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Soil geochemical data from the Nordkinn Peninsula, Finnmark

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REPORT

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Soil geochemical data from the Nordkinn peninsula, Finnmark

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Summary:

The Nordkinn Peninsula consists of a series of Neoproterozoic fluvial, cross-bedded sandstones belonging to the Kalak Nappe complex which are derived from basement terraines of the Fennoscandian shield (Roberts, 2007). On first glance the area appears to hold little promise for mineral exploration. However, numerous low density geochemical surveys (Nordkalott project – Bølviken et al., 1986 , Kola project – Reimann et al., 1996, re-analysis of old Nordkalott samples – Reimann et al., 2011) show distinct geochemical anomalies (rare earth elements - REEs, U, and Th, but also Pb, Bi, Zn, and Sb) on the Nordkinn and adjacent Varanger Peninsula. Because of the numerous unexplained anomalies it was decided to cover the Nordkinn Penisula (ca. 2000 km^2) with a local scale geochemical survey at a sample density of 1 site per 2 km^2. During the summer of 2011 soil samples were collected from 808 locations at 1 km distance along ca. 30 traverses cutting the Nordkinn Penisula in east-west direction with 2 km spacing between the traverses. Due to logistical reasons the Koifjord-/Sandfjellet area could not be covered and parts of the Digermul Peninsula remained uncovered because Tana commune did not provide landing permits for the helicopter. All samples were air dried and sieved to pass a 2 mm nylon screen. Analyses for 65 elements, including all REEs, were carried out by a commercial laboratory based on an aqua regia extraction and following tight quality control procedures. The regional distribution of most elements depicts geological boundaries. Maximum concentrations observed for the sum of the REEs exceed 2000 mg/kg and the high REE values are clearly bound to one of the sandstone units. Several additional geochemical anomalies could be outlined.

Keywords:	Finnmark	Nordland-Troms
till	geochemistry	Geochemical mapping

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1. INTRODUCTION

The Nordkinn Peninsula consists of a series of Neoproterozoic fluvial, cross-bedded sandstones belonging to the Kalak Nappe complex which are derived from basement terraines of the Fennoscandian shield (Roberts, 2007). On first glance the area appears to hold little promise for mineral exploration. However, numerous low density geochemical surveys (Nordkalott project – Bølviken et al., 1986, Kola project – Reimann et al., 1996, re-analysis of old Nordkalott samples – Reimann et al., 2011) show distinct geochemical anomalies (REEs, U, Th but also Pb, Bi, Zn, Sb) on the Nordkinn and adjacent Varanger Peninsula. Because of these numerous unexplained anomalies it was decided to cover the Nordkinn Penisula (ca. 2000 km^2) with a local scale geochemical survey at a sample density of 1 site per 2 km^2. NGU has not carried out such local scale geochemical surveys aimed at mineral exploration since almost 20 years. This survey was thus also aimed at providing the needed experience for planning further investigations.

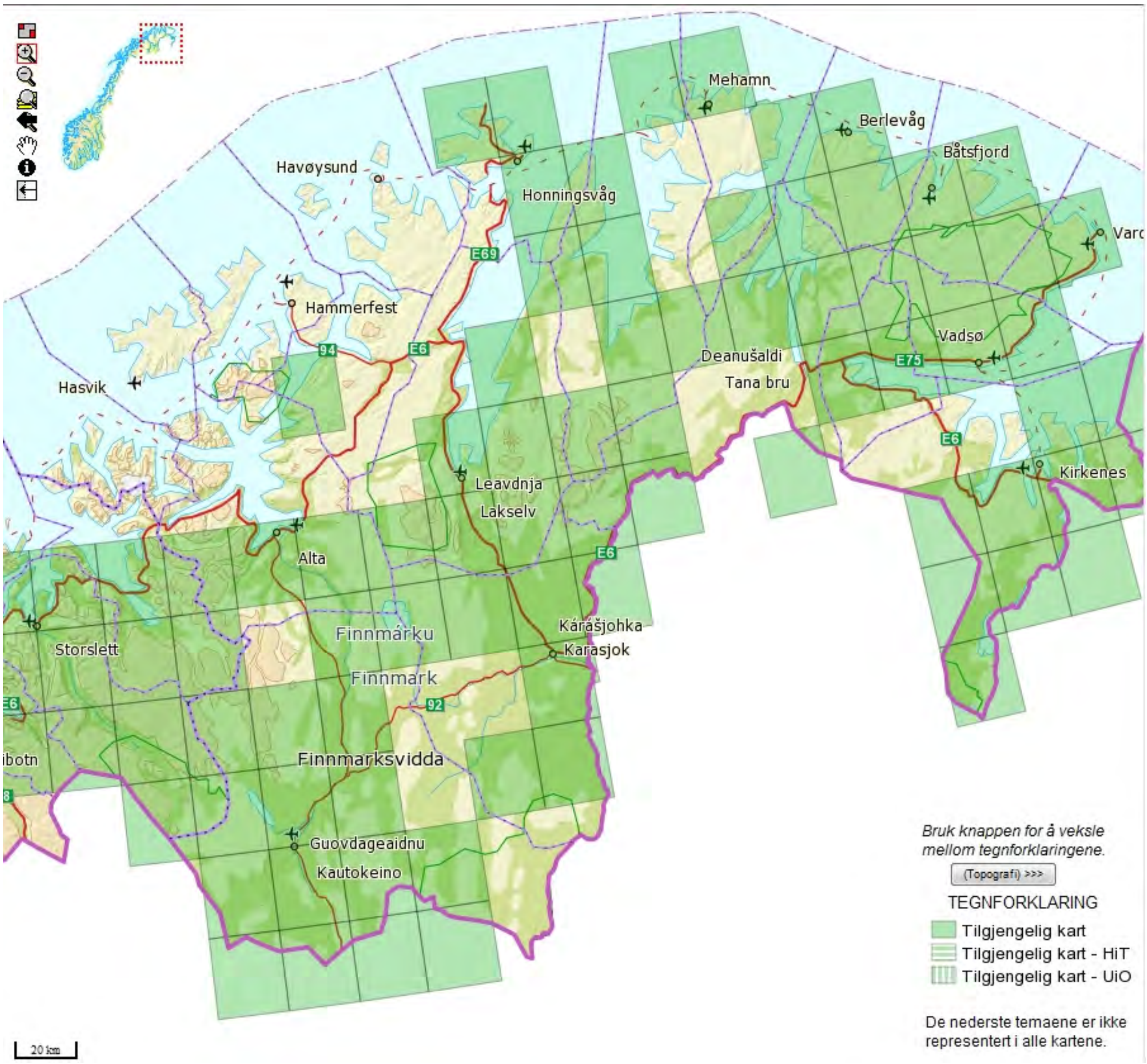

Figure 1. Index map showing location in Norway and available bedrock maps in scale 1:50000 in green.

In addition to the 1:50000 scale bedrock maps that partially cover the target area, three bedrock maps in 1:250000 scale cover the whole area. In Figure 2, these are outlined in purple, namely Nordkapp, Honningsvåg and Vadsø (North to East).

Nordkapp
Honningsvåg Vadsø

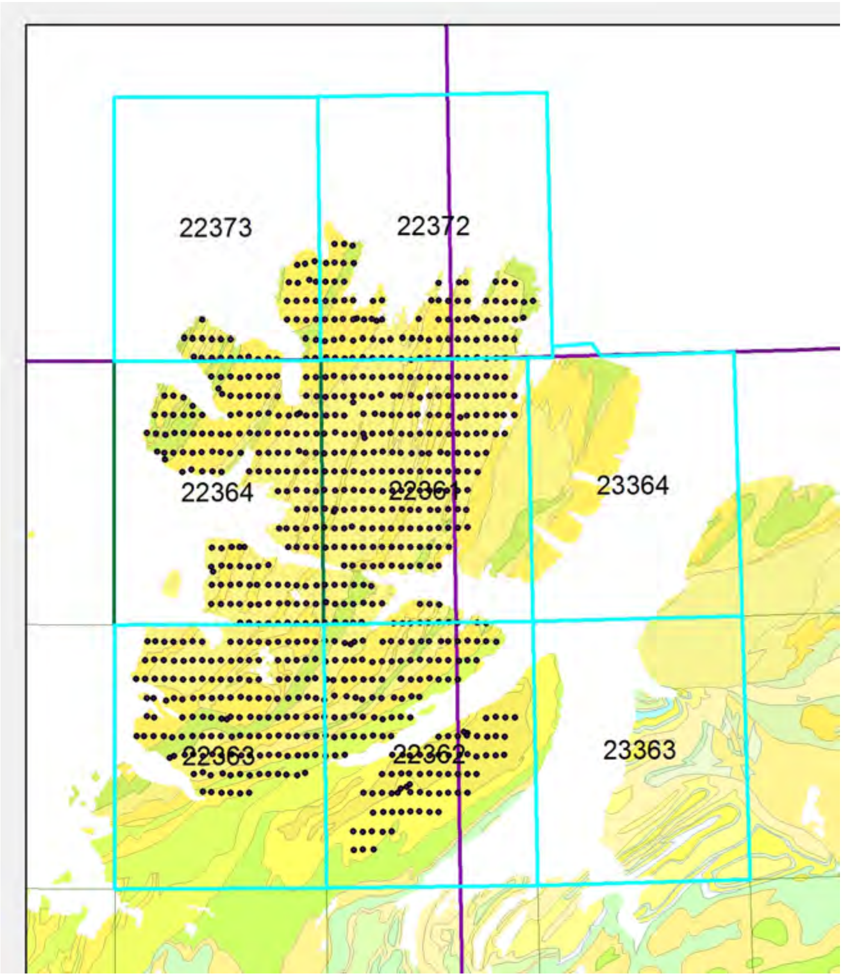

Figure 2. Maps covering the survey area. Five digit numbers are map sheet numbers in the M711 series.

Quaternary deposits of the area are dominated by regolith and thin till layer. Figure 3 also displays small areas of marine deposits and glaciofluvial sediments that were avoided during sampling.

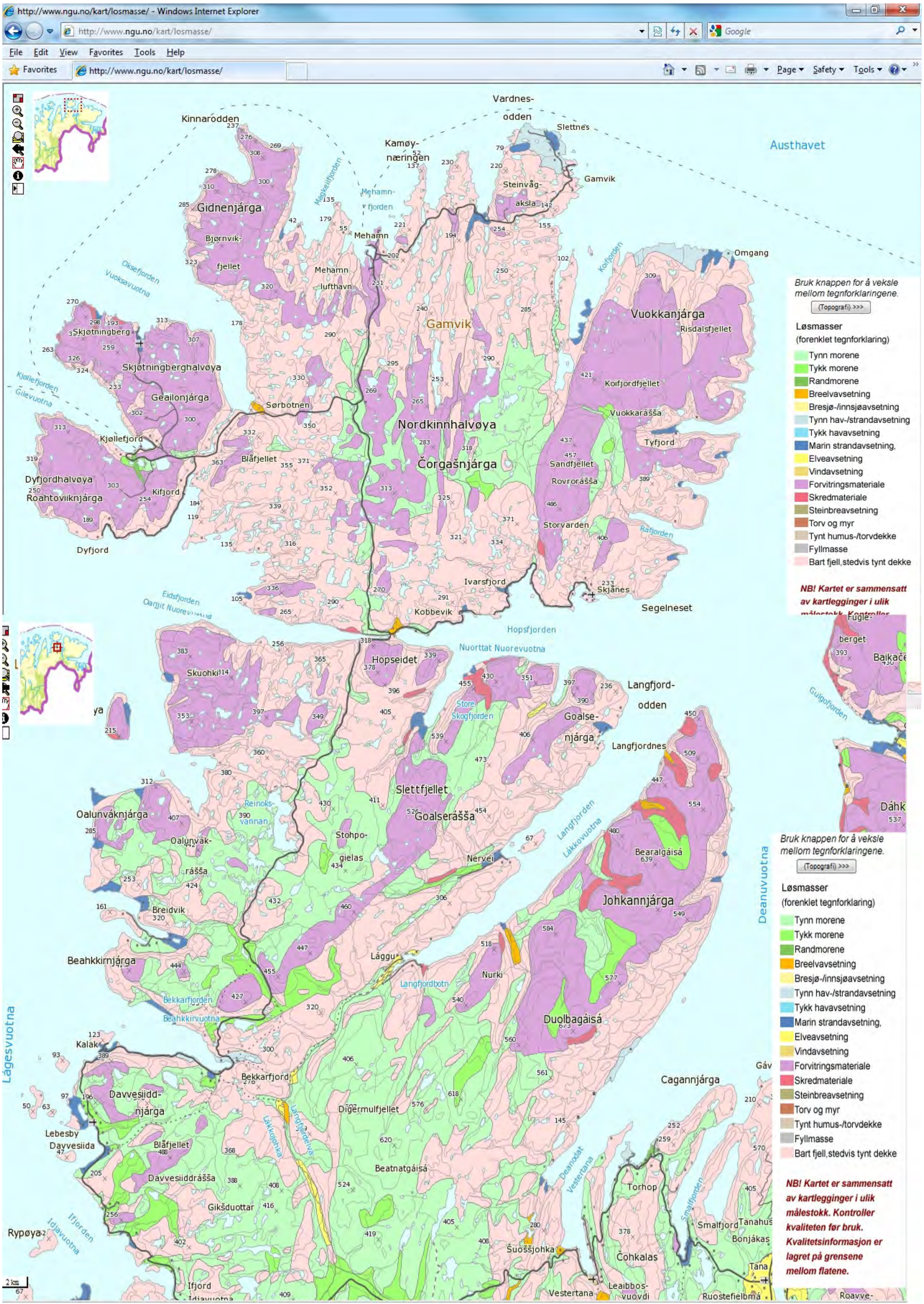

Figure 3. Quternary deposits of the Nordkinn-Bekkarfjord area.

METHODS.

1.1 Planning Stage and Field work

During the planning stage the Nordkinn Peninsula was covered by a grid of ca. 30 traverses in east-west direction at 2 km distance. Along the traverses the sample spacing was 1 km. It was estimated that with the resources available for field work, it would be possible to cover the whole area as far south as to the base of Bekkarfjord with some 1100samples

In the field sample pits were dug by paint free steel spade down to well into the mineral soil layer. Glaciofluvial deposits were consciously avoided during sampling. Samples were collected into RILSAN® plastic bags using a small steel trowel. Figure 4 shows a typical sample pit, the equipment used and a typical sample. Sample weight was on average 1,2 kg. The field crew was not allowed to wear any jewelry while handling samples. Most sample sites were accessed on foot from the closest road along the traverses. Some areas were accessed from the sea-side by the 37' "Polarjo" of SNO and for 4 days helicopter transport was used to drop off samplers in the field in the morning and collect them again in the evening.

Figure 4. Typical sample pit with sampling tool and sample.

Because the landing permits for the helicopter from Tana commune were not received for the desired time span, parts of the Digermul peninsula remained uncovered. Early on it also transpired that it was impossible to collect samples from the whole Nordkinn Peninsula within the given budget and it was decided to drop sampling of the rather difficult to access Koifjord-/Sandfjellet area. Supporting this decision was the fact that this was a low priority area based on earlier results. In total 808 localities were sampled. The samplers worked individually, and on the average, 1 sampler was able to collect 7,2 samples per day. Field work was carried out in the period 08.08 – 05.09.2011, with the crew fluctuating between 2 and 7 people.

Field duplicate samples were collected at a rate of one in every twenty five samples. At one site a large (35 kg) sample was collected for the preparation of a project standard.

1.2 Sample preparation

Upon arrival at the NGU laboratories, samples were dried at temperatures below 40 °C. Subsequently all samples were dry sieved to <2mm (9 mesh) until 2 alliquots of 30+ g and one of 60+ g was obtained, sparing the surplus material and discarding the >2mm fraction. Nylon sieves were used, and no jewelry was allowed during preparation work. Cross contamination via sample dust during sieving was controlled by sieving samples one at a time in a vented box, and cleaning all tools in water in between every sample. Following the preparation all samples were randomized and a split of the project standard MINN was inserted at a rate of one in twenty samples (36 in total). In addition 8 splits of the project standard NIDELV were also inserted at random positions. The laboratory inserted further 33 splits of its own QC sample DS8. The laboratory also prepared analytical duplicates of 51 samples.

1.3 Analytical method

Alliquots of 30+ g of all samples were shipped to ACME laboratories in Vancouver, Canada. For the GEMAS project this laboratory had won the international tender for analysis in aqua regia extraction (Reimann et al., 2009). A 15 g sample weight was used for the extraction. The samples were digested in 90 ml aqua regia and leached for one hour in a hot (95 °C) water bath. After cooling, the solution was made up to a final volume of 300 ml with 5% HCl. The sample weight to solution volume ratio is 1g per 20 ml. The solutions were analyzed using a Spectro Ciros Vision emission spectrometer (ICP-AES) and a Perkin Elmer Elan 6000/9000 inductively coupled plasma emission mass spectrometer (ICP-MS). Analytical results were returned within 1 month after receiving the samples.

1.4 Quality control

Table 1, 2 and 3 show the analytical results for the standards MINN, NIDELV and DS8. Table 4 shows the estimate of precision based on the analytical duplicates. All in all most results were satisfactory, Tables 1-3 clearly identify the “problematic” elements, where maps should be viewed with care: Ge, Ta, W, In, Pd, Pt, Re, Te. In most cases the observed problems were due to very low concentrations of these elements in our standards MINN and NIDELV, i.e. analytical results at or below the limit of detection. Standard NIDELV was used as project standard when submitting the stored samples from Nordland/Troms (Reimann et al., 2011) and median results for Nidelv analysed this time compared to the ones received earlier are also provided in Table 2. In laboratory standard DS8 only Ge and Ta have so low concentrations that they remain problematic (Table 3). X-charts (for an example see Figure 5) indicate that there exist no problems with time trends or breaks in analytical results. To be able to estimate analytical precision based on analytical duplicates and to calculate the practical detection limits, it was agreed with the laboratory that all instrument readings were reported, independent of detection limit. Duplicate results (Table 4) reveal the following elements as plagued by poor reproducibility: Re, Pd, Pt, Te, Au, and Ta. In some cases it was decided to show the instrument readings below the official detection limit in a map, these maps are clearly marked as such. For a few elements (e.g. S) it was decided to use the much lower practical detection limit rather than the “official” laboratory detection limit (see Table 5).

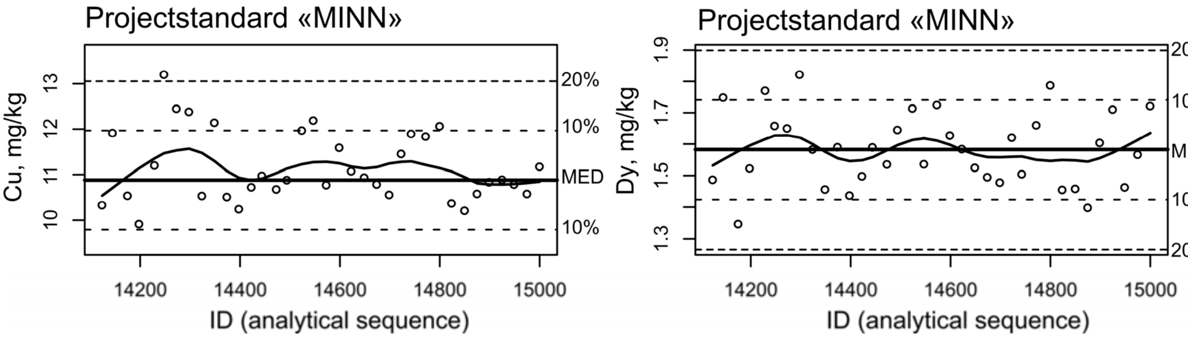

Figure 5. X-chart for Cu and Dy, depicting stability for project standard "MINN".

1.5 Data analysis

Geochemical data are compositional data (Aitchison, 1986; Filzmoser et al., 2009) and thus require special care during data analysis. Compositional data do not plot into the standard Euclidian room but rather on the Aitchison simplex. All statistical methods that are based on Euclidian distances (like calculating the mean and the standard deviation or calculating a correlation matrix) will thus return faulty results (Filzmoser et al., 2009, 2010). Thus here EDA (exploratory data analysis) techniques and simple order statistics as suggested by Reimann et al., (2008) are used.

2. RESULTS AND COMMENTS

2.1 Data tables

A statistical overview for the datset is provided in Table 5. The table is built around minimum, maximum and median value and provides the values for a number of additional quantiles (percentiles) of the distribution. When using (for the data at hand unsuited) classical statistical methods and calculating mean and standard deviation to derive at “thresholds” for anomalies in the case of a normal distribution 2.6% of all data will be identified as anomalies at both ends of the distribution – thus Q2 and Q98 (or Q5 and Q95) can be taken as lower and upper threshold for the data. However, quite often CP-Plots (see below) provide a better means of identifying anomalies in the data.

The “MAD” is the median absolute deviation (Reimann et al., 2008). For compositional data it should replace the standard deviation and is as such a measure of variation of the data. However, it is not allowed to calculate this measure for untransformed, “raw” data, they have to be either log-transformed MAD.log) or, better, “ilr” (isometric logratio, Egozcue et al.,

2003) transformed (MAD.ilr) prior to the calculation. Unfortunately they cannot be back-transformed to the original data space because the log transformation changes the distances of the observations from the center asymmetrically. The MAD.log (MAD.ilr) can thus not really replace the standard deviation. It rather informs about the stability of the part x on the remainder 1-x and small values indicate a high stability. As an additional measure of variation the "powers" are thus provided, they provide a direct impression of the orders of magnitude variation for each variable.

To get a better "feeling" for the data, Table 6 shows median, 98th percentile value and maximum concentration for the Nordkinn and the directly comparable Nordland/Troms dataset (Reimann et al., 2011). They are comparable in terms of grain size, laboratory procedures, and number of samples, but of course the Nordland/Troms dataset covers a much larger area and represents a different geological setting. For all three percentiles the highest value is marked in bold print. The table shows that the analytical results for the Nordkinn samples returned unusually high values for Au, Fe, all REEs, Hg, Mn, Nb, Sb, Ti, Tl, U, Y and Zr. It is obvious that especially the REEs returned very unusual results on the Nordkinn Peninsula (see for example the maximum value of Dysprosium (Dy) with 49 mg/kg).

2.2 Cumulative Probability (CP-) Plot

Plots of the cumulative distribution function are one of the most informative displays of geochemical distributions (Reimann et al., 2008). In the plots the concentration is plotted along the X-axis and the cumulative probability is plotted along the Y-axis, and it allows the direct visual recognition of breaks in the curve which may be indicative of different geochemical processes. Breaks in the uppermost few percentiles of the distribution are often used as threshold for anomaly identification.

2.3 Mapping

There exist many different methods for producing geochemical maps (see discussion in Reimann, 2005 or in Chapter 5 of Reimann et al., 2008). In mineral exploration so called "growing dot maps" as introduced by Bjørklund and Gustavsson (1987) are probably most often used. However, they focus the attention almost exclusively on the high values, the "anomalies" and are less well suited to study the data in more detail, e.g., in relation to geology or to detect more local anomalies that may not be characterized by especially high values in relation to the whole dataset but rather display barely high values for their surroundings.

To detect such more subtle features in the dataset it has proved helpful to use classes and to base these classes on percentiles of the distribution. EDA has developed an own symbolset, which is based on 5 classes, and was developed to provide an even optical weight of the symbols associated with these classes in a map. Here the EDA symbolset with accentuated outliers was used (Reimann et al., 2008) and the symbols were directly plotted on geological maps. The percentiles for a change in the symbols are 2 – 25 – 75 – 98%. The lowest values (0-2 %) are marked by large open circles, the values from 2 – 25 % of the data by small open circles, the inner 50% of the dataset are marked by a dot, the values from 75 to 98% by a cross and all values above the 98th percentile by a black square that grows in addition in direct relation to the analytical result (in order to be able to detect the highest value in the maps). As all the maps are prepared on a backdrop of a generalized bedrock map based on the available maps in scale 1:50000 and 1:250000 hosted by http://geo.ngu.no/kart/berggrunn/ (Roberts, 1973, 1981, 1998, 2006a, 2006b, Roberts & Siedlecka 2011, Siedlecka 2009 and Siedlecka et al), the reader will note that for many elements the chosen classes are able to depict geology more or less 1:1. An excerpt of the legend for the 1:250000 scale map series is showed in Figure 6.

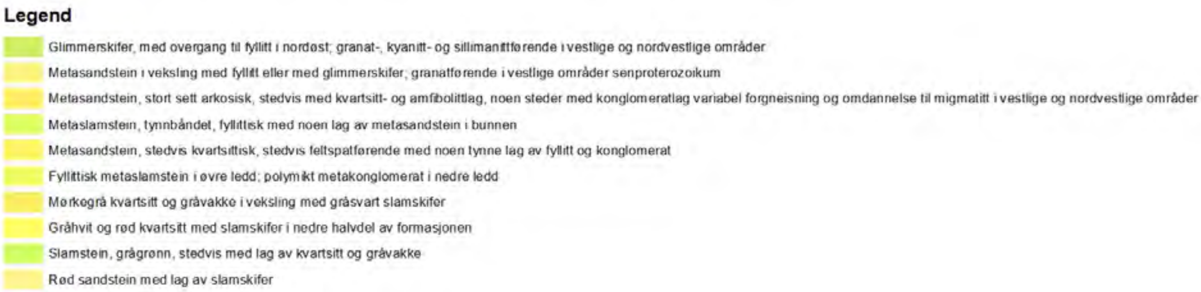

Figure 6. Excerpt from legend of 1:250000 bedrock maps.

Because the dataset is provided with this report it is possible and up to the reader to use different mapping techniques. Note, however, that in the provided data files all values below detection are marked as "<DL" while NGU had the original instrument readings available, i.e. values for every sample. When using large datasets with hundreds of samples and more, these results do often still contain valuable information. For example, for S the laboratory's official detection limit is 200 mg/kg, while the QC results indicate that values down to 2 mg/kg are still reliable. Thus a full order of magnitude real, natural variation would have been lost when setting all values below the DL to ½ of the detection limit. For producing the maps in this report the dataset with all instrument readings was used (negative instrument readings were set to a very small positive value).

3. CONCLUSIONS

Studying the maps the following features draw attention:
(1) The area is clearly divided into several geochemically distinct geological units, following by and large the established divisions in the geological map.
(2) A gold anomaly consisting of several high values occurs in the north-eastern part of the survey area.
(3) A distinct As, B, Fe, (Hg), Mo, P, S, Sr, and Te anomaly occurs on the Digermul Peninsula. This is the area where the original low density survey had also indicated a Pd anomaly (see maps in Reimann et al., 2011), but this is not re-established. Given the element combination the most likely source would appear to be the occurrence of a black (organic rich) shale/schist unit on the Digermul Peninsula. The occurrence of black shales would also explain erratic high Pd and Pt concentrations in the samples.
(4) A distinct band of high Cr, Mg, Ni-values in the southernmost part of the survey area. This anomaly either indicates the presence of an un-mapped mafic dyke or of a mafic layer in the sediments. A feature like this could be used as a marker to study the extent of glacial transport in this area.
(5) The most distinct feature is probably the occurrence of a large central sandstone unit, running in a north-east south-west direction over the whole Nordkinn Peninsula. This unit is enriched in a large number of elements and especially in the REEs – the maximum value for the sum of the REEs (excluding Y) reaches a stunning value of over 2000 mg/kg. Within this

unit more local anomalies of a variety of elements occur, e.g. Cu, Ba and K (see (8)) in the central parts or Ti (see (9) in the southwestern parts. Furthermore, based on the analytical results of some other elements (e.g., Cs, Sb), it is possible to subdivide this large unit into a number of geochemically distinct subunits all running in a northeastern-southwestern direction.
(6) Lead (Pb) shows a number of high values in the northernmost part of the survey are. These values are not bound to any of the mapped geological units.
(7) A number of enhanced Zn concentrations were observed in the central sandstone unit (see 5). Especially the easternmost subdivision of the unit appears to be enriched in Zn, P, Ni, Nb, Mg, and Cs (depleted in Sb).
(8) A Cu-Bi-Ba-K anomaly is observed in the central parts of the survey area within the central sandstone unit (see (5). The maximum Cu concentration is over 600 mg/kg.
(9) A Ti-Nb-Sn-V-(Ta)-(W) anomaly is observed in the southwestern corner of the survey area, again within the central sandstone unit (see (5)).

In summary the maps show the power of a detailed geochemical soil survey in aiding geological mapping in an area that is difficult to subdivide based on geological field observations alone. The high values of the REEs are very unusual even in a European perspective.

4. ACKNOWLEDGEMENTS

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Table 1. Project standard "Minn" - Min, Q50, Max and precision values.

MINN n=36		Alphabetical								Sorted by precision			
Element	Min	Q50	Max	Precision	Element	Min	Q50	Max	Precision	Element	Precision	Element	Precision
Ag	1,62	1,75	2	4,4	**Mo**	12	13,2	15,2	4,9	**Ge**	n.d	**U**	6,1
Al	8705	9574	10985	5,4	**Na**	844	1014	1307	12,1	**Ta**	n.d	**Er**	5,9
As	22,1	24,9	28,2	5,4	**Nb**	1,14	1,38	1,61	8,7	**B**	18,5	**K**	5,5
Au	0,0969	0,112	0,159	7,7	**Nd**	8,62	11,2	13,9	12,2	**Tm**	18,0	**Al**	5,4
B	1,73	2,61	5,17	18,5	**Ni**	34,7	37,7	40,7	3,8	**Hf**	16,2	**As**	5,4
Ba	230	276	309	4,1	**P**	704	796	952	5,4	**Lu**	14,1	**P**	5,4
Be	4,47	5,13	6,6	9,4	**Pb**	116	124	135	4,3	**Re**	13,6	**Cr**	5,3
Bi	5,75	6,5	7,62	4,5	**Pd**	0,089	0,115	0,135	7,9	**Pr**	13,3	**In**	5,2
Ca	6589	7223	8091	6,3	**Pr**	2,54	3,2	3,88	13,3	**Eu**	13,0	**Ga**	5,2
Cd	2,14	2,3	2,67	6,1	**Pt**	0,316	0,343	0,378	4,5	**Tb**	12,5	**Sb**	5,1
Ce	22,1	28,7	33,7	11,7	**Rb**	35,5	37,8	42,2	3,4	**Nd**	12,2	**Mn**	5,0
Co	6,94	7,43	8,84	4,9	**Re**	0,0433	0,056	0,067	13,6	**Na**	12,1	**Co**	4,9
Cr	106	120	135	5,3	**S**	1472	1605	1748	4,1	**Sc**	11,9	**Mo**	4,9
Cs	2,28	2,39	2,78	3,6	**Sb**	4,82	5,59	6,29	5,1	**Ce**	11,7	**Ti**	4,8
Cu	101	111	120	3,1	**Sc**	1,95	2,27	3,1	11,9	**Yb**	10,5	**V**	4,8
Dy	0,827	1,15	1,39	7,3	**Se**	4,32	5,02	5,96	4,8	**La**	10,4	**Se**	4,8
Er	0,483	0,612	0,765	5,9	**Sm**	1,53	1,89	2,28	9,4	**Y**	9,7	**Sn**	4,6
Eu	0,31	0,409	0,544	13,0	**Sn**	6	6,41	7,41	4,6	**Zr**	9,6	**Pt**	4,5
Fe	23114	24630	26759	3,0	**Sr**	55,1	66,3	76,7	7,6	**Be**	9,4	**Bi**	4,5
Ga	4,32	4,67	5,44	5,2	**Ta**	0,025	0,025	0,025	0,0	**Sm**	9,4	**Ag**	4,4
Gd	1,15	1,45	1,77	8,9	**Tb**	0,162	0,206	0,257	12,5	**Gd**	8,9	**Pb**	4,3
Ge	0,05	0,05	0,178	0,0	**Te**	4,45	4,96	5,54	6,3	**Ho**	8,7	**Tl**	4,2
Hf	0,0624	0,0879	0,116	16,2	**Th**	6,13	6,93	8,08	8,2	**Nb**	8,7	**S**	4,1
Hg	0,168	0,193	0,238	4,1	**Ti**	990	1179	1342	4,8	**Th**	8,2	**Ba**	4,1
Ho	0,171	0,237	0,29	8,7	**Tl**	5,04	5,33	5,86	4,2	**Pd**	7,9	**Hg**	4,1
In	2,01	2,16	2,52	5,2	**Tm**	0,0705	0,0939	0,115	18,0	**Li**	7,8	**W**	4,0
K	3857	4286	4737	5,5	**U**	2,41	2,78	3,13	6,1	**Au**	7,7	**Ni**	3,8
La	12,2	15,8	19,2	10,4	**V**	37,1	40,9	45,3	4,8	**Sr**	7,6	**Cs**	3,6
Li	24,1	26,9	31,9	7,8	**W**	2,61	2,93	3,52	4,0	**Dy**	7,3	**Rb**	3,4
Lu	0,0758	0,096	0,143	14,1	**Y**	4,88	6,19	7,39	9,7	**Ca**	6,3	**Mg**	3,3
Mg	5703	6153	6717	3,3	**Yb**	0,463	0,615	0,726	10,5	**Te**	6,3	**Cu**	3,1
Mn	562	607	690	5,0	**Zn**	288	306	344	2,5	**Cd**	6,1	**Fe**	3,0
					Zr	1,56	1,94	2,48	9,6			**Zn**	2,5

Table 2. Project standard "Nidelv" - Min, Q50, Max and precision values. Q50 values for Nordland+Troms dataset given in addition.

NIDELV n=8						Alphabetical						Sorted by precision			
Element	Min	Q50	Nordland +Troms Q50 (N=53)	Max	Precision	Element	Min	Q50	Nordland +Troms Q50 (N=53)	Max	Precision	Element	Precision	Element	Precision
Ag	0,0253	0,0378	0,0405	0,0463	16,8	Mo	0,248	0,282	0,287	0,335	6,4	Ge	nd	Eu	8,9
Al	7491	8422	7883	9507	6,0	Na	106	138	105	175	18,2	In	nd	Ho	8,9
As	2	2,5	2,27	3,12	23,7	Nb	0,426	0,536	0,37	0,608	11,6	Pd	nd	Yb	8,8
Au	0,0005	0,00101	0,000704	0,00387	55,0	Nd	10,1	11,3	10,3	12,7	6,1	Pt	nd	Cu	8,6
B	0,5	1,21	0,982	2,37	87,0	Ni	25,6	27,5	27,9	30,2	4,2	Re	nd	Lu	8,6
Ba	28,5	30,1	29,6	33,2	4,7	P	403	443	434	471	5,4	S	nd	Th	8,6
Be	0,124	0,163	0,158	0,211	32,4	Pb	6,26	7,1	6,99	7,66	10,1	Ta	nd	Zr	8,4
Bi	0,01	0,0669	0,0609	0,128	55,6	Pd	0,005	0,005	-0,0002028	0,005	0,0	Te	nd	Sn	7,9
Ca	1970	2220	2072	2591	3,8	Pr	2,84	3,08	2,68	3,83	3,7	B	87	Tb	7,7
Cd	0,0552	0,0826	0,0829	0,102	29,1	Pt	0,001	0,001	0,000059	0,001	0,0	Se	81	Sr	7,6
Ce	23,9	25,3	25	29	6,0	Rb	10,3	11,6	11,6	12,3	6,5	Bi	56	Tl	7,2
Co	7,2	8,03	8,07	8,89	5,4	Re	0,0005	0,0005	0,0000895	0,00144	0,0	Au	55	K	6,9
Cr	37	39	37,2	45,7	3,9	S	100	100	56,6	100	0,0	Hg	33	Rb	6,5
Cs	0,738	0,802	0,818	0,859	3,1	Sb	0,0713	0,0867	0,0841	0,104	11,9	Be	32	Mo	6,4
Cu	18,7	21,1	21,5	22,5	8,6	Sc	1,48	1,69	1,76	2,01	9,4	Cd	29	La	6,2
Dy	1,1	1,29	1,14	1,37	9,1	Se	0,05	0,11	0,186	0,227	81,0	As	24	Zn	6,2
Er	0,577	0,659	0,588	0,752	14,5	Sm	1,84	1,99	1,75	2,49	5,8	Na	18	Nd	6,1
Eu	0,367	0,403	0,323	0,451	8,9	Sn	0,463	0,52	0,575	0,734	7,9	Ag	17	Ce	6,0
Fe	12912	14238	13125	15990	3,3	Sr	8,9	10,4	8,79	12,2	7,6	W	16	Al	6,0
Ga	2,31	2,48	2,37	2,73	9,0	Ta	0,025	0,025	0,000179	0,025	0,0	Er	15	Sm	5,8
Gd	1,31	1,61	1,38	1,82	9,3	Tb	0,216	0,245	0,202	0,282	7,7	Tm	13	Co	5,4
Ge	0,05	0,05	0,0414	0,05	0,0	Te	0,01	0,01	0,0135	0,0263	0,0	Ti	12	P	5,4
Hf	0,0224	0,0407	0,049	0,0512	10,6	Th	2,61	2,95	3,05	3,25	8,6	Sb	12	Y	5,0
Hg	0,0241	0,0548	0,0499	0,0937	33,2	Ti	495	570	520	665	12,0	Nb	12	V	4,8
Ho	0,219	0,261	0,222	0,321	8,9	Tl	0,0884	0,102	0,0904	0,112	7,2	Li	11	Ba	4,7
In	0,01	0,01	0,00777	0,0296	0,0	Tm	0,0819	0,099	0,0762	0,116	13,0	Hf	11	Ni	4,2
K	1276	1360	1325	1544	6,9	U	0,537	0,588	0,549	0,658	9,6	Pb	10	Mn	4,1
La	11,3	12,3	12,1	13,9	6,2	V	21	23,4	21,3	26,8	4,8	U	9,6	Cr	3,9
Li	8,8	10,1	9,06	11,6	11,2	W	0,133	0,179	0,138	0,202	15,8	Sc	9,4	Ca	3,8
Lu	0,0674	0,086	0,078	0,131	8,6	Y	5,63	6,18	5,88	7,03	5,0	Gd	9,3	Pr	3,7
Mg	5636	6137	5722	6895	3,6	Yb	0,458	0,569	0,523	0,657	8,8	Dy	9,1	Mg	3,6
Mn	239	258	252	300	4,1	Zn	36,1	39,6	38,2	42,4	6,2	Ga	9,0	Fe	3,3
						Zr	1,69	2,45	3,21	2,68	8,4			Cs	3,1

Table 3. Laboratory standard "DS8" - Min, Q50, Max and precision values.

DS8 (laboratory standard) n=33	Alphabetical									Sorted by precision			
Element	Min	Q50	Max	Precision	Element	Min	Q50	Max	Precision	Element	Precision	Element	Precision
Ag	1,62	1,75	2	4,4	Mo	12	13,2	15,2	4,9	Ge	nd	U	6,1
Al	8705	9574	10985	5,4	Na	844	1014	1307	12,1	Ta	nd	Er	5,9
As	22,1	24,9	28,2	5,4	Nb	1,14	1,38	1,61	8,7	B	18,5	K	5,5
Au	0,0969	0,112	0,159	7,7	Nd	8,62	11,2	13,9	12,2	Tm	18,0	Al	5,4
B	1,73	2,61	5,17	18,5	Ni	34,7	37,7	40,7	3,8	Hf	16,2	As	5,4
Ba	230	276	309	4,1	P	704	796	952	5,4	Lu	14,1	P	5,4
Be	4,47	5,13	6,6	9,4	Pb	116	124	135	4,3	Re	13,6	Cr	5,3
Bi	5,75	6,5	7,62	4,5	Pd	0,089	0,115	0,135	7,9	Pr	13,3	In	5,2
Ca	6589	7223	8091	6,3	Pr	2,54	3,2	3,88	13,3	Eu	13,0	Ga	5,2
Cd	2,14	2,3	2,67	6,1	Pt	0,316	0,343	0,378	4,5	Tb	12,5	Sb	5,1
Ce	22,1	28,7	33,7	11,7	Rb	35,5	37,8	42,2	3,4	Nd	12,2	Mn	5,0
Co	6,94	7,43	8,84	4,9	Re	0,0433	0,056	0,067	13,6	Na	12,1	Co	4,9
Cr	106	120	135	5,3	S	1472	1605	1748	4,1	Sc	11,9	Mo	4,9
Cs	2,28	2,39	2,78	3,6	Sb	4,82	5,59	6,29	5,1	Ce	11,7	Ti	4,8
Cu	101	111	120	3,1	Sc	1,95	2,27	3,1	11,9	Yb	10,5	V	4,8
Dy	0,827	1,15	1,39	7,3	Se	4,32	5,02	5,96	4,8	La	10,4	Se	4,8
Er	0,483	0,612	0,765	5,9	Sm	1,53	1,89	2,28	9,4	Y	9,7	Sn	4,6
Eu	0,31	0,409	0,544	13,0	Sn	6	6,41	7,41	4,6	Zr	9,6	Pt	4,5
Fe	23114	24630	26759	3,0	Sr	55,1	66,3	76,7	7,6	Be	9,4	Bi	4,5
Ga	4,32	4,67	5,44	5,2	Ta	0,025	0,025	0,025	0,0	Sm	9,4	Ag	4,4
Gd	1,15	1,45	1,77	8,9	Tb	0,162	0,206	0,257	12,5	Gd	8,9	Pb	4,3
Ge	0,05	0,05	0,178	0,0	Te	4,45	4,96	5,54	6,3	Ho	8,7	Tl	4,2
Hf	0,0624	0,0879	0,116	16,2	Th	6,13	6,93	8,08	8,2	Nb	8,7	S	4,1
Hg	0,168	0,193	0,238	4,1	Ti	990	1179	1342	4,8	Th	8,2	Ba	4,1
Ho	0,171	0,237	0,29	8,7	Tl	5,04	5,33	5,86	4,2	Pd	7,9	Hg	4,1
In	2,01	2,16	2,52	5,2	Tm	0,0705	0,0939	0,115	18,0	Li	7,8	W	4,0
K	3857	4286	4737	5,5	U	2,41	2,78	3,13	6,1	Au	7,7	Ni	3,8
La	12,2	15,8	19,2	10,4	V	37,1	40,9	45,3	4,8	Sr	7,6	Cs	3,6
Li	24,1	26,9	31,9	7,8	W	2,61	2,93	3,52	4,0	Dy	7,3	Rb	3,4
Lu	0,0758	0,096	0,143	14,1	Y	4,88	6,19	7,39	9,7	Ca	6,3	Mg	3,3
Mg	5703	6153	6717	3,3	Yb	0,463	0,615	0,726	10,5	Te	6,3	Cu	3,1
Mn	562	607	690	5,0	Zn	288	306	344	2,5	Cd	6,1	Fe	3,0
					Zr	1,56	1,94	2,48	9,6			Zn	2,5

Table 4. Precision of analytical duplicates and field duplicates.

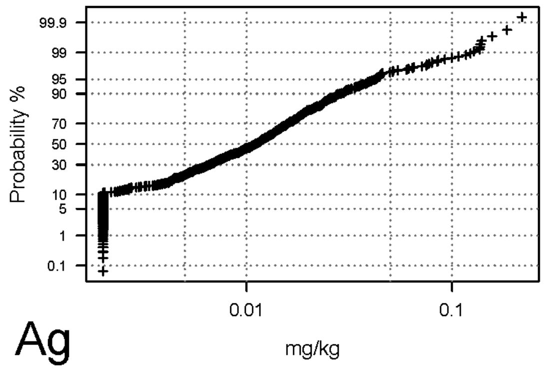
Analytical (weighing) duplicates N=86 pairs				Field duplicates N=30 pairs			
Alphabethical		Sorted		Alphabethical		Sorted	
Element	Precision	Element	Precision	Element	Precision	Element	Precision
Ag	22,9	Re	1741	Ag	42	Re	389
Al	2,6	Pd	262	Al	12	Pt	299
As	8,5	Pt	151	As	40	Pd	251
Au	72,1	Te	99	Au	82	Te	99
B	33,6	Au	72	B	54	Au	82
Ba	4,3	Ta	61	Ba	19	Ta	69
Be	17,2	B	34	Be	32	Cd	58
Bi	14,4	Ge	32	Bi	21	Ge	55
Ca	5,7	Hg	30	Ca	34	B	54
Cd	20,5	In	30	Cd	58	Hg	48
Ce	5,2	W	28	Ce	29	S	46
Co	3,2	Ag	23	Co	16	Ag	42
Cr	4,1	Cd	21	Cr	15	As	40
Cs	3,6	Be	17	Cs	9	In	36
Cu	3,2	S	16	Cu	22	Mo	35
Dy	5,5	Se	16	Dy	28	Gd	35
Er	5,7	Bi	14	Er	29	Ca	34
Eu	5,8	Hf	11	Eu	32	La	34
Fe	3,2	Sb	8,6	Fe	10	Nd	34
Ga	3,6	As	8,5	Ga	11	Pr	34
Gd	7,2	Lu	8,4	Gd	35	Be	32
Ge	32,2	Tm	7,7	Ge	55	Eu	32
Hf	10,7	Mo	7,6	Hf	27	Sm	32
Hg	30,3	Gd	7,2	Hg	48	Se	32
Ho	4,6	Sn	6,3	Ho	27	Tb	31
In	30,3	Sr	6,2	In	36	Y	29
K	2,9	Nb	6	K	15	Er	29
La	4,5	Eu	5,8	La	34	W	29
Li	4,7	Yb	5,8	Li	15	Ce	29
Lu	8,4	Ca	5,7	Lu	25	Dy	28
Mg	2,5	Er	5,7	Mg	16	Ho	27
Mn	3,4	Tb	5,6	Mn	22	Tm	27
Mo	7,6	Dy	5,5	Mo	35	Hf	27
Na	4,5	Ce	5,2	Na	14	Lu	25
Nb	6	Nd	4,9	Nb	23	P	24
Nd	4,9	P	4,8	Nd	34	Yb	24
Ni	2,9	Li	4,7	Ni	13	Nb	23
P	4,8	Zr	4,7	P	24	Cu	22
Pb	3,7	Ho	4,6	Pb	11	Mn	22
Pd	262,4	Sm	4,6	Pd	251	Th	21
Pr	4,3	La	4,5	Pr	34	Bi	21
Pt	151,2	Na	4,5	Pt	299	Zr	20
Rb	4,1	U	4,4	Rb	14	Ba	19
Re	1741,1	Ba	4,3	Re	389	Sr	19
S	16,3	Pr	4,3	S	46	Sb	18
Sb	8,6	Cr	4,1	Sb	18	U	18
Sc	3,8	Rb	4,1	Sc	11	Co	16
Se	15,7	Tl	4	Se	32	Mg	16
Sm	4,6	V	4	Sm	32	Tl	15
Sn	6,3	Ti	3,9	Sn	13	Li	15
Sr	6,2	Y	3,9	Sr	19	Cr	15
Ta	61,3	Sc	3,8	Ta	69	K	15
Tb	5,6	Th	3,8	Tb	31	Rb	14
Te	98,8	Pb	3,7	Te	99	Na	14
Th	3,8	Zn	3,7	Th	21	Ni	13
Ti	3,9	Cs	3,6	Ti	11	Sn	13
Tl	4	Ga	3,6	Tl	15	Al	12
Tm	7,7	Mn	3,4	Tm	27	Zn	12
U	4,4	Co	3,2	U	18	Ti	11
V	4	Cu	3,2	V	10	Ga	11
W	28,3	Fe	3,2	W	29	Sc	11
Y	3,9	K	2,9	Y	29	Pb	11
Yb	5,8	Ni	2,9	Yb	24	V	10
Zn	3,7	Al	2,6	Zn	12	Fe	10
Zr	4,7	Mg	2,5	Zr	20	Cs	9

Table 5. Statistical parameters of the mapped dataset. N=808.

