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Olavi Kontoniemi
Juha Mursu
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Hirsikangas gold prospect in Himanka, western Finland,

Claim areas Hirsi 1 and 2 (7847/1 and 8036/1)

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The Hirsikangas gold prospect in Himanka, western Finland, claim areas Hirsi 1 and 2 (7847/1 and 8036/1)

Abstract

The Hirsikangas gold prospect is located in the municipality of Himanka in Western Finland, about 40 km NE of the Kokkola-city. Geological Survey of Finland has explored the area during 2004-2006. Exploration included boulder tracing, bedrock mapping, petrological and mineralogical studies, geophysical surveys and diamond drilling (4094 m).

The study area is situated within the Bothnian schist belt (Himanka volcanites) and also in the NW-part of the Paleoproterozoic Raahe-Ladoga deformation zone. The bedrock of the Hirsikangas area consists mainly of mica schist, mafic and ultramafic volcanites and felsic schist (host rock of the prospect). Regional prograde metamorphism took place in amphibolite facies.

Structurally, dextral folding possibly associated with a strike slip shearing system is perhaps the most significant source of the dilational structures focusing fluid flow. Hydrothermal alteration is moderately strong compared to other Svecofennian gold occurrences and two types of alteration occur: ductile sericite-quartz-K-feldspar-carbonate –alteration and more brittle quartz-chlorite-epidote-biotite –alteration. Principal ore minerals are pyrrhotite, arsenopyrite and löllingite with accessory ilmenite, sphalerite, chalcopyrite, scheelite and gold. Gold and related minerals occur typically at boundaries or fractures of silicate minerals but rarely also associated with sulphide minerals. The mineralogy and chemistry of the prospect suggest that the prospect represents a relatively high level of the fluid system.

Ductile-brittle sheared en echelon ore lenses are vertical and plunge gently to SE. The two best intersections are in DH 316 and 324. First (DH 316) is 80.2 m at 1.7 ppm Au including 7 m at 6 ppm Au and second 7.4 m with an average Au-content of 9.2 ppm. With a rough calculation the most dense drilled part of the prospect gives about 2 Mt indicated and inferred resources at 1.85 ppm Au.

GTK has made the “Environmental baseline report” of the Hirsikangas prospect area (in Finnish).

Keywords

Himanka, Hirsikangas, gold prospect, exploration, claim, geological mapping, geophysical surveys, drilling

Geographical area

Finland, Western Finland province, Himanka, Hirsikangas

Map sheet

2413 07 and 10

Other information

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The Hirsikangas gold prospect in Himanka, western Finland, claim areas Hirsi 1 and 2 (7847/1 and 8036/1).
Hirsikankaan kultaesiintymä Himangalla, Länsi-Suomessa, valtausalueilla Hirsi 1 ja 2 (7847/1 ja 8036/1).</td></tr>
<tr><td colspan="4">Tiivistelmä
Hirsikankaan kultaesiintymä sijaitsee Himangan kunnassa n. 7 km itäkaakkoon kuntakeskuksesta karttalehdellä 2413 10. GTK teki alueella kultatutkimuksia vuosina 2004-2006. Ne käsittivät lohkare-etsintää, kallioperäkartoitusta, petrologisia ja mineralogisia tutkimuksia, geofysikaalisia mittauksia ja syväkairausta (yht. 4094 m).
Esiintymä sijaitsee Himangan vulkaniittijaksolla ja samalla ns. Raahe-Laatokka –vyöhykkeen luoteisosassa. Alueen kallioperä koostuu pääasiassa kiilleliuskeesta, mafisesta ja ultramafisesta vulkaniitista ja felsisestä liuskeesta (esiintymän isäntäkivi). Kivilajit ovat metamorfoituneet amfiboliittifasieksen oloissa.
Rakenteellisesti ympäristöä luonnehtivat kulun suuntainen hiertosysteemi ja siihen liittyen oikeakätinen poimuttuminen esiintymän NW-puolella. Hierto on sekä plastista että haurasta ja se on luonut yhdessä poimuttumisen kanssa suotuisia avautuvia rakenteita malmifluideille. Muuttuminen on kohtalaisen voimakasta verrattuna svekofennisiin esiintymiin yleensä ja sitä on periaatteessa kahta tyyppiä: plastisiin rakenteisiin liittyen serisiitti-kvartsikalimaasälpä-karbonaatti –muuttumista ja hauraaseen rakoiluun liittyen kvartsi-kloriitti-epidootti-biotiitti –muuttumista.
Tyypillisiä malmimineraaleja esiintymässä ovat magneettikiisu, arseenikiisu, löllingiitti ja grafiitti sekä harvemmin esiintyvät ilmeniitti, sinkkivälke, kuparikiisu, scheeliitti sekä kulta seuralaismineraaleineen. Kulta seuralaisineen esiintyy yleensä silikaattimineraalien väleissä ja raoissa, mutta harvemmin myös sulfidimineraalien yhteydessä. Esiintymän mineralogia (karkea kulta, metallinen antimoni) ja kemismi viittaavat siihen, että ollaan suhteellisen ylhäällä fluidisysteemissä.
Plastisesti ja hauraasti hiertyneet malmilinssit ovat pystyasentoisia ja painuvat loivasti kohti kaakkoa. Kaksi parasta malmilävistystä ovat rei'issä 316 ja 324. Ensimmäisessä kullan keskipitoisuus 80.2 m:n lävistyksessä on 1.7 ppm sisältäen paremman 7 m:n osan pitoisuudella 6 ppm ja jälkimmäisessä 7.4 m:n matkalla 9.2 ppm. Tiheämmin kairatussa osassa perinteisellä profiiliarviolla tehdyn laskennan tuloksena esiintymässä on karkeasti arvioiden malmivaroja n. 2 Mt keskipitoisuudella 1.85 ppm Au.
GTK on tehnyt tutkimusalueesta suomenkielisen ympäristön perustilaselvityksen.</td></tr>
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Himanka, Hirsikangas, kultaesiintymä, malminetsintä, valtaus, geologinen kartoitus, geofysikaaliset mittaukset, syväkairaus</td></tr>
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Contents

1 INTRODUCTION

The Geological Survey of Finland (GTK) is Finland’s national geoscience agency. As the key government agency involved in the mineral resources sector, GTK is also active in promoting mineral exploration and mining in Finland. GTK's core activities range from geological mapping, through exploration, evaluation, and processing of natural resources, with a strong research effort in analysis of geological processes and mineral systems as well as in development and application of exploration and benefication technologies. GTK’s vision is to evolve into a European centre of excellence for natural resources and their sustainable use and to consolidate its role as the national geoinformation centre. GTK maintains a careful balance of resources between its primary responsibilities for public domain mapping and geodata management, technological and conceptual research and development, and provision of commercial services to both public and private sector clients. GTK´s services are to a large extent based on methodologies and technical solutions developed and tested in house before being adapted to commercial projects. GTK is currently contributing to some twenty R&D projects within the European Commission and various other science and technology projects in different fields of earth sciences.

The Geological Survey of Finland operates under the Ministry of Trade and Industry and has been established in 1885. GTK’s main office is located in Espoo, near Helsinki, and has regional offices also in Kuopio, Kokkola and Rovaniemi. It has a permanent staff of 800, including about 300 geologists, geochemists, chemists and geophysicists.

One of the main duties of the Geological Survey of Finland is to promote mineral exploration and mining in Finland. GTK is responsible for acquisition and management of geoscience information in Finland, with a particular emphasis on to providing high quality data to the exploration and mining sector. Through a comprehensive mapping and research program, GTK also identifies and documents areas with mineral potential, in order to encourage follow-up exploration and exploitation by the private sector, with the aim of supporting sustainable use of both bedrock resources and surface deposits. All GTK discoveries are offered to the private sector through an open tendering process arranged by the Ministry of Trade and Industry. Neither the Finnish Government nor GTK have any role in the downstream development of mineral deposits.

Finland can be considered an attractive exploration target in many respects. Geoscientific data coverage is excellent, but large areas can be considered underexplored. Finland is a modern, western EU country, which has a highly educated population and very highly developed infrastructure with good port facilities, an extensive high-voltage power grid and a comprehensive road and airport network.

GTK offers the minerals industry expertise in Fennoscandian economic geology, as well as confidential, client-tailored exploration services, including geophysical surveys and modern chemical, mineralogical and mineral processing laboratory services, both within Finland and worldwide.

GTK started exploration at Hirsikangas in the year 2004 as a part of a 4-year’s project “Exploration for gold in Central Finland”. The aim of this project is to explore gold resources and to find new gold potential areas in the Central Finland region. The first indication of the gold mineralisation in the Hirsikangas area was a gold bearing (3.6 ppm) boulder (Fig. 1), which was found by Kari Ahlholm (layman) in the autumn 2003.

Figure 1. Gold bearing felsic schist boulder about 2 km SE from the Hirsikangas outcrop area. The whole boulder is seen in the small figure and the length of a compass in the bigger figure is 12 cm.

In the autumn 2004, after two days boulder tracing the Hirsikangas outcrop area with the same lithology as the reference boulder was found. The mineralisation was located after geophysical ground measurements and drilling program during 2004-2006.

Gold has been occasionally (especially after 80's) actively explored in the Ostrobothnia by GTK and by some exploration companies (Outokumpu, Belvedere Resources etc.). The most significant deposits are Laivakangas in Raahe (Nordic Mines) and Kopsa in Haapajärvi (Belvedere Resources) (Fig. 2).

The status of the Hirsikangas occurrence is at this moment a prospect mostly because of a sparse drilling grid. GTK's decision to offer this target after very short (2 years) exploration work to international tender is based on the encouraging geological and geophysical results. Strongly sheared and altered host rock (felsic schist) is throughout mineralised and the length of the mineralisation is at least 800-1000 m.

2 GEOGRAPHY AND GENERAL DESCRIPTION

2.1 Location, access and infrastructure

The Hirsikangas gold prospect is located in the municipality of Himanka in Western Finland, about 40 km NE of the Kokkola-city (Fig. 2), at Lat. 64.0479, Long. 23.8018 (decimal degrees), Finnish KKJ Zone 2 coordinates 7105350N and 2490500E. The municipality of Himanka (Fig. 3) has a total population of about 3200, of whom about 1000 live in the centre of Himanka.

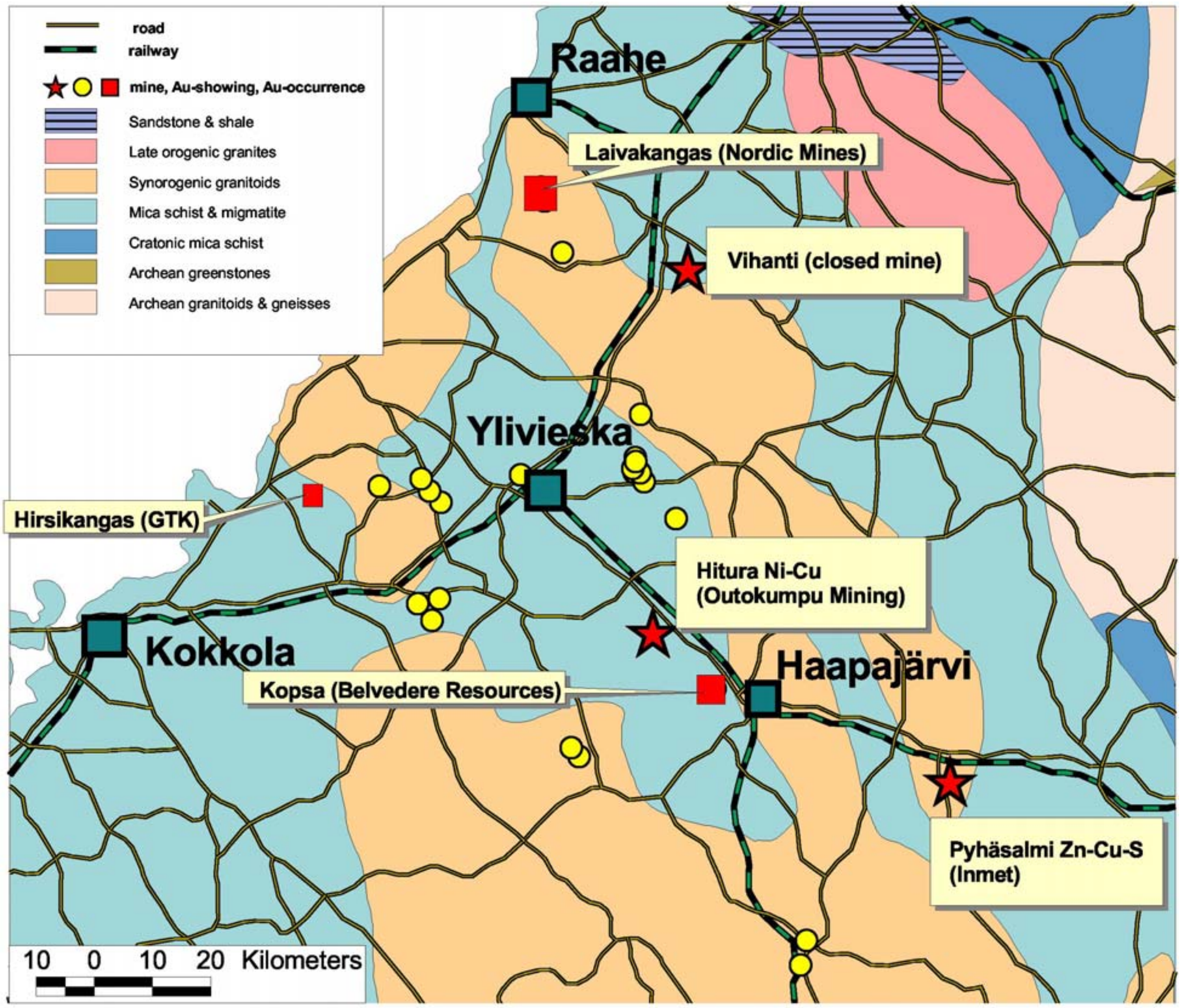

Figure 2. Location of the Hirsikangas prospect and other gold occurrences, showings and base metal mines. The bedrock map is simplified after Korsman et al. (1997).

