Meurastuksenaho

Alternative Names: Mutka-Aho 3
Occurence type: deposit

Commodity	Rank	Total measure	Total production	Total resource	Importance
gold	1	2,05 t	NA	2,05 t	Small deposit
cobalt	3	1784 t	NA	1784 t	Small deposit
copper	3	NA	NA	NA	NA
molybdenum	4	NA	NA	NA	NA
silver	4	NA	NA	NA	NA
rare earth element	4	NA	NA	NA	NA

Easting EUREF: 593755
Northing EUREF: 7343820
Easting YKJ: 3593965
Northing YKJ: 7346892

Discovery year: 1984
Discovered by: Geological Survey of Finland
Province: Kuusamo-Kuolajärvi (Co, Au)
District: Kuusamo (Co, Au)
Comments: Initial indication was a weak aeromagnetic and electromagnetic anomaly in a geologically "right" area. This showed to contain a distinct electromagnetic ground anomaly; the deposit was detected by trenching and drilling into the electromagnetic anomaly.
References: 8, 13, 17, 18, 21

Mineral deposit type

Group: Metallogenic deposit
Main type: Orogenic (metamorphic hydrothermal)
Sub type 1: Au-Co-Cu
Comments: The auriferous fluids were transported along deep, rift-tectonic faults up to the greenschist-metamorphic environment, concentrated on the antiform; the metals precipitated in structurally controlled sites close to impermeable dolerites and metavolcanic units or, rather, in the more competent sericite quartzite units between the more plastic mafic units.
References: 9, 11, 12, 13, 16, 19, 21

Dimension

Expression: exposed
Form: discordant
Shape: irregular
Length (m): 265
Width (m): 20
Thickness (m): NA
Depth (m): 245
Area (ha): NA
Dip azim: 135
Dip: 80
Plunge azim: NA
Plunge dip: NA
Orientation method: NA
Dimension comments: The occurrence is NE-trending, >220 m long (open to the NE and SW), 10-30 m wide, open at depth of 210 m, dips to the SE at 80-85°.

Holder history

Current holder: Latitude 66 Cobalt Oy
Years: 2018
Holding type: Mining concession (old law)

Previous holders:

Company	Years	Holding type	Comments
Kuusamo Gold Oy	2015-2018	Mining concession (old law)	NA
Dragon Mining Oy	2010-2015	Mining concession (old law)	NA
Polar Mining Oy	2003-2010	Mining concession (old law)	NA
Outokumpu Oy	1997-2003	Mining concession (old law)	NA
Outokumpu Oy	1992-1997	Claim (old law)	NA
Geological Survey of Finland	1983-1988	Claim (old law)	NA

EXPLORATION ACTIVITY

Dragon Mining Oy

Years	Activity type	Geologist	Exploration result	Ref
2011-2013	ore deposit evaluation	NA	NA	15
	Environmental assessment			

Outokumpu Oy

Years	Activity type	Geologist	Exploration result	Ref
1993-1994	core drilling	NA	NA	6
	25 diamond drill holes, in total 2426 m			

1992-1992	detailed geochemistry	NA	NA	

1990-1993	detailed geophysics	NA	NA	

Geological Survey of Finland

Years	Activity type	Geologist	Exploration result	Ref
1989-1989	feasibility study	Erkki Vanhanen	NA	1, 9, 11, 12, 13, 17, 20
	A preliminary feasibility study by GTK 1989			

1989-1989	regional geochemistry	NA	geochemical anomaly	
	Country-wide till-geochemical survey			

1984-1986	core drilling	Erkki Vanhanen.	mineral resource indicated	13, 17, 18, 20
	Core drilling (reconnaissance drilling): 12 diamond-drill holes, total 2163 m.			
	Intersections			
	HoleID	NA		
	From-To	NA		
	Length	4m		
	gold	5,5ppm		
	HoleID	NA		
	From-To	NA		
	Length	3m		
	gold	3,6ppm		
	HoleID	NA		
	From-To	NA		
	Length	2m		
	gold	5,4ppm		
	HoleID	NA		
	From-To	NA		

	Length	25m
	gold	1ppm
	silver	3ppm
	cobalt	3460ppm
	copper	3820ppm
	HoleID	NA
	From-To	NA
	Length	1m
	gold	70,3ppm
	HoleID	NA
	From-To	NA
	Length	1m
	gold	12,3ppm
	HoleID	NA
	From-To	NA
	Length	1m
	gold	9,9ppm
	HoleID	NA
	From-To	NA
	Length	1,5m
	gold	22ppm

1983-1987	detailed geophysics	Erkki Vanhanen	mineral occurrences	13
	A weak aeromagnetic anomaly which at ground also includes an electric anomaly.			

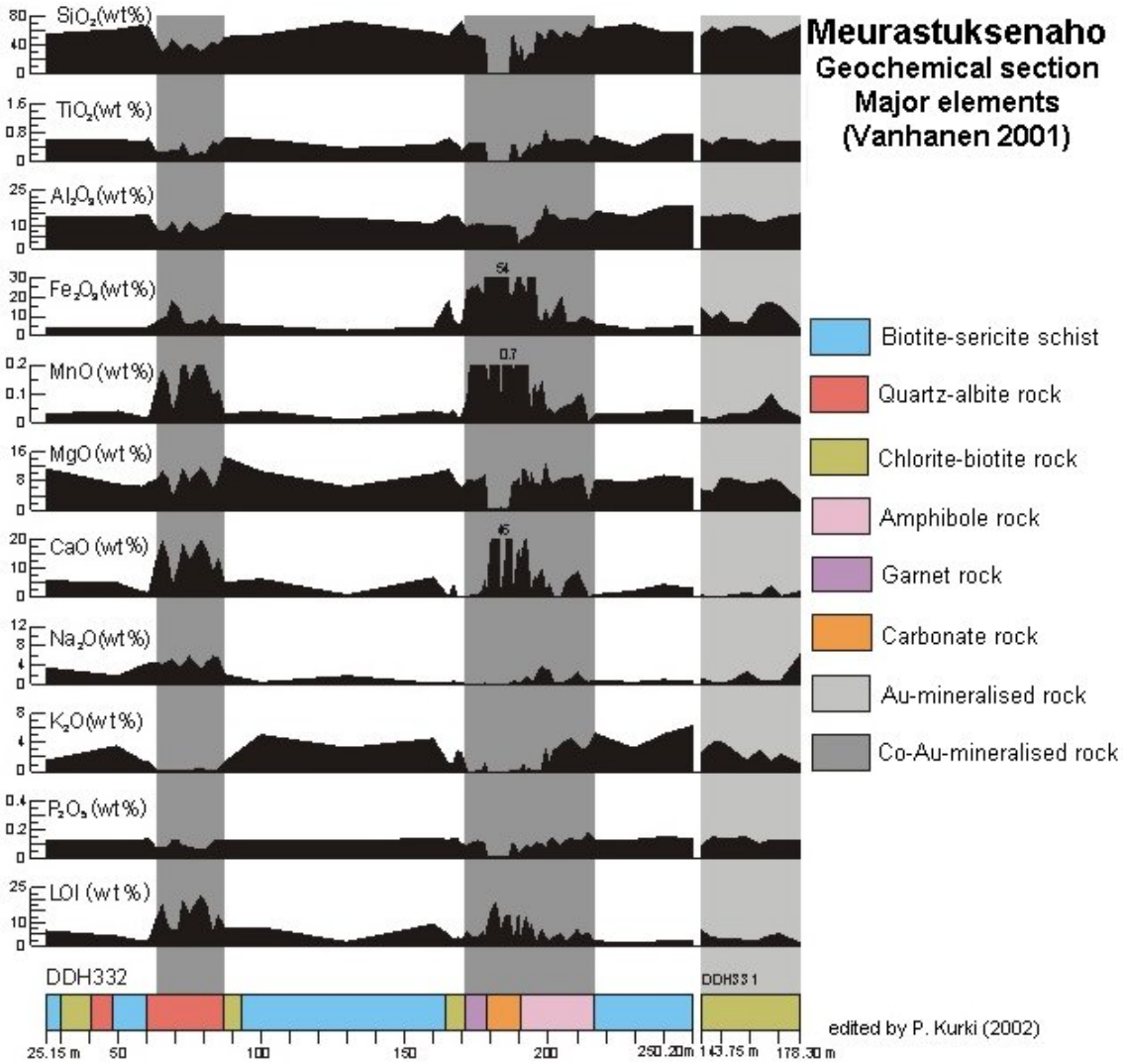
1982-1982	regional geophysics	NA	key geological features	1, 9, 11, 12, 13, 17, 20
	Low-altitude airborne magnetic, electromagnetic and radiometric survey. Initial indication was a weak aeromagnetic and -electric anomaly in a geologically "right" area, this showed to contain a distinct electric ground anomaly.			

