DANMARKS OG GRØNLANDS GEOLOGISKE UNDERSØGELSE RAPPORT 2001/123

The Pd + Pt dispersion in noritic and undifferentiated mafic rocks of the Archaean craton east of Maniitsoq, southern West Greenland

A study based on re-analysis of rock samples from sulphide mineralised sections of mafic rocks within the "Norite belt" collected by GGU 1982

Karsten Secher

GEOLOGICAL SURVEY OF DENMARK AND GREENLAND
MINISTRY OF ENVIRONMENT AND ENERGY

G E U S

DANMARKS OG GRØNLANDS GEOLOGISKE UNDERSØGELSE RAPPORT 2001/123

The Pd + Pt dispersion in noritic and undifferentiated mafic rocks of the Archaean craton east of Maniitsoq, southern West Greenland

A study based on re-analysis of rock samples from sulphide mineralised sections of mafic rocks within the "Norite belt" collected by GGU 1982

Karsten Secher

GEOLOGICAL SURVEY OF DENMARK AND GREENLAND
MINISTRY OF ENVIRONMENT

G E U S

Abstract

A total of183 samples of mafic rocks (mainly norite and amphibolite) with pronounced Ni-Cu sulphide mineralisation from the Archaean 'Norite belt' in West Greenland has been analysed for Pd, Pt and Au. The Ni-Cu sulphide occurrences show an apparent typical Pd + Pt dispersion pattern for mineralisations related to layered intrusions. The value of the PGE content is slightly increased as a function of the amount of sulphide. Especially Pt and Au shows mobility as part of later mineralisations processes, resulting in anomalous values of up to 2.1 ppm for each element. Peak values for Pd are at 0.6 ppm in both norite and amphibolite.

The amount of sulphides within the 'Norite belt' implies that the potential for PGE rich mineralisations is limited.

Contents

Introduction

The investigation reported here was carried out according to agreement with the Bureau of Minerals and Petroleum (BMP), Nuuk, dated 6 March 2001 with extension of 4 April 2001 (Jr. No 6940/2001-00).

The project (GEUS no. 14711) is based on analytical results form re-analysis of selected rock samples collected by GGU (K. Secher) in 1982 in West Greenland. The selection of samples is based on previous analyses for PGE with values up to 1.1 ppm (combined Pd + Pt) in 28 samples of sulphide rich sections within the 'Norite belt', analysed by Bondar-Clegg labs (Fire Assay/DC Plasma; Appendices 7-9).

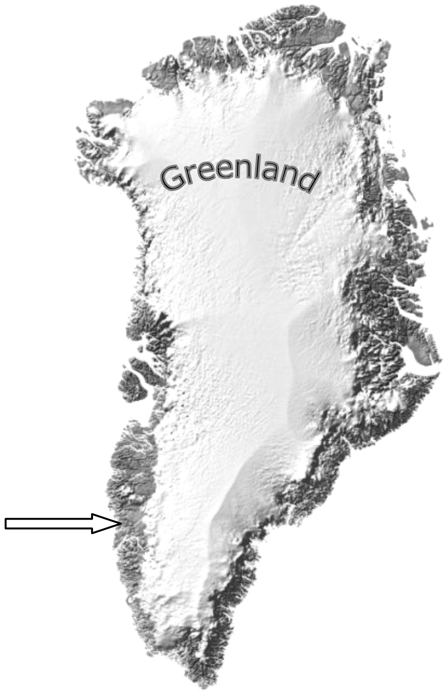


Figure 1. *Location of sample area shown by the arrow.*

In this project a total of 183 samples were submitted to Actlabs Ltd. Canada, for Fire Assay-ICP-MS (code 1C-research, for precious metals Au, Pt, Pd). The samples were analysed in one batch. GGU/GEUS sample numbers used are from the series 257401–257700.

Sample preparation and data handling has been carried out by Inge Rytved and Else Moberg, GEUS.

Sample material

Rock samples were collected during fieldwork in 1982. A selection of 183 samples was made for the investigation reported here. Brief sample descriptions are listed in Appendix 1.

The following rock types are used in this report. In the table (Appendix 1) a visual estimate of the sulphide content of the rock is given by a % value where appropriate.

Amphibolite;	Medium grain sized rock, dark green to blackish, foliated texture
Beforsite;	Fine grained dyke rock, light to read brown, homogeneous texture
Dolerite;	Very fine grained dyke rock, grey to black, ophitic to homogenous texture
Dunite;	Medium grain sizes rock, olive to light yellowish green, granular texture
Gabbro; leuco-;	Coarse grained rock, grey to brownish green, granular to xeno-morph texture
Garnet schist;	Medium to coarse grained, greygreen to black, schistose texture
Gneiss, biotite;	Fine to medium grained, light grey to olive grey, brownish, foliated texture
Mylonite;	Fine grained rock, grey to brown, variable or cataclastic texture
Norite;	Medium grained, olive grey, granular texture
Pegmatite;	Coarse grained, light grey to pink, variable texture
Soapstone (talc schist);	Very fine grained, grey to green, homogeneous to foliated texture
Ultramafite;	Medium to coarse grained, green to black, granular texture

The original purpose of the sample collection was related to a GGU resource evaluation programme, aimed at an understanding of the known Ni-Cu-sulphide mineralisation. This had previously been outlined for the Archaean noritic and ultramafic rocks by Kryolitselska-bet Øresund A/S (KØ).

Most of the different rock types belong to a suite of noritic-gabbroic rocks described from the so-called 'Norite belt' by KØ , as reviewed by Nielsen (1973) and Keto (1998).

Geological setting

The area hosting the analysed samples of sulphide mineralised rocks is located within the Archaean craton of central West Greenland. A number of lump-shaped bodies of norite are joined in a curved and somehow irregular belt (the 'Norite belt'), c.15 x 75 km along the eastern flank of the Finnefjeld gneiss complex in the area between Søndre Isortoq and Niaqunngunaq/Fiskefjord. The size of individual bodies varies from 2 x 4 km to only a few metres across.

The age of the norite belt is unknown but it is most likely that the rocks were intruded during the later part of the Archaean plutonism in the area, probably succeeding the intrusion of the Finnefjeld gneiss complex within the Akia terrane (3034 Ma, Garde 1997). This inter-pretation is supported by arguments in Garde (1991) for relations between norites and post-kinematic diorites (3017 Ma, Garde 1991) of the Fiskefjord area. The 'Norite belt' along the eastern flank of the domed Finnefjeld gneiss complex may be part of a tectonic setting structurally controlled by the Finnefjeld intrusion and later exposed to slight deformation. The norite is more or less unaffected by the high grade retrograde metamorphism observed in the surrounding basement (Garde 1991). A division in a northern and southern part of the 'Norite belt' was based on field observations (Secher 1982a), with the northern part characterised by few large norite bodies and a southern part consisting of several small pods of norite.

The norite is locally seen with gradual transistion into coarser grained leuconoritic and leucogabbroic rock types. The norite is typically homogeneous but at a few localities igneous banding is noted with alternating layers composed of plagioclase and hypersthene with accessory chromite (Secher 1982 a, b). There are no detailed petrographic or geochemical descriptions available.

Additionally the sample area is characterised by several horizons and layers of amphibolite, locally with pillow structures (Kalsbeek & Garde 1989). The number of amphibolite layers is increasing towards the southern and eastern part of the area.

Sulphide mineralisation

The sulphide occurrences are scattered throughout the norite belt. The mineral assemblage is rather uniform, with pyrrhotite as the predominant mineral accompanied by chalcopyrite, pyrite and pentlandite in a primary(?) texture together with pyrite, linneaite, bravoite and magnetite in a replacement texture. Different modes of sulphide accumulation are recognised such as disseminations, veinlets, interstitial fillings and massive lumps. The sulphides are as a rule creating rustzones and gossans in outcrops (Secher & Stendal 1989; Fig.2). The average sulphide content in the mineralised rocks is around 2 vol% and locally up to 25% of the total rock volume.

The occurrences are typically scattered as single spots and lenses, less than 5 m and rarely exceeding 25 m in length. Consequently, an ore reserve is difficult to calculate and has for the Ni+Co+Cu content so far been estimated as probably too small for economic exploitation. (Keto 1987,1998; Shore 2000). Prior to this study, PGE analyses have only been carried out on few samples during exploration campaigns up to now. KØ mentioned (as reported in Nielsen 1973) the typical Ni:Pd+Pt ratio in the sulphide mineralisation as in the order of 50 000:1. Similar values were found by Secher (1988), varying to 5000:1 in PGE enriched samples.

According to Naldrett & Duke (1980), magmatic sulphide deposits of Ni, Co and Cu acts as collectors of PGEs. Concentration of these sulphides is commonly caused by gravitational settling in the primary silicate magma. Crystallisation of the sulphide liquid is forming the major minerals pyrrhotite, chalcopyrite, pentlandite and pyrite all of which may contain PGEs in solid solution. Later redistribution of the metals is typical, i.e. by hydrothermal processes. So far the appearance of sulphides within the 'Norite belt' fits into this description as a primary magmatic formation.