The claims (Fig. 3 and 4) of Hirsi 1 and 2 (Hirsikangas prospect) are located on the national 1:20000 map sheets 2413 07 and 2413 10. Access most easily to the Hirsikangas is about 3.5 km from the centre of Himanka (highway 8) by a paved road and then south 5 km by a timber haulage gravel road, which is used all the year round by heavy vehicles. The nearest railway station is at Kannus (about 30 km south), a high voltage power line at Himanka (5 km NW) and the distance to Kokkola airport (Kruunupyy) is 60 km.

2.2 Titles

GTK currently has two claims for exploration in the Hirsikangas area, covering 152.6 hectares together (Table 1, Fig. 3 and 4). Besides this only Belvedere Resources has claims in this region, about 10 km east at the Hietajärvi gold showing. All the land within Hirsikangas area is privately owned.

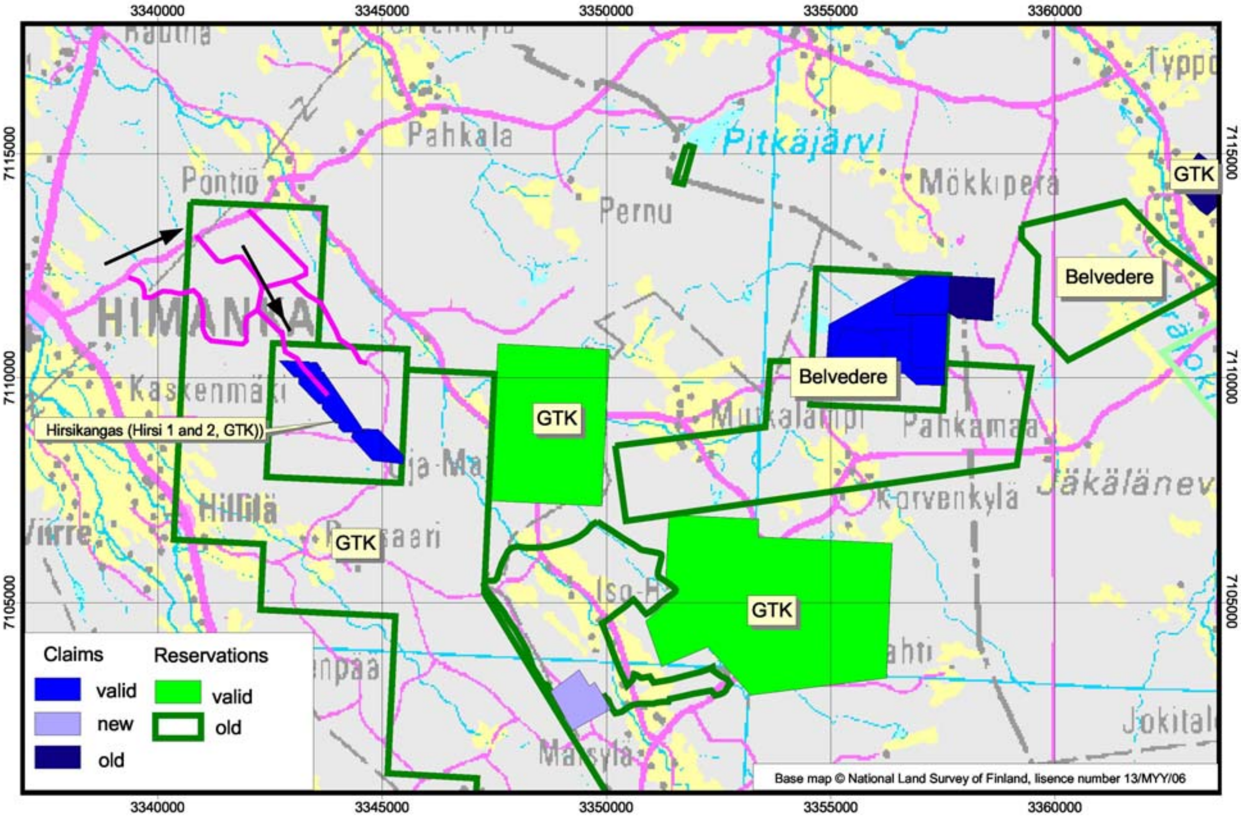

Figure 3. Claims, reservations and infrastructure nearby the Hirsikangas gold prospect.

Table 1. Claims at Hirsikangas.

Name	Register number	Map sheet 1:20000	Area (hectares)	Reg. Date	Expiry date
Hirsi 1	7847/1	2413 07, 10	99.7	15.11.2004	15.11.2009
Hirsi 2	8036/1	2413 10	52.9	08.11.2005	08.11.2010

A claim entitles (exploration licence) the holder (individual or company) to carry out exploration activities in the claim area with or without the consent of the landowner. The claimant must, however, compensate the landowner in full for any permanent or temporary damage or inconvenience caused by the exploration activities inside or outside the claim area. The claimant shall also act in compliance with environmental legislation and other laws and regulations.

2.3 Physiography, climate and vegetation

The Hirsikangas occurrence is located in an area with gently sloping moraine hills and boggy land between them. A deep, excavated drain (Jänesjärvenoja) runs through the area. Mostly the study area lies 34-36 m above see level (asl) and the highest knolls reach 40 m asl. Outcrops are quite abundant in the moraine area and based on diamond drillings the bedrock is usually covered by an overburden of 1 – 10 m (mean slightly over 4 m). The overburden consist mostly of sandy till and locally also of peat. The thickness of the peat varies 0.5 – 2 m in the boggy area.

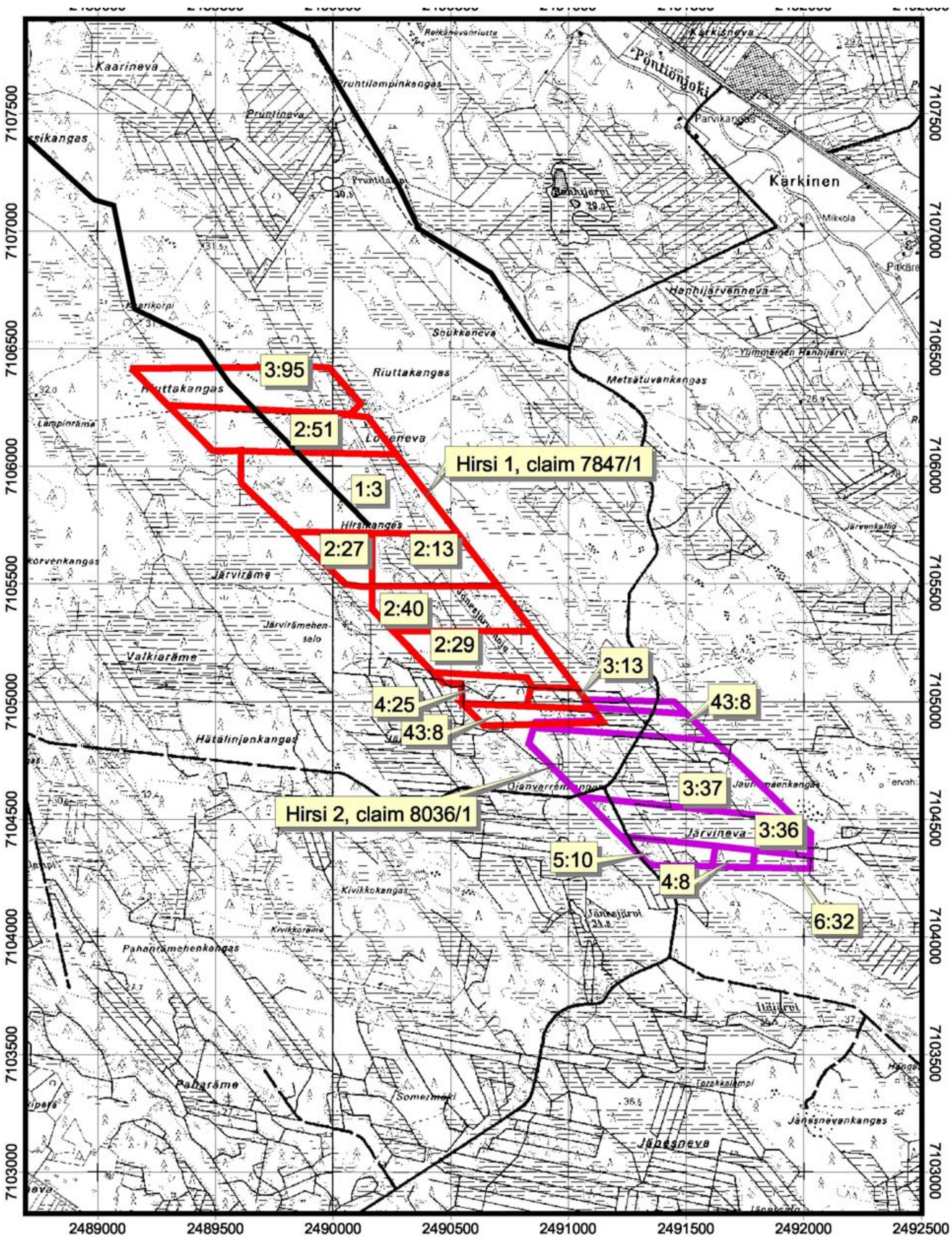

Figure 4. Location of the claims Hirsi 1 and 2. Register numbers of the estate in woodland are shown. Base map © National Land Survey of Finland, lisence number 13/MYY/06.

Weather conditions follow the typical northern Fennoscandian climate, with a temperate summer and cold winter. The temperature is mostly between 10 and 25 ^{o}C (mean in the western Finland 14.5 ^{o}C, *www.ilmatieteenlaitos.fi*) during the summer months (June – August) and between 0 and –30 ^{o}C (mean –8.9 ^{o}C) during the winter months (December – February). The average annual rain amount is between 500 and 550 mm in the Himanka region. The terrain is covered by snow for 5-6 months during the winter and at that time bogs, small rivers and lakes are frozen.

Most of the study area is forested with pine, spruce and birch. There are some areas reforested with pine or spruce and the age of saplings varies from 5 to 30 years. Besides the stumpy pines in the boggy land there crow twigs, mosses and various types of grass.

2.4 Property history

In the region of Hirsikangas a few old low-grade gold indications exists, but they have not lead to any exploration work. About 8 km SE from Hirsikangas an outcrop area (Isokallio – Matalatkalliot) of plagioclase porphyritic subvolcanic rock with arsenopyrite-bearing shears was discovered. Mr. Porko (layman) has sent to Outokumpu in the beginning of 90’s one gold-bearing boulder about 600 m NW of Hirsikangas.

The first indication of the Hirsikangas gold mineralisation was a gold bearing (3.6 ppm) boulder (about 2 km to SE, Järvineva), which was found by Kari Ahlholm (layman) in the autumn 2003. In the autumn 2004, after two days boulder tracing the Hirsikangas outcrop area with the same lithology as the reference boulder was found. The mineralisation was located after geophysical ground measurements and drilling program during 2004-2006.

3 REGIONAL GEOLOGY

3.1 Geological setting

The bedrock of Finland is divided into two main areas: eastern Karelian and western Svecofennian domain (Korsman et al. 1997). The simplified bedrock map is seen in the figure 5. The Hirsikangas prospect is located within the Svecofennian area, which is composed of three different arc complexes and of the central Finland granitoid complex. The prospect area belongs also to the so-called Raahe-Ladoga zone (i.a. Korsman 1988, Ekdahl 1993), which runs parallel to the Archean craton margin and represents the product of complex Paleoproterozoic subduction and collision processes (Gaál 1986 and 1990). The Raahe-Ladoga deformation zone is divided into different shear zones especially in the NW-part of the zone and is the most important sulphide ore zone of Finland.

The Savo schist belt consists of moderately to strongly metamorphosed, in places also intensively sheared Paleoproterozoic rocks (Kousa et al. 2000). The supracrustals are mostly migmatised mica gneisses intercalated with minor quartz-feldspar gneisses, graphite schists and aphibolites of volcanic origin and locally with some dolomite and skarn. Volcanic rocks (mainly felsic and mafic) have only limited extension, but host numerous massive sulphide deposits (Pyhäsalmi, Vihanti). The Bothnian schist belt is dominated by metamorphosed greywackes and pelites of turbiditic origin (Kousa et al. 2000). The greywackes contain thin elongated intercalations of mafic to intermediate metavolcanic rocks. Only in few places felsic or ultramafic volcanites occur.

