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Sodankylä, Sakiatieva
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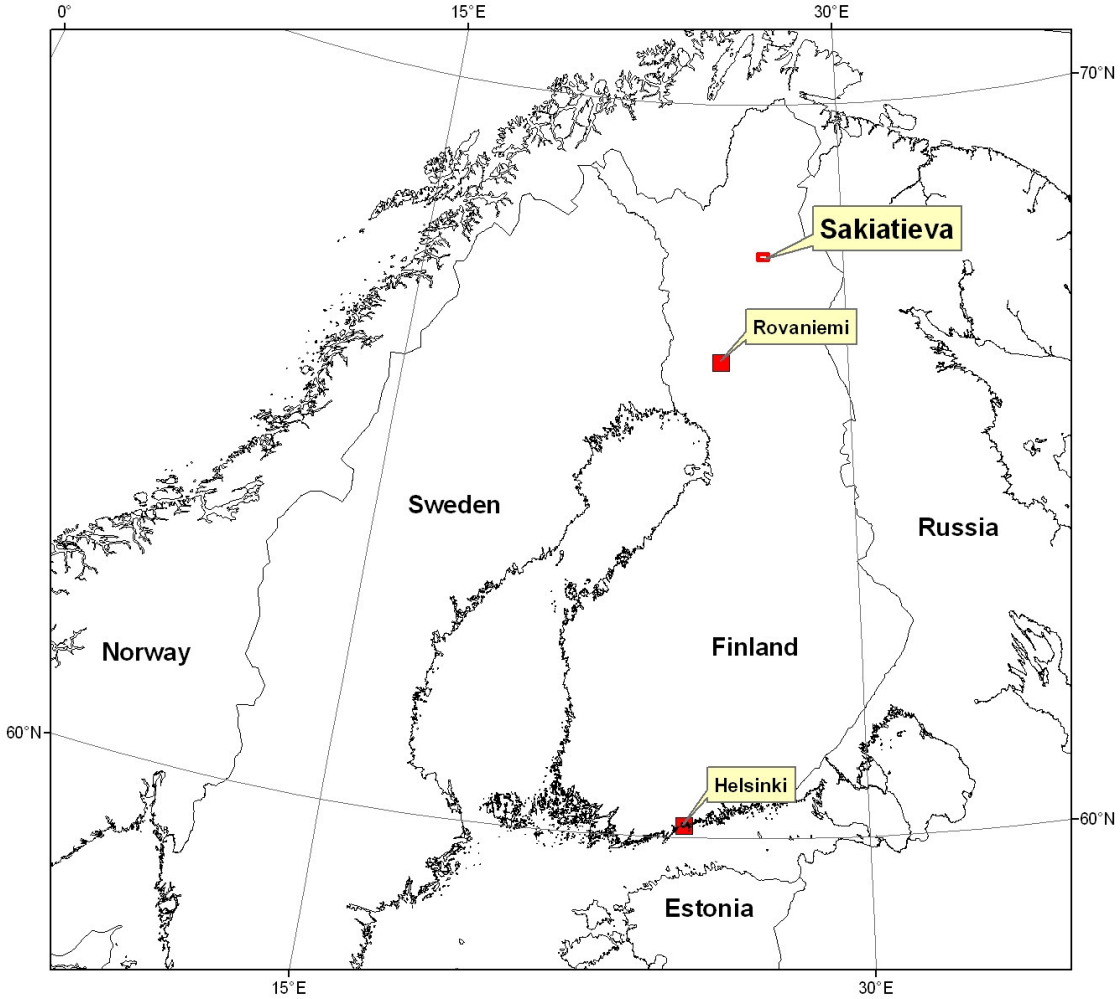
The Sakiatieva gold prospect in the Central Lapland Greenstone Belt, Finland



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The Sakiatieva gold prospect in the Central Lapland Greenstone Belt, Finland

Abstract

Geological Survey of Finland (GTK) has explored the Sakiatieva area during 1999-2004. Sakiatieva is located in the municipality of Sodankylä, about 70 km to the northeast from the town of Sodankylä. The target area is part of the Paleoproterozoic Central Lapland Greenstone Belt. GTK has carried out drilling, trenching, till geochemistry and geophysical surveys. Trenching and drilling resulted in the discovery of the Sakiatieva gold mineralisation which is controlled by a SW-trending alteration and deformation zone. Based on current drilling results, the occurrence is 150 m long and 10 m wide, but it is open at depth and along strike at both ends. The Sakiatieva gold occurrence is hosted by mafic volcanic rocks and graphitic phyllites. The main gangue minerals of the altered and mineralized zone are carbonate, quartz, diopside, biotite, feldspar and chlorite. Main sulphide mineral is pyrrhotite. Gold occurs as native, free grains with gangue and pyrrhotite. Other ore minerals detected at Sakiatieva are chalcopyrite, pyrite, tellurides galena, sphalerite, scheelite and molybdenite. The most significant gold-enriched intersections are given below:

Trench	Length vs Au g/t
M10/2001	6.0 m @ 4.8 g/t
M11/2001	2.0 m @ 1.4 g/t
x M2/2004	7.0 m @ 13.7 g/t
M3/2004	3.0 m @ 3.1 g/t

Drill hole	Intersection	From the depth (m)
R310	2.0 m @ 3.3 g/t	28.0
R311	1.0 m @ 4.8 g/t	69.0
R256	1.5 m @ 2.8 g/t	53.0
xx R258	1.5 m @3.8 g/t	49.0
xxx R259	1.0 m @ 4.8 g/t	79.0

x including 2.0 m @ 36.9 g/t, **xx** 0.75 m @ 7 g/t, **xxx** 0.5 m @ 8.4 g/t
.

Keywords

exploration, claim, report, magnetic and VLF-R measurements, sulphide occurrence, gold

Geographical area

Finland, Province of Lapland, Sodankylä, Ruosselkä, Sakiatieva

Map sheet

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INTRODUCTION

The Geological Survey of Finland (GTK) is a government organization under the Ministry of Trade and Industry. GTK's duties are based on the law, which defines the primary tasks of GTK as mapping using geological, geophysical and geochemical methods. GTK provides information for sustainable use of natural resources especially for exploration and mining industry, construction, land use planning, nature conservation and environmental studies. GTK has office in Espoo, Kuopio and Rovaniemi, with a permanent staff 700, including about 300 geologists, geochemists and geophysicists.

Since its foundation, GTK has been involved in mineral exploration in Finland. Projects have ranged from regional to prospect scale and have led to discovery of number of significant deposits. Today GTK's role is to acquire data from new areas and prospects to encourage further evaluation by the private sector, and the Central Lapland Greenstone belt is one of the GTK's main gold exploration areas. All discoveries and prospects, which are considered to host a significant mineralization, are internationally tendered to the private sector through the Ministry of Trade and Industry in the earliest exploration stage as possible; GTK has no direct role in the mining business. Finland can be considered to be an attractive exploration target in several respects. Geoscientific data coverage is excellent, but large areas can be considered under-explored. Finland is a modern western country with a highly educated population; infrastructure is highly developed with good port facilities, an extensive voltage power grid, and a comprehensive road and airport network. Taxation laws are favourable, and the mining law is strong. In addition the country is close to major European markets.

GTK's role is to provide confidential and customized expert services to exploration and mining companies in the Fennoscandian shield and worldwide. These include all aspects and scales of mineral exploration and prospect evaluation, from planning and implementing regional exploration programs, detailed mineralogical studies and deposit modelling.

GTK discovered the Sakiatieva Au occurrence after a systematic geochemical, geophysical, heavy mineral and drilling program during 1999–2004 in the Ruosselkä area. The area was targeted after a regional scale geochemical survey, which showed anomalous Au concentrations in till over an area of 150 km^2. A heavy mineral survey followed, and this revealed angular gold nuggets in till within the gold anomalous area. One of sampling sites was located at the Sakiatieva gold prospect (Figs. 1 and 2). The follow up drilling results have

been promising and the area is considered to have potential for a significant gold mineralization and the Ministry of Trade and Industry of Finland offers it for purchase through an international tendering process.

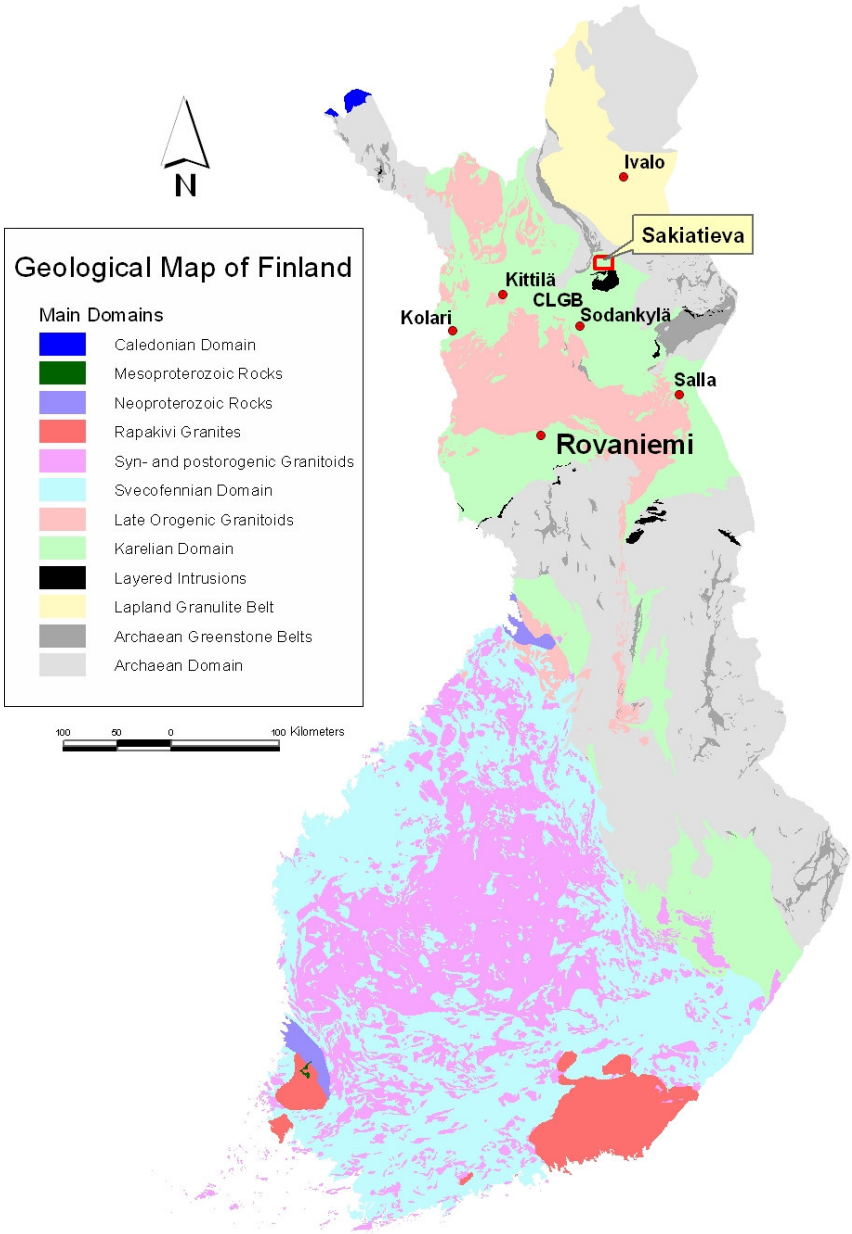

Fig. 1. The Sakiatieva gold prospect is in the northeastern part of the Central Lapland Greenstone Belt (CLGB).

