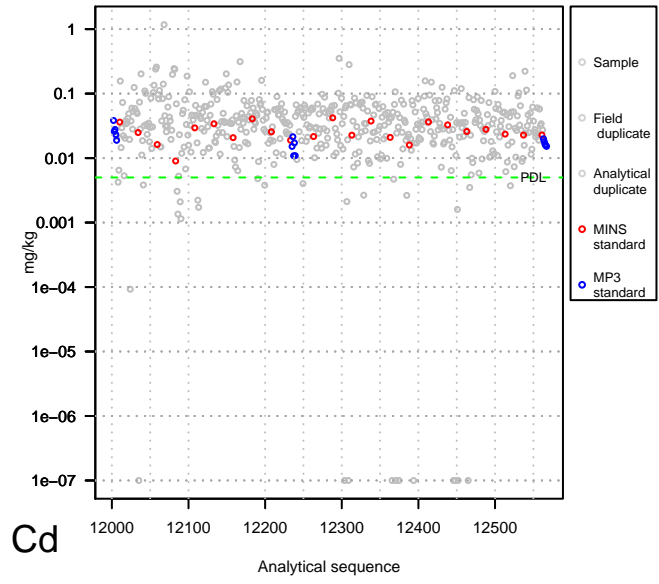
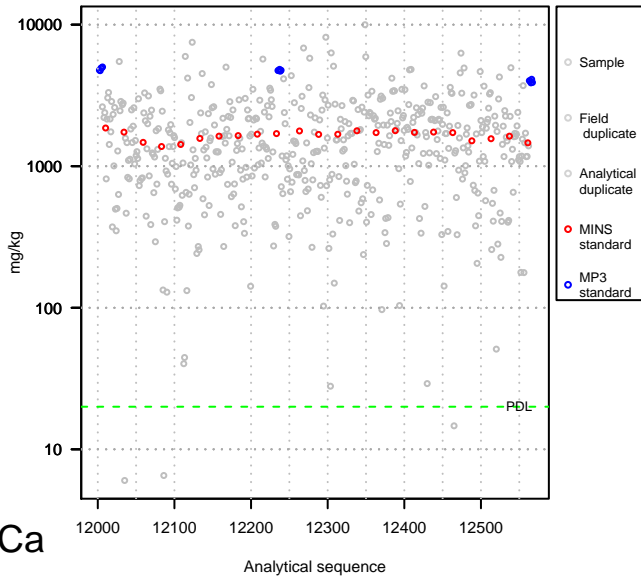
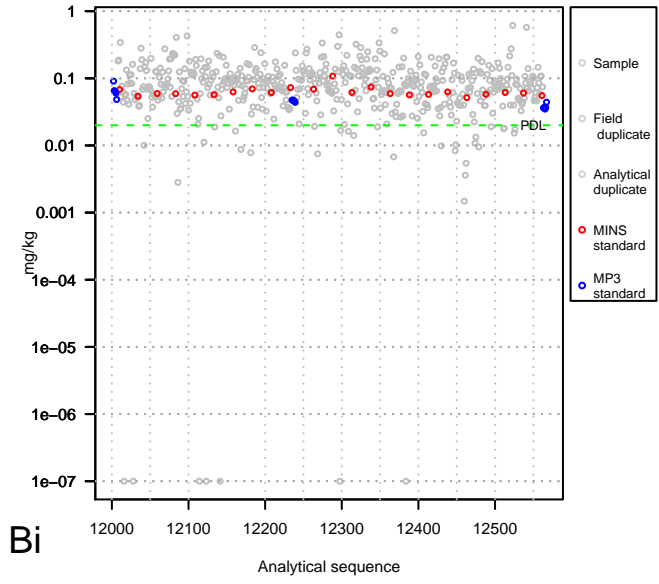
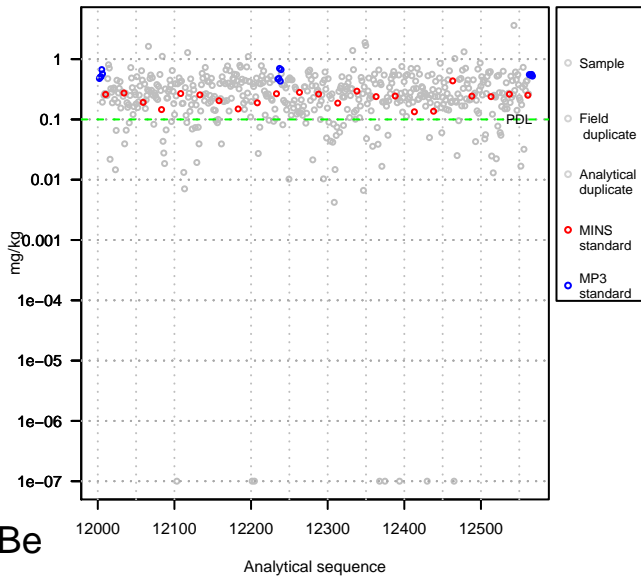
Ele	n>PDL	Min mg/kg	Q2 mg/kg	Q5 mg/kg	Q10 mg/kg	Q25 mg/kg	Q50 mg/kg	Q75 mg/kg	Q90 mg/kg	Q95 mg/kg	Q98 mg/kg	Max mg/kg	P
Se	316	<0.05	<0.05	<0.05	<0.05	<0.05	0.16	0.41	0.675	0.891	1.21	1.95	1.6
Sn	455	<0.05	0.0675	0.106	0.155	0.249	0.388	0.602	0.9	1.03	1.42	4.24	1.9
Sr	460	<0.5	1.55	2.36	3.3	5.14	7.51	11.8	18.9	25.9	41.1	67.3	2.1
Ta	4	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	0.0856	0.2
Te	231	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.0317	0.0424	0.0534	0.0652	0.146	0.9
Th	461	<0.1	0.393	0.686	1.23	2.39	3.87	5.56	8.14	9.98	12.7	43.3	2.6
Ti	462	49.5	120	224	367	668	1030	1384	1977	2774	3299	5306	2
Tl	457	<0.01	0.0133	0.0186	0.036	0.0596	0.104	0.176	0.263	0.389	0.537	2.25	2.4
U	462	0.0708	0.114	0.196	0.329	0.509	0.711	1.02	1.59	2.48	4.77	10.9	2.2
V	459	<1	2.29	5.13	10.9	22.1	36.4	51.3	69.8	92.6	111	164	2.2
W	432	<0.01	<0.01	<0.01	0.0155	0.0278	0.046	0.0732	0.122	0.168	0.322	2.9	2.5
Y	462	0.356	0.726	1.17	1.98	3.86	5.5	7.91	12.1	14.9	22	305	2.9
Zn	462	0.243	1.24	3.86	7.32	20.6	31.8	49.3	66.1	76.7	93.6	302	3.1
Zr	458	<0.1	0.188	0.418	0.631	1.27	2.17	3.48	5.25	7.12	8.87	52.2	2.7

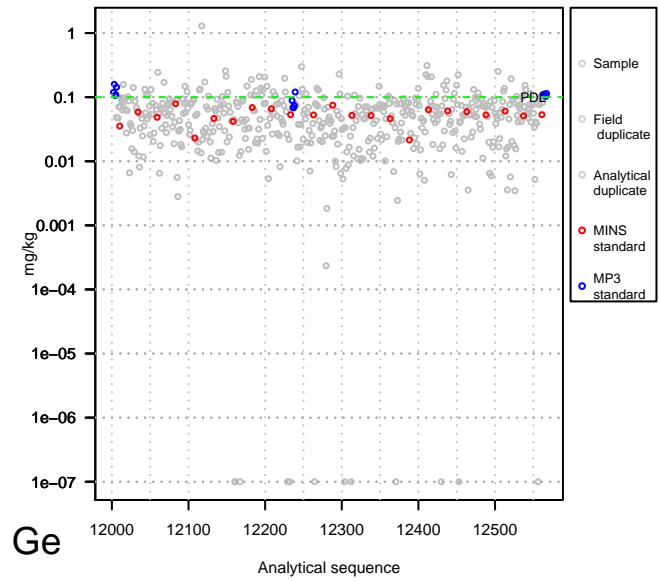
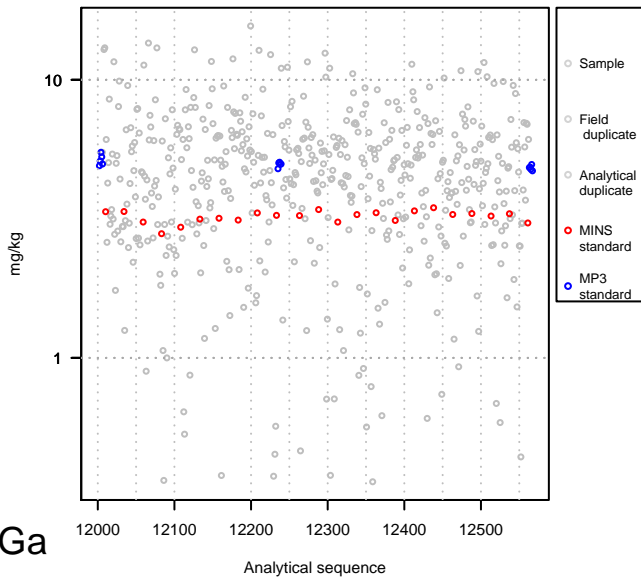
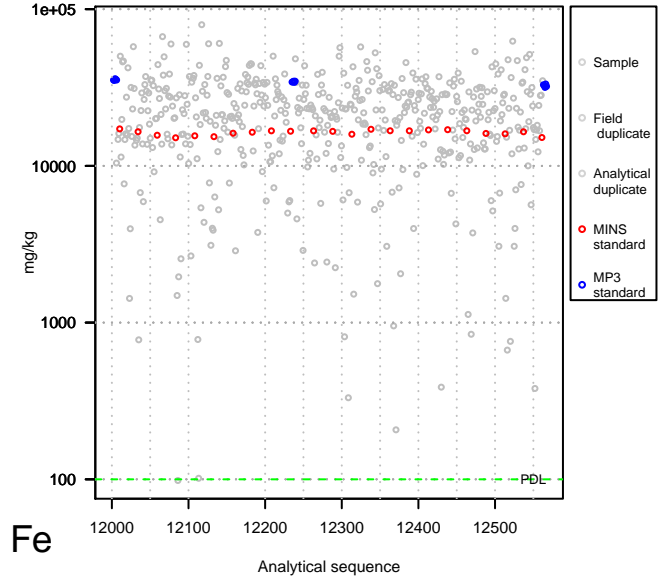
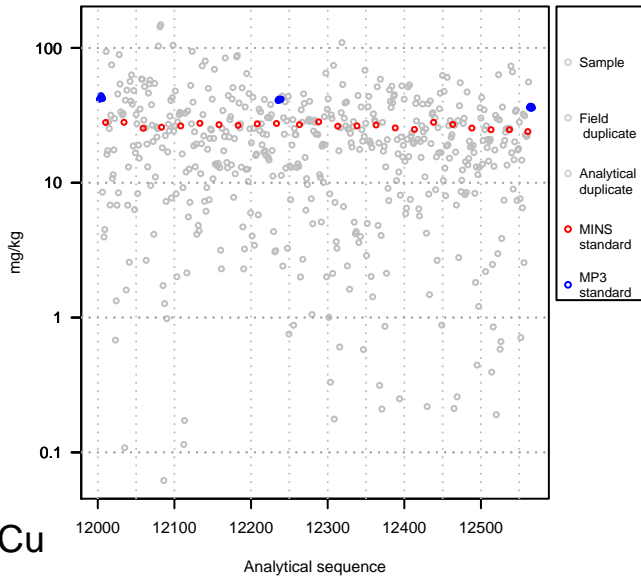
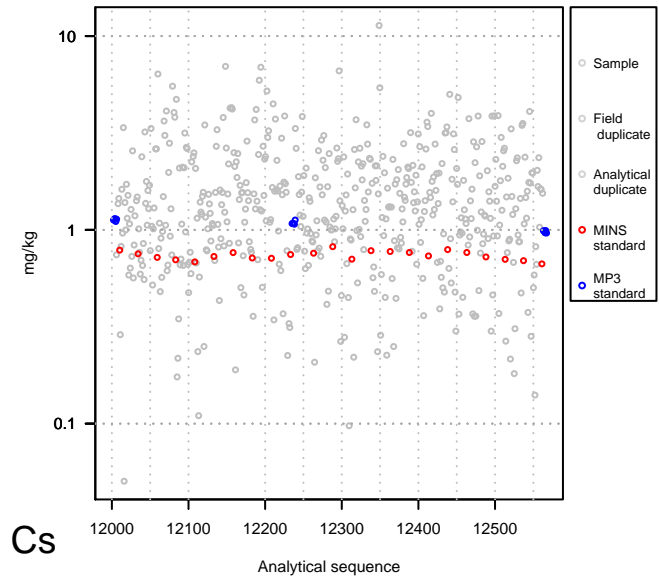
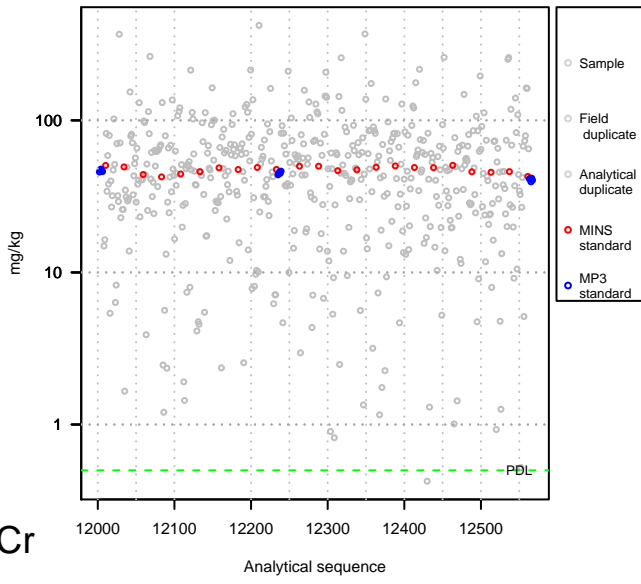
Appendix 1: Random plots

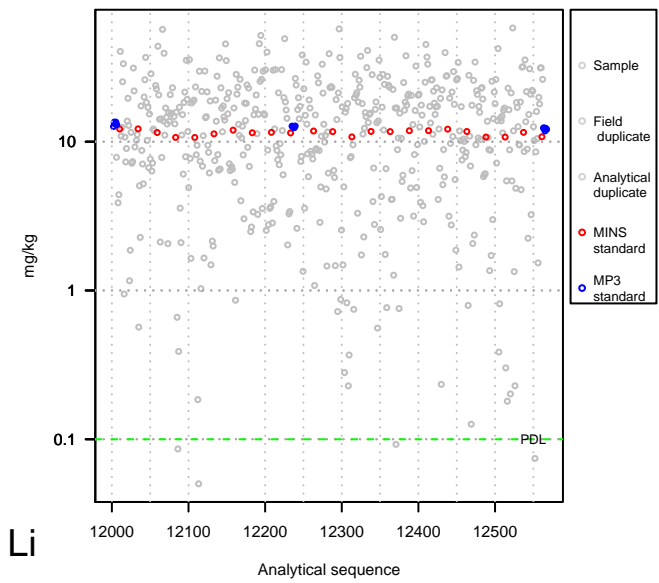
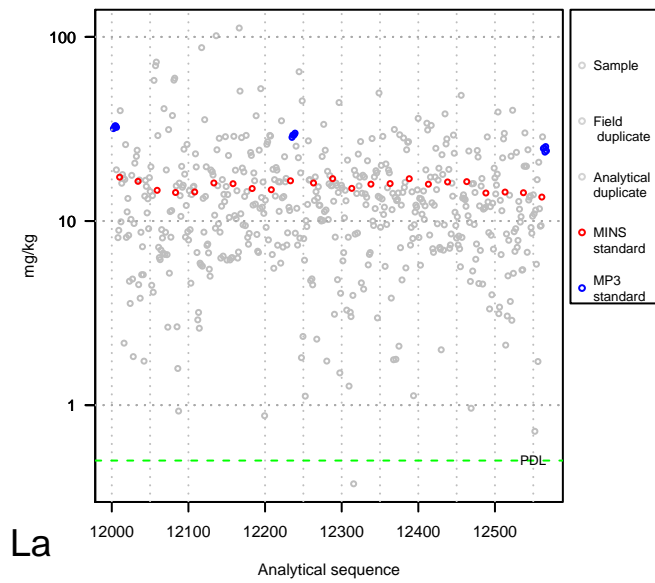
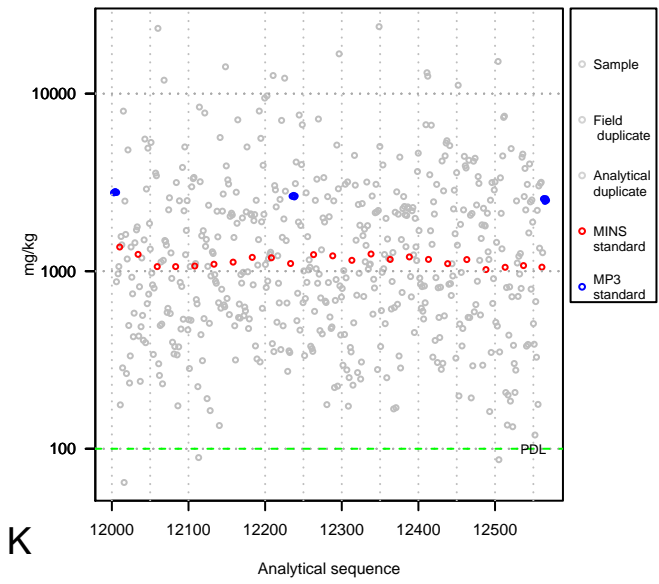
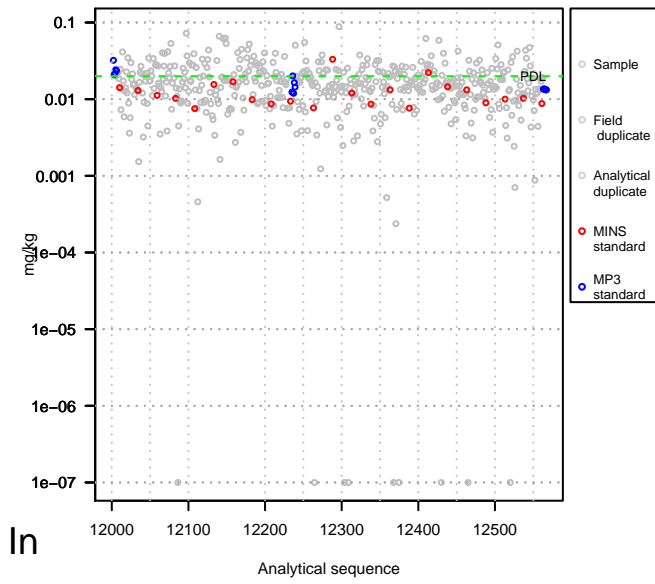
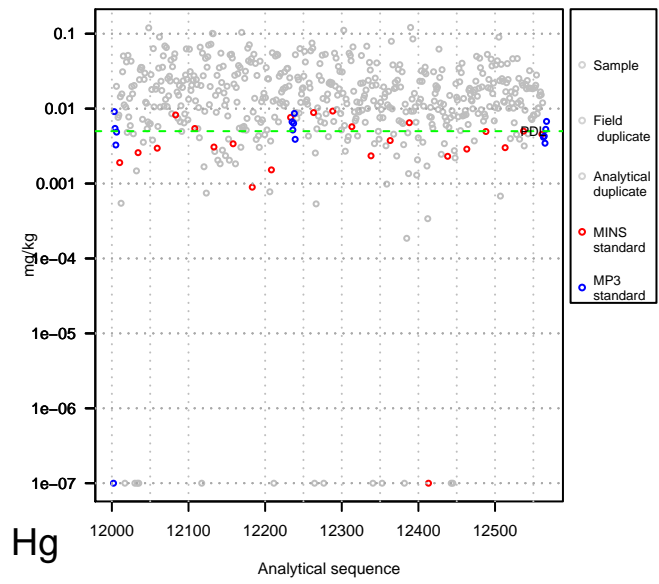
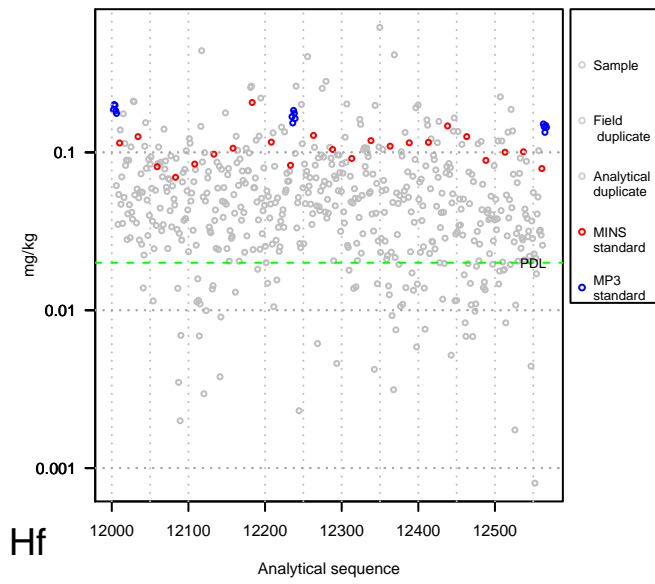
Random plots of all samples with field and analytical duplicates in addition to the in-house standards MINS and MP3.

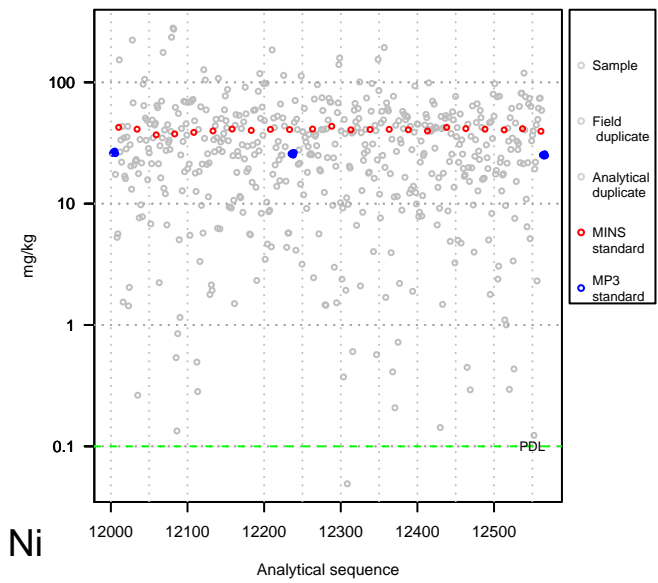
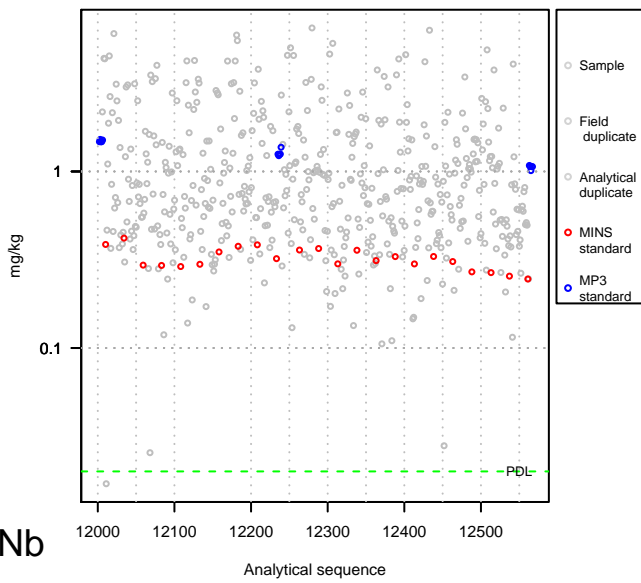
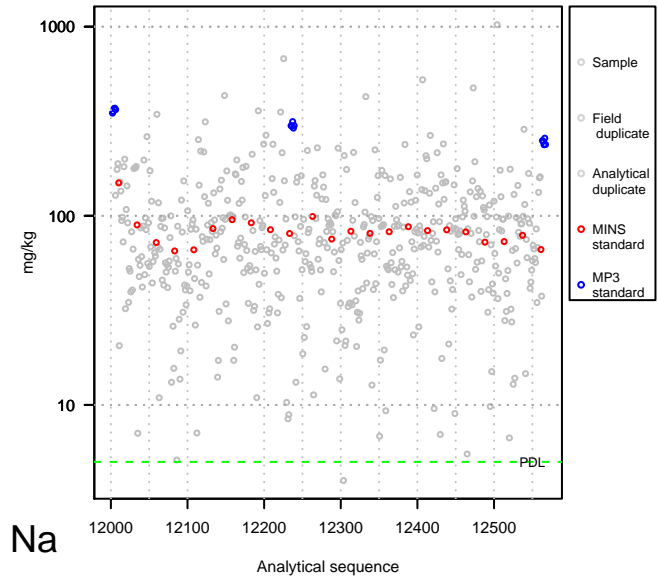
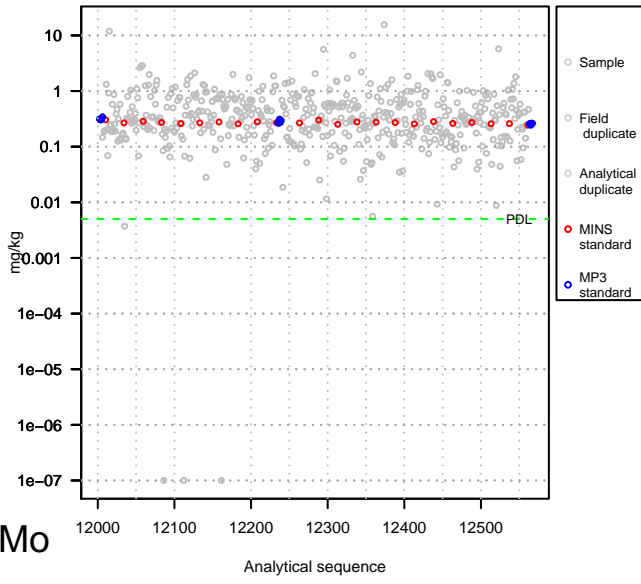
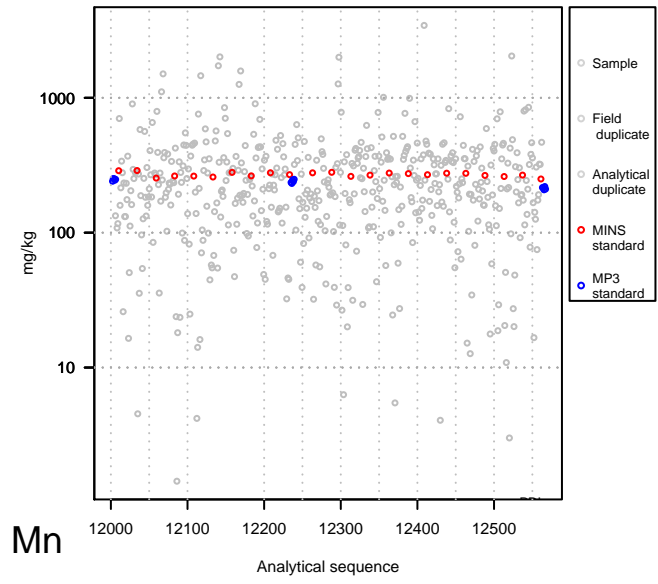
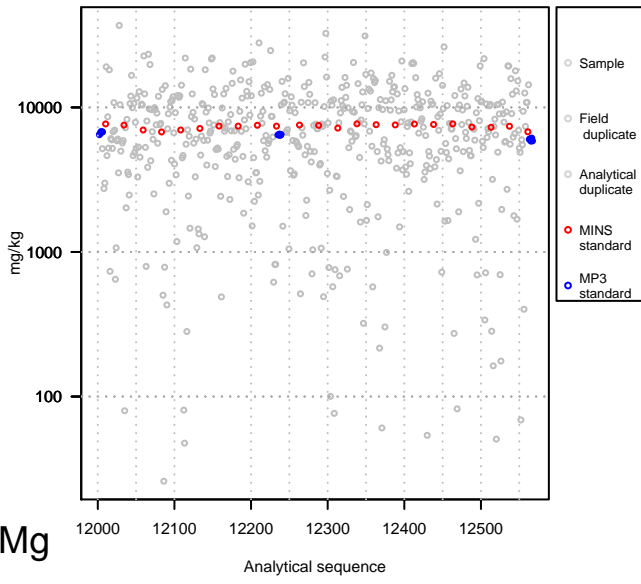
The practical detection limit (PDL) is indicated by a green dotted line for some elements.

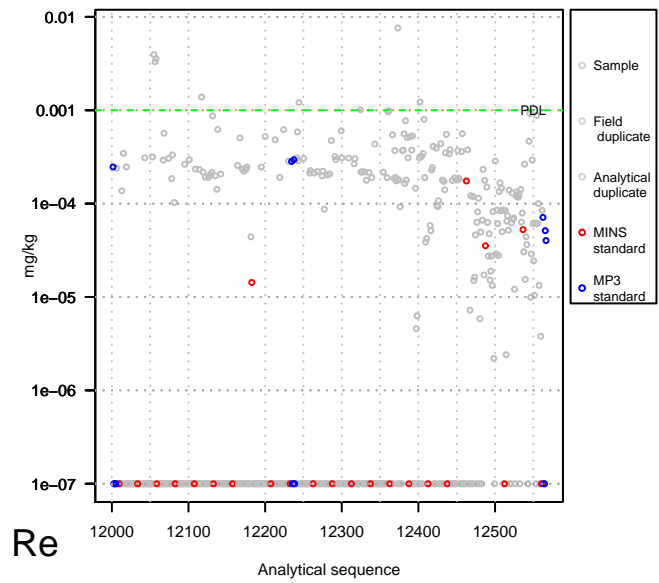
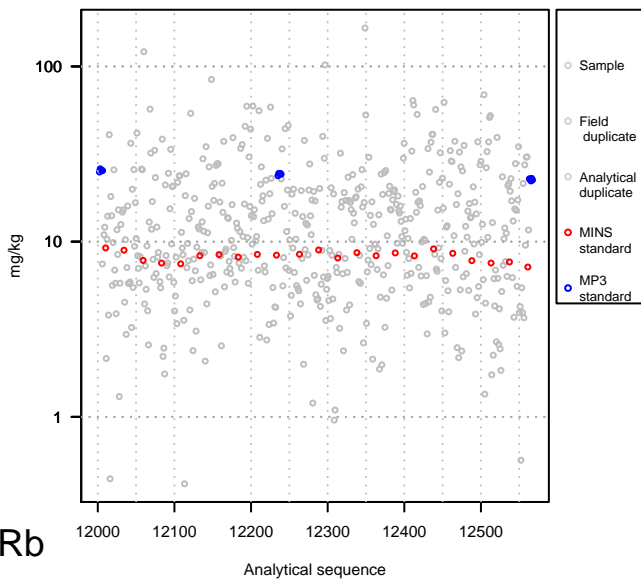
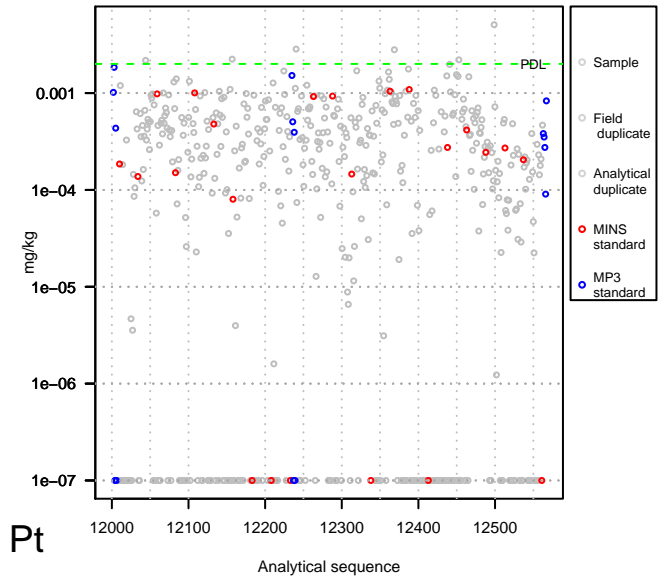
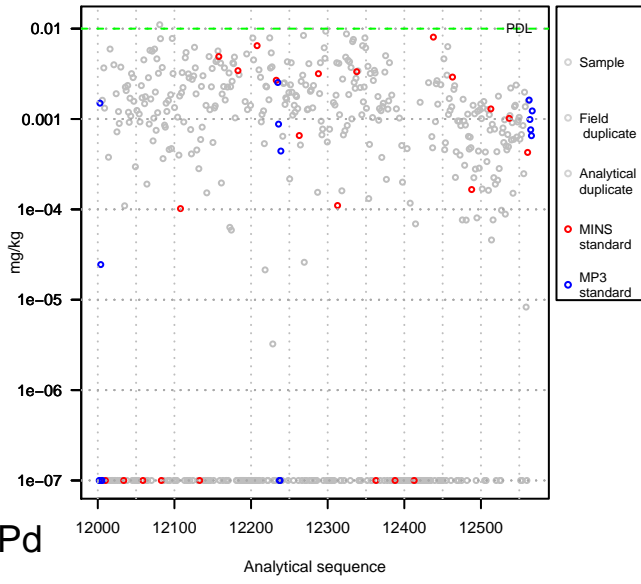
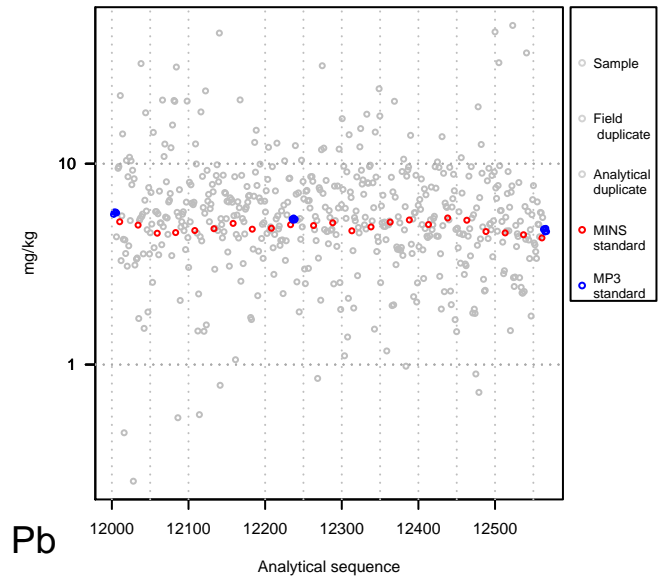
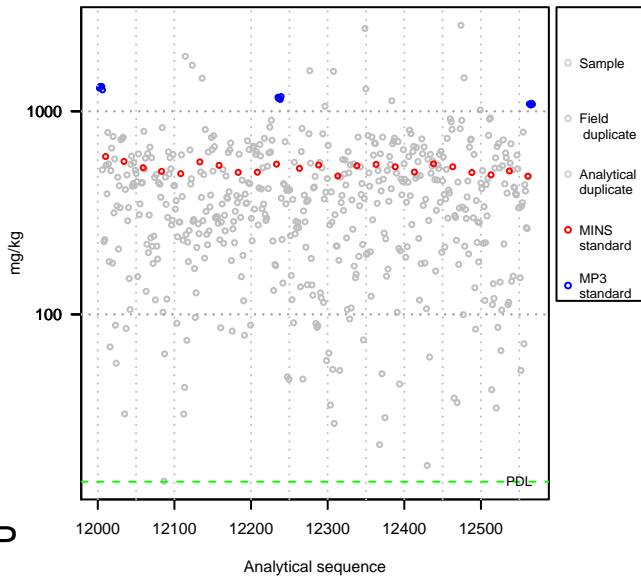


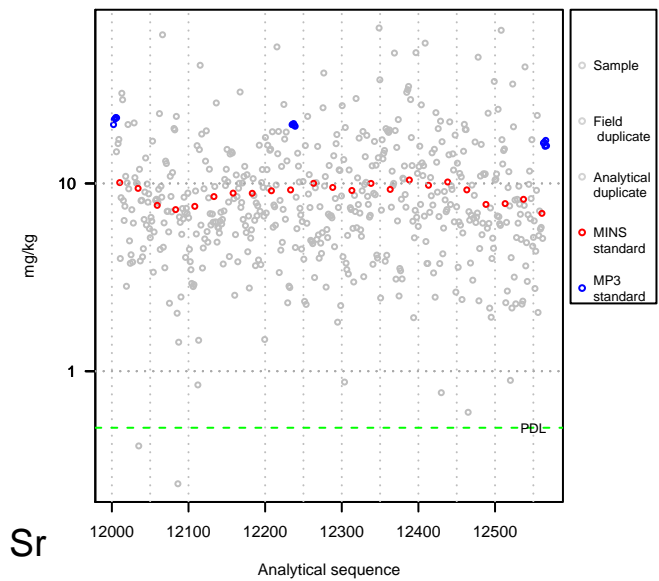
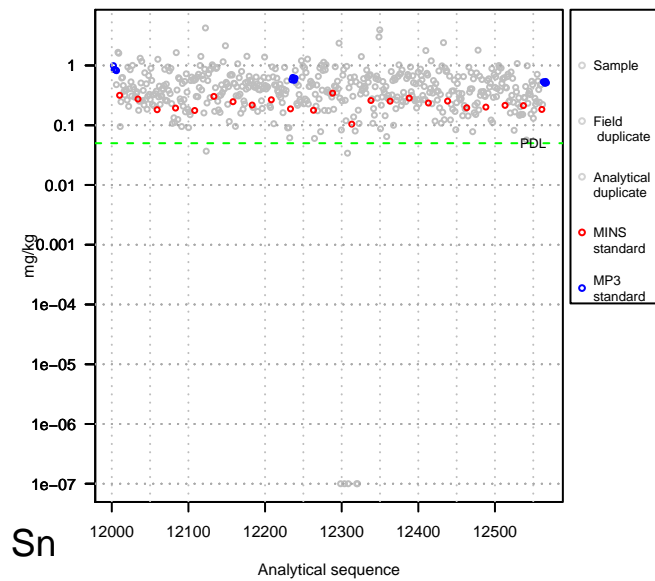
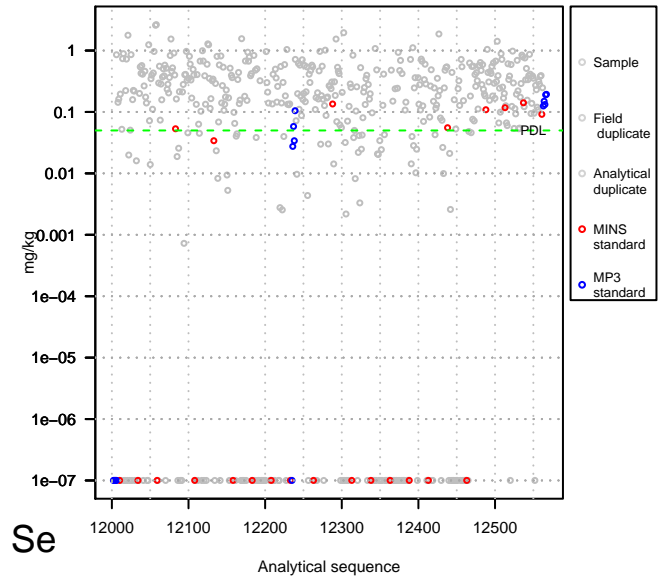
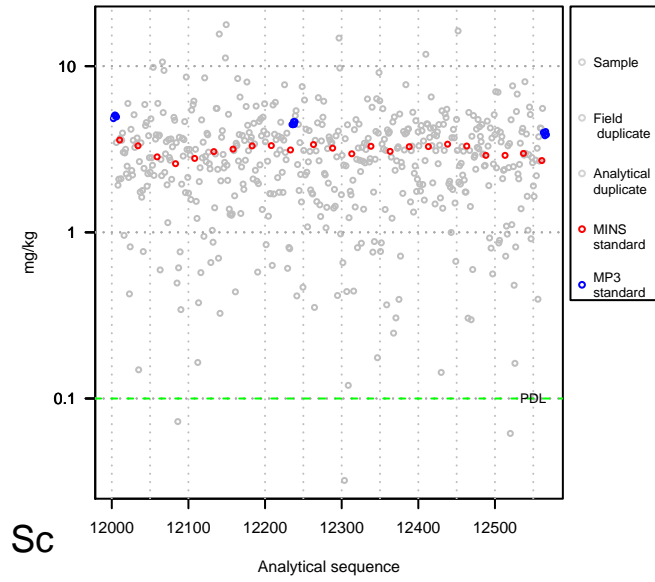
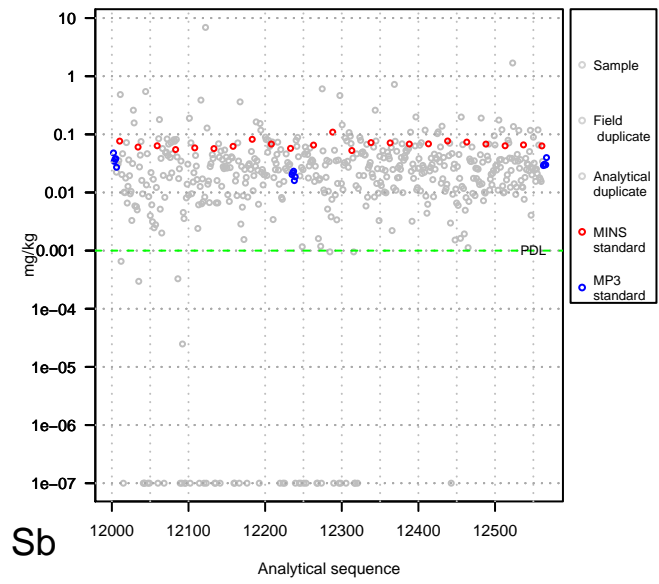
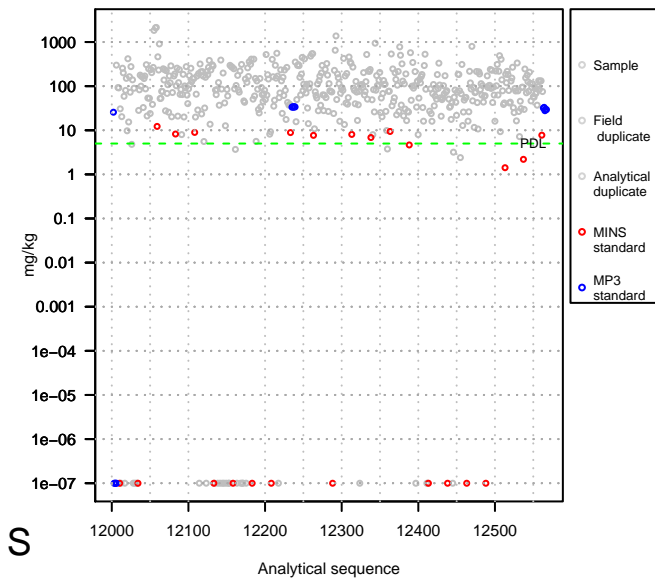