Figures

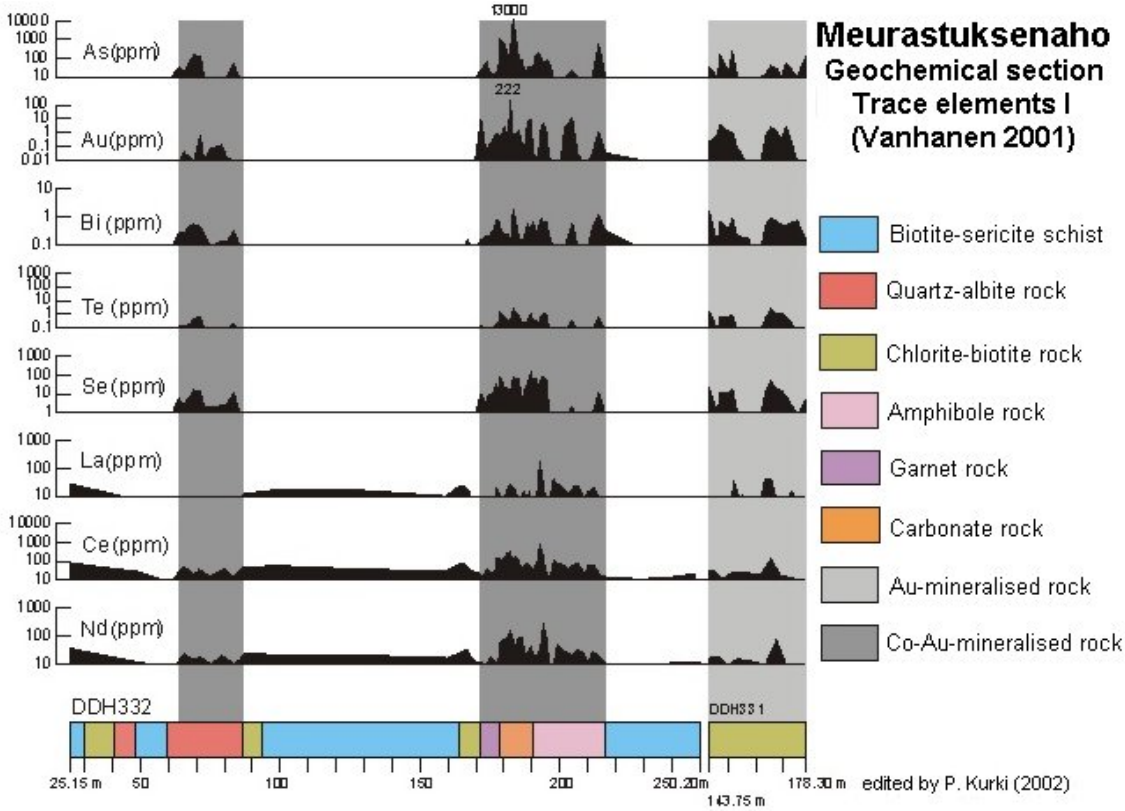
Drilling site in 1998:

Meurastuksenaho site. One of the drill-hole collars on right. Photo Pasi Eilu 25/8/1998.

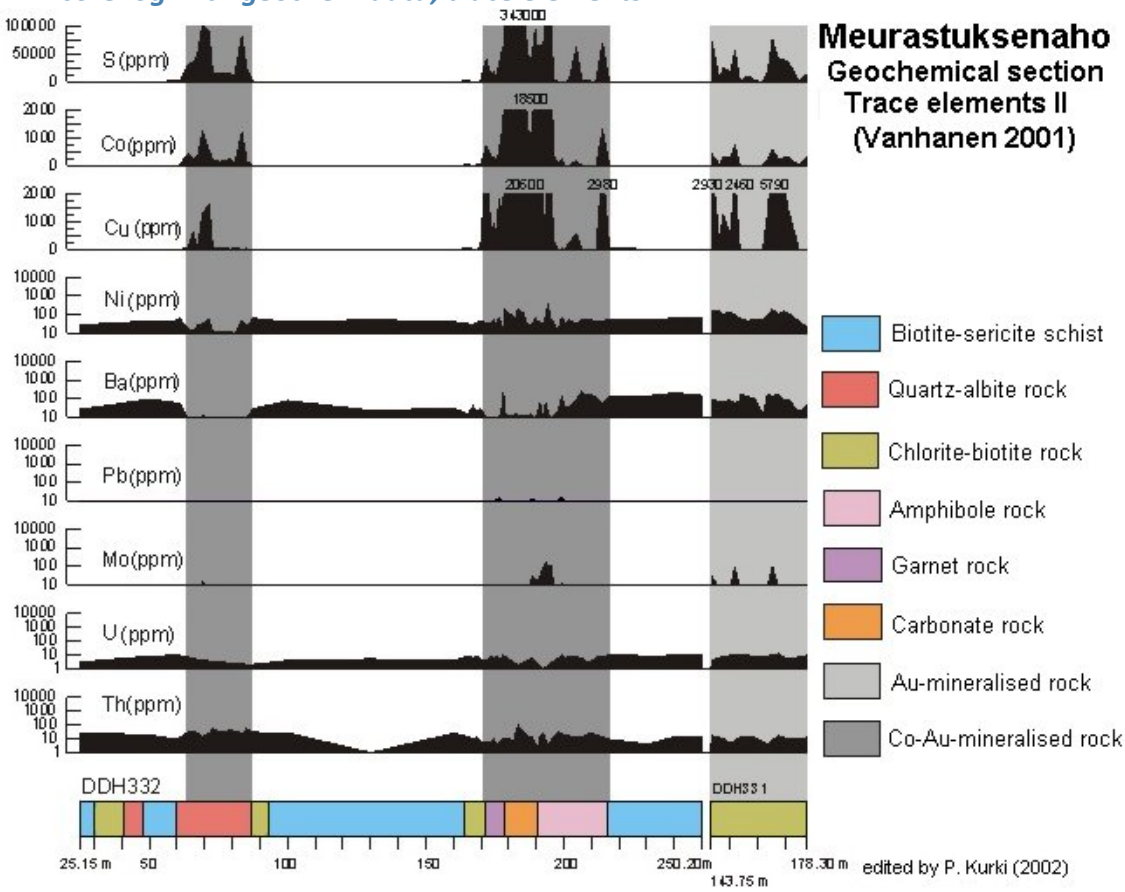
Drill core log with geochem data; major elements:



Drill core log with geochem data; trace elements:



Drill core log with geochem data; trace elements:



RESOURCES AND RESERVES

Most recent

Type:	Company:	Year:	Date:	Calc Method:	Reference:
Resource	Dragon Mining Oy	2013	31.12.2013	JORC code	3, 15
	Comments: Mineral resources remain unchanged 15.9.2015. According to EIA report, the U content is 2.3 ppm and Th content 6.6 ppm				
	Category:	**Indicated mineral resource**			
	Tonnage:	**61000 t**			
	gold	2,4 ppm			
	cobalt	0,1 %			
	Cutoff:	**gold 1 ppm**			
	Category:	**Inferred mineral resource**			
	Tonnage:	**831000 t**			
	gold	2,3 ppm			
	cobalt	0,21 %			
	Cutoff:	**gold 1 ppm**			
	Category:	**Indicated and inferred mineral resource**			
	Tonnage:	**892000 t**			
	gold	2,3 ppm			
	cobalt	0,2 %			
	Cutoff:	**gold 1 ppm**			

Previous calculations

Type:	Company:	Year:	Date:	Calc Method:	Reference:
Resource	Polar Mining Oy	2011	NA	JORC code	2
	Category:	**Indicated and inferred mineral resource**			
	Tonnage:	**366000 t**			
	gold	3,6 ppm			
	cobalt	0,24 %			
	copper	0,28 %			
	Cutoff:	**gold 0,5 ppm**			
	Comments: Cut off either at 0.5 ppm Au or 0.05 % Co, plus a statistically derived high grade cut of 37 ppm Au. Block dimensions used in the model were 6 m NS x 2m EW x 5 m vertical				

Type:	Company:	Year:	Date:	Calc Method:	Reference:
Resource	Polar Mining Oy	2004	NA	NA	4
	Category:	**NA**			
	Tonnage:	**0,284 Mt**			
	gold	2,3 ppm			
	copper	0,28 %			
	cobalt	0,25 %			
	Cutoff:	**NA**			

Type:	Company:	Year:	Date:	Calc Method:	Reference:
Resource	Geological Survey of Finland	2001	NA	NA	10, 21
	Comments: Meurastuksenaho is also enriched in Mo and REE				

	Category:	**Inferred mineral resource**			
	Tonnage:	**0,15 Mt**			
	gold	3 ppm			
	cobalt	0,25 %			
	Cutoff:	**NA**			

Type:	**Company:**	**Year:**	**Date:**	**Calc Method:**	**Reference:**
Resource	Geological Survey of Finland	1989	NA	Non-compliant resource estimate	17, 21
	Category:	**Inferred mineral resource**			
	Tonnage:	**1 Mt**			
	gold	0,6 ppm			
	cobalt	0,13 %			
	Cutoff:	**NA**			
	Category:	**Inferred mineral resource**			
	Tonnage:	**0,12 Mt**			
	gold	4,4 ppm			
	cobalt	0,27 %			
	Cutoff:	**NA**			
	Comments: Part of main estimation				

Type:	**Company:**	**Year:**	**Date:**	**Calc Method:**	**Reference:**
Resource	Geological Survey of Finland	1980	NA	Non-compliant resource estimate	14
	Category:	**Inferred mineral resource**			
	Tonnage:	**0,034 Mt**			
	gold	3,6 ppm			
	Cutoff:	**NA**			

GEOLOGY

Host rock: Silicate-siltstone, Quartzite

Silicate-siltstone (Host rock)

Rock type: Host rock
Proportion: major
Grain size: NA
Color: NA
References: 9, 11, 12, 13, 17, 19, 20, 21

Metamorphic description:

Type:	Facies:	Degree:	Relation to mineralization:	Min P- Max P (kbar)	MIn T- Max T (°C)
Regional	epidote amphibolite metamorphic facies	low metamorphic grade	NA		
Comments: Metamorphic assemblage: biotite-sericite-chlorite-quartz-albite indicates conditions above the biotite isograd					