Ele-ment	official DL	Practi-cal DL	Min	Q2	Q5	Q10	Q25	Q50	Q75	Q90	Q95	Q98	Max	MAD.log	MAD.ilr	Powers
Ag	0,002	0,002	0,001	0,001	0,001	0,001	0,0056	0,011	0,018	0,029	0,042	0,077	0,22	0,354	0,577	2,3
Al	100	100	546	2149	3671	5780	10262	15105	18261	21186	22994	25453	32809	0,157	0,261	1,8
As	0,1	0,1	<0,1	0,14	0,37	0,62	1,2	2,3	4,3	8,1	13	18	67	0,411	0,669	3,1
Au	0,0002	0,0002	<0,0002	0,0001	0,0001	0,0001	0,00024	0,00070	0,0013	0,0023	0,0033	0,0049	0,034	0,495	0,806	2,5
B	1	1	<1	<1	<1	<1	<1	<1	1,0	1,5	1,9	2,2	3,8			0,9
Ba	0,5	0,5	3,1	9	11	15	24	45	68	95	115	127	190	0,333	0,542	1,8
Be	0,1	0,1	<0,1	<0,1	<0,1	0,11	0,21	0,34	0,47	0,63	0,74	0,91	1,91	0,244	0,398	1,6
Bi	0,02	0,02	<0,02	0,036	0,049	0,067	0,10	0,13	0,18	0,24	0,28	0,36	0,96	0,18	0,293	2
Ca	100	50	<50	<50	58	98	287	619	1039	1567	1965	2357	11714	0,398	0,648	2,7
Cd	0,01	0,01	<0,01	<0,01	<0,01	<0,01	0,014	0,024	0,037	0,056	0,079	0,13	0,71			1,5
Ce	0,1	0,1	2,1	7,7	13	18	30	54	91	127	149	174	799	0,352	0,573	2,6
Co	0,1	0,1	<0,1	0,73	1,5	2,8	6,2	10	13	15	17	20	179	0,188	0,306	3,6
Cr	0,5	0,5	0,61	3,1	5,7	8,9	16	21	26	30	35	43	187	0,154	0,251	2,5
Cs	0,02	0,02	0,092	0,51	0,73	1,0	1,7	2,8	3,8	4,7	5,1	5,9	11	0,24	0,391	2,1
Cu	0,01	0,01	0,51	1,5	2,9	5,0	10	16	23	28	33	42	660	0,249	0,405	3,1
Dy	0,02	0,02	0,18	0,34	0,56	0,80	1,3	2,2	3,8	5,7	7,0	8,7	49	0,336	0,547	2,4
Er	0,02	0,02	0,048	0,16	0,26	0,37	0,64	1,0	1,7	2,4	2,9	3,7	17	0,308	0,501	2,6
Eu	0,02	0,02	0,033	0,083	0,14	0,22	0,38	0,63	1,1	1,7	2,2	2,7	22	0,349	0,568	2,8
Fe	100	100	1010	5207	9074	14198	22109	28010	32589	36646	39524	45063	158298	0,116	0,195	2,2
Ga	0,1	0,1	0,16	1,0	1,8	2,5	3,7	5,2	6,5	7,6	8,2	9,0	12	0,168	0,273	1,9
Gd	0,02	0,02	0,14	0,40	0,63	0,85	1,6	2,8	5,0	7,7	9,9	12	80	0,371	0,604	2,8
Ge	0,1	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	0,10	0,15	0,18	0,23	0,46			1
Hf	0,02	0,02	<0,02	<0,02	0,023	0,034	0,059	0,089	0,13	0,17	0,20	0,25	0,57	0,234	0,381	1,8
Hg	0,005	0,005	<0,0025	<0,0025	<0,0025	0,0027	0,0062	0,011	0,017	0,025	0,032	0,040	0,17	0,331	0,538	2,5
Ho	0,02	0,02	0,031	0,060	0,11	0,15	0,25	0,42	0,70	1,0	1,3	1,6	8,1	0,329	0,536	2,4
In	0,02	0,02	<0,02	<0,02	<0,02	<0,02	<0,02	<0,02	0,023	0,029	0,034	0,040	0,065			0,8
K	100	100	181	547	667	853	1754	3712	5202	6599	7420	8298	12902	0,288	0,471	1,9
La	0,5	0,5	0,632	2,0	3,3	5,8	11	20	37	56	65	82	408	0,389	0,634	2,8
Li	0,1	0,1	<0,1	0,61	1,5	3,2	7,1	12	17	21	25	29	59	0,248	0,403	3,1
Lu	0,02	0,02	<0,02	0,02	0,032	0,047	0,075	0,11	0,16	0,24	0,29	0,34	1,2	0,246	0,401	2,1
Mg	100	50	<50	273	777	1523	3020	4933	6428	7464	8043	9280	21057	0,197	0,323	2,9
Mn	1	1	<1	22	43	69	136	229	343	471	567	791	18372	0,29	0,473	4,6
Mo	0,01	0,01	0,018	0,085	0,12	0,15	0,24	0,39	0,61	1,2	2,1	4,3	23	0,297	0,483	3,1
Na	10	1	<1	<1	<1	7,4	20	38	59	84	93	122	373	0,335	0,545	2,9
Nb	0,02	0,02	<0,01	0,082	0,15	0,31	0,90	1,6	2,5	3,2	3,6	4,1	6,5	0,309	0,503	2,8
Nd	0,02	0,02	0,591	1,9	3,1	5,4	10	18	34	51	64	79	498	0,384	0,625	2,9
Ni	0,1	0,1	0,142	1,3	3,4	5,5	11	18	21	25	28	32	81	0,174	0,283	2,8
P	10	10	23	73	102	148	235	357	508	682	769	890	2126	0,247	0,402	2
Pb	0,01	0,01	1,6	3,3	4,5	5,3	6,8	8,9	12	17	20	28	134	0,169	0,275	1,9
Pd	0,01	0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	<0,01	0,011	0,023			0,7
Pr	0,02	0,02	0,182	0,538	0,865	1,5	2,9	5,0	9,1	14	17	21	131	0,37	0,603	2,9
Pt	0,002	0,002	<0,002	<0,002	<0,002	<0,002	<0,002	<0,002	<0,002	<0,002	<0,002	0,0021	0,0036			0,6
Rb	0,1	0,1	0,89	4,9	6,3	8,3	21	42	57	69	75	83	135	0,251	0,409	2,2
Re	0,001	0,001	<0,001	<0,001	<0,001	<0,001	<0,001	<0,001	<0,001	0,0011	0,0014	0,0019	0,0031			0,8
S	200	2	<2	12	29	42	69	110	159	234	311	440	1746	0,26	0,424	3,2
Sb	0,02	0,02	<0,02	0,032	0,037	0,047	0,068	0,106	0,168	0,232	0,296	0,38	1,2	0,294	0,479	2,1
Sc	0,1	0,1	0,11	0,23	0,45	0,64	1,2	1,9	2,4	2,8	3,2	3,6	5,7	0,206	0,336	1,7
Se	0,1	0,05	<0,05	<0,05	0,08	0,14	0,24	0,36	0,53	0,75	0,94	1,2	4,1	0,255	0,416	2,2
Sm	0,02	0,02	0,16	0,41	0,66	1,1	2,0	3,4	6,1	9,5	12	14	101	0,361	0,588	2,8
Sn	0,1	0,1	<0,1	0,11	0,18	0,23	0,35	0,55	0,74	0,90	1,0	1,1	1,7	0,224	0,365	1,5
Sr	0,5	0,5	<0,5	1,3	1,8	2,5	3,9	5,6	9,0	15	19	23	52	0,267	0,434	2,3
Ta	0,05	0,05	<0,05	<0,05	<0,05	<0,05	<0,05	<0,05	<0,05	<0,05	<0,05	<0,05	<0,05			
Tb	0,02	0,02	0,031	0,064	0,096	0,14	0,24	0,42	0,74	1,1	1,4	1,7	10	0,352	0,573	2,5
Te	0,02	0,02	<0,02	<0,02	<0,02	<0,02	<0,02	<0,02	0,023	0,033	0,038	0,049	0,083			0,9
Th	0,1	0,1	<0,1	1,1	1,9	2,6	3,8	5,2	7,1	9,0	9,8	10,7	19,8	0,203	0,33	2,6
Ti	10	10	<10	28	58	223	981	1527	2024	2406	2658	3060	4303	0,202	0,33	2,9
Tl	0,02	0,02	<0,02	0,032	0,053	0,070	0,18	0,33	0,43	0,51	0,56	0,63	1,9	0,212	0,345	2,3
Tm	0,02	0,02	<0,02	0,021	0,035	0,055	0,089	0,14	0,21	0,31	0,37	0,46	1,9	0,28	0,456	2,3
U	0,1	0,1	0,10	0,33	0,48	0,67	0,91	1,2	1,7	2,3	3,0	4,2	34	0,209	0,341	2,5
V	2		<2	6,8	9,9	14	19	29	37	43	48	56	89	0,19	0,31	2
W	0,1	0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	<0,1	0,22			0,6
Y	0,01	0,01	0,80	1,5	2,5	3,5	6,1	10	18	26	32	42	163	0,357	0,581	2,3
Yb	0,02	0,02	0,061	0,14	0,21	0,33	0,52	0,77	1,1	1,7	2,0	2,6	9,6	0,254	0,414	2,2
Zn	0,1	0,1	0,36	4,6	9,9	15	31	49	64	74	83	94	254	0,207	0,337	2,9
Zr	0,1	0,1	<0,1	0,65	1,1	1,6	2,7	4,2	5,9	7,7	9,8	12	29	0,252	0,411	2,8

Table 6. Comparison of the Nordkinn and Nordland+Troms datasets.

		Nordkinn N=808			Nordland + Troms N=982		
ELEMENT	DL	MEDIAN	Q98	MAX	MEDIAN	Q98	MAX
Ag	0,002	**0,011**	**0,077**	**0,22**	0,0151	0,12	0,45
Al	100	**15105**	**25453**	**32809**	9864	27054	44069
As	0,1	**2,3**	**18**	**67**	1,9	17,7	376
Au	0,0002	**0,001**	**0,005**	**0,034**	0,001	0,004	0,026
B	1	**<1**	**2,2**	**3,8**	<1	2,8	9,4
Ba	0,5	**45**	**127**	**190**	30,6	165	405
Be	0,1	**0,3**	**0,9**	**1,9**	0,2	0,8	3,2
Bi	0,02	**0,1**	**0,4**	**1,0**	0,1	0,3	4,4
Ca	100	**619**	**2357**	**11714**	1687	22245	207605
Cd	0,01	**0,02**	**0,13**	**0,71**	0,03	0,20	0,65
Ce	0,1	**54**	**174**	**799**	36,1	121	685
Co	0,1	**10**	**20**	**179**	8	24	55
Cr	0,5	**21**	**43**	**187**	20,9	88,4	475
Cs	0,02	**2,8**	**5,9**	**11,0**	1,2	4,6	8,4
Cu	0,01	**16**	**42**	**660**	15,8	72,7	123
Dy	0,02	**2**	**9**	**49**	1	5	20
Er	0,02	**1,0**	**3,7**	**17,0**	0,6	2,2	9,2
Eu	0,02	**0,6**	**2,7**	**22,0**	0,3	1,3	5,4
Fe	100	**28010**	**45063**	**158298**	18037	43188	89669
Ga	0,1	**5**	**9**	**12**	3	10	14
Gd	0,02	**3**	**12**	**80**	2	6	24
Ge	0,1	**<0,1**	**0,23**	**0,46**	<0,1	0,20	0,77
Hf	0,02	**0,09**	**0,25**	**0,57**	0,03	0,19	0,38
Hg	0,005	**0,011**	**0,040**	**0,170**	0,007	0,033	0,062
Ho	0,02	**0,4**	**1,6**	**8,1**	0,2	0,8	3,4
In	0,02	**<0,02**	**0,04**	**0,07**	<0,02	0,05	0,12
K	100	**3712**	**8298**	**12902**	1659	8487	13630
La	0,5	**20**	**82**	**408**	15,7	59,2	413
Li	0,1	**12**	**29**	**59**	11	37	76
Lu	0,02	**0,1**	**0,3**	**1,2**	0,1	0,3	1,0
Mg	100	**4933**	**9280**	**21057**	5044	17559	49350
Mn	1	**229**	**791**	**18372**	195	751	1558
Mo	0,01	**0**	**4**	**23**	0	4	40
Na	10	**38**	**122**	**373**	73,6	347	2010
Nb	0,02	**1,6**	**4,1**	**6,5**	0,5	3,0	6,5
Nd	0,02	**18**	**79**	**498**	12,5	47,7	256
Ni	0,1	**18**	**32**	**81**	14,4	53,3	157
P	10	**357**	**890**	**2126**	518	1550	7430
Pb	0,01	**8,9**	**28**	**134**	4,9	23,9	180
Pd	0,01	**<0,01**	**0,011**	**0,023**	<0,01	<0,01	0,030
Pr	0,02	**5**	**21**	**131**	3	13	65
Pt	0,002	**<0,002**	**0,0021**	**0,0036**	<0,002	0,0022	0,0065
Rb	0,1	**42**	**83**	**135**	17,1	72,9	295
Re	0,001	**<0,001**	**0,0019**	**0,0031**	<0,001	0,0014	0,0028
S	200	**110**	**440**	**1746**	<200	467	2655
Sb	0,02	**0,11**	**0,38**	**1,20**	0,04	0,33	0,96
Sc	0,1	**1,9**	**3,6**	**5,7**	1,72	5,83	11
Se	0,1	**0,4**	**1,2**	**4,1**	0,3	1,2	4,3
Sm	0,02	**3**	**14**	**101**	2	8	33
Sn	0,1	**0,6**	**1,1**	**1,7**	0,3	1,5	3,5
Sr	0,5	**5,6**	**23**	**52**	7,44	82,6	934
Ta	0,05	**<0,05**	**<0,05**	**<0,05**	<0,05	<0,05	0,072
Tb	0,02	**0,4**	**1,7**	**10,0**	0,2	0,8	3,9
Te	0,02	**<0,02**	**0,05**	**0,08**	<0,02	0,08	0,49
Th	0,1	**5**	**11**	**20**	5	17	72
Ti	10	**1527**	**3060**	**4303**	797	2583	3629
Tl	0,02	**0,3**	**0,6**	**1,9**	0,1	0,5	1,4
Tm	0,02	**0,1**	**0,5**	**1,9**	0,1	0,3	1,2
U	0,1	**1**	**4**	**34**	1	4	33
V	2	**29**	**56**	**89**	24,4	91,5	209
W	0,1	**<0,1**	**<0,1**	**0,22**	<0,1	0,44	0,94
Y	0,01	**10**	**42**	**163**	5,77	22,7	106
Yb	0,02	**0,8**	**2,6**	**9,6**	0,5	1,9	7,7
Zn	0,1	**49**	**94**	**254**	32	107	230
Zr	0,1	**4**	**12**	**29**	1	10	16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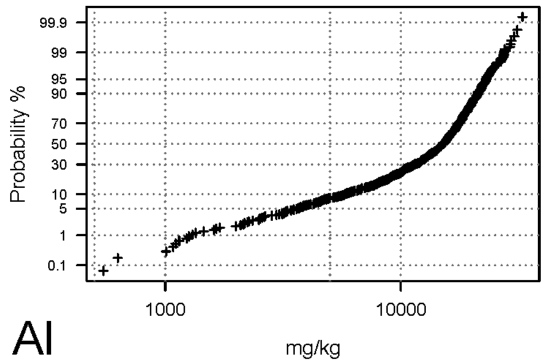
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mg/kg
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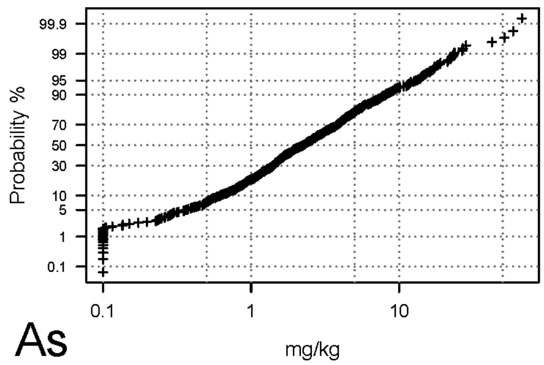
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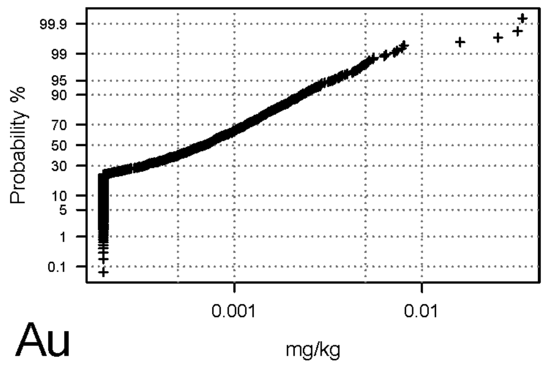
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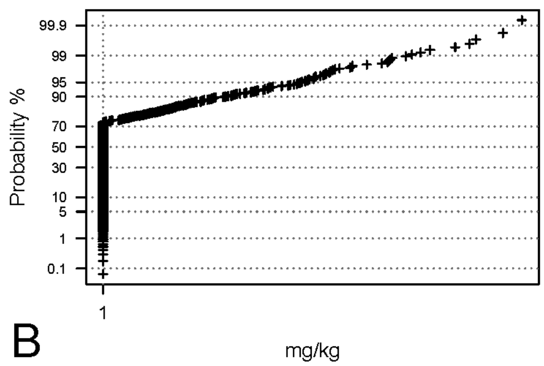
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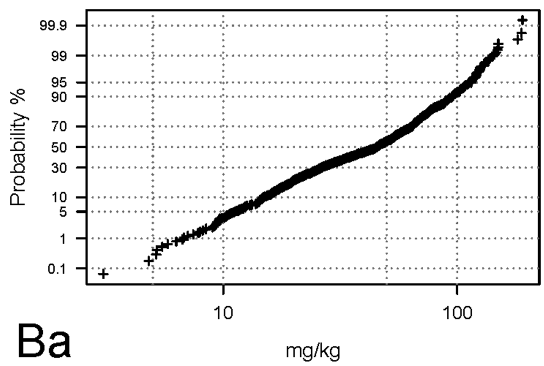
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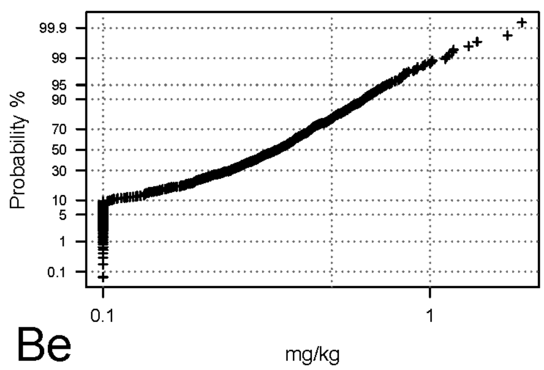
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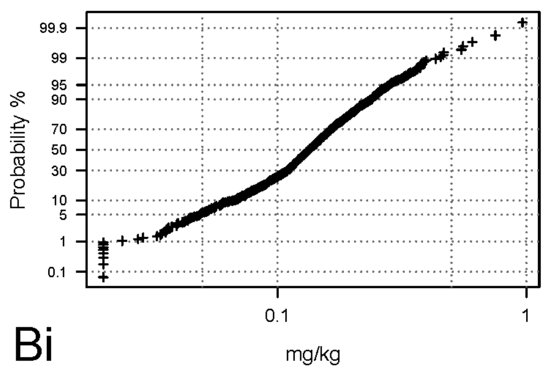
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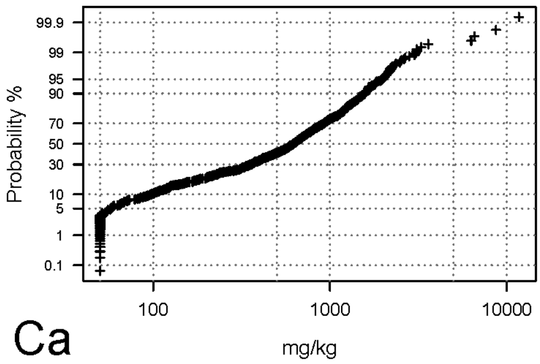
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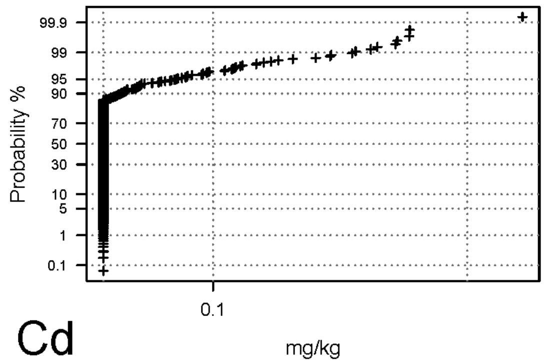
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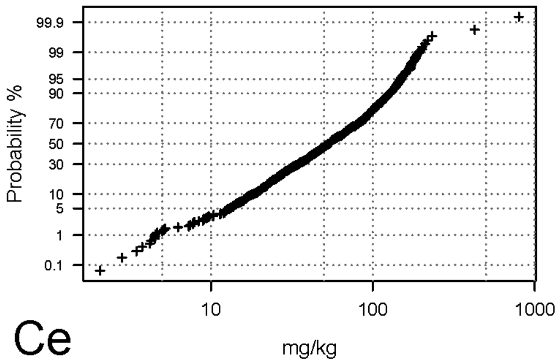
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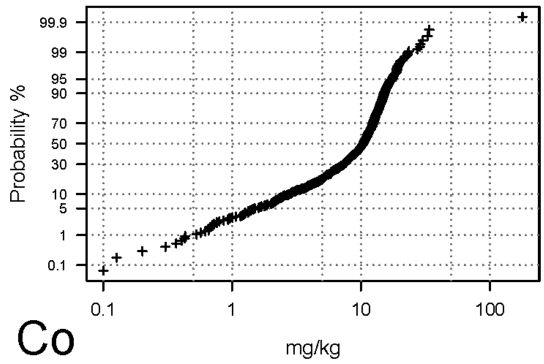
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1
10
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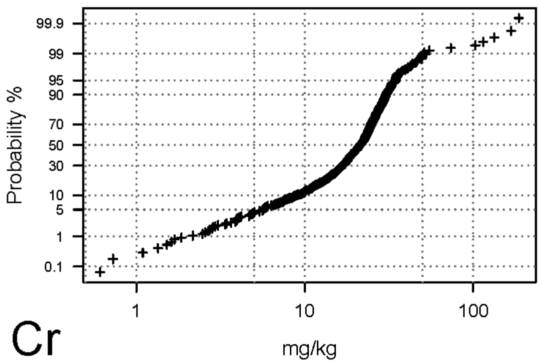
Co
mg/kg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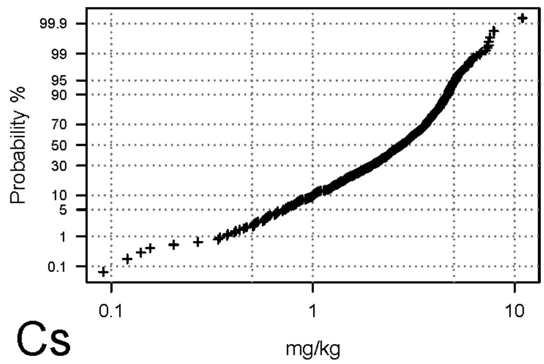
Cr
mg/kg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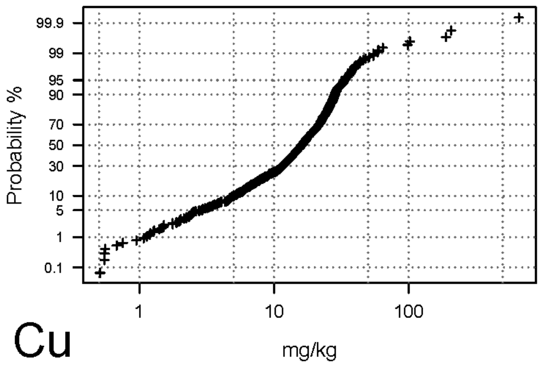
0.1
0.1
1
10
Cs
mg/kg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0.1
1
10
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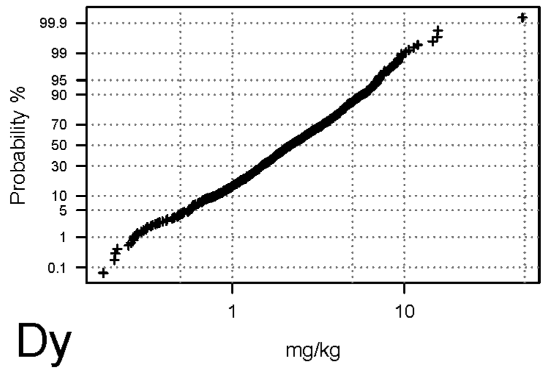
mg/kg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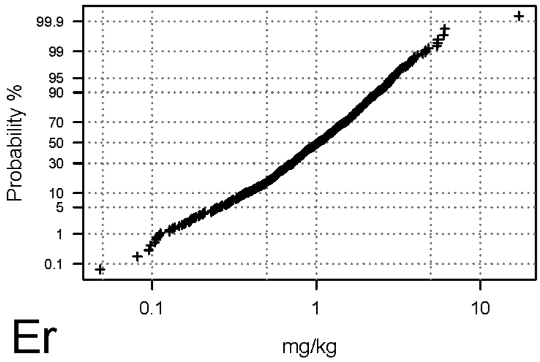
30
10
5
1
0.1
1
10
Dy
mg/kg



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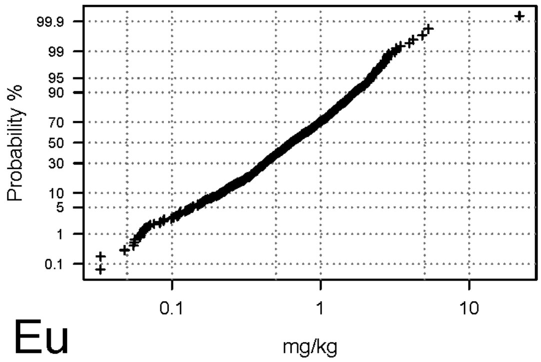

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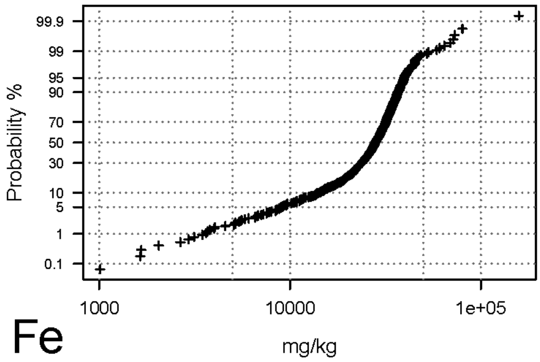

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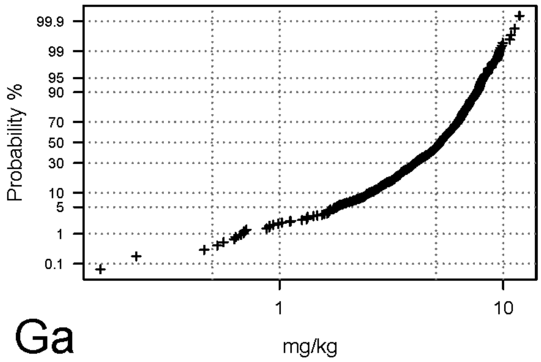

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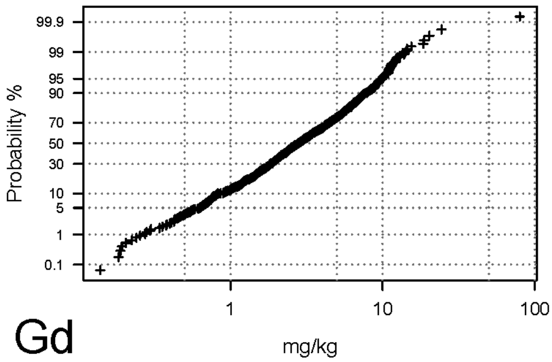

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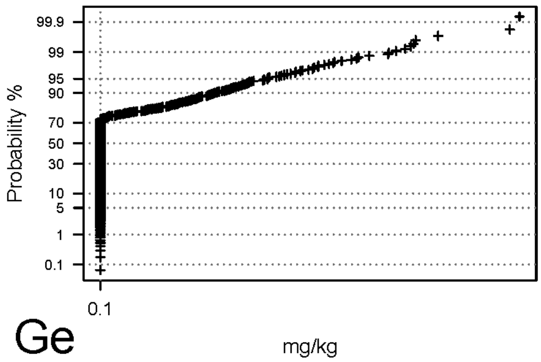

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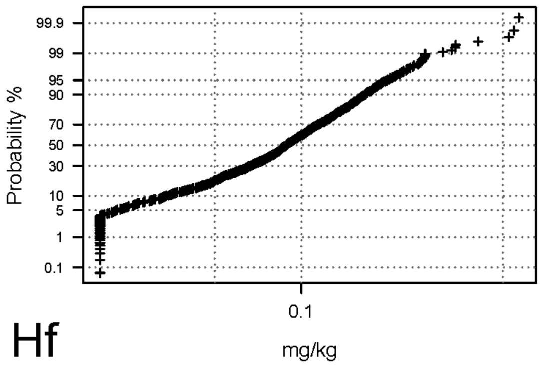

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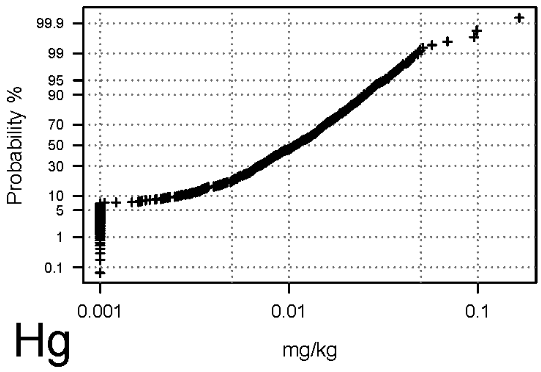

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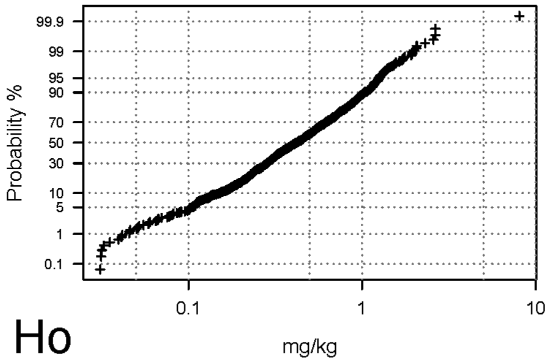

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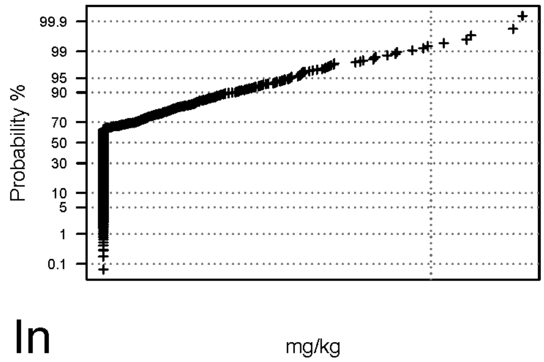

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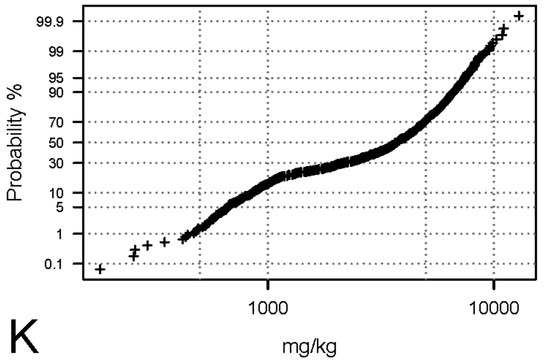

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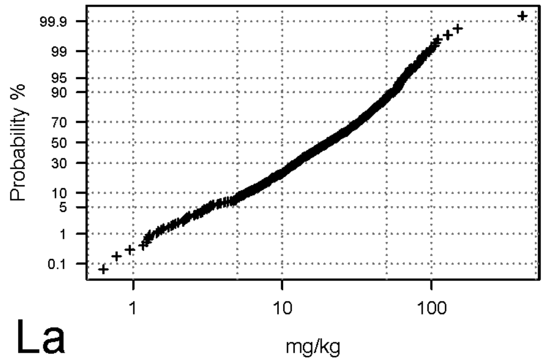

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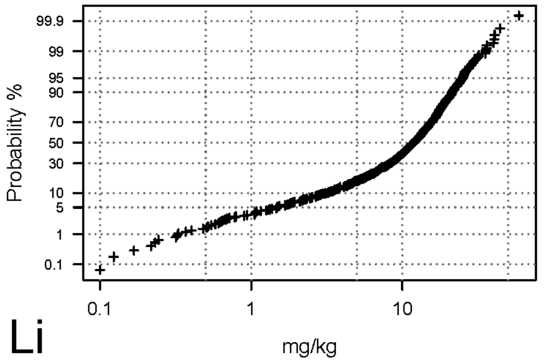

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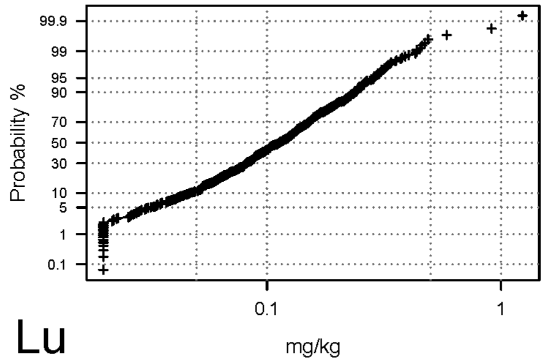

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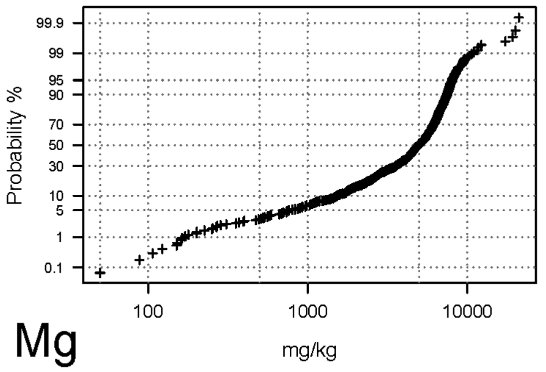

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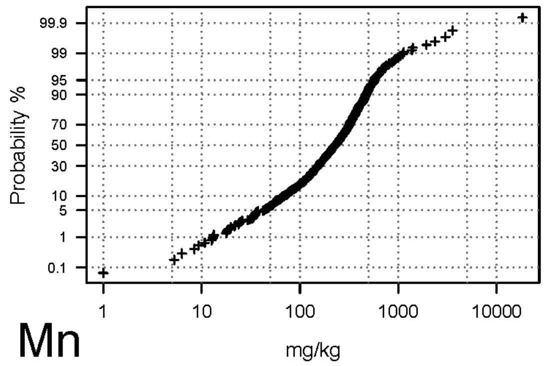

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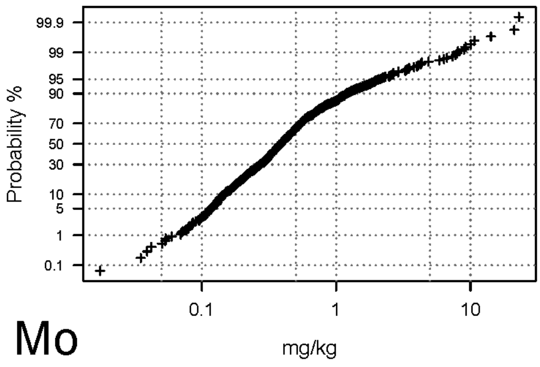
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10
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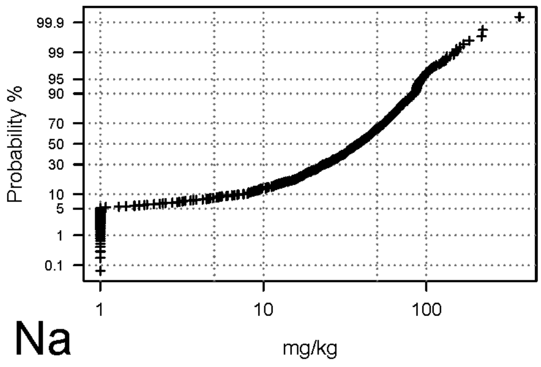
0.1
0.1
1
10
mg/kg
Mo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0.1
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10
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mg/kg
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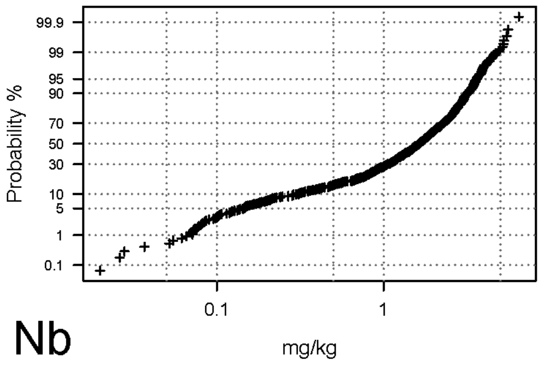
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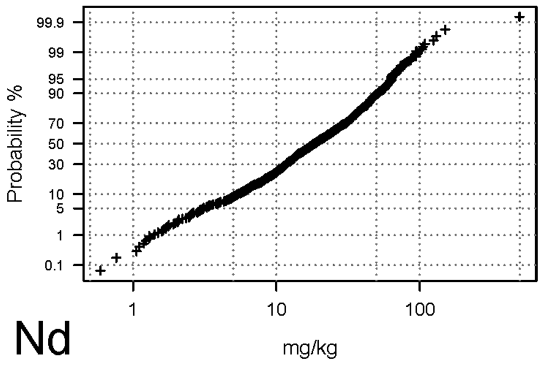
mg/kg
Nb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0.1
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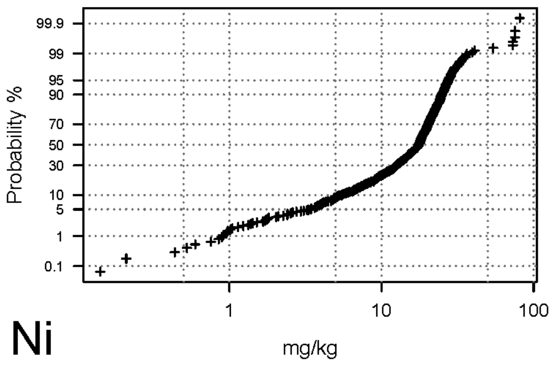
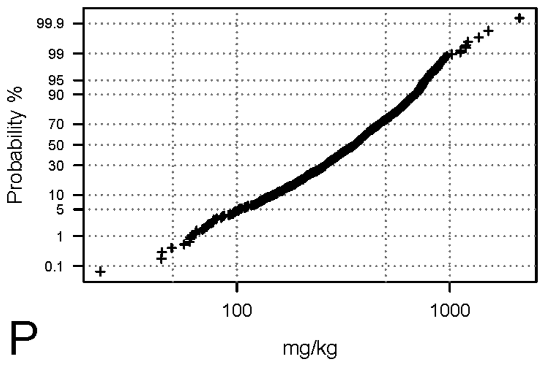
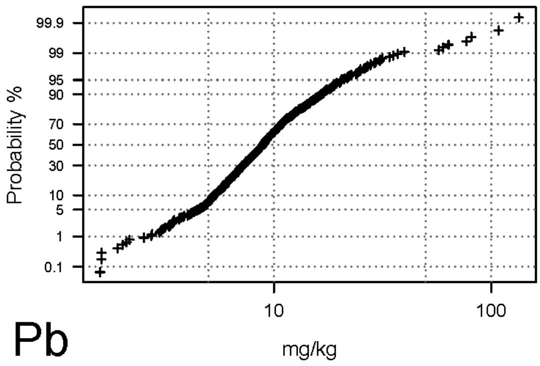
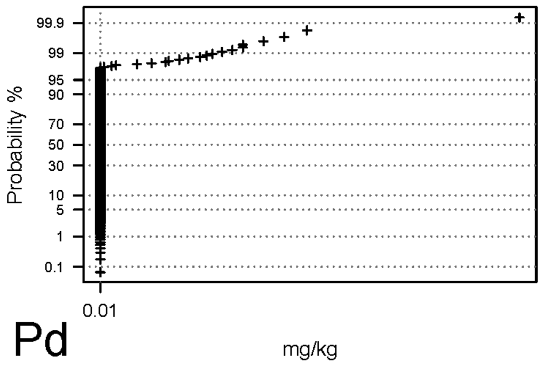
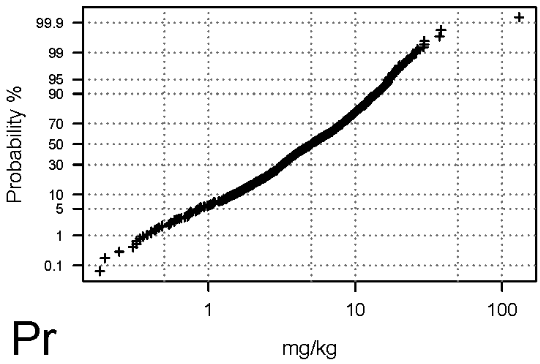
mg/kg
Nd