Figure 2. *Typical gossan in the norite south of lake Q.*

This type of deposit normally includes Ni and Cu as major products and has a low PGE content as by-product from an ore with disseminated sulphides settled in horizons of layered intrusions with mafic and ultramafic rock types. In general such mineralisations can conveniently be classified according to the tectonic setting in four groups, which accounts for a majority of the known Ni-Cu sulphide ores. Using the description of Eckstrand et al (eds.) (1995) for Canadian mineral deposits, the mineralisation in the West Greenland 'Norite belt' can be placed in either subtype 27.1c (type Expo Ungava and Raglan in Quebec) or 27.1d (type Loraine, Quebec, also including Voiseys Bay, Newfoundland). A characteristic feature of the Greenland deposit is low Ni:Cu ratios which are in the range of 1,5–4 (Secher 1988), as typically found in Canadian examples of subtype 27.1d.

The PGE in magmatic sulphides is often characterised by a specific distribution of the total PGEs (Naldrett & Duke 1980). Such data are not available for this study, where only values for Pd + Pt (+Au) have been acquired. Other primary magmatic features together with low but significant values of Pd and Pt as well as low and stable ratios of Pd/Pt points to a common magmatic origin. Increase of this ratio usually points to interference from other (e.g. hydrothermal) processes or simply other origins.

The role of Au in the described sulphides is generally well correlated with the PGE dispersion.

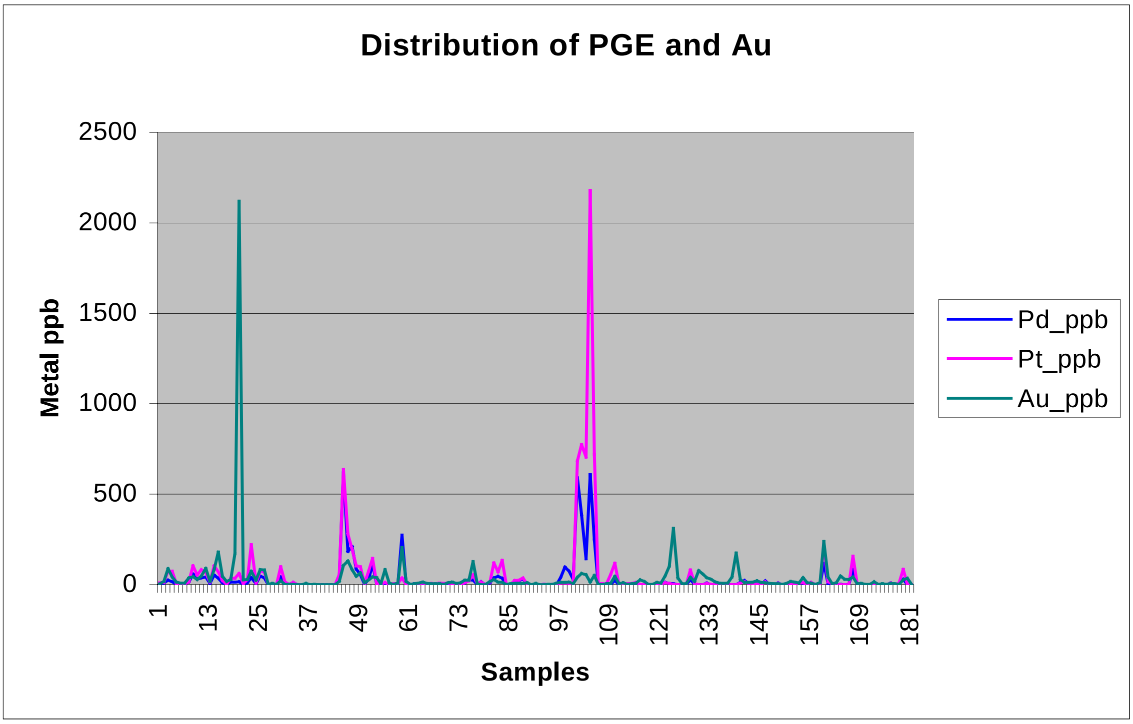


Figure 3. *Distribution of Pd, Pt and Au in 183 samples.*

Analytical results

- Peak values of Pd in three samples are 0.6 ppm and in five sample 0.2–0.4 ppm from mineralised norite as well as in amphibolite.
- A peak value for Pt in one sample is 2.2 ppm and in four samples 0.7 ppm, all from heavily mineralised amphibolite. Five samples show values of 0.2–0.6 ppm in mineralised norite.
- In total four samples show values for PGE (Pd+Pt) at 1.0–2.7 ppm in mineralised rocks.
- Only one sample shows an anomalous Au value of 2.1 ppm in slightly mineralised norite.

Considering the Pd/Pt ratio, 90% of the values are in the range 0.2–1.7, which is the typical picture for rocks of the 'Norite belt'. Most values above 1.7 are from rocks of non-noritic or altered rocks, such as amphibolites (Appendices 4-6).

Discussion

The division in a northern and a southern part could favour a view of an inclined section of an originally coherent mafic/ultramafic sheet-like intrusion, inclined to the Southwest and exposed on the surface as different sections of a sub vertical layer, which upwards is dissolved and divided into pods. Accordingly, the northern part represents the deepest crustal level, and the amount and size of sulphide mineralisation found here compared to the southern part is in agreement to this model. The observed primary igneous banding is also located in the northern part. All this supports an assumed original location of the mineralisation in the lower part of a supposed mafic intrusive layer, where gravitationally separated sulphide ore would be located.

The sulphide accumulations with peak values of PGEs are confined to different hosts in two areas in the northern half of the sample area. Here, the locality at lake Q is representing the typical norite hosted type of sulphide occurrence (peak Pd), and the locality at lake A an atypical sulphide rich amphibolite showing both peak Pt and Pd values.

Conclusion and recommendations

The Ni-Cu sulphide occurrences within the 'Norite belt' show a rather uniform Pd /Pt dispersion picture for mineralisations related to large layered intrusions. The value of the PGE content is slightly increased as a function of the amount of sulphide, i. e. where later processes have influenced the accumulation of Pd + Pt and Au. Especially Pt and Au show mobility as part of later mineralisation processes, resulting in anomalous values of up to 2.1 ppm for each element. However, the limited amount of sulphides within the 'Norite belt' apparently reduces the potential for PGE rich mineralisations.

A sulphide mineralised amphibolite near lake A (Appendix 3) in the NE corner of the sample area shows relatively high values of both Pd and Pt, 0.6 and 2.2 ppm respectively. The rock type is a coarse grained (gabbroic?) amphibolite in a single lens-shaped body, max 15x50 m, in outcrops apparently not related to the 'Norite belt'.

The results presented here are based on an approximately representative collection of samples from mineralisations and rock types within the 'Norite belt'. Mineral showings outside this 'belt' have only been visited on a reconnaissance base (by helicopter) and accordingly a limited number of samples were collected. This is the situation around the locality near lake A, where PGEs are accumulated in a type of sulphides of unknown origin. On this ground it is recommend to carry out further field examination and collection around mineralised amphibolites near lake A. At the same time collection along an E-W profile from lake A to lake Q should be carried out, allowing new sampling of different types of amphibolite and norite/gabbro.

References

Eckstrand, O.R., Sinclair, W.D. & Thorpe, R.I. (eds.) 1995: Geology of Canadian mineral deposit types. Geology of Canada, no.8, Geological Survey of Canada, 640 pp.

Garde, A.A. 1991: Post-kinematic diorite intrusion in Archaean baement rocks around outer Fiskefjord, southern West Greenland, Bull. Geol. Soc. Denmark, **39**, 167-177.

Garde, A.A. 1997: Accretion and evolution of an Archean high-grade grey gneiss-amphibolite complex the Fiskefjord area, southern West Greenland. Geology of Greenland Survey Bulletin **177,** 115 pp.

Kalsbeek, F. & Garde, A.A. 1989: Geological map of Greenland 1:500 000, Frederikshåb Isblink – Søndre Strømfjord, Sheet 2, Descriptive text, 36 pp, GGU Map series.

Keto,L. 1987: Nikkelprospektering i Sukkertoppen området. 10 pp. Kryolitselskabet Øresund A/S. GEUS Archive no.21538

Keto, L. 1998 Fifty years of ore exploration in Greenland by Kryolitselskabet Øresund A/S; a memoir, Danmarks og Grønlands Geologiske Undersøgelse Rapport **1998/29**,33 pp.

Naldrett, A.J. & & Duke, J.M.1980: Platinum metals in magmatic sulphide ores, Science **208**, 1417-1424.

Nielsen, B.L.1973: A survey of economic minerals, GGU Rapport **56**, 45 pp.

Secher, K.1982a: Noritic rocks and associated nickel-copper-sulphide occurrences in Sukkertoppen district, central West Greenland, GGU Rapport **115**, 30-34.

Secher, K.1982b: Feltdagbog, Noritbæltet. 1982, Internal GGU report, 78 pp.

Secher, K.1988: Analysenotat om Bondar-Clegg ædelmetalanalyser af Ni-Cu-mineraliseringer i noritbæltet øst for Maniitsoq, Vestgrønland. GGU internal note. 4pp.

Secher, K & Stendal, H.1989: Weathering products of sulphides in the Arctic with a case history on a Cu-Ni-sulphide occurrence in West Greenland, in: Barto-Kyriakidis (ed.): Weathering; its products and deposits II, 499-522, Athens: Theophrastus Publishing & Proprietary Co.

Shore, M, 2000: Report on field activities: June –August 2000 Kangia Project (Greenland Norite Belt), Maniitsoq area, South-west Greenland, Falconbridge Ltd. 33 pp. + appendices. GEUS no 21762 (Closed file).

