

Saattopora

Occurrence type: deposit

Commodity	Rank	Total measure	Total production	Total resource	Importance
gold	1	6,94 t	6,94 t	0 t	Small deposit
copper	2	5650,54 t	5650,54 t	0 t	Occurrence

Easting EUREF: 390696,508
Northing EUREF: 7521912,224

Easting YKJ: 3390825
Northing YKJ: 7525055

Discovery year: 1985

Discovered by: Outokumpu Oy

Province: Kittilä (Au, Cu)

District: Sirkka (Cu, Au, Ni, Co)

Comments: Discovery: A base metal occurrence adjacent to the gold deposit was discovered in 1970 by detailed bedrock mapping and diamond drilling, and the gold deposit was detected in 1985 by reanalysing Au of the earlier drill core. Two main lodes, the northern A lode and the southern B lode, both dipping to the N, and a smaller C lode.

References: 1, 6, 12, 16, 21, 29, 30, 33, 35, 37

Mineral deposit type

Group: Metallogenetic deposit

Main type: Orogenic (metamorphic hydrothermal)

Sub type 1: Au-Cu

Comments: During mineralisation, the Au-bearing veins were preferably developed in the most compact lithological units, chiefly in albitised rocks. Probably, albitisation predated gold mineralisation and produced competent units which were structurally favourable for gold mineralisation. Precipitation of gold was probably induced by fluid-rock (graphite) interaction, that caused changes in pH and fO₂ of the fluid and fluid unmixing.

References: 7, 10, 18

Dimension

Expression: exposed

Area (ha): NA

Form: discordant

Dip azim: 0

Shape: irregular

Dip: 85

Length (m): 325

Plunge azim: NA

Width (m): 20

Plunge dip: NA

Thickness (m): NA

Orientation method: NA

Depth (m): NA

Dimension comments: The two main lodes are up to 20 wide and 250–400 m long. The deposit is open at the depth of 200 m

Holder history

Current holder: Outokumpu Mining Oy

Years: 1979

Holding type: Mining concession (old law)

EXPLORATION ACTIVITY

Geological Survey of Finland

Years	Activity type	Geologist	Exploration result	Ref
2004-2004	regional geophysics	NA	key geological features	
<i>Low-altitude airborne magnetic, electromagnetic and radiometric survey</i>				

Outokumpu Oy

Years	Activity type	Geologist	Exploration result	Ref
1985-1994	percussion drilling	Tuomo Korkalo, Erkki Korvuo	mineral reserve defined	6, 18, 37
<i>Percussion drilling 27.2. km, RC drilling 0.7 km. Diamond drilling at site in 20x20 m grid which was filled by 5x5 m grid of percussion drilling during mining.</i>				
1984-1988	excavation	Tuomo Korkalo, Erkki Korvuo	key geological features	4, 6, 11, 16, 17, 18, 36, 37
<i>Exploration trenching. removal of overburden above the ore bodies</i>				
1983-1994	core drilling	Tuomo Korkalo, Erkki Korvuo	mineral reserve defined	6, 11, 16, 17, 18, 37
<i>Diamond drilling 34 km. In the mine area, drilled in 20x20 m grid which was filled in by 6.25 x 6.25 m grid of percussion drilling during mining.</i>				
Intersections				
HoleID				
From-To				
Length				
gold				
copper				

Geological Survey of Finland

Years	Activity type	Geologist	Exploration result	Ref
1981-1982	regional geochemistry	NA	NA	
<i>Regional geochemical till survey</i>				

Outokumpu Oy

Years	Activity type	Geologist	Exploration result	Ref
1960-1995	detailed geochemistry	Tuomo Korkalo, Erkki Korvuo	geochemical anomaly	4, 6, 11, 16, 17, 18, 36, 37
1960-1995	detailed geology	Tuomo Korkalo, Erkki Korvuo	key geological features	4, 6, 11, 16, 17, 18, 36, 37
<i>Note that gold was not targetted before 1984</i>				

