

BOLIDEN KUHMO OY

**Final exploration work report
Hyrynsalmi – Sika-aho
ML2013:0047**

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ML2013-0047_1_31012018.docx

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ML2013-0047_Indexmap_31012018.jpg

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ML2013-0047_4_31012018_1.xlsx

Survey and logistic report on a VTEM survey on the Kuhmo areas 2008.pdf

ML2013-0047_2008_VTEM_R531.gdb

ML2013-0047_4_31012018_2.xlsx

Aerogeophysical survey in Kuhmo-Suomussalmi area 2005.pdf

ML2013-0047_2005_MLEM_R531_aplev.xyz

ML2013-0047_2005_MLEM_R531_dtm.xyz

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ML2013-0047_6_31012018.xlsx

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ML2013-0047_MMI_Analysisdata_31012018_1.csv

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ML2013-0047_7_31012018 .xlsx

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ML2013-0047_Drillhole_Section_HYR-SA-6-17_31012018.pdf
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ML2013-0047_Drillhole_Section_HYR-SA-14_31012018.pdf
ML2013-0047_Drillhole_Section_HYR-SA-15-16_31012018.pdf

Folder includes both dry and wet photos of the drill core. 224 jpg-files all together.

1. INTRODUCTION

This is a final exploration work report of nickel exploration on Sika-aho exploration permit in municipality of Hyrynsalmi at Moisiovaara village (figure 1). The area of the permit is 69,39 hectares and it is located on UTM25 map sheet R5312. The permit has lapsed in September 2017.

