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Saku Vuori, Niilo Kärkkäinen, Pekka Huhta, Tuire Valjus
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RITAKALLIO GOLD PROSPECT, HUITTINEN, SW FINLAND

GTK

GEOLOGIAN TUTKIMUSKESKUS **KUVAILULEHTI**

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Tekijät Saku Vuori, Niilo Kärkkäinen, Pekka Huhta, Tuire Valjus	**Raportin laji** Myyntiraportti **Toimeksiantaja** GTK

Raportin nimi

Ritakallio gold prospect, Huittinen, SW-Finland

Tiivistelmä

Huittisten Ritakallion kulta-aihe on uusi, GTK:n alueellisen moreenigeokemian perusteella (2002) löydetty kohde. Geokemiallisten ja raskasmineraalitutkimusten perusteella kyseessä on vähintään 2300 m pitkä ja 600 m leveä kulta-anomaalinen vyöhyke. Korkein kallionäytteestä analysoitu kultapitoisuus alueella on 36.5 g/t ja lohkarenäytteessä korkein pitoisuus on 36.2 g/t Au. Ritakallion mineralisaatio on paljolti saman tyyppinen kuin lähellä sijaitseva Jokisivun kultaesiintymä, jonka kaivostoiminnan käynnistämisestä on tehty päätös aiemmin tänä vuonna (Polar Mining Oy).

Ritakallion alueella on vuosina 2003-2004 tehty malminetsintä- ja kallioperäkartoitusta (7 km^2), moreenin geokemiallisia ja raskasmineraalitutkimuksia (37 tutkimuskaivantoa), geofysiikan maastomittauksia (magneettinen 7.08 km^2 , slingram 5.85 km^2, IP 6.25 km^2), moreeni- ja kallionäytteiden iskuporauksia (214 paikkaa) ja syväkairauksia kahdessa profiilissa (yhteensä 610 m). Lisäksi on tehty geofysiikan tulkintoja, petrofysikaalisia mittauksia sekä mikroskooppi- ja mikroanalysaattoritutkimuksia. Analysoiduista kairasydännäytteistä yhteensä 25.4 m sisälsi yli 1 g/t kultaa. Korkein pitoisuus oli 1 m @ 3.85 g/t ja pisin lävistys 4.7 m @ 1.7 g/t. Vastaavasti iskuporauksen kalliomurskenäytteissä korkein mitattu pitoisuus on 8.5 g/t (~1 m näytettä) ja pohjamoreenissa 1.2 g/t Au.

Ritakallion mineralisaation isäntäkivenä on kiilleliuske/gneissiympäristössä oleva dioriitti-gabro-intruusio, jota leikkaavat kultapitoiset hierrot ja kvartsijuonet. Kultaan liittyvä muuttuminen isäntäkivessä on havaittavissa tyypillisesti sulfidien, serisiitin ja kvartsin määrän kasvuna. Kulta esiintyy vapaina rakeina silikaattien väleissä ja sulkeumina sulfideissa. Kultaa on myös komposiittirakeina Bi-, Sb- ja Te-mineraalien kanssa. Kullan raekoko vaihtelee <0.01-1 mm:n ja puhtaus 930 ja 1000:n välillä.

Alue on suojattu 6 valtauksella käsittäen yhteensä 5.77 km^2. Valtausalueella ei ole merkittäviä pohjavesivaroja, eikä sen lähialueilla ei ole luonnonsuojelualueita. Asuttuja tiloja on valtausalueen eteläreunalla, mutta ne sijoittuvat kulta-anomaalisen alueen ulkopuolelle.

Ritakallion kultamineralisaatiota lävistävien syväkairaprofiilien pitkän etäisyyden (~1.2 km) ja useiden näiden välille ja ulkopuolelle sijoittuvien kultaviitteiden perusteella Ritakallion kulta-aihetta voidaan pitää hyvin potentiaalisena lisätutkimusten ja malminetsinnän kohteena.

Asiasanat (kohde, menetelmät jne.)

Kulta, malminetsintä, geokemia, geofysiikka, kairaus

Maantieteellinen alue (maa, lääni, kunta, kylä, esiintymä)

Länsi-Suomen lääni, Huittinen, Ritakallio

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Kokonaissivumäärä 53 s.	**Kieli** englanti	Hinta	**Julkisuus** salainen

EXECUTIVE SUMMARY

Ritakallio is a recently discovered gold prospect in SW Finland. The occurrence was found by the Geological Survey of Finland in a regional scale gold exploration program in 2002. After initial weak indication in the Ritakallio area, comprehensive exploration work was launched with encouraging results.

Currently available information from Ritakallio consists of geochemical, geophysical, petrophysical, heavy mineral and microanalytical data in addition to geological field observations. The highest gold concentration in the area was discovered in outcrop sampling (36.5 g/t) and it was akin to the highest value in a glacial erratic boulder sample (36.2 g/t). In all 600 m of diamond core drilling has been completed in two profiles, and in total 25.4 m record gold concentration over 1 g/t. The highest concentration in drill core is 1 m at 3.85 g/t and the longest section 4.7 m at 1.7 g/t. Percussion drilling samples from bedrock (~1 m of core for a sample) recorded up to 8.5 g/t and from basal till 1.2 g/t Au. Geophysical ground surveys performed for the area include magnetic (7.08 km^2), slingram (5.85 km^2) and induced polarity (6.25 km^2) measurements.

The critical host rock for gold at Ritakallio is a mafic intrusion which is enveloped by mica schists and gneisses. All these rock types contain gold-enriched shear zones and quartz veins but they are more abundant in the mafic rocks. Gold is associated with alteration that is characterised by the presence of sulphides, sericite and excess quartz. Gold occurs as native free grains between silicate gangue and within sulphides, with the grain size ranging from <0.01 up to 1 mm and fineness from 930 to 1000. Gold also forms composite grains with Bi-, Sb- and Te-rich minerals.

Geochemical and heavy mineral gold anomalies cover a 2300 m long and 600 m wide area at Ritakallio. This area is protected with 6 exploration claims (5.77 km^2), the first two of which will expire on 30.9.2009 and the other four on 12.5.2010. There are no environmentally protected areas in the area or in the vicinity. Furthermore, Ritakallio does not include any significant aquifers and the permanent settlements within the claim area are located outside the gold anomaly area.

Ritakallio shows geological features similar to nearby Jokisivu gold deposit where Dracon Minining NL (Polar Mining Oy) in 2005 has decided to begin mining.

The distance between the two diamond drilling profiles at Ritakallio is long (1.2 km). The fact that there are abundant indications for gold between and beyond the drilled profiles lends support to the conclusion that the Ritakallio prospect area has a high potential for further discovery of gold.

Keywords: SW-Finland, gold, geochemistry, geophysics, drilling, potential

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1. INTRODUCTION

Aim of this study

Gold is currently actively explored by the Geological Survey of Finland (GTK) in southern Finland which is considered as a potential region not least due to past gold mines. The opening of the first Finnish gold mine at Haveri led to the first intensive gold exploration period in southern and western Finland during the 1940s, but systematic work has only been done since the late 1980s resulting in the discovery of the Orivesi gold ore (mined 1994–2003) and several so far subeconomic gold occurrences (http://www.gtk.fi/explor/eco_gold_frame.htm).

The Ritakallio prospect is a new gold occurrence discovered by GTK during 2002. After the first indication, all the exploration methods employed have yielded positive results. This report will present the collected data and address the gold potential of the target.

Ritakallio is located close to the Jokisivu gold deposit where Dracon Minining NL has decided to soon begin mining as its second Nordic gold operation (http://www.dragon-mining.com.au/pages/media%20releases/mr_28june2005.htm). Several geological features show analogies between the Ritakallio mineralization and the Jokisivu deposit.

The recent status of the Ritakallio occurrence is a prospect. GTK's decision of an early release of this target to international tender is based on the very promising first-stage exploration program results. In addition to close geological and spatial relationship with the Jokisivu project, notable is the short distance (40 km by road) to the Vammala processing plant.

Role of the Geological Survey of Finland

The reporting of the Ritakallio prospect to Ministry of Trade and Industry of Finland for open international tender is in accordance with the main duties of the GTK.

One of the main duties of GTK is to promote mineral exploration and mining in Finland. GTK is responsible for national mapping and geoscience information related to bedrock and Quaternary geology, geophysics, geochemistry and mineral occurrences. The data are available in digital form, or as maps, reports and publications. GTK is involved in mineral exploration from regional- to prospect-scale projects and acquires sufficient data on prospects to encourage further evaluation by the private sector. All discoveries and prospects are tendered to the private sector. GTK also offers the minerals industry confidential expertise in Fennoscandian economic geology, customer-tailored exploration services, and modern chemical, mineralogical and GIS laboratory services on a confidential basis both in Finland and worldwide.

2. GEOGRAPHY

Location

The Ritakallio gold occurrence is in southwestern Finland, 160 km NW of Helsinki (Fig. 1). It is in the municipality of Huittinen, province of West-Finland (base map sheet 2112 04; KKJ-coordinates x= 6778 550, y=2432 700; EurefFin geographic coordinates 61°61"36.407', 22°6"54.62'). On the map, the name of the locality is Ritakallionmaa.

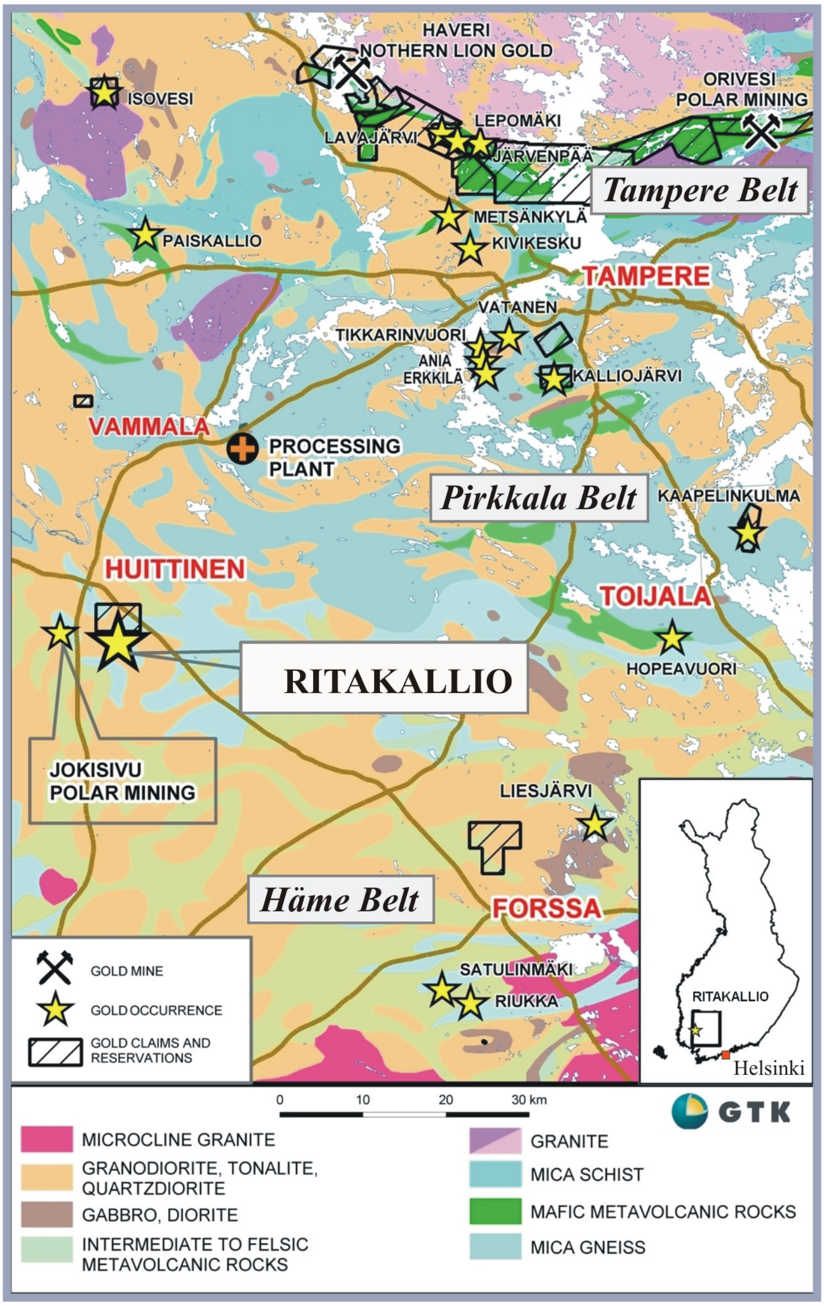

Figure 1. Location of the Ritakallio prospect and other adjacent gold occurrences.

Infrastructure

Ritakallio is situated in a rather flat forest area showing altitude differences on the scale of tens of metres (Fig. 2). To the south of the claim area there are a few farms and the river Loimijoki. The main road number 2, from Helsinki to Pori, is only 5 km north of Ritakallio, and several gravel and forest roads lead to the claim area. The closest town is Huittinen, 8 km NW of Ritakallio. The closest railway station also is at Huittinen, and the closest airport and harbour are in Pori, 70 km NW of Ritakallio.

The Vammala gold processing plant is 40 km from Ritakallio (by road), and only 5 km to the east of Ritakallio is the Jokisivu gold deposit. Both the Vammala plant and the Jokisivu prospect are held and under development by Polar Mining Oy (Dracon Mining NL).

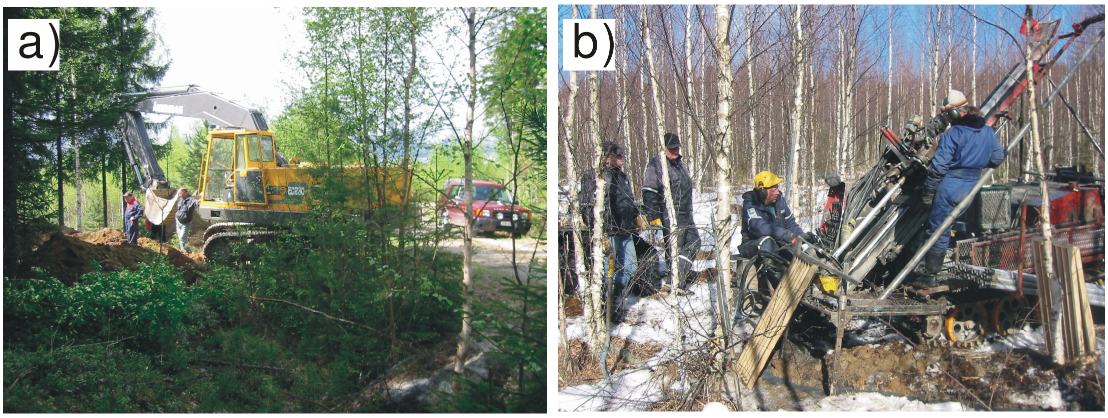

Figure 2. Sampling in the Ritakallio area: a) heavy mineral exploration in till and b) diamond core drilling.

Physiography, climate and vegetation

The local terrain is characterised by basal moraine. The off-road conditions are good because hard till covers most of the area. Based on percussion drilling data, the thickness of the overburden varies from zero to 20 m, and averages at 5.8 m. The underlying bedrock is fresh in terms of weathering. There are no lakes in the Ritakallio area.

The climate conditions follow the typical central Fennoscandian climate with temperate summers and cold winters. Summer temperatures (June-August) are typically between 15 to 25 ^{o}C, whereas in winter (December-March) they fall into the range of –5 ^{o}C to –30 ^{o}C. The terrain is covered with snow and the lakes are frozen commonly 4–5 months during the winter.

The Ritakallio area represents a rather typical forestry environment of SW Finland. It shows diverse regions of common birch, pine and spruce trees. The minor, shallow wet soil areas in topographical depressions can be classified as swamps based on vegetation.

3. GENERAL DESCRIPTION

Ritakallio gold occurrence

The first indication of gold in the Ritakallio area was detected during 2002 as a slightly increased gold content in the fine fraction of a till sample (Huhta 2005). The sample was taken during a regional heavy mineral survey. This work was directed by regional gold indications of the previous nation-scale low-density geochemical mapping (1 sample/4 km^2). Though the increased gold content was still rather low (21 mg/t), the place was estimated potential for gold mineralisation, according to the recently created high-resolution aeromagnetic maps where Ritakallio was shown to be in a structure interpreted as NE–SW-oriented shear zone (Fig. 7).

Subsequently, mineralised glacial erratic boulders with arsenopyrite and quartz veins were found nearby the site of the first geochemical anomaly. During the autumn of 2003, more systematic heavy mineral sampling was carried out. Gold grains were found to occur in abnormally abundant amounts in heavy mineral concentrates of till in the area (Huhta 2005). In addition, tens of new boulders with promising gold assay values (up to 36 g/t Au) were found. This launched a more intense exploration during 2004 and resulted in versatile indications of gold potential in the Ritakallio area.

Ore potential

Geochemical and heavy mineral exploration data demonstrates that the Ritakallio area is endowed with several gold anomalous localities and boulders. They are dispersed throughout the whole 2300 m long and 600 m wide area that was chosen for detailed work based on the first-stage heavy mineral studies and geophysical data. However, there are also showings of gold beyond this area supporting an idea of a large-scale gold mineralisation at Ritakallio. Every stage of the investigations that took place in the Ritakallio area during 2002–2004 gave consistently good results for gold, and subsequently led to the decision to report this target.

Claims

The Ritakallio prospect consists of six claims, which cover an area of 577 hectares (Fig. 3 & Table 1). Up until 2.2.2003 the same area was a GTK's claim reservation area and GTK also had two claim reservations (expired 22.2.2005) north of the present claims. Two of the claims will expire on 30.9.2009 and the rest on 12.5.2010. The claims include properties of 95 landowners. The properties are typically around 5 hectares in size with the largest one being 58.9 hectares.

The nearest gold claims are located 1.6 kilometres SW of Ritakallio and are presently held by Polar Mining Oy. Polar Mining also has the mining lease and a test mine at Jokisivu, 5 km west of Ritakallio. Calcite and dolomite marble mines at Vampula (Partek Nordcalc Oy) are located 15 km south of Ritakallio.

