



15. november 2023

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Ferskvandsmonitoring ved MEXPL 2014-21 Greenland Ruby rubinmine nær Aappaluttoq i 2023

Dette notat præsenterer resultaterne af myndighedernes ferskvandsmonitoring ved MEXPL 2014-21 Greenland Ruby rubinmine ved Aappaluttoq i 2023. Programmet blev gennemført ved et endagstilsyn den 12. august.

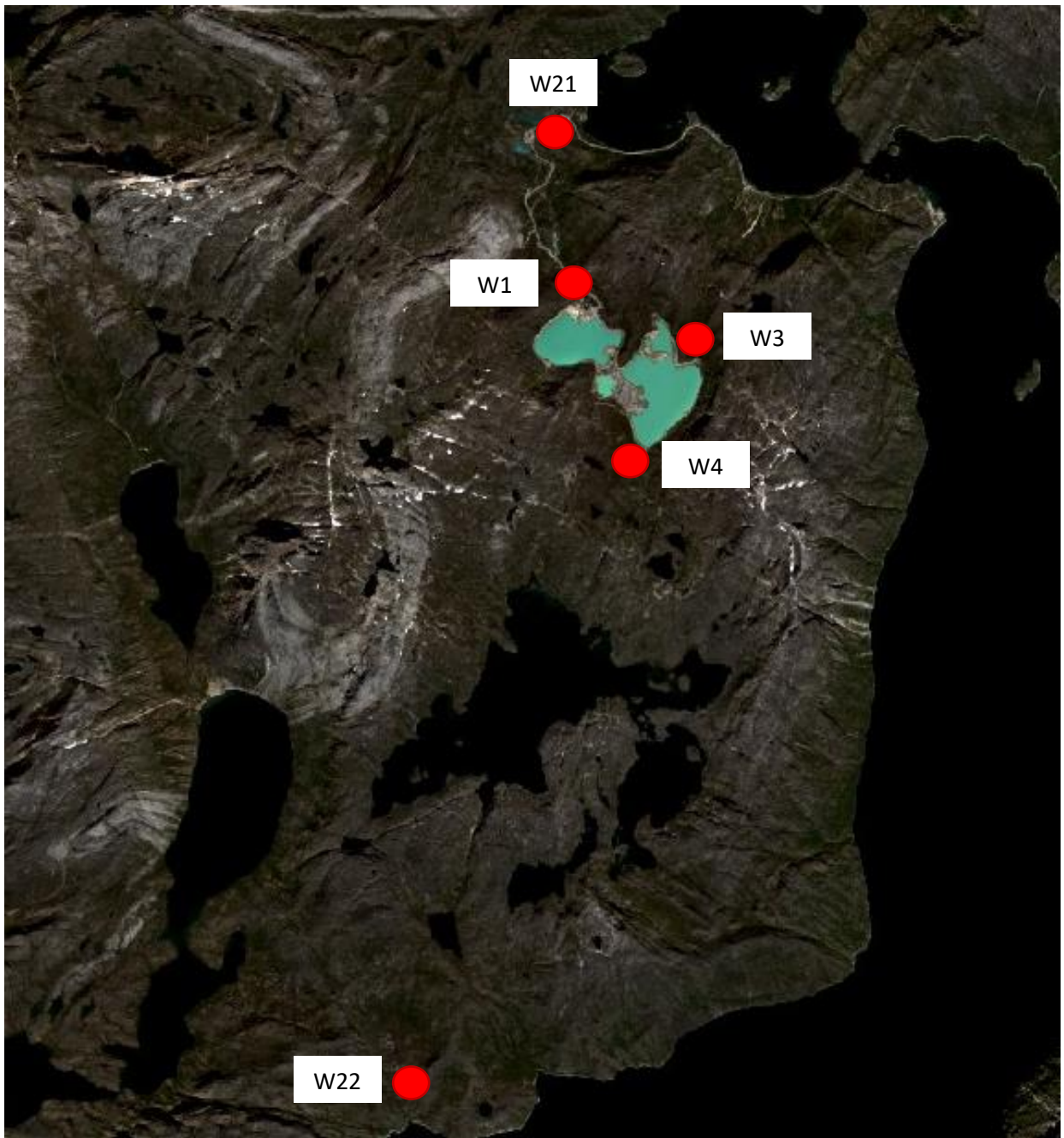
Minen, dvs. selve bruddet, er anlagt på en tidligere halvø midt i søen Ukkaata Qaava. Søen modtager især vand fra to tilløb til det sydøstlige bassin, mens afløbet sker fra det nordvestlige bassin. Vandstanden i søen blev i løbet af årene 2015 og 2016 sænket 10 meter, og søen var efterfølgende opdelt i to adskilte bassiner, forbundet af en gravet kanal. I det sydøstlige bassin deponeredes tailings og waste-rock fra minen, mens det nordvestlige bassin fungerede som et slags klaringsbassin, hvorfra vandet løb til fjorden Tasiusaa via en ca. tre kilometer lang elv forbi sprængstoflager og mine-camp. I sommeren 2023 indsendte selskabet en §44-ansøgning om midlertidig nedlukning af minen. Pumperne, der tidligere har pumpet vand fra selve bruddet, blev slukket, hvilket har medført en vandstigning på ca. 25 m ved besøget den 12. august.

Yderligere informationer om selve tilsynet kan findes vedhæftet i mailen (mrk. "Inspection check list Grl Ruby 2023").

