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Ore Exploration in Pasvik, 2000

ScanMining AB 2000-12-02

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ScanMining

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APPENDIX LIST

1. *Introduction*

During the field season 2000, ScanMining has conducted exploration for Au-Cu-Zn ores in the Pasvik greenstone belt. On the basis of regional and detailed geochemical till sampling performed 1998 and 1999, five targets were selected for further investigation: Finntjörna (Cu-Au), Skogum (Au), Elgbekken (Au), Gjedde Lake (Au) and Kobbfoss (Au-Cu-Zn) (app 1). The prospects are situated in the Sör-Varanger district, eastern Finnmark county, 60-km south south-west of Kirkenes, between the Russian and the Finnish border.

Geological bedrock mapping and exploration drilling was carried out on each prospect. The exploration drilling program accounted 356 drill holes along profiles perpendicular to the direction of the ancient ice movement. The distance between the profiles at Finntjörna was 100 metres and at Skogum, Elgbekken and Kobbfoss 200 metres, with a sampling distance within the profiles of 25 metres. At the Gjedde Lake Prospect exploration drilling was performed in a grid of 25 metres. Furthermore, the drill cores from the earlier found Gjedde Lake Au mineralisation were re-logged in order to achieve more knowledge about the processes, which led to the mineralisation and eventual related alterations.

The areas of interest are situated within the early Proterozoic *Pasvik Greenstone Belt*, which is subdivided in the *lower Pasvik Group* and *upper Langvannet Group*, separated by the major Poritash Fault which can be traced hundreds of kilometres to the east in Russia (app 2). All prospects, except for Finntjörna, are situated within the Langvannet Group.

At the Gjedde Lake target, three parallel gold mineralisations, of which one has been defined to a length of 350 metres, and discordant to the present mineralisation, are established by exploration drilling both in the lodgement-till and in bedrock samples. The mineralised zones are not delimited along their prolongation. Further investigations should include exploration drilling to follow the extension along the strike of the zone and a combined diamond- and RC-drilling program to determine the geometry and gold content.

The exploration drilling program at Kobbfoss has not been possible to finish during the summer. The strongest gold anomalies point out the bog area as the major target. However, the results from the five profiles from the area with the Cu-Zn till anomalies is indicating high metal content in the lodgement-till and enhanced Cu-Zn content in the bedrock samples.

Extended dense surface till sampling toward south west and exploration drilling in the Kobbfossmyran bog during the winter is highly recommended to define the Au anomaly in the lodgement-till and determine a target area for RC and core drilling. Further exploration-drilling is also motivated between the northern profiles and further to the north to trace the anomaly northward.

The result from the exploration drilling in Skogum confirms Cu anomaly in the lodgement-till. A weak Cu mineralisation has also been defined in the bedrock. At Elgbekken a Cu anomaly in the surface-till has been traced to a weak Cu mineralisation in the bedrock. In order to evaluate the anomaly a two step program is proposed. First step is to investigate the till transport in the area and to perform a dense surface-till sampling to the west. Second step is to carry out an exploration drilling program if the results indicate a surface-till anomaly to the west.

The result from the 100 metres spaced exploration drillings at Finntjörna has defined a delineated, low grade Cu-mineralisation in the bedrock with Cu content $\geq 0.1\%$, presumably associated to a shear zone. It is likely that higher grades can be defined by denser exploration drilling, but the tonnage is expected to be low.

Based on the results from the exploration drilling and the bedrock mapping, the area of the claims is decreased closer to the actual mineralisation zones. The claim at the Skogum prospect is withdrawn.

2. *Historical Background of the Exploration in the Pasvik Greenstone Belt*

Beside the work within the frame of the Gjedde Lake project, there has been an extensive Ni-Cu exploration done by A/S Sydvaranger and A/S Sulfidmalm in a joint venture during 1971-1973. A/S Sulfidmalm continued exploration in the area during 1975-1985. More than forty drill holes were drilled, totalling more than 5 700m, to test geochemical and geophysical anomalies in the Pasvik Greenstone Belt (Hodges, 1995). During this period no Ni-Cu mineralisation was located. In 1988 Russian and Norwegian geologists started a collaboration correlating the Pechenga Greenstone belt, hosting extensive Ni-Cu-ores, and the Pasvik Greenstone Belt. That emanated in a new period of exploration focused on the "productive Ni-Cu zone" associated to the lower Pasvik Group in the Pasvik Greenstone Belt. Falconbridge ltd. performed core drilling 1991-1993 in the area of the Oksfjellet, which was preceded by aerogeophysical surveying, geological mapping and identification of the "productive zone" within the Pasvik Group.

Not much detailed geological work or geophysical interpretations have been done in the Langvannet Group, beside what is done in connection to the Gjedde Lake gold mineralisation. The Gjedde Lake project started when a Russian geologist, during geological traverse mapping 1993, discovered a gold bearing quartzite on the shore of the Gjedde Lake (Melezhik 1995). A brief sampling of, what then was thought to be an outcrop, showed that there was significant amount of gold ($\leq$ 10 ppm).

Kenor A/S claimed the area and together with NGU, Au exploration started in the vicinity of the lake. Geological mapping and ground geophysical survey was performed (Ettner 1995, Lauritsen 1995, Lauritsen 1996), followed by regional till sampling (Finne 1996) and core drilling (Ihlen et.al. 1996, Ihlen 1998), to test the geophysical and geochemical anomalies. Additional dense till sampling was performed after the core drilling program to try to follow the extension of the Au-mineralisation (Finne 1997). The anomaly testing approach resulted in a non-economic, low-grade Au-mineralisation.

1998 Kenor A/S and ScanMining AB formed a jointly owned company, Scanor Mining A/S, to explore the Pasvik Greenstone Belt for gold and base metals. The principal aim was to implement ScanMinings exploration method, Scansystem, which has been successful to find ores in till covered areas. Furthermore to develop the Au-mineralisation at Gjedde Lake and to bring the new explored targets to the same level of knowledge as the Gjedde Lake target. This work started in 1998 with regional till sampling, followed by dense sampling in 12 anomalous areas 1999 from which five promising targets were selected for continued exploration.

There are two versions of regional geological maps covering the area of interest, from which only one is reviewed by the NGU, Berggrunskart Kirkenes 1:250 000 (Siedlecka, 1995). The other two geological maps provided from NGU, Vaggatem (Lieungh, 1988a) and Skogfoss (Lieungh, 1988b), both in scale 1:50 000, finished 1998 are detailed but not reviewed and finally approved by the NGU. They are compiled prior to the regional aerogeophysical survey. Geological descriptions of these map sheets are not published, but there exist an exploration report describing the area (Lieungh, 1988c).

The stratigraphy and the geological models presented in the two different map sets are mismatching. However, there are some good studies dealing with the geotectonic settings of the lower Proterozoic Greenstone Belt, but most of them are done on the other side of the Russian border i.e. Pechenga Greenstone Belt. Although correlation has been made between Pechenga and Pasvik by Russian and Norwegian geologists during the end of eighties and the beginning of nineties (Melezhik et.al. 1995), (Melezhik et.al. 1994a) and (Melezhik & Sturt 1994). The understanding of the timing of deformation and metamorphism is rather limited, at least concerning the rocks belonging to the lower and central part of the Langvannet Group.

One of the difficulties when establishing stratigraphy and a geodynamic evolution model of the Pasvik Greenstone Belt is the poor exposure of the bedrock. That concerns especially the areas with complex tectonic style, such as the lithologies in the central part of the Langvannet Group, where Gjedde Lake gold mineralisation is situated. In these areas it is rather tectonostratigraphy than lithostratigraphy to be studied because of strongly folded, sheared, thrusted and imbricated rocks.

3. Geological setting

The areas of interest are situated within the *Pasvik Greenstone Belt*, which is a part of the 1000 km long, discontinuously developed, early Proterozoic *Polmak-Opukasjärvi-Pechenga-Imanda/Varzuga-Ust'Ponoy Greenstone Belts*, where the main part is located in Russia (Melezhik et.al. 1995), (Melezhik et.al. 1994a) and (Melezhik & Sturt 1994). These very extensive greenstone belts are interpreted as intracontinental rifts, forming sedimentary basins with mafic volcanic activity, which has created thousands of metres of volcanic piles and sedimentary units.

The *Pasvik Greenstone Belt* is uncomfortably overlaying Archaean basement to the north. The southern boundary forms a south dipping, low angle thrust where the Archaean basement is overthrusted upon the lower Proterozoic rocks. The general stratigraphy of the Pasvik Greenstone Belt comprises two lithological groups tectonically separated by the major Poritash Fault. The *lower, Pasvik Group* and the upper *Langvannet group* (app 2).

The stratigraphy of the Pasvik Group is dominated by cyclic sedimentary and volcanic sequences, containing basaltic – andesitic volcanites and volcaniclastic sediments interbedded with thin horizons of graphite bearing schists, red sandstones, dolomitic marbles and rhyolitic – dasitic volcanites. Ultramafic intrusions occur mainly in the central part of the stratigraphy.

The Langvannet Group contains mainly andesitic volcanites and volcaniclastic sediments forming mafic schists interbedded with graphite Fe-sulphide bearing schists, quartzites, and carbonate rock. Small gabbroic sills occur.

Comprehensive descriptions, especially regarding the mineralogy, tectonic style and the alterations of the Gjedde Lake Au-mineralisation, have been made by Ihlen et.al. (1996) and Ihlen (1998 draft). The results in these works are mainly from the core drilling at the Au-mineralisation. Braathen (1997) has done a regional study of the geological structures and regional geotectonic style.

Beside syn-depositional deformations and faulting, three regional deformation stages, D_1 - D_3, can be recognised in the Pasvik Greenstone Belt. The first two, D_1 - D_2, were caused by north-south compression of the crust and the third D_3 was due to east-west compression forming the present shape of the Pasvik Greenstone Belt. The second deformation stage was the most extensive, developing isoclinal folding and extensive low angle thrusts (Braathen, 1997).

According to Braathen, a characteristic structural feature for the Pasvik Greenstone Belt is the increasing strain toward south, from the low strain zone in the Pasvik group via a Fold Belt in the lower Langvannet Group, to the South Pasvik Thrust Zone (Ihlen, 1998 draft). SPTZ is, at a rough estimate, about 900 metres wide, low angle shear zone dipping 25^0 - 40^0 to the south, caused during the second deformation stage D_2 in the region. However, Strongly sheared and imbricated rocks affected by the SPTZ occur in the area of the Gjedde Lake. No signs of extensively sheared rocks have been observed laterally to the east. Instead, the rocks are isoclinally folded in this area. The reason for the different deformation style along strike of the deformation zone, could be the different positions within the stress field and/or differences in competence during the second deformation stage (app 2).

Finntjörna is situated in the upper part of the Pasvik group. Gjedde Lake is in the lower part of the South Pasvik Thrust Zone. Kobbfoss is located in the fold belt in the lower part of the Langvannet Group, while Elgbekken and Skogum are in the central part of the Langvannet Group (app 2).

The stratigraphy and the tectonic style of the Langvannet Group are not well understood, mainly because the area has not been studied in detail within the frame of the extensive Ni-Cu exploration the past years, but also because there is small access to the bedrock, due to thick overburden. The outcropping is less than 1%.

4. Gjedde Lake

4.1 Quaternary Geology

The Gjedde Lake gold mineralisation, situated in lower part of the South Pasvik Thrust Zone, has been prospected since the first gold finding 1993. The area is hilly, containing small lakes and bogs. The till cover is not very thick, but evenly distributed with big boulders which are often more than 3m^3 and up to 100m^3 and can be mistaken as outcrops. This situation makes a geological mapping very difficult.

The Gjedde Lake area has a thin sandy silty till-cover, with 1 to 3 metres depth and a till surface rich in block. The low topography is following the underlying bedrock, which is weathered down to 2 – 4 metres. The thin till-cover together with the weathered bedrock indicates a weak ice rework, giving rise to a hummocky, slightly drumlinised landscape. The surface and lodgement-till sampling is showing a short transportation distance of material (50 – 200 metres) and an ice movement direction of 210^o. This is also according with the quaternary map of the area (Carlson et al. 1983).

4.2 Bedrock Geology

Strongly sheared and altered rocks host the gold mineralisation at Gjedde Lake (app 3). The first gold finding on the shore of the Gjedde Lake is hosted by a grunerite-sulphide-bearing quartzite, which was thought to be an outcrop (Melezhik 1995). Later core drillings showed that it was boulders moved by the ice (Ihlen et.al. 1996).

The mineralisation occurs mainly in a grunerite-sulphide-bearing quartzite, but also in the adjacent rocks, which are sheared and altered beyond recognition. These rocks, here called tectonites, are forming quartz veined, partly silicified and strongly foliated amphibole-quartz-carbonate-biotite-schists, dipping approximately 40^o south. Chlorite and quartz shear bands appear frequently within this unit. They are intercalated with mafic, fine grained, chlorite schists, biotite schists, and amphibolites, which occasionally are garnet bearing. Late generations of milky quartz veins are both crosscutting and conform to the banded rocks and close to the gold mineralisation some of which are arsenopyrite bearing.

A significant pervasive silicification occurs discordant to the banding in the tectonites caused by silica rich solutions flooding during the extensive shearing. Small graphite and pyrrhotite filled fractures are common mainly in the tectonites. Magnetite occurs in some of the fine grained, strongly sheared mafic schists and in thin layers of dark grey quartzites.

Underlain the tectonites to the north occur graphite bearing, dark grey strongly folded siltstones. A construction from the drill cores gives them an outcropping position approximately at the southern shore of Gjedde Lake (Ihlen, 1998 draft).

The southern margin of the thrust belt is uncertain because of the poor bedrock exposure. Although, local boulder with sheared rocks belonging to the thrust zone can be observed approximately 900 metres south of the lake. Further to the south the lithology changes to a white mica bearing andesitic sandstone.

The formation of the gold mineralisation has been debated by different authors, whether it is the result of selectively sulphidized Fe-oxide replacement in Banded Iron Formation or sulphidized, shear-hosted mafic silicate alteration zones (Melezhik, 1995; Ettner, 1995; Covello, 1997). However, Melezhik (1995) and Ihlen et.al. (1996) showed that Au and S are showing correlation, but there are also high S values without gold content. Chalcopyrite and pyrrhotite seems to have close time relation with the gold. Microscopic studies are indicating that fractures with native gold contain chalcopyrite and pyrrhotite (Ihlen et.al., 1996).

A log/log plot of all assays demonstrates a certain correlation between As and Au, but the high gold values are not associated with As, although high As values are mostly associated with anomalous Au. Thin section studies are showing that the native gold was formed later than the arsenopyrite, after a tectonic event, filling fractures or situated on the boundaries of arsenopyrite crystals. All drill cores are not assayed for Au, not even lithologies that are containing arsenopyrite.

Au-bearing structures, west of the known Au-mineralisation are defined by the exploration drilling program during the summer 2000, drilled in a 25 metres grid.

