Kuikkapuro

Alternative Names: Kuikka
Occurence type: deposit

Commodity	Rank	Total measure	Total production	Total resource	Importance
gold	1	0,78 t	NA	0,78 t	Occurrence

Easting EUREF: 596356,576
Northing EUREF: 7226931,191
Easting YKJ: 3596568
Northing YKJ: 7229956

Discovery year: 1997
Discovered by: Geological Survey of Finland
Province: Kuhmo (Ni, Ag, Au)
District: Tormua (Au)
Comments: Discovery by GTK: the first indications were a regional Au anomaly in till and an auriferous sample from a glacial erratic boulder, found by an amateur prospector; further indications were the high Au, As and Te concentrations detected by percussion drilling into till-bedrock interface; the first diamond-drill hole intersected the lode
References: 1, 3, 4, 5, 10, 11, 12

Mineral deposit type

Group: Metallogenic deposit
Main type: Orogenic (metamorphic hydrothermal)
Comments: Formed after the peak metamorphic event under slightly retrograde conditions near the ductile-brittle transition. An orogenic "mesothermal" deposit with a distinct structural control and having formed under amphibolite-facies conditions.
References: 2, 9, 10, 13

Dimension

Expression: exposed
Form: discordant
Shape: irregular
Length (m): 1000
Width (m): 22
Thickness (m): NA
Depth (m): NA
Area (ha): NA
Dip azim: 70
Dip: 60
Plunge azim: NA
Plunge dip: NA
Orientation method: NA
Dimension comments: 1 km long, 15-30 m wide, dips at 60° to the ENE, open at both ends and at depth

Holder history

Current holder: Kalevala Gold Oy
Years: 2016

Holding type: Application for mining permit

Previous holders:

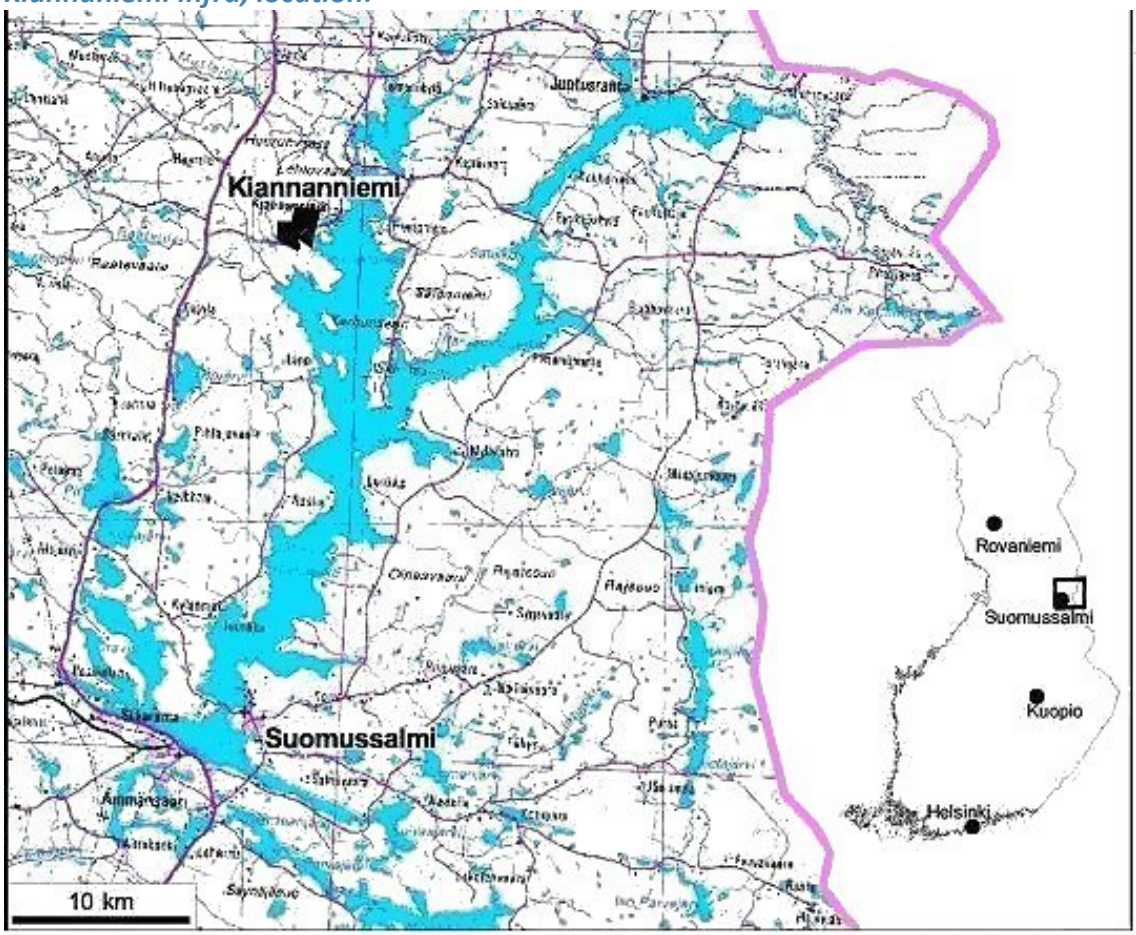
Company	Years	Holding type	Comments
Mineral Exploration Network (Finland) Limited	2013-2016	Claim (old law)	NA
Polar Mining Oy	2003-2006	Claim (old law)	NA
Outokumpu Oy	2001-2003	Claim (old law)	NA
Geological Survey of Finland	1996-2001	Claim (old law)	NA

Figures

Kuikkapuro main exploration trench photo:

Kuikkapuro, main trench in Aug. 2003. Photo Pasi Eilu

Kiannaniemi infra, location:



Roads (purple), lakes and rivers (blue) and railway (black line to the W of Suomussalmi town). From Pietikäinen et al. (2001).

EXPLORATION ACTIVITY

Lionsgold

Years	Activity type	Geologist	Exploration result	Ref
2018-2018	mining pilot	NA	NA	5
	Lionsgold, with its JV partner Kalevala, making metallurgical tests on the ore			

Mineral Exploration Network (Finland) Limited

Years	Activity type	Geologist	Exploration result	Ref
2016-2016	percussion drilling	NA	mineral occurrences	4, 5
	"Infill RAB drilling programme at Kuikka confirmed the continuity of high grade gold mineralisation between the GTK diamond drill hole collars with over 19 significant gold intersections. The 19 drill hole collars were at 12.5 m spacing, holes were inclined at 45 or 60 degrees and drilled perpendicular to mineralisation strike. The average downhole depth attained was 49 m." I total, 937 m was drilled.			
	Intersections			
	HoleID	KU002		
	From-To	NA		
	Length	6m		
	gold	15,58ppm		
	HoleID	KU005		
	From-To	NA		
	Length	6m		
	gold	18,1ppm		

2013-2016	detailed geochemistry	NA	geochemical anomaly	4
	Till sampling in the Syrjälä Project region			

2013-2016	detailed geophysics	NA	geophysical anomaly	4
	Ground magnetic and IP survey in the Syrjälä Project area			

Outokumpu Oy

Years	Activity type	Geologist	Exploration result	Ref
2001-2002	detailed geology	Jukka Jokela	key geological features	
	Palaeostress modelling of the area (cosulting to Outokumpu by GTK)			

2001-2002	resource assessment	Jukka Jokela	NA	13

Geological Survey of Finland

Years	Activity type	Geologist	Exploration result	Ref
1998-1999	core drilling	Kimmo Pietikäinen	mineral occurrences	3, 7, 10

	52 diamond-drill holes, total 4359 m	
	Intersections	
	HoleID	NA
	From-To	NA
	Length	0,7m
	gold	183ppm
	HoleID	NA
	From-To	NA
	Length	1m
	gold	115ppm
	HoleID	NA
	From-To	NA
	Length	16m
	gold	19ppm
	HoleID	NA
	From-To	NA
	Length	6,8m
	gold	1,8ppm
	HoleID	NA
	From-To	NA
	Length	3m
	gold	11,4ppm
	HoleID	NA
	From-To	NA
	Length	2m
	gold	26,2ppm
	HoleID	NA
	From-To	NA
	Length	4,4m
	gold	8,6ppm
	HoleID	NA
	From-To	NA
	Length	1m
	gold	54ppm

1994-1999	percussion drilling	Kimmo Pietikäinen	key geological features	2, 3, 7, 10, 13

1994-1999	detailed geochemistry	Kimmo Pietikäinen	geochemical anomaly	7
	Extensive Au-Te anomaly in till.			

1994-1999	detailed geology	Kimmo Pietikäinen	key geological features	2, 3, 7, 10, 13

1994-1999	detailed geophysics	Kimmo Pietikäinen	geophysical anomaly	10
	IP indicated the pyrite-rich horizons and ground-magnetic survey possible shear or fault zones; no specific response by slingram.			

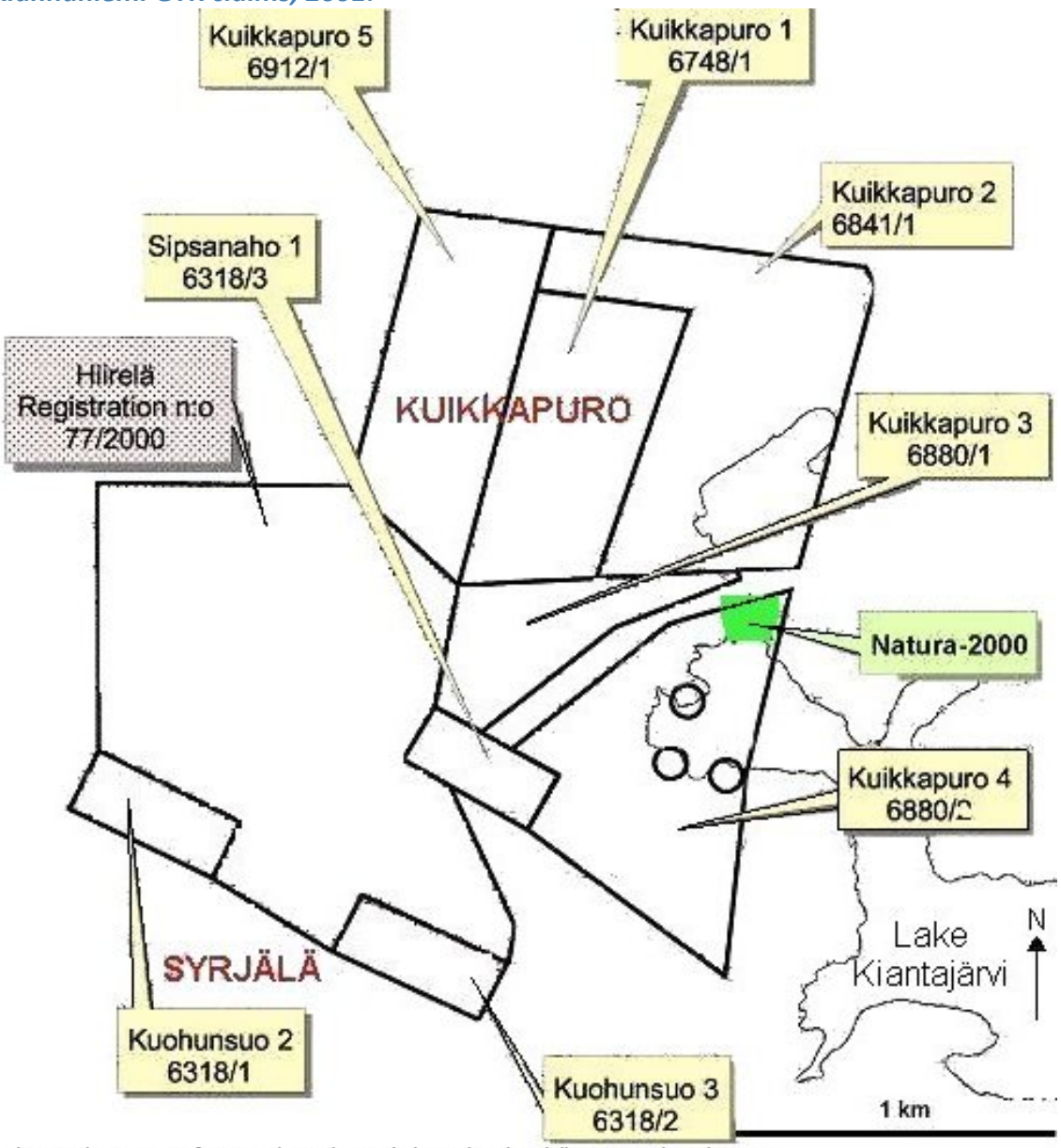
1990-2001	regional geochemistry	Markku Tenhola	geochemical anomaly	
	Greenstone belt-wide till-geochemical survey with 16 samples per one square kilometre			

1987-1987	regional geochemistry	Markku Tenhola	geochemical anomaly	7
	Country-wide till-geochemical survey			

1977-1977	regional geophysics	NA	key geological features	2, 3, 7, 10, 13
	Low-altitude airborne magnetic, electromagnetic and radiometric survey			

Figures

Kiannaniemi GTK claims, 2001:



Location map for exploration claims in the Kiannanniemi area.
From Pietikäinen et al. (2001).