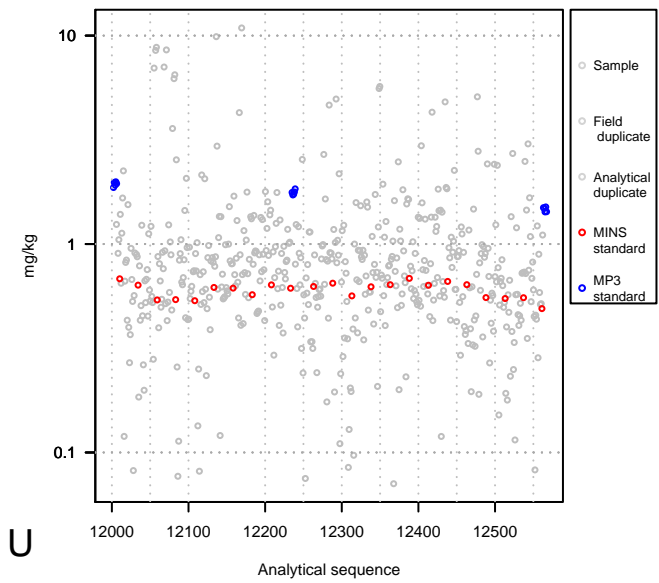
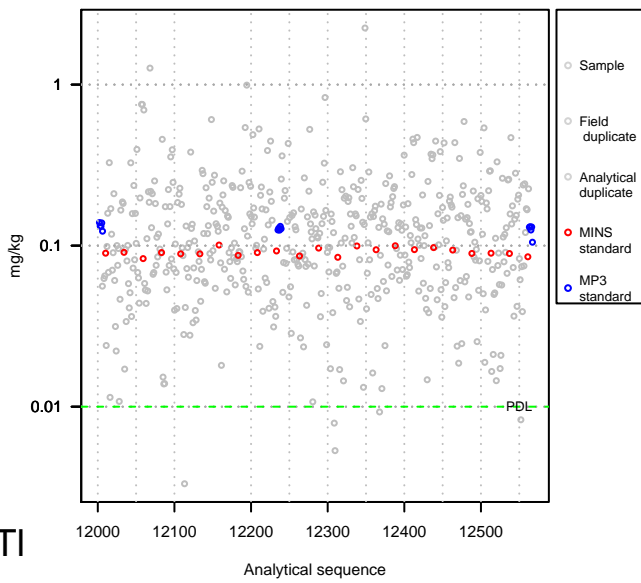
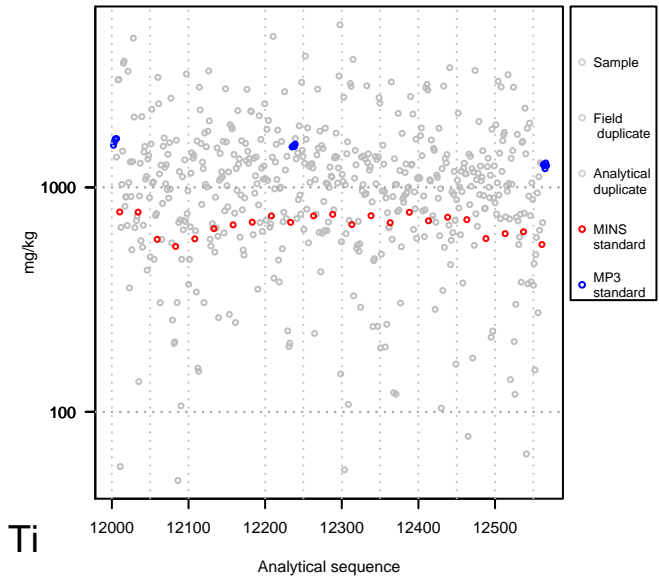
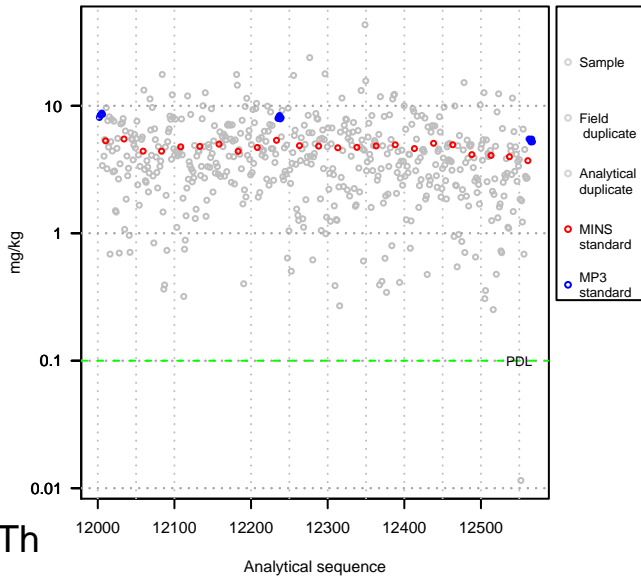
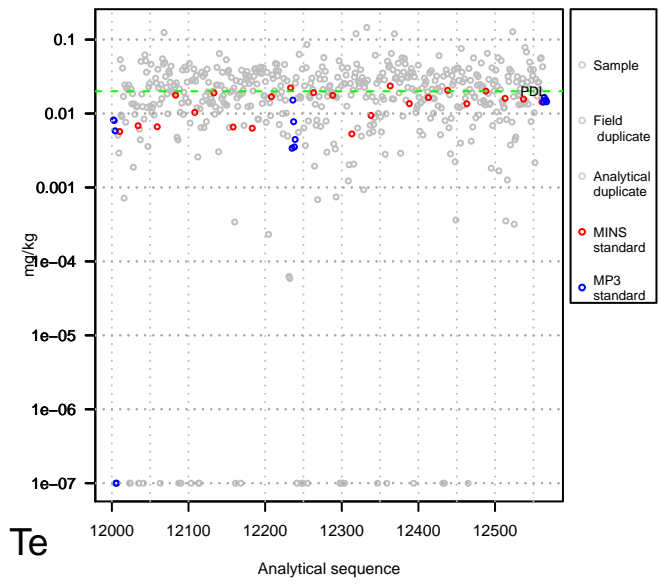
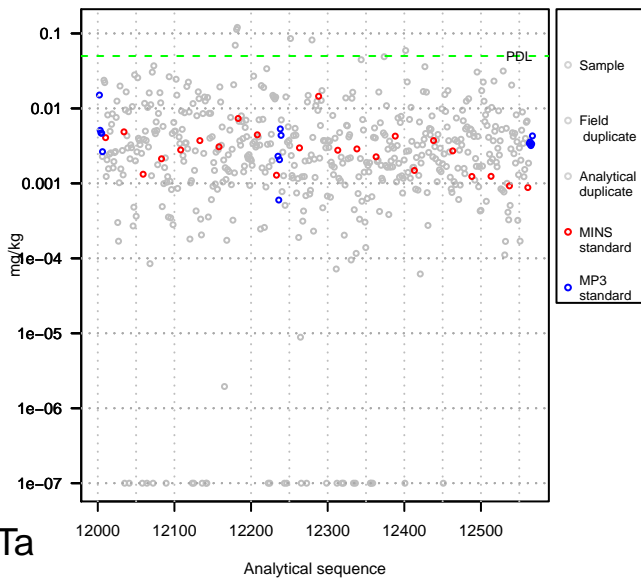


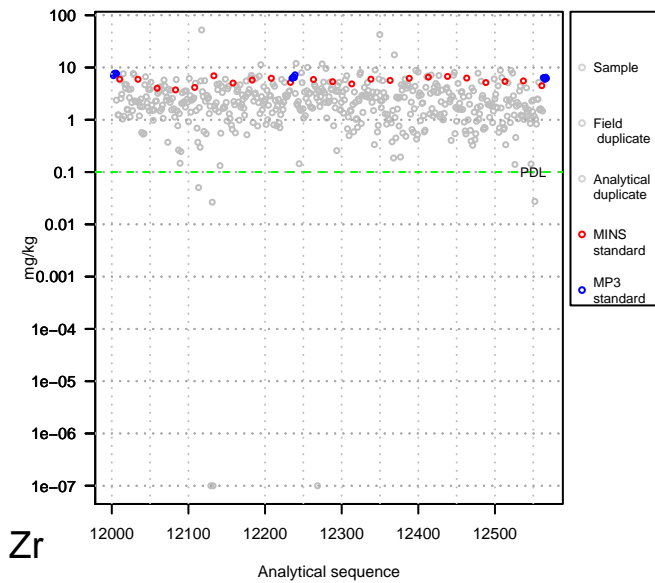
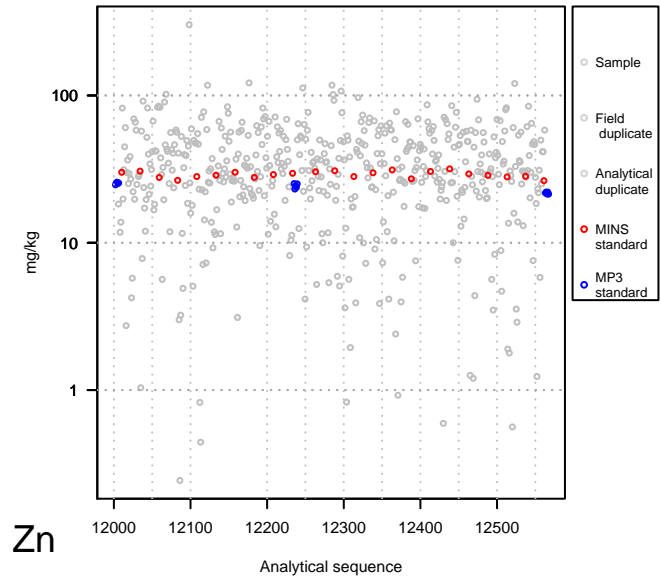
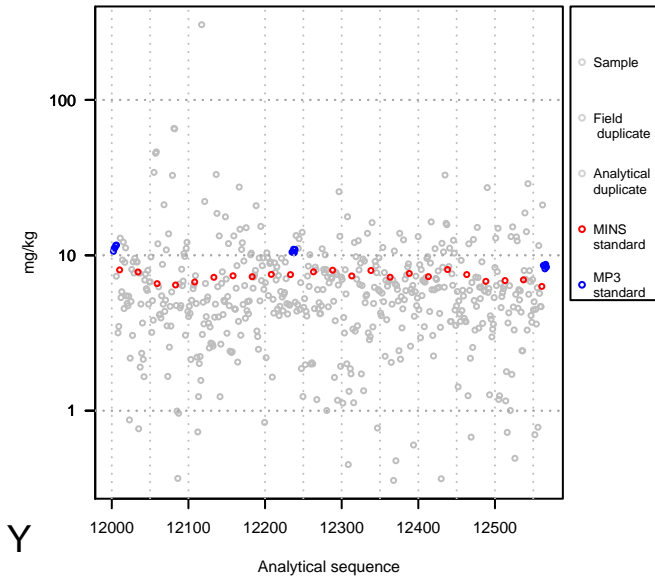
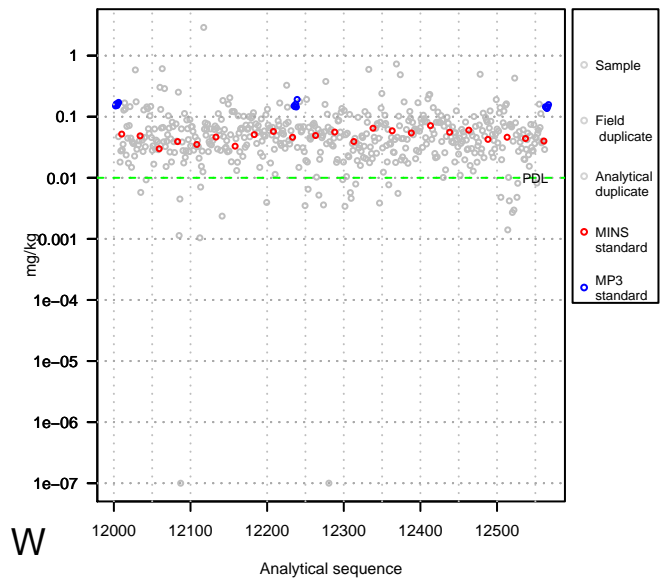
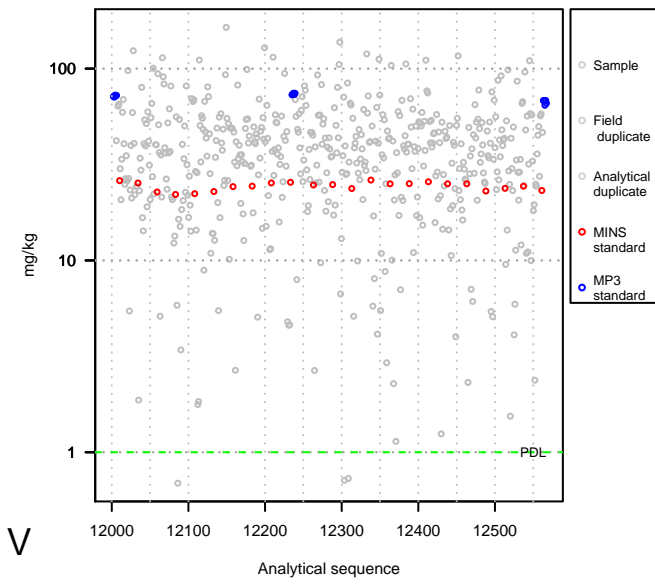












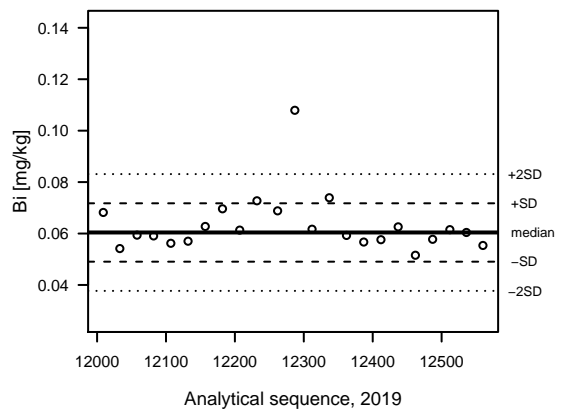
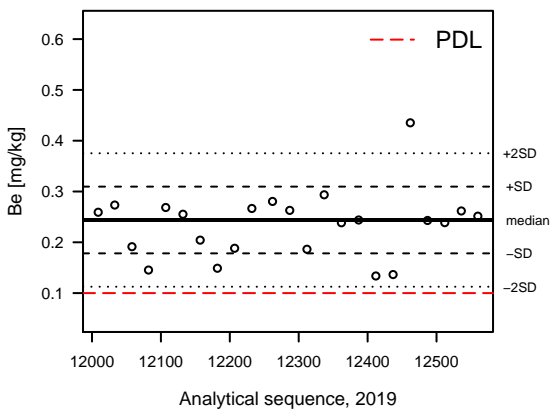
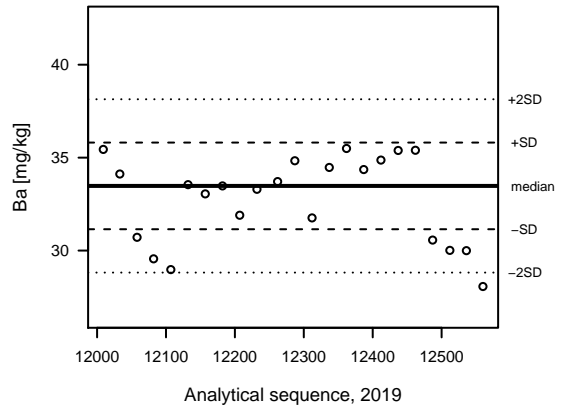
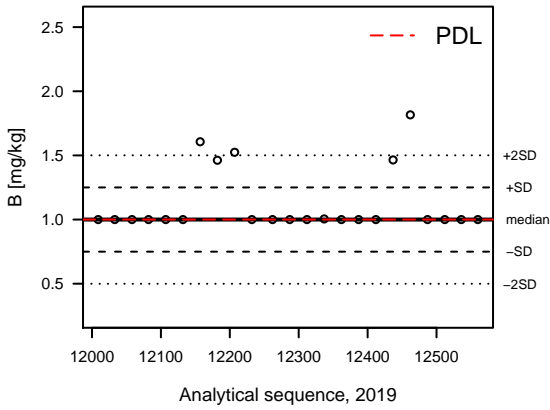
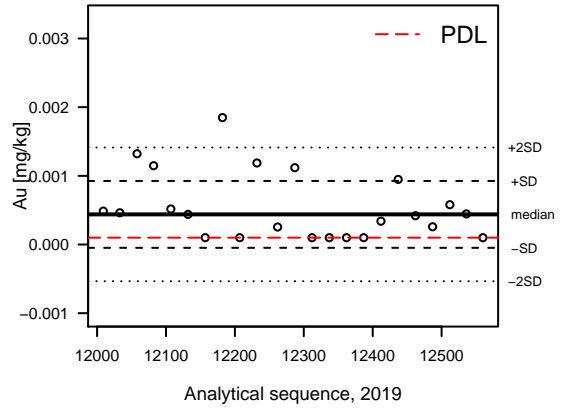
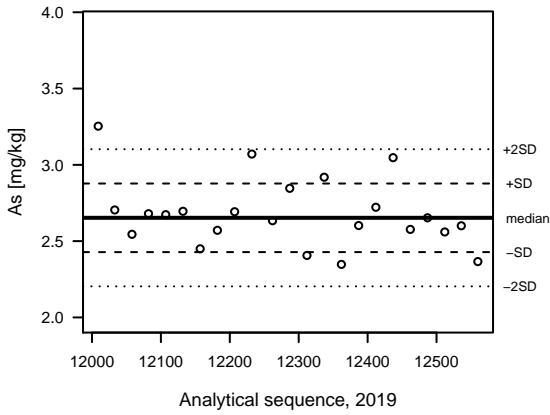
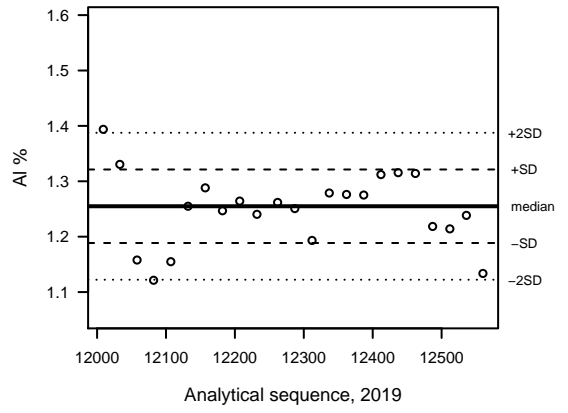
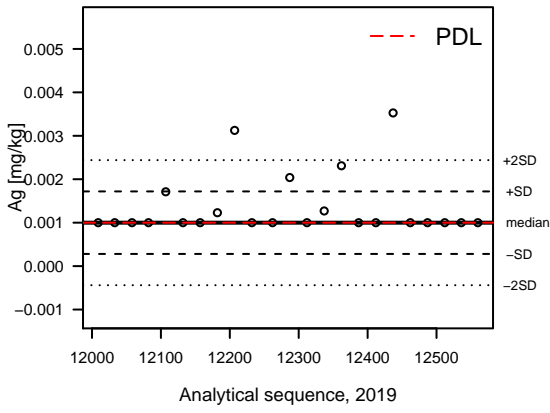
Appendix 2: X-charts

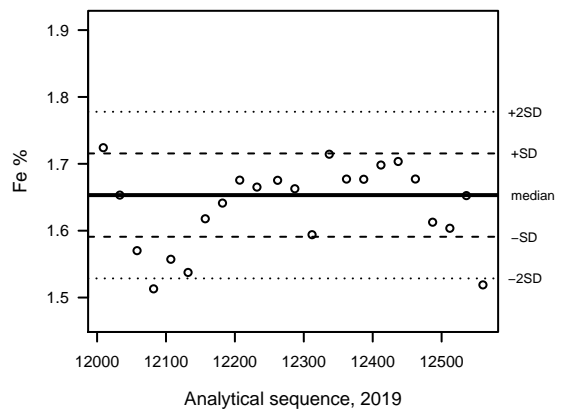
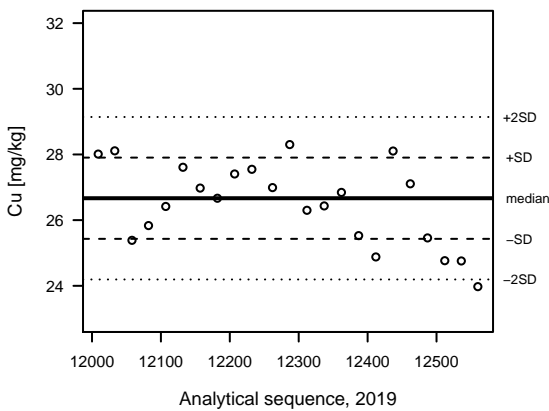
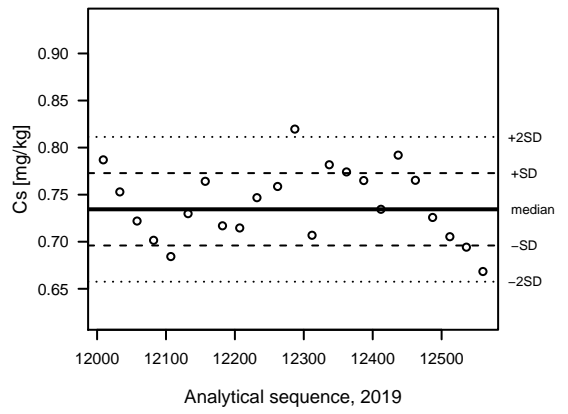
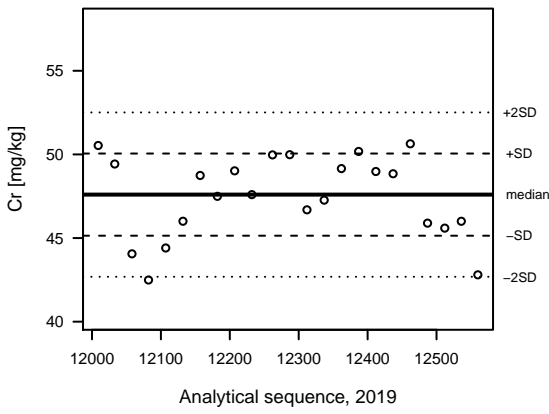
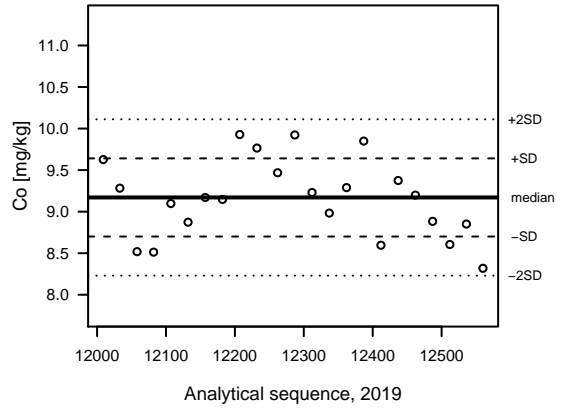
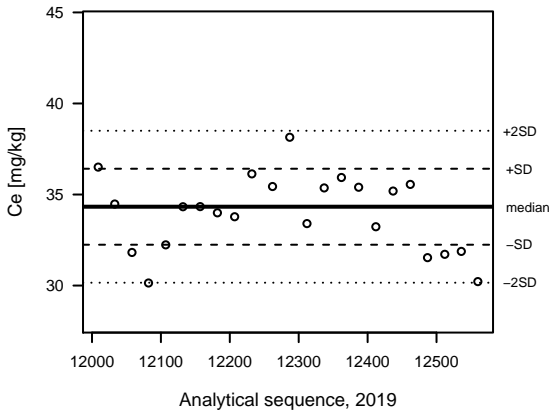
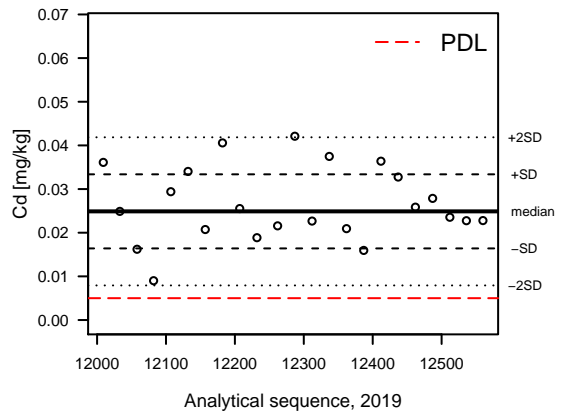
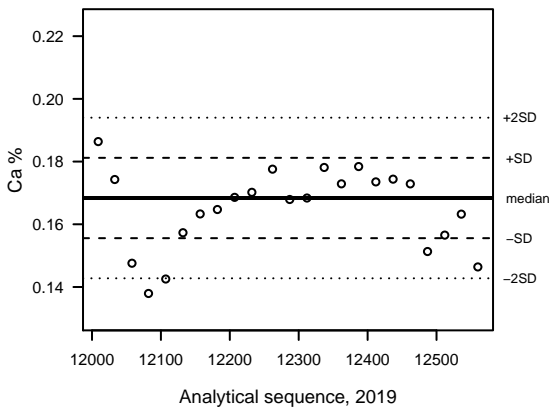
X-charts of the MINS in-house standard.

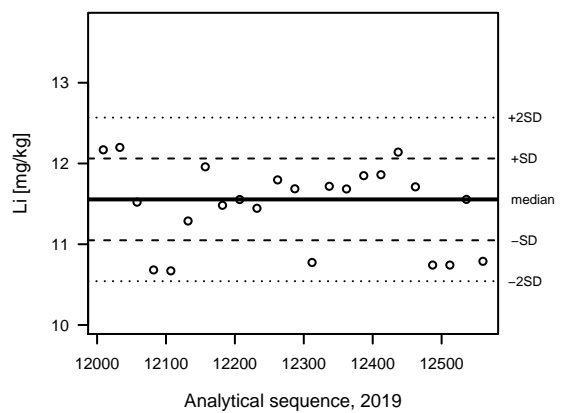
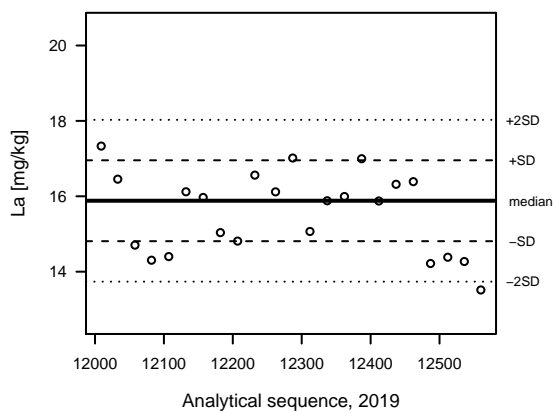
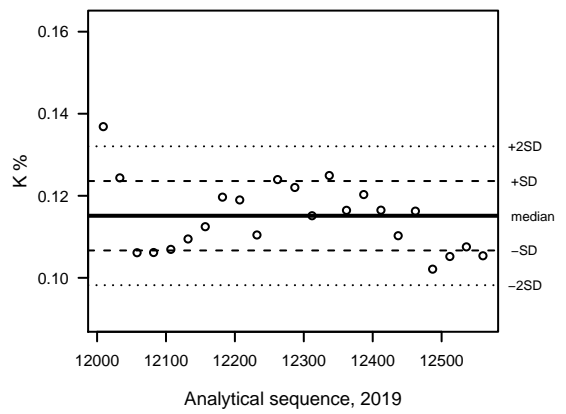
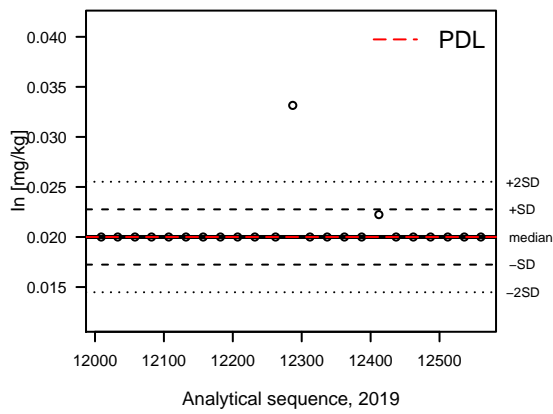
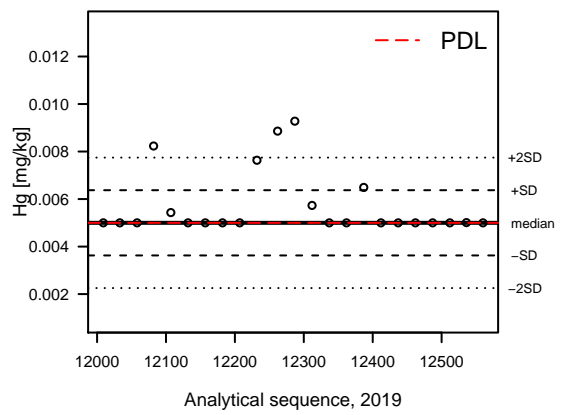
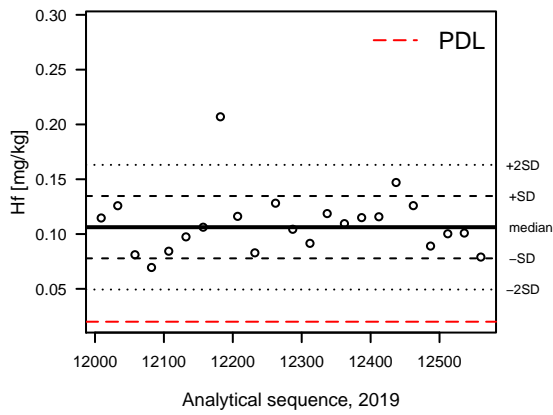
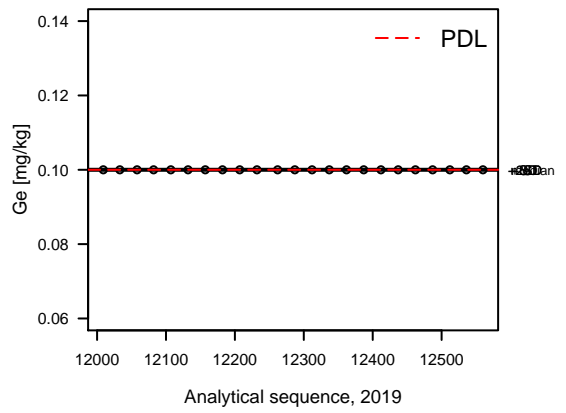
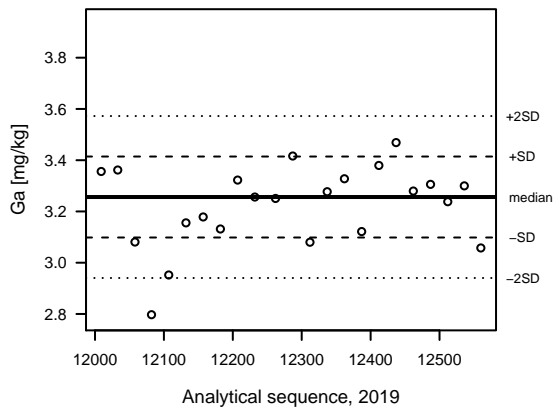
23 analysis plotted in the same order as the analytical sequence in the lab.

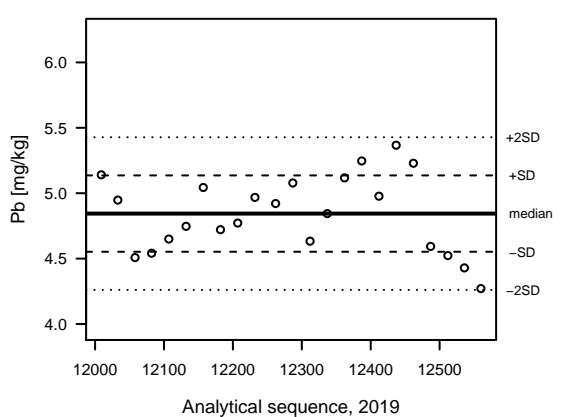
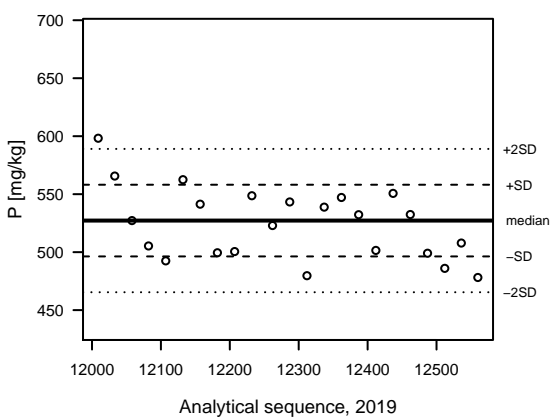
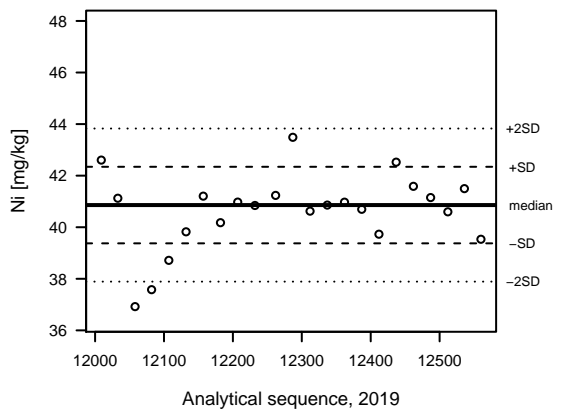
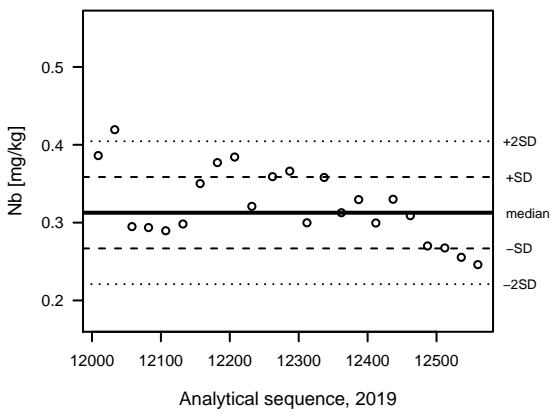
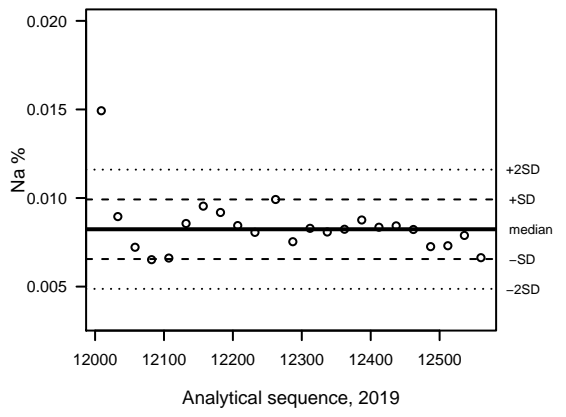
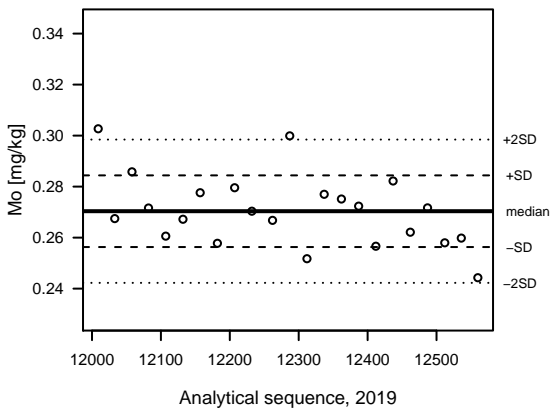
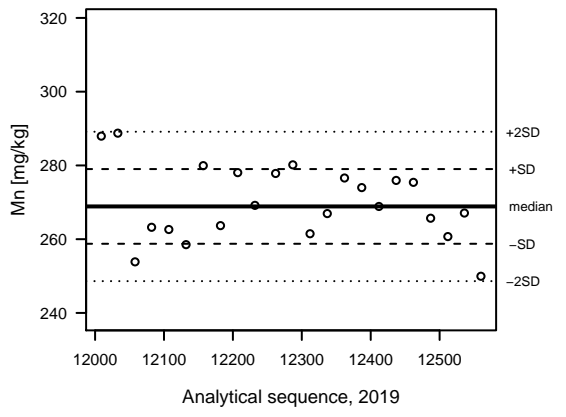
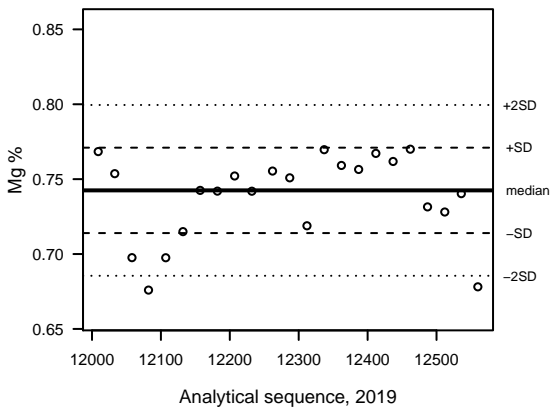
The median is indicated by a solid line, dashed lines are drawn at median \pm 1 standard deviation (SD) and dotted lines are drawn at median \pm 2 standard deviations (2SD).

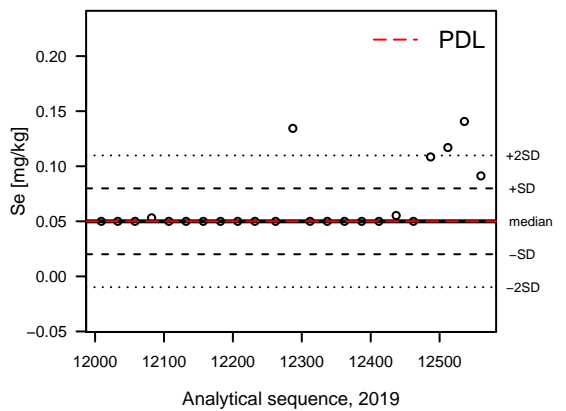
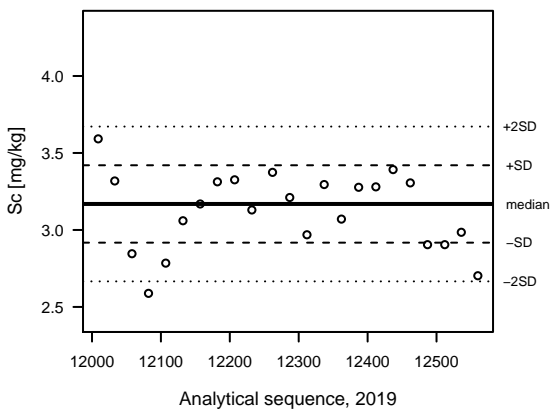
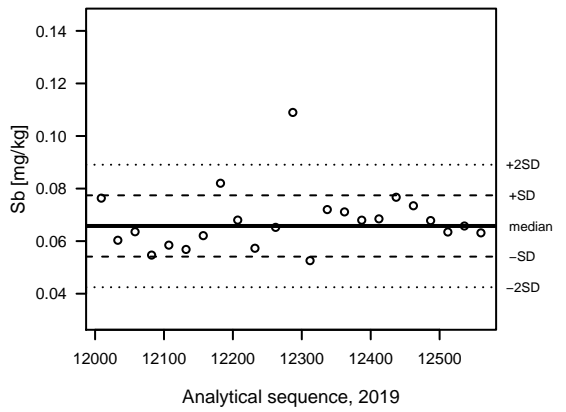
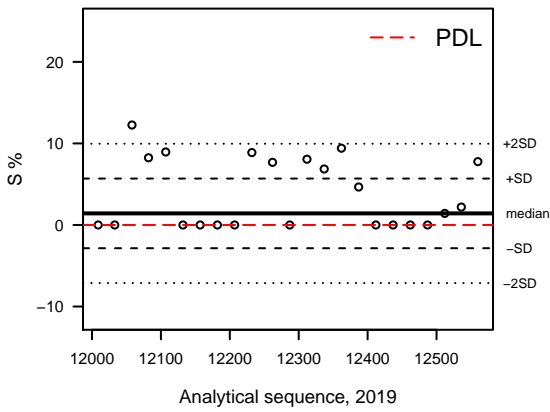
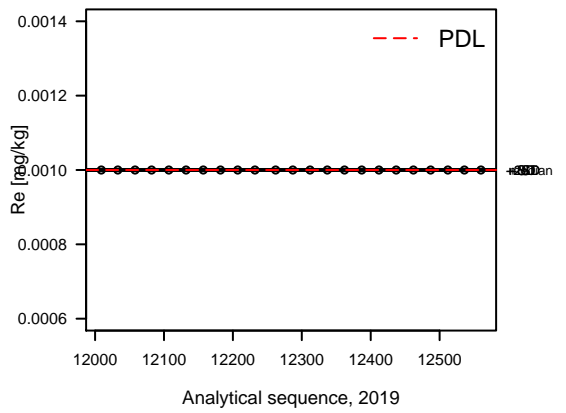
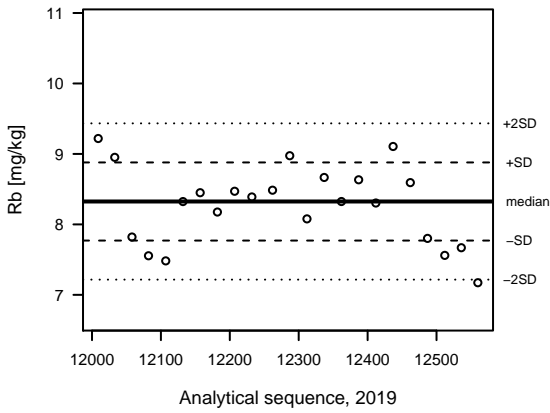
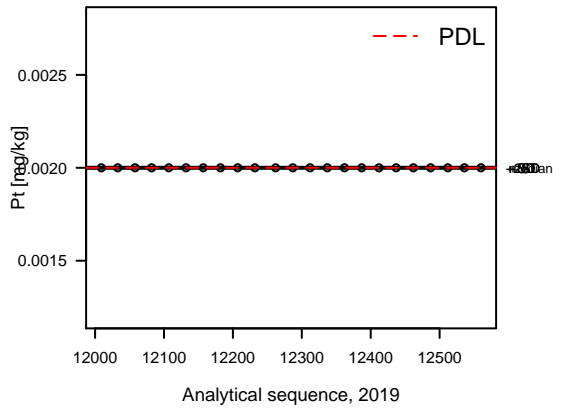
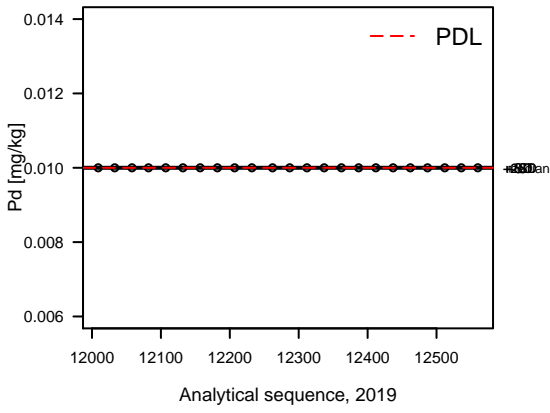
A red dash dotted line is draw at the practical detection limit (PDL) for those elements with concentrations close to the PDL

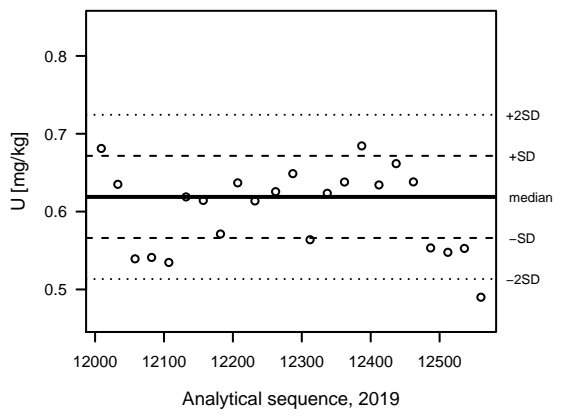
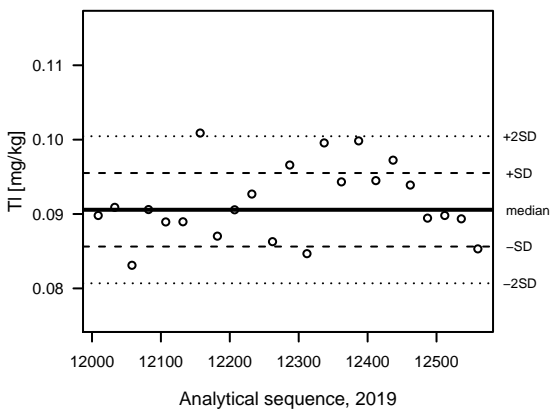
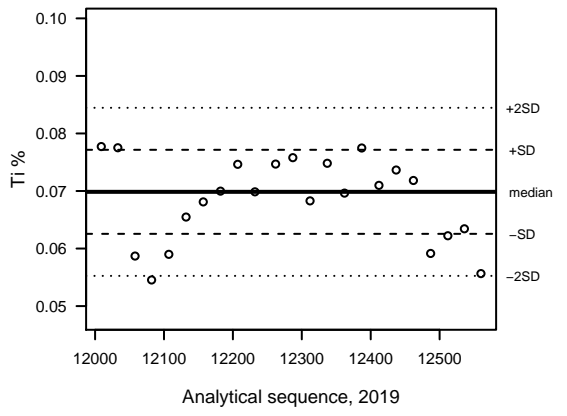
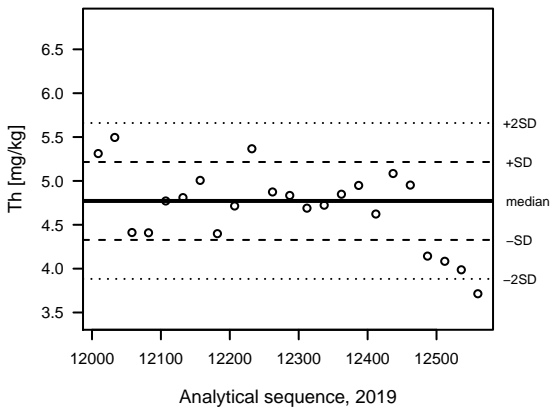
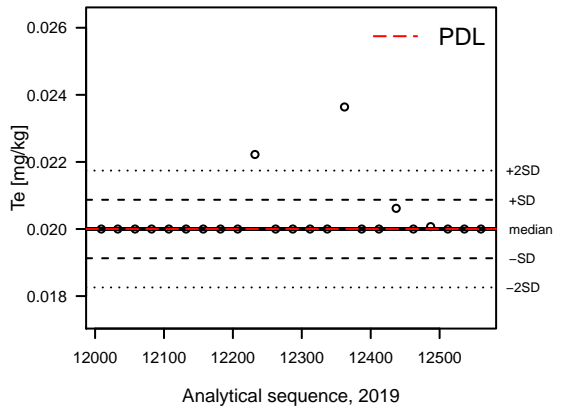
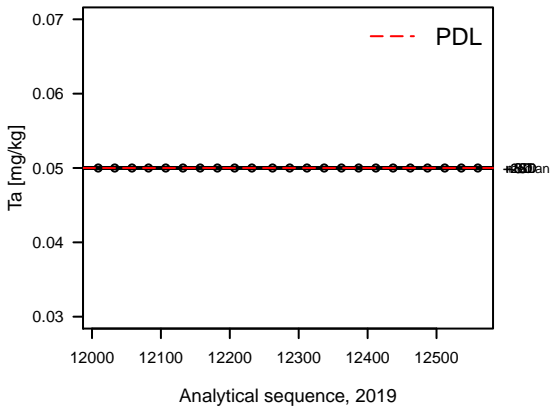
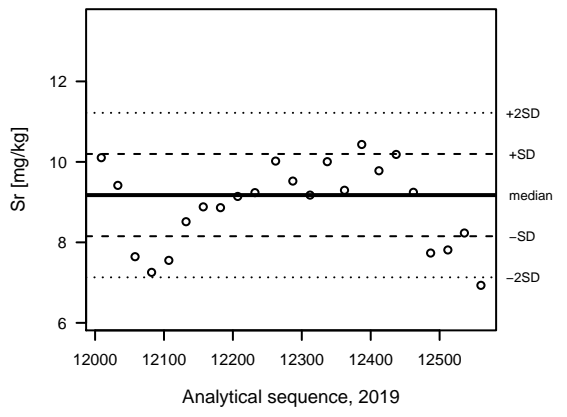
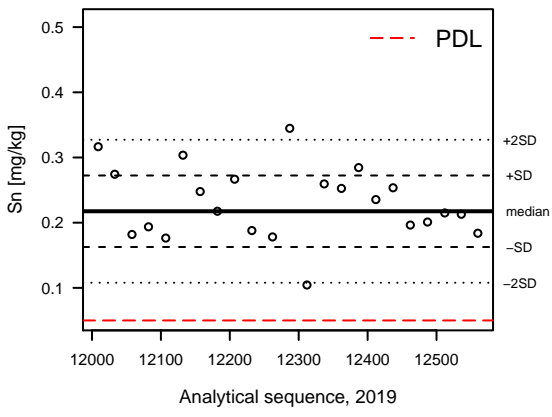