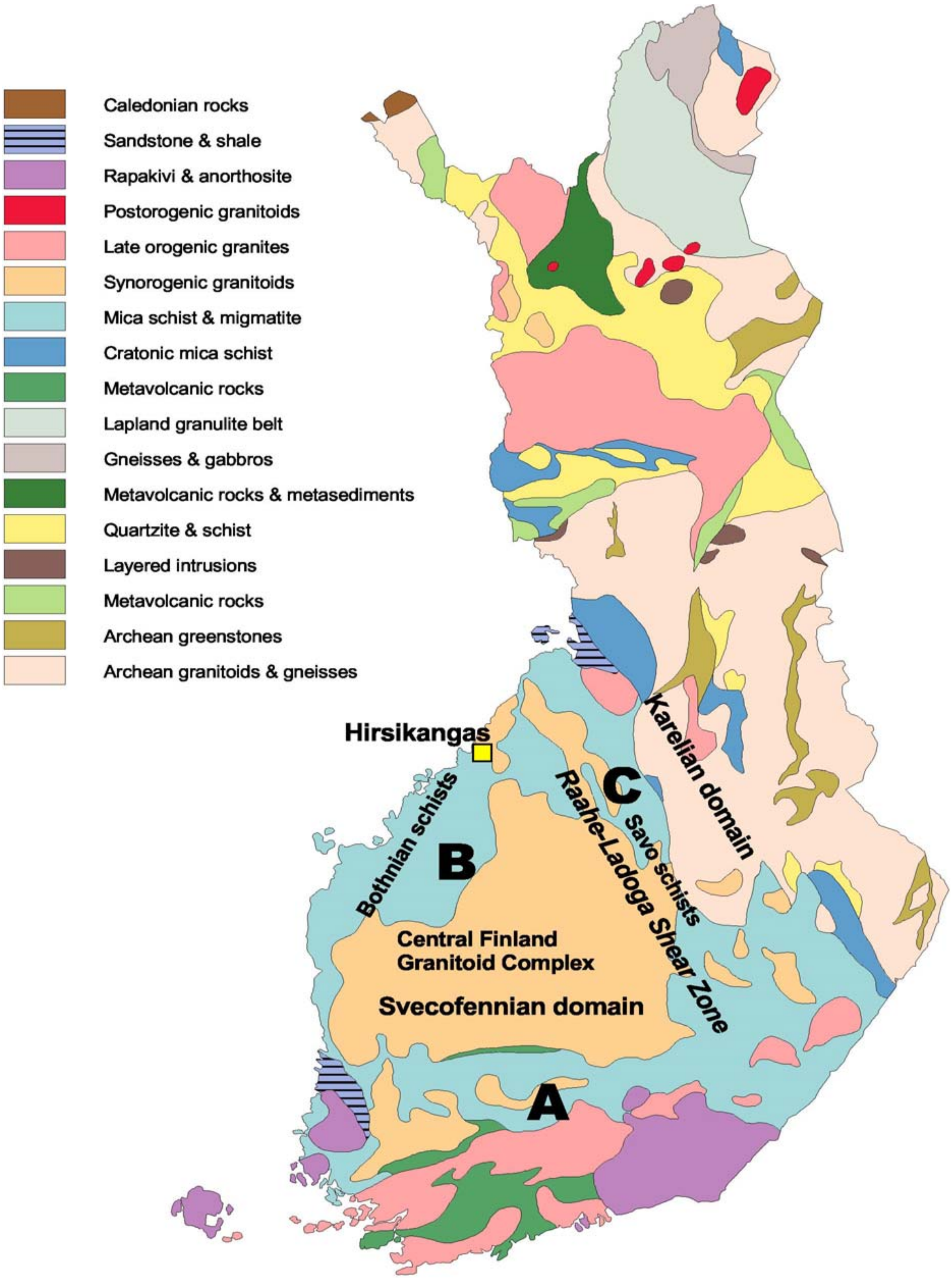

Figure 5. Geological setting of the Hirsikangas prospect on the bedrock map of Finland. Simplified after Korsman et al. (1997). A = accretionary arc complex of southern Finland, B = accretionary arc complex of central and western Finland, C = primitive arc complex of central Finland.

3.2 Economic geology

In the vicinity of the Rautio batholith (Figs. 2 and 6) gold exploration has been done during the last decades by the Rautaruukki company, Outokumpu company and Geological Survey of Finland. Many small showings (Fig. 6) have been found, but only one subeconomic Cu-Co-Au-occurrence (Põllä or Jouhineva). Data concerning the gold showings and occurrences of Finland are available in a public GTK's FINGOLD database, which is attainable at the GTK's www-address *http://en.gtk.fi/ExplorationFinland/Commodities/Gold.html*.

4 EXPLORATION

4.1 Current exploration programme

GTK started exploration at Hirsikangas in the year 2004 as a part of a 4-year's project "Exploration for gold in Central Finland". The aim of this project is to explore gold resources and to find new gold potential areas in the Central Finland region. The first indication of the gold mineralisation in the Hirsikangas area was a gold bearing (3.6 ppm) boulder, which was found by Kari Ahlholm (layman) in the autumn 2003. In the autumn 2004, after two days boulder tracing the Hirsikangas outcrop area with the same lithology as the reference boulder was found. The mineralisation was located after geophysical ground measurements and drilling program during 2004-2006.

The exploration work at Hirsikangas was carried out by Olavi Kontoniemi (research leading, mapping, drilling), Juha Mursu (geophysics), Jorma Isomaa (mapping), Rauli Lempiäinen (boulder tracing, assistance) and Hannu Koskivuori (boulder tracing, assistance).

GTK started exploration in the autumn 2004 by boulder tracing, ground geophysical measurements and first stage diamond drilling. After this work a gold potential horizon was located and the best intersection (DH 304) was 5 m / 3 ppm gold. In 2005 – 2006 the drilling was continued by other four stages (table 2), and at the same time was made bedrock mapping and extra geophysical measurements in the study area.

4.2 Exploration techniques and results

Boulder tracing and geological mapping

Boulder tracing and preliminary outcrop mapping were the first reconnaissance stage exploration methods used in the area of Hirsikangas. The work was made mainly in the claim areas but also southeast from Hirsikangas as far as in the region of the Märsylä village. Geological mapping was made only in the claim areas Hirsi 1 and 2. In all 46 (54 assays) boulder observations and 69 outcrop observations (11 assays) were made (see Figs. 7 and 8). Samples from boulders were taken by hammer and from outcrops by a small drill machine (mini-drill). Results of assays are listed in the related material (CD-ROM) of this report.

Diamond drilling, sample preparation and assays

Diamond drilling was made partly with T-56 (core 42 mm) and partly with wire line equipment (40 mm) (table 2). Location of the drill holes was measured with CPD-RTK-GPS (Carrier Phase Differential – Real Time Kinematic – GPS) with under 0.1 m's accuracy. For assays each core was halved with a diamond saw, and divided usually into one metre long samples. Samples (1604) were crushed at the Kuopio laboratory of GTK by a Mn steel jaw crusher and pulverised by a ring mill with a carbon steel bowl.

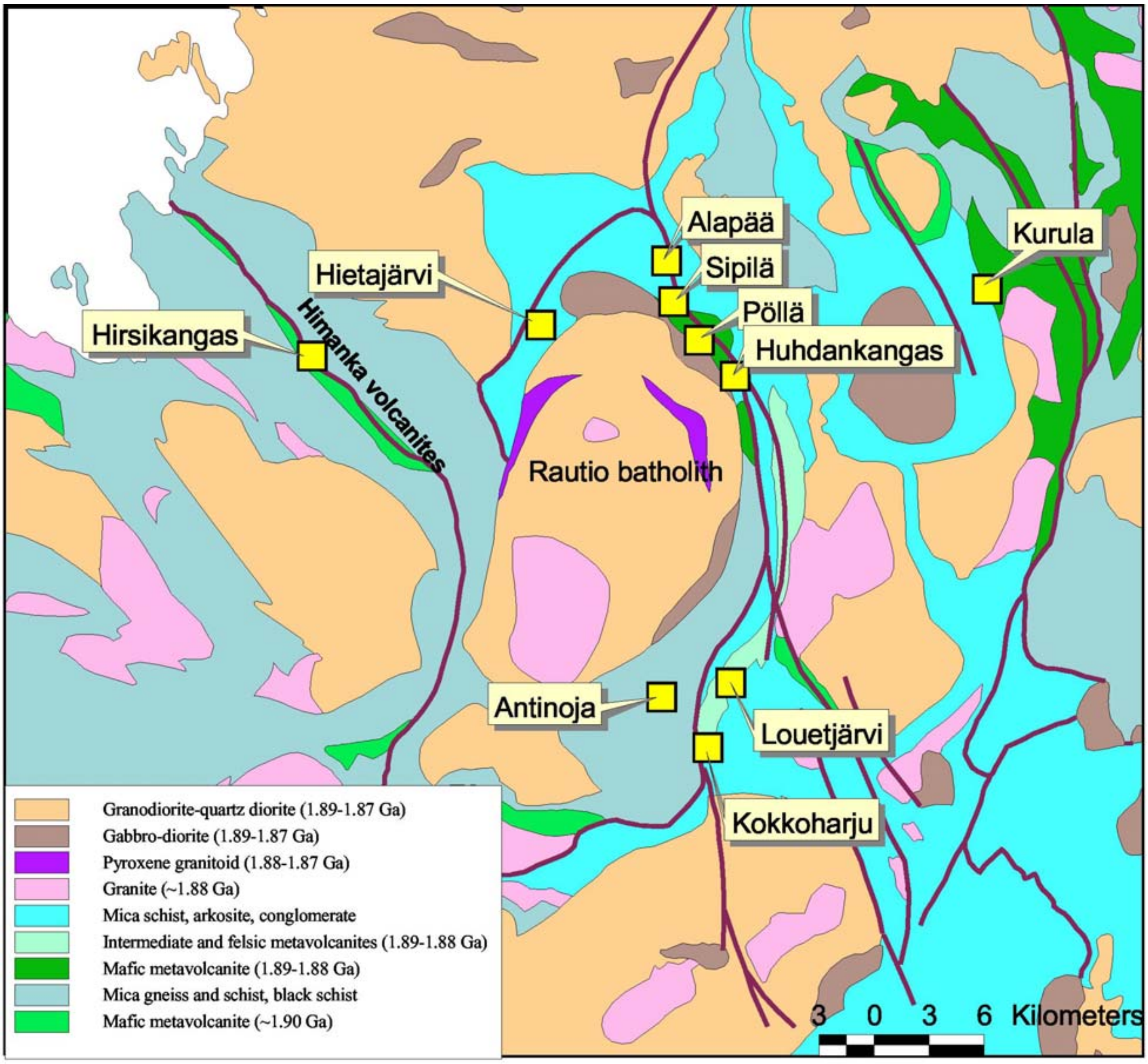

Figure 6. Gold showings and occurrences in the vicinity of the Rautio batholith. Deformation zones (mostly shear zones) are shown by purple lines. Geology after Korsman et al. (1997).

Table 2. Diamond drilling at Hirsikangas.

Period	**Contractor**	**Holes**	**Core (mm)**	**ID-numbers**	**Total (m)**
29.11.2004 – 13.01.2005	Geotek Oy	9	42	301 – 309	1052.20
29.08.2005 – 23.09.2005	Arctic Drilling	8	40	310 – 317	995.05
26.10.2005 – 16.11.2005	Oy Kati Ab	6	40	318 – 323	1195.20
20.03.2006 – 09.05.2006	GTK	5	42	324 – 328	460.10
13.06.2006 – 05.07.2006	GTK	4	42	329 – 332	391.70
Total		**32**			**4094.25**

Each mineralised sample with following elements were analysed by GTK method 511P, which is based on ICP-AES technique with aqua regia digestion: Ag, Al, As, B, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, K, La, Li, Mg, Mn, Mo, Na, Ni, P, Pb, S, Sc, Sr, Ti, V, Y and Zn. In the beginning (DH 301-309) gold and related elements (Bi, Sb, Se, Te) were analysed by GTK method 523U (20 g, aqua regia digestion, Hg-coprecipitation, GFAAS) and also the samples from DH 310-312, 318 and 324-332 were analysed by the same method. Best intersections of DH 301-309 and all samples from DH 314-317, 319-323 were analysed by GTK method 703P (sample 10-15 g) or 705P (sample 50 g). The codes mean a method, where gold is determined by the ICP-AES technique after fire assaying. Bi, Sb, Se and Te of those samples were analysed by GTK method 511U (GFAAS, sample 0.15 g).

Outcrop and boulder samples were analysed by the method 511P, and gold and related elements by the method 523U.

For whole rock analyses 17 samples, mainly sulphide-poor ones, were taken from the drill cores and crushed in a Mn steel jaw crusher and pulverised in a tungsten carbide bowl before analyses by the GTK method 175X (pressed powder pellets). The following compounds and elements were determined: Na_2O, MgO, Al_2O_3, SiO_2, P_2O_5, K_2O, CaO, TiO_2, MnO, Fe_2O_3, S, Cl, Sc, V, Cr, Ni, Cu, Zn, Ga, As, Rb, Sr, Y, Zr, Nb, Mo, Sn, Sb, Ba, La, Ce, Pb, Bi, Th and U.

From the drill cores were made 47 polished thin sections at GTK's Kuopio laboratory and microanalyses of gold and related ore minerals were performed on 7 polished thin sections at the Espoo laboratory using a Cameca SX50 microprobe. The acceleration potential was 20 kV and the current strength 30 nA with 1 μm diameter of the electronic beam.

Digital photos of three drill cores (DH 307, 315 and 322), all results like chemical analyses, drill core reports, drilling profiles and microanalyses are in the related material (CD-ROM) of this report.