Kuikkapuro exploration trench photo 2:

Kuikkapuro, second trench in Aug. 2003. Photo Pasi Eilu

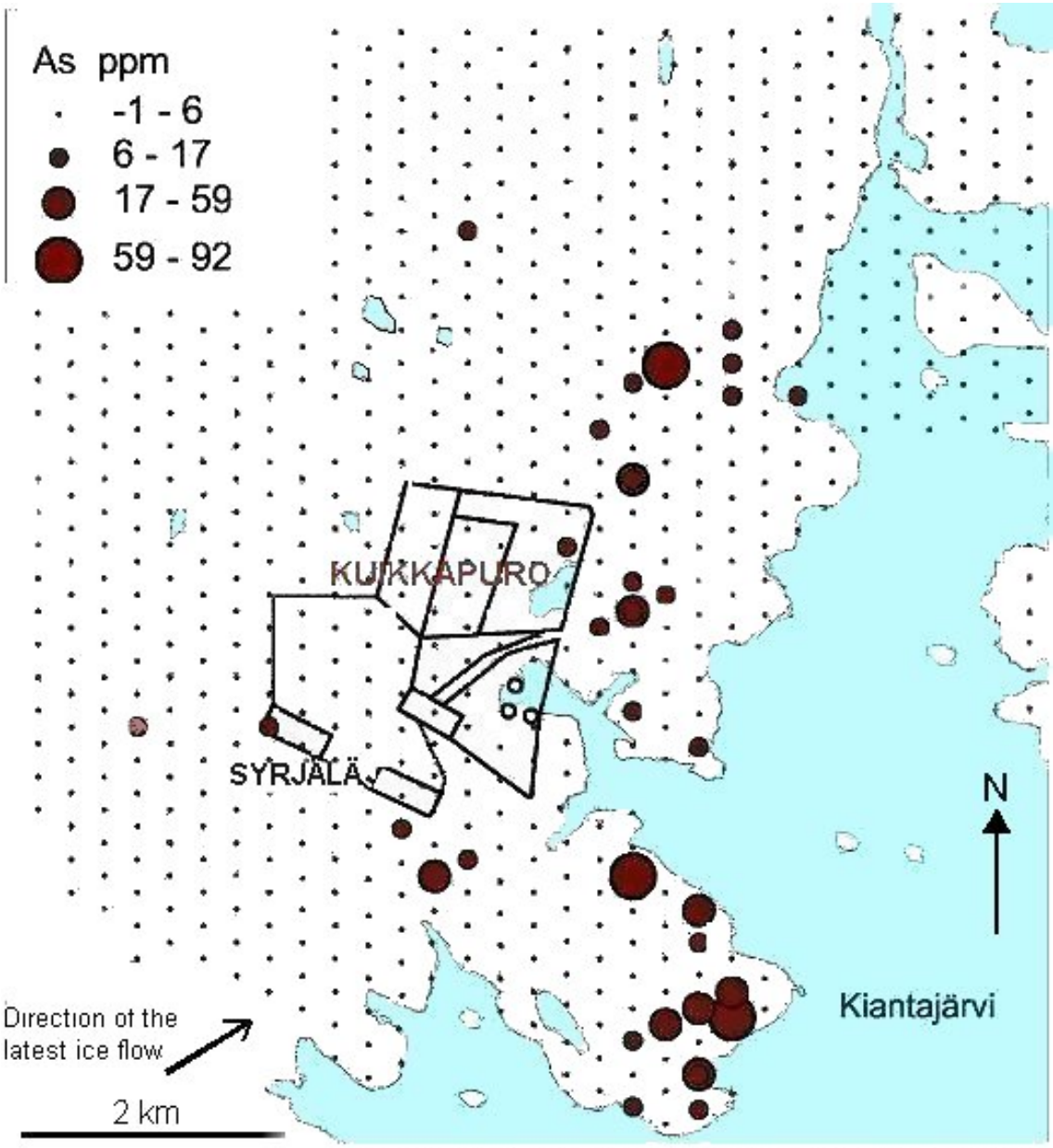
Kuikkapuro: close up of mineraliseed zone in an exploration trench 1:

Mineralisation, biotitsation, sulphidation in mafic metavolcanic rock, Kuikkapuro, Suomussalmi greenstone belt. Second trench, view along strike. Photo Pasi Eilu.

Kuikkapuro: close up of mineraliseed zone in an exploration trench 1:

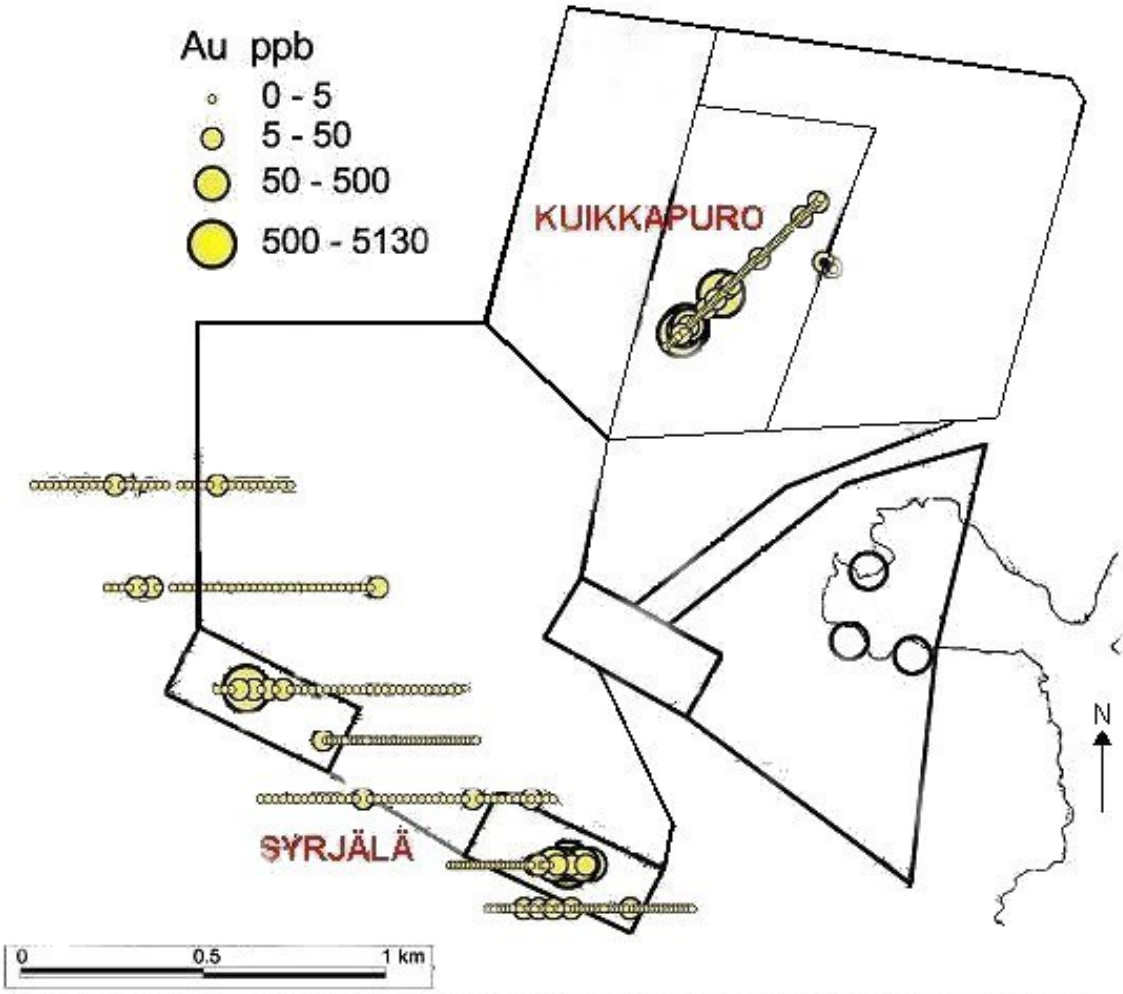
**Kuikkapuro, view along strike, across the main trench to the NNW.
Rusty rock is mineralised, the pale grey on left is unmineralised, altered metatholeiite.
Field of view about 5 m. Photo Pasi Eilu 16 May 2006.**

Kiannaniemi, As in till:



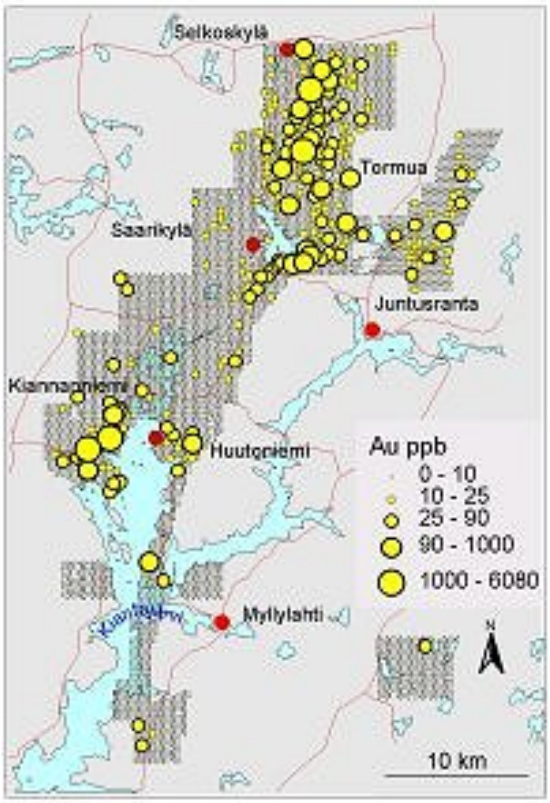
Arsenic in basal till in the Kiannanniemi area. Also the claim boundaries are indicated. From Pietikäinen et al. (2001)

Kuikkapuro-Syrjälä: Au in till-bedrock interface:



Gold in the till-bedrock interface in the Kiannanniemi area. Also the claim boundaries are indicated. From Pietikäinen et al. (2001)

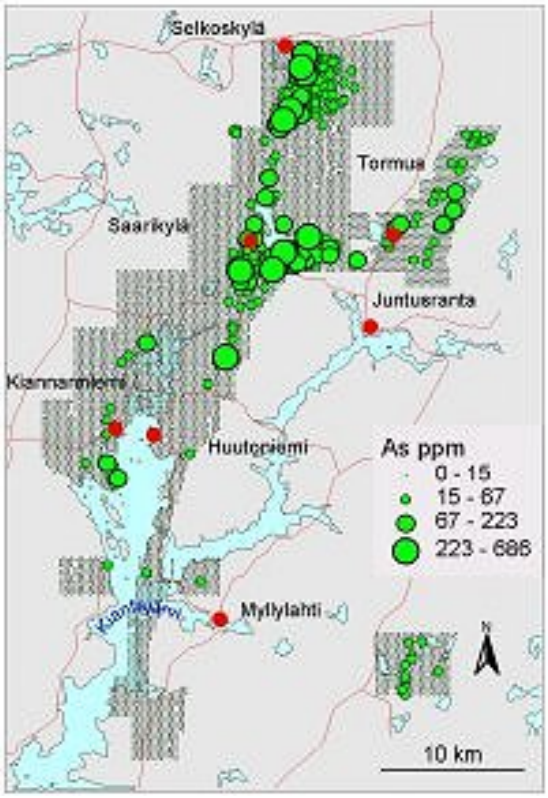
Suomussalmi greenstone belt: aeromagnetic image and gold occurrences:

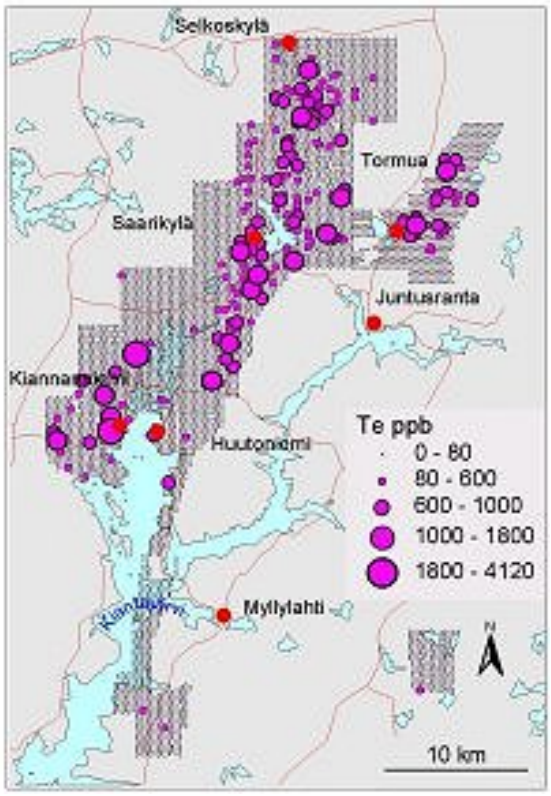


Suomussalmi greenstone belt

As, Au and Te in till

(Luukkonen et al. 2002)





RESOURCES AND RESERVES

Most recent

Type:	Company:	Year:	Date:	Calc Method:	Reference:
Resource	Geological Survey of Finland	2000	NA	Non-compliant resource estimate	3, 10
	Category:	**Inferred mineral resource**			
	Tonnage:	**0,054 Mt**			
	gold	14,6 ppm			
	Cutoff:	**NA**			

GEOLOGY

Host rock: Tholeiitic basalt

Tholeiitic basalt (Host rock)

Rock type: Host rock
Proportion: major
Grain size: NA
Color: NA
References: 2, 6, 7, 8, 10, 13
Comments: The deposit is in tholeiitic metabasalt in a second-order, D3 to D4, NNW-trending, lithology-parallel, ductile shear zone. Alteration mineral assemblages (biotite-calcite) indicate mineralisation under amphibolite-facies conditions. Coarse, free native gold in quartz veins and their immediate, intensely biotitised host rock. Auriferous quartz veins 1 cm to 1 m thick

Ore minerals:

Mineral	Proportion	Mineral texture
Altaite	minor	
Arsenopyrite	major	
Bravoite	minor	
Chalcopyrite	minor	
Cobaltite	minor	
Covellite	minor	
Galena	minor	
Gold	minor	
	Free gold in quartz veins, closely associted with arsenopyrite, grain size up to one millimetre.	
Hessite	minor	
Ilmenite	minor	
Iron	minor	
Molybdenite	minor	
Pentlandite	minor	
Petzite	minor	
Pyrite	major	
Pyrrhotite	major	
Sphalerite	minor	
Stibiopalladinite	minor	
Sylvanite	minor	
Talnakhite	minor	
Tsumoite	minor	
Volynskite	minor	
Wolframite	minor	
Zincochromite	minor	

Other minerals:

Mineral	Proportion	Mineral texture
Ankerite	present	Alteration product
Biotite	present	
Calcite	present	Alteration product
Chlorite	present	Alteration product
Epidote	present	
Garnet	present	Alteration product
K-Feldspar	present	
Plagioclase	present	Alteration product

Quartz	present	
Scheelite	present	
Titanite	present	Alteration product

Alteration:	Distribution:	Degree:	Relation to mineralization:
biotite alteration	Disseminated	Strong	Syn
Comments: Proximal alteration assemblage: quartz-biotite-calcite-ankerite-titanite. The obvious alteration halo charcterised by biotite+quartz is 10-30 m wide. To the west, the proximal alteration grades into granet-biotite alteration (reflecting a change in primary rock type?)			

Metamorphic description:

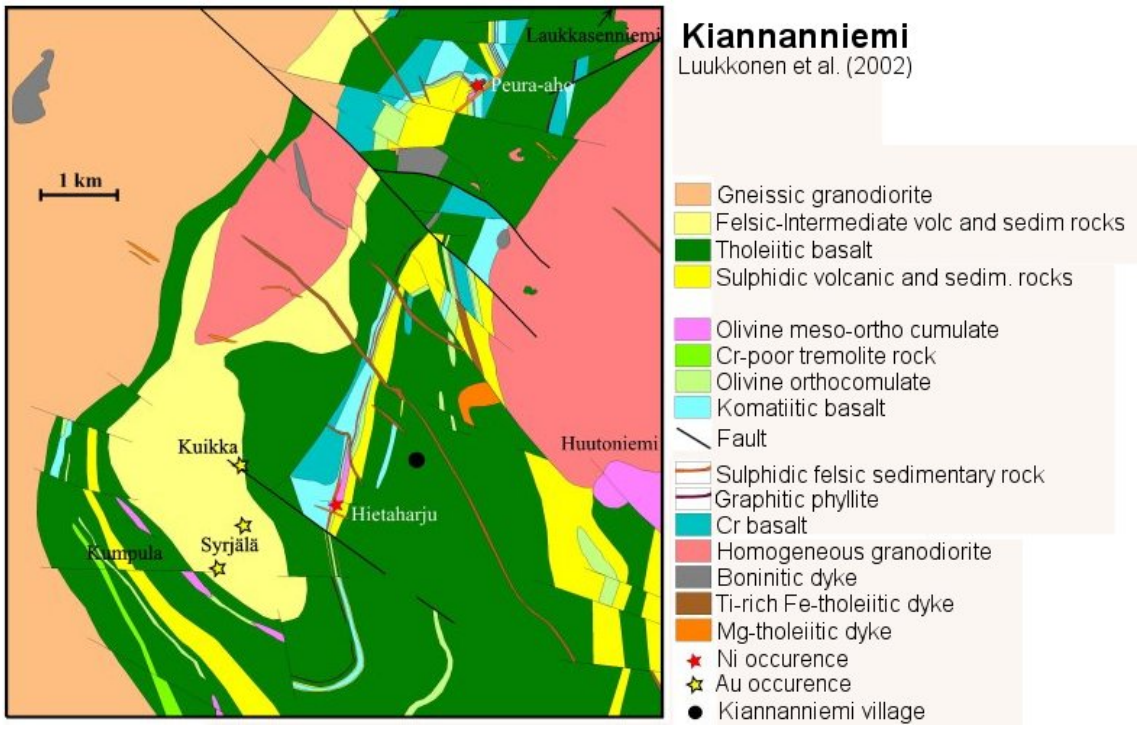
Type:	Facies:	Degree:	Relation to mineralization:	Min P- Max P (kbar)	MIn T- Max T (°C)
Regional	epidote amphibolite metamorphic facies	medium metamorphic grade	NA		
Comments: Lower-amphibolite facies or upper-greenschist facies regional metamoprhic peak. Metamorphic mineral assemblage is: plagioclase-hornblende-titanite-K feldspar ± quartz, ilmenite, zircon, pyrrhotite, chalcopyrite. Possibly, a retrograde overprint at greenschist-facies PT conditions [3], also suggested by the late formation of chlorite and epidote.					

Geological age:

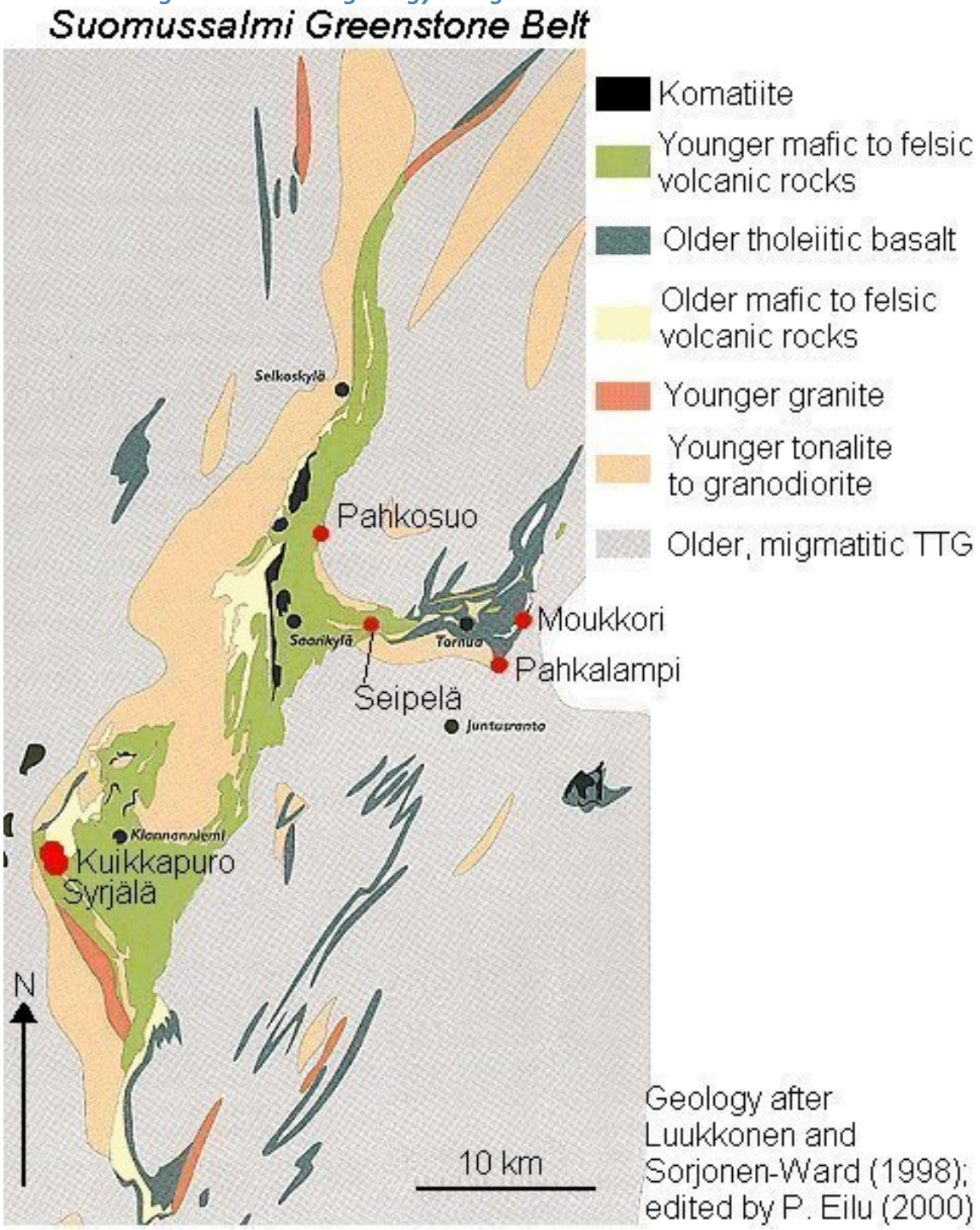
Geological era:	Max age - Minage (Ma):	Inferred age (Ma):	Age of mineralization:
Neoarchean (2800-2500 Ma)	2700-2800		N
Comments: The tholeiitic host is within the 2.8-2.7 Ga(?) Saarikylä Group sequence.			