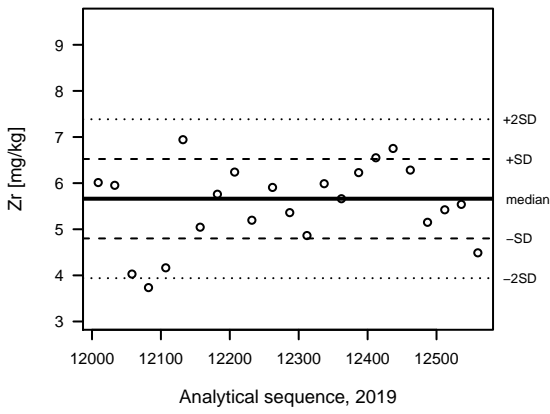
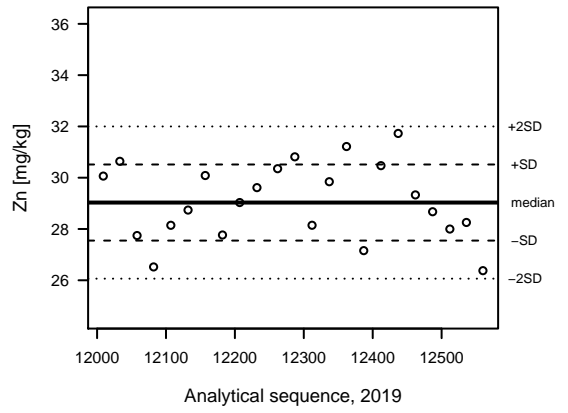
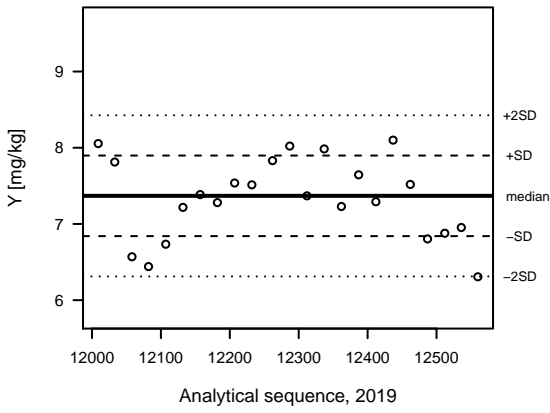
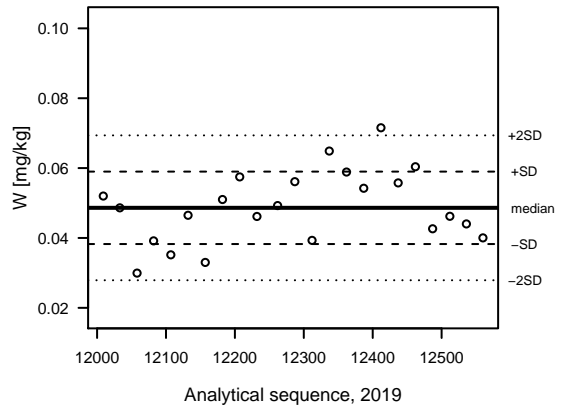
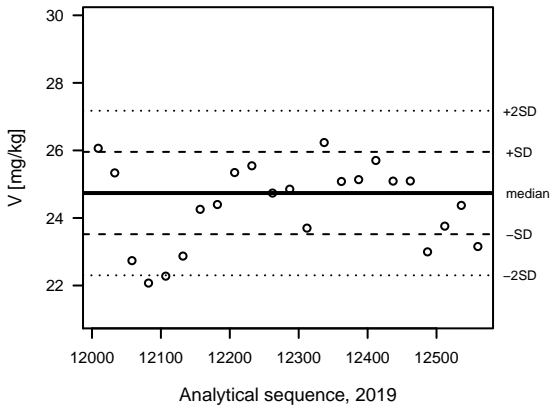










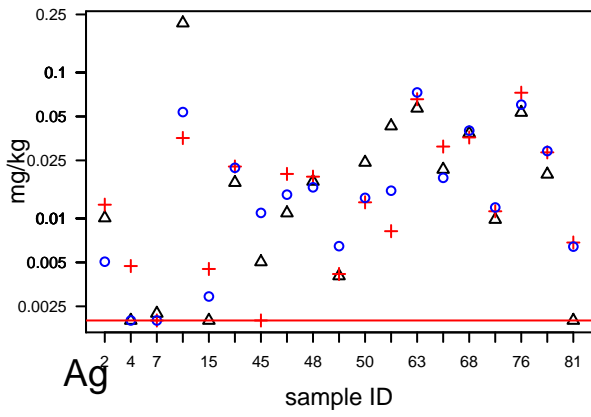


Appendix 3: Samples re-analysed from previous surveys

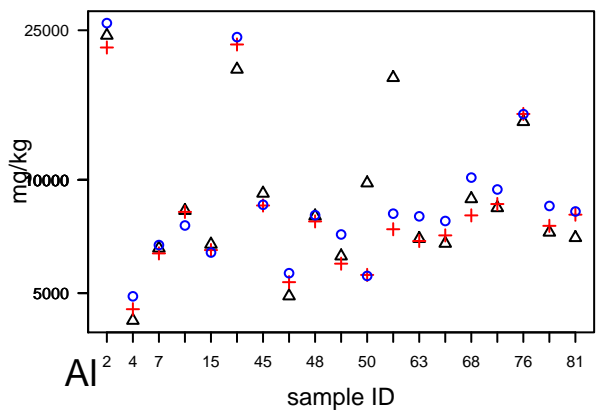
Analytical results for 19 samples (no:2, 4, 7, 10, 15, 17, 40, 45, 47, 48, 49, 50, 62, 63, 66, 68, 73, 76, 77 and 81) from the Nordland/Troms collection (Reimann et al., 2011) which were re-analysed along with the North-Trøndelag and Fosen samples in 2013-2014 (Finne et al., 2014) and also with in the present survey of South-Trøndelag. The same lab, Bureau Veritas Minerals, Vancouver, Canada, have been used for all three sample collections.

Sample collection	Symbology
Nordland/Troms	Δ
North-Trøndelag and Fosen	+
South-Trøndelag	○
Laboratory detection limit	—

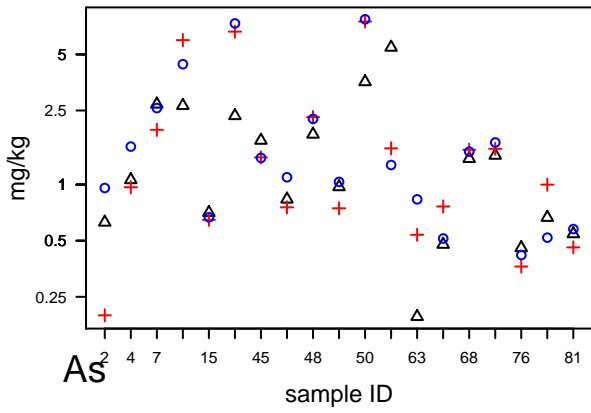
Till, Re-analysis



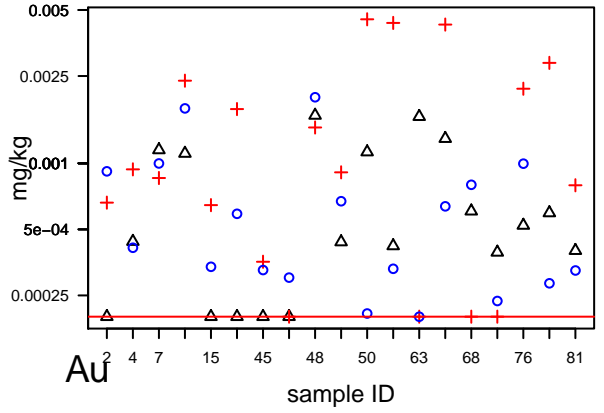
Till, Re-analysis



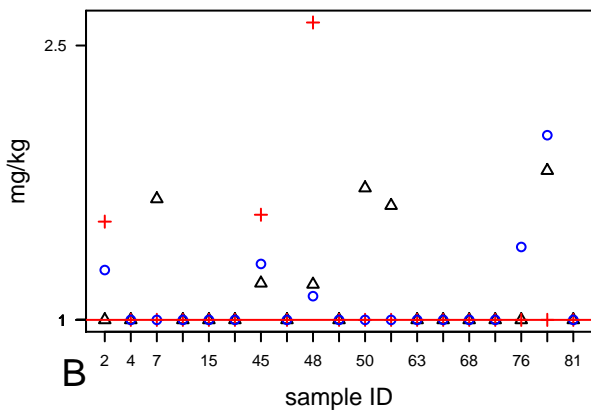
Till, Re-analysis



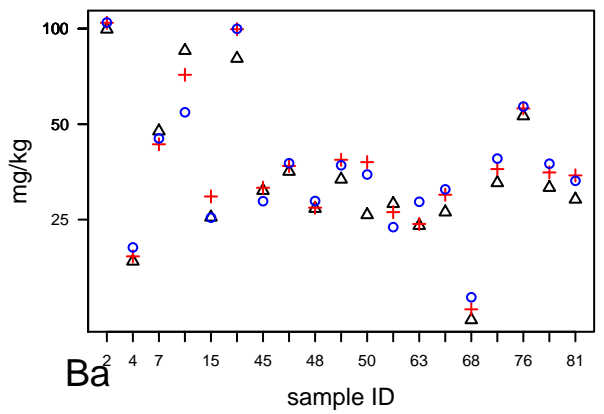
Till, Re-analysis



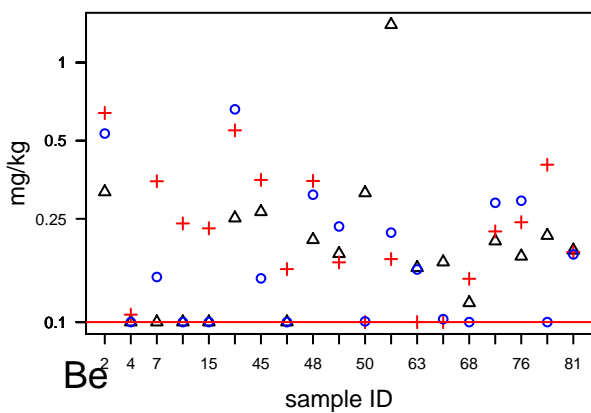
Till, Re-analysis



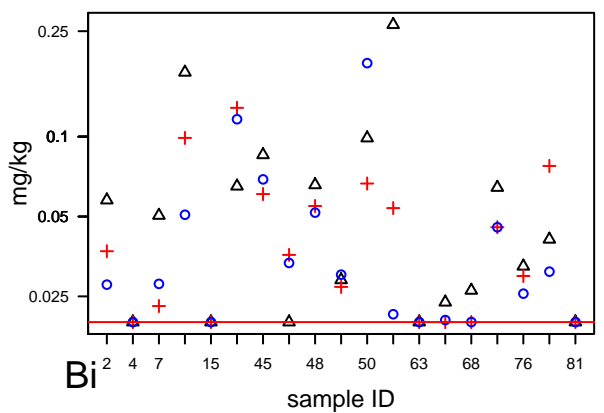
Till, Re-analysis



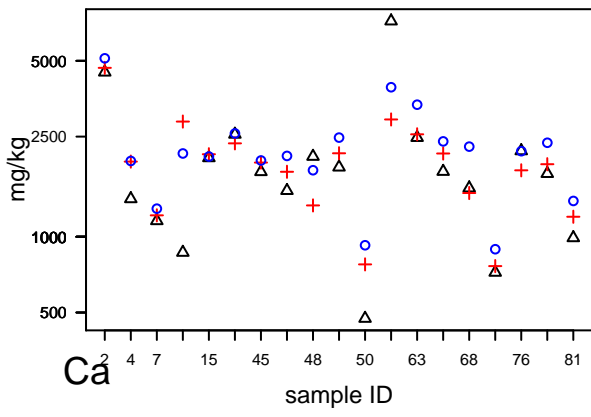
Till, Re-analysis



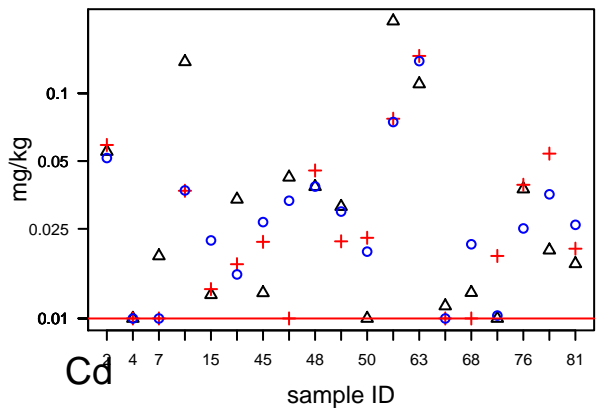
Till, Re-analysis



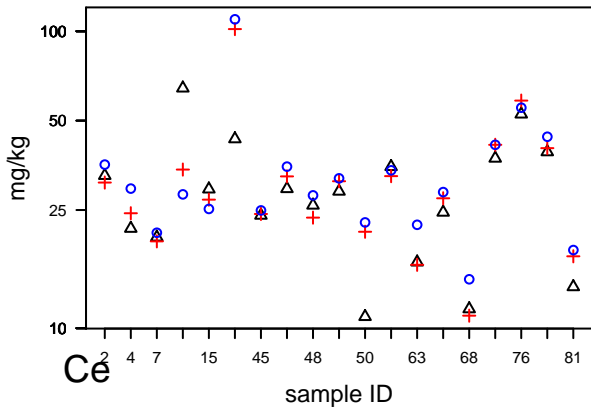
Till, Re-analysis



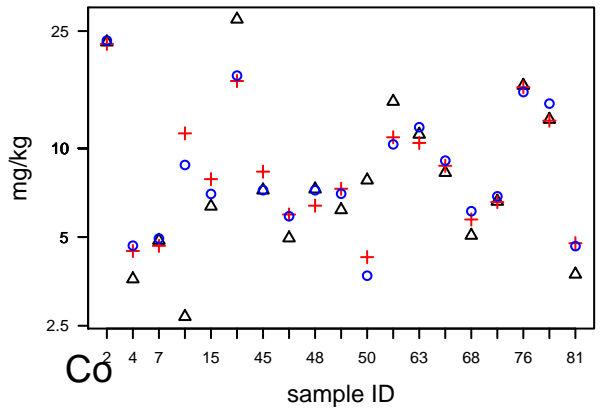
Till, Re-analysis



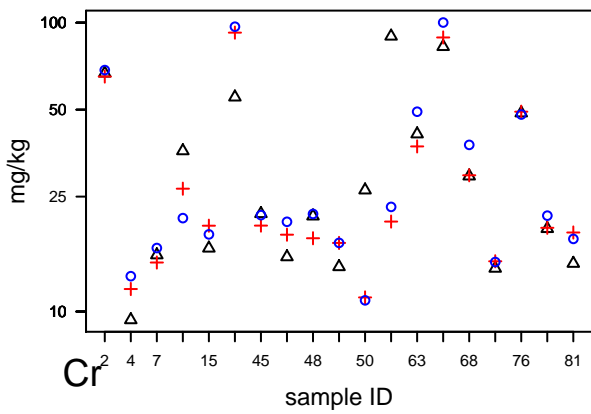
Till, Re-analysis



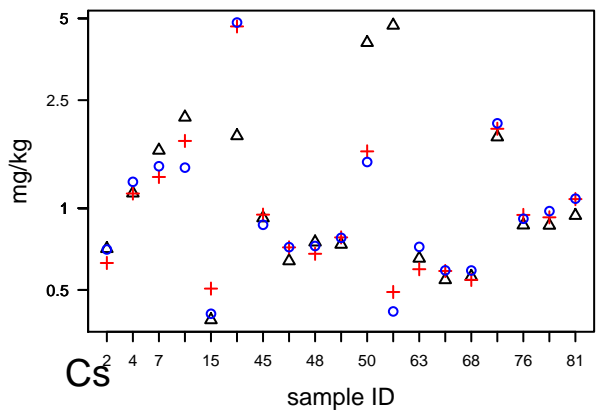
Till, Re-analysis



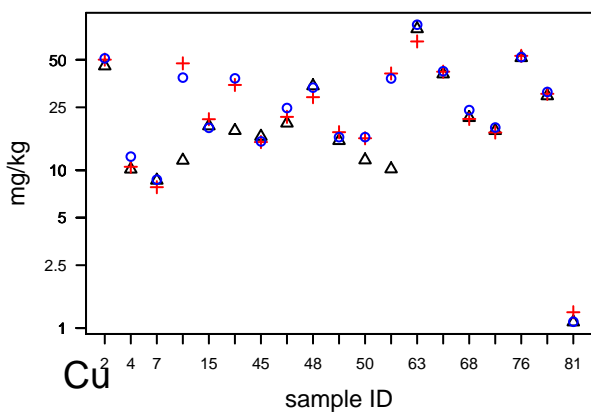
Till, Re-analysis



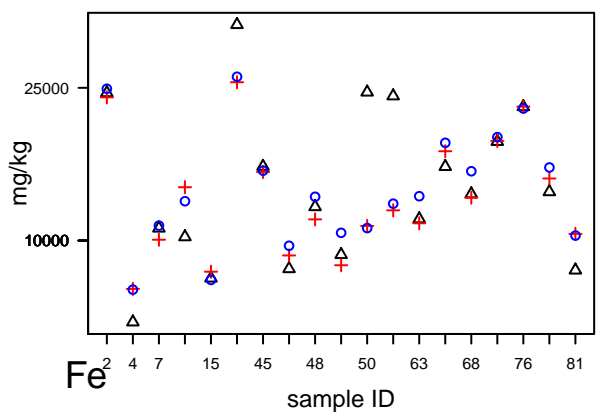
Till, Re-analysis



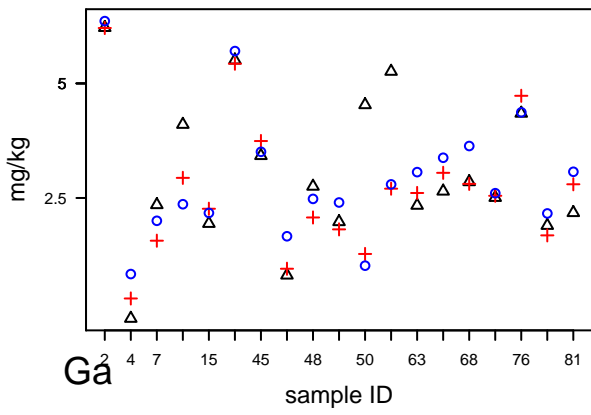
Till, Re-analysis



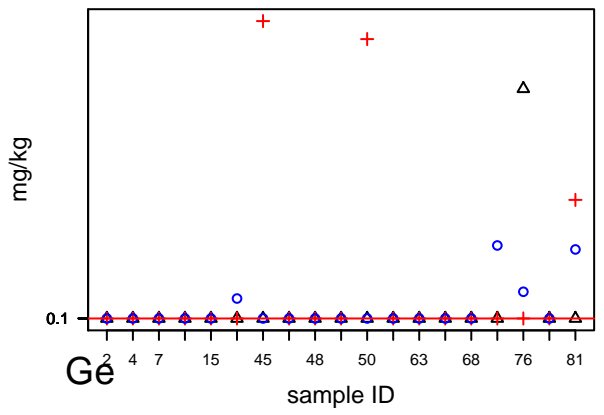
Till, Re-analysis



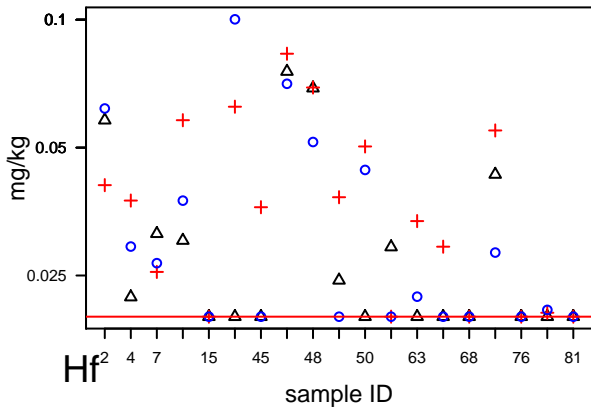
Till, Re-analysis



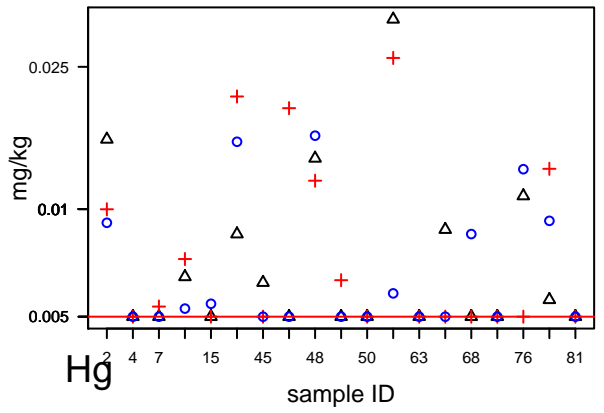
Till, Re-analysis



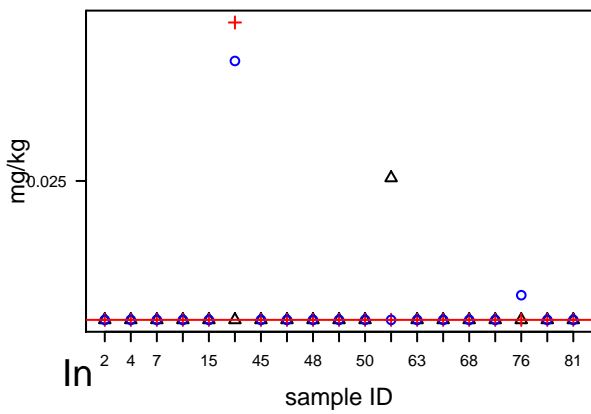
Till, Re-analysis



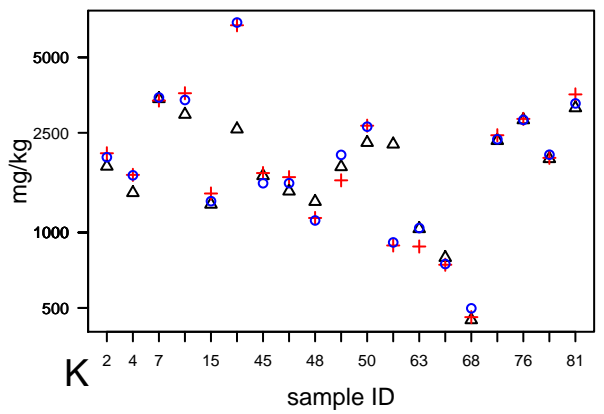
Till, Re-analysis



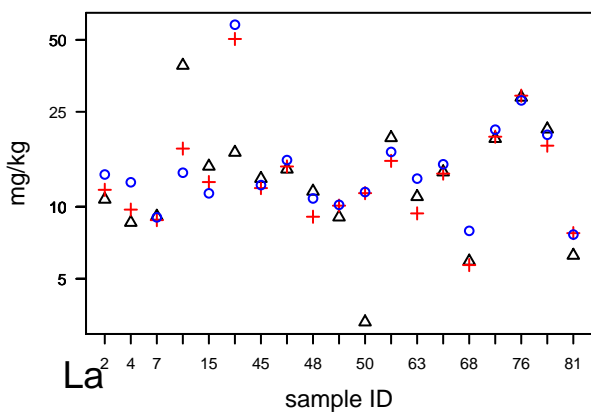
Till, Re-analysis



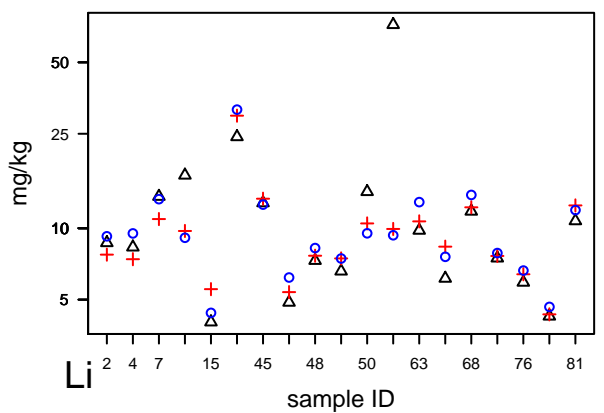
Till, Re-analysis



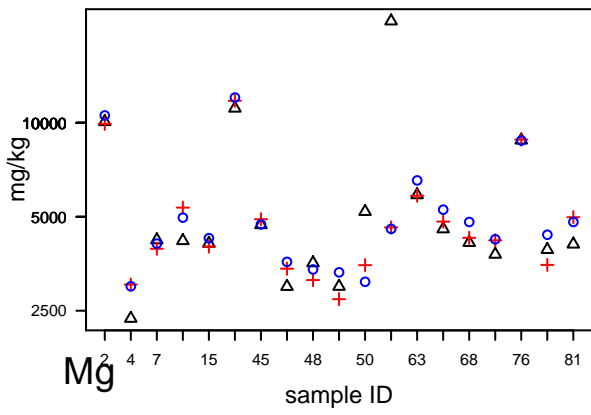
Till, Re-analysis



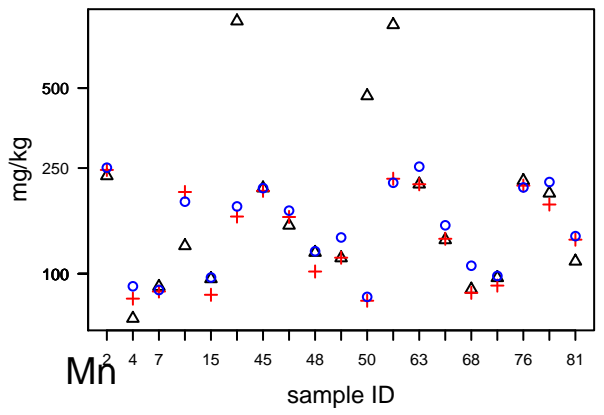
Till, Re-analysis



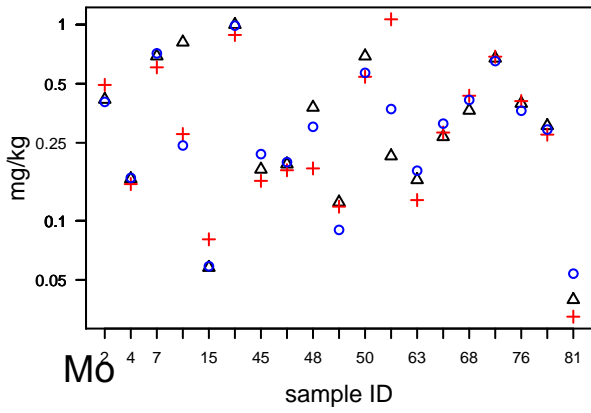
Till, Re-analysis



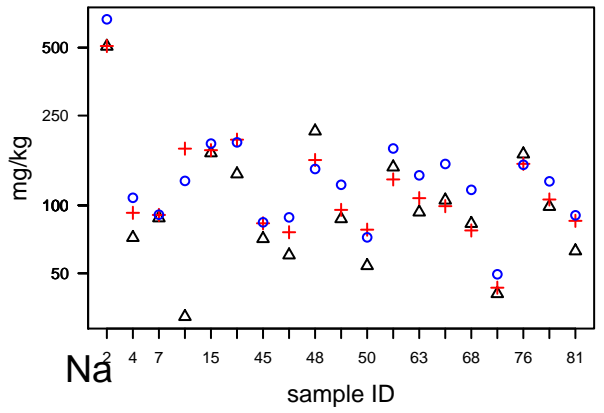
Till, Re-analysis



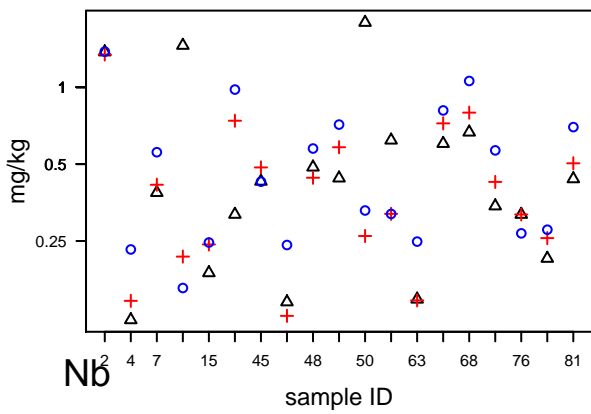
Till, Re-analysis



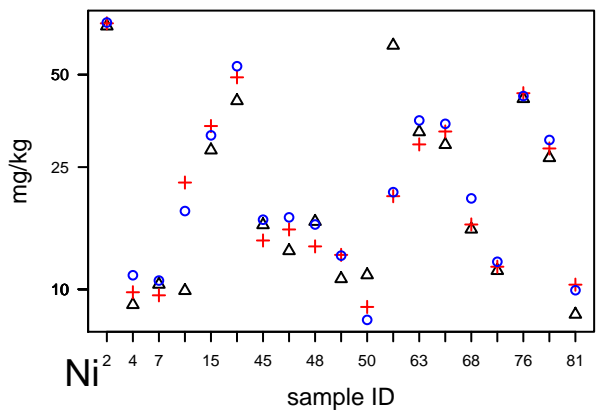
Till, Re-analysis



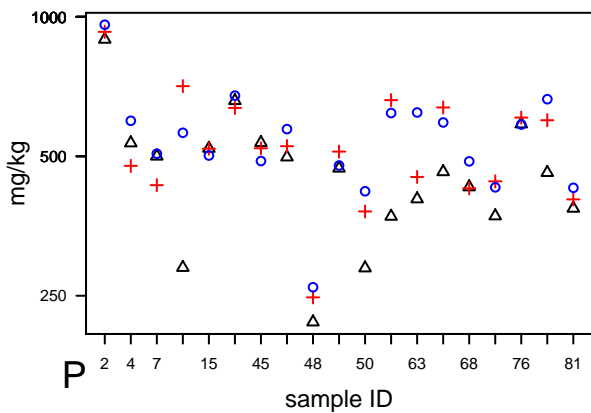
Till, Re-analysis



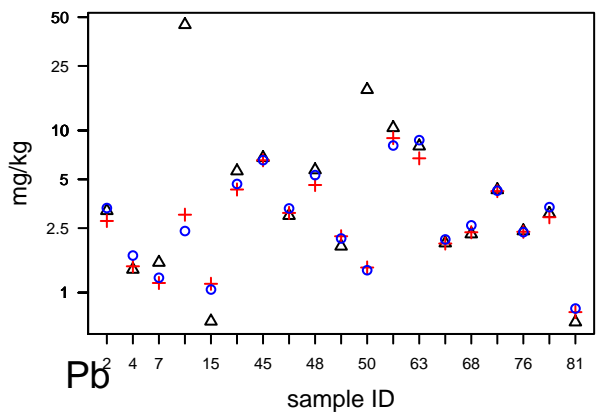
Till, Re-analysis



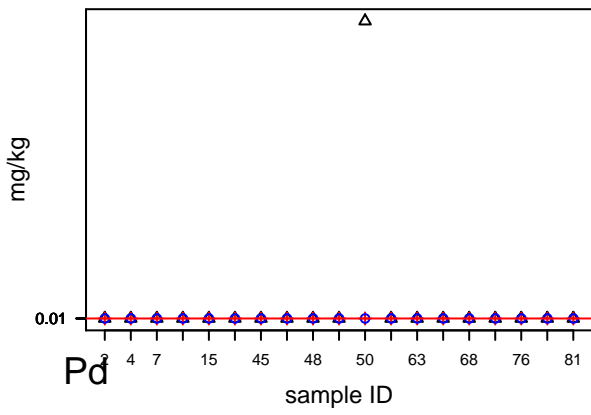
Till, Re-analysis



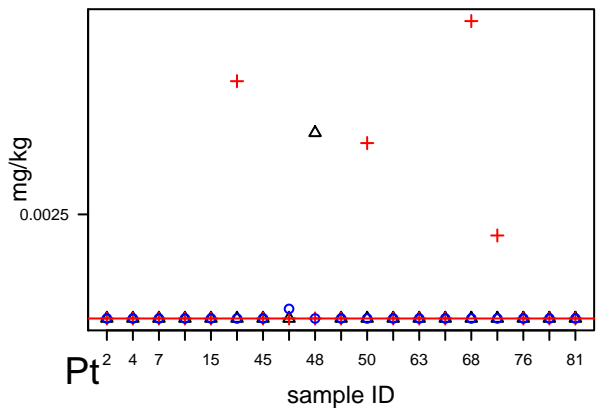
Till, Re-analysis



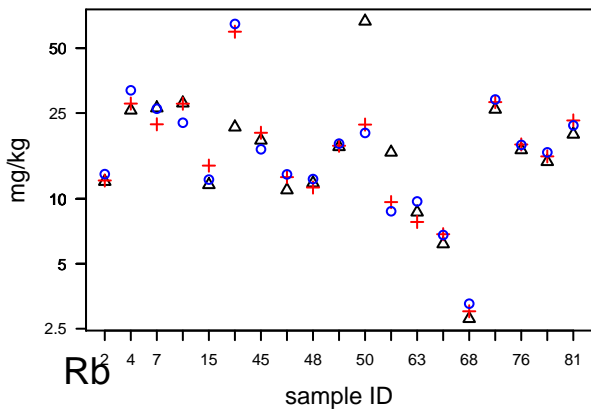
Till, Re-analysis



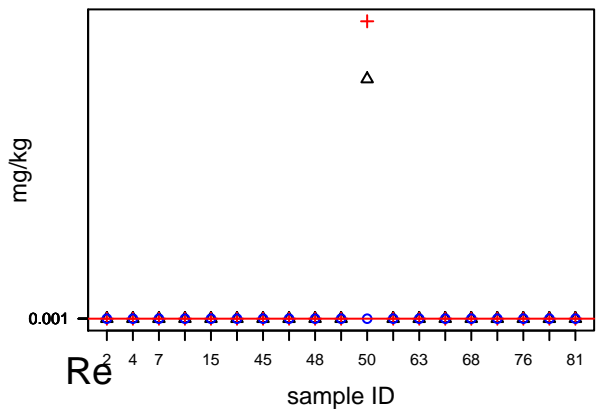
Till, Re-analysis



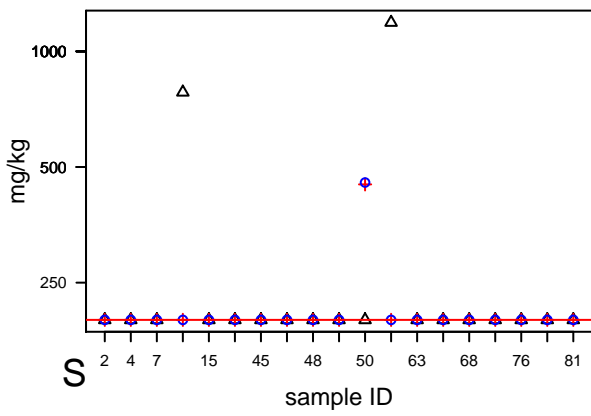
Till, Re-analysis



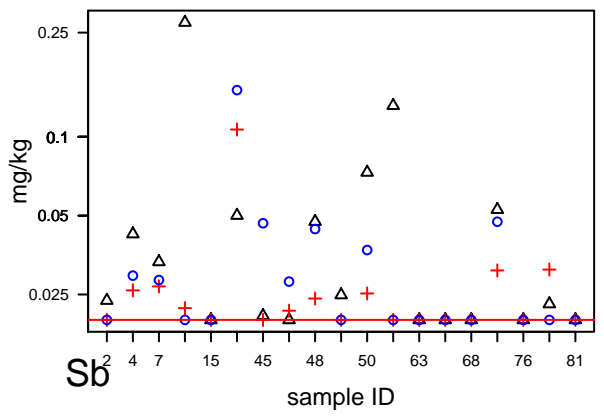
Till, Re-analysis



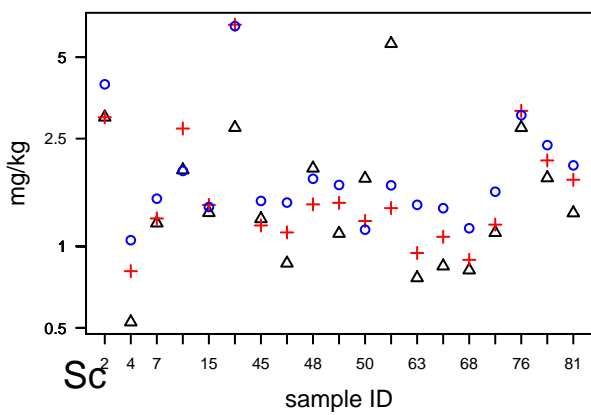
Till, Re-analysis



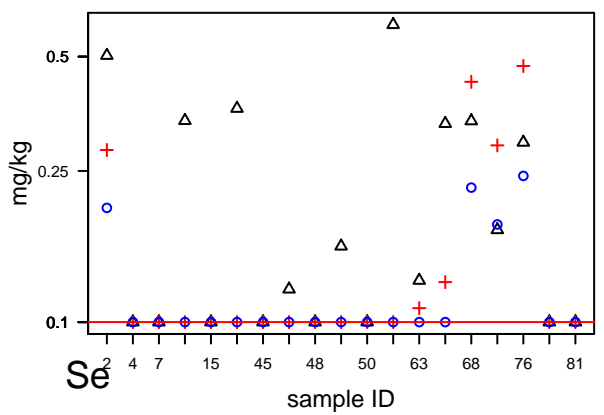
Till, Re-analysis



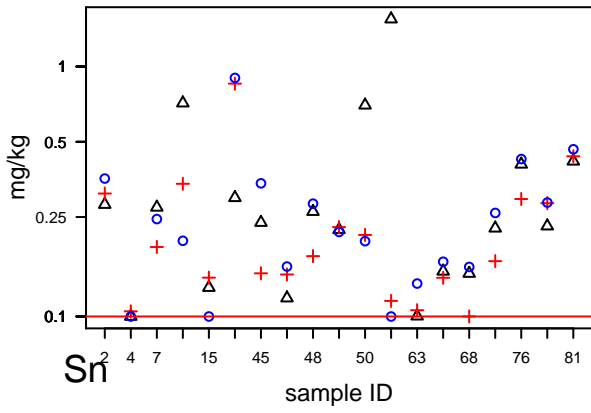
Till, Re-analysis



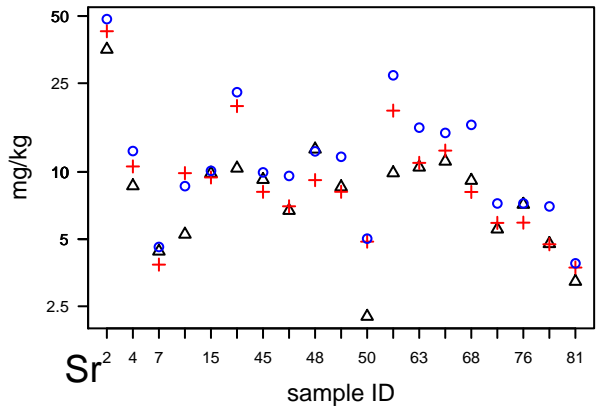
Till, Re-analysis



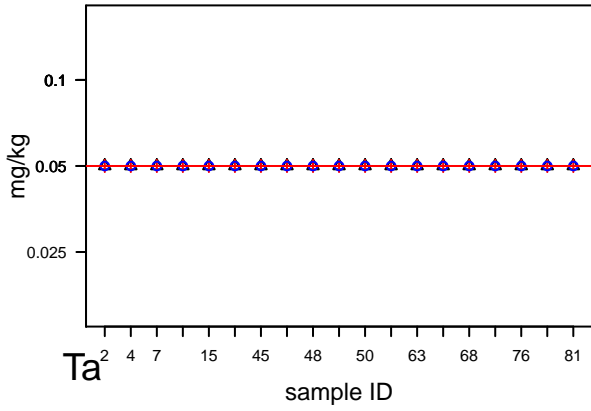
Till, Re-analysis



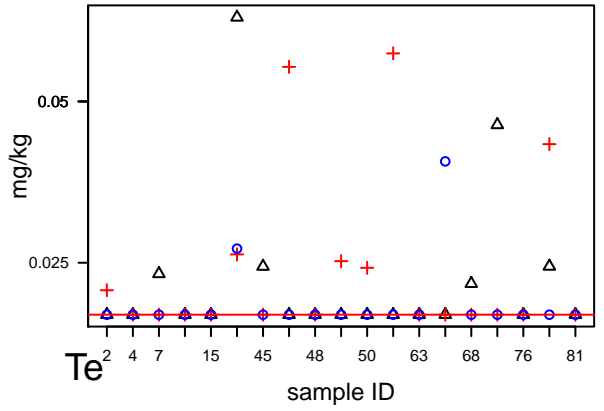
Till, Re-analysis



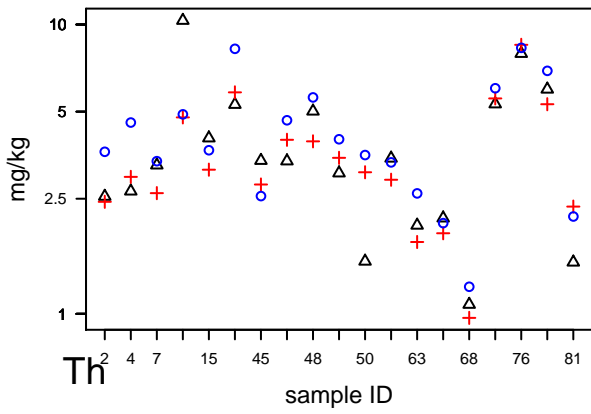
Till, Re-analysis



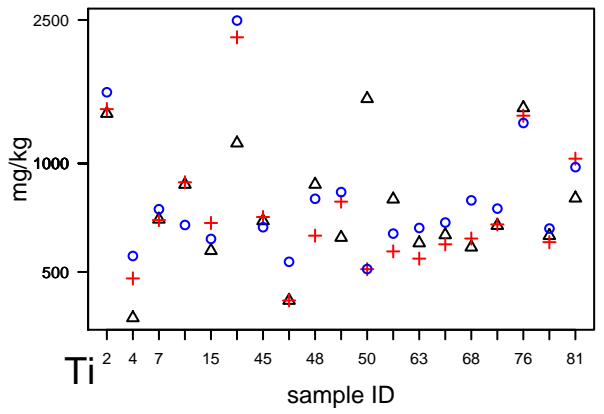
Till, Re-analysis



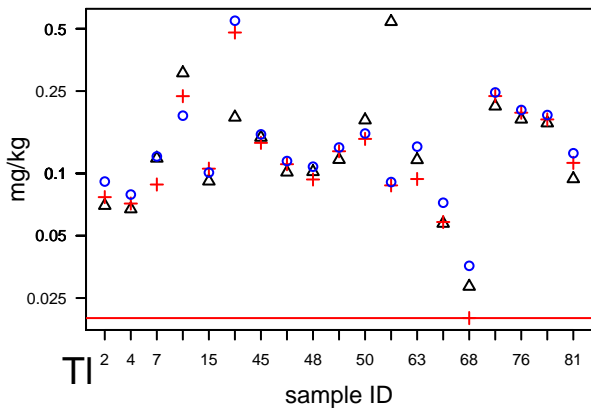
Till, Re-analysis



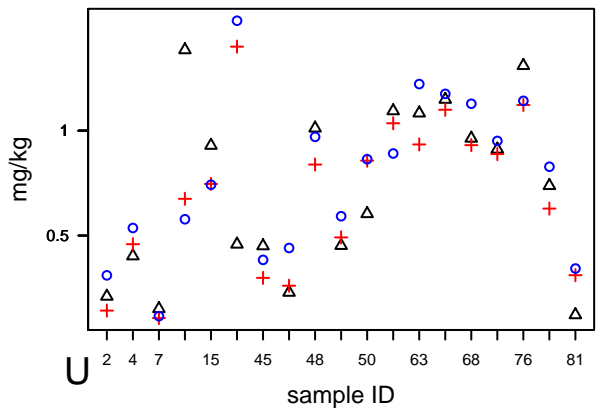
Till, Re-analysis



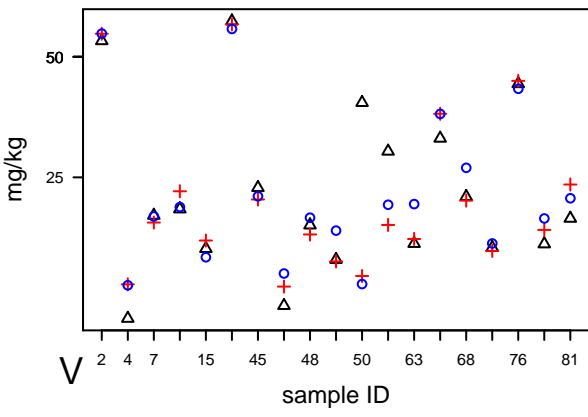
Till, Re-analysis



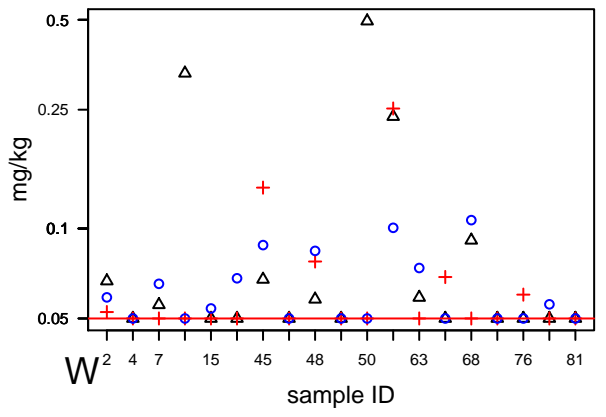
Till, Re-analysis



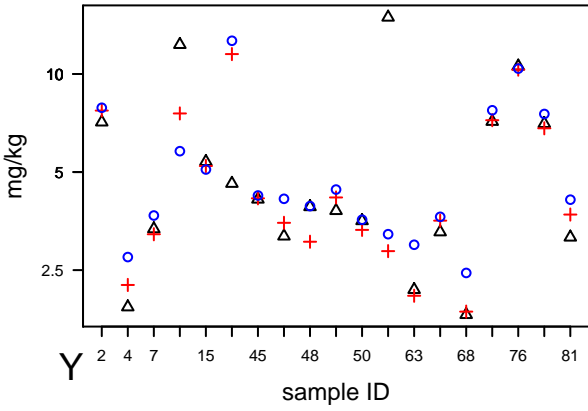
Till, Re-analysis



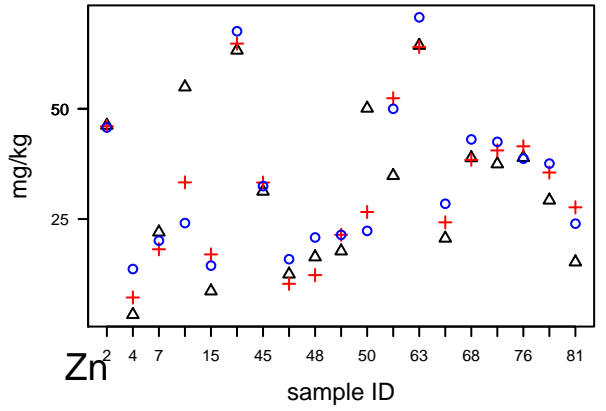
Till, Re-analysis



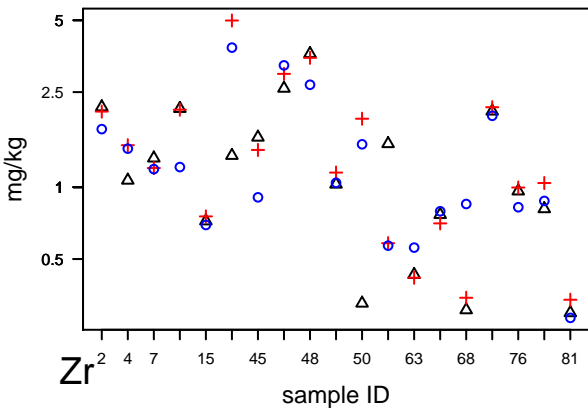
Till, Re-analysis



Till, Re-analysis



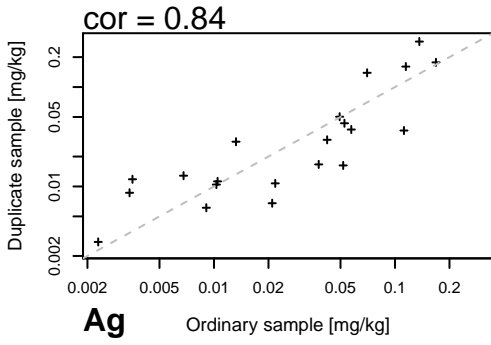
Till, Re-analysis



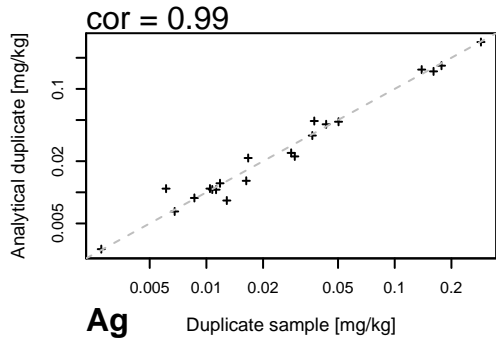
Appendix 4: Correlation plots duplicates

The correlation between ordinary sample and duplicate sample (left hand figure) and the correlation between duplicate sample and analytical duplicate (right hand figure) shown for all elements that have at least five duplicate pairs above PDL. Above each plot the covariance or correlation (cor) is given.