Appendices:

Appendix 1: Analytical results

Sample ID	Latitude	Longitude	Description	Pd ppb	Pt ppb	Au ppb	Σ PGE	Pd/Pt	PGE/Pd	Pt/Pd
257414	65,37587	-51,54002	Amphibolite,1-5%	5,1	9,7	5	14,8	0,53	2,90	1,90
257418	65,35713	-51,56010	Norite, <1%	7,5	12,5	19	20,0	0,60	2,67	1,67
257419	65,35912	-51,54913	Norite, <1%	23,1	77	88	100,1	0,30	4,33	3,33
257420	65,35912	-51,54913	Norite, <1%	16,4	74,5	43	90,9	0,22	5,54	4,54
257421	65,35912	-51,54935	Norite, 1-5%	1,9	4,3	15	6,2	0,44	3,26	2,26
257422	65,35912	-51,54935	Norite	0,7	1,3	9	2,0	0,54	2,86	1,86
257425	65,36856	-51,55547	Norite	1,9	2,5	8	4,4	0,76	2,32	1,32
257426	65,36856	-51,55547	Norite, <1%	14,6	15,5	37	30,1	0,94	2,06	1,06
257427	65,36856	-51,55547	Norite, <1%	57,4	104	45	161,4	0,55	2,81	1,81
257428	65,36856	-51,55547	Norite, <1%	29,5	51,2	29	80,7	0,58	2,74	1,74
257429,1	65,36856	-51,55547	Norite, 1-5%	36,8	82,2	48	119,0	0,45	3,23	2,23
257429,2	65,36856	-51,55547	Norite, 1-5%	42,6	64,5	91	107,1	0,66	2,51	1,51
257430	65,36856	-51,55547	Norite	6,1	14,7	18	20,8	0,41	3,41	2,41
257431	65,36856	-51,55547	Norite, 1-5%	53	104	82	157,0	0,51	2,96	1,96
257433	65,36856	-51,55547	Norite, 1-5%	34,2	70	181	104,2	0,49	3,05	2,05
257434	65,36856	-51,55547	Norite	10,9	22,5	47	33,4	0,48	3,06	2,06
257435	65,36856	-51,55547	Norite	1,6	1,4	19	3,0	1,14	1,88	0,88
257436	65,36856	-51,55547	Norite	14,2	33,6	29	47,8	0,42	3,37	2,37
257441	65,36991	-51,55096	Norite, <1%	15	33,1	171	48,1	0,45	3,21	2,21
257442	65,36991	-51,55096	Norite, <1%	16,2	62,4	2120	78,6	0,26	4,85	3,85
257443	65,36991	-51,55096	Norite, <1%	2,5	4,1	26	6,6	0,61	2,64	1,64
257444	65,37037	-51,54967	Norite, 1-5%	10,9	27,9	28	38,8	0,39	3,56	2,56
257445	65,37037	-51,54967	Norite, <1%	38,1	221	75	259,1	0,17	6,80	5,80
257446	65,37046	-51,54967	Norite, <1%	3,8	8,8	25	12,6	0,43	3,32	2,32
257447,1	65,37525	-51,53484	Norite, 5-10%	47,8	74,7	82	122,5	0,64	2,56	1,56
257447,2	65,37525	-51,53484	Norite, 5-10%	36,4	67,6	80	104,0	0,54	2,86	1,86
257448	65,37844	-51,50553	Norite	0	0,4	3	0,4	0,00		
257449	65,37844	-51,50553	Norite	0,4	0,6	6	1,0	0,67	2,50	1,50
257450	65,37835	-51,50553	Norite	0,3	0,6	2	0,9	0,50	3,00	2,00
257451	65,37472	-51,53159	Norite, 5-10%	41,9	99	21	140,9	0,42	3,36	2,36
257454	65,38082	-51,59334	Amphibolite	14	16,4	3	30,4	0,85	2,17	1,17
257455	65,38134	-51,60132	Beforsite	0,9	1,9	3	2,8	0,47	3,11	2,11
257456	65,38431	-51,60071	Amphibolite	11,6	11,1	2	22,7	1,05	1,96	0,96
257457	65,38420	-51,60998	Amphibolite	0	0,3	0	0,3	0,00		
257458	65,38420	-51,60998	Amphibolite	0	0,3	0	0,3	0,00		
257459	65,34894	-51,60397	Mylonite	0	0,3	6	0,3	0,00		
257460	65,34975	-51,60764	Leucogabbro	0	0,2	0	0,2	0,00		
257461	65,34984	-51,60764	Leucogabbro	0	0,3	2	0,3	0,00		
257462	65,35820	-51,60925	Leucogabbro	0,2	0,2	0	0,4	1,00	2,00	1,00
257469	65,37045	-51,55139	Amphibolite,<1%	0,2	0,4	0	0,6	0,50	3,00	2,00
257470	65,37045	-51,55139	Amphibolite	0	0,3	0	0,3	0,00		
257471	65,43628	-51,56434	Mylonite	0,4	0,8	0	1,2	0,50	3,00	2,00