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

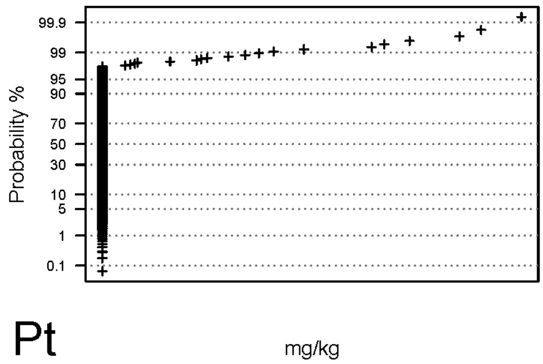

Probability %
99.9
99
95
90
70
50
30
10
5
1
0.1
100
1000
mg/kg
P


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

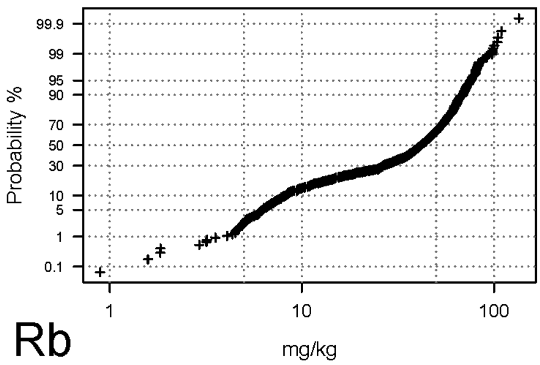

Probability %
99.9
99
95
90
70
50
30
10
5
1
0.1
0.01
mg/kg
Pd



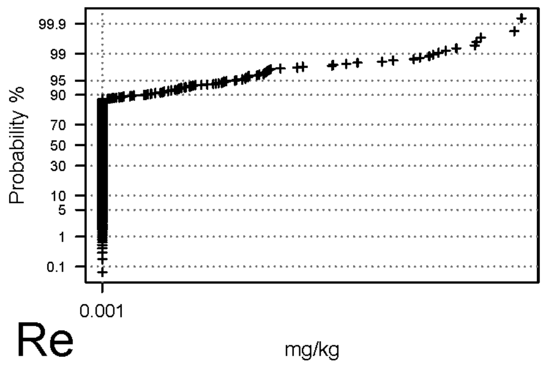
Pr



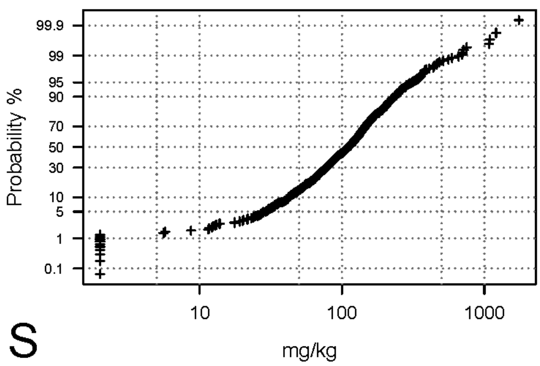
Pt



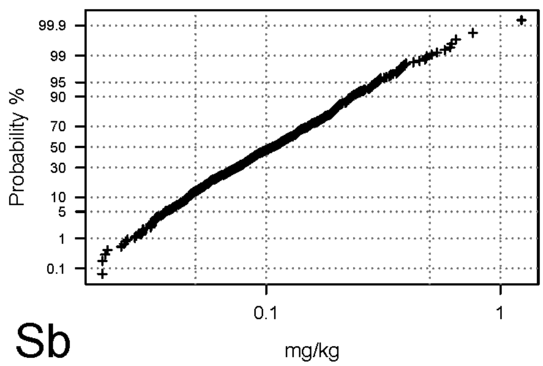
Rb



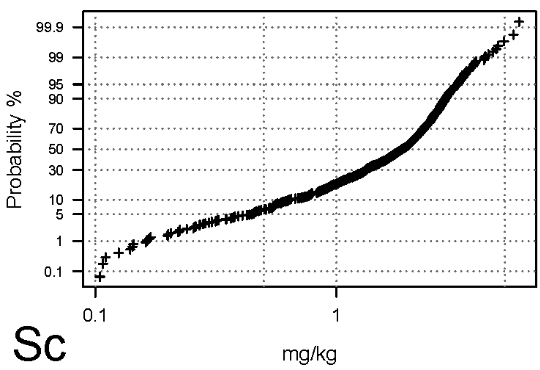
Re



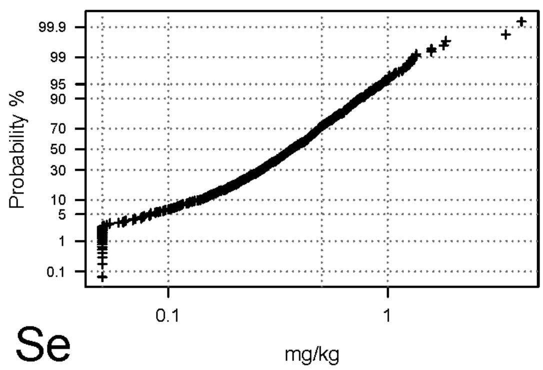
S



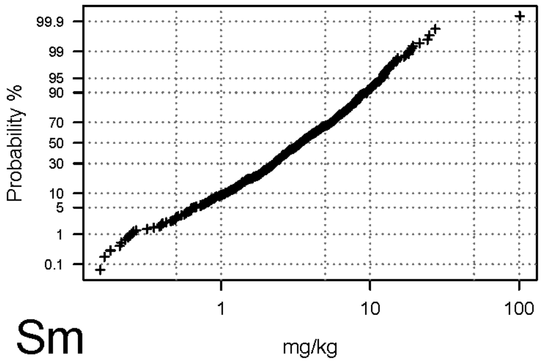
Sb

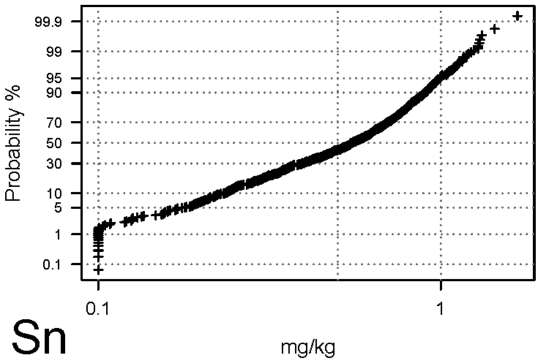


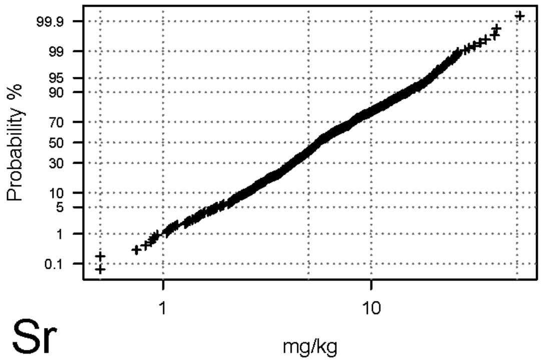
Sc

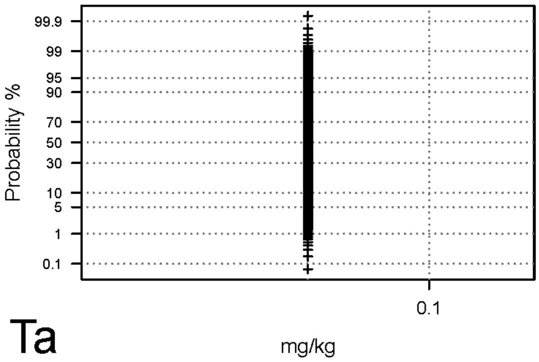


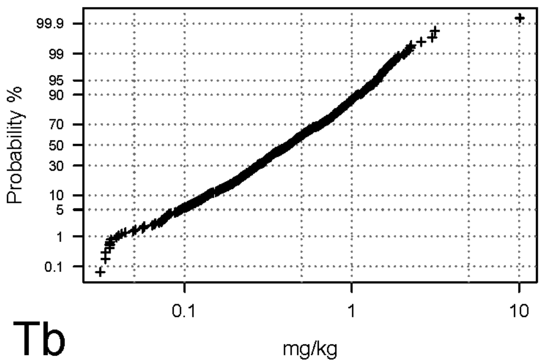
Se

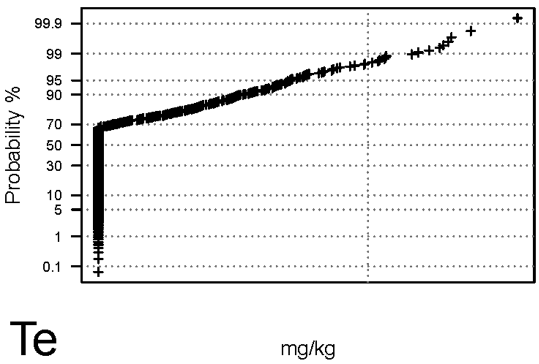

Probability %
mg/kg
Sm

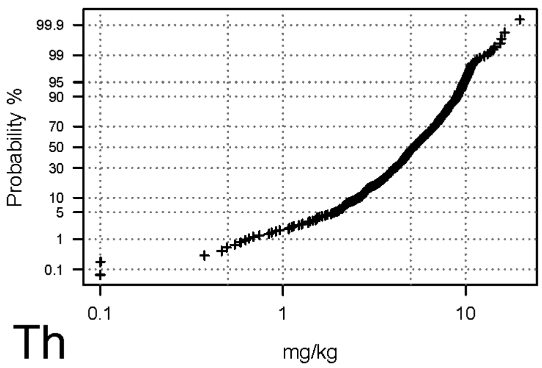

Probability %
mg/kg
Sn

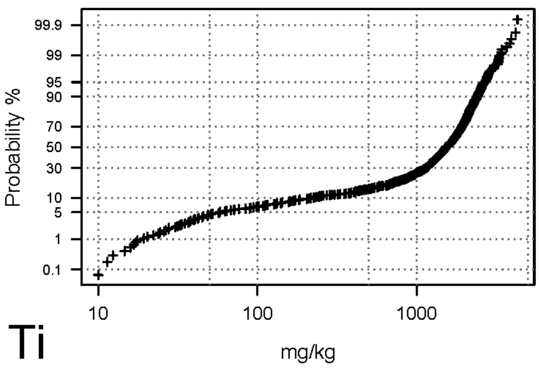

Probability %
mg/kg
Sr

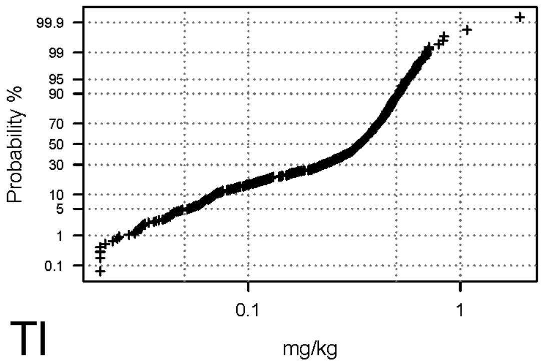

Probability %
mg/kg
Ta


Probability %
mg/kg
Tb

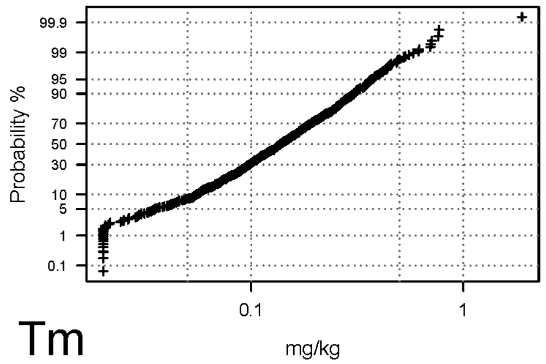

Probability %
mg/kg
Te


Probability %
mg/kg
Th

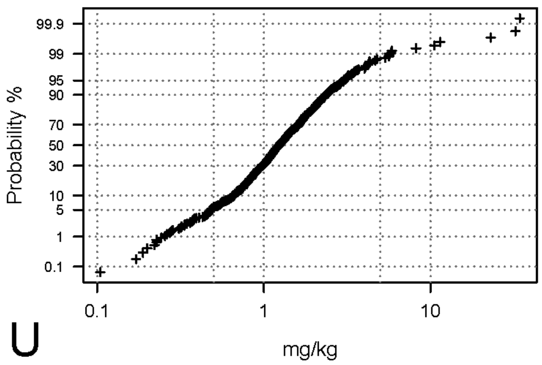

Probability %
mg/kg
Ti



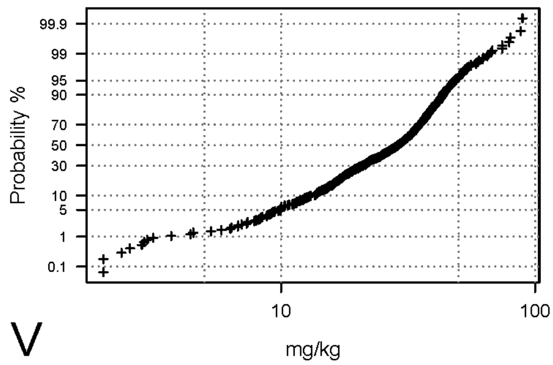
Tl



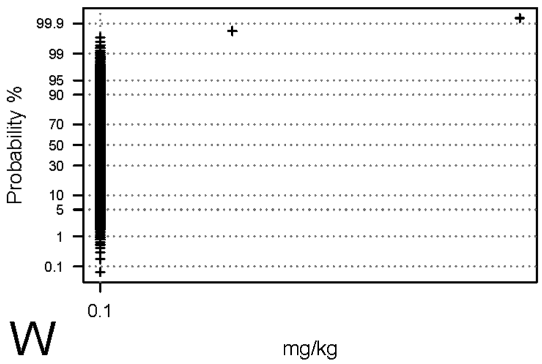
Tm



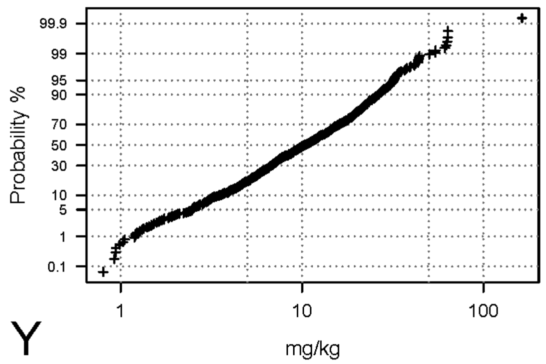
U



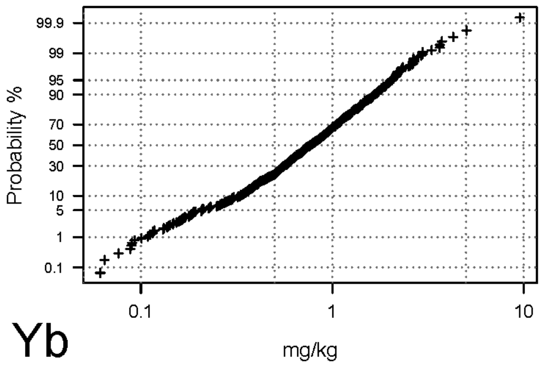
V



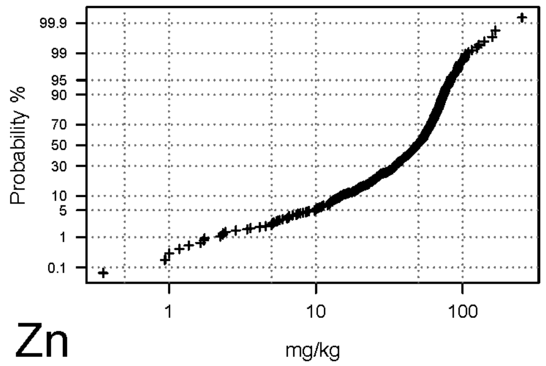
W



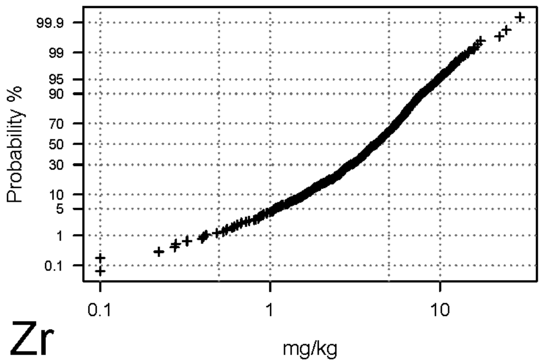
Y

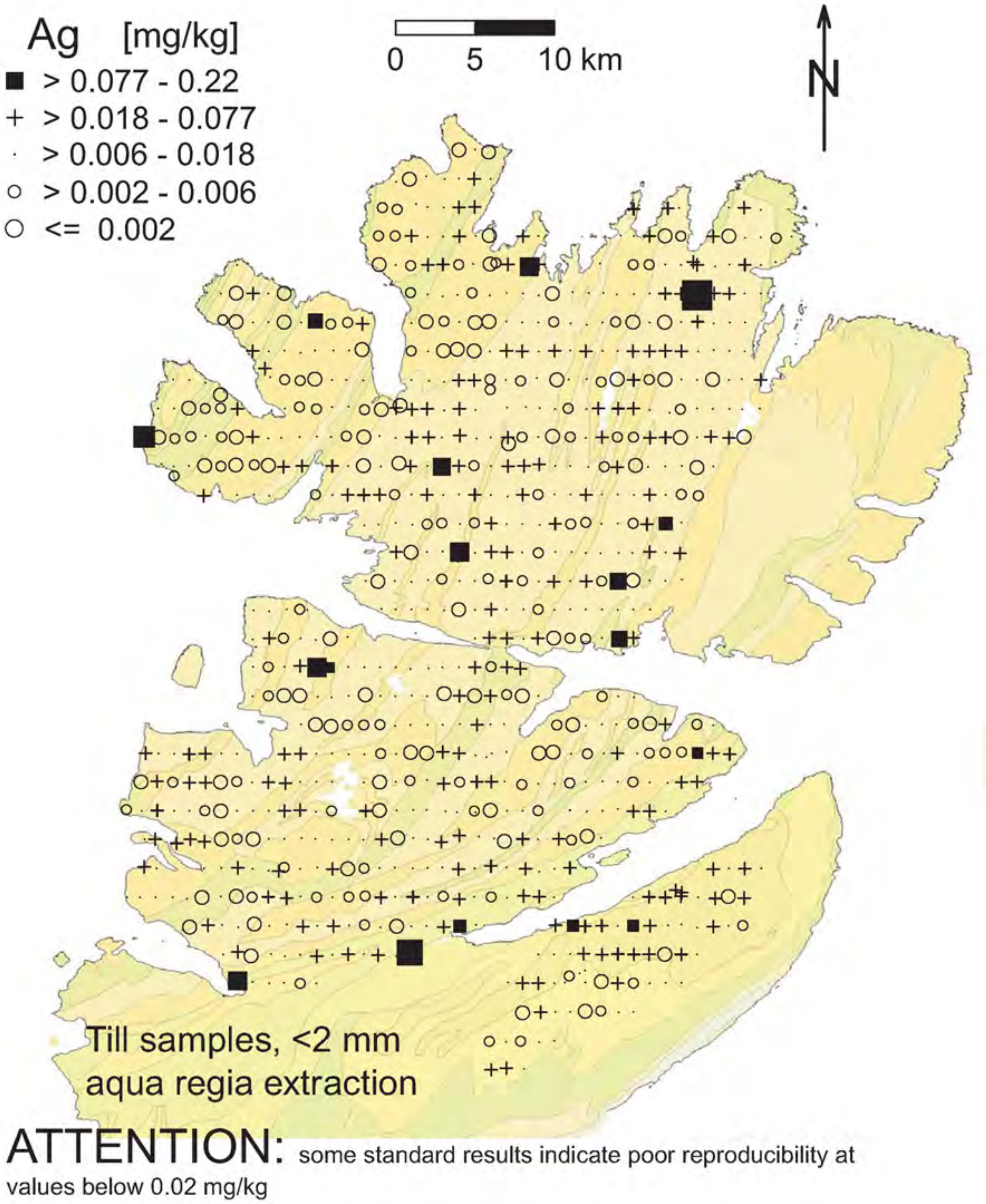


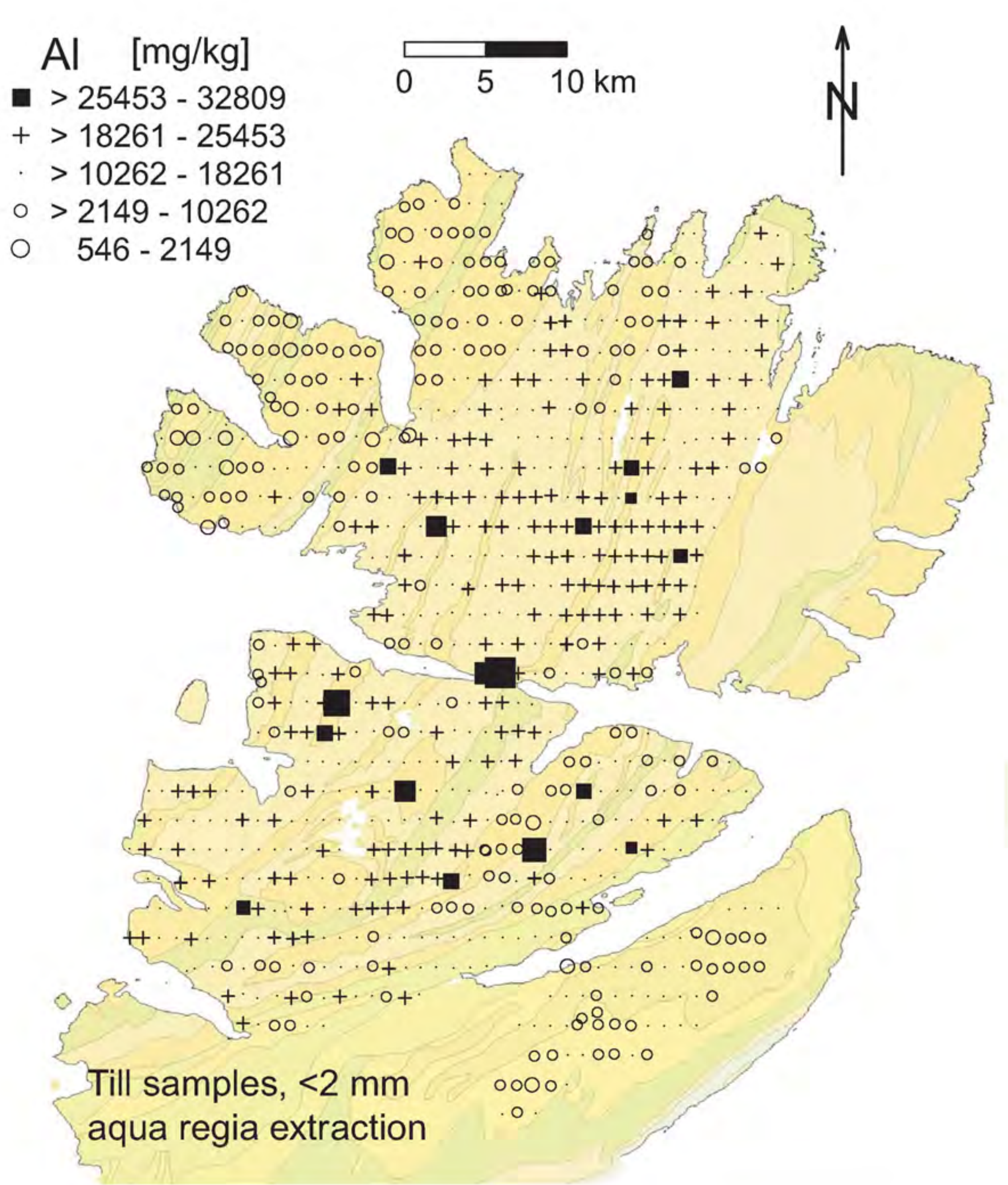
Yb

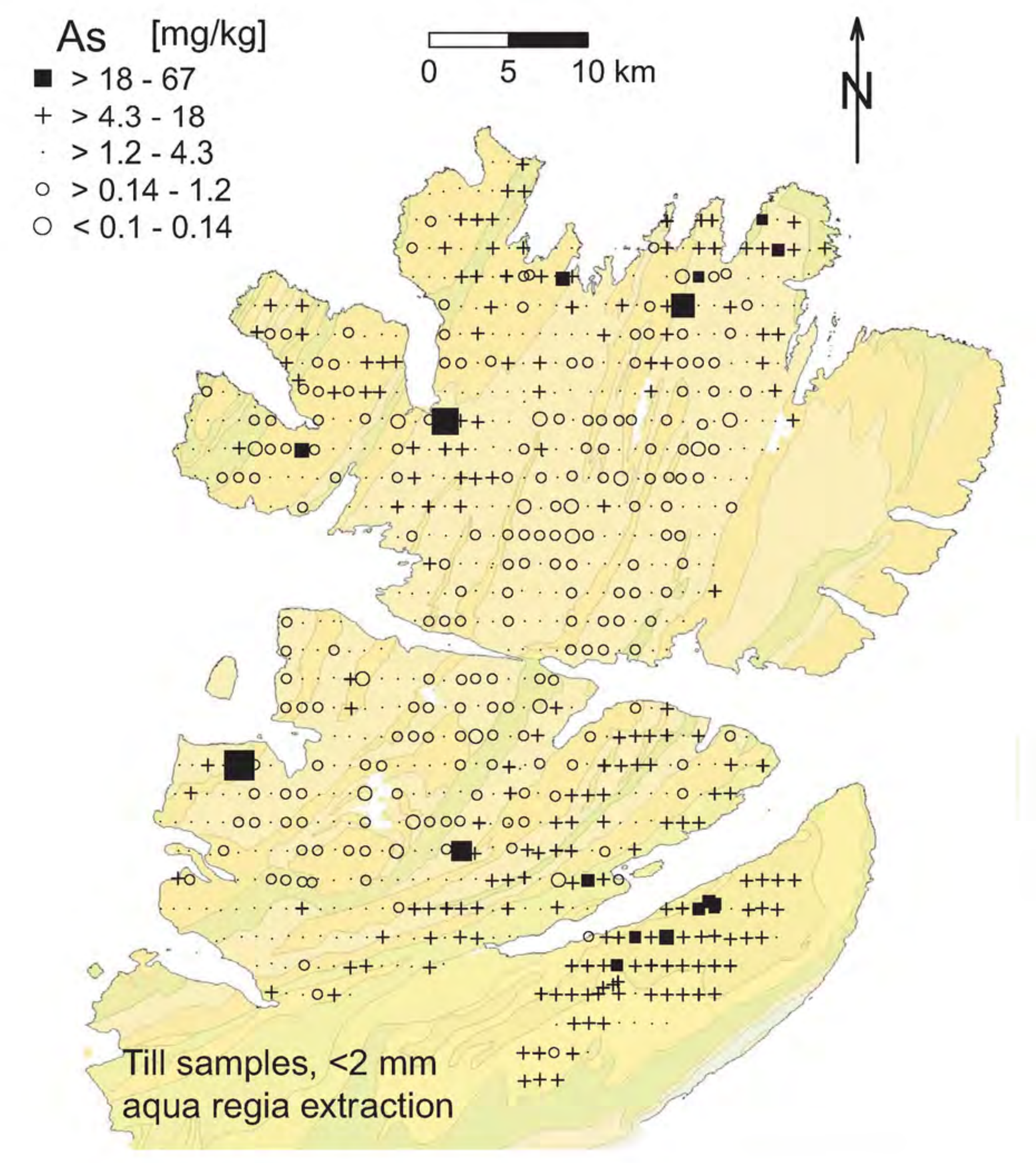


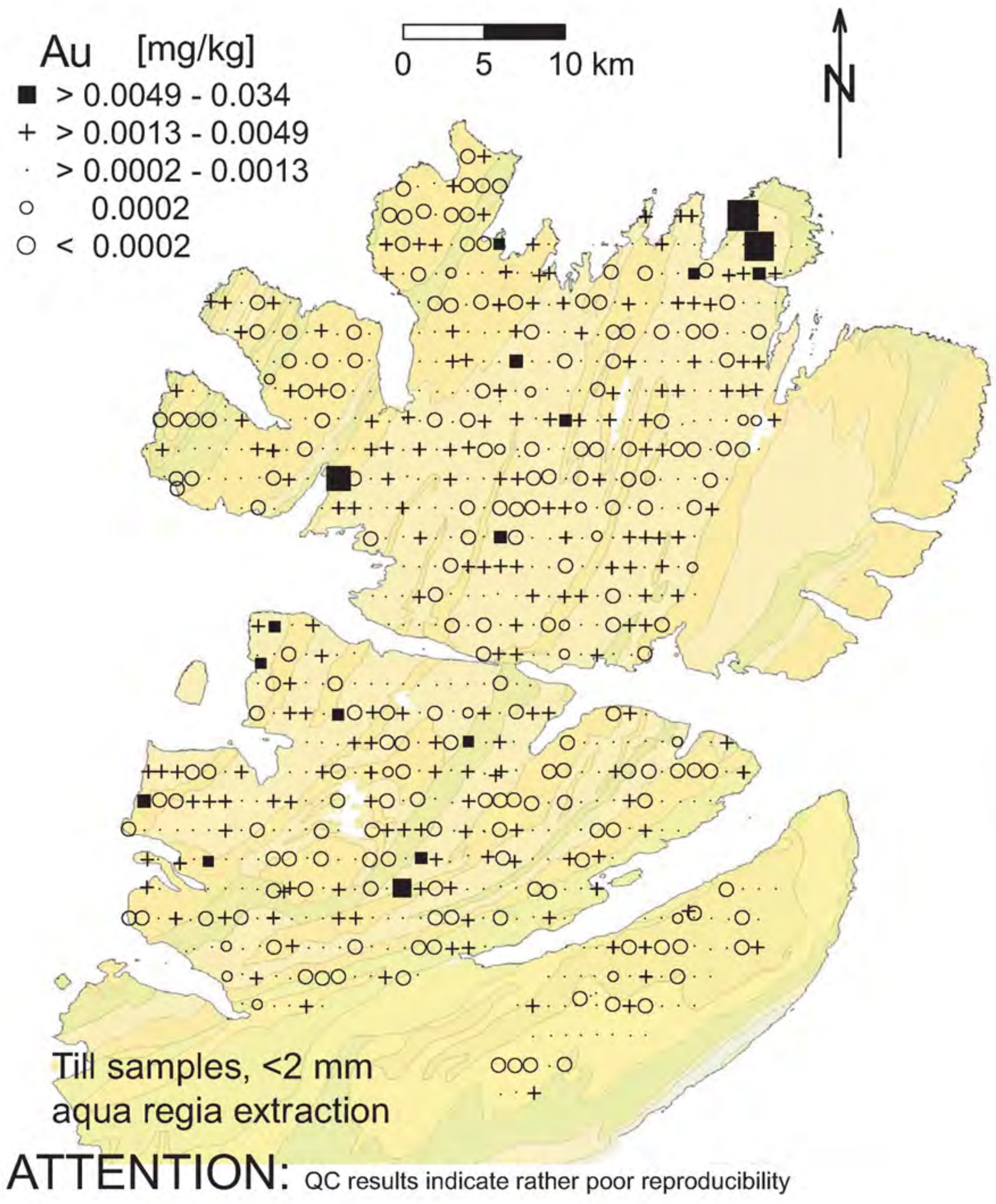
Zn

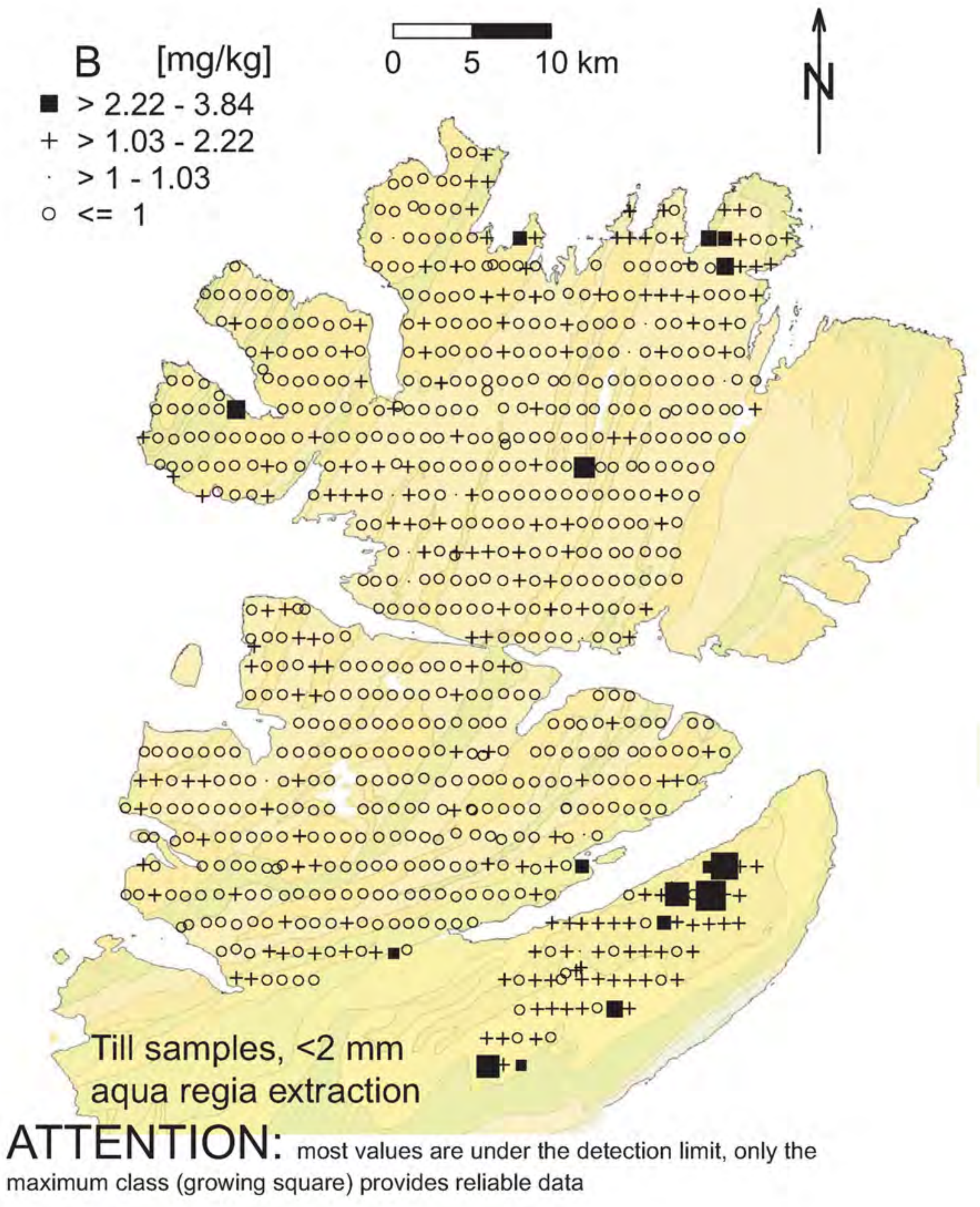

Probability %
99.9
99
95
90
70
50
30
10
5
1
0.1
0.1
1
10
Zr
mg/kg

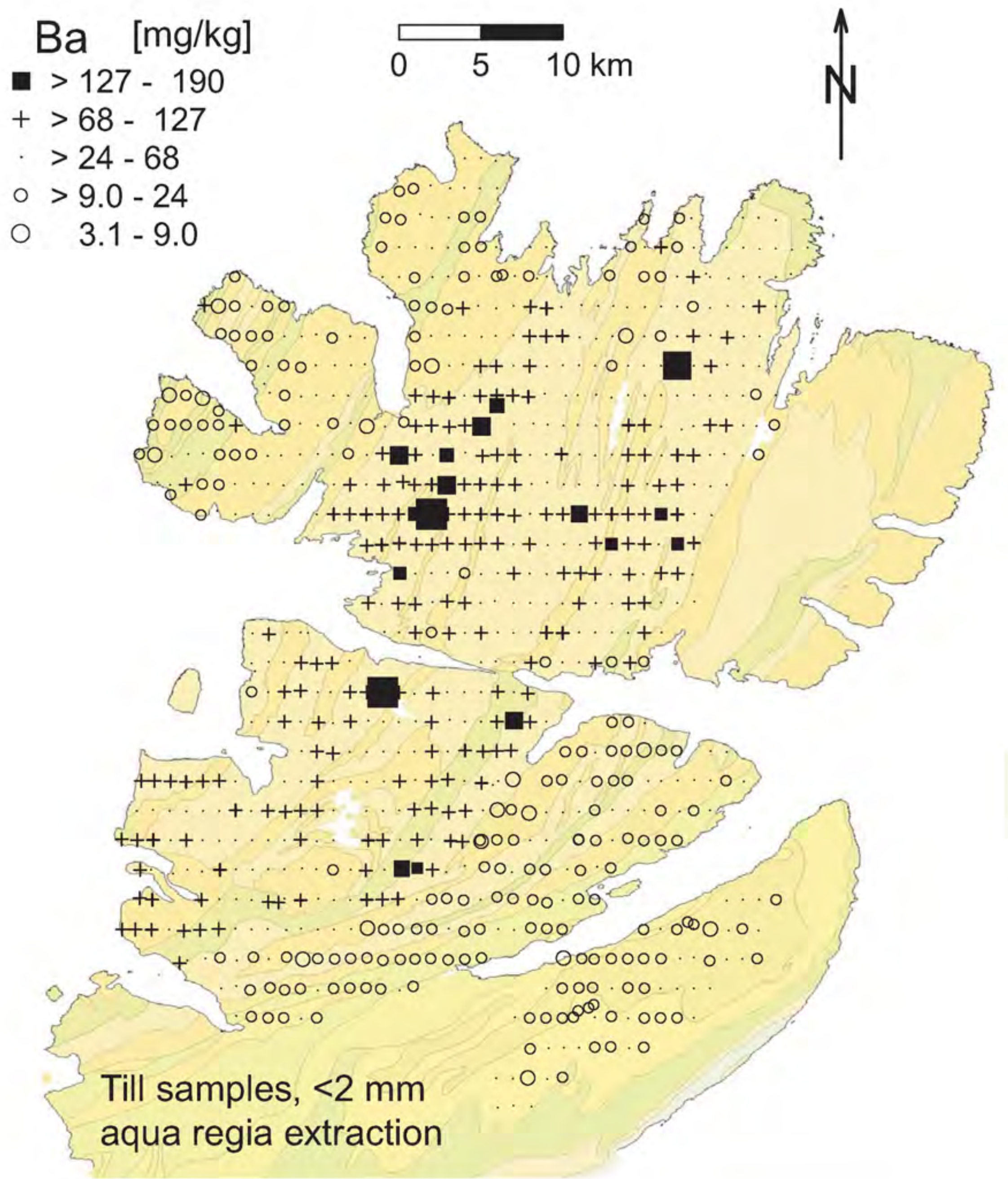

Ag [mg/kg]
> 0.077 - 0.22
> 0.018 - 0.077
> 0.006 - 0.018
> 0.002 - 0.006
<= 0.002
0 5 10 km
N
Till samples, <2 mm
aqua regia extraction
ATTENTION: some standard results indicate poor reproducibility at values below 0.02 mg/kg

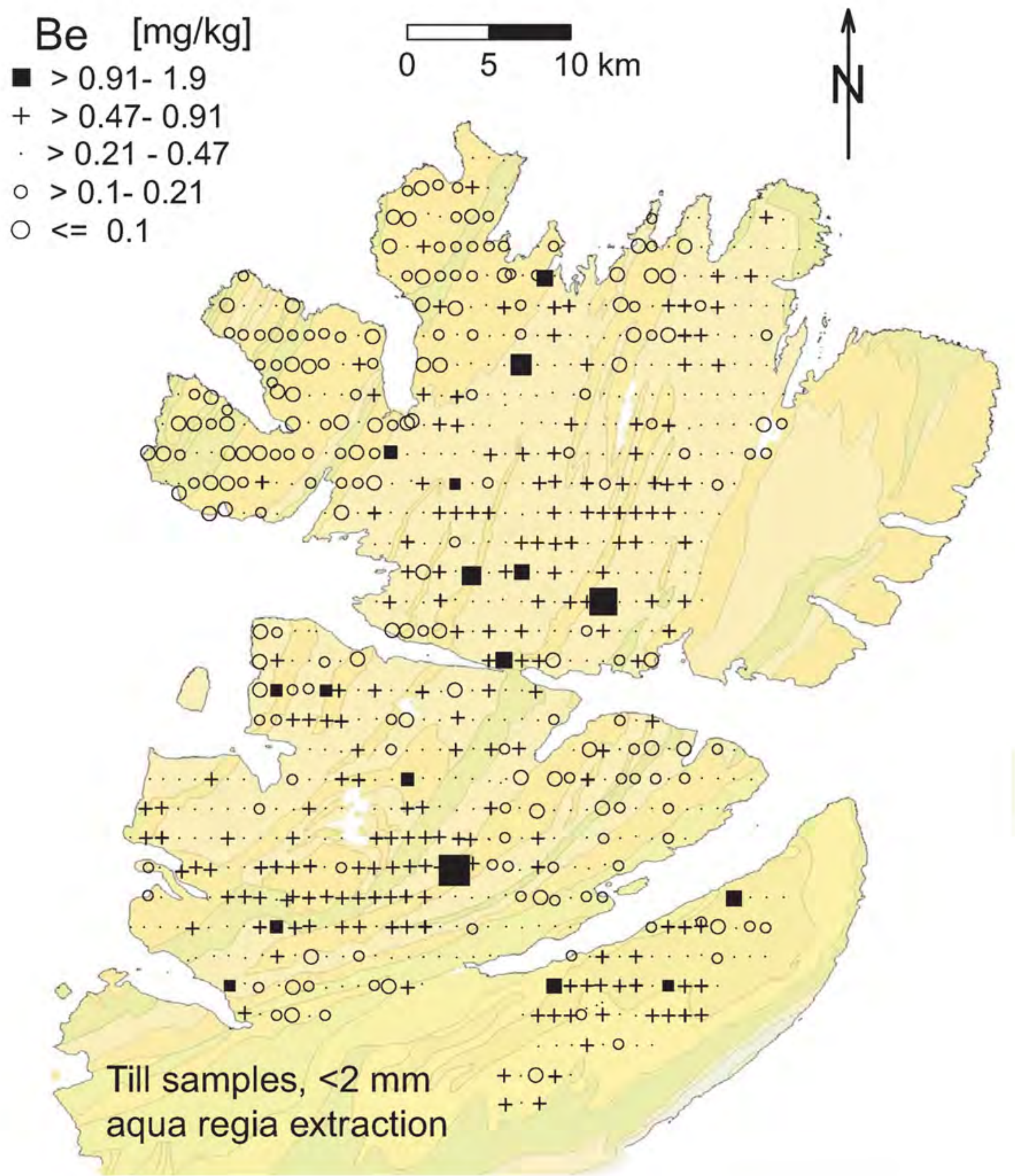

Al [mg/kg]
> 25453 - 32809
> 18261 - 25453
> 10262 - 18261
> 2149 - 10262
546 - 2149
0 5 10 km
N
Till samples, <2 mm
aqua regia extraction

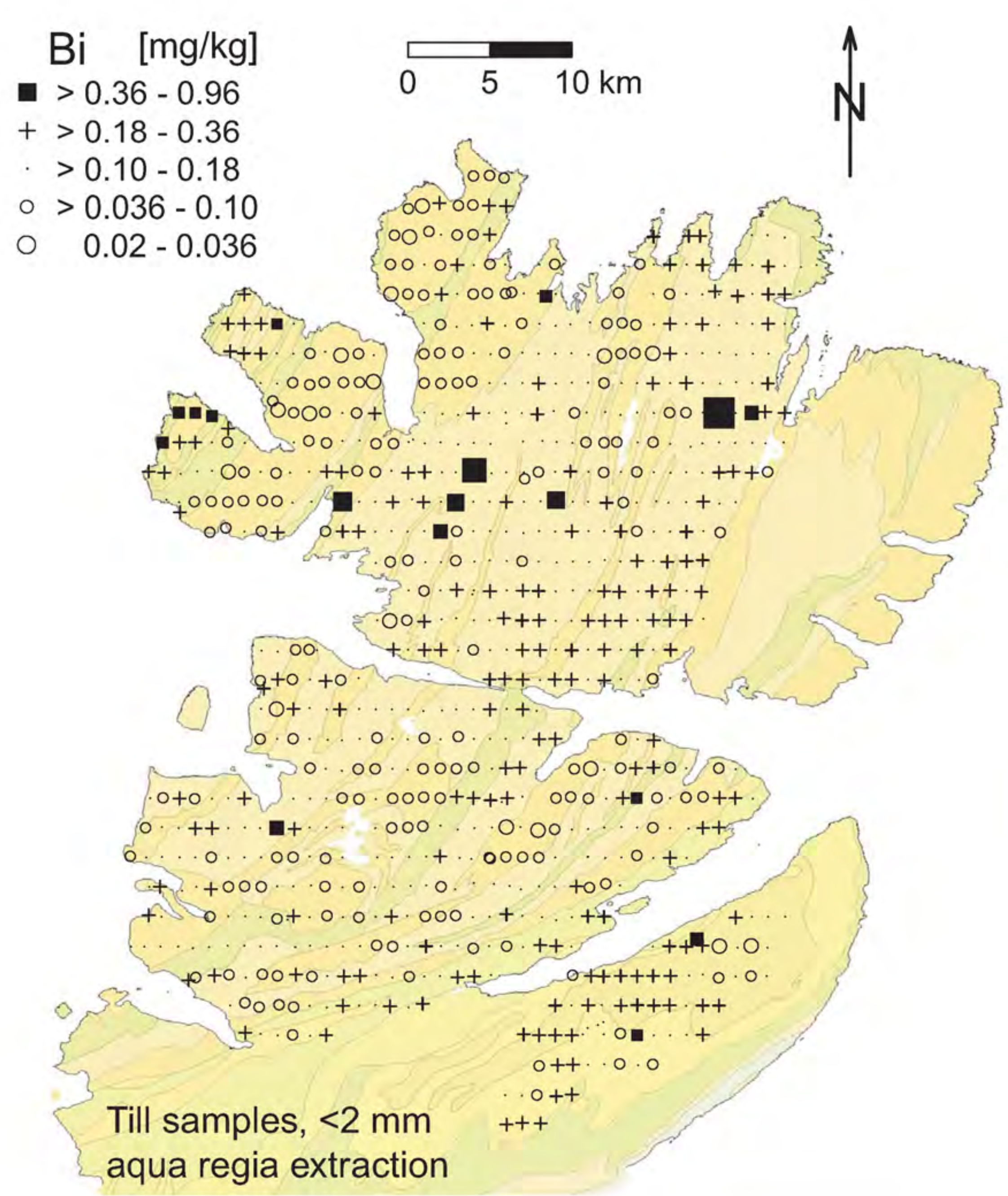

As [mg/kg]
> 18 - 67
> 4.3 - 18
> 1.2 - 4.3
> 0.14 - 1.2
< 0.1 - 0.14
0
5
10 km
N
Till samples, <2 mm
aqua regia extraction