Lokaliteter

Der blev udtaget vandprøver ved 5 lokaliteter (Figur 1):

- W3 og W4 i de to tilløb til søens sydøstlige bassin
- W1 i elven ca. 200 meter nedstrøms udløbet fra søens nordvestre bassin
- W21 i elven nedstrøms sprængstoflager og camp og ca. 300 meter opstrøms udløbet i fjorden
- W22 i en elv ca. 8 km sydvest for minen (= referencestation).



Figur 1 Oversigt over prøvestationer. Sentinel-2 L2A billede fra 8. august 2023.

Metode

Vandprøverne blev udtaget efter retningslinjerne i DCE's indsamlingsinstruks, og der blev både indsamlet ufiltrerede prøver og prøver filtreret gennem et 0.45 μm nylonfilter. Grønlands vandkvalitetskriterier er baseret på filtrerede prøver. Forskellen mellem de filtrerede og ufiltrerede prøver giver et mål for mængden af suspenderet partikulært stof.

Både filtrerede og ufiltrerede vandprøver blev analyseret på DCE's akkrediterede laboratorium i Roskilde.

Se desuden "Test report no. 1117" fra DCE, Aarhus Universitet med yderligere metode og analysebeskrivelse. Rapporten er indsat som bilag i dette notat.

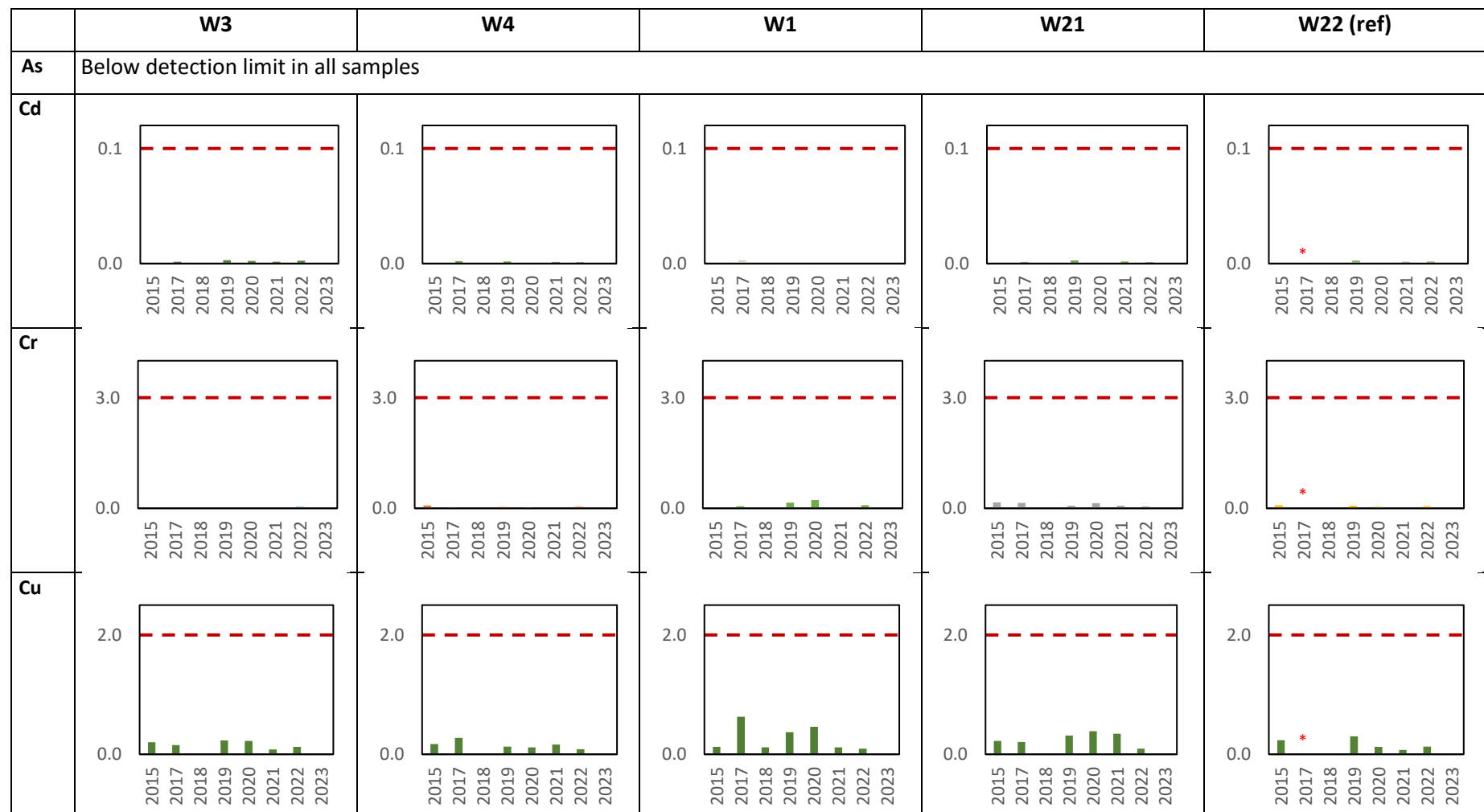
Resultater

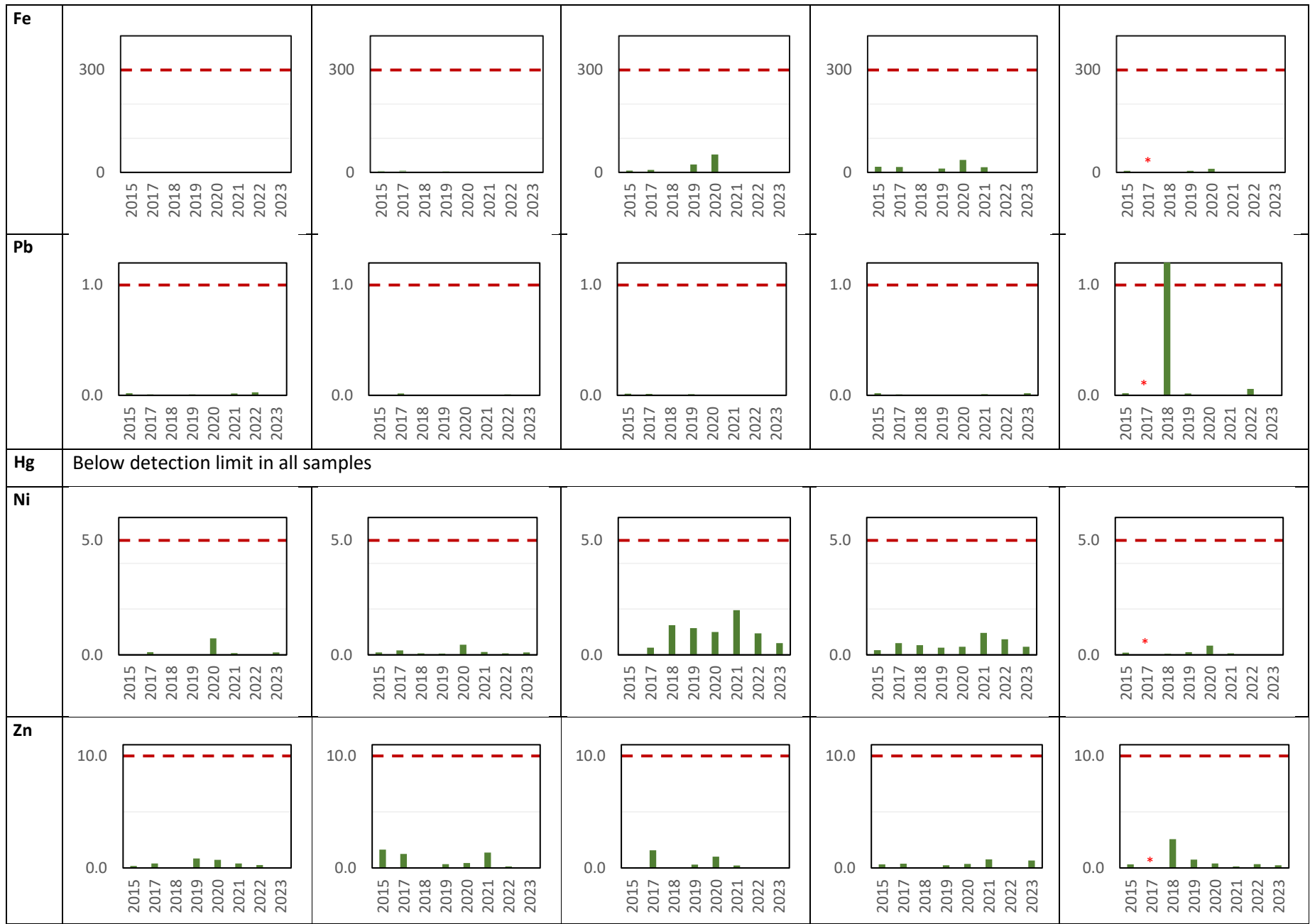
Resultaterne fra 2023 er vist i Figur 2, (filtrerede prøver) og Figur 3, (ufiltrerede prøver) sammen med resultaterne fra de samme lokaliteter i 2015 og 2017-2022. Figurene viser resultaterne for de metaller, for hvilke der er etableret grønlandske vandkvalitetskriterier (GWQC). Kriterieværdierne er angivet på figurene som stiplede linjer.

Ingen af metallerne (cadmium (Cd), krom (Cr), kobber (Cu), jern (Fe), bly (Pb), nikkel (Ni) og zink (Zn)) i den opløste fraktion i 2023 optræder i koncentrationer, der overskrider GWQC fastsat af de grønlandske myndigheder. Langt de fleste koncentrationer af de relevante metaller, som nævnes i GWQC, ligger desuden under måleinstrumentets detektionsgrænse.