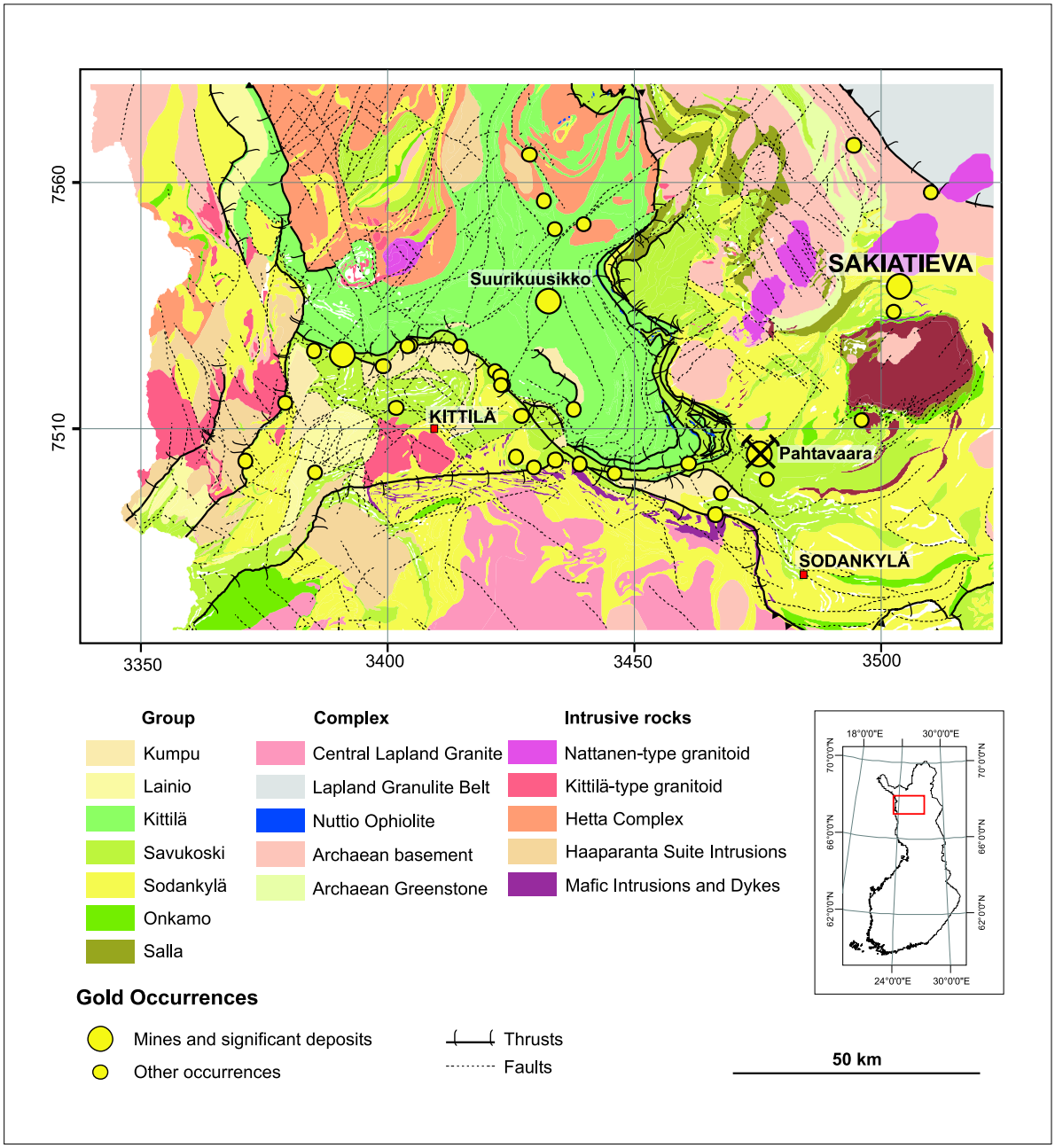

Fig. 2. The Sakiatieva gold prospect on the geological map of the Central Lapland Greenstone Belt.

GENERAL PROPERTY DESCRIPTION

Titles

GTK has currently four exploration claims and two claim reservations in the Sakiatieva area, and has applied for two additional claims for the area (Fig. 3, Table 1). Within these leases there currently are two known Au occurrences, which are named as Ruosselkä 8 and Sakiatieva. The land within the exploration claims areas is state owned. An exploration licence entitles the holder to carry out activities in the claim area with or without the consent of the landowner. The claim holder must, however, compensate the landowner in full for any permanent or temporary damage or inconveniences caused by the exploration activities inside or outside the claim area. The claimant shall also act in compliance with environmental legislation and other land laws and regulations.

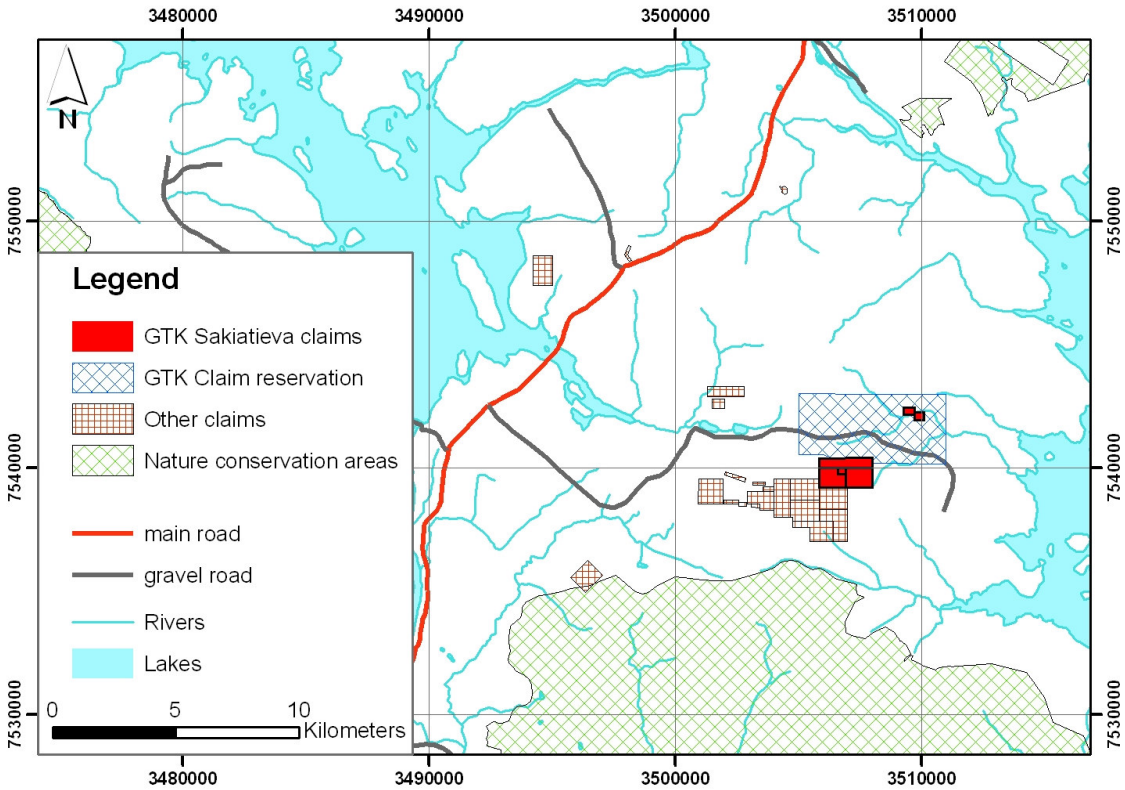

Fig. 3. Location of the Sakiatieva exploration claims in the Ruosselkä area.

Table 1. GTK Claims in the Ruosselkä area

Claim name	Claim no.	Map sheet	Claim size	Claim registered	Claim expires
Ruosselkä 8	7300/1	374102	7.6 ha	5 Nov. 2001	5 Nov. 2006
Sakiatieva	7392/1	374102	77.4 ha	26 Feb.2002	26 Feb. 2007
Sakiatieva 1	7921/1	374102		applied	
Sakiatieva 2	7921/2	374102		applied	
Sorva 1	7782/2	374102	13.5 ha	11 May 2004	11 May 2009
Sorva 2	7782/3	374102	12 ha	11 May 2004	11 May 2009

Location, access and infrastructure

The Sakiatieva prospect is located in the Ruosselkä area about 70 kilometres northeast of the Sodankylä town in the province of Lapland, northern Finland at Lat. 67.7555°N, Long. 27.2335°E (decimal degrees), Finnish KKJ zone 3 coordinates 7540000N 3505000E (Fig. 4). The Sodankylä town is the administration centre of the municipality of Sodankylä of which the total population is about 6700. The claims of GTK are located on the national map sheets 3741 02 and 374103. Road access to the area is by the national highway no. 4 and along a good quality timber haulage road (25 km). The last two kilometres is a timber haulage track, which is drivable for four-wheel drives but passable for heavy vehicles only in winter when the ground is frozen. The nearest railway station is at Rovaniemi, 135 km from Sodankylä. In Sodankylä, there is a small airport for charter traffic. The Rovaniemi, Kittilä and Ivalo airports serve daily flights to Helsinki.