1960-1995	detailed geophysics	Tuomo Korkalo, Erkki Korvuo	geophysical anomaly	4, 6, 11, 17, 18, 36, 37
<i>No response detected.</i>				

RESOURCES AND RESERVES

Most recent

Type:	Company:	Year:	Date:	Calc Method:	Reference:
Resource	Outokumpu Oy	1991	NA	Non-compliant resource estimate	28
<i>Comments: Include to calc = N, because ore mining after 1991 is 0.99 Mt, which exceeds the 0.01 Mt resource reported in 1991.</i>					
Category:	Poorly estimated mineral resource, poorly documented				
Tonnage:	10000 t				
gold	7 ppm				
copper	0,19 %				
Cutoff:	gold 1,5 ppm				
<i>Comments: p. 139 in Parkkinen, J. 1991.</i>					

Previous calculations

Type:	Company:	Year:	Date:	Calc Method:	Reference:
Resource	Outokumpu Oy	1990	NA	Non-compliant resource estimate	28
<i>Comments: Include to calc = N, because ore mining after 1990 is 1.5 Mt, which exceeds the 0.15 Mt resource reported in 1990.</i>					
Category:	Poorly estimated mineral resource, poorly documented				
Tonnage:	152000 t				
gold	3 ppm				
copper	0,66 %				
Cutoff:	gold 1,5 ppm				
<i>Comments: p. 139 in Parkkinen, J. 1991.</i>					
Type:	Company:	Year:	Date:	Calc Method:	Reference:
Resource	Outokumpu Oy	1988	NA	Non-compliant resource estimate	4, 11, 17
<i>Comments: Include to calc = N, because ore mining after 1988 is 2.150 Mt, which exceeds the 0.68 Mt resource reported in 1988.</i>					
Category:	Poorly estimated mineral resource, poorly documented				
Tonnage:	0,68 Mt				
gold	3,6 ppm				
copper	0,26 %				
Cutoff:	gold 1,55 ppm				

MINING

Saattopora

Easting EUREF: 390696,508

Northing EUREF: 7521912,224

Status: Closed

Operating years: 1988-1995

Years in production: 8

Total ore mined: 2150016 t

References: 2, 3, 5, 14, 18, 32, 34

Total production:

Product	Product measure
copper	5650,54 t
gold	6,94 t

Other materials:

Material type	Material measure
Waste rock	3581597 t

Mining activity:

Year	Ore mined	Ore processed	Activity type	Production	Other material
1995	157408 t	157408 t	underground mining	gold 476,94 kg copper 440,74 t	Waste rock 0 t
1994	343862 t	343862 t	underground mining	gold 904,35 kg copper 859,65 t	Waste rock 19355 t
1993	192246 t	202153 t	underground mining	gold 454,84 kg copper 424,52 t	Waste rock 864 t
1992	297533 t	368780 t	open-pit and underground mining	gold 1025,2 kg copper 1032,58 t	Waste rock 11236 t
1991	524355 t	480907 t	open-pit mining	gold 2024,61 kg copper 1394,63 t	Waste rock 630488 t
1990	288977 t	250959 t	open-pit mining	gold 878,35 kg copper 627,39 t	Waste rock 1091379 t
1989	345635 t	335012 t	open-pit mining	gold 1179,24 kg copper 871,03 t	Waste rock 1684244 t
1988	0 t	0 t	open-pit mining		Waste rock 144031 t

Figures

View from air to the Saattopora Mine:



Saattopora mine, Kittilä, Central Lapland greenstone belt.
View to the NE. Photo by permission of Outokumpu Oyj.

The early stage of open pit mining:



Operations during the early stages of open pit mining at Saattopora.
Photo by permission of Outokumpu Oyj.

The main pit at 1992:



Saattopora, Kittilä. Main pit and the adit to the underground workings, August 1992. View along strike of the Sirkka Line shear zone.

(Photo by P. Eilu)

The main pit at 1998:



Saattopora, Kittilä. Main pit 23/8/1998. View roughly along strike of the Sirkka Line shear zone.

