Final Exploration work report

BOLIDEN FINNEX OY

Final exploration work report Polvijärvi – Saramäki 1 and Saramäki 2 ML2012:0224 ML2013:0056

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CONTENT

1. INTRODUCTION

This is a final exploration work report of copper exploration on Saramäki 1 and Saramäki 2 exploration permits in the municipality of Polvijärvi at Sotkuma and Saarivaara villages (Fig. 1). The total area of the permits is 166,7 hectares and they are located on UTM25 map sheet P5321.Permits have lapsed in October and November 2017. A three-year extension for both of the permits was applied but the applications were withdrawn in June 2020.

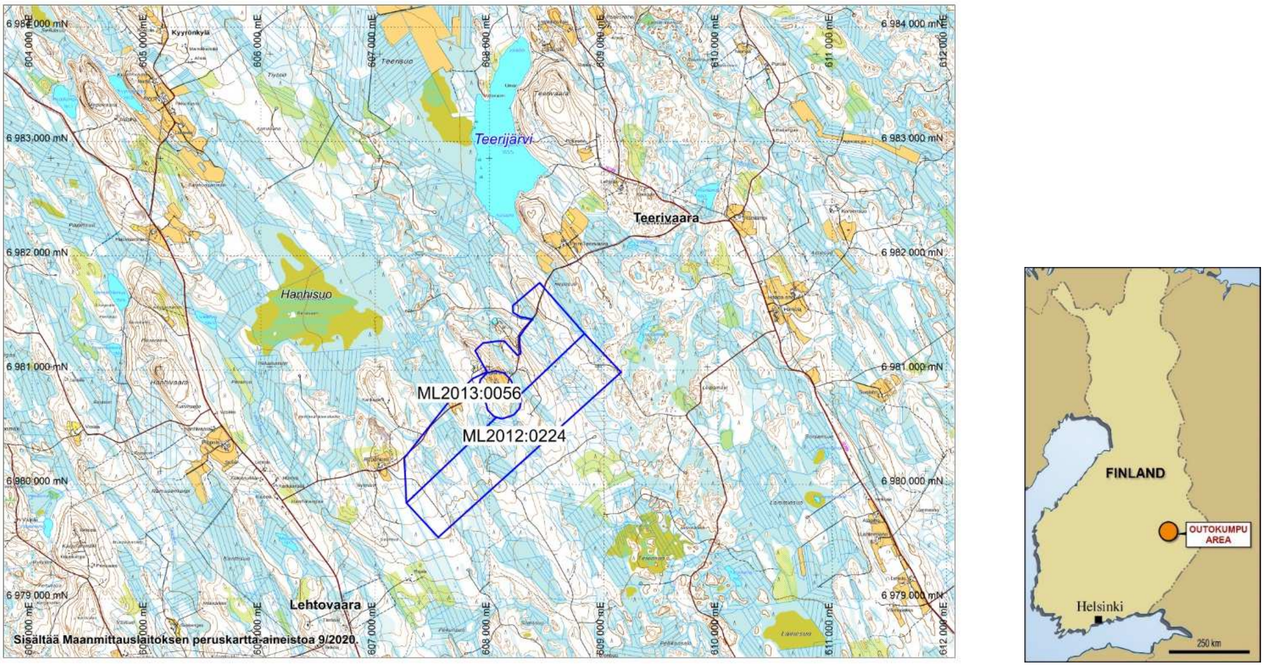

Figure 1. Location of the lapsed Saramäki 1 and 2 exploration permits. Projection: ETRS-TM35FIN. Grid: 1000m x 1000m.

1.1 Transportation

Saramäki project area is located about 20 km NW of the Polvijärvi town. The permit area can be accessed via local roads 15786 from Hukkala village or 15789 from Haapovaara village (Fig. 2). Both roads are diverging of the road 502 from Polvijärvi to Maarianvaara. There are few small tracks across the permit areas.

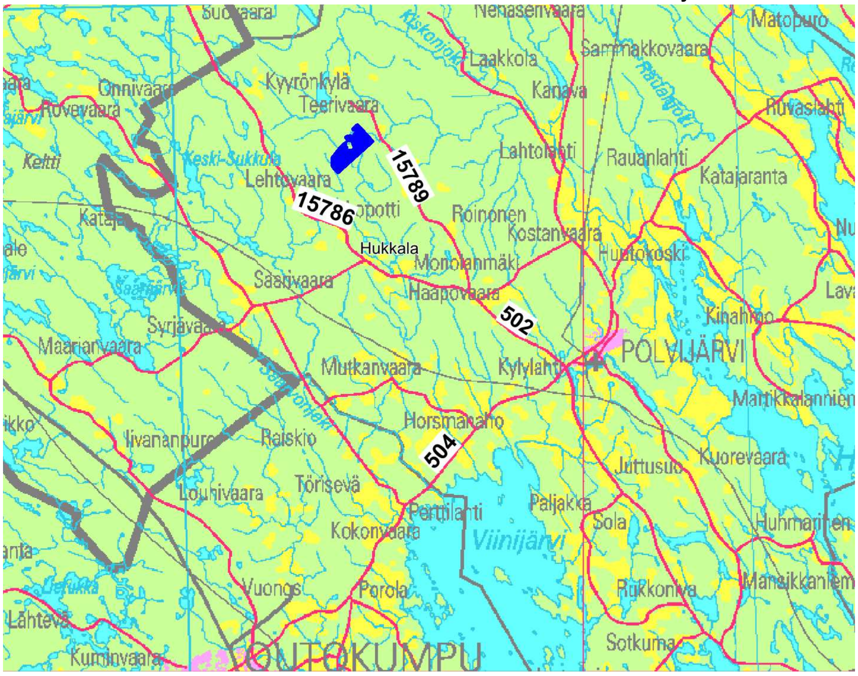

Figure 2. Access to the permit area (blue solid polygon). Road 504: Outokumpu-Polvijärvi-Koli, road 502: Ylämylly-Polvijärvi-Maarianvaara, unnamed local roads15786 and 15789.

1.2 Nature protection and landowners

Saramäki project area is not located on a Natura 2000 protection area but adjacent to one called Hanhisuo which is protected for open swamp (aapasuo) and few specified species (mosses, hays, reeds etc.). The closest privately owned protection area is located roughly 4 km north of the permit.

Saramäki area is not on or near to the classified ground water areas. The closest ground water area is Paavonahonkangas II class reservoir ~2,5 km north of the permit. Figure 3 shows the location of the nature protection areas ground water areas and registered ancient relics closest to the permit.