Geological age:

Geological era:	Max age - Minage (Ma):	Inferred age (Ma):	Age of mineralization:
Paleoproterozoic (2500-1600 Ma)	1600-2500		N

Quartzite (Host rock)

Rock type: Host rock
Proportion: major
Grain size: NA
Color: NA
References: 9, 11, 12, 13, 17, 19, 20, 21

Ore minerals:

Mineral	Proportion	Mineral texture
Bornite	minor	
Chalcopyrite	minor	
Cobaltite	minor	
Cobaltpentlandite	minor	
Covellite	minor	
Gold	minor	
	Native gold, with a maximum detected grain size 0.5-1 mm, is chiefly related to the most Co-rich parts of the mineralisation. Visible gold as inclusions in pyrrhotite, chalcopyrite and pyrite and along sulphide-calcite grain boundaries	
Ilmenite	minor	
Magnetite	minor	
Molybdenite	minor	
Pyrite	major	
Pyrrhotite	major	
Rutile	minor	

Selenide	minor
Telluride	minor
Uraninite	minor

Other minerals:

Mineral	Proportion	Mineral texture
Almandine	present	Alteration product
Amphibole	present	Alteration product
Biotite	present	
Calcite	present	
Chlorite	present	Alteration product
Dolomite	present	Alteration product
Epidote	present	
Garnet	present	Alteration product
Hornblende	present	Alteration product
Quartz	present	
Scheelite	present	
Sericite	present	
Staurolite	present	Alteration product
Talc	present	Alteration product

Alteration:	Distribution:	Degree:	Relation to mineralization:
silicification	NA	NA	Post
albitic alteration	NA	Strong	Pre
Comments: Outer proximal alter: almandine-chlorite-quartz-biotite-epidote-staurolite-actinolitic hornblende-all sulphides ± gold *Inner proximal alter: calcite-all sulphides-magnetite-gold* *Mg-Fe metasomatism: chlorite-quartz + carbonate veins* *Main host (metasedimentary rock = metasiltstone?):* *Possibly, locally intense albitization of clastic sediments and spilitisation of volcanic units when the 2.206 Ga mafic sills and dykes heated the evaporite-bearing sequence and put hot brines into circulation.*			
biotite alteration	NA	NA	Syn
sulphidation	NA	NA	Syn
carbonate alteration	NA	NA	Syn
sericitic alteration	NA	NA	Syn
chloritic alteration	NA	NA	Syn

Metamorphic description:

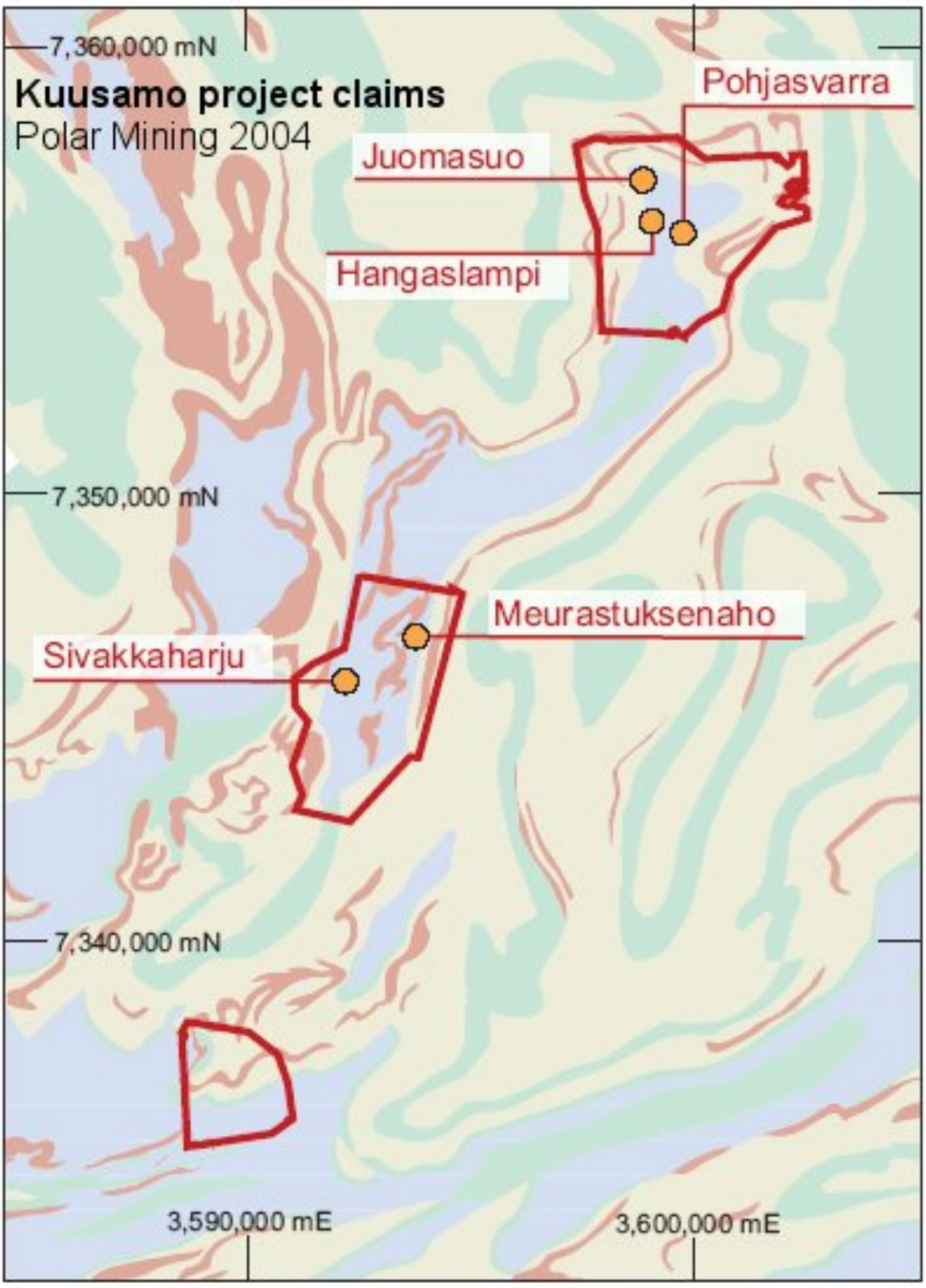
Type:	Facies:	Degree:	Relation to mineralization:	Min P- Max P (kbar)	MIn T- Max T (°C)
Regional	epidote amphibolite metamorphic facies	low metamorphic grade	NA		
Comments: Metamorphic assemblage: quartz-albite					

Geological age:

Geological era:	Max age - Minage (Ma):	Inferred age (Ma):	Age of mineralization:		
Paleoproterozoic (2500-1600 Ma)	1800-2070	1819	Y		
Comments: Mineralisation between 2.07-1.8 Ga.					
Radiometric age:	**Method:**	**Age:**	**Error (Ma):**	**Mineral:**	**Reference:**
	Pb-Pb	1819		Pyrrhotite	1, 7, 13, 21

Figures

Regional geology + Polar Mining claims in 2004:



Source:www.dragon-mining.com.au/pdf/Annual2004.pdf

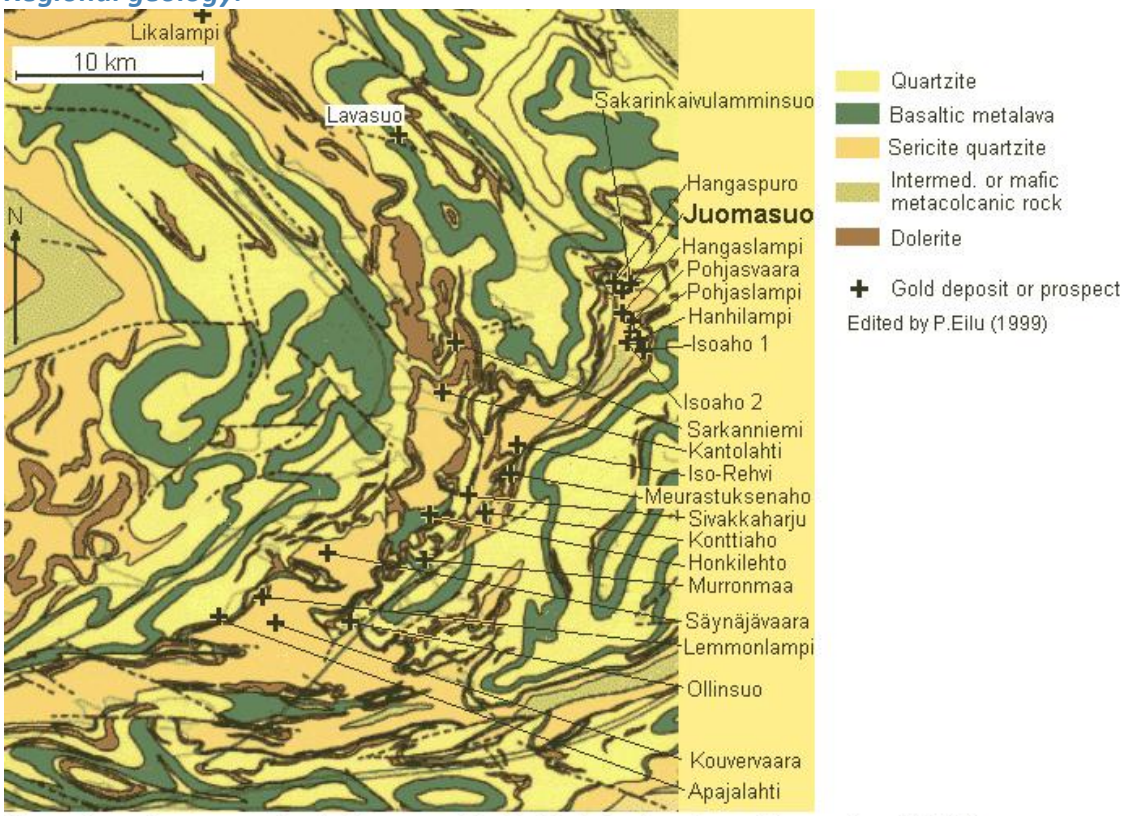
Quartzite, sericite quartzite

Orthoquartzite, phyllite, dolomite, arkose

Mafic volcanics and tuff, basic and intermediate lava

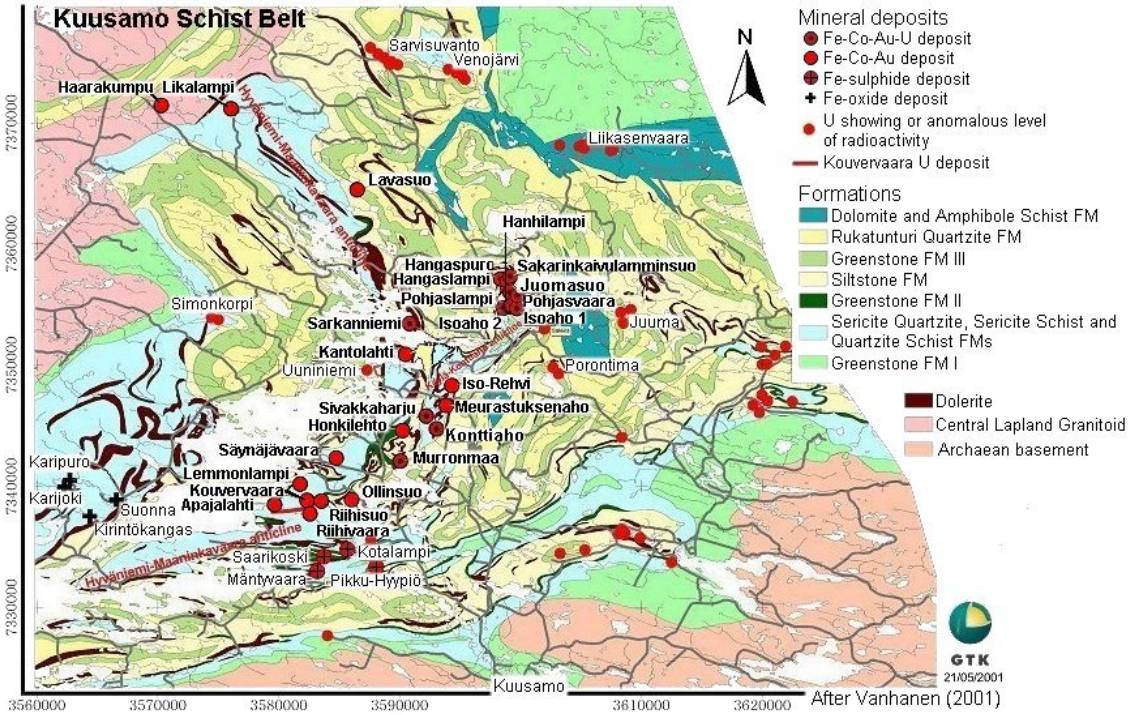
Hornblendite, albite dolerite

Regional geology:

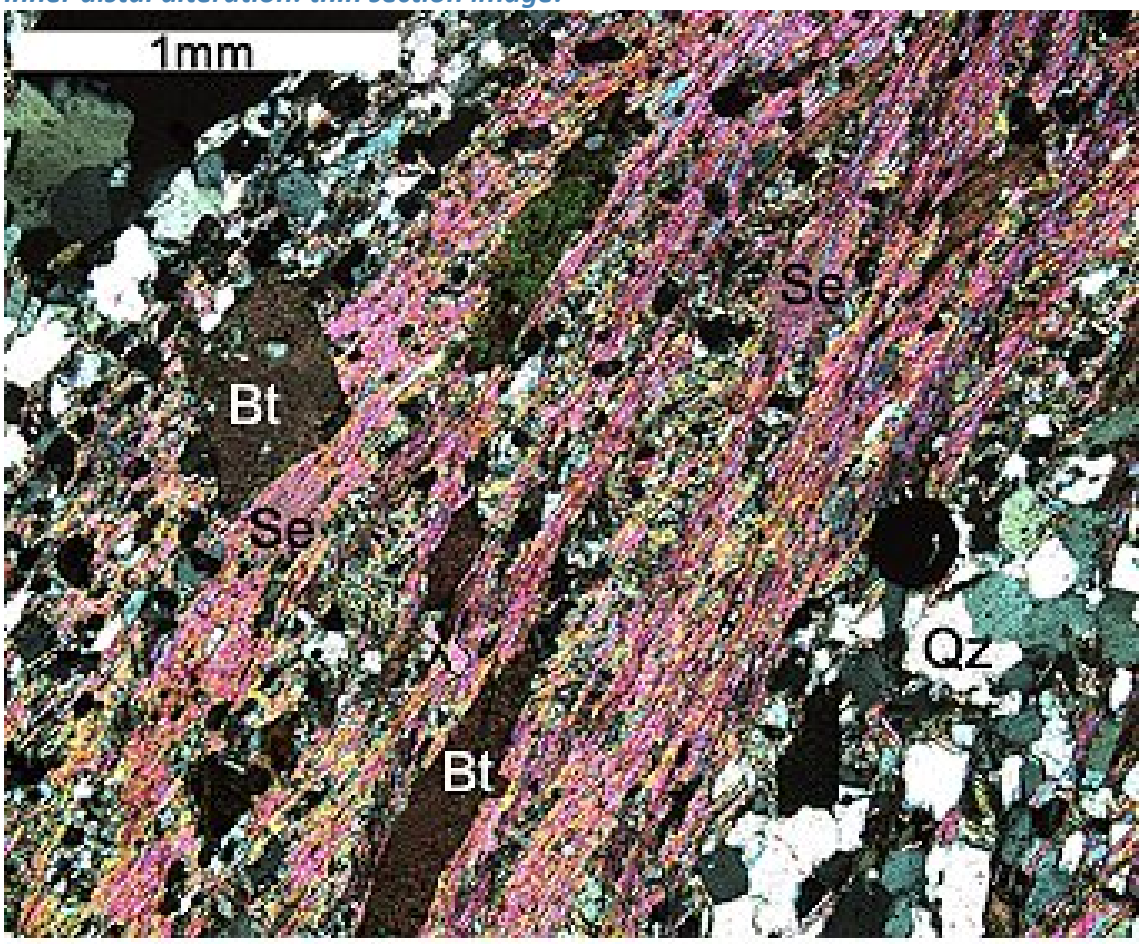


Deposits and prospects in the Kuusamo Schist Belt. Geology from Silvennoinen (1992).
Solid and dashed, curved lines indicate boundaries between lithological units, faults and shear zones

Regional geology and mineral deposits of the Kuusamo area:

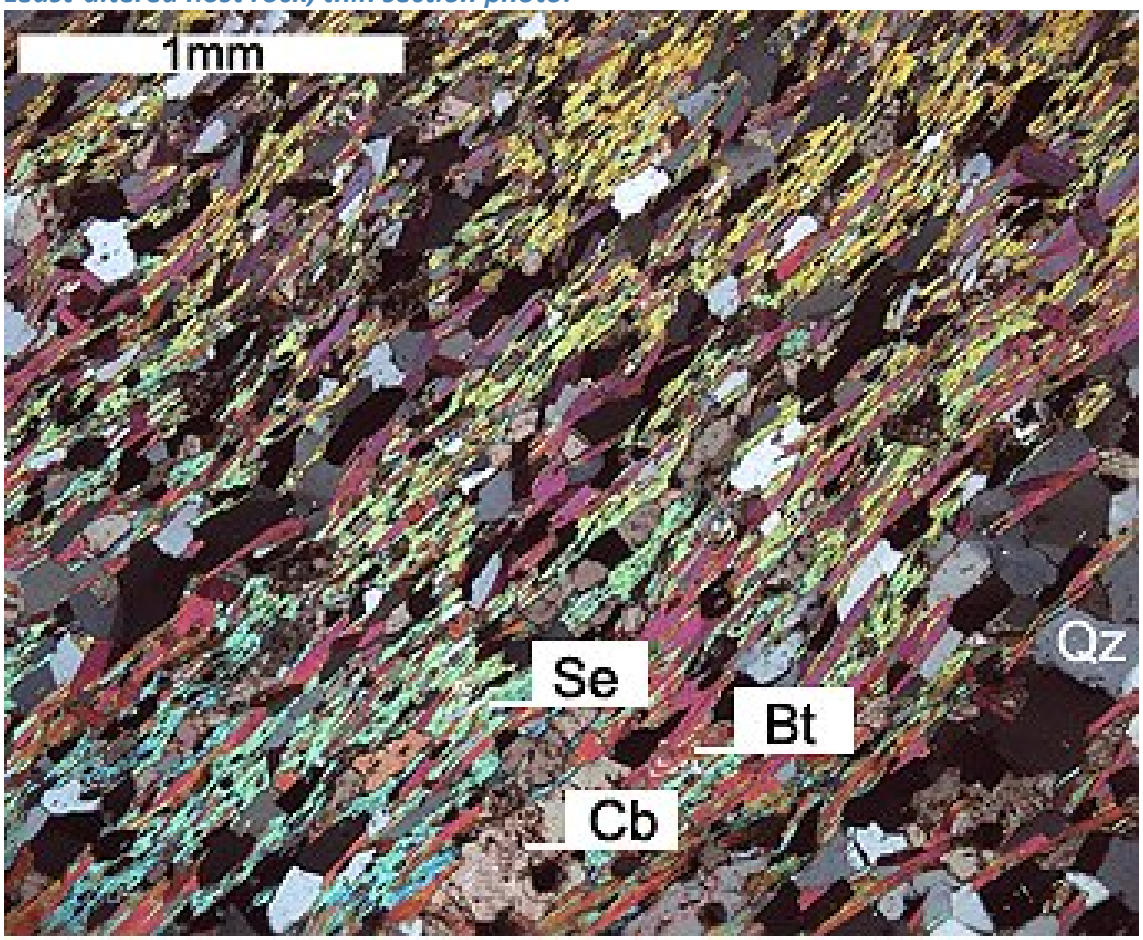


Inner distal alteration: thin section image:



Quartz-albite-chlorite-sericite rock, metasedimentary(?) rock from the inner distal alteration zone at Meurastuk-senaho, Kuusamo Schist Belt. Bt = biotite, Qz = quartz, Se = sericite. Crossed polarisers. Photo Erkki Vanhanen.