Dense surface till sampling has defined a gold anomalous area sizing 1000 by 500 metres. Exploration drilling in 25 metres grid has showed high gold grades in the lodgement till samples indicating three parallel mineralised zones. High Au-contents (more than 1500 ppb and up to 2500 ppb) in bedrock samples are defined along three distinct parallels about 350 metres long. These Au-mineralisations are also confirmed by high Au-contents in the lodgement-till samples.

According to the ground magnetic survey, the new mineralisations appear on a magnetic discontinuity, which also can be traced on the aeromagnetic map. These structures are discordant to the known Au mineralisation, with an angle of 38°, according to a presumed strike constructed from the drill cores by Ihlen (1998 draft).

It is obvious that the first found Au mineralisation is structurally controlled and mainly of epigenetic origin. The gold appears in fractures in broken, mainly euhedral arsenopyrite crystals, orientated parallel to the schistosity. Native gold also occurs along the margins of pyrite and in veinlets in quartz.

The gold mineralisations were formed due to the extensive shearing within the south Pasvik Thrust Zone. Great amounts of fluids were flooding the system, especially in a late stage of the thrusting, which can be seen in the drill cores as pervasive silicification, leaching the sheared rocks. Formation of vertical to sub-vertical transform faults facilitated the escape of the gold bearing fluids were the main gold content was precipitated. The geometry of the latest gold mineralisation indicates presence of a transform fault. This is also indicated by the dense surface-till sampling where the Au-anomaly is continuing toward north north-east (app 6).

To verify this a combination of RC-drilling and core drilling with orientation of the cores is recommended. Since the mineralisation is not delimited along the strike of the structure, an exploration drilling program should be carried out to trace the continuation of these zones.

5. Kobbfoss

5.1 Quaternary Geology

The Kobbfoss prospect is situated 3-4 km east of the Elgryggen in a low land, dominated by a bog, Kobbfossmyran, and some small lakes in the west. The eastern area has a thin till cover with partly high bedrock exposure. The low topography and the rather close position to the Pasvikelva makes certain till wash out possible, but the till composition in the area is not differing from not reworked till in appearing in topographically higher areas. Samples from the surface-till-sampling program carried out during March 2000 on the frozen Kobbfoss bog are indicating 7 – 10 metres silty sediment beds. When the ice sheet retreated toward the south the area was dammed, giving rise to an ice-lake, where considerable amounts of silty sediments were deposited.

The Kobbfoss exploration target is showing strong Au and Cu-Zn anomalies in two areas (apps 7 – 11). A dense surface-till sampling in a grid of 100 metres was carried out in mars 2000. 127 till samples were collected with drilling equipment carried by a snowmobile.

The Au anomalies are situated in the Kobbfossmyran bog, in the western part of the prospect (app 7), while the Cu-Zn anomalous area is situated to the east (apps 8 – 11). During the summer 2000, an exploration drilling program was carried out in five profiles with 200 metres spacing, on the east side of the Kobbfossmyran bog to explain the Cu-Zn anomalies. The till-cover in that area is only 1 to 3 metres deep and the bedrock exposure is high, which omitted sampling of the lodgement-till from 22 of total 72 drill holes.

The results from the follow up work of the Cu-Zn anomaly is showing that it is possible to trace mineralisations in the bedrock using till geochemical technique. The maximal till transportation distance is defined 250 metres and a direction of 250°.

The wet conditions in the bog during the summer limited the exploration drilling to the dry areas to the east. For this reason only a small part of the anomalies were drilled. As the gold anomaly is not fully delineated dense surface sampling should be extended toward south west during the winter. In order to investigate the whole anomaly area an exploration drilling campaign during the winter should be performed.

The result from the exploration drilling and bedrock mapping during the summer 2000 are showing that the surface-till sampling should be extended to the north and to the west of the present sampled area.

5.2 Bedrock Geology

The Kobbfoss Au-Cu-Zn prospect is situated in the lower part of the Langvannet Group within an isoclinally folded belt. The area is dominated by mafic volcaniclastic siltstones (mafic schists) interbedded with thin but laterally extensive horizons of graphite-bearing schists and minor quartzitic sandstones (meta-cherts). In the upper part of this unit occur porphyritic mafic volcanites and minor amygdaloidal basaltic lavas, tectonically overlain by the strongly sheared and imbricated rocks of the South Pasvik Thrust Zone (app 12).

The thickness of this unit in the Langvannet Group is normally less than 1 500 metres, but in the area of Kobbfoss it is more than 2 600 metres caused by repetition due to isoclinal folding during D_2 deformation. Tectonically the prospect is situated in the right limb of a D_3 syncline with south plunging fold axes, within the D_2 fold belt. The second deformation phase D_2 has caused isoclinal folding, with axial planes dipping 40^0 to south east. Crenulation cleavage is often shown in the mafic schists, indicating a later D3 deformation phase (app 2).

The dominating mafic schists are representing thick monotonous units of fine grained, green, more or less foliated rocks sometimes with vague banding. The protolithe is probably volcanic tuff.

The quartzites are fine grained, light grey and sometimes banded brownish coloured, the later due to a mostly low content of clino-amphibole (grunerite). Occasionally there is a faint dark grey banding, containing fine disseminated magnetite. They are interpreted as sandy sediments (ortho-quartzites). Where the magnetite bands are representing horizons of heavy minerals. No cross-bedding or ripples has been observed.

The graphite-bearing schists are only observed in bedrock samples from the exploration drilling. They are fine grained, grey to dark grey foliated rocks with different proportion of graphite and sulphides, mainly pyrrhotite. They occur as thin tens of metres, but laterally extensive beds within the monotonous unit of the mafic schists and are easily recognised on the aeromagnetic map.

A very high magnetic gradient on the aeromagnetic map (total field and residual) has a north-eastern direction and is crosscutting the stratigraphical units in a low angle (app 3). This gradient is in the position of the Au anomalies in the Kobbfossmyran bog, which is not yet drilled. It is not clearified whether the magnetic gradient represents a blind, east south-east dipping, magnetic body or if it is due to a combination of a deep-seated body and a magnetic lineament representing a shear zone. The structure can be traced to the north up into the rocks of the Pasvik Group. Furthermore the direction of this structure is the same as the direction of the gold bearing structure at the Gjedde Lake deposit (app 13).

Exploration drilling was performed in four profiles with 200 metres spacing to explain the Cu-Zn anomalies from the surface-till sampling. The results are indicating high Cu-Zn content in the lodgement-till in the two northernmost profiles with increasing values toward north (apps 8 and 10). The Cu-Zn content in the rock samples is also increased in those profiles, but lower than in the lodgement-till samples (apps 9 and 11). This means thatthe position of an outcropping Cu-Zn mineralisation is probably situated between the northernmost profiles. Denser drilling should give a more comprehensive answer in that issue.

6. Finntjörna

6.1 Quaternary Geology

The Finntjörna is situated above the timberline, on a high level plateau with a gentle slope to south, close to the Finnish border.

Regional and dense till sampling during 1998-99, defined increased content of copper and a weak gold anomaly in the area. To trace the anomaly, 72 exploration-drill holes were drilled in 4 profiles with 100m spacing.

In this area the till is sandy-silty 1 to 4 metres deep. The underlying bedrock is not strongly weathered as in the Gjedde Lake area, which may depend on the topographical position in the southern slope with a high exposure to the ice movement from the south west.

The relationship between the surface-till anomaly and the anomaly in the lodgement-till indicates transport not longer than 150 – 200 metres and the direction is 210°.

A strong, wide spread Cu anomaly in the lodgement-till is defined by the exploration drilling (apps 14 and 15).

6.2 Bedrock Geology

The Finntjörna prospect is situated in a mainly mafic tuffitic unit of the Pasvik Group in the western part of the Pasvik Greenstone Belt. Litho-stratigraphically it lies in the same position as the Cu-Ni mineralisations explored by Falconbridge ltd. between 1988 and 1992. A/S Sulfidmalm have performed Ni-Cu exploration in the Finntjörna area during the 70-ies without success. The overburden is low which means that the outcropping is good in general.

The mafic tuffitic schists, overlain a dasitic, grey, fine to medium grained gneiss, are interbedded with dolomitic marbles and felsic volcanic rocks (app 16). Several ultramafic sills occur. Upper greenschist facies and at least four deformation stages have affected the rocks, which are situated in the left limb of a south dipping D3 antiform within a D2 monocline structure. The main cleavage in the Pasvik Group monocline is dipping $10^0 - 15^0$ to south west. Secondary brittle to ductile shear zones are developed, which is demonstrated by displacement of the dolomitic marble horizon.

A Cu-mineralisation, with Cu-content $\geq 0.1\%$, has been defined by the exploration drilling (app 17). The appearance is not clear, but it can be related to a late brittle to ductile shearing. No alteration of the bedrock, caused by ore forming fluids, has been observed in spite of the fact that the bedrock is partly well exposed in the anomalous area, which means that there is little/or no possibility for a big stratiform ore body.

No further exploration is motivated in the area at this moment.

7. Skogum and Elgbekken

7.1 Quaternary geology and till sampling

The regional and dense surface-till sampling in Skogum and Elgbekken during performed 1998-1999 resulted in the localisation of gold anomalies east of the Sukkeråsen. In order to trace the anomalies, 100 exploration drill holes in 6 profiles were drilled at Elgbekken prospect and 74 exploration drill holes distributed in 4 profiles at Skogum.

The till in this area is sandy to sandy-silty with a depth of 2 – 5m. Most of the fine fraction of the till was washed out by glacial water flows. The till is probably not reworked, but some slope washes may occur. The correlation between the geochemistry of the till composition and the composition of the bedrock indicates short till transportation with a uniform ice-flow direction of 30^0. The fact that the area is close to a calving bay in the front of the esker-system that is lining the valley, could have given rise to an ice-flow direction rotated more to the east. Flutings in the area between Elgbekken and Gjedde are interpreted as indications of a late ice-flow during a second stadial with a direction of 75°. The influence of this direction of till transport should be investigated before more exploration drillings are performed.

The result from the exploration drilling in Skogum confirm Cu-(Au) anomaly in the lodgement-till, showed by the surface till (app 18). A weak Cu mineralisation without gold is defined in the bedrock (app 19).

No further exploration is motivated at the Skogum prospect. The claim is withdrawn.

The results from the exploration drilling in Elgbekken confirm the Cu anomaly in the lodgement-till indicated by the surface-till sampling (app 20). A weak Cu mineralisation is also defined in the bedrock (app 21). Further Cu-exploration in the area is not motivated.

The gold anomaly in Elgbekken is not confirmed by the exploration drilling (app 23). One possible explanation is a long ice-transport, indicated by the copper anomalies in the area. In order to evaluate the anomaly it is necessary to continue the exploration in two stages: first is to investigate the till transport in the area and a dense surface-till sampling to the west. Second stage is to carry out an exploration drilling program.

7.2 Bedrock geology

Skogum and Elgbekken prospects are situated within the right limb of a D_3 syn-form, in the upper part of the Langvannet Group (app 3). The prospects are occurring within the same litho-stratigraphical level in the upper part of a monotonous, andesitic volcaniclastic unit containing mainly sandstones and minor interbedded siltstones. Gabbroic medium grained amphibolites, interpreted as mafic sills, occur.

The sandstones are fine grained, grey, massive to faint, banded and occasionally mica foliated. Garnets are common, occurring in up to 10mm euhedral crystals.

The prospects are structurally situated on the left limb of a D_3 synform structure. The main schistosity is dipping $40^0 - 60^0$ to southeast.

8. Conclusions and recommendations

The follow-up of the surface-till anomalies in the area with exploration drilling and sampling of the lodgement-till and bedrock surface, is showing that the assumed transport direction of the till is correct. The conclusion is that the till properties in the area are suitable for ore exploration using till-geochemistry.

Cu-mineralisations in the bedrock are indicated at Finntjörna, Skogum and Elgbekken prospects. Cu-Zn-mineralisation is indicated, but not delimited at the Kobbfoss prospect. A good Au-mineralisation associated to a shear zone discordant to the already known mineralisation at Gjedde Lake prospect is defined but not delimited.

According to the results from the exploration drilling and the bedrock mapping, continued exploration on the present targets should include in order of priority:

Gjedde Lake

- a combined RC and core drilling program to define the new mineralisation
- exploration drilling in the prolongation of the new Au mineralisation
- trenching in connection to the mineralisation confirmed by the exploration drilling
- ground geophysics

Kobbfoss

- dense surface till sampling with Cobra in the Kobbfossmyran bog during the winter to delineate the Au anomaly toward south west
- exploration drilling during the winter in the Kobbfossmyran bog to confirm the surface-till Au anomalies
- dense surface-till sampling toward north and west since the Cu-Zn-Au anomalies are not delimited in these directions
- trenching in connection to the mineralisation confirmed by exploration drilling
- ground geophysics
- core drilling

Within the long term planing of the exploration in the areas following targets is to be investigated:

Elgbekken

- investigation of the till transport in the anomalous area
- dense surface-till sampling toward west since the Au anomalies are not delimited in that direction

Finntjörna

- trenching in connection to the mineralisation confirmed by exploration drilling

References:

Braathen, A., 1997: Results from a structural Study in Pasvik, North Norway. NGU Report No. 97.018, 31 pp.

Ettner, D., 1995: Preliminary geological investigations of the Gjedde Lake prospect, Pasvik, Norway. GEOCARE report to Kenor, 12 pp.

Carlson, A. B., Sollid, J. L. & Watterdal, T., 1983: Pasvik kvartärgeologisk kart M 1:75 000. Geografisk Institutt, Universitet i Oslo.

Covello, L., 1997: Geological Evaluation of the Gjedde Lake Gold Occurrence Pasvik, North Norway. Covello, Bryan and Associates Ltd. report to Kenor, 10 pp.

Finne, T. E., 1996: Geochemistry of Topsoil in Vaggatem – Skogfoss. NGU Report No. 96. 142, 13 pp.

Finne, T. E., 1997: Evaluation of Detailed C-horizon Sampling as Prospecting Method at Gjedde Lake Gold Mineralisation., NGU Report No. 97.172, 8 pp.

Hodges, D. J. 1995: Nickel-Copper Exploration Along the Extension of the Pechenga Zone in Pasvik, Norway (extended abstract). in Geology of the Eastern Finnmark – Western Kola Peninsula Region. NGU Spec. Publ. No 7, 373-374 p.

Ihlen, P., Often, M. & Braathen, A., 1996: Core drilling at Gjedde Lake and Regional Structural Geological Investigations in Pasvik, North Norway. NGU Report No. 96.145, 29 pp.

Ihlen, P., 1998: Gjedde Lake Au-As Occurrence, Pasvik area, North Norway: Drill-Hole geology and Core Logs. NGU Report 98.003 (DRAFT), 24 pp.

Lauritsen, T. 1995: Geofysiske bakkemålinger ved Gjeddevann i Pasvik, Sör-Varanger Kommune, Finnmark 1995. NGU Report 95 119, 10 pp.