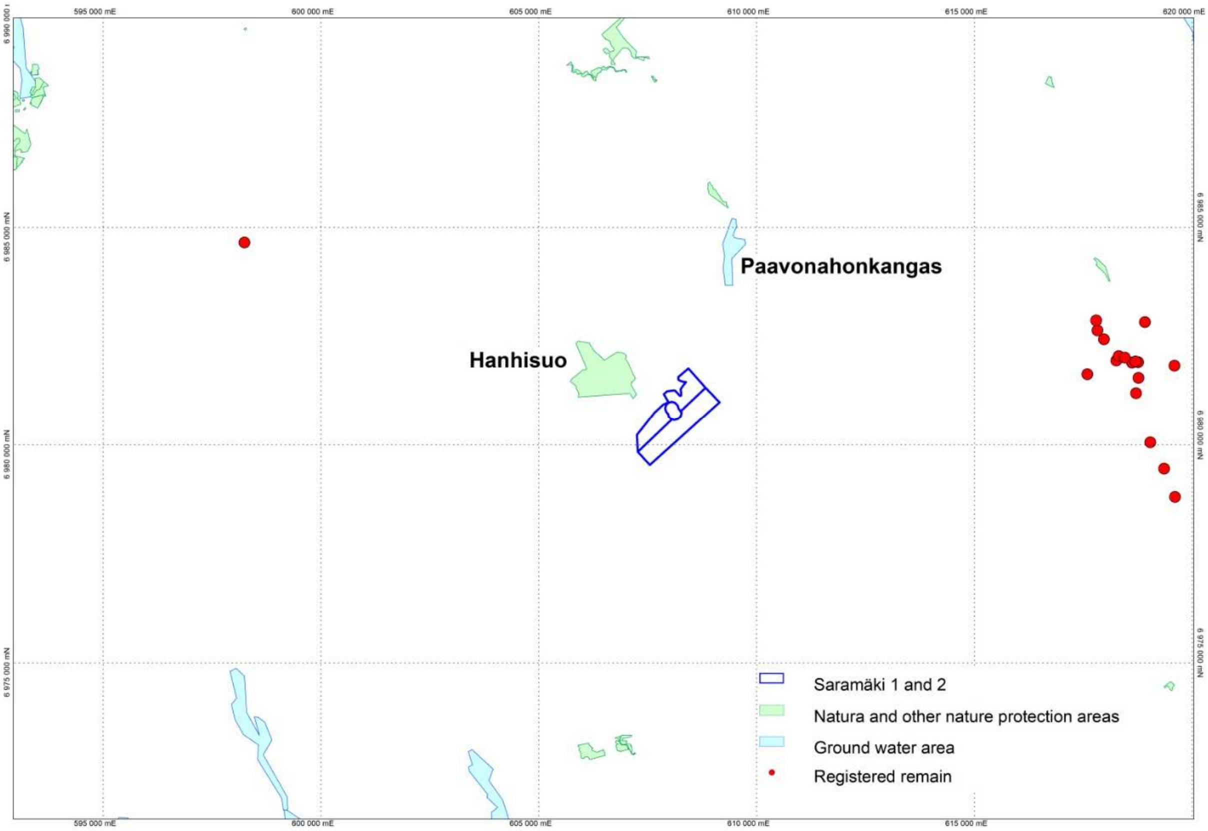

Figure 3. Lapsed permits, Natura 2000, private conservation, groundwater areas and registered relics of Finnish National Board of Antiquities. Projection: ETRS-TM35FIN. Grid: 5000m x 5000m.

Saramäki 1 and 2 permit areas include 10 estates. About 50% of the land area is owned by a forestry company Tornator Oyj.

1.3 General geological description

The Saramäki prospect locates at the southern tip of the large, 15 km long and ca. 0.5 km thick, 40-50° E dipping sheet-like Miihkali serpentinite-mafite massif (Fig 4). The deposit locates somewhat displaced of the S-end of the main Miihkali massive in a relatively thin (<50-100m), fault-controlled, 20-25 degrees SE dipping, and shallowly NE plunging horizon of highly tectonised black schists, tremolite-diopside-skarns and phlogopite-tremolite-carbonate rocks. In comparison to many other Outokumpu type prospects serpentinites are near absent at Saramäki; the mineralised zone contains only local thin slivers of mostly pervasively talctremolite altered ultramafic material. (Kontinen et al. 2006).

The sulphide mineralisation shows the typical habitus of the Outokumpu type Cu-ores in North Karelia, being contained in an about 2 km long, 300 m wide and usually less than 20m thick sheet or ribbon of somewhat discontinuous, pinching and swelling sulphide concentrations (Fig 5). The partly massive-semimassive mineralisation has the same attitude than the controlling shear-fault zone,

plunging at 25° to the NE and having a side inclination at 20-25° to the SE. Though considerable in size, the Cu mineralisation at Saramäki appears to be thoroughly of relatively low grade. Based on a tentative estimate by Saastamoinen (1972), the economically most interesting part of the Saramäki deposit probably contains 3.4 Mt of mineralised rock with 0.71 wt.% Cu, 0.63 wt.% Zn, 0.05 wt.% Ni, 0.086 wt.% Co, and 12.39 wt.% S. As a whole the mineralisation, however, seems to contain at least 13.5 Mt tons of sulphide-mineralised rock with 0.36 wt.% Cu on average (Saastamoinen, 1972, Kontinen et al. 2006).

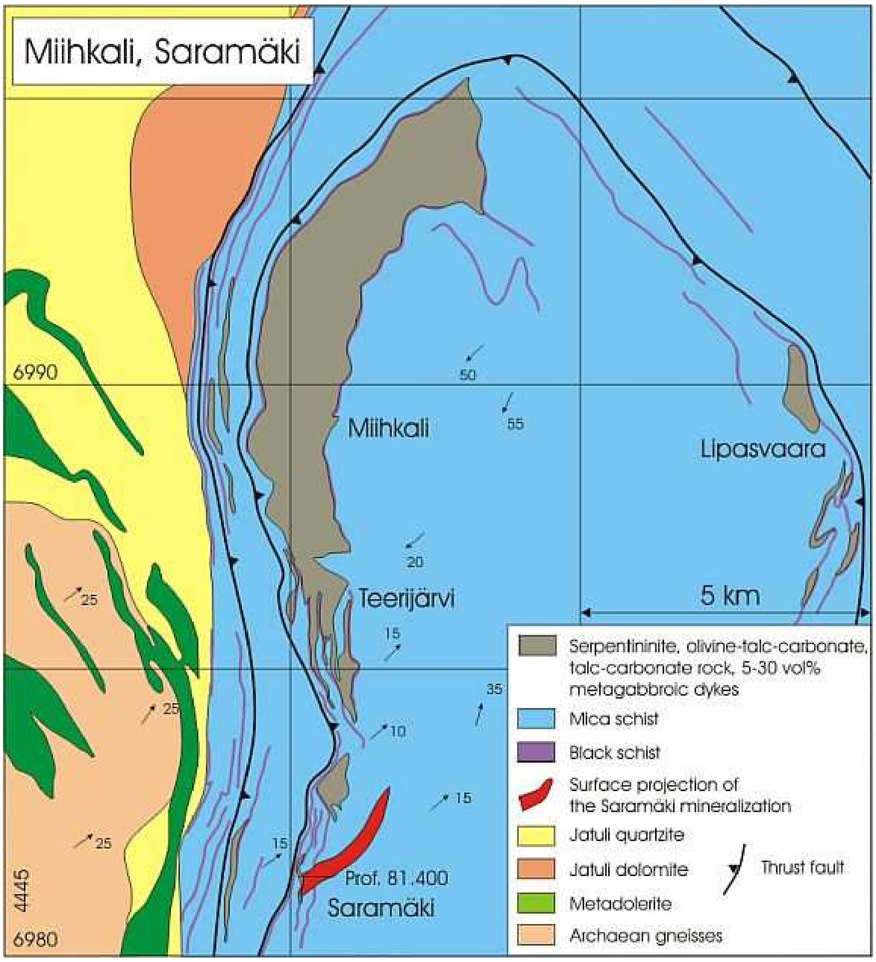

Figure 4. Geological map of the Miihkali massif showing the location of the Saramäki Cu deposit at its south tip. Location of the cross-section profile 81.400 of the Saramäki Cu deposit in Fig. 5 is shown. (Kontinen et al. 2006).