Least-altered host rock, thin section photo:

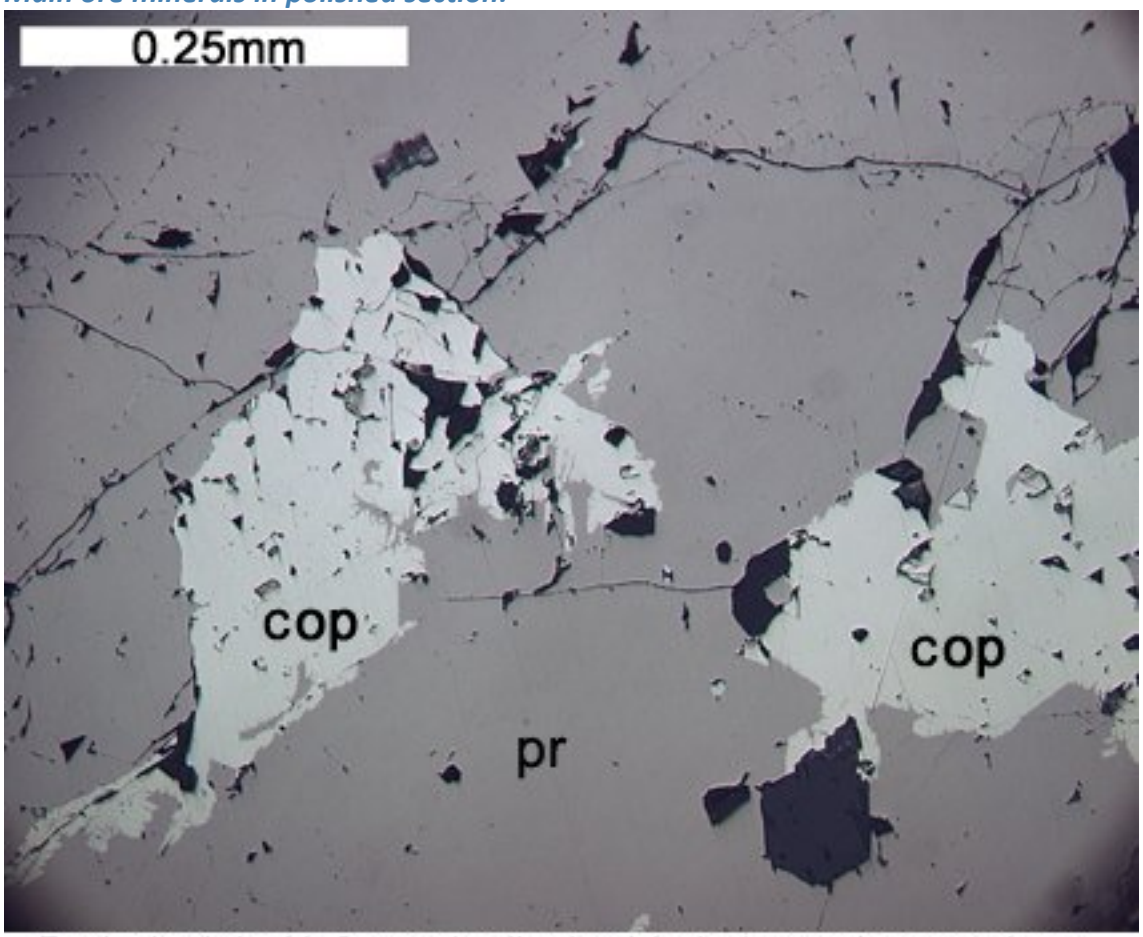


Biotite-sericite schist, least-altered fine-grained meta-sedimentary rock at Meurastuksenaho, Kuusamo Schist Belt. Bt = biotite, Cb = carbonate, Se = sericite. Crossed polarisers. Photo Erkki Vanhanen.

Altered, weakly deformed mafic lava or dolerite; thin section photo:

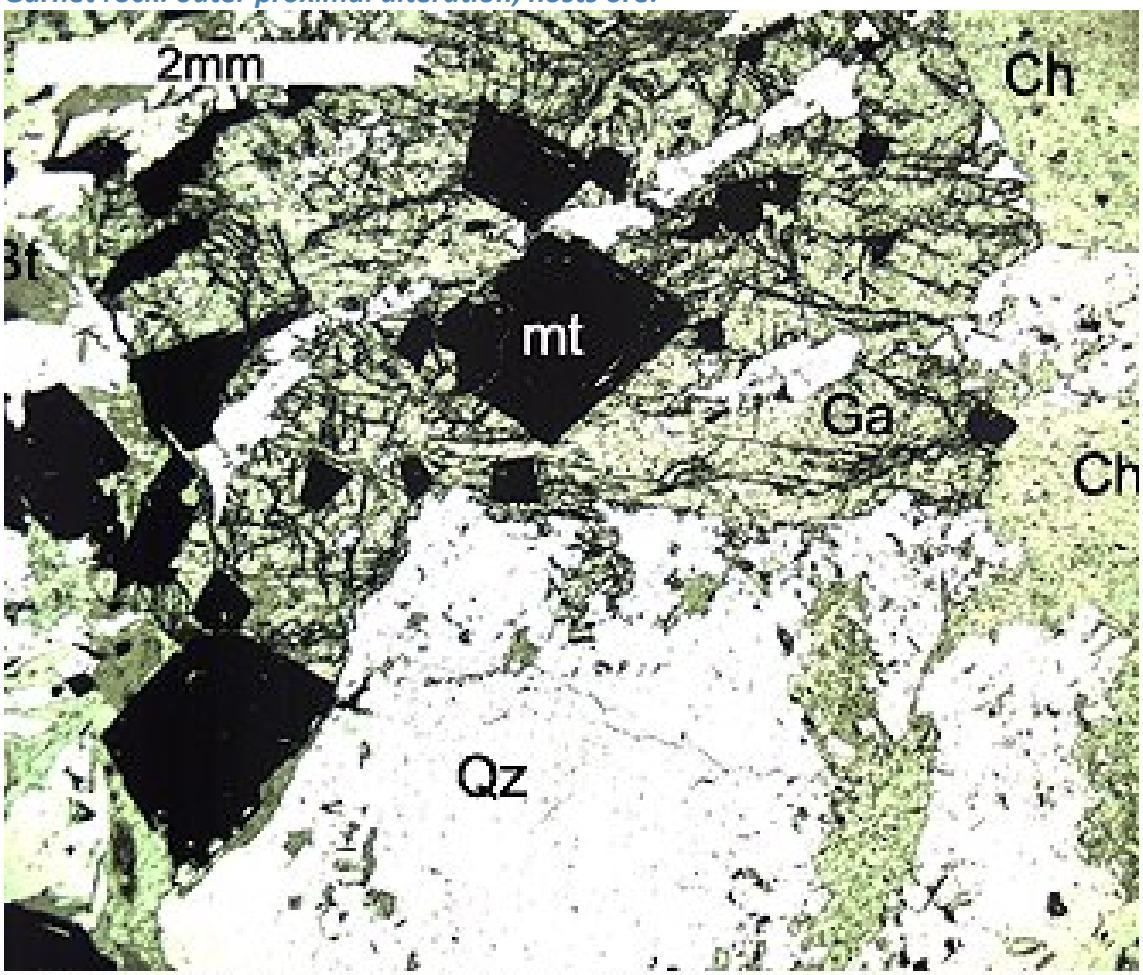
Subophitic albite-carbonate rock, altered mafic lava or dolerite. Meurastuksenaho, Kuusamo Schist Belt. Crossed polarisers. Photo Erkki Vanhanen.