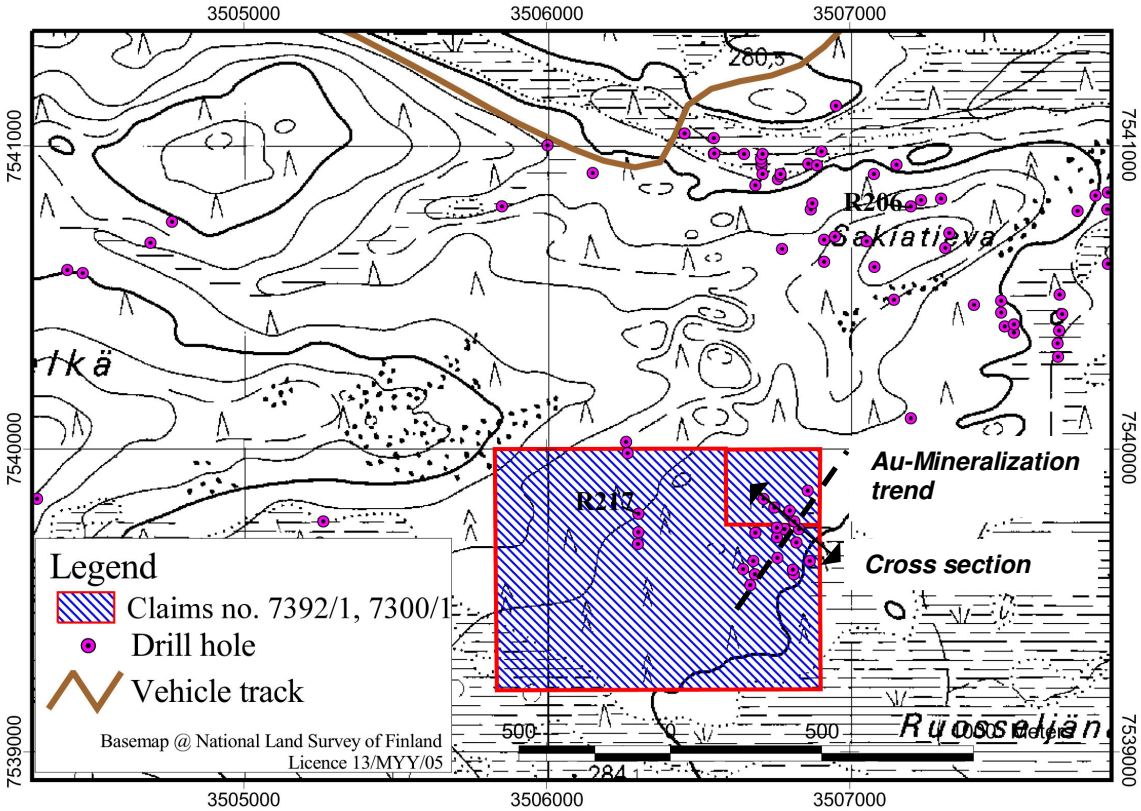

Fig. 4. Topographic map of the Sakiatieva prospect showing the location of Sakiatieva (no. 7392/1) and Ruosselkä 8 (no. 7300/1) claims, diamond drill hole collars. The interpreted gold mineralisation trend and the location of the cross section in Fig. 10 are also shown.

Physiography, climate and vegetation

The weather conditions in the area are those of the characteristic northern Fennoscandian climate with temperate summer and cold winter. During the summer months (June–August) the rainfall is 90 mm and the temperature is mostly between 10°C and 25°C, and during the winter months (October – April) between -5°C and -35°C. Snow covers the terrain, and bogs, lakes and rivers are frozen, annually 6–7 months, and maximum thickness of the snow varies from 0.8 to 1.2 m in the end of March.

Most of the area is gently undulating hilly terrain (260 – 380 m asl.). The Sakiatieva prospect lies in the lower terrain (about 280 m asl.). The prospect area is rather difficult to pass by heavier vehicles during the spring and early summer and the drilling is should be conducted in late summer or in winter when the ground is frozen. Two small, water-rich brooks named Ruosselänhaara and Sompiohaara run through the area: the one to W and the other to E from the water divide in the Eilitsemänvuoma valley. The watershed of the brooks is located in the Eilitsemän vuoma valley.

In the region, weathering-resistant rock types, such as quartzite and granite, are well exposed whereas the outcrops of soft rocks like metasediments and metavolcanic rocks are uncommon. Especially the altered and deformed, gold-mineralised, rocks are deeply weathered and, hence, are rarely exposed.

The overburden is composed of till except for peat bogs and narrow sandy areas associated with rivers and brooks. The thickness of till varies from one to 30 m. The thickest till cover is in the area of end moraines of the Sakiatieva hill. Tills have been drifted from northwest.

The Ruosselkä area is a typical sub-arctic terrain. Pines predominate in the forests of well-drained areas, whereas spruces and mountain birch grow in the low and poorly drained areas. The ground vegetation is composed of lichens, mosses and heather and various types of grass. The wood have been cut into timber during 70's and thereafter reforested several times. Especially in the Sakiatieva area, the reforestration with pine has been unsuccessful.

Property history

The Ruosselkä area was first explored for nickel at the end of 1960's (Nenonen et al. 1975). In addition, the late-post orogenic Nattanen type granites were explored for Mo during 1980's (Front et al. 1985).

The results of regional geochemical mapping of till showed the first indications of gold in the area (Salminen 1995) indicating 150 km^2 of Au-anomalous terrain (Fig. 5). This encouraged to follow-up studies in the Ruosselkä area. GTK carried out a pilot heavy mineral study during the summer 1988 in an area of 120 km^2. The results revealed angular gold nuggets in several samples in the southern part of the Ruosselkä area. GTK started a local scale exploration program to locate the source of the gold in 1999. During the exploration campaign, several targets in the gold anomalous areas were drilled and trenched and a gold occurrence was located in the Sakiatieva prospect. Furthermore, several other gold, copper and nickel showings were indicated during the program.

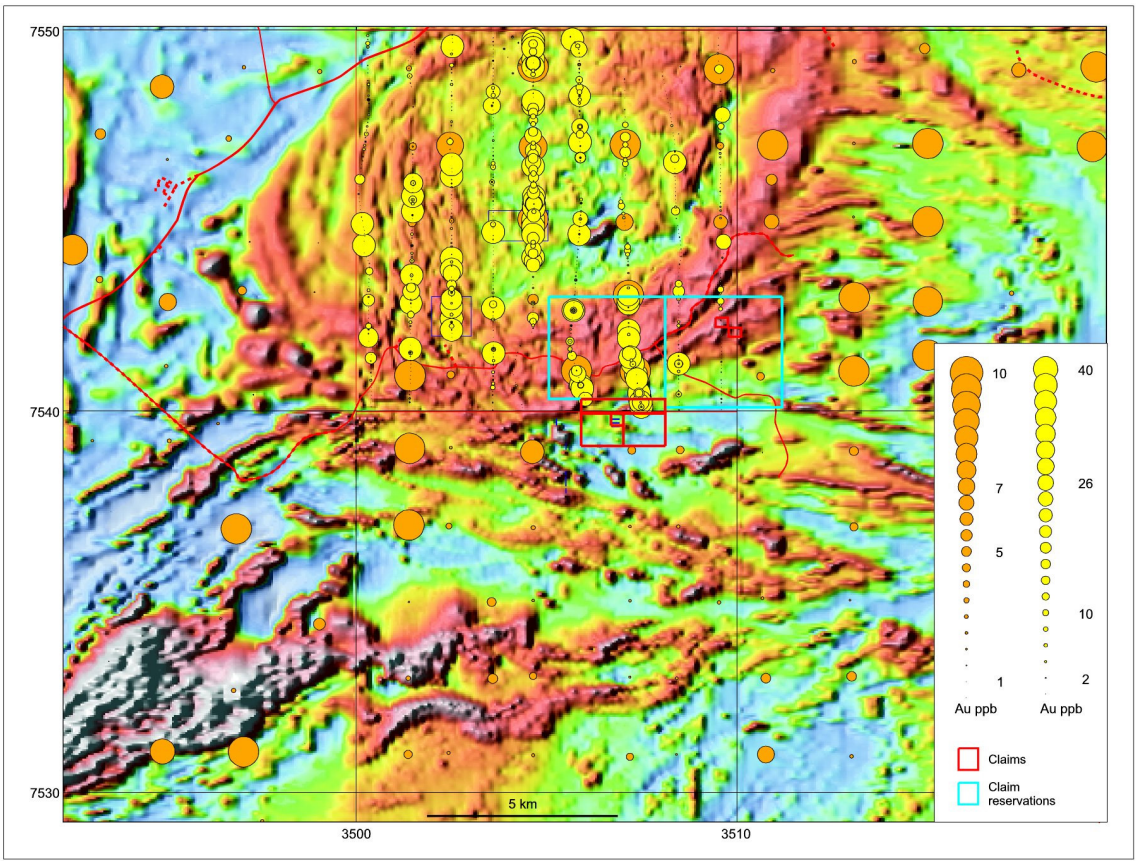

Fig. 5. The results of the regional (orange symbols) and local (yellow symbols) geochemical surveys of the fine fraction of till (<0.06 mm). In the Ruosselkä area, gold concentrations in most samples are above the regional median (1.2 ppb). Background map is a colour-shaded aeromagnetic image. The GTK claims and claim reservations also shown in the map.

REGIONAL GEOLOGY

Geological setting

The bedrock of the Ruosselkä area is composed of a sedimentary and volcanic sequence of the Early Proterozoic Central Lapland Greenstone Belt (Figs. 2 and 6). The hilly areas at Ruosselkä and Sakiatieva are mostly well exposed. Quartzites of the Sodankylä Group (age 2.20–2.40 Ga) occur on the northern slope of the Sakiatieva hill and on the top of the Ruosselkä hill. Savukoski Group (age ca. 2.13 Ga) sedimentary and volcanic rocks cover the area south of the quartzites. Carbonate-rich layers of the quartzite have benn transformed into tremolite and diopside skarns in the contact zone of a granite dyke on the northern slope of the Sakiatieva hill indicating a contact metamorphic effect. There are two zones of the Sattasvaara type komatiites and schists of the Matarakoski Formation (belongs to the Savukoski Group) south of Ruosselkä. The rocks are tightly folded and there are several thrusts and steeply dipping faults within the unit (Lehtonen et al. 1998). The bulk geometry of the area is the result of NE-SW directed shortening. The regional metamorphic grade of the rocks in the area is from greenshist to lower-amphibolite facies.

Granite dykes similar to the late-orogenic Nattanen granites intersect all the other lithological units in the area. The coarse grained, reddish granite dykes are from 5 to 40 m wide, have a NE strike and a dip to the SE.

East-west trending, mafic to ultramafic volcanic rocks with carbonaceous sedimentary interlayers occur in the Sakiatieva hill and to the south of it. These rocks have been affected by potassic metasomatism and they contain biotite and sulphides. The sulphide-rich parts contain 0.1–0.2 % Cu and in places they have anomalous Au and Pd values. Sporadically the altered parts contain small native Cu grains and fine-grained gold (Rantala 2003).

There also are magnetite-rich and very fine-grained sulphide-disseminated ultramafic rocks (serpentinites) as elongated bodies both to the north and south of Sakiatieva. They contain sulphide Ni from 0.1 % up to 0.5 %. The importance of them for exploration is not resolved yet.