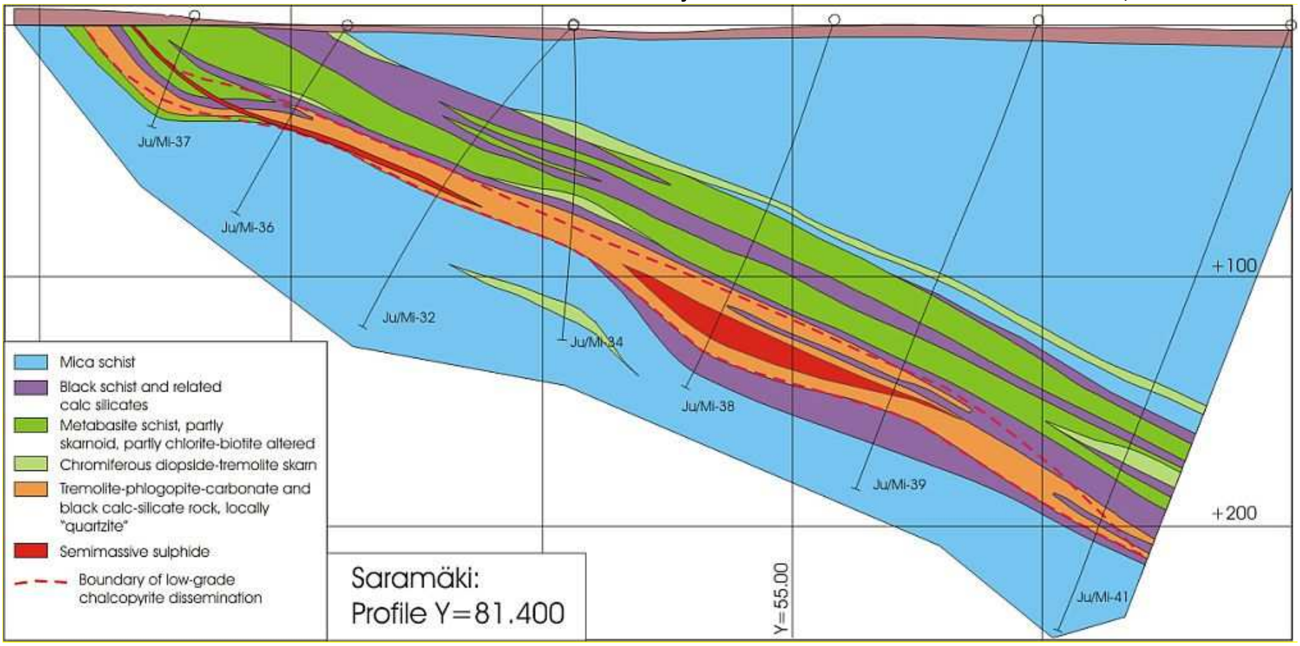

Figure 5. Cross-section profile 6981.400 of the Saramäki deposit (Fig 4). The NE-looking profile is based on Outokumpu drill core reports, and a review of most of the included cores by Kontinen A.. (Kontinen et al. 2006).

2. EXPLORATION HISTORY

2.1 Previous exploration

The first indication of the deposit, which has a surface outcrop in its SW tip, but which is covered by a relatively thick (>5 m) till blanket, was by a chalcopyrite bearing glacial float found in the late 1950s by a local resident. After several campaigns of boulder tracing, geological mapping, and geophysical survey in the years 1959-1967, the deposit was located by drilling in the year 1967. In the period 1967-1972 in total of ca. 15 km of diamond drill holes were drilled to outline the extent of the deposit. A few more holes were added during 1980s (Kontinen et al. 2006).

2.2 Boliden exploration

Boliden became the permit holder for Saramäki 1 and 2 at the end of 2014. An Australian company Altona Mining Ltd (Vulcan Resources Ltd previously) was the permit holder before Boliden and the exploration results from 2006-2014 will be reported here as well. Exploration field work has included in-house magnetic and electromagnetic surveys, several geochemical sampling campaignes and diamond drilling. Other work has included different kinds of desktop studies like lithogeochemical studies and geological and mineral resource modelling. Figure 6 is summarizing all the work that has been carried on or near the Saramäki deposit. All the data related to the exploration between 2011-2017 has been reported annually as required. Exploration data from 2006 to 2011 is reported to TUKES with this document.

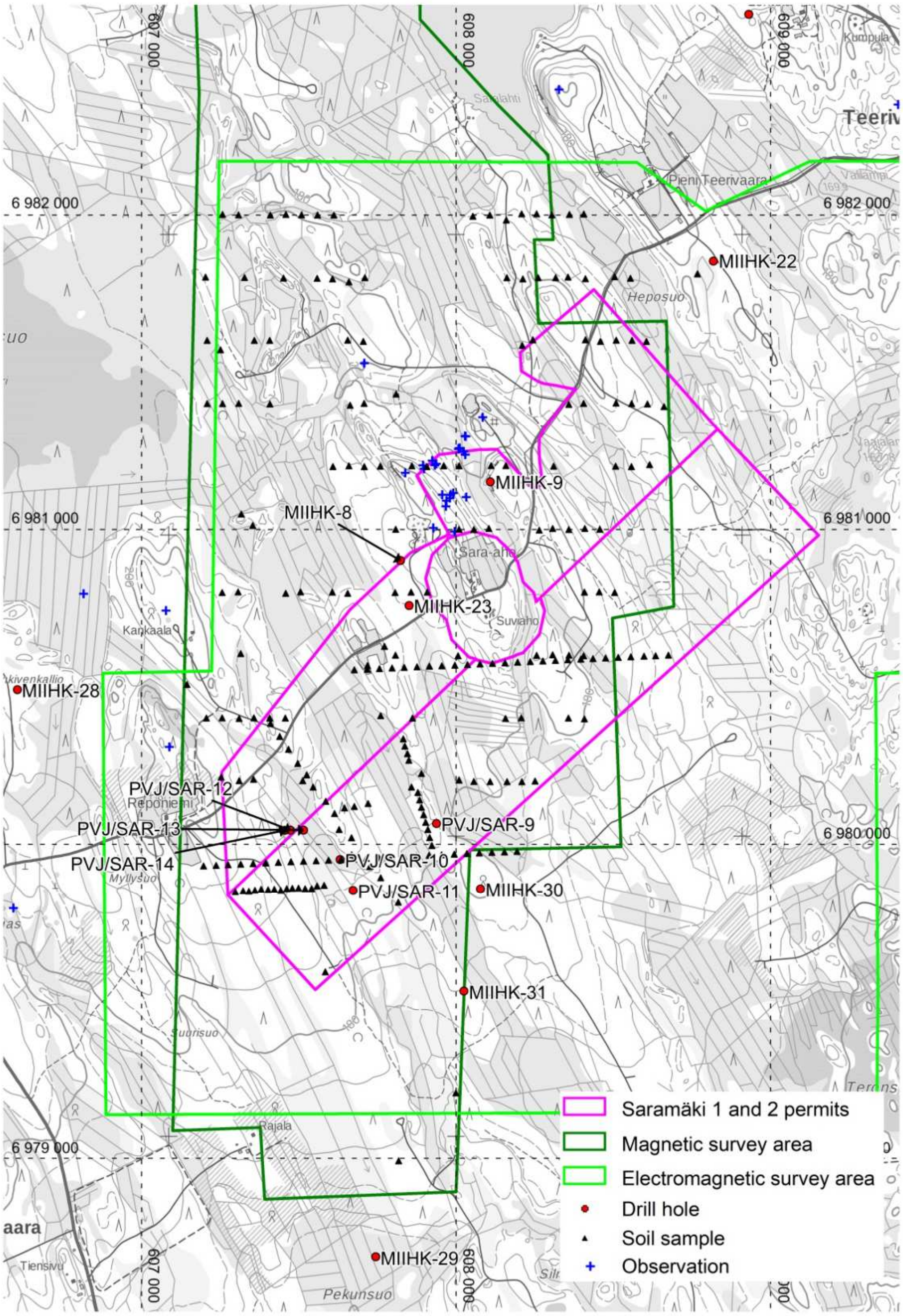

Figure 6. Index map showing Altona Mining and Boliden exploration programmes on or near the Saramäki deposit. Projection: ETRS-TM35FIN. Grid: 1000m x 1000m. Basemap raster ©Maanmittauslaitos 2/2020.