Table 1. Currently legitimate claims of the Ritakallio area

Name	Claim ID	Expiry date	Area
Ritakallionmaa 1	7864 / 1	30.9.2009	99.5 hectares
Ritakallionmaa 2	7864 / 2	30.9.2009	99.4 hectares
Ritakallionmaa 3	7926 / 1	12.5.2010	95.3 hectares
Ritakallionmaa 4	7926 / 2	12.5.2010	92.7 hectares
Ritakallionmaa 5	7926 / 3	12.5.2010	99.8 hectares
Ritakallionmaa 6	7926 / 4	12.5.2010	89.8 hectares *total ~ 5.77 km*^{2}

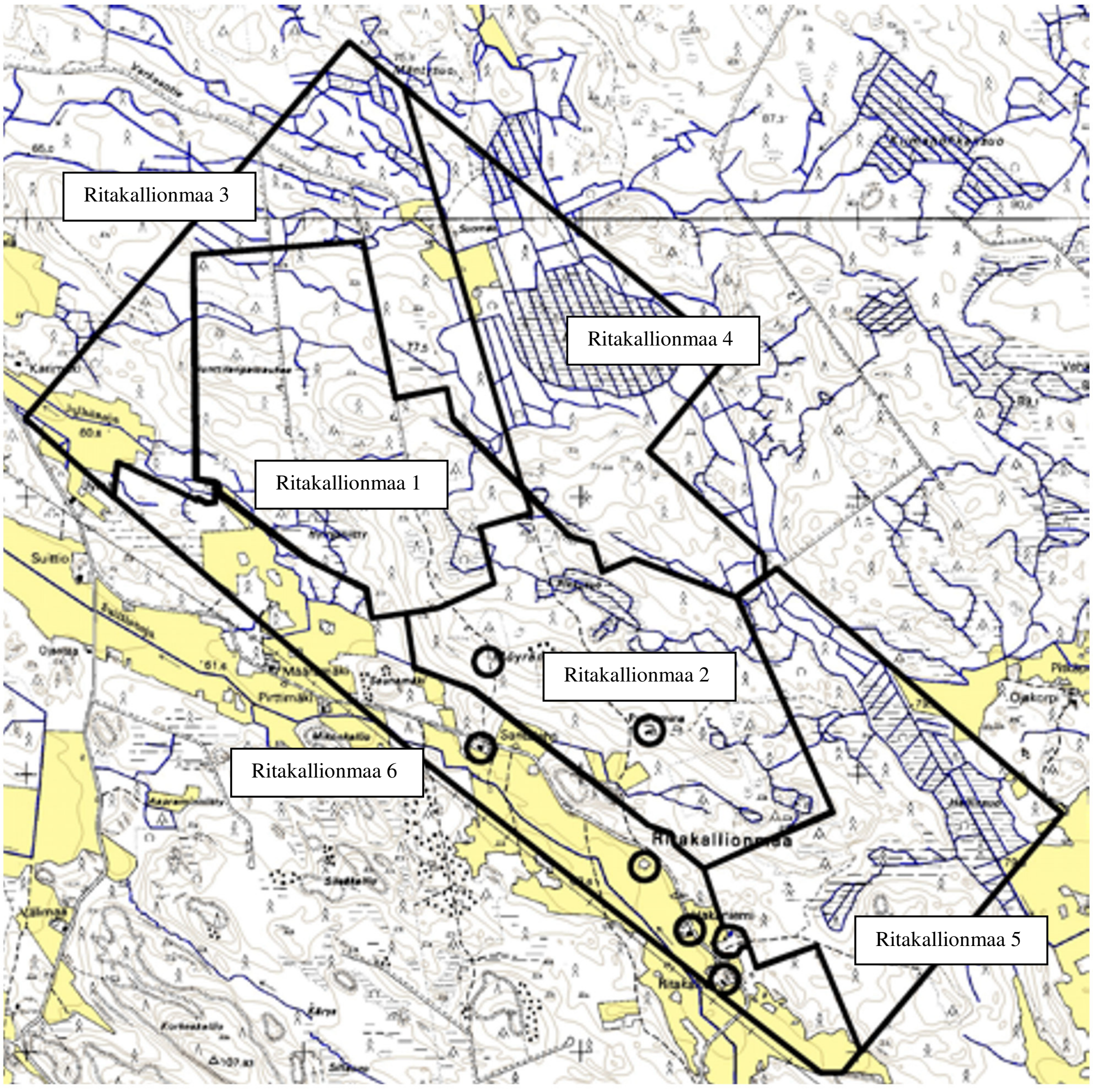

Figure 3. Ritakallio claims marked with thick black lines on base map (gray-brown = 5 m height contours, blue = ditches, yellow = agricultural land, solid and dashed thin black lines = roads and tracks). Length of the claimed area is ~3.8 km and width from 1.3 to 1.8 km. Circles indicate cottages and farm houses that are excluded from the claim areas.

4. REGIONAL GEOLOGY

Geological setting

The bedrock of the area is mainly composed of mica schists and gneisses, granodiorite, granite, and minor mafic intrusive rocks (Fig. 4). Ritakallio is in the western part of the Paleoproterozoic Pirkkala migmatite belt. Gneissic and migmatitic rocks have a dominantly sedimentary origin, and include greywackes, slates and siltstones, and graphite-rich units. There also are minor mafic volcanic rock formations bordered by skarns, carbonate rocks and metacherts.

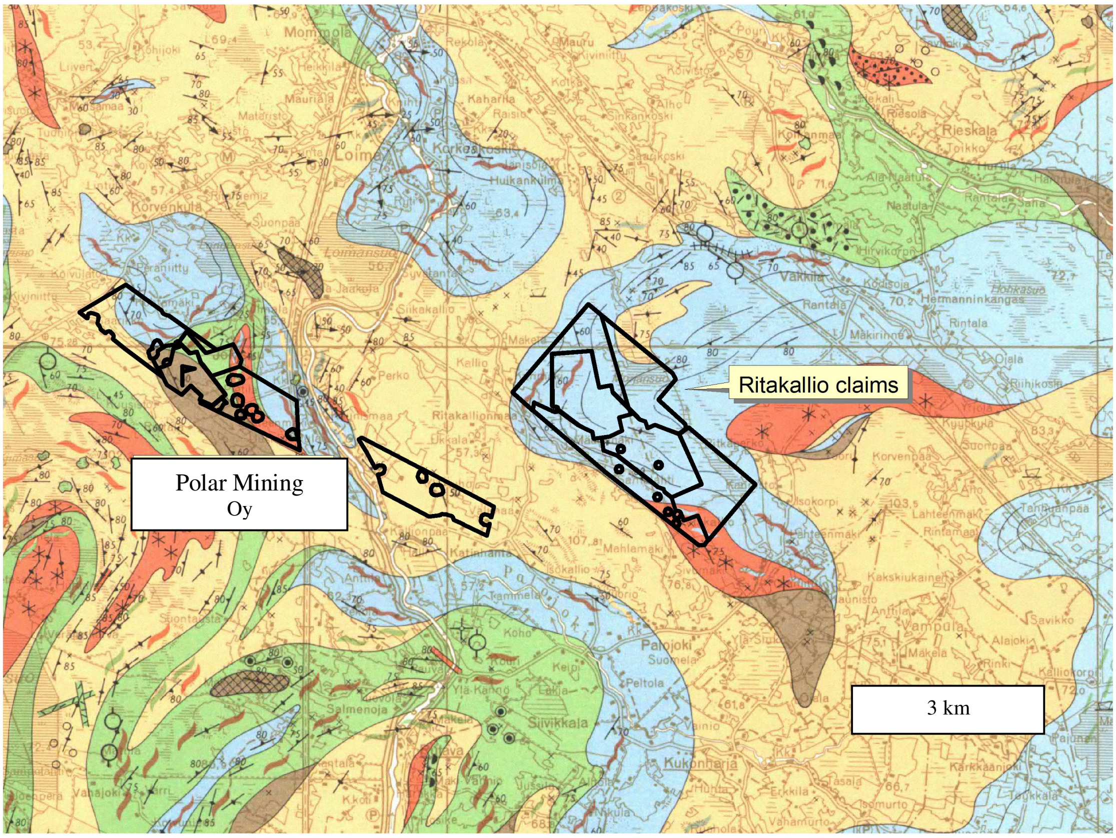

Figure 4. Pre-Quaternary rocks and claims of the Ritakallio – Jokisivu area (orange = granodiorite, blue = mica gneiss, green = mafic metavolcanites, red = granite and brown = gabbro). Geology from Matisto (1976).

The sedimentation of this supracrustal sequence took place before arc-volcanism at 1.9 Ga and was followed by migmatization during the Svecofennian orogeny at ca. 1880 Ma ago. Complex folding patterns and structures developed in different, partly overlapping events during the Svecofennian orogeny. There are recumbent folds that are related to early stages of deformation. This was followed by a second major deformation that produced originally east-west trending, flat lying fold axes with vertical fold planes. As a result of later deformation events, the folds of the Pirkkala migmatite belt typically show complex interference structures at the current erosion level.

Economic geology

The Pirkkala migmatite belt is one of the Ni-Cu potential regions in Finland, also known by the name 'Vammala Ni-belt' and hosting the now closed Vammala and Kylmäkoski Ni-mines in ultramafic intrusions (Papunen ja Gorbunov 1985). North of the Pirkkala migmatite belt is the Tampere belt, mainly composed of arc-type intermediate volcanic rocks, and hosting the presently closed gold mines at Orivesi and Haveri (Fig. 1). Currently both of these old mining districts are under active gold exploration, Haveri by Northern Lion Gold Corp. and Orivesi by Polar Mining Oy (see www.gtk.fi/exploration/gold).

In recent decades several gold discoveries have been made in southern Finland, most situated in the Pirkkala and Tampere belts (Fig. 1). Presently, the most promising occurrence is the Jokisivu gold deposit at Huittinen within the Pirkkala belt. At Jokisivu, gold is associated with shear zones and quartz veins hosted by dioritic-gabbroic bodies intruding mica gneisses, tonalites and granodiorite gneiss (Luukkonen 1994). The Jokisivu deposit has been under feasibility study by Polar Mining Oy and recently the company made the decision to start production there in late 2005 (see www.dragon-mining.com.au /media release 28th June 2005).

Quaternary geology

During the last glacial period, the continental ice sheet eroded the soil and bedrock in the Ritakallio area. As a result, the basal moraine at Ritakallio is composed only of one till unit, usually a 4–7 m thick layer covering the bedrock (Huhta 2005). Till is an important exploration material in this region, because it provides the material for geochemical mapping, heavy mineral studies and survey of mineralised boulders.

The glacial striations on the bedrock surface indicate the ice drift direction towards the SE and indicate that the till material came from the direction of 290^{o} (ie. roughly from NW). The boulders (glacial erratics), as well as the other till material including gold grains, are here mainly transported for only hundreds of metres. This conclusion is based on the observations that gold grains are dispersed vertically throughout the till layer, from bottom to top, and that most of the boulders on the surface and inside the till are of the same rock type as the surrounding bedrock. Obviously only a small amount of boulders has been transported long distances.

5. EXPLORATION AND RESULTS

Methods

Exploration methods applied in the Ritakallio area include glacial erratic boulder survey, outcrop mapping and sampling, heavy mineral studies of till, mineralogical studies, diamond core drilling, ground geophysical surveys and geochemical mapping of till and bedrock with percussion drilling (Table 2). New regoional high-resolution aerogeophysical data (50 m line-spacing) was also available from the Ritakallio area. Sample material and analytical data are stored in the facilities of GTK.

During 2002 – 2003, fieldwork and heavy mineral studies were done within a couple of weeks. The main method applied was ground geophysical IP (induced polarisation) survey for an area about 3 km^2. During 2004 the methods employed were geochemical and heavy mineral studies, and detailed ground geophysical surveys. In addition, diamond drilling was done in two profiles simultaneously with the geochemical studies. Primary aim of the drilling was to obtain geological data. The first profile extended across the aerogeophysically outlined gold-potential area. The other profile was targeted to an IP-anomaly on the NW-end of the prospect area.

Table 2. Exploration methods used in the Ritakallio gold prospect area during 2002 – 2004.

Method	Number of observations/ samples	Area / amount	Results
Early exploration			
- Mineralised boulders	42 assays	7 km^2	Max. 36.2 g/t Au
- mineralised bedrock	3 assays		Max. 36.5 g/t Au
Geological mapping (within claim area)	18 outcrops or outcrop clusters	5.8 km^2	Outcrop geology map
Ground geophysical mapping			
- magnetic		7.08 km^2	Lithological boundaries and structures (gold-critical structures)
- slingram		5.85 km^2	
- IP		6.25 km^2	
(High-resolution aerogeophysics in 2003)	(line-spacing 50 m)	(covers larger area)	
Heavy mineral and geochemical studies of till			
- heavy minerals (2002)	1 sample	1 pit	No nuggets
- heavy minerals (2003)	16 samples	11 pits	Max. 50 Au-nuggets
- heavy minerals (2004)	18 samples	16 pits	Max. 40 Au-nuggets
- geochemistry (2002)	1 sample		21 mg/t Au
- geochemistry (2003)	20 samples		Max. 65 mg/t Au
- geochemistry (2004)	15 samples		Max. 84 mg/t Au
Geochemical studies by percussion drilling			
- till	214 samples	2 km^2	Max. 1.2 g/t Au
- bedrock chips	202 samples	2 km^2	Max 8.5 g/t Au
Diamond core drilling			
- assays (ICP-MS/AES)	428 samples	427.1 m	Max. 3.9 g/t Au
- assays (XRF)	7 samples		Lithological samples
- petrophysics	~1000 measurements	610.4 m	Susceptibility, apparent resistivity, density
Microscopic studies	34 polished thin sections		Gold and associated minerals identified
Microprobe analyses	2 polished casts		Gold and associated minerals analysed

Heavy mineral studies

Heavy mineral studies were based on till samples taken from one to several different depth levels on the walls of 3 to 5 m deep pits. A tractor excavator made the diggings during 2003 and a heavy excavator during 2004 (Fig. 2). The sample size is 10 litres (20 kg). Simultaneously, a small till sample (200 g) was taken for chemical analyses that were done from the sieved <2 mm fraction of the till. Also mineralised boulders from excavations were taken for chemical analyses.

Heavy minerals from till samples were separated by the "Gold Hound," an equipment using a water-and-gravity-based method. Gold grains were counted by hand from the mineral concentrates under the stereomicroscope. The largest number of grains detected in one sample was 50 (Fig. 5). Three samples contained from 40 to 50 grains of gold and 15 samples from 5 to 24 grains. From the 34 samples only 6 did not contain any gold grains. Anywhere in Finland, the background number of gold grains in a 10 litre till sample is 0, whereas 1 to 3 grains means usually a regional anomaly, and more than 4 grains is an indication of a local bedrock source for gold.

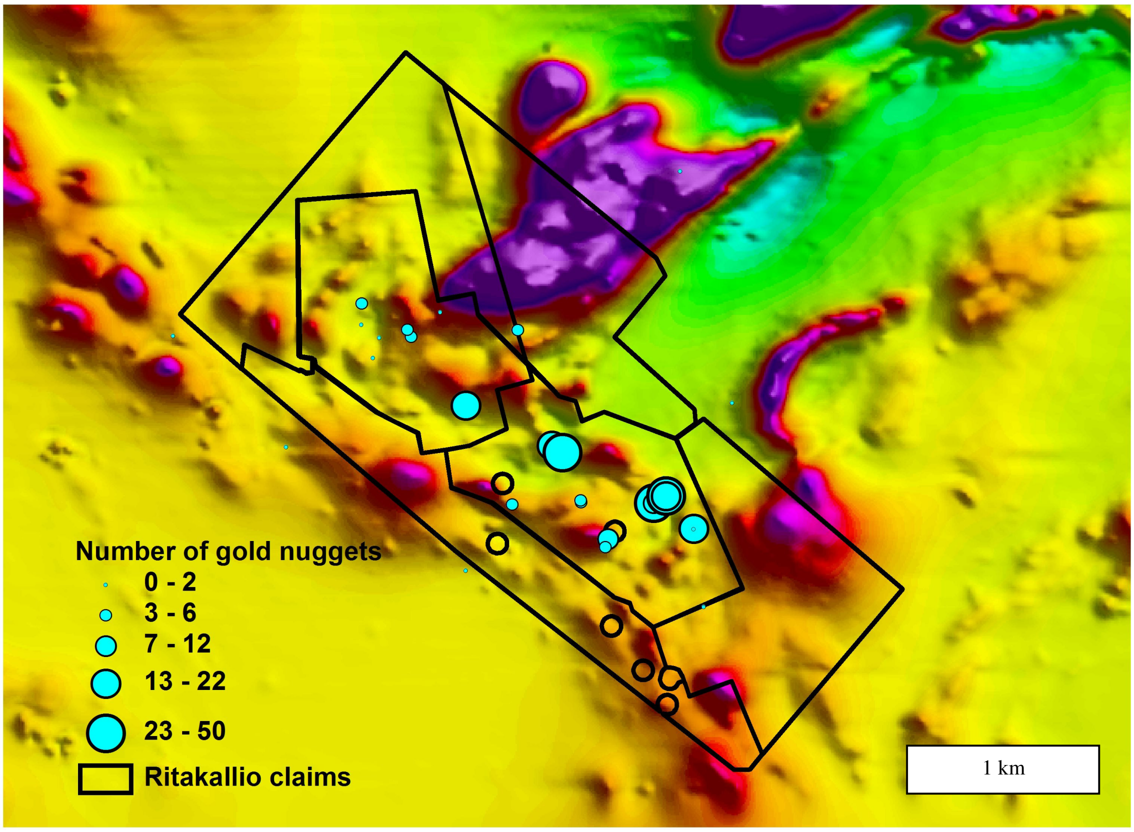

Figure 5. The location of heavy mineral excavation sites and the number of gold grains in 20 kg till samples at Ritakallio (Modified after Huhta 2005). Base map is low-altitude high-resolution aeromagnetic map (purple = high values, green = low values). Note that the unfilled black circles are not sampling sites, but are excluded from the claims.

Geochemical analyses were also made of heavy mineral samples. Analytical procedures and methods for samples were: drying in an oven (GTK laboratory method code 11), sieving to fraction <2 mm (method code 26), pulverising the split sample in carbon steel bowl (method code 40), aqua regia leaching and determination by ICP-MS (sample 2 g, method code 512Ma), aqua regia leaching and determination by ICP-AES (sample 2 g, method code 512P) and pyrolytic determination of Hg (code 822L). More detailed descriptions on these methods are available in the geochemical laboratory catalogue of the Geological Survey of Finland (Appendix 1).

In general, the gold concentrations were relatively low (maximum 83.8 mg/t) but the anomalous values spatially cover the whole study area quite well (Fig. 6). The maximum concentration of arsenic is 471 g/t, whereas the Bi, Sb, Te and W record maximum values of 0.7, 0.2, 0.1 and 3 g/t, respectively.

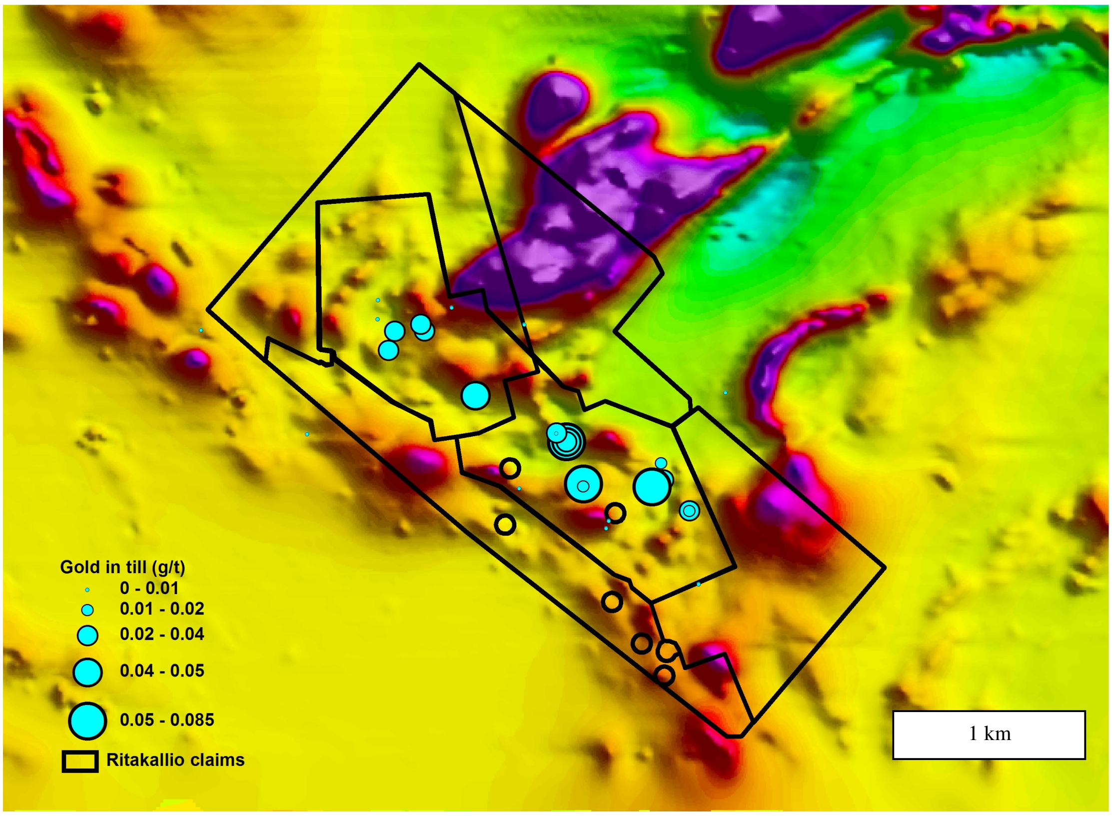

Figure 6. The geochemistry of till in excavation pits at Ritakallio. Base map is low-altitude high-resolution aeromagnetic map (purple = high values, green = low values). Note that the unfilled black circles are areas excluded from the claims.