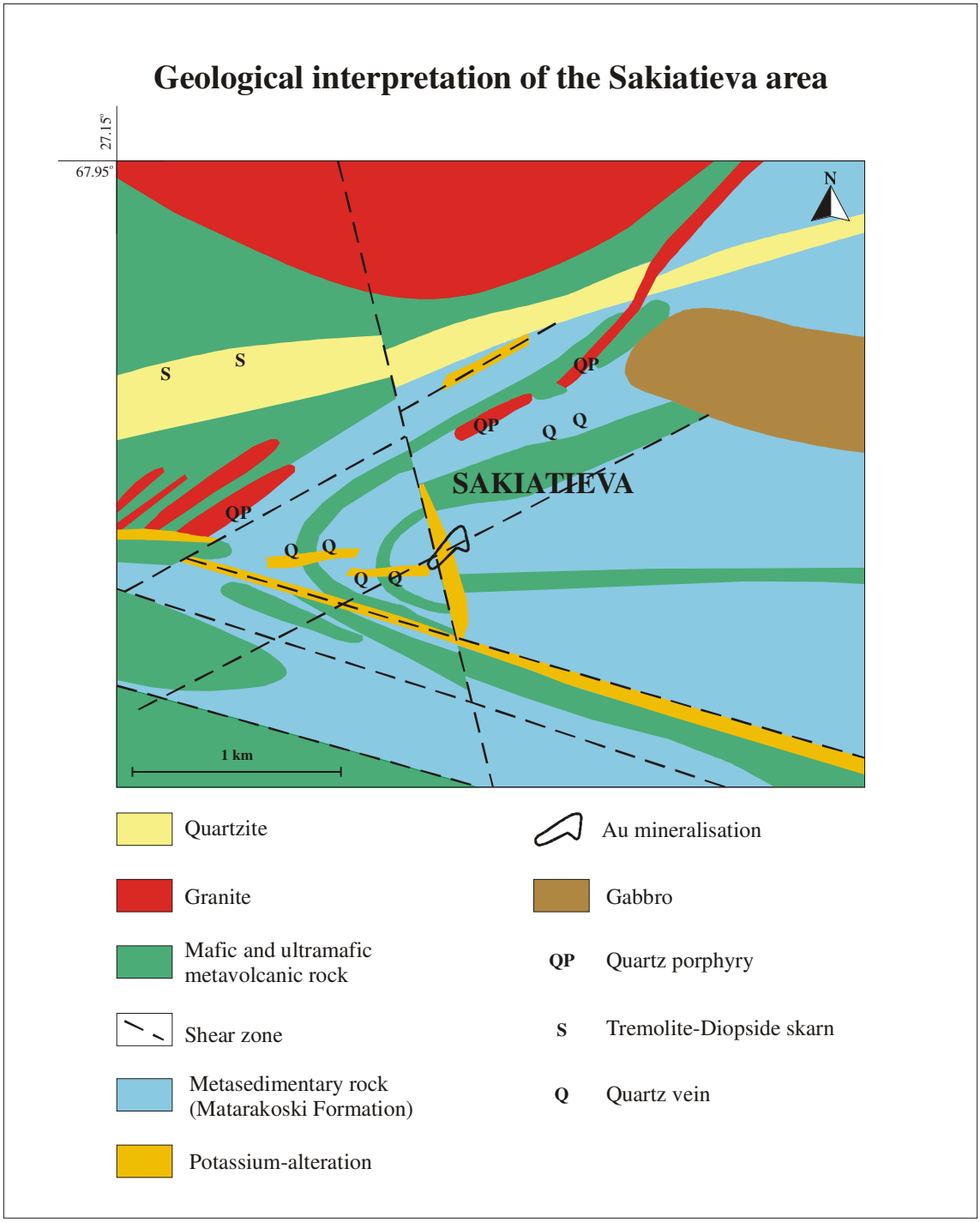

Fig. 6. Geological map of the Sakiatieva area.

Several, up to 50 m wide shear zones have been interpreted to cut the country rocks south of Ruosselkä (Figs. 6 and 7). The ESE-WNW trend dominates and the shear zones cut all volcanic and sedimentary rock and serpentinite units and form the NE-dipping main thrust zone in the area. On the top of the Ruosselkä hill, there are quartz-hematite breccias

associated with this shear zone. The shear zone continues further to the WNW turning first into a massive sulphide-bearing amphibole rock and then into a magnetite-bearing amphibole rock at Urakkaselän Palo.

At Sakiatieva, NNW-SSE and NE-SW trending shear zones intersect a ESE-WNW trending thrust zone. The drilling-indicated gold mineralization at Sakiatieva is located at the intersection zone of these shear and fault zones (Fig. 6).

An east-west trending shear zone at the contact between sericite-quartzite and mafic volcanic rock units is located three kilometres south of Ruosselkä hill. There ia abundant talc and kaolin associated with this shear zone (Fig. 7).

A number of N-S trending faults cut through the whole area investigated (Fig. 7). South of Ruosselkä, the faults cut the wide ESE-trending shear zones and alla lithological units, also the granite dykes. The faults appear as distinct weakly magnetic zones in the aeromagnetic maps and as valleys in the terrain. The valleys grow mainly birches, juniper and spruces, thus their trends can be easily followed in aerial coloured photos.

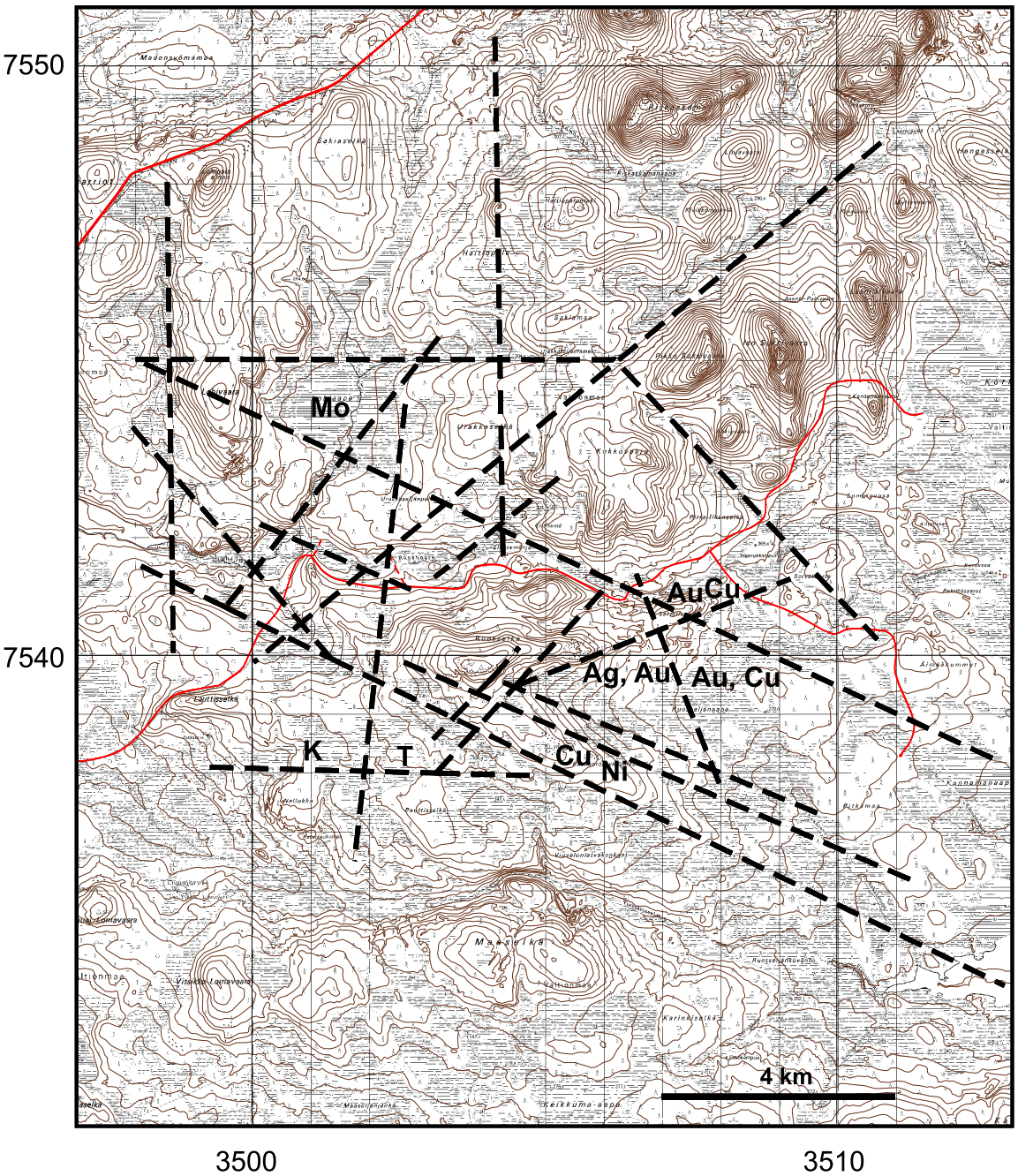

Fig. 7. Faults of the Ruosselkä area as broken black lines, and related mineralizations (K = kaolin, T = talc).

Quarternary geology

Glacial drift covers the Ruosselkä area except for the highest hills. The drift is 1–40 m thick. In the area of thick drift, till consist of two distinct units. The upper one refers to the till bed 2 and the lower one to the till bed 3 according to the classification of Hirvas et al. (1977) for the

northern Finland. The topmost layer of the drift consists of outwash gravel and stony till banks of the terminal flow of the latest glaciation.

Several metres thick saprock between glacial till and fresh bedrock is common. Gold mineralization related alteration and deformation zones have weathered down to tens of metres.

Bedrock is exposed on the tops of hills and on their steep slopes. On the top of Ruosselkä quartzite is most commonly exposed as boulder fields, which form as a result of freezing and thawing frost action. Granite and mafic volcanic rocks are outcropping on the Sakiatieva hill.

The glacial transport distance in the region has been estimated at the locality of Roivainen, eight km north of Ruosselkä, using magnetic a susceptibility data from till (Härkönen et al. 1981). This investigation showed that the glacial flow was from WNW in both of the till beds. Also, it indicated that the transport distance of magnetite grains in the till varies from 50–100 m in the areas where the thickness of the drift is 1–3 m to up to two kilometres where the thickness of the drift is 10 m.

Economic geology

There is no metal mining in the immediately vicinity of Sakiativa, but there is a small dimension stone quarry at the eastern end of the Sakiatieva granite outcrop from where coarse grained, brownish granite was mined and processed. The product was named as "Lapponia Brown" (Rask 1990).

About 60 km north of Sakiatieva, there is the Ivalojoki River area with the historical gold panning areas where alluvial and supergene gold was discovered in 1868. Panning is still going on, mostly as a tourist attraction, with individual panning prospects typically containing a few hundreds grams of pannable gold. However, there has been very little modern exploration for primary gold in the area.

The Suurikuusikko gold deposit, which is about 75 km W, and the Pahtavaara gold mine, which is about 50 km SW of the Sakiativa area, are previously-tendered prospects discovered by GTK in the Central Lapland Greenstone Belt. At Suurikuusikko, Riddarhyttan Resources Ab has defined a 2.5 Moz resource, (http://www.gsf.fi/explor/gold/suurikuusikko.htm). The current resource (indicated + inferred, published 21.12.2004) is 14.9 million tons at 5.2 g/t

Au. Pahtavaara, on the other hand, is an operating mine which produced about 32000 oz (1060 kg) in 2004 (http://www.scanmining.se/pressmeddelanden/050112_pm.html).

EXPLORATION

The Sakiatieva prospect is the first known gold occurrence in the Ruosselkä area. A Cu-Co-occurrence lies about ten kilometres to the SW from Sakiatieva at Maaselkä (Rossi 1983). About 15 kilometres south of Sakiatieva, there is a chromium occurrence associated with the Koitelainen layered intrusion (Mutanen 1979) with several potential ore bodies summing up perhaps >100 Mt @ 13–16 % Cr. The Keivitsa Ni-Cu-Au-PGE occurrence (Mutanen 1997), which is currently explored by Scandinavian Gold Limited (http://www.scangold.com), is about 30 km to the SW of Sakiatieva.