2.2.1 Geophysics

The whole Saramäki project area was covered with continuous Overhouser ground magnetic survey that was completed in 2016 (Fig. 6 and 7*).* The work was conducted by Boliden personnel. Detailed results have been reported in appendix 3 of the annual Miihkali-Saramäki-Horsmanaho North exploration report 2016. The main benefit from continuous survey over the older station survey is increased resolution along the lines allowing for more detailed lithological and structural mapping. Three-dimensional inversion of the dataset and parts of it was carried out.

Electromagnetic (EM) surveys (Figs. 6 and 7) were performed in addition to the magnetics to 1) test deep EM methods, 2) differentiate between anomalies observed in the magnetic surveys and 3) help define dips that magnetic modelling cannot solve due to the assumed remanence. The Boliden in-house EM method (EM34) was used. Survey was measured with four frequencies between 88Hz and 2024Hz. The conductors that give response at the lowest frequency and real component correlate with observations of black schists, whereas serpentinite is expected to only show response at higher frequencies.

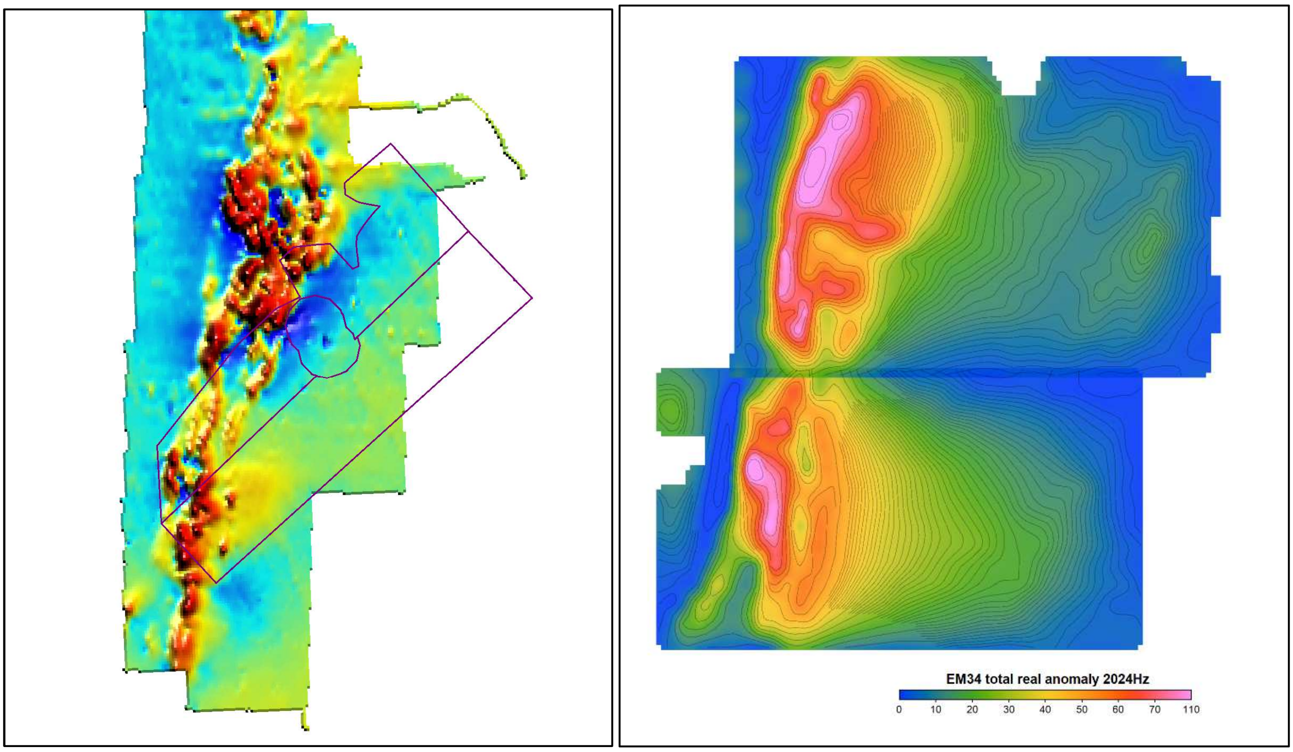

Figure 7. Total magnetic intensity on the left and total ream anomaly on the right.

2.2.2 Geochemistry

2.2.2.1 Till Sampling 2015

Boliden conducted a test in Saramäki to answer the question if portable XRF (pXRF) is a trustworthy method for analysing till compared to a proper laboratory analysis. We tested sampling at various depths and the effects of sample preparation in results. We also looked for gold in the heavy mineral fraction of till. A test line with 20m sample spacing was sampled over the Saramäki deposit, where the mineralisation subcrops beneath c. 5m thick till cover (Fig. 8A). Some samples were also taken down-ice and up-ice of the subcropping mineralisation (Fig. 8A). At every sampling site a "shallow" sample was taken from the C-horizon at c. 10-15cm below the B-horizon. At some sampling sites an additional "medium" sample was taken from 40-50cm depth or 15cm below the shallow sample. At some sampling sites two "deep" samples were taken at 90-135cm depth: one as a heavy mineral sample and one as a geochemistry sample.

Samples taken for geochemical analysis were c. 1 litres in size and the heavy mineral samples were 5 litres. Samples were dried in a drying oven at the core logging facilities at least 12 hours or until dry. After drying the samples were sieved with a 2mm sieve. The sieved samples were analysed with a pXRF (model: Olympus InnovX Delta Premium) in both Mining and Soil modes. Samples were then pulverized with a tungsten carbide ring mill. Pulverized samples were reanalysed with pXRF. The samples were then sent to ALS laboratory for analysis. The soil mode in pXRF proved to be better and the comparison with the lab results is made with the soil mode pXRF data. Heavy mineral samples were processed by Palsatech Oy. First the samples were preconcentrated with Knelson concentrator and then micropanned. Gold and other heavy minerals were looked for under stereomicroscope.

Heavy mineral samples yielded gold grains in every sample. Two samples from the top of the subrcopping mineralisation have 11 grains, whereas other samples have much less than that (Fig. 8B). Distinct anomalies can be seen in the shallow and medium samples indicating the Saramäki mineralisation (Fig. 9). Grinding of the samples before pXRF analysis slightly lowers the Cu and Zn concentrations. The resuls show that in terms of Cu and Zn, pXRF compares with lab analysis very well (Fig. 9). The goodness of fit r2 is very good.