(Photo by P. Eilu)

The main pit at 1998:



Saattopora, Kittilä. Main pit 23/8/1998.

(Photo by P. Eilu)

View from air to the Saattopora Mine:



Saattopora during mining. Photo Outokumpu Oyj.

The main pit at 2001:



Saattopora main pit, Kittilä, 10/06/2001. Photo P. Eilu

GEOLOGY

Host rock: Graphite Phyllite, Intermediate volcanic rock

Wall rock: Komatiite

Graphite Phyllite (Host rock)

Rock type: Host rock

Proportion: major

Grain size: NA

Color: NA

References: 6, 7, 8, 10, 11, 13, 16, 18, 19, 20, 22, 25, 37

Comments: Graphitic phyllites. A few millimetres to several metres thick quartz-carbonate veins; these are chiefly N-S trending, but there also are E-W trending, conjugate(?), veins with similar mineralogy as the N-S trending veins. The auriferous veins are tension cracks opened during folding. Abundant calcite veins in the hangingwall tuffite. The auriferous veins are undeformed, hence probably related to the regional D3 stage of deformation.

Ore minerals:

Mineral	Proportion	Mineral texture
Bismuthinite	minor	
Chalcopyrite	minor	
Gersdorffite	minor	
Gold	present	<i>Mainly free native gold in quartz-carbonate veins and in their immediate wallrock, chiefly associated with quartz, carbonates and sulphides, locally also with U-Th oxides. Fineness: < 1 % Ag, traces of Cu and As</i>
Graphite	present	
Nickeline	minor	
Pentlandite	minor	
Pyrite	major	
Pyrrhotite	major	
Rutile	minor	
Telluride	minor	
Tucekite	minor	
Uraninite	minor	

Other minerals:

Mineral	Proportion	Mineral texture
Albite	present	
Ankerite	present	
Dolomite	present	
Quartz	present	
Tourmaline	present	

Structures

Breccia

Textures

Massive

Alteration:	Distribution:	Degree:	Relation to mineralization:
albitic alteration	NA	NA	Pre
<i>Comments: Albitisation and part of carbonation may have preceded gold mineralisation, taken place before regional deformation, as a synvolcanic, spilitic stage of alteration, related to the formation of the syngenetic base-metal mineralisation in the phyllites. Albitised zones are 1–90 m wide and their lateral and vertical extents are several hundreds of metres</i>			
carbonate alteration	NA	NA	Syn
sulphidation	NA	NA	Syn
sericitic alteration	NA	NA	Syn
<i>Comments: Sericitisation, sulphidation and main carbonation, with formation of abundant quartz veins, are most probably related to the syn-peak metamorphic gold mineralisation.</i>			

Metamorphic description:

Type:	Facies:	Degree:	Relation to mineralization:	Min P- Max P (kbar)	Min T- Max T (°C)
Regional	greenschist metamorphic facies	low metamorphic grade	NA		
<i>Comments: Metamorphic peak during D2, thrusting during D3 was at least partly post-peak, late metamorphic; Metamorphic mineral assemblage: talc-chlorite ± carbonate (metakomatiites), quartz-albite-chlorite ± biotite, sericite, graphite (phyllites).</i>					

Geological age:

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

Intermediate volcanic rock (Host rock)

Rock type: Host rock

Proportion: major

Grain size: NA

Color: NA

References: 6, 7, 8, 11, 13, 18, 19

Comments: Due to their early alteration, are commonly called albitites. A few millimetres to several metres thick quartz-carbonate veins; these are chiefly N-S trending, but there also are E-W trending, conjugate(?), veins with similar mineralogy as the N-S trending veins. The auriferous veins are tension cracks opened during folding. Abundant calcite veins in the hangingwall tuffite. The auriferous veins are undeformed, hence probably related to the regional D3 stage of deformation.