Lauritsen, T. 1996: Ground VLF and Magnetic Surveys at the Gjedde Lake in Pasvik, Sör-Varanger, Finnmark, 1996. NGU report 96.085, 7pp.

Lieungh, B., 1988a: Vaggatem. Berggrunnskart 2333, M 1:50 000. NGU.

Lieungh, B., 1988b: Skogfoss. Berggrunnskart 2433, M 1:50 000. NGU.

Lieungh, B., 1998c: Geologisk beskrivelse av kartbladene Svanik, Skogsfoss, Vaggatem, Krokfjell. Prospektering A/S Rapport nr. 2025, 107 pp.

Melezhik, V. A., Sturt, B. A., 1994: General Geology and Evolutionary History oft the Aerly Proterozoic Polmak-Pasvik-Pechenga-Imanda/Varzuga-Ust'Ponoy Greenstone Belt in the Northeastern Baltic Shield. Earth-Science Rev., 201-241p.

Melezhik, V. A., Hudson-Edwards, K. A., Skuf'in P. K. & Nilsson, L.-P., 1994a: Pechnega Area, Russia – Part 1: Geological Setting and Comparison with Pasvik, Norway. Inst. Minin Metall., Section B, Applied Earth Science 103, 129-145 p.

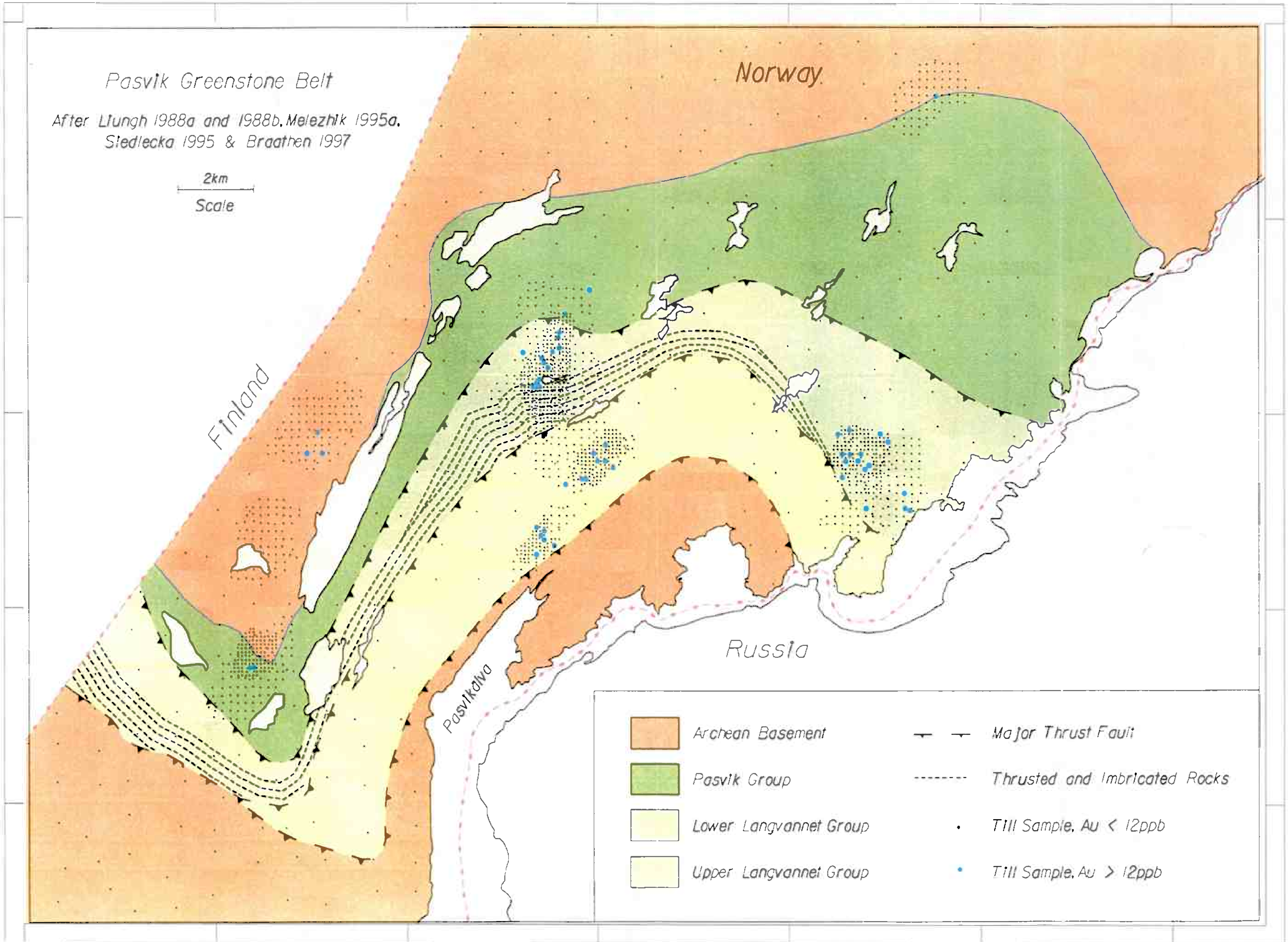
Melezhik, V. A. 1995: The Gjedde Lake gold occurrence in Pasvik. NGU Report No. 95.079, 25 pp.

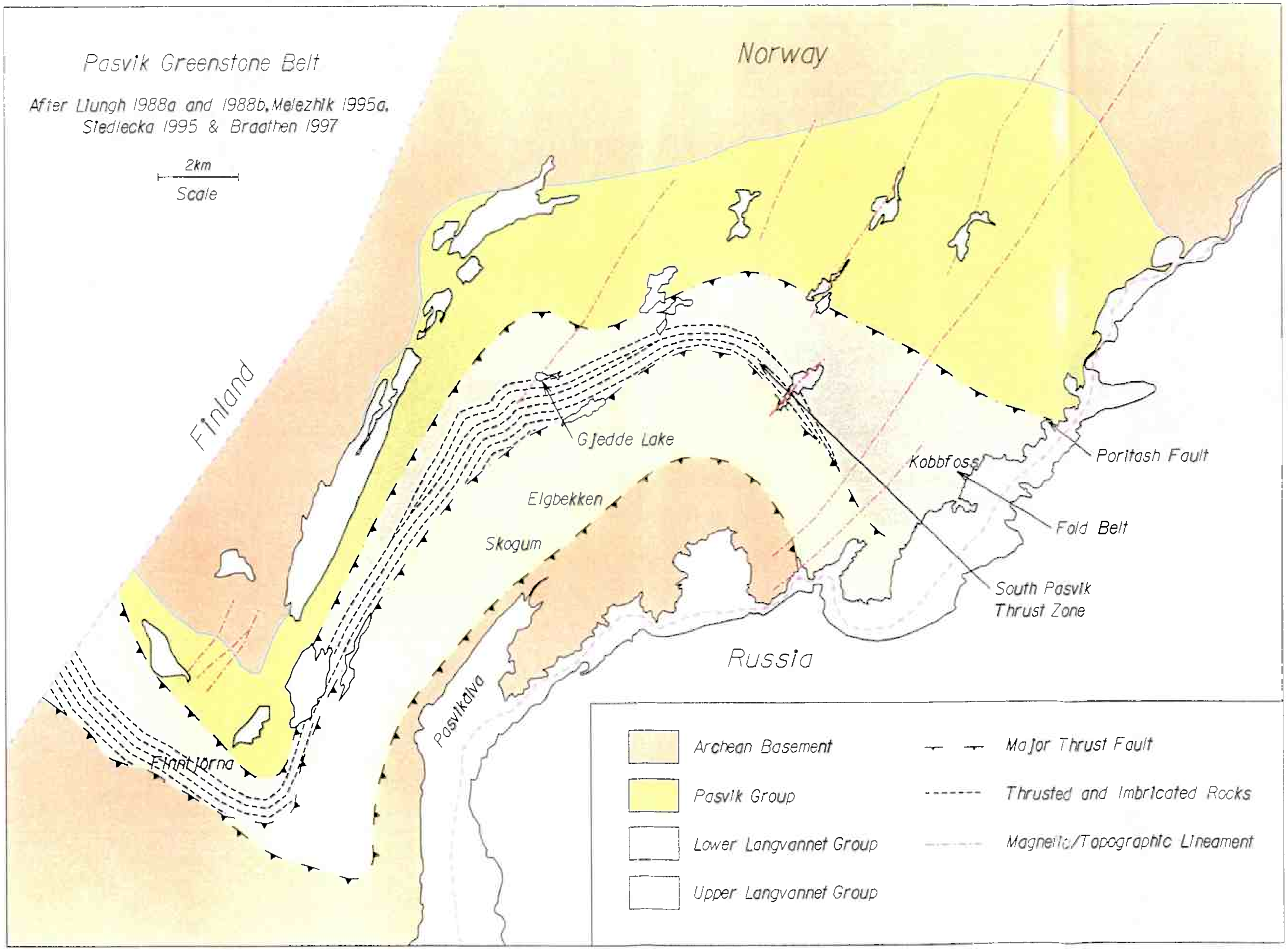
Melezhik, V. A. et. al. 1995a: The Early Proterozoic Pasvik-Pechenga Greenstone Belt 1:100 000 Geological Map, Stratigraphic Correlation and Revision of the Stratigraphic Nomenclature. in Geology of the Eastern Finnmark – Western Kola Peninsula Region. NGU Spec. Publ. No 7, 81-91 p.

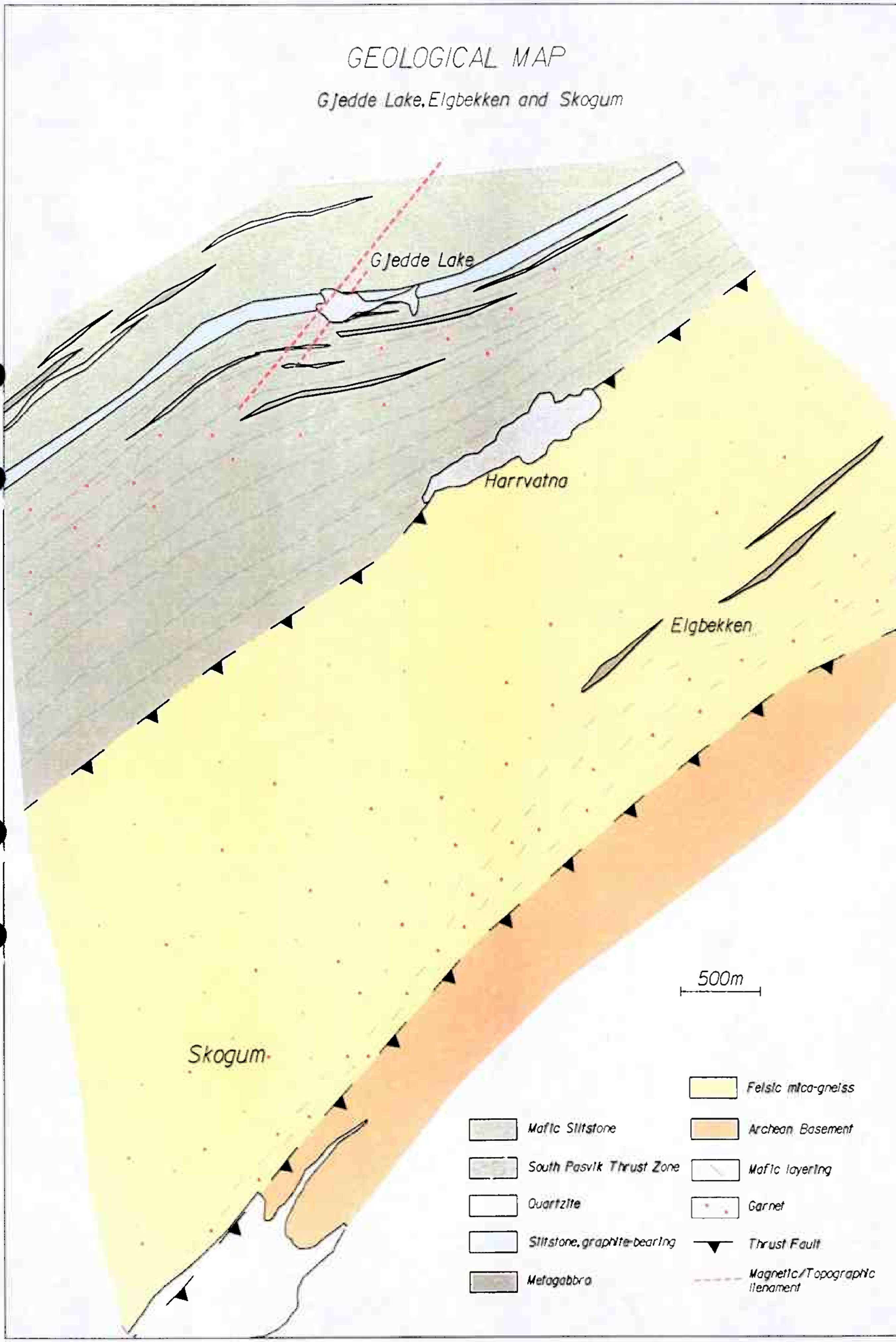
Melezhik, V. A., Often, M., 1996: The geology and ore deposits of the Pechenga Greenstone Belt. (Field trip Guidebook), NGU Report No. 96.123, 91 pp.