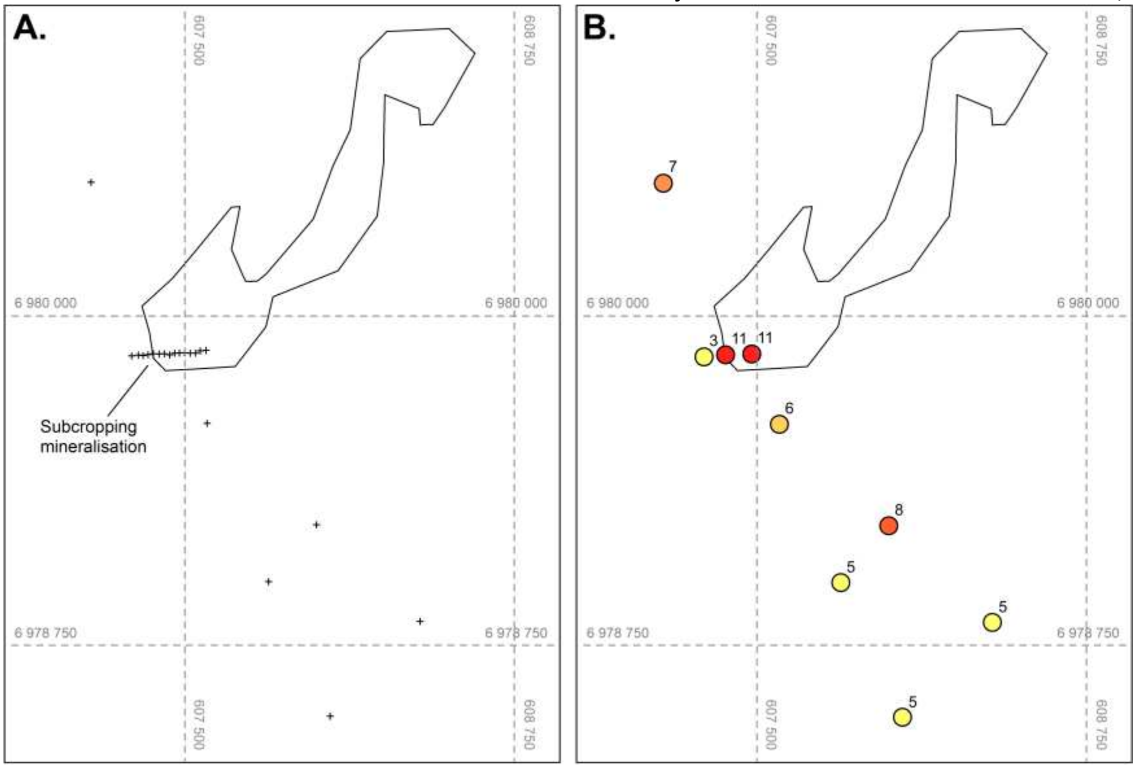

Figure 8. A.) Till sampling sites at Saramäki (crosses). The mineralisation is outlined. A densely sampled profile crosses over the subcropping mineralisation. B.) Sampling sites for heavy mineral samples and gold grain counts in the heavy mineral fraction. Projection: ETRS-TM35FIN.

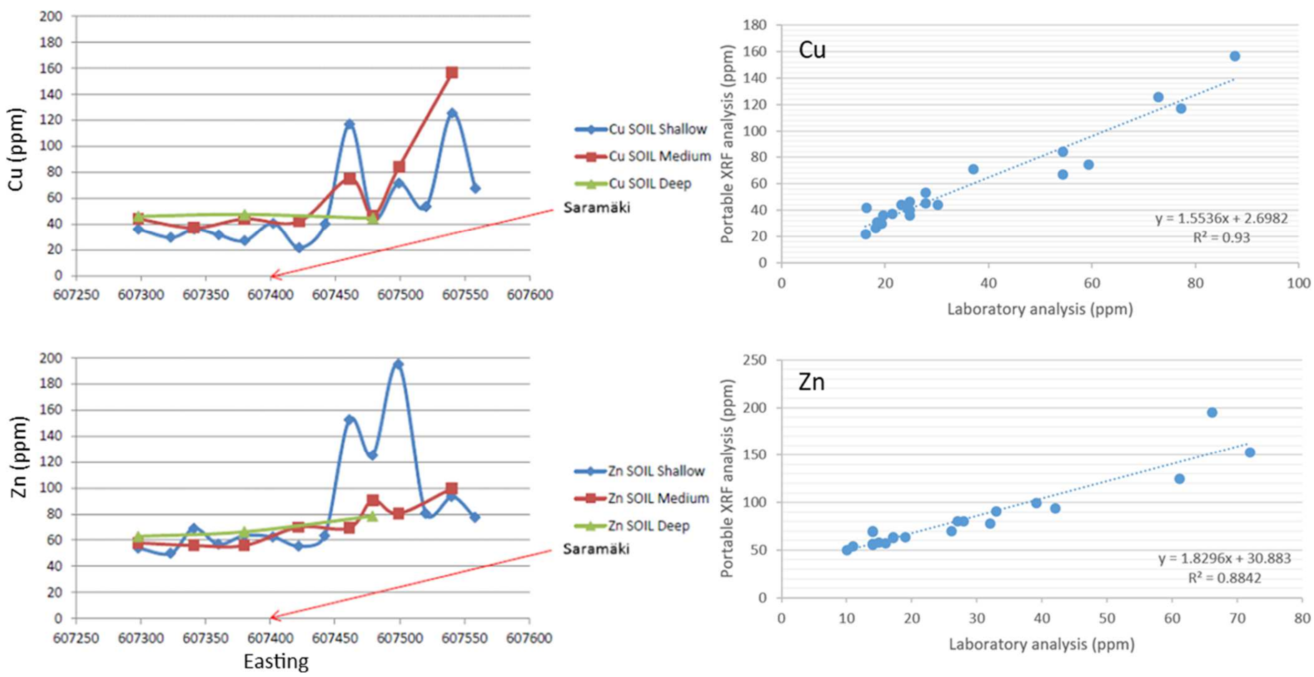

Figure 9. Comparison of sampling depths and analytical methods. Charts on the left illustrate pXRF analyses of Cu and Zn relative to depth. The strongest anomalies come from shallow sampling. The subrcopping Saramäki

mineralisation is indicated with an arrow. On the right, ungrinded pXRF analyses (average of two readings) are compared with ICP-AES/MS analyses from lab. The correlation is very good.

2.2.2.2 Till Sampling 2016

In 2016 Boliden did regional till sampling over the Miihkali area. The Saramäki area was the southernmost part of the sampled region. The samples were collected with a shovel from soil B-horizon. They were analysed with pXRF (model: Olympus InnovX Delta Premium DP-6000) in Geochem mode directly through the plastic sample bag three times and an average was calculated.

Portable XRF is a reliable tool for many chemical elements, but low level Co is not possible to analyse. Copper, Ni and Zn are useful for exploring Outokumpu-type deposits and can also be reliably analysed with pXRF. Many Cu analyses were below the detection limit of the method, but two anomalies stand out (Fig. 10). One Cu anomaly is located at a serpentinite fragment. Two interesting anomalies are in the SW corner of the sampled area (Fig. 10), not far from the subcropping Saramäki mineralisation. Nickel was mainly below the detection limit. The sample at the serpentinite, which was anomalous for Cu, is also anomalous for Ni (Fig. 10). The Ni concentration in this sample is similar to what is usually in serpentinite rock, implying that this sample is probably weathered serpentinite. Zinc anomalies can be found in the W and SW parts of the area and also at the serpentinite (Fig. 10), coinciding with the Cu and Ni anomalies. High Zn can be related to Saramäki-type mineralisations.

