Kivisuo

Alternative Names: Teponsärkkä
Occurence type: prospect

Commodity	Rank	Total measure	Total production	Total resource	Importance
gold	1	NA	NA	NA	NA

Easting EUREF: 713444,004
Northing EUREF: 6971475,382
Easting YKJ: 3713702
Northing YKJ: 6974396

Discovery year: 1986
Province: Ilomantsi (Au)
District: Hattu (Au)
References: 7, 9, 13

Mineral deposit type

Group: Metallogenic deposit
Main type: Orogenic (metamorphic hydrothermal)
Comments: Precipitation of gold by desulphidation of fluid and, possibly, by decomposition of Au-bisulphide, -thiosulphide and -telluride complexes of fluid due to cooling and/or changes in pH and fO2. Probably, gold precipitated just below 500°C with sulphides due to reaction between the mineralising fluid and wall-rock (chiefly by sulphidation). The formation of the present low-temperature Te and Bi minerals probably took place as subsolidus reactions with cooling temperature.
References: 5, 9

Dimension

Expression: exposed
Form: discordant
Shape: NA
Length (m): NA
Width (m): NA
Thickness (m): NA
Depth (m): NA
Area (ha): NA
Dip azim: 115
Dip: 80
Plunge azim: NA
Plunge dip: NA
Orientation method: NA
Dimension comments: Subvertical lodes open along strike and at a shallow depth

Holder history

Current holder: Endomines Oy
Years: 2021-2024
Holding type: Exploration permit

Previous holders:

Company	Years	Holding type	Comments
Geological Survey of Finland	NA	NA	NA

Endomines Oy	2012	Reservation	NA
Endomines Oy	2004-2011	Claim (old law)	NA
Polar Mining Oy	2003-2006	NA	NA

EXPLORATION ACTIVITY

Endomines Oy

Years	Activity type	Geologist	Exploration result	Ref
2015-2015	detailed geochemistry	NA	NA	3
	Sampling the base of till, campaign started in March 2015			

2012-2014	core drilling	Jaakko Liikanen	mineralized zone identified	2
	2013: 18 diamond-drill holes			
	Intersections			
	HoleID	KIV-10		
	From-To	168-169		
	Length	1m		
	gold	5,3ppm		

2011-2011	detailed geophysics	Jaakko Liikanen	geophysical anomaly	
	Airborne low-altitude [VTEM] geophysical surveys were completed over the entire permit area			

Geological Survey of Finland

Years	Activity type	Geologist	Exploration result	Ref
1989-1994	excavation	Martti Damsten	NA	1, 4, 7, 9, 10

1989-1994	core drilling	Martti Damsten	NA	1, 4, 5, 7, 9, 10
	GTK: 13 diamond-drill holes, total 1763 m.			
	Intersections			
	HoleID	NA		
	From-To	NA		
	Length	4,9m		
	gold	4ppm		
	HoleID	NA		
	From-To	NA		
	Length	2m		
	gold	4,4ppm		
	HoleID	NA		
	From-To	NA		
	Length	2m		
	gold	9,5ppm		

1989-1994	detailed geophysics	Martti Damsten	NA	9
	No response on magnetic, slingram or IP methods. Magnetic and electric methods do show the structural features of the area, including those which control gold mineralisation .			

1989-1989	regional geophysics	NA	key geological features	1, 7
	Low-altitude airborne magnetic, electromagnetic and radiomatric survey			

1989-1994	detailed geochemistry	Martti Damsten	geochemical anomaly	4, 7, 9, 11, 14

	Regional Au, As and B till anomaly, local Au, Te and Bi anomaly. Au content within the till anomaly is from tens of ppb to >1 ppm. Best combination for defining exploration targets: Au + Te + Bi - better than Au alone. A 0.5-1 km wide Au anomaly in till along the western-southwestern contact of the Kuittila tonalite.