Survey for mineralised glacial erratic boulders

The first gold-riched boulders at Ritakallio were found at the surface during 2002. The boulders were basic intrusive rocks containing vein quartz and arsenopyrite. Because of the poor exposure conditions, boulder tracing was focused on surface boulders and stones from excavations, road ditches and trenches in the forest cultivation areas. Boulder sampling focused mainly on sheared gabbroic rocks in rather restricted areas near the roads. Not all of the area is covered with systematic boulder tracing. Several gold-rich boulders were found from excavations. In total, 42 boulders were analysed during 2003-2004.

In 2003 analytical procedures were: standard coarse crushing the whole sample using Mn-steel jaws (method code 30), pulverising the split sample in carbon steel bowl (method code 40), aqua regia digestion and determination by ICP-AES [or GFAAS Ag, As,Cd, Pb, Bi, Sb, Se and Te]) (sample 0.15 g, method code 511P) and Pb-fire assay and determination by ICP-AES (sample 50 g, method code 705P), whereas in 2004 they were 30, 40, and aqua regia leaching and determination by ICP-MS (sample 2 g, method code 512Ma) and Pb-fire assay and determination by ICP-AES (sample 25g, method code 704P).

Of the 42 boulder samples, three contained over 10 g/t gold and 8 from 1 to 10 g/t of gold (Fig. 7). Eleven samples were analysed during 2003 and 31 in 2004, of which 6 and 15 samples contained >1 pmm gold, respectively. The highest gold concentration (36 g/t) was detected in a sheared and quartz-veined gabbroic rock. Also some boulders of sulphide bearing mica gneiss were found to contain substantial amounts of gold (max 11 g/t).

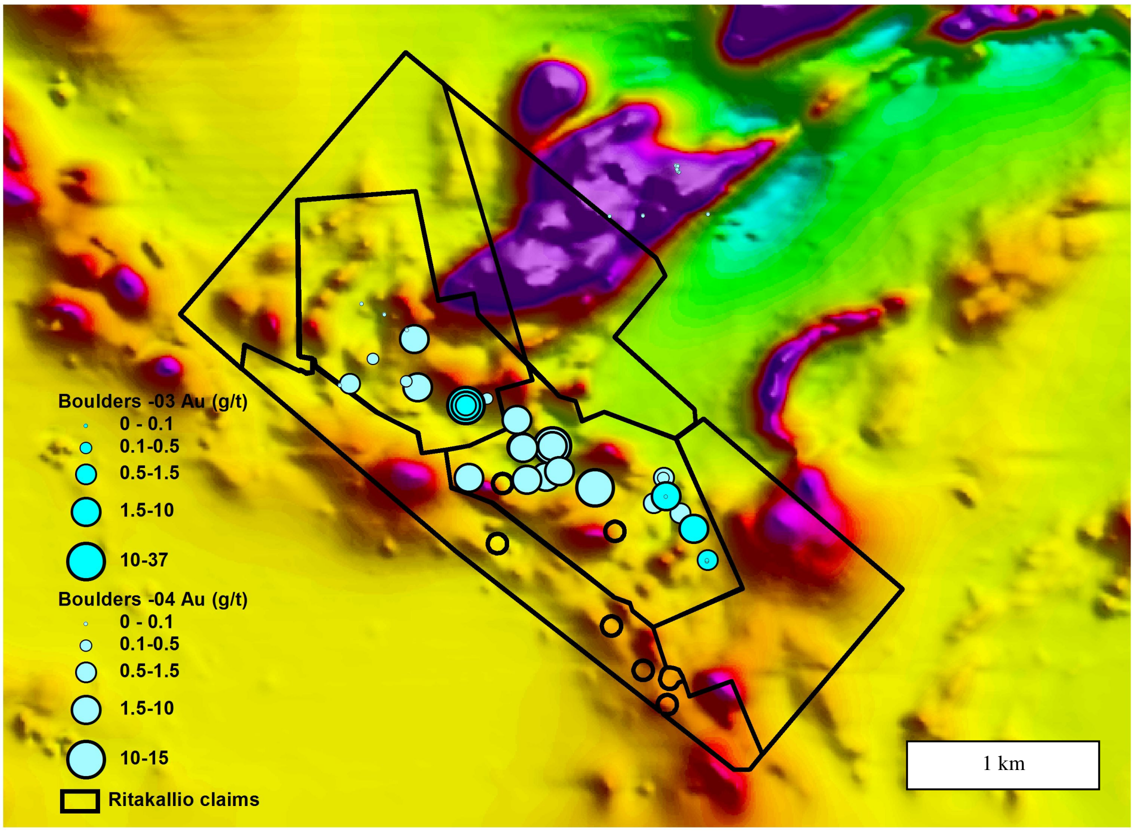

Figure 7. The locations and gold concentrations of boulders collected in years 2003 and 2004 at Ritakallio. Base map is low-altitude high-resolution aeromagnetic map (purple = high values, green = low values; g/t = ppm).

Geophysical mapping

Low-altitude (30 m) airborne magnetic, electromagnetic (slingram) and radiation (K, Th, U) maps with 400 m line-density cover nearly all Finland. Of the Ritakallio region there also is available high-resolution aerogeophysical data with 50 m line-spacing (Fig. 8). It was flown during 2003 for the use of the GTK's industrial mineral exploration. On the high-resolution aeromagnetic map, Ritakallio is located in a NW–SE-oriented zone with scattered magnetic anomalies, and this zone is almost perpendicular to a strong NE–SW-oriented magnetic anomaly (Figs. 7 and 8). The first interpretation for this feature was that the NW–SE anomaly pattern represents remnants of broken mafic intrusion and thus this zone would be a highly gold potential major shear zone. Below in this report a more detailed geological and structural explanation of the anomaly pattern is represented.

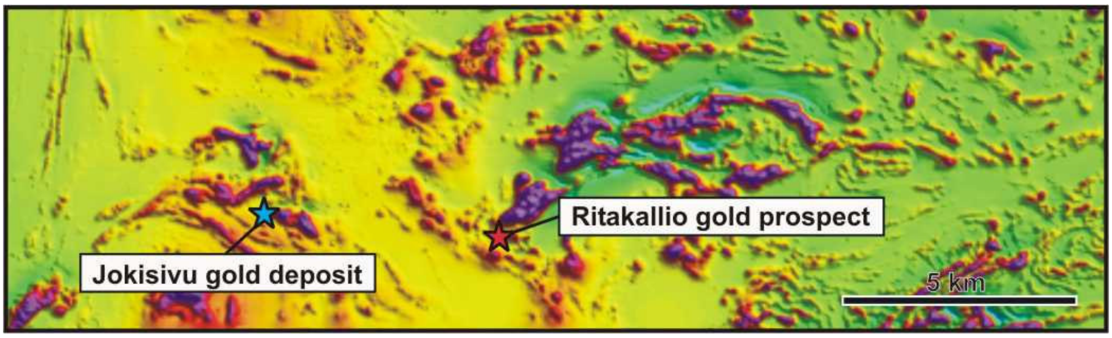

Figure 8. High-resolution aerogeophysical data, flight altitude 30 m, line-spacing 50 m, fixed-wings. Note the location of Ritakallio in a prominent NW-SE-oriented structure.

The geophysical ground survey results are summarized in Table 3 and illustrated in appendices 2–7. The ground survey performed during 2003 included only electromagnetic (slingram) and IP survey because the high-quality aeromagnetic data was available. The surveys covered an area of 3.2 km^2. During the following year, the surveyed area was expanded (e.g. IP to 6.25 km^2) and supplemented by ground magnetic and slingram measurements (7.08 and 5.85 km^2) (Valjus 2005). Furthermore, several multi-channel IP profiles were measured in the central Ritakallio area and geophysicists interpreted some of these profiles. Ground-penetrating radar measurements were also done in the Ritakallio area along some of the percussion drilling profiles resulting in continuous bedrock surface interpretations (Huhta 2005). All the geophysical survey points were located with GPS.

Table 3. Geophysical ground surveys in the Ritakallio area.

Method	Point spacing (m)	Line spacing(m)	Array configuration	Area (km^2) 2003	Area (km^2) 2004
Magnetic	10	50			7.08
Slingram	20	100	coil spacing 60 m frequency 3600 Hz		5.85
IP (induced polarisation)	20	100	dipole-dipole a = 20 m, n=3	3.21	3.04
IP, with multi-channel	10	100	dipole-dipole a = 10 m, n=1-8		1.8

Petrophysical measurements (density, susceptibility, and inductive resistivity) were done in the GTK petrophysical laboratory on various samples for the use in geophysical interpretations. The material measured included samples from one boulder and one outcrop in addition to drill core. Mass susceptibility measurements were done in the petrophysical laboratory on each of the core samples that were analysed for gold. In addition, during geological logging, susceptibility was measured by a field instrument in one-metre spacing from all drill core. Furthermore, 59 density measurements were done on the drill core samples.

Geological mapping

In the Ritakallio claim area outcrops have a sporadic distribution. Gabbroic rocks are exposed in a few localities adjacent to the southwestern margin of the claim area, whereas mica schist is exposed on the northeastern side. The gabbro area (e.g. figs. 11 – 13) is outlined mainly by the percussion drilling and geophysical data. The rock chips from percussion drilling were first identified in the field and afterwards analysed by XRF. During heavy mineral survey only a few excavations reached the bedrock surface and were of use in bedrock mapping. Thin section and other petrographic studies were done as part of a Master thesis project presently under progress at the University of Oulu (Hannu Lahtinen). Preliminary results of that work were available for the preparation of this report.

Figure 9. Gold-rich gabbro (1.2 g/t) of Ritakallio typified by quartz veins and shearing (observation 71.4-HML-04). The hammer handle is 60 cm long.

<u>Outcrop sampling</u>

Most of the outcrop samples taken for chemical analyses are hand specimens for the petrographic purpose. Two gabbro and three mica gneiss outcrop areas were sampled in more detail with a diamond saw. The diamond saw was used in flat outcrops and for continuous profile sampling of gold potential sheared mafic intrusive rocks or quartz veins. One mineralised gabbroic outcrop (Fig. 9) with microscopic gold was sampled for heavy mineral separation in addition to geochemical analyses. This sample (071-4-HML-04) weighed 10 kg, from which the heavy mineral fraction was concentrated by the "Gold Hound" after crushing. Subsequently, the yielded minerals were studied with microprobe at GTK.

Analytical procedures and methods for the outcrop samples were: oven drying (method code 11), standard coarse crushing the whole sample using Mn-steel jaws (method code 30), separate splitting/subsampling by riffle splitter to 100–150 g (method code 35, only one sample), pulverising the split sample in carbon steel bowl (method code 40), aqua regia leaching and determination by ICP-MS (sample 2g, method code 512Ma), aqua regia leaching and determination by ICP-AES sample 2g, method code 512P), HF-$HClO_4$-digestion and determination by ICP-MS (sample 0.2 g, method code 307M) and XRF analysis using powder pellets (method code 175X).

The highest detected gold content was 36 g/t (sample 59.3-HML-04) in folded quartz veins in mica gneiss to the east of the mafic intrusion (Figs. 10 and 11). The highest gold content (3.6 g/t) in gabbroic outcrop was in sheared and quartz veined gabbro that is located adjacent to the southwestern part of claim area (Figs. 9 and 10).

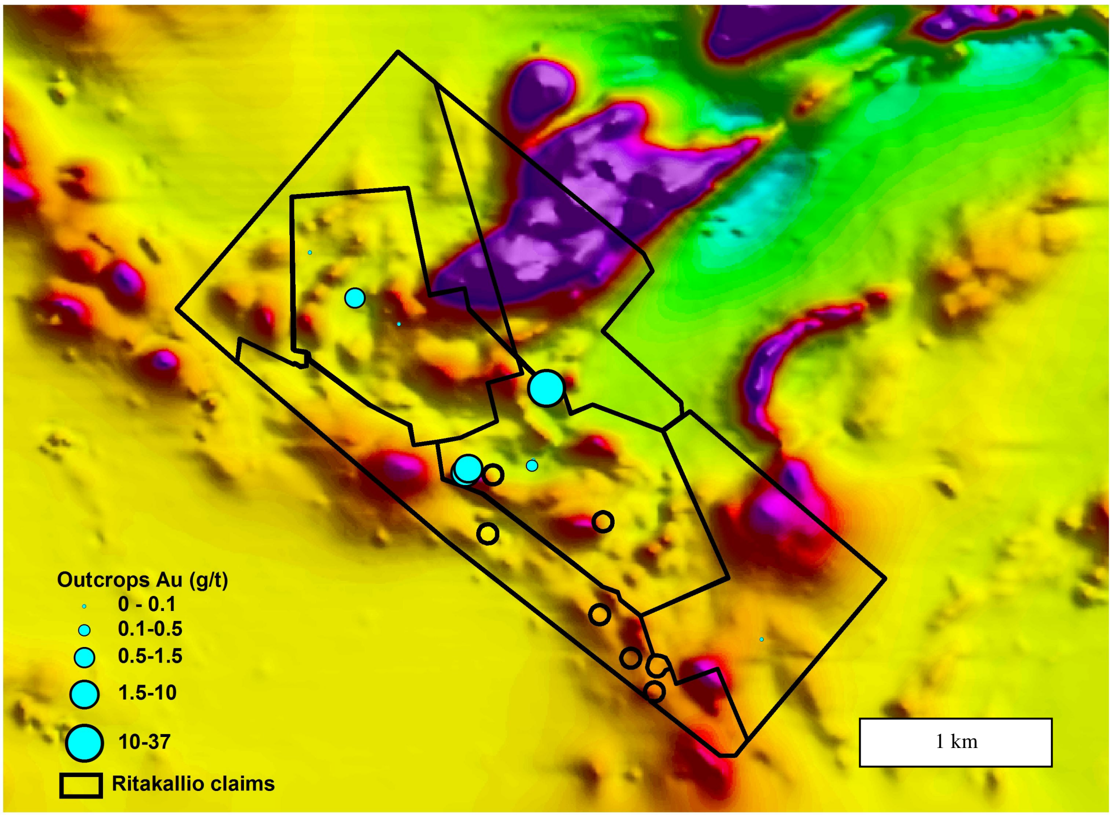

Figure 10. Gold in outcrops, sampled with hammer and saw at Ritakallio. Base map is low-altitude high-resolution aeromagnetic map (purple = high values, green = low values; g/t=ppm).

Percussion drilling

Geochemical exploration in the area was in part based on sampling by light percussion drilling of basal till and underlying bedrock. Suunnittelukeskus Oy carried out percussion drilling by GM 100 machine with air or water flushing. Drilling was done along several profiles across the critical area (Fig. 11). The distance between the profiles is approximately 300 metres and the distance from one drilling site to another is 30 metres. Profiles dominantly follow the existing roads and forest trails.

In total 202 bedrock samples and 214 till samples were taken from 214 sites. A great variety of elements were analysed from all the collected till and bulk rock material by ICP-AES, ICP-MS and XRF (only bedrock samples) methods. Reliability of bedrock percussion drilling results is mainly good but as large (>1m^3) boulders (glacial erratics) occur in the Ritakallio area some samples may be unrepresentative.

<u>Lithology</u>

The rock types detected by percussion drilling are shown in Figure 11. Rock types

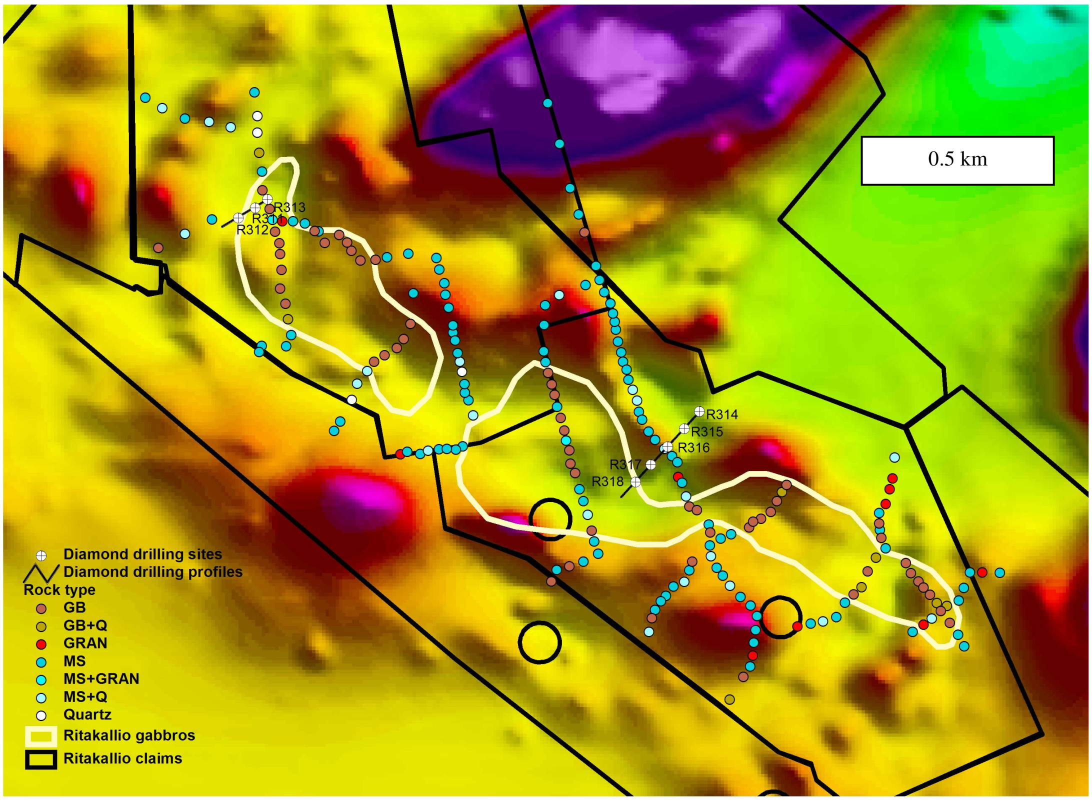

Figure 11. Geochemical sampling sites, observed lithology and diamond drilling profiles at Ritakallio (GB = gabbro, GB+Q = gabbro and quartz veins, GRAN = granite, MS = mica schist, MS+GRAN = mica schist and granite and MS+Q = mica schist and quartz veins). Light yellow line represents interpreted extent of Ritakallio gabbros. Base map is low-altitude high-resolution aeromagnetic map (purple = high values, green = low values). Note that non-magnetic mica gneisses interfingered with magnetic pyrrhotite- and graphite-rich layers enclose the non-magnetic Ritakallio gabbros. The high magnetic anomaly to the north is caused by a sequence of metachert, skarn and mafic volcanic rocks.

were mainly determined based on textures and grain size variations in hand specimens. Although XRF analyses were made of all of the samples, the division of mica schists and gabbros was problematic due overlapping major element variations (e.g. in SiO_2). As the entire sample material was analysed, including the host rock and the dykes/veins, the very detailed geochemical interpretation based on XRF data is questionable especially when some of the rocks have also apparently been altered. However, some immobile element ratios combined with e.g. potassium concentrations gave further help in the rock type identification.