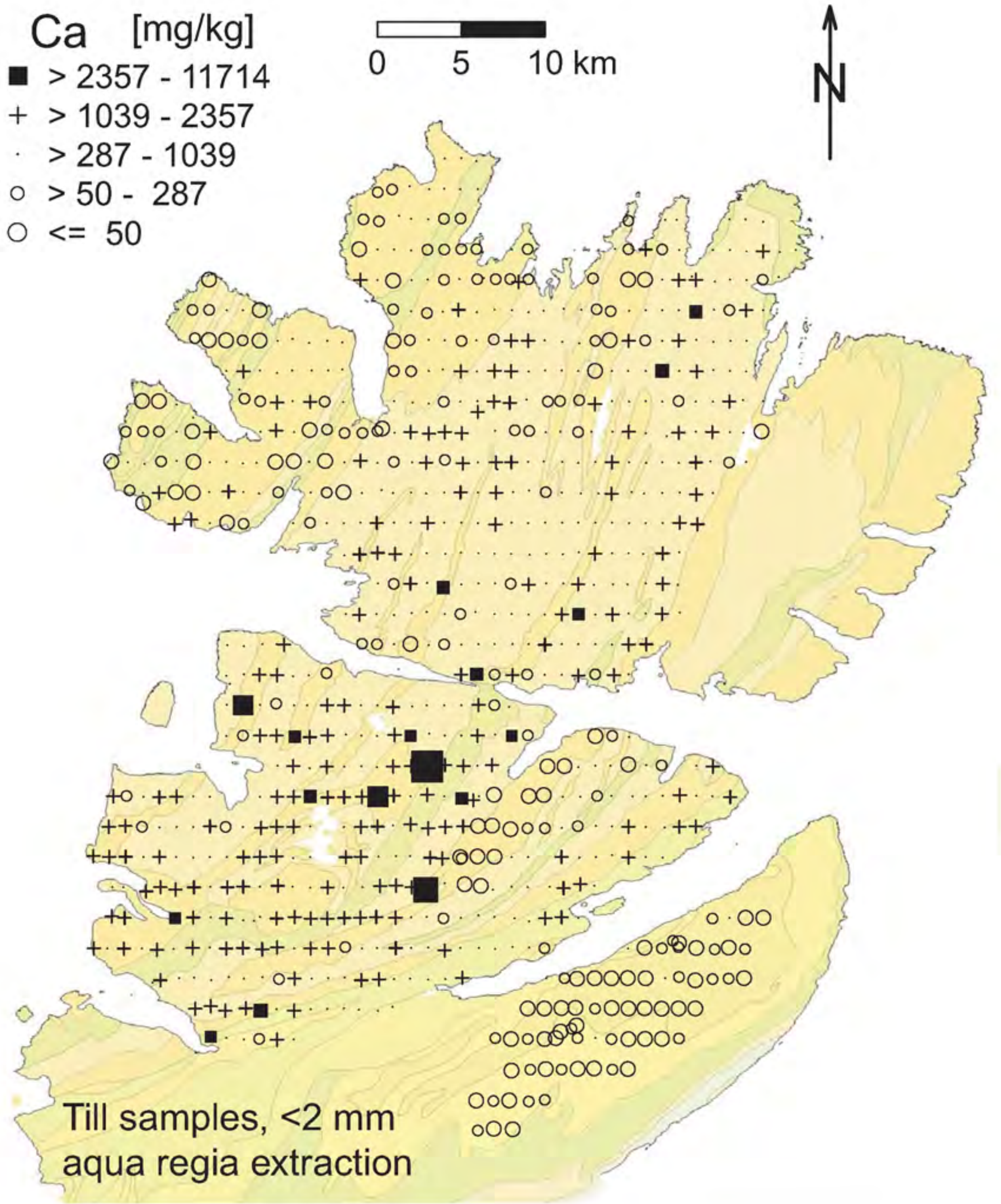

Au [mg/kg]
> 0.0049 - 0.034
> 0.0013 - 0.0049
> 0.0002 - 0.0013
0.0002
< 0.0002
0 5 10 km
N
Till samples, <2 mm
aqua regia extraction
ATTENTION: QC results indicate rather poor reproducibility

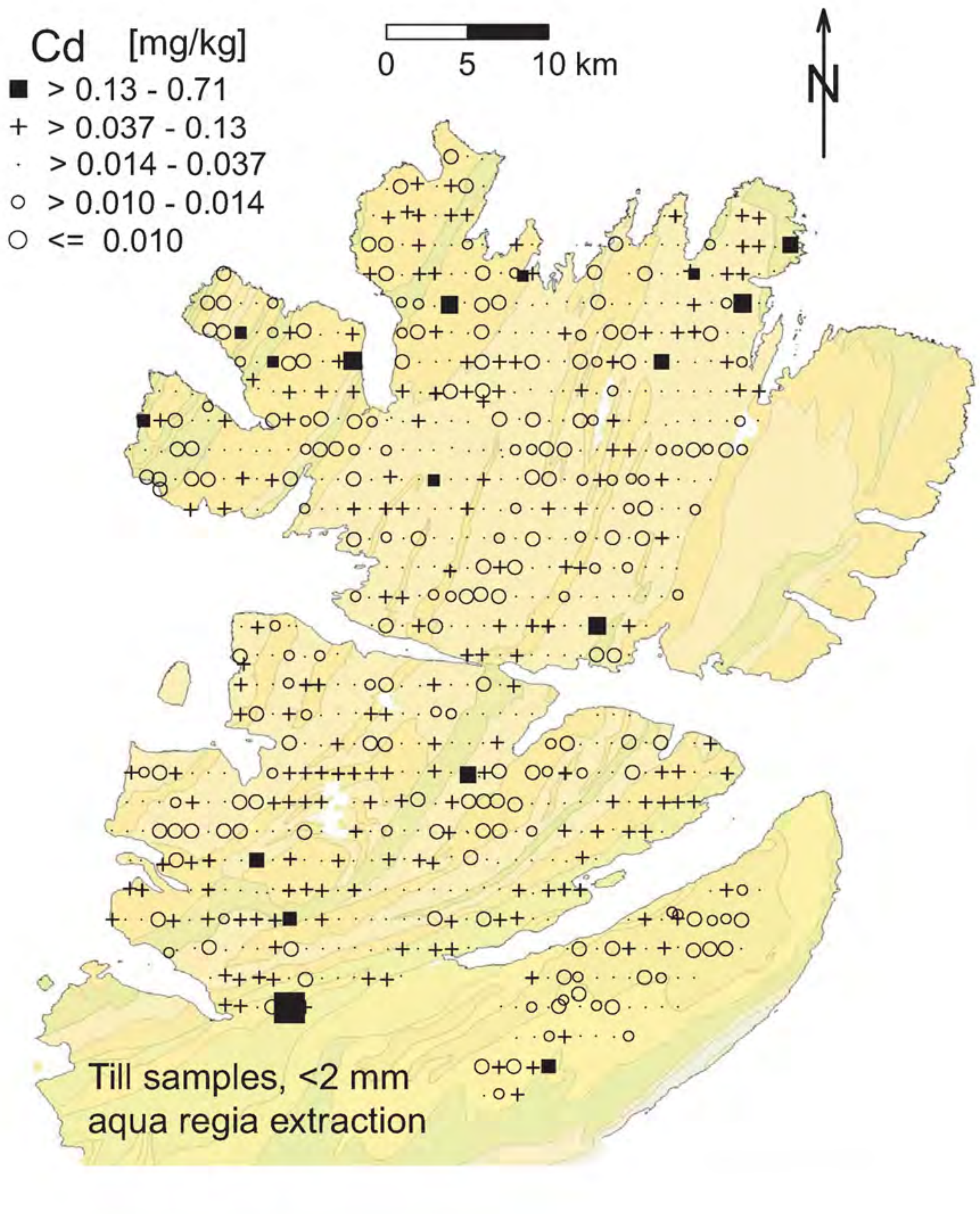

B [mg/kg]
> 2.22 - 3.84
> 1.03 - 2.22
> 1 - 1.03
<= 1
0 5 10 km
N
Till samples, <2 mm
aqua regia extraction
ATTENTION: most values are under the detection limit, only the maximum class (growing square) provides reliable data

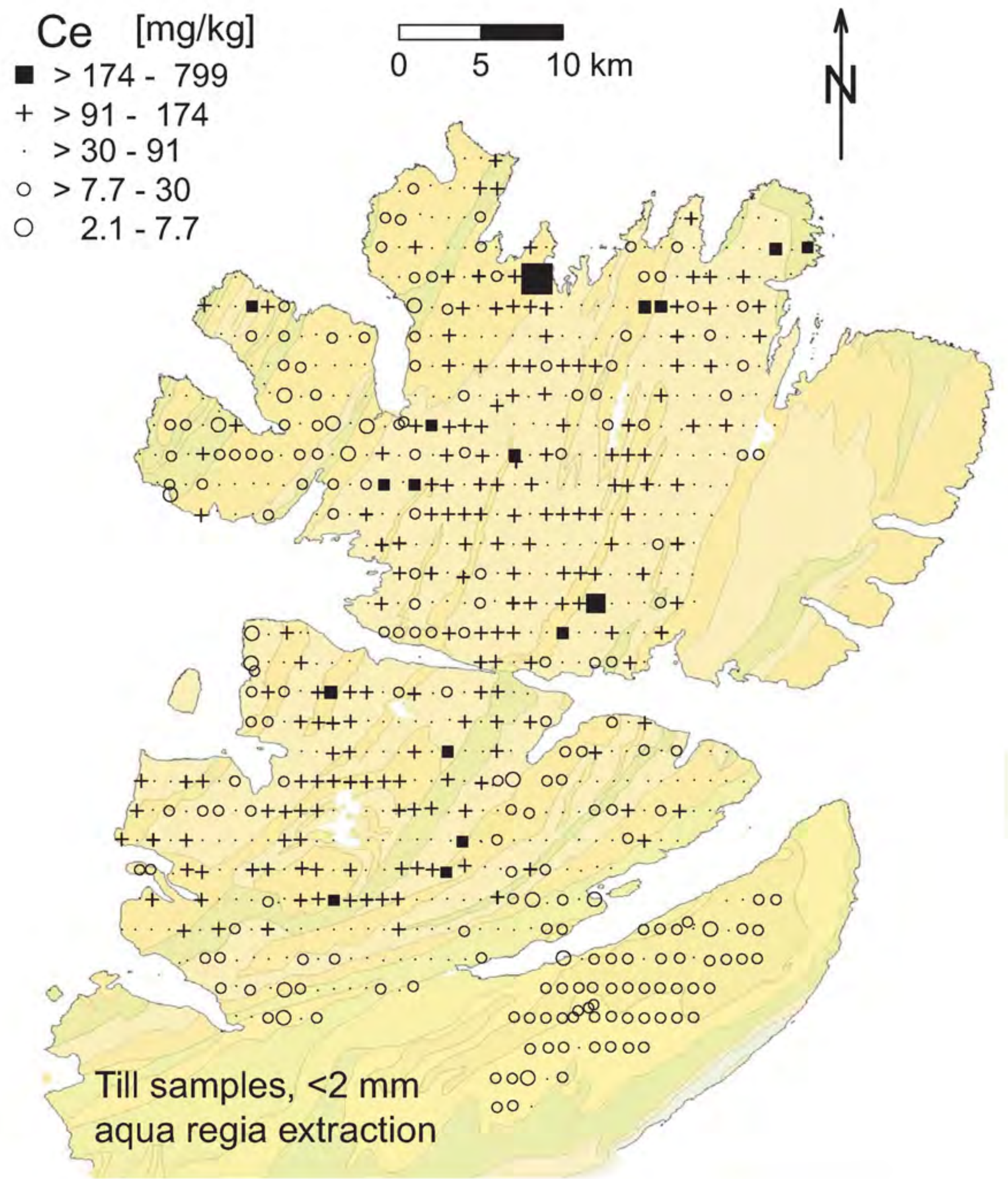

Ba [mg/kg]
> 127 - 190
> 68 - 127
> 24 - 68
> 9.0 - 24
3.1 - 9.0
0 5 10 km
N
Till samples, <2 mm
aqua regia extraction

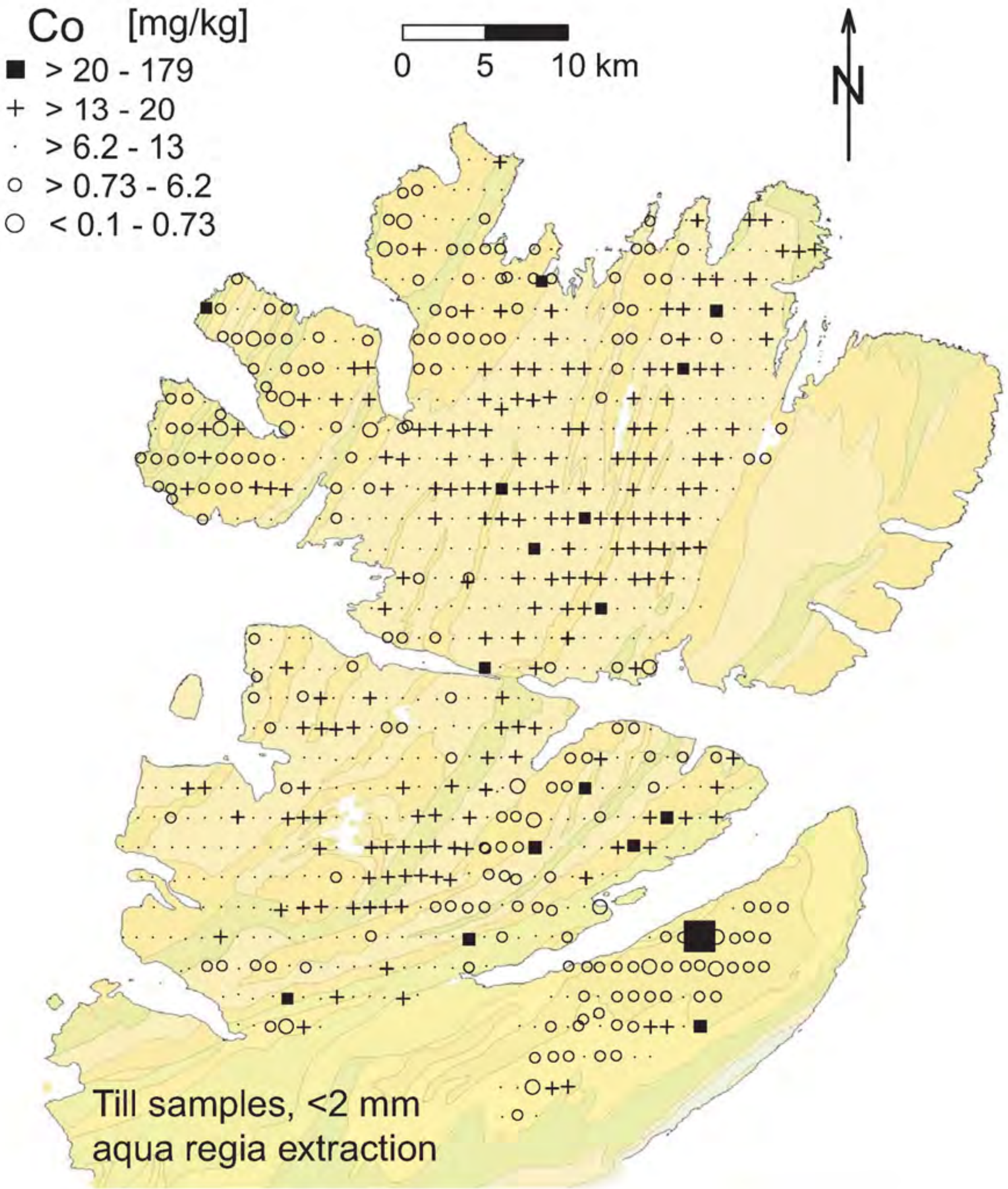

Be [mg/kg]
■ > 0.91- 1.9
+ > 0.47- 0.91
· > 0.21 - 0.47
○ > 0.1- 0.21
○ <= 0.1
0 5 10 km
N
Till samples, <2 mm
aqua regia extraction

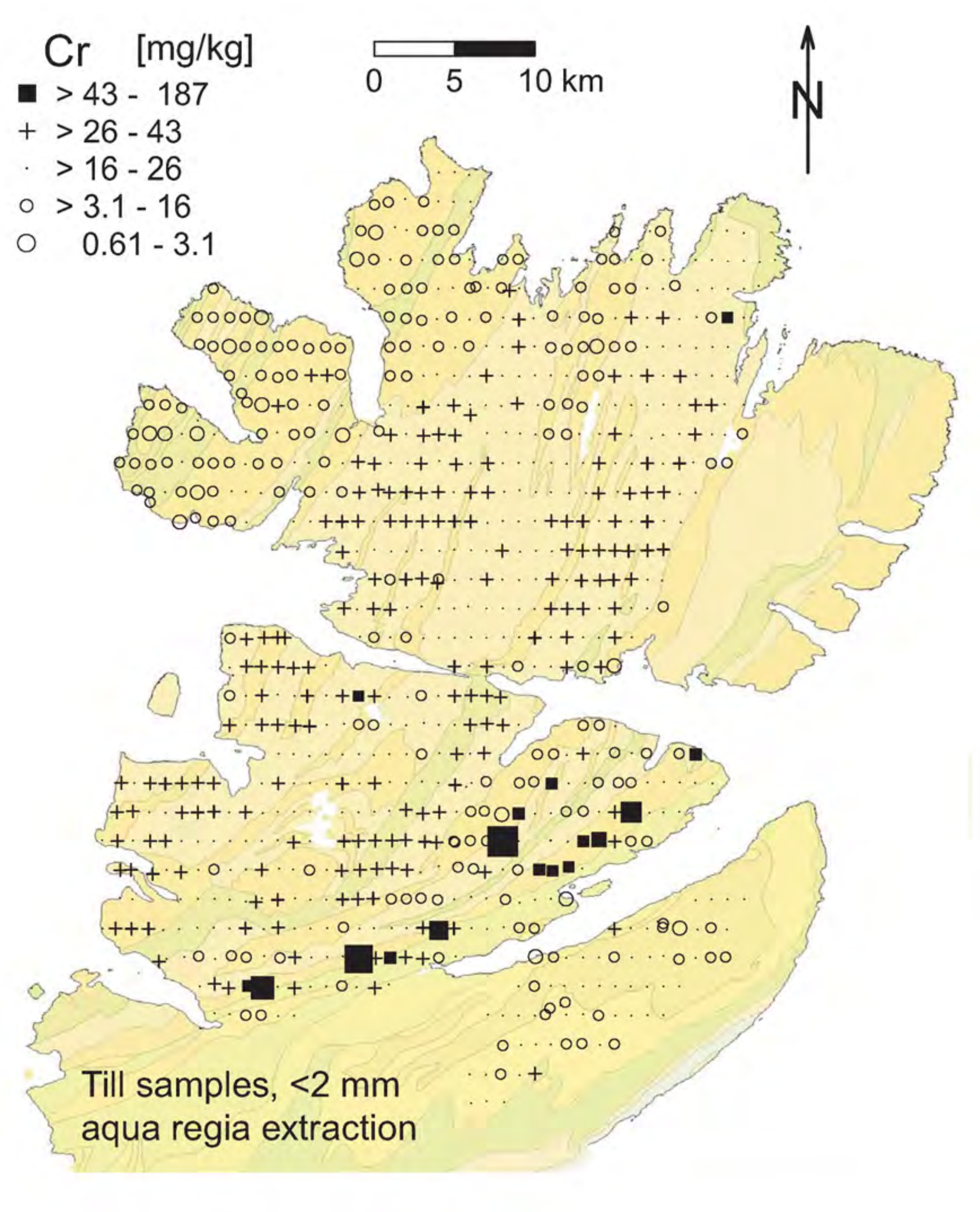

Bi [mg/kg]
> 0.36 - 0.96
> 0.18 - 0.36
> 0.10 - 0.18
> 0.036 - 0.10
0.02 - 0.036
0 5 10 km
N
Till samples, <2 mm
aqua regia extraction

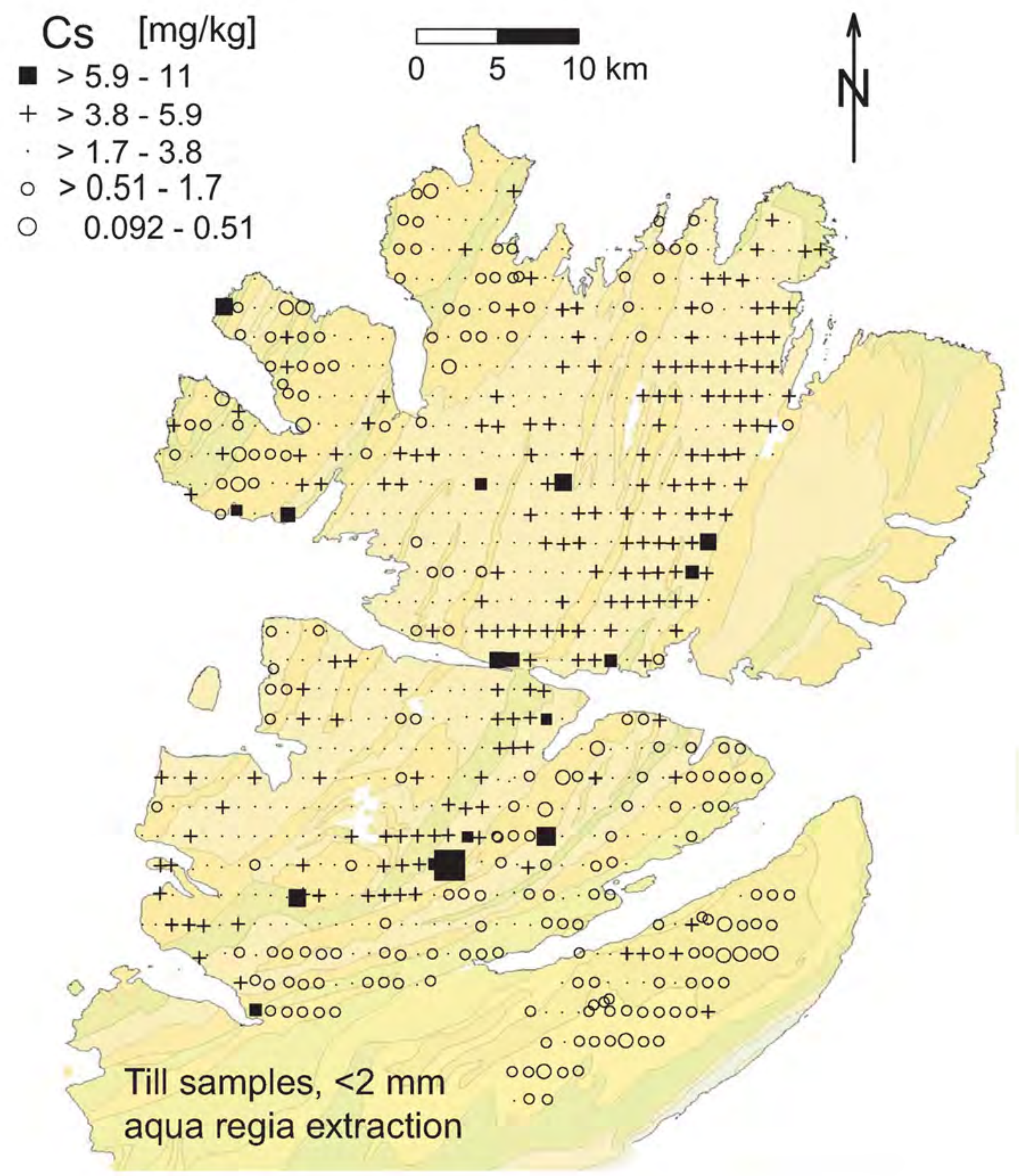

Ca [mg/kg]
> 2357 - 11714
> 1039 - 2357
> 287 - 1039
> 50 - 287
<= 50
0
5
10 km
N
Till samples, <2 mm
aqua regia extraction

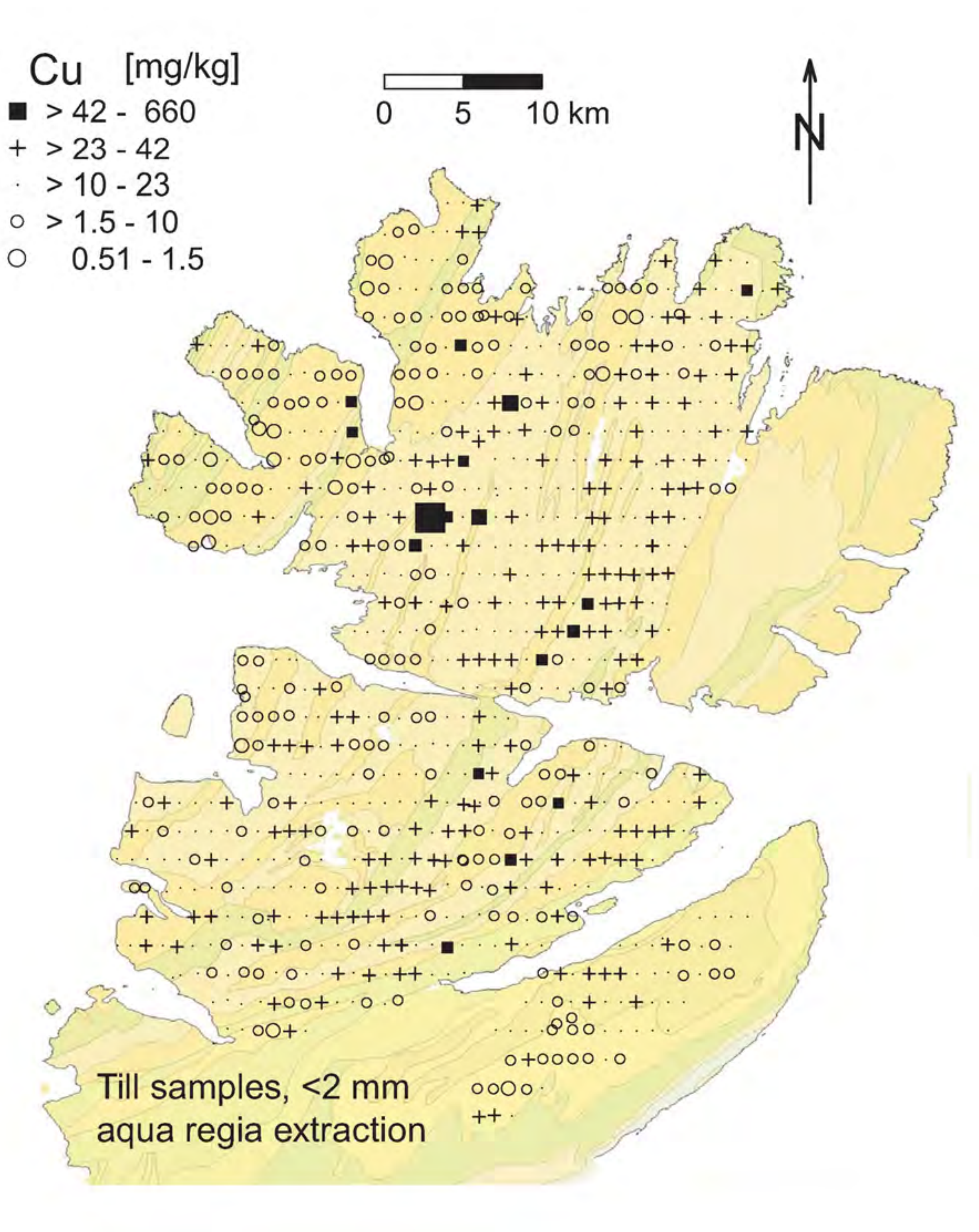

Cd [mg/kg]
■ > 0.13 - 0.71
+ > 0.037 - 0.13
· > 0.014 - 0.037
○ > 0.010 - 0.014
○ <= 0.010
0 5 10 km
N
Till samples, <2 mm
aqua regia extraction

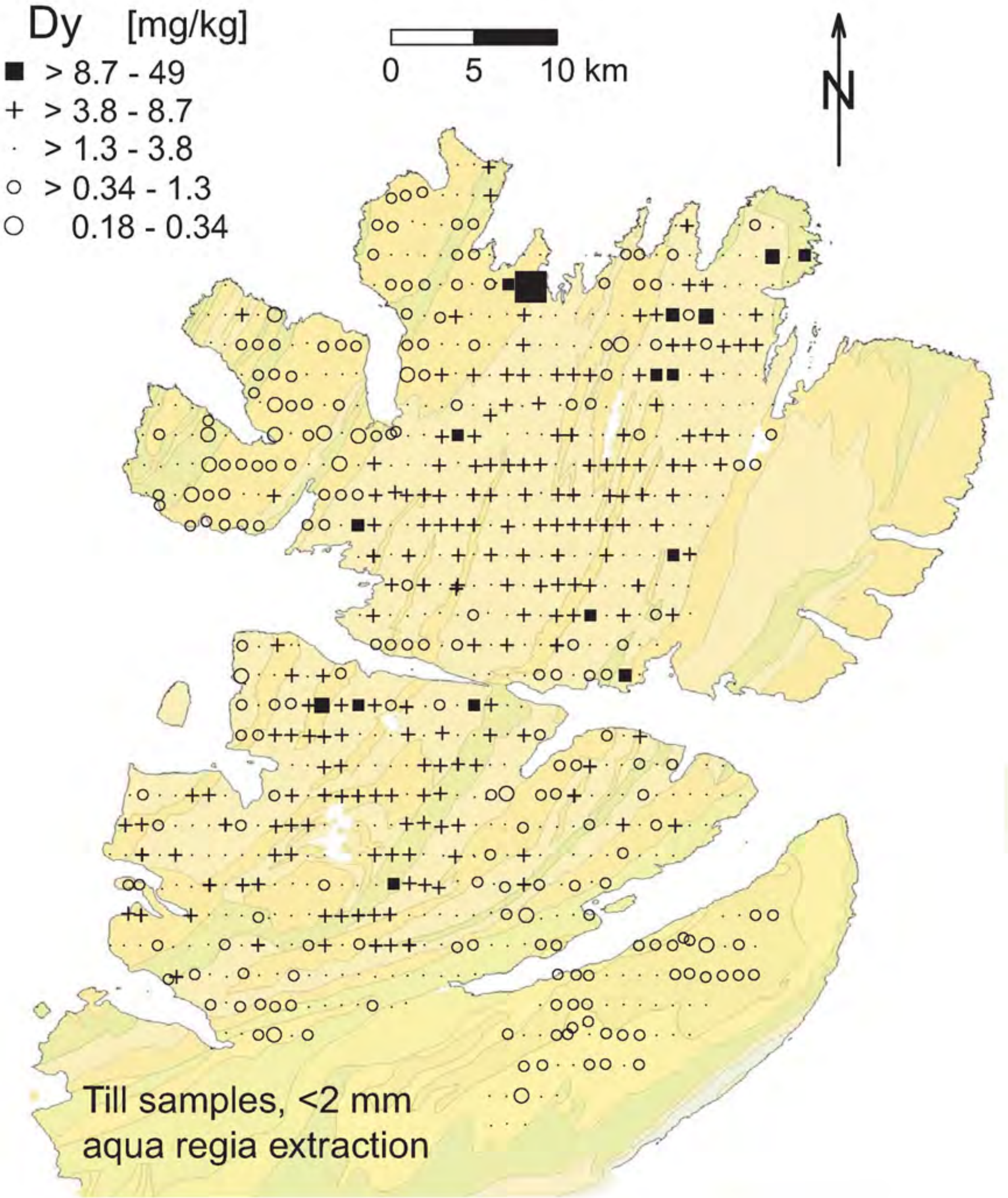

Ce [mg/kg]
> 174 - 799
> 91 - 174
> 30 - 91
> 7.7 - 30
2.1 - 7.7
0 5 10 km
N
Till samples, <2 mm
aqua regia extraction

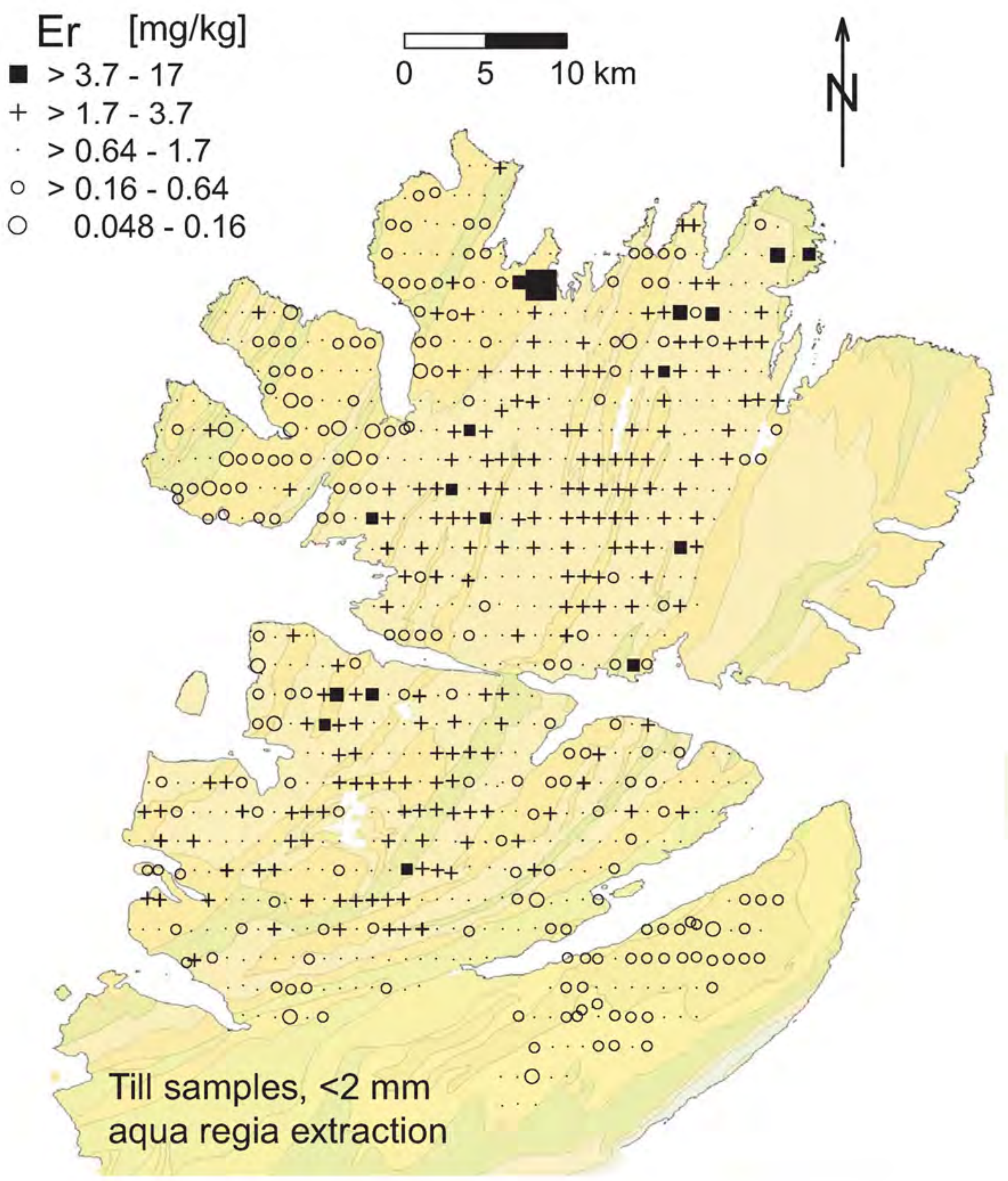

Co [mg/kg]
> 20 - 179
> 13 - 20
> 6.2 - 13
> 0.73 - 6.2
< 0.1 - 0.73
0
5
10 km
N
Till samples, <2 mm
aqua regia extraction

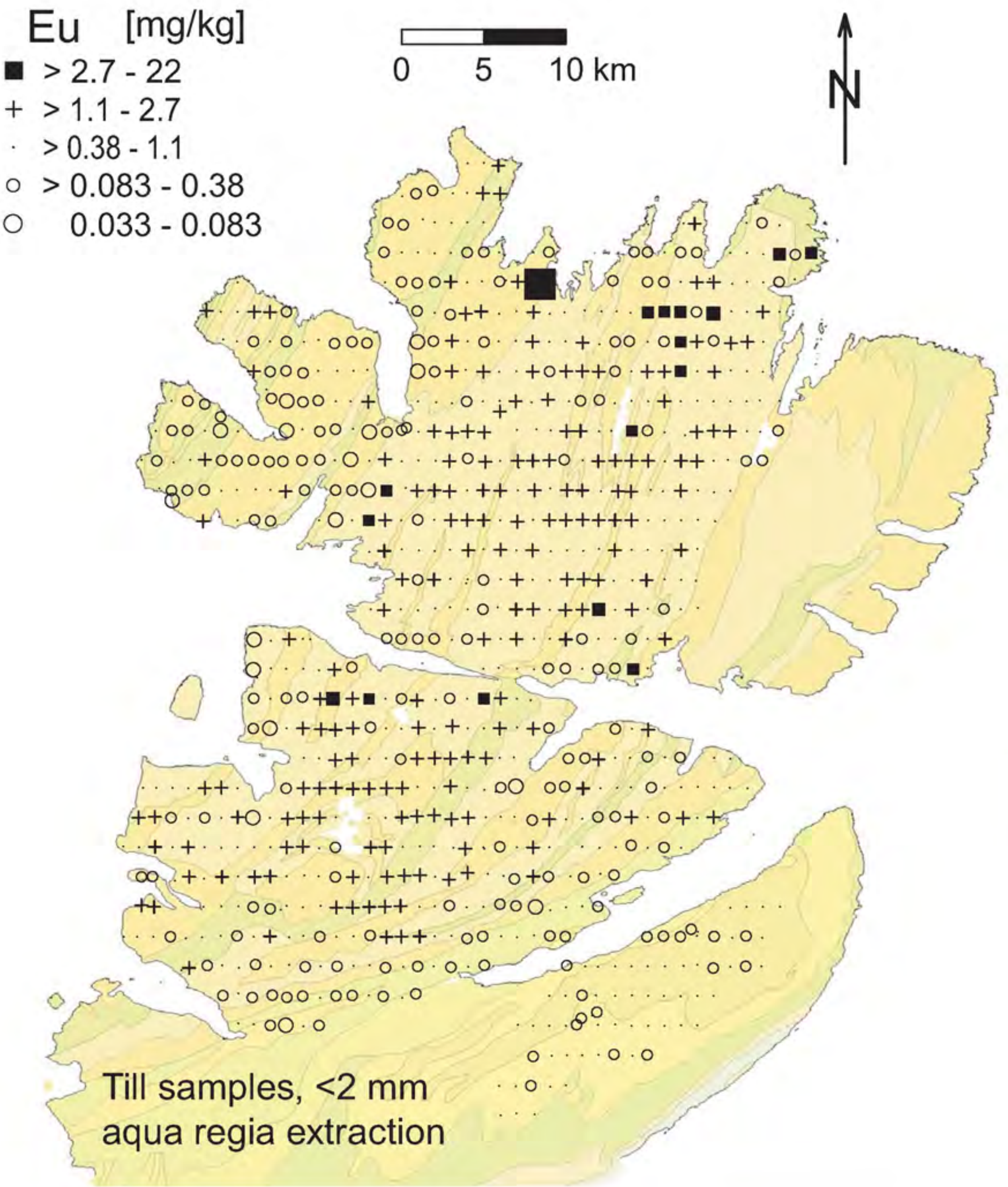

Cr [mg/kg]
■ > 43 - 187
+ > 26 - 43
· > 16 - 26
○ > 3.1 - 16
○ 0.61 - 3.1
0 5 10 km
N
Till samples, <2 mm
aqua regia extraction

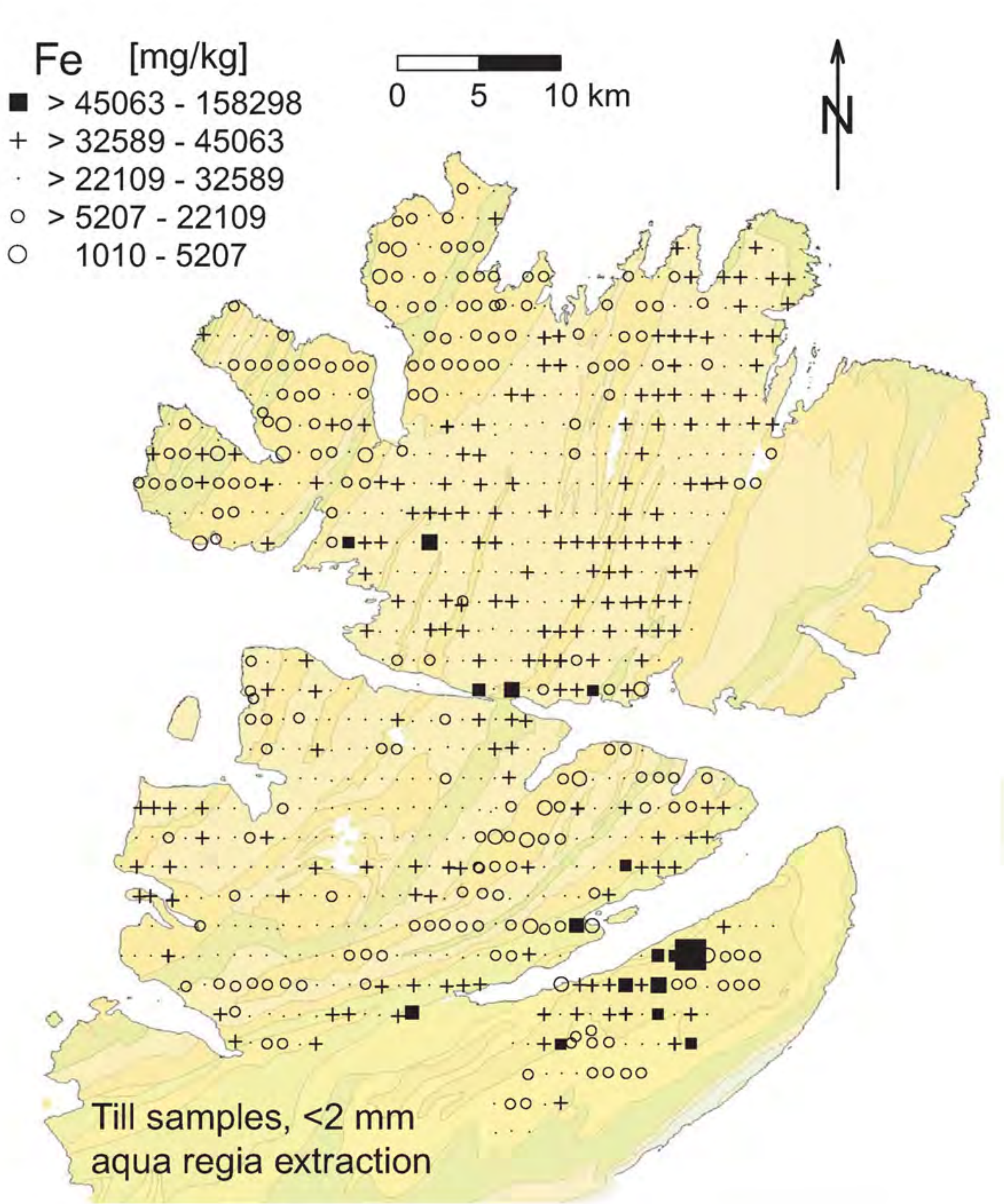

Cs [mg/kg]
> 5.9 - 11
> 3.8 - 5.9
> 1.7 - 3.8
> 0.51 - 1.7
0.092 - 0.51
0 5 10 km
N
Till samples, <2 mm
aqua regia extraction