Figures

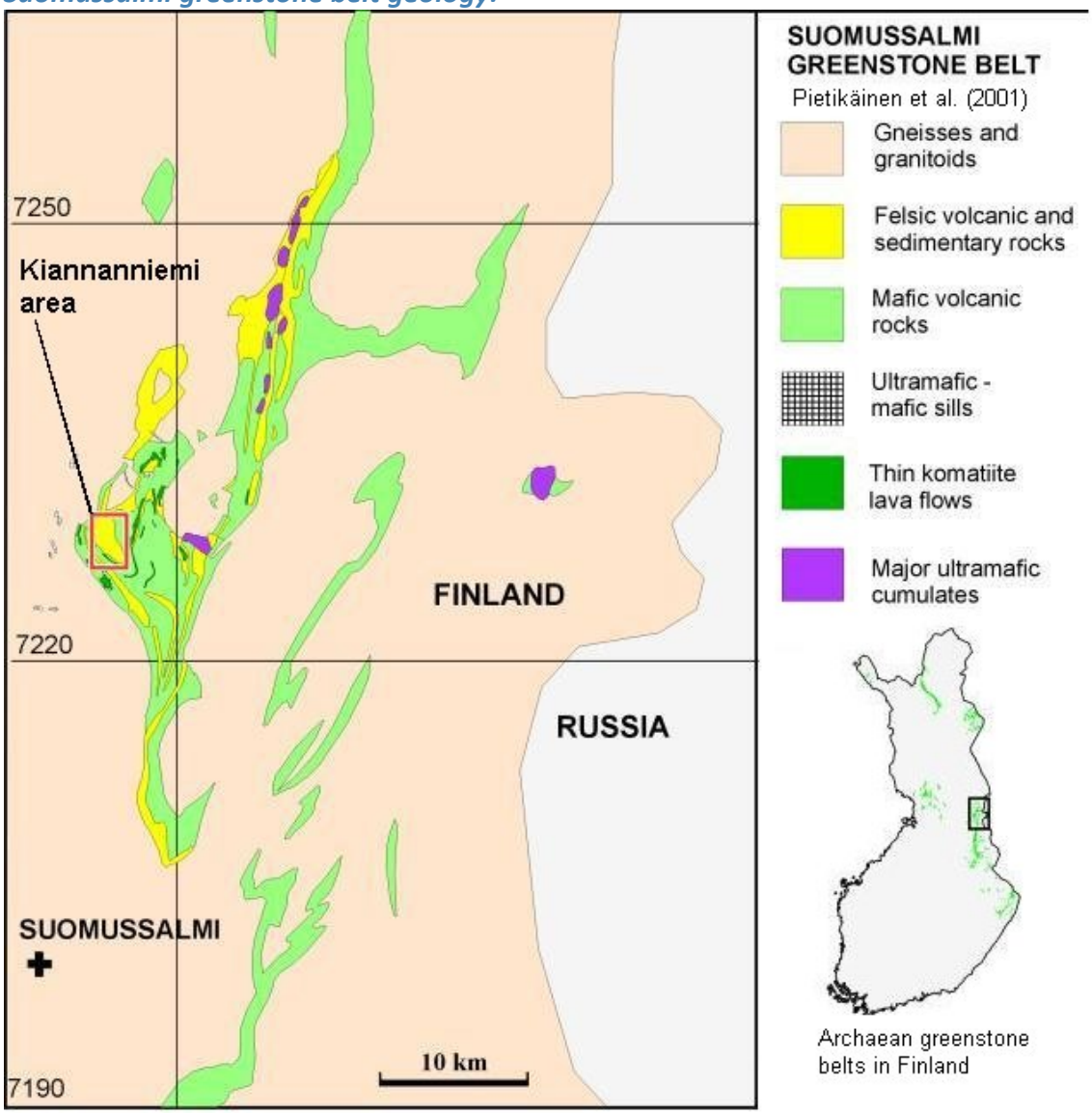
Kiannanniemi area geology, gold and nickel occurrences:



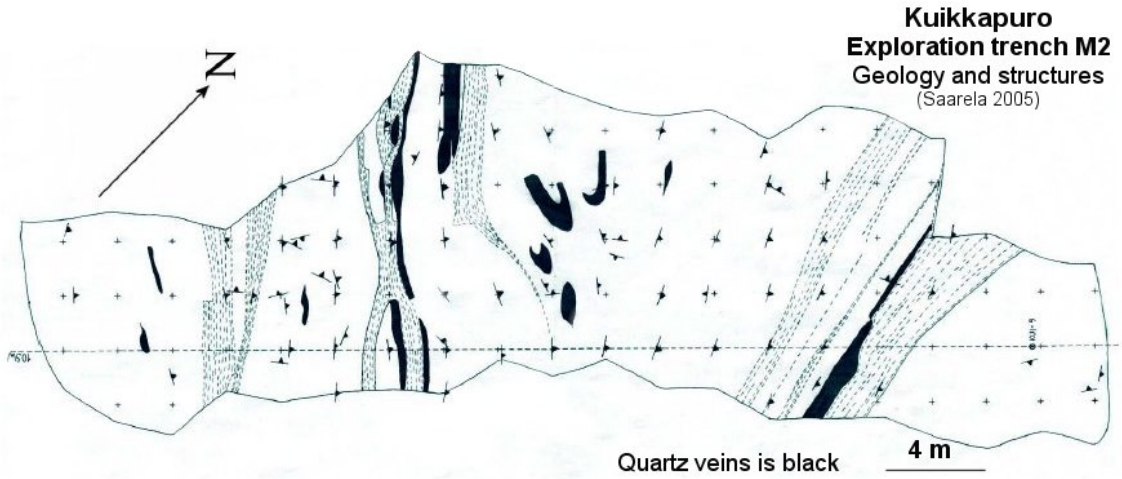
Suomussalmi greenstone belt geology and gold occurrences:



Suomussalmi greenstone belt geology:



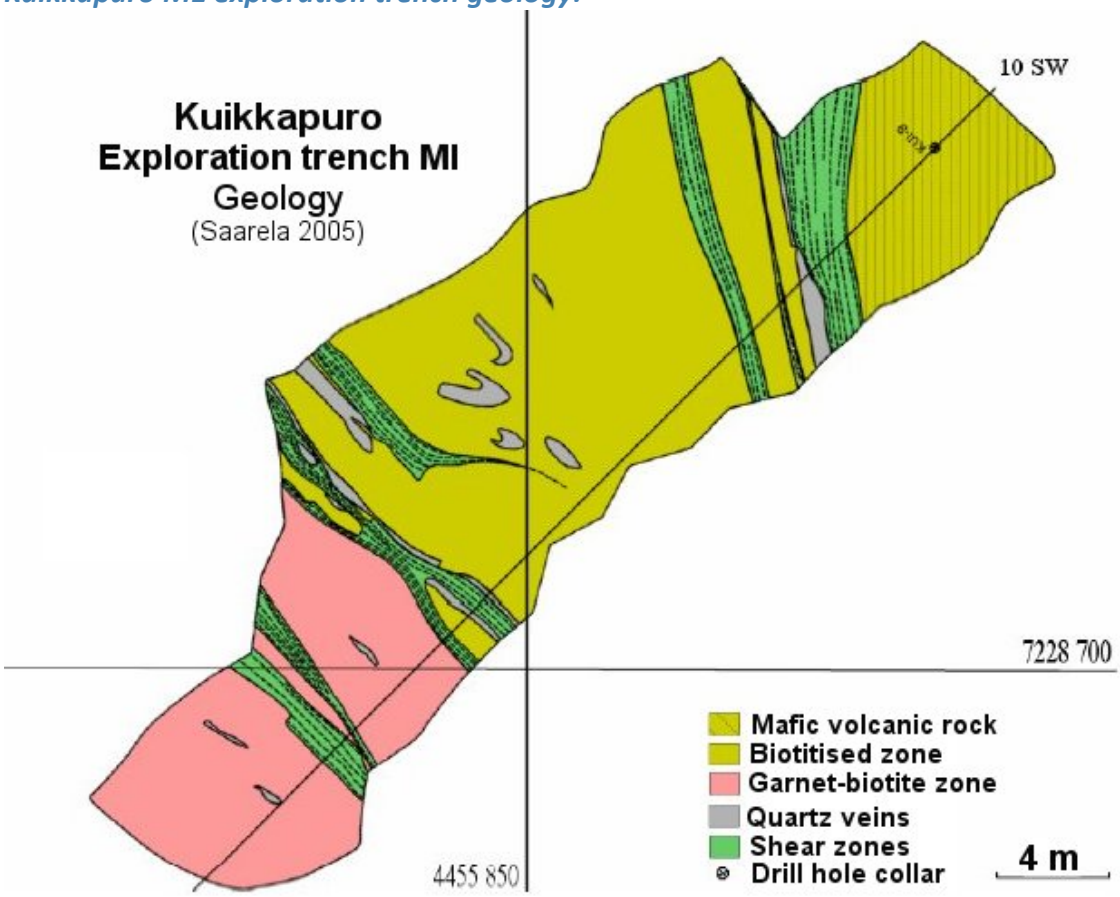
Kuikkapuro exploration trench M2:



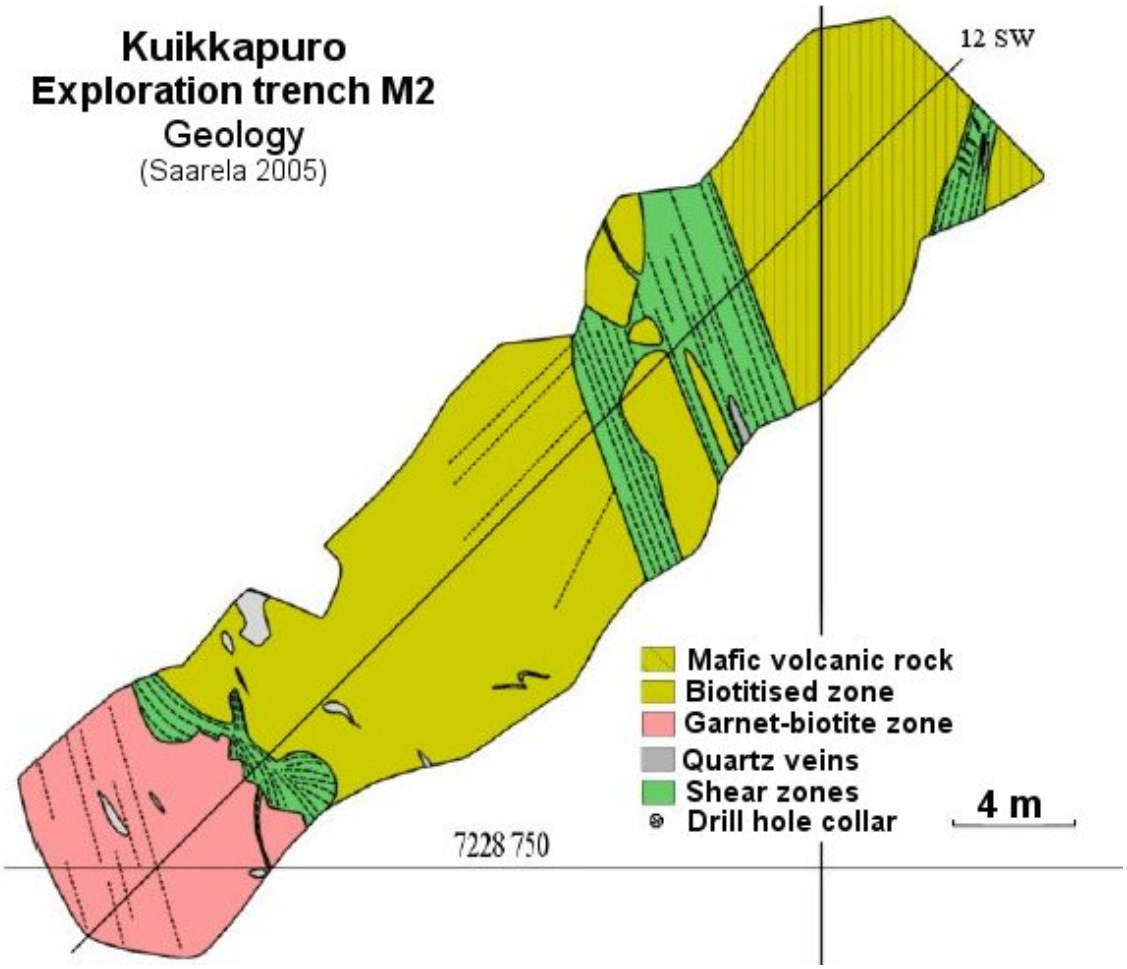
Kuikkapuro unaltered host rock:

Kuikkapuro: unaltered mafic host rock. From Pietikäinen et al. (2001)