Till geochemistry

Initially at each percussion drilling site the till bed was penetrated and at least one metre was drilled down to the bedrock to be sure that the bit is not within a boulder. After the depth of the bedrock surface was detected and bedrock sampled, another drilling was done to take a 200–500 g till sample just above the bedrock surface.

Analytical procedures and methods for till samples were: oven-drying (method code 11), sieving to fraction <2 mm (method code 26), pulverising the split sample in carbon steel bowl (method code 40), aqua regia leaching and determination by ICP-MS (sample 2 g, method code 512Ma), aqua regia leaching and determination by ICP-AES (sample 2 g, method code 512P), Pb-fire assay and determination by ICP-AES (sample 25 g, method code 704P) and/or pyrolytic determination of Hg (method code 822L).

The highest gold concentration in the basal till samples was 1200 mg/t (ppb) in the NW-corner of the sampling area (Fig. 12). Five of the 214 till samples contained from 300 to 900 mg/t gold and 17 samples from 100 to 300 mg/t. The background value in till geochemical samples is less than 3 mg/t (in fraction <0.06 mm) and the first anomalous value detected at Ritakallio (2002) was 21 mg/t Au.

The gold-related trace elements As, Bi, W and Sb have the highest concentrations at the same sites as the high gold values. Although Te and Au have a positive correlation, the highest Te values are not always coupled with a high Au in till. The concentration of arsenic in till is usually 110 g/t, and the maximum content 3000 g/t. Bi is usually 0.4 g/t (max. 5 g/t), Sb 0.1 g/t (max. 1 g/t), Te 12 mg/t (max. 740 mg/t) and W 7 g/t (max. 50 g/t).

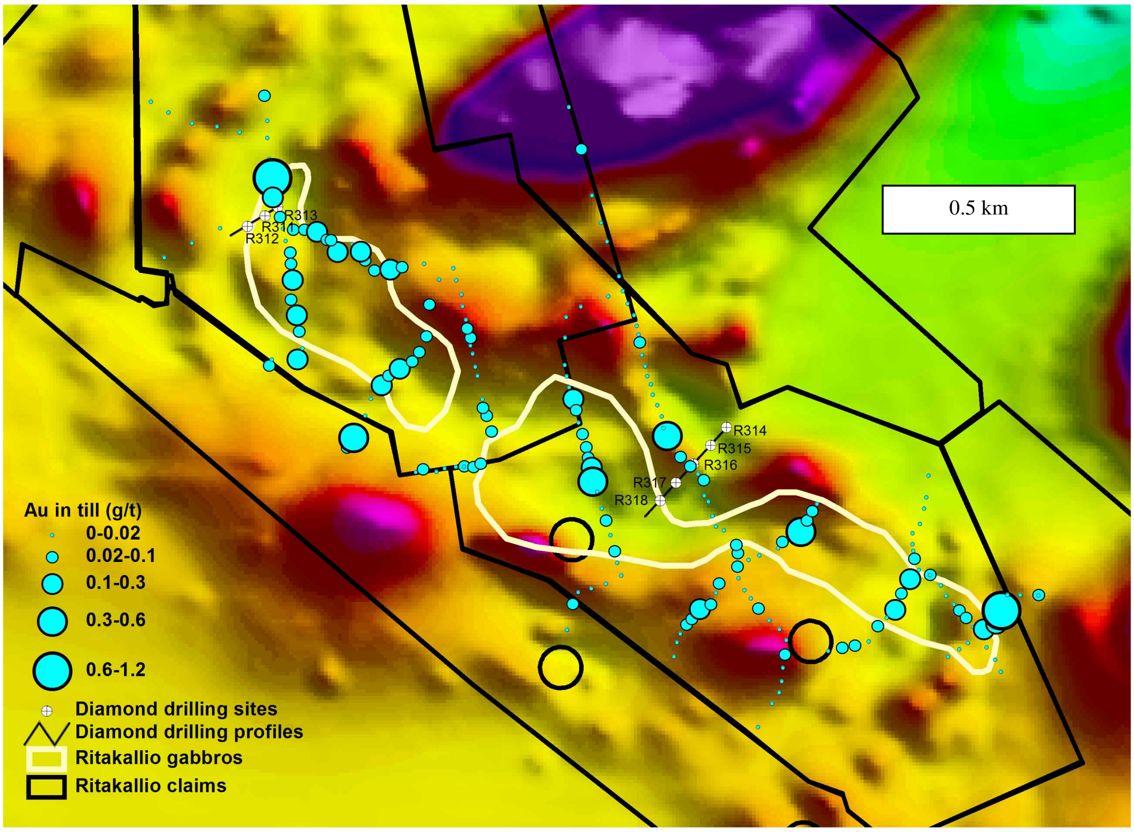

Figure 12. Gold concentrations in till samples (< 2 mm fraction) at Ritakallio. Base map is a low-altitude high-resolution aeromagnetic map (purple= high values, green= low values; g/t=ppm).

Bedrock geochemistry

Percussion drilling for at least 1 m of solid rock ensured that the sample achieved represents bedrock instead of a boulder. The sample typically consisted of rock chips with size range of <1 – 25 mm and represents roughly the drilled 1 metre of the bedrock.
Analytical procedures and methods for samples were: oven-drying (method code 11), standard coarse crushing of the whole sample using Mn-steel jaws (method code 30), pulverising the split sample in carbon steel bowl (method code 40), aqua regia leaching and determination by ICP-MS (sample 2 g, method 512Ma), Pb-fire assay and determination by ICP-AES (sample 50 g, method code 705P) and XRF analysis using powder pellets (method code 175X).

A large number of rock chip samples were gold anomalous. The highest recorded gold concentration was 8.5 g/t in the central Ritakallio area (Fig. 13). Ten of the 202 samples contain 0.3 to 1.0 g/t Au. The concentrations of Ag, Bi, Te, Sb and As demonstrate positive correlation with gold. The concentration of arsenic is usually 180 g/t, and maximum content 5700 g/t. Bi is usually 0.6 g/t (max. 17 g/t), Sb 0.1 g/t (max. 1.6 g/t), Te 40 mg/t (max. 3000 mg/t) and W 5 g/t (max. 147 g/t).

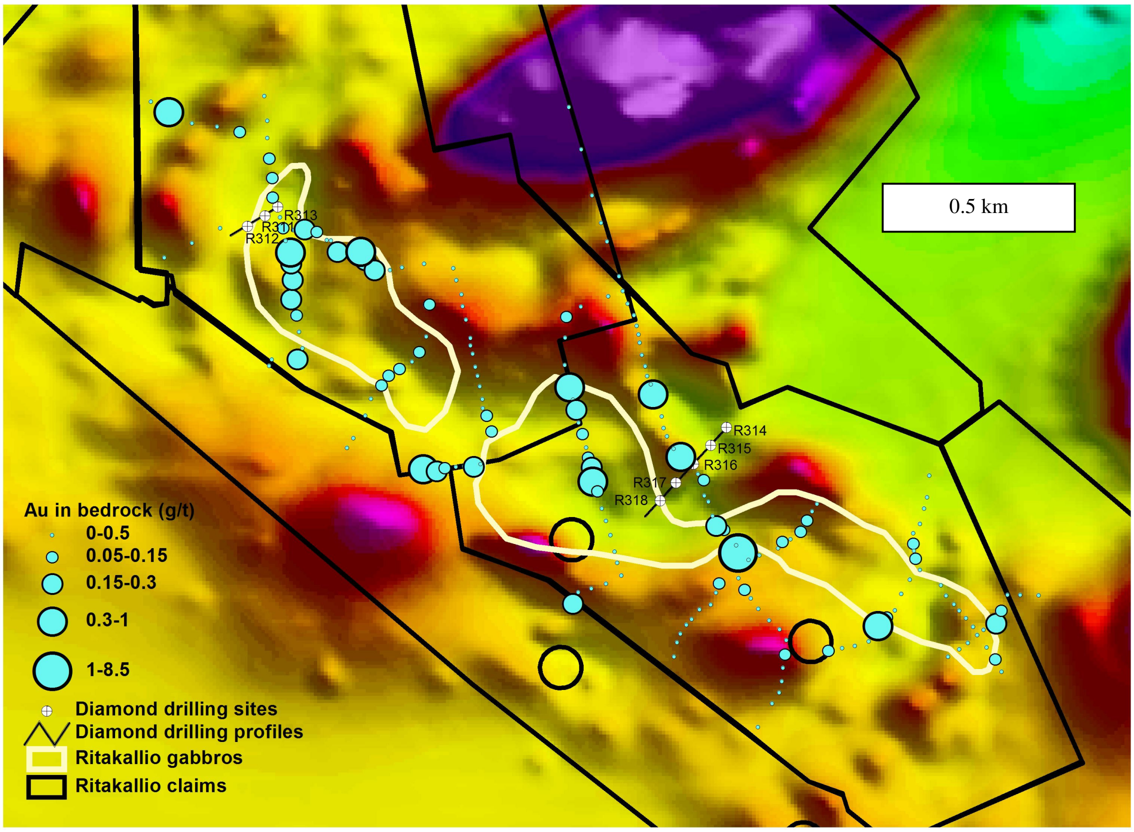

Figure 13. Gold concentrations in bedrock samples at Ritakallio. Base map is a low-altitude high-resolution aeromagnetic map (purple = high values, green = low values; g/t = ppm).

Although scheelite is typically associated with an increased gold content in mineralised outcrops and in drill core, geochemical data does not show correlation between W and gold. However, the fact that the W analyses are based on aqua regia partial leaching could explain the observed bias, as scheelite commonly remains at least partly undissolved in the leach.

Diamond core drilling

Diamond core drilling was done in two profiles, one primarily for achieving a good geological cross section of the central Ritakallio area and the other for testing a strong IP anomaly in northwestern part of the area close to the assumed fold crest (see Appendix 3). Drilling was done at the same time as geochemical sampling, so the data from the latter were not available for planning the core drilling. Drilling was done by using 56 mm bit and the GTK's GM 100 machine (Fig. 2 b). In total, 610.4 metres were drilled in 8 holes (appendix 8).

Geological observations

The two dominant rock types observed in the Ritakallio diamond drill cores are gabbroic rocks and mica schists (Fig. 14). Gabbroic rocks can be divided into two types based on textural criteria: an even-grained type which is dominant and a "spotted" -type that exhibits round spots of amphibole with a diameter of ~1 cm which is also relatively common. Both gabbroic types have igneous layering which is demonstrated by modal variations of plagioclase and amphiboles. In general, the igneous structures are sub-horizontal whereas the contacts to mica gneiss show dip between 30–40 degrees. Shear zones and quartz veins that contain sulphides and scheelite cut the gabbros. Other shear zones and faults that are locally associated with potassium alteration and carbonate veins also cut gabbro. In rare occurrences garnets are found in gabbroic rocks (Fig. 14).

Mica gneisses are typically fine-grained and relatively uniform in composition but locally garnets and biotite flakes give the rock a more heterogenic appearance. Some of the composition and grain size variations may represent changes in the sedimentary sequence in addition to graphite-bearing seams. Similar to gabbroic rocks, shear zones and quartz veins that contain sulphides and scheelite cut the mica gneiss, which are also later deformed or faulted. In addition to foliation patterns, mica gneisses also have lineation in places.

Both of the dominant rock types are cut by granitic dykes that are typically <1 m wide, although locally reach the thickness of 10 m (Fig. 14). These granitic rocks show variation from fine-grained aplite to coarse-grained pegmatite. It is not uncommon to find minor sulphides within the aplitic veins.

Chemical analyses of core

In total, 427.1 metres (428 samples) of drill core was analysed, which represents 70% of the total length of the core. Additionally, seven samples were analysed by XRF and ICP-MS/AES for major and trace element composition.

After logging drill cores were cut in half with a saw, and generally one-metre samples were analysed. Analytical procedures and methods of drill cores were: standard coarse crushing the whole sample using Mn-steel jaws (method code 30), grinding with swing-mill in a steel bowl (method code 50), aqua regia leaching and determination by ICP-MS (sample 2g, method code 512Ma) and Pb-fire assay and determination by ICP-AES (sample 50 g, method code 705P).

In total, 25.5 metres of core has a gold content over 1 g/t and 95.5 metres over 0.3 g/t (Fig. 15; Appendices 10–14). The highest gold content was 3.9 g/t, in mica gneiss in hole R314 (depth range 41.00–42.00 m; Table 4). The thickest clearly mineralised section within gabbro was 4.7 metres with 1.7 g/t gold. Based on the analytical data, Bi and Te have a marked positive correlation with gold. In addition, Ag, As and Sb show some positive correlation with gold.

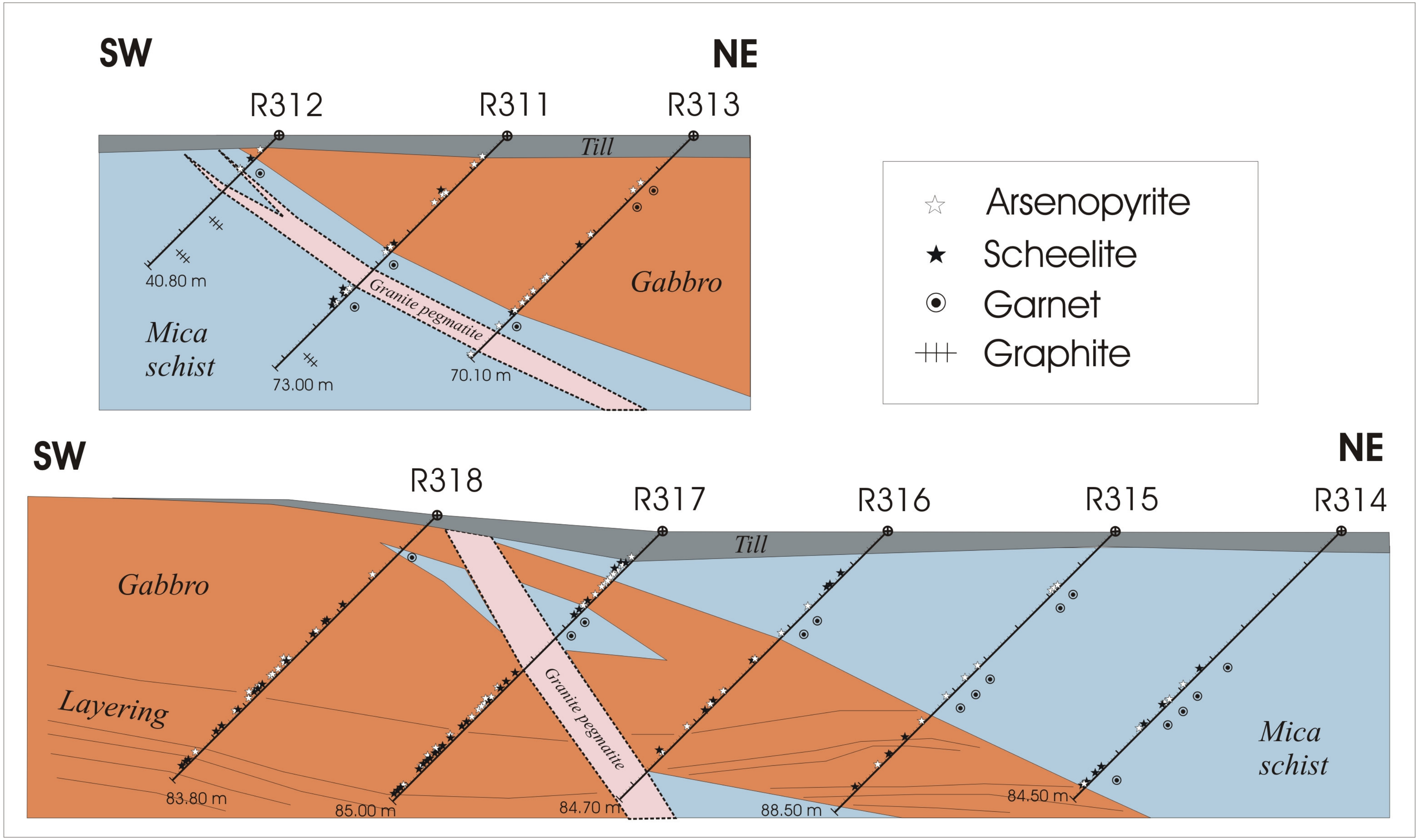

Figure 14. Lithology of Ritakallio diamond drilling profiles. Locations and scales are indicative.

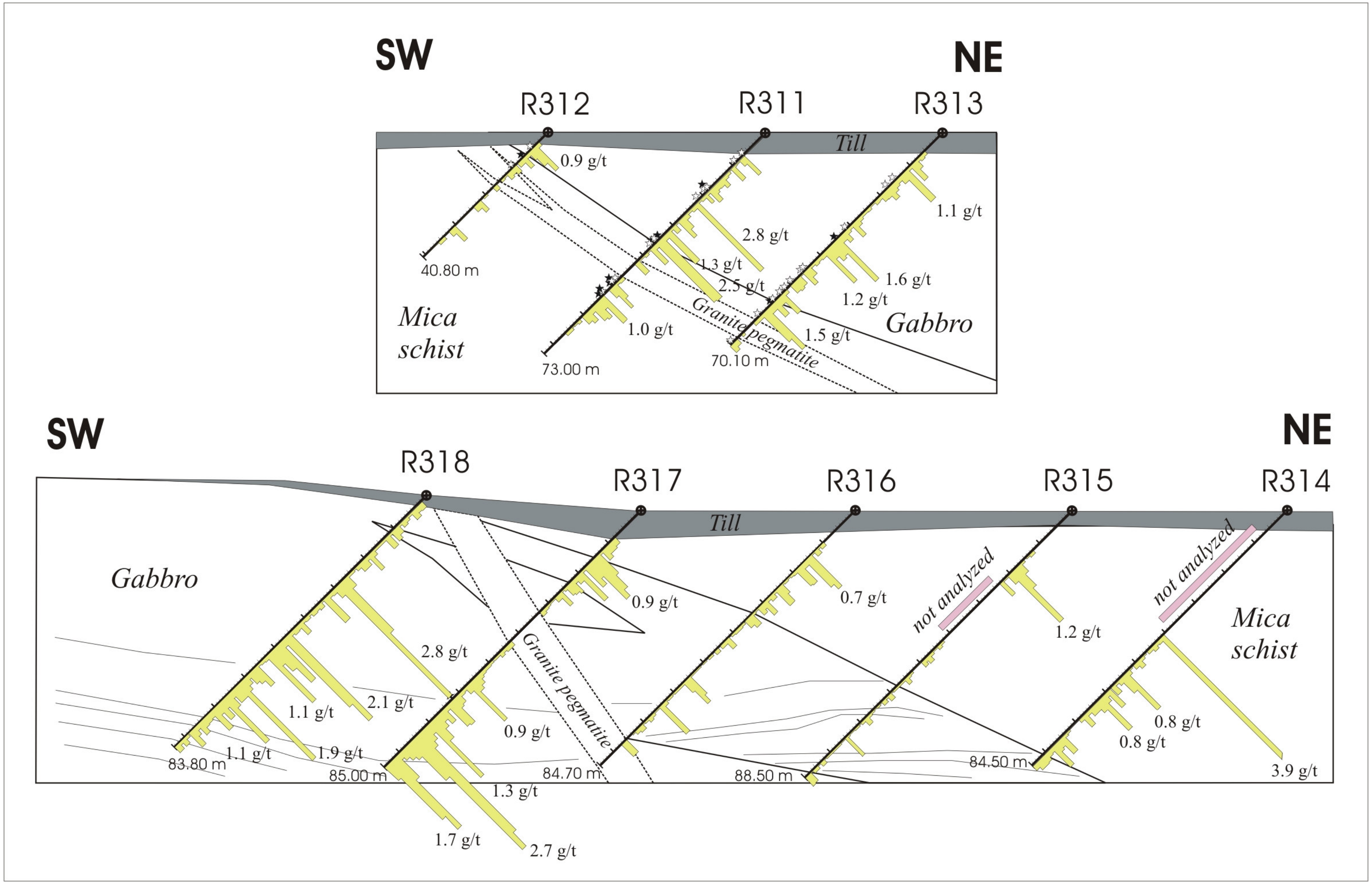

Figure 15. Diamond drilling profiles and gold concentrations of drill core (g/t=ppm). Locations and scales are indicative.