Current exploration program – Exploration techniques and results

Sampling, drilling, sample preparation and assaying

The used diamond drill core size was 35 mm (T46 bit) during shallow test drilling of the first drilling campaign. The core losses were up to 70% in the weathered bedrock and the zones of alteration and gold mineralization were also those of the deepest weathering. To improve core recovery, 75 mm core size (T86 bit) was used during the follow up drilling in winter 2003. In spite of the larger core diameter, the core losses still were significant in the weathered rock. The target zone was trenched in summers 2003 and 2004 to expose the gold mineralization in the weathered bedrock. In the exploration trenches, weathered bedrock samples analyzed (each about four kg) consist of nine sub-samples collected within one square meter area. Polymeric liquids in drilling fluids were used during the last drilling campaign in October 2004. This improved the core recovery significantly and core losses were reduced to 10%.

The diamond core was halved with diamond saw, and the core was sampled for the assay using geological contacts with a maximum sample length of one metre. The half core was crushed in a jaw crusher and pulverized in a ring or a disc mill depending on the sample weight. The entire trench samples each about four kg in size were pulverized in a disc mill. For gold assays of the drill cores, the Geological Survey of Finland Geolaboratory method 522U (GFAAS, aqua regia leach, Hg co-precipitation, 20 g of sample material and for the trench samples 704A and 705A (GFAAS, Pb-Fire Assay, 25–50 g sample) were used. In addition, to evaluate cyanide-soluble free gold, the sodium cyanide leach method with a 3-hour tumbling with the LeachWELL accelerator (Geolaboratory method 235A) was used for 12 high grade samples.

In each sample, also the elements Ag, Al, As,B, Ba, Ca, Cd, Co, Cr, Cu, Fe, La, Li, Mg, Mo, Na, Ni, P, Pb, Sb, Sc, Si, Sr, Th, Ti, V, Y and Zn were analysed with the GTK method 511P, which is based on the ICP-AES technique with aqua *regia* digestion.

Geochemical surveys

Gold and tellurium were assayed from the archived till samples collected in 1970's during the regional geochemical mapping program (Gustavsson et al. 1979) using Geological Survey of Finland Geolaboratory method 522U (GFAAS; *aqua regia* leach, Hg-co-precipitation, 20 g <0.06 mm fraction of till). The mean concentration of gold in 1117 samples in the area of 100 square kilometres is 9.4 ppb and the standard deviation 19.7 ppb. In the Ruosselkä area, gold concentration exceeds 20 ppb in 100 samples.

In addition, the c-horizon of till was sampled in a 50 m x 50 m grid in two one-km^2 areas of Urakkaseljänpalo and Urakkaselkä. Visible stones were separated from the sample and stone-free samples were powdered and assayed by ICP-AES and GAAS.

A heavy mineral survey of till covers 120 square kilometres in the Ruosselkä area and consists of 25 large samples. Each sample is about 200 kg and was collected within a 10 m x 10 m area from five subsites. The initial concentration of samples was done with a sluice and furrow and the concentrate was hand panned to magnetite. The final separations were made with an electromagnetic separator (Fantz) in the GTK mineral laboratory at Rovaniemi.

Geological mapping

GTK has mapped the region including the Ruosselkä area at 1:100,000 scale and the geological map will be published in 2005. A more detailed geological mapping in the Ruosselkä area has been done during the current exploration program (Rantala 2002). However, the outcrop conditions in the Sakiatieva prospect are poor and the local-scale geological map (Fig. 6) is mainly based on geophysical surveys, trench mapping and drilling.

Geophysical surveys

High-resolution, low-altitude airborne magnetic, electromagnetic and radiometric surveys completely cover the Ruosselkä area. The survey altitude is 30–50 meters, line spacing 200 meters and data point interval 12 m. Electromagnetic VLF-R, magnetic, and resistance IP methods have been used for ground geophysical surveys in the area (Fig. 8 and Appendix 2).

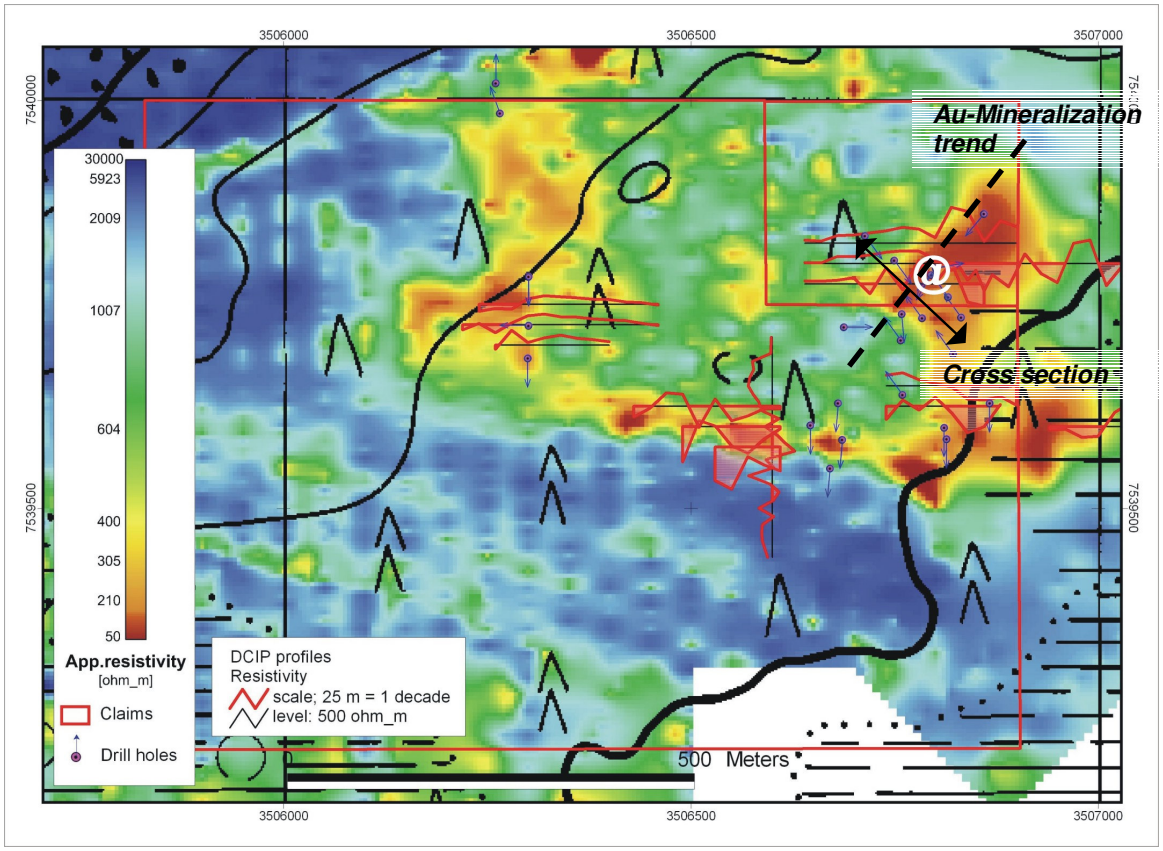

Fig. 8. Ground VLF-R apparent resistivity map with DCIP apparent resistivity profiles from Sakiatieva. The symbol @ shows the location of the gold mineralization at Sakiatieva.

PROPERTY GEOLOGY

The Sakiatieva gold prospect

The dominant trend of lithological units in the Sakiatieva area is E-W. The rocks have been folded and metamorphosed at greenshist to lower-amphibolite facies conditions possibly slightly before the gold mineralization took place. The minor fold axis measured from oriented drill core plunges moderately to the NE. It was interpreted earlier that a NNW-trending shear zone at Sakiatieva controls the potassium alteration in a large scale, but the recent work suggests that the known gold occurrence is associated with an ENE-trending shear zone (Fig 7). Ground geophysical surveys reveal the structures reasonably well (Fig. 8). The proximal alteration minerals are sulphides (pyrrhotite, chalchopyrite, pyrite; total sulphur 0.2–10.0 %), carbonate, quartz, diopside, biotite, sericite, albite and K feldspar. Syanide-leach

assays indicate that the gold is free milling. Microscopic native gold has been observed along grain boundaries of silicates, carbonate and sulphides (Fig. 12).

The proximal alteration zone in the mafic volcanic rocks is defined by carbonate, biotite, coarse grained diopside and sulphides. The proximal alteration in the graphitic sedimentary rocks is marked by serisitization, silicification, carbonatization and sulphidation. The calcareous interlayers of graphitic sedimentary rocks are altered into coarse-grained diopside-carbonate-sulphide rocks. Quartz-carbonate-sulphide veins and breccias are abundant in the proximal alteration zone.

The highest gold concentrations at Sakiatieva are associated with intense carbonate alteration. The drill-tested mineralization is at least 150 m long and 10 m wide and is parallel with an ENE-trending shear zone. The entire altered zone is 50–200 m wide and 400 m long based on the ground geophysical measurements (Fig. 8). The results of the geophysical surveys (VLF-R and IP) indicate that the gold mineralization related alteration is inhomogeneous. Higher gold grades appear to form steeply NE plunging zones, which have a lower resistivity than the less altered parts. The gold grades in the weathered bedrock sampled from the exploration trenches are higher than in fresh rock indicating supergene enrichment in the weathering profile (Fig. 9 and 10).

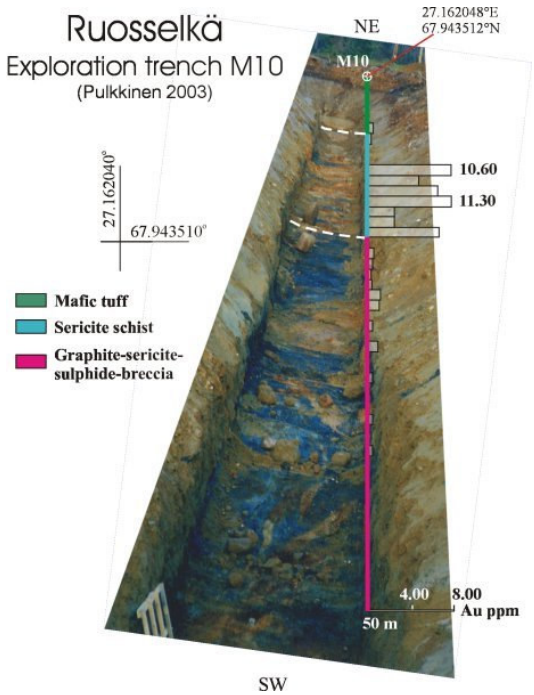

Fig. 9. Exploration trench M10.

The dominating WNW-trending shear zone can be traced for about 10 km to the west of Sakiatieva. The rocks in this shear zone include altered metakomatiites (chlorite-amphibole rocks), graphitic tuffs and carbonaceous schists with calcareous interlayers. The metal concentrations of the altered rocks contain in one to two meter sections rise up to 0.3 ppm Au, 0.5 % Cu, 400 ppm Mo and 0.2–0.5 % Ni.