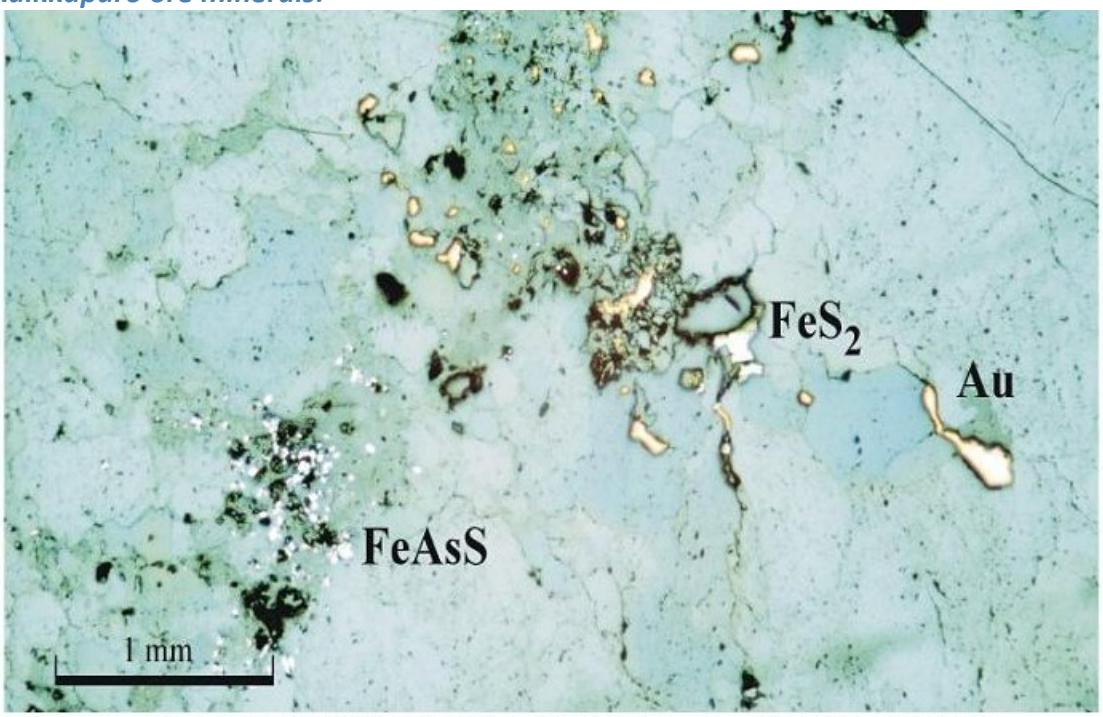
Kuikkapuro M1 exploration trench geology:



Kuikkapuro M2 exploration trench geology:



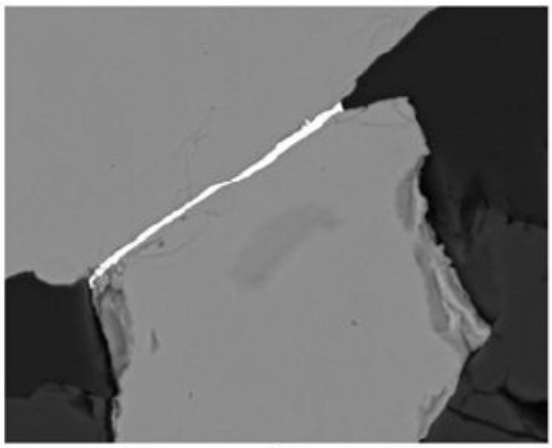
Kuikkapuro ore minerals:



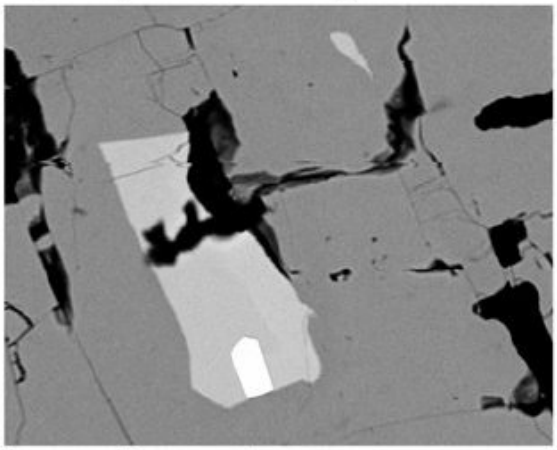
Gold (Au), arsenopyrite (FeAsS) and pyrite (FeS2) in quartz vein, R361/24.20, Kuikkapuro.
Note that gold occurs as metallic grains separate from arsenides and sulphides.
From Pietikäinen et al. (2001).

Kuikkapuro: siting of gold:

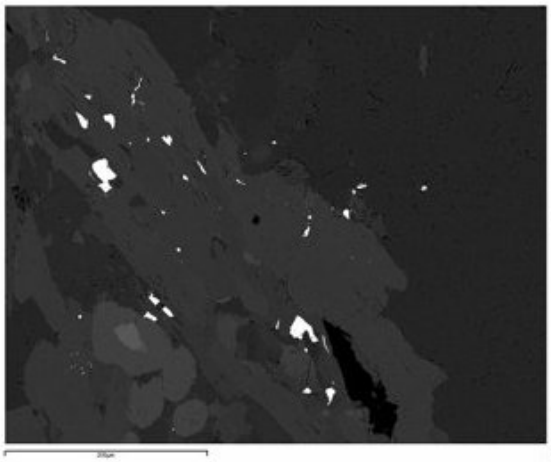
Siting of gold at Kuikkapuro (Saarela 2005)



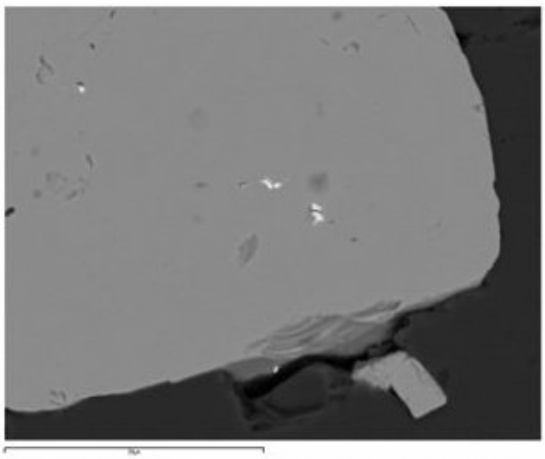
Gold in a fracture in arsenopyrite.
Scale bar 20 μm.



Gold in löllingite, all surrounded by arsenopyrite.
Scale bar 30 μm.

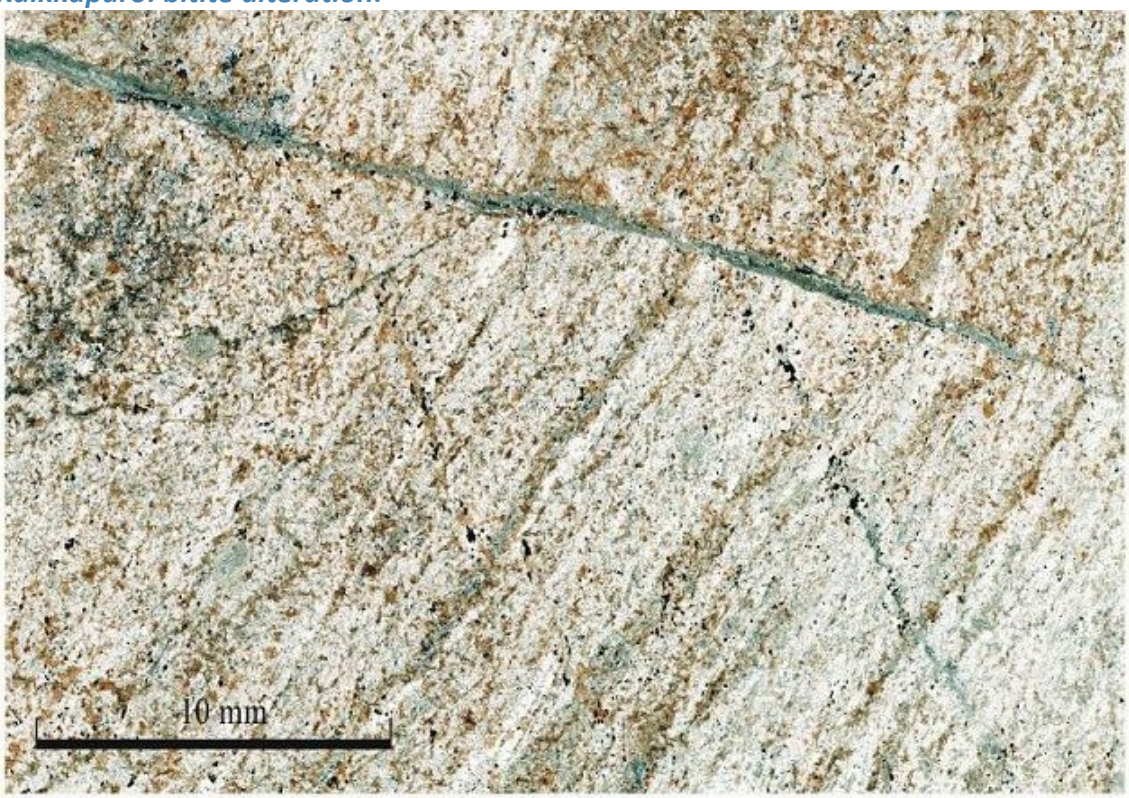


Gold with amphibole and quartz.
Scale bar 100 μm.



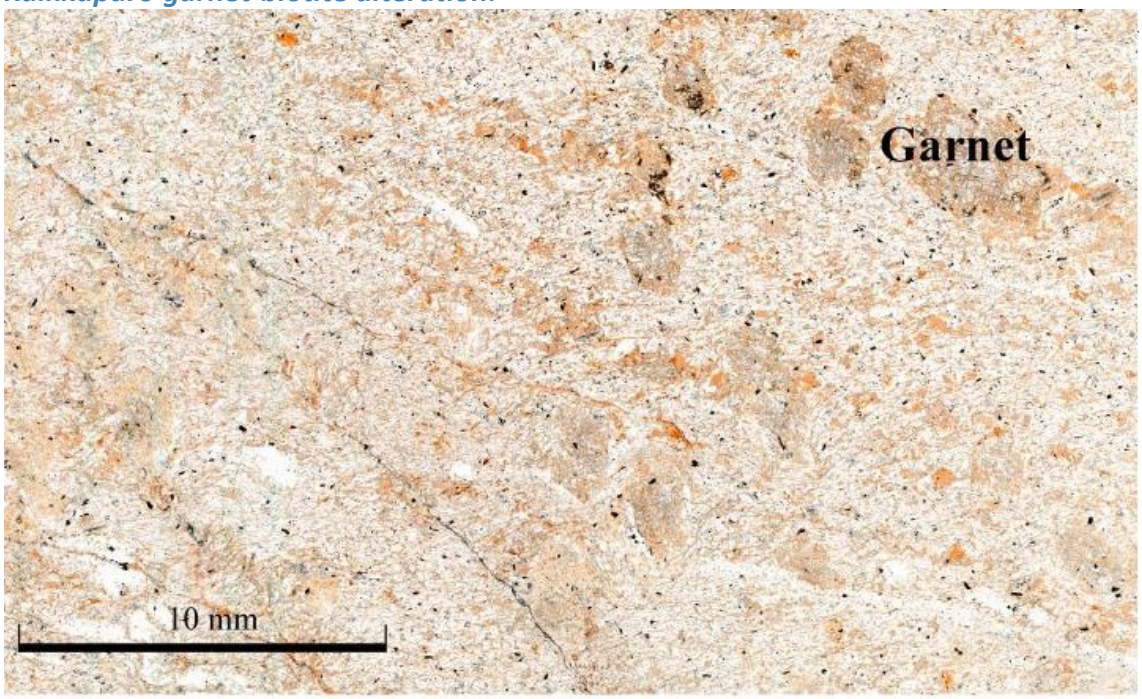
Silver-gold telluride grains in arsenopyrite.
Scale bar 30 μm.