Structures

Breccia

Textures

Massive

Alteration:	Distribution:	Degree:	Relation to mineralization:
albitic alteration	NA	NA	NA

Metamorphic description:

Type:	Facies:	Degree:	Relation to mineralization:	Min P- Max P (kbar)	Min T- Max T (°C)
Regional	greenschist metamorphic facies	low metamorphic grade	NA		

Comments: Metamorphic peak during D2, thrusting during D3 was at least partly post-peak, late metamorphic.

Geological age:

Geological era:	Max age - Minage (Ma):	Inferred age (Ma):	Age of mineralization:
Paleoproterozoic (2500-1600 Ma)	1600-2500		N
Paleoproterozoic (2500-1600 Ma)	1662-1894	1739	Y

Comments: Palaeomagnetic indications from remanent magnetism suggest that the main alteration stage took place during 1880–1840 Ma.

Radiometric age:	Method:	Age:	Error (Ma):	Mineral:	Reference:
	Pb-Pb	1662	5	Pyrrhotite	22
	U-Pb	1684	5	Rutile	22
	Pb-Pb	1704	4	Pyrrhotite	22
	U-Pb	1707	8	Rutile	22
	U-Pb	1781	18	Monazite	22
	Pb-Pb	1894	46		

Komatiite (Wall rock)

Rock type: Wall rock

Proportion: minor

Grain size: NA

Color: NA

References: 6, 7, 8, 10, 11, 13, 18, 19

Metamorphic description:

Type:	Facies:	Degree:	Relation to mineralization:	Min P- Max P (kbar)	Min T- Max T (°C)
Regional	greenschist metamorphic facies	low metamorphic grade	NA		

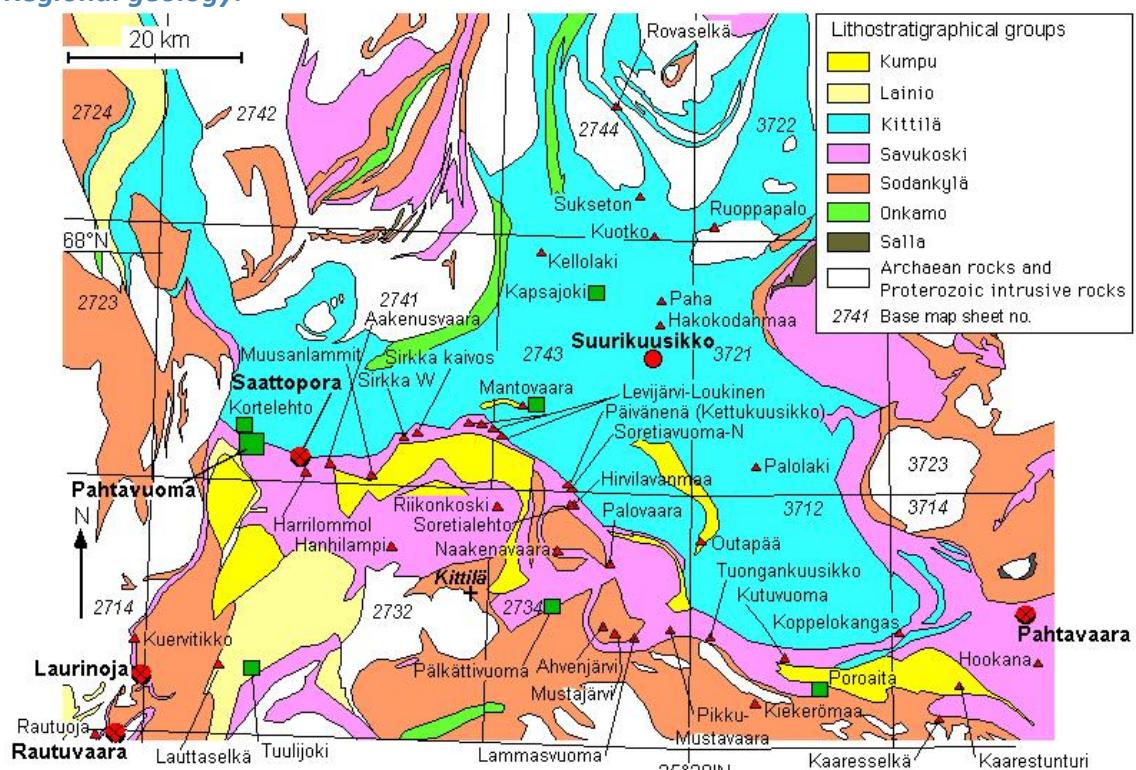
Comments: Metamorphic peak during D2, thrusting during D3 was at least partly post-peak, late metamorphic; Talc-chlorite ± carbonate.