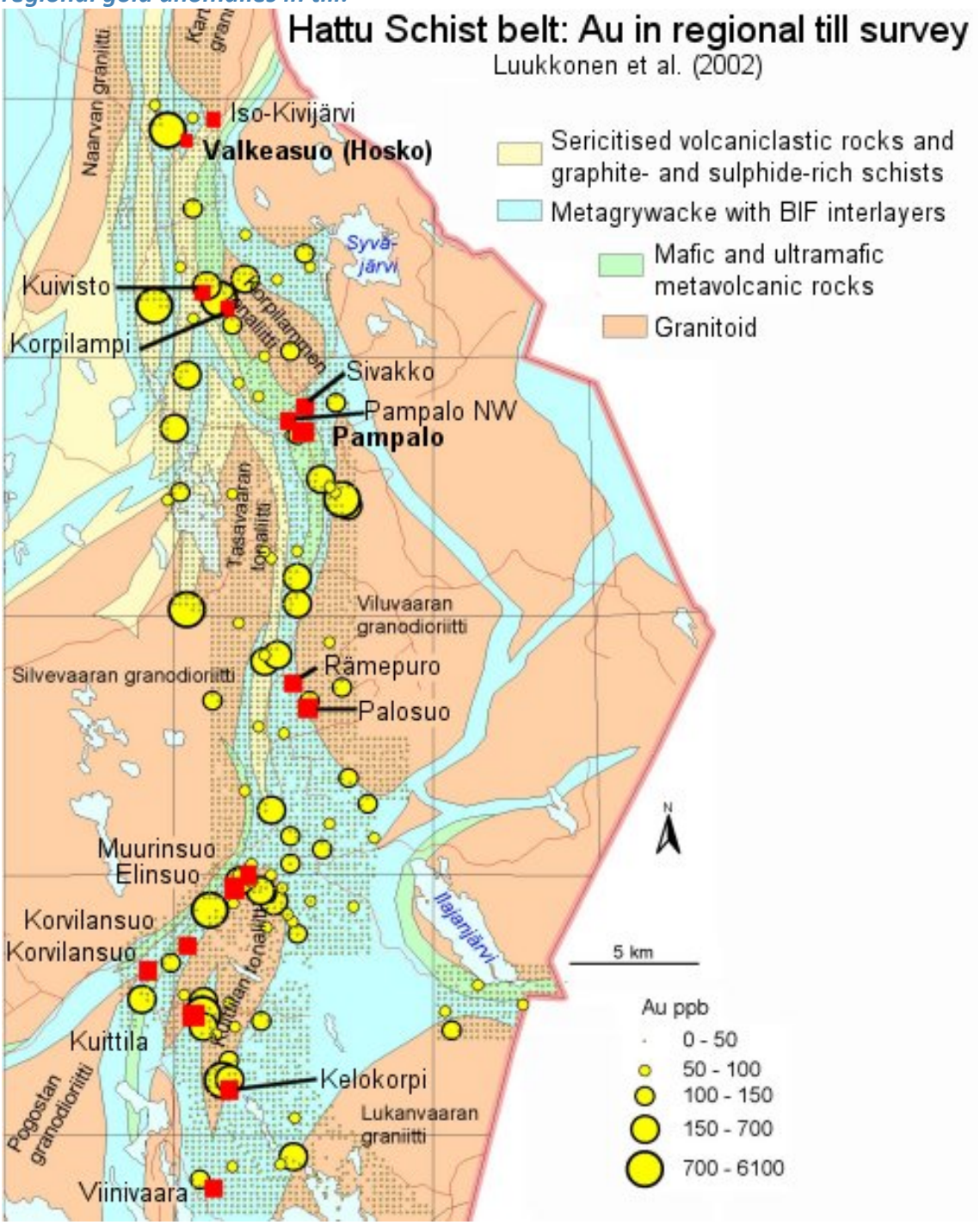
1989-1994	detailed geology	Martti Damsten	NA	1, 4, 7, 9, 10

1983-1989	regional geochemistry	Aimo Hartikainen	geochemical anomaly	
	Greenschist belt-wide till-geochemical survey with 16 sampling sites per one sq.km			

1982-1982	regional geochemistry	Aimo Hartikainen	geochemical anomaly	4, 7
	Country-wide till-geochemical survey			

Figures

regional gold anomalies in till:



GEOLOGY

Host rock: Mica schist, Mafic tuff, Quartz vein, Andesite
Wall rock: Tonalite, Porphyry

Mica schist (Host rock)

Rock type: Host rock
Proportion: major
Grain size: NA
Color: NA
References: 5, 6, 8, 9, 11, 12, 14
Comments: The mica schists of volcano-sedimentary origin are interbedded with mafic metatuffites and intruded by felsic porphyry dikes. Lodes formed by dissemination and quartz-tourmaline veins. S and B isotopes suggest the metasedimentary rocks being the main source for gold. Cu-isotopes suggest local sources => not much of Cu mobility in the Hattu belt Au systems? B isotopes suggest magmatic source for the early Mo-W±Au mineralisation

Ore minerals:

Mineral	Proportion	Mineral texture
Arsenopyrite	minor	
Bismuth	minor	
Chalcopyrite	minor	
Gold	minor	
	Disseminated in host rocks and in quartz-tourmaline veins. Gold occurs intergrown with tellurides, arsenopyrite and pyrrhotite in silicate matrix and, in the mafic metavolcanic rocks, the tellurides and arsenopyrite are associated with sulphides and ilmenite. Fineness 86% Au, 12% Ag (1 sample).	
Hedleyite	minor	
Ilmenite	minor	
Mackinawite	minor	
Marcasite	minor	
Molybdenite	minor	
Pentlandite	minor	
Pyrite	major	
Pyrrhotite	major	
Pyrrhotite	major	
Rutile	minor	
Sphalerite	minor	
Tsumebite	minor	

Other minerals:

Mineral	Proportion	Mineral texture
Albite	present	
Biotite	present	
Calcite	present	
Chlorite	present	Alteration product
Hornblende	present	Alteration product
K-Feldspar	present	
Muscovite	present	
Quartz	present	
Scheelite	present	
Siderite	present	

Titanite	present
Tourmaline	present

Structures
Folded
Comments: Sorjonen-Ward et al. (2015): The mineralised zone coincides with an area where foliation and lithic layering dips are less steep than in most of the Hattu belt, at 55-70°, and fold axes plunge moderately northward throughout the zone.

Textures
Granoblastic

Alteration:	Distribution:	Degree:	Relation to mineralization:
tourmalinisation	Veins	Weak	NA
biotite alteration	Disseminated	Moderate	Syn
sericitic alteration	Disseminated	Moderate	Syn

Metamorphic description:

Type:	Facies:	Degree:	Relation to mineralization:	Min P- Max P (kbar)	MIn T- Max T (°C)
Regional	amphibolite metamorphic facies	medium metamorphic grade	NA		-550
Comments: Progressive regional metamorphism on ca. 2750-2700 Ma, apparently peaked soon after gold mineralisation, at a temperature of about 550±50°C. Thermal peak was synchronous or outlasted deformation. A relatively strong, but unevenly distributed Palaeoproterozoic overprint; Plagioclase-quartz-biotite. Molnar et al. (2016): Regional metamorphic peak at ca. 2.70 Ga.					

Geological age:

Geological era:	Max age - Minage (Ma):	Inferred age (Ma):	Age of mineralization:		
Neoarchean (2800-2500 Ma)	2693-2708		Y		
Comments: Mineralization is either pre-peak metamorphic and formed under greenschist-facies conditions, or syn-peak metamorphic.					
Neoarchean (2800-2500 Ma)	2708-2780	2744	N		
Comments: Pre-gold stuff.					
Radiometric age:	**Method:**	**Age:**	**Error (Ma):**	**Mineral:**	**Reference:**
	U-Pb	2708		Titanite	9
	Re-Os	2780	8	Molybdenite	9, 15

Mafic tuff (Host rock)

Rock type: Host rock
Proportion: minor
Grain size: NA
Color: NA
References: 5, 6, 9, 12

Comments: The mica schists of volcano-sedimentary origin are interbedded with mafic metatuffites and intruded by felsic porphyry dikes.

Textures
Granoblastic

Metamorphic description:

Type:	Facies:	Degree:	Relation to mineralization:	Min P- Max P (kbar)	MIn T- Max T (°C)
Regional	amphibolite metamorphic facies	medium metamorphic grade	NA		-550
Comments: Progressive regional metamorphism on ca. 2750-2700 Ma, apparently peaked soon after gold mineralisation, at a temperature of about 550±50°C. Thermal peak was synchronous or outlasted deformation. A relatively strong, but unevenly distributed Palaeoproterozoic overprint.					

Geological age:

Geological era:	Max age - Minage (Ma):	Inferred age (Ma):	Age of mineralization:
Neoarchean (2800-2500 Ma)	2726-2754		N

Quartz vein (Host rock)

Rock type: Host rock
Proportion: minor
Grain size: NA
Color: NA
References: 5, 9
Comments: Quartz-tourmaline veins

Other minerals:

Mineral	Proportion	Mineral texture
Quartz	major	
Tourmaline	present	

Andesite (Host rock)

Rock type: Host rock
Proportion: minor
Grain size: NA
Color: NA
References: 1, 5, 6, 9, 12

Metamorphic description:

Type:	Facies:	Degree:	Relation to mineralization:	Min P- Max P (kbar)	MIn T- Max T (°C)
Regional	amphibolite metamorphic facies	medium metamorphic grade	NA		-550
Comments: Progressive regional metamorphism on ca. 2750-2700 Ma, apparently peaked soon after gold mineralisation, at a temperature of about 550±50°C. Thermal peak was synchronous or outlasted deformation. A relatively strong, but unevenly distributed Palaeoproterozoic overprint.					