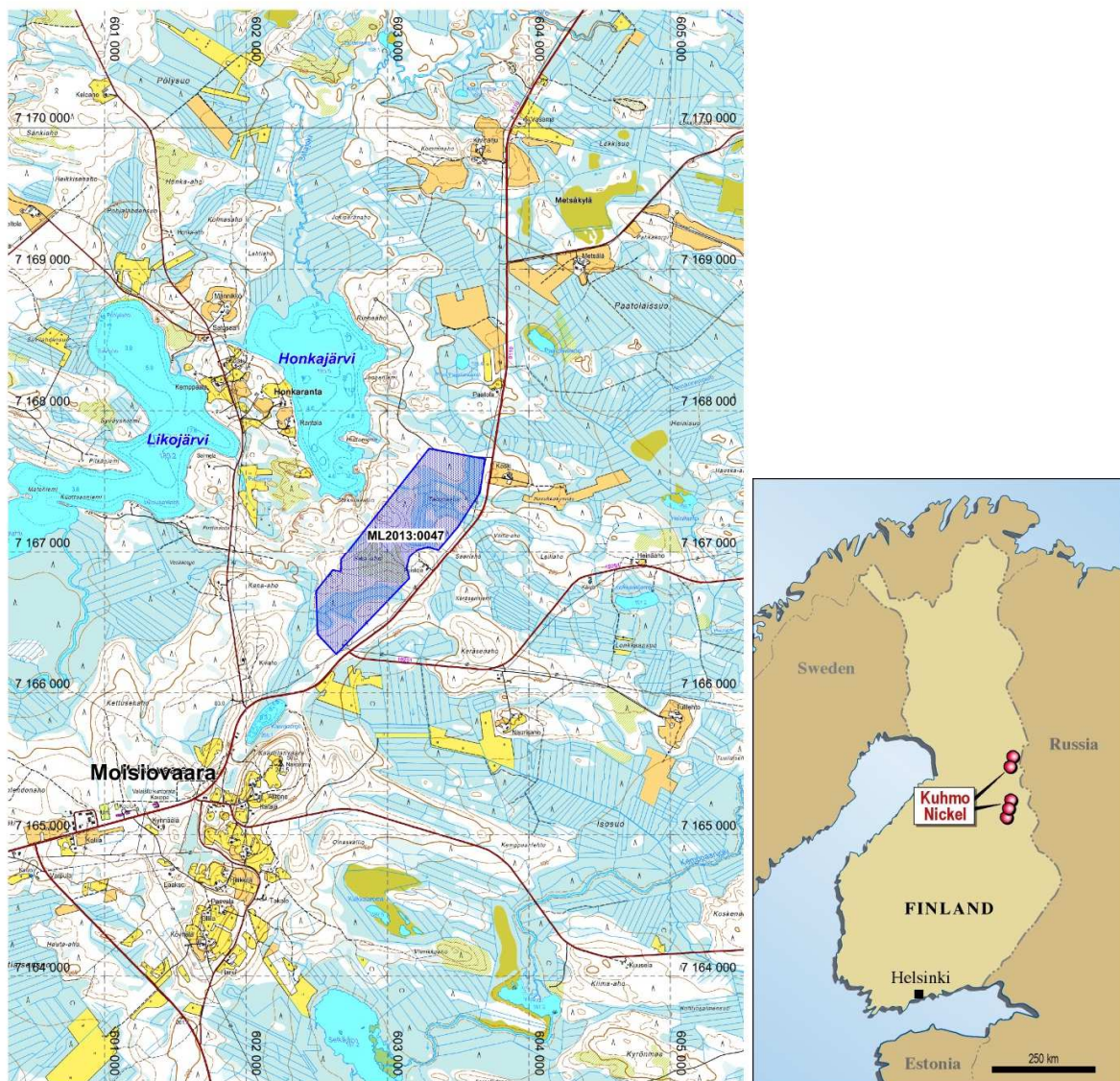


Fig 1. Location of the lapsed Sika-aho exploration permit. Projection: ETRS-TM35FIN. Grid: 1000m x 1000m.

1.1 Transportation

Sika-aho permit area is located to the east of national road number 5. It is situated about 40 km east of Hyrynsalmi and 40 km south of Suomussalmi municipalities. The closest village, Moisiovaara is only 3 km to southwest of permit area. The map below shows the access roads to get to the permit area. The road 9110 turns to the east of road 5. There is also one small track across the middle part of the permit area.



Fig 2. Access to the permit area (blue solid polygon). Road 904: Hietaperä-Hyrynsalmi road. Road 9110: Kumpula-Moisiovaara-Jumaliskylä-Laherma road. Road 9070: Pyssylahti-Palovaara-livantiira-Ypykkävaara-Moisiovaara road.

1.2 Nature protection and landowners

Sika-aho exploration permit is not located on or near Natura 2000 or other conservation areas. The closest Natura areas are 5-6 kilometers away to northwest and southeast.

The closest ground water area, Ryötinsärkkä 2nd class reservoir, is located almost 3 kilometers to the north of the permit. Figure 3 shows the location of the Natura protection areas and ground water areas closest to the permit.