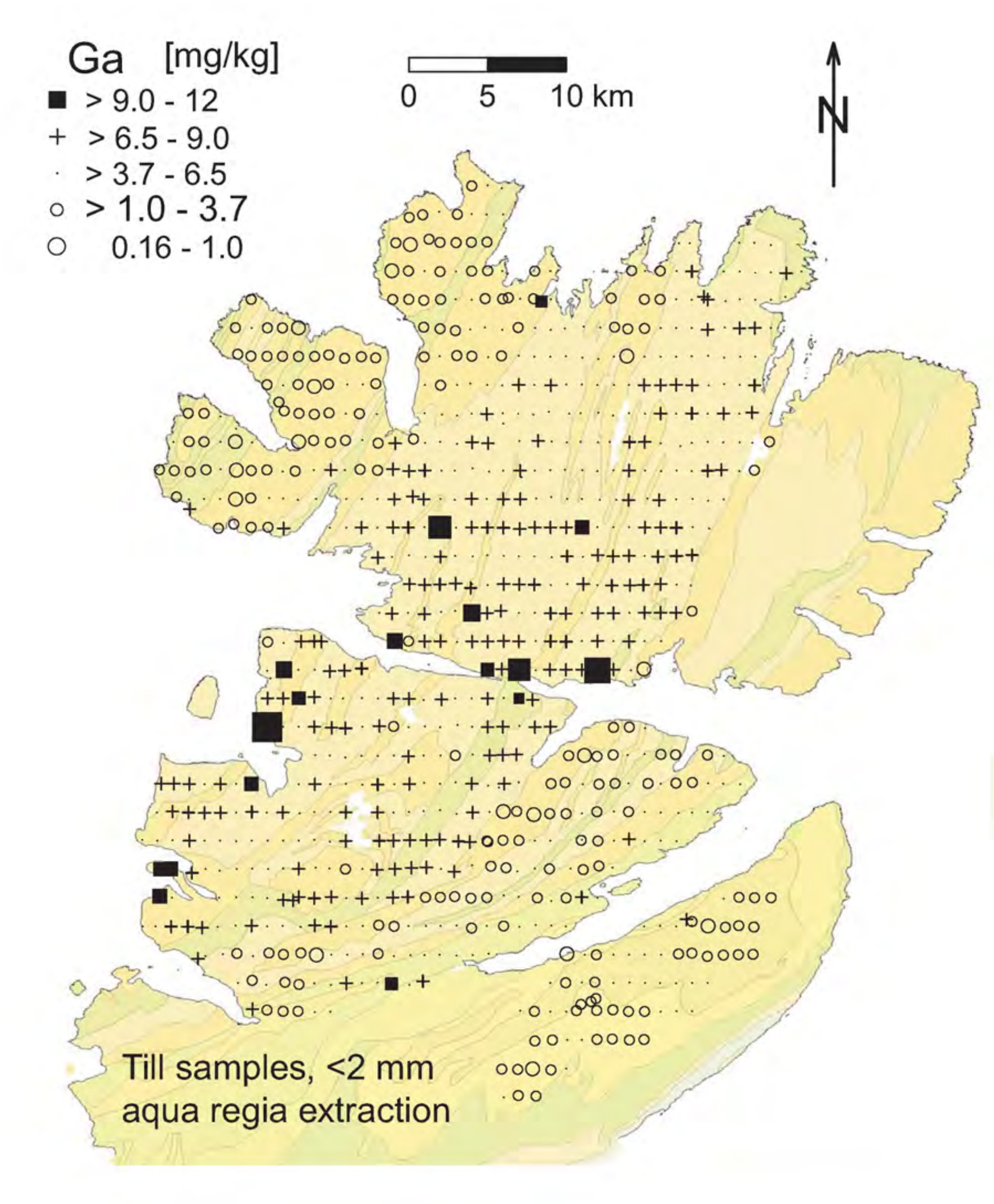

Cu [mg/kg]
> 42 - 660
> 23 - 42
> 10 - 23
> 1.5 - 10
0.51 - 1.5
0 5 10 km
N
Till samples, <2 mm
aqua regia extraction

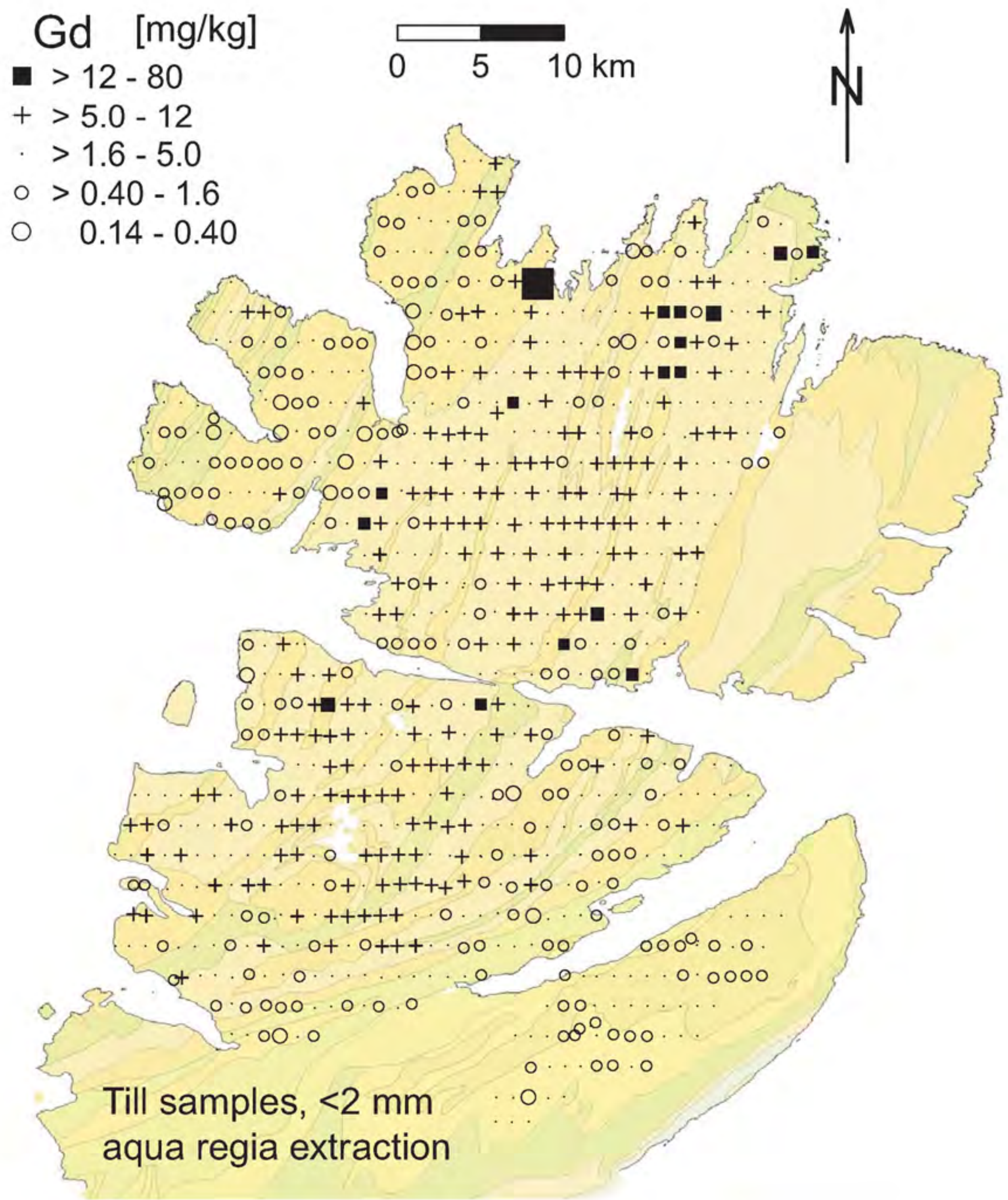

Dy [mg/kg]
> 8.7 - 49
> 3.8 - 8.7
> 1.3 - 3.8
> 0.34 - 1.3
0.18 - 0.34
0 5 10 km
N
Till samples, <2 mm
aqua regia extraction

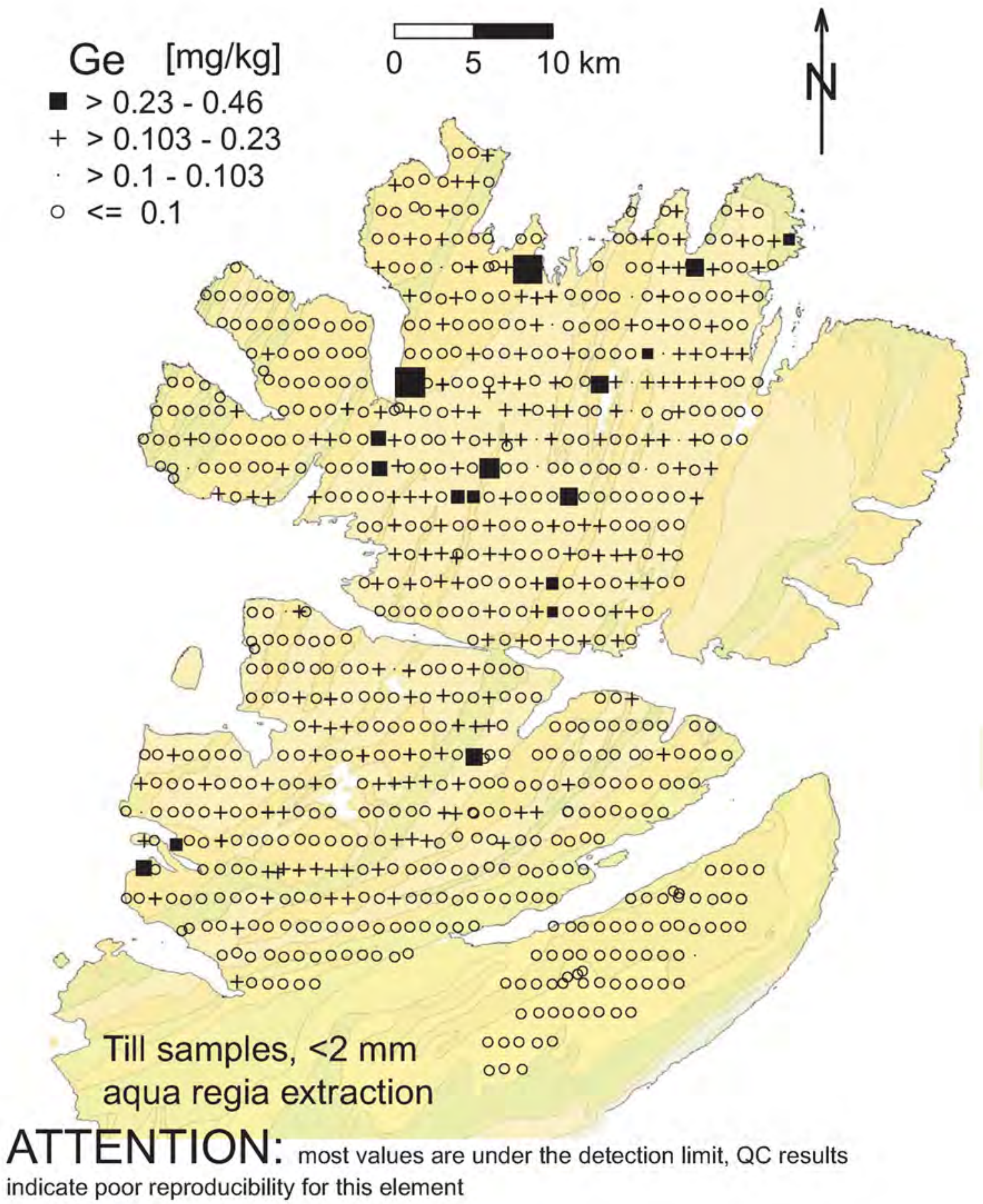

Er [mg/kg]
> 3.7 - 17
> 1.7 - 3.7
> 0.64 - 1.7
> 0.16 - 0.64
0.048 - 0.16
0 5 10 km
N
Till samples, <2 mm
aqua regia extraction

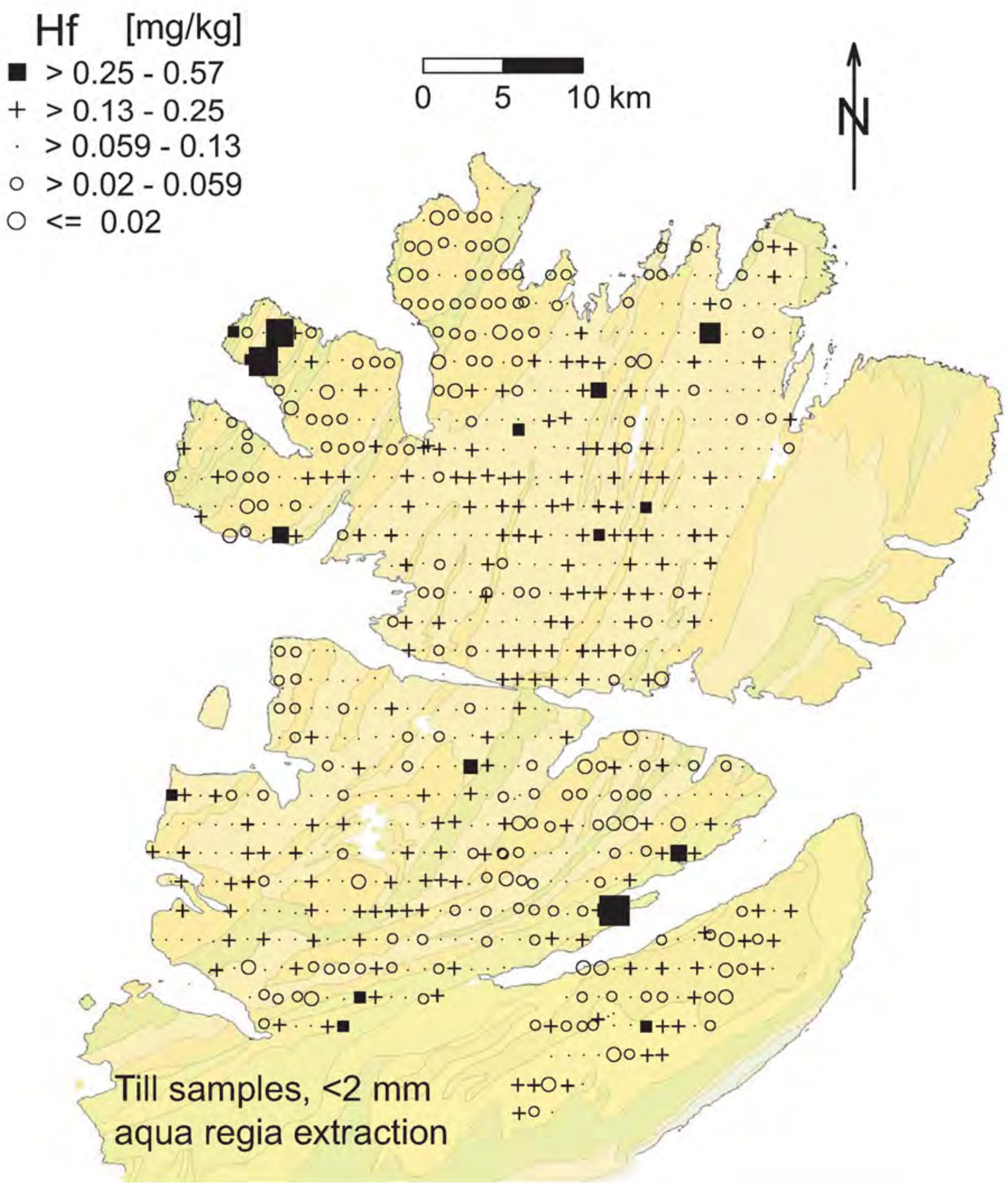

Eu [mg/kg]
> 2.7 - 22
> 1.1 - 2.7
> 0.38 - 1.1
> 0.083 - 0.38
0.033 - 0.083
0 5 10 km
N
Till samples, <2 mm
aqua regia extraction

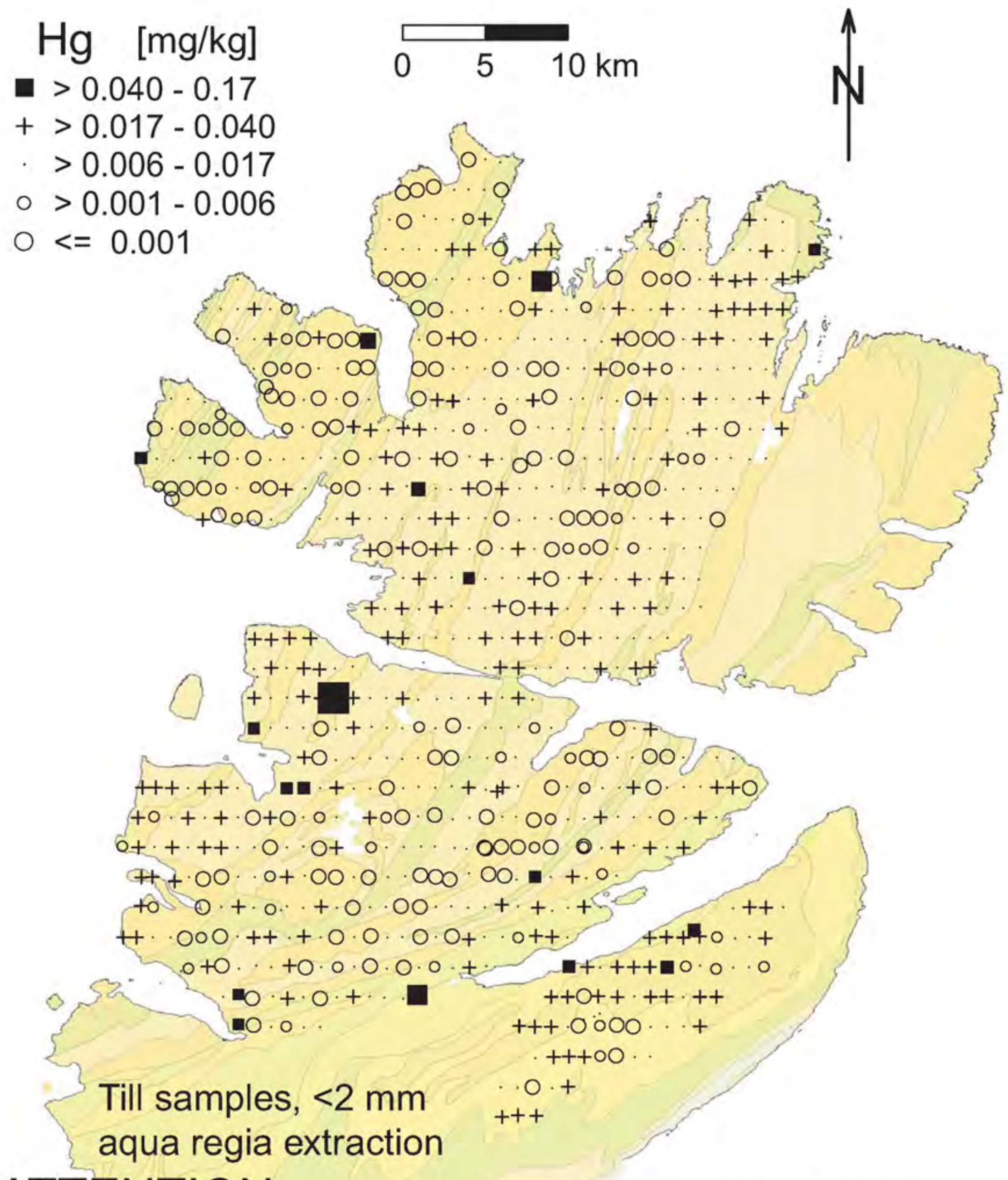

Fe [mg/kg]
> 45063 - 158298
> 32589 - 45063
> 22109 - 32589
> 5207 - 22109
1010 - 5207
0 5 10 km
N
Till samples, <2 mm
aqua regia extraction


Ga [mg/kg]
> 9.0 - 12
> 6.5 - 9.0
> 3.7 - 6.5
> 1.0 - 3.7
0.16 - 1.0
0 5 10 km
N
Till samples, <2 mm
aqua regia extraction

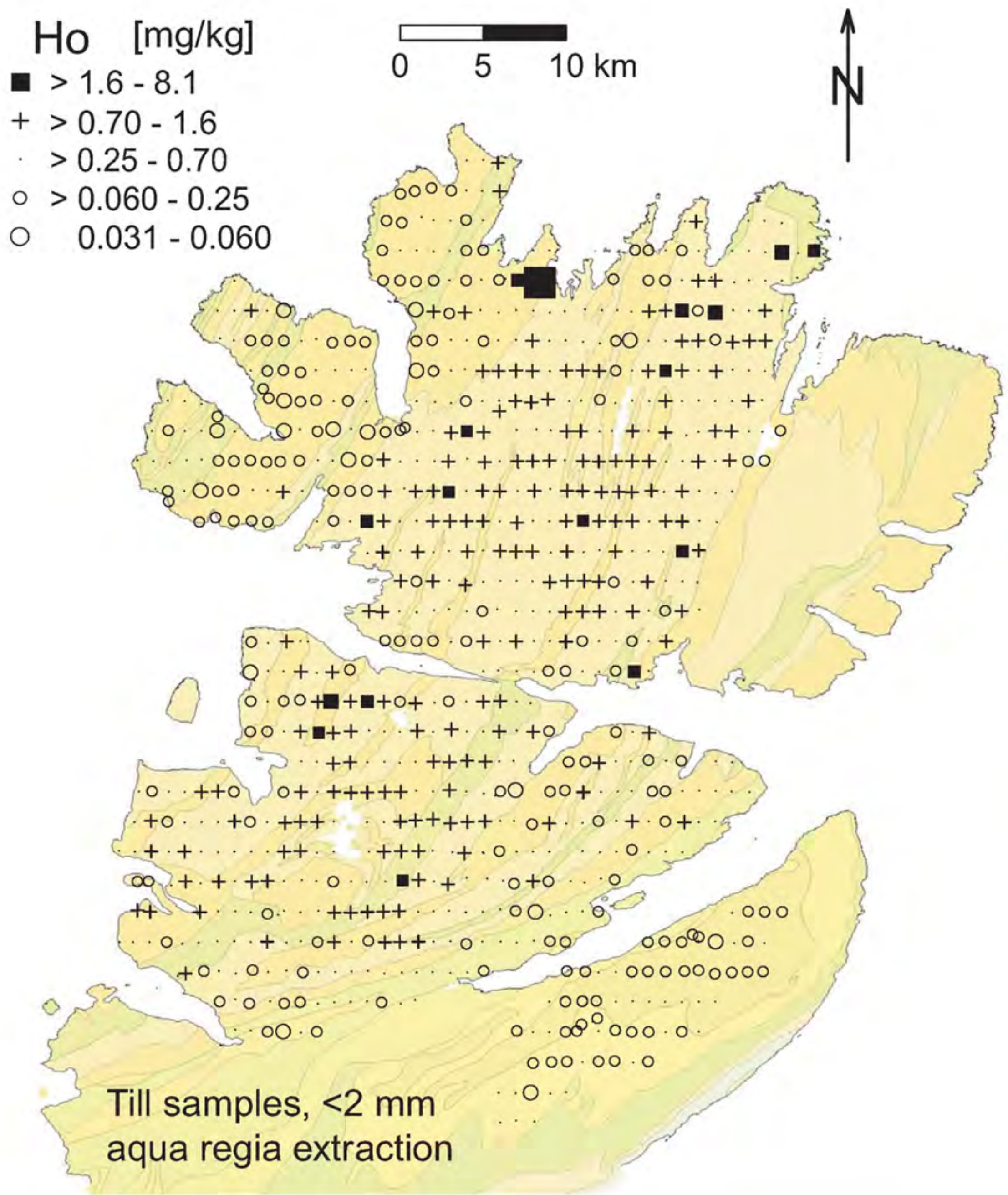

Gd [mg/kg]
> 12 - 80
> 5.0 - 12
> 1.6 - 5.0
> 0.40 - 1.6
0.14 - 0.40
0 5 10 km
N
Till samples, <2 mm
aqua regia extraction

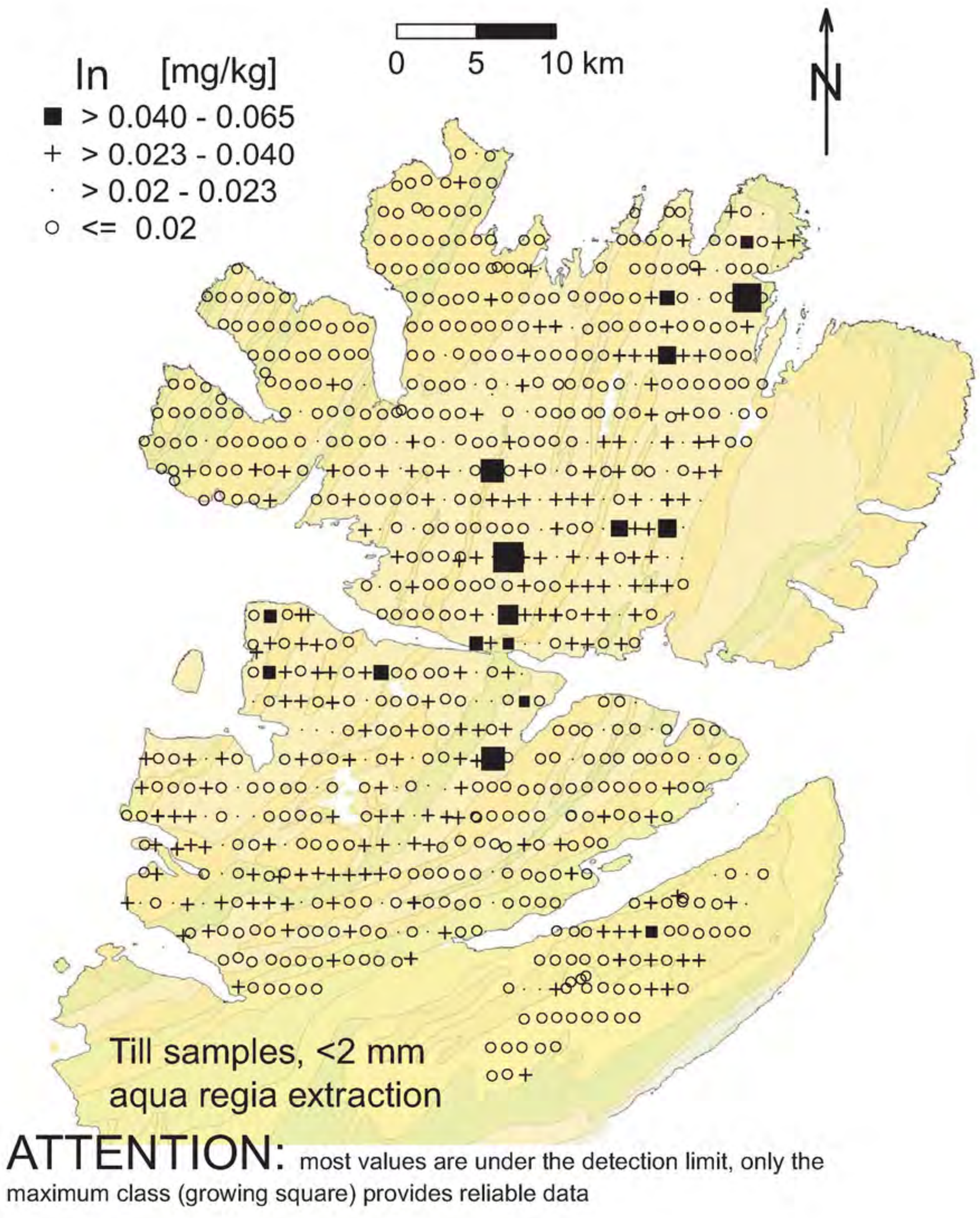

Ge [mg/kg]
■ > 0.23 - 0.46
+ > 0.103 - 0.23
· > 0.1 - 0.103
○ <= 0.1
0 5 10 km
N
Till samples, <2 mm
aqua regia extraction
ATTENTION: most values are under the detection limit, QC results indicate poor reproducibility for this element

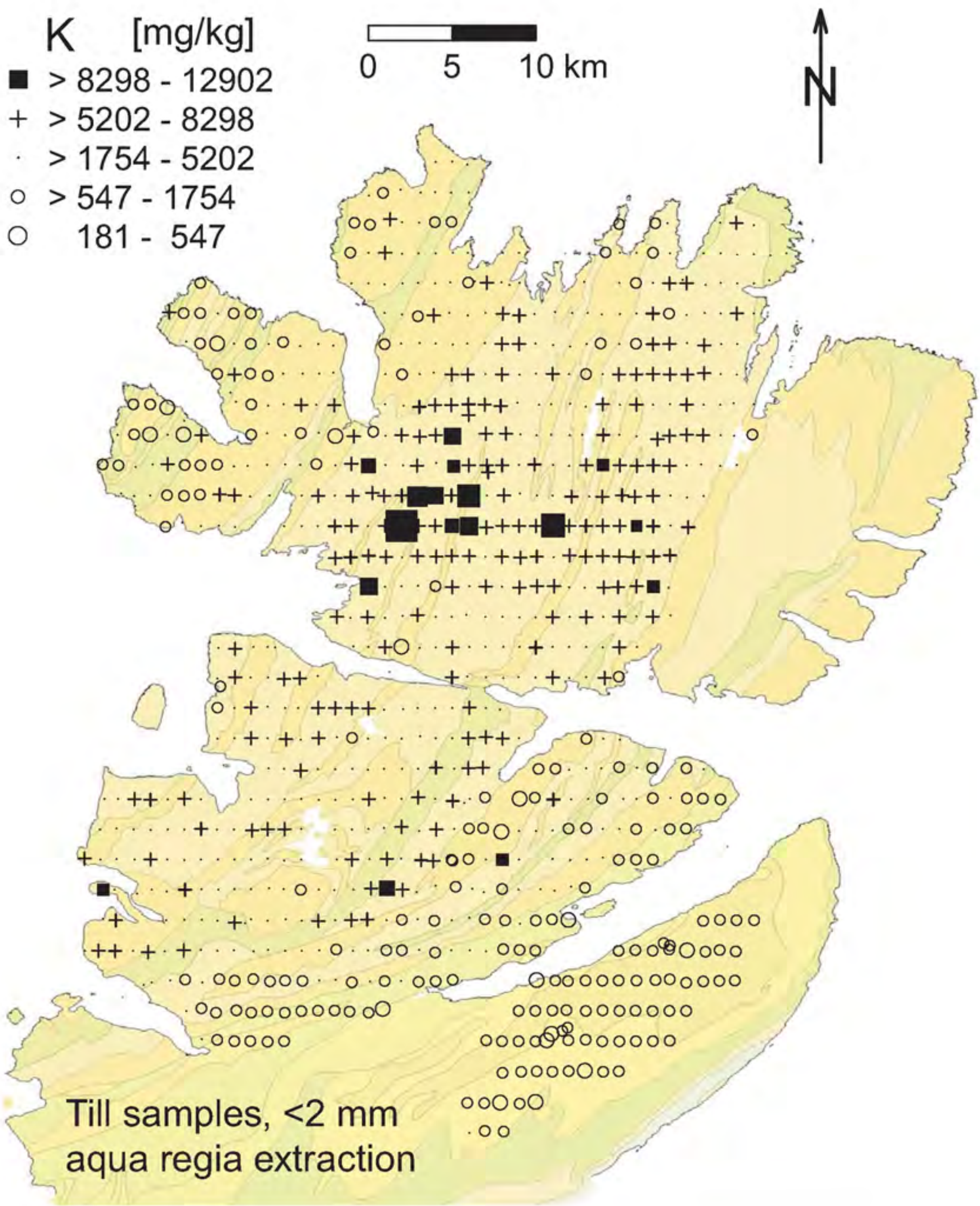

Hf [mg/kg]
■ > 0.25 - 0.57
+ > 0.13 - 0.25
· > 0.059 - 0.13
○ > 0.02 - 0.059
○ <= 0.02
0 5 10 km
N
Till samples, <2 mm
aqua regia extraction

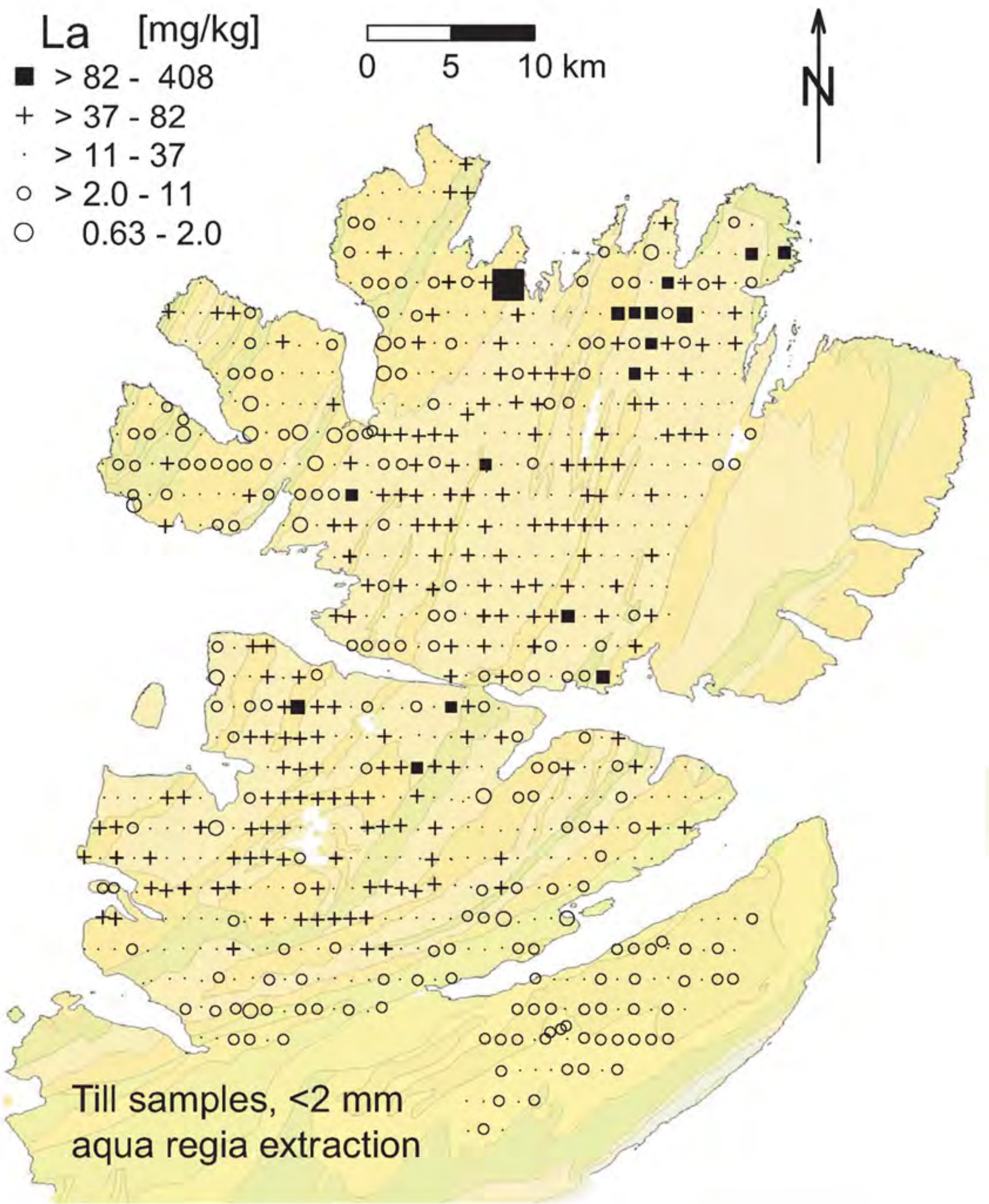


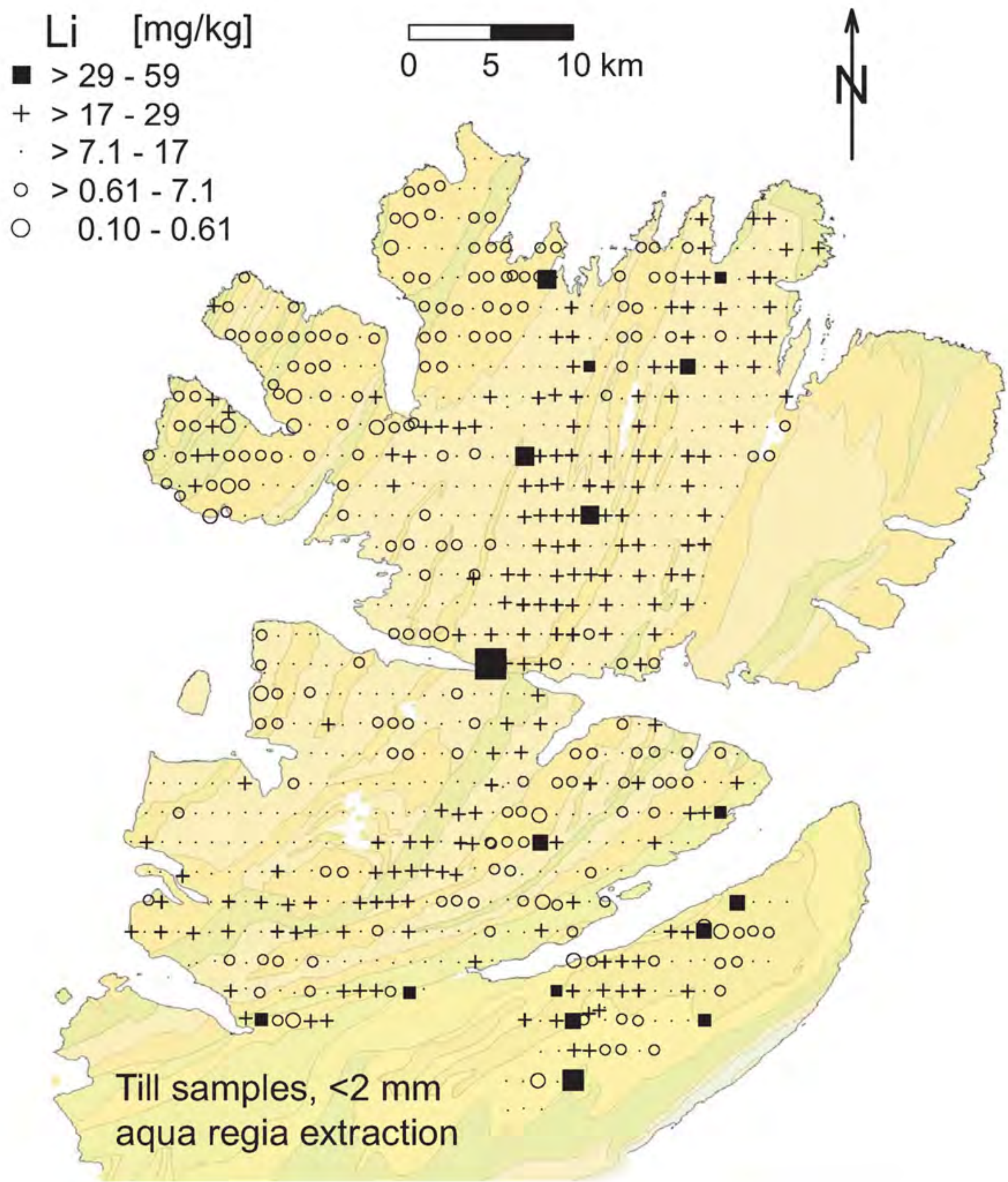
ATTENTION: the project standard indicates poor reproducibility for this element

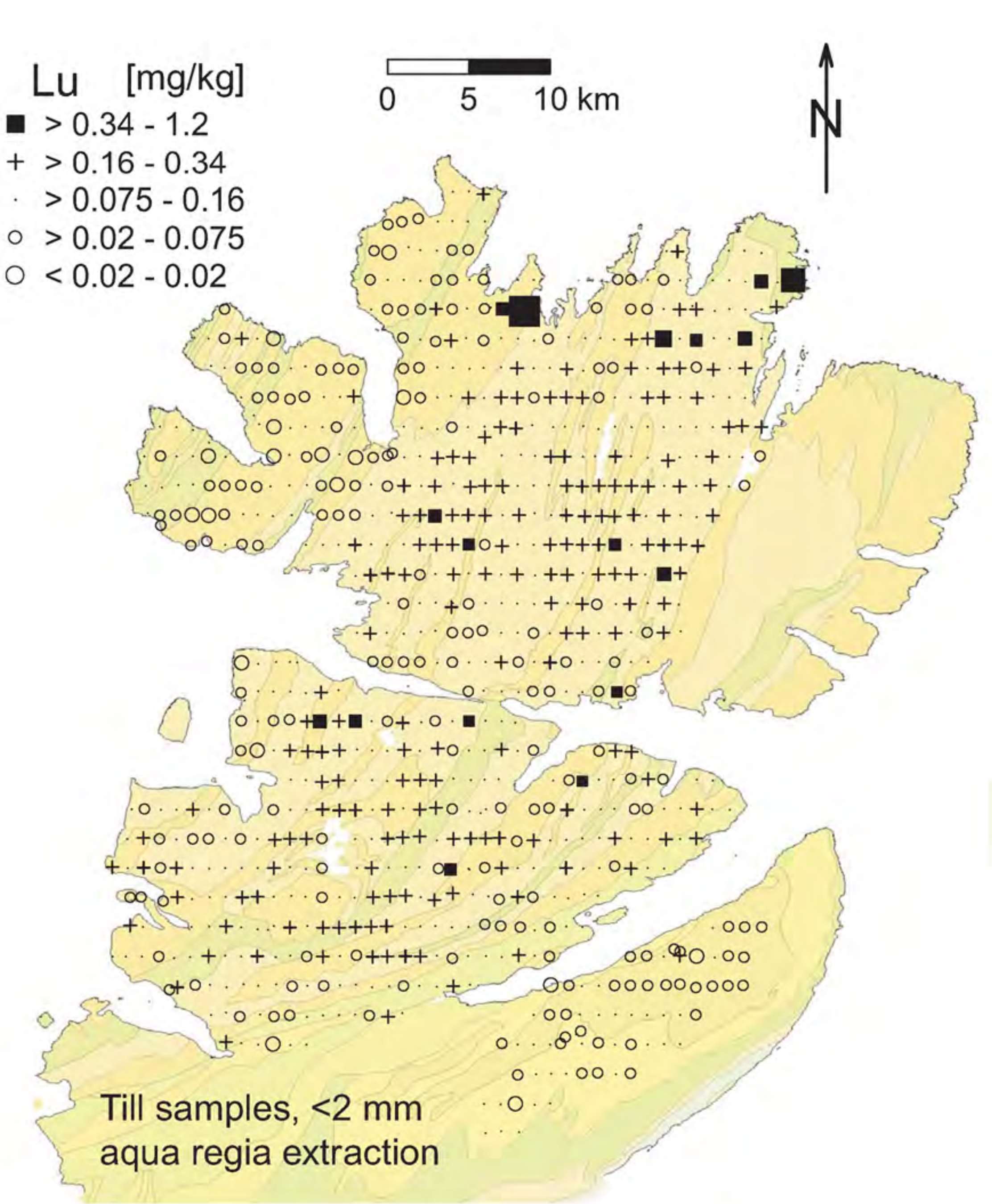

Ho [mg/kg]
> 1.6 - 8.1
> 0.70 - 1.6
> 0.25 - 0.70
> 0.060 - 0.25
0.031 - 0.060
0 5 10 km
N
Till samples, <2 mm
aqua regia extraction

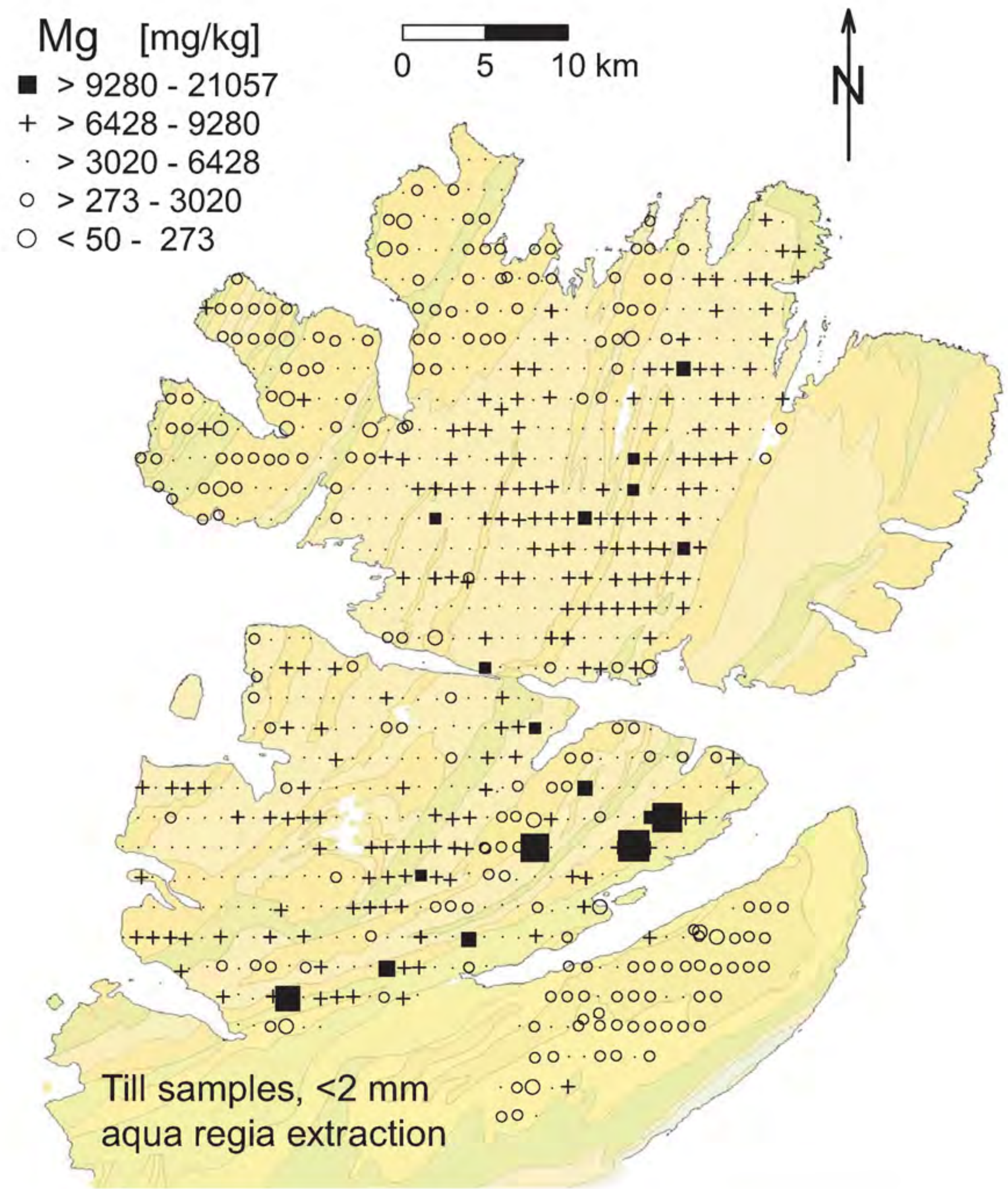

In [mg/kg]
> 0.040 - 0.065
> 0.023 - 0.040
> 0.02 - 0.023
<= 0.02
0 5 10 km
N
Till samples, <2 mm
aqua regia extraction
ATTENTION: most values are under the detection limit, only the maximum class (growing square) provides reliable data