Geological age:

Geological era:	Max age - Minage (Ma):	Inferred age (Ma):	Age of mineralization:
Neoarchean (2800-2500 Ma)	2726-2754		N

Tonalite (Wall rock)

Rock type: Wall rock
References: 12

Metamorphic description:

Type:	Facies:	Degree:	Relation to mineralization:	Min P- Max P (kbar)	MIn T- Max T (°C)
Regional	amphibolite metamorphic facies	medium metamorphic grade			-550

Geological age:

Geological era:	Max age - Minage (Ma):	Inferred age (Ma):	Age of mineralization:		
Neoarchean (2800-2500 Ma)	2747-2747	2747	N		
Comments: Non-mineralised tonalite intrusion					
Radiometric age:	**Method:**	**Age:**	**Error (Ma):**	**Mineral:**	**Reference:**
	U-Pb	2747	6	Zircon	12

Porphyry (Wall rock)

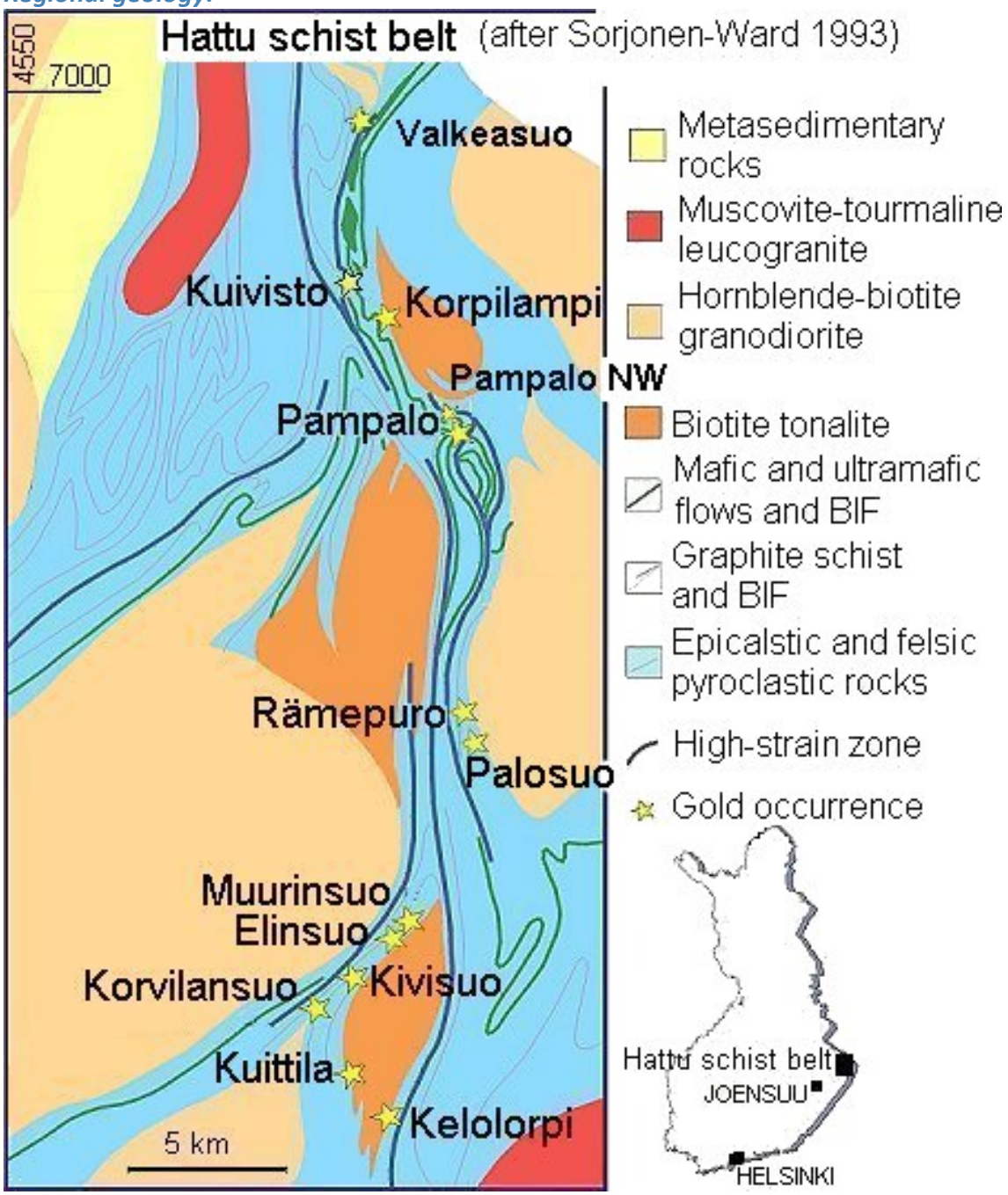
Rock type: Wall rock
References: 4, 9
Comments: Unmineralised