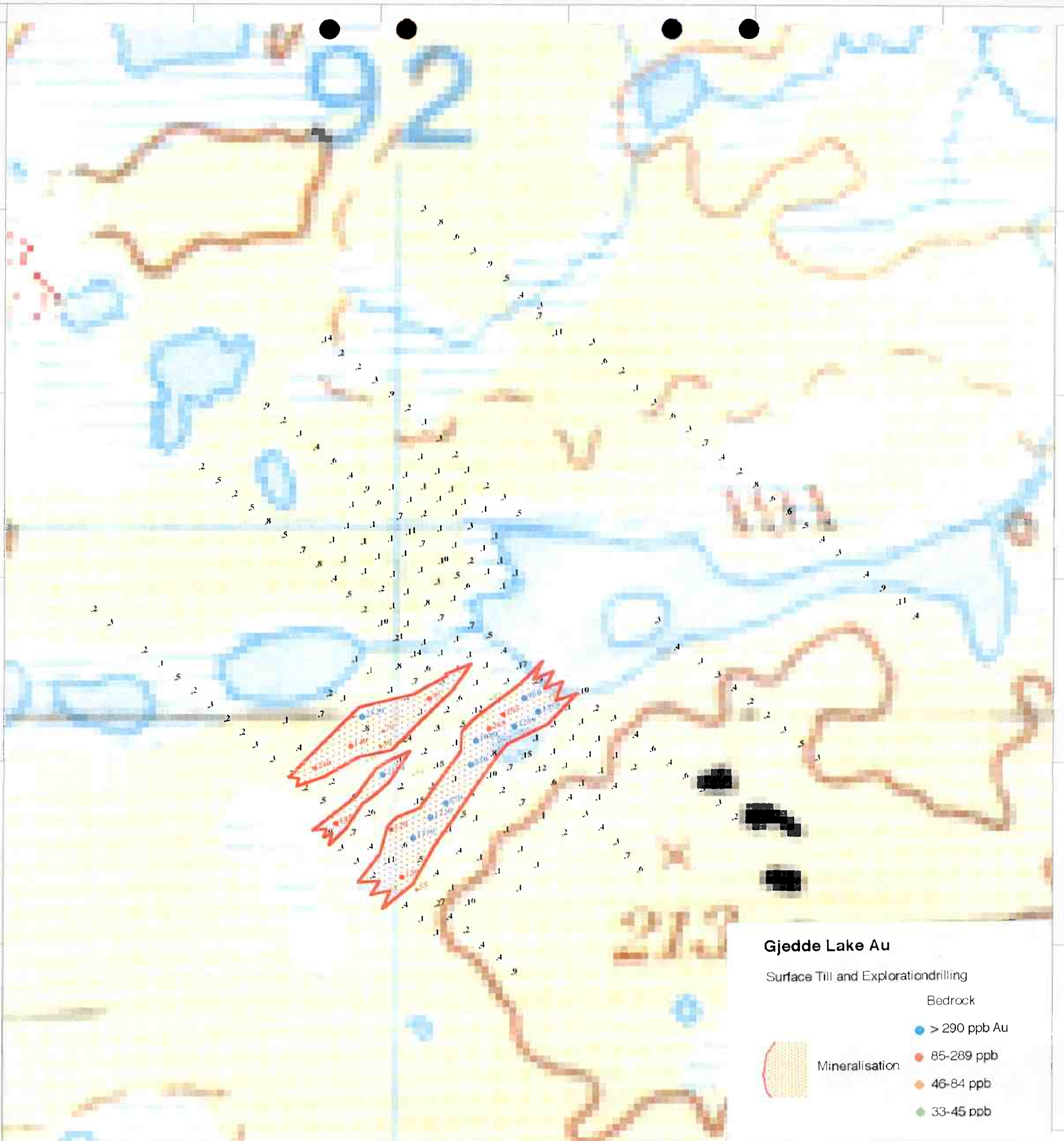
Siedlecka, A. et. al., 1985: Lithostratigraphy and Correlation of the Archean and Early Proterozoic Rocks of Finnmarksvidda and the Sörvaranger District. NGU bull. 403, 7-36 p.

Siedlecka, A. & Nordgulen, Ö., 1995: Geologisk kart över Norge, Kirkenes, M 1:250 000, NGU


Pasvik Greenstone Belt
After Ljungh 1988a and 1988b, Melezhik 1995a, Siedlecka 1995 & Braathen 1997
2km
Scale
Norway
Finland
Russia
Pasvikelva
Archean Basement
Pasvik Group
Lower Langvannet Group
Upper Langvannet Group
Major Thrust Fault
Thrusted and Imbricated Rocks
Till Sample, Au < 12ppb
Till Sample, Au > 12ppb


Pasvik Greenstone Belt
After Ljungh 1988a and 1988b, Melezhik 1995a, Siedlecka 1995 & Braathen 1997
2km
Scale
Norway
Finland
Russia
Gjedde Lake
Elgbekken
Skogum
Kobbfoss
Poritash Fault
Fold Belt
South Pasvik Thrust Zone
Finntjorna
Pasvikalva
Archean Basement
Pasvik Group
Lower Langvannet Group
Upper Langvannet Group
Major Thrust Fault
Thrusted and Imbricated Rocks
Magnetic/Topographic Lineament


GEOLOGICAL MAP
Gjedde Lake, Elgbekken and Skogum
Gjedde Lake
Harrvatna
Elgbekken
Skogum
500m
Felsic mica-gneiss
Mafic Siltstone
Archean Basement
South Pasvik Thrust Zone
Mafic layering
Quartzite
Garnet
Siltstone, graphite-bearing
Thrust Fault
Metagabbro
Magnetic/Topographic lienament



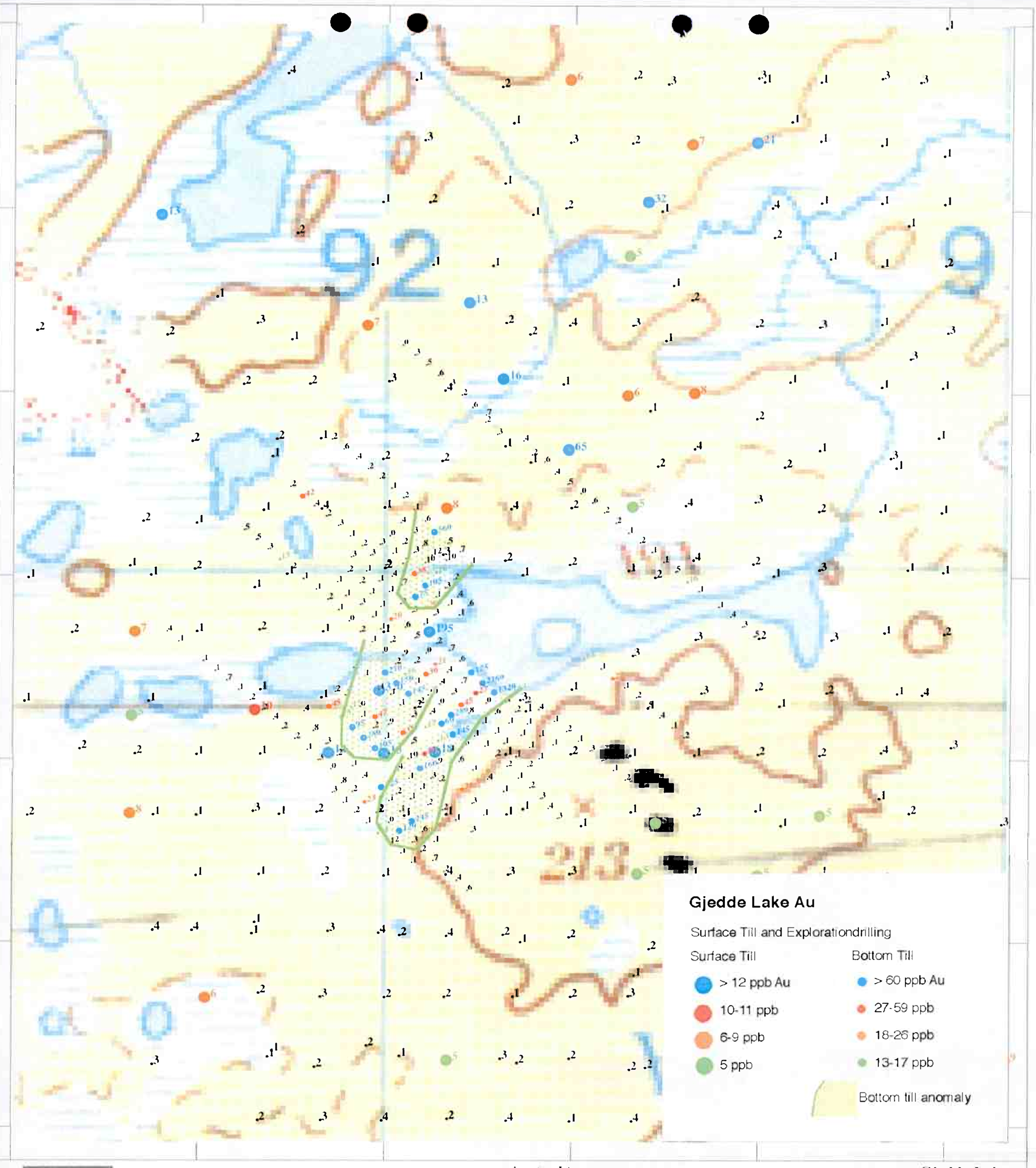
Au (ppb)

95%	290
90%	85
85%	46
80%	33

Gjedde Lake
00-12-11
284 st
Skala: 1:4300

ScanMining

Appendix 4

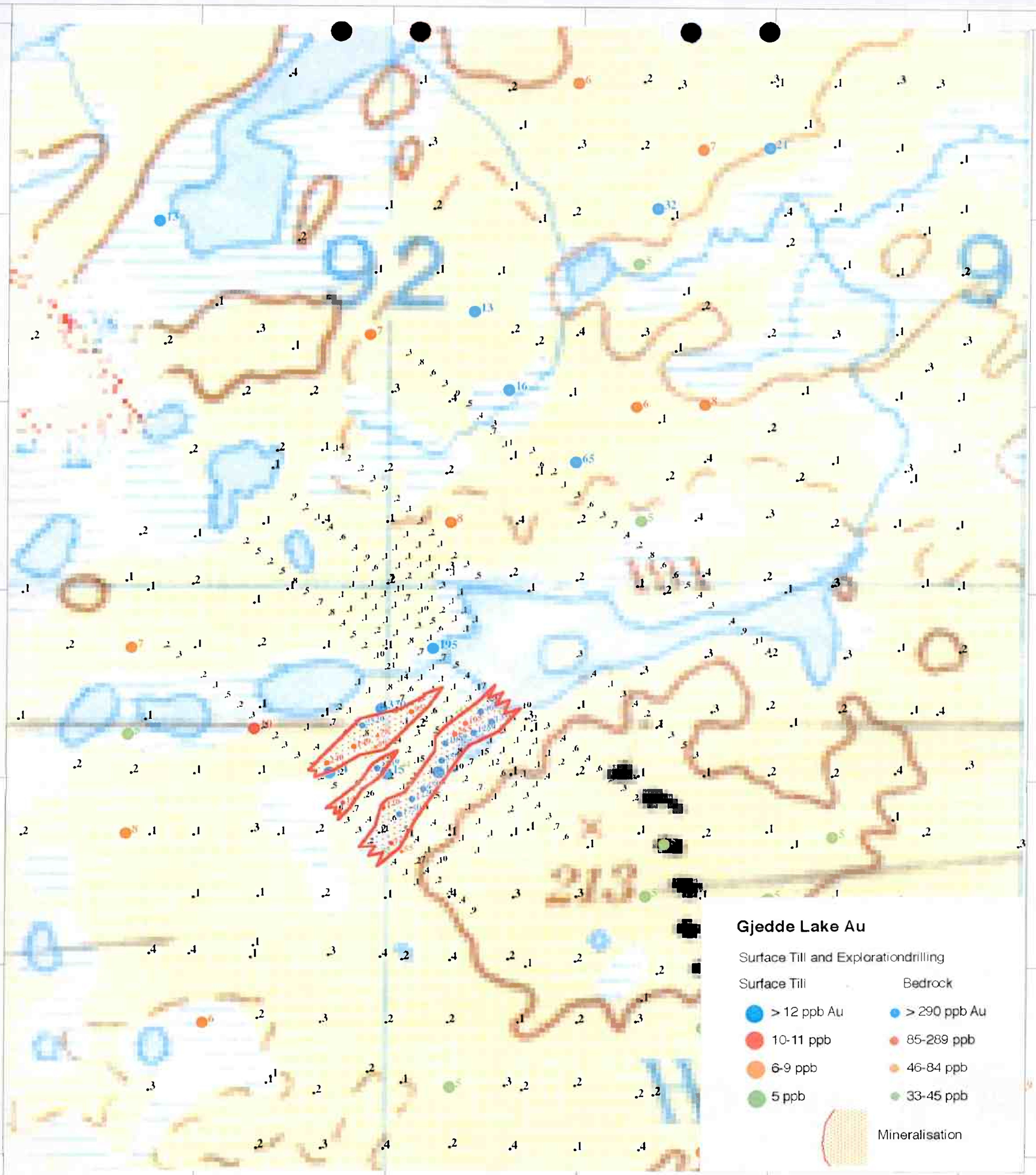


Au (ppb)	
95%	60
90%	27
85%	18
80%	13

Gjedde Lake
00-12-11
283 st
Skala: 1:6000

ScanMining

Appendix 5



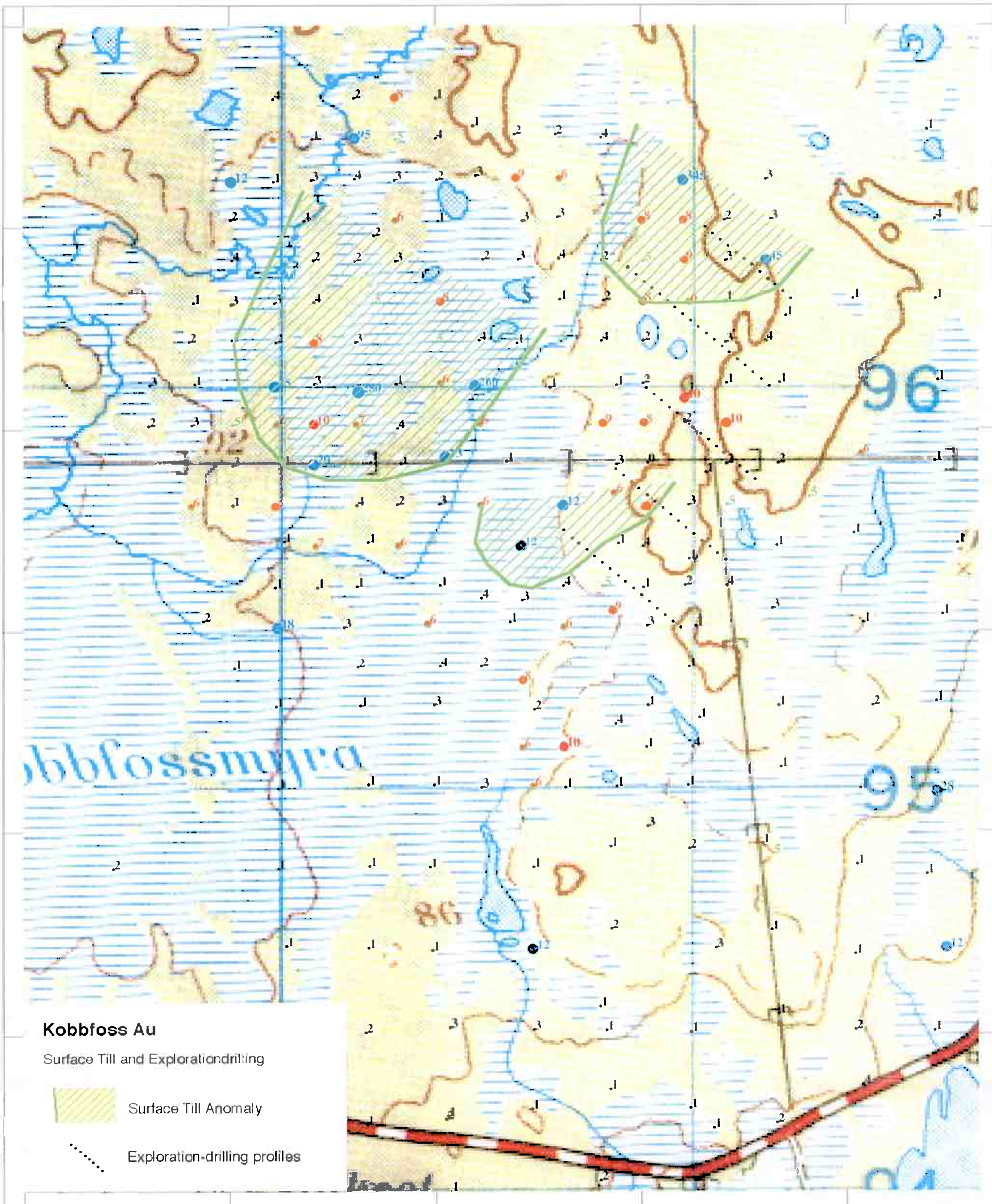
ScanMining

Au (ppb)