Geophysical surveys

Regional geophysical surveys

GTK carried out regional low altitude airborne measurements in the area of map sheet 2413 in the year 2000 employing magnetic, electromagnetic and radiometric methods. The prospect area and its surroundings are thus well covered, and low altitude surveys now extend to almost the whole of Finland. The map of aeromagnetic total component data covering the Hirsikangas prospect area and its surroundings is shown in fig. 7.

Locations, staked lines

Line staking was carried out in two stages corresponding to the phases of the geophysical survey. The first stage took place in October-November 2004 and the second stage, in February-March 2006 and the second stage was associated to an increment in the survey area. A summary of the line staking is given in table 3.

Table 3. Line staking.

Co-ordinate system	**Staked area**	**Method / Device used**	**Accuracy**	**Time**
Special AB [1)]	1.56 km^2	Line staking / DGPS [2)]	< 2 m	October-November 2004
Special AB [1)]	2.47 km^2	Line staking / DGPS [2)]	< 2 m	February-March 2006

1) AB is rotated 39.6 degrees counter-clockwise from KKJ.
2) Differential corrected GPS, Fokus service 2 m precision

Ground geophysics

A summary of ground geophysical measurements is given in table 4. Both magnetic and induced polarization measurements were performed by GTK in 2004 and 2006. The effect of the Earth's varying magnetic field concerning to measured magnetic data were corrected by base station recordings. Results of ground surveys are seen in appendices 1 and 2.

Table 4. Ground geophysics.

Method / Device	Survey area	Station spacing	Line spacing	Number of data points	Method parameters	Survey time
Magnetic / Scintrex EnviMag	2.47 km^2	10	100	2606	Total component	October-November 2004
Magnetic / Scintrex EnviMag	1.56 km^2	10	100	1685	Total component	February-March 2006
Induced Polarization / Scintrex IPR-10	2.47 km^2	20	100	1316	Dipole-Dipole; a = 20 m, n = 2	October 2004
Induced Polarization / Scintrex IPR-10	1.56 km^2	20	100	855	Dipole-Dipole; a = 20 m, n = 2	June-September 2006

Drill core petrophysics

A total of 19 drill core samples were measured in GTK’s Petrophysics Laboratory in Kuopio, including 8 from drill hole R316 and 11 from R317. Susceptibility, remanent magnetization and density were measured in all of these. Apparent resistivity was successfully analysed only in 5 samples (2 samples from drill hole R316 and 3 from R317). The results of petrophysical laboratory measurements are shown in table 5.

Table 5. Petrophysical data of some drill core samples.

Sample id	Co-ordinates		D [kg/m^3]	K [* 10^{-6} SI]	J [mA/m]	Q [-]	Resistivity [Ωm]			Chargeability [%]	
	X	Y					R(0.1 Hz)	R(10 Hz)	R(500 Hz)	PL	PT
R316/139.10	7105383	2490522	2685	290	570	48.93	-	-	-	-	-
R316/139.80	7105383	2490522	2690	2980	6040	49.47	-	-	-	-	-
R316/140.40	7105383	2490522	2687	2100	5050	58.55	-	-	-	-	-
R316/141.10	7105383	2490522	2675	1460	3370	56.44	-	-	-	-	-
R316/141.60	7105383	2490522	2665	780	2110	65.95	-	-	-	-	-
R316/142.10	7105383	2490522	2695	6170	11630	45.97	-	-	-	-	-
R316/142.70	7105383	2490522	2767	540	830	37.7	37000	31300	26500	16	28
R316/143.40	7105383	2490522	2688	210	410	47.77	11300	10700	10100	6	11
R317/29.50	7105232	2490655	2726	1830	4080	54.33	-	-	-	-	-
R317/30.30	7105232	2490655	2683	170	210	30.18	-	-	-	-	-
R317/31.10	7105232	2490655	2708	2410	3540	35.83	-	-	-	-	-
R317/32.20	7105232	2490655	2715	1010	1970	47.51	-	-	-	-	-
R317/32.80	7105232	2490655	2716	1180	2140	44.2	-	-	-	-	-
R317/49.80	7105232	2490655	2729	80	40	11.86	19200	15500	13300	19	31
R317/50.80	7105232	2490655	2695	160	20	3.12	7400	6630	6110	10	17
R317/51.50	7105232	2490655	2694	50	30	15.28	9230	8790	8370	5	9
R317/52.60	7105232	2490655	2681	90	30	8.09	-	-	-	-	-
R317/53.50	7105232	2490655	2728	430	470	26.64	-	-	-	-	-
R317/54.50	7105232	2490655	2705	4520	8360	45.09	-	-	-	-	-

PL=100*[R(0.1Hz)-R(10Hz)]/R(0.1Hz)
PT=100*[R(0.1Hz)-R(500Hz)]/R(0.1Hz)

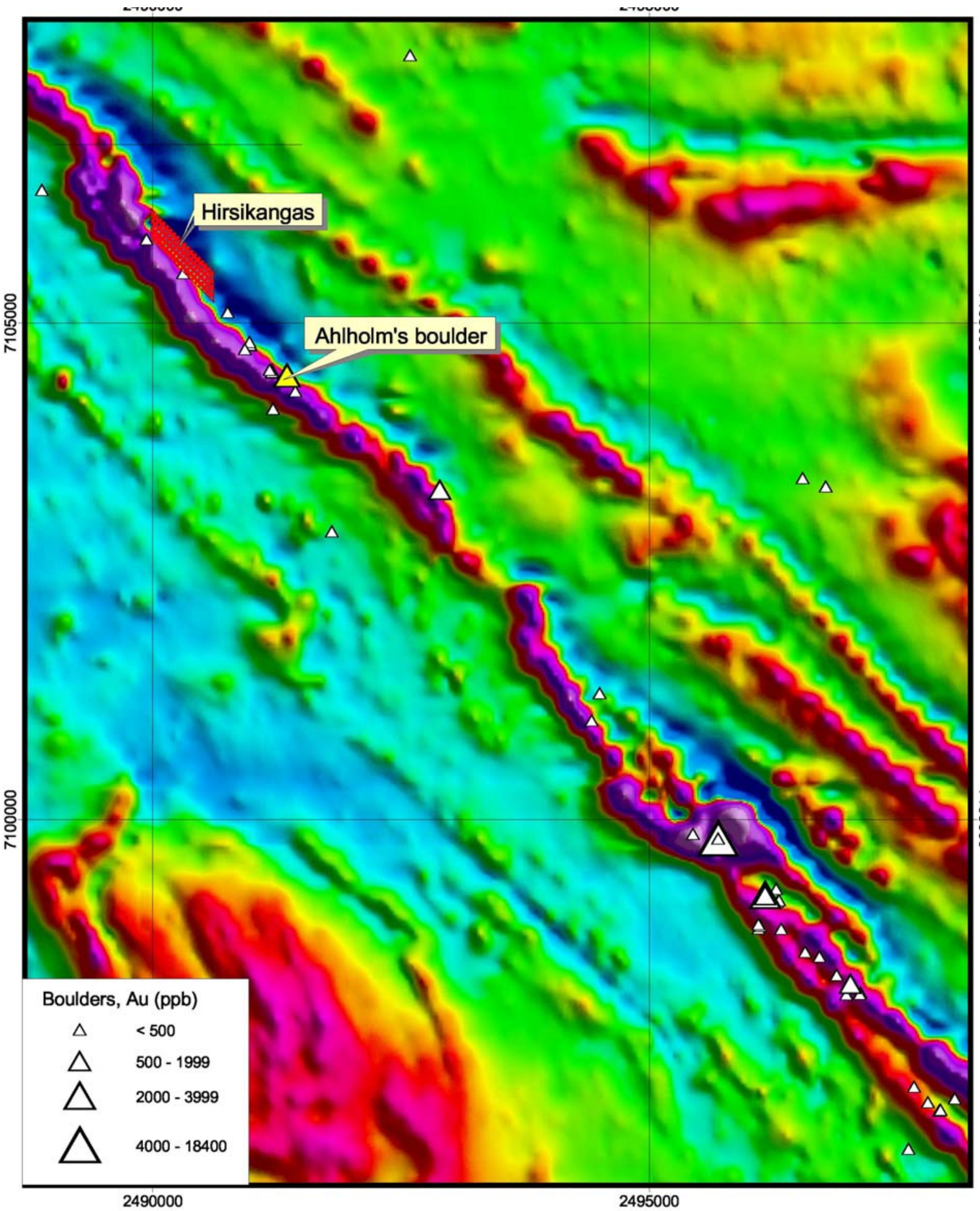

Figure 7. Results of the boulder tracing presented on the low-altitude shaded aeromagnetic map (purple = high values, blue = low values).

5 PROPERTY GEOLOGY

5.1 Geology of the Hirsikangas area

Quaternary geology

The overburden of the Hirsikangas area was deposited during and immediately after the end of the last glaciation. Low drumlins running in NW-SE direction are typical and they are composed mainly of sandy till. The bedrock is relatively well exposed. Between drumlins, peat-covered depressions occur. The average thickness of the overburden is slightly over 4 meters. More exact description of the quaternary geology can be found in a “basic environmental condition” –report (Putkinen et al. 2006)

Bedrock geology

The bedrock of the Hirsikangas area consists mainly of mica schist, mafic and ultramafic volcanites and felsic schist (host rock of the gold mineralisation) (see fig. 8). The strike of volcanites follows the direction of positive magnetic anomalies (see fig. 7 and 13). NW of the Hirsikangas prospect dextral folding is associated possibly with a strike slip shearing system. Ductile-brittle shears are focused within vertical en echelon lenses of felsic schist (fig. 8 and 13), and the orientation of lenses follows the strike of ductile shears and perhaps also the axial plane of folding.

Regional prograde metamorphism took place in amphibolite facies and the most characteristic metamorphic minerals in metasediments are biotite, andalusite and fibrolitic sillimanite.

The host rock of the gold mineralisation is called felsic schist, which is a very strongly sheared and altered rock unit (fig. 9). In places the rock has a weak porphyric appearance and in places pebble structures similar like in sediments or in deformed intrusive breccias. The principal minerals of the felsic schist are quartz, plagioclase and micas (biotite, muscovite) with accessory minerals such as ore minerals, sphene, apatite, zircon and secondary K-feldspar, chlorite, sericite, carbonate, epidote, green amphibole, garnet and tourmaline.

Outside the mineralisation the most common rock type is quartz-veined, banded mica schist, which mainly consist of quartz, plagioclase and micas (biotite, muscovite) with accessories like ore minerals, chlorite, apatite, sphene, zircon and tourmaline. In places, mica schist has andalusite and sillimanite porphyroblasts. Younger tourmaline and garnet bearing pegmatite veins also occur.

In the western side of the mineralisation, is a 200-300 m wide volcanic horizon, which is called Himanka volcanites (Kousa et al. 2000). They are composed of mafic lavas with pillow and breccia structures and with lens shaped ultramafic interbeds (fig. 10).

The main minerals in mafic volcanites are green amphibole (tremolite – actinolite), diopside, chlorite and plagioclase and in ultramafic volcanites also metamorphic olivine and talc. Between the mica schist and the volcanite unit, is often found a reaction skarn, which contains mainly quartz, diopside, green amphibole, plagioclase, epidote, biotite and carbonate and occasionally ore minerals.

5.2 Alteration of the host rock and ore mineralogy

The host rock of the gold mineralisation is called felsic schist, which is a very strongly sheared and altered rock unit (Fig. 9 and 11).

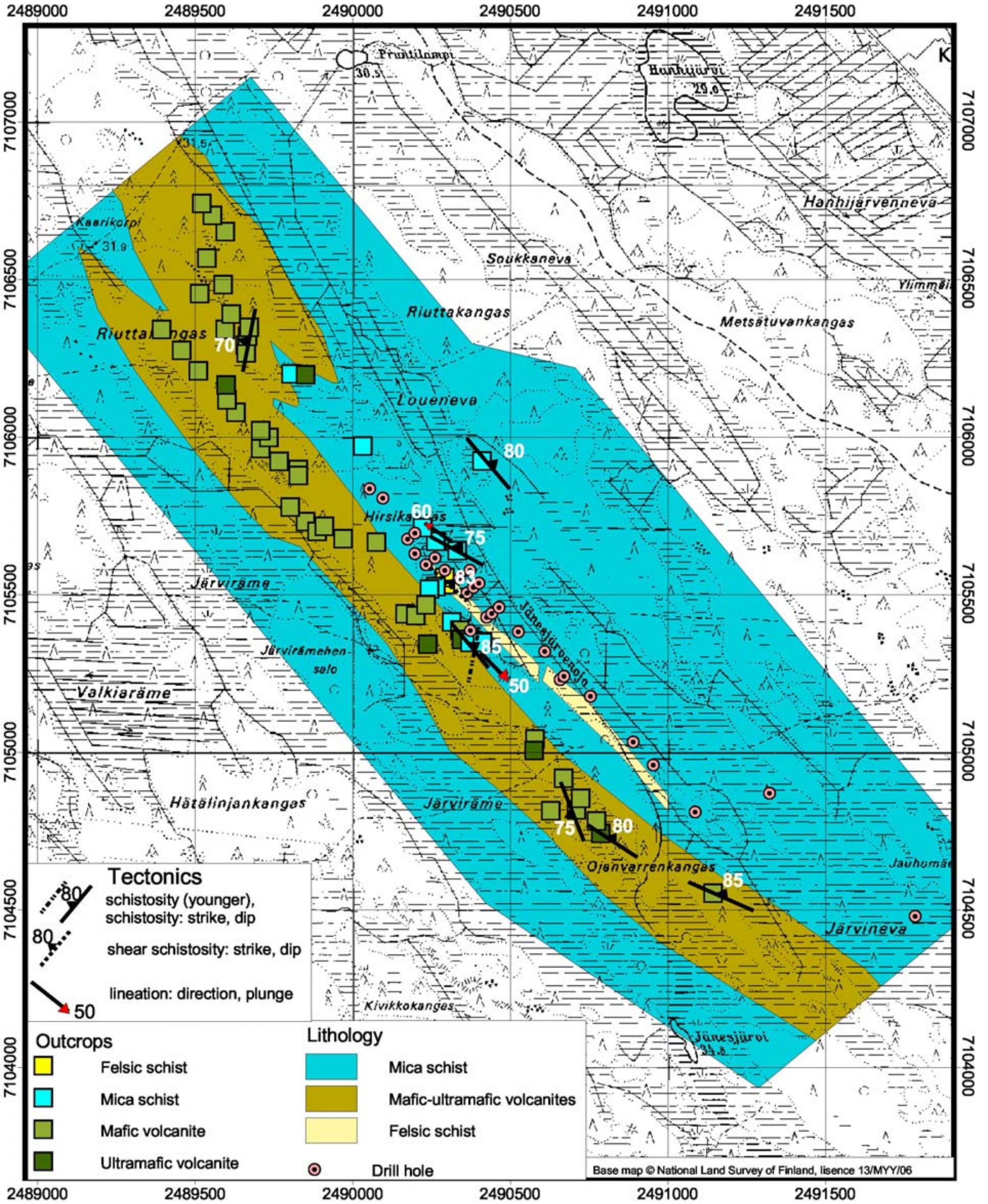

Figure 8. Geology of the Hirsikangas area based on outcrop mapping, drilling and geophysical ground measurements.