Metamorphic description:

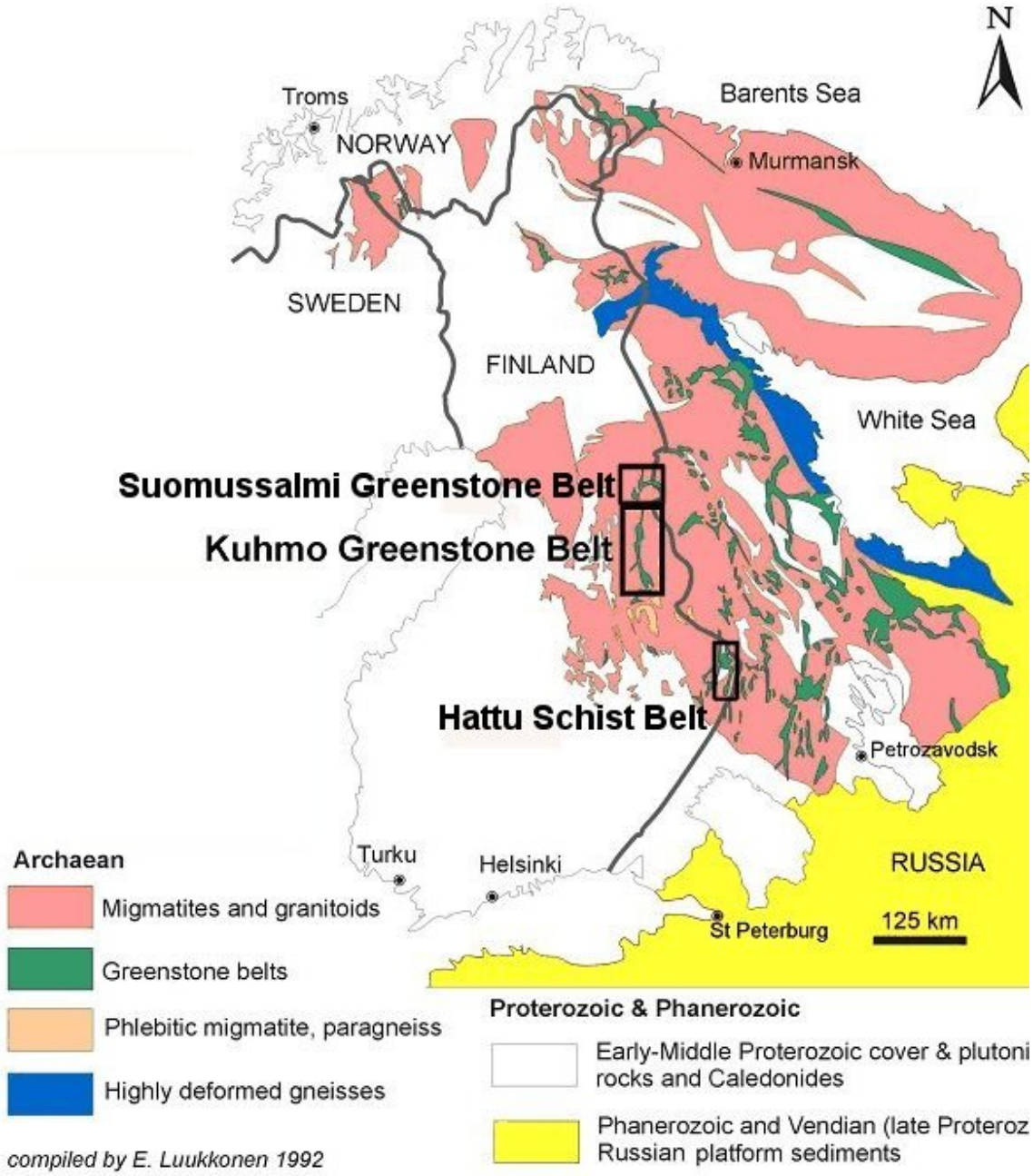
Type:	Facies:	Degree:	Relation to mineralization:	Min P- Max P (kbar)	MIn T- Max T (°C)
Regional	amphibolite metamorphic facies	medium metamorphic grade			