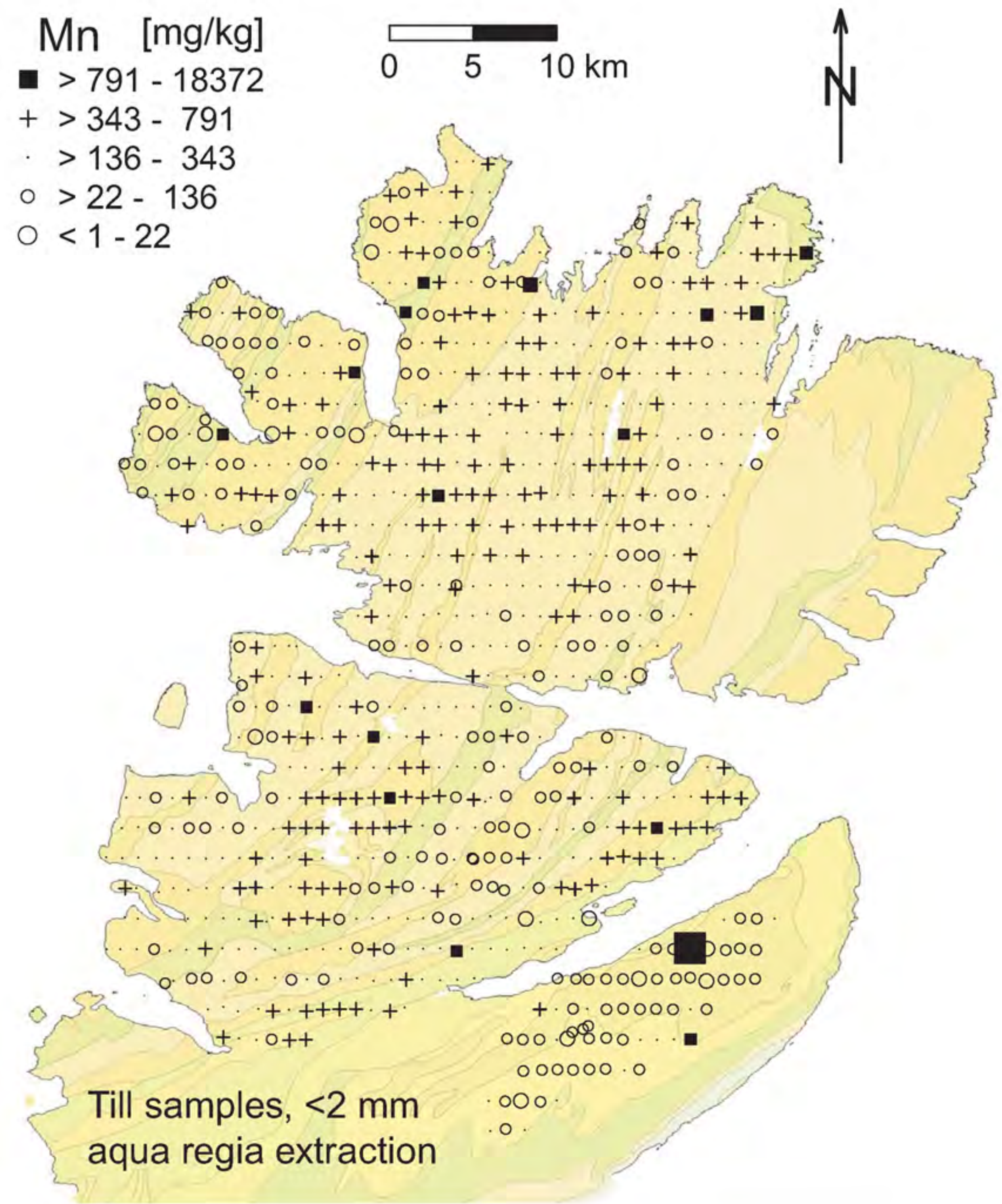

K [mg/kg]
> 8298 - 12902
> 5202 - 8298
> 1754 - 5202
> 547 - 1754
181 - 547
0 5 10 km
N
Till samples, <2 mm
aqua regia extraction

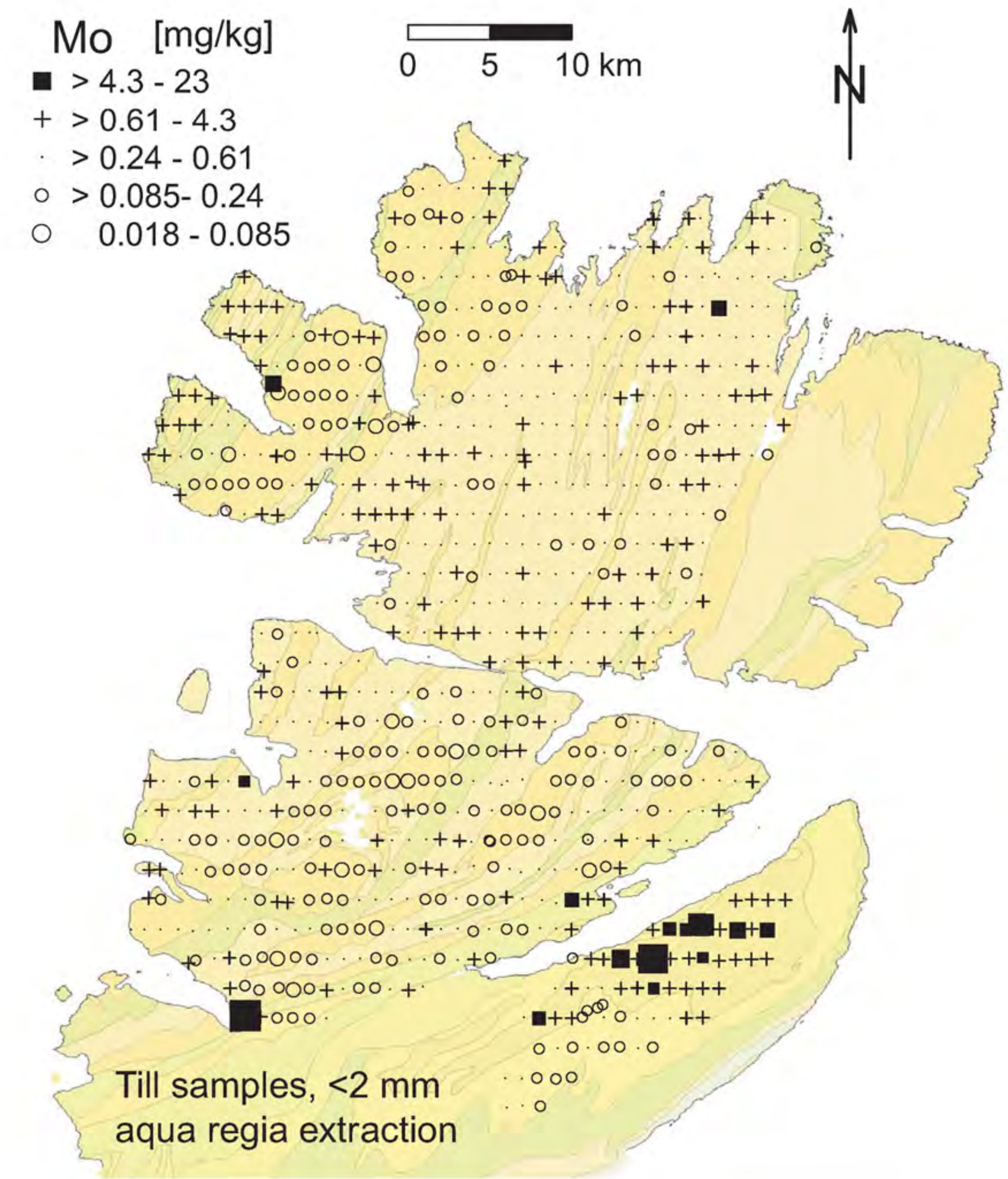

La [mg/kg]
> 82 - 408
> 37 - 82
> 11 - 37
> 2.0 - 11
0.63 - 2.0
0 5 10 km
N
Till samples, <2 mm
aqua regia extraction

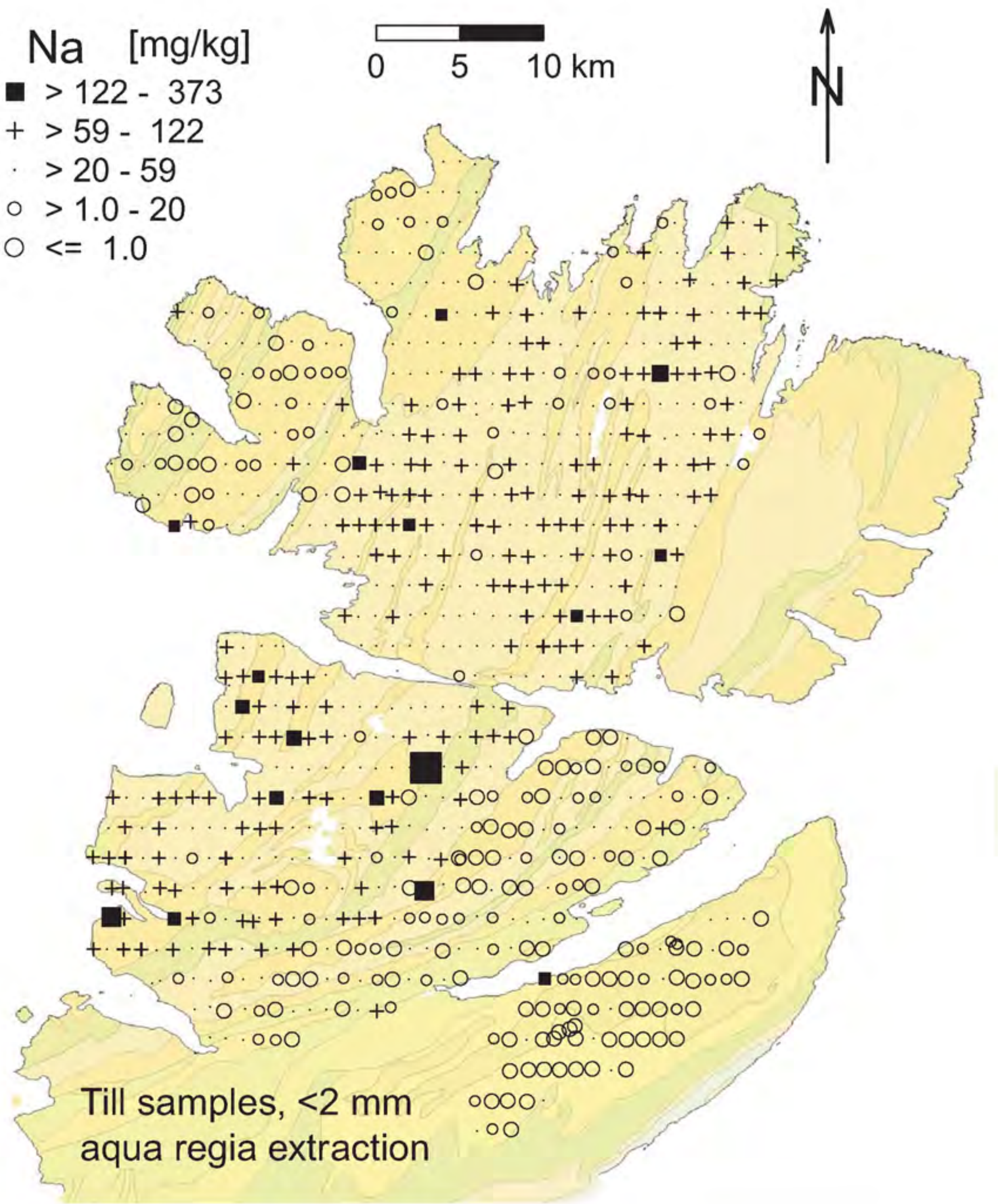

Li [mg/kg]
> 29 - 59
> 17 - 29
> 7.1 - 17
> 0.61 - 7.1
0.10 - 0.61
0 5 10 km
N
Till samples, <2 mm
aqua regia extraction

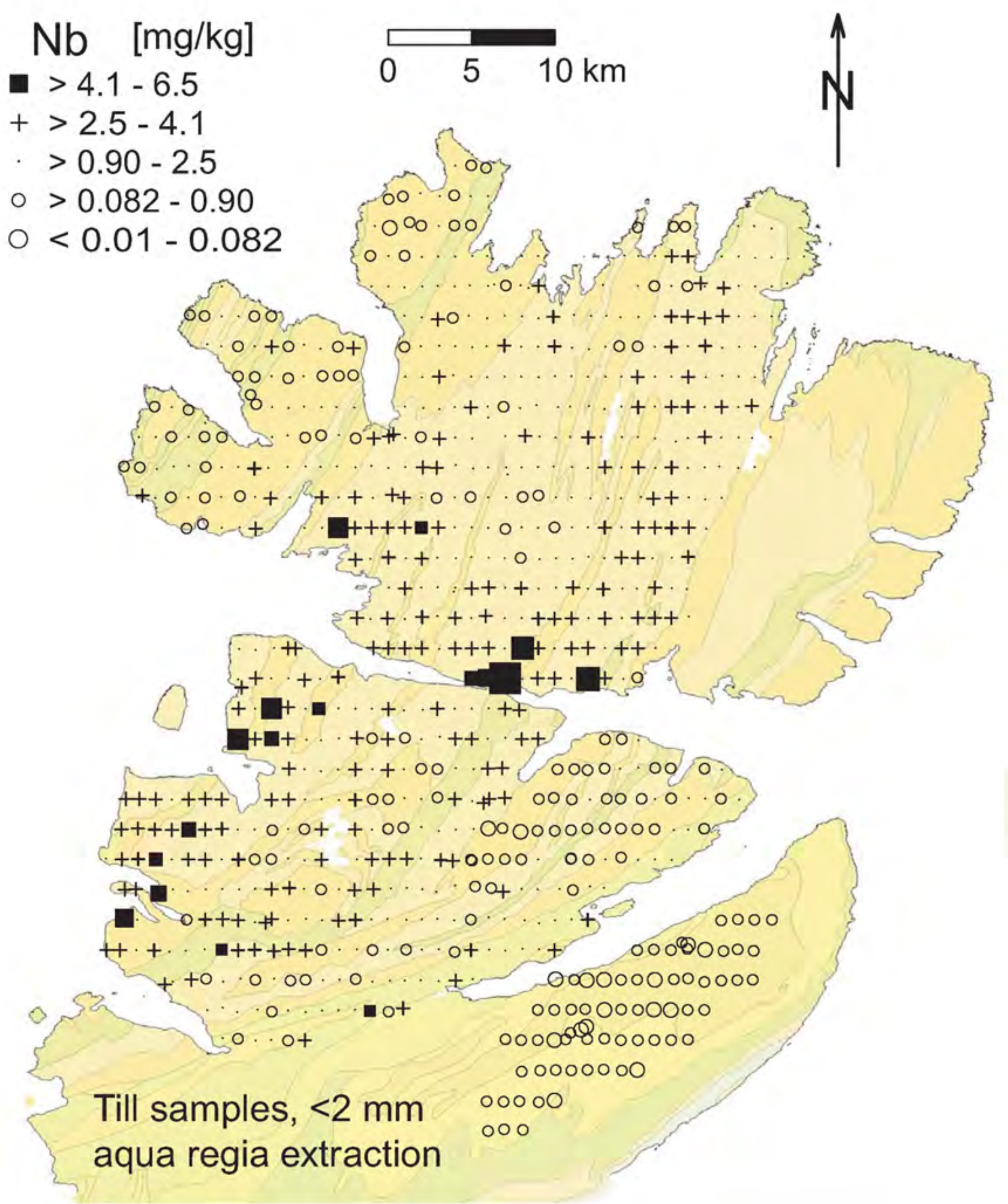

Lu [mg/kg]
> 0.34 - 1.2
> 0.16 - 0.34
> 0.075 - 0.16
> 0.02 - 0.075
< 0.02 - 0.02
0 5 10 km
N
Till samples, <2 mm
aqua regia extraction

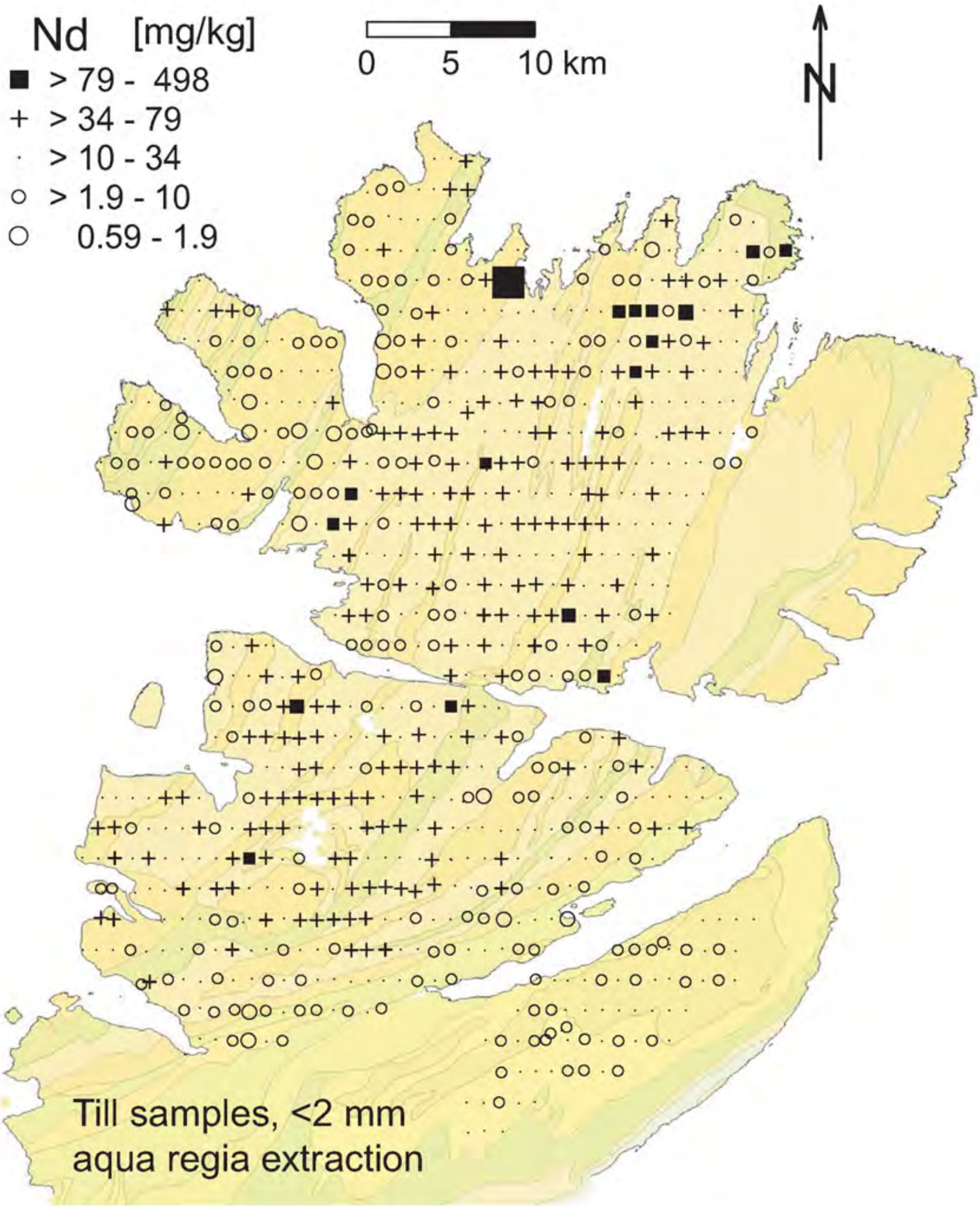

Mg [mg/kg]
> 9280 - 21057
> 6428 - 9280
> 3020 - 6428
> 273 - 3020
< 50 - 273
0 5 10 km
N
Till samples, <2 mm
aqua regia extraction

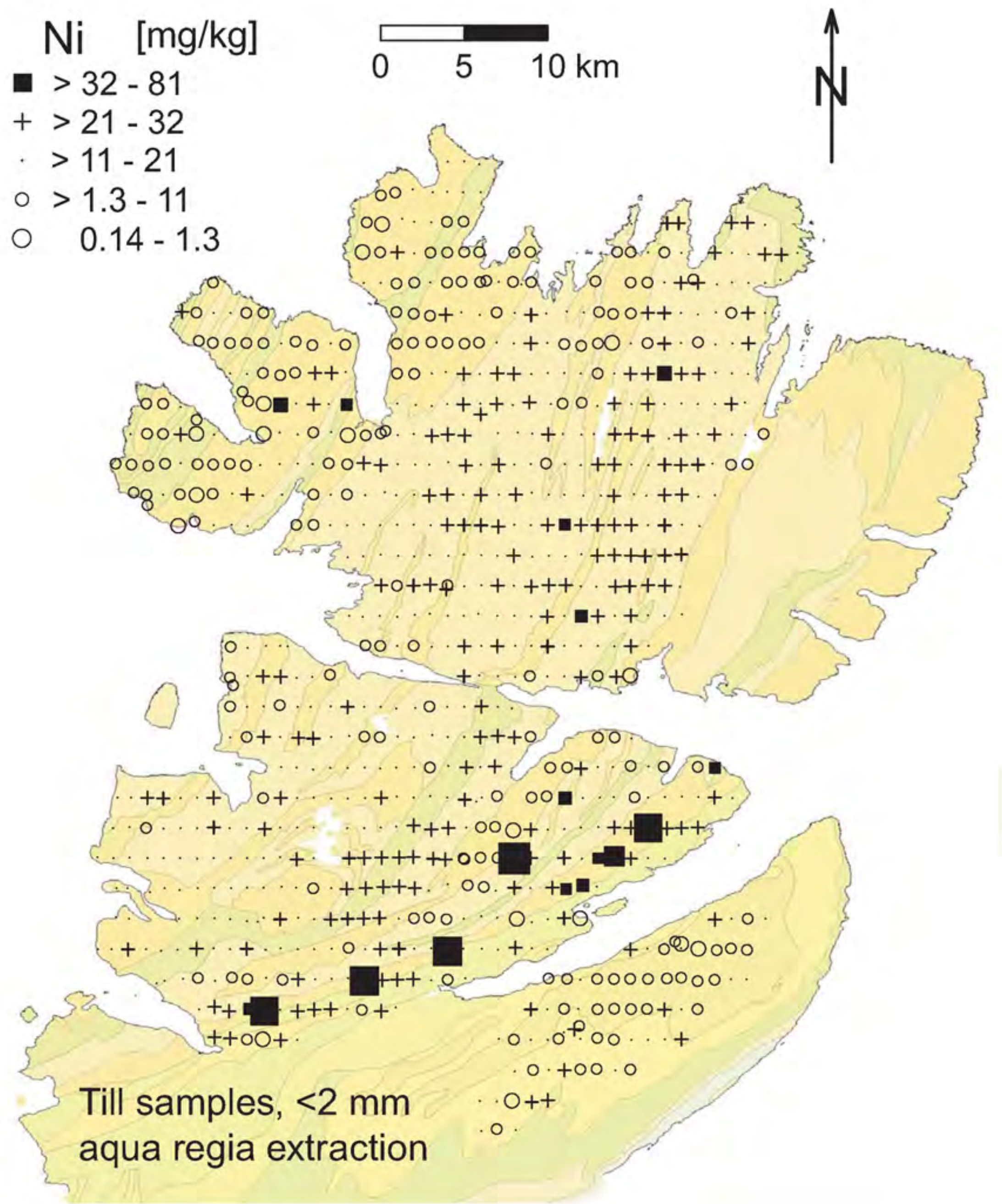

Mn [mg/kg]
■ > 791 - 18372
+ > 343 - 791
· > 136 - 343
○ > 22 - 136
○ < 1 - 22
0 5 10 km
N
Till samples, <2 mm
aqua regia extraction

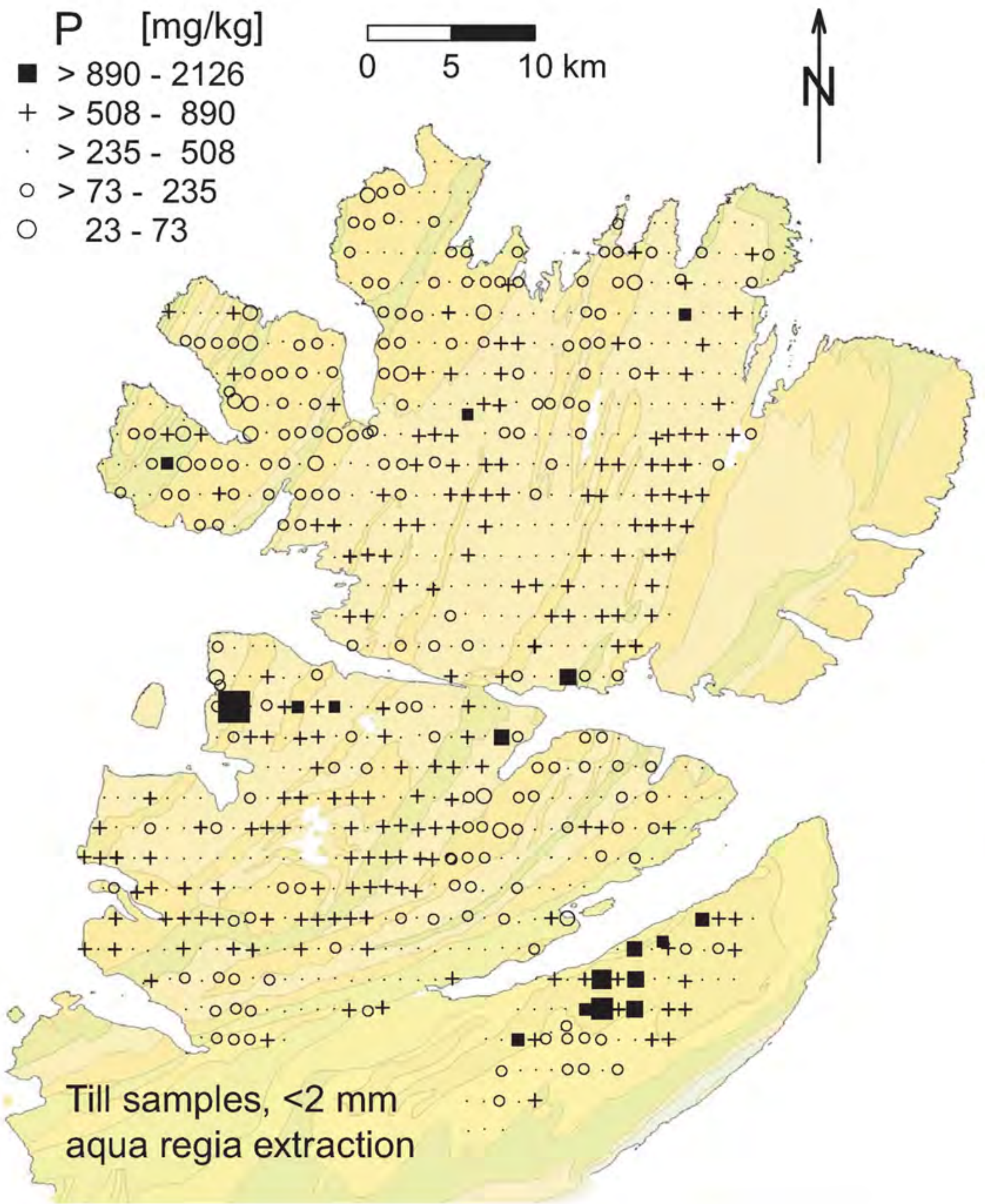

Mo [mg/kg]
> 4.3 - 23
> 0.61 - 4.3
> 0.24 - 0.61
> 0.085- 0.24
0.018 - 0.085
0 5 10 km
N
Till samples, <2 mm
aqua regia extraction

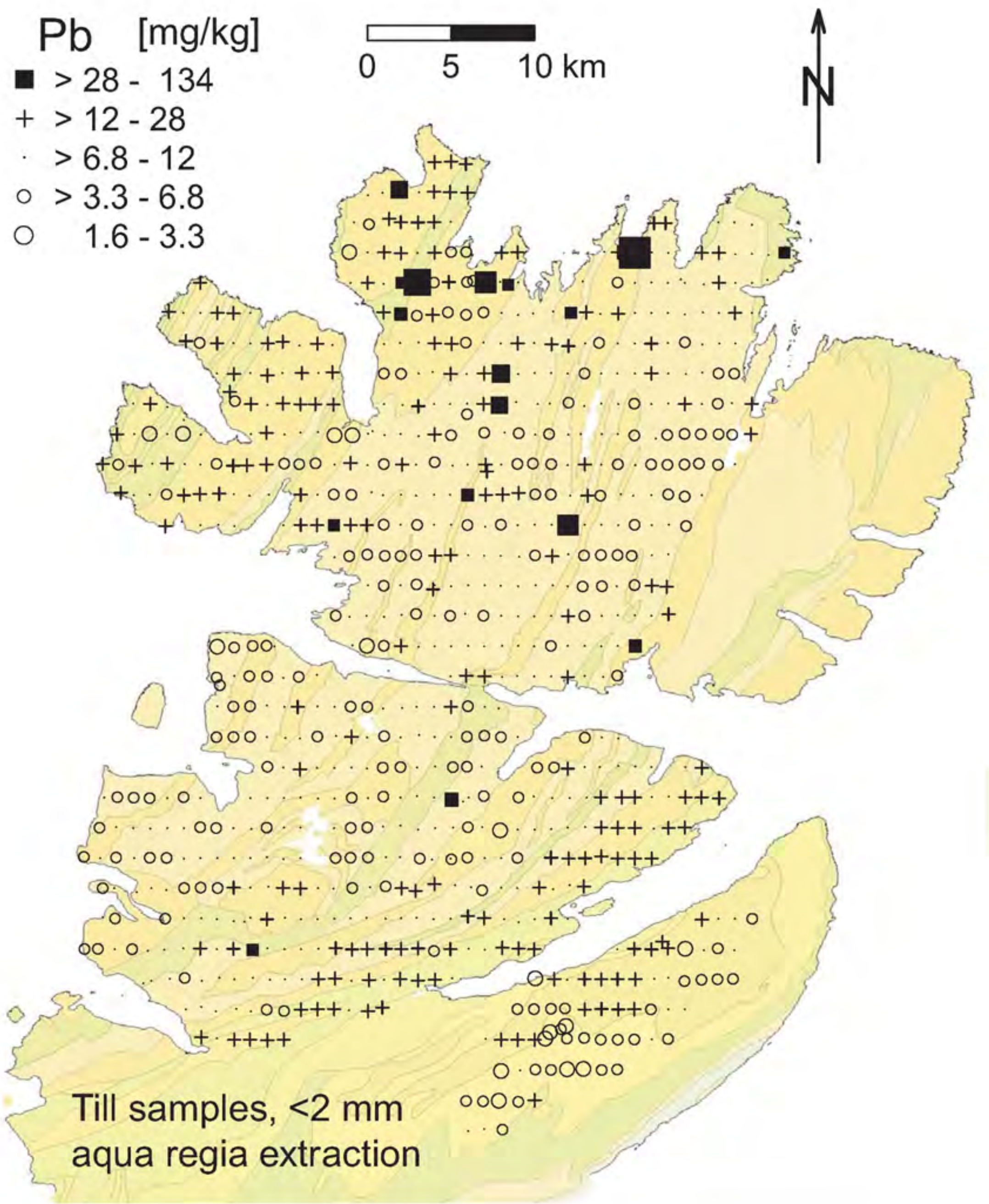

Na [mg/kg]
■ > 122 - 373
+ > 59 - 122
· > 20 - 59
○ > 1.0 - 20
○ <= 1.0
0 5 10 km
N
Till samples, <2 mm
aqua regia extraction

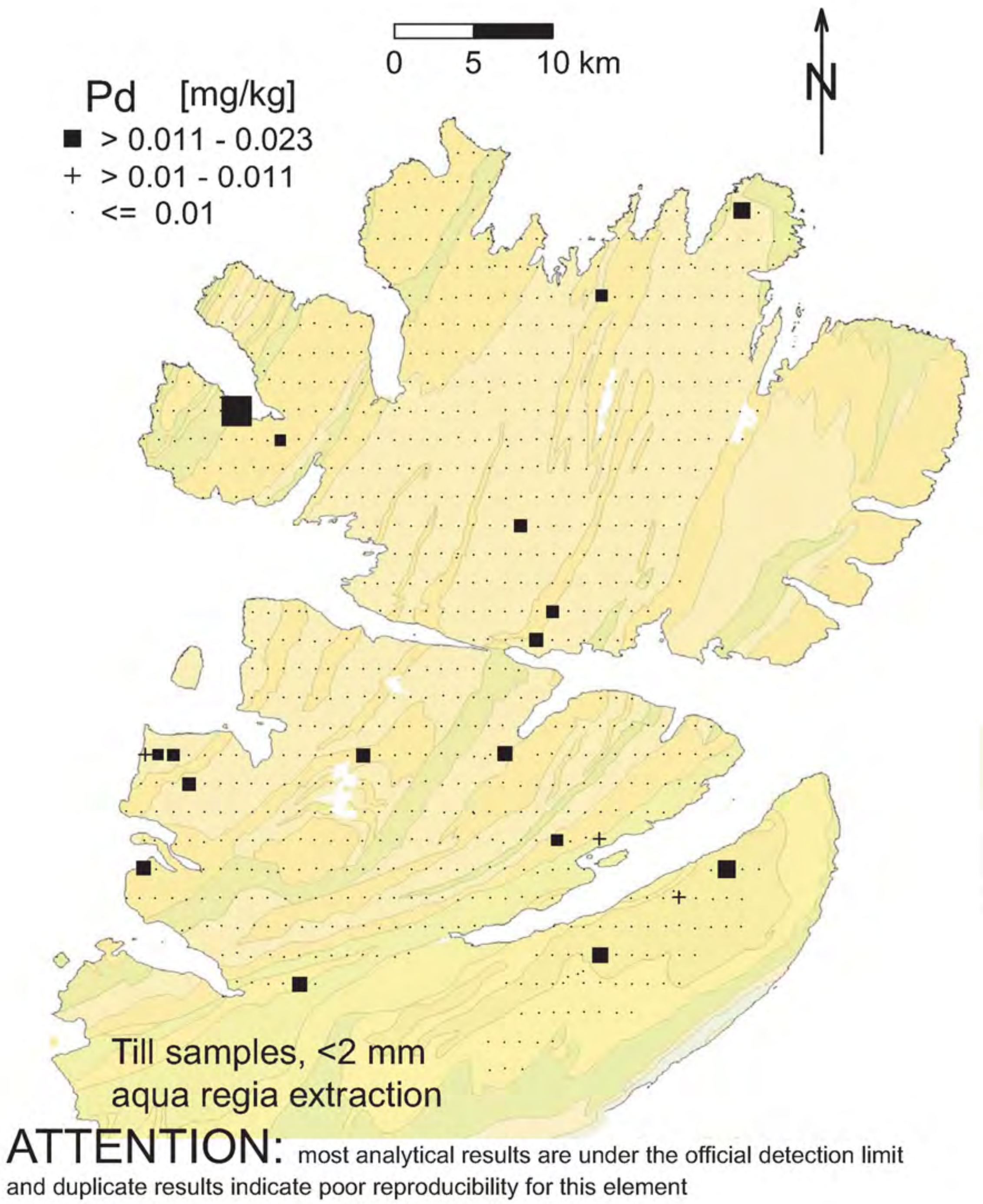

Nb [mg/kg]
> 4.1 - 6.5
> 2.5 - 4.1
> 0.90 - 2.5
> 0.082 - 0.90
< 0.01 - 0.082
0 5 10 km
N
Till samples, <2 mm
aqua regia extraction

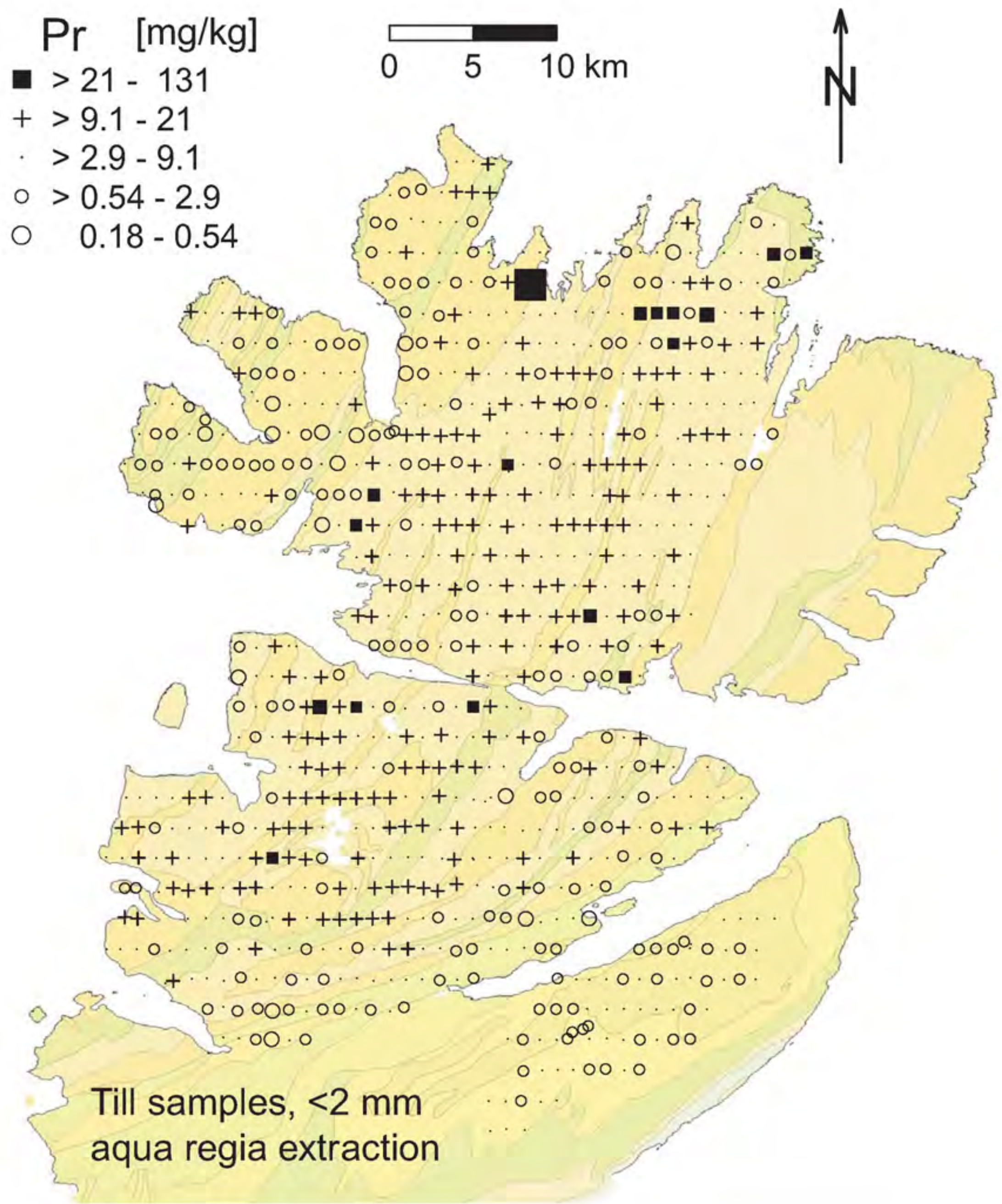

Nd [mg/kg]
> 79 - 498
> 34 - 79
> 10 - 34
> 1.9 - 10
0.59 - 1.9
0 5 10 km
N
Till samples, <2 mm
aqua regia extraction

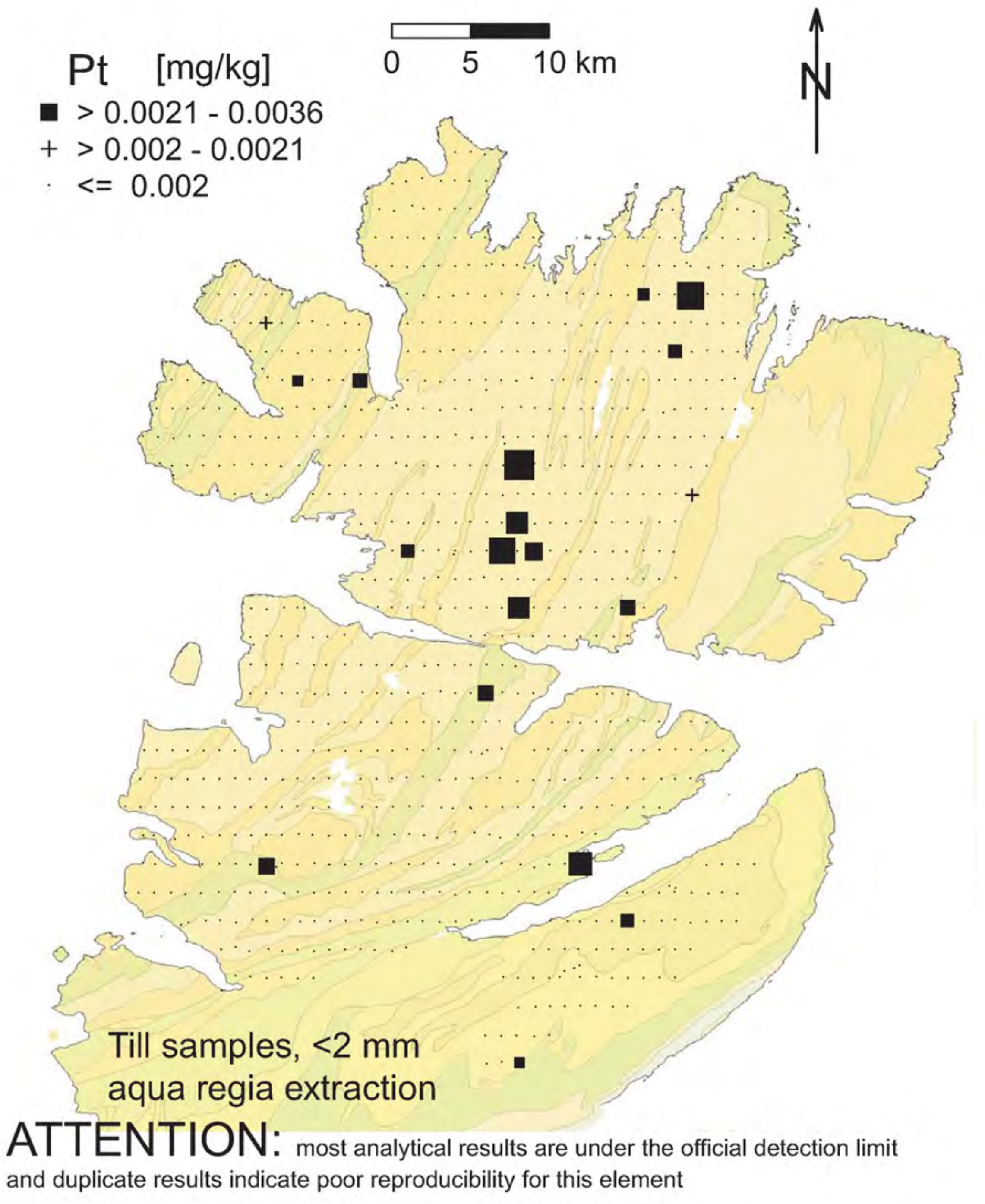

Ni [mg/kg]
> 32 - 81
> 21 - 32
> 11 - 21
> 1.3 - 11
0.14 - 1.3
0 5 10 km
N
Till samples, <2 mm
aqua regia extraction