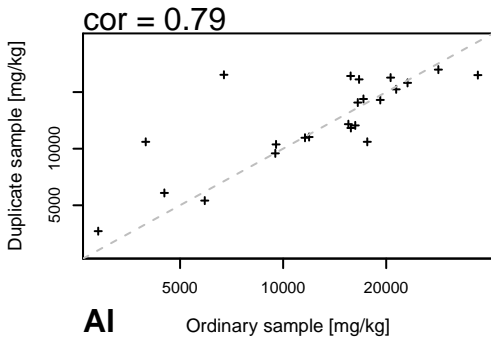
Field duplicates



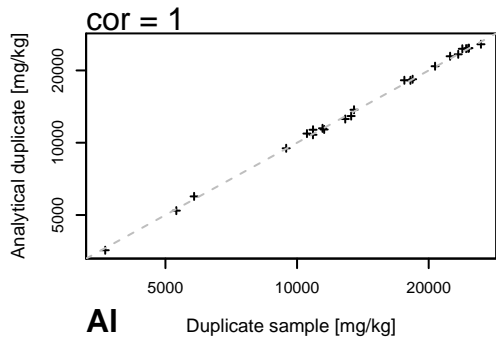
Analytical duplicates



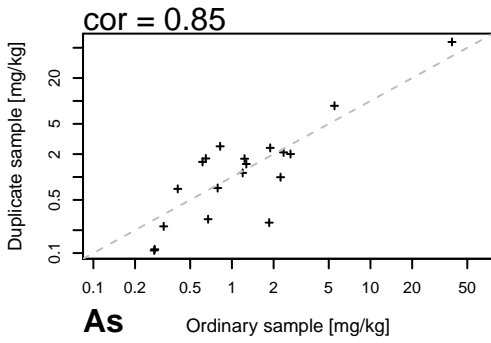
Field duplicates



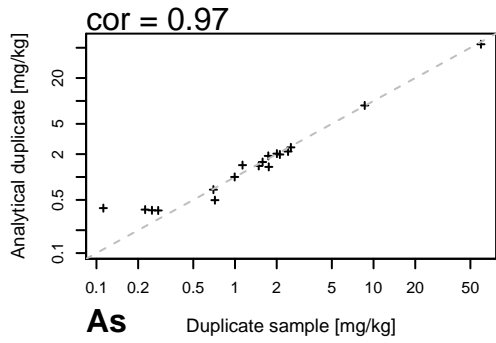
Analytical duplicates



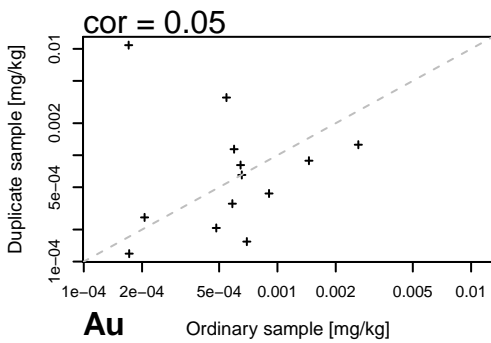
Field duplicates



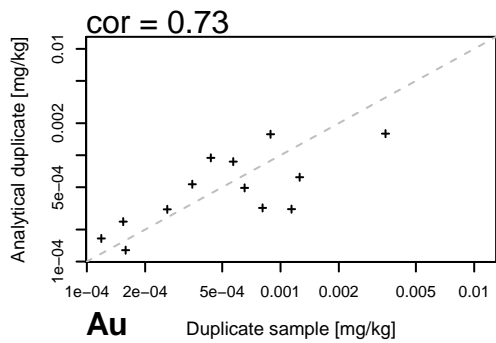
Analytical duplicates



Field duplicates



Analytical duplicates

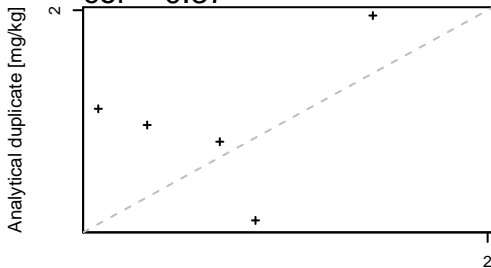
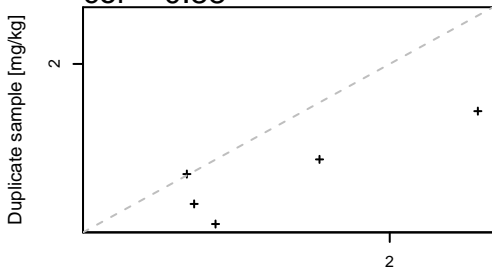


Field duplicates

Analytical duplicates

cor = 0.88

cor = 0.37



B Ordinary sample [mg/kg]

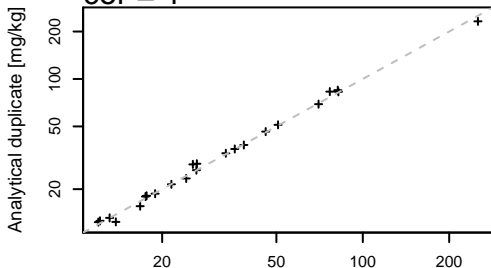
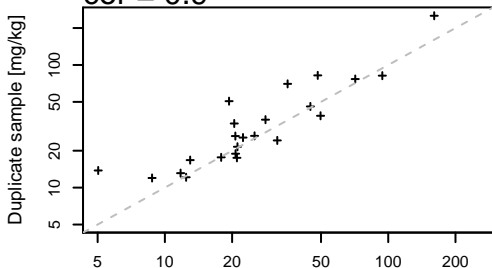
B Duplicate sample [mg/kg]

Field duplicates

Analytical duplicates

cor = 0.9

cor = 1



Ba Ordinary sample [mg/kg]

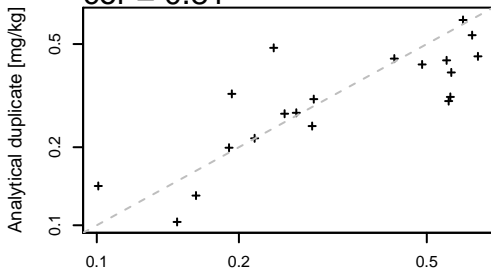
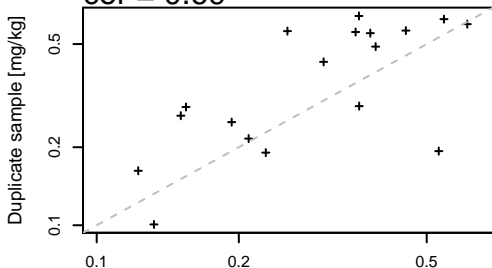
Ba Duplicate sample [mg/kg]

Field duplicates

Analytical duplicates

cor = 0.69

cor = 0.81



Be Ordinary sample [mg/kg]

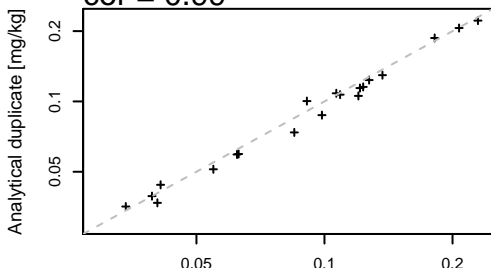
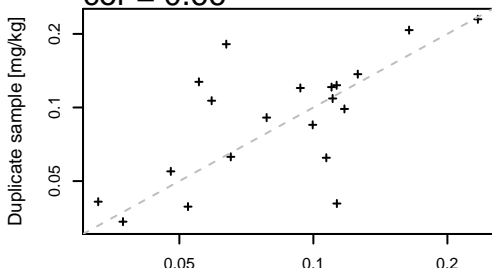
Be Duplicate sample [mg/kg]

Field duplicates

Analytical duplicates

cor = 0.66

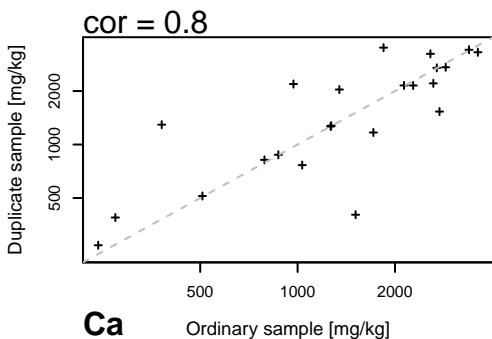
cor = 0.99



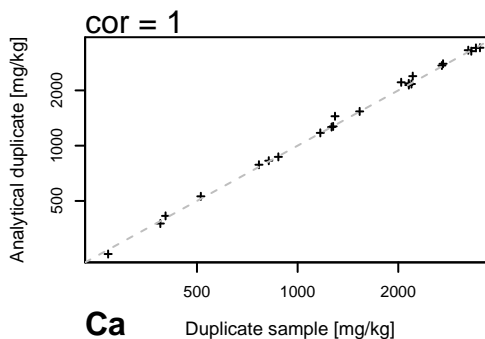
Bi Ordinary sample [mg/kg]

Bi Duplicate sample [mg/kg]

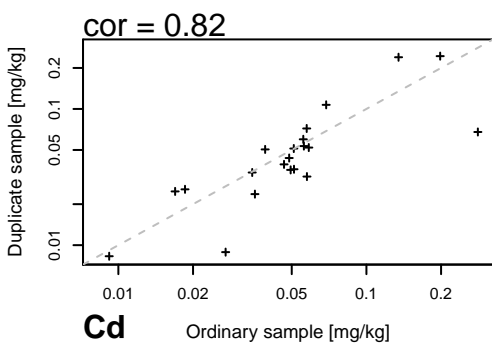
Field duplicates



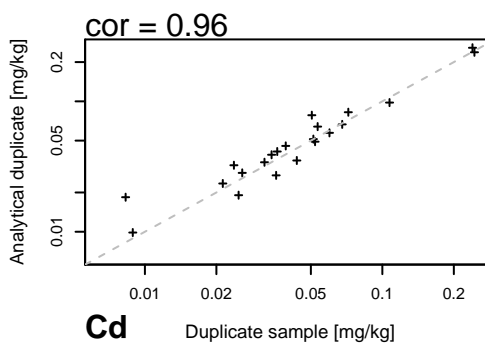
Analytical duplicates



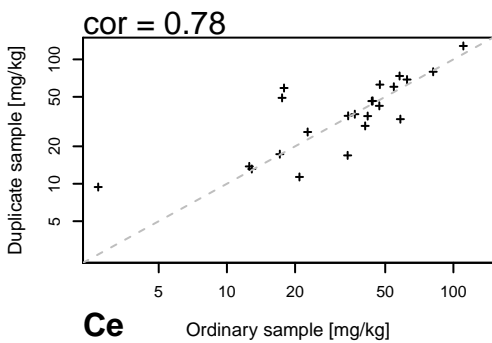
Field duplicates



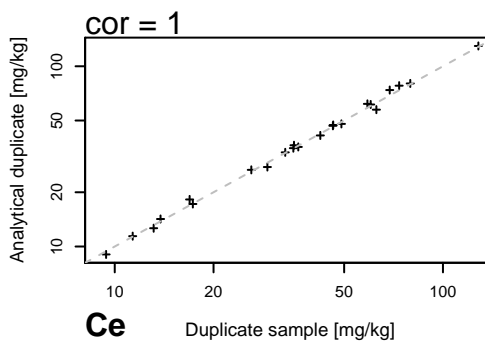
Analytical duplicates



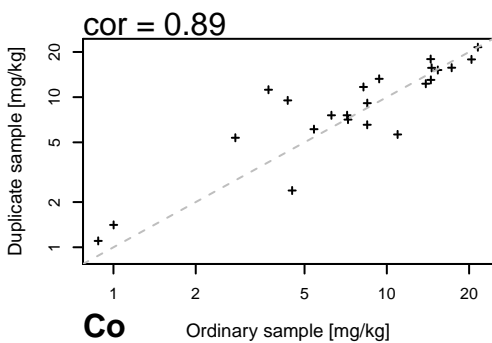
Field duplicates



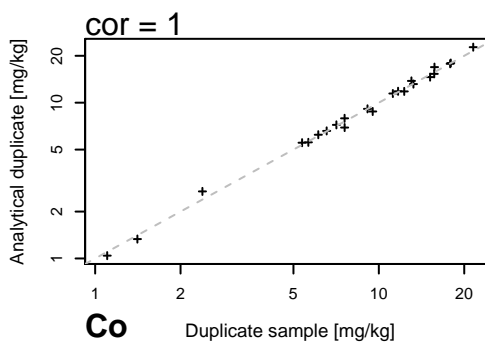
Analytical duplicates



Field duplicates



Analytical duplicates

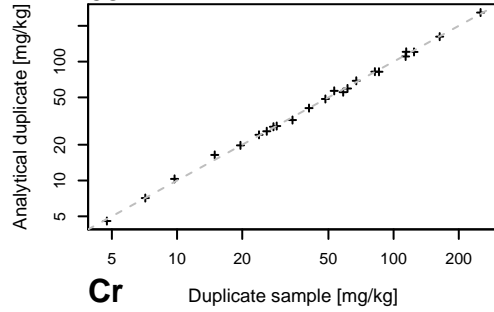
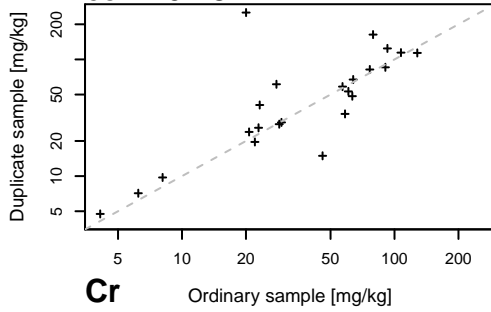


Field duplicates

Analytical duplicates

cor = 0.78

cor = 1

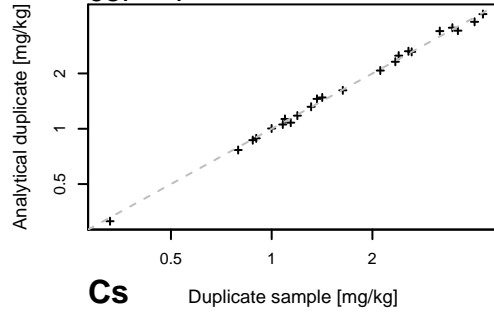
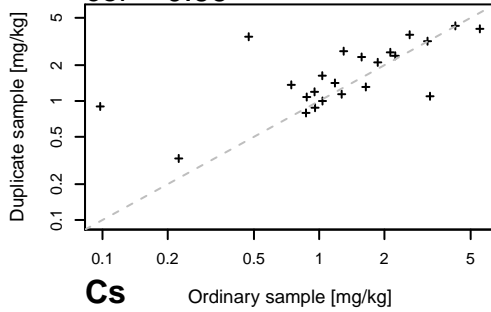


Field duplicates

Analytical duplicates

cor = 0.66

cor = 1

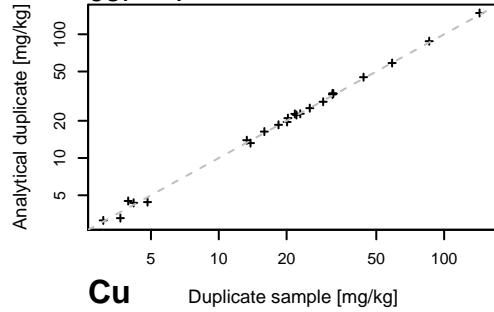
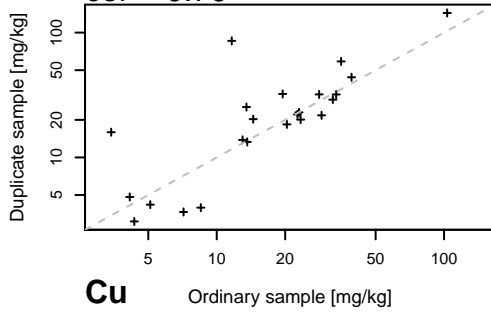


Field duplicates

Analytical duplicates

cor = 0.79

cor = 1

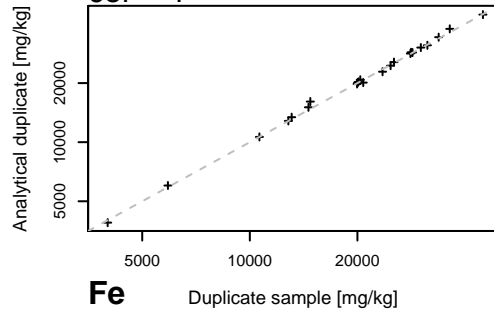
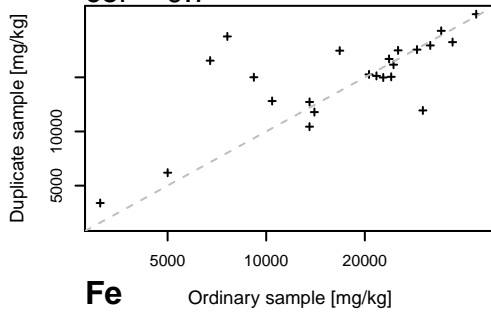


Field duplicates

Analytical duplicates

cor = 0.7

cor = 1

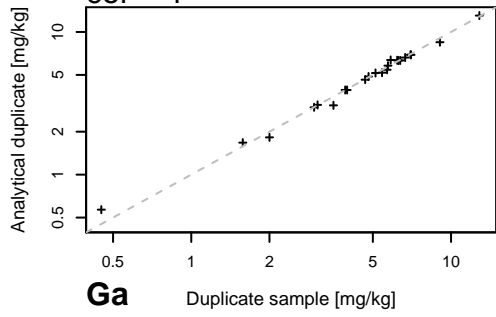
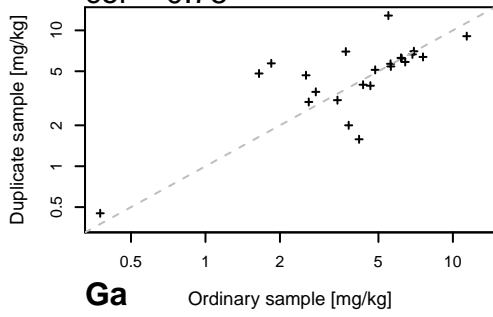


Field duplicates

Analytical duplicates

cor = 0.75

cor = 1

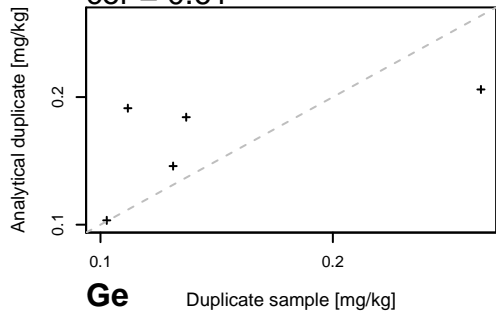
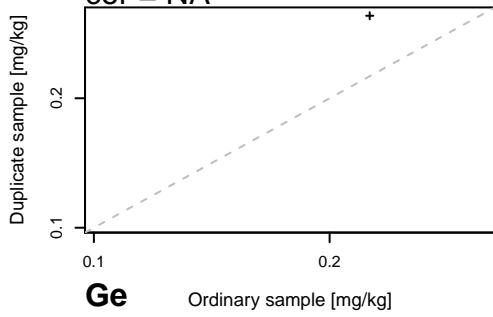


Field duplicates

Analytical duplicates

cor = NA

cor = 0.61

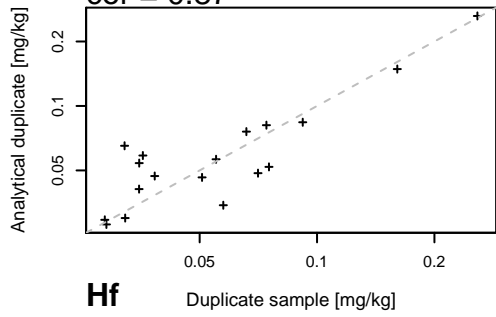
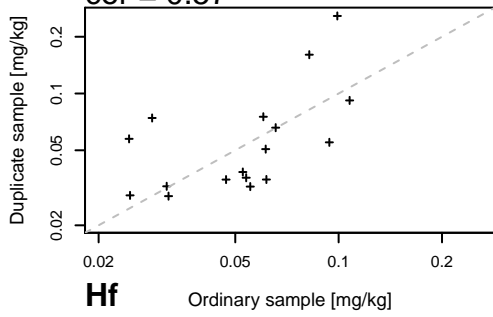


Field duplicates

Analytical duplicates

cor = 0.57

cor = 0.87

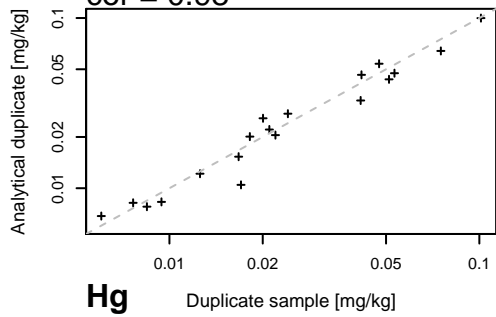
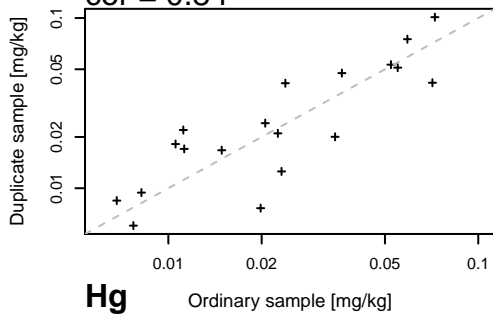


Field duplicates

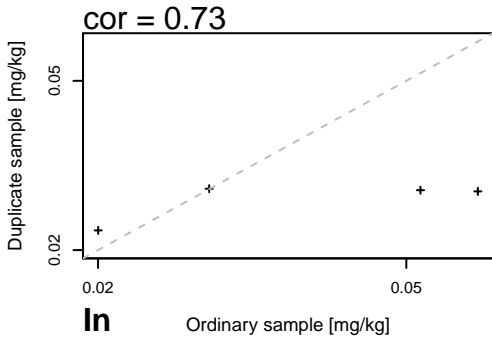
Analytical duplicates

cor = 0.84

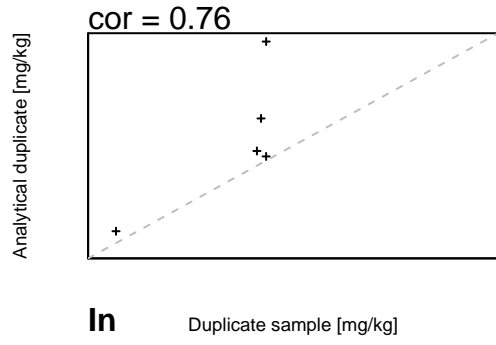
cor = 0.98



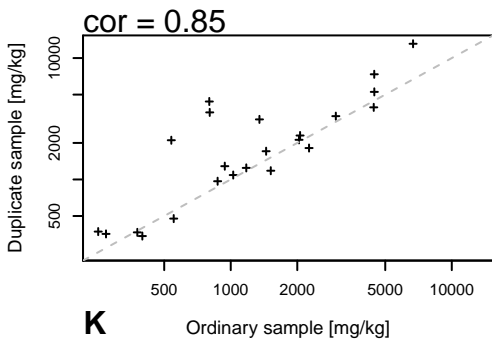
Field duplicates



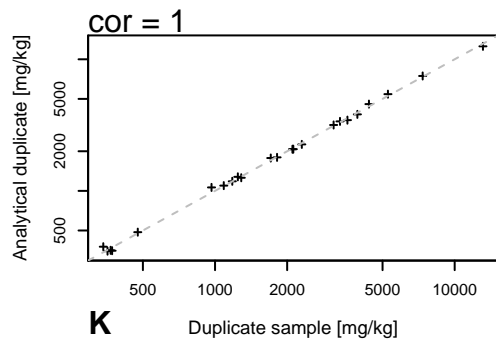
Analytical duplicates



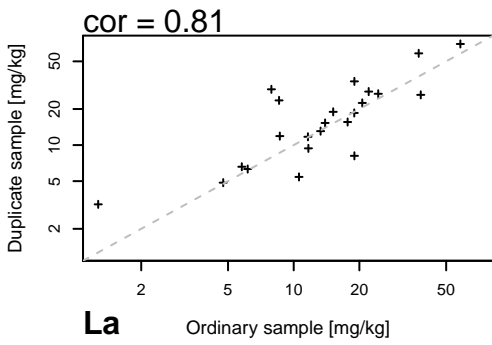
Field duplicates



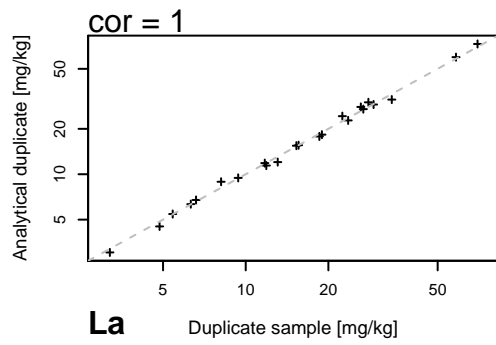
Analytical duplicates



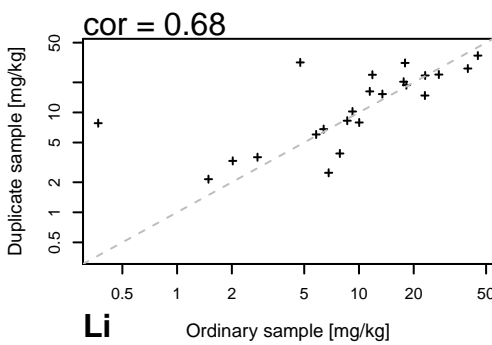
Field duplicates



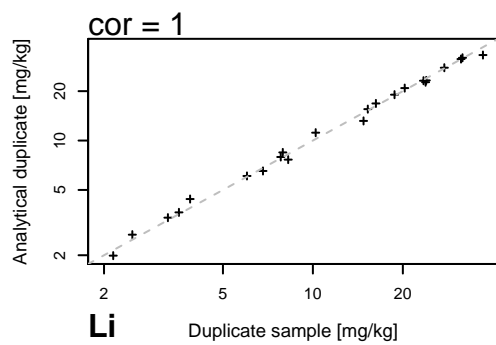
Analytical duplicates



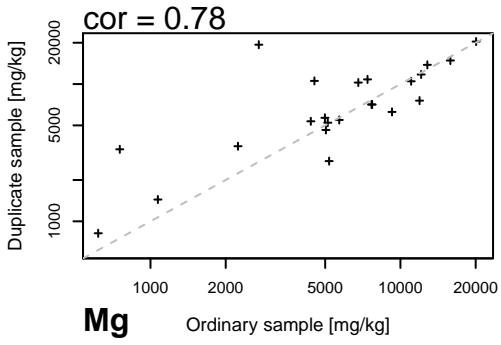
Field duplicates



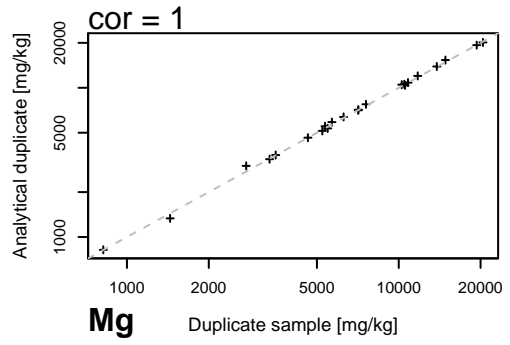
Analytical duplicates



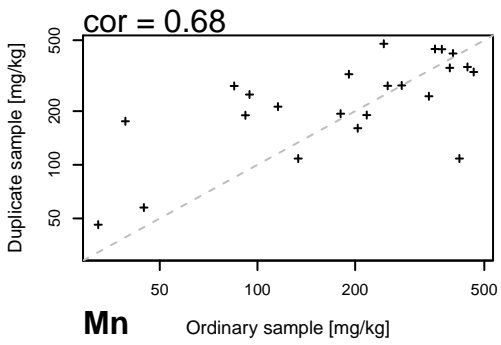
Field duplicates



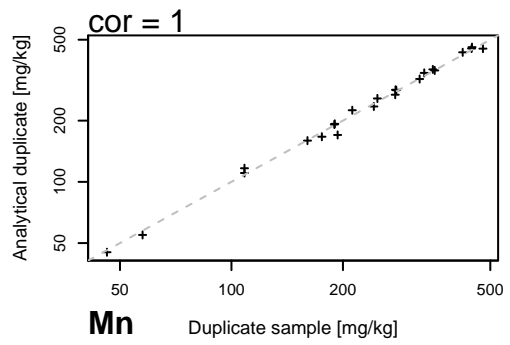
Analytical duplicates



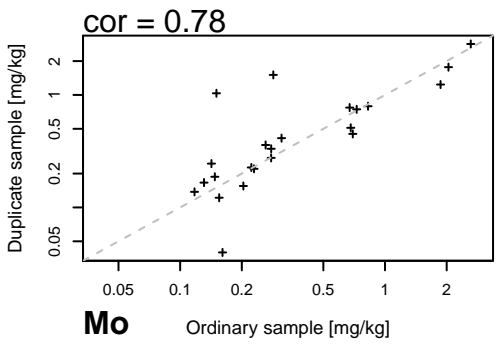
Field duplicates



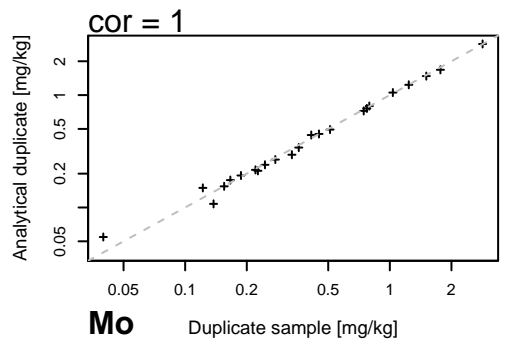
Analytical duplicates



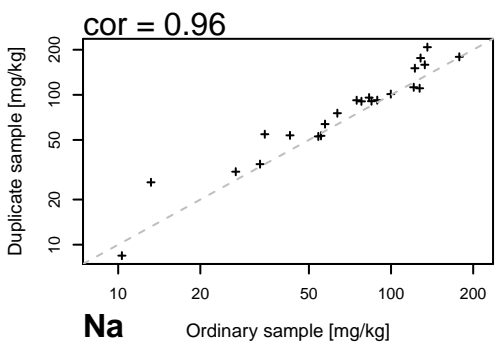
Field duplicates



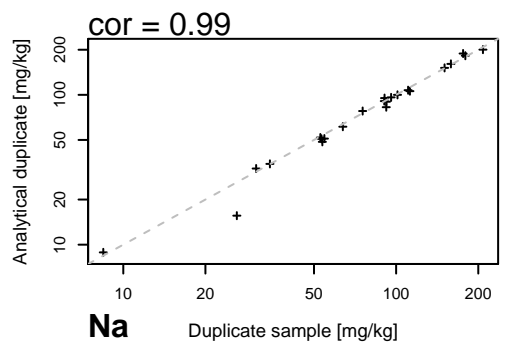
Analytical duplicates



Field duplicates



Analytical duplicates

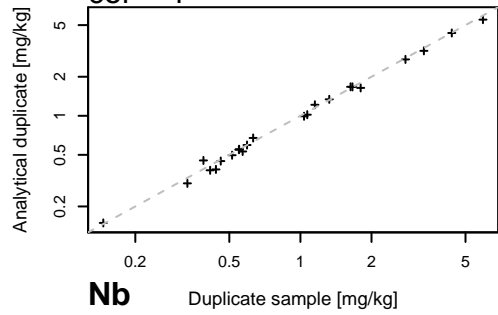
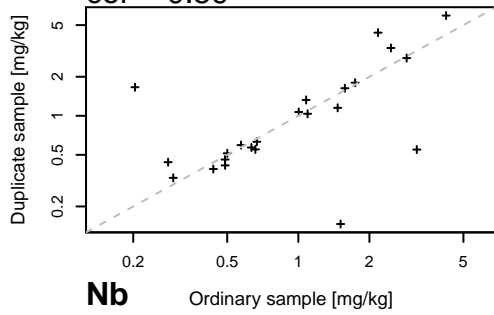


Field duplicates

Analytical duplicates

cor = 0.59

cor = 1

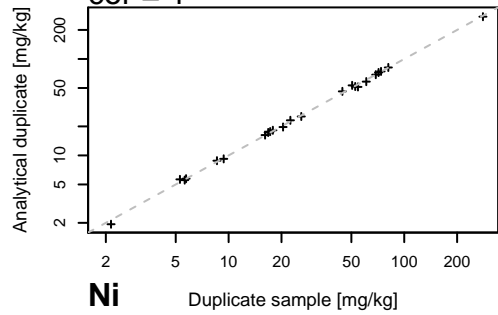
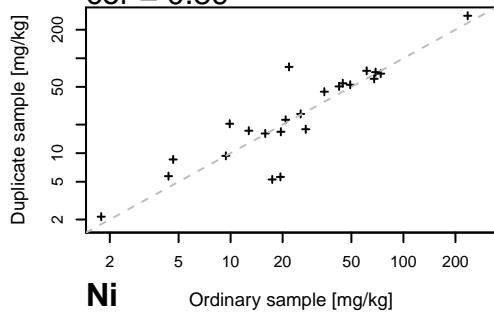


Field duplicates

Analytical duplicates

cor = 0.89

cor = 1

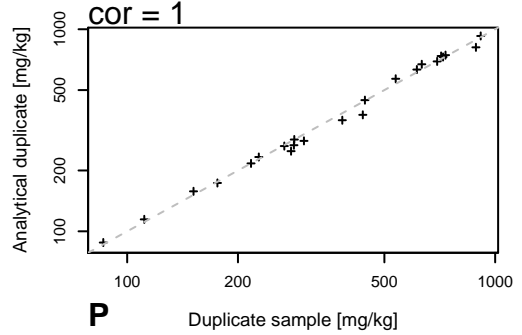
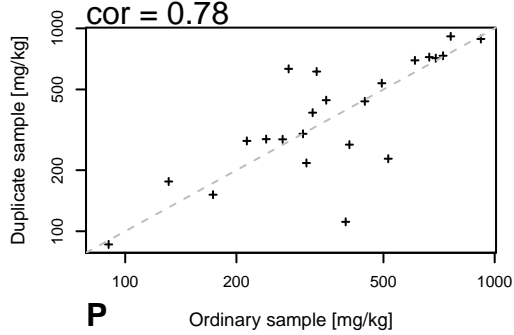


Field duplicates

Analytical duplicates

cor = 0.78

cor = 1

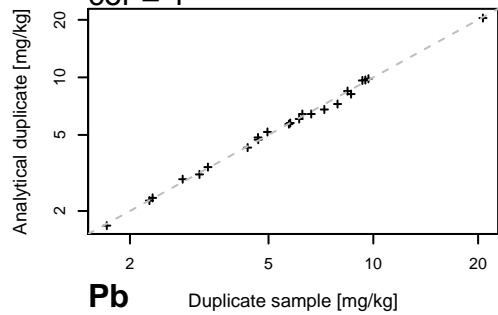
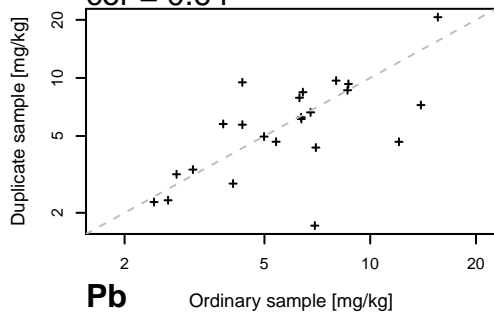


Field duplicates

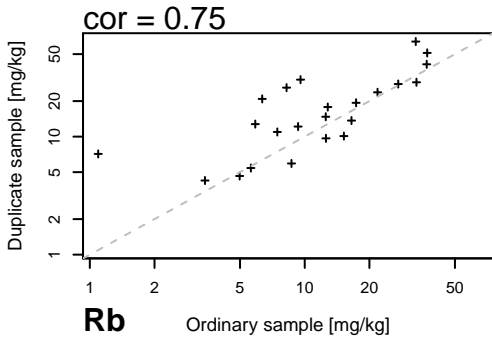
Analytical duplicates

cor = 0.64

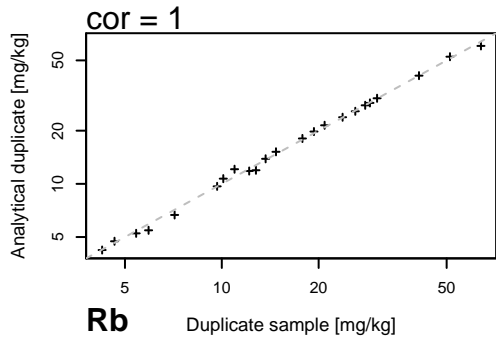
cor = 1



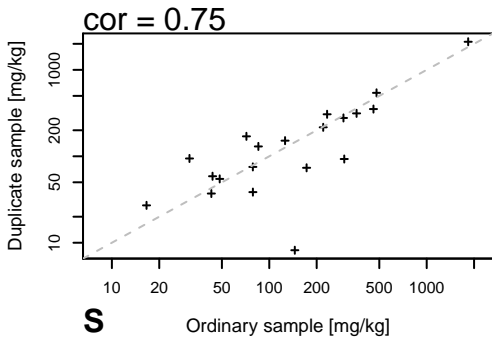
Field duplicates



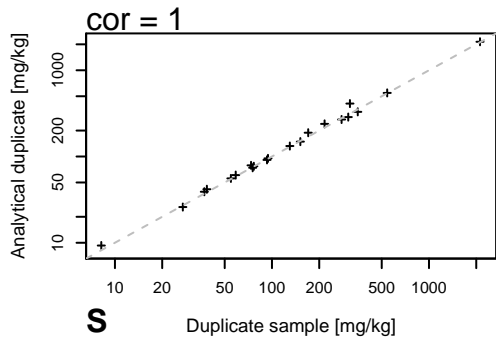
Analytical duplicates



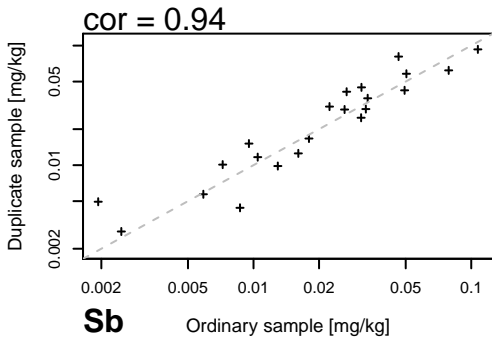
Field duplicates



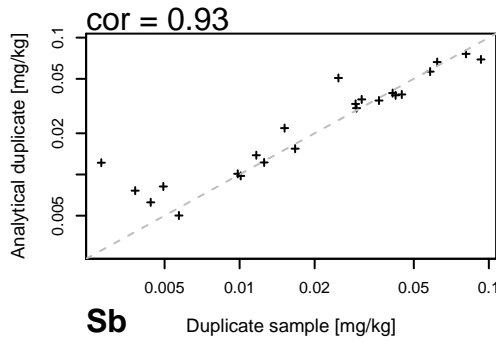
Analytical duplicates



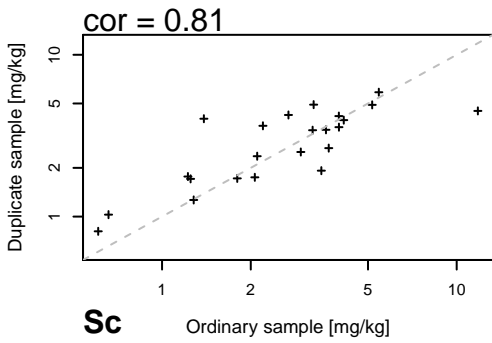
Field duplicates



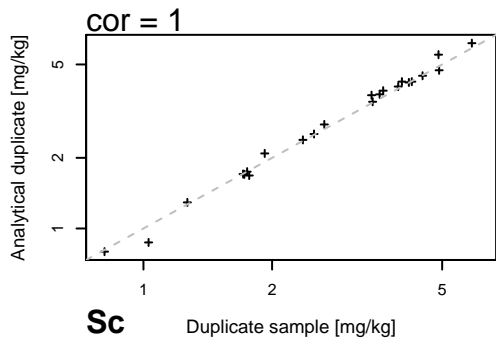
Analytical duplicates



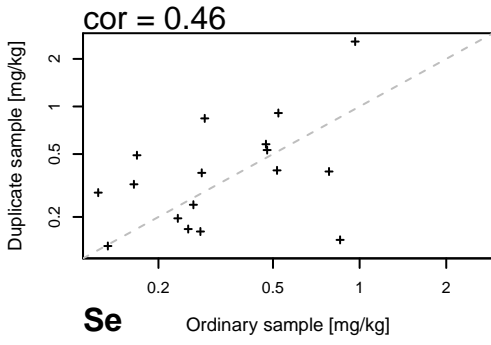
Field duplicates



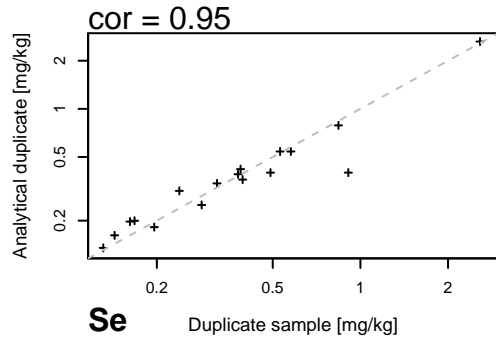
Analytical duplicates



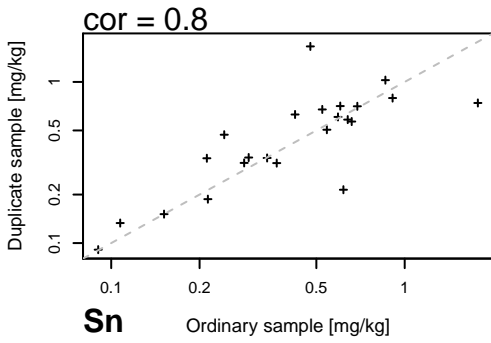
Field duplicates



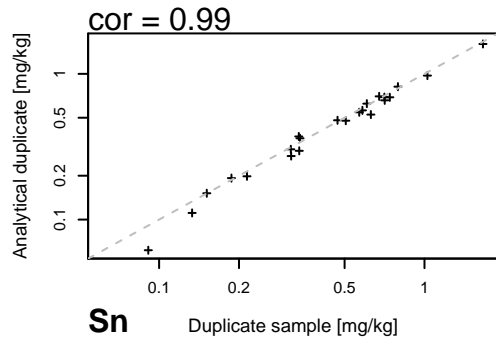
Analytical duplicates



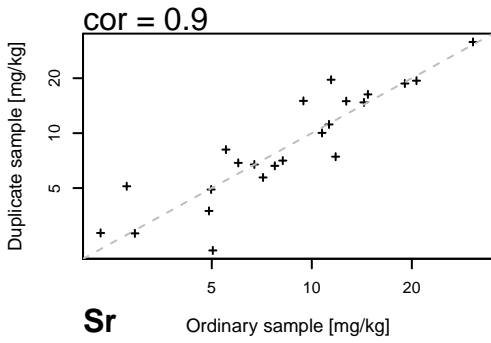
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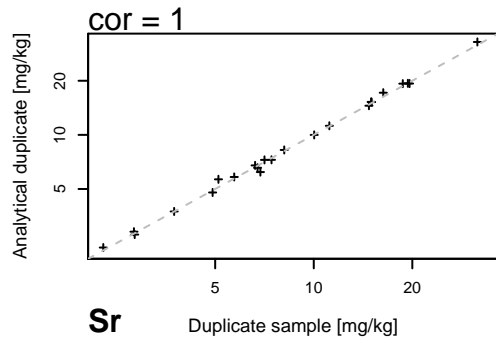
Analytical duplicates