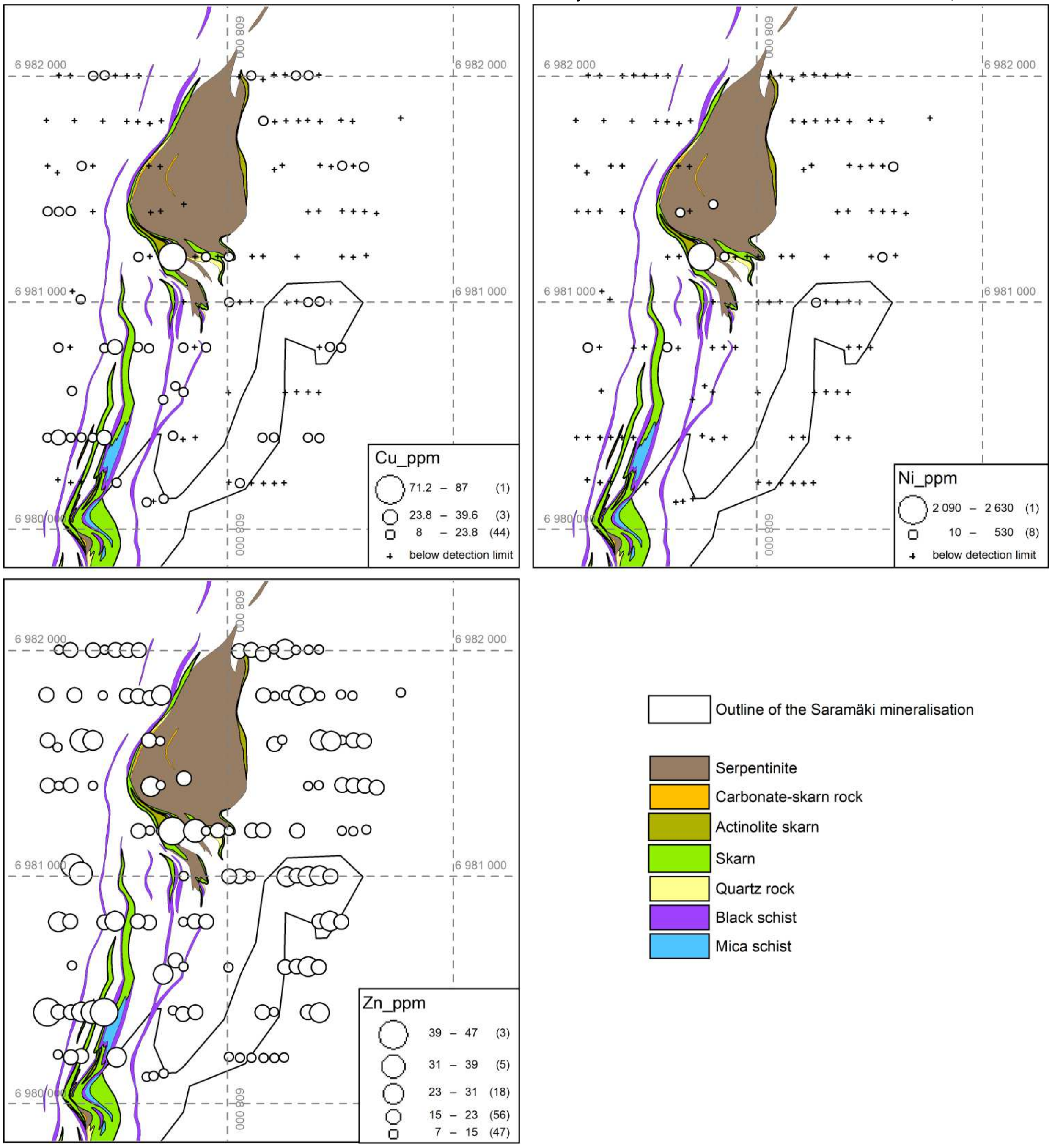

Figure 10. Copper, Ni and Zn concentrations of till samples taken in 2016 near Saramäki. Most of the background geology is mica schist, which is omitted (white) in the detailed geological map. A clear Cu-Ni-Zn anomaly can be found near a serpentinite body. Also the SW corner of the sampled area is anomalous in Cu and Zn. Projection: ETRS-TM35FIN.

2.2.2.3 Mobile Metal Ion sampling

Test sampling for mobile metal ions in 2006 was done on two profiles and c. 40m sample spacing. The sampling aimed to test the mineralisation at different depths. Details of the 2006 sampling, sample preparation and analyses used are missing. In 2016 Boliden sampled two profiles at different orientations than the previous sampling. The sample spacing on the western profile was 50m and on the eastern profile 25m. Samples were taken with a shovel into plastic bags. Samples were analysed with pXRF before sending to ALS laboratory for Ionic Leach analysis. Portable XRF analyses did not reveal anything useful.

All four lines contain Cu anomalies near the western margin of the mineralisation (Fig. 11). Three lines have Co anomalies at the western margin of the mineralisation (Fig. 11). Nickel anomalies are also more on the western side. Zinc is more scattered. The northern line of 2006 sampling has a strong Zn anomaly in the east, where the mineralisation is already at great depths. This anomaly is difficult to explain. The southern line of the 2006 sampling crossed over the subrcropping mineralisation and this location is well defined by anomalous Cu, Co, Ni and also somewhat anomalous in Zn (Fig. 11).

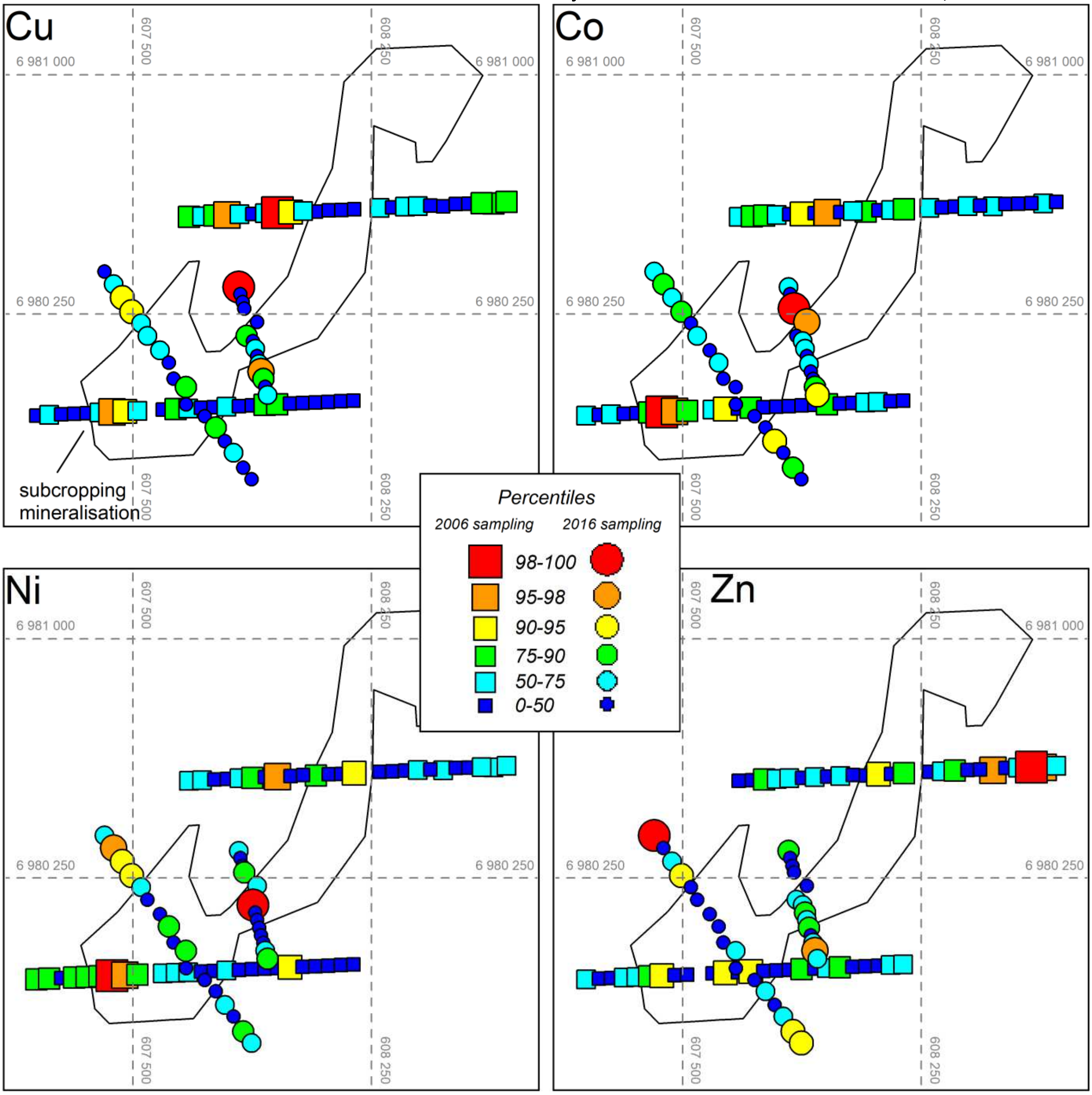

Figure 11. Mobile metal ion test profiles over the Saramäki mineralisation. The mineralisation is outlined. Projection: ETRS-TM35FIN.

2.2.3 Drilling

Nine drill holes for a total advance of 1940m were drilled to the Saramäki deposit in 2008 and 2016-2017. Table 1 is summarizing the drill hole collar information. Drillhole locations are presented in figure 7.