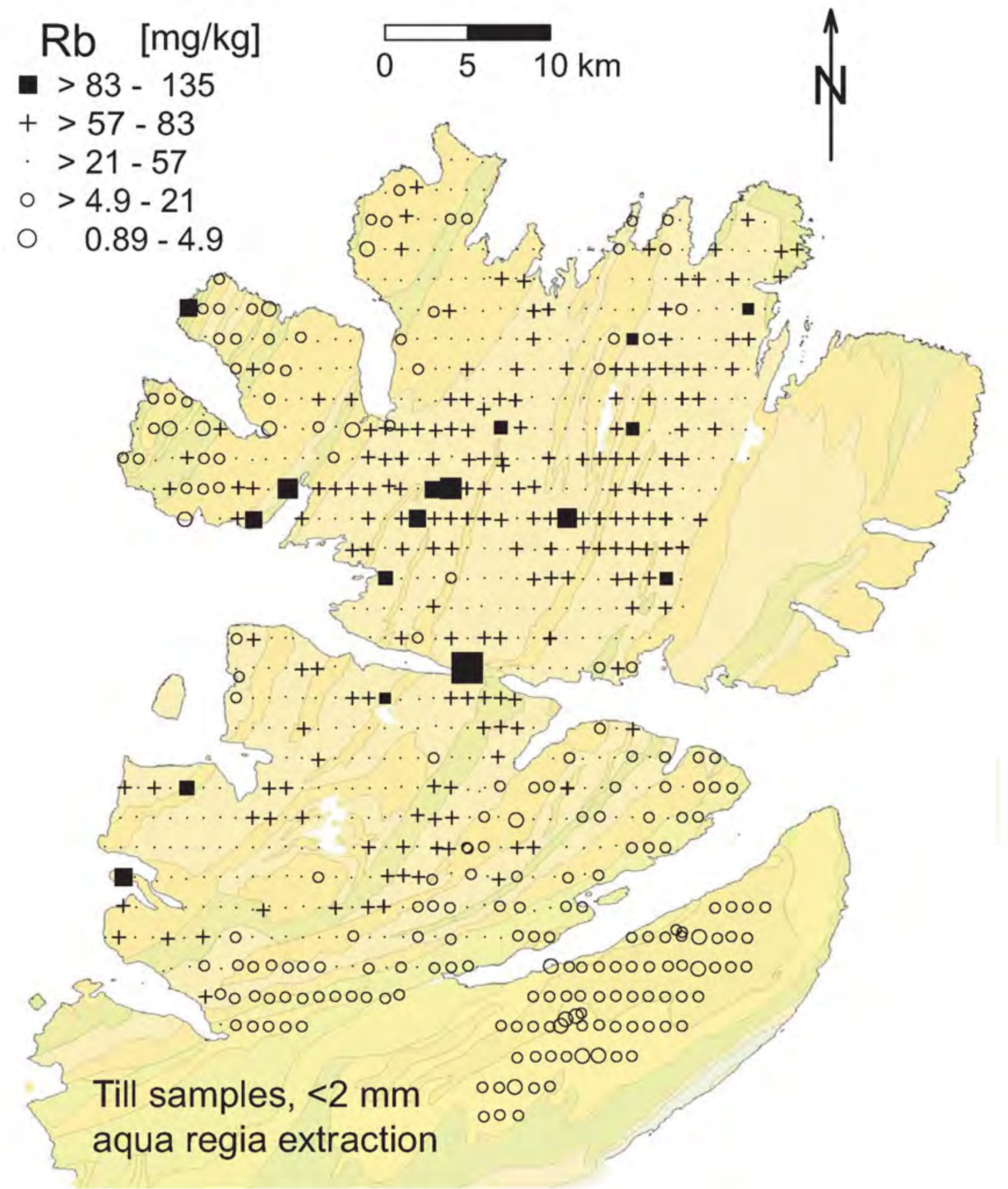

P [mg/kg]
■ > 890 - 2126
+ > 508 - 890
· > 235 - 508
○ > 73 - 235
○ 23 - 73
0 5 10 km
N
Till samples, <2 mm
aqua regia extraction

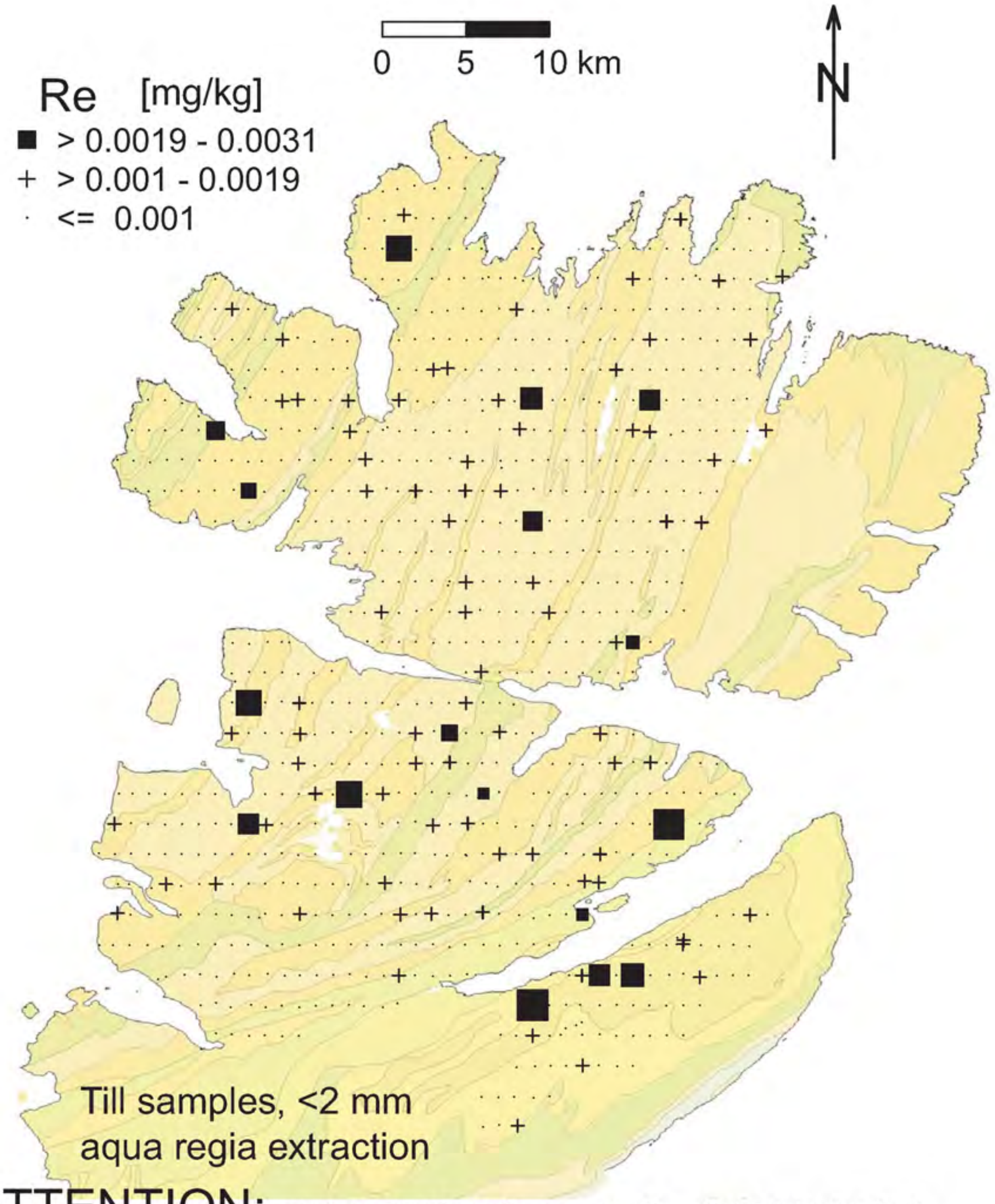

Pb [mg/kg]
> 28 - 134
> 12 - 28
> 6.8 - 12
> 3.3 - 6.8
1.6 - 3.3
0 5 10 km
N
Till samples, <2 mm
aqua regia extraction


0
5
10 km
N
Pd [mg/kg]
> 0.011 - 0.023
> 0.01 - 0.011
<= 0.01
Till samples, <2 mm
aqua regia extraction
ATTENTION: most analytical results are under the official detection limit
and duplicate results indicate poor reproducibility for this element

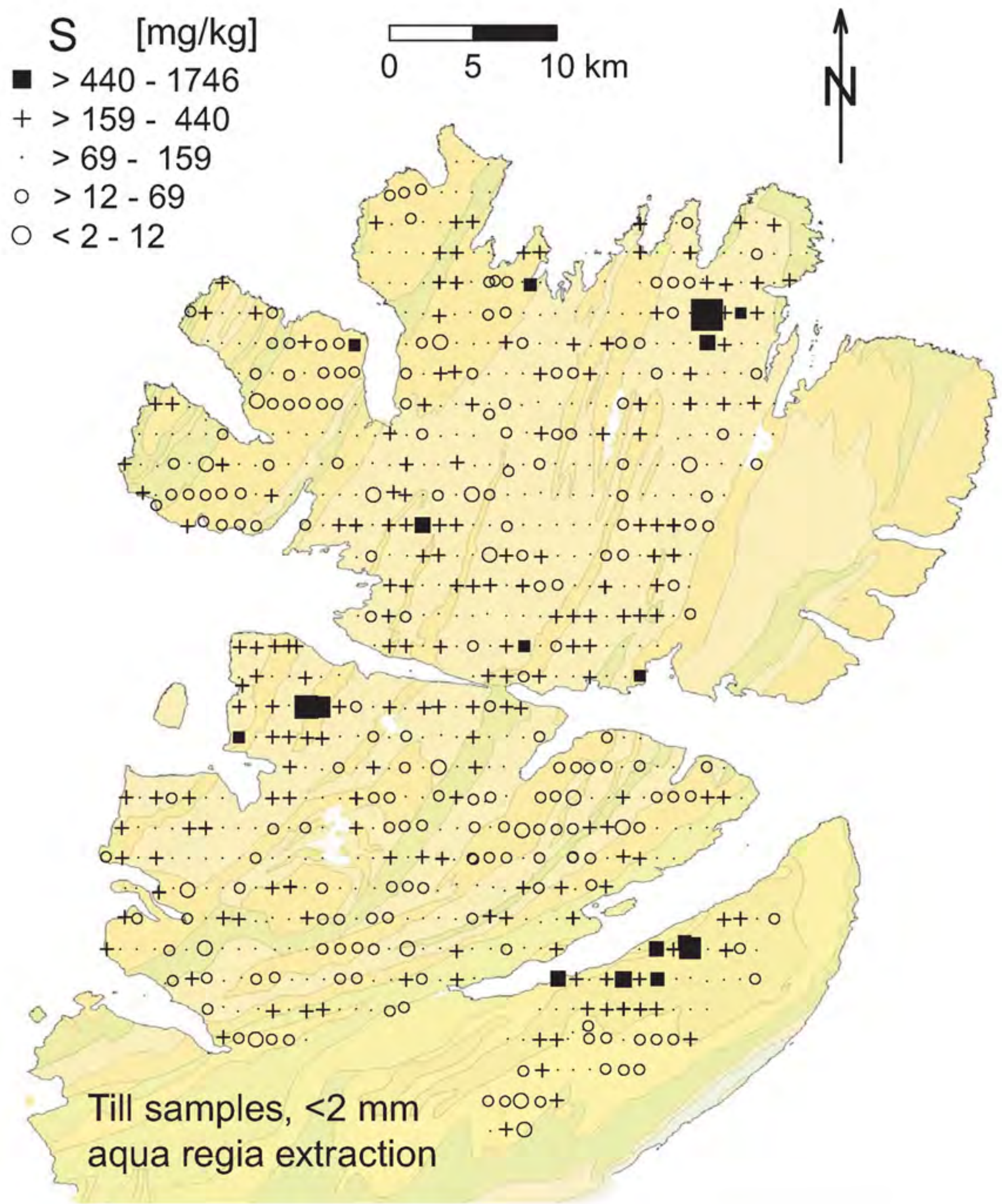

Pr [mg/kg]
> 21 - 131
> 9.1 - 21
> 2.9 - 9.1
> 0.54 - 2.9
0.18 - 0.54
0 5 10 km
N
Till samples, <2 mm
aqua regia extraction

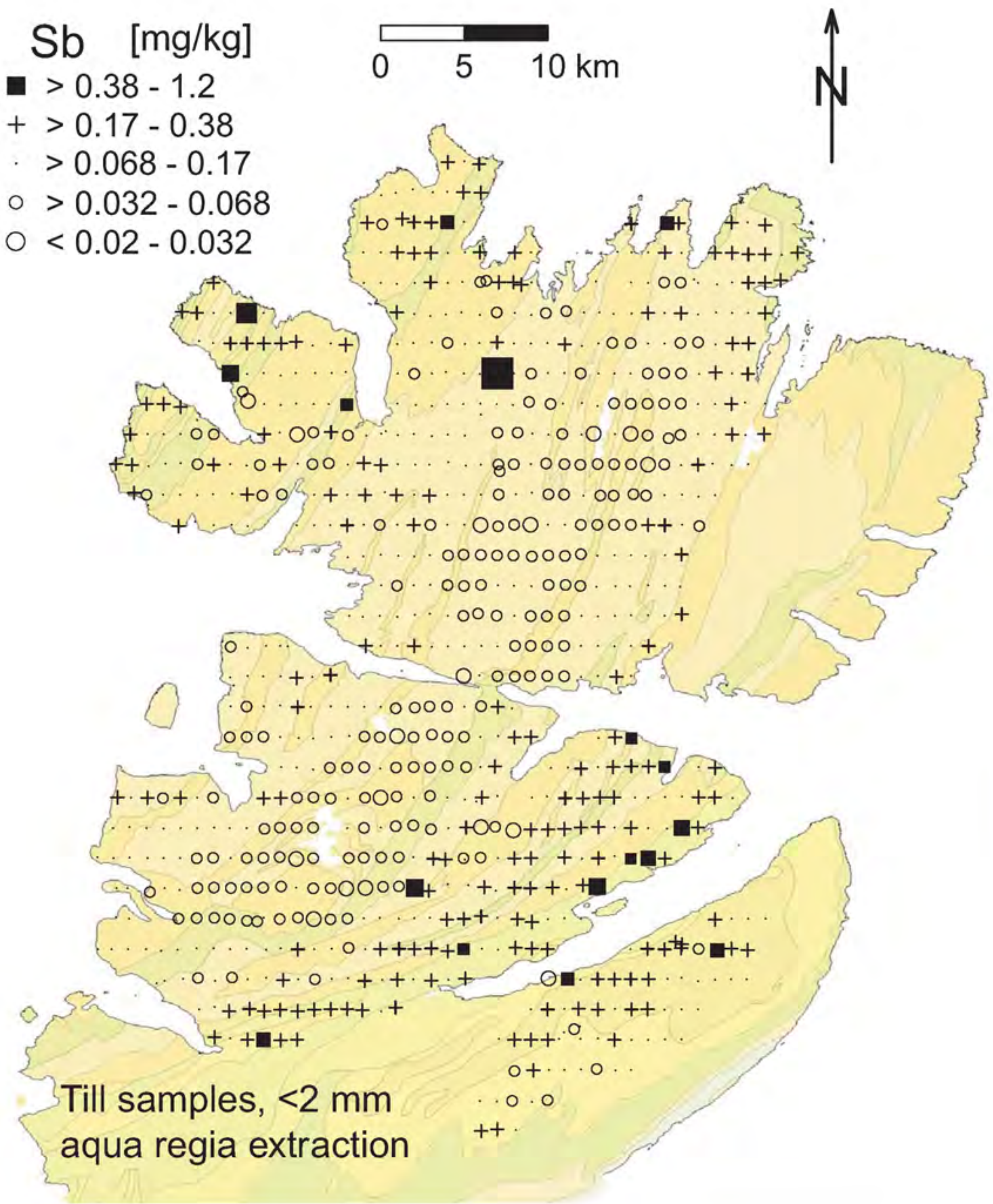

Pt [mg/kg]
> 0.0021 - 0.0036
> 0.002 - 0.0021
<= 0.002
0 5 10 km
N
Till samples, <2 mm
aqua regia extraction
ATTENTION: most analytical results are under the official detection limit
and duplicate results indicate poor reproducibility for this element

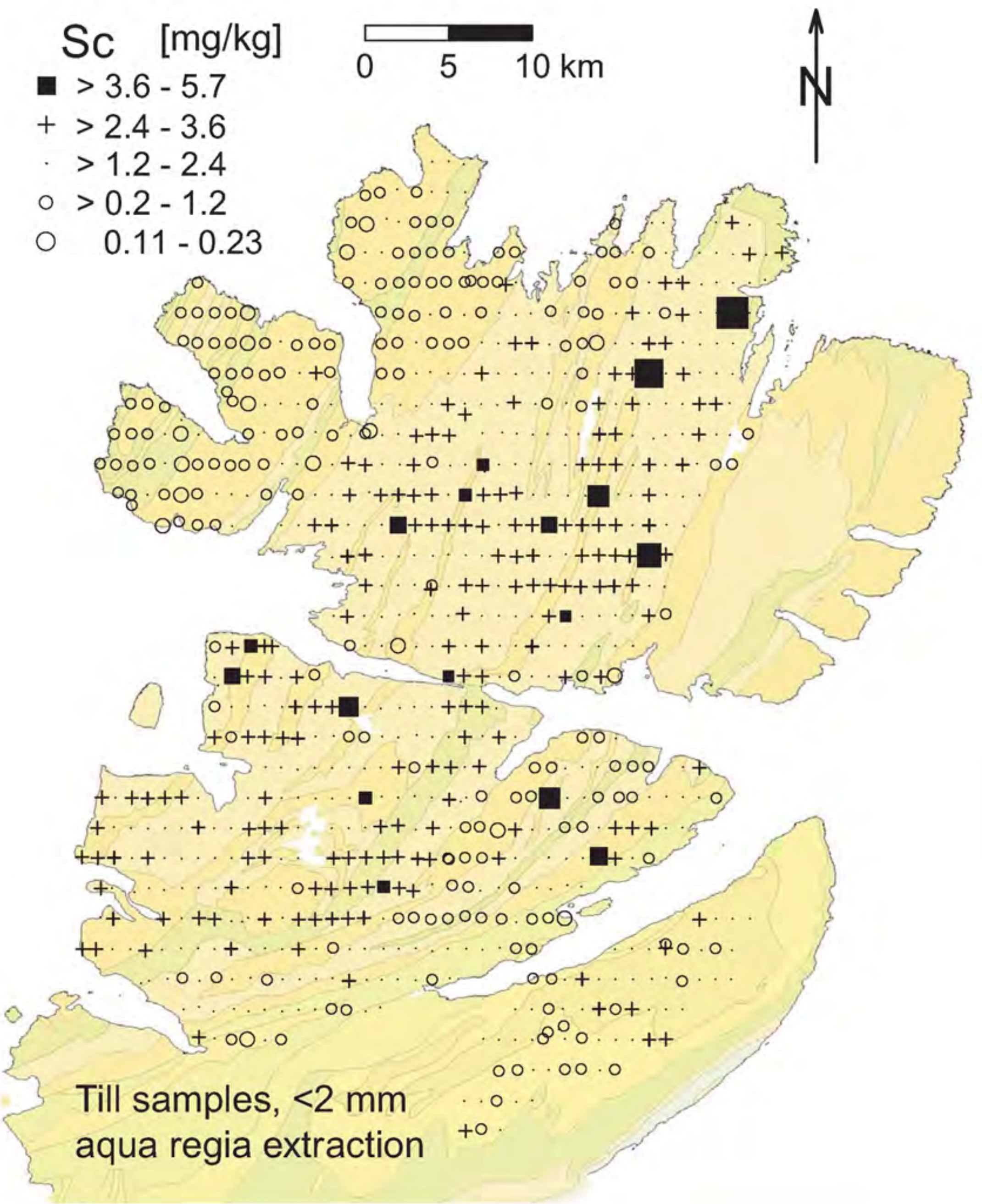

Rb [mg/kg]
> 83 - 135
> 57 - 83
> 21 - 57
> 4.9 - 21
0.89 - 4.9
0 5 10 km
N
Till samples, <2 mm
aqua regia extraction

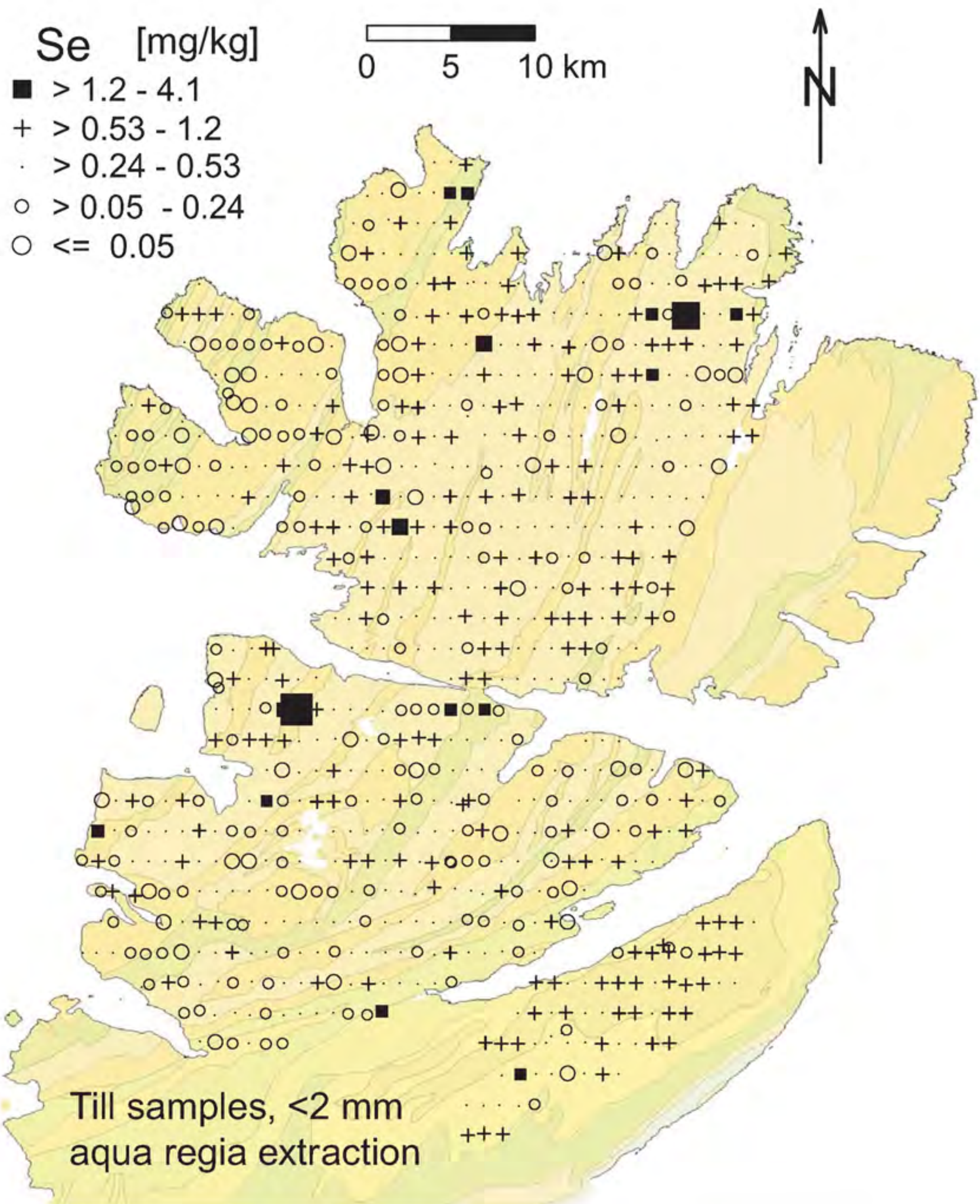


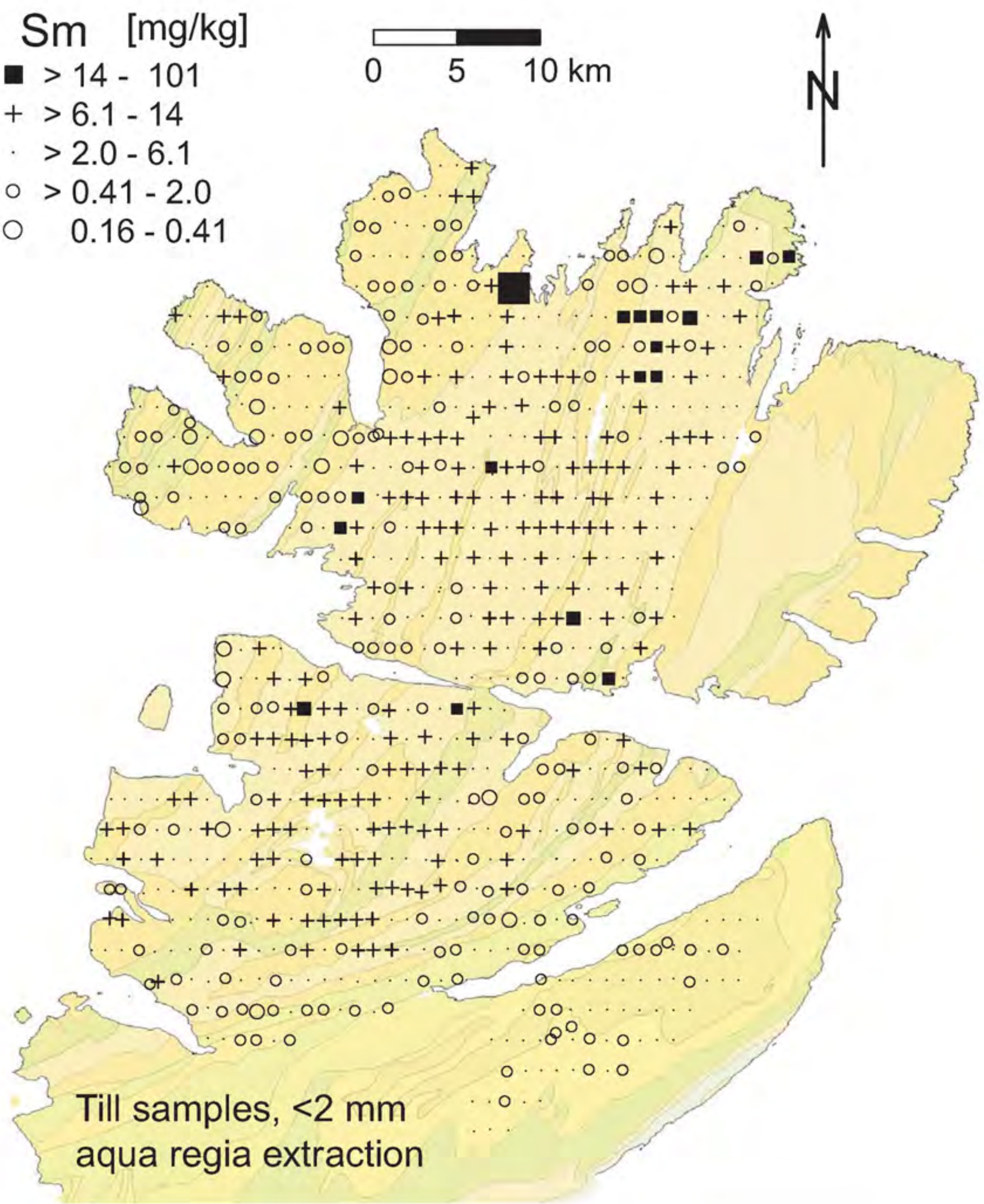
ATTENTION: most analytical results are under the official detection limit and duplicate results indicate very poor reproducibility for this element

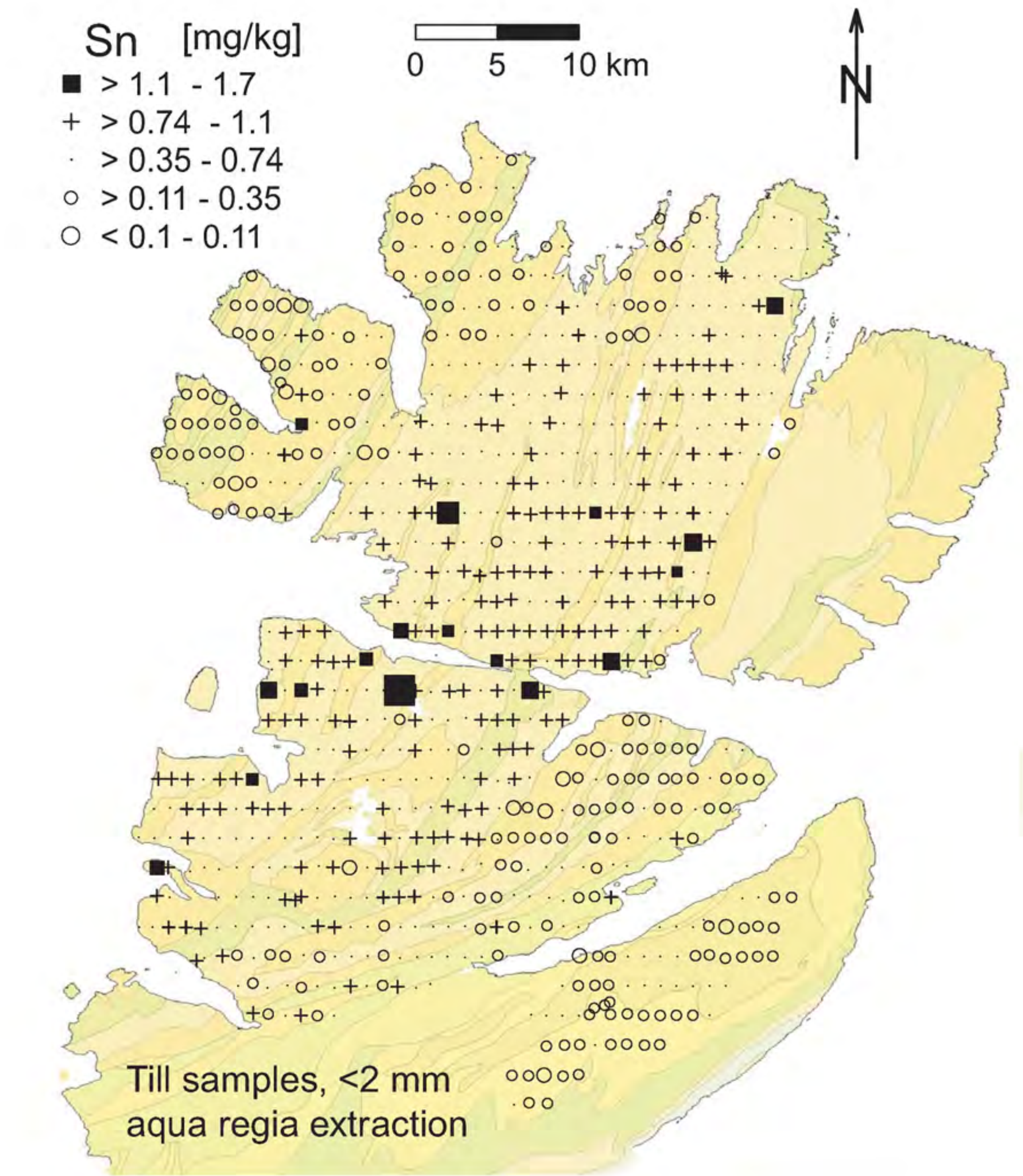

S [mg/kg]
■ > 440 - 1746
+ > 159 - 440
· > 69 - 159
○ > 12 - 69
○ < 2 - 12
0 5 10 km
N
Till samples, <2 mm
aqua regia extraction

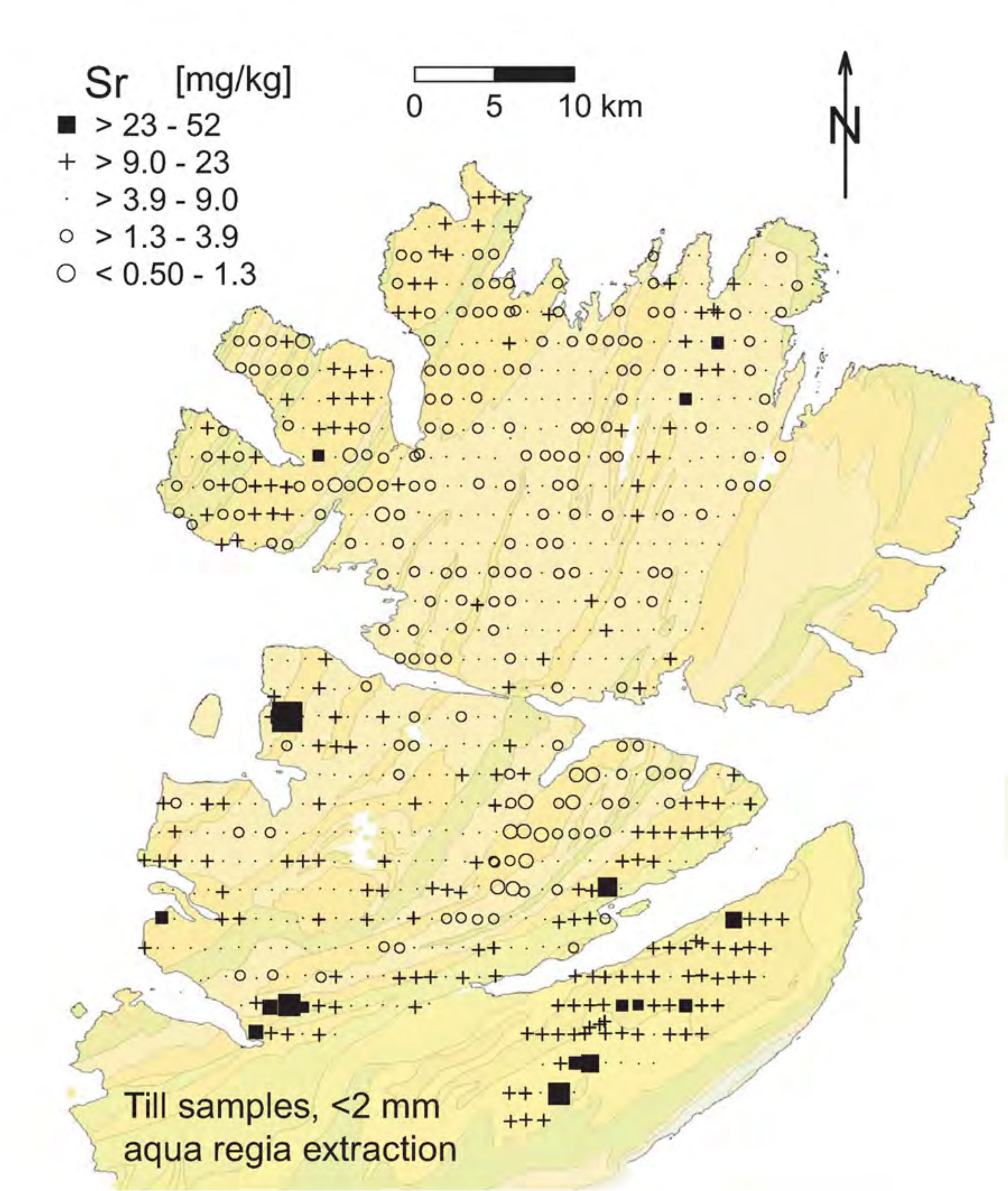

Sb [mg/kg]
■ > 0.38 - 1.2
+ > 0.17 - 0.38
· > 0.068 - 0.17
○ > 0.032 - 0.068
○ < 0.02 - 0.032
0 5 10 km
N
Till samples, <2 mm
aqua regia extraction

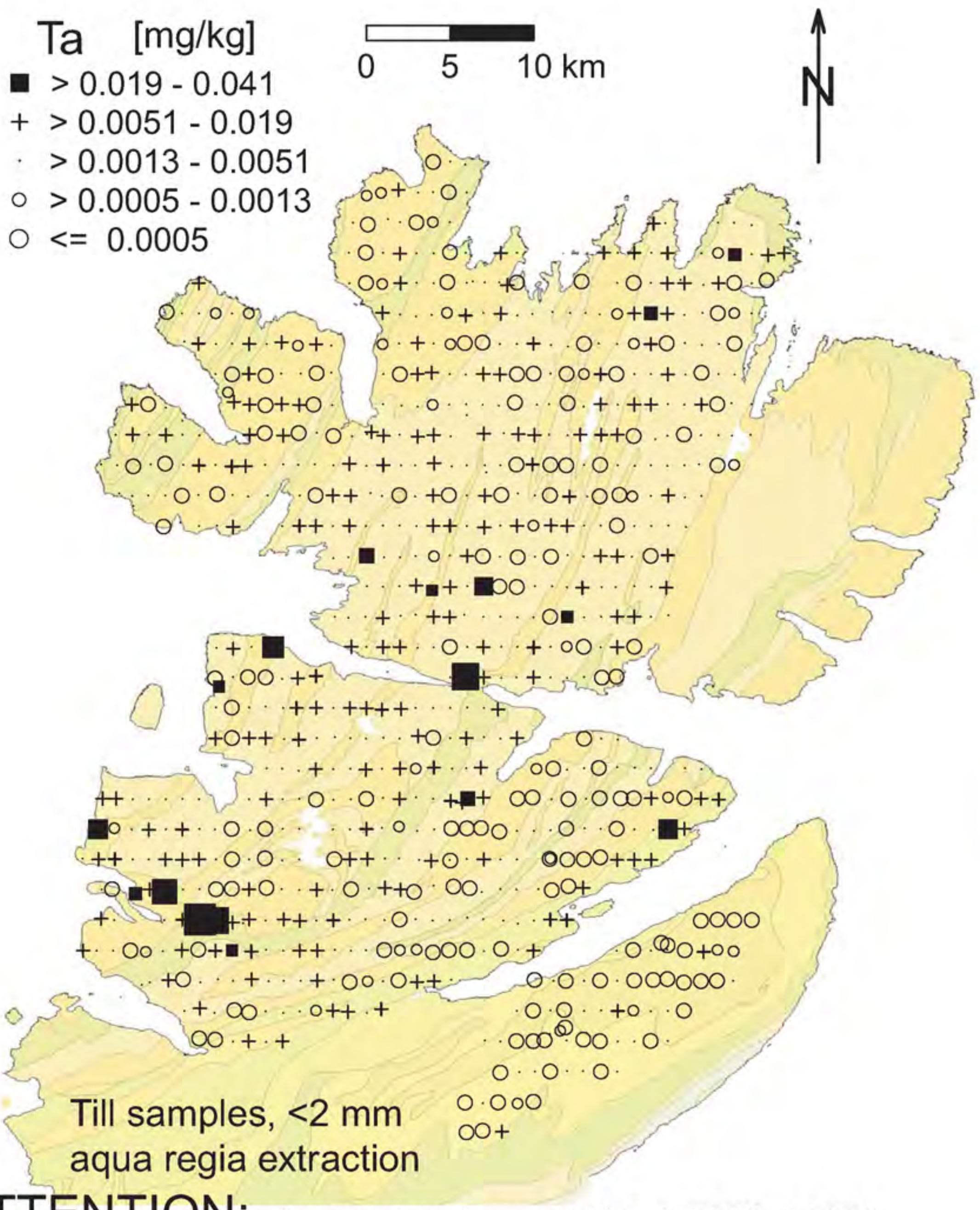

Sc [mg/kg]
> 3.6 - 5.7
> 2.4 - 3.6
> 1.2 - 2.4
> 0.2 - 1.2
0.11 - 0.23
0 5 10 km
N
Till samples, <2 mm
aqua regia extraction


Se [mg/kg]
> 1.2 - 4.1
> 0.53 - 1.2
> 0.24 - 0.53
> 0.05 - 0.24
<= 0.05
0
5
10 km
N
Till samples, <2 mm
aqua regia extraction

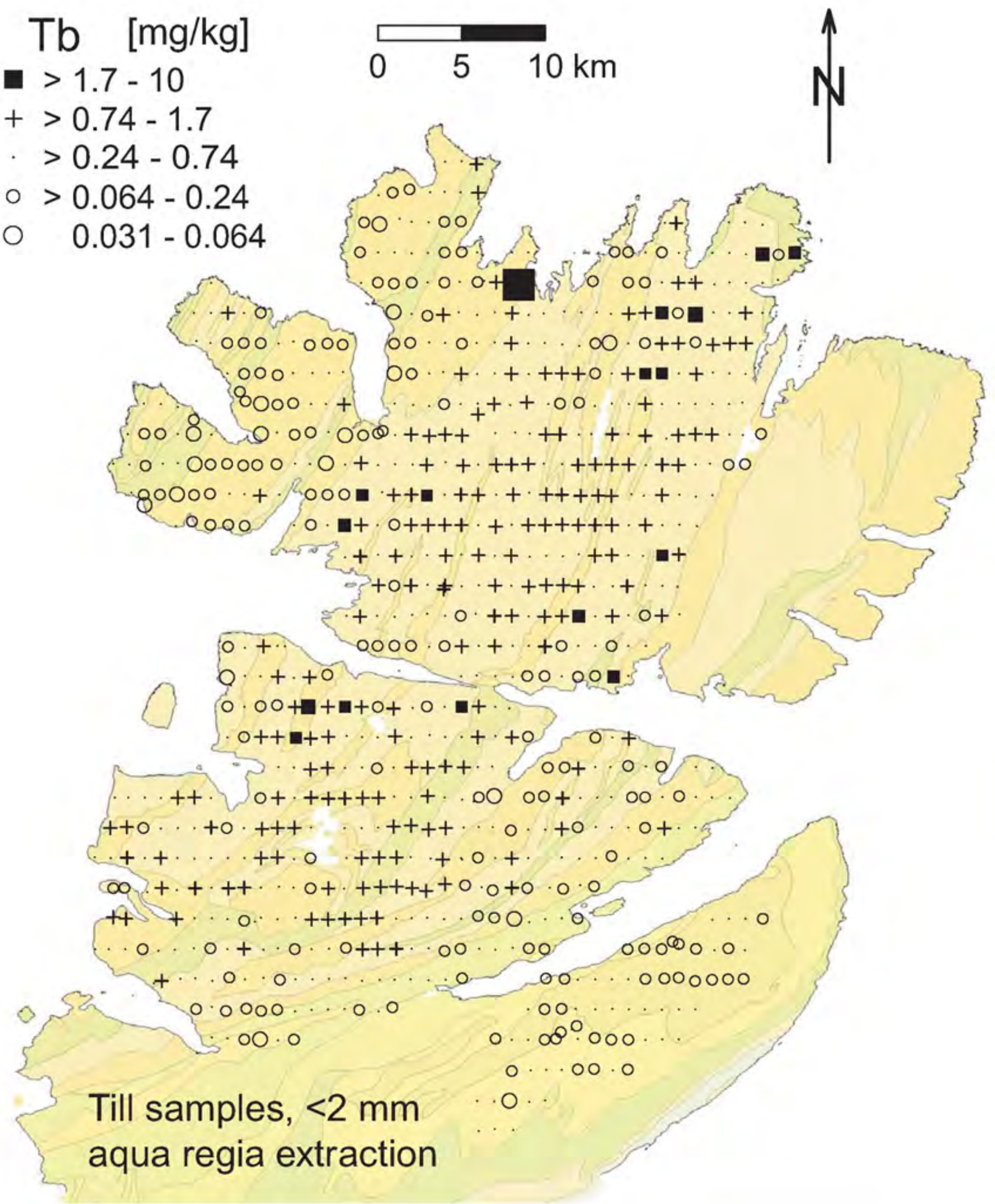

Sm [mg/kg]
■ > 14 - 101
+ > 6.1 - 14
· > 2.0 - 6.1
○ > 0.41 - 2.0
○ 0.16 - 0.41
0 5 10 km
N
Till samples, <2 mm
aqua regia extraction

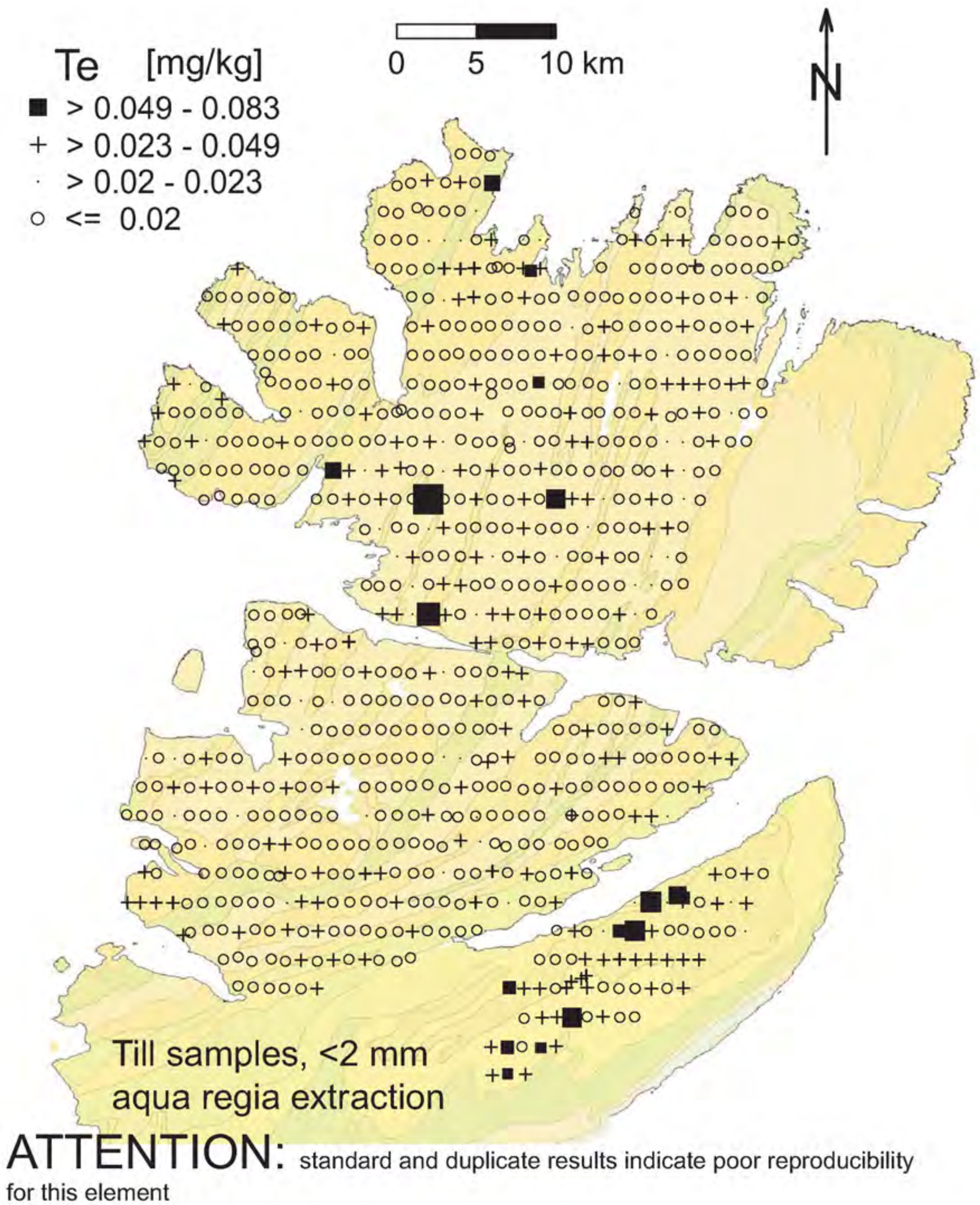

Sn [mg/kg]
> 1.1 - 1.7
> 0.74 - 1.1
> 0.35 - 0.74
> 0.11 - 0.35
< 0.1 - 0.11
0 5 10 km
N
Till samples, <2 mm
aqua regia extraction