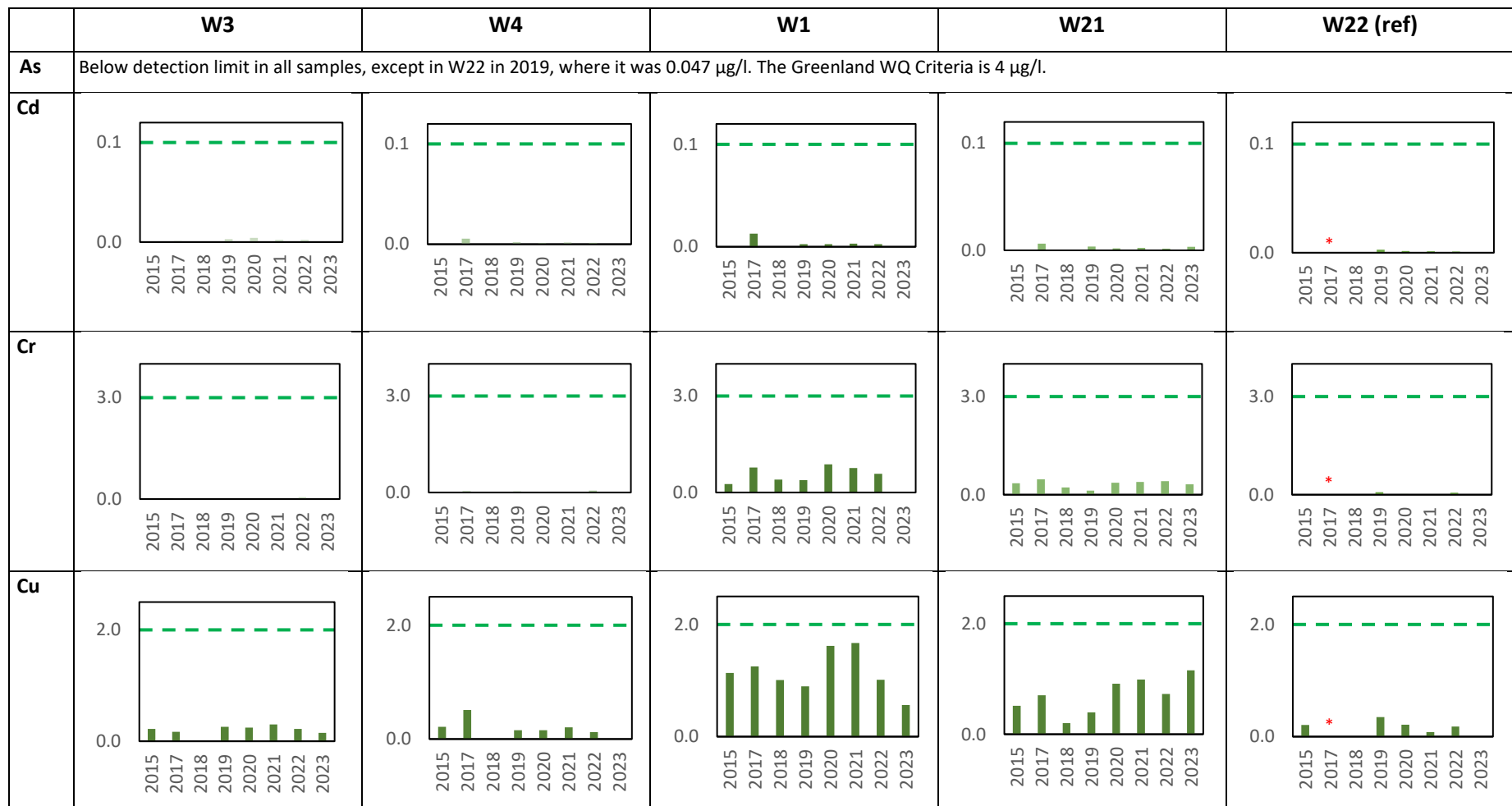
Grænseværdierne nævnt i GWQC gælder, som nævnt, kun for den opløste fraktion og er kun fastsat for de vigtigste og for de mest almindelige metaller.

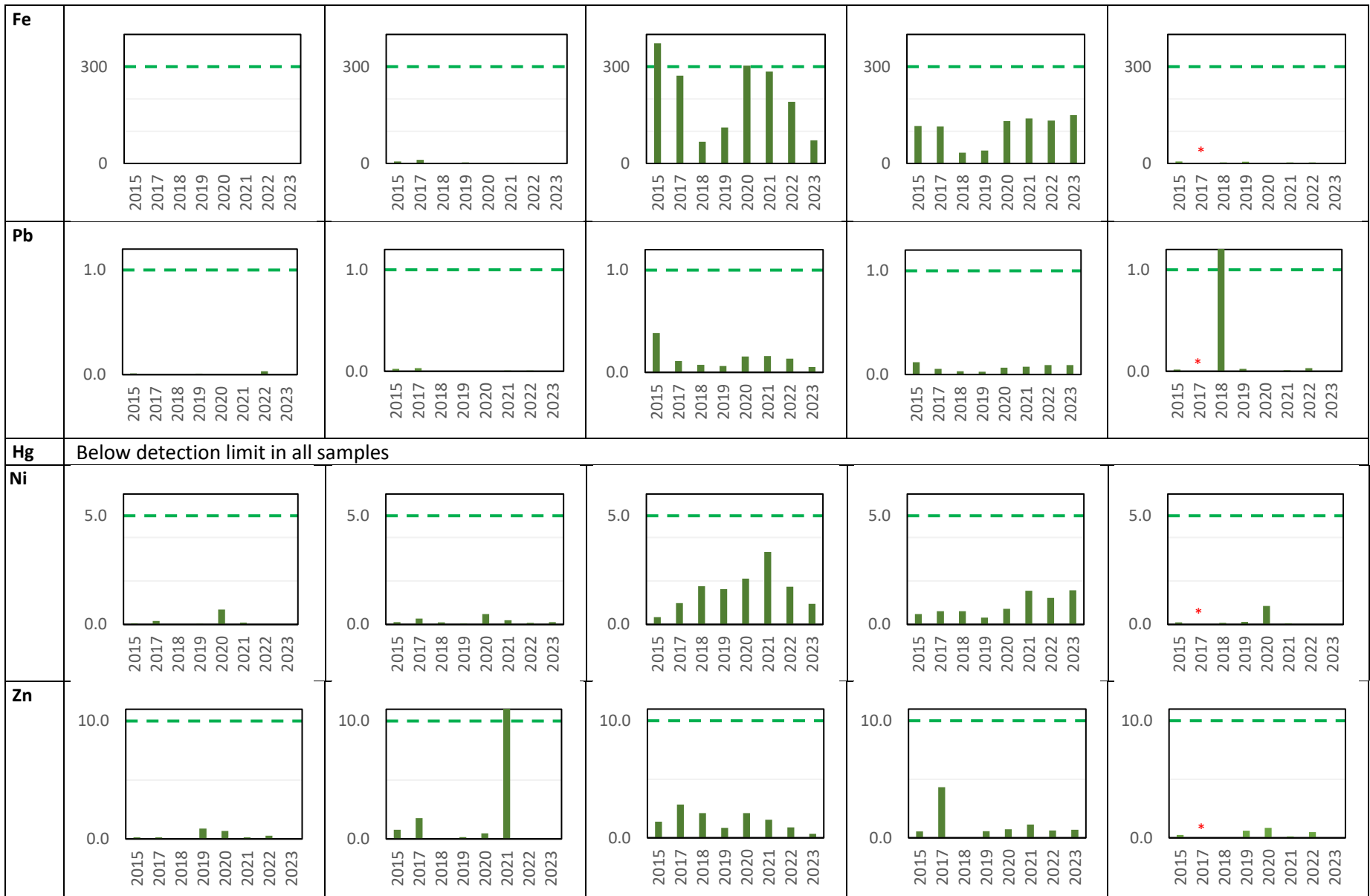
Figur 2. Indholdet af udvalgte metaller i filtrerede vandprøver i 2015 og 2017-2023. Det grønlandske vandkvalitetskriterie er markeret med rød stiplede linje. Alle vandprøver er taget i august eller starten af september. Markeringen * betyder, at værdien mangler.