95%	12
90%	10
85%	6
80%	5
	0

Gjedde Lake
00-12-11
265 st
Skala: 1:6000

Appendix 6

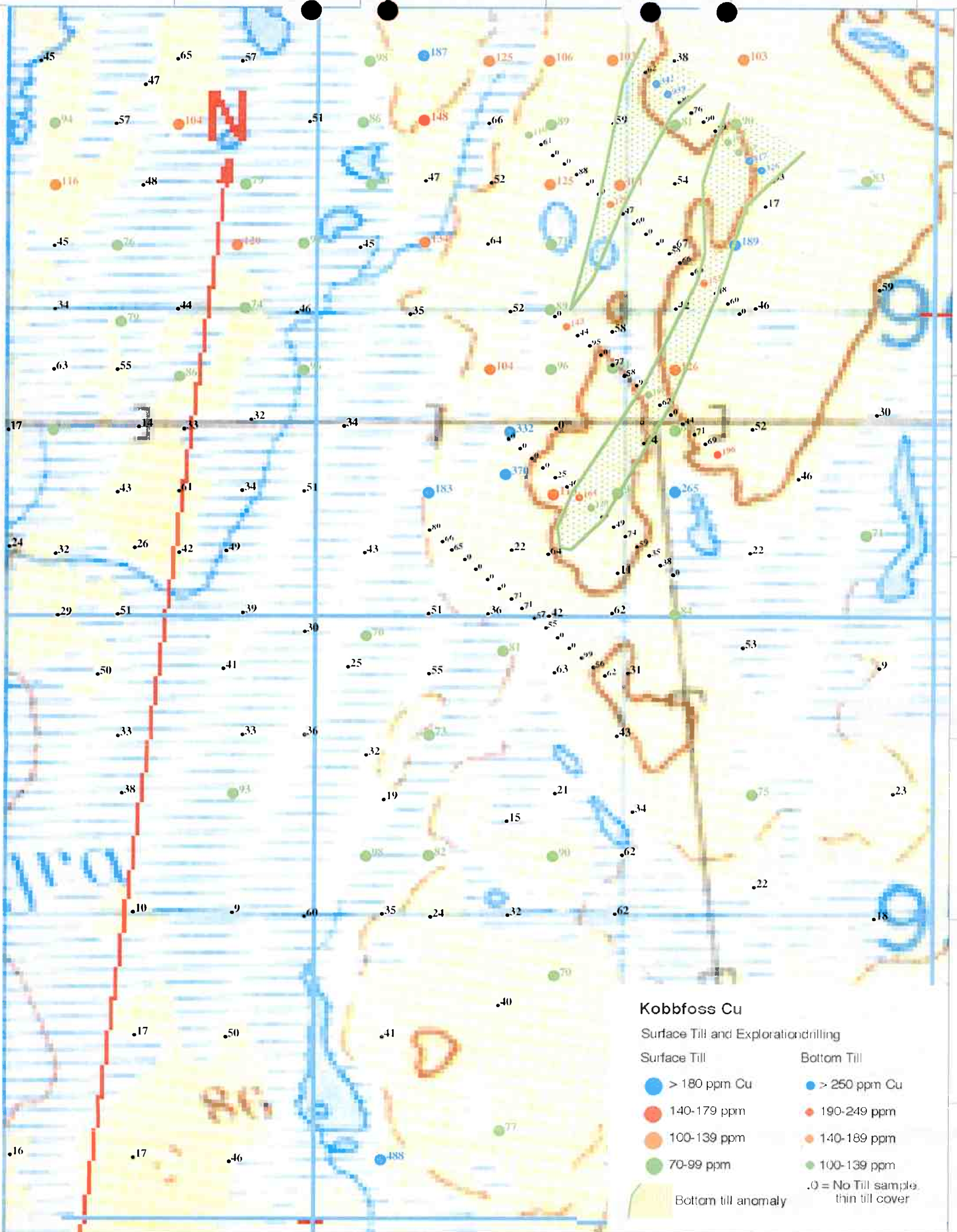


ScanMining

Au (ppb)

ppb Au >	12
ppb Au	10
ppb Au	8
ppb Au	6
0-4 ppb Au	0

Kobbfoss. surface till
00-12-13
250 st
Skala: 1:10000

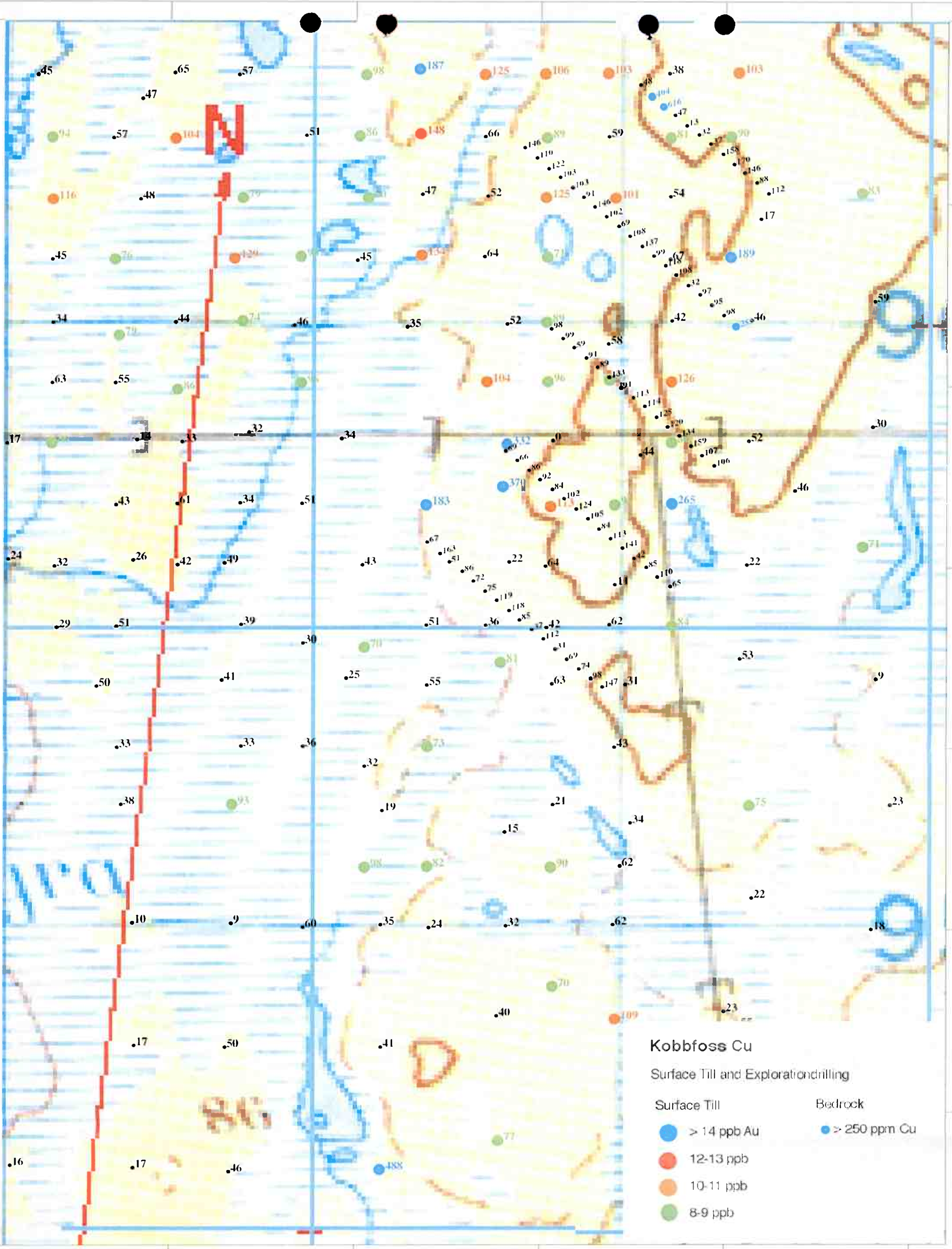


Cu (ppm)

95%	180
90%	140
85%	100
80%	70
	0

Kobbfoss
00-12-09
159 st
Skala: 1:6000

ScanMining

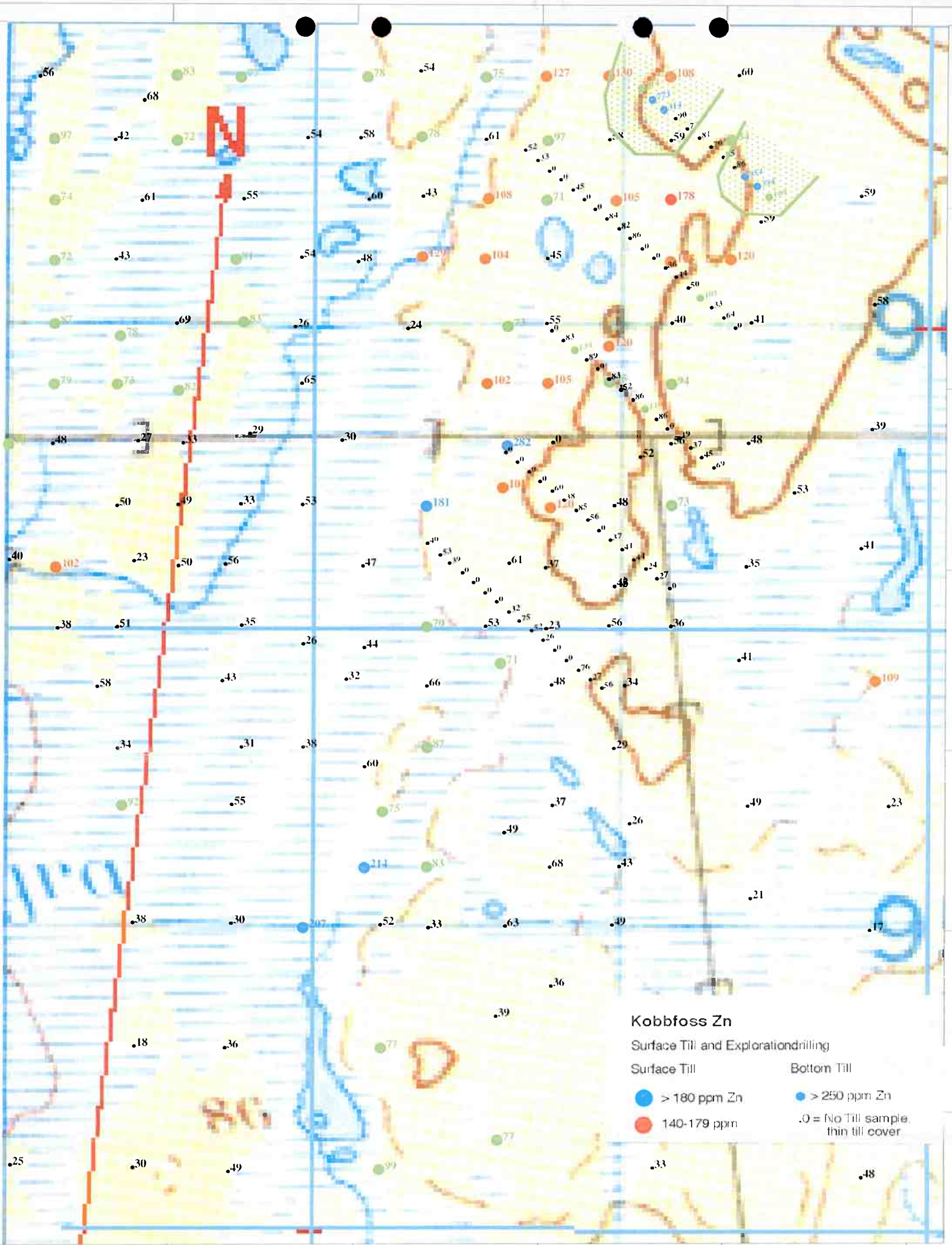


Cu (ppm)

95%	180
90%	140
85%	100
80%	70
	0

ScanMining

Kobbfoss
00-12-09
159 st
Skala: 1:6000

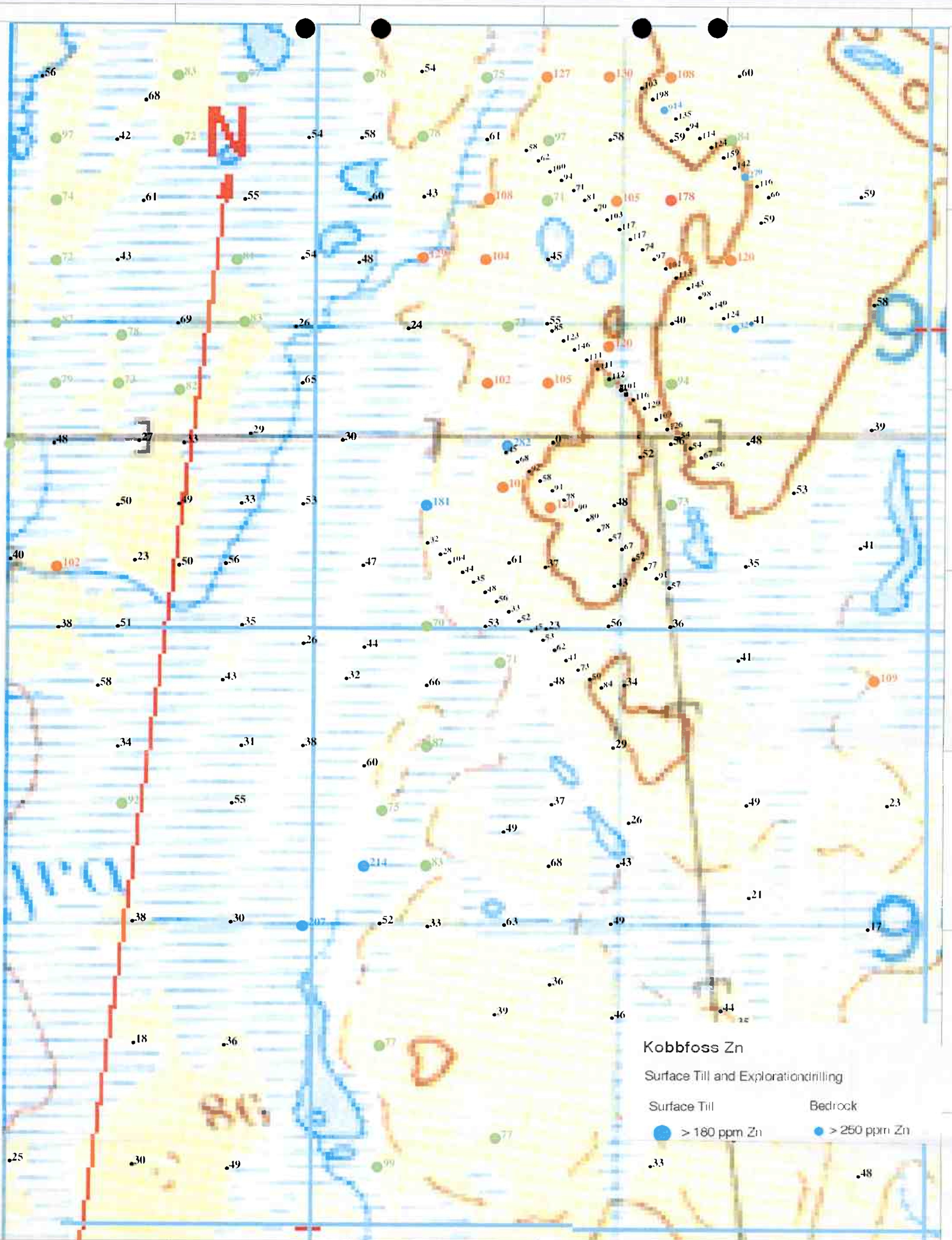


Zn (ppm)