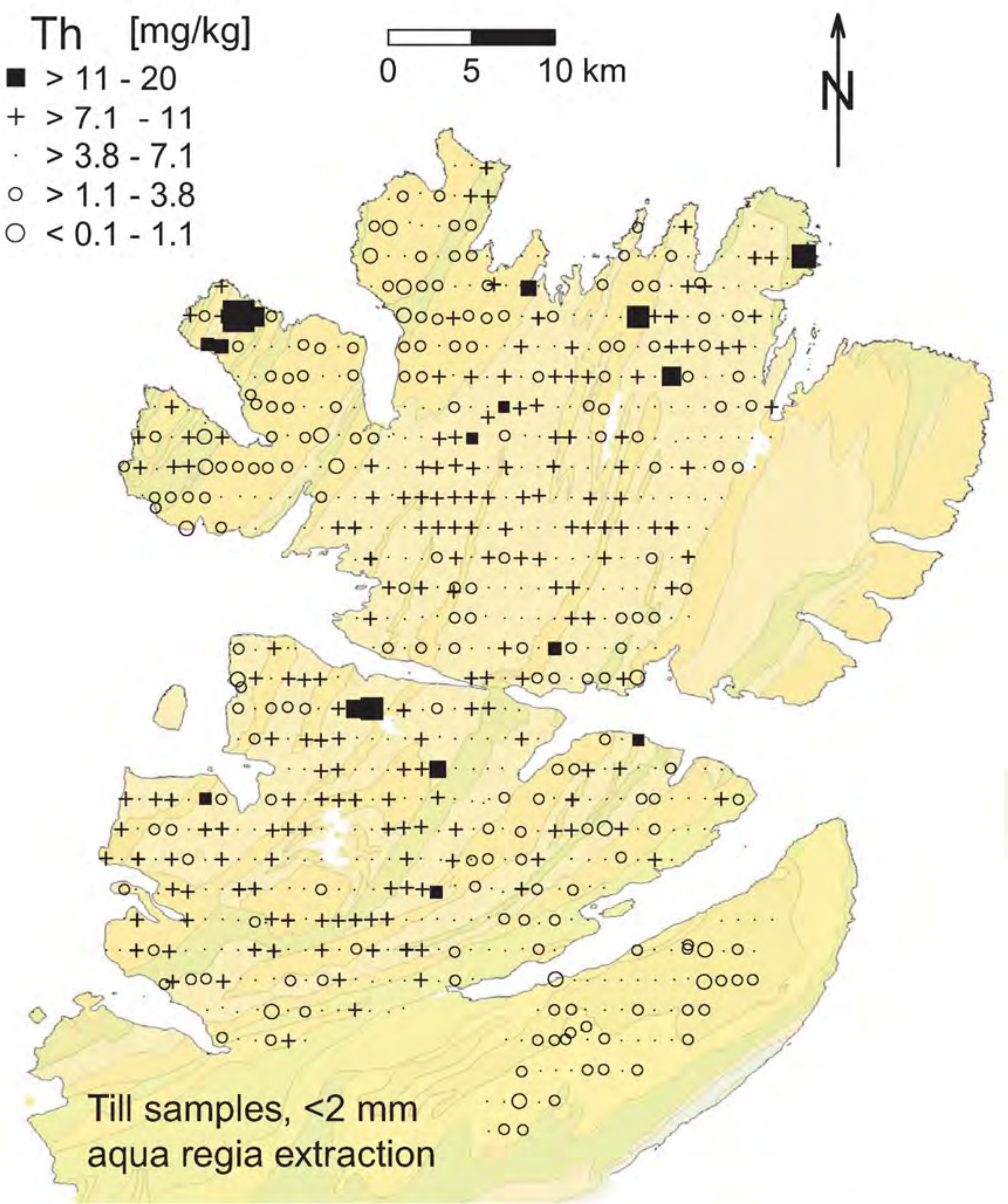

Sr [mg/kg]
> 23 - 52
> 9.0 - 23
> 3.9 - 9.0
> 1.3 - 3.9
< 0.50 - 1.3
0 5 10 km
N
Till samples, <2 mm
aqua regia extraction

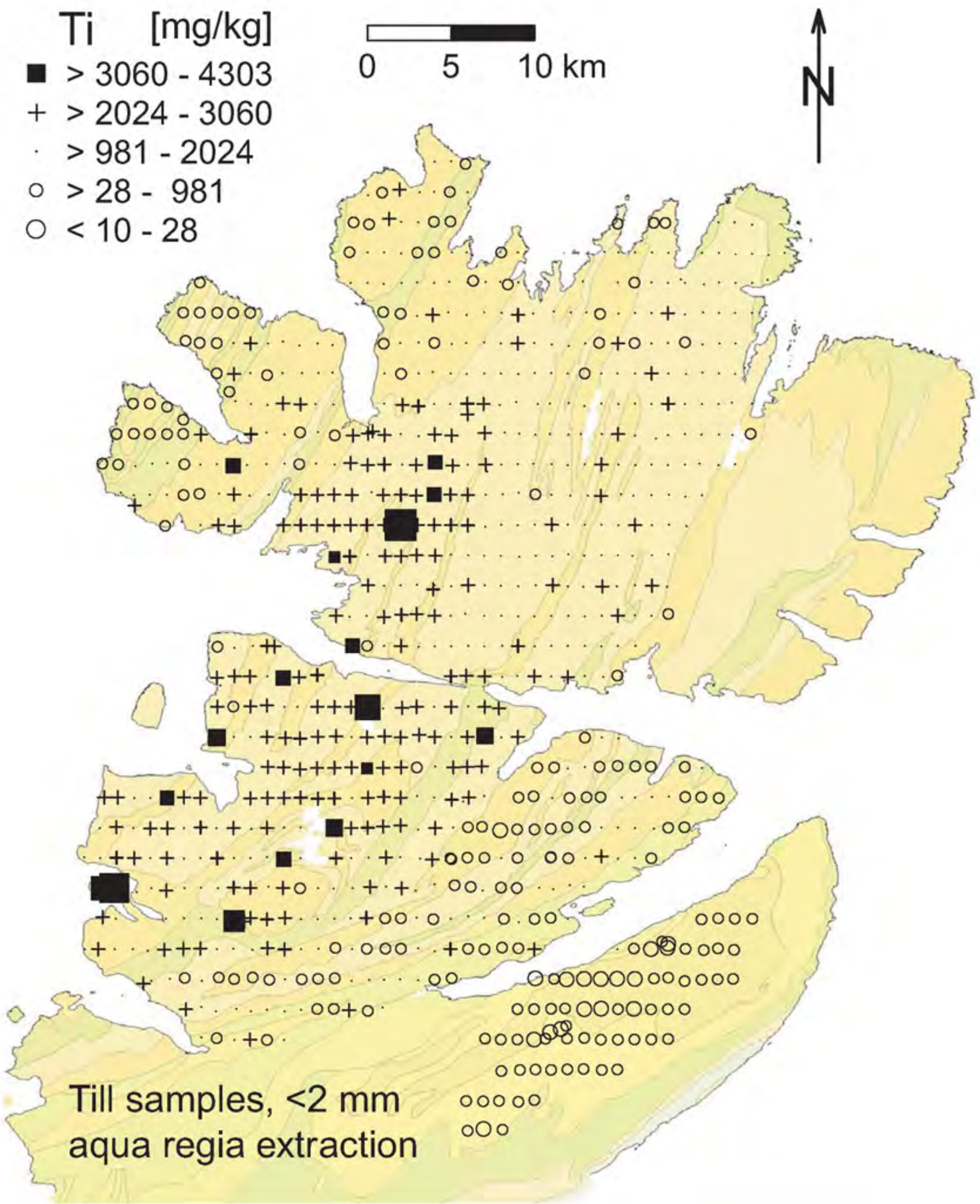


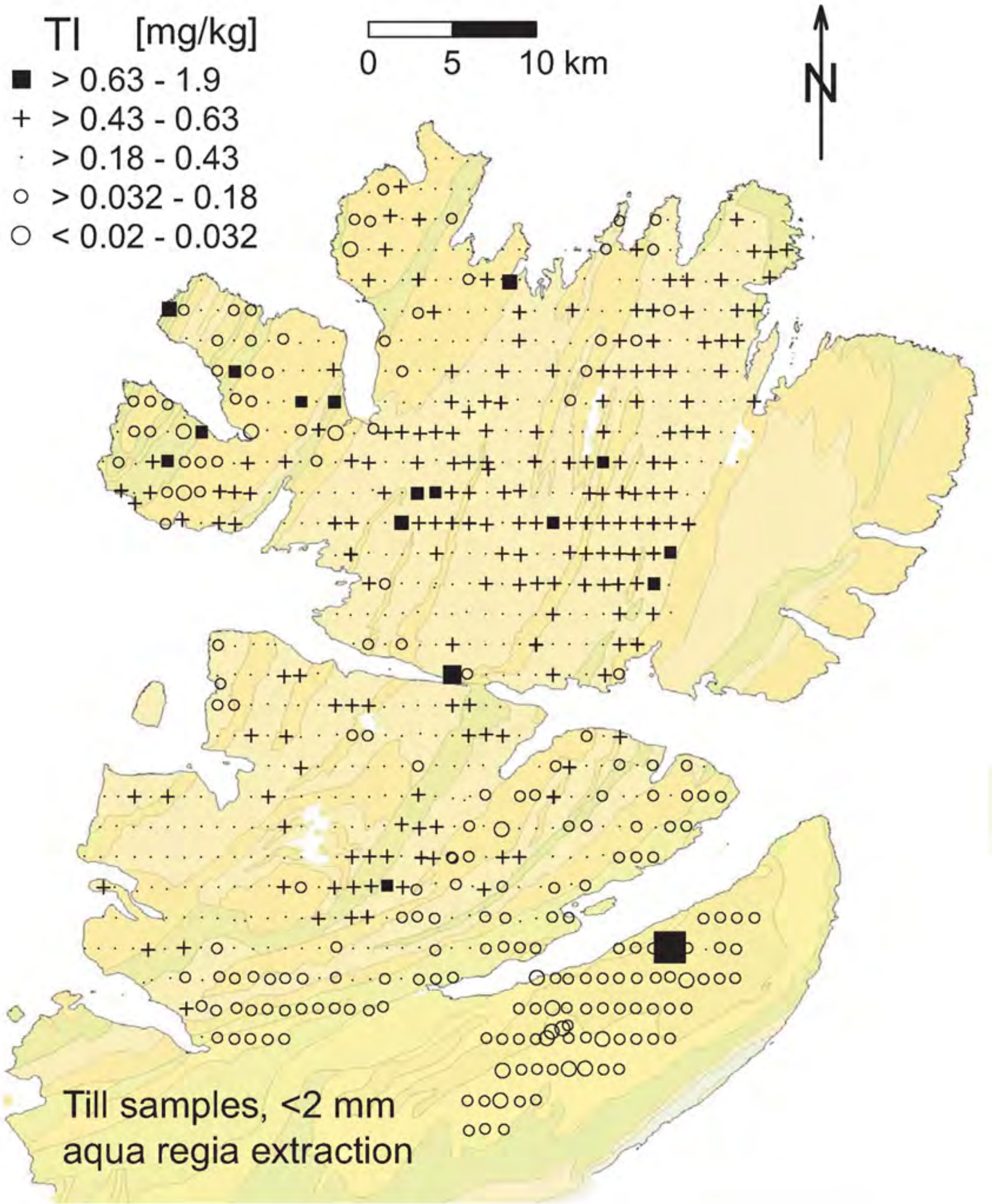
ATTENTION: all analytical results are under the official detection limit of 0.05 mg/kg - the map shows the instrument readings below the DL

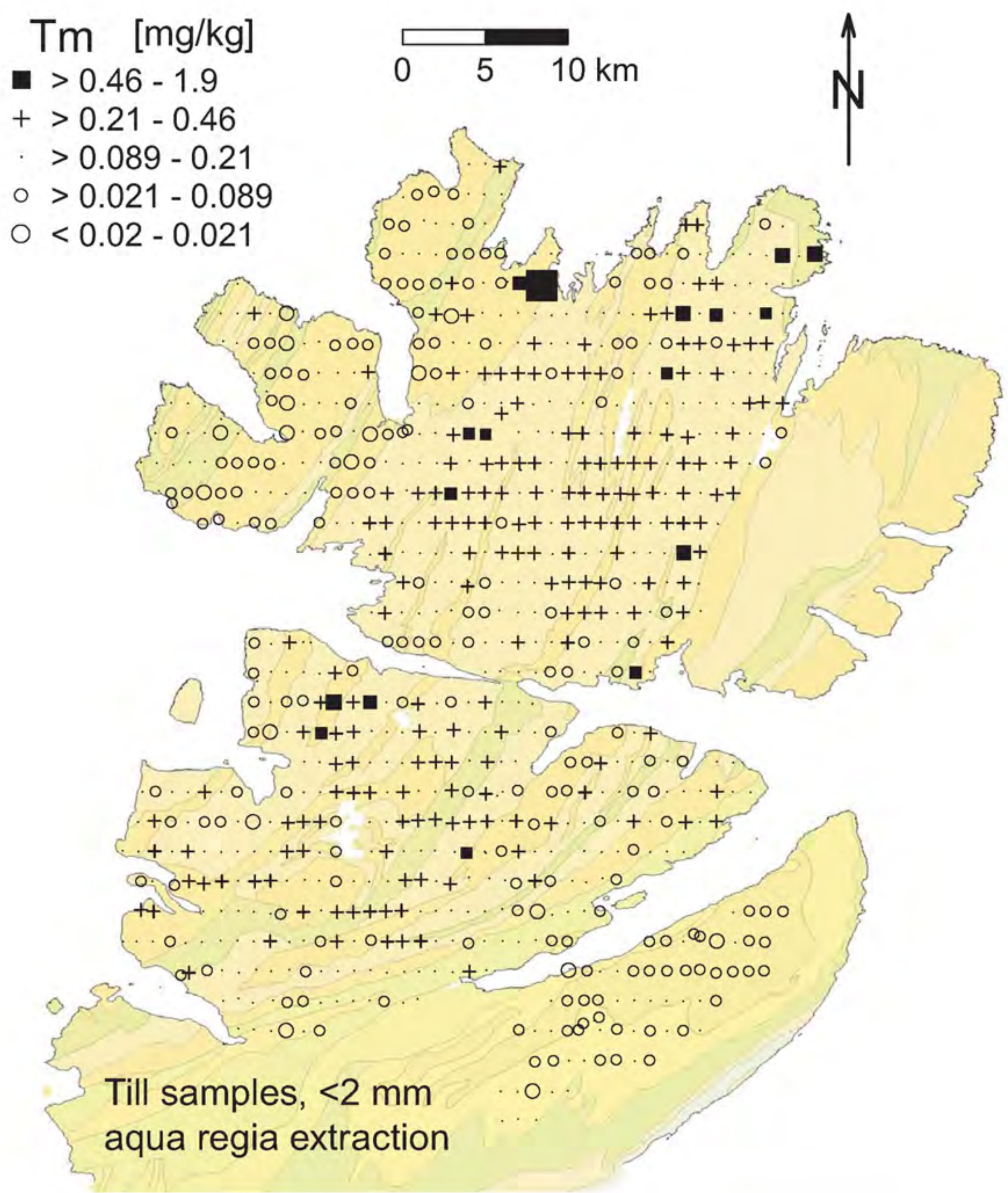

Tb [mg/kg]
> 1.7 - 10
> 0.74 - 1.7
> 0.24 - 0.74
> 0.064 - 0.24
0.031 - 0.064
0 5 10 km
N
Till samples, <2 mm
aqua regia extraction

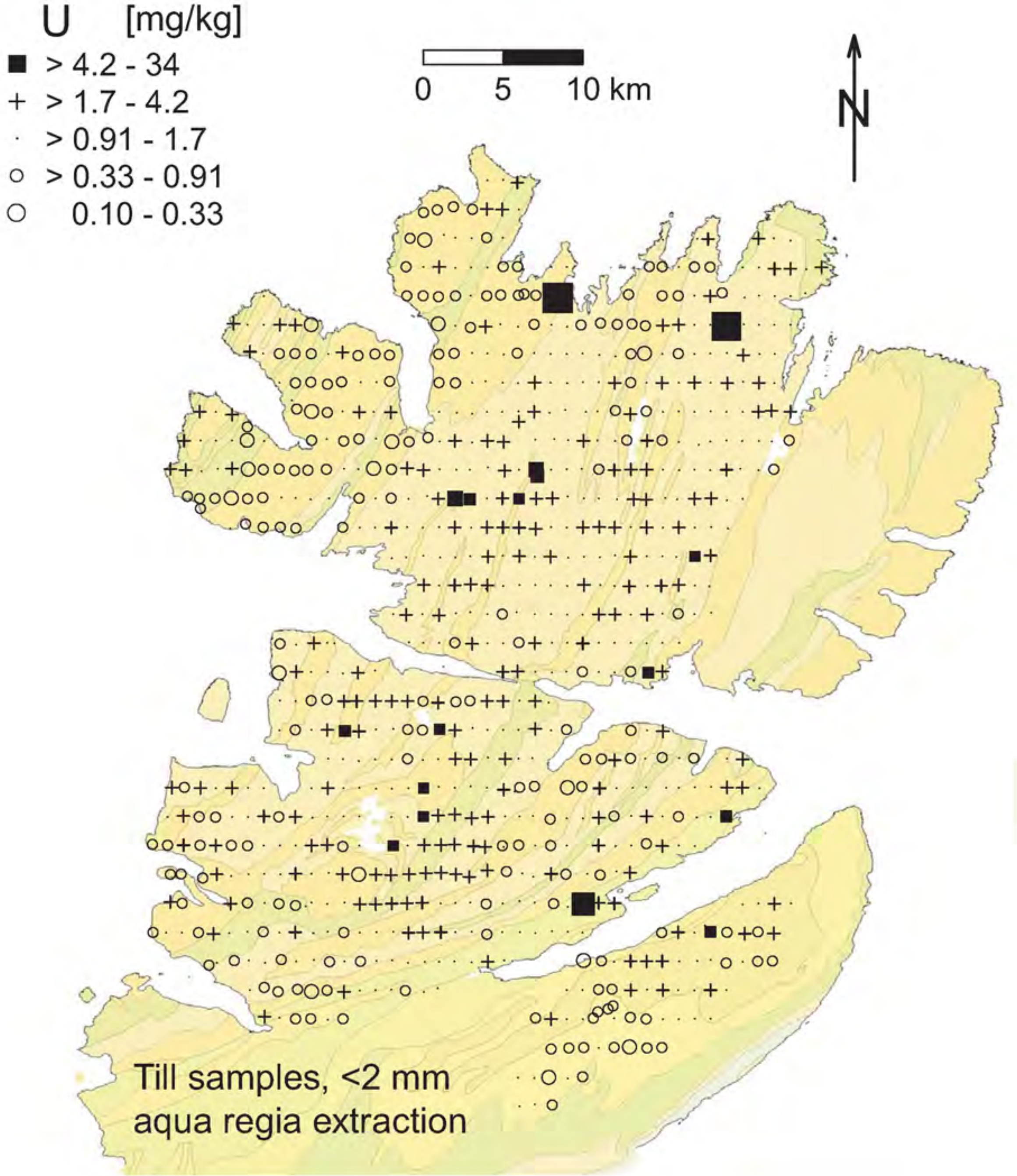

Te [mg/kg]
> 0.049 - 0.083
> 0.023 - 0.049
> 0.02 - 0.023
<= 0.02
0 5 10 km
N
Till samples, <2 mm
aqua regia extraction
ATTENTION: standard and duplicate results indicate poor reproducibility for this element

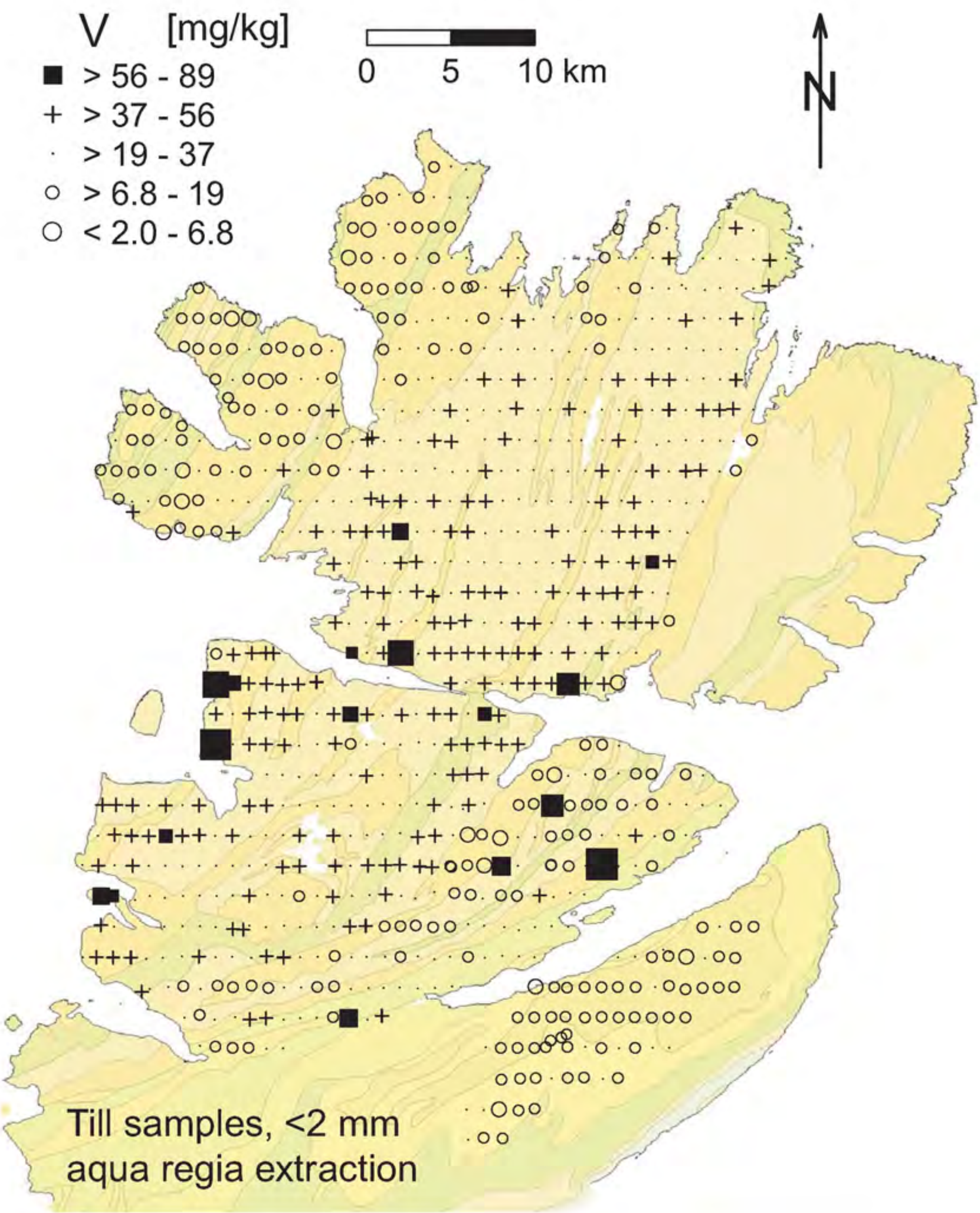

Th [mg/kg]
> 11 - 20
> 7.1 - 11
> 3.8 - 7.1
> 1.1 - 3.8
< 0.1 - 1.1
0 5 10 km
N
Till samples, <2 mm
aqua regia extraction

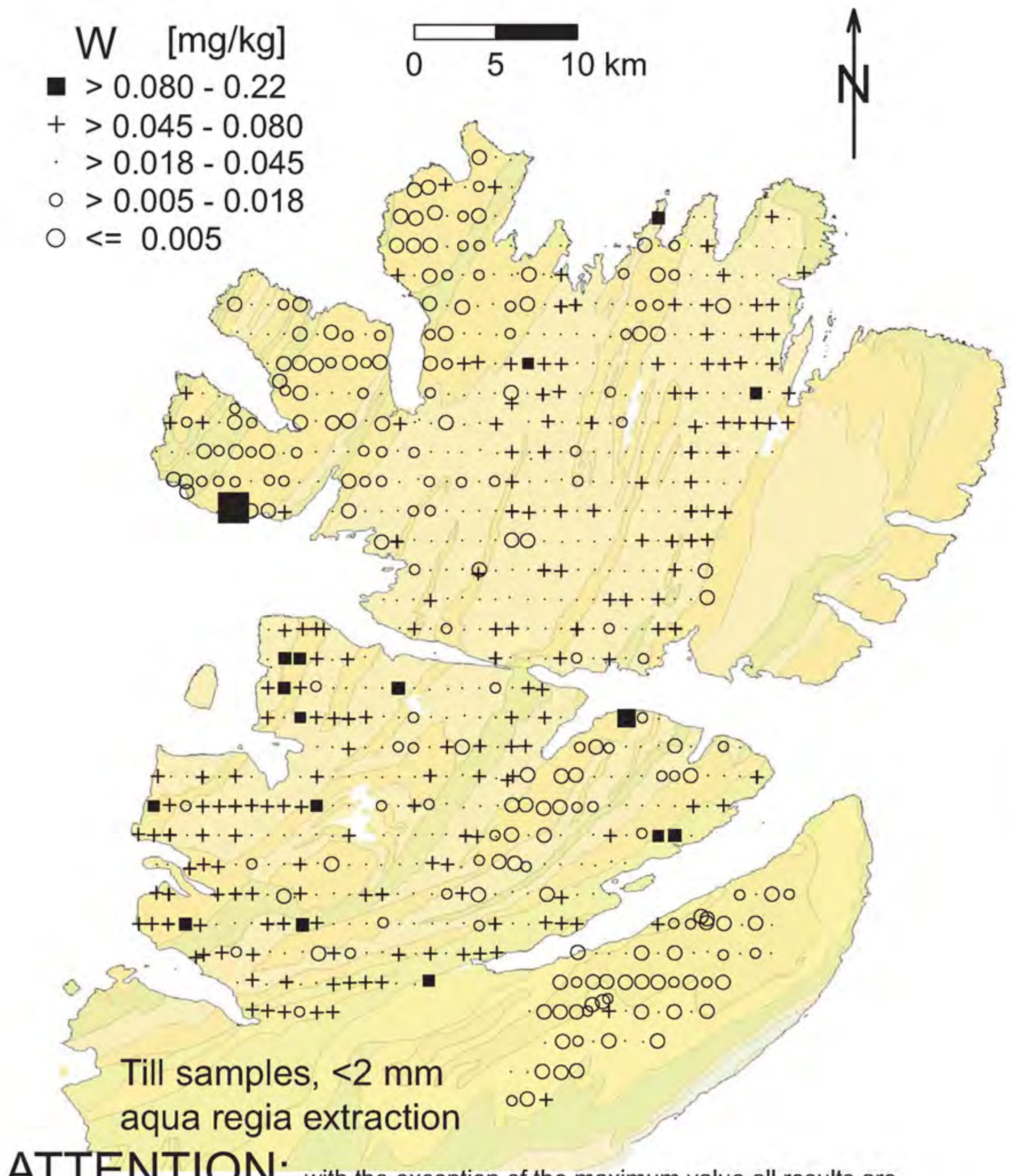

Ti [mg/kg]
■ > 3060 - 4303
+ > 2024 - 3060
· > 981 - 2024
○ > 28 - 981
○ < 10 - 28
0 5 10 km
N
Till samples, <2 mm
aqua regia extraction


Tl [mg/kg]
> 0.63 - 1.9
> 0.43 - 0.63
> 0.18 - 0.43
> 0.032 - 0.18
< 0.02 - 0.032
0 5 10 km
N
Till samples, <2 mm
aqua regia extraction

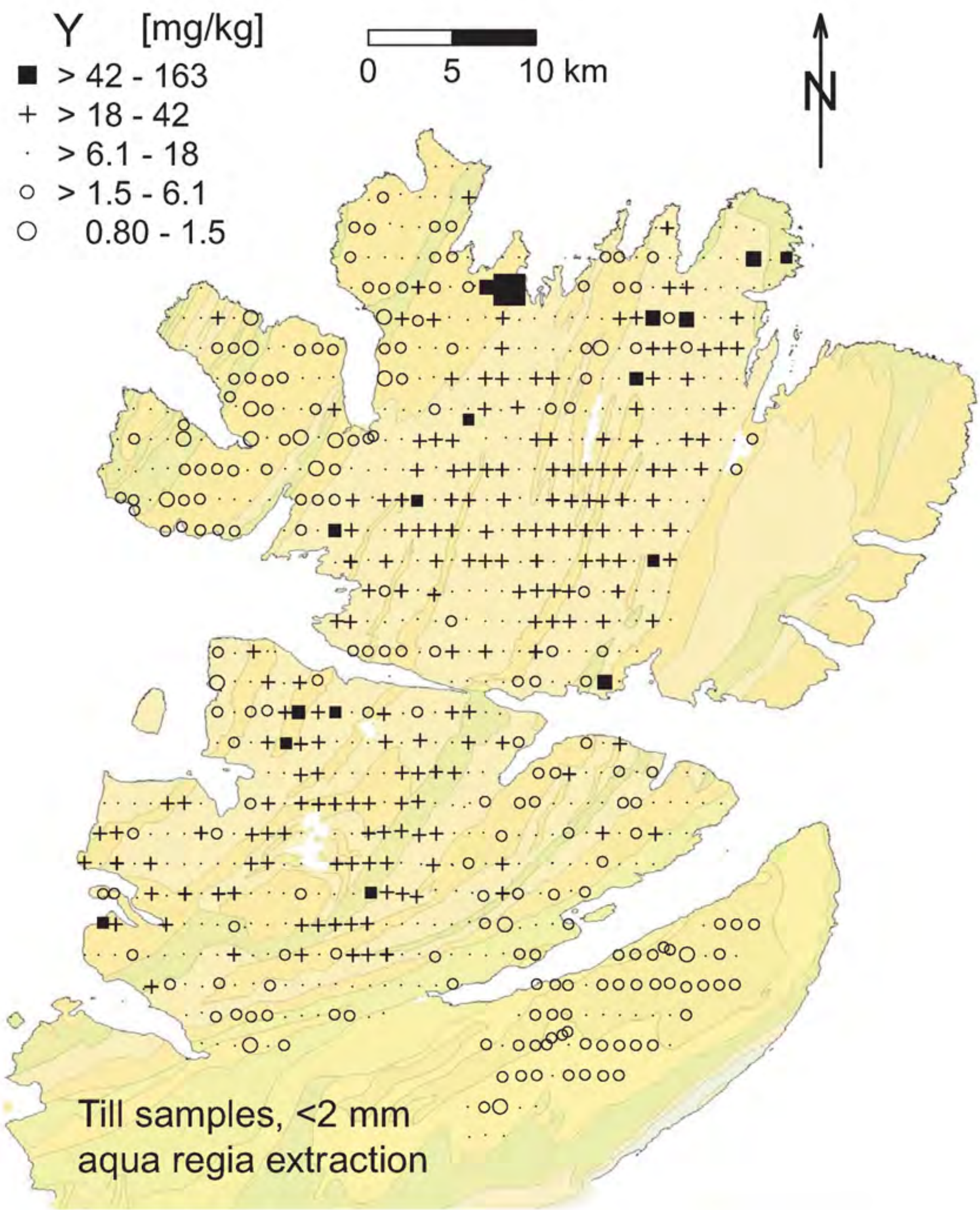

Tm [mg/kg]
> 0.46 - 1.9
> 0.21 - 0.46
> 0.089 - 0.21
> 0.021 - 0.089
< 0.02 - 0.021
0
5
10 km
N
Till samples, <2 mm
aqua regia extraction

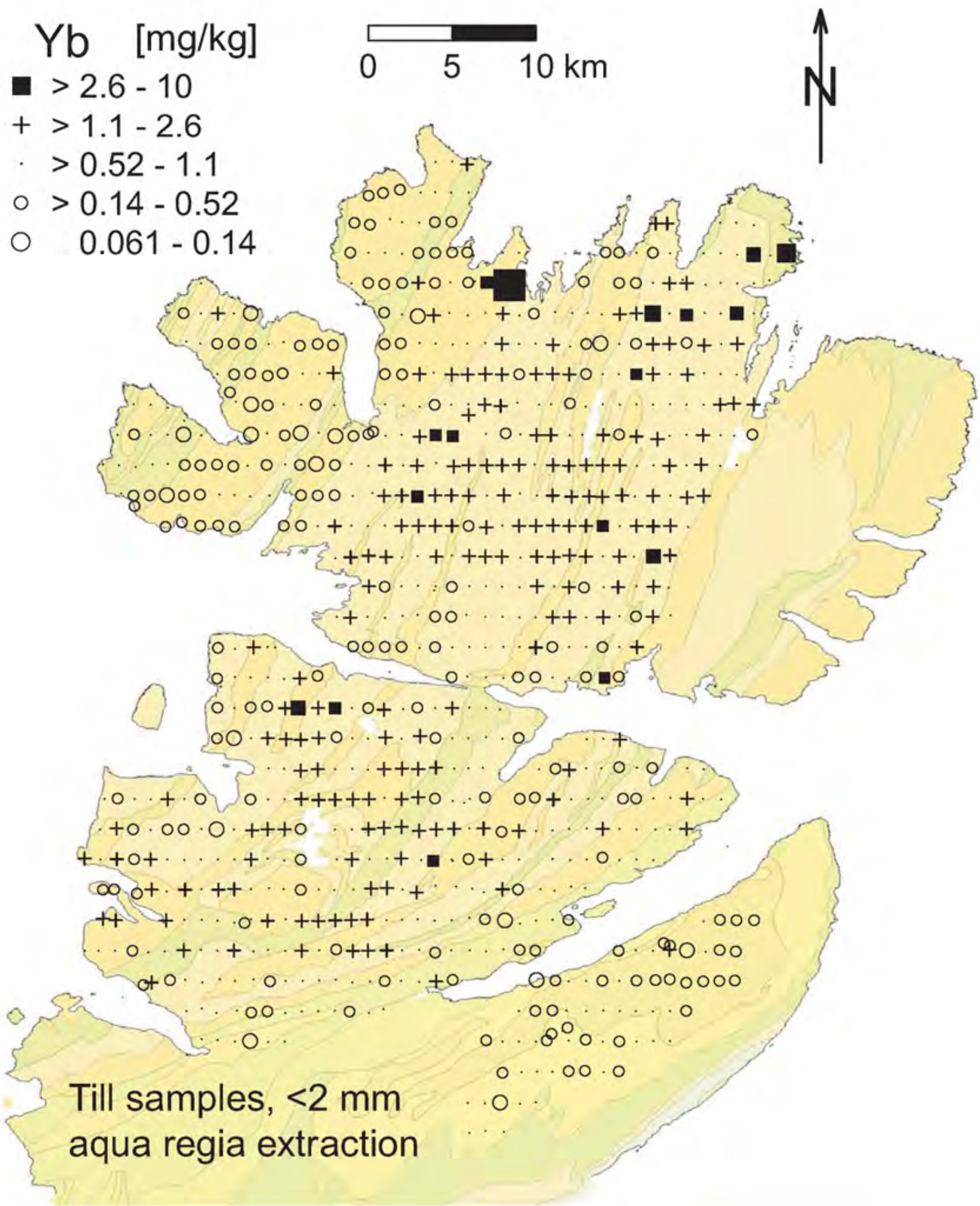

U [mg/kg]
> 4.2 - 34
> 1.7 - 4.2
> 0.91 - 1.7
> 0.33 - 0.91
0.10 - 0.33
0
5
10 km
N
Till samples, <2 mm
aqua regia extraction

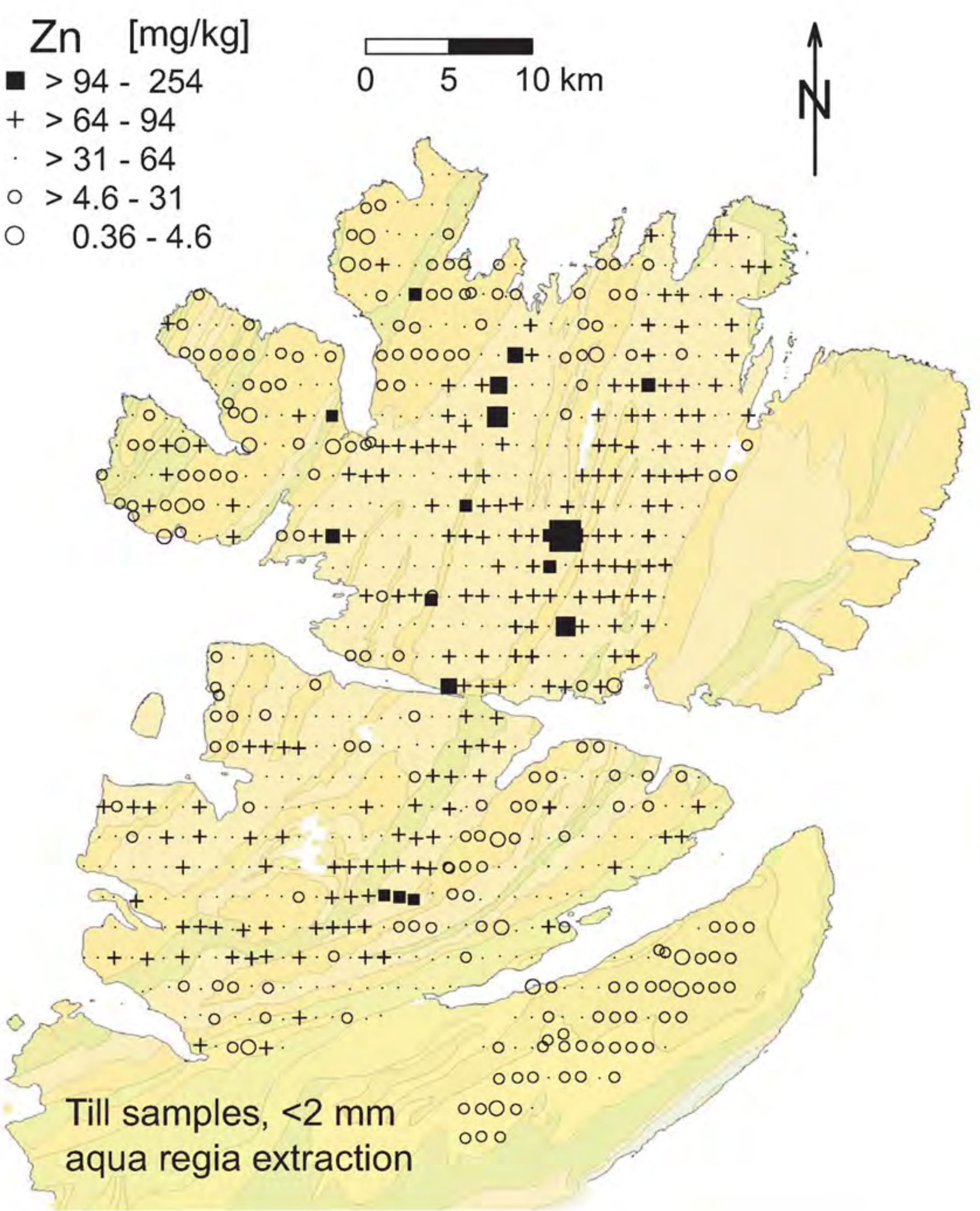

V [mg/kg]
■ > 56 - 89
+ > 37 - 56
· > 19 - 37
○ > 6.8 - 19
○ < 2.0 - 6.8
0 5 10 km
N
Till samples, <2 mm
aqua regia extraction

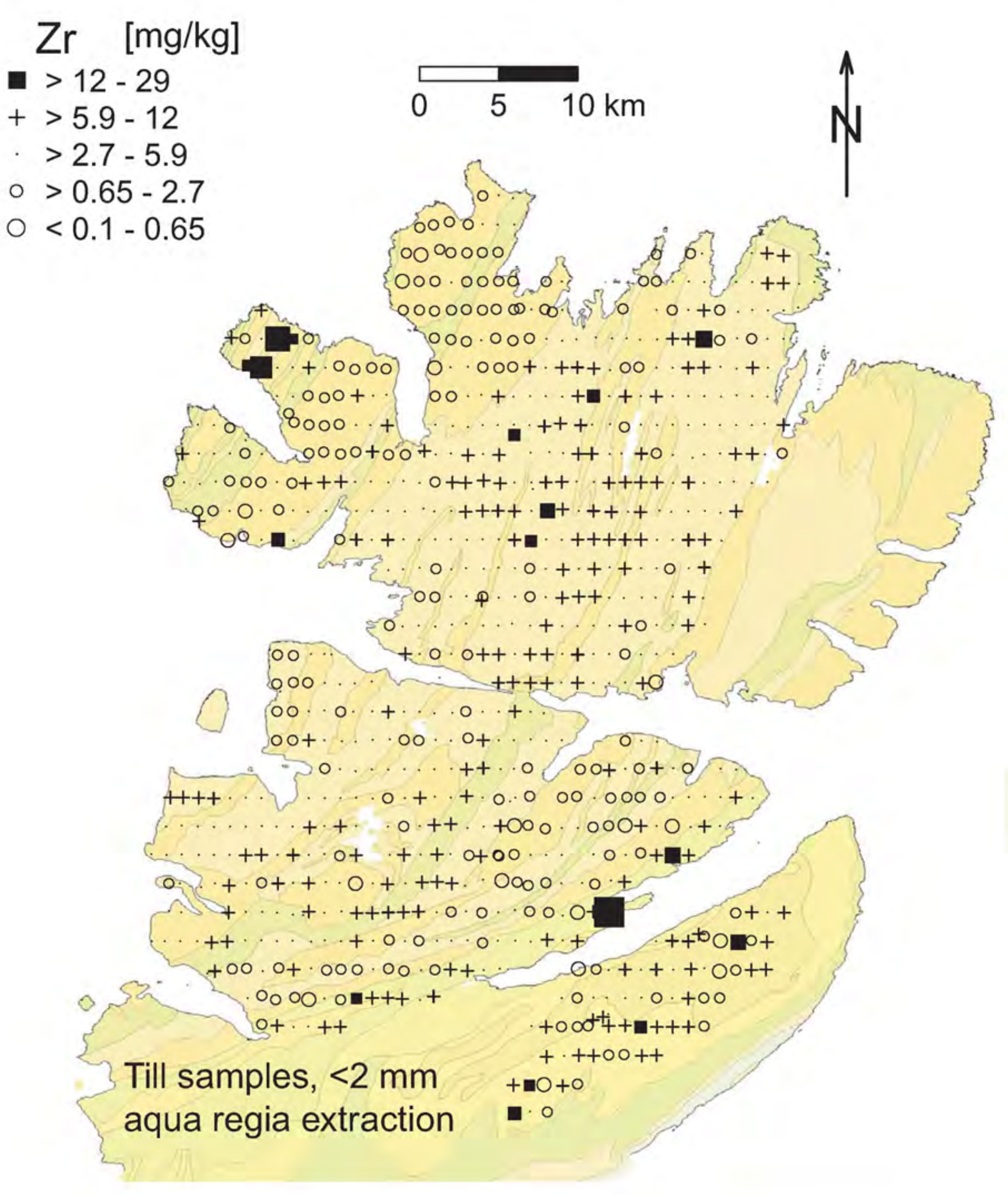


ATTENTION: with the exception of the maximum value all results are below the official detection limit of 0.1 mg/kg, the map shows the instrument readings below the DL


Y [mg/kg]
> 42 - 163
> 18 - 42
> 6.1 - 18
> 1.5 - 6.1
0.80 - 1.5
0 5 10 km
N
Till samples, <2 mm
aqua regia extraction


Yb [mg/kg]
> 2.6 - 10
> 1.1 - 2.6
> 0.52 - 1.1
> 0.14 - 0.52
0.061 - 0.14
0 5 10 km
N
Till samples, <2 mm
aqua regia extraction


Zn [mg/kg]
■ > 94 - 254
+ > 64 - 94
· > 31 - 64
○ > 4.6 - 31
○ 0.36 - 4.6
0 5 10 km
N
Till samples, <2 mm
aqua regia extraction


Zr [mg/kg]
> 12 - 29
> 5.9 - 12
> 2.7 - 5.9
> 0.65 - 2.7
< 0.1 - 0.65
0 5 10 km
N
Till samples, <2 mm
aqua regia extraction