Geological age:

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

Figures

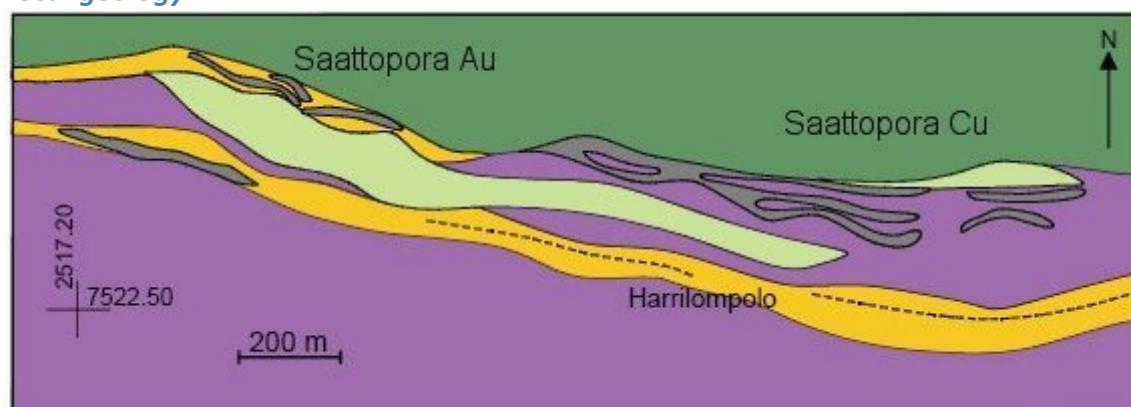
Regional geology:



Zinc (green) and gold (red) deposits and significant prospects in the central parts of the Central Lapland greenstone belt. Lithostratigraphy from Lehtonen et al. (1998).

Edited by P. Eili (2007)

Local geology:



Kittilä group

 Mg-tholeiitic metavolcanite

 Albite schist

Savukoski group

 Ultramafic rock

----- Harrilompolo Au-Cu deposit

 Phyllite, mica schist, tuffite

 Saattopora I Au-Cu ore deposit

 Saattopora II Cu-Au deposit

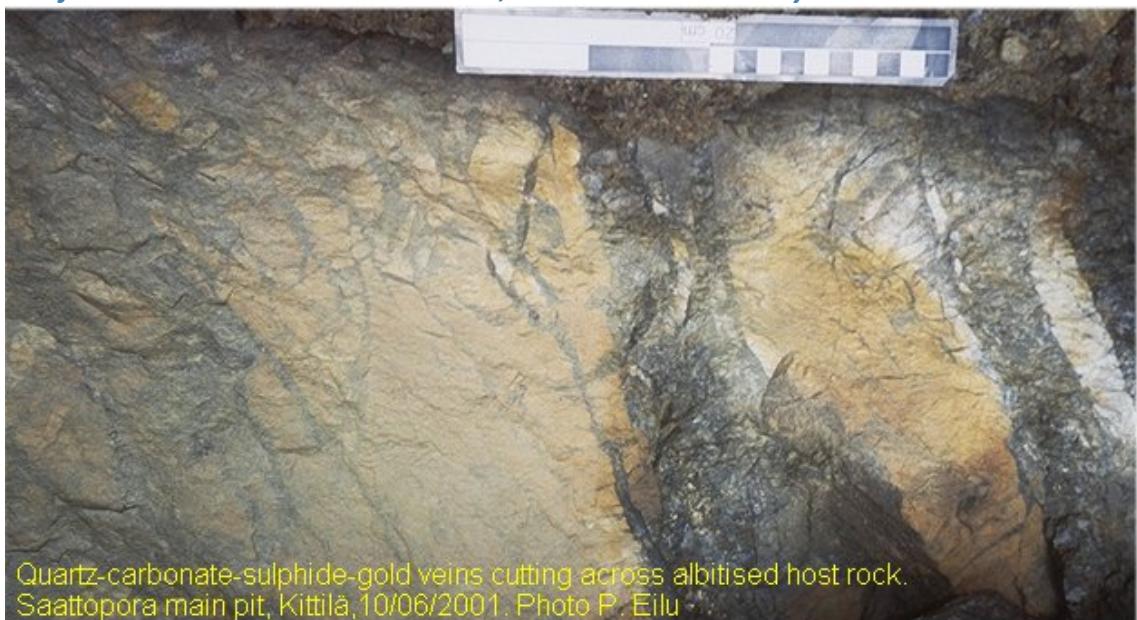
Saattopora area
Strongly simplified surface geology
(Korkalo 2006)