Figur 3. Indholdet af udvalgte metaller i ufiltrerede vandprøver i 2015 og 2017-2023. Der er ingen vandkvalitetskriterier for ufiltrerede prøver, men kriteriet for filtrerede prøver er markeret med grøn stiplede linje. Alle vandprøver er taget i august eller starten af september. Koncentrationerne er angivet i µg/l. Markeringen * betyder at værdien mangler.





Bilag 1

Water samples from the Aappaluttoq Ruby Mine Southwest Greenland in 2023. Test report no. 1117, DCE, Aarhus Universitet.

Analyseresultater og detektionsgrænser for samtlige 61 analyserede grundstoffer.

Test report no. 1117

Water samples from the Aappaluttoq Ruby Mine, Southwest Greenland in 2023

Customer: Katrine Ravndrup (GINR) for The Environmental Agency for Mineral Resource Activities, Nuuk (EAMRA)

Sample collection:

Sampling place: Near the Aappaluttoq Ruby Mine, Southwest Greenland

Sampling time: August 2023

Sample type: Freshwater

Sampling performed by: Greenland Institute of Natural Resources (GINR).

Sampling methods: Standard DCE methods

Uncertainty in sampling: Not evaluated here

Analyses:

Analyses performed by: University of Aarhus, Institute for Ecoscience
National Centre for Environment and Energy (DCE)
Frederiksborgvej 399
4000 Roskilde

Date of analyses: October 2023

Analytical methods: Freshwater samples were acidified to pH<2 with Merck Suprapure nitric acid and analysed for elemental composition by ICP-MS (Agilent 7900).

Uncertainty of measurement: The laboratory is accredited by the Danish accreditation body DANAK to analyses of freshwater for the elements in listed in Appendix 1 with the specified detection limits and measurement uncertainties. The detection limits during the day of analyses (calculated as 3 SD on blank samples) were determined based on

measurements of a series of blank samples treated in the same way as the samples. Blank values were subtracted from the sample values. The detection limits during the day of analyses are shown in the tables and it is indicated with a '<DL' if measured values were below the detection limit.

Notes: For quality assessment/quality control (QA/QC), a certified freshwater reference material (SLRS-6) was analysed along with the freshwater samples. The reference material was analysed with satisfactory results and the results are provided in the report after the sample results.

Data in this report has also been sent in an excel file.

Contact person: Jens Søndergaard (DCE)

Appendixes: Appendix 1. Uncertainty of measurements.

The results represent only samples that have been analyzed.

Responsible for the report:

Date: 25 October 2023

Signature:



Jens Søndergaard

Position: Senior Researcher and Head of Laboratory

Element concentrations in freshwater samples

Results are given in µg/l. Greyed rows are duplicate measurements. The detection limit (DL) of the analyses is determined as 3 standard deviations on blank values measured during the analyses. Non-accredited elements are marked with a * in the table. <DL= below the detection limit. The values for the Greenland Water Quality Criteria for mining activities (GWQC) are shown for reference.