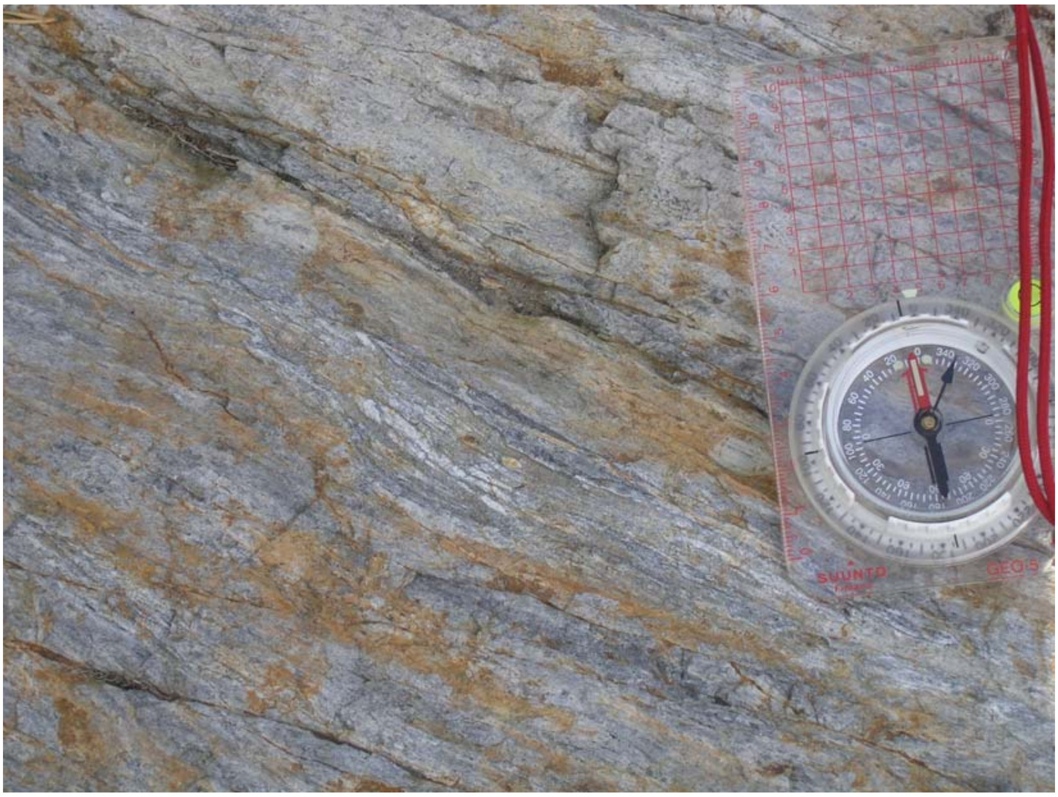

Figure 9. Close shot of strongly sheared and altered felsic schist at an outcrop OMK-2005-11, X=7105.533 and Y=2490.290.

Figure 10. Ultramafic lava with breccia structure at an outcrop OMK-2005-23, X=7105.358 and Y=2490.341.

In places the rock has a weak porphyritic appearance (fig.12) and in places pebble structures like sediments or deformed intrusive breccias might have. Thus it is possible that a parent rock of felsic schist is mica schist, plagioclase porphyry or greywacke-type metasediment or all together. Shearing of the felsic schist is mostly ductile type appearing as shear schistosity but in places brittle fractures with quartz, ore mineral and amphibole-chlorite-epidote fillings also occur.

Because it seems that there are at least two types of alteration, the mineral assemblages of each type are listed in table 6.

Table 6. Alteration types in the host rock of the Hirsikangas gold mineralisation.

Parent minerals (hypothetical)	First type (ductile)	Second type (fractures and quartz veins)
Quartz	Quartz	Quartz
Plagioclase	Sericite	Chlorite
Biotite	K-feldspar	Epidote
Muscovite	Chlorite	Carbonate
± K-feldspar	Epidote	Rutile
± Hornblende	Carbonate (brownish)	Biotite
	Sphene	Green amphibole
	Tourmaline	± Sericite
	± Garnet	± Diopside
	± Scheelite	± Garnet
	Other ore minerals	Ore minerals

When the gold mineralisation occurs in mafic volcanite inclusions, it usually is related to fracturing or quartz veining and the alteration corresponds to the second type. Between the mica schist or felsic schist and the mafic volcanite a reaction rim is common, where the rock is altered to diopside-amphibole skarn.

Ore minerals are typically present as irregular disseminations throughout the sheared and altered host rock forming discontinuous bands within the foliation. The most characteristic ore minerals are pyrrhotite, arsenopyrite and löllingite with accessory graphite, ilmenite, sphalerite, chalcopyrite, scheelite and gold with associated minerals.

Gold and associated minerals typically occur at boundaries or fractures of the silicate minerals but rarely also associated with sulphide minerals. Gold occurs mainly in native form or as electrum, Ag content variying 6 – 39 wt-% (analyses in “related material”). Although the gold grains are generally less than 20 μm in diameter, grains up to 1-2 mm in size have been recorded from many drill cores. The most common mineral associated with gold is native antimony and other minerals found by Turbo Scan are aurostibite ($AuSb_2$), gudmundite (SbFeS), ullmannite (SbNiS) and some Sb-Pb-sulphide (boulangerite ?) and Bi-telluride.

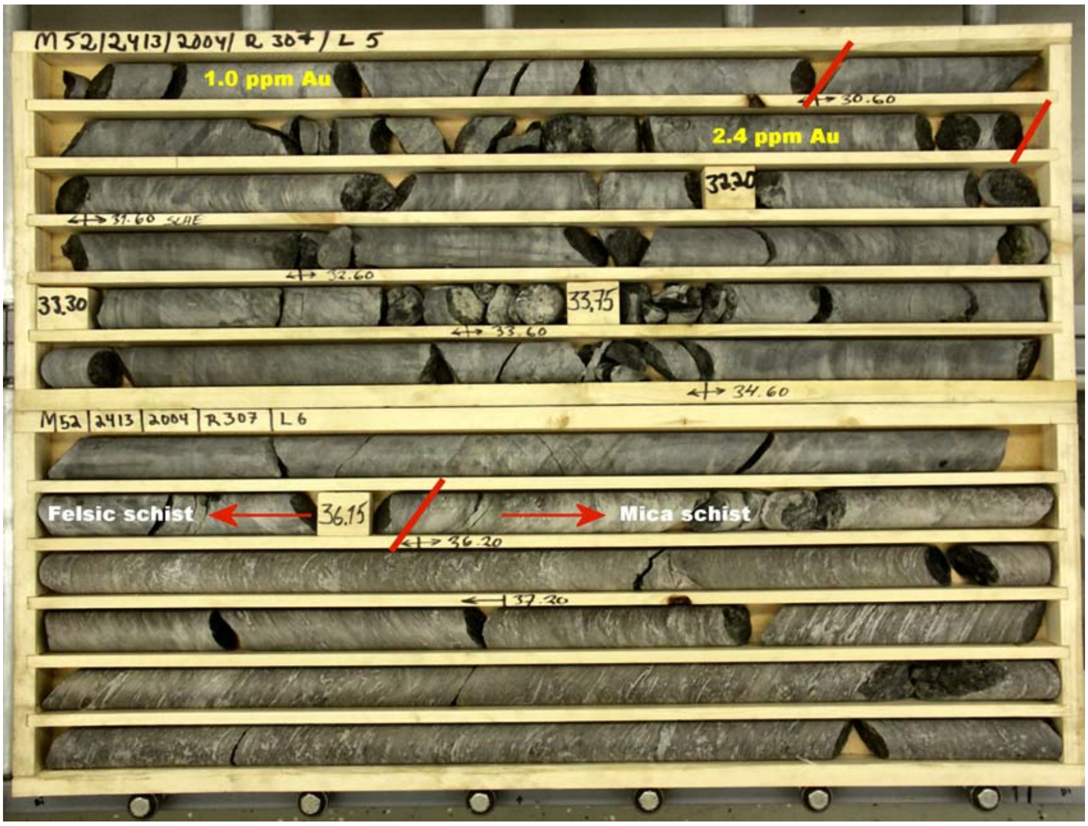

Figure 11. Typical contact between gold-bearing felsic schist and mica schist (DH 307).

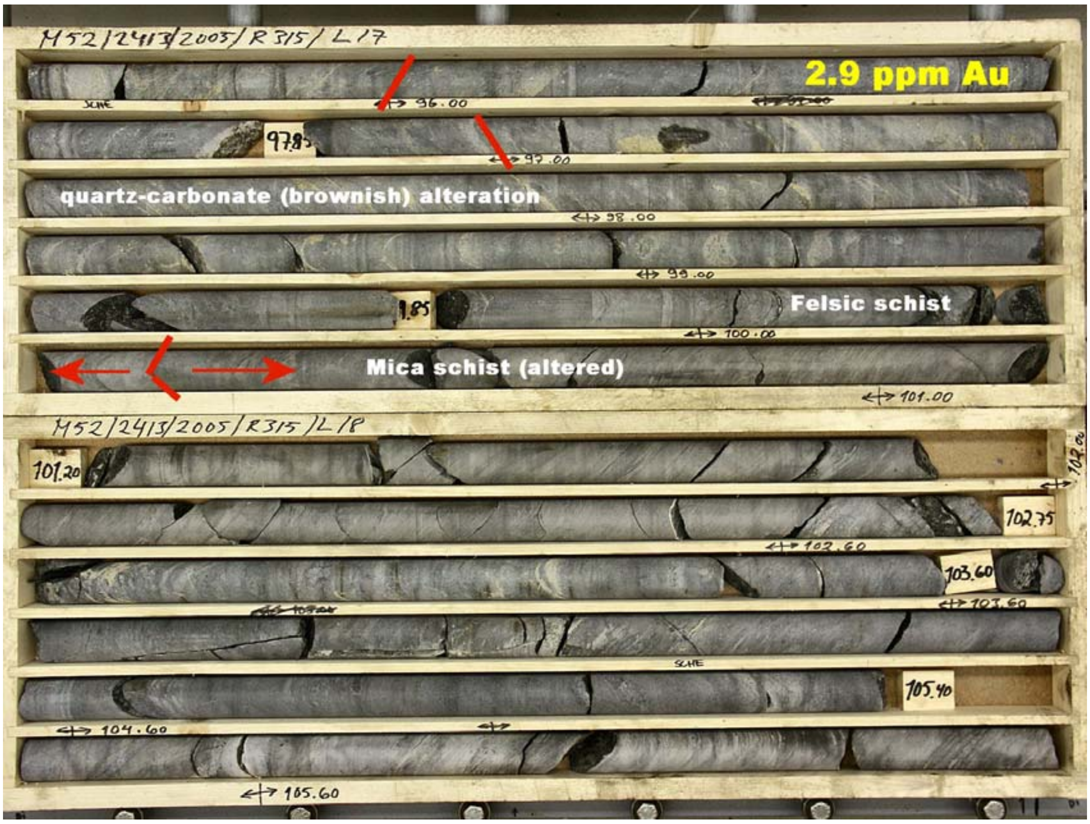

Figure 12. Alteration of the host rock with a weak porphyric appearance within DH 315.

5.3 Structural features of the prospect

NW of the Hirsikangas prospect dextral folding is possibly associated with a strike slip shearing system (fig. 13).