Auriferous veins in albitized host rock, the northern ore body A:

Quartz-carbonate-sulphide-gold veins cutting across albitised host rock.
Saattopora main pit, Kittilä, 10/06/2001. Photo P. Eilu

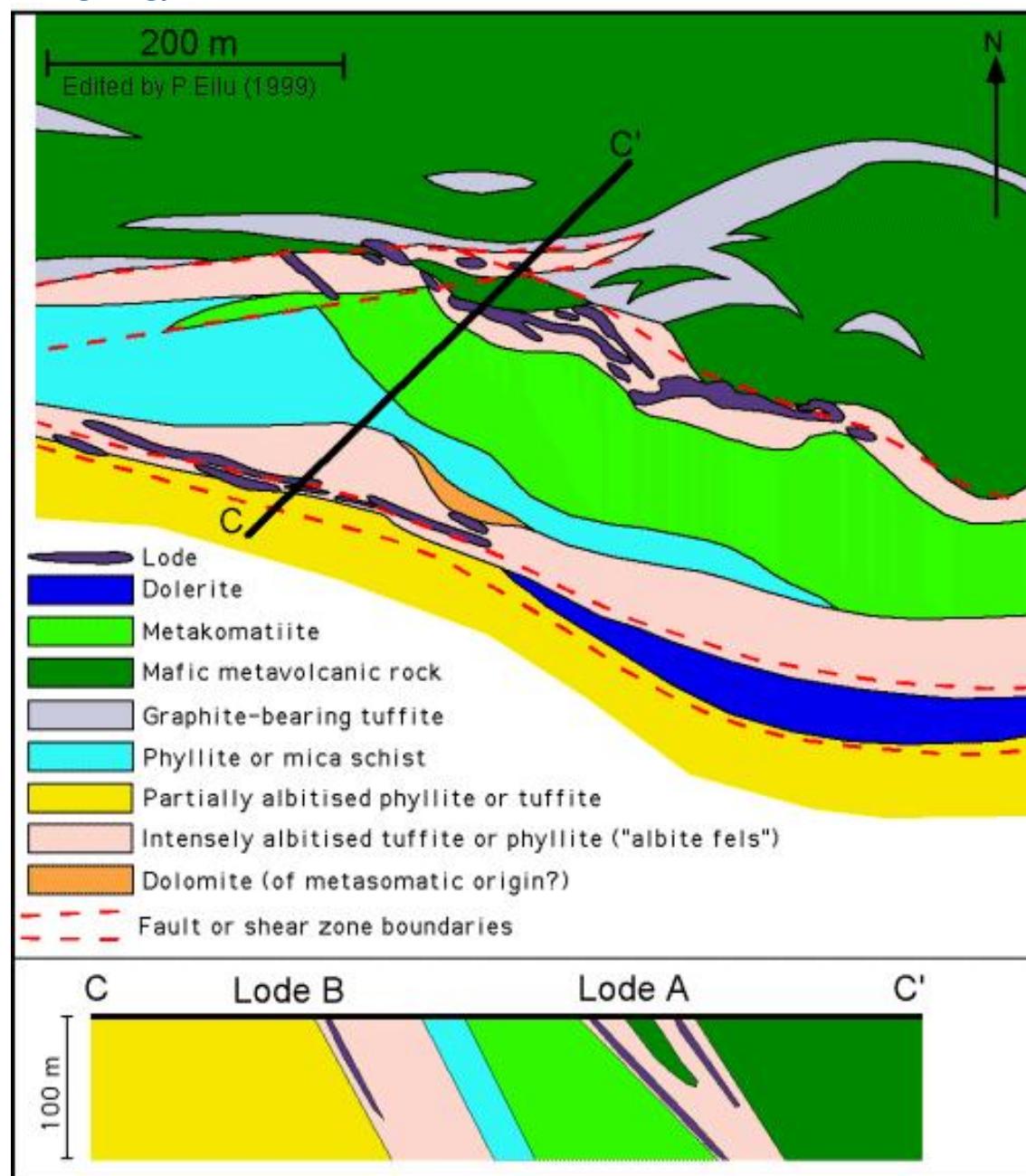


Auriferous veins in albitized host rock, the northern ore body A:



Quartz-carbonate-sulphide-gold veins cutting across albitised host rock.
Saattopora main pit, Kittilä, 10/06/2001. Photo P. Eilu

Local geology:



Geological map of the Saattopora area. Modified after Korvuo (1997).

Auriferous vein in albited host rock:



Saattopora, Kittilä. Proximal alteration and low-grade ore in albitised metatuffite. Mineral assemblage probably quartz - sericite - albite - Fe dolomite - pyrite - pyrrhotite - chalcopyrite. Auriferous quartz-calcite-Fe dolomite/ankerite-pyrite-pyrrhotite veins related to brittle deformation synchronous with gold mineralisation.

Field of view 9 cm. Photo Jari Väätäinen.

Auriferous veins in metatuffite:



Saattopora, Kittilä. Intermediate to proximal alteration with auriferous quartz-ankerite +/- pyrite and pyrrhotite veins in intermediate metatuffite low-grade ore. The length of the compass plate is 12 cm.

(Photo by P. Eilu)

Distal alteration with quartz-calcite vein network in metatuffite:



Saattopora, Kittilä. Distal alteration with quartz-calcite vein network in the main host rock, intermediate metatuffite. The length of the compass plate is 12 cm.