Kuikkapuro: bitite alteration:



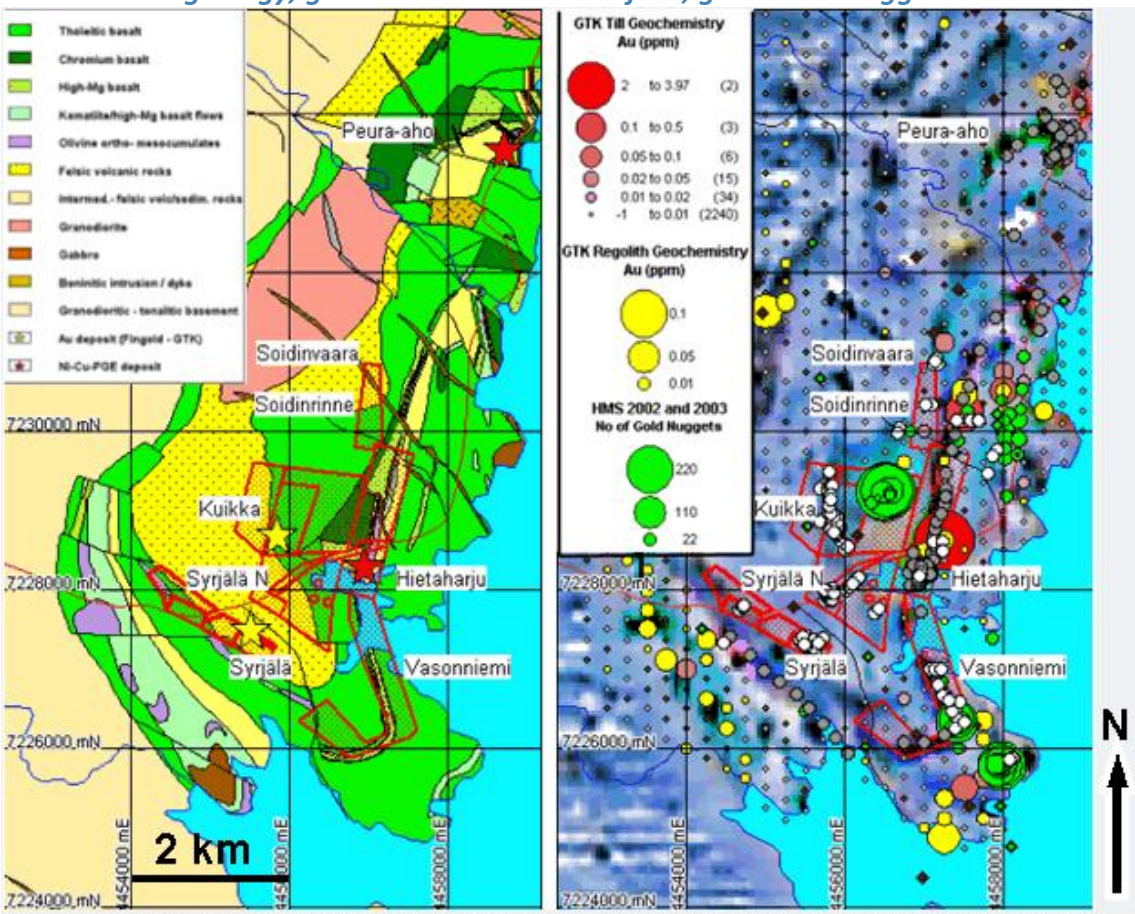
Photomicrograph of biotite alteration zone, R361/16.00m, at Kuikkapuro, Suomussalmi.
From Pietikäinen et al. (2001).

Kuikkapuro garnet-biotite alteration:



Photomicrograph of garnet-biotite alteration zone towards the west of the Kuikkapuro deposit.
From Pietikäinen et al. (2001).

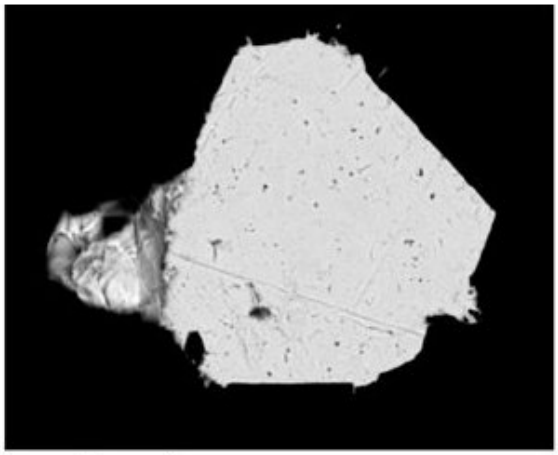
Kiannaniemi: geology, gold at till-bedrock interface, gold micro nuggets in till:



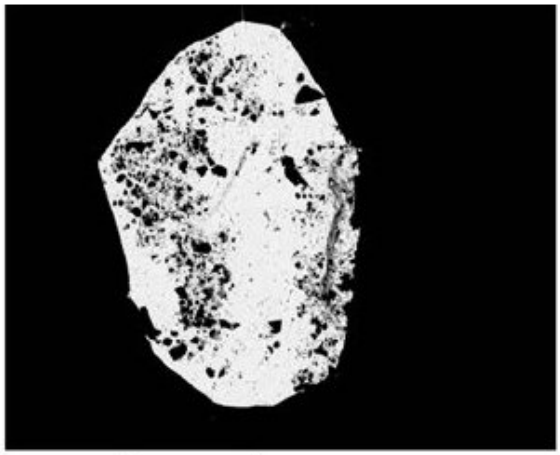
Kiannanniemi area: geology on left, till and regolith geochemistry and gold nuggets in till on right. Three known gold occurences in the area are: Syrjälä, Vasoniemi, and Kuikkapuro (= Kuikka in the map). From Goode 2004.

Kuikkapuro siting of gold 2:

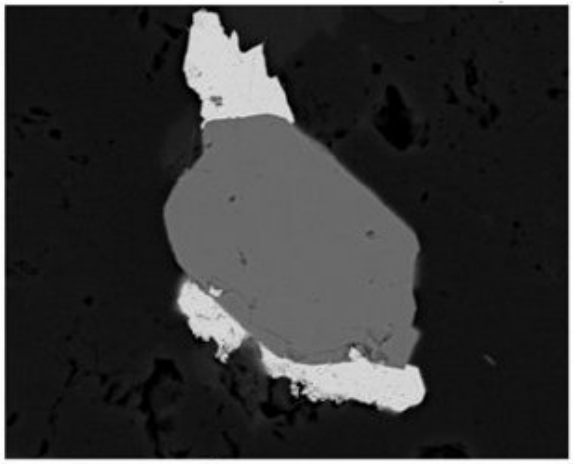
Siting of gold at Kuikkapuro (Saarela 2005)



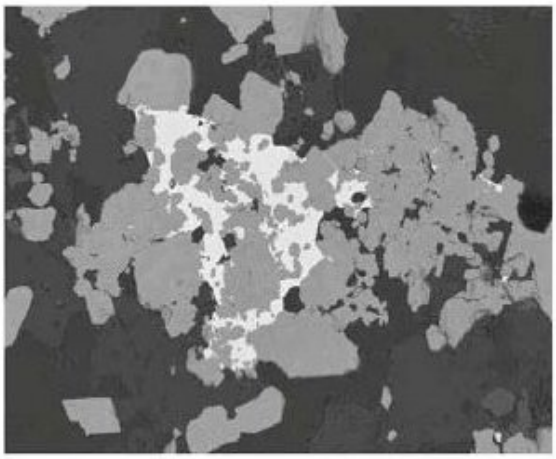
Gold grain in quartz vein. Scale bar 10 μm.



Gold grain in quartz vein. Scale bar 30 μm.

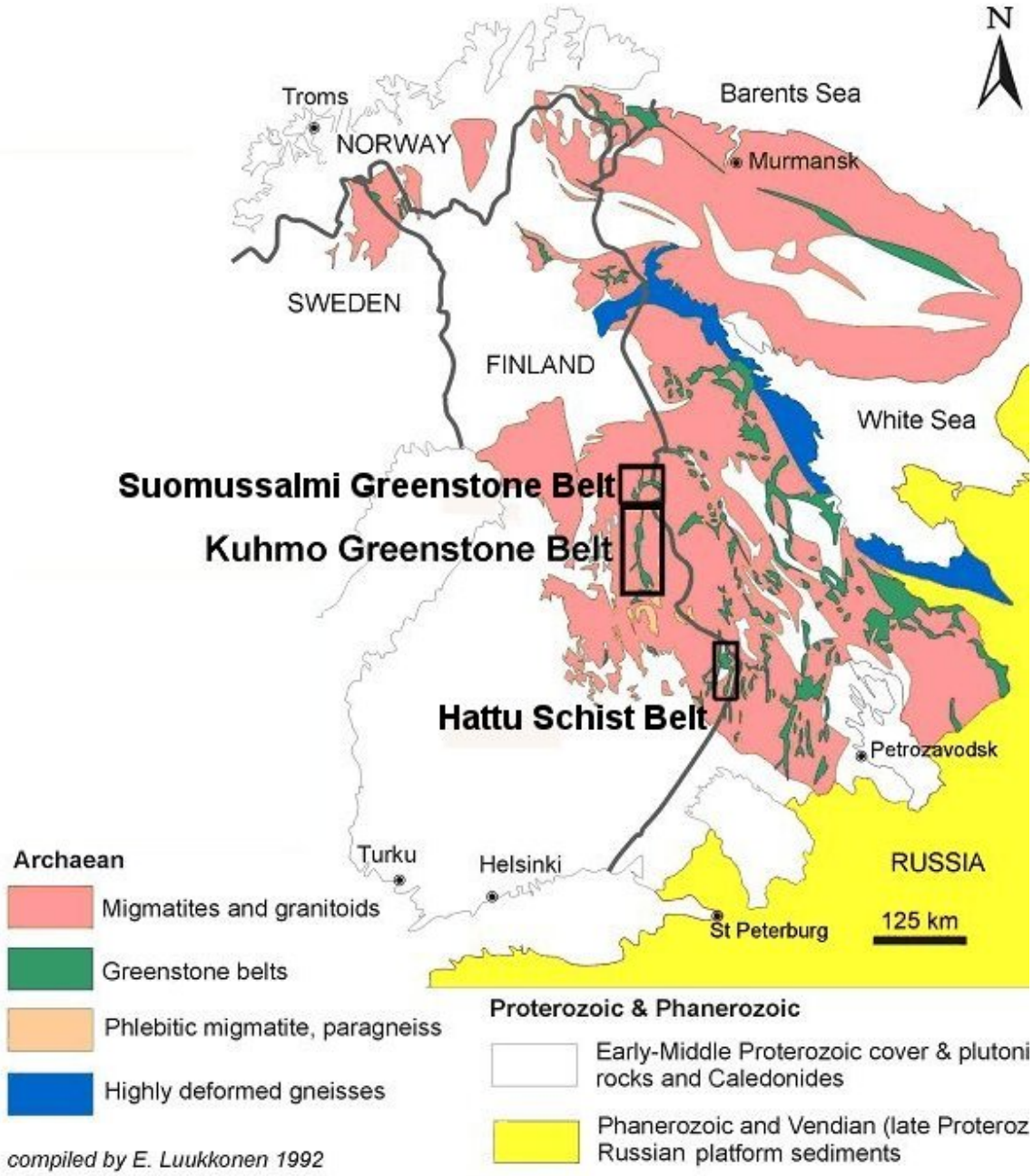


Gold around an arsenopyrite grain. Scale bar 20 μm.