Main ore minerals in polished section:



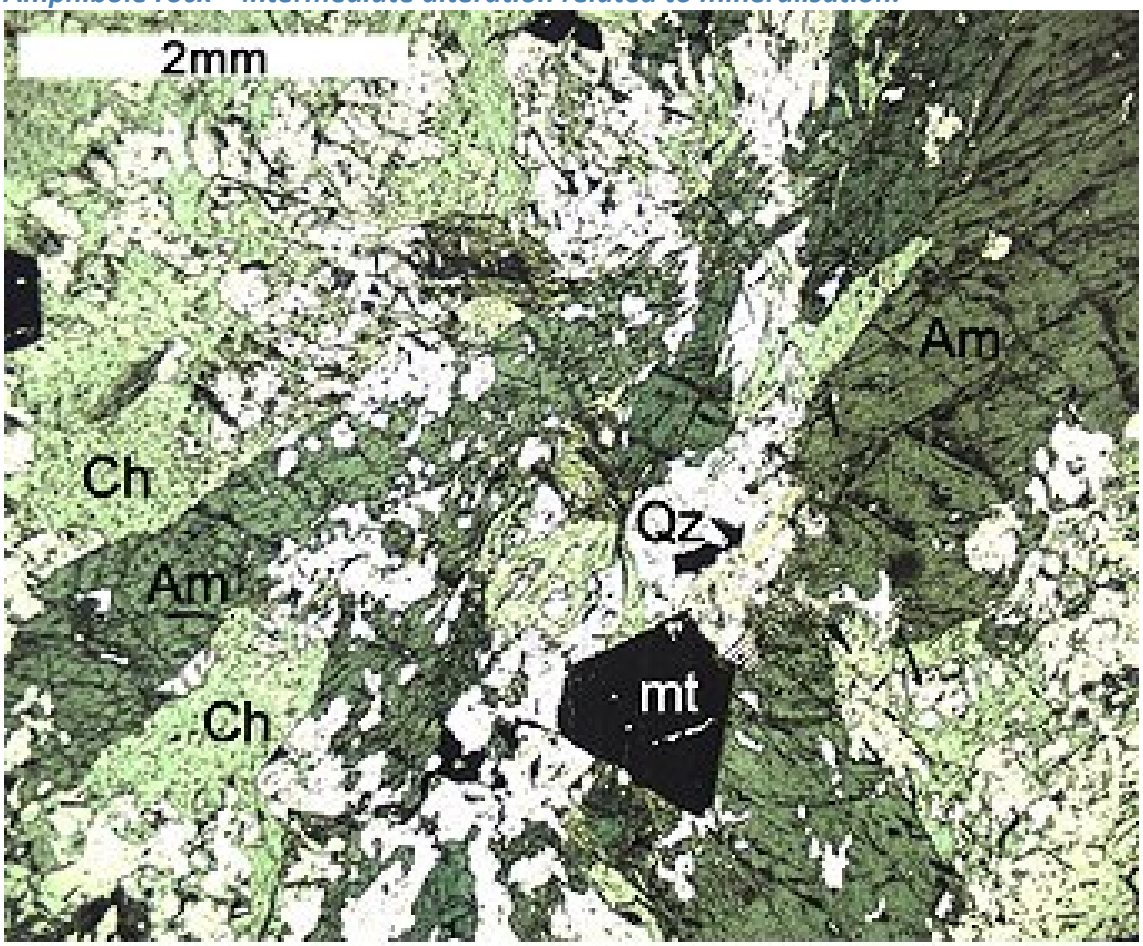
Pyrrhotite (pr) with Co-pentlandite (cop) inclusions or intergrowths at Meurastuksenaho, Kuusamo Schist Belt. Reflected light. Photo Erkki Vanhanen.

Garnet rock: outer proximal alteration, hosts ore:



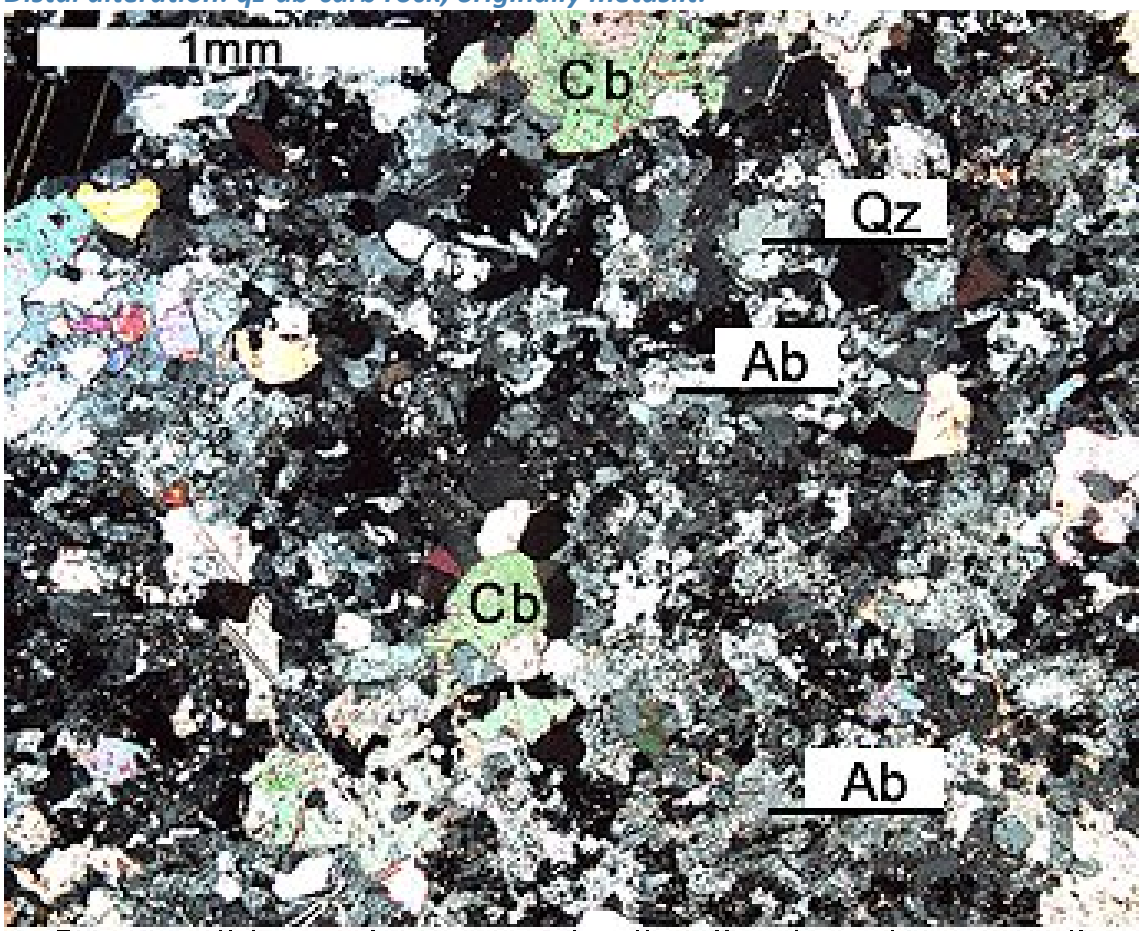
Garnet rock, outer proximal gold mineralisation-related alteration zone at Meurastuksenaho, Kuusamo Schist Belt. Ch = chlorite, Ga = garnet, mt = magnetite, Qz = quartz. Parallel polarisers. Photo Erkki Vanhanen.

Amphibole rock = intermediate alteration related to mineralisation:



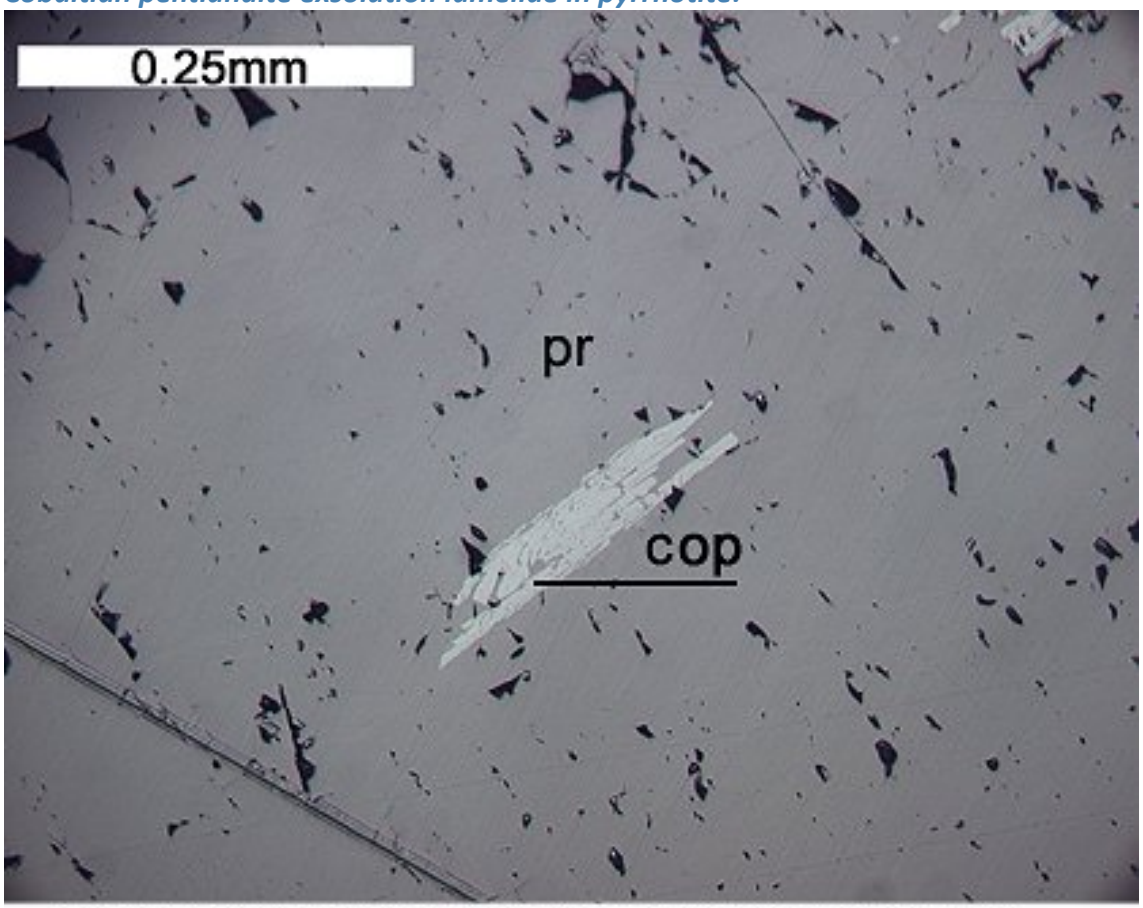
Amphibole rock, intermediate gold mineralisation-related alteration zone at Meurastuksenaho, Kuusamo Schist Belt. Am = amphibole, Ch = chlorite, mt = magnetite, Qz = quartz. Parallel polarisers. Photo Erkki Vanhanen.