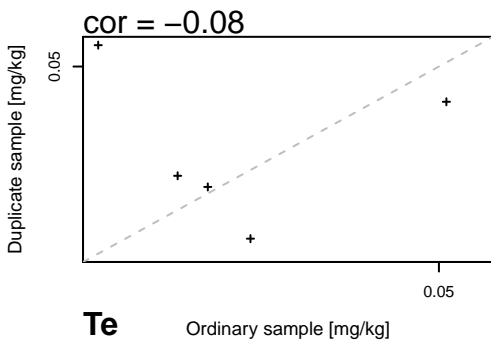
Field duplicates



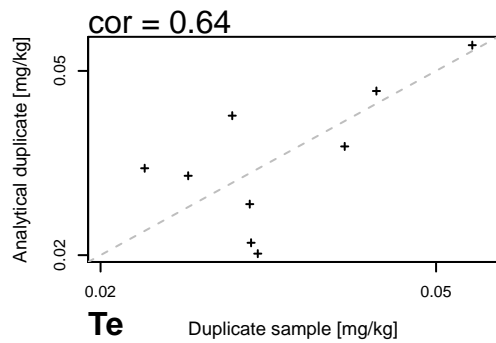
Analytical duplicates



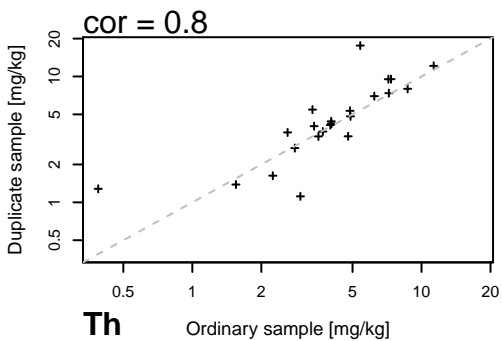
Field duplicates



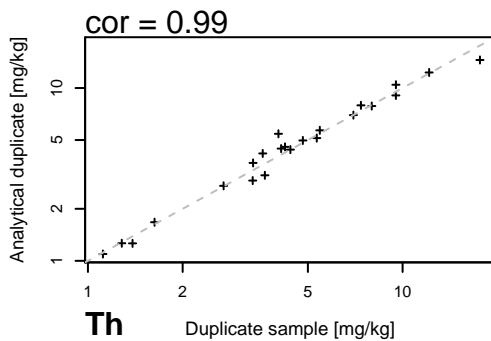
Analytical duplicates



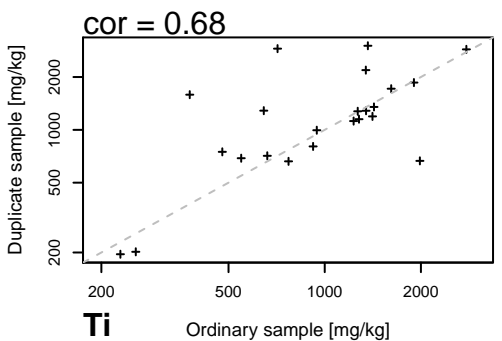
Field duplicates



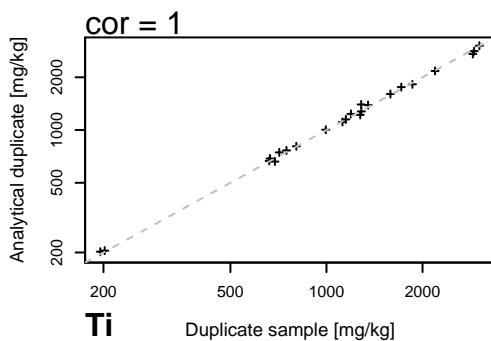
Analytical duplicates



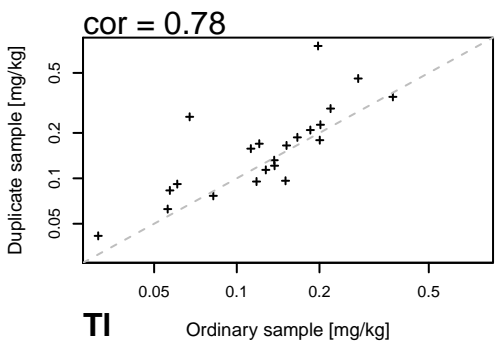
Field duplicates



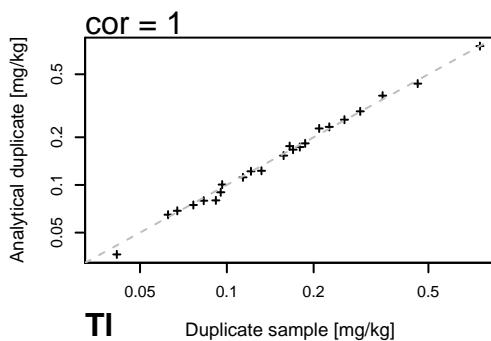
Analytical duplicates



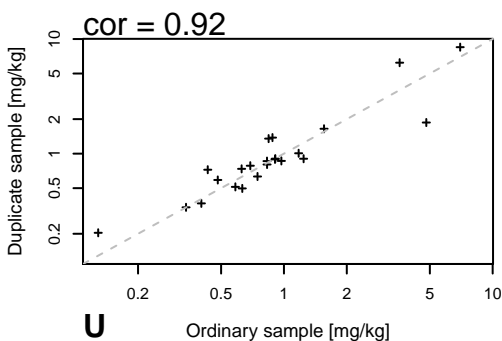
Field duplicates



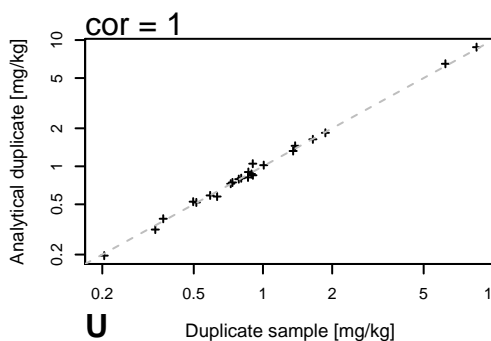
Analytical duplicates



Field duplicates



Analytical duplicates

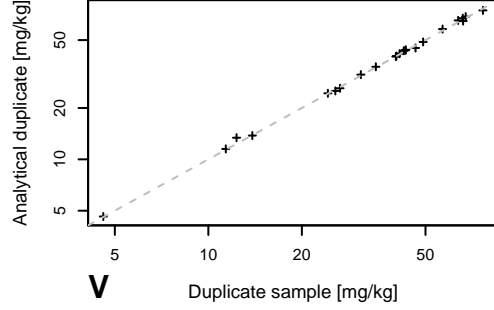
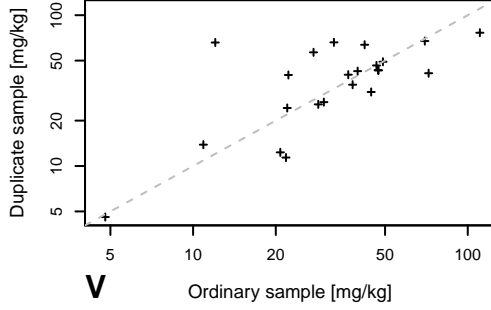


Field duplicates

Analytical duplicates

cor = 0.72

cor = 1

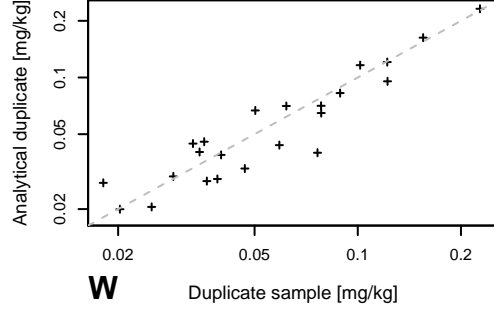
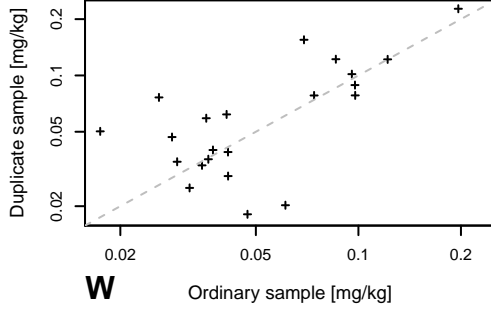


Field duplicates

Analytical duplicates

cor = 0.65

cor = 0.93

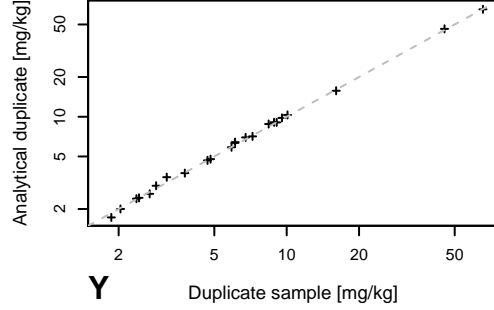
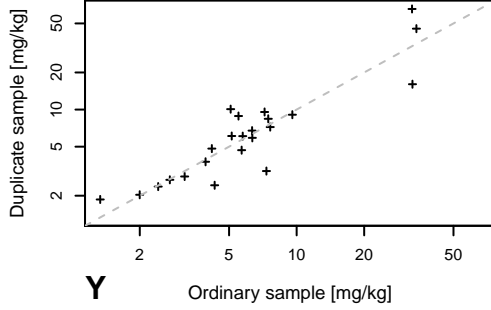


Field duplicates

Analytical duplicates

cor = 0.91

cor = 1

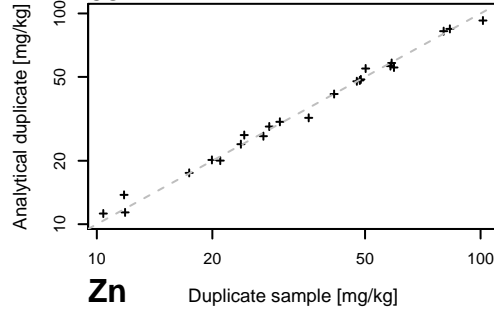
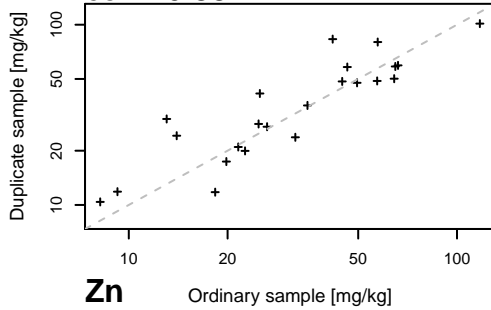


Field duplicates

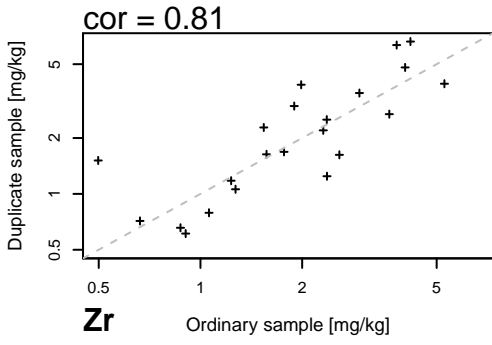
Analytical duplicates

cor = 0.88

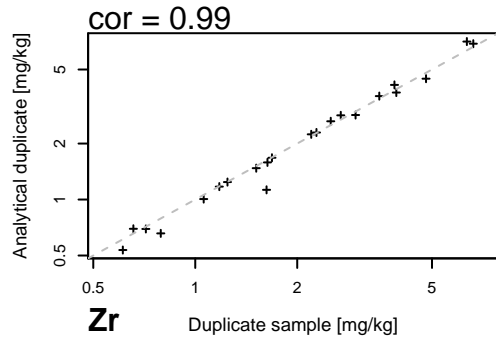
cor = 1



Field duplicates



Analytical duplicates

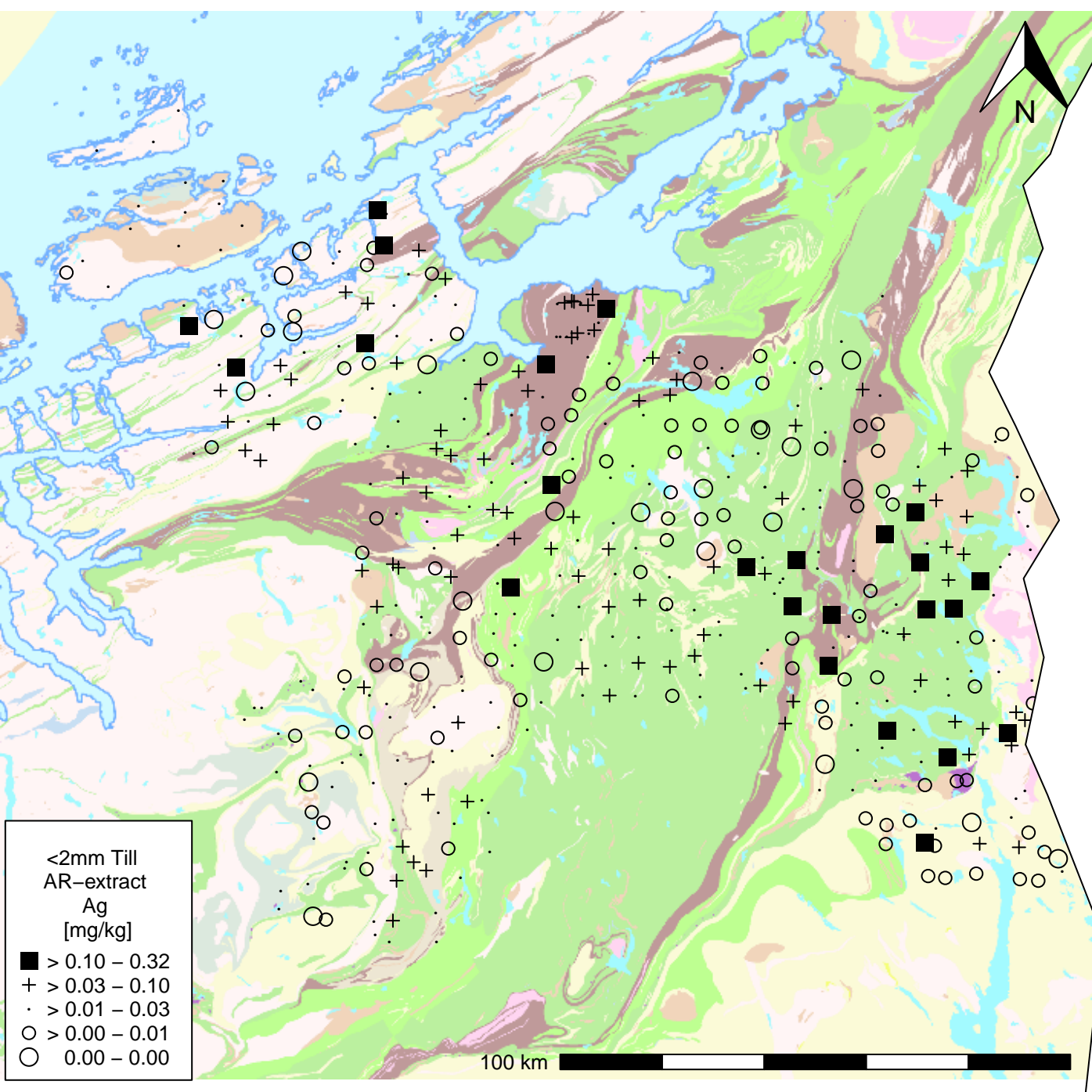


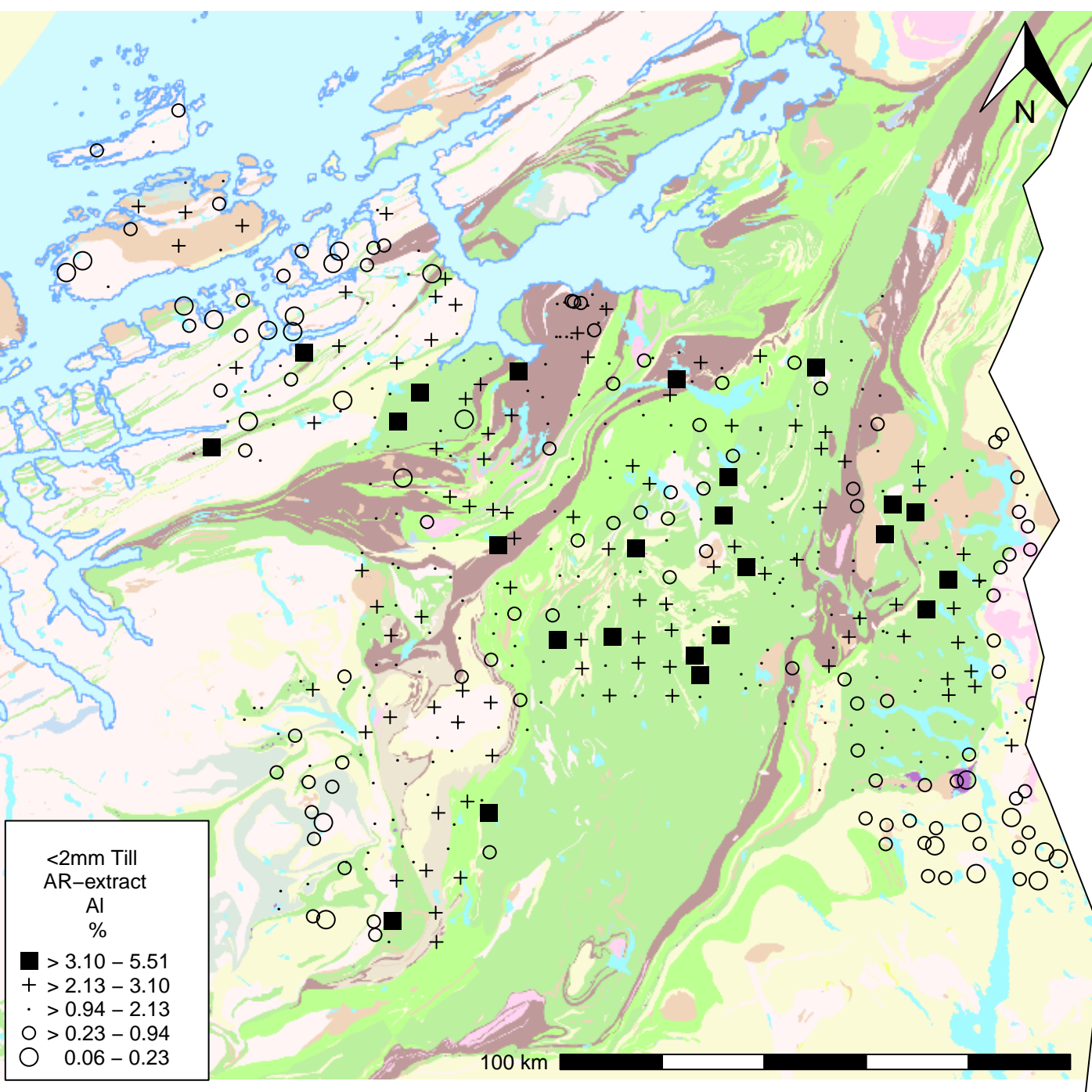
Appendix 5: Geochemical maps

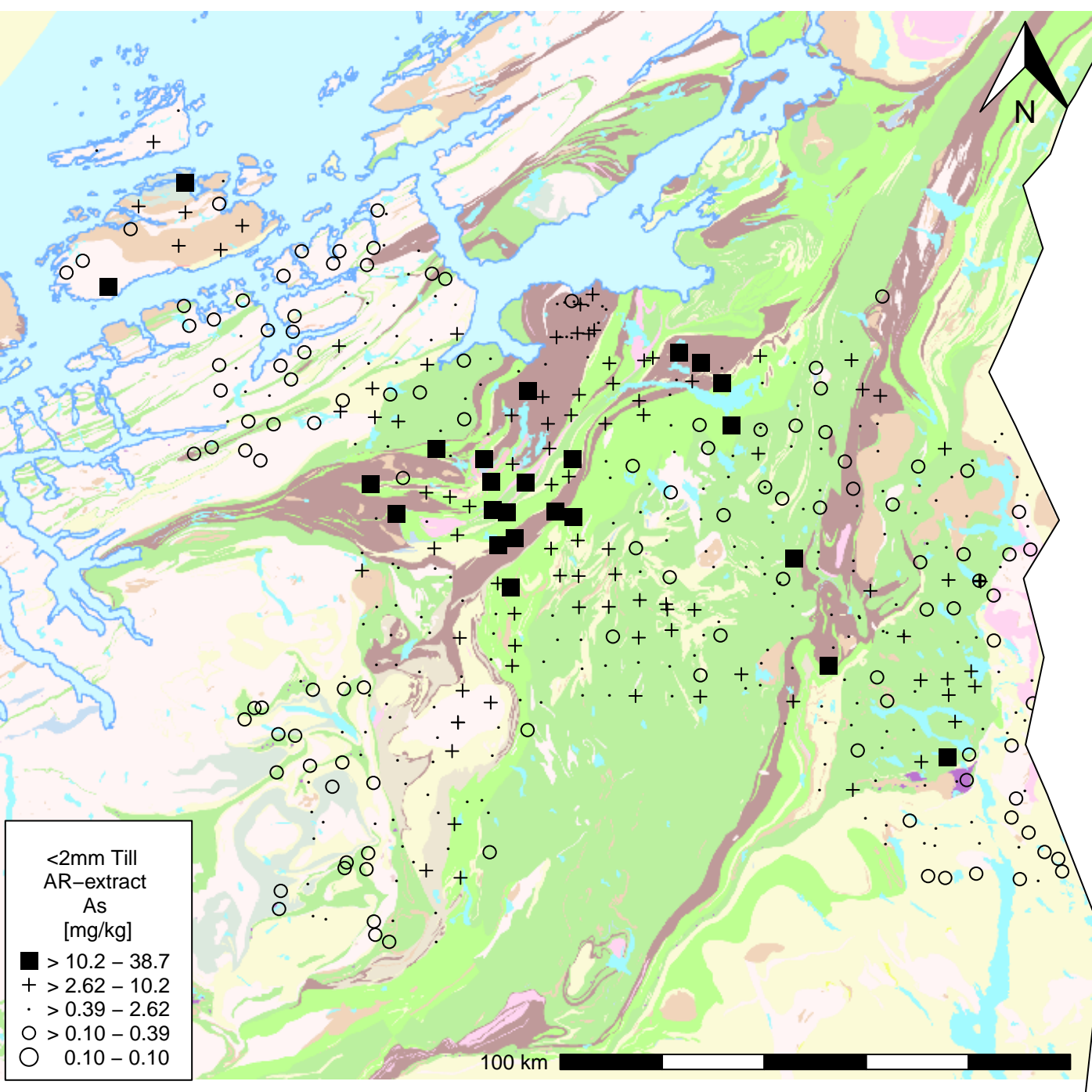
Geochemical maps of the survey area for all elements except Au, B, Ge, In, Pd, Pt, Re, Ta and Ta due to poor data quality plotted on top of bedrock map.

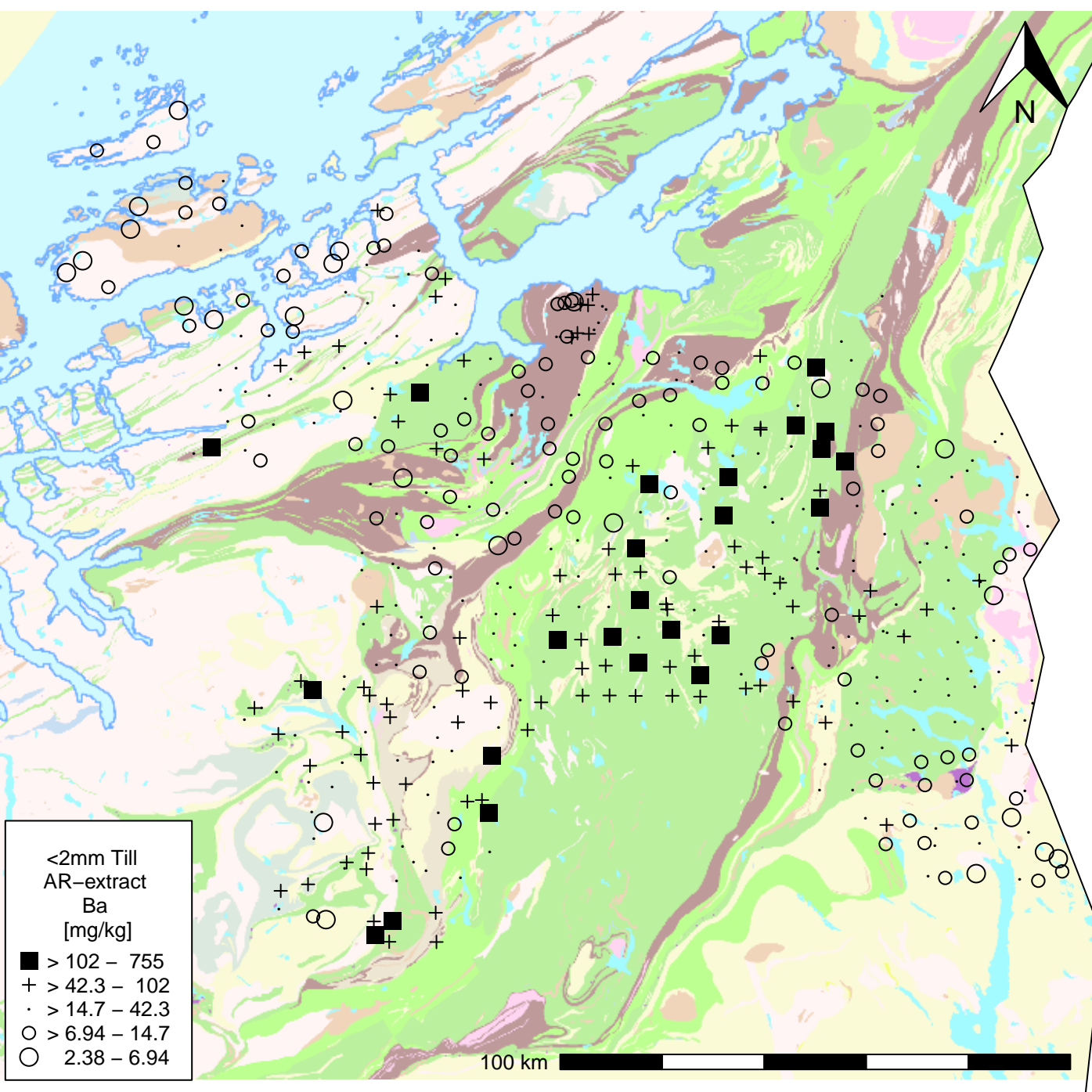
EDA map interval: 0-5%, 5-25%, 25-75%, 75-95%, 95-100%

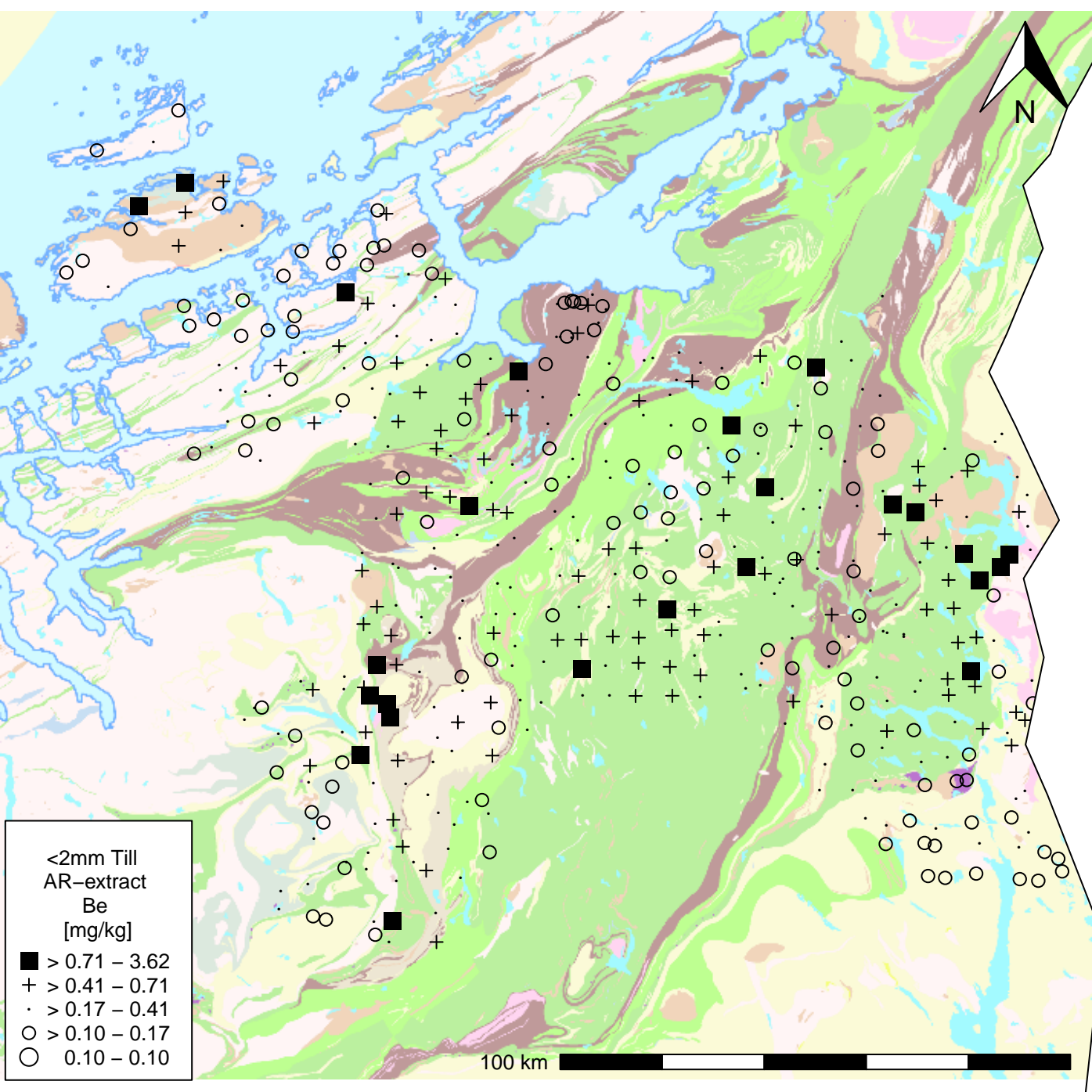
 Gangbergarter	 Dyke rocks
 Mylonitt - breksje	 Mylonite - breccia
 Tillitt - diamiktitt	 Tillite - diamictite
 Sandstein - siltstein	 Sandstone - siltstone
 Skifer	 Schists
 Karbonater	 Carbonates
 Pyroklastisk bergart	 Pyroclastic rocks
 Karbonatitt	 Carbonatite
 Felsiske vulkansk bergart	 Felsic volcanites
 Felsisk skifer	 Felsic schists
 Mafiske vulkansk bergart	 Mafic volcanites
 Båndet jernmalm	 Banded iron ore
 Fyllitt	 Phyllite
 Glimmergneis	 Mica schist
 Granitt - granittisk gneis	 Granite - granitic gneiss
 Grønnstein	 Greenstone
 Hornblenditt - mangeritt	 Hornblendite - mangerite
 Amfibolitt	 Amphibolite
 Anortositt	 Anorthosite
 Dioritt - gabbro	 Diorite - gabbro
 Ultramafisk bergart	 Ultramafic rocks