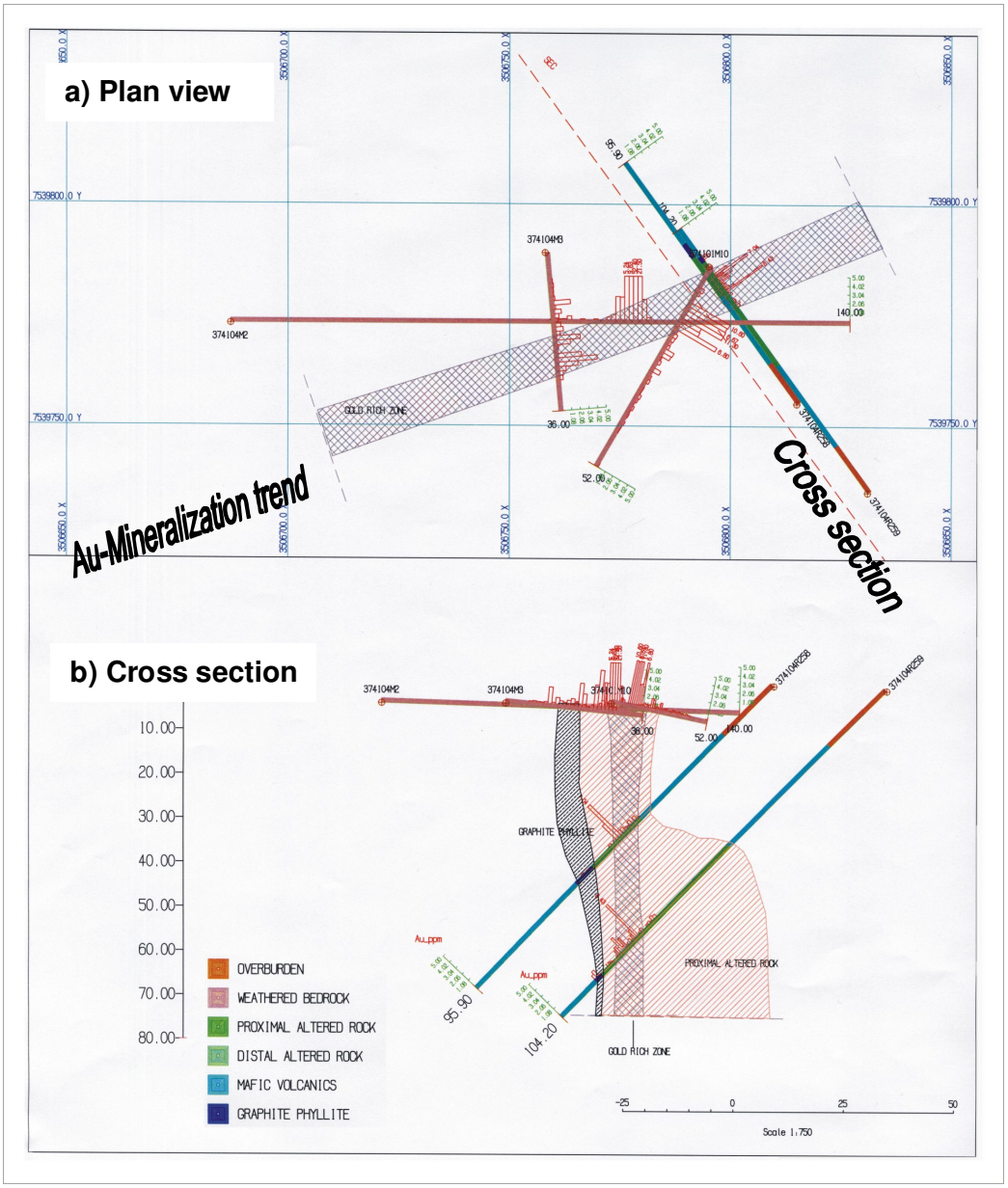

Fig. 10. **a)** Plan view and **b)** cross section showing the exploration trenches (M10, M3, M4) and drill holes (R258, R259) of the Sakiatieva mineralization.

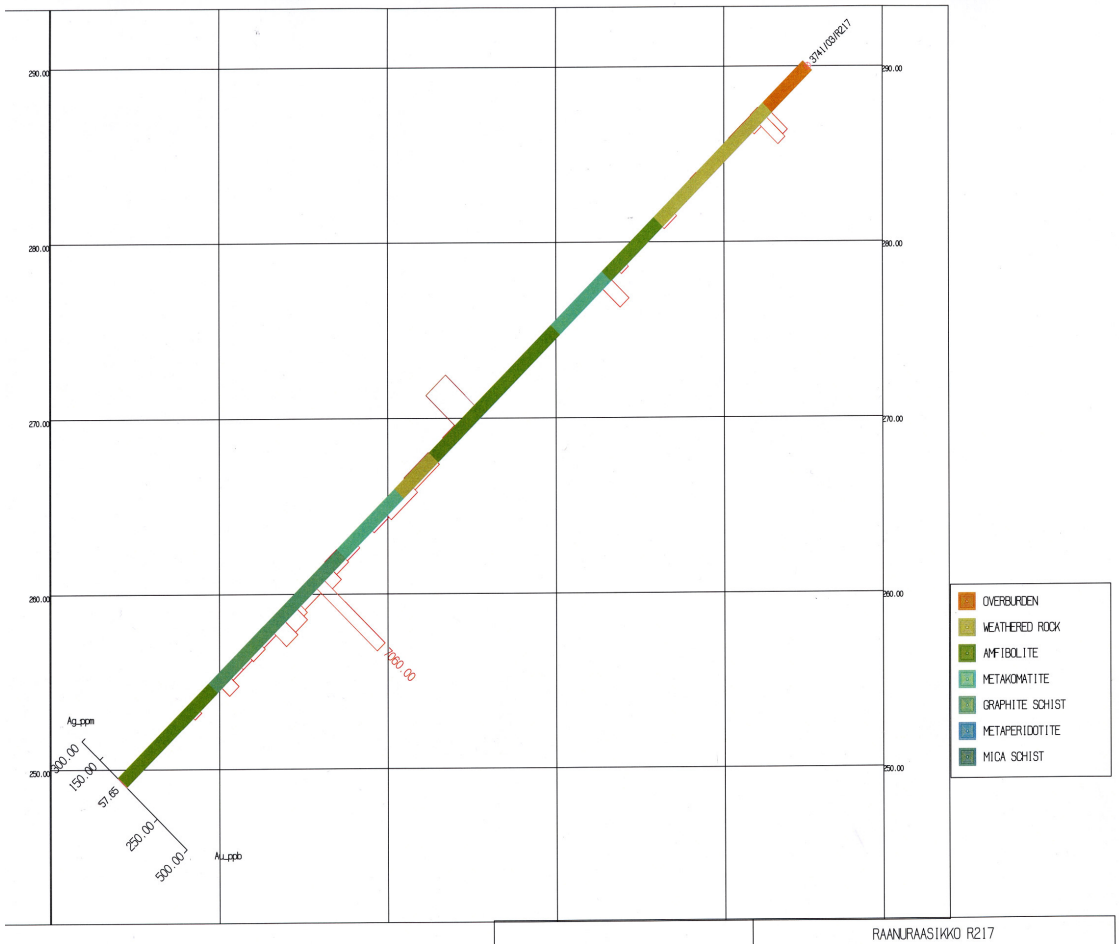

Fig. 11. Drill hole R217 which is 500 m to the west of the Sakiatieva occurrence (location see Fig 4). The drill hole intersects alteration zones with 7 g/t Au between 41.00–41.65 m and 244 g/t Ag between 27.65–29.30 m.

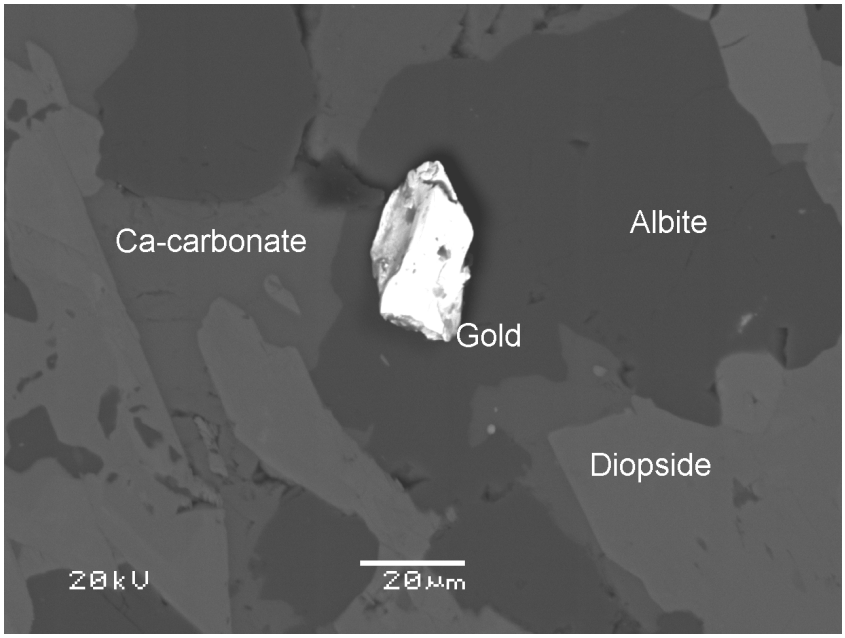

Fig. 12. Gold grain associated with the silicates (R259). A SEM image.

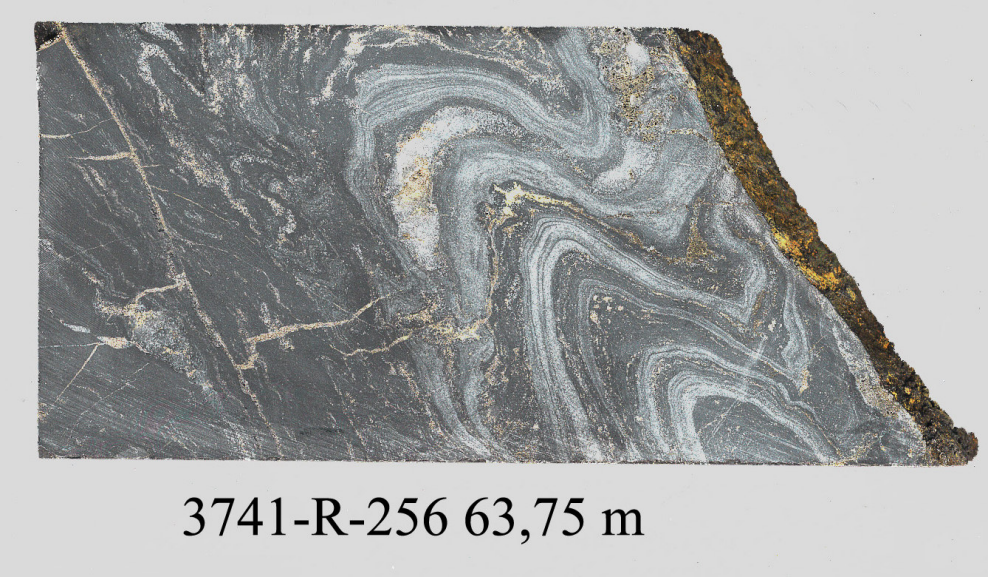

Fig. 13. Tightly folded quartz and sulphide rich skarn banded graphitic phyllite (hole R526).