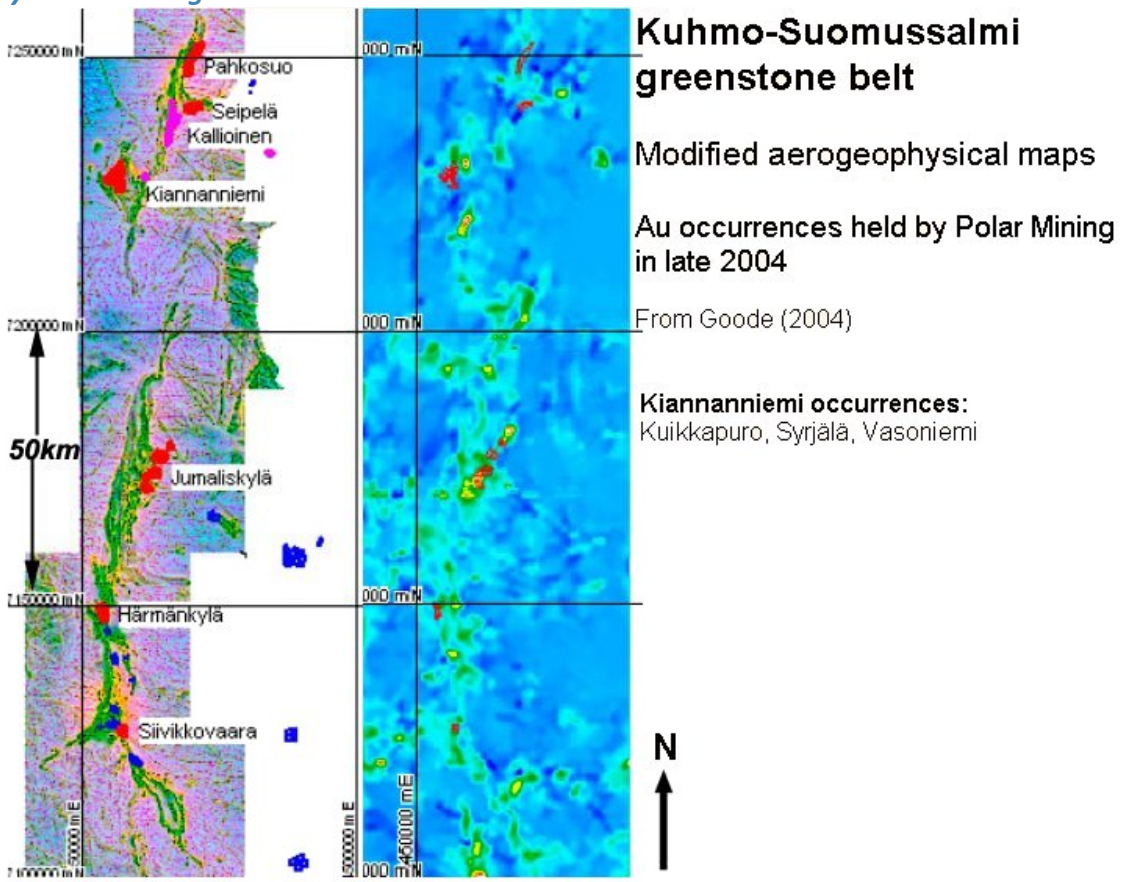
Gold forming a network with arsenopyrite. Scale bar 100 μm.

East Finland greenstone belts in the Archaean of Fennoscandia:

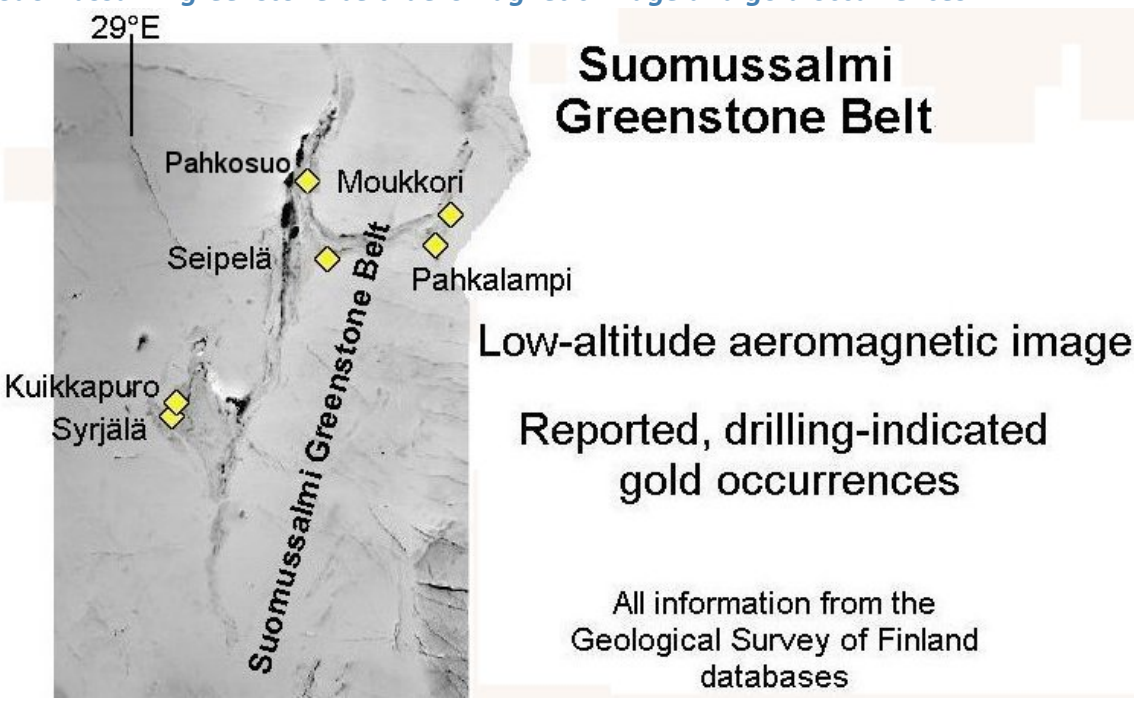


Kuhmo and Suomussalmi greenstone belts: processed aerogeophysics and tenements held

by Polar Mining in 2004:

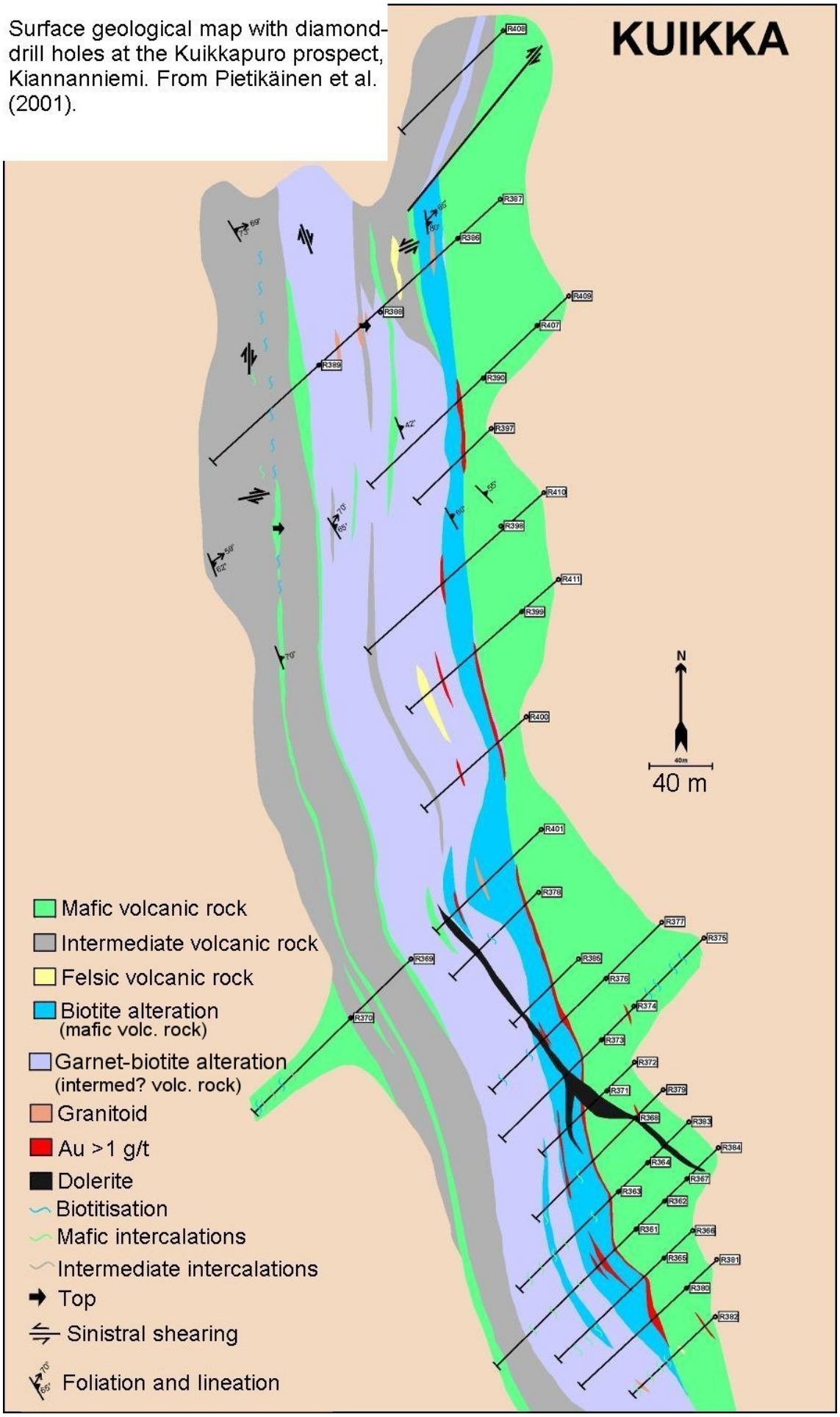


Suomussalmi greenstone belt: aeromagnetic image and gold occurrences:

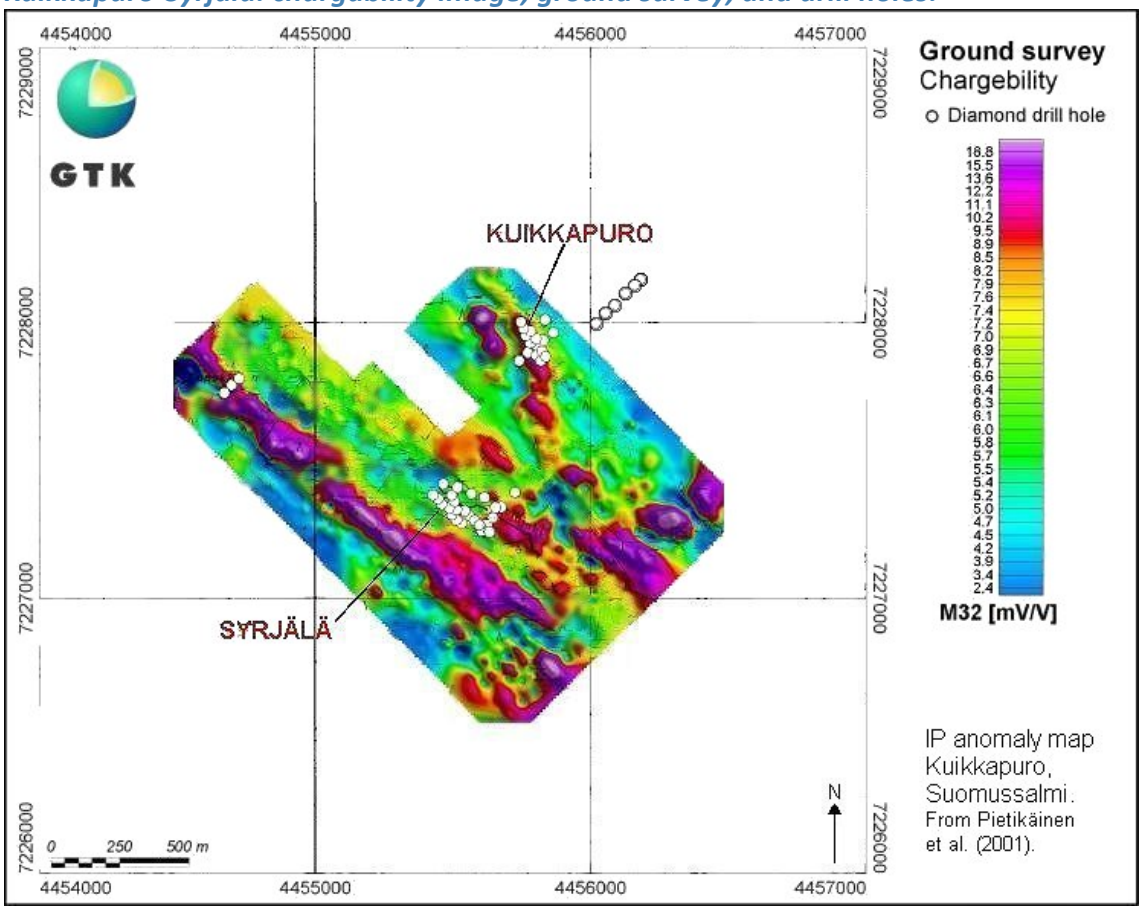


Kuikkapuro: geology map and drilling:

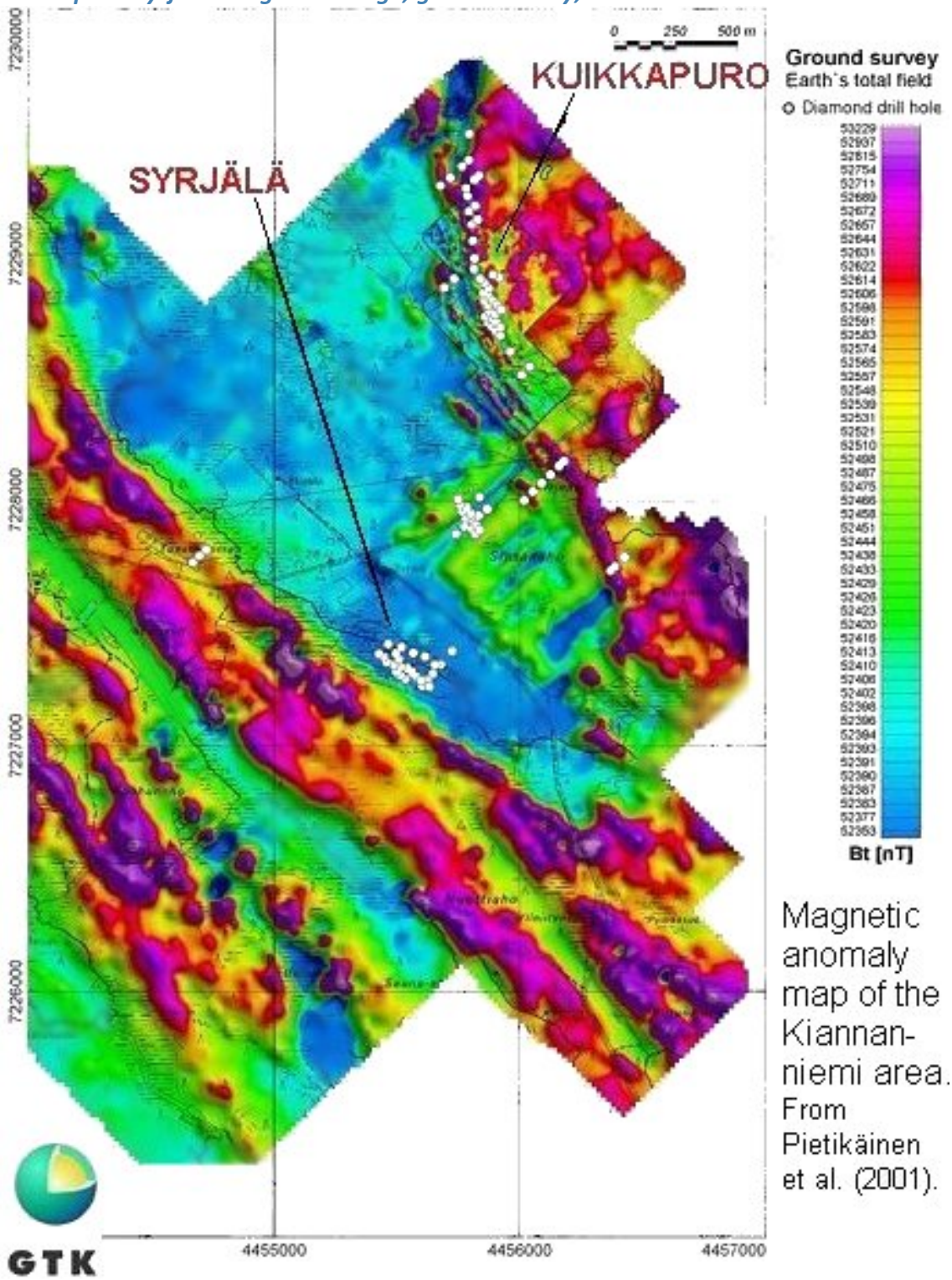
Surface geological map with diamond-drill holes at the Kuikkapuro prospect, Kiannanniemi. From Pietikäinen et al. (2001).



Kuikkapuro-Syrjälä: chargability image, ground survey, and drill holes:

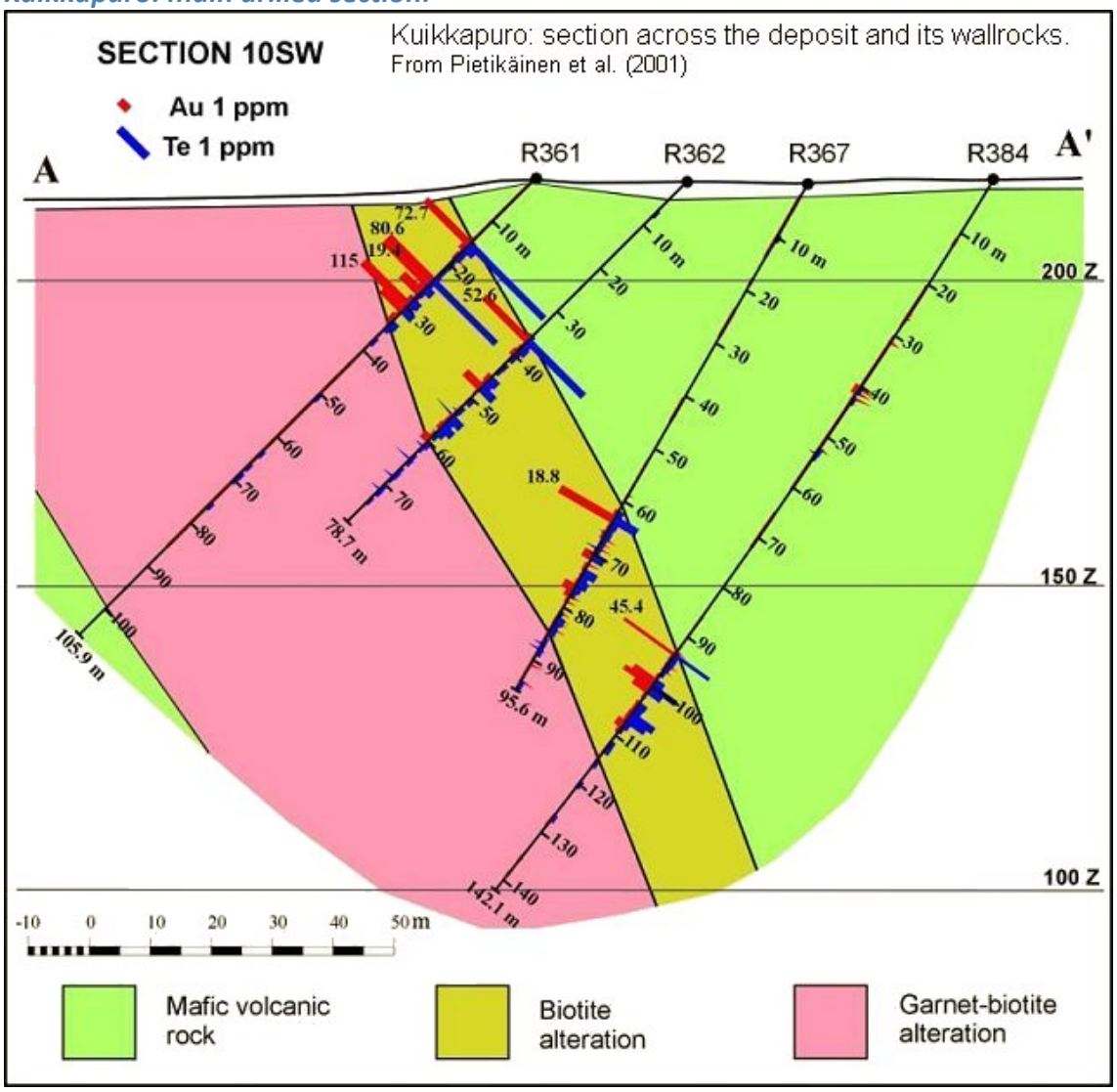


Kuikkapuro-Syrjälä: magnetic image, ground survey, and drill holes:



Magnetic anomaly map of the Kiannan-niemi area. From Pietikäinen et al. (2001).

Kuikkapuro: main drilled section:



REFERENCES

1. Goode, K. 2004. Dragon Mining NL (DRA) - Bringing Scandinavian Gold Mines into Production. 12 p. *http://en.gtk.fi/export/sites/en/informationservices/explorationnews/2004/k_goode_report.pdf*

2. Halkoaho, T. & Pietikäinen, K. 1999. Ni and Au prospects of the Kuhmo and Suomussalmi greenstone belts. In: H. Papunen & P. Eilu (eds.) Geodynamic Evolution and Metallogeny of the Central Lapland, Kuhmo and Suomussalmi Greenstone Belts, Finland. University of Turku, Inst. Geol. Mineral. Publ. 42, 60-63.

3. Heino, T. 2000. Mineral Resource Assessment of the Kuikkapuro 1 (mine reg. N:o 6748/1), Kuikkapuro 2 (N:o 6841/1), Kuikkapuro 3 (N:o 6880/1), Kuikkapuro 4 (N:o 6880/2) and Kuikkapuro 5 (N:o 6912/1) gold mineralizations. Geological Survey of Finland, Report CM06/4511/2000/1.

4. Kolar Gold 2016. Stock exchange release 13 October 2016. Online at https://www.trustnet.com/Investments/Article.aspx?id=201610130700084062M

5. Lionsgold 2018. Median release 9 Nov 2018. Accessible at: http://en.gtk.fi/export/sites/en/informationservices/explorationnews/2018/2018_11_09_Lionsgold_mining_and_exp

6. Luukkonen, E. 1992. Late Archaean and Early Proterozoic structural evolution in the Kuhmo-Suomussalmi Terrain, eastern Finland. Annales Universitatis Turkuensis. Ser. A. II 78, 1-37.

7. Luukkonen, E., Halkoaho, T., Hartikainen, A., Heino, T., Niskanen, M., Pietikäinen, K. & Tenhola, M. 2002. Itä-Suomen arkeeiset alueet -hankkeen (12201 ja 210 5000) toiminta vuosina 1992-2001 Suomussalmen, Hyrynsalmen, Kuhmon, Nurmeksen, Rautavaaran, Valtimon, Lieksan, Ilomantsin, Kiihtelysvaaran, Enon, Kontiolahden, Tohmajärven ja Tuupovaaran alueella. Geological Survey of Finland, Report M19/4513/2002/1. 265 p. (in Finnish) *http://tupa.gtk.fi/raportti/arkisto/m19_4513_2002_1.pdf*

8. Ojala, J. 2006. Personal communication 16 May 2006.

9. Papunen, H., Halkoaho, T., Liimatainen, J. & Luukkonen, E. 2001. Metallogeny of the Archaean Tipasjärvi-Kuhmo-Suomussalmi greenstone belt, Finland. AGSO - Geoscience Australia, Record 2001/37, 456-458.

10. Pietikäinen, K., Hartikainen, A., Niskanen, M. & Tenhola, M. 2000. The gold prospects; Kuikka, Syrjälä N, Syrjälä S and Tupakkiloma in Kiannanniemi, Suomussalmi, Eastern Finland. *http://tupa.gtk.fi/raportti/valtaus/m06_4511_2000_1.pdf*

11. Poutiainen, M. & Luukkonen, E. 1994. The geology and fluid inclusion studies of some epigenetic gold deposits in the Archean Kuhmo and Suomussalmi greenstone belts, eastern Finland. In: M. G. Izquierdo, A. M. C. Suarez, G. M. Guevara, D. Vanko & G. J. C. Viaggio (eds) Fifth Biennial Pan-American Conference on Research on Fluid Inclusions, Cuernavaca, Morelos, Mexico, May 19-21, 1994. Abstracts, 77-78.

12. Saarela, P. 2003. Kullan esiintymistä kontrolloivat rakennegeologiset tekijät Suomussalmen Kuikkapurolla. MSc thesis. Department of Geosciences, University of Oulu. 53 p. (in Finnish)

13. Sorjonen-Ward, P. & Luukkonen, E.J. 2005. Archean rocks. In: Precambrian Geology of Finland - Key to the Evolution of The Fennoscandian Shield. Elsevier Science B.V., Amsterdam, 19-99.