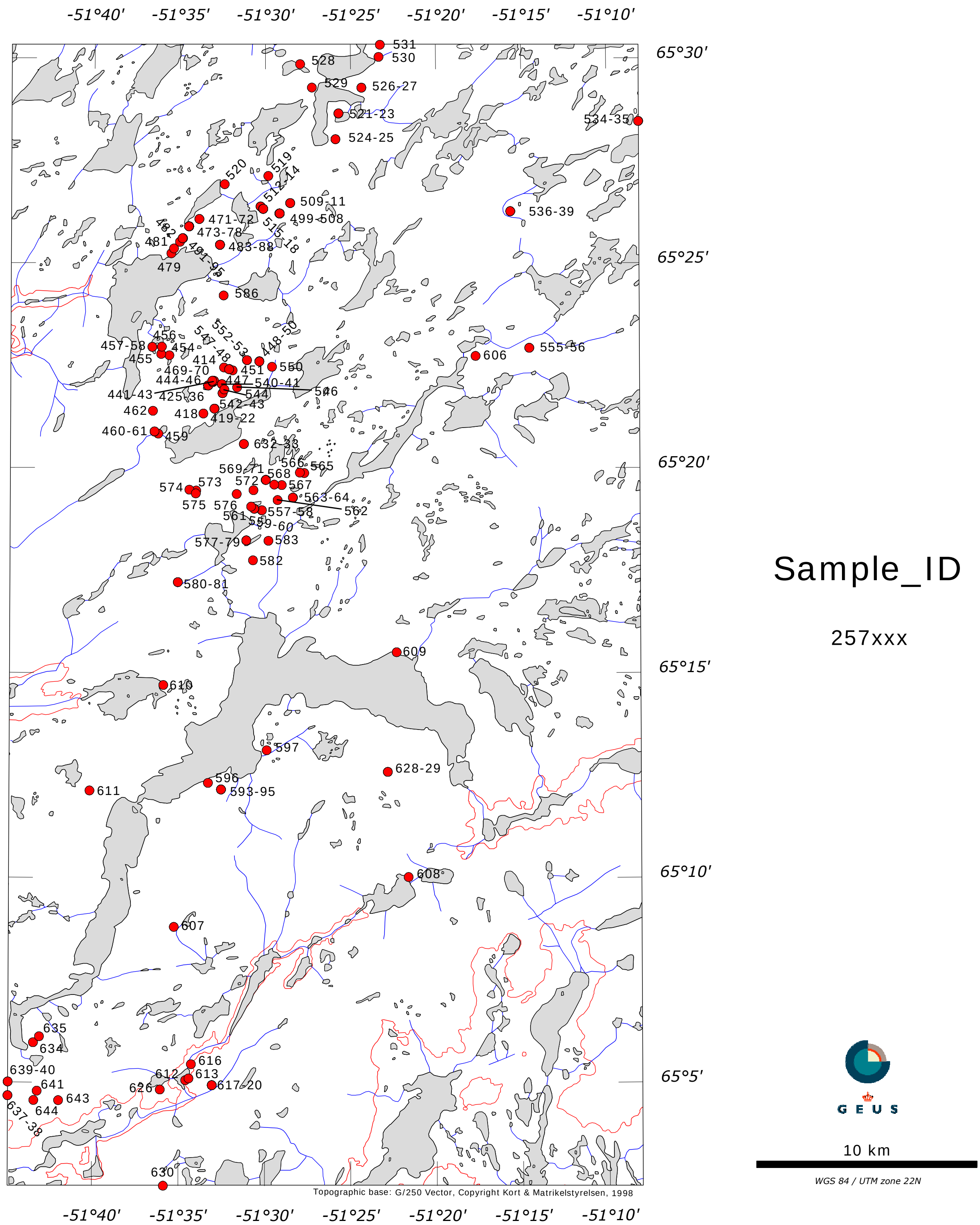
Sample ID	Latitude	Longitude	Description	Pd ppb	Pt ppb	Au ppb	Σ PGE	Pd/Pt	PGE/Pd	Pt/Pd
257472	65,43628	-51,56434	Mylonite	0,2	0,5	0	0,7	0,40	3,50	2,50
257473	65,43329	-51,57425	Leucogab.<1%	40,5	56,2	18	96,7	0,72	2,39	1,39
257474	65,43329	-51,57425	Norite, 1-5%	618	636	107	1254,0	0,97	2,03	1,03
257475	65,43329	-51,57425	Norite, 5-10%	185	278	130	463,0	0,67	2,50	1,50
257476	65,43329	-51,57425	Norite, 5-10%	211	197	83	408,0	1,07	1,93	0,93
257477	65,43329	-51,57446	Norite, 5-10%	85,9	104	47	189,9	0,83	2,21	1,21
257478	65,43329	-51,57446	Norite, 5-10%	54,3	98,2	65	152,5	0,55	2,81	1,81
257479	65,42228	-51,59163	Gabbro,<1%	2,9	5,1	11	8,0	0,57	2,76	1,76
257481	65,42428	-51,58906	Gabbro,<1%	31,7	76,7	26	108,4	0,41	3,42	2,42
257482	65,42698	-51,58326	Norite, 1-5%	113	145	43	258,0	0,78	2,28	1,28
257483	65,42579	-51,54414	Norite, 5-10%	1,4	4,8	38	6,2	0,29	4,43	3,43
257484	65,42579	-51,54414	Norite, <1%	1,9	2,8	4	4,7	0,68	2,47	1,47
257485	65,42579	-51,54414	Norite, 5-10%	1,7	12,3	82	14,0	0,14	8,24	7,24
257486	65,42579	-51,54414	Norite, 5-10%	0,5	0,9	8	1,4	0,56	2,80	1,80
257487	65,42579	-51,54414	Norite, 5-10%	1,8	5	3	6,8	0,36	3,78	2,78
257488	65,42579	-51,54414	Norite, 5-10%	2,1	5,3	9	7,4	0,40	3,52	2,52
257491	65,42843	-51,58025	Norite, 1-5%	274	36,2	205	310,2	7,57	1,13	0,13
257492	65,42843	-51,58046	Norite	1,1	0,9	18	2,0	1,22	1,82	0,82
257493	65,42843	-51,58046	Norite	1,1	1,7	3	2,8	0,65	2,55	1,55
257494	65,42843	-51,58046	Norite	3,3	2,5	4	5,8	1,32	1,76	0,76
257495	65,42843	-51,58068	Norite	1,1	2,5	9	3,6	0,44	3,27	2,27
257499	65,43856	-51,48589	Norite, 10-15%	0,9	8,4	15	9,3	0,11	10,33	9,33
257500	65,43856	-51,48589	Norite, 10-15%	0,8	1,2	6	2,0	0,67	2,50	1,50
257501	65,43856	-51,48589	Norite, 10-15%	2,1	6,4	4	8,5	0,33	4,05	3,05
257502	65,43856	-51,48589	Norite, 10-15%	0,6	3,2	4	3,8	0,19	6,33	5,33
257503	65,43856	-51,48612	Norite, 15-20%	5,2	8,9	5	14,1	0,58	2,71	1,71
257504	65,43856	-51,48612	Norite, 20-25%	4	5,5	3	9,5	0,73	2,38	1,38
257505	65,43856	-51,48589	Norite, 15-20%	2,1	7,9	10	10,0	0,27	4,76	3,76
257506	65,43856	-51,48589	Norite, 20-25%	3,4	4,5	14	7,9	0,76	2,32	1,32
257507	65,43856	-51,48612	Norite, 10-15%	1,2	0,9	6	2,1	1,33	1,75	0,75
257508	65,43856	-51,48589	Norite	0,5	0,3	10	0,8	1,67	1,60	0,60
257509	65,44279	-51,47555	Norite, 15-20%	8,7	10,3	25	19,0	0,84	2,18	1,18
257510	65,44279	-51,47555	Norite, 20-25%	26,4	20,8	24	47,2	1,27	1,79	0,79
257511	65,44279	-51,47555	Norite, 5-10%	25	54,2	127	79,2	0,46	3,17	2,17
257512	65,44141	-51,50451	Norite, 1-5%	3	4,8	5	7,8	0,63	2,60	1,60
257513	65,44141	-51,50451	Norite, >50%	16	14,5	0	30,5	1,10	1,91	0,91
257514	65,44141	-51,50451	Norite, 1-5%	0,6	0,5	0	1,1	1,20	1,83	0,83
257515	65,44043	-51,50212	Norite, 1-5%	9,9	15,8	18	25,7	0,63	2,60	1,60
257516	65,44043	-51,50190	Norite, 5-10%	37	120	28	157,0	0,31	4,24	3,24
257517	65,44043	-51,50190	Norite, 1-5%	46,2	69,6	14	115,8	0,66	2,51	1,51
257518	65,44043	-51,50190	Norite, 10-15%	34,3	135	12	169,3	0,25	4,94	3,94
257519	65,45383	-51,49703	Amphibolite	0,7	0,7	2	1,4	1,00	2,00	1,00
257520	65,45044	-51,53961	Amphibolite	0,7	0,8	4	1,5	0,88	2,14	1,14
257521	65,47928	-51,42838	Norite, 1-5%	20,9	22,5	7	43,4	0,93	2,08	1,08
257522	65,47918	-51,42838	Norite, 1-5%	20	23,5	7	43,5	0,85	2,18	1,18
257523	65,47928	-51,42838	Amphibolite,1-5%	32,1	35,4	7	67,5	0,91	2,10	1,10
257524	65,46876	-51,43136	Norite, <1%	1,7	2,4	11	4,1	0,71	2,41	1,41
257525	65,46876	-51,43136	Norite	0	0,2	0	0,2	0,00		
257526	65,48973	-51,40591	Norite	0,4	0,5	6	0,9	0,80	2,25	1,25
257527	65,48973	-51,40591	Norite, balltype	0	0,3	0	0,3	0,00		
257528	65,49930	-51,46596	Amphibolite	2,4	2,3	0	4,7	1,04	1,96	0,96
257529	65,48977	-51,45442	Amphibolite	0,3	0,7	2	1,0	0,43	3,33	2,33

Sample ID	Latitude	Longitude	Description	Pd ppb	Pt ppb	Au ppb	Σ PGE	Pd/Pt	PGE/Pd	Pt/Pd
257530	65,50223	-51,38911	Norite	0,8	1,2	3	2,0	0,67	2,50	1,50
257531	65,50718	-51,38781	Norite	0,6	1,1	8	1,7	0,55	2,83	1,83
257534,1	65,47591	-51,13485	Amphibolite,>20%	40,1	9	13	49,1	4,46	1,22	0,22
257534,2	65,47591	-51,13485	Amphibolite,>20%	95,5	7,9	13	103,4	12,09	1,08	0,08
257534,3	65,47591	-51,13485	Amphibolite,>20%	74,5	6	14	80,5	12,42	1,08	0,08
257535	65,47591	-51,13507	Amphibolite,5-10%	28,2	3,1	4	31,3	9,10	1,11	0,11
257536,1	65,43938	-51,26045	Amphibolite,>20%	590	684	40	1274,0	0,86	2,16	1,16
257536,2	65,43938	-51,26045	Amphibolite,>20%	387	775	63	1162,0	0,50	3,00	2,00
257537	65,43938	-51,26045	Amphibolite,>20%	143	704	55	847,0	0,20	5,92	4,92
257538	65,43938	-51,26045	Amphibolite,>15%	609	2180	15	2789,0	0,28	4,58	3,58
257539	65,43938	-51,26045	Amphibolite,>15%	246	719	51	965,0	0,34	3,92	2,92
257540	65,36912	-51,54211	Norite, 1-5%	1	5,3	2	6,3	0,19	6,30	5,30
257541	65,36912	-51,54211	Norite/Beforsite	0,6	4,9	0	5,5	0,12	9,17	8,17
257542	65,36543	-51,54143	Norite, <1%	0,9	4,7	5	5,6	0,19	6,22	5,22
257543	65,36543	-51,54143	Norite, <1%	1,5	56,7	7	58,2	0,03	38,80	####
257544	65,36696	-51,53972	Norite, 5-10%	22,3	119	46	141,3	0,19	6,34	5,34
257546	65,37516	-51,53505	Norite	0,2	0,6	5	0,8	0,33	4,00	3,00
257547	65,37516	-51,53505	Norite, 5-10%	0	0,7	11	0,7	0,00		
257548,1	65,37516	-51,53505	Norite	0,5	4,1	3	4,6	0,12	9,20	8,20
257548,2	65,37516	-51,53505	Norite	1,1	6,6	5	7,7	0,17	7,00	6,00
257550	65,37620	-51,49322	Dolerite	10,4	11,1	8	21,5	0,94	2,07	1,07
257552	65,37887	-51,51761	Leucogabbro	0,7	2,1	27	2,8	0,33	4,00	3,00
257553	65,37887	-51,51761	Pegmatite (red)	0	0,4	18	0,4	0,00		
257555	65,38379	-51,24220	Biotite gneiss	0,3	0,3	2	0,6	1,00	2,00	1,00
257556	65,38379	-51,24220	Mylonite	0	0,6	3	0,6	0,00		
257557	65,31781	-51,50313	Gneiss, 1-5%	0	0,9	13	0,9	0,00		
257558	65,31781	-51,50291	Garnet schist	1	2,2	8	3,2	0,45	3,20	2,20
257559	65,31843	-51,51024	Amphibolite,1-5%	12,4	10,2	49	22,6	1,22	1,82	0,82
257560	65,31843	-51,51045	Amphibolite,1-5%	6,8	6	100	12,8	1,13	1,88	0,88
257561	65,31932	-51,51346	Amphibolite,1-5%	4,3	2,5	311	6,8	1,72	1,58	0,58
257562	65,32197	-51,48766	Amphibolite,1-5%	0	0,4	37	0,4	0,00		
257563	65,32298	-51,47261	Amphibolite	0	0,4	4	0,4	0,00		
257564	65,32298	-51,47283	Amphibolite,1-5%	0	0,4	5	0,4	0,00		
257565	65,33297	-51,46169	Norite, 1-5%	28,1	80,4	40	108,5	0,35	3,86	2,86
257566	65,33314	-51,46600	Norite, <1%	1,2	6,5	18	7,7	0,18	6,42	5,42
257567	65,32809	-51,48362	Metagabbro	0	0,3	79	0,3	0,00		
257568	65,32826	-51,49094	Amphibolite,1-5%	0,3	0,6	58	0,9	0,50	3,00	2,00
257569	65,33023	-51,49913	Amphibolite,1-5%	8,3	5,5	38	13,8	1,51	1,66	0,66
257570	65,33014	-51,49935	Amphibolite,1-5%	0,9	1,1	30	2,0	0,82	2,22	1,22
257571	65,33014	-51,49913	Amphibolite,1-5%	1,1	0,9	17	2,0	1,22	1,82	0,82
257572	65,32599	-51,51115	Amphibolite,1-5%	5,2	6,9	8	12,1	0,75	2,33	1,33
257573	65,32580	-51,56693	Leucogabbro	0,3	0,2	6	0,5	1,50	1,67	0,67
257574	65,32616	-51,57357	Amphibolite	0,2	0,3	9	0,5	0,67	2,50	1,50
257575,1	65,32464	-51,56732	Amphibolite	0,3	0	42	0,3		1,00	
257575,2	65,32464	-51,56732	Amphibolite	0,3	0	174	0,3		1,00	
257576	65,32443	-51,52750	Amphibolite	11,7	7,8	29	19,5	1,50	1,67	0,67
257577	65,30555	-51,51809	Amphibolite,1-5%	21,2	16,2	13	37,4	1,31	1,76	0,76
257578	65,30555	-51,51809	Amphibolite,1-5%	5,6	5,4	13	11,0	1,04	1,96	0,96
257579	65,30555	-51,51809	Amphibolite,1-5%	8,5	6	14	14,5	1,42	1,71	0,71
257580	65,28853	-51,58458	Norite	1,8	0,2	20	2,0	9,00	1,11	0,11
257581	65,28853	-51,58458	Leucogabbro	0,8	0	12	0,8		1,00	
257582	65,29747	-51,51157	Amphibolite,1-5%	19,9	17	11	36,9	1,17	1,85	0,85