95%	180
90%	140
85%	100
80%	70
	0

Kobbfoss
00-12-09
159 st
Skala: 1:6000

ScanMining

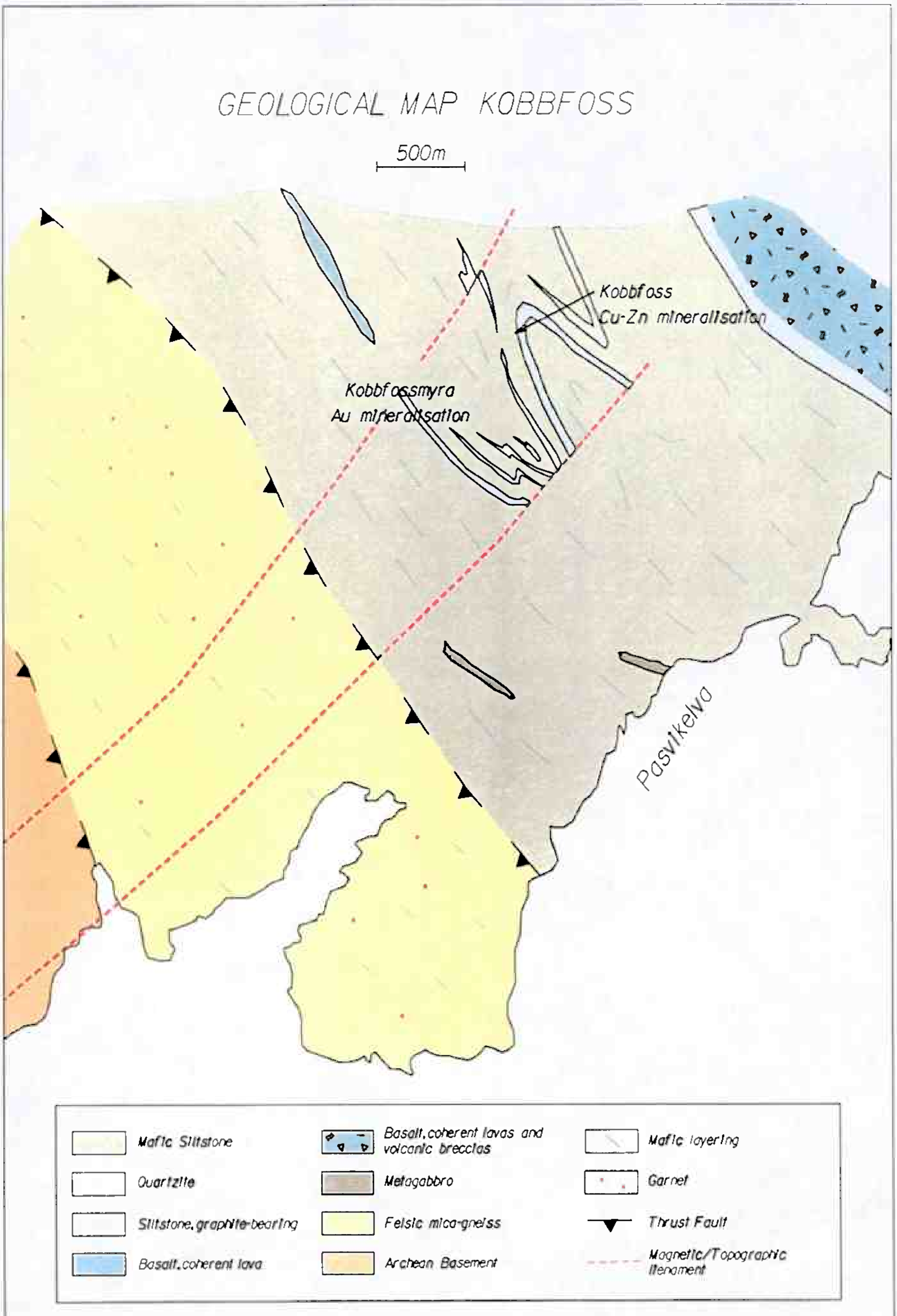


ScanMining

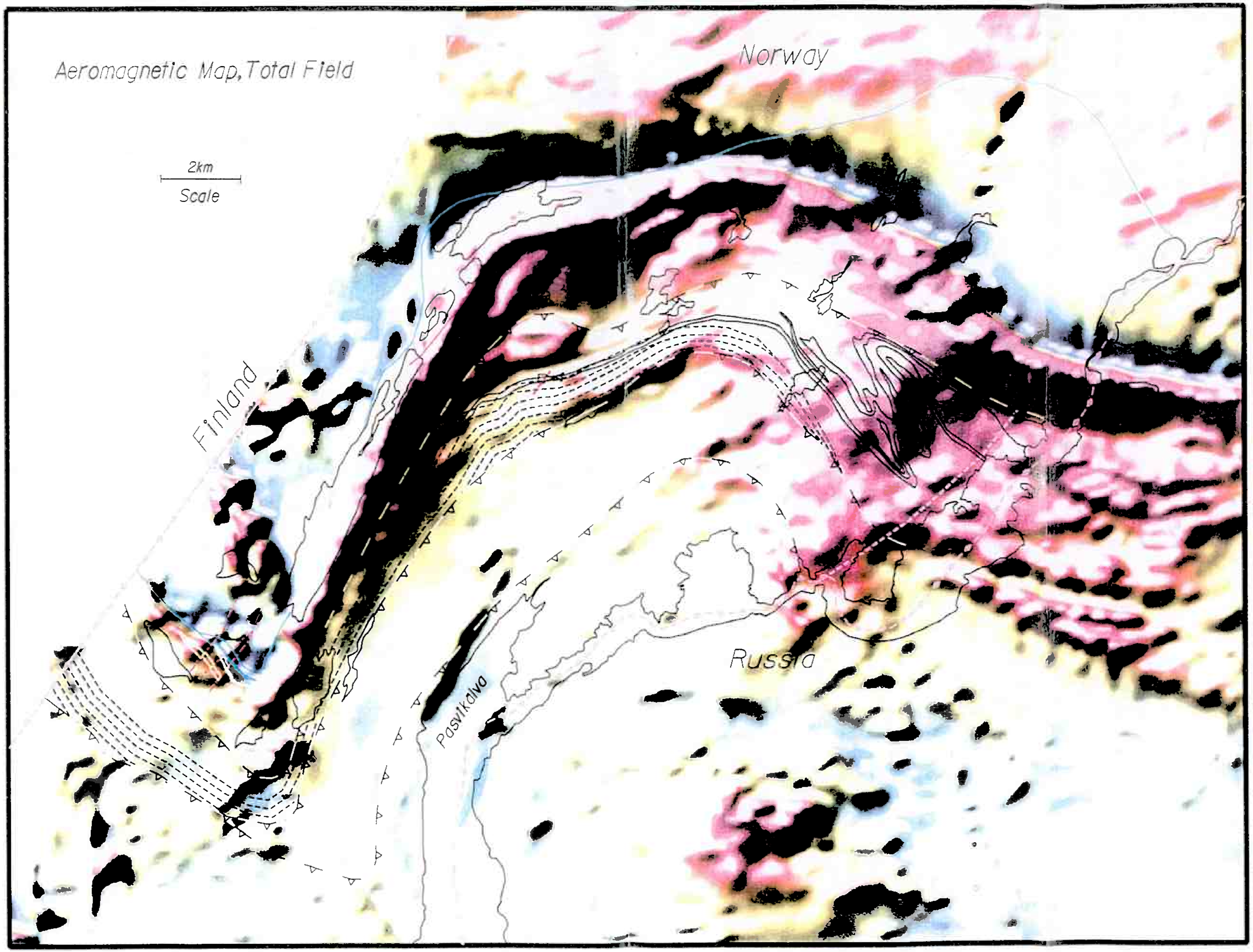
Zn (ppm)

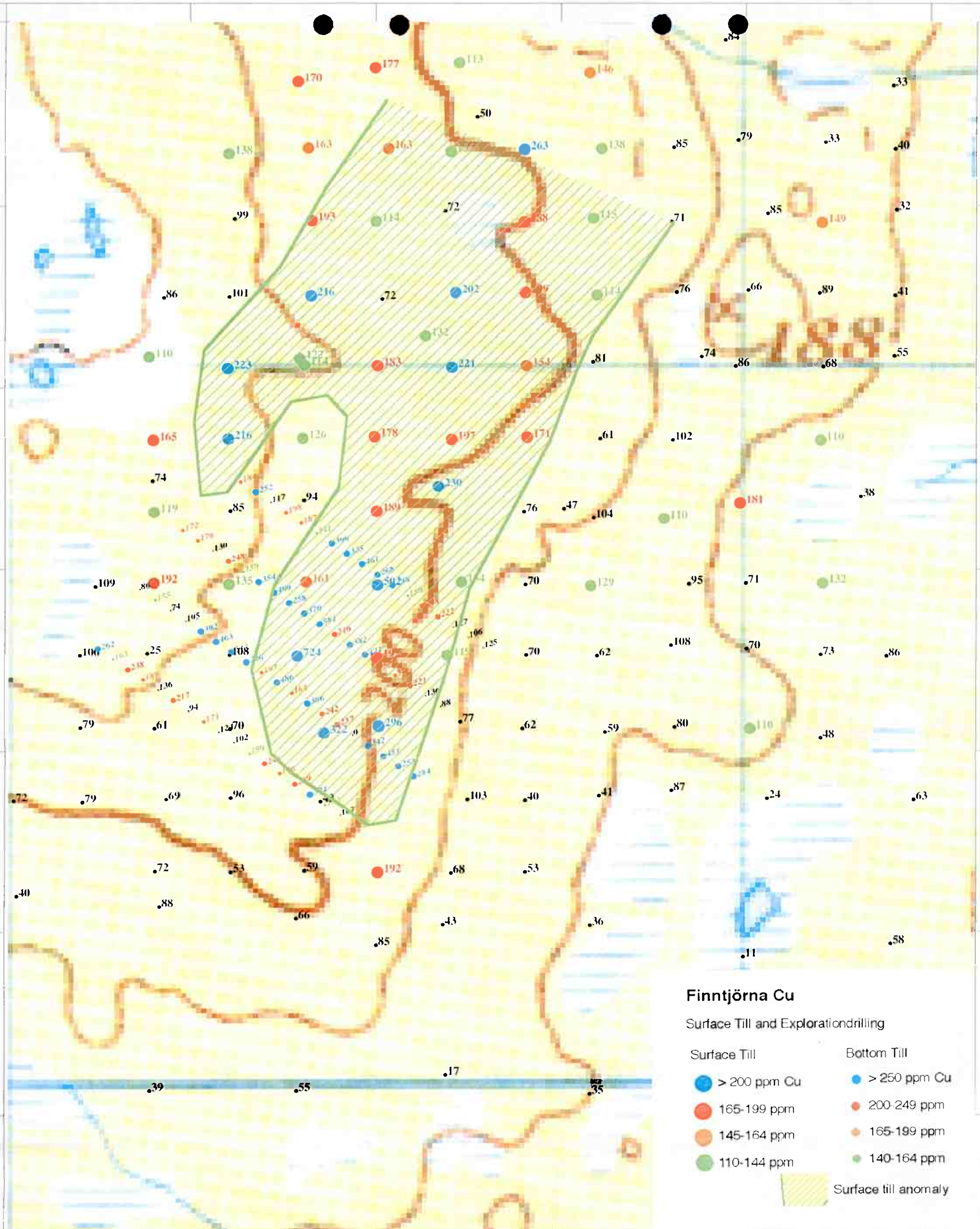
95%	180
90%	140
85%	100
80%	70
	0

Kobbfoss
00-12-09
159 st
Skala: 1:6000



GEOLOGICAL MAP KOBBFOSS
500m
Kobbfoss
Cu-Zn mineralisation
Kobbfossmyra
Au mineralisation
Pasvikelva
Mafic Siltstone
Quartzite
Siltstone, graphite-bearing
Basalt, coherent lava
Basalt, coherent lavas and volcanic breccias
Metagabbro
Felsic mica-gneiss
Archean Basement
Mafic layering
Garnet
Thrust Fault
Magnetic/Topographic lienament