Other targets near the Sakiatieva prospect

In addition to the main zone at Sakiatieva, there are other gold targets in a NE-trending fault which passes through metakomatiitic and felsic volcanic rocks on the top of a small hill NE of the Sakiatieva prospect. The rocks in the eight meters wide shear zone are altered into the assemblage of hornblende, biotite, chlorite and a fine-grained pyrrhotite-chalcopyrite. Native

gold was observed in a thin section made from an outcrop sample from this shear zone. Gold is as inclusions in hornblende and is associated with small chalcopyrite grains (Rantala 2002). The drill hole R206 (see Fig. 4 for location) intersects the shear in the felsic volcanic rock and contains up to 0.1–0.7 % Cu and 0.5–1.5 g/t Au in a 3 m section from 61.70 m of down-hole depth.

Hematite/magnetite veins

N-S orientated faults cut the Ruosselkä granite complex. At least one of the faults contains a fine-grained granite dyke with hematite veins. These veins apparently are the source of some gold nuggets and hematite-gold nuggets in till in the north slope of the hill NE of the Sakiatieva claims (Fig. 14).

Fig. 14. Gold, magnetite, hematite and gold-hematite grains in heavy mineral concentrate separated with sluice and panning from till of the Sakiatieva hill.

It has been interpreted that most of the shear zones are steeply dipping because horizontal dislocations are quite small. One of the NW-trending faults cuts through the southern part of Ruosselkä (Fig. 7). On the top of the Ruosselkä hill, the fault contains quartz-hematite breccia. Further NW in the area named Allas, the fault zone is composed of strongly disseminated to semimassive Fe-sulphides in an amphibole rock. One kilometre NW of the Allas target, in the Urakkaselän Palo target, there is a magnetite rich amphibole rock inside the granite. The gold assays of the quartz-hematite breccia were below detection limit, but the disseminated sulphide rock at the Allas target contains up to 0.82 % Cu and 0.11 g/t Au. The maximum value assayed from a chip sample of the magnetite-rich amphibole rock is 0.1 g/t Au.

ENVIRONMENTAL STATEMENT

Environmental aspects

There are no nature conservation areas in the immediate vicinity of the Sakiatieva prospect. The nearest conservation area is five kilometres south in Koitelainen (Natura area). In the prospect area, the spruce and birch wood have been logged during 1970's. After the logging, the area was reforested for pine but the results have been poor and the forest has very little timber quality trees in the Sakiatieva prospect area.

DISCUSSION AND CONCLUSIONS

GTK discovered the Sakiatieva Au occurrence after a systematic geochemical, geophysical, heavy mineral and drilling program during 1999–2004. The area was targeted after a regional scale geochemical survey which indicated anomalous Au concentrations in till over an area of 150 km^2. Heavy mineral surveys have proved to be useful when defining targets in the gold anomalous area. Drilling results in the Sakiatieva prospect have been promising and the prospect, and the surrounding Ruosselkä area, is considered to have potential for a significant gold occurrence.

The gold mineralisation at Sakiatieva is structurally controlled and follows the deformed contact zones between mafic volcanic rocks and graphitic sedimentary rocks. The gold-related wallrock alteration is characterised by sericite, carbonate, quartz and sulphides in sedimentary rocks and biotite, carbonate, sulphides, quartz and calc silicates in mafic and ultramafic rocks.

The host rocks were folded and metamorphosed at greenschist to lower-amphibolite facies conditions. The geometry of the rock units is mainly the result of NE-SW directed shortening.

The deformed and altered gold mineralised zones in the Ruosselkä area, and in the Sakiatieva prospect, are commonly deeply weathered. The core recovery from the weathering zone using conventional diamond drilling has been poor and this complicates resource estimates. The use of polymeric compounds in drilling fluids with triple tube core barrel improves the core recovery. However, weathering could be a bonus in exploitation, as the rock is softer and gold could more easily extracted from weathered rock. In addition, there is supergene gold enrichment in the weathering profile.

RECOMMENDATIONS FOR FUTURE WORK

Obviously, more work (especially drilling) is needed to better evaluate the extent and grades at Sakiatieva, and other targets in the Ruosselkä area. To locate the source of the gold nuggets (eg. Fig. 14) recovered in the heavy mineral survey, exploration work should be continued in the area north of Ruosselkä. The current exploration program has also indicated an association between gold and hematite. Further studies could test the occurrence of the IOCG-type deposits in the area. The high magnetic anomaly in the centre of the area remains untested.

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Appendices

1. Drill hole details
2. Ground geophysical methods

Appendix 1

The list of drillholes (R138) and trenches (M10) in the Sakiatieva prospect
(Drillholes within the Sakiatieva and Ruosselkä 8 claims)

Drill hole	X	Y	Z	Direction°	Dip°	Depth m	Number of request for analysis
M/3741/99/R138	7539.629	3506.681	280	185	45	59.25	70599
M/3741/99/R139	7539.584	3506.686	280	185	45	43.10	70600
M/3741/99/R140	7539.549	3506.549	280	185	45	43.95	70601
M/3741/00/R308	7539.794	3506.801	290	80	45	32.15	not analysed
M/3741/00/R309	7539.599	3506.811	290	180	45	144.80	78381
M/3741/00/R310	7539.794	3506.801	290	220	45	36.10	78378
M/3741/00/R311	7539.861	3506.860	290	220	45	124.30	78377
M/3741/02/R210	7539.984	3506.266	285	340	45	61.90	84879
M/3741/02/R211	7539.784	3506.301	285	180	45	60.60	84880
M/3741/02/R212	7539.724	3506.301	285	270	45	40.30	84881
M/3741/02/R213	7539.684	3506.300	285	180	45	37.10	84882
M/3741/03/R217	7539.784	3506.301	290	180	45	57.65	78854
M/3741/04/R252	7539.834	3506.714	280	144	45	149.05	91372
M/3741/04/R253	7539.804	3506.750	279	144	45	110.70	91373
M/3741/04/R254	7539.639	3506.760	278	324	60	128.05	91821
M/3741/04/R255	7539.706	3506.758	279	324	45	68.75	91389
M/3741/04/R256	7539.733	3506.784	279	324	45	91.05	91383
M/3741/04/R257	7539.689	3506.822	279	324	45	131.50	91385
M/3741/04/R258	7539.759	3506.816	279	324	45	95.90	91822
M/3741/04/R259	7539.734	3506.832	278	324	45	104.20	91388
M/3741/01/M10	7539.786	3506.795	290	210		52.00	64922
M/3741/01/M11	7539.585	3506.814	290	180		82.00	64923
M/3741/01/M12	7539.602	3506.647	290	180		75.00	64924
M/3741/04/M1	7539.784	3506.301	290	180		61.00	64880
M/3741/04/M2	7539.722	3506.688	280	90		140.00	64881
M/3741/04/M3	7539.738	3506.759	280	175		36.00	64882
M/3741/04/M4	7539.629	3506.867	280	180		34.00	64883

Appendix 2

Sodankylä; Sakiatieva area

Geophysical ground surveys

Data included to claim report

Magnetic

Data files:	m3741031.xyz (1999),
	02mgld374103_1_cut.xyz (2001-2002),
	03mg374102_1_cut.xyz (2003)
Equipment:	Proton magnetometer
Area:	3 survey area
Line direction:	SW-NE, N-S
Line spacing	50-100m
Point separation:	10m

VLF-R

Data files:	v3741031.xyz, v3741032.xyz (1999),
	02vrld374103_1_cut.xyz (2001-2002),
	03vr374102_1_cut.xyz (2003),
Equipment:	Geonics EM16R
VLF-R stations:	GBR 16.0 kHz / DHO38 23.4 kHz
Area:	3 survey area
Line direction:	SW-NE, N-S
Line spacing	50-100m
Point separation:	10m

DC-IP

Data_file:	02ip374102_1.xyz (2002, 13 profiles)
Equipment:	Syscal IP

Array:	Bipole-dipole / A50BM20N
Area:	15 profiles
Line direction:	E-W / N-S
Point separation:	20 m

Table 1. Geophysical ground measurements included to report in Sakiatieva study areas.

	points	***line_km***	***Area [km^2]***
Magnetic	8182	96.47	~ 6.25
EM; VLF-R	8873	86.40	~ 6.25
IP	159	2.60	15 profiles

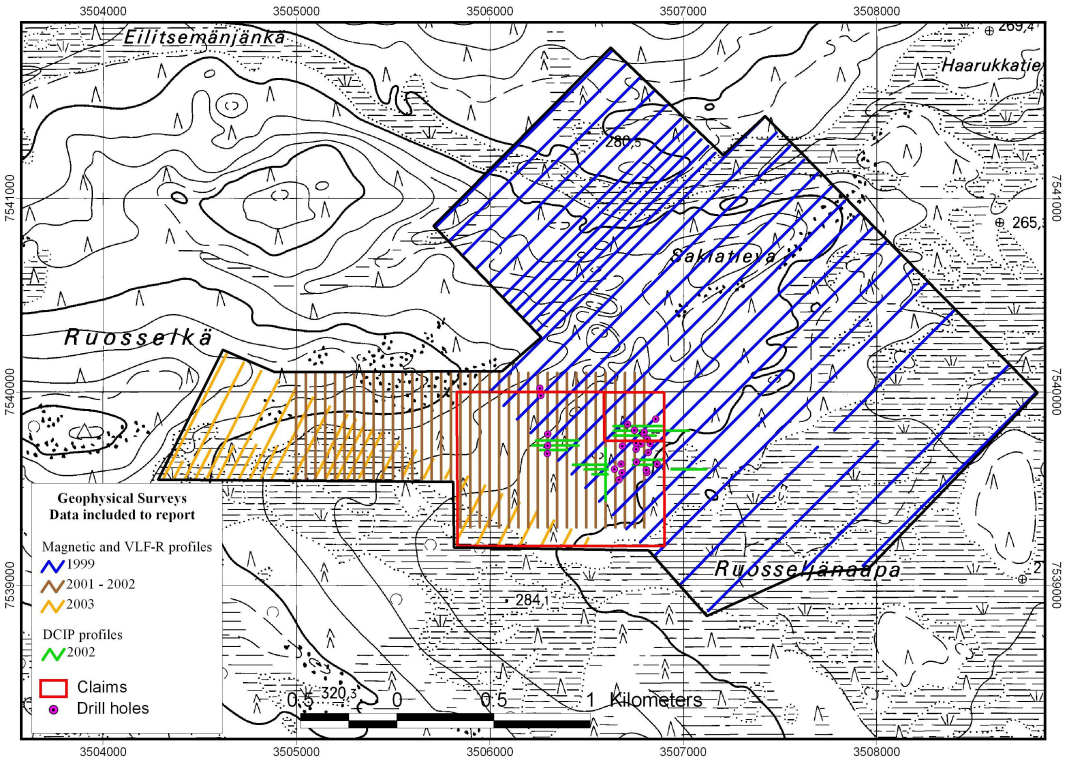

Figure 1. Index map of ground geophysical data included to report in Sakiatieva claim areas.