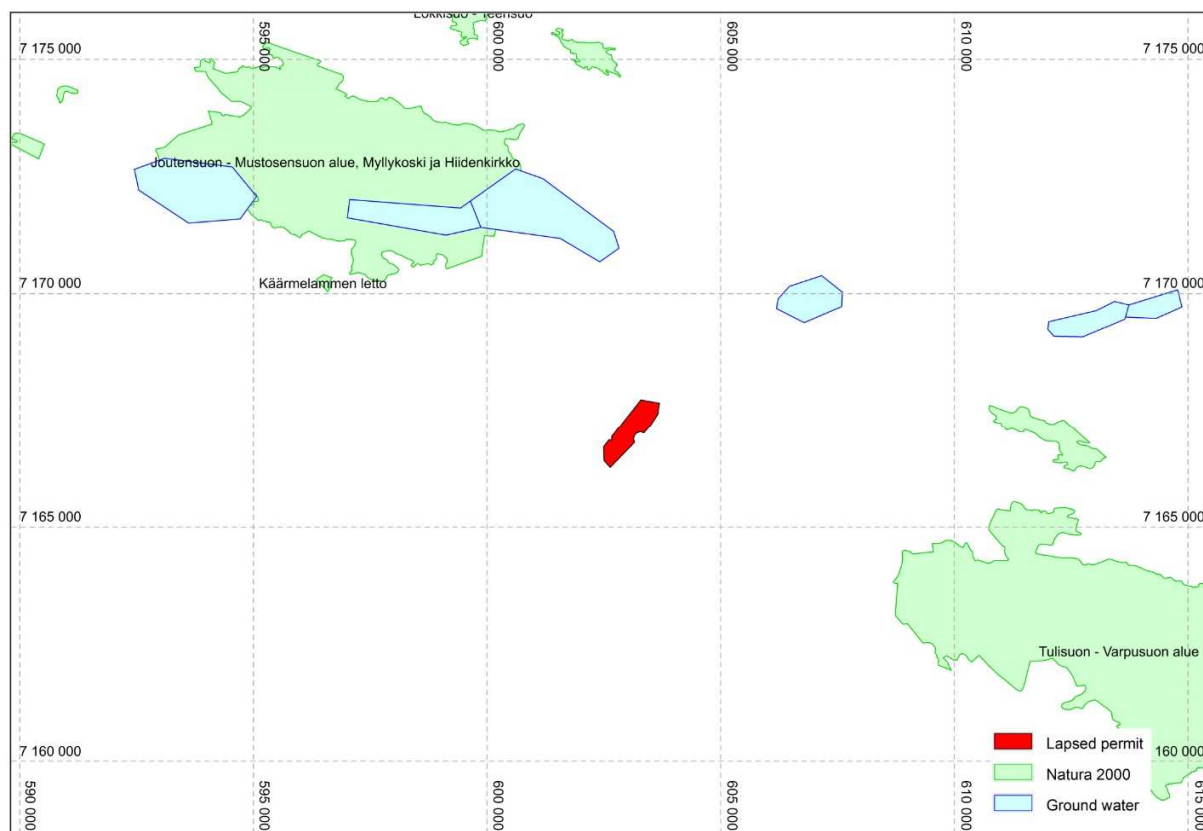


Fig 3. Lapsed permit, Natura 2000 and groundwater areas. Projection: ETRS-TM35FIN. Grid: 5000m x 5000m.

Sika-aho permit area is located on seven estates which are all owned by private landowners.

1.3 General geological description

The Hyrnsalmi Region is located at the centre of the Kuhmo greenstone belt and hosts two significant nickel occurrences called Sika-aho and Arola, and two poorly known occurrences called Riihilampi and Piiraisen Malmi.

The Sika-aho nickel deposit is hosted by sheared felsic, mafic, ultramafic rocks and minor graphitic schist within the western edge of the north-northeast trending Tammasuo Shear Zone. Regionally, the Tammasuo Shear Zone separates a sequence of mafic and minor ultramafic units in the east from a regional antiform comprising mafic rock overlain by a thick

ultramafic sill and a relatively thick komatiite sequence. To the west of Sika-aho the local geology consists of a multiply deformed synform of komatiite and chromian basalt. The nickel deposit is located a few metres west from talc-carbonate altered komatiitic cumulates and comprises a one to nine metre wide zone of massive sulphides developed over approximately 80 metres of strike length; disseminated and sheared over an additional 150 metres to the north-northeast. This occurrence extends at least 150 metres below surface with a dip of 85° to southeast (GTK, 1998 and 2002).

The host rock is often quartz rich and partially carbonated chlorite schist and has been interpreted as originating from the highly altered and contaminated basal portion of a komatiitic lava flow of pyroxenite composition. The XRF analysis on the komatiitic host rock indicates the origin as a possible distal part of a lava flow, MgO-content being 18.5 – 23.9 weight -% (normalised to volatile free). The host rocks are strongly silicified, however the high Ni:Cu ratio (>15:1) of mineralisation is consistent with a primary magmatic origin. Nickel tenor is 5-20% for nickel mineralisation grading over 0.5% and has wider variation from 3% up to 55% for lower grade (0.3-0.5% nickel) mineralisation. The principal sulphide minerals are pyrrhotite and pentlandite. Pentlandite occurs as individual grains and as intergrowths with, or as inclusions and flames within, pyrrhotite (GTK, 1998 and 2002).