Table 1. Drill hole collar information in ETRS TM35FIN projection (also azimuth) of Altona/Boliden drilling.

Hole	Easting	Northing	Elevation	Azimuth	Dip	Length (m)
PVJ/SAR-9	607937.12	6980066.36	181.39	267.23	-64.9	275.26
PVJ/SAR-10	607630.76	6979951.60	185.87	266.23	-65	148.9
PVJ/SAR-11	607672.51	6979853.26	180.97	270.43	-65.2	151.77
PVJ/SAR-12	607472.91	6980044.95	186.27	271.63	-64.6	118.8
PVJ/SAR-13	607514.60	6980045.37	185.84	270.33	-65	140
PVJ/SAR-14	607454.66	6980044.79	186.88	269.83	-48	91.9
MIIHK-8	607823.1	6980901.78	189.53	267.33	-59.23	350
MIIHK-9	608108.37	6981151.42	180.91	267.33	-48.9825	321
MIIHK-23	607850.16	6980758.73	186.43	267.33	-58.17	342.3
Total						**1939.93**

Vulcan Resources/Altona Mining drilling results

Six diamond holes were planned to test the eastern extension of the mineralisation at +200m depth and open-pit potential on shallow levels. The first hole PVJ/SAR-9 was targeting the extension of the mineralised intersection (3.08m @ 0.79%Cu from 202.82m) in historic Ju/Mi-72 ~50m to the east. The hole did intersect weakly mineralised skarn at interpreted position with 4.36m @ 0.48%Cu from 242m. Considering that the traverses to the north do contain wide intersections at the same position, the potential to another concentration of sulphides further to the east remains open.

Next two holes PVJ/SAR-10 and -11 were drilled inside the shallower mineralisation to test the existing mineralisations and their width. PVJ/SAR-10 was drilled 35m up-dip of Ju/Mi-38 with 11.2m @ 0.75%Cu from 123.3m. The hole did intersect widely sulphidized skarn with the best intersection of 1.81m @ 1.74%Cu from 99.19m. PVJ/SAR-11 was drilled 35m up-dip of Ju/Mi-103 (5.5m @ 0.66%Cu from 142.62m). Weakly disseminated pyrrhotite, chalcopyrite and sphalerite were detected with the best intersection of 1.60m @ 0.51%Cu from 119.34m. Both tests did ensure the lens-like appearance of the sulphide concentrations in the mineralised plate with maximum width of 80 and 60 metres on these sections at ~100 metres depth.

The last three drill holes PVJ/SAR-12, -13 and -14 were targeting the sclosest to the surface on the northernmost section. Interpretation of the historic data showed that the mineralized unit was getting thicker and closer to the surface towards the north. The chosen section contained untested gap at the interpreted position of the mineralised part of the deposit (no drilling further to the north either). Coincidently the gap is located also on one of the NW-SE structures that is intersecting above mentioned historic drill holes (Ju/Mi-38 and -103) to the south. The drilling was very successful with the intersections of 13m @ 0.62%Cu and 0.07%Co from 58m, 11.8m @ 1.47%Cu and 0.11%Co from 65m and 6m @ 0.84%Cu and 0.07%Co from 81m, from west to east (Fig. 12). All the intersections were in moderately to strongly chlorite-biotite altered, pyrrhotite-chalcopyrite bearing (Note! No pyrite!) and weakly to moderately brecciated rocks (Fig. 13).

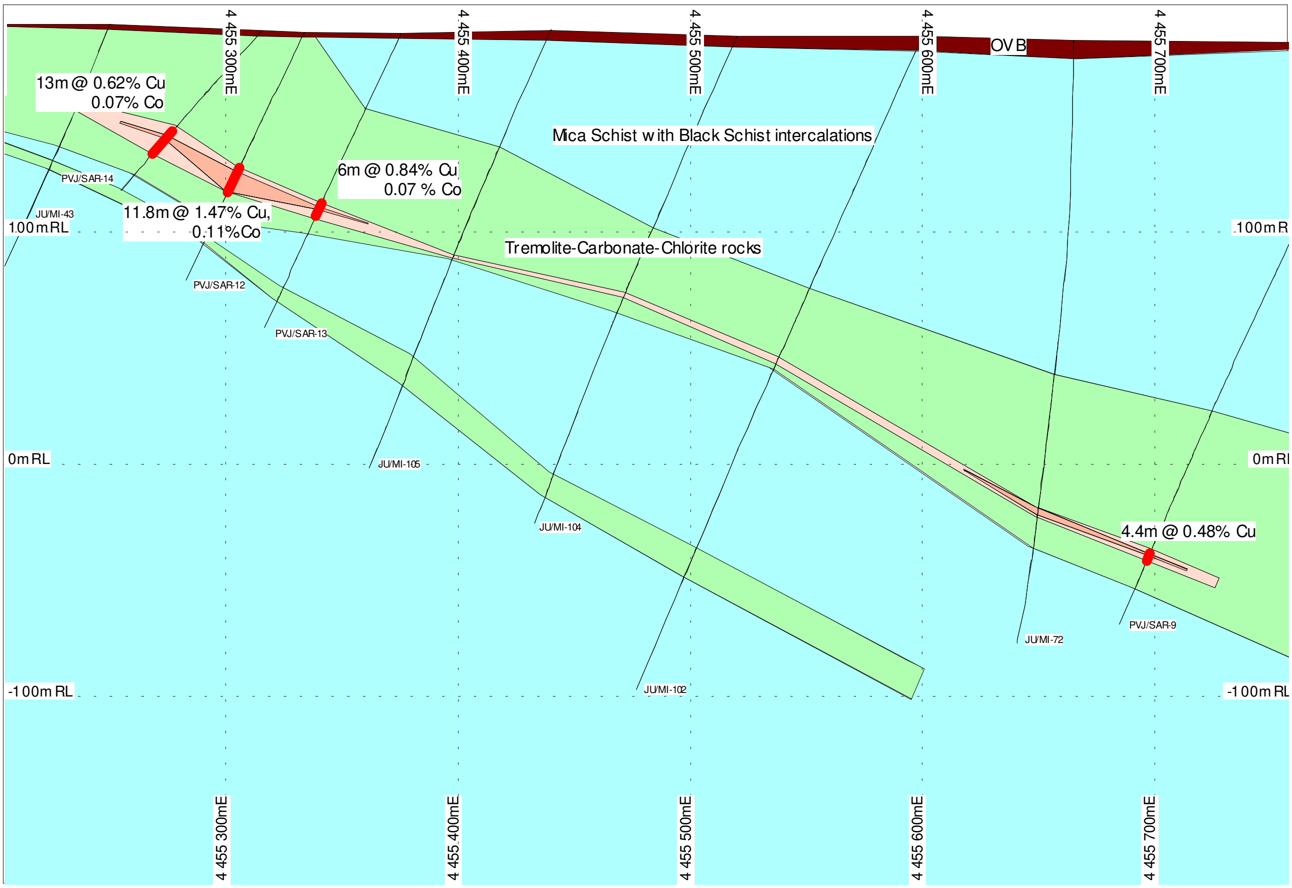

Figure 12. PVJ/SAR-9, -12, -13 and -14 and drilling results. Disseminated mineralisation in pink and >1% Cu in red. Green colour is presenting the Outokumpu style rock assemblage and blue the surrounding Kalevian schist. Projection: Finnish KKJ Zone4, Section: 6981500 mN looking to north.