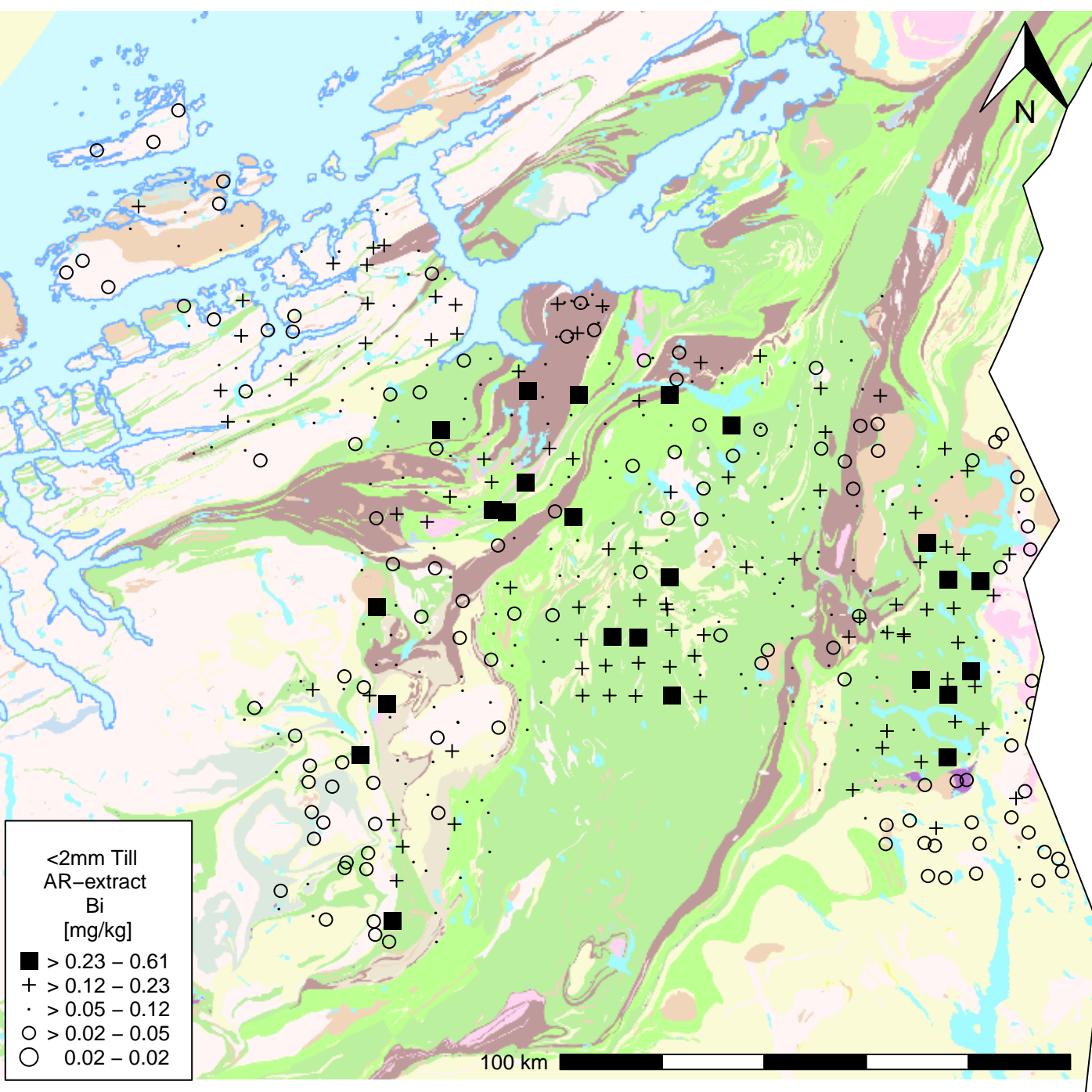


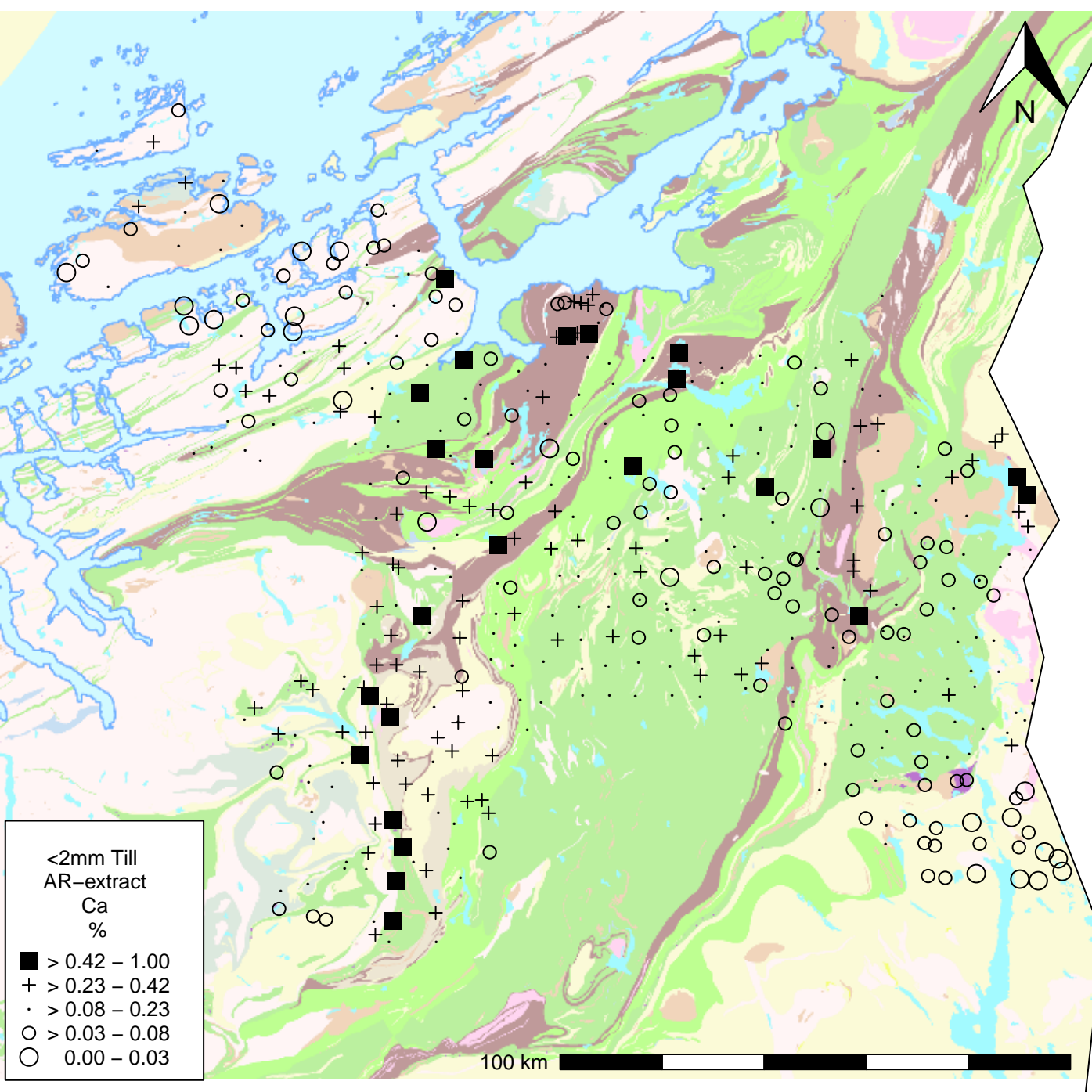


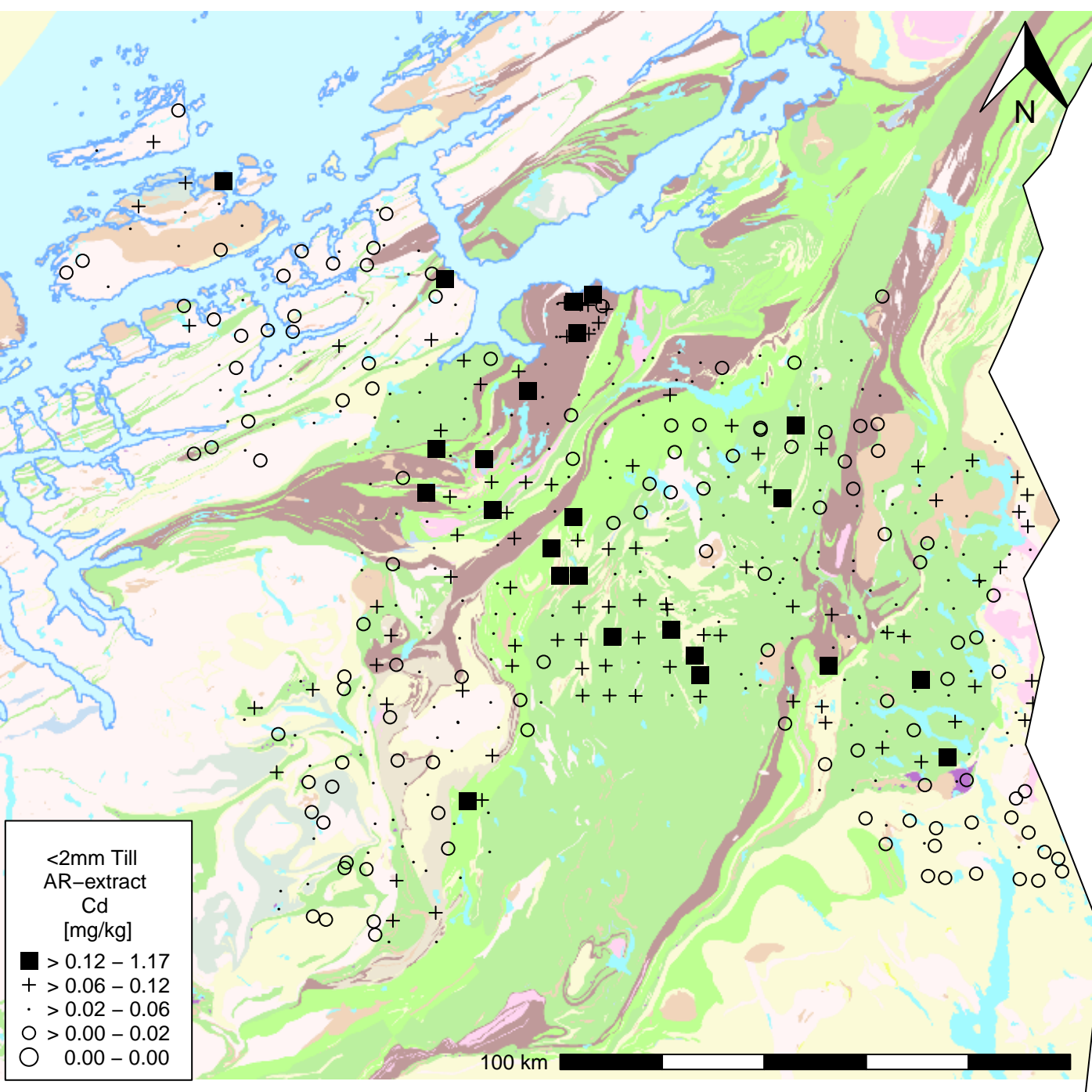


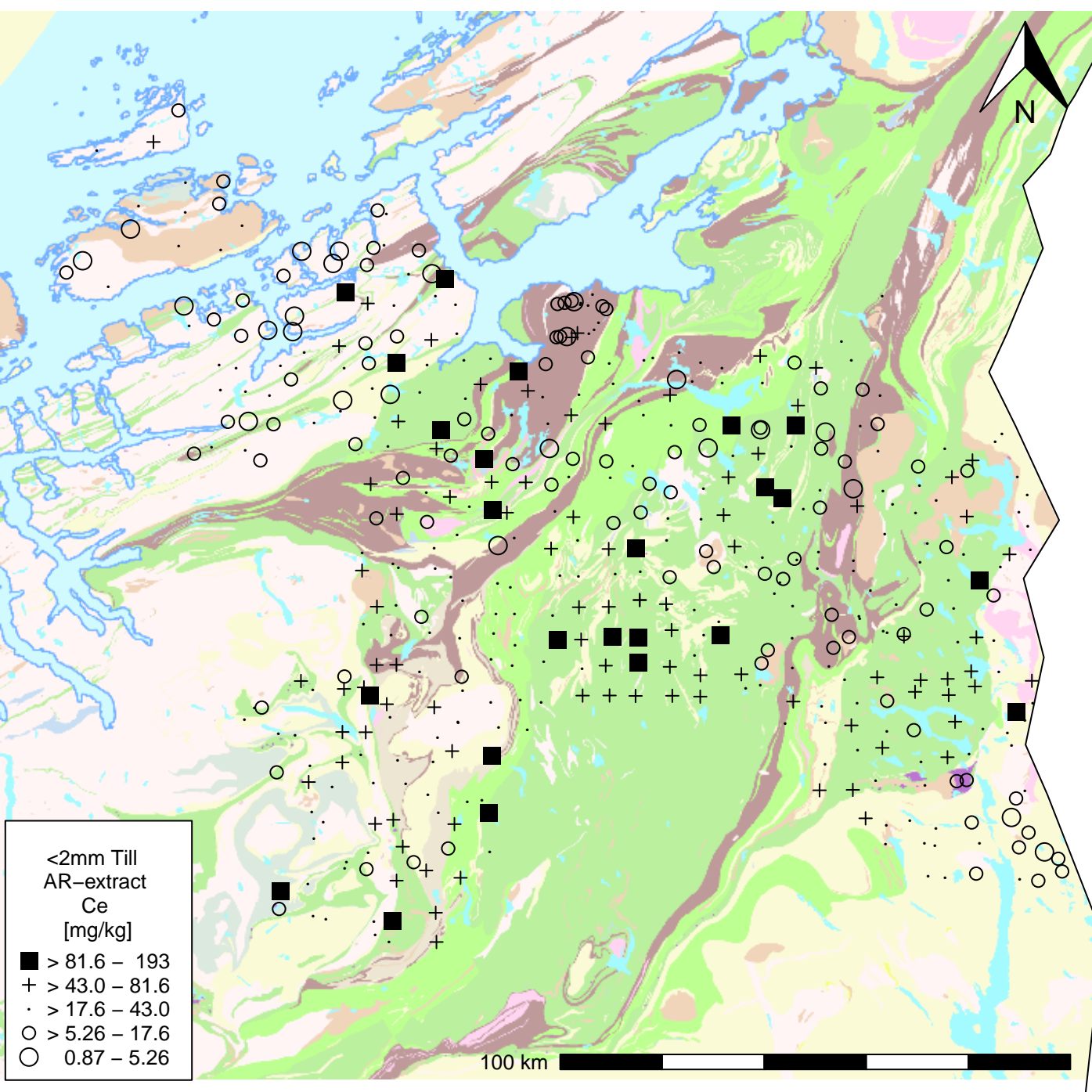


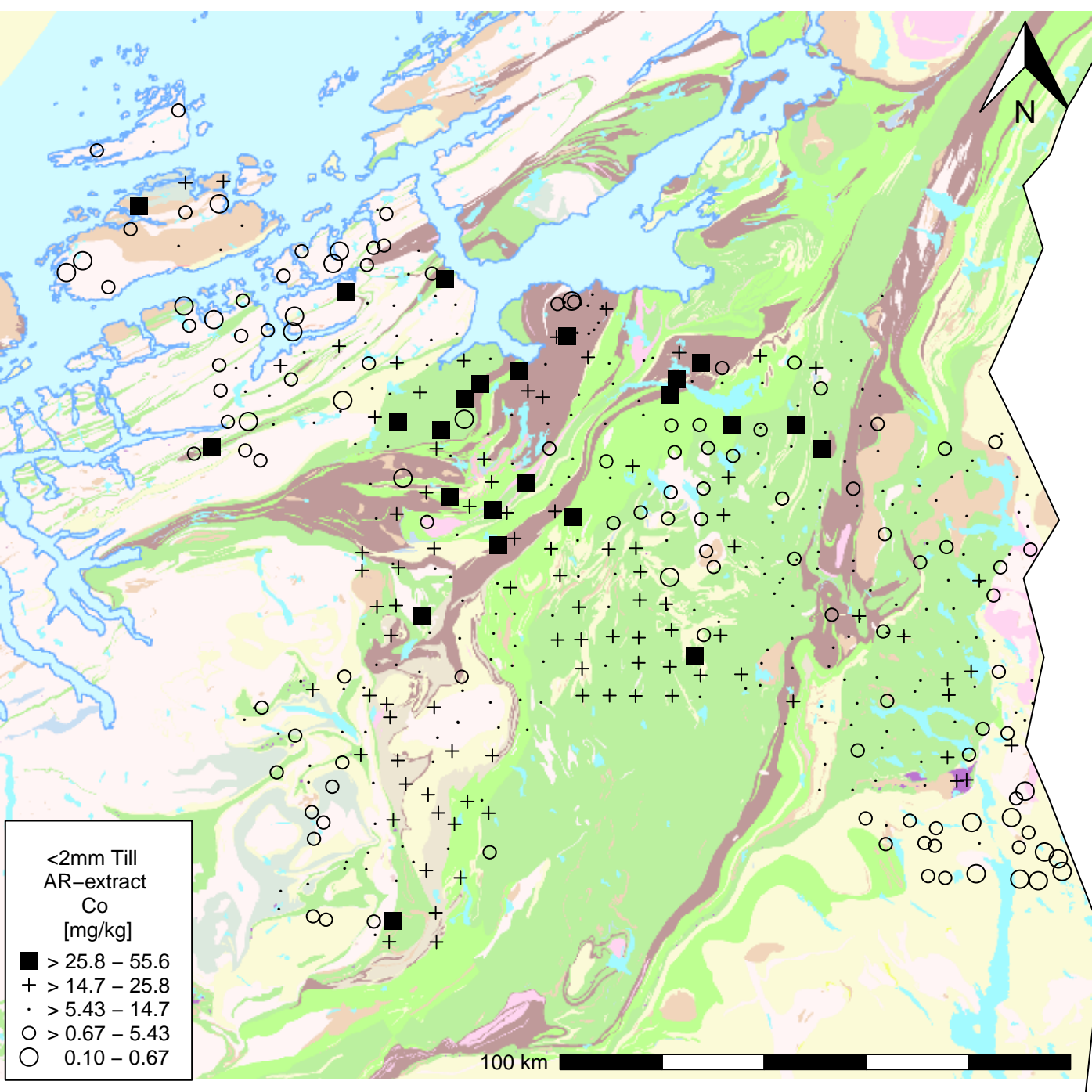


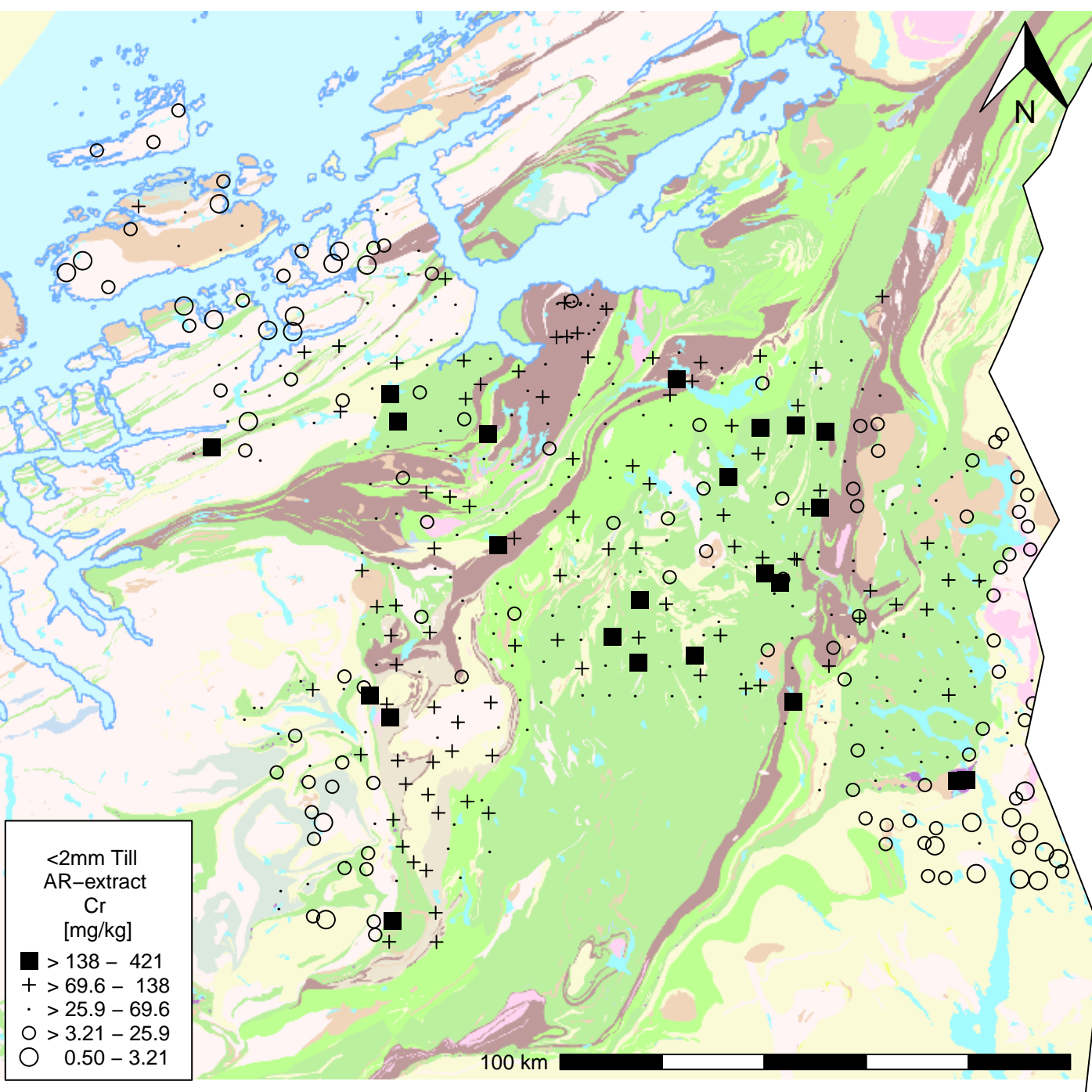


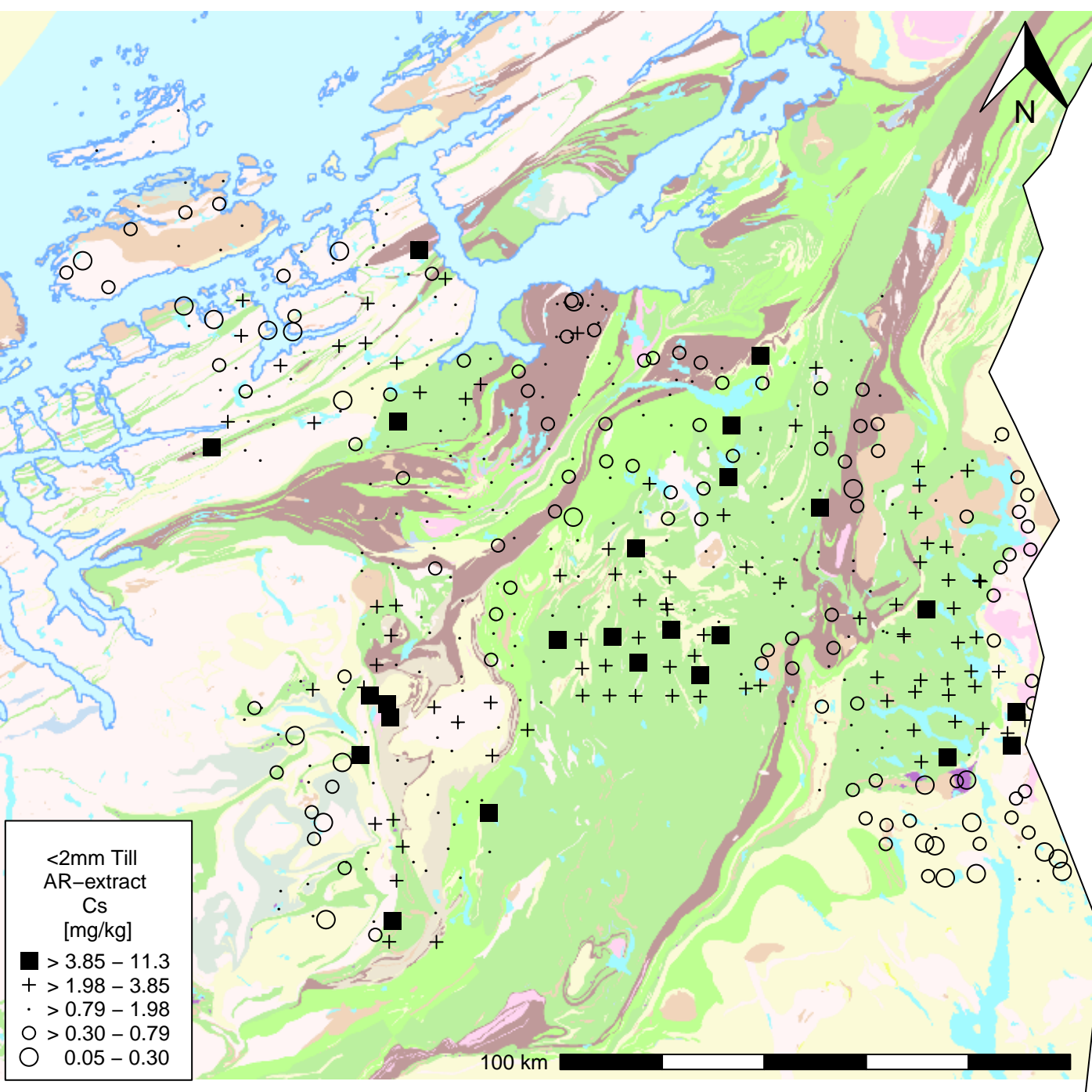


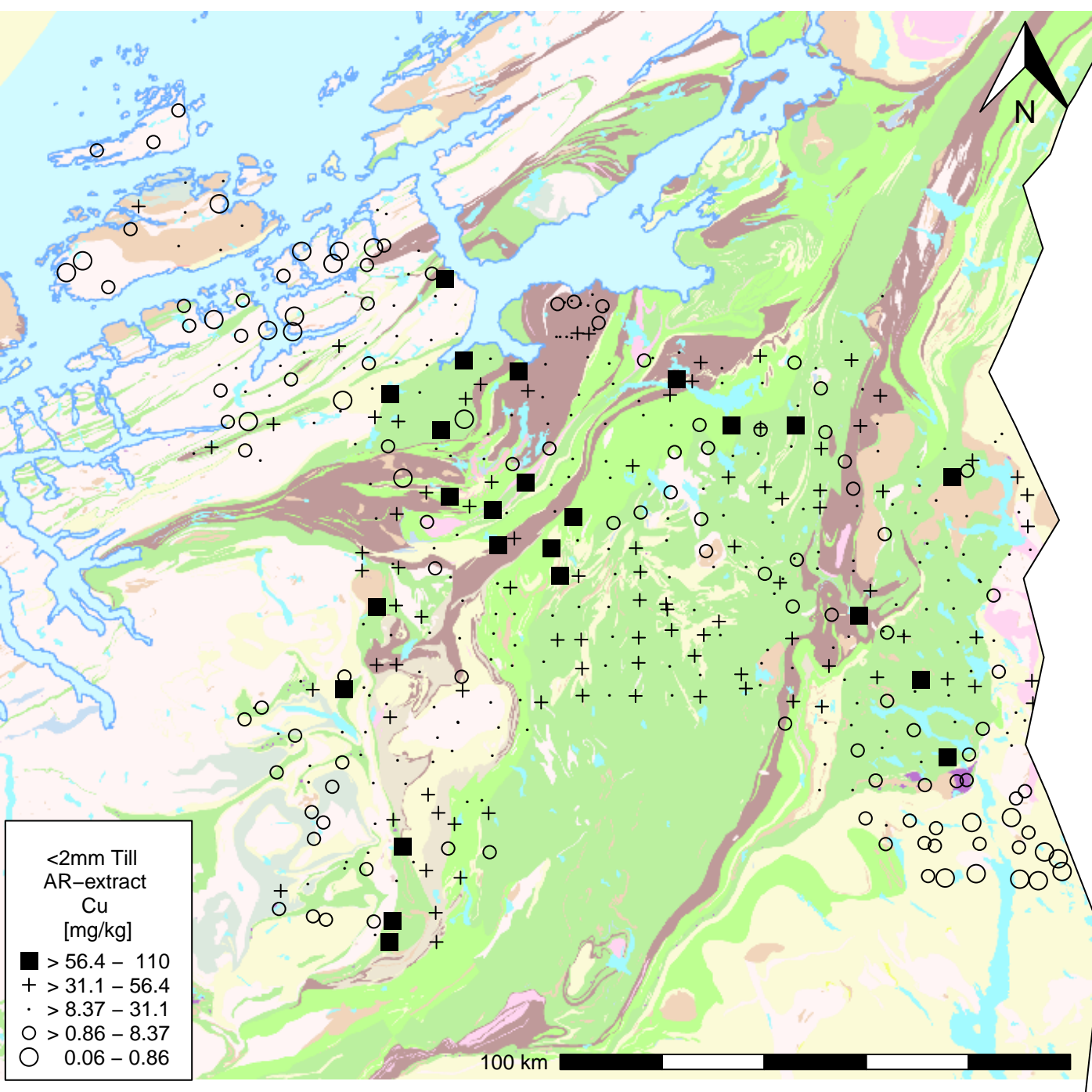


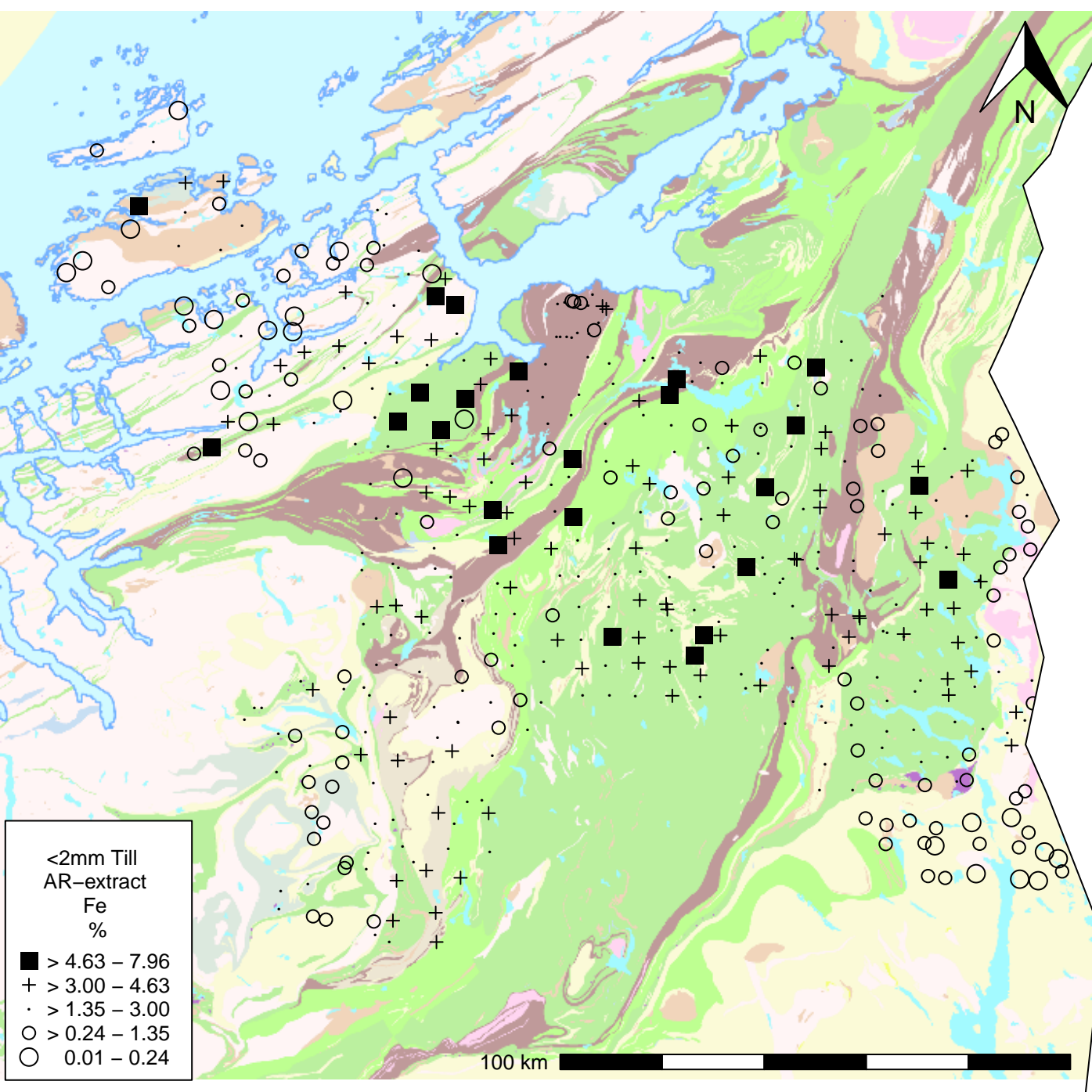








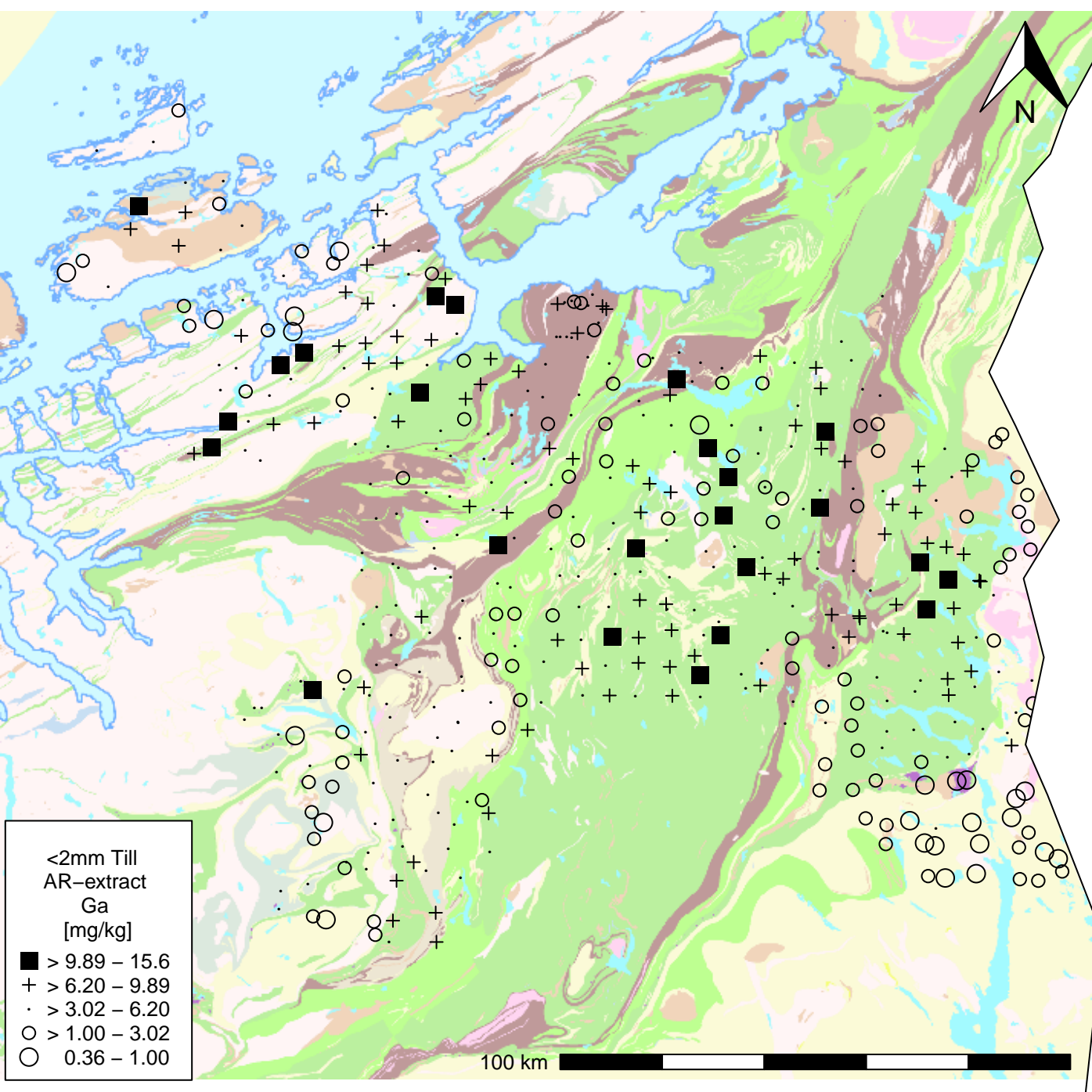


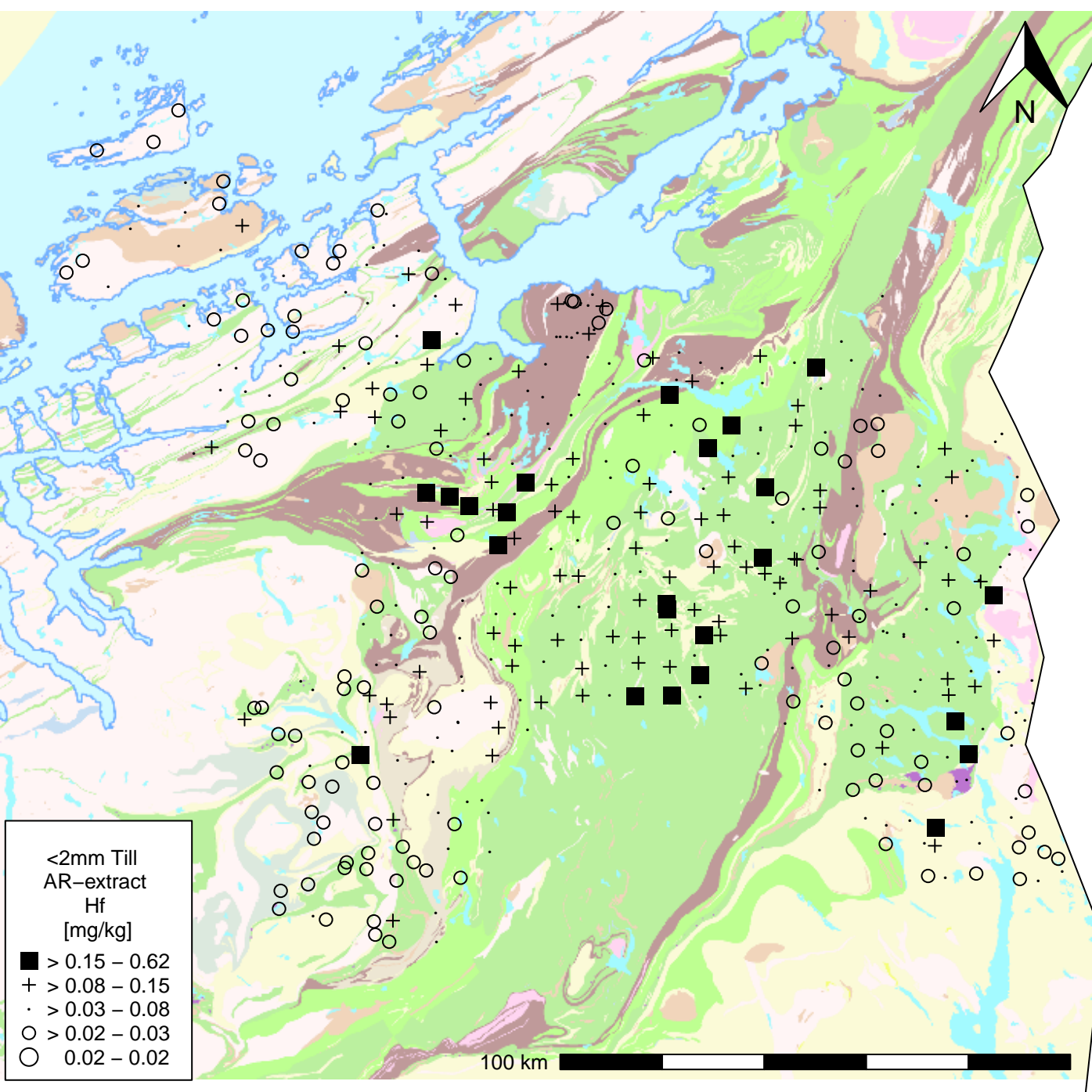


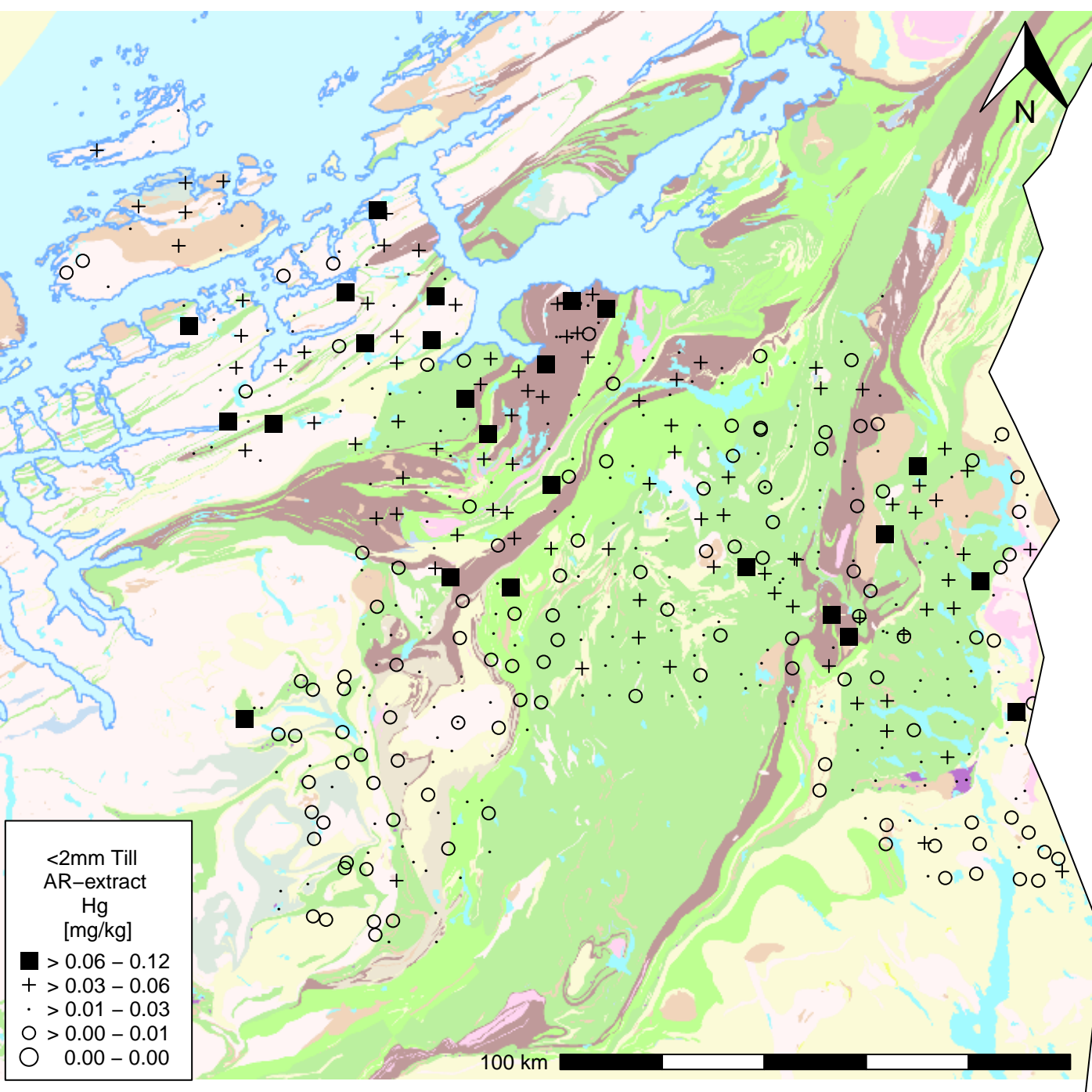
<2mm Till
AR-extract
Fe
%

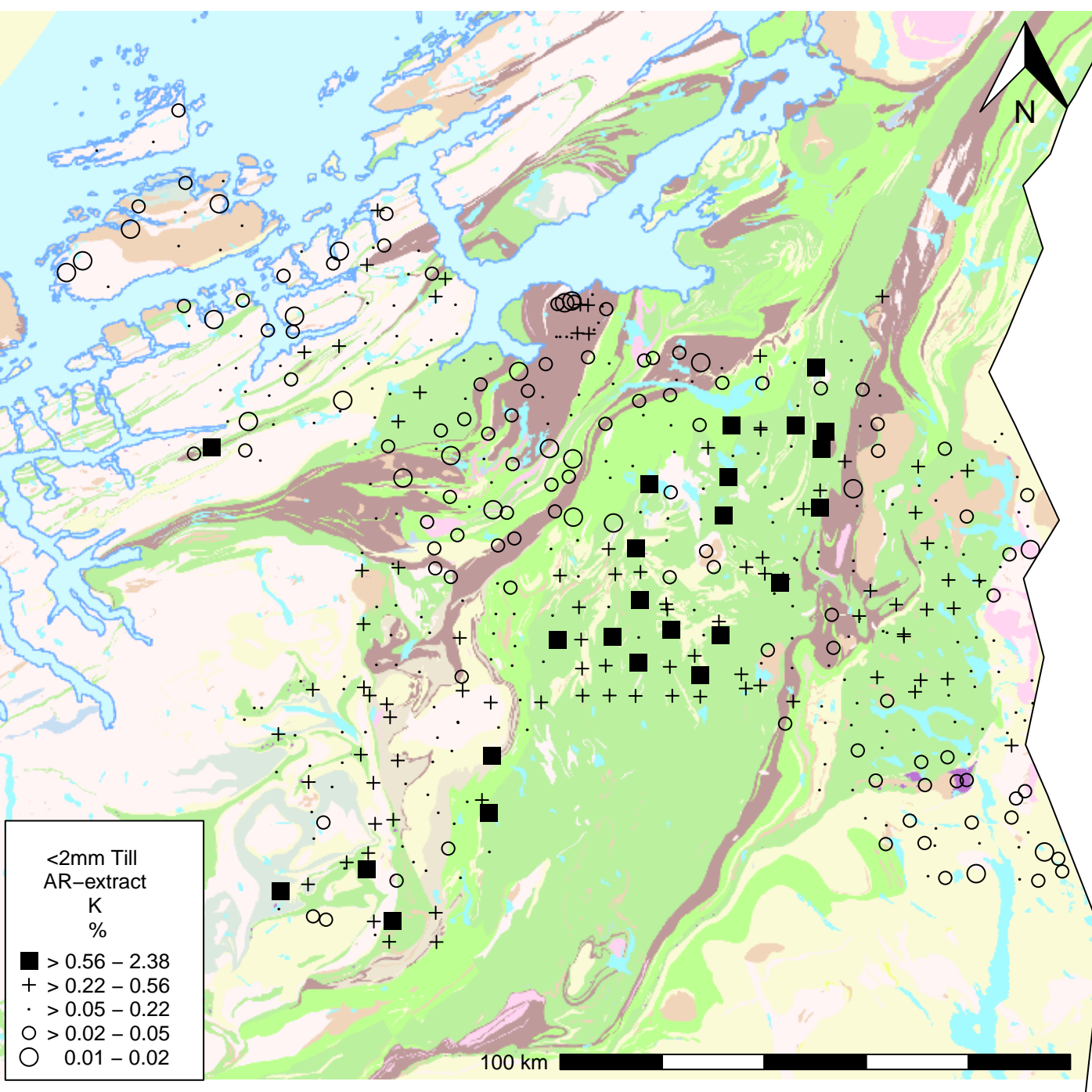
- > 4.63 – 7.96
- + > 3.00 – 4.63
- > 1.35 – 3.00
- > 0.24 – 1.35
- 0.01 – 0.24