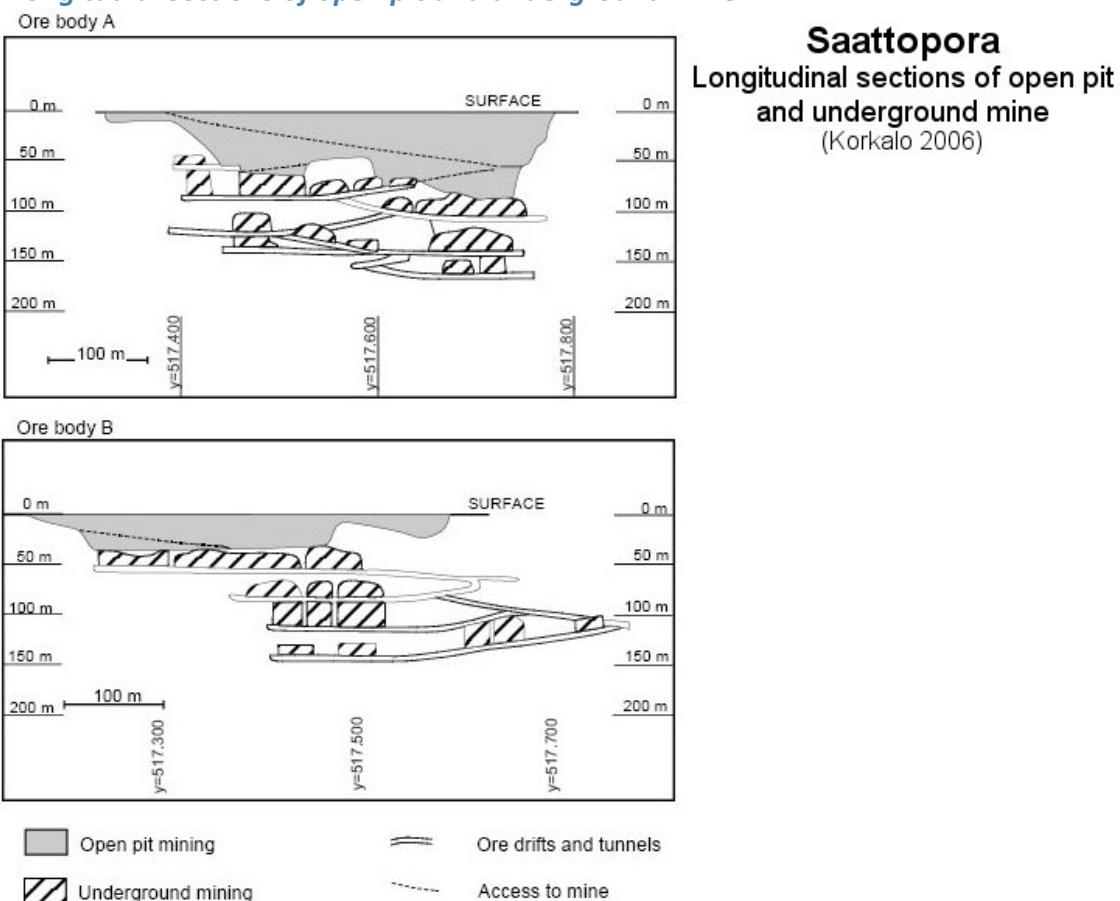
(Photo by P. Eilu)

Ore outcrop:

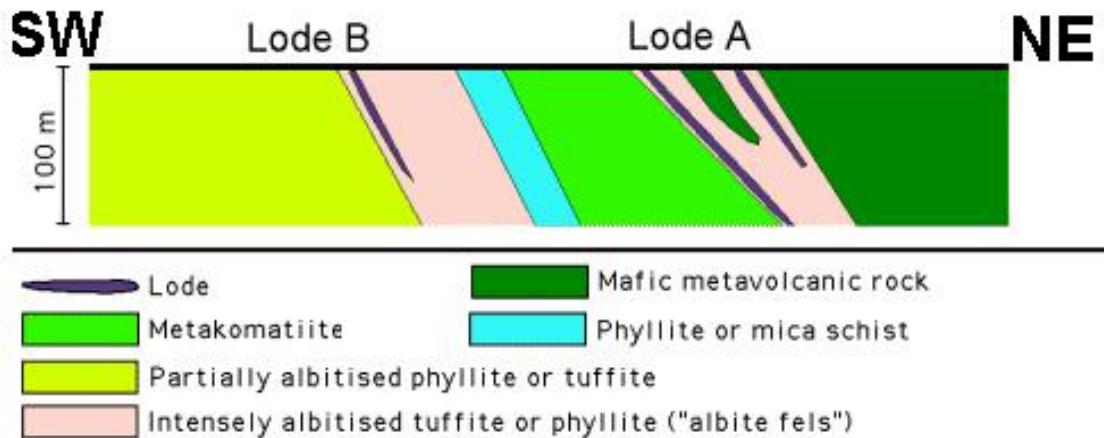


Pyrrhotite-chalcopyrite dominated breccia ore in massive albite rock at Saattopora.
Field of view about 7 cm. Photo Jari Väätäinen.

A longitudinal sections of open pit and underground mine:



A section across the Saattopora deposit:



Section across the Saattopora deposit and its wall rocks.
Modified from Korvuo (1997) by P. Eilu (2001).

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