Sample ID	Latitude	Longitude	Description	Pd ppb	Pt ppb	Au ppb	Σ PGE	Pd/Pt	PGE/Pd	Pt/Pd
257583	65,30540	-51,49658	Amphibolite,1-5%	0,9	0,2	7	1,1	4,50	1,22	0,22
257586	65,40519	-51,54050	Norite/beforsite	0,5	0	4	0,5		1,00	
257593	65,20422	-51,54233	Soapstone/schist	8,2	5,7	5	13,9	1,44	1,70	0,70
257594	65,20422	-51,54233	Soapstone/schist	0,3	0	2	0,3		1,00	
257595	65,20422	-51,54233	Pegmatite	1	0	6	1,0		1,00	
257596	65,20691	-51,55499	Norite	1,4	4,5	18	5,9	0,31	4,21	3,21
257597	65,22020	-51,49810	Peridotite	1,9	2,2	15	4,1	0,86	2,16	1,16
257606	65,38055	-51,29462	Ultramafite	8,9	7,3	8	16,2	1,22	1,82	0,82
257607	65,14828	-51,58779	Norite	6,6	10,9	38	17,5	0,61	2,65	1,65
257608	65,16861	-51,36056	Amphibolite,<1%	0,3	0,3	10	0,6	1,00	2,00	1,00
257609	65,26008	-51,37193	Amphibolite,1-5%	10,7	12	8	22,7	0,89	2,12	1,12
257610	65,24667	-51,59851	Dunite	1,3	1,9	3	3,2	0,68	2,46	1,46
257611	65,20370	-51,66980	Norite, 1-5%	1	2,2	10	3,2	0,45	3,20	2,20
257612	65,08596	-51,57646	Norite, 5-10%	118	226	239	344,0	0,52	2,92	1,92
257613	65,08668	-51,57326	Norite, 1-5%	6,2	15,7	42	21,9	0,39	3,53	2,53
257616	65,09245	-51,57097	Norite, balltype	0,9	3,4	4	4,3	0,26	4,78	3,78
257617	65,08394	-51,55084	Amphibolite,1-5%	0,5	0,3	10	0,8	1,67	1,60	0,60
257618	65,08394	-51,55084	Amphibolite,1-5%	1,2	1	49	2,2	1,20	1,83	0,83
257619	65,08394	-51,55084	Amphibolite	0,4	0,3	31	0,7	1,33	1,75	0,75
257620	65,08394	-51,55084	Amphibolite,1-5%	0,9	0,3	28	1,2	3,00	1,33	0,33
257626	65,08214	-51,60094	Norite, 5-10%	83,5	156	43	239,5	0,54	2,87	1,87
257628	65,21142	-51,38059	Leucogabbro	4,2	5	5	9,2	0,84	2,19	1,19
257629	65,21142	-51,38059	Amphibolite,5-10%	0,6	0,4	7	1,0	1,50	1,67	0,67
257630	65,04300	-51,59773	Amphibolite,1-5%	0	0,4	3	0,4	0,00		
257632	65,34477	-51,52057	Amphibolite	0,5	0,6	3	1,1	0,83	2,20	1,20
257633	65,34477	-51,52057	Amphibolite,1-5%	1,2	1,2	17	2,4	1,00	2,00	1,00
257634	65,10119	-51,72345	Norite	0,2	0	3	0,2		1,00	
257635	65,10363	-51,71772	Norite	0,3	0	5	0,3		1,00	
257637	65,07961	-51,74785	Soapstone	0,2	0,3	3	0,5	0,67	2,50	1,50
257638	65,07961	-51,74785	Amphibolite	8,1	7,2	6	15,3	1,13	1,89	0,89
257639	65,08519	-51,74772	Amphibolite	0	0	4	0,0			
257640	65,08519	-51,74772	Amphibolite	3,9	7,1	3	11,0	0,55	2,82	1,82
257641	65,08149	-51,71972	Norite, 1-5%	29,6	84,2	27	113,8	0,35	3,84	2,84
257643	65,07767	-51,69898	Norite, 1-5%	0,3	0	35	0,3		1,00	
257644	65,07770	-51,72287	Amphibolite,1-5%	0	0,2	3	0,2	0,00		

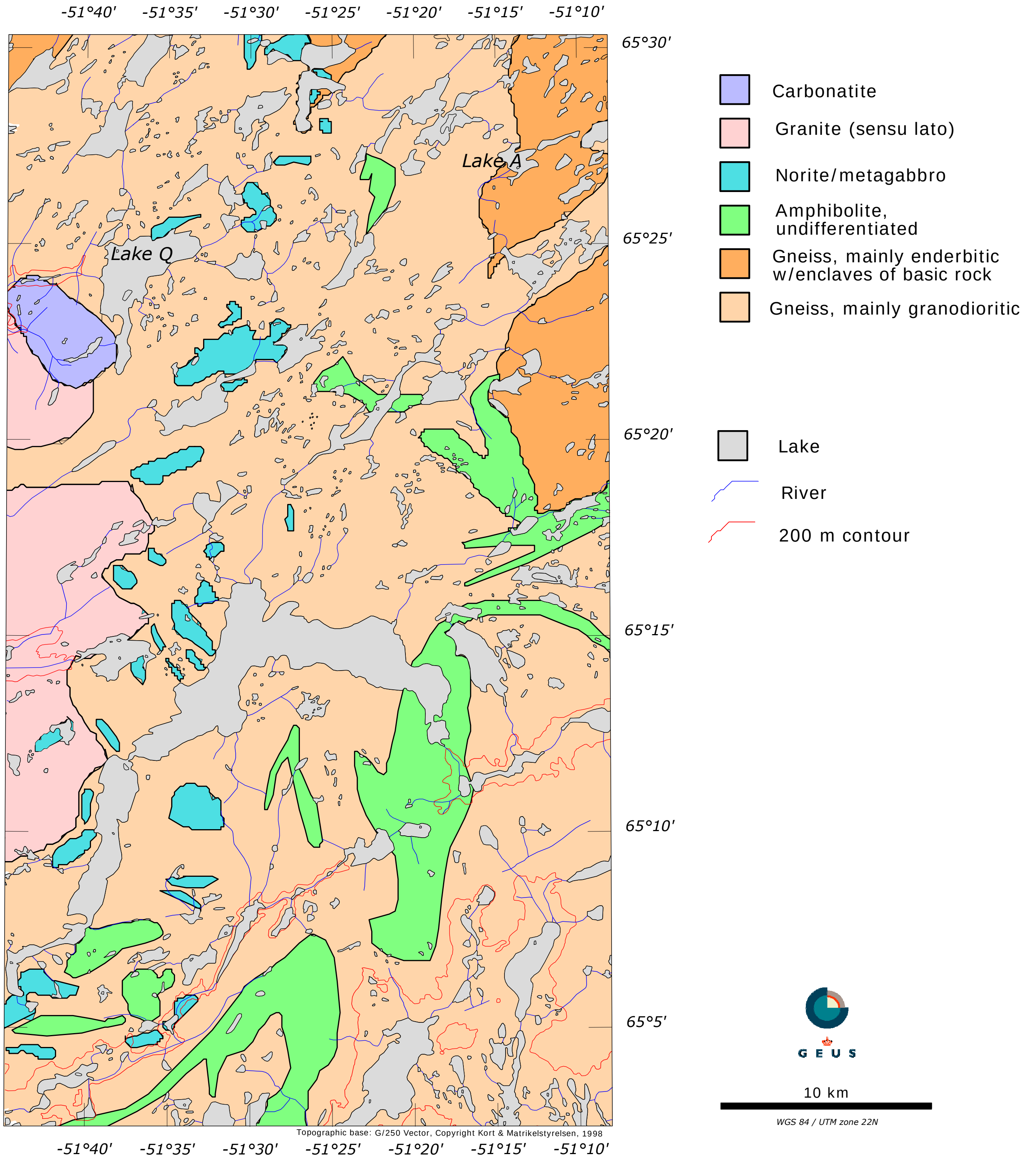
Appendix 2:

Sample localities



Appendix 3:

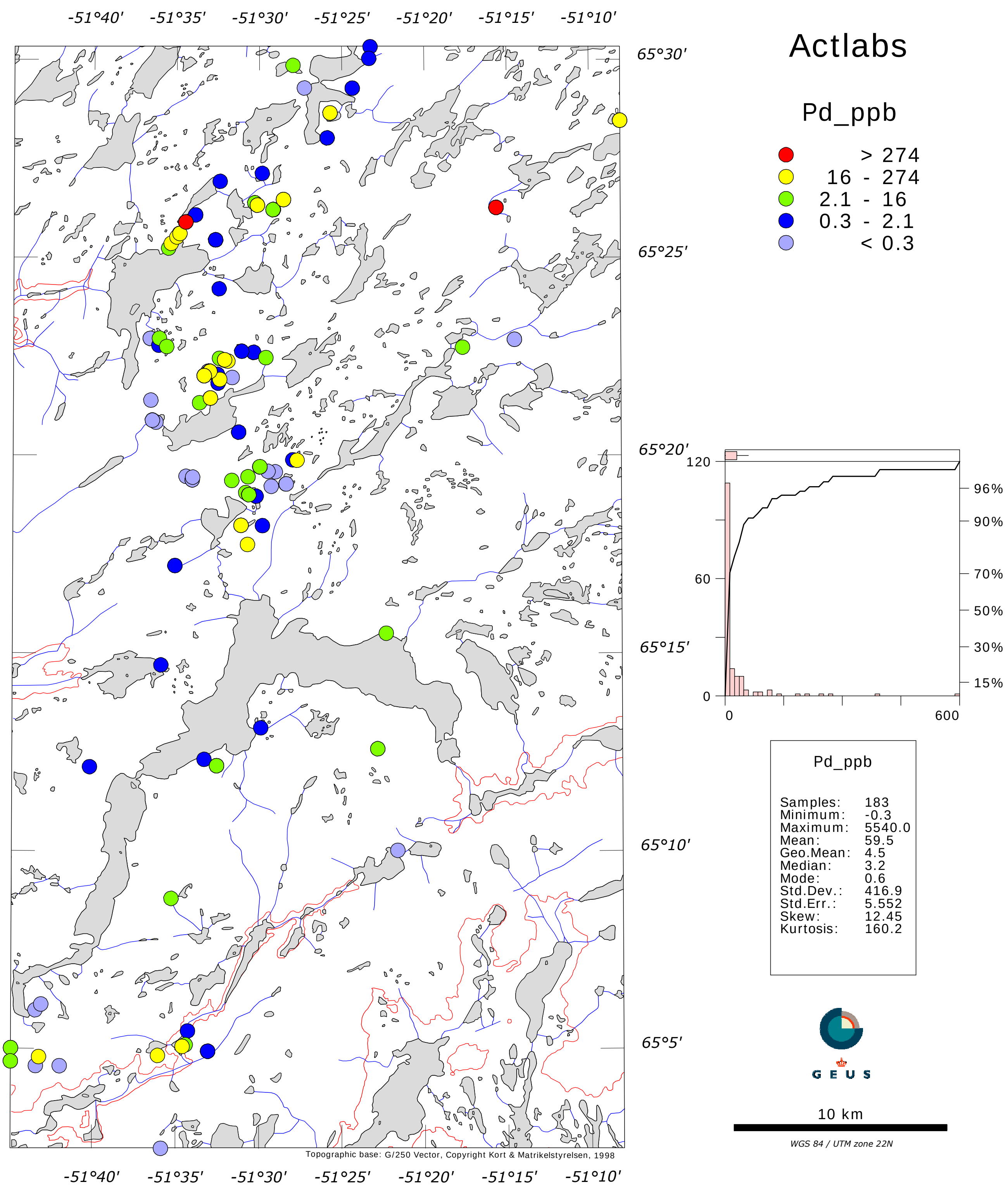
Simplified geological map



Appendix 4:

Rock samples

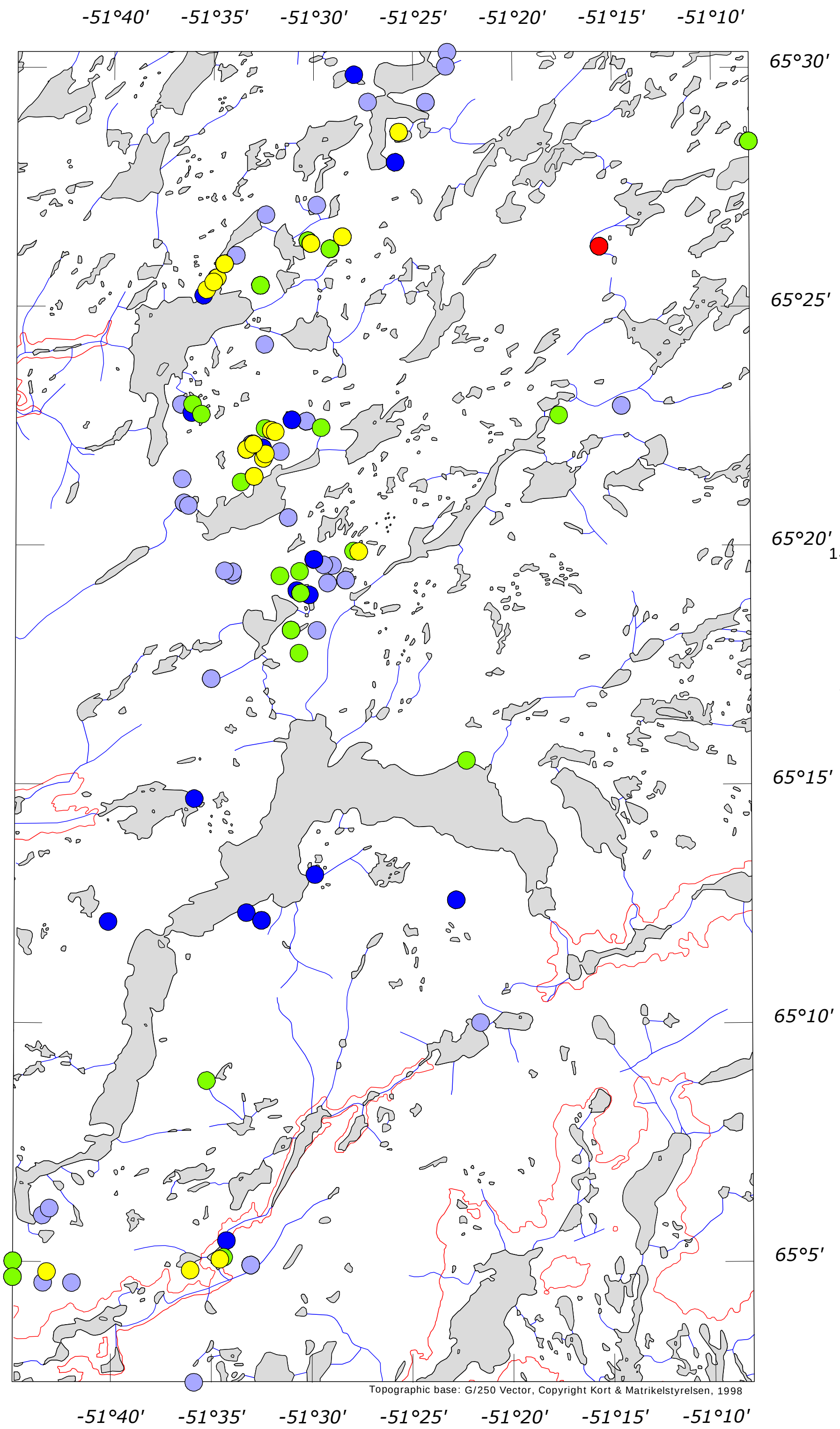
analysed by ICP - MS



Appendix 5:

Rock samples

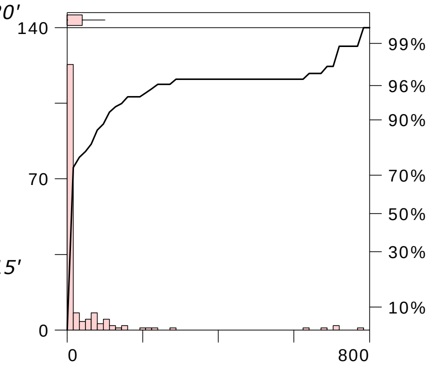
analysed by ICP - MS



Actlabs

Pt_ppb

- > 684
- 17.1 - 684
- 6.2 - 17.1
- 1.9 - 6.2
- < 1.9



Pt_ppb

Samples:	181
Minimum:	-0.3
Maximum:	2180.0
Mean:	53.4
Geo.Mean:	5.3
Median:	5.4
Mode:	0.6
Std.Dev.:	199.6
Std.Err.:	3.852
Skew:	7.658
Kurtosis:	71.41