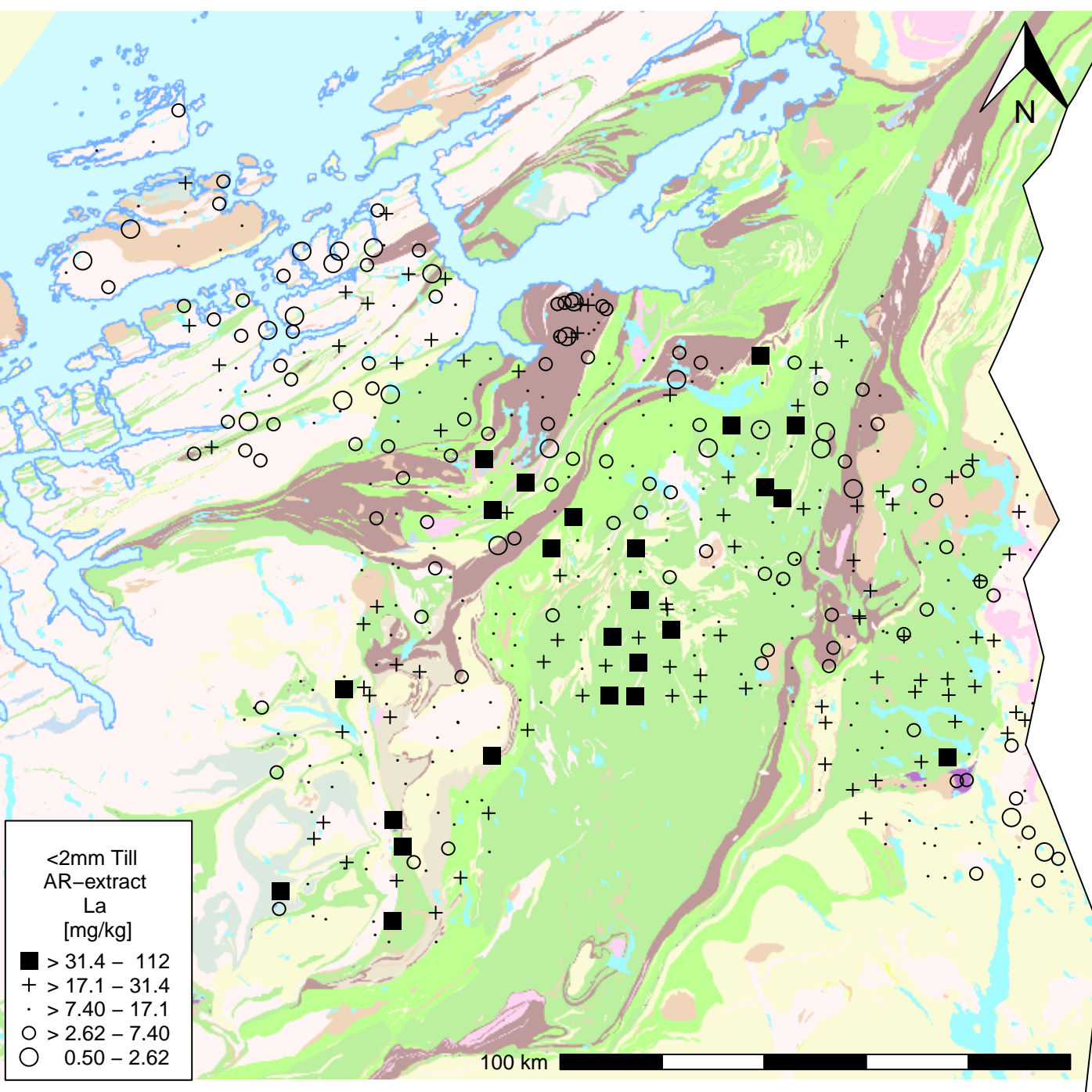
100 km

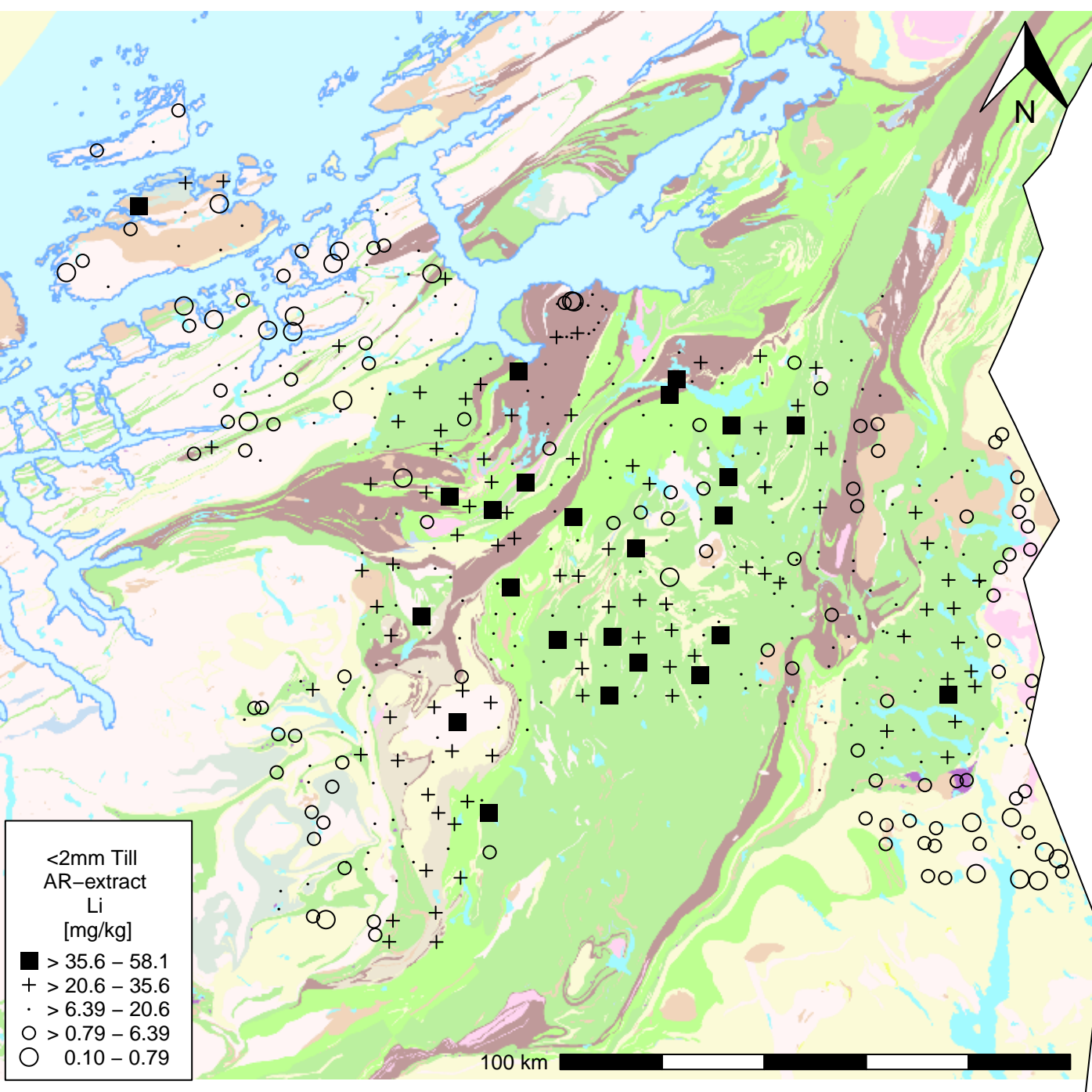


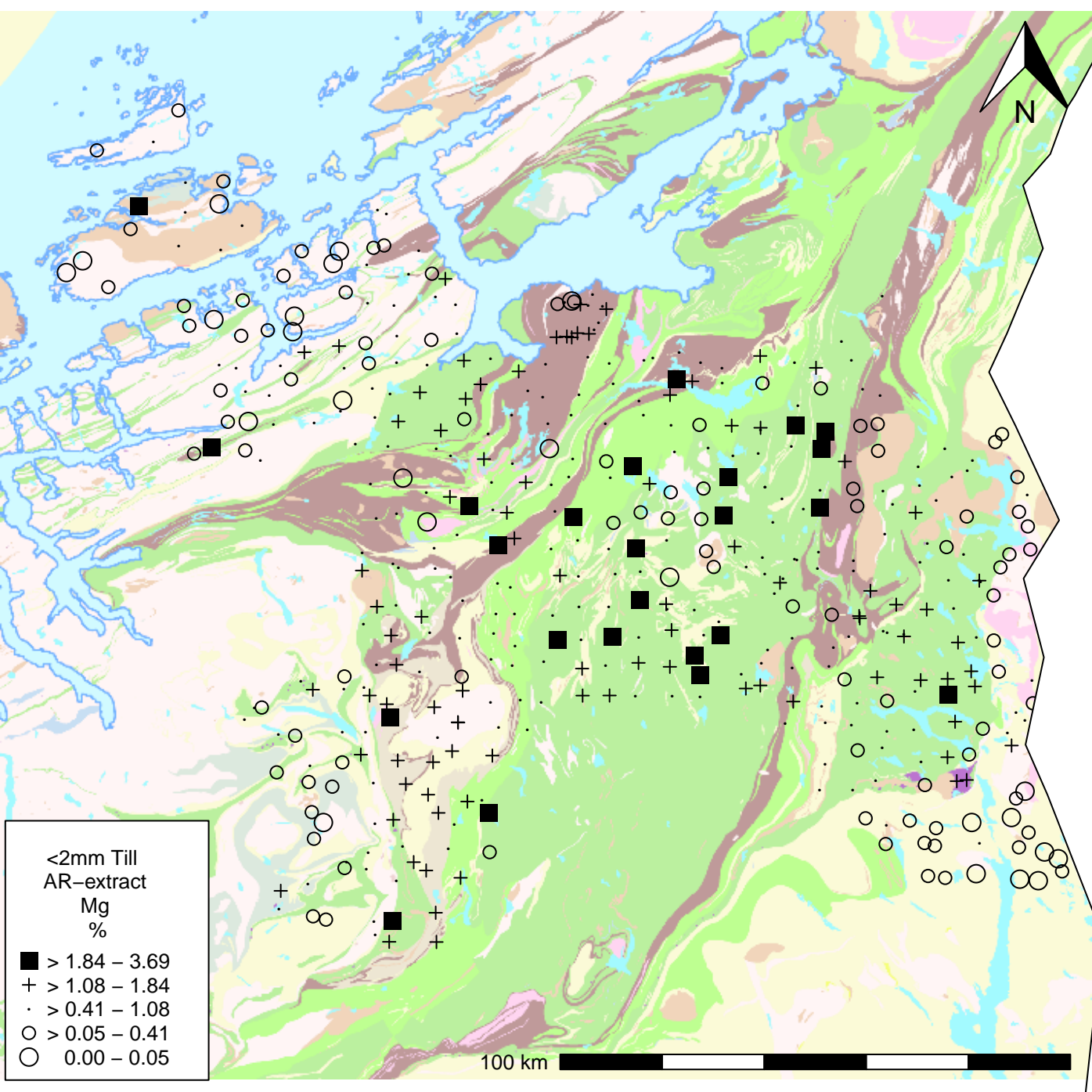


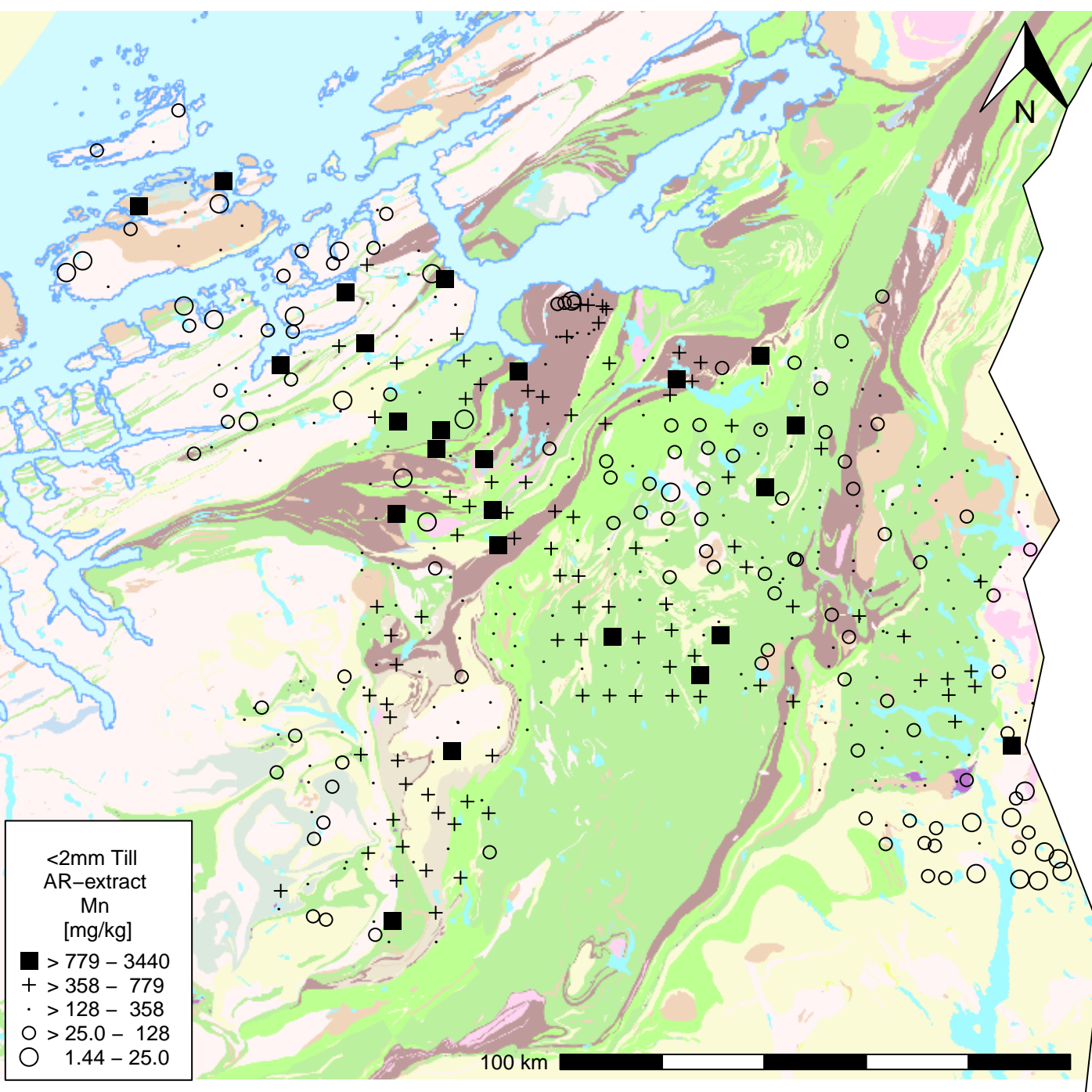


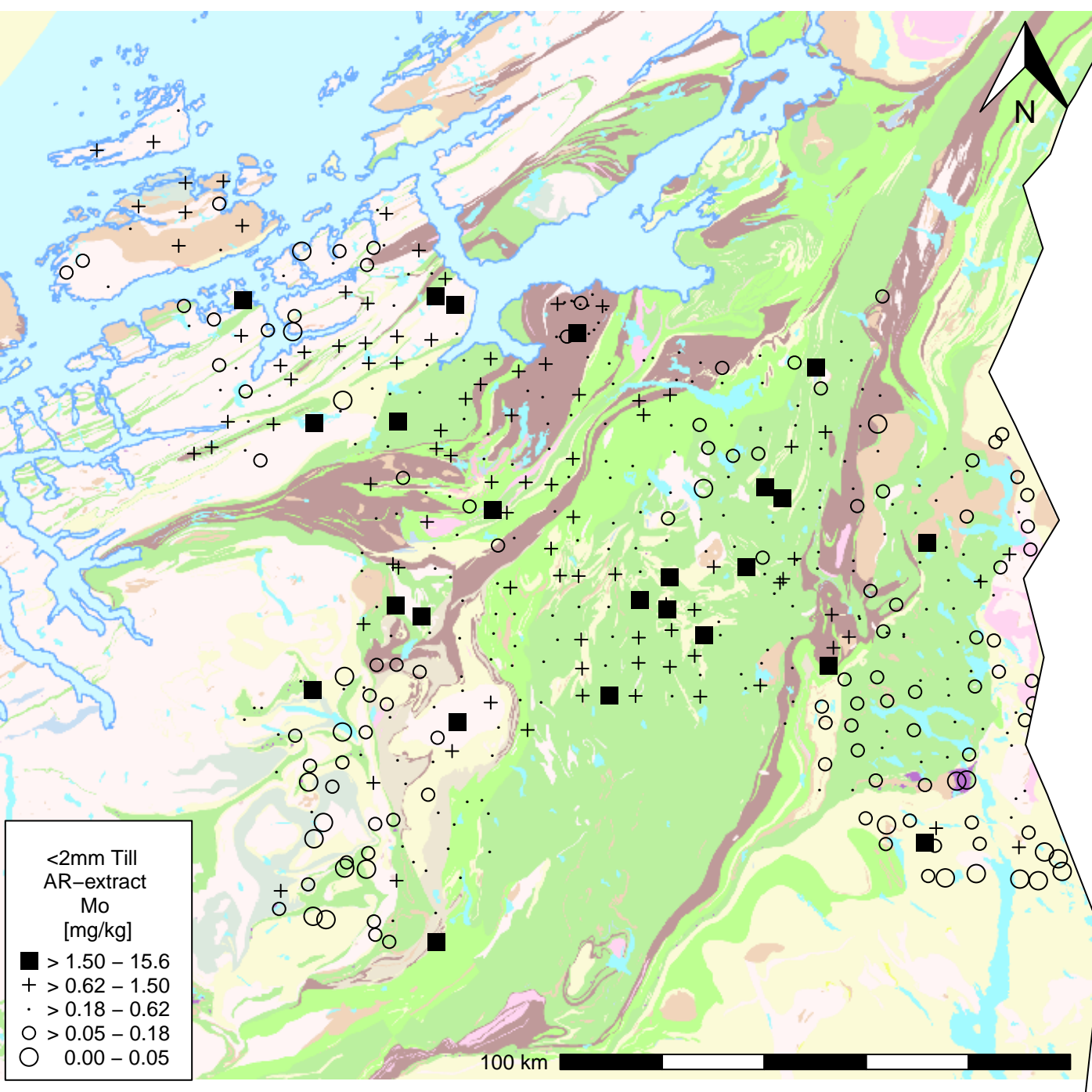


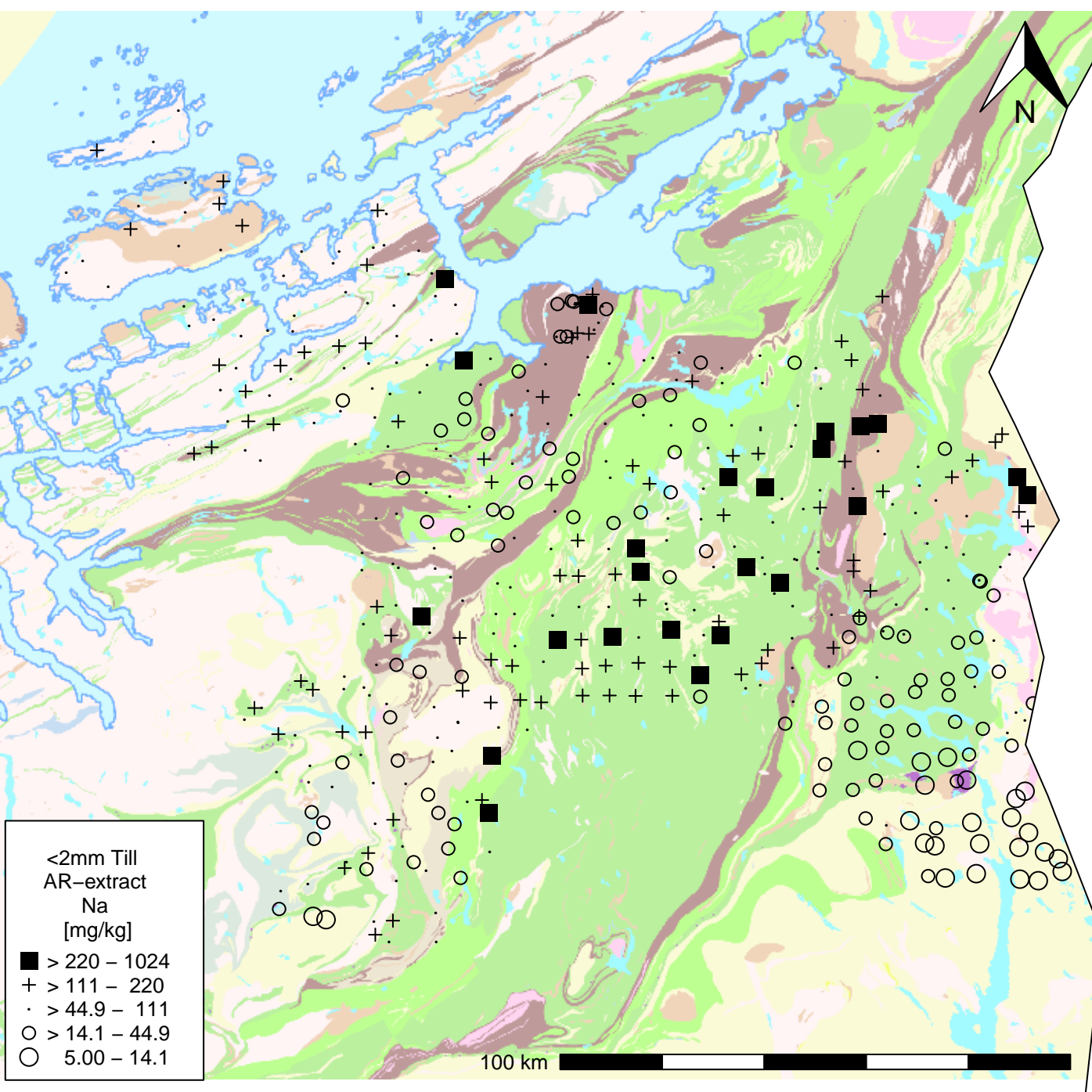


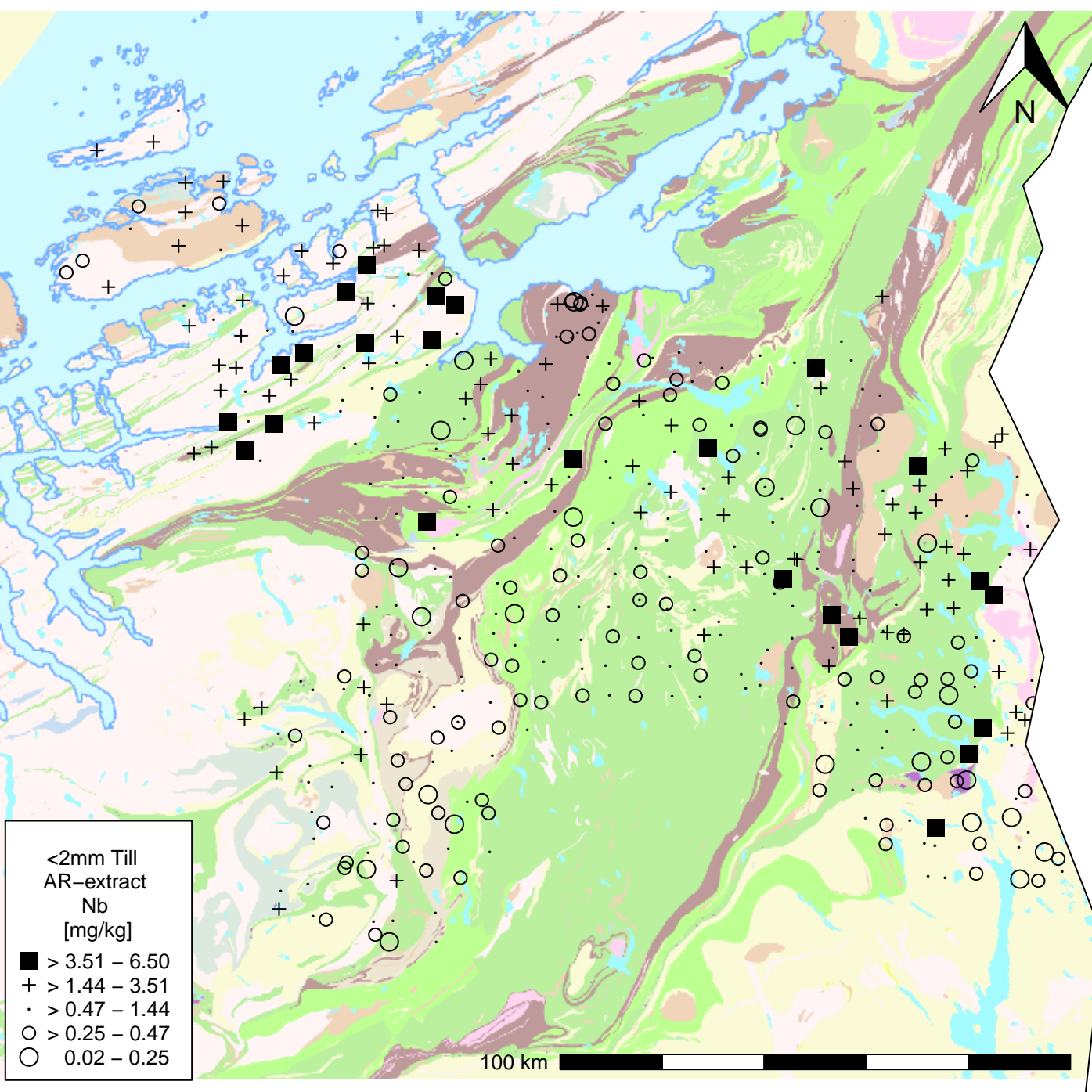


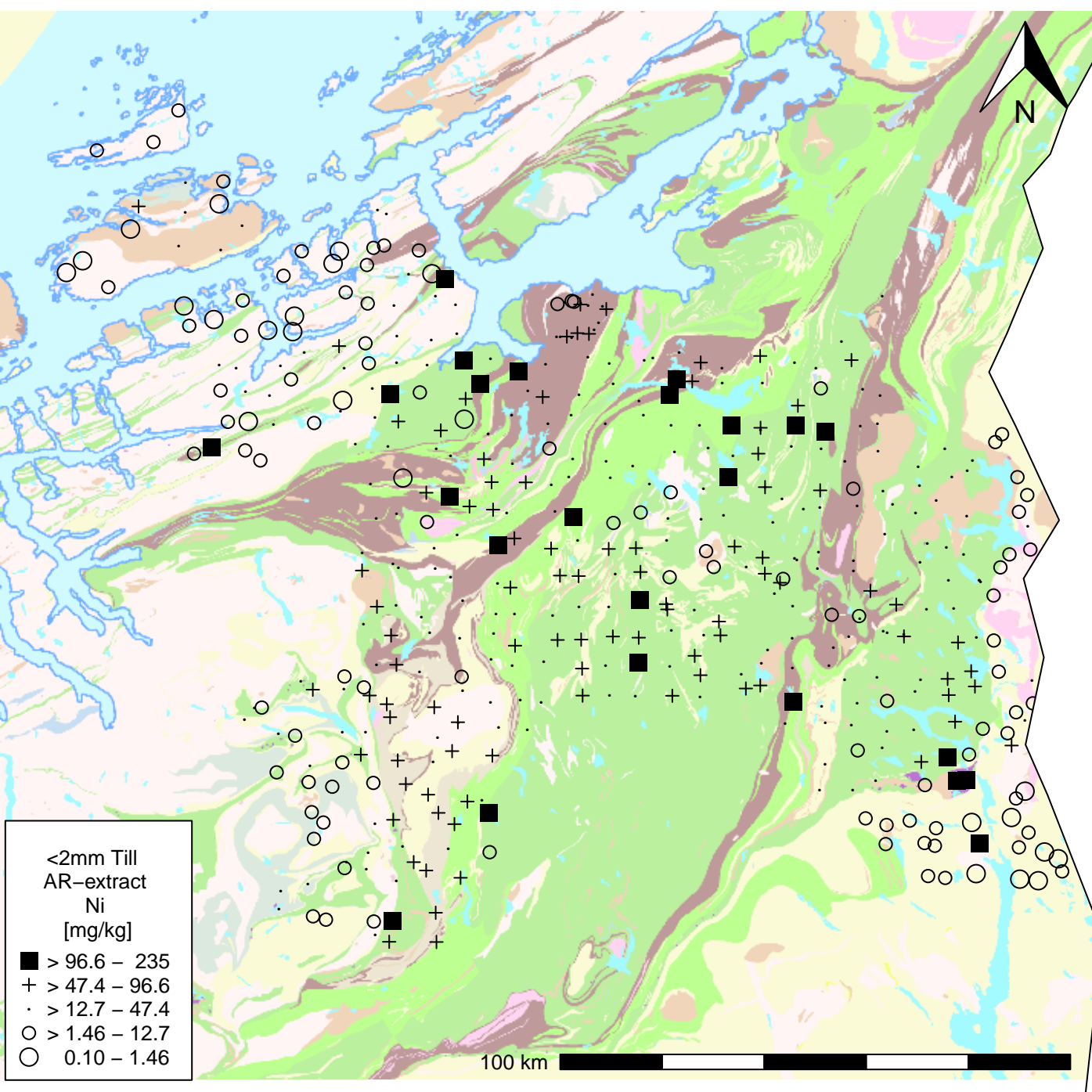


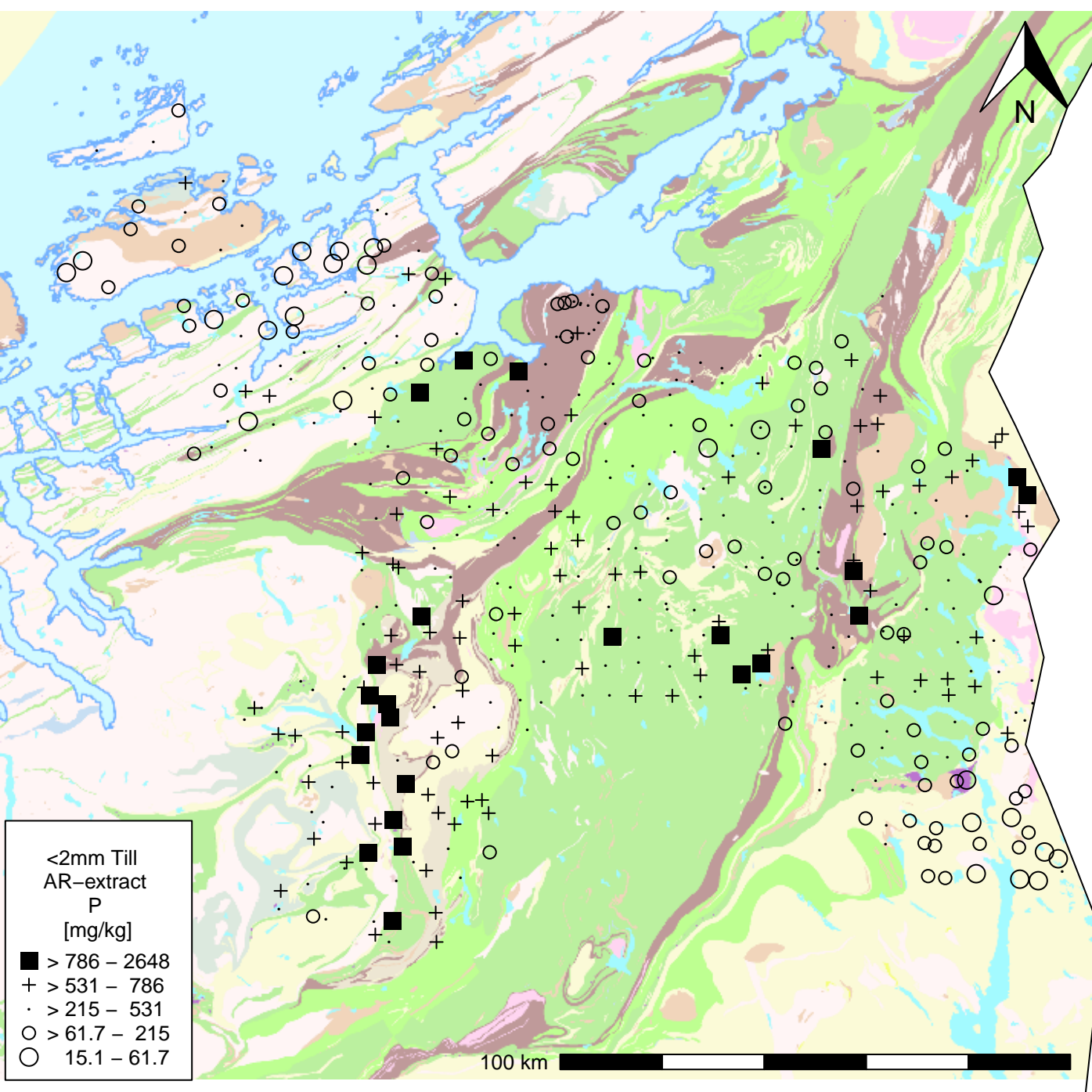


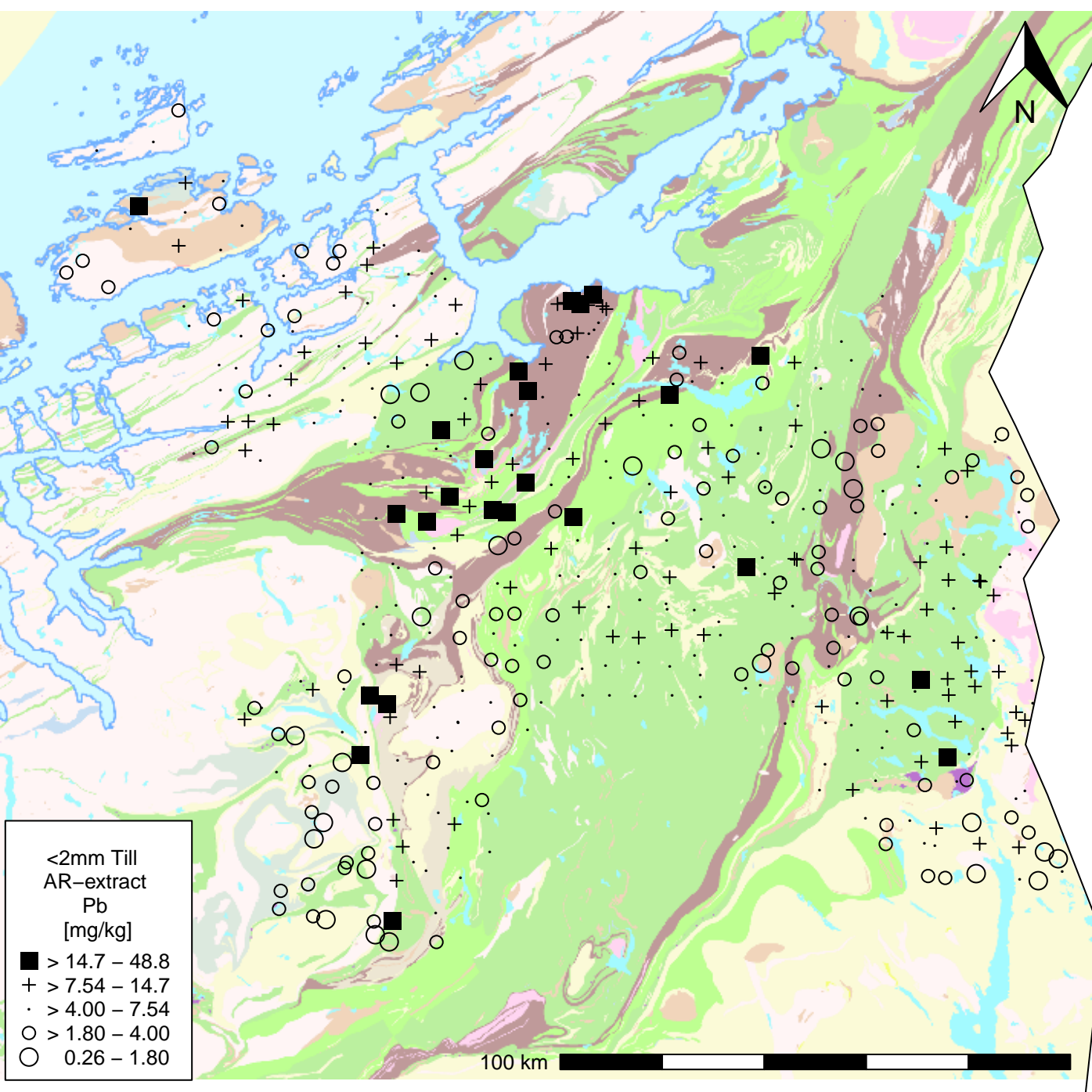








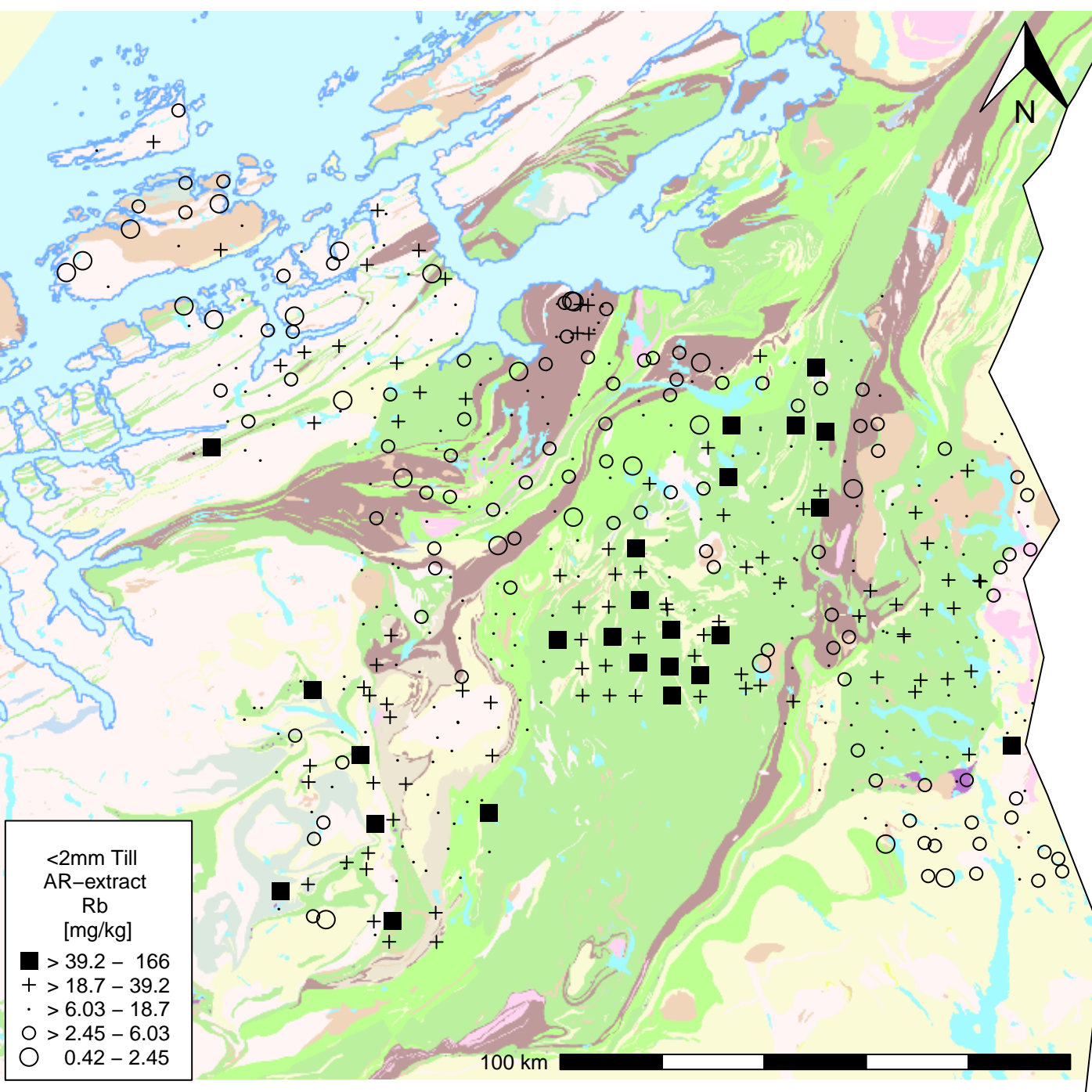


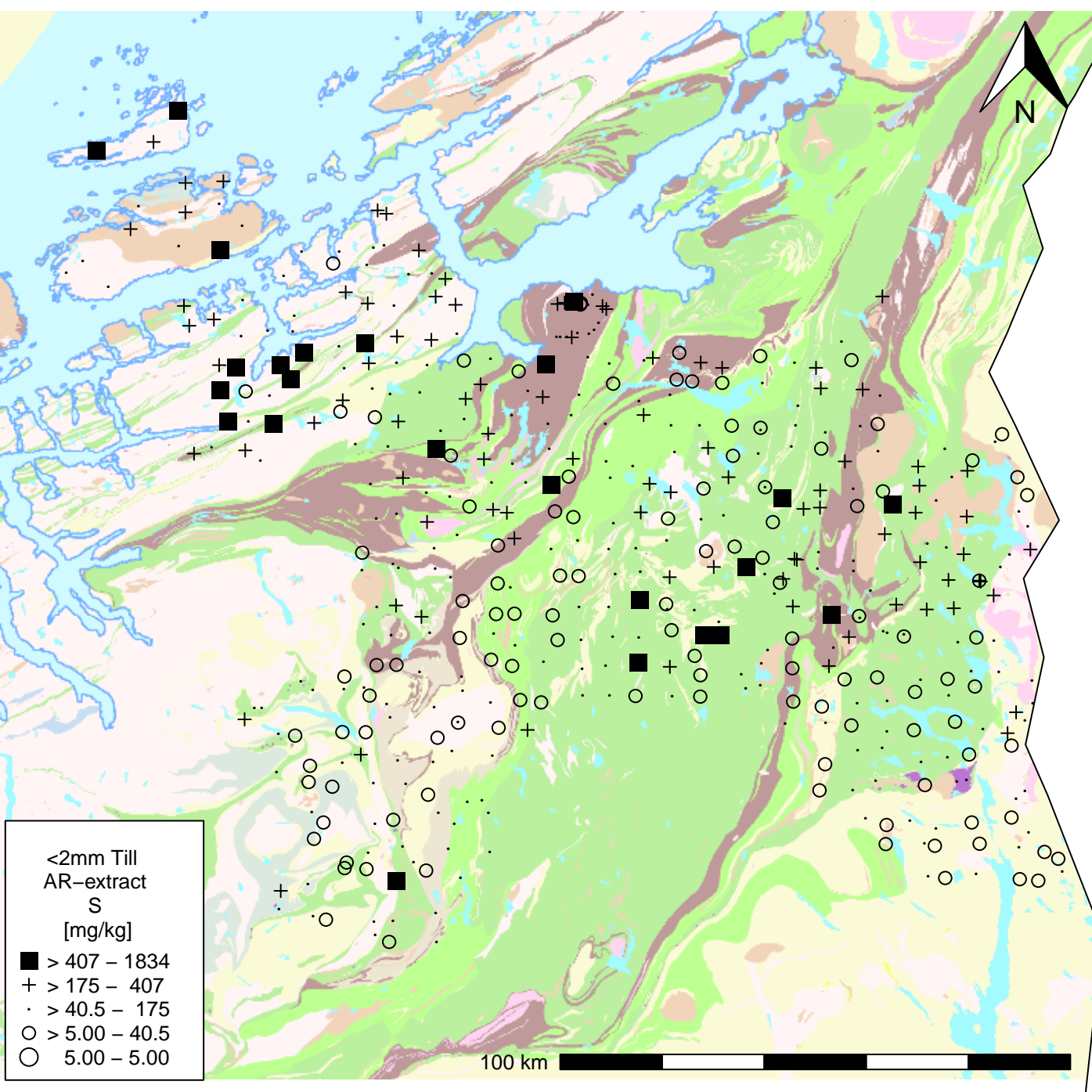


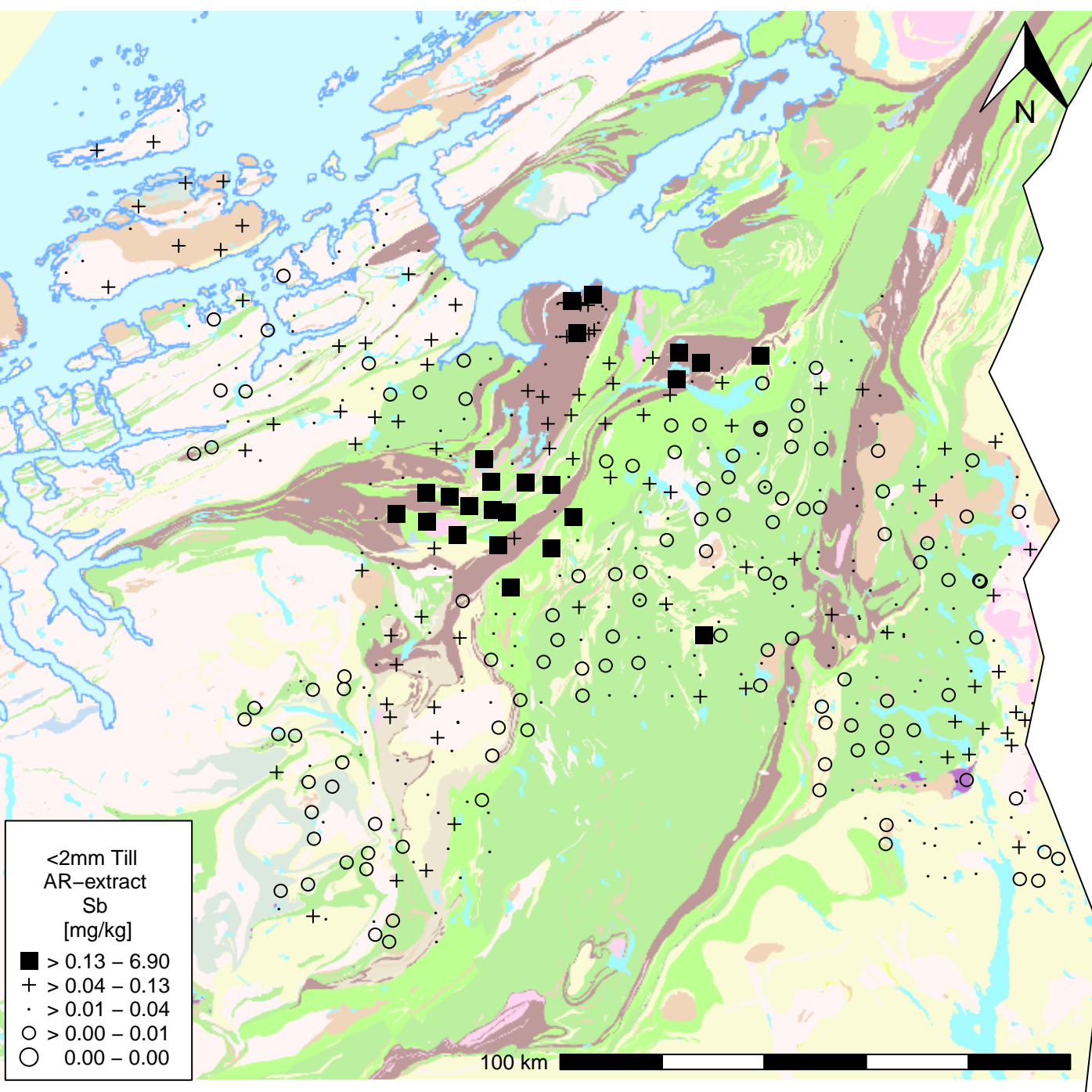
<2mm Till
AR-extract
Pb
[mg/kg]

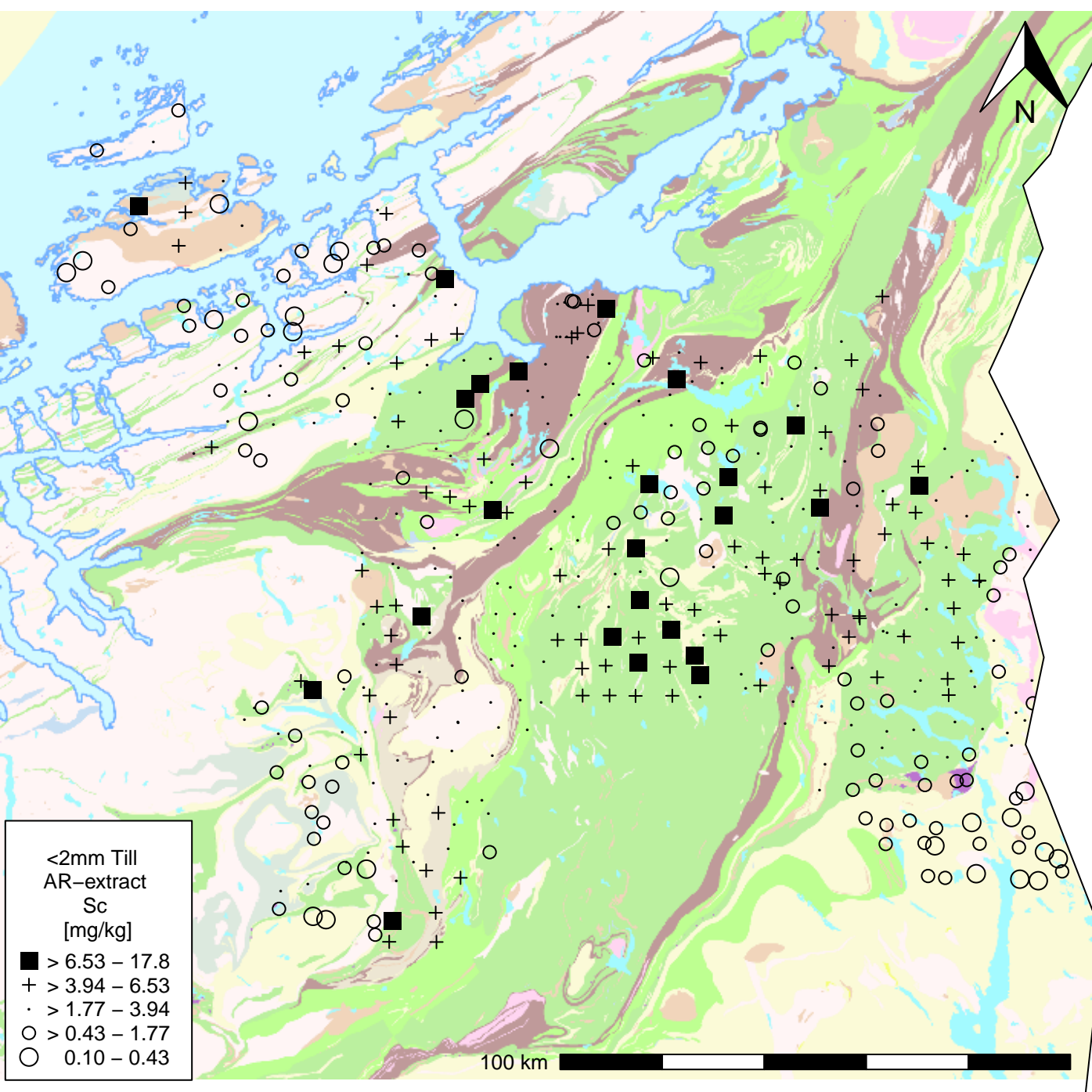
- > 14.7 – 48.8
- + > 7.54 – 14.7
- > 4.00 – 7.54
- > 1.80 – 4.00
- 0.26 – 1.80