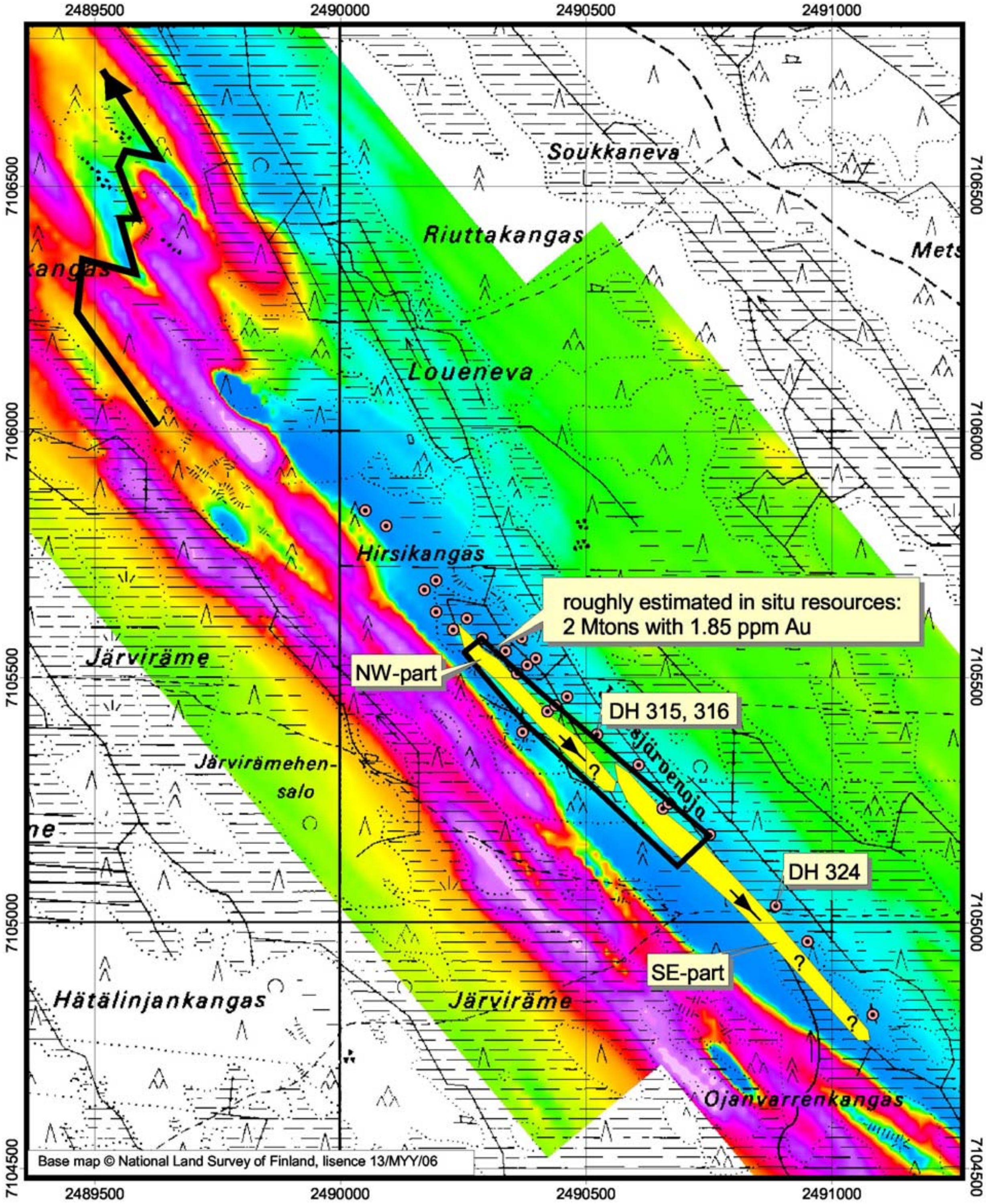

Figure 13. Vertical projection of possible ore shoots (yellow areas) presented on a magnetic total field map (ground measurements, see App. 1).

Ductile-brittle shears are focused within vertical en echelon lenses of felsic schist, and the orientation of the lenses follows the strike of the ductile shears and perhaps also the axial plane of the shear folding. Lenses or ore shoots plunge gently to SE, but the dip of the plunge is uncertain because of sparse drilling. Lineation observations at the outcrops are made from quartz veins, which tells maybe nothing about the plunge of the ore shoots. Felsic schist has magnetic pyrrhotite, which causes a weak positive anomaly (see App. 1) but there occurs also non-magnetic pyrrhotite, which means that mineralisation might exist also outside the positive magnetic anomaly. The anomaly weakens to the SE-direction perhaps with the plunge of the ore. SE-part of the prospect is drilled only sparsely by short holes (fig 14). In appendices 5 and 6 two cross-sections (DH 315, 316 and DH 324 in fig.13) of the prospect are presented.

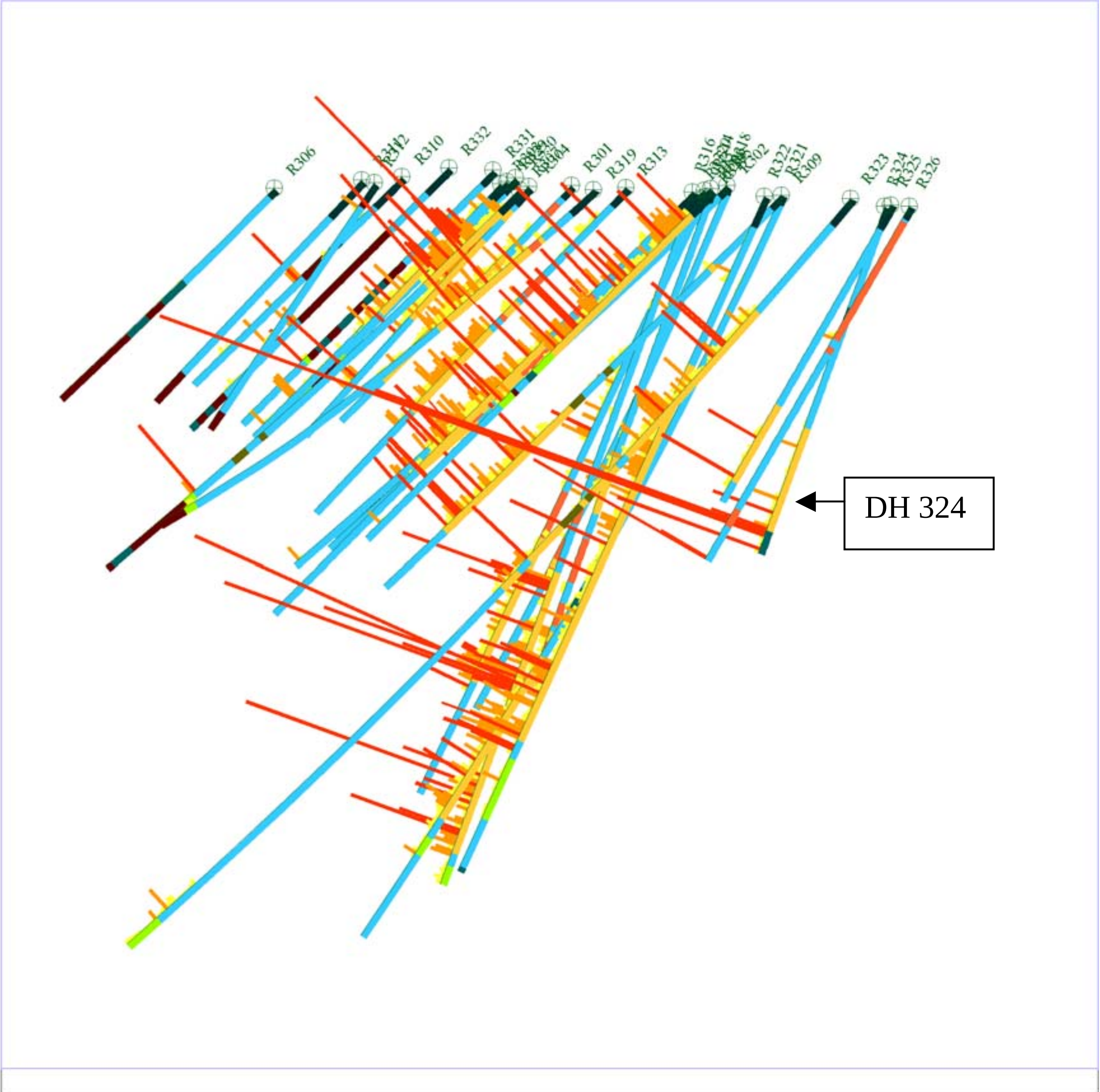

Figure 14. Surpac presentation of drill holes focused to the northwest direction. Dept of DH 324 is 110 m. Felsic schist yellow, mica schist blue, volcanite green and brown and gold content with yellow (< 500 ppb), orange (500-2000 ppb) and red (>2000 ppb) bars.

5.4 Chemistry of the prospect

Base metal contents are usually very low (tens of ppm) within the felsic schist but some samples of the altered mica schist, graphite-sulphide schist of DH 328 or skarn samples might have elevated contents. Maximum Cu content is 914 ppm, Zn 1620 ppm, Pb 130 ppm and Ni 892 ppm, respectively. Sulphur content of the gold-bearing rock is mostly below 1 % but graphite-sulphide schist has up to 8.41 % S. Statistical variables and correlation coefficients of Au, As and Sb and mean gold contents of the best intersections are listed in tables 7, 8 and 9. Gold shows only a weak correlation (Spearman's) with antimony in the case of all samples (table 5) but no correlation with any other metal, if gold content is over 0.5 ppm.

Table 7. Statistics of drill core assays in the Hirsikangas prospect.

All core assays	Cases	**Mean**	Median	Minimum	Maximum
Au (ppb)	1604	**602**	**206**	< 5	**34700**
As (ppm)	1604	**673**	170	< 15	32700
Sb (ppm)	1604	**12.7**	1.4	< 0.05	8990
If gold > 500					
Au (ppb)	422	**1848**	**1025**	502	**34700**
As (ppm)	422	**1346**	602	< 15	32700
Sb (ppm)	422	**35.8**	3.2	0.21	8990
Au>500, NW-part (Fig. 13)					
Au (ppb)	264	**1655**	**981**	502	**16500**
As (ppm)	264	**1143**	639	< 15	9550
Sb (ppm)	264	**5.4**	3.3	0.21	221
Au>500, SE-part (Fig. 13)					
Au (ppb)	158	**2170**	**1125**	517	**34700**
As (ppm)	158	**1685**	465	< 15	32700
Sb (ppm)	158	**86.5**	3.1	0.24	8990

Table 8. Correlation coefficients (Pearson) of As and Sb with respect to gold.

Pearson correlation			
Data set	Cases	Au/As	Au/Sb
All core assays	1604	0.141	0.040
If gold > 500 ppb	422	0.018	0.014
Spearman's rho			
Data set	Cases	Au/As	Au/Sb
All core assays	1604	**0.551**	**0.474**
If gold > 500 ppb	422	0.091	0.218

Table 9. Best intersections at the Hirsikangas prospect.

DH-ID	Northing	Easting	From	To	m	Au (ppm)
301	7105553	2490335	41.00	46.00	5.00	2.1
302	7105579	2490368	114.60	120.60	6.00	1.2
304	7105507	2490359	18.70	36.70	18.00	1.6
307	7105430	2490421	21.10	31.60	10.50	2.4
309	7105321	2490606	121.00	127.30	6.30	2.4
316	7105383	2490522	110.60	190.80	80.20	1.7
			including:			
			110.60	116.60	6.00	3.5
			136.60	143.60	7.00	6.0
			169.80	175.80	6.00	3.6
317	7105232	2490655	7.25	58.80	51.55	1.4
			including:			
			29.80	34.80	5.00	2.7
			48.80	54.80	6.00	2.8
322	7105242	2490667	138.50	164.30	25.80	1.9
			including:			
			138.50	147.50	9.00	3.4
323	7105179	2490751	74.00	80.00	6.00	1.6
324	7105034	2490886	92.40	99.80	7.40	9.2
			including:			
			92.40	95.20	2.80	21.3
326	7104812	2491083	109.00	110.30	1.30	7.7

5.5 Geological interpretation

The Raahe-Ladoga zone has experienced a range of metamorphic (subducting plate during convergence and/or thickening of the crust during collision, late thermal event) and magmatic (different phases of granitoid intrusion) processes that have contributed to generation and migration of gold-bearing fluids (Kontoniemi 1998). These fluids were particularly focussed into obliquely oriented dilational sites, and the role of relatively competent rock units (granitoids, plagioclase porphyry and coarse, quartz-rich sediments) was important in channelling fluids to higher crustal levels.

The Hirsikangas gold prospect is situated in a contact area of the Himanka volcanites and pelitic schists and the host rock of the gold mineralisation is called felsic schist, which is probably composed of strongly sheared and altered porphyry and greywacke type sediment. Regional prograde metamorphism took place in amphibolite facies and the most characteristic metamorphic minerals in metasediments are biotite, andalusite and fibrolitic sillimanite.

NW of the Hirsikangas prospect dextral folding is associated possibly with a strike slip shearing system. Ductile-brittle shears are focused within vertical en echelon lenses of felsic schist, and the orientation of the lenses follows the strike of the ductile shears and perhaps also the axial plane of shear folding. Lenses or ore shoots plunge gently to SE, but the dip of the plunge is uncertain because of sparse drilling.

The mineralogy and chemistry of the prospect (low base metals, high Sb and existence of coarse gold) suggest that the prospect represents a relatively high level of the fluid system. Thus it is possible that the gold mineralisation will continue following the plunge of ore shoots into deeper levels.