Table 4. Selected gold data of diamond core from Ritakallio. All the gold contents exceeding 0.9 g/t are included in the table.

Drill core	From	To	Au (g/t)	Drill core	From	To	Au (g/t)
R311	22.00	23.10	2.81	R317	56.70	57.40	0.90
R311	31.40	32.70	1.27	R317	69.80	70.60	1.31
R311	33.85	35.25	2.54	R317	73.60	74.65	2.42
R311	35.25	36.10	2.48	R317	74.65	75.70	2.74
R311	53.65	55.00	1.00	R317	75.70	76.90	0.92
R312	4.40	5.40	0.92	R317	82.00	83.00	1.68
R313	11.50	13.00	1.13	R317	83.00	84.00	1.36
R313	34.20	35.25	1.62	R318	28.30	29.30	1.25
R313	38.20	39.20	1.21	R318	29.30	30.30	2.79
R313	57.55	58.60	1.51	R318	46.20	47.20	2.08
R313	58.60	59.60	1.09	R318	47.20	48.20	1.67
R314	41.00	42.00	3.87	R318	52.60	53.60	1.14
R315	19.00	20.00	1.23	R318	62.30	63.30	1.88
R317	15.80	16.80	0.91	R318	67.10	68.00	1.08

Mineralogical studies

Thin section investigations show that the main minerals of Ritakallio gabbros are plagioclase and amphibole. Minor and accessory minerals include biotite, quartz, apatite, zircon, oxides and sulphides. Amphiboles and biotite represent alteration products of pyroxenes but biotite may also have an igneous origin in the most evolved gabbro. Mica gneisses contain mainly plagioclase, biotite and quartz plus oxides and sulphides as accessory minerals. Sulphides occur as dissemination and veined dissemination. In both rock types gold is associated with alteration that is typified by the presence of quartz, sulphides and sericite. Quartz occurs as veins or in matrix related to alteration of other minerals. The latter is typically combined with sericitisation. The main sulphide minerals in altered zones are arsenopyrite and löllingite.

Microprobe analyses of the ore minerals were done at GTK with Cameca Camebax SX50 microprobe. Accessory opaque minerals detected include ilmenite, titanomagnetite, pyrite, pyrrhotite, calcopyrite, pentlandite, rutile, scheelite, gold, native bismuth, maldonite, aurostibite, bismuthinite, sphalerite, galena and unspecified Te-Bi-, Pb-Bi-S-, Bi-F-, W-Ta- and As-S-Co-Ni-Fe minerals. Gold occurs as free grains between silicate gangue and in sulphides such as arsenopyrite and löllingite. Furthermore, composite grains of gold with sulphides and Bi-minerals were detected (Fig. 16). A number of arsenopyrite grains show a core of löllingite and small inclusions of gold close to their boundary and some of the gold grains within the silicate gangue appear to be mantled with Bi-minerals. The grain size of gold varies from infinitesimal grains in sheared rocks up to ~1 mm in quartz veins. Fineness of gold ((Au/[Au+Ag])*1000) ranges from 930 to 1000.

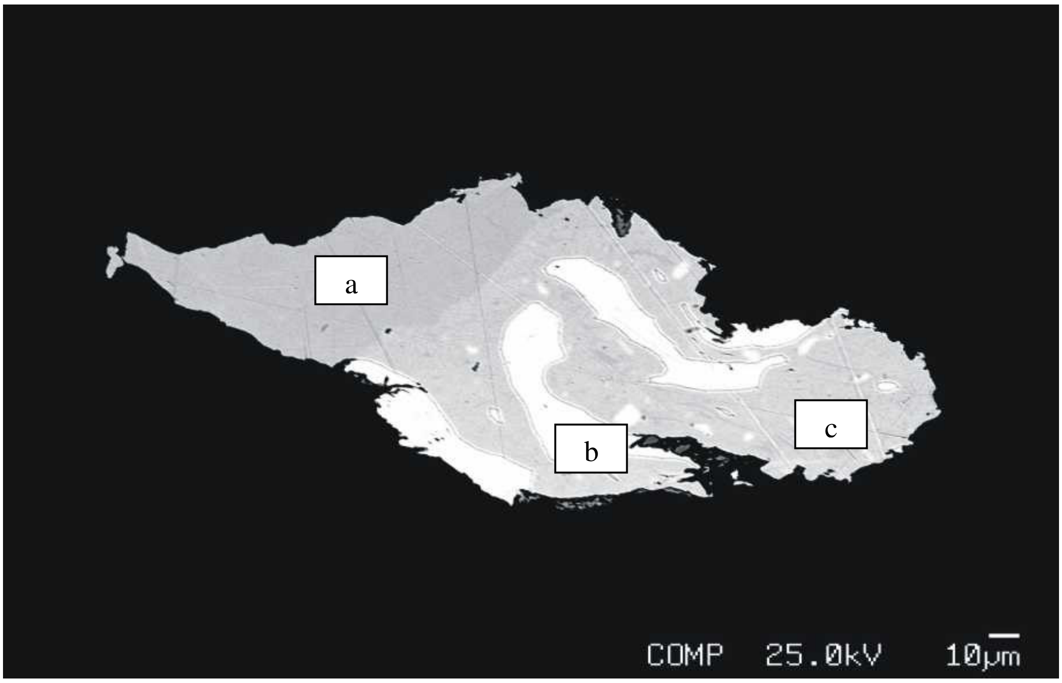

Figure 16. Secondary electron microprobe image from a grain (~0.3 mm) that consists of silver bearing gold (a), native bismuth (b) and gold (c). Sample is from the gold-rich gabbros shown in Figure 8 (observation point 71-4-HML-04).

6. PROPERTY GEOLOGY

Lithology

A gabbro enveloped by mica gneiss hosts the Ritakallio gold occurrence. The gold typically occurs in shear bands and quartz veins in the host gabbro that actually consists of a number of adjacent bodies. Enrchment of gold is not restricted to a gabbroic host as the shear bands and quartz veins in mica gneisses also contain high gold values.

The gabbroic rocks of Ritakallio area can be classified as subalkaline tholeiites, that demonstrate enrichment of light REE, although some trace-element ratios imply that the magma was contaminated with crustal material. Supracrustal xenoliths are observed within the intrusion in addition to cross-cutting mafic dykes. By composition the gabbroic bodies contain gabbro, diorite and quartz-diorite. In general, the ranges of major components show marked variations: e.g. MgO ~3–7 wt.%, Fe_2O_3 ~8–12 wt.%, SiO_2 ~50–61 wt.% and Al_2O_3 16–18 wt.%. Two gabbro types and observed igneous layering point to sub-horizontal position and some of the modally graded layers indicate upward top direction of the intrusion. Furthermore, modal variations within the intrusion provide evidence that fractional crystallization took place to some extent (Figs. 17a and b).

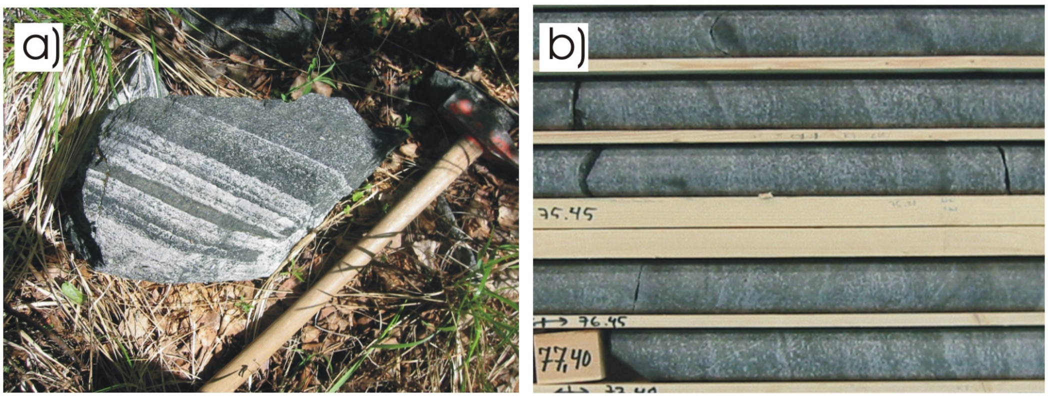

Figure 17. Igneous layering observed in a) gabbroic boulder in the central Ritakallio area and b) in diamond drill core (R318, ~72.50–77.80 m).

Structural geology

Lithologies in drilling profiles indicate that the intrusion is rather conformable with the primary layering of the enclosing sedimentary rocks. Both hanging- and footwall contacts of the intrusion show dip towards N to NE with angles of ~30–40 degrees. As a consequence of this, a large synformal (probably synclinal) fold that has a plunge roughly towards NE is believed to dominate the lithology of the Ritakallio area (Fig. 18). Bearing in mind the existence of multiple deformation events in the SW Finland, the kinematic correlation of Ritakallio structures to regional deformation events is complicated. However, locally it is possible to define the main structural patterns such as foliation in addition to shear zones and/or quartz veins that both typically associate with gold.

Observations are based mainly on diamond drilling profiles in the NW (R311–R313) and central part (R314–R318) of the area where intrusive rocks have been detected. The central part shows a major foliation trend of 100^{o}–110^{o} (up to 125^{o}; 'a' in Fig. 18) and minor trend of ~75^{o} ('b' in Fig. 18). The former dips roughly towards NE at 60 degrees, whereas the latter is sub-vertical. However, sub-vertical foliation is also observed parallel with a trend of 100^{o}– 110^{o}. Both structures show evidence of ductile folding and brittle faulting. In general, the 100^{o}–110^{o}- trending structures are dextral whereas the ~75^{o}-trending structures appear to be sinistral; nevertheless, contrasting observations are made in both cases. These two structures are associated with anomalous concentrations of gold in addition to a lineament of 060^{o}/60^{o}. In the central part of the Ritakallio area, there are gold-rich quartz-veins and shear zones in a gabbroic body having a trend of 135^{o} with a dip of ~45^{o} towards the NE that cut the main foliation in a dextral manner ('c' in Fig. 18).

The drill profile in the NW-corner of the Ritakallio area shows gold-rich quartz veins and shears that have trend of 160^{o} with a dip of ~70^{o} towards NE ('d' in Fig. 18). Next to the drilling site are ~75^{o} trending sub-vertical shears parallel to some of the observed structures in the central Ritakallio area ('e' in Fig. 18). These two patterns are the main gold critical structures in the NW-partt of the study area. Nevertheless, a trend of 100^{o} –110^{o} cannot be excluded. The lithological boundaries of the gabbroic body also have a gold-anomalous character throughout the study area.

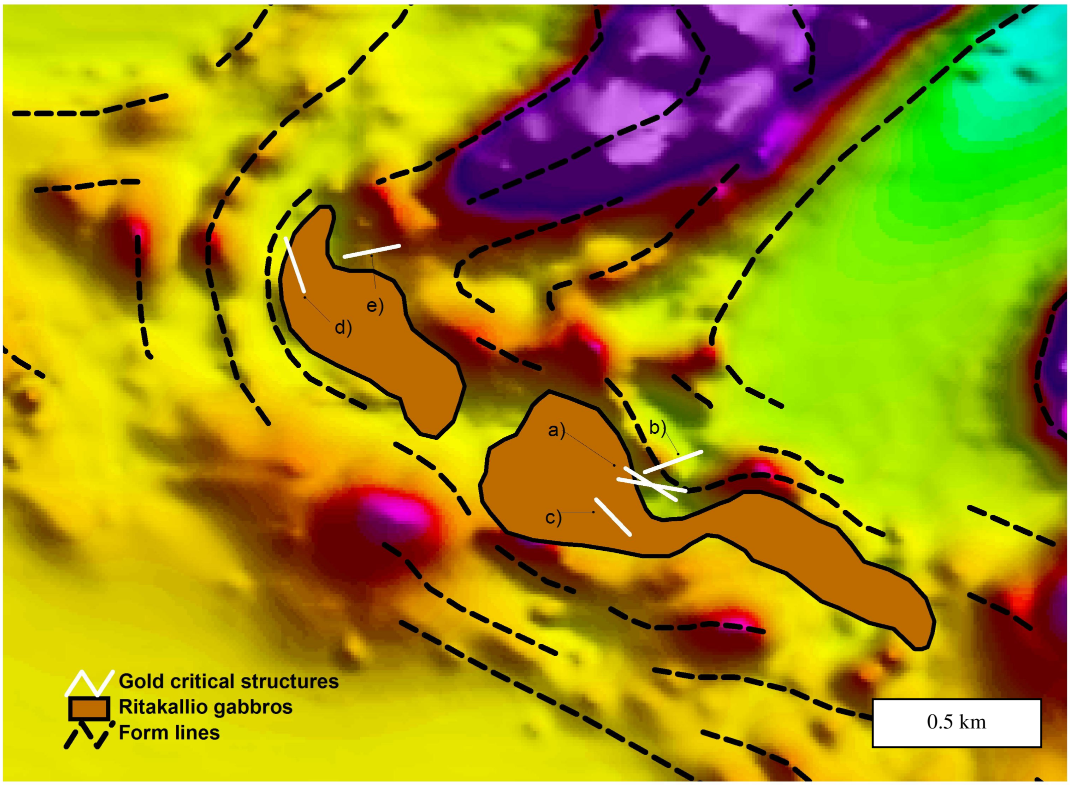

Figure 18. Observed gold-critical structure orientations and overall structural patterns at Ritakallio. Form lines delineate the Ritakallio fold discussed in the text. For explanation for 'a', 'b, 'c', 'd' and 'e', see text.

Geological interpretation

General outlines

As the gold occurs in shear bands and quartz veins it implies a close relationship between the mineralisation and deformation. The current concept on the origin of the gold mineralisation is related to the formation of the Ritakallio fold. The fact that the Ritakallio area consists of two main gabbroic bodies and some minor gabbro occurrences can be the result of deformation related splintering of a large intrusion or injection of several bodies initially.

Based on current knowledge, we envisage the existence of one main gabbroic body accompanied by a few minor ones that all represent early conformable subvolcanic injections of mafic magma into the sedimentary sequence. During the early stages of deformation, the main gabbroic body was boudinaged, half in a compressional environment that also produced layer-parallel foliation in sediments. Subsequently, probably during the main peak of deformation and metamorphism when the Ritakallio fold was developing, the gabbroic bodies were again subjected to compression. Simultaneously, the mica gneisses and gabbros were sheared. In contrast to mica gneisses, the gabbros were partially deformed in a brittle manner.

As the Ritakallio rocks were infiltrated with hydrothermal fluids, gold started to precipitate mainly in gabbros as a consequence of favourable composition and competence difference in comparison to the surrounding rocks. A substantial area of the outlined gabbro is covered with shearing and gold mineralisation, according to till and bedrock geochemistry, heavy mineral studies and Au-bearing boulders: this supports the idea that the more competent gabbroic bodies formed the favoured sites for mineralization.

Structures controlling the gold

In general, both brittle and ductile deformation structures are observed in the Ritakallio area, from which some are directly associated with gold whereas some structures apparently show evidence of gold remobilisation. The main gold controlling structural pattern is considered to relate to the formation of the Ritakallio fold (Fig. 19). During the compression, early foliation and boudinaged gabbroic bodies were sheared in a dextral manner in the central Ritakallio area. This event produced 100^{o} –110^{o} trending and 60 degrees towards NE dipping gold-rich shear zones dominantly within mica gneisses but also some minor shears in the gabbroic bodies adjacent to their boundaries.

The main gold-enriched structure that developed in gabbroic bodies cuts dextrally the early layer-parallel foliation, demonstrating a trend of 135^{o} with dip of ~45^{o} towards NE. These shear related quartz veins are also present close to the fold hinge in the NW-part of the Ritakallio area, but with a different strike and dip (160^{o} and ~70^{o} towards NE).

In summary, the main gold-anomalous structures in mica gneisses follow the Ritakallio fold pattern as well as the locations of gabbroic bodies (Fig. 19). However the main gold anomalous structures within gabbros are dominantly discordant with surrounding ones, excluding the nearby areas of the Ritakallio fold hinge. The plunge of the Ritakallio fold axis may be evidenced by observed lineament of $060^{o}/60^{o}$. As the graded igneous beds show upward top direction it implies that the Ritakallio fold may be synclinal.

If the deepest markedly gold-enriched sections of drill cores R317 and R318 can be connected, it becomes probable that the gold-rich structures dip towards NE at ~45 degrees. If these zones are projected to the surface, and their assumed strike (130^{o}) is followed towards the NW, the gold-enriched structures would hit the Au-rich bedrock detected in percussion drilling about 200 m away from the site where the zone is detected in the drill holes ('A' in Fig. 19).

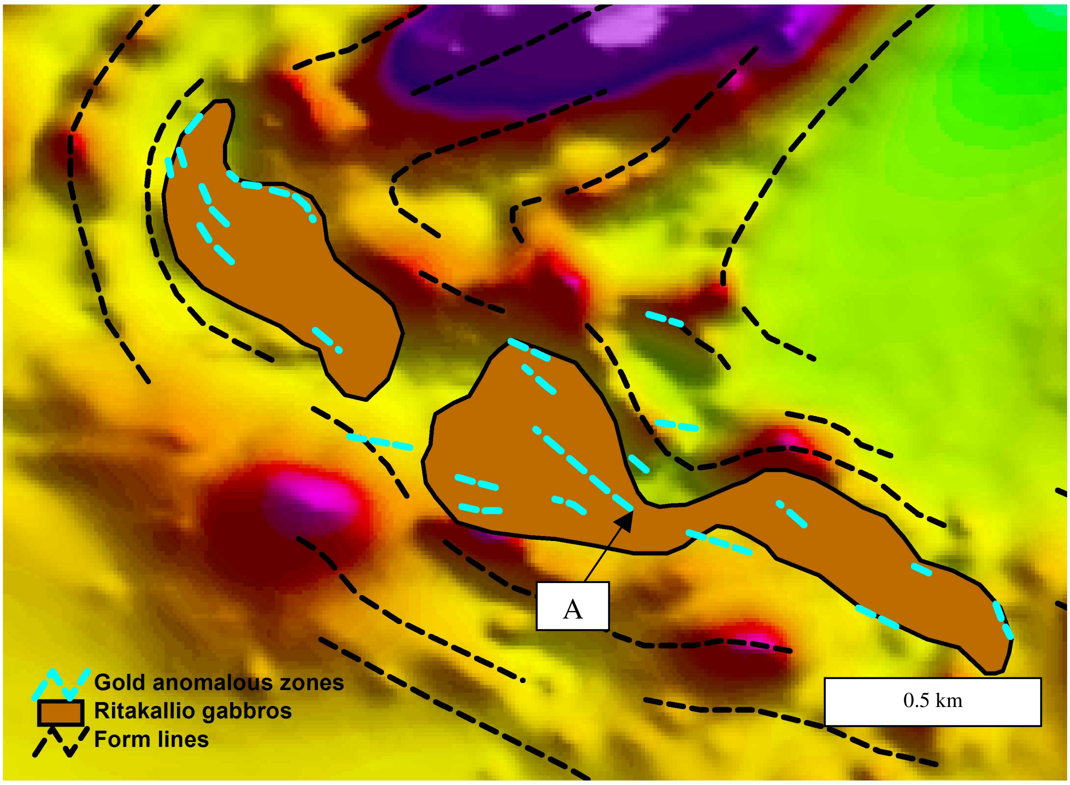

Figure 19. Main interpreted gold anomalous zones and structural patterns of Ritakallio area. Blue dashed line A is an interpreted continuation at the bedrock surface of the gold-enriched zone observed in drill core.