Aeromagnetic Map, Total Field
2km
Scale
Norway
Finland
Russia
Pasvikalva

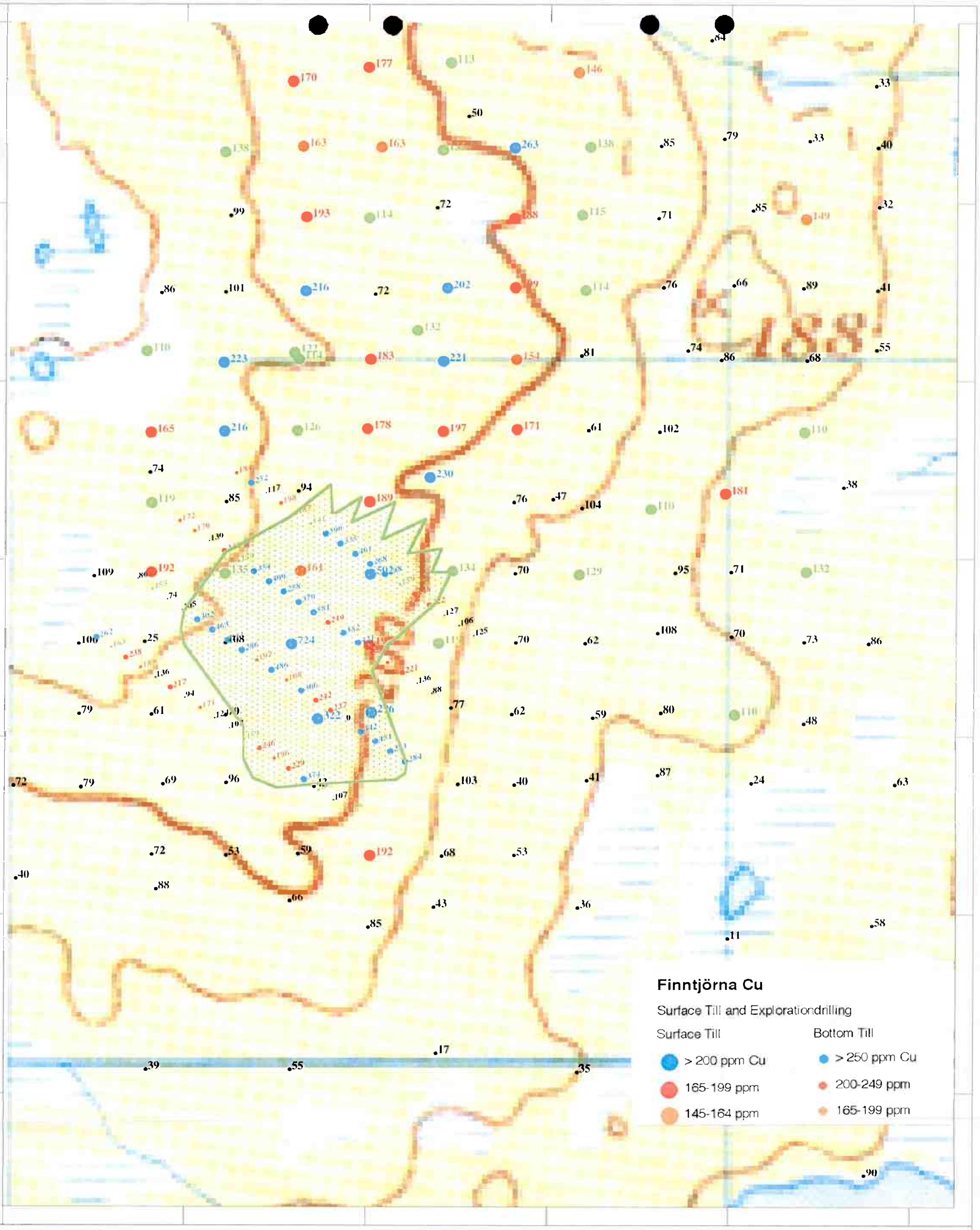


ScanMining

Cu (ppm)	
95%	200
90%	165
85%	145
80%	110
	0

Finntjörna
00-12-09
138 st
Skala: 1:5000

Appendix 14



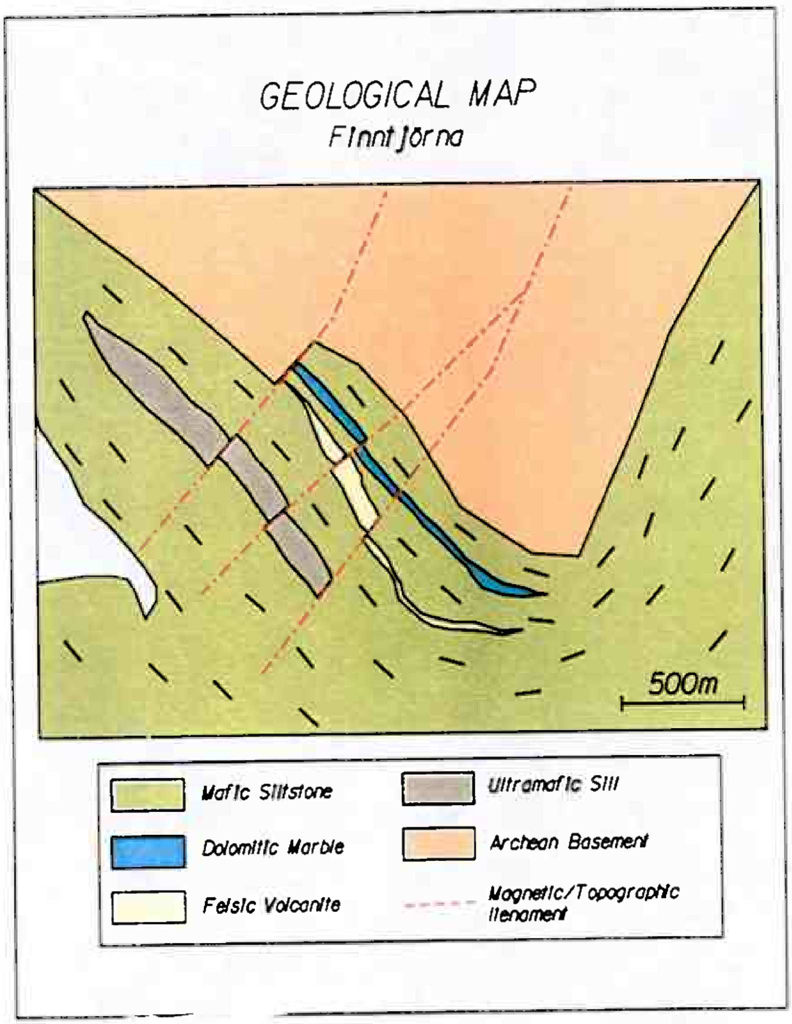
Cu (ppm)

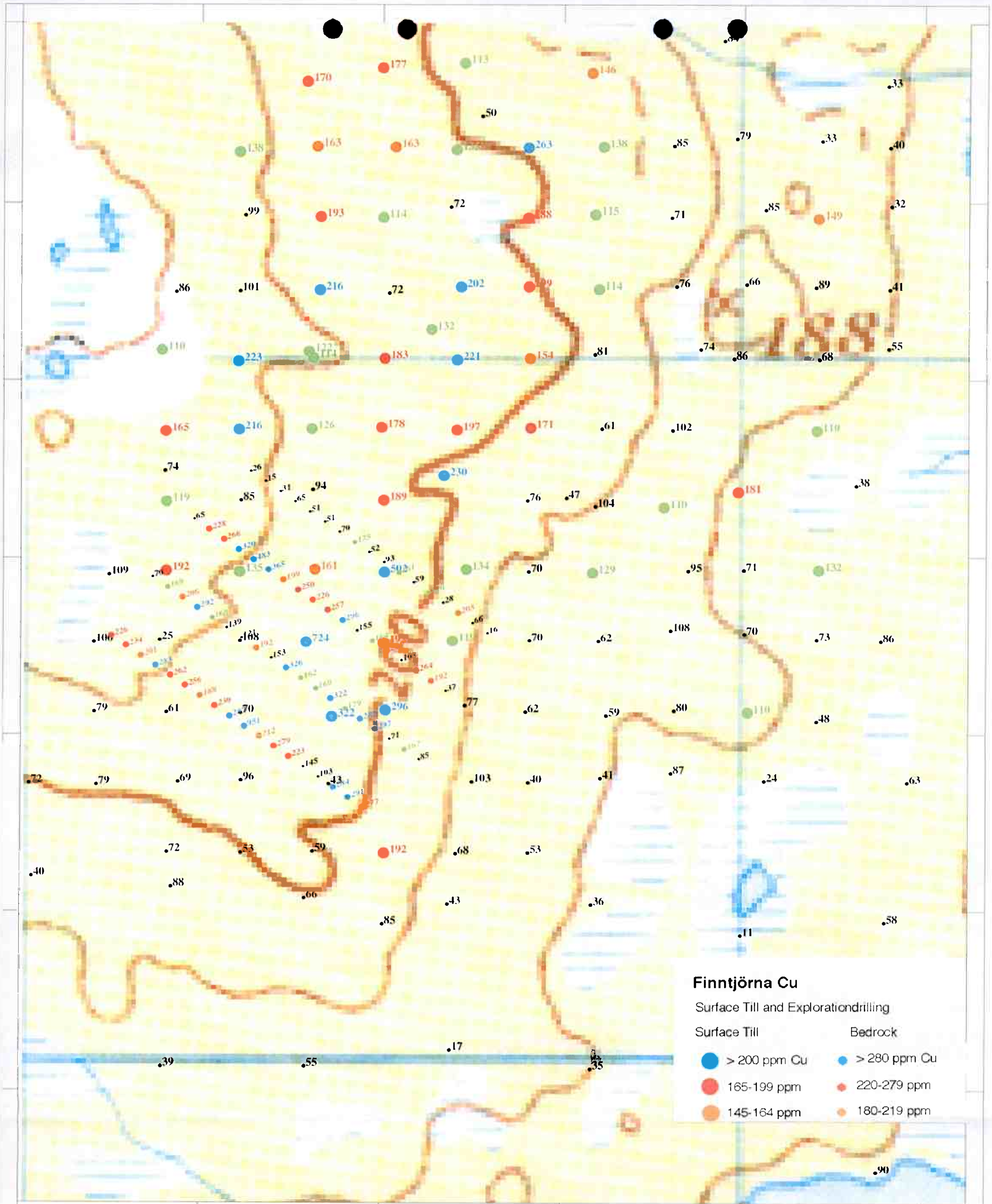
95%	200
90%	165
85%	145
80%	110
	0

ScanMining

Finntjörna
00-12-09
138 st
Skala: 1:5000

Appendix 15


GEOLOGICAL MAP
Finntjörna
500m
Mafic Siltstone
Ultramafic Sill
Dolomitic Marble
Archean Basement
Felsic Volcanite
Magnetic/Topographic lienament

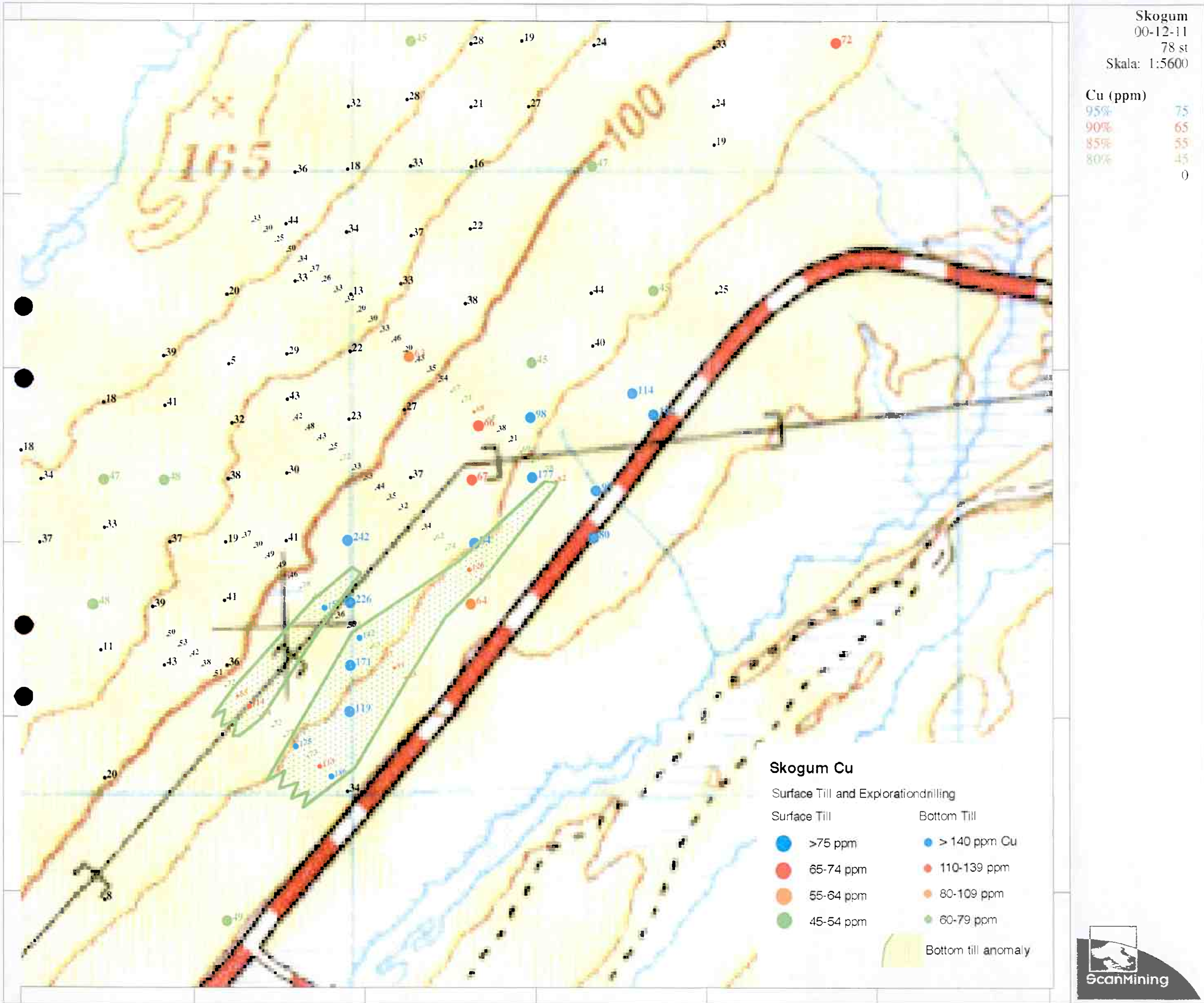


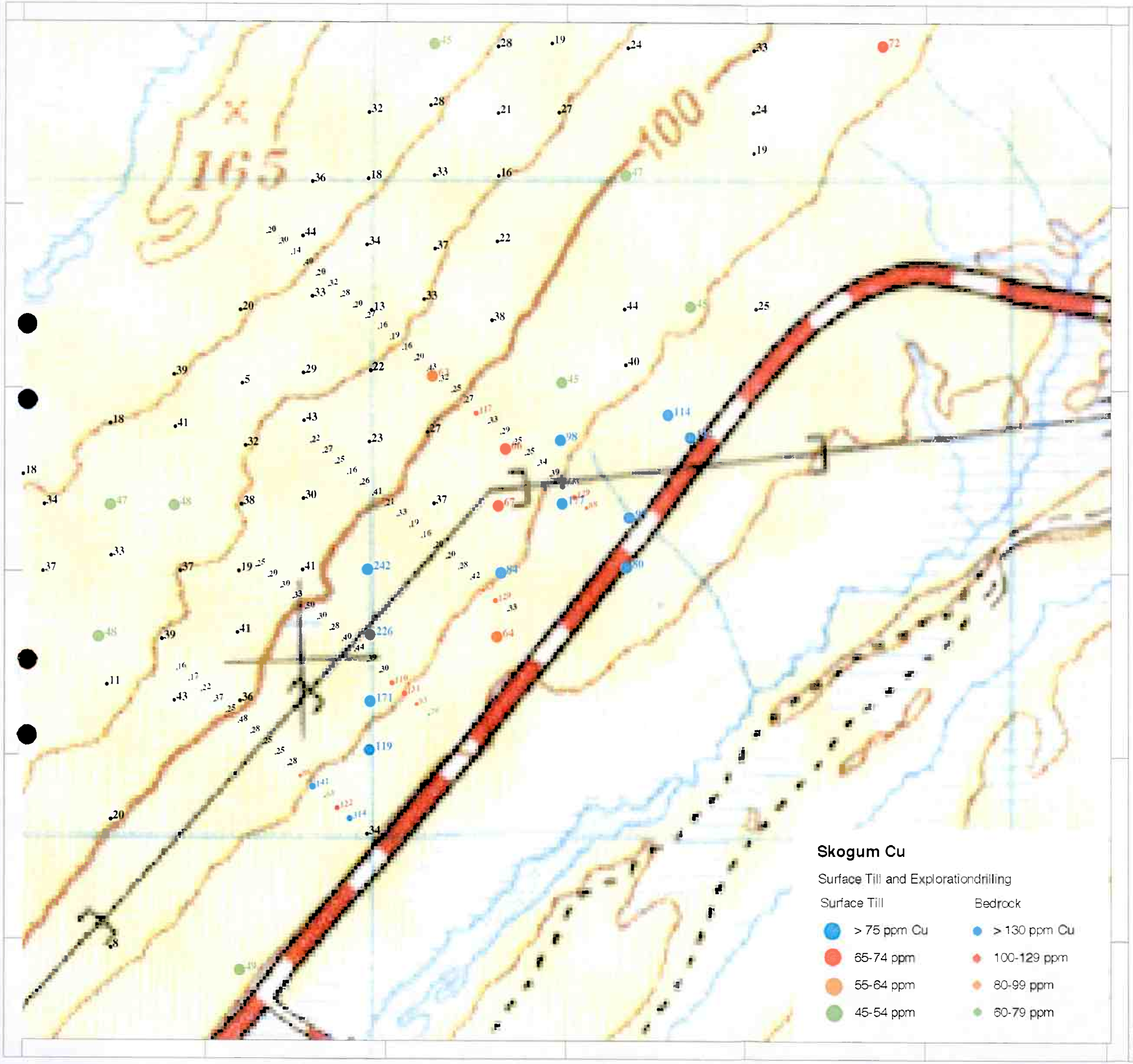
Cu (ppm)