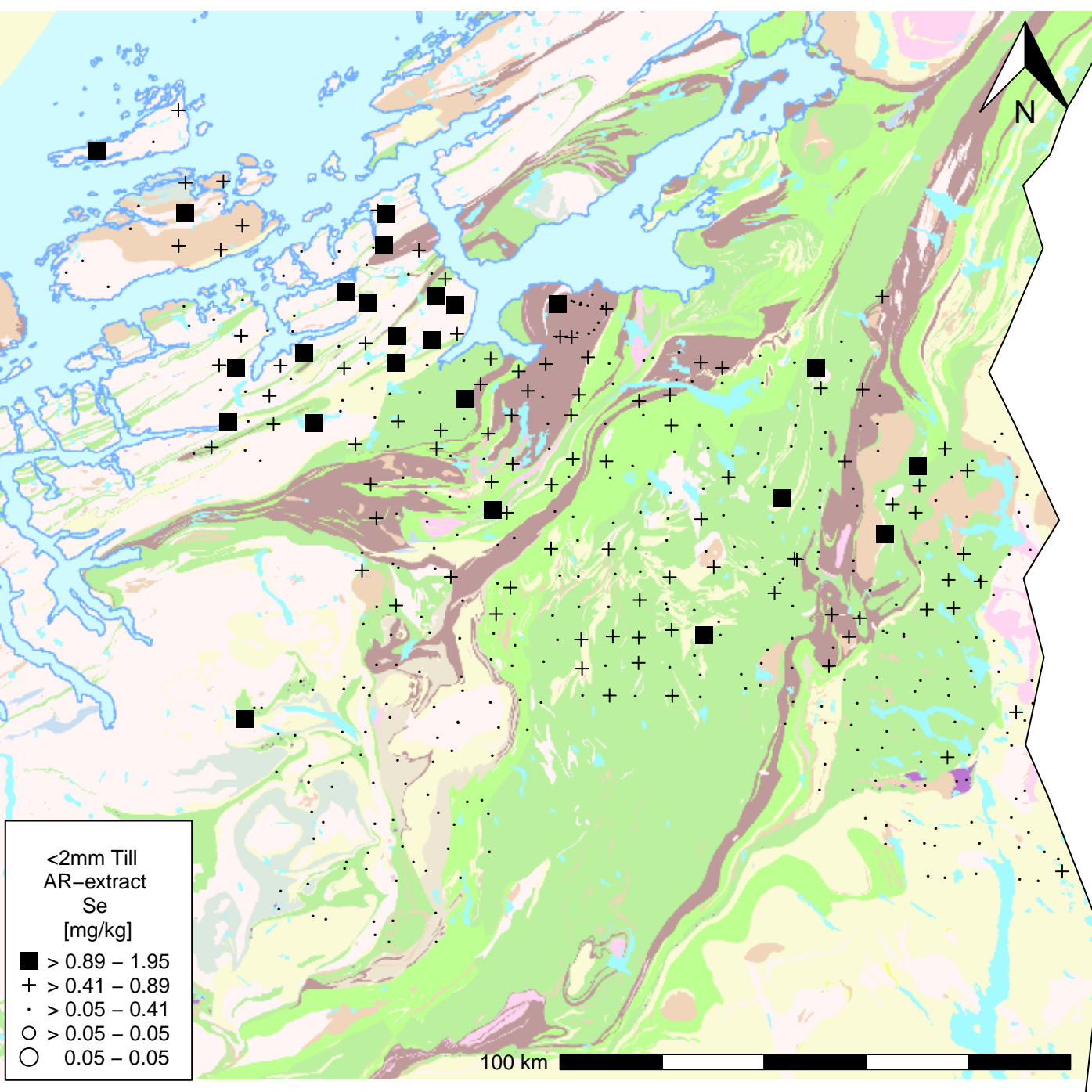
100 km

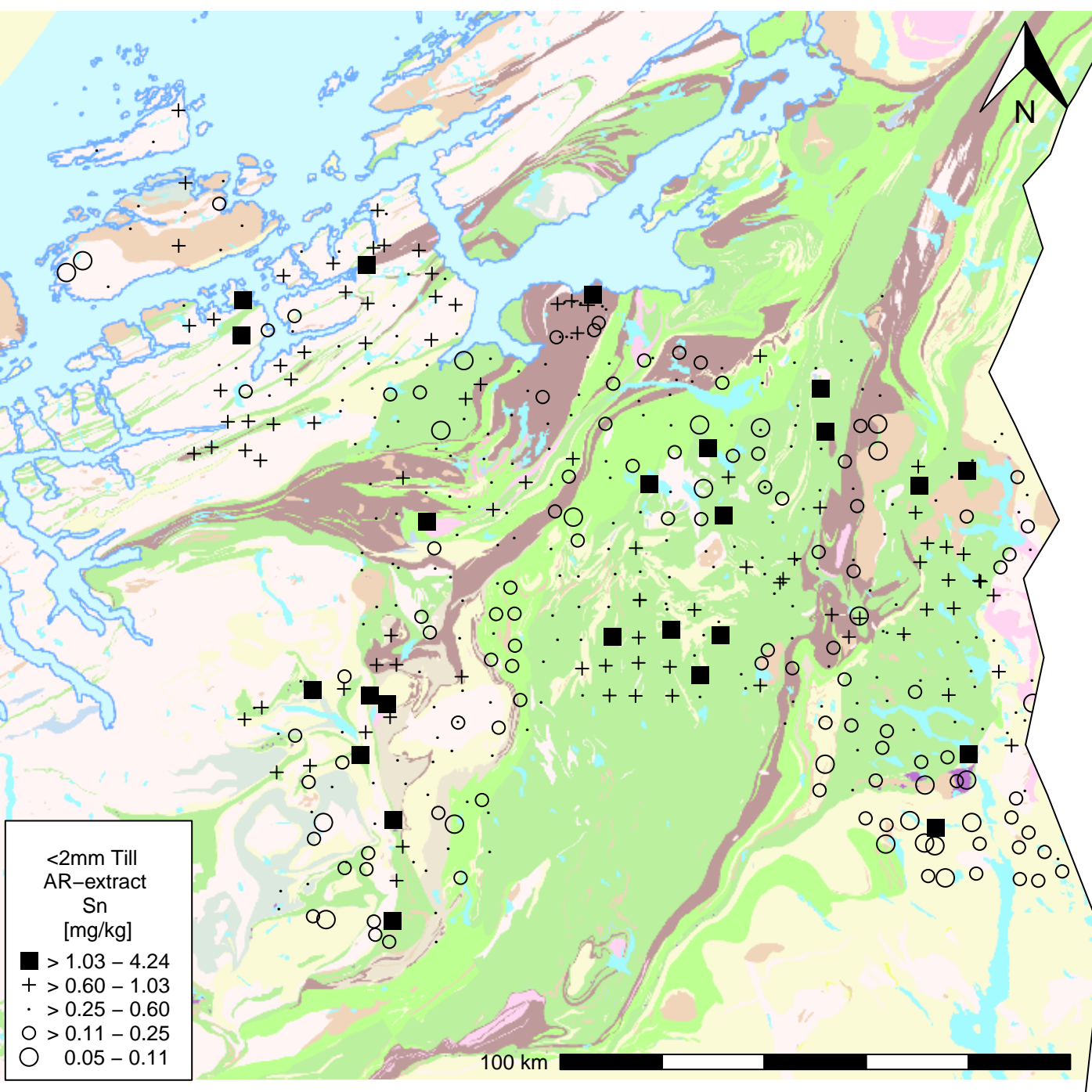


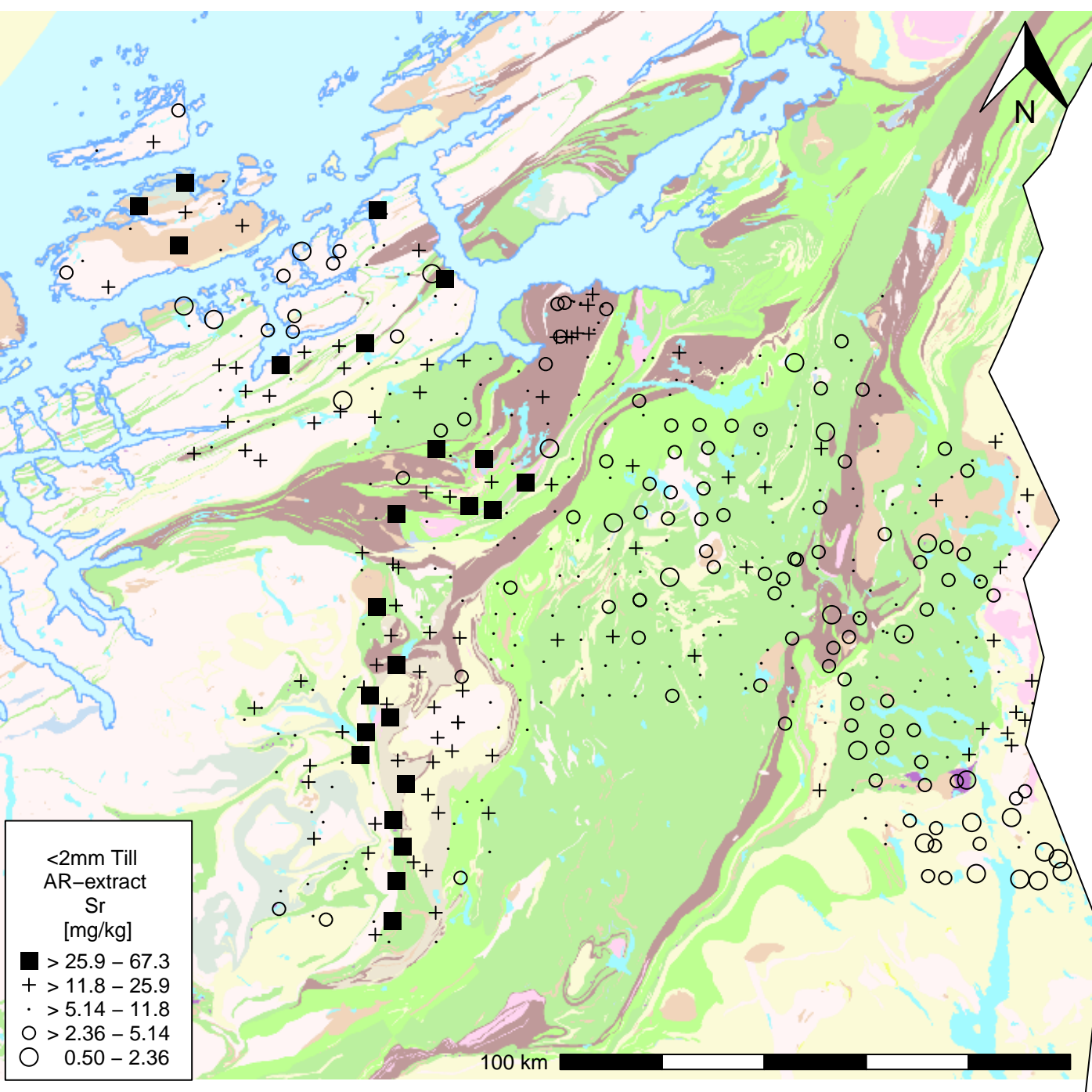


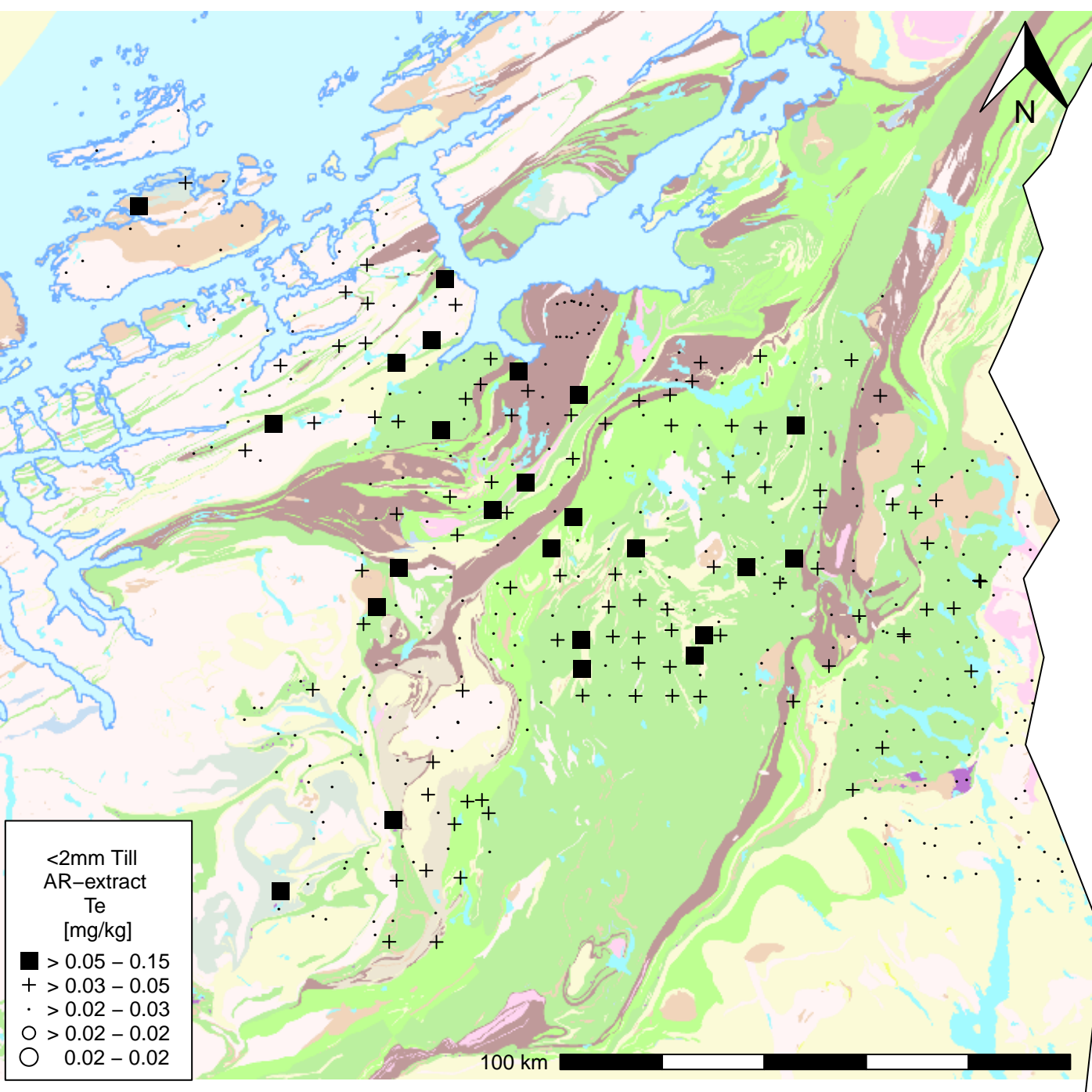


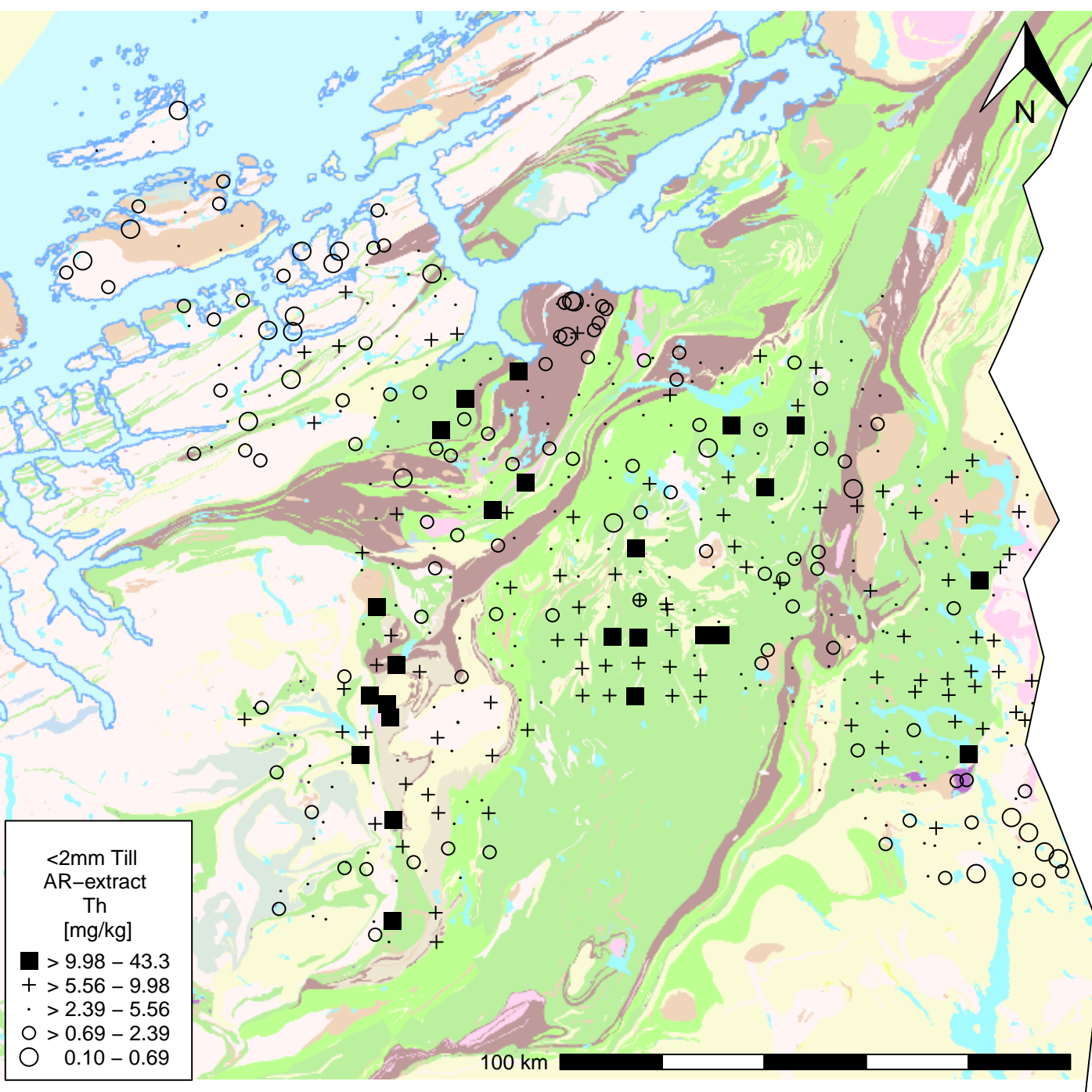


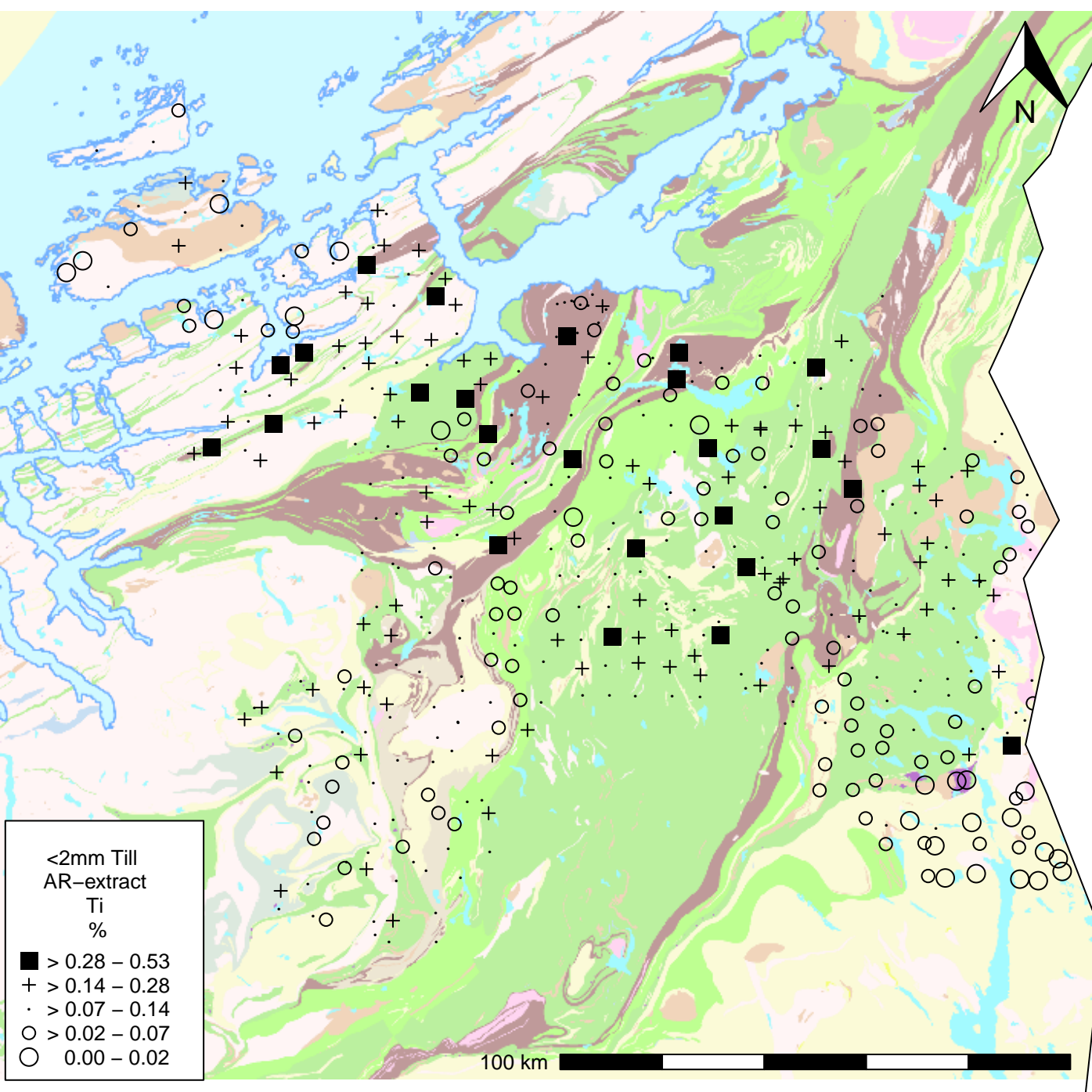


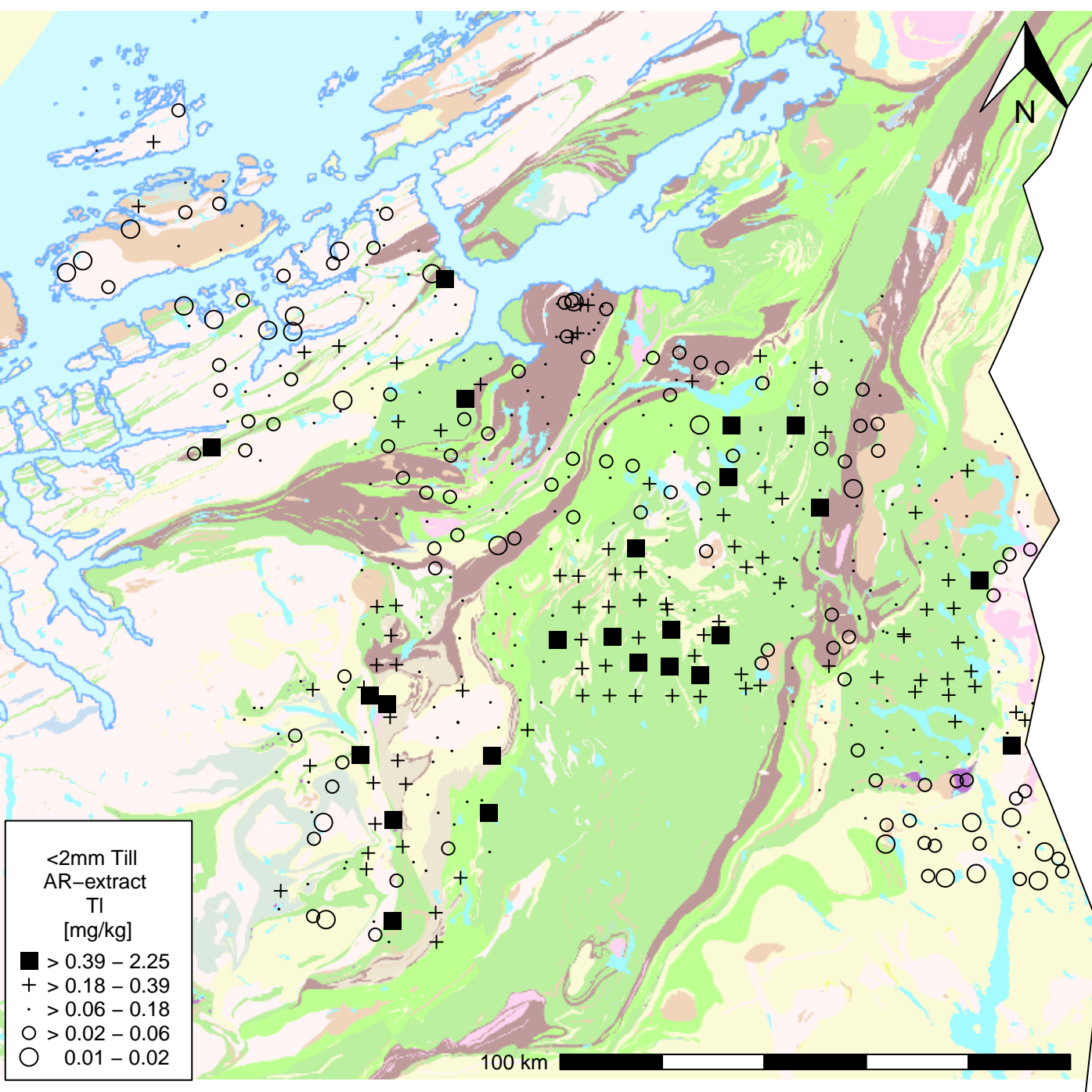


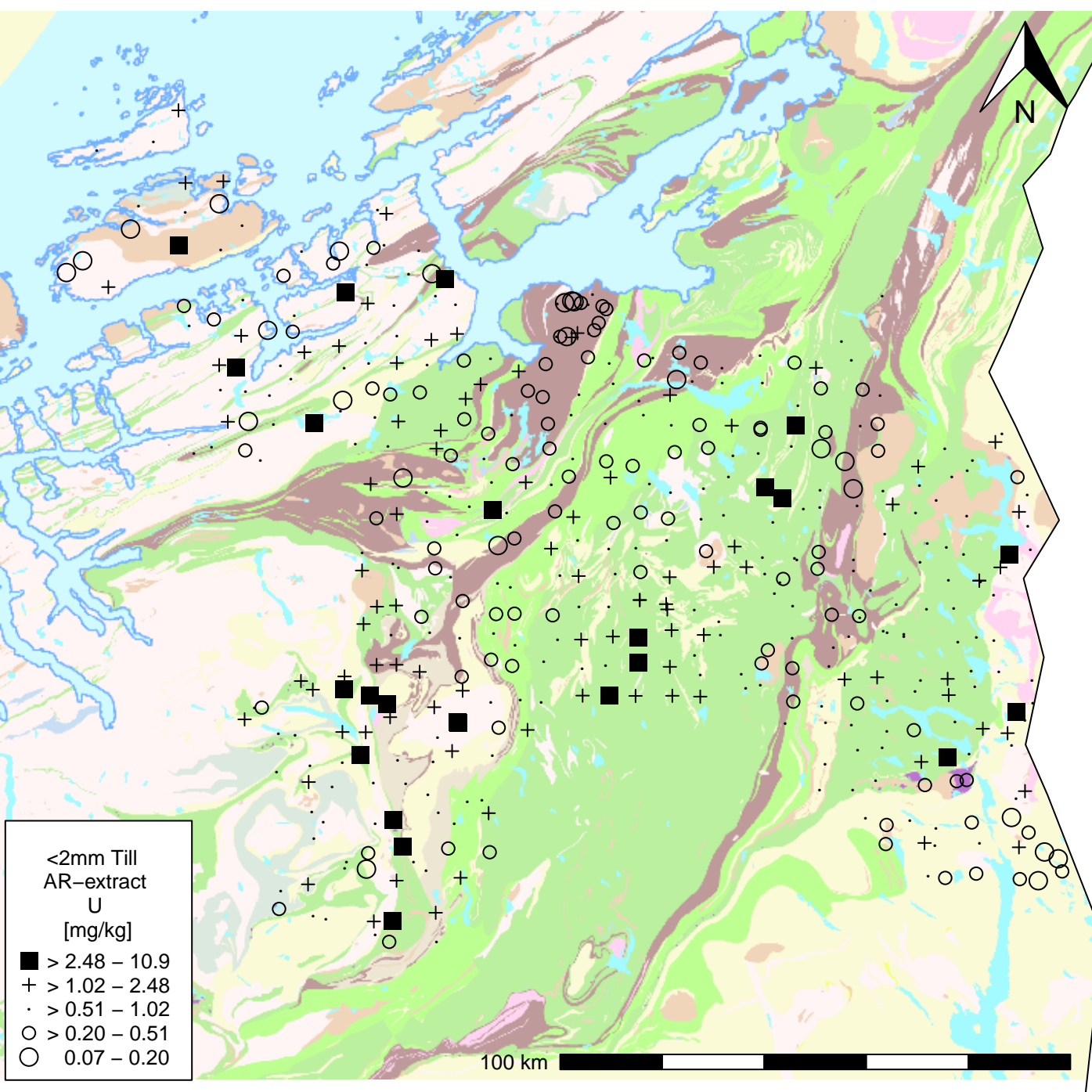


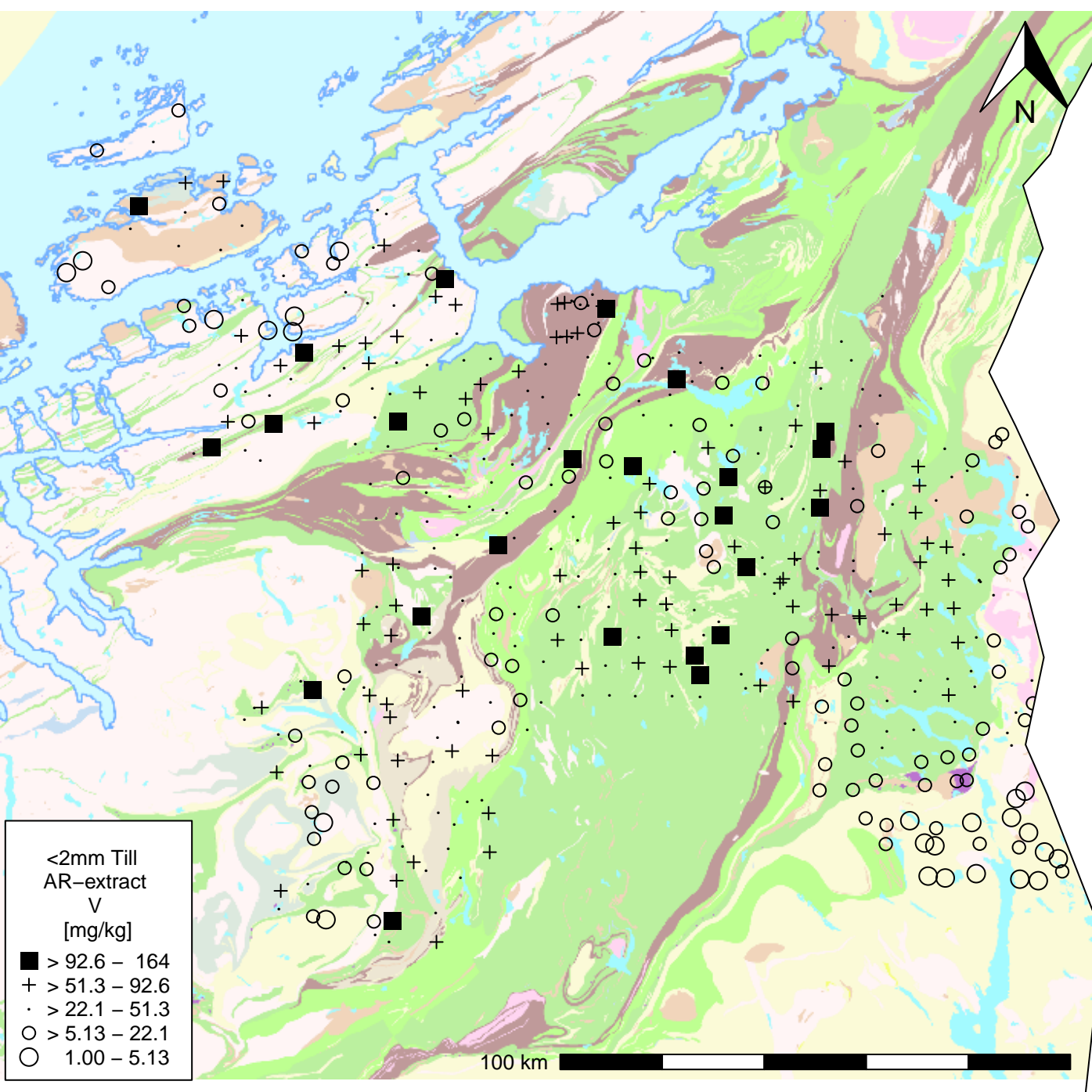


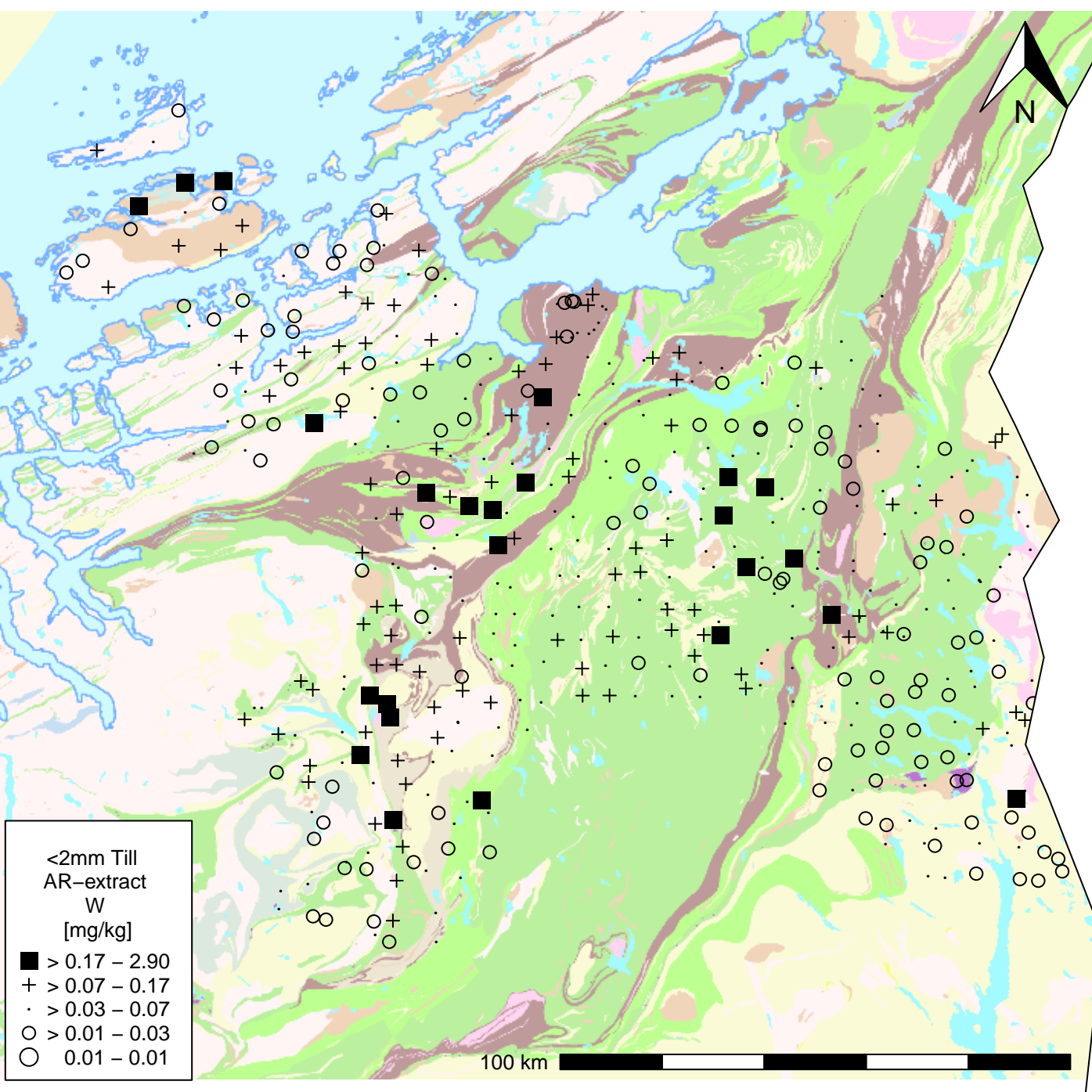


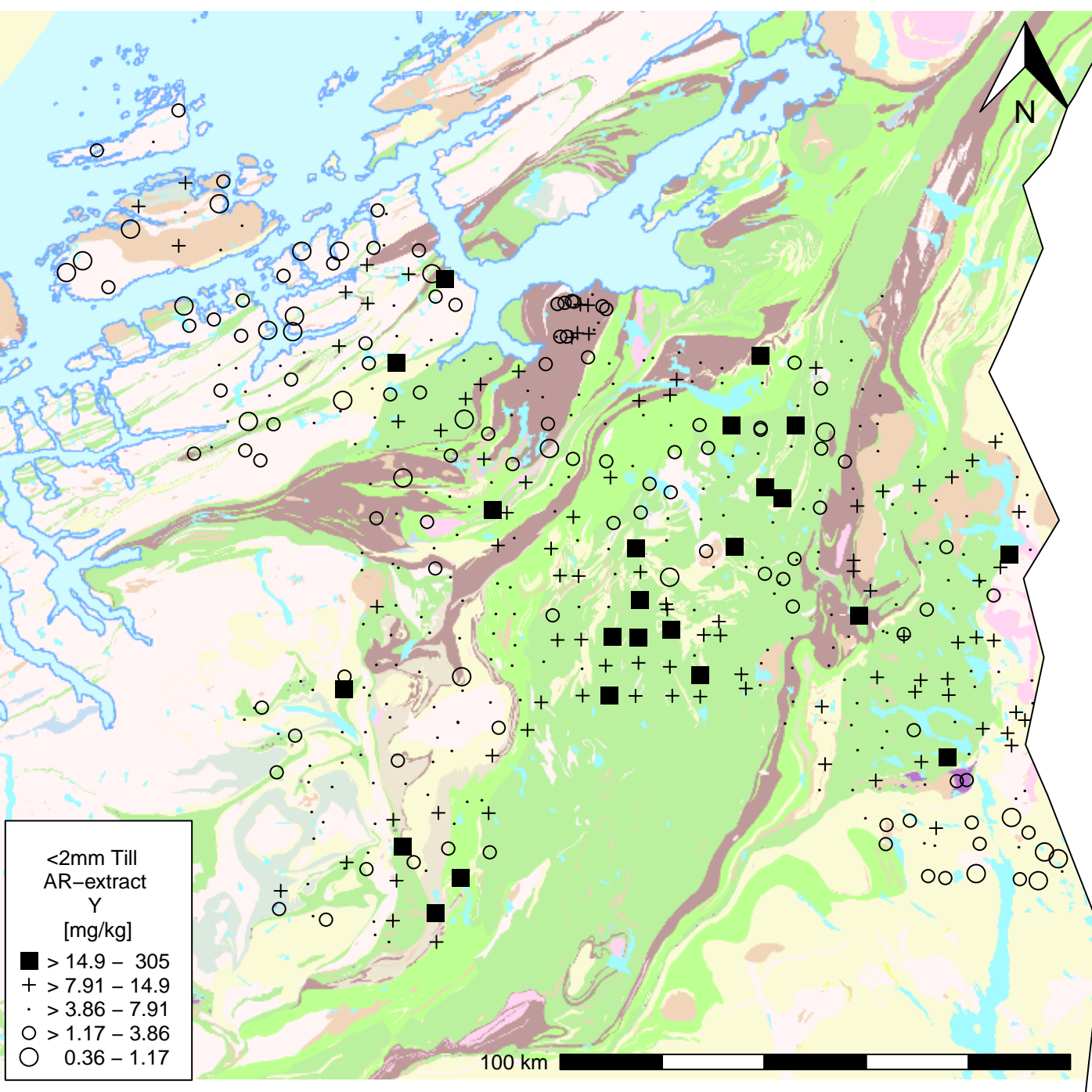


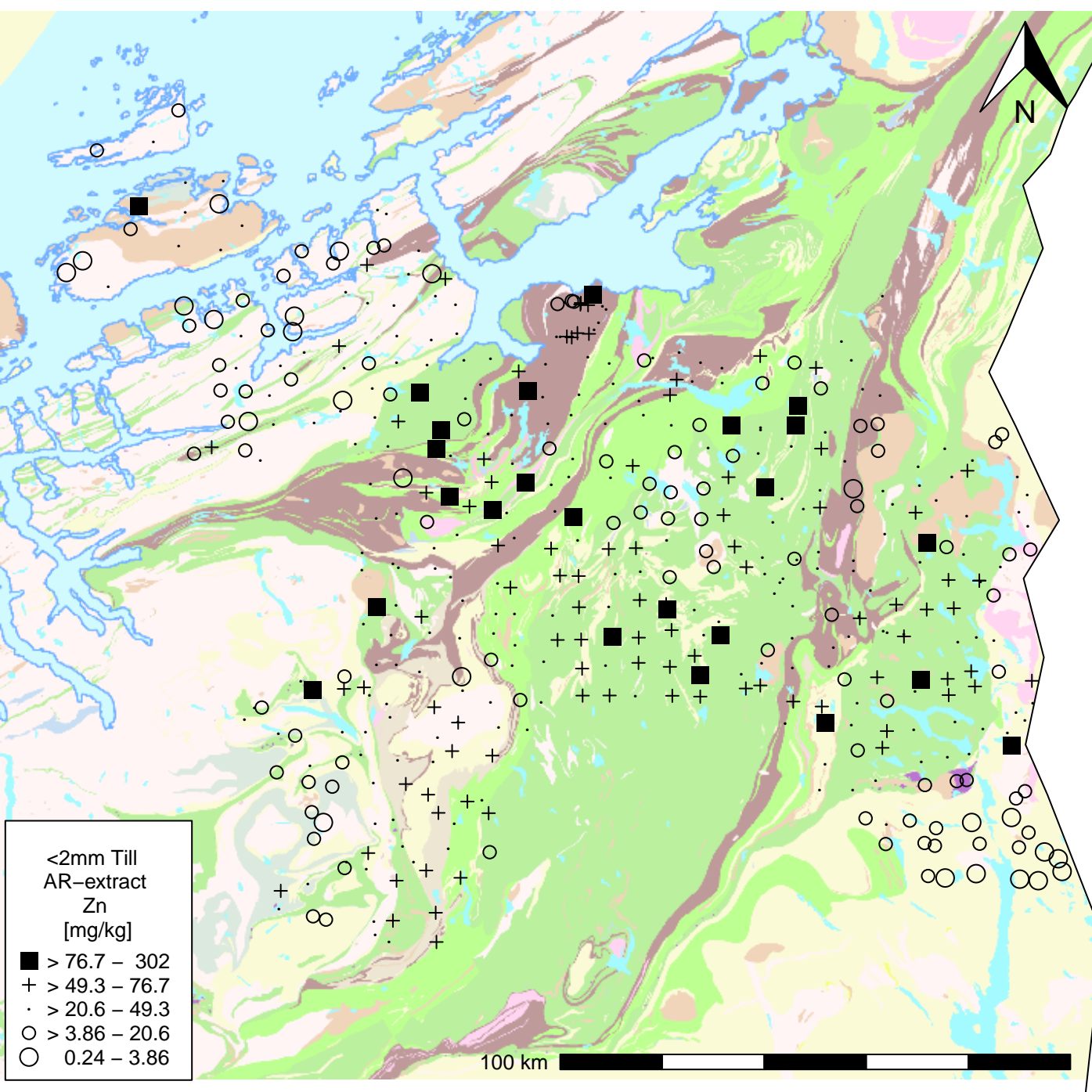


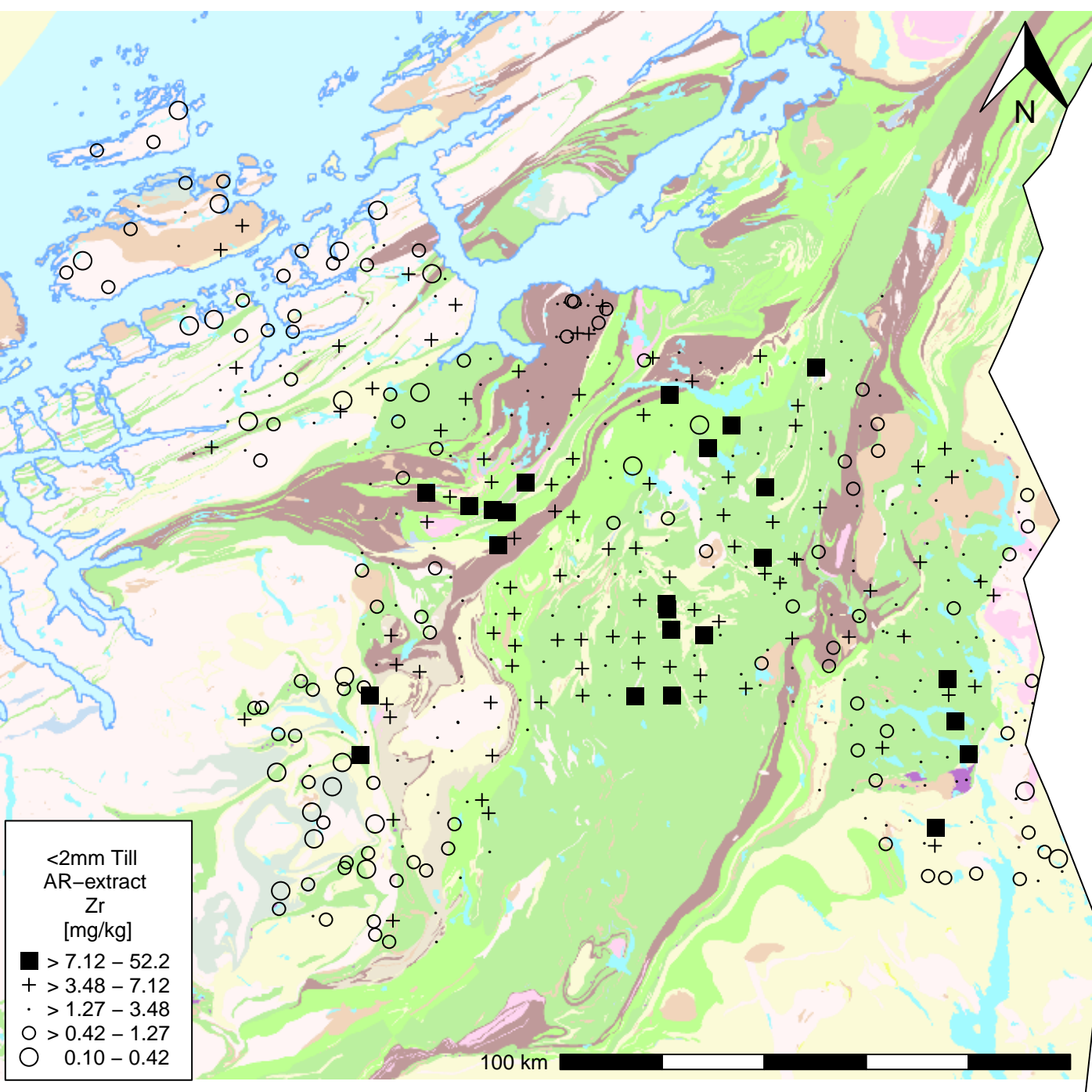














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