Late processes

Gold-rich structures of the Ritakallio area are cut by minor sharp faults associated with potassic alteration and minor carbonate veins. Some of these faults contain traces of gold combined with arsenopyrite and other sulphides implying remobilisation of the former to some extent. The dominant latter structures are illustrated in Figure 20. They partly overprint the main gold critical structures complicating the general picture. For instance, throughout the Ritakallio area there is a sub-vertical, 100°–110°-trending, foliation and faults that coincide in plane with early planes of parallel foliation in central Ritakallio. In the NW-part of the Ritakallio area, this sub-vertical pattern penetrates the early fold structure and causes decrease of susceptibility of rocks and partial disappearance of the Ritakallio fold structure in aeromagnetic maps. The three illustrated patterns in Figure 20 may represent the results of later deformation events during retrograde metamorphism that probably also caused minor remobilisation of gold.

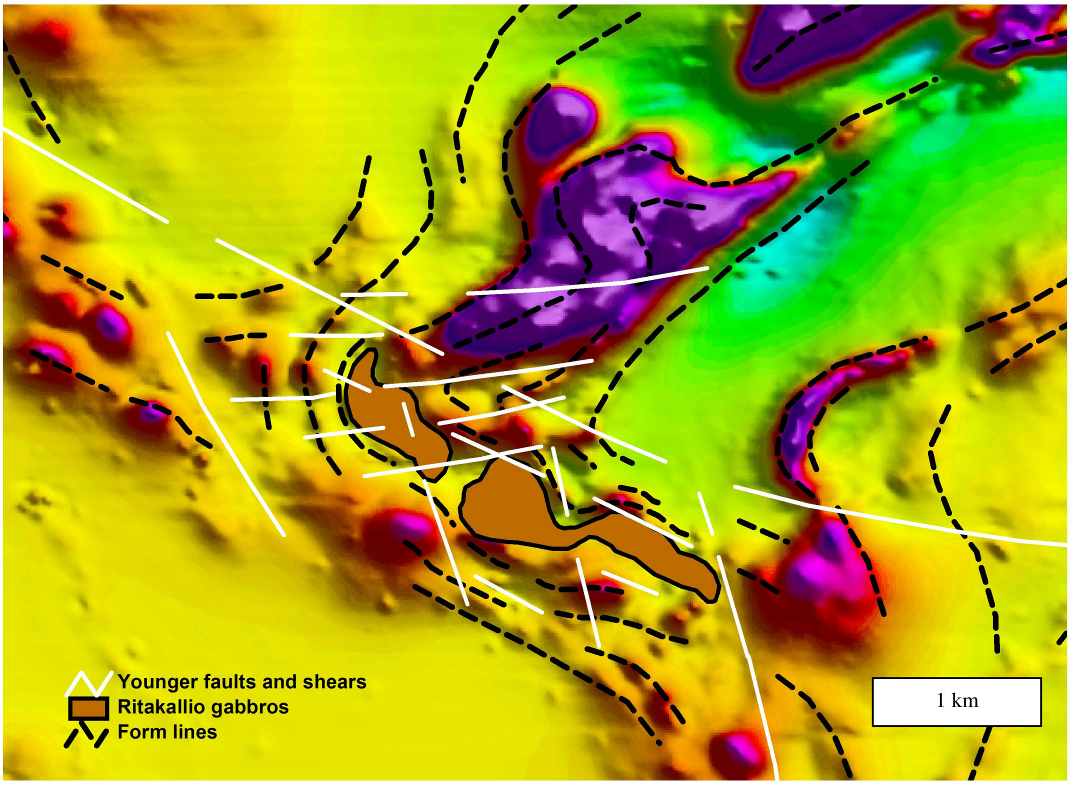

Figure 20. Overall structural patterns and assumed later structures that cut the gold enriched zones of the Ritakallio area.

7. SUMMARY OF RESULTS

Results of all the exploration methods employed indicate that Ritakallio is a gold prospect with marked potential for ore discovery. There are separate gold anomalous locations or subareas, although the current dispersion or grouping can be the result of sparse sampling and in fact represent one single deposit.

The highest gold content in an outcrop sample was ~36 g/t, which is the same value as the highest value detected in an erratic boulder in the area. Percussion drilling sampling across the critical zone by 30 m point distance gave a maximum gold content of 8.5 g/t in rock chip samples, whereas the highest gold content in < 2mm fraction of till is 1.2 g/t. Diamond core drilling yielded 3.9 g/t as a maximum content of gold per 1 metre, whereas the longest "ore-grade" section was 4.7 metres with 1.7 g/t.

Based on interpretation of geophysical data and structural observations from outcrops and drill cores, the occurrence of gold has a structural control that follows the Ritakallio fold pattern. Gold-rich quartz veins and shears occur both in mica gneisses and gabbroic rocks. However, the latter more likely are the potential host for a significant gold deposit, as is the case of the adjacent Jokisivu gold deposit (Luukkonen 1994).

Currently available data on observed gold-rich structures leave them open both along strike and at depth. Gold concentrations in bedrock and in till that exceed 0.5 g/t form an elongated area that is roughly NW–SE oriented, 2350 m long and 620 m wide. Diamond drilling demonstrates that concentrations over 0.5 g/t Au continue at least to the depth of 65 m. The thickest gold-rich zones so far detected are 2–4 metres wide and typically record average concentrations between 1.7 and 2.6 g/t (R311, 31.4–36.1 m; 4.7 m at 1.7 g/t and R317, 73.6–75.7 m; 2.1 m at 2.6 g/t).

Based on all the accumulated data, mainly gathered during 2004 by GTK, there is a great potential for the discovery of more gold in the Ritakallio area.

8. ENVIRONMENTAL STATEMENT

General description

The major part of the Ritakallio claim is economic forest area. The vegetation of the forestland is quite typical for SW Finland. It shows diverse regions of birch, pine (Scot Pine) and spruce (Norway Spruce) trees. The diversity of vegetation in the mixed forest is rather limited. Small wetland areas, classified as swamps, occur in the northwestern and soutwestern parts of the claim (Fig. 21). There are no lakes in the Ritakallio claim. The area does not include any significant aquifers of glaciofluvial sediments. The groundwater from sandy moraines can locally be of interest to single households. The permanent settlement, a few farms, are located in the southwestern part of the Ritakallio claim (Fig. 21). The farms are outside the Au-mineralised area.

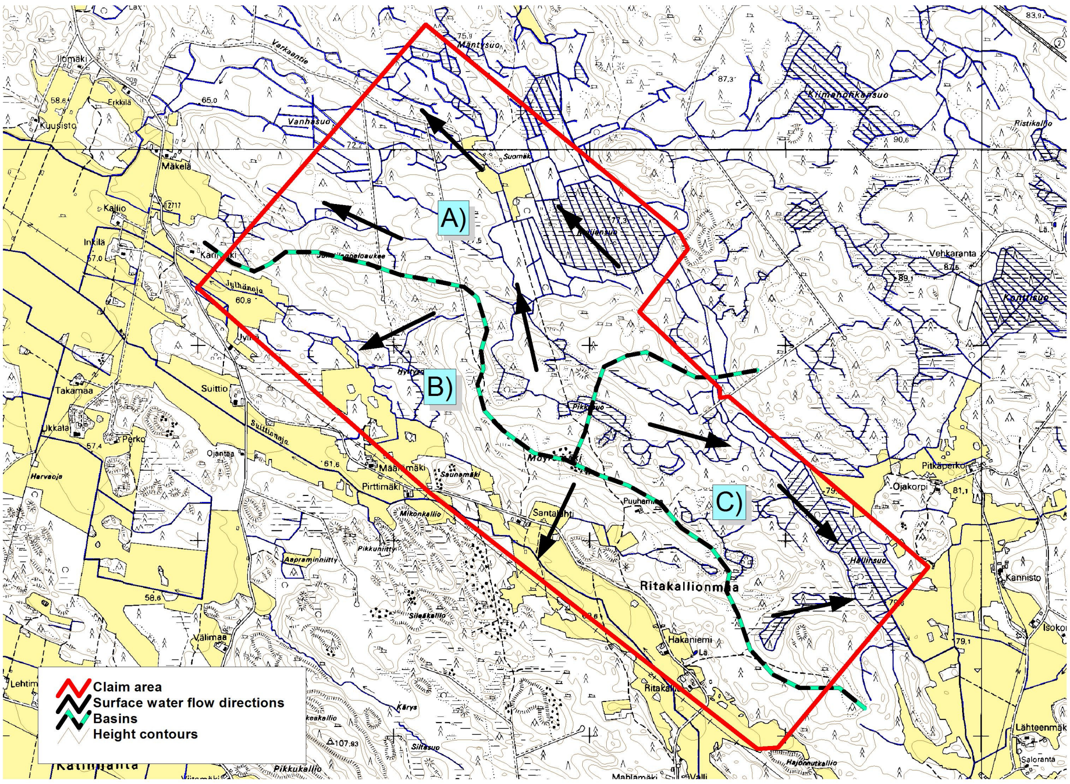

Figure 21. Topography map of the Ritakallio claim area and its surroundings. Symbols A), B) and C) mark small basins (parts of three catchments within the claim) and the dashed line for watersheds (see text). Length of the claimed area is ~3.8 km and width from 1.3 to 1.8 km. Keys: brown = 5 m height altitude contours, blue = ditches, yellow = agricultural land, solid and dashed black lines = roads and tracks.

The area of the Ritakallio claim is divided into three small basins (catchments A, B and C in Fig. 21). Figure 21 shows the flow direction of surface water, in the north toward NW, in the southwest to SW, and in the east toward SE. Despite of differences in the surface runoff within the claim area, all the surface waters from Ritakallio eventually flow into the River Loimijoki, to the northwest of the claim area (not seen in Fig. 21).

Protected areas

There are no protected areas in the Ritakallio claim area or nearby, according to the Finnish Environment Institute (SYKE).

Geochemistry of Quaternary sediments

<u>Glacial sediments (Till)</u>

Geochemical description of the overburden (Quaternary sediments) in the Ritakallio area is based on till samples taken by percussion drilling during the exploration work in the area. The samples were taken from the lowest part of the till layer. Geochemical data is presented in Table 5.

Table 5. Geochemistry of the till in the Ritakallio area (data from the present study) and in the regional scale sub-province D3 (Elo et al. 1992). Concentrations have been measured using the hot aqua regia digestion and ICP-AES for element determinations.

Element	Regional sub-province (D_3) (Elo et al. 1992)	Ritakallio basal till (percussion drilling)	Ritakallio basal till (percussion drilling)	Ritakallio till samples (excavation)
	median of the <0.06 mm till fraction	mean of the <2.0 mm fraction	maximum of the <2.0 mm fraction	maximum of the <2.0 mm fraction
As (g/t)	5	125	3060	471
Co (g/t)	15	14	39	20
Fe (%)	3.5	2.8	11.7	3.4
Ni (g/t)	27	33	212	34
Cr (g/t)	63	57	724	50
Zn (g/t)	88	91	1160	74
Cd (g/t)	-	0.2	12	0.2
Hg (g/t)	-	<0.005	0.01	0.016
S (g/t)	240	2580	45900	2200

The till in the Ritakallio area is characterized by elevated concentrations of As and S. The mean concentration of As is significantly greater than the median in the regional sub-province D_3, within which Ritakallio is located. By contrast, the means of the other metals are similar with the regional data. However, the maximum concentrations of the metals at Ritakallio exceed the regional levels by orders from ~2 times to ~600 times.

In Finland, heavy metal concentrations of till are generally somewhat higher in the <0.06 mm than <2.0 mm fraction due to metal enrichment into the clay fraction. However, the till at Ritakallio contains local weathered bedrock material that causes the anomalously high metal concentrations. Furthermore, the elevated concentrations indicates the abundance of the sulphides, especially in the lower parts of the till bed. The till data from the excavation represent solely till material less mixed with regolith (preglacial weathered).

Postglacial stream sediments

The geochemistry of the postglacial stream sediments in the Ritakallio area is discussed here on the basis of the Geochemical Atlas of Finland (Lahermo et al. 1996). The data in Table 6 are from areas adjacent to Ritakallio. As seen in Table 6, the Ritakallio area shows elevated concentrations (excluding the sulphur) of the heavy metals compared with means of the stream sediments found in Finland. Especially, concentrations of As, Ni and Zn are anomalous, being twice as great as their mean concentrations in Finland.

Table 6. Metal and sulphur concentrations of stream sediments in the adjacent areas of the Ritakallio claim and in general in Finland (Lahermo et al. 1996).

Element	Organic stream sediment in Ritakallio area	Winsored mean of Finland
As (g/t)	8.3-9.3	4.4
Co (g/t)	19.9-21.4	13.2
Fe (%)	3.6-3.8	3.2
Ni (g/t)	29.5-31.6	17.2
Cr (g/t)	49.0-52.1	34.6
Zn (g/t)	86.8-93.8	56.1
Cd (g/t)	0.3	0.2
Hg (g/t)	-	0.05
S (g/t)	921-1011	1726

Geochemistry of surface waters

Also the geochemistry of surface water in the Ritakallio area is discussed here on the basis of the surface water data published in the Geochemical Atlas of Finland (Lahermo et al. 1996). Stream water geochemistry in the areas adjacent to Ritakallio does not differ significantly from the mean values found in Finland (Table 7).

Table 7. pH and heavy metal and sulphate concentration of the stream water in the adjacent areas of Ritakallio and in general in Finland (Lahermo et al. 1996).

	Stream water in Ritakallio area	Windsored mean of Finland	98^{th} percentile
pH (stream water)	~6.4-6.5	~5.8	
pH (fountain or well)	(~6.1-6.2)	-	
As (µg/l)	1.0-1.2	-	2.4
Co (µg/l)	0.2	0.3	
Fe (mg/l)	0.5-0.6	0.9	
Ni (µg/l)	1.3-1.6	1.2	
Cr (µg/l)	0.4	-	1.6
Zn (µg/l)	2.8-3.3	4.6	
Cd (µg/l)	0-0.02	-	0.08
Hg (µg/l)	-	-	
SO_4^{2-} (mg/l)	8.9-11.0	7.7	

Main lithogeochemical features of rocks

Ritakallio bedrock samples show dispersed concentrations of metals without obvious relationship to a specific rock type, although anomalous gold concentrations are typically related to gabbroic rocks. The major element data show large variations within each rock type due to alteration-related modifications. As the metal concentrations at Ritakallio also demonstrate wide ranges independent of the host rock, all the rock types are managed collectively. In general, bedrock samples show somewhat increased concentrations of As and S on average and significantly high maximum values of selected metals (Table 8). These increased metal concentrations are commonly associated with various sulphides.

Table 8. Metals, As and sulphur in bedrock in the Ritakallio area (source: this study).

Element	Ritakallio bedrock samples average (percussion drilling)	Ritakallio bedrock samples maximum (percussion drilling)
As (g/t)	182	5700
Co (g/t)	17	63
Fe_2O_3 (%)	7.2	14.5
Ni (g/t)	39	299
Cr (g/t)	80	798
Zn (g/t)	106	814
Cd (g/t)	0.2	6.8
S (g/t)	3465	37200

Summary

There are no protected areas nearby the claim area and Ritakallio area does not have any natural landmarks. Most of the claim area is economic forestland characterized by mixed forest of birch, pine and spruce. Few farms and cottages are located in the SW-part of the claim area.

The Ritakallio area does not include any significant ground water aquifers. Ground water in moraine formation may locally be used by single households. The area is divided into three small catchments, from which surface water flows via ditches to the River Loimijoki.

Geochemistry of Quaternary sediments in the Ritakallio area shows elevated concentrations of sulphide-related elements in till. That also holds for As, whose concentration is abnormally high compared to the data in regional scale (Table 9). Similar chemical features are characteristic for stream waters and sediments, too.

The Ritakallio claim area records increased concentrations of metals that are associated with gold mineralisation and the local sulphidic schists. Currently, the available data concerning the environmental base line of the Ritakallio claim area is limited and provides only a general picture of the present conditions. In future, more detailed studies on till, ground and surface water as well as organic stream sediments are needed in order to obtain sufficient information on baseline conditions for environmental impact assessments.

Table 9. Recommended maximum concentrations in surface soils and summary of selected percussion drilling results (source: Elo *et al.* (1992), Puolanne *et al.* (1994) and this study).

Element	Recommended maximum values in surface soil	Ritakallio till samples average	Ritakallio till samples maximum	Ritakallio bedrock samples average	Ritakallio bedrock samples maximum
As (g/t)	50	125	3060	182	5700
Co (g/t)	50	14	39	17	63
Ni (g/t)	100	33	212	39	299
Cr (g/t)	100	57	724	80	798
Zn (g/t)	300	91	1160	106	814
Cd (g/t)	3	0.2	12	0.2	6.8
Hg (g/t)	2	<0.005	0.01	-	-

9. DISCUSSION AND CONCLUSIONS

Ritakallio is a recently discovered gold occurrence in SW Finland and further supports to the concept that this part of Finland also is potential region for gold mineralisation.

The Ritakallio occurrence can be classified as epigenetic (mesothermal) orogenic gold mineralisation based on its similarity to the Jokisivu deposit in terms of structural and lithological setting, mineral assemblages and textures. Fluid inclusion studies indicate the past presence of several fluid types at Jokisivu of which fluids the gold is associated with the types that follow the peak of metamorphism (Ristolainen 1999). This would imply that gold was also precipitated during or soon after the main peak of metamorphism at Ritakallio;

this would not exclude a close relationship with gold mineralisation and deformation. The fineness of the gold and the occurrence of löllingite grains that are mantled with arsenopyrite further support the proposed orogenic origin of the Ritakallio gold occurrence. The mutual relationship between gold, löllingite, and aresenopyrite also shows that the timing of gold mineralization does not predate the regiona metamorphic peak.

Arsenopyrite and scheelite can be used as detectors of hydrothermally altered zones. As the scheelite can be detected with UV-light, the indicative character can be easily utilised in practice, e.g. with outcrops, boulders and heavy mineral concentrates. Although gold-rich samples do not have any substantially anomalous petrophysical characters, the use of further geophysical ground surveys should not be excluded. Currently available samples barely represent all the possible variations of gold-rich rocks that are present at Ritakallio.

Encouraging results from Ritakallio provide a good foundation for a second stage of exploration. However, in order to launch substantial and active exploration in the Ritakallio area, the most convenient approach is the swift release to open international tender with anticipation of later beneficiation that would serve the general strategy of the Ministry of Trade and Industry.

10. RECOMMENDATIONS FOR FURTHER WORK

1) A 5 – 10 km diamond drilling program should be commenced. Diamond drilling profiles should be placed between the existing ones and in the SE-part of the Ritakallio area where there also are gabbroic rocks which seem to be the most potential host to ore in the area. Furthermore, both existing diamond drilling profiles should be extended so that they also reach the SW contact of the gabbroic bodies.

2) Excavation of SW-NE oriented trenches for exposing the bedrock surface in the central Ritakallio area combined with sampling and detailed structure observations in the bedrock surface.

3) Detailed percussion drilling sampling between the current drill profiles and extension of the area.

4) More detailed environmental base line study should be carried out including the till, ground and surface waters as well as organic stream sediments.