Figures

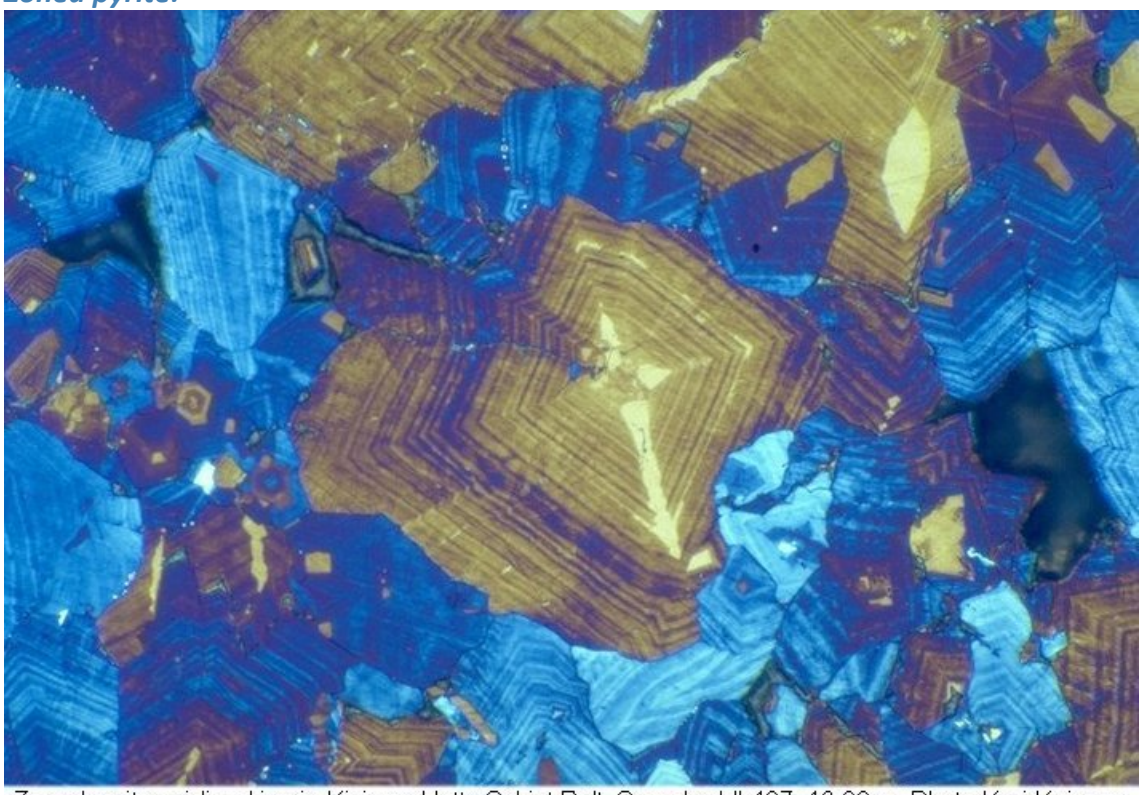
Regional geology:



Location in the Carelian craton:

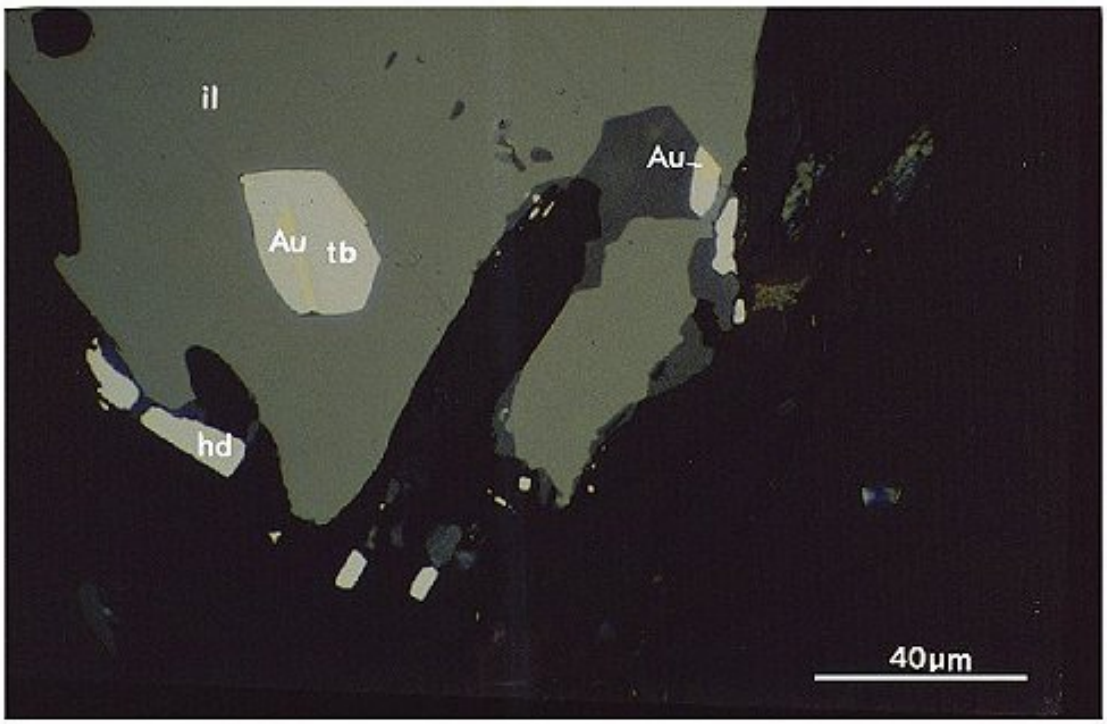


Zoned pyrite:



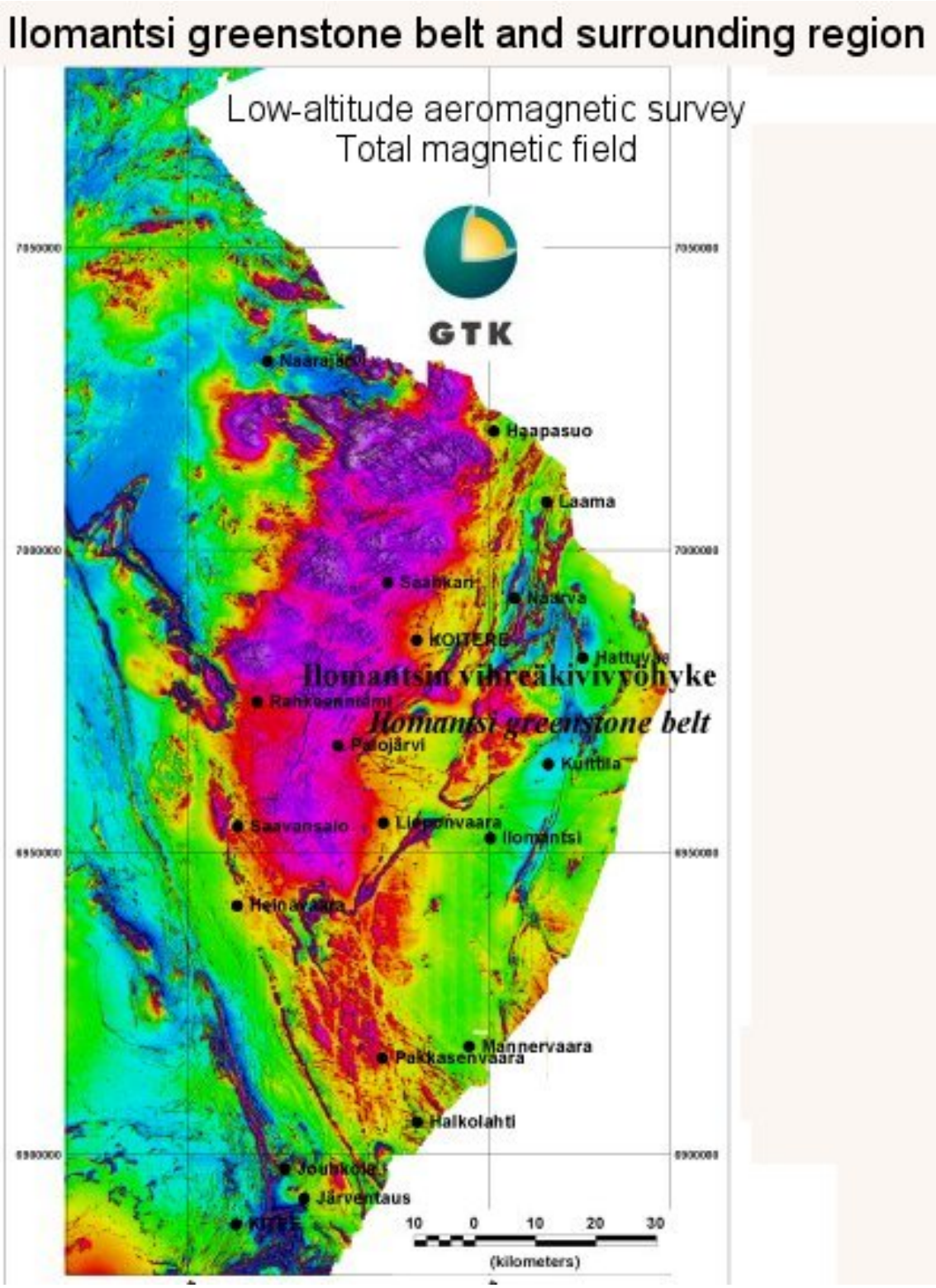
Zoned pyrite oxidised in air. Kivisuo, Hattu Schist Belt. Sample ddh467, 13.90 m. Photo Kari Kojonen.