GEUS

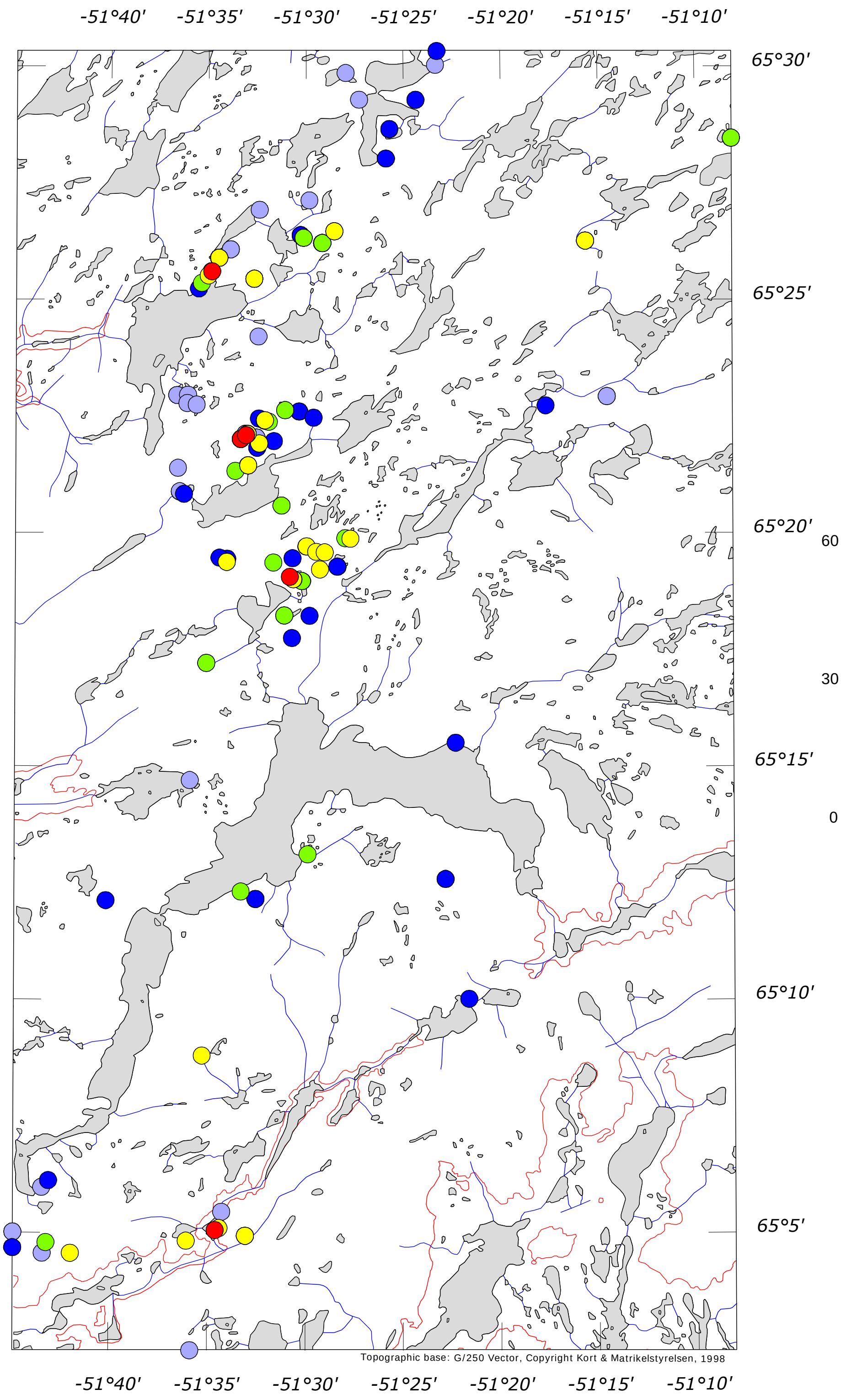
10 km

WGS 84 / UTM zone 22N

Appendix 6:

Rock samples

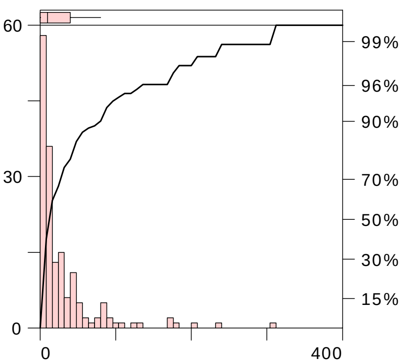
analysed by ICP - MS



Actlabs

Au_ppb

- > 180
- 30 - 180
- 12 - 30
- 4 - 12
- < 4



Au_ppb

Samples:	181
Minimum:	-2
Maximum:	2120
Mean:	39
Geo.Mean:	14
Median:	11
Mode:	3
Std.Dev.:	161.6
Std.Err.:	3.466
Skew:	11.85
Kurtosis:	149

GEUS

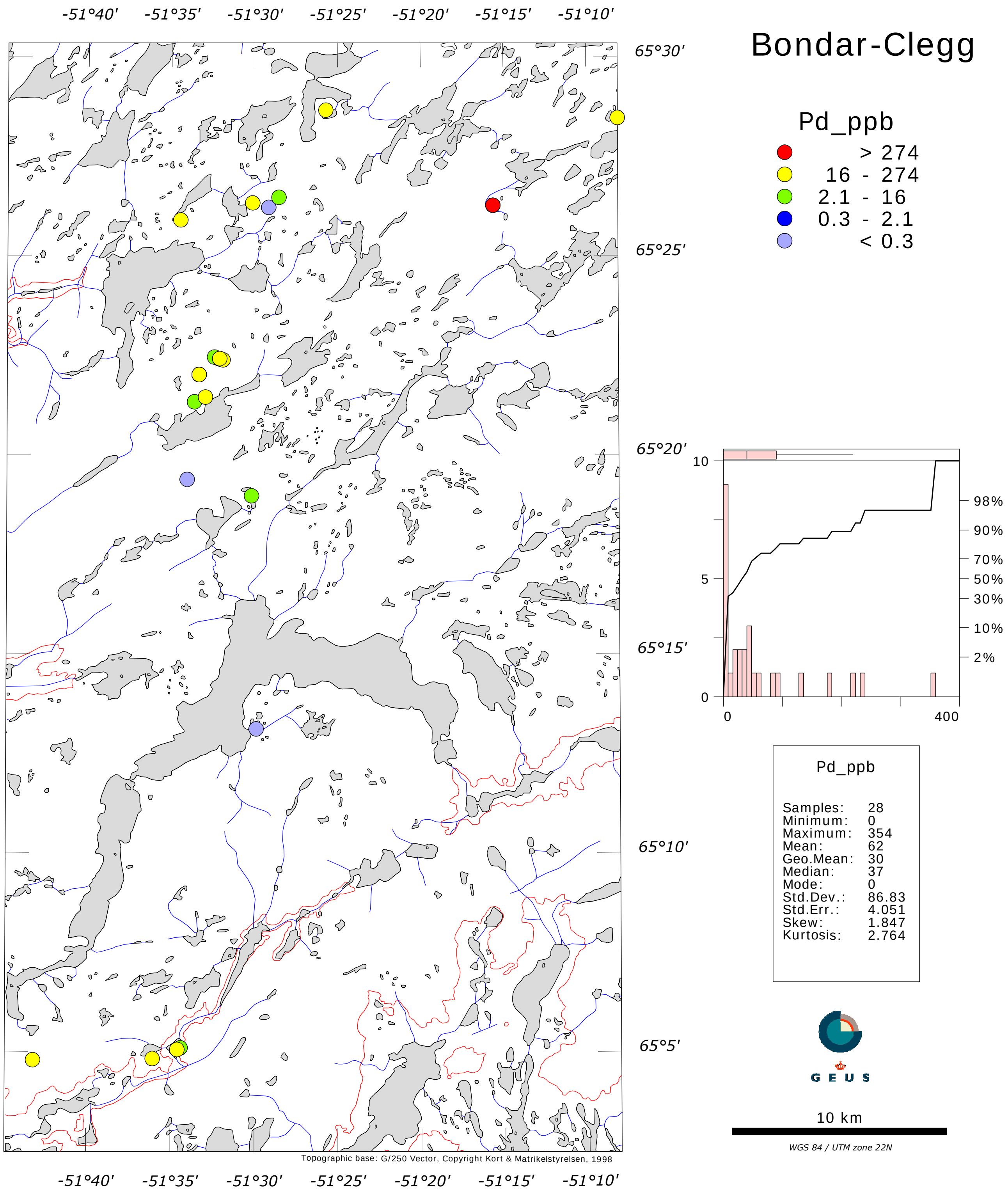
10 km

WGS 84 / UTM zone 22N

Appendix 7:

Rock samples

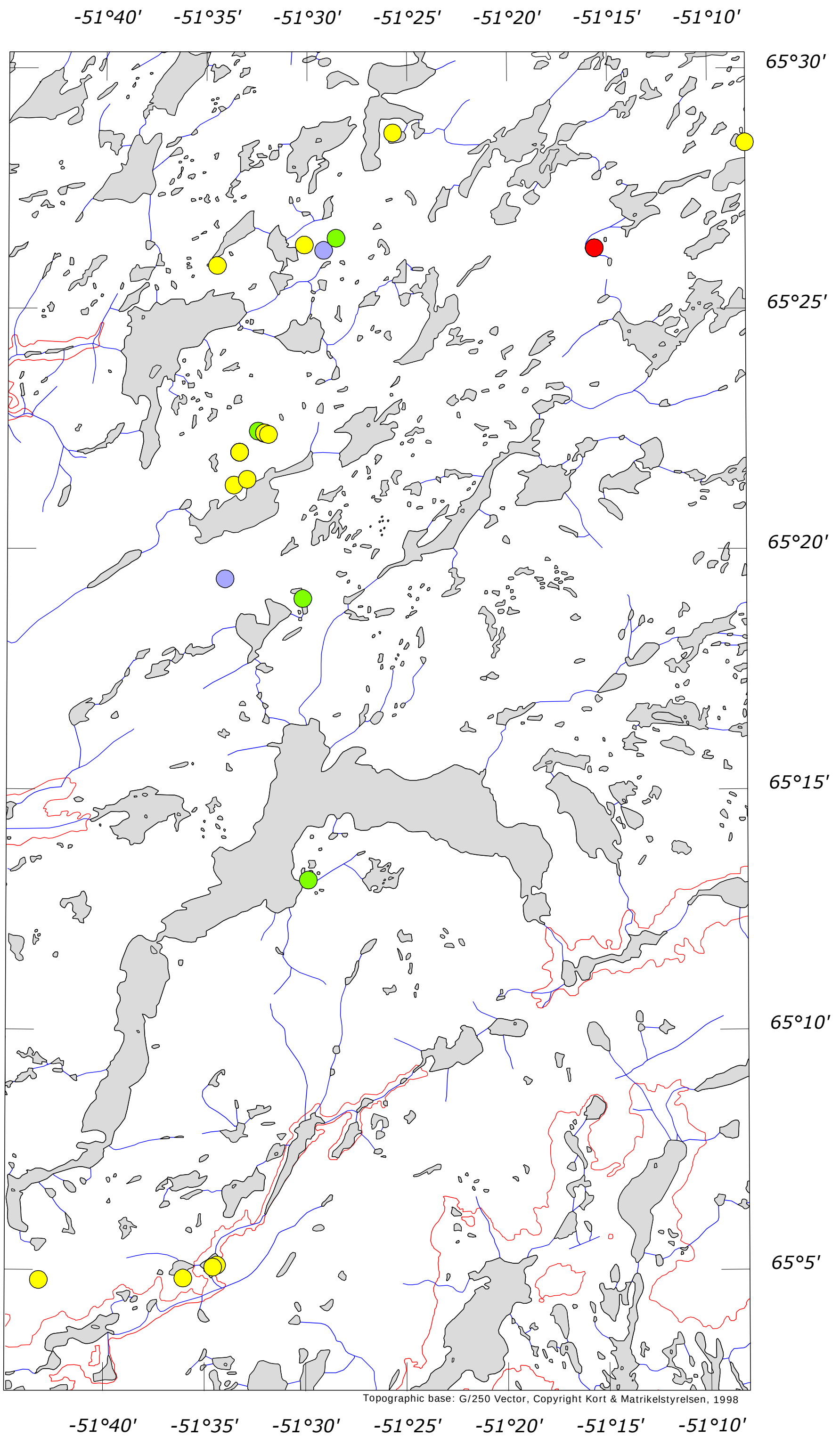
analysed by Fire Assay/DC Plasma



Appendix 8:

Rock samples

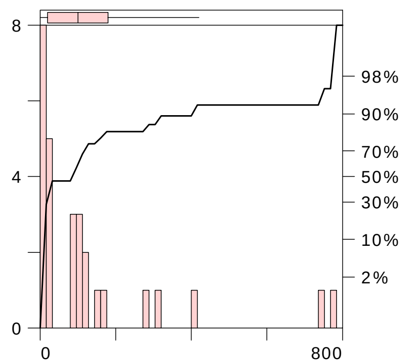
analysed by Fire Assay/DC Plasma



Bondar-Clegg

Pt_ppb

- > 684
- 17.1 - 684
- 6.2 - 17.1
- 1.9 - 6.2
- < 1.9



Pt_ppb

Samples:	28
Minimum:	0
Maximum:	769
Mean:	137
Geo.Mean:	63
Median:	94
Mode:	52
Std.Dev.:	202.7
Std.Err.:	6.189
Skew:	2.079
Kurtosis:	3.545

GEUS

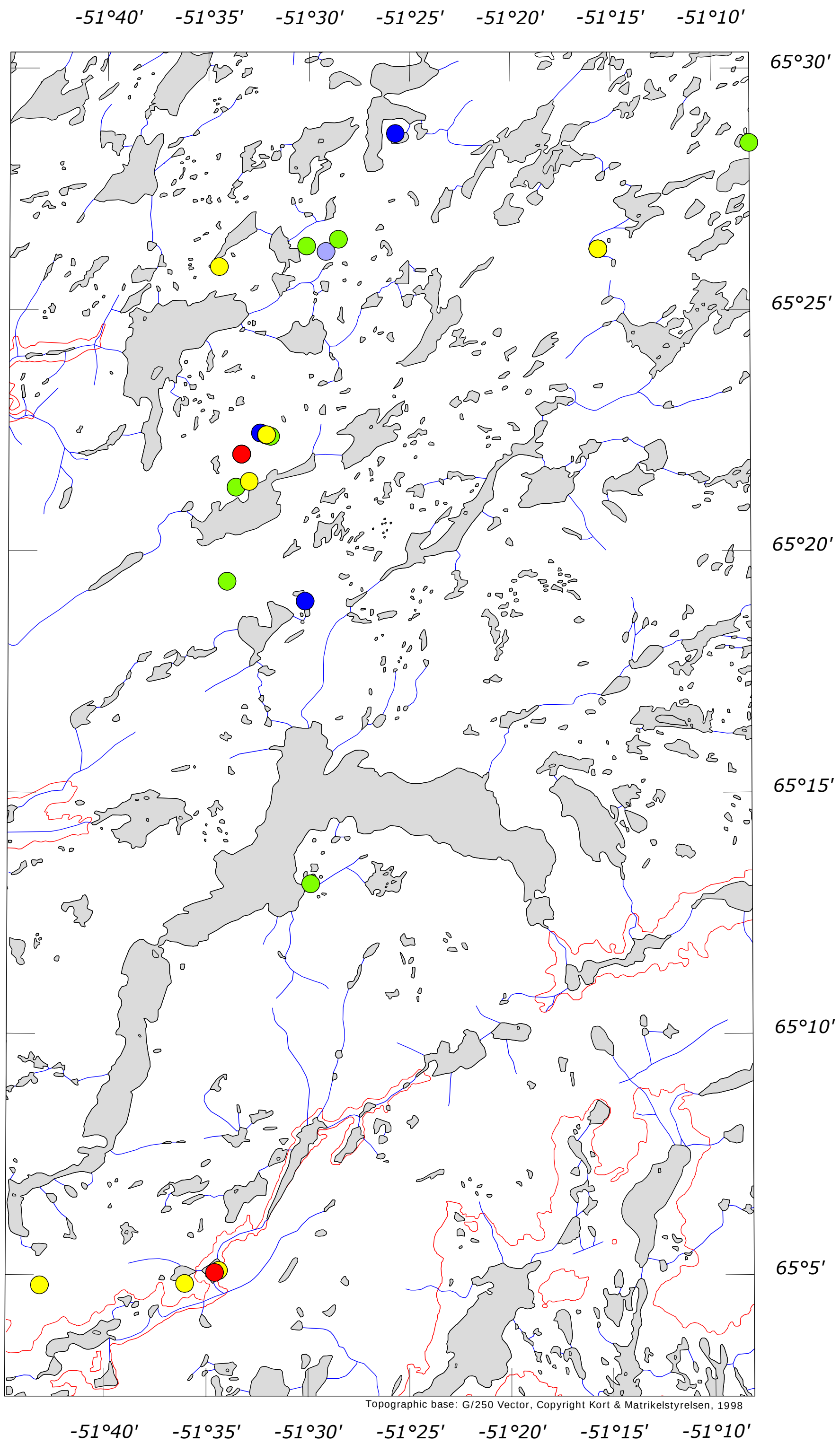
10 km

WGS 84 / UTM zone 22N

Appendix 9:

Rock samples

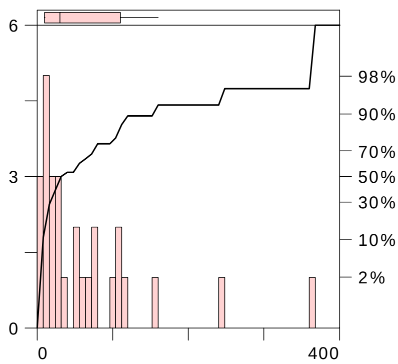
analysed by Fire Assay/DC Plasma



Bondar-Clegg

Au_ppb

- > 180
- 30 - 180
- 12 - 30
- 4 - 12
- < 4



Au_ppb

Samples:	28
Minimum:	0
Maximum:	362
Mean:	65
Geo.Mean:	38
Median:	34
Mode:	63
Std.Dev.:	80.45
Std.Err.:	3.899
Skew:	2.137
Kurtosis:	4.674

10 km

WGS 84 / UTM zone 22N