Espoo 14.10.2005

Saku Vuori Niilo Kärkkäinen

Pekka Huhta Tuire Valjus

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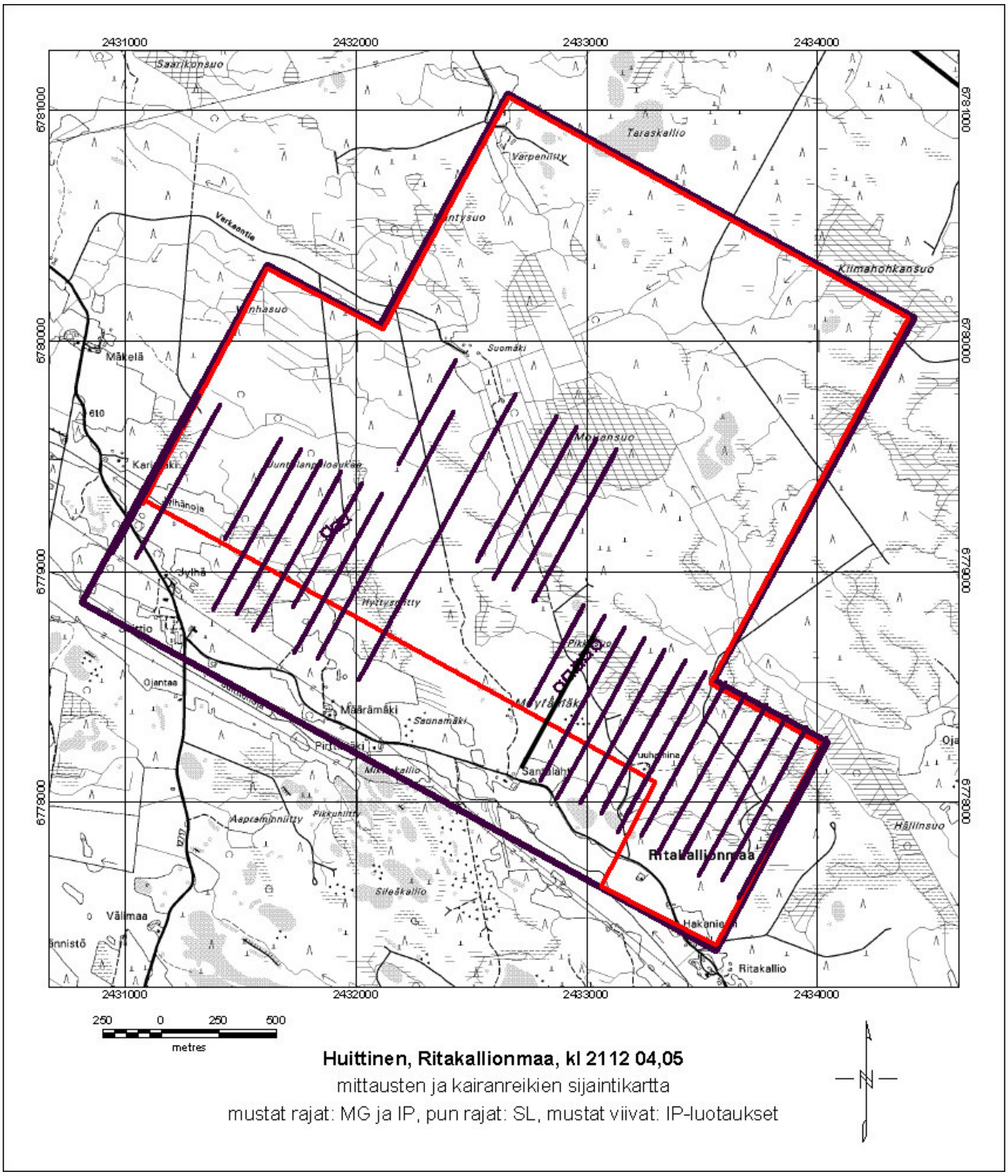
12. APPENDICES

Appendix 1. Data CD-ROM

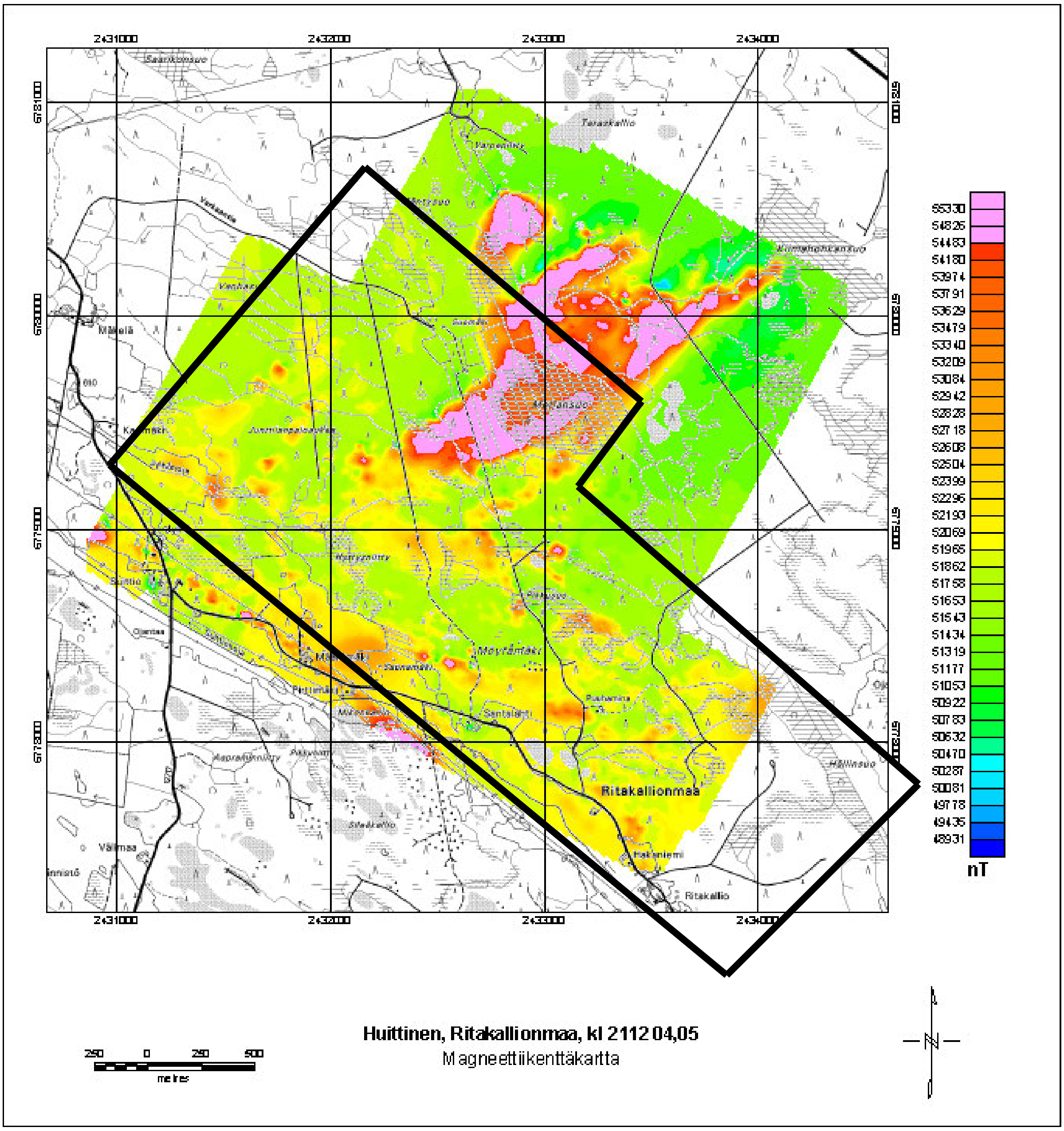
List of research material and primary data included in CD:

1) Geolaboratory_service_manual
2) CM06_ GIS information and analytical data
    - 2.1 Boulders
        - 2.1.1 Boulder_geochemistry
        - 2.1.2 Boulder_geophysics
    - 2.2 Deep_Drilling
        - 2.2.1 Drillcore_geophysics
            - 2.2.1.1 Drillcore_all_log
            - 2.2.1.2 Drillcore_selected_petrophysics
            - 2.2.1.3 Dc_Geochemically_analysed_samples
        - 2.2.2 Drillcore_geochemistry
        - 2.2.3 Drillcore_locations_(excel)
        - 2.2.4 Drillcore_loppi_data_(gemcom)
        - 2.2.5 Drillcore_ photographs
    - 2.3 Heavy_minerals
        - 2.3.1 Nuggets
        - 2.3.2 Geochemisty
    - 2.4 Microprobe_analyses
    - 2.5 Till_geochemistry_2002
    - 2.6 Outcrop_samples
    - 2.7 Mapping_data
        - 2.7.1 Shapes
    - 2.8 Percussion_Drilling
        - 2.8.1 Bedrock
        - 2.8.2 Till
3) CM06_Fieldphotos_04
4) CM06_Geophysical_ground_surv
    - 3.1 Ritakallio_geoph_03
    - 3.2 Ritakallio_geoph_04

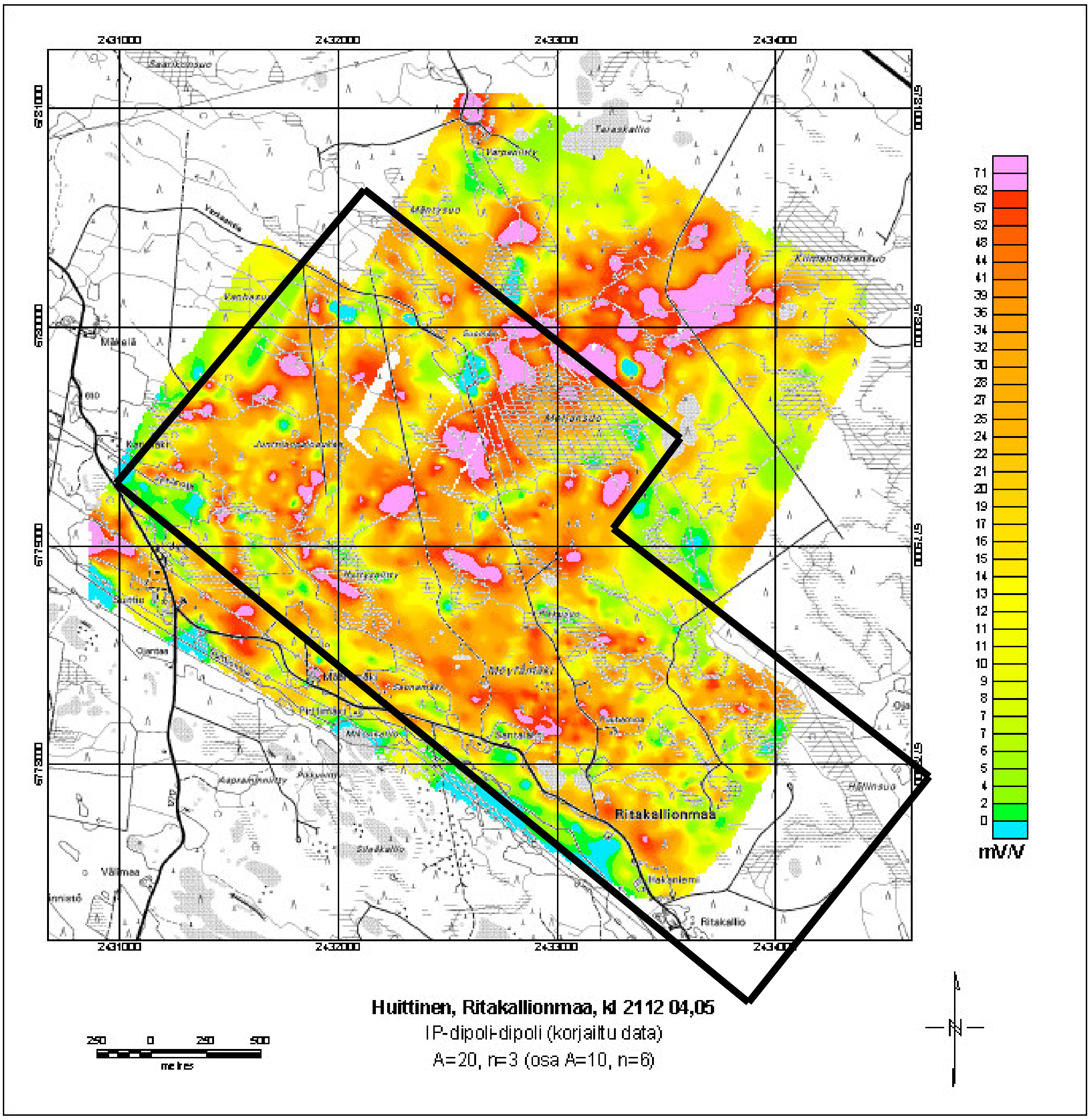
Appendix 2. Geophysical ground surveys at Ritakallio (red rectangle = slingram, black rectangle = magnetic and IP, black lines = multi-channel IP profiles)



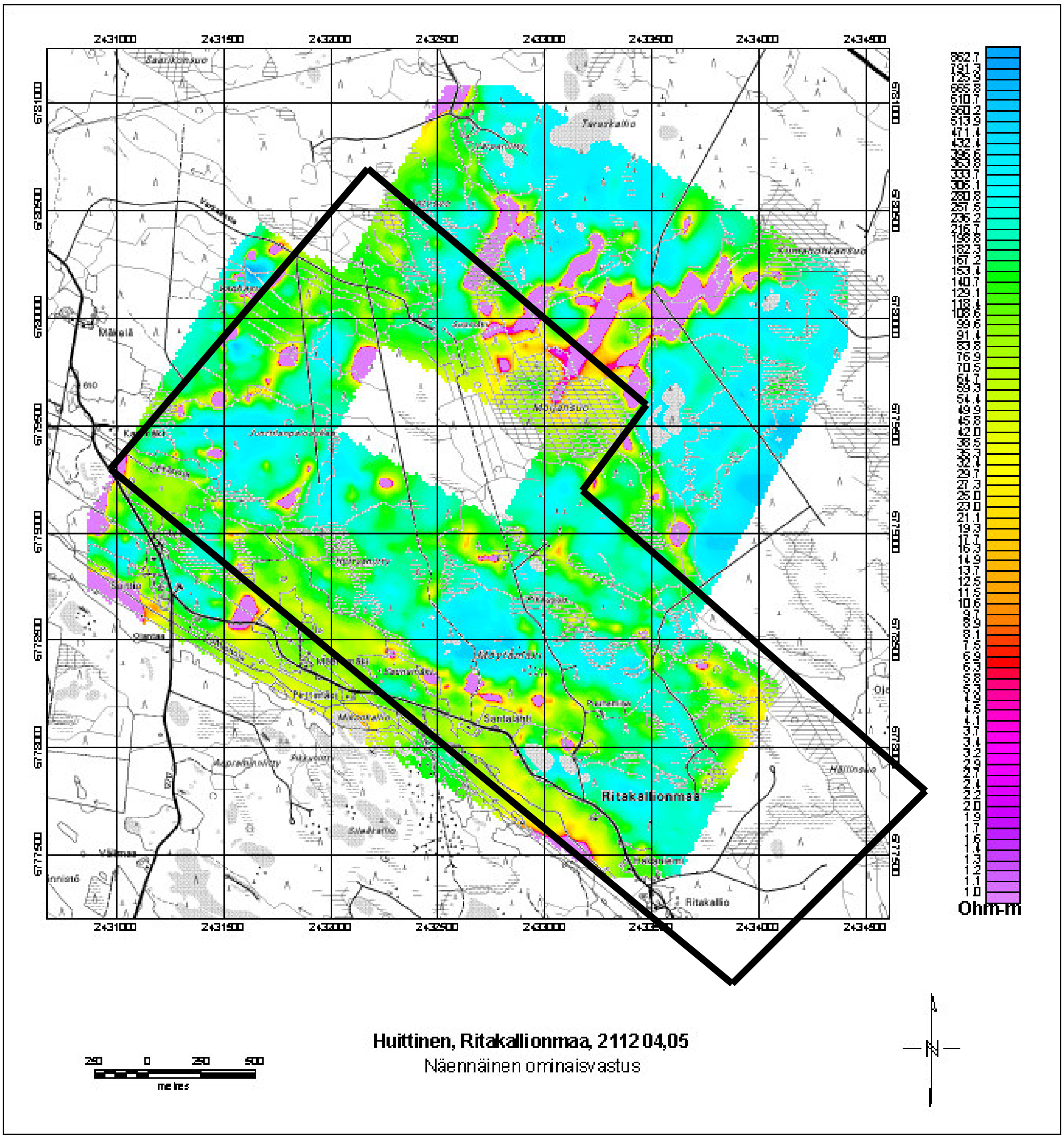
Appendix 3. Ground magnetic map of the Ritakallio area (black line = claim areas [outline location is indicative])



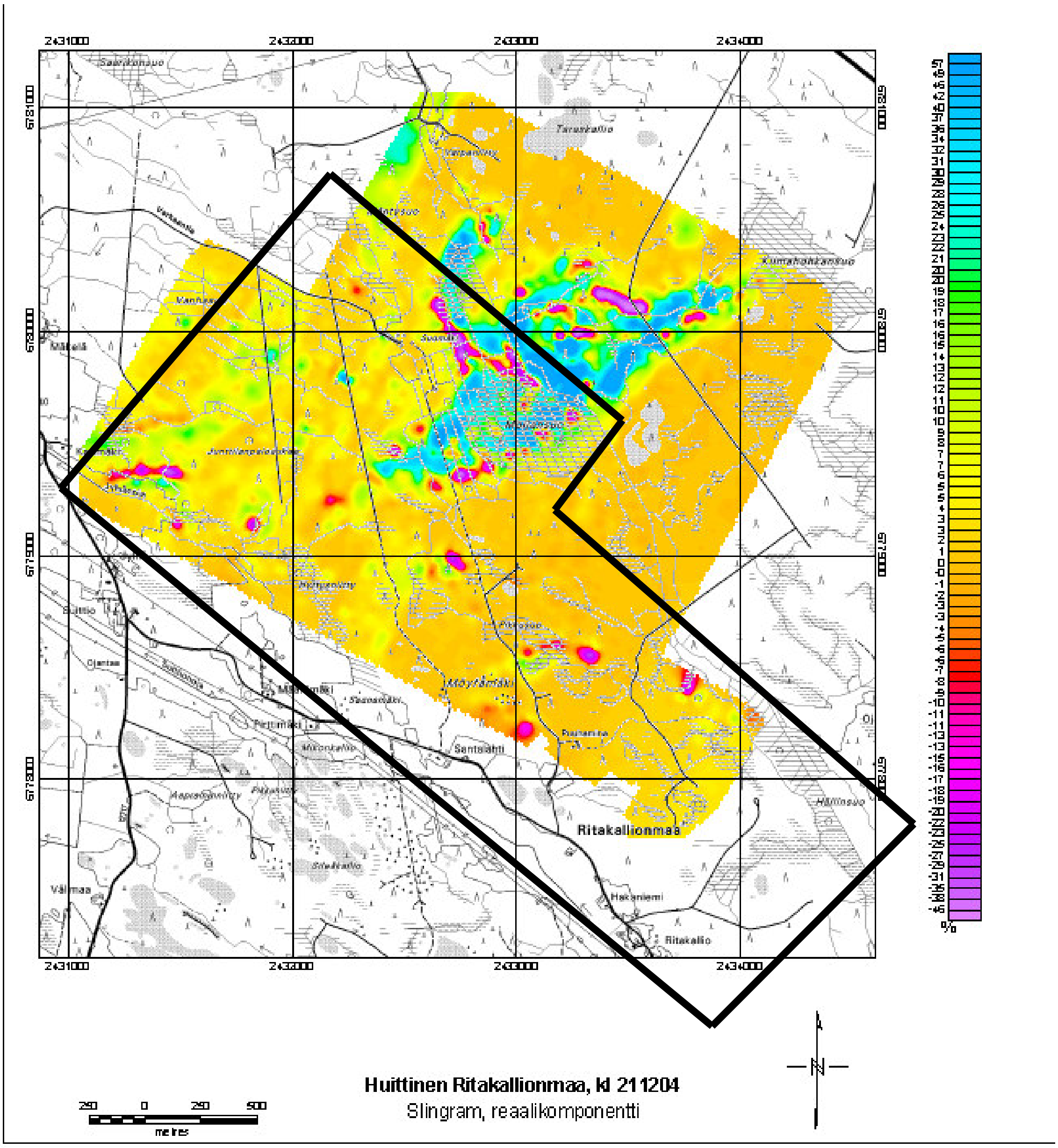
Appendix 4. IP map of the Ritakallio area (black line = claim areas [outline location is indicative])