Gold, tellurides, ilmenite:



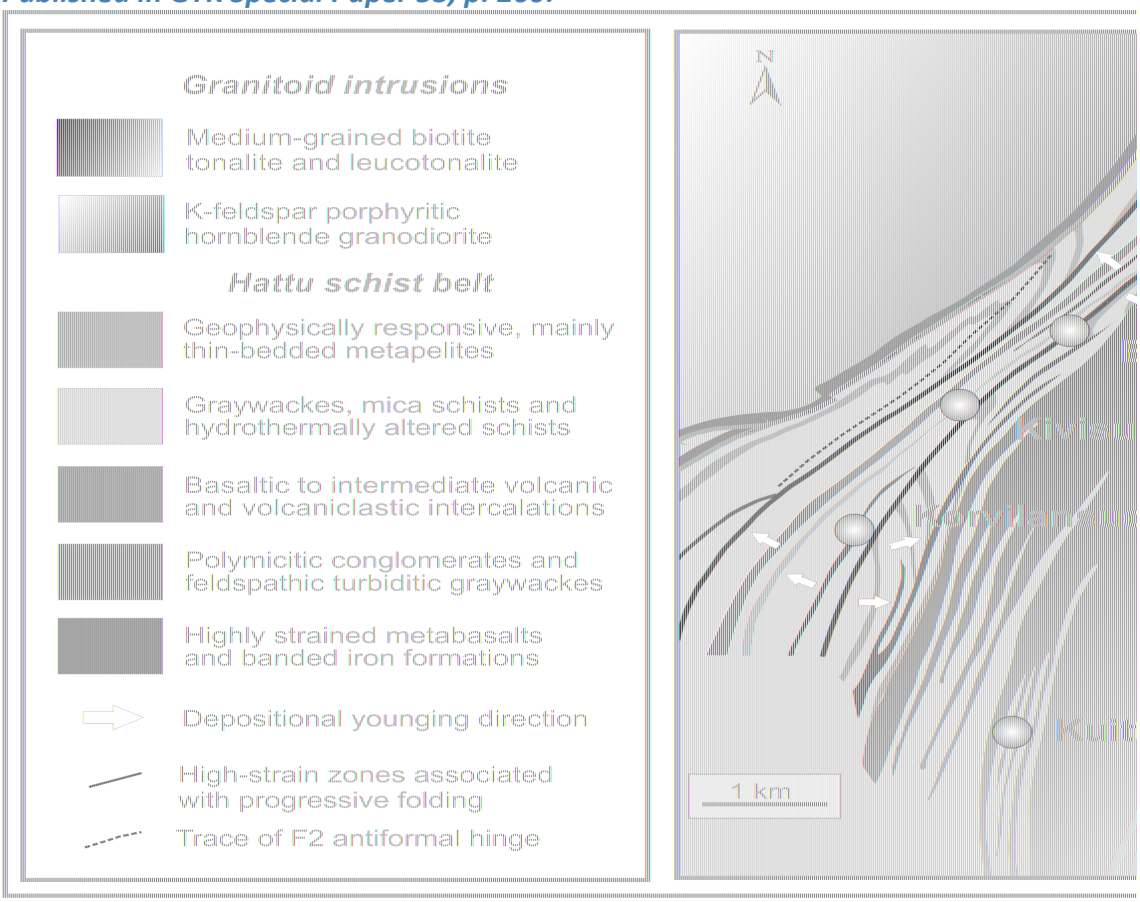
Ilmenite (il) with inclusions of native gold (Au) and tellurobismuthite (tb) intergrown with hedleyite (hd), host rock amphibolite, Kivisuo, Ilomantsi. Ddh 348, depth 54.30 m. From Kojonen et al. (1993).

Regional low-altitude airborne magnetic image:



Kuttila-Muurinsuo area, Ilomantsi greenstone belt. Image by Peter Sorjonen-Ward, 2011.

Published in GTK Special Paper 53, p. 260:



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