ID no	Lab no	Location	Station	Comment	Li	Be	Na	Mg	Al	P	K	Ca*	Sc*
Greenland Water Quality Criteria for mining activities (GWQC)													
DL					0.014	0.006	2	0.2	0.1	3	48	14	0.014
69667	-	Fiskenæsset	W22 (ref)	unfiltered	0.077	<DL	1181	141	4.7	<DL	126	455	<DL
69667	-	Fiskenæsset	W22 (ref)	unfiltered	0.080	<DL	1189	142	4.8	<DL	131	455	<DL
69668	-	Fiskenæsset	W22 (ref)	filtered	0.082	<DL	1199	141	<DL	<DL	129	455	<DL
69669	-	Fiskenæsset	W22 (ref)	filtered	0.077	<DL	1211	144	<DL	<DL	133	455	<DL
69670	-	Fiskenæsset	W4	unfiltered	0.192	<DL	1403	181	6.9	<DL	343	1880	0.085
69671	-	Fiskenæsset	W4	filtered	0.196	<DL	1423	184	1.9	<DL	356	1922	0.086
69672	-	Fiskenæsset	W4	filtered	0.199	<DL	1427	189	5.4	<DL	360	1904	0.089
69673	-	Fiskenæsset	W3	unfiltered	0.056	<DL	863	99	11.0	<DL	<DL	235	<DL
69674	-	Fiskenæsset	W3	filtered	0.052	<DL	871	98	2.5	<DL	<DL	243	<DL
69675	-	Fiskenæsset	W3	filtered	0.049	<DL	874	98	3.5	<DL	53	242	0.016
69676	-	Fiskenæsset	W1	unfiltered	0.399	<DL	1424	602	163.7	<DL	1813	2281	0.029
69677	-	Fiskenæsset	W1	filtered	0.306	<DL	1404	566	3.8	<DL	1744	2234	<DL
69678	-	Fiskenæsset	W1	filtered	0.307	<DL	1396	563	4.7	<DL	1720	2236	<DL
69679	-	Fiskenæsset	W21	unfiltered	0.899	<DL	4119	1346	253.5	<DL	2962	5199	0.140
69680	-	Fiskenæsset	W21	filtered	0.256	<DL	1637	433	12.7	<DL	1220	1800	0.017
69681	-	Fiskenæsset	W21	filtered	0.250	<DL	1622	429	7.5	<DL	1189	1765	0.016

Ti*	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga*	As	Se	Rb	Sr	Y*	Zr*	Nb*	Mo
		3		300		5	2	10		4							
0.05	0.042	0.300	0.035	25	0.001	0.10	0.08	0.08	0.004	0.034	0.774	0.001	0.007	0.000	0.002	0.004	0.002
<DL	<DL	<DL	0.278	<DL	0.005	<DL	<DL	<DL	0.004	<DL	<DL	0.320	2.05	0.006	<DL	<DL	0.088
<DL	<DL	<DL	0.280	<DL	0.005	<DL	<DL	<DL	0.005	<DL	<DL	0.327	2.06	0.007	<DL	<DL	0.087
<DL	<DL	<DL	0.099	<DL	0.003	<DL	<DL	0.156	<DL	<DL	<DL	0.327	2.05	0.001	<DL	<DL	0.016
<DL	<DL	<DL	0.094	<DL	0.003	<DL	<DL	0.077	<DL	<DL	<DL	0.329	2.06	0.001	<DL	<DL	0.117
0.057	0.121	<DL	0.195	<DL	0.010	0.11	<DL	<DL	0.014	<DL	<DL	0.360	6.63	0.005	<DL	<DL	0.561
0.057	0.105	<DL	<DL	<DL	0.005	0.10	<DL	<DL	0.014	0.051	<DL	0.370	6.70	0.002	<DL	<DL	0.604
0.127	0.111	<DL	0.040	<DL	0.007	<DL	<DL	<DL	0.014	<DL	<DL	0.370	6.71	0.004	<DL	<DL	0.616
0.093	<DL	<DL	0.175	<DL	0.020	<DL	0.15	<DL	0.004	<DL	<DL	0.170	2.00	0.008	<DL	<DL	0.016
<DL	<DL	<DL	0.140	<DL	0.019	0.11	<DL	<DL	<DL	<DL	<DL	0.165	2.00	0.004	<DL	<DL	0.016
<DL	<DL	<DL	0.139	<DL	0.018	0.11	<DL	<DL	0.004	<DL	<DL	0.162	2.00	0.005	<DL	<DL	0.008
5.753	0.196	<DL	1.782	72	0.059	0.95	0.56	0.346	0.053	<DL	<DL	4.475	8.70	0.032	<DL	0.007	0.457
<DL	0.062	<DL	0.294	<DL	0.005	0.50	<DL	<DL	0.010	<DL	<DL	4.118	8.12	0.002	<DL	<DL	0.569
<DL	0.055	<DL	0.281	<DL	0.007	0.53	<DL	<DL	0.008	<DL	<DL	4.099	8.12	0.003	<DL	<DL	0.625
7.710	0.390	0.315	3.880	150	0.099	1.57	1.15	0.690	0.084	0.044	<DL	7.051	19.04	0.061	<DL	0.009	1.886
<DL	0.048	<DL	0.596	<DL	0.008	0.36	<DL	0.660	0.013	<DL	<DL	2.888	6.37	0.003	<DL	<DL	0.887
<DL	0.047	<DL	0.561	<DL	0.007	0.35	<DL	<DL	0.012	<DL	<DL	2.857	6.28	0.001	<DL	<DL	0.690