Distal alteration: qz-ab-carb rock, originally metasilt:



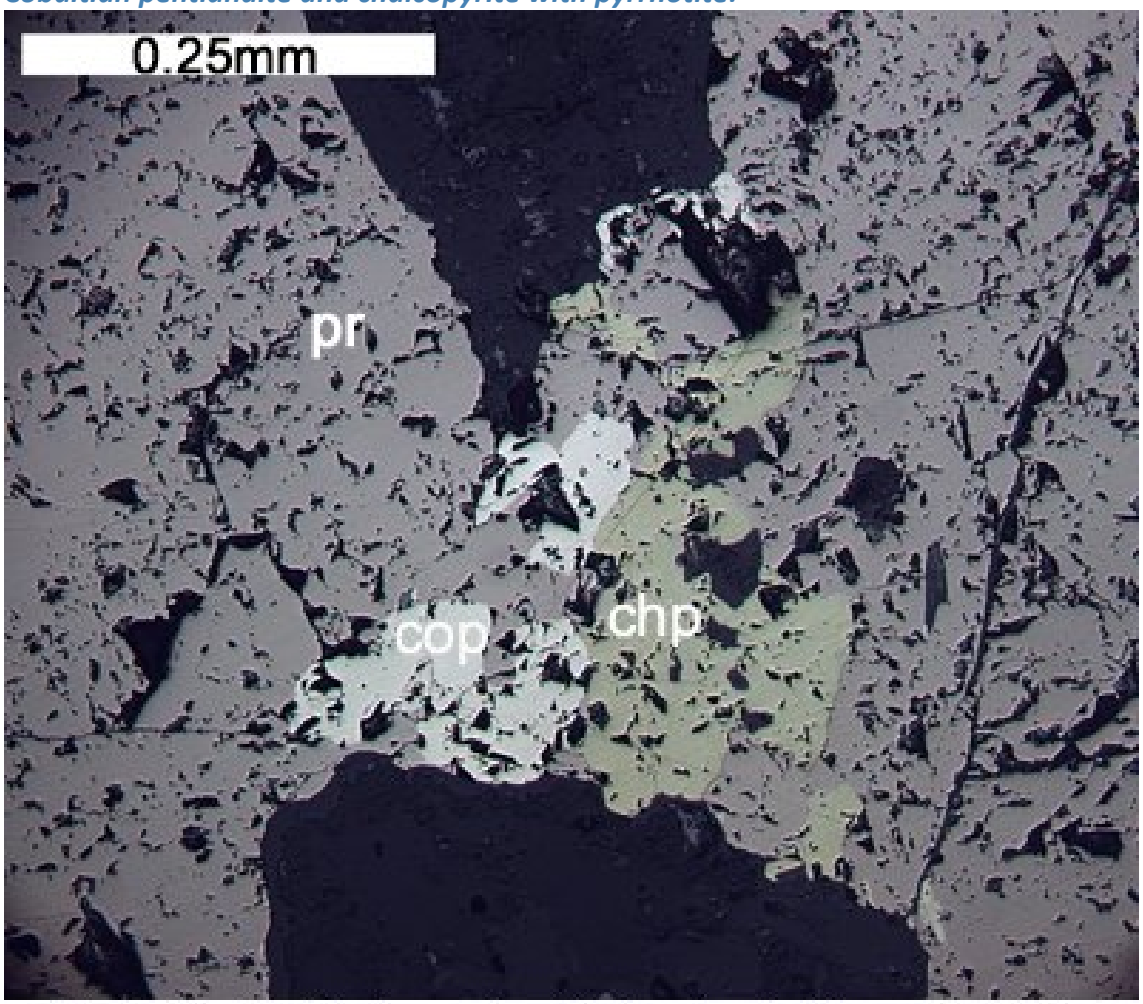
Quartz-albite-carbonate rock, distally altered metasedimentary rock at Meurastuksenaho, Kuusamo Schist Belt. Ab = albite, Cb = carbonate, Qz = quartz. Crossed polarisers. Photo Erkki Vanhanen.

Cobaltian pentlandite exsolution lamellae in pyrrhotite:



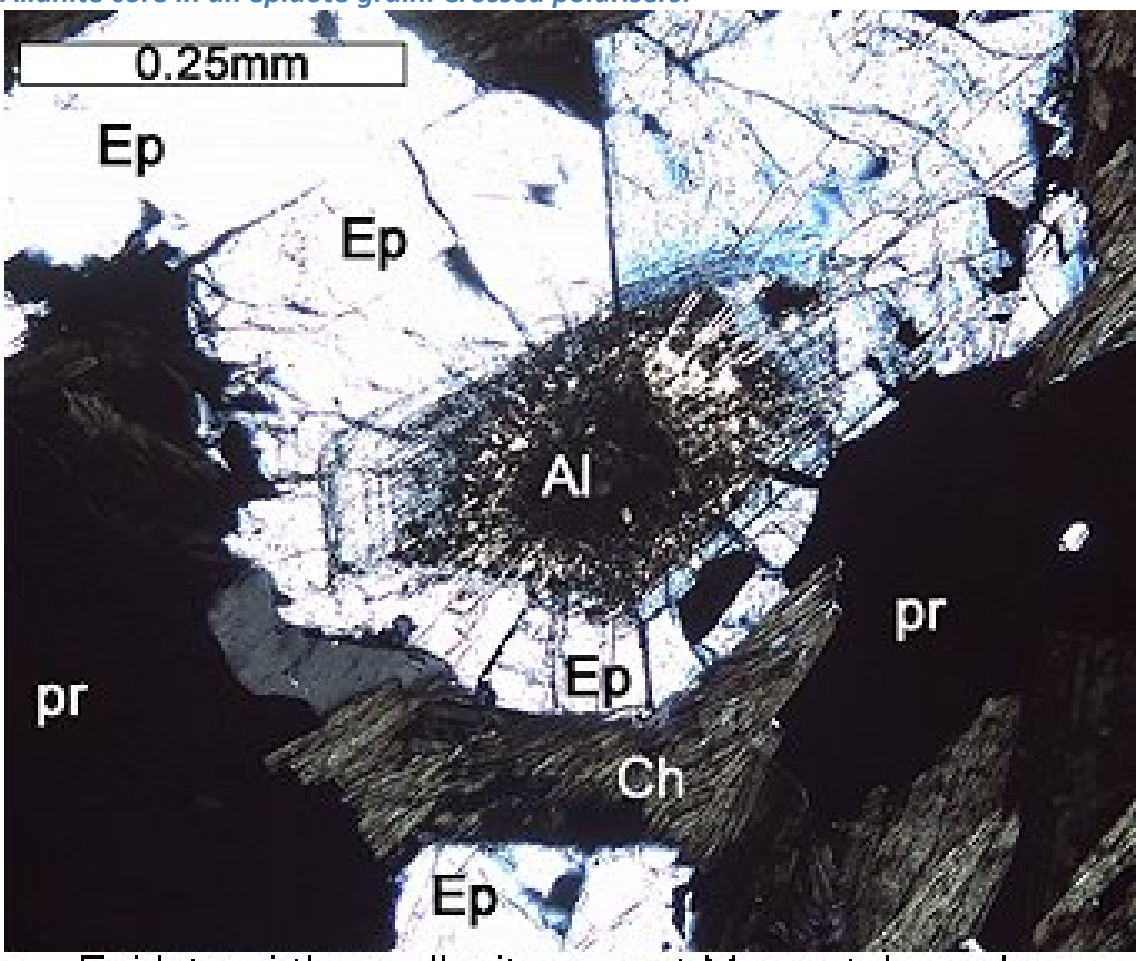
Pyrrhotite (pr) with Co-pentlandite (cop) exsolution lamellae at Meurastuksenaho, Kuusamo Schist Belt. Reflected light. Photo Erkki Vanhanen.