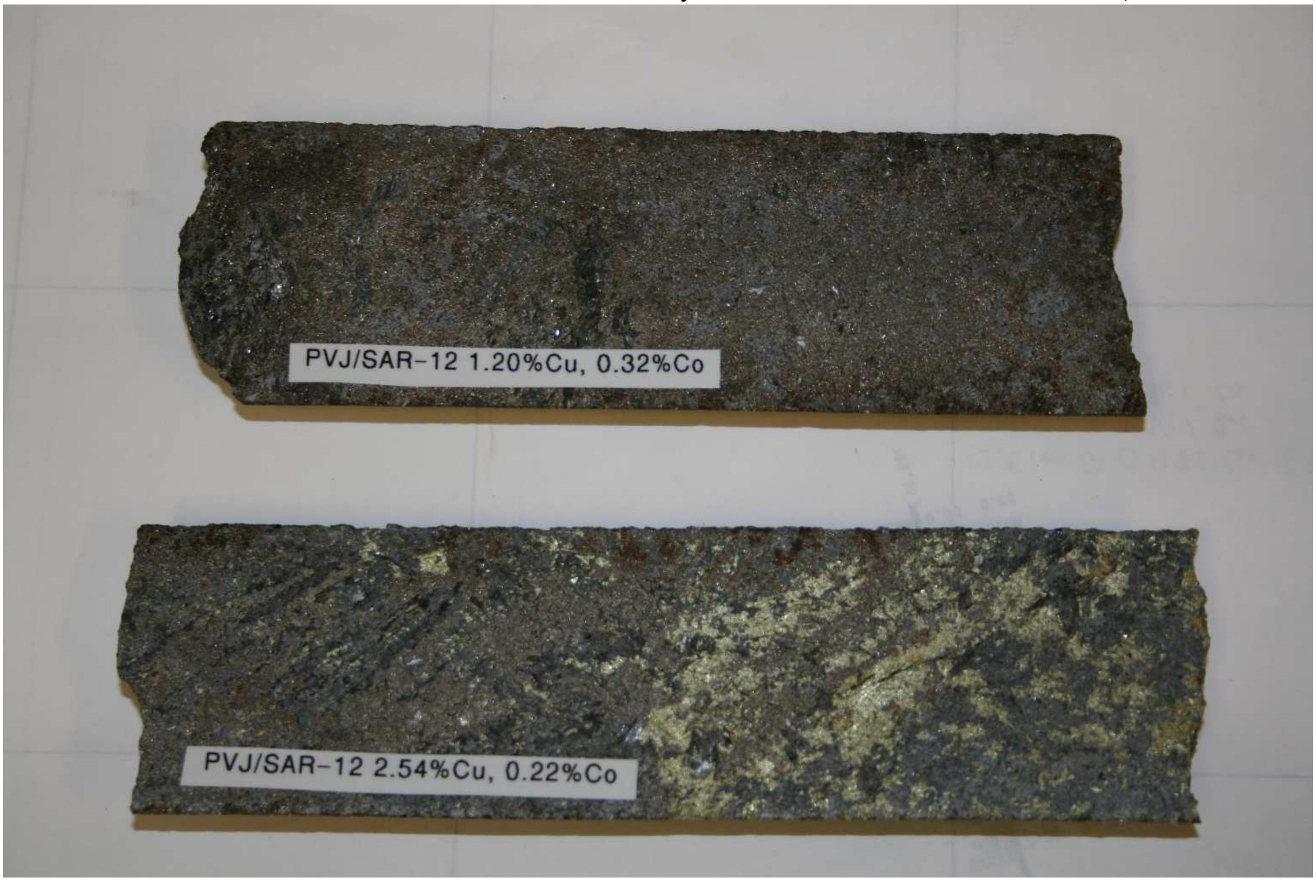

Figure 13. Samples of Saramäki pyrrhotite-chalcopyrite mineralised tremolite-chlorite-carbonate skarns. Samples PVJ/SAR-12/73.07m (up) and PVJ/SAR-12/74.97m (below).

Boliden drilling results

Three drillholes were drilled in 2016 and 2017 mainly to test different geophysical targets.

MIIHK-8 target was previously untested thickening in a historical slingram survey. Additionally drillhole locates near a known serpentinite body. MIIHK-8 intersected black schist with minor tremolite skarn within for the first 75m and was followed by mica schist until c.a. 147m. After the mica schist, an Outokumpu style skarn rock sequence was encountered with anomalous nickel contents to the depth of 153m. The skarn sequence was followed by a black schist unit with tremolite skarn interlayers until 202m. One of the interlayers hosted a 25cm pyrrhotite rich massive sul-phide vein with 0.475% Cu. Rest of the hole was mainly mica schist.

MIIHK-9 was planned to test a known Outokumpu rock sequence at depth. Historical drill holes intersect altered skarns including thin massive sulphide veins with up to 3% Ni contents. These veins were also mapped from an outcrop by Boliden in 2015. MIIHK-9 intersected two sequences of Outokumpu assemblage rocks, the first from the surface to 53m and the second between 115m and 176m. These sequences were separated by a mica schist unit. The anticipated sulphide veins were encountered within the first set closer to the surface but with low base metal contents. The latter sequence didn't contain any mineralisation. This sequence was followed by 60m thick unit of black schist followed by mica schists.

MIIHK-23 targeted a magnetic anomaly in Boliden's ground magnetic data. The anomaly resembles the anomaly caused by the shallow part of the Saramäki mineralisation. MIIHK-23 was concurrently a step-out hole towards south from the drill hole MIIHK-8. The drillhole intersected mica schist and minor black schist for the first 165m before a 20m thick section of black schist which is flanked by 5-10m of Outokumpu style rocks from both ends. No mineralisation was observed within these rocks. A mica schist is met again between 197m-215m before a 6m section of skarn rocks. This section hosts the same massive sulphide vein that was previously encountered in drill hole MIIHK-8. The vein didn't return any significant metal contents. The rest of the hole consists of mica schist and thin interlayers of black schist.

Table 2. The most significant drilling results.

Hole ID	From (m)	Width (m)	Copper (%)	Gold (g/t)	Cobalt (%)	Nickel (%)	Zinc (%)	Sulphur (%)
PVJ/SAR-9	242	3.68	**0.45**	0	0.04	0.05	0.11	8.38
PVJ/SAR-10	99.19	1.81	1.74	0	0.05	0.11	0.93	9.51
incl.	99.19	0.81	3.22	0	0.04	0.12	0.46	10.50
PVJ/SAR-11	119.34	1.60	0.51	0.03	0.05	0.06	0.71	9.51
PVJ/SAR-12	65.00	11.82	1.47	0.48	0.11	0.08	0.12	7.73
incl.	70.00	6.82	1.96	0.59	0.13	0.09	0.15	8.19
PVJ/SAR-13	65.50	1.00	0.45	0.27	0.03	0.05	0.03	1.47
PVJ/SAR-13	81.00	6.00	0.84	0	0.07	0.05	0.05	6.53
incl.	83.00	1.19	2.37	0	0.09	0.06	0.08	8.89
PVJ/SAR-14	56.30	1.03	0.46	0	0.04	0.05	0.04	4.54
PVJ/SAR-14	58.00	13.00	0.62	0	0.07	0.07	0.08	7.00
incl.	61.00	2.00	1.12	0	0.07	0.08	0.20	8.46
MIIHK-8	164.24	0.25	0.48	0.01	0.02	0.04	0.02	3.58

3. MINERAL RESOURCES

Boliden did perform an in-house mineral resource calculation of the Saramäki deposit but it hasn't been formally reported and isn't going to be published here. The result of the calculations were not encouraging enough for further exploration.

4. FOLLOW-UP

Initially Boliden applied extension to the permits but within three years that the applications were pending it was decided to relinquish the permits.

The further potential and untested ideas of the deposit is discussed in different parts of this report (see 2.2.3 Drilling for example).

5. REFERENCES

Kontinen et al. 2006. Description and genetic modelling of the Outokumpu-type rock assemblage and associated sulphide deposits.

Saastamoinen, J., 1972. Miihkalin jakson tutkimukset vuosina 1966-1972. Outokumpu, malminetsintä, tutkimusraportti 001/4311, 4313/JyS/72, 27 p.