6 RESOURCE ESTIMATION

Because of sparse drilling, especially in the SE-part of the prospect, no essential resource estimation was made. Only roughly are calculated resources in the area, where drilling profile distance is 50 or 100 m (see fig. 13). Calculation was made with conventional sectional outlining of the mineralised bodies with 1 ppm cut-off grades for gold. Less than 4 m's interval below the cut-off grade inside the intersections are taken with. The measured average density for the mineralised samples (2.7 g/cm^3) was used in the calculations.

If the estimation is made in the area presented in the figure 13 and the calculations are made with the ore body architecture shown in appendix 5, indicated and inferred resources are about 2 Mtons at the average gold content of 1.85 ppm.

7 ENVIRONMENTAL STATEMENT

A basic environmental condition –study by GTK (Putkinen et al. 2006, in Finnish) was made in the area of Hirsikangas. The text below is from the abstract of that report.

No Natura or any other protected areas occur in the area or in neighbourhood. The quaternary deposits and bedrock as well as the conditions of surface and ground water of the actual claim area and its immediate surroundings are described in the report. The analyse results of the surface and ground water samples, brook sediments and soil samples taken in the summer 2006 are also presented.

The samples were analysed in the accredited geolaboratory of Geological Survey of Finland. Abnormal baseline concentrations of the potential toxic elements were not found in the glacial till samples. However, some till samples contained anomalous concentrations of chromium, copper, nickel and zinc. Vanadium concentration (66,4 mg/kg) slightly exceeds the Finnish SAMASE guideline for vanadium (50 mg/kg). Moreover, abnormally high concentrations of sulphur were detected in some samples, which is characteristic for glacial sediments in Central Ostrobothnia.

In contrast to till samples arsenic concentrations in stream sediments of Jänesjärvenoja exceed the baseline concentration of As in till. The arsenic concentrations were 10.2 and 43.8 mg/kg exceeding the Finnish SAMASE guideline for arsenic (10 mg/kg). One subsurface water sample had anomalous arsenic concentration, 59 µg/l, exceeding the limit for household water by tenfold. In addition, the subsurface water sample was saline (Na 412 mg/l and Cl 1000 mg/l), and had high electric conductivity, 363 mS/m, and abnormally great concentration of strontium (1950 µ/l).

8 DISCUSSION AND CONCLUSIONS

The first indication of the Hirsikangas gold mineralisation was a gold bearing (3.6 ppm) boulder (about 2 km to SE, Järvineva), which was found by Kari Ahlholm (layman) in the autumn 2003. After two days boulder tracing in the autumn 2004 the outcrop area of Hirsikangas with felsic schist lithology similar to the reference boulder was found. The mineralisation was located after geophysical ground measurements and drilling program during 2004-2006. The exploration project was very busy and that's why some significant investigations (structural, mineralogical, geochemical etc.) for genetic interpretation remained uncompleted. Also beneficiation tests should be made for this kind of gold mineralisation.

However, the data presented in this study lead to the following concluding statements:

1. The Paleoproterozoic Hirsikangas gold prospect is typically epigenetic, orogenic (mesothermal) and shear zone related in origin.
2. The host rock of the mineralisation is called felsic schist, which is probably composed of strongly sheared and altered porphyry (perhaps subvolcanic intermediate rock) and greywacke type sediment.
3. Regional prograde metamorphism took place in amphibolite facies.
4. Structurally, dextral folding possibly associated with a strike slip shearing system is perhaps the most significant source of dilational structures focusing fluid flow.
5. Ductile-brittle sheared en echelon ore lenses are vertical and plunge gently to SE.
6. Hydrothermal alteration is moderately strong compared to other Svecofennian gold occurrences and two types of alteration occur: ductile sericite-quartz-K-feldspar-carbonate –alteration and more brittle quartz-chlorite-epidote-biotite –alteration.
7. Principal ore minerals are pyrrhotite, arsenopyrite, löllingite and graphite with accessory ilmenite, sphalerite, chalcopyrite, scheelite and gold with associated minerals.
8. Gold and associated minerals typically occur at boundaries or fractures of silicate minerals and more rarely also associated with sulphide minerals.
9. The mineralogy and chemistry of the prospect suggest that the prospect represents a relatively high level of the fluid system.
10. The gold mineralisation plunges to SE into deeper levels.

9 RECOMMENDATIONS FOR FURTHER WORK

Obviously, more exploration work (especially drilling) is needed to better evaluate the extent and grade of the Hirsikangas gold prospect. Because the prospect has visible gold grains, it is better to use drillings with core diameter over 60 mm and assays with sample weight over 100 g. Also beneficiation tests would be very important for this kind of gold mineralisation. The intersection of DH 304 is very near the surface of the bedrock.

The whole region nearby the Hirsikangas prospect, especially the related Himanka volcanites, is highly gold potential. Thus the region is highly potential to find a new gold province in Finland.

The Hirsikangas gold mineralisation would be also a good target for genetic examinations among Proterozoic orogenic occurrences.

Kuopio 07.12.2006

Olavi Kontoniemi	Juha Mursu

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APPENDICES

1. Magnetic map (ground measurements) of the Hirsikangas area.
2. Apparent chargeability map of the Hirsikangas area.
3. List of drill hole details.
4. List of related material (Data CD-ROM).
5. Cross-section in the profile DH 315, 316.
6. Cross-section in the profile DH 324.

Contact information

Contact persons:

Dr. Pekka Nurmi (*pekka.nurmi@gtk.fi*)

Dr. Erkki Luukkonen *(erkki.luukkonen@gtk.fi*)

Dr. Olavi Kontoniemi *(olavi.kontoniemi@gtk.fi*)

Geological Survey of Finland, Kuopio office:

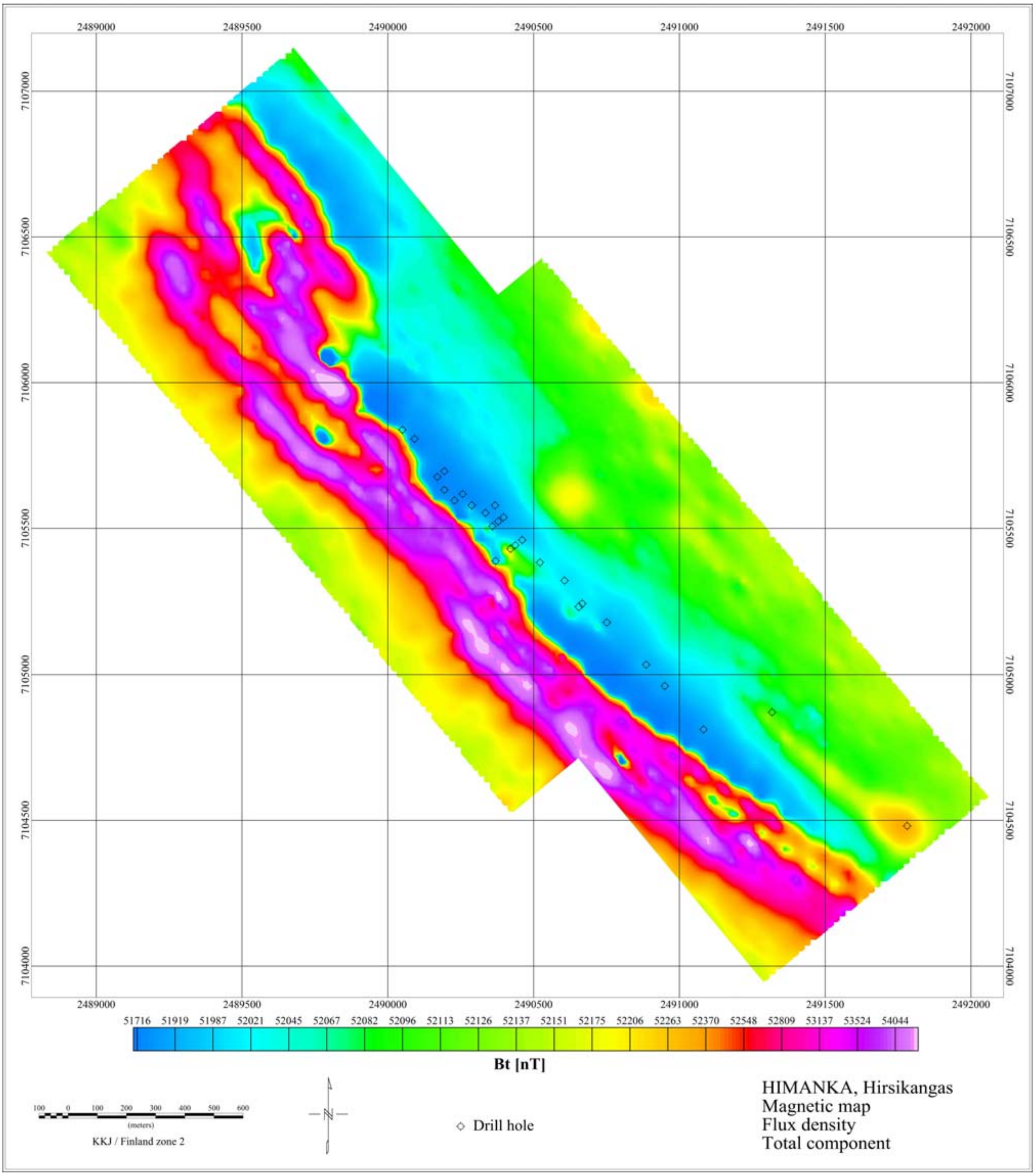
Visiting address:	Neulaniementie 5
	KUOPIO
Postal address:	P.O. Box 1237
	FIN-70211 Kuopio
	FINLAND
Phone:	+358 20 550 11
Fax:	+358 20 550 14

http://www.gtk.fi

Useful Internet links:

http://www.gtk.fi/explor/

App. 1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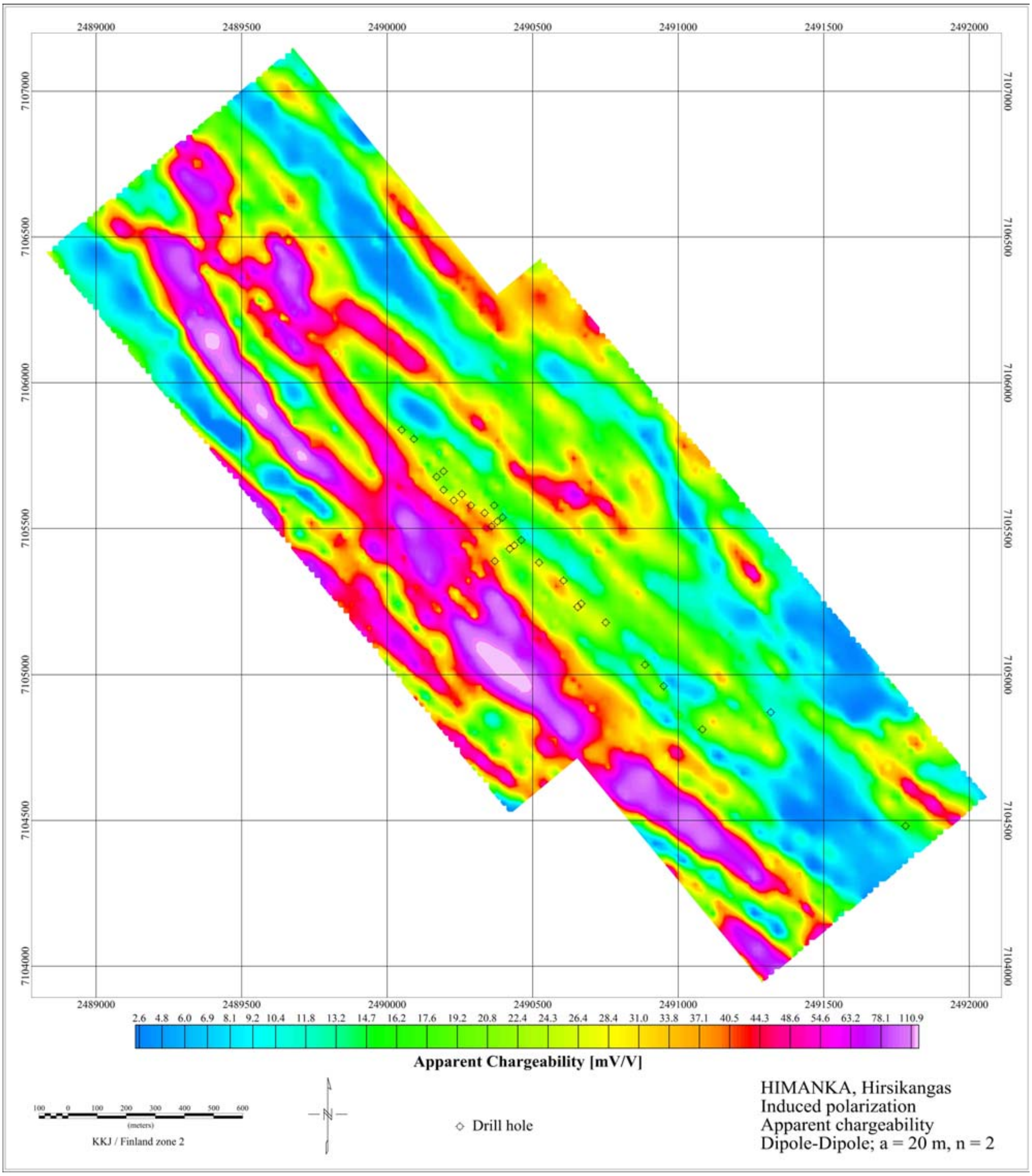
51716 51919 51987 52021 52045 52067 52082 52096 52113 52126 52137 52151 52175 52206 52263 52370 52548 52809 53137 53524 54044
Bt [nT]
100 0 100 200 300 400 500 600
(meters)
KKJ / Finland zone 2
N
◇ Drill hole
HIMANKA, Hirsikangas
Magnetic map
Flux density
Total component

App. 2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2491500
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7107000
7106500
7106000
7105500
7105000
7104500
7104000
2.6 4.8 6.0 6.9 8.1 9.2 10.4 11.8 13.2 14.7 16.2 17.6 19.2 20.8 22.4 24.3 26.4 28.4 31.0 33.8 37.1 40.5 44.3 48.6 54.6 63.2 78.1 110.9
Apparent Chargeability [mV/V]
100 0 100 200 300 400 500 600
(meters)
KKJ / Finland zone 2
N
◇ Drill hole
HIMANKA, Hirsikangas
Induced polarization
Apparent chargeability
Dipole-Dipole; a = 20 m, n = 2

Appendix 3. List of drill hole details.