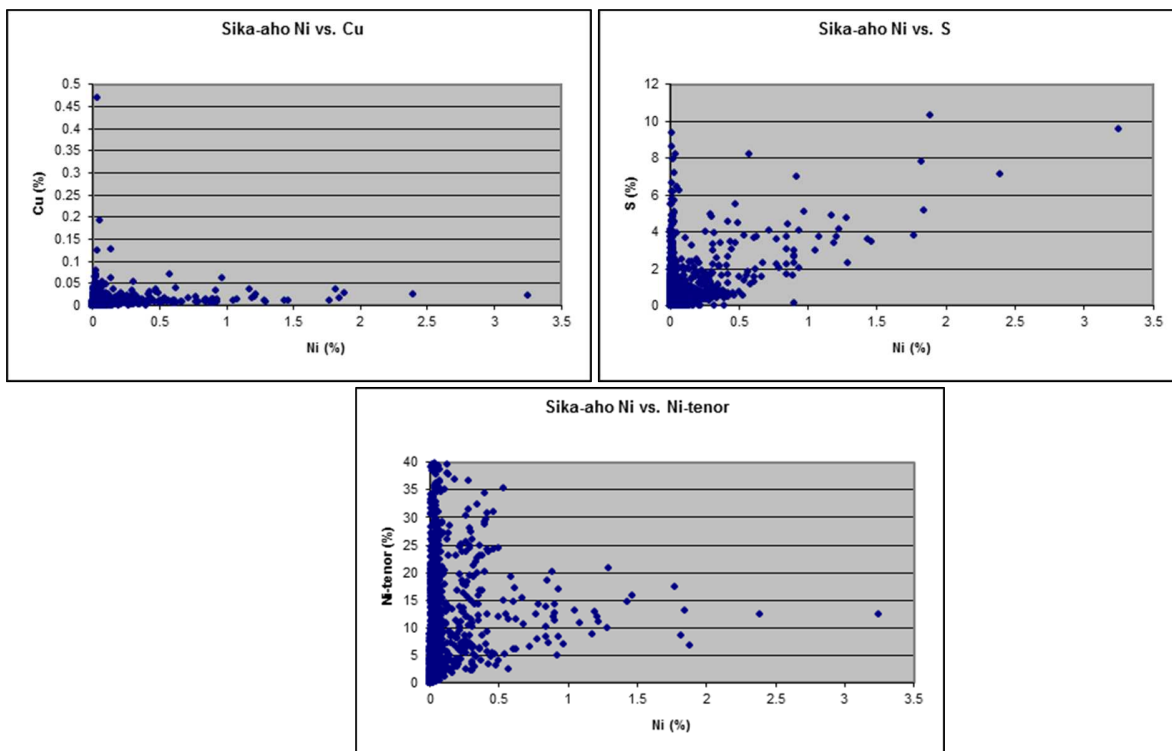


Fig 4. Diagrams on the Sika-aho assay data

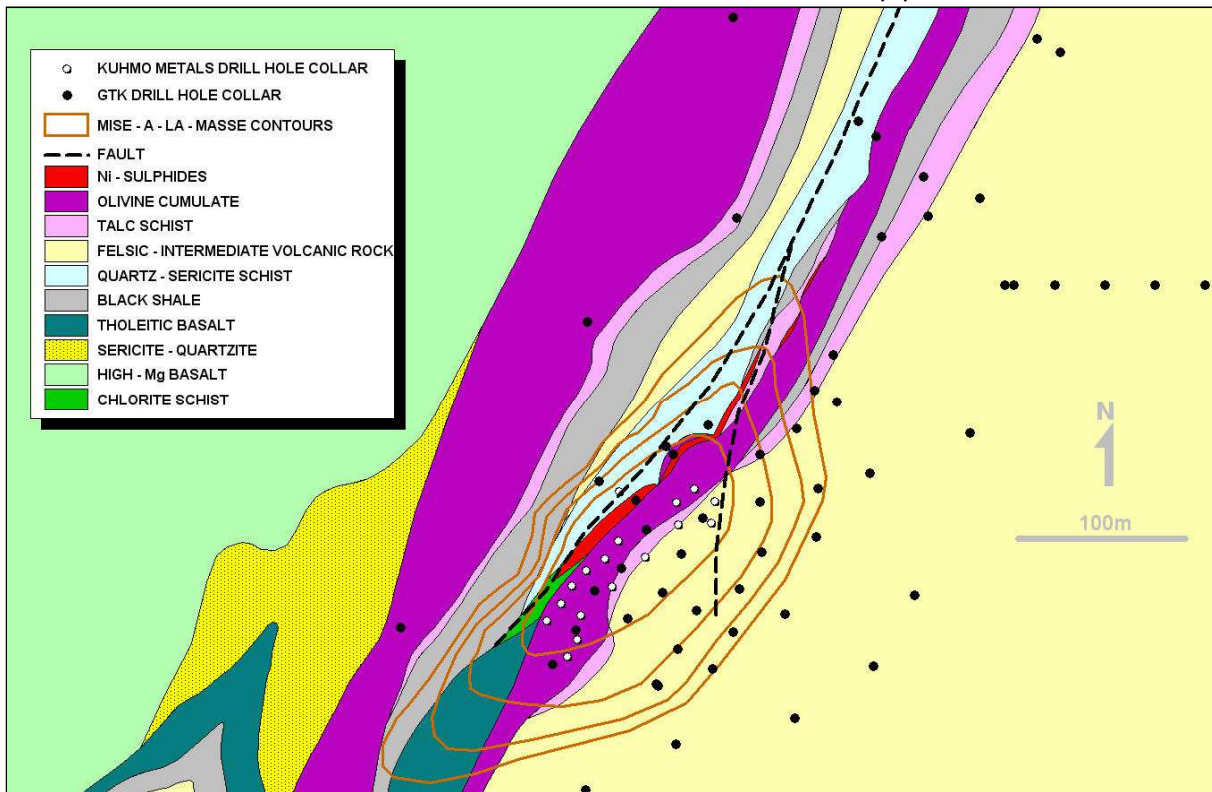


Fig 5. Geological map (modified after GTK, 1998) of the Sika-aho Ni-occurrence. Ni-occurrence is shown in red. Mise-a-la-Masse anomaly is shown as brown contours, Kuhmo's drill hole collars as white dots and GTK's drill hole collars as black dots.

2. EXPLORATION HISTORY

2.1 Previous exploration

No significant exploration for nickel was completed within the Sika-aho area prior to the 1990's when GTK completed bedrock mapping, magnetic and electromagnetic ground based surveys. Till geochemistry completed between 1993 and 1995 at a spacing of 16 samples per square kilometre showed the presence of gold and cobalt anomalies near Sika-aho that were followed-up with detailed till and bedrock sampling, ground geophysical surveys and shallow diamond drilling. The intersection of anomalous mineralisation in a single drill hole at Sika-aho was followed by infill drilling that established the presence of a nickel-anomalous komatiite unit. Total drilling at the Sika-aho deposit completed by the GTK is 75 diamond drill holes for 7,386.65 metres. Geophysical surveys completed include gravity, magnetic and Mise-a-la-masse methods.

The best intercepts at Sika-aho were encountered in holes R306 and R319, drilled by the GTK in 1994 – 1997, returned 7 metres @ 1.26% nickel and 3.74% sulphur and 8 metres @ 1.16% nickel and 4.86% sulphur respectively.

GTK completed a polygonal resource estimate based on a vertical cross section in 1998 which quotes 175,000 tonnes at 0.7% nickel down to 300 metres below surface (GTK, 1998).

2.2 Kuhmo Metals Oy and Boliden Kuhmo Oy exploration

Kuhmo Metals Oy, a Finnish subsidiary of Australian Altona Mining Ltd, was sold to Boliden in late 2014. The sell included all the tenement assets, exploration history and products of Kuhmo Metals and the staff. The company name was changed to Boliden Kuhmo Oy. The work completed by both companies are handled here as one.

Kuhmo Metals' work on expired permit has included MMI (Mobile Metal Ion) sampling, diamond drilling and aerogeophysics (figure 6). Since the active phase the work has mainly included in-house 3D modelling of the mineralisation and the key geological surfaces of the Sika-aho deposit. Once the nickel prices raced down in 2008 the work on the project was decreased to minimum. Figure 5 is showing all the exploration activities completed by Kuhmo Metals.