95%	200
90%	165
85%	145
80%	110
	0

Finntjörna
00-12-09
138 st
Skala: 1:5000

Appendix 18


Skogum
00-12-11
78 st
Skala: 1:5600
Cu (ppm)
95% 75
90% 65
85% 55
80% 45
0
165
100
Skogum Cu
Surface Till and Explorationdrilling
Surface Till
Bottom Till
>75 ppm
65-74 ppm
55-64 ppm
45-54 ppm
> 140 ppm Cu
110-139 ppm
80-109 ppm
60-79 ppm
Bottom till anomaly
ScanMining

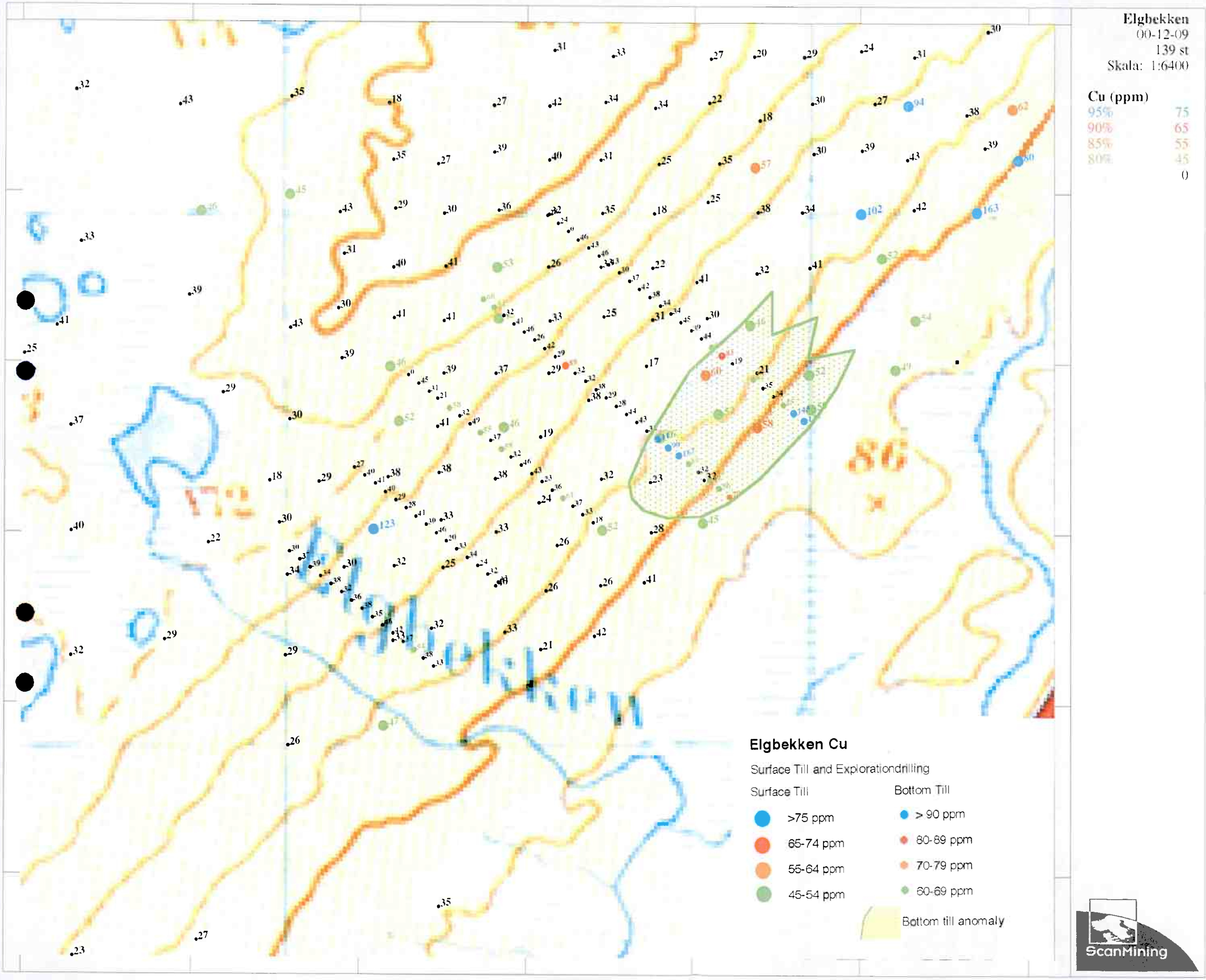


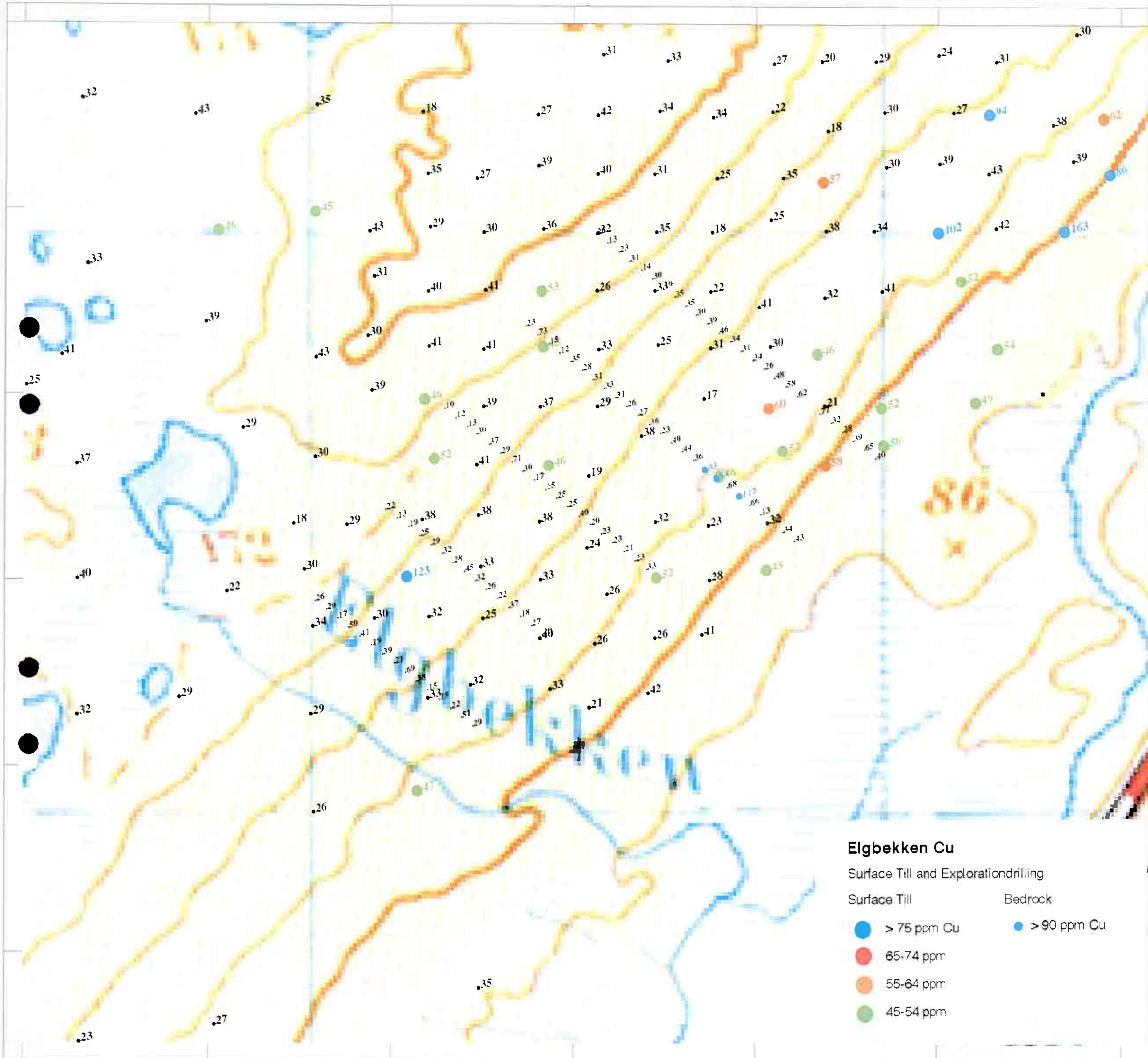
Skogum
00-12-09
78 st
Skala: 1:5600

Cu (ppm)

95%	75
90%	65
85%	55
80%	45
	0

ScanMining


Elgbekken
00-12-09
139 st
Skala: 1:6400
Cu (ppm)
95% 75
90% 65
85% 55
80% 45
0
Elgbekken Cu
Surface Till and Explorationdrilling
Surface Till
>75 ppm
65-74 ppm
55-64 ppm
45-54 ppm
Bottom Till
> 90 ppm
80-89 ppm
70-79 ppm
60-69 ppm
Bottom till anomaly
ScanMining



Elgbekken
00-12-09
139 st
Skala: 1:6400

Cu (ppm)

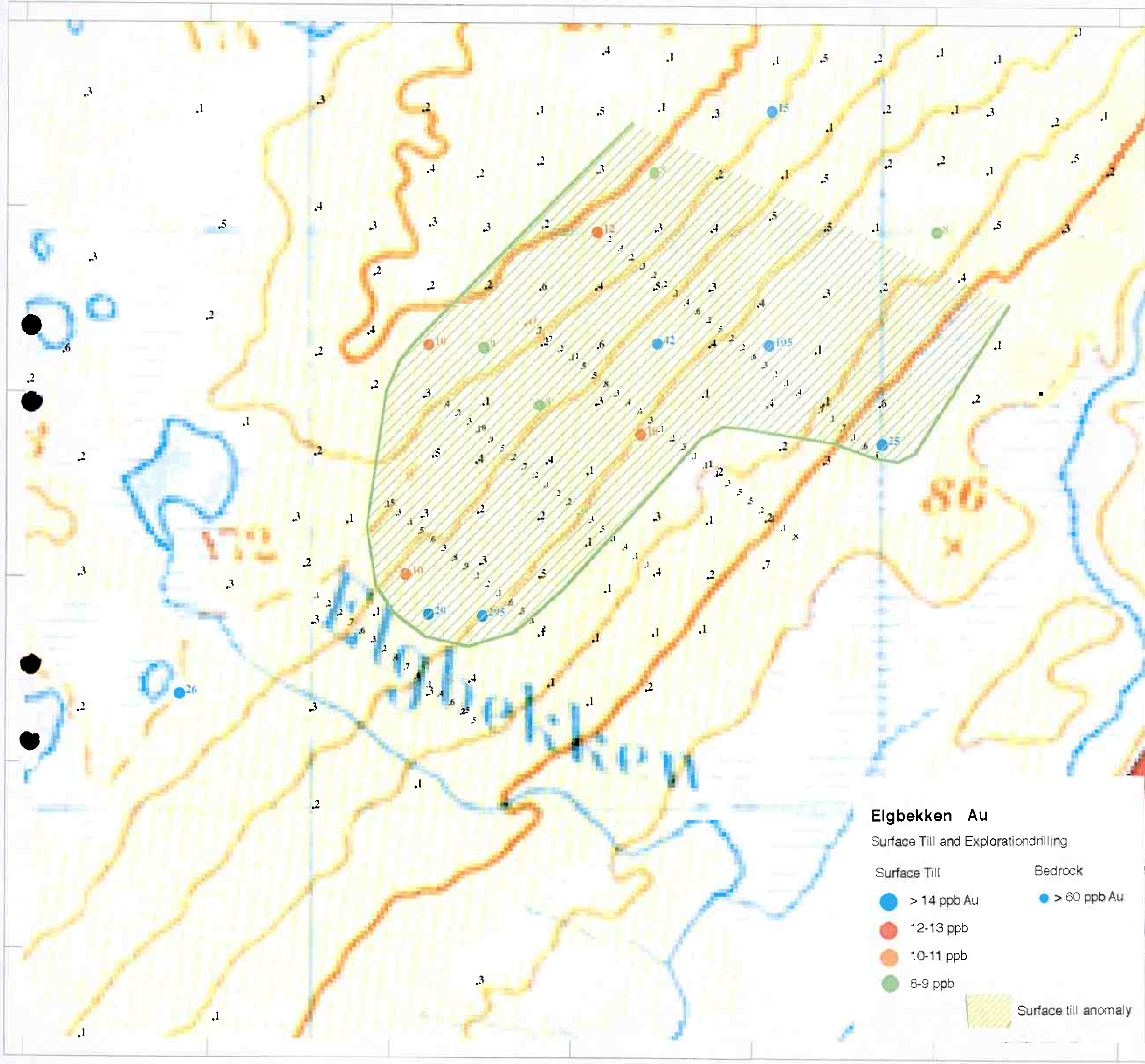
95%	75
90%	65
85%	55
80%	45
	0

ScanMining

Elgbekken
00-12-11
139 st
Skala: 1:6400

Au (ppb)

95%	14
90%	12
85%	10
80%	8
	0



ScanMining