Cobaltian pentlandite and chalcopyrite with pyrrhotite:



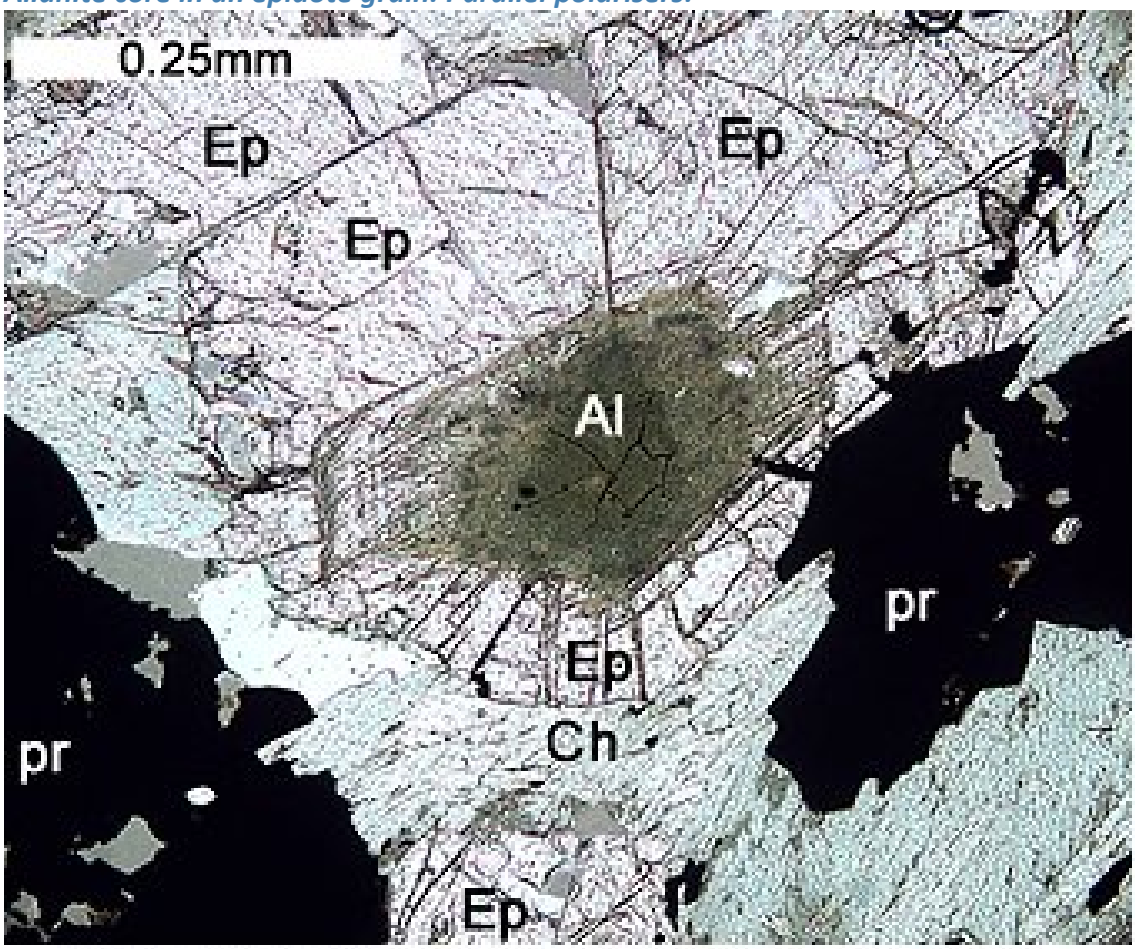
Pyrrhotite (pr) with Co-pentlandite (cop) and chalcopyrite (chp) inclusions at Meurastuksenaho, Kuusamo Schist Belt. Reflected light. Photo Erkki Vanhanen.

Allanite core in an epidote grain. Crossed polarisers:



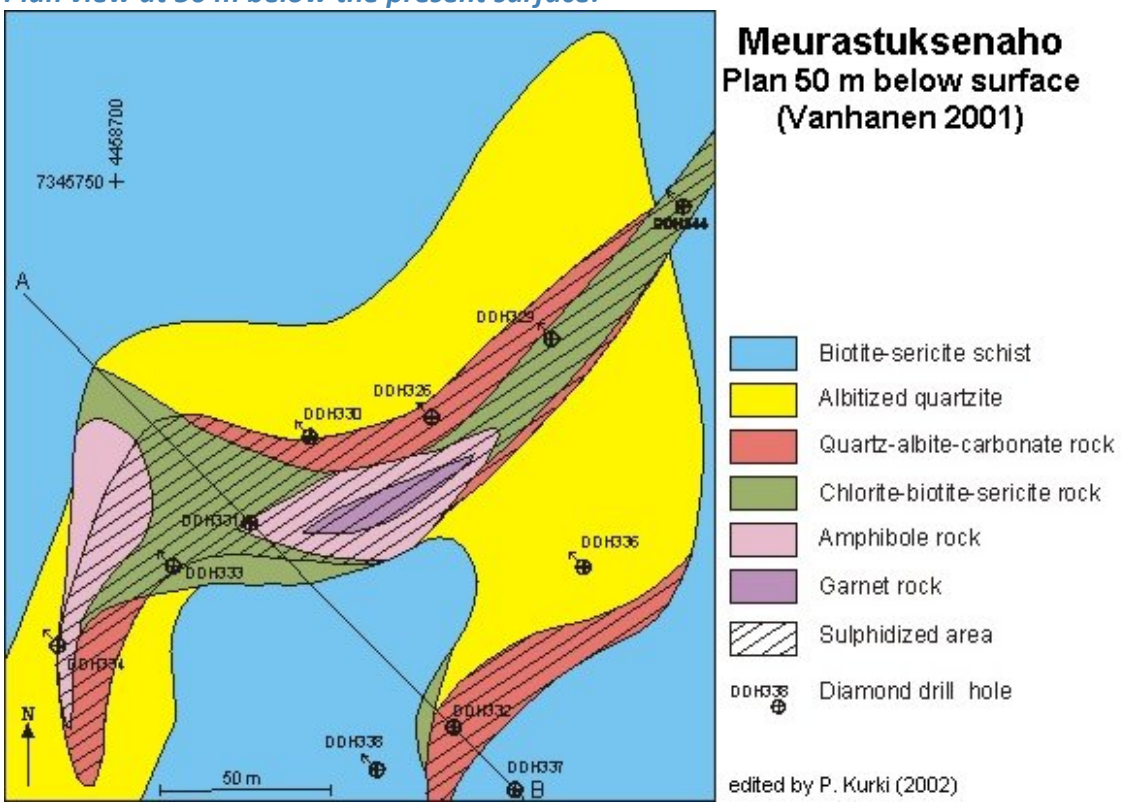
Epidote wirth an allanite core at Meurastuksenaho, Kuusamo Schist Belt. Al = allanite, Ch = chlorite, Ep = epidote, pr = pyrrhotite. Parallel polarisers. Photo Erkki Vanhanen.

Allanite core in an epidote grain. Parallel polarisers:

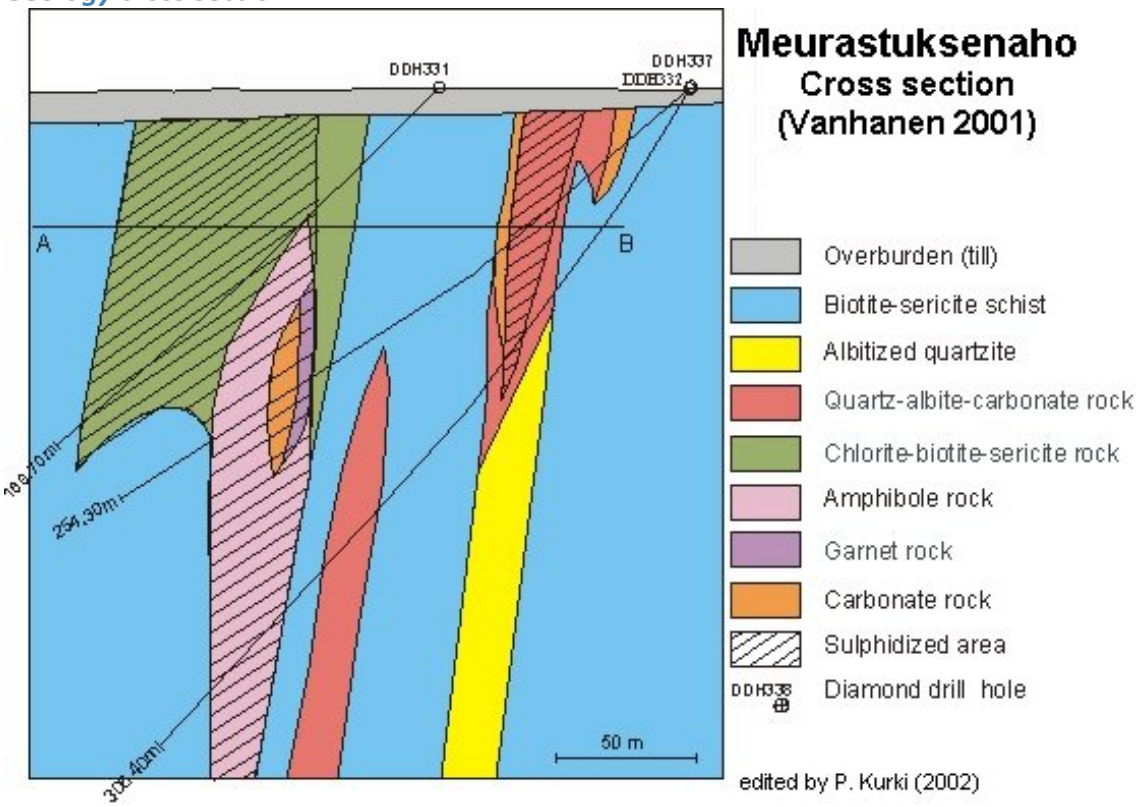


Epidote wirth an allanite core at Meurastuksenaho, Kuusamo Schist Belt. Al = allanite, Ch = chlorite, Ep = epidote, pr = pyrrhotite. Crossed polarisers. Photo Erkki Vanhanen.

Plan view at 50 m below the present surface:



Geology cross section:



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