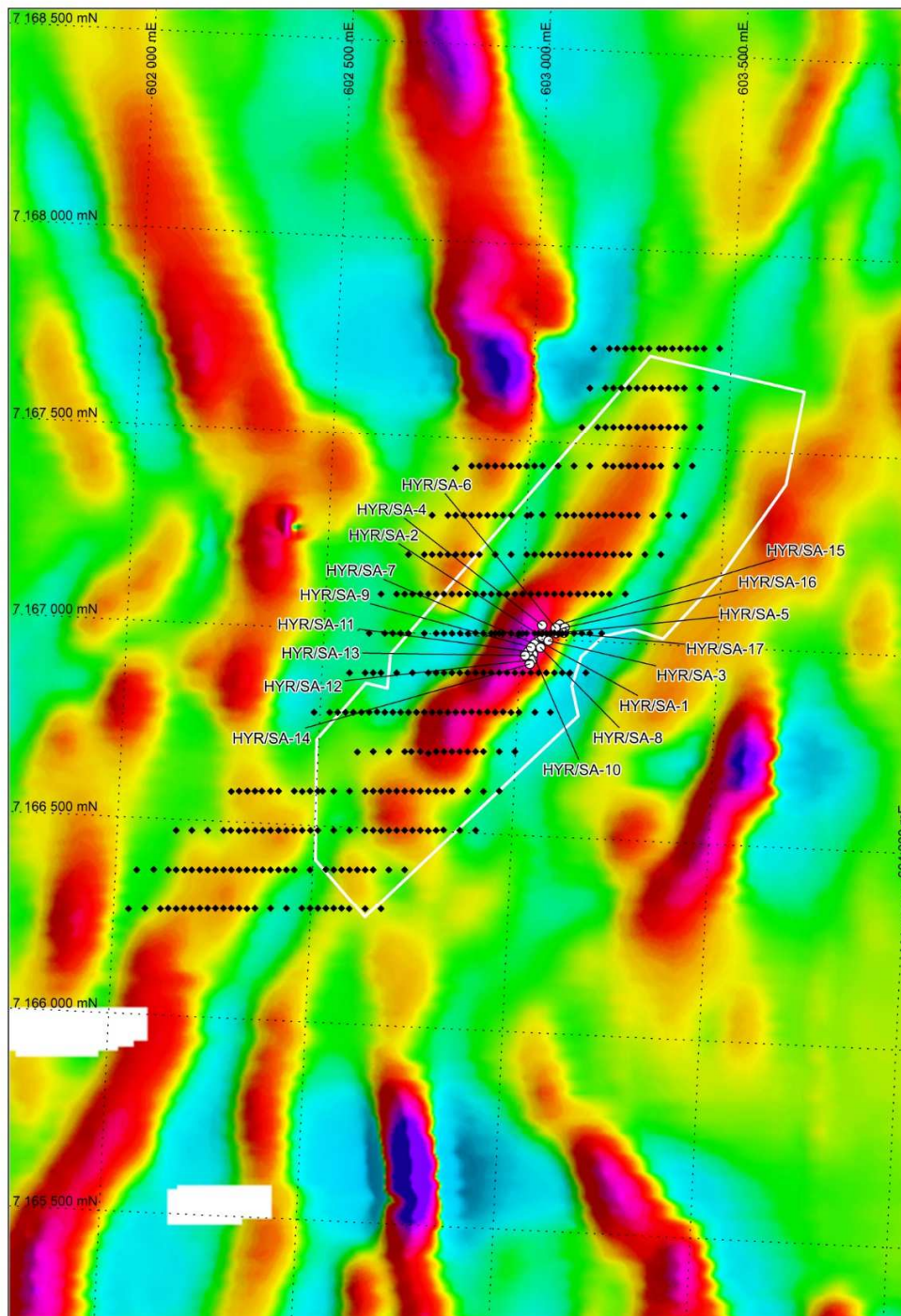


Fig 6. Sika-aho permit area (white polygon), drilling (white circles) and MMI sampling points (black diamonds) on a magnetic image (1VD) after VTEM survey. Projection: ETRS-TM35FIN. Grid: 500m x 500m.

2.2.1 Exploration results

Geophysics

VTEM

Sika-aho was part of large scale VTEM helicopter borne survey of the Kuhmo-Suomussalmi belt in 2008 (survey area 4 in the reports). The survey was contracted by Geotech Airborne Ltd. Interpretation of the results was conducted by Astrock Oy. VTEM survey was flown on 50 meter line spacing. Detailed information and results are attached in appendix 3.

LOW-ALTITUDE FIXED-WING SURVEY

A low altitude (30 m) EM and magnetic survey at 50 metre line spacing was contracted by the GTK in April 2005. The system used included an electromagnetic dual-frequency unit and a magnetometer. Airborne geophysical surveys in-filled the high quality data already acquired by Kuhmo from GTK and Outokumpu databases. The data was processed for Kuhmo Metals by Tapio Lehtonen from Astrock Oy. The work was contracted by the GTK. Detailed information and results are attached in appendix 3.

Geochemistry

MMI

MMI sampling was planned to cover the known deposit and its possible southern and northern continuations. The whole area was sampled at 100m line spacing and mainly at 20m sample intervals. The traverse on top of the known deposit was sampled at 10m sample interval. Sampling was completed in two phases during field seasons 2006 and 2007.

Results

Nickel results show three individual strong anomalies. Highest values (400 - 2600ppb) are situated west from the Sika-aho deposit and are possibly related to separate komatiite units from the known Sika-aho komatiites. This anomalous area has a strike extent of 700m and remains open to the north. The second anomaly (500 - 1300ppb) is located on top of the Sika-aho deposit and south from that. The anomaly is located on top of the deposit but it is weaker than the anomaly to the west. On the other hand the anomaly shows increasing values southwest from the drilled deposit along the Tammasuo shear zone. The third nickel anomaly (500 - 2200ppb) can be seen at the south-easternmost traverse of the area and it is clearly related to a magnetic anomaly.