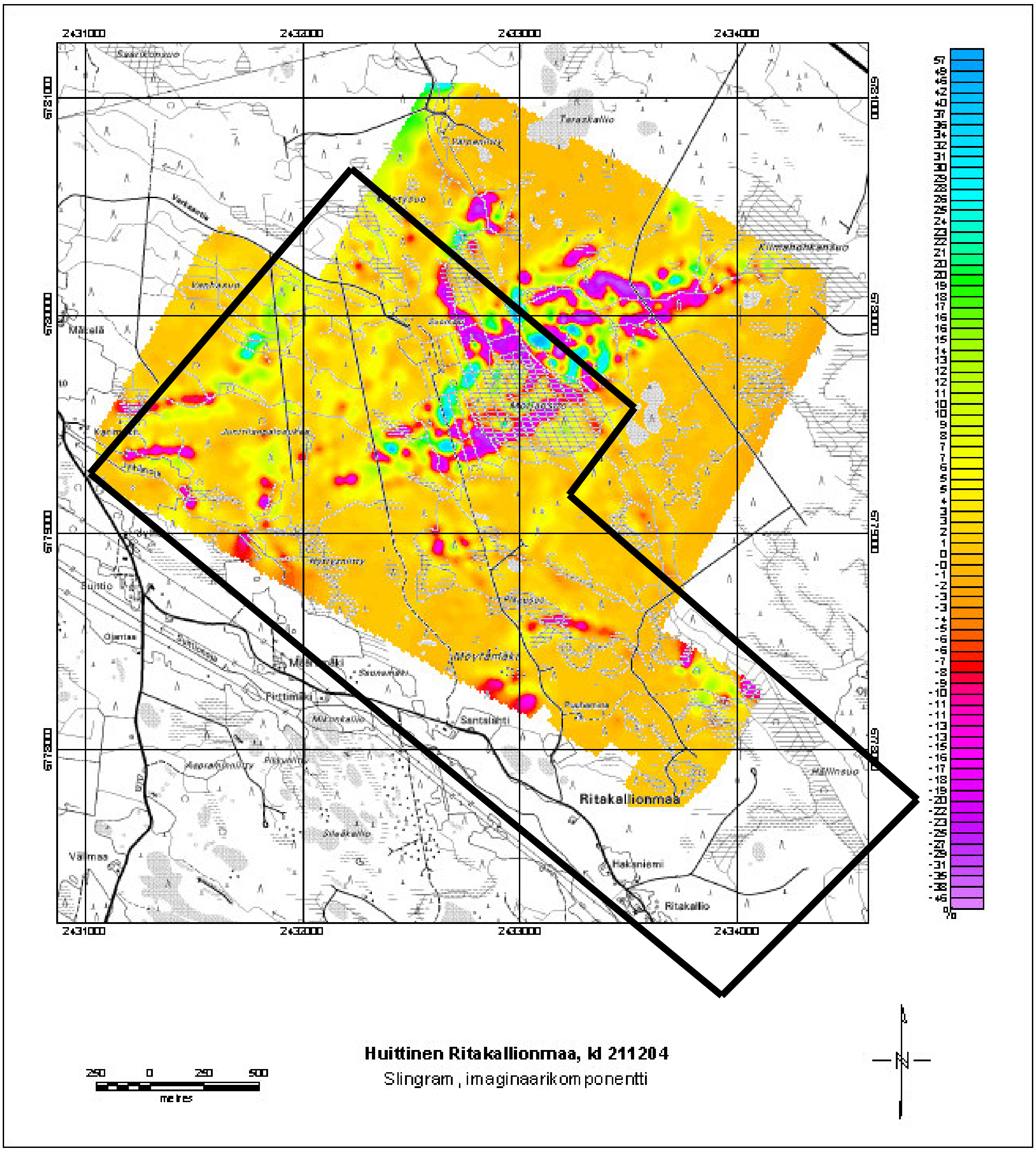
Appendix 5. Resistivity map, based on IP measurements (black line = claim areas [outline location is indicative])



Appendix 6. Sligram-Real component map of the Ritakallio area (black line = claim areas [outline location is indicative])



Appendix 7. Sligram-imaginary component map of the Ritakallio area (black line = claim areas [outline location is indicative])



Appendix 8. Drill hole locations at Ritakallio.

Drill hole	x	y	z	HzPrec	VtPrec
311	6779198	2431916	71.305	0.01	0.025
312	6779170	2431872	69.438	0.012	0.028
313	6779218	2431948	74.193	0.012	0.028
314	6778680	2433039	86.971	0.038	0.06
315	6778634	2432997	89.066	0.017	0.031
316	6778595	2432964	90.278	0.494	0.704
317	6778548	2432921	90.135	0.009	0.015
318	6778499	2432882	92.326	0.017	0.034

Appendix 9. Analysis orders from Ritakallio samples. Order numbers refer to GTK laboratory files

Samples	Order number(s)
Excavation	50448
Outcrops	87113 and 87081
Percussion drilling (bedrock)	87077
Percussion drilling (till)	87078
Drill cores (XRF)	87113
Drill cores	87111, 87293 and 87294
Boulders	87081 and 86820

0.0 X Appendix 10. Drill cores/Gemcom/Legend

LEGEND

ASSAYS : AU-GT (LEFT)

- 0.0000 - 0.1000
- 0.1000 - 0.4000
- 0.4000 - 1.5000
- 1.5000 - 3.0000
- 3.0000 - 1000.0000

LITHOLOGY : ROCK-TYPE (RIGHT)

- Soil
- Pegmatite
- Diorite
- Micaschist
- Granite

ASSAYS : AS-PPM (RIGHT)

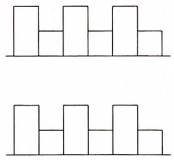
- 0.0000 - 10000.0000
- 10000.0000 - 1000000.0000

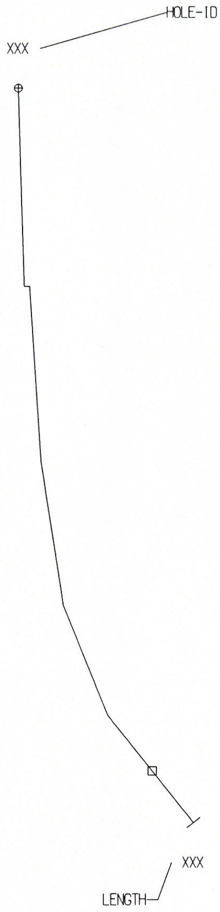
ASSAYS : AU-GT (LEFT)

Upper Bound 2.0000
Lower Bound 0.0000

ASSAYS : AS-PPM (RIGHT)

Upper Bound 10000.0000
Lower Bound 1.0000





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0.0 X

Geological Survey of Finland
Espoo Office
Betonimiehenkuja 4
Espoo, FIN-02150
Finland

UNITS : METRES DATE: 05/09/02 TIME: 13:57:13

RITAKALLIO, Huittinen
LEGEND
13.06.2005

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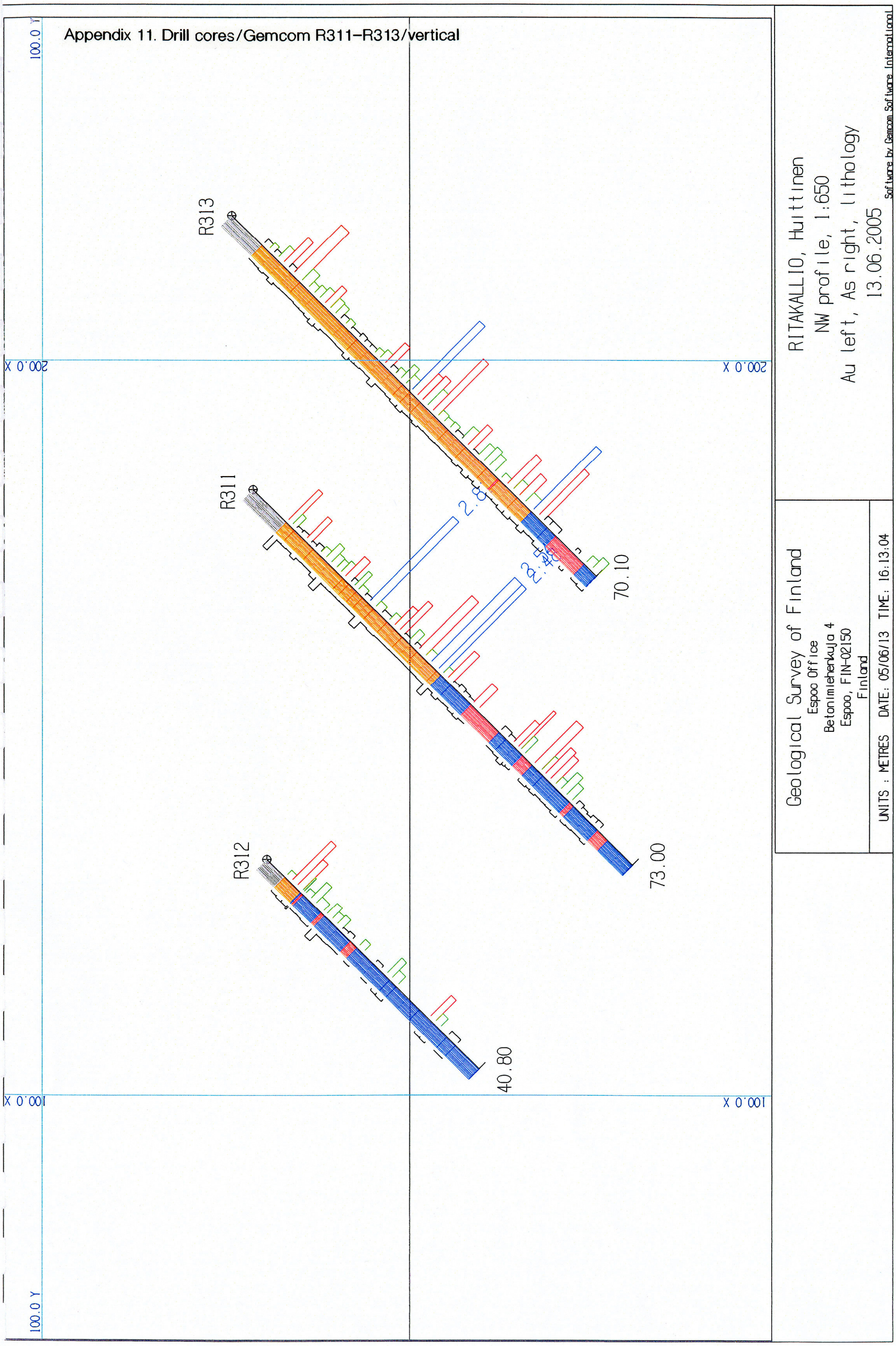
Software by Gemcom Software International

Appendix 11. Drill cores/Gemcom R311–R313/vertical



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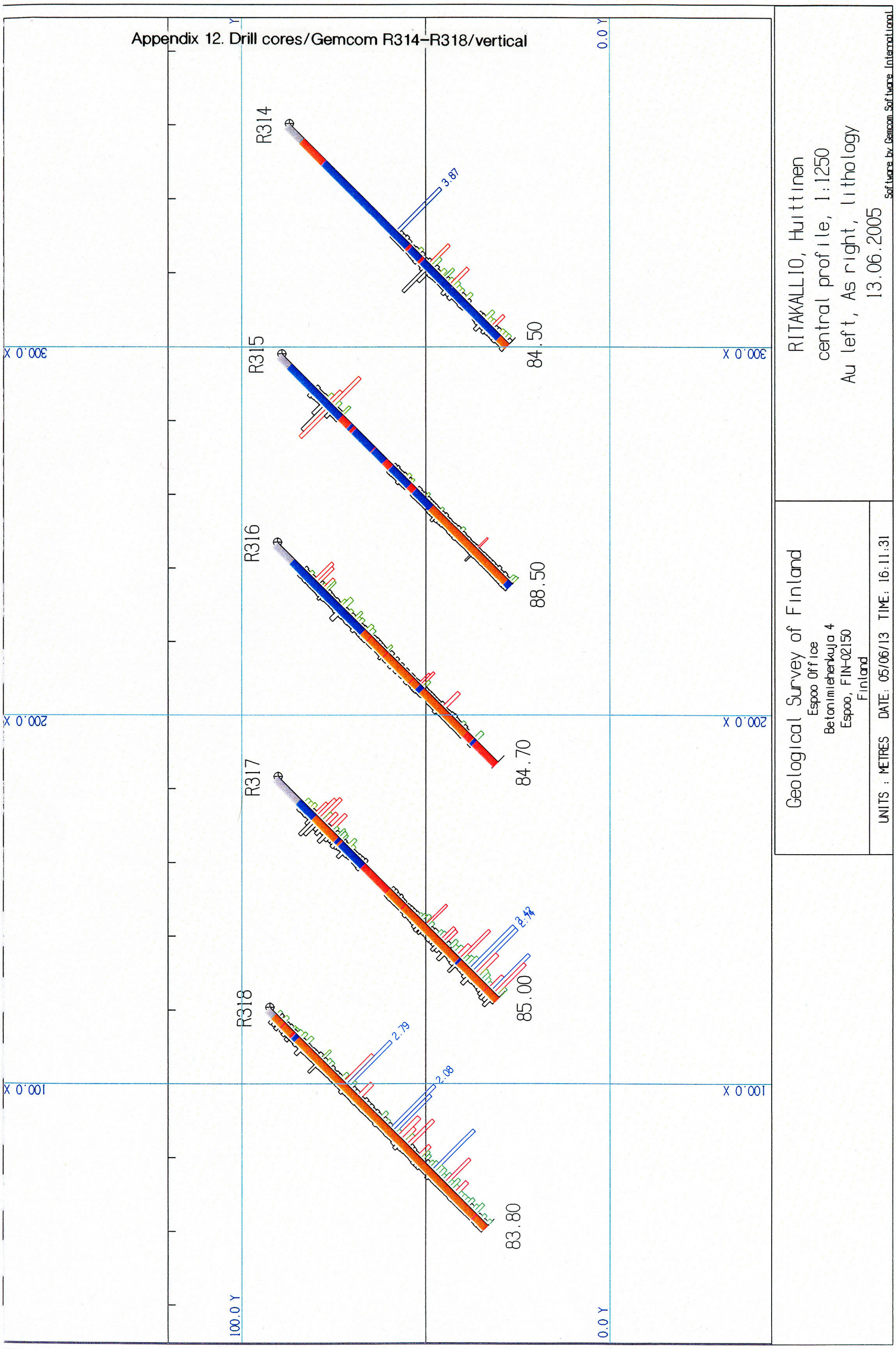
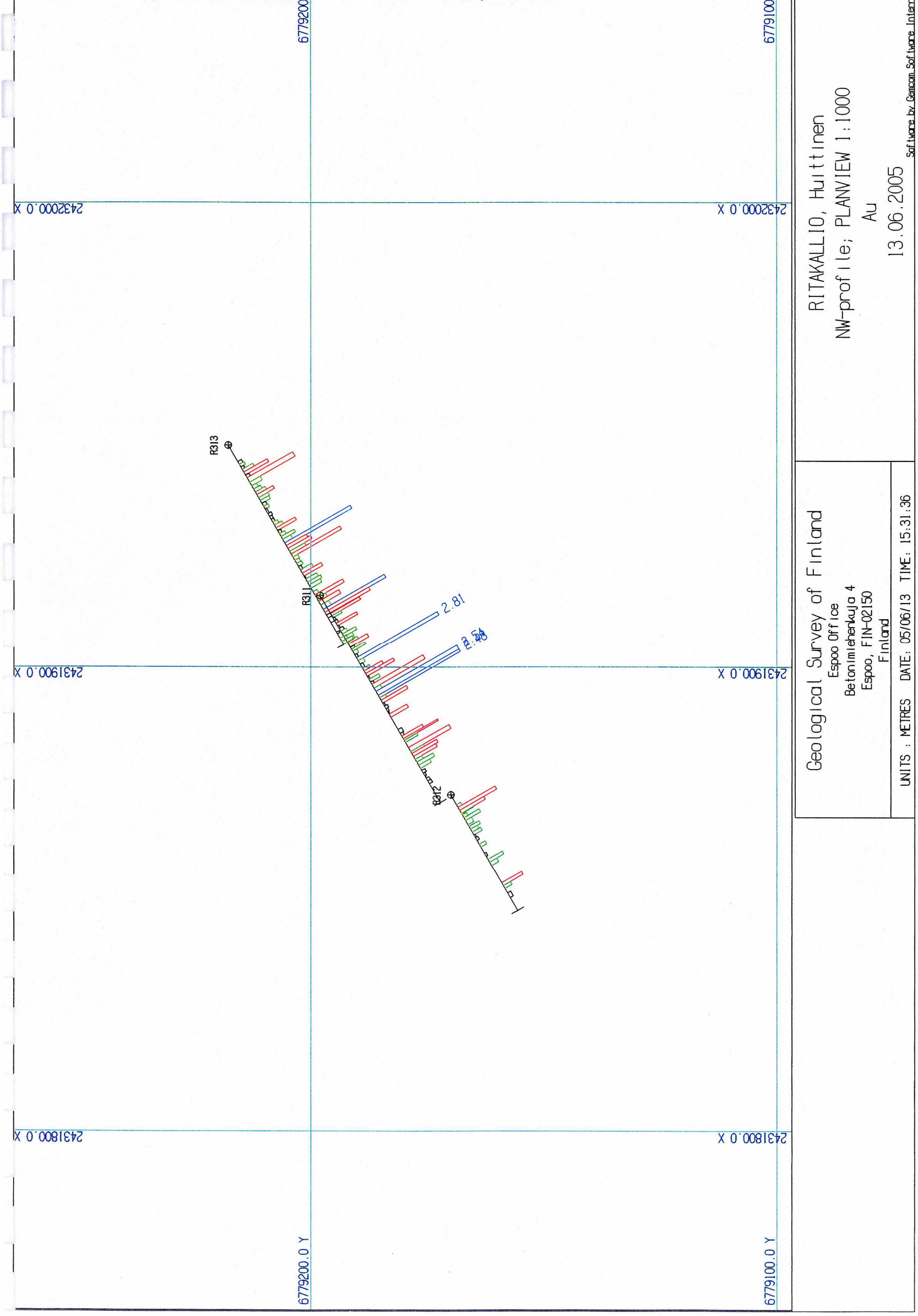
Appendix 12. Drill cores/Gemcom R314–R318/vertical



Appendix 13. Drill cores/Gemcom R311–R313/plan view



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Appendix 14. Drill cores/Gemcom R3144–R318/plan view