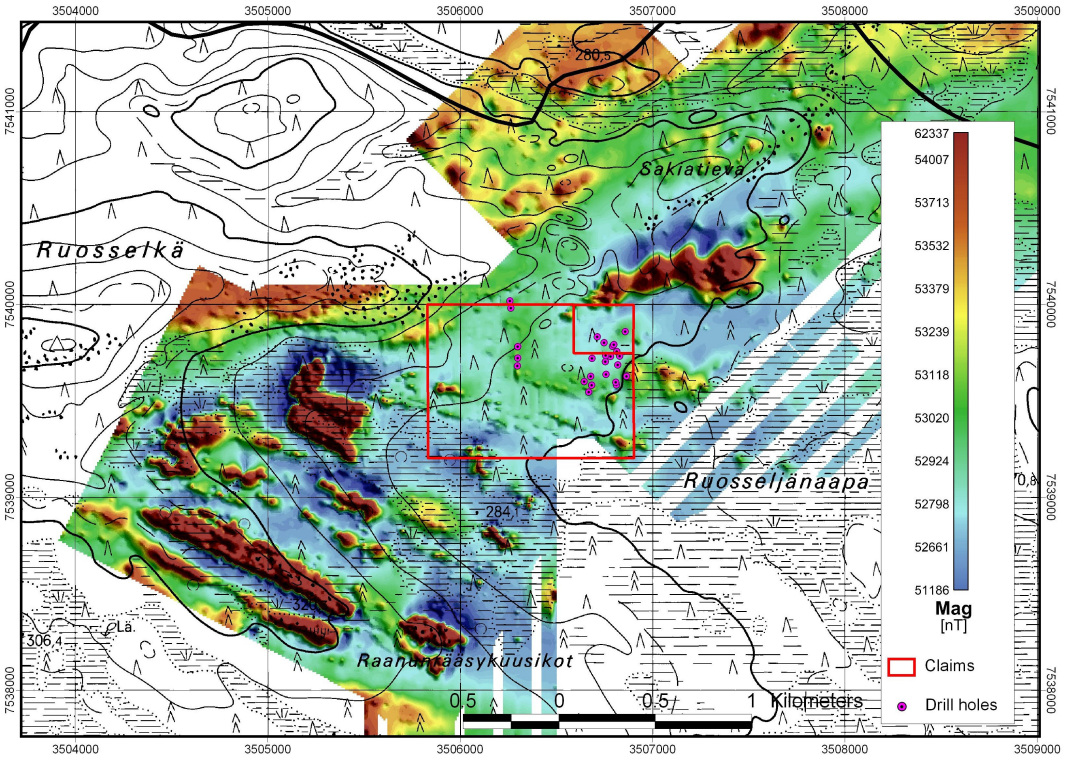

Figure 2. Shaded relief map of total magnetic field from Sakiatieva area. Illuminated from northeast. Line spacing 50/100m m and station spacing 10 m

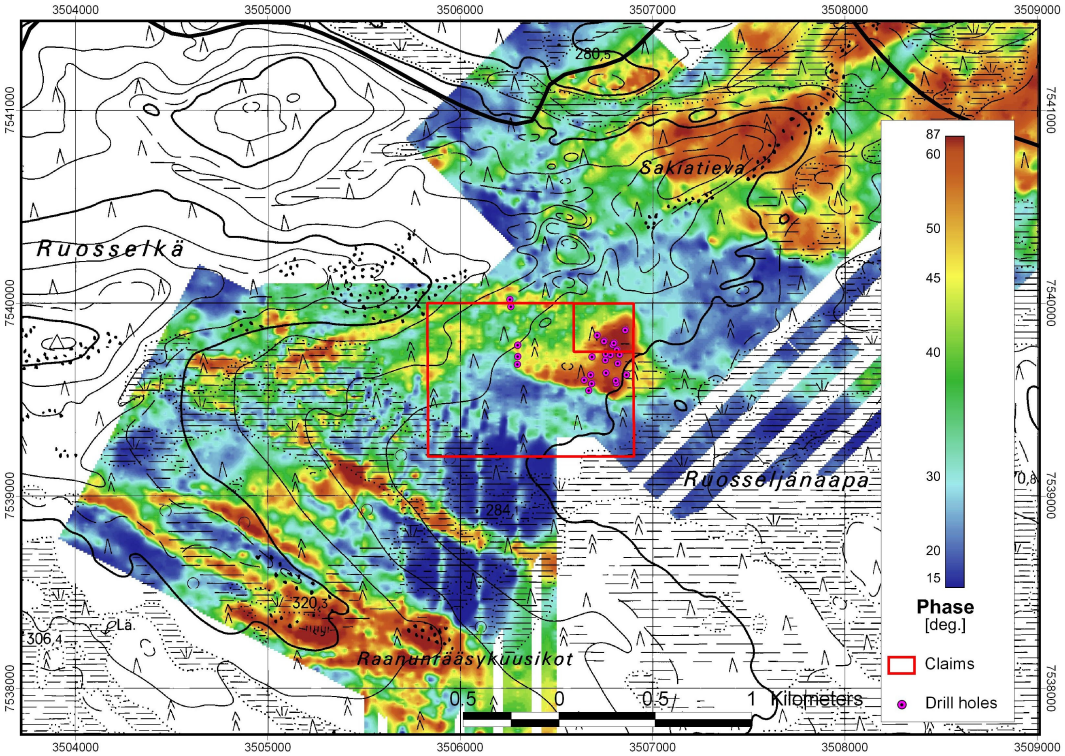

Figure 3. VLF-R phase map from Sakiatieva area. Conductors can be seen as areas where phase angle is over 50 degrees. Line spacing 50/100 m, station spacing 10 m.

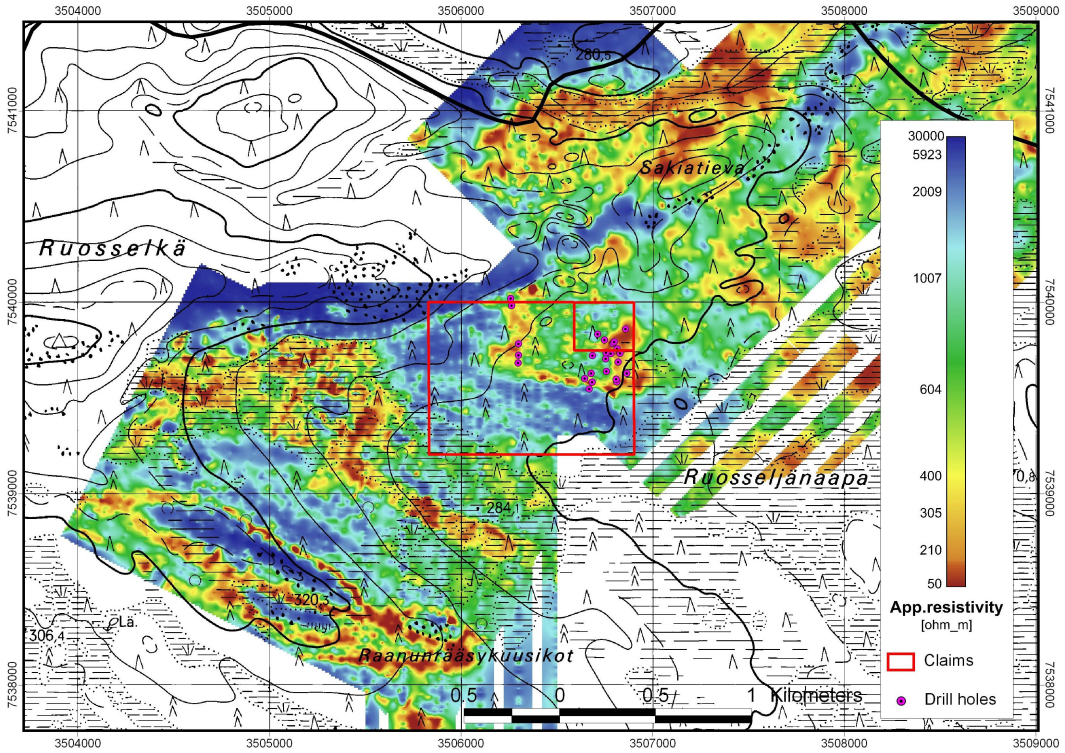

Figure 4. VLF-R apparent resistivity map from Sakiatieva area. Line spacing 50/100 m, station spacing 10 m.

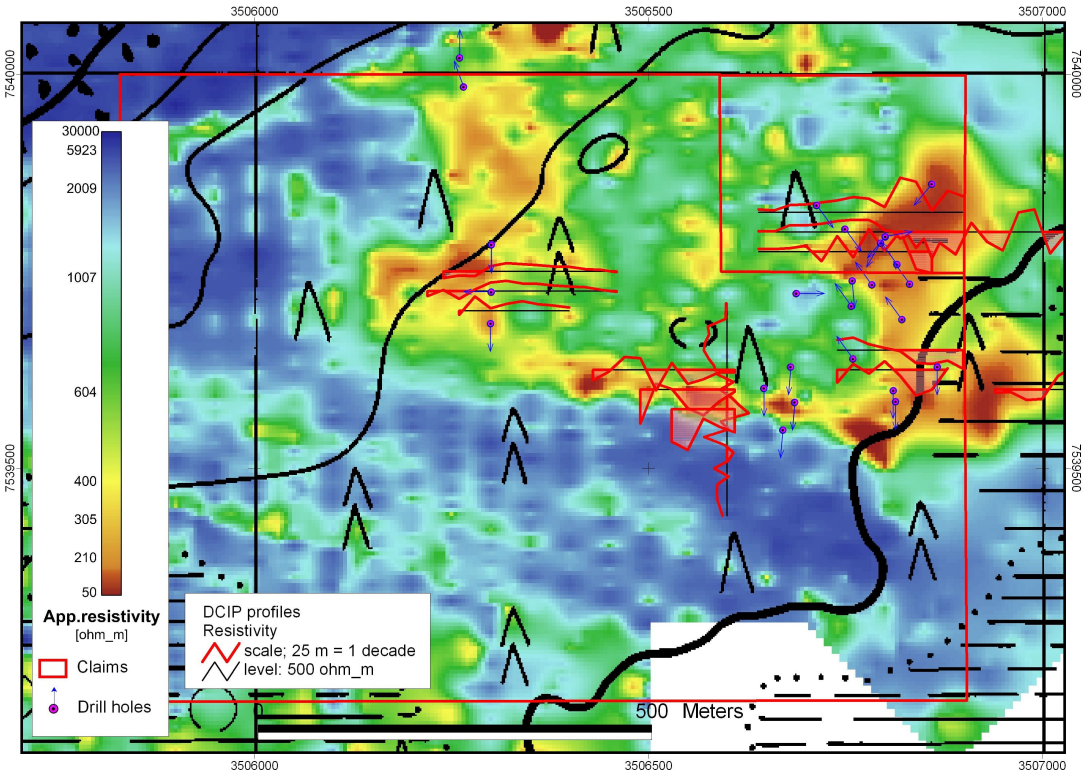

Figure 5. VLF-R apparent resistivity color surface and DCIP apparent resistivity profiles from Sakiatieva claim areas.