Copper values are highest (500 - 1900ppb) north and north-west of the Sika-aho deposit where it is clearly related to the western contact zone of the magnetic anomaly which represents the komatiite unit west from the Sika-aho structure. These anomalously high copper values can be traced along the same lithology approximately 700m to south-west and are coincident with the nickel anomaly. The highest individual copper value is 7300ppb.

Palladium values have in general a moderate correlation with magnetic anomalies. Especially the western side of the Sika-aho komatiites is generally anomalous (2 – 9.7ppb), and anomalies are coincident also with nickel, copper, chromium and cobalt anomalies. There is also an anomaly (2.5 – 6.9ppb) coincident with sedimentary indicators, zinc, lead and cerium, at the south-west corner of the area. Palladium seems to have a strong negative correlation with organic sample material.

Chromium is generally anomalous on top and west of the Sika-aho deposit, where also nickel, copper, cobalt and palladium are anomalous. Highest individual value (3140ppb) is located in the south and on the top of a magnetic anomaly, being coincident with a nickel anomaly and therefore a strong indicator for ultramafic rocks.

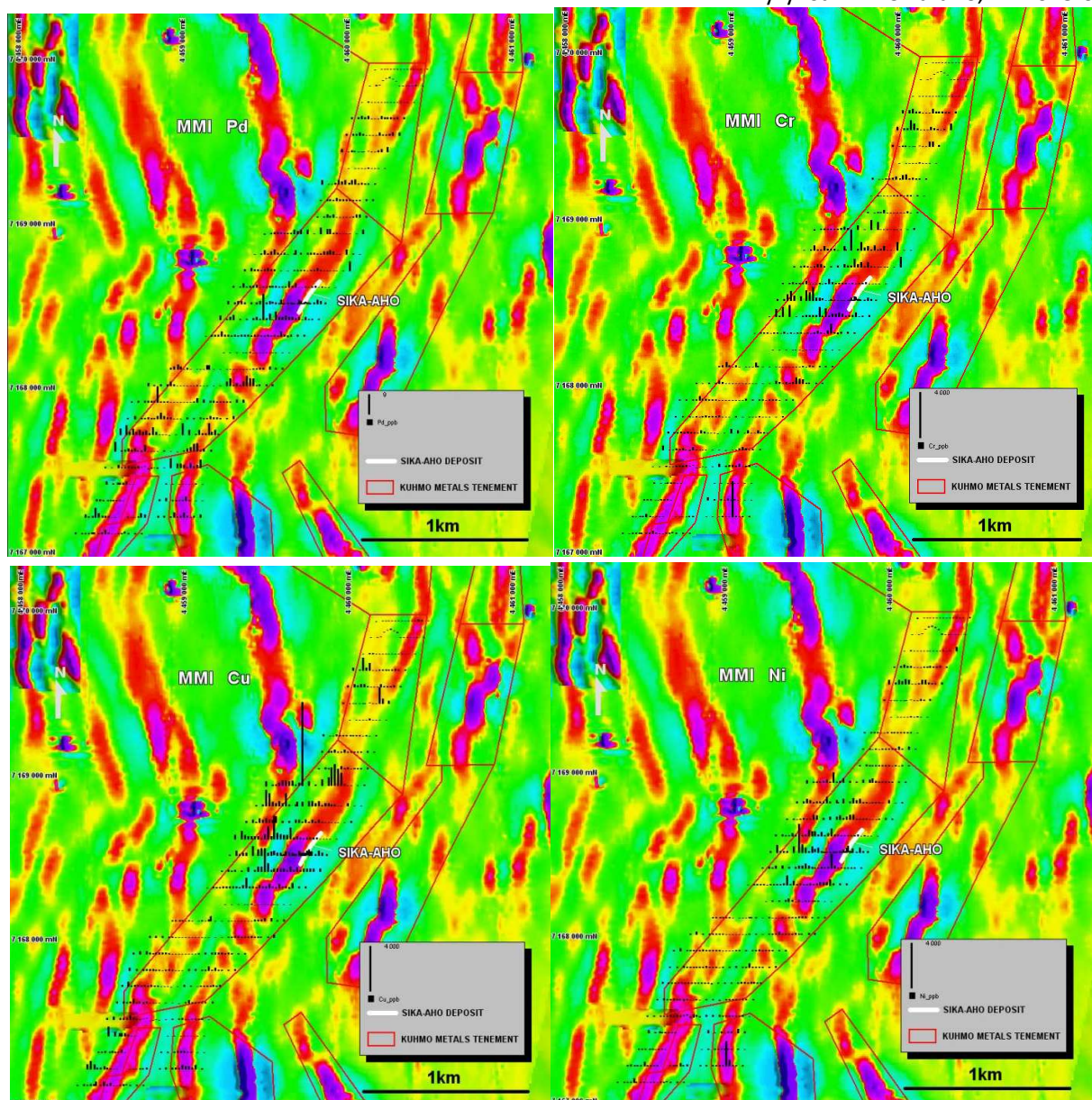


Figure 6: Raw assay data of Sika-aho / Moisiovaara MMI sampling programmes in 2006 and 2007 for Ni, Cu, Pd and Cr. Individual element ratios are shown as black histograms on top of magnetic image (VTEM 2008). Sika-aho deposit is shown as white trendline and label and Kuhmo's tenement status over the area in 2007 in red. Map grid is 1km x 1km.

Drilling

Kuhmo Metals Oy completed a 17 hole drilling programme at Sika-aho in 2007. Drilling was contracted by Geopale Oy and included 1044 metres of WL-66 coring (Table 1). The main objectives of the program were to in-fill GTK's drilling, increase understanding on geology, test the continuation of the mineralisation to the south and to obtain samples for possible