Ru*	Pd*	Ag*	Cd	Sb	Te*	Cs	Ba	La*	Ce*	Pr*	Nd*	Sm*	Eu*	Gd*	Tb*	Dy*	Ho*
			0.1														
0.004	0.001	0.001	0.001	0.012	0.006	0.001	0.003	0.0001	0.0002	0.0001	0.0007	0.0003	0.0004	0.0001	0.0001	0.0002	0.0001
<DL	0.001	<DL	<DL	<DL	<DL	0.003	0.325	0.0510	0.0358	0.0105	0.0331	0.0032	0.0005	0.0028	0.0003	0.0014	0.0002
<DL	0.001	<DL	<DL	<DL	<DL	0.003	0.320	0.0519	0.0350	0.0102	0.0368	0.0047	<DL	0.0034	0.0003	0.0014	0.0002
<DL	0.001	<DL	<DL	<DL	<DL	0.003	0.309	0.0097	0.0038	0.0019	0.0058	0.0006	<DL	0.0002	<DL	<DL	<DL
<DL	<DL	<DL	<DL	<DL	<DL	0.003	0.327	0.0135	0.0068	0.0026	0.0083	0.0011	<DL	0.0006	<DL	0.0003	<DL
<DL	0.003	<DL	<DL	<DL	<DL	0.002	0.643	0.0382	0.0302	0.0072	0.0250	0.0025	<DL	0.0031	0.0001	0.0011	0.0002
<DL	0.003	<DL	<DL	<DL	<DL	0.003	0.647	0.0181	0.0081	0.0031	0.0078	0.0009	<DL	0.0007	<DL	<DL	0.0001
<DL	0.002	<DL	<DL	<DL	<DL	0.003	0.667	0.0188	0.0117	0.0033	0.0126	0.0013	<DL	0.0004	<DL	0.0007	0.0002
<DL	0.001	<DL	<DL	<DL	<DL	0.002	1.147	0.0424	0.0649	0.0077	0.0294	0.0035	0.0005	0.0027	0.0004	0.0014	0.0002
<DL	<DL	<DL	<DL	<DL	<DL	0.001	1.143	0.0177	0.0257	0.0039	0.0119	0.0023	<DL	0.0011	<DL	0.0006	0.0001
<DL	0.001	<DL	<DL	<DL	<DL	0.002	1.154	0.0222	0.0300	0.0045	0.0151	0.0022	<DL	0.0015	<DL	0.0009	0.0002
<DL	0.004	<DL	<DL	<DL	<DL	0.044	2.742	0.4271	0.5277	0.0830	0.2639	0.0313	0.0032	0.0232	0.0019	0.0069	0.0010
<DL	0.003	<DL	<DL	<DL	<DL	0.025	1.096	0.0311	0.0181	0.0058	0.0210	0.0020	<DL	0.0012	0.0001	0.0008	0.0001
<DL	0.004	<DL	<DL	<DL	<DL	0.027	1.052	0.0402	0.0256	0.0081	0.0262	0.0031	<DL	0.0019	0.0001	0.0007	<DL
<DL	0.010	<DL	0.003	<DL	<DL	0.066	4.831	0.7487	0.9292	0.1458	0.4690	0.0560	0.0060	0.0455	0.0036	0.0121	0.0020
<DL	0.002	<DL	<DL	<DL	<DL	0.019	0.890	0.0383	0.0340	0.0067	0.0226	0.0025	<DL	0.0019	0.0001	0.0008	0.0001
<DL	0.002	<DL	<DL	<DL	<DL	0.020	0.864	0.0262	0.0198	0.0050	0.0147	0.0025	<DL	0.0015	<DL	<DL	0.0001

Er*	Tm*	Yb*	Lu*	Hf*	Ta*	W*	Re*	Pt*	Au*	Hg*	Tl*	Pb	Bi*	Th*	U*
										0.05		1			
0.0002	0.0002	0.0005	0.0001	0.0002	0.001	0.003	0.001	0.001	0.0003	0.002	0.002	0.009	0.0005	0.0001	0.0004
0.0005	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	0.0005	0.0286
0.0004	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	0.0003	0.0274
<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	0.0033
<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	0.0005	<DL	0.0040
<DL	<DL	<DL	<DL	<DL	<DL	0.006	<DL	<DL	<DL	<DL	<DL	<DL	<DL	0.0003	0.1401
<DL	<DL	<DL	<DL	<DL	<DL	0.006	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	0.0385
<DL	<DL	<DL	<DL	<DL	<DL	0.004	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	0.0501
0.0005	<DL	0.0006	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	0.0037
0.0005	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	0.0005	<DL	0.0032
<DL	<DL	0.0006	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	<DL	0.0022
0.0024	0.0003	0.0025	0.0001	<DL	<DL	0.030	<DL	<DL	<DL	<DL	0.004	0.052	0.0012	0.0213	0.1619
<DL	<DL	<DL	<DL	<DL	<DL	0.057	<DL	<DL	<DL	<DL	0.003	<DL	<DL	<DL	0.0407
0.0003	<DL	<DL	<DL	<DL	<DL	0.059	<DL	<DL	<DL	<DL	0.003	<DL	<DL	0.0002	0.0440
0.0057	0.0006	0.0029	0.0005	<DL	<DL	0.078	0.001	<DL	<DL	<DL	0.012	0.090	0.0016	0.0130	0.4604
<DL	<DL	<DL	<DL	<DL	<DL	0.047	<DL	<DL	<DL	<DL	0.003	0.020	<DL	0.0004	0.0464
<DL	<DL	<DL	<DL	<DL	<DL	0.042	<DL	<DL	<DL	<DL	0.003	<DL	<DL	<DL	0.0400

Measured element concentrations in certified reference material (SLRS-6) analysed along with the samples (for QA/QC)

Results are given in µg/l. The detection limit (DL) of the analyses is determined as 3 standard deviations on blank values measured during the analyses. Non-accredited elements are marked with a * in the table. <DL= below the detection limit. ND=Not determined. Numbers in brackets are information/reference values only (i.e. not certified values).