Hole_id	northing	easting	elevation	length (m)	azimuth[x)]	dip at start	cases (m)
R301	7105553	2490335	33.7	88.90	230	45.8	
R302	7105579	2490368	33.7	142.20	230	44.7	
R303	7105579	2490288	33.7	57.70	230	45.9	
R304	7105507	2490359	33.7	90.30	230	46.9	7.0
R305	7105538	2490397	33.2	141.30	230	44.6	
R306	7105388	2490370	33.9	80.90	230	45.4	
R307	7105430	2490421	33.6	151.00	230	45.0	
R308	7105460	2490461	33.4	149.70	230	44.8	
R309	7105321	2490606	33.5	150.20	230	45.0	
R310	7105677	2490170	34.6	79.35	230	44.5*	
R311	7105632	2490194	34.1	81.70	230	46.4	
R312	7105596	2490229	33.7	80.00	230	55.4	
R313	7105524	2490379	33.4	121.30	230	45.3	
R314	7105538	2490397	33.2	142.80	230	70*	5.0
R315	7105383	2490522	33.6	160.10	230	45*	
R316	7105383	2490522	33.6	198.70	230	70*	
R317	7105232	2490655	33.8	130.00	230	45*	
R318	7105579	2490368	33.7	156.70	230	68.4	
R319	7105442	2490437	33.5	147.90	230	42.8	
R320	7105460	2490461	33.4	180.00	230	64.8	
R321	7105321	2490606	33.5	230.10	230	65.7	
R322	7105242	2490667	33.8	199.90	230	65.7	
R323	7105179	2490751	33.9	280.60	230	49.9	
R324	7105034	2490886	33.3	99.80	230	70*	6.0
R325	7104961	2490950	34.3	92.20	230	60*	
R326	7104812	2491083	35.4	110.30	230	60*	
R327	7104871	2491318	35.3	76.10	230	50*	
R328	7104481	2491781	35.9	81.70	230	50*	
R329	7105618	2490257	34.0	97.00	230	45*	
R330	7105696	2490194	34.3	99.40	230	45*	
R331	7105807	2490092	35.4	96.30	230	45*	
R332	7105838	2490050	35.7	99.00	230	45*	

* Inclinometer not used
[x)] Azimuth not measured downhole

Appendix 4. List of related material (Data CD-ROM).

1. CLAIM AREAS
   - pdf-, shp- and shx-files

2. DOCUMENTS
   - CM19_2413_2006_1_10.doc
   - CM19_2413_2006_1_10.pdf

3. DRILLING
   - pdf-core reports
   - assays (xls)
   - shape-files
   - profiles (jpg)
   - photos (jpg)

4. GEOCHEMISTRY
   - boulders (xls)
   - outcrops (xls)
   - microanalyses (xls)

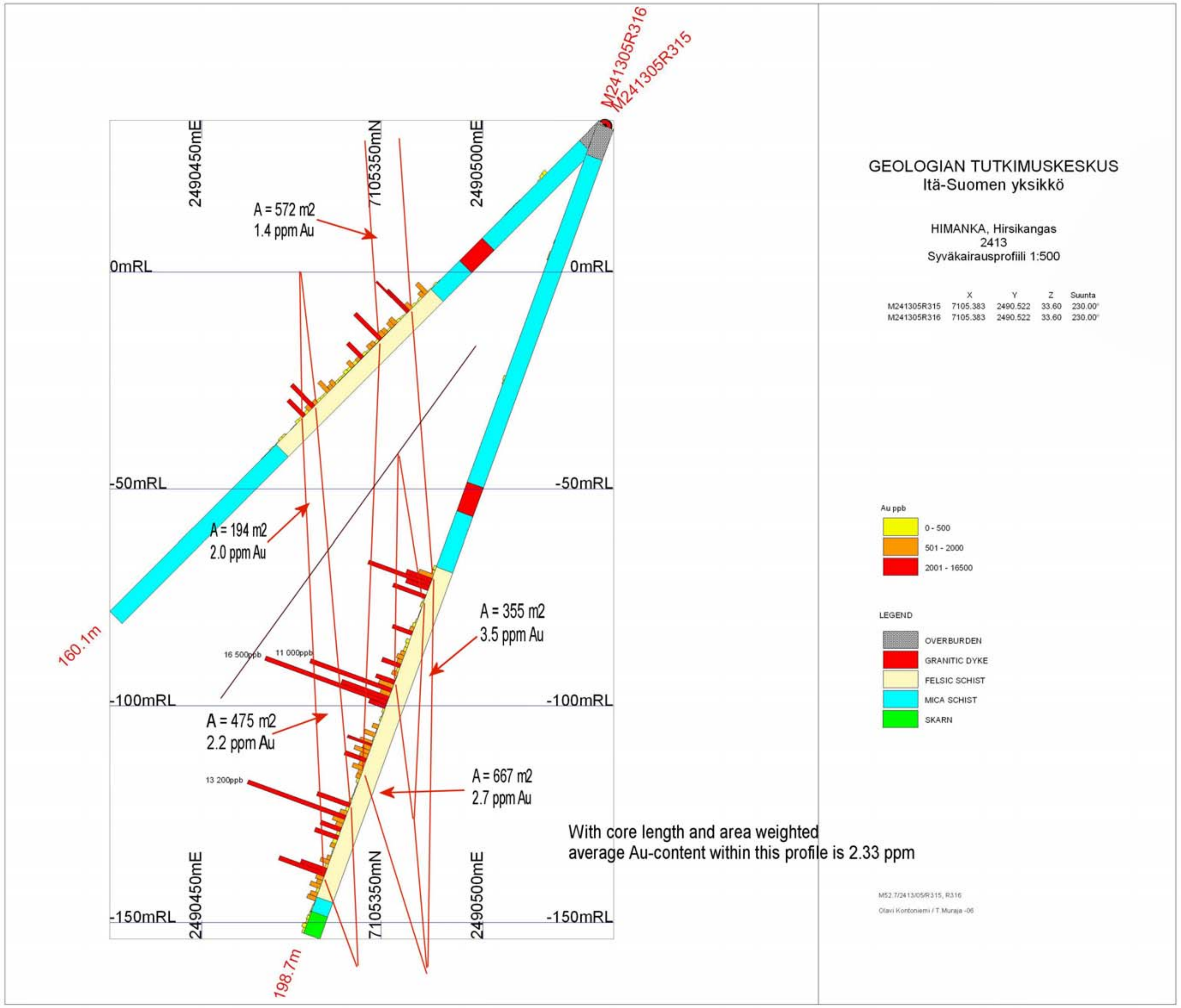
5. GROUND GEOPHYSICS
   - data
   - maps

6. GEOLOGY
   - bedrock map
   - outcrops

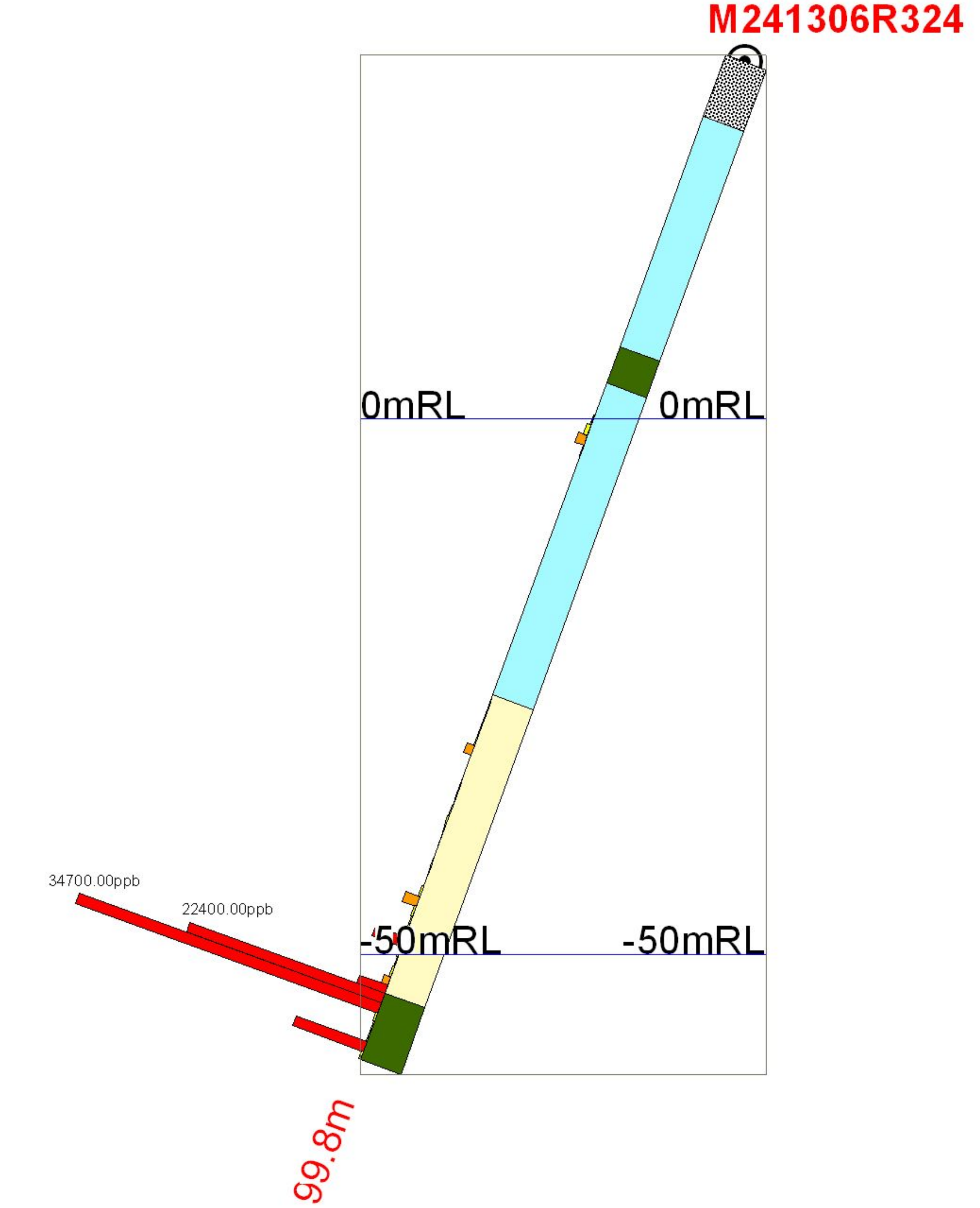
7. DESCRIPTION
   - data sets
   - analyses
   - ground geophysics

8. LEGAL NOTICE

Appendix 5.


M241305R316
M241305R315
2490450mE
7105350mN
2490500mE
A = 572 m2
1.4 ppm Au
0mRL
0mRL
-50mRL
-50mRL
A = 194 m2
2.0 ppm Au
160.1m
16 500ppb
11 000ppb
A = 355 m2
3.5 ppm Au
-100mRL
-100mRL
A = 475 m2
2.2 ppm Au
13 200ppb
A = 667 m2
2.7 ppm Au
With core length and area weighted
average Au-content within this profile is 2.33 ppm
-150mRL
-150mRL
198.7m
GEOLOGIAN TUTKIMUSKESKUS
Itä-Suomen yksikkö
HIMANKA, Hirsikangas
2413
Syväkairausprofiili 1:500
X Y Z Suunta
M241305R315 7105.383 2490.522 33.60 230.00°
M241305R316 7105.383 2490.522 33.60 230.00°
Au ppb
0 - 500
501 - 2000
2001 - 16500
LEGEND
OVERBURDEN
GRANITIC DYKE
FELSIC SCHIST
MICA SCHIST
SKARN
M52.7/2413/05/R315, R316
Olavi Kontoniemi / T.Muraja -06

Appendix 6.



GEOLOGIAN TUTKIMUSKESKUS
Itä-Suomen yksikkö

HIMANKA, Hirsikangas
2413

Syväkairausprofiili 1:500

M241306R324 X=7105.034, Y=2490.886, Z=33.30, suunta 230°

Au ppb
0 - 500
501 - 2000
2001 - 34700

LEGEND
OVERBURDEN
FELSIC SCHIST
MICA SCHIST
MAFIC VOLCANITE

M52.7/2413/06/R324

Olavi Kontoniemi / T.Muraja -06