metallurgical testing. Fourteen drill holes intersected nickel sulphides. Mineralisation consists of banded pyrrhotite dominated sulphides with visible pentlandite, and is hosted by quartz-sericite-chlorite-carbonate (\pm fuchsite) mylonite. Mineralised zone is bordered by talc-carbonate rock to the east and unmineralised mylonite to the west. The semimassive portion of the deposit has approximately 100 metres of strike length, dips steeply to east and the thickness varies from 0.5m up to ~15 metres.

Highlights of the results include:

- Mineralisation extended some 20m to the south
- Longest intercept: HYR/SA-8: 17.85 metres at 0.76% nickel
- Highest grades: HYR/SA-2 : 0.50 metres at 4.39% nickel

Collar, survey, assaying and geological logging information with core photos and drill hole sections are attached in appendix 5.

Table 1. Drill hole collar information in Finnish KKJ4 projection of Kuhmo Metals Oy drilling.

Hole	Easting	Northing	Elevation	Azimuth	Dip	Length (m)
HYR/SA-1	4459690.6	7168505.7	210.9	300	-48.6	44.3
HYR/SA-2	4459698.8	7168516.3	210.6	300	-52.7	39.9
HYR/SA-3	4459714.8	7168506.4	210.2	300	-64.6	78.8
HYR/SA-4	4459699.3	7168545.6	210.3	117	-48.2	32.4
HYR/SA-5	4459734.7	7168525.8	207.9	300	-63.4	84.9
HYR/SA-6	4459733.1	7168539.1	207.8	300	-43.5	41.9
HYR/SA-7	4459679.3	7168498.4	211.7	300	-44.5	43.2
HYR/SA-8	4459694.9	7168488.9	211.5	300	-64.1	85.6
HYR/SA-9	4459670.9	7168489.6	211.4	300	-44.5	34.1
HYR/SA-10	4459676.1	7168471.8	210.9	300	-62.0	70.0
HYR/SA-11	4459664.1	7168478.9	211.2	300	-44.4	40.5
HYR/SA-12	4459674.1	7168457.5	211.2	300	-64.1	83.4
HYR/SA-13	4459655.6	7168468.8	211.2	300	-42.9	36.4
HYR/SA-14	4459667.8	7168447.4	211.3	300	-62.0	82.6
HYR/SA-15	4459743.9	7168547.3	206.6	300	-44.5	44.2
HYR/SA-16	4459756.6	7168539.8	205.4	300	-63.0	104.6
HYR/SA-17	4459754.3	7168526.8	206.5	300	-56.8	96.8
Total						1043.6

3. MINERAL RESOURCES

New mineral resource calculations on a lapsed permit haven't been conducted by Boliden.

4. FOLLOW-UP

Boliden Kuhmo has decided to relinquish the permit on expiry.