ID	Lab no	Li	Be	Na	Mg	Al	P	K	Ca*	Sc*
DL		0.014	0.006	2	0.2	0.1	3	48	14	0.014
SLRS-6	-	0.360	<DL	2499	1857	27	<DL	842	7484	0.218
SLRS-6	-	0.412	0.009	2598	1938	28	<DL	886	7538	0.225
SLRS-6	-	0.386	<DL	2667	1998	29	<DL	902	7645	0.228
Certificate mean		ND	(0.0066)	2760	2133	34	ND	651	8760	ND
Certificate uncertainty (2 SD)		ND	(0.0022)	220	58	2	ND	54	200	ND

Ti*	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga*	As	Se	Rb	Sr	Y*	Zr*	Nb*	Mo
0.055	0.042	0.300	0.04	24.7	0.001	0.100	0.08	0.08	0.004	0.034	0.774	0.001	0.01	0.000	0.002	0.004	0.002
0.488	0.267	<DL	2.03	73.3	0.049	0.549	20.19	1.72	0.011	0.533	<DL	1.431	38.6	0.109	<DL	<DL	0.153
0.497	0.275	<DL	2.03	81.6	0.050	0.543	20.58	1.75	0.013	0.532	<DL	1.421	38.7	0.108	<DL	<DL	0.152
0.514	0.284	<DL	2.07	86.4	0.050	0.531	20.46	1.70	0.009	0.552	<DL	1.404	38.5	0.109	<DL	<DL	0.158
ND	0.351	0.252	2.12	84.3	(0.053)	0.616	23.90	1.76	ND	0.570	ND	ND	40.7	ND	ND	ND	0.215
ND	0.006	0.012	0.10	3.6	(0.012)	0.022	1.80	0.12	ND	0.080	ND	ND	0.3	ND	ND	ND	0.018

Ru*	Pd*	Ag*	Cd	Sb	Te*	Cs	Ba	La*	Ce*	Pr*	Nd*	Sm*	Eu*	Gd*	Tb*	Dy*	Ho*
0.004	0.001	0.001	0.001	0.012	0.006	0.001	0.003	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000
<DL	0.020	<DL	0.005	0.294	<DL	0.005	12.385	0.188	0.228	0.045	0.167	0.031	0.006	0.026	0.003	0.015	0.003
<DL	0.019	<DL	0.005	0.291	<DL	0.005	12.454	0.191	0.232	0.046	0.168	0.029	0.007	0.025	0.003	0.015	0.003
<DL	0.019	<DL	0.004	0.280	<DL	0.005	12.295	0.189	0.224	0.044	0.169	0.031	0.007	0.023	0.003	0.015	0.003
ND	ND	ND	0.006	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
ND	ND	ND	0.001	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Er*	Tm*	Yb*	Lu*	Hf*	Ta*	W*	Re*	Pt*	Au*	Hg*	Tl*	Pb	Bi*	Th*	U*
0.000	0.000	0.000	0.000	0.000	0.001	0.003	0.001	0.001	0.000	0.002	0.002	0.009	0.000	0.000	0.000
0.009	0.001	0.007	0.001	<DL	<DL	0.011	0.013	0.006	0.001	<DL	0.004	0.153	0.002	0.010	0.074
0.009	0.001	0.007	0.001	<DL	<DL	0.010	0.012	0.004	0.000	<DL	0.005	0.147	0.001	0.009	0.074
0.009	0.001	0.009	0.001	<DL	<DL	0.013	0.013	0.003	<DL	<DL	0.003	0.145	0.001	0.005	0.071
ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.170	ND	ND	0.070
ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.026	ND	ND	0.003

Appendix 1. Uncertainty of measurements

Accredited detection limits and uncertainties for ICP-MS analyses of freshwater:

Expanded uncertainty, $k=2$ (95% confidence), in $\mu\text{g/l}$.

Parameter	Detection limit (DL)	Lower uncertainty U_{abs}	Upper uncertainty U_{rel} (%)
Li	1.0	0.67	15
Be	0.2	0.1	5
Na	55	37	10
Mg	10	6.7	10
Al	10	6.7	10
P	15	10	15
K	25	17	10
V	0.2	0.13	5
Cr	0.2	0.13	5
Mn	2.5	1.7	15
Fe	10	6.7	5
Co	0.2	0.1	10
Ni	0.5	0.3	10
Cu	0.8	0.5	10
Zn	10	6.7	15
As	1.0	0.67	20
Se	0.5	0.3	10
Sr	0.5	0.3	5
Mo	2.0	1.3	15
Cd	0.1	0.07	10
Sb	2.0	1.3	10
Cs	0.1	0.07	10
Ba	1.0	0.67	5
Pb	0.3	0.2	10

Calculation of uncertainties:

Detection limit (DL): The lowest result that is significant different from zero.

The total uncertainty (U_c) can be calculated from the formula:

$$U_c = \sqrt{U_{abs}^2 + U_{rel}^2 C^2} ;$$

U_{abs} = Lower uncertainty: The absolute uncertainty dominating at the lower measuring level (here set to 2/3 DL).

U_{rel} = Upper uncertainty: The relative uncertainty for samples with a high concentration.

C = Concentration.

Example:

The calculated total uncertainty U_c of a sample with a concentration of 5.1 mg/kg with $U_{abs} = 0.2$ and $U_{rel} = 24\%$ based on the formula gives:

$$U_{5,1} = U_c = \sqrt{0.2^2 + \left(\frac{24\%}{100\%}\right)^2 5.1^2} = 1.2$$

This means that there is a 95% probability that the true result is between 3.9 and 6.3.