# Juomasuo

**Alternative Names:** K1
**Occurence type:** deposit

| Commodity | Rank | Total measure | Total production | Total resource | Importance |
|---|---|---|---|---|---|
| gold | 1 | 16,46 t | 0,1 t | 16,36 t | Medium sized deposit |
| cobalt | 2 | 15680,68 t | 24,68 t | 15656 t | Medium sized deposit |
| copper | 3 | NA | NA | NA | NA |
| rare earth oxide | 3 | 1696,03 t | 0 t | 1696,03 t | Small deposit |
| uranium | 4 | NA | NA | NA | NA |
| thorium | 5 | NA | NA | NA | NA |

**Easting EUREF:** 598681,704
**Northing EUREF:** 7353837,058
**Easting YKJ:** 3598894
**Northing YKJ:** 7356913

**Discovery year:** 1985
**Discovered by:** Geological Survey of Finland
**Province:** Kuusamo-Kuolajärvi (Co, Au)
**District:** Kuusamo (Co, Au)
**Comments:** Discovery by GTK: ground geophysical checking of a low-altitude airborne electric anomaly
**References:** 2, 3, 4, 5, 11, 23, 24, 25, 26, 27, 30, 32, 36, 38, 39, 40

## 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:** 14, 27, 29, 30, 31, 35, 37, 38

## Dimension

**Expression:** exposed
**Form:** discordant
**Shape:** irregular
**Length (m):** 100
**Width (m):** 30
**Thickness (m):** NA
**Depth (m):** 300
**Area (ha):** 50
**Dip azim:** 235
**Dip:** 50
**Plunge azim:** NA
**Plunge dip:** NA
**Orientation method:** NA
**Dimension comments:** The steeply dipping deposit is open at the depth of 300-350 m. No lithological control on mineralisation indicated. Au-Co ore enveloped by Au-poor cobalt ore.

## 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 | 2003-2009 | Claim (old law) | NA |
| Outokumpu Oy | 1993-2003 | Mining concession (old law) | NA |
| Outokumpu Oy | 1986-1993 | Claim (old law) | NA |
| Geological Survey of Finland | 1983-1990 | NA | NA |

# EXPLORATION ACTIVITY

## Latitude 66 Cobalt Oy

| Years | Activity type | Geologist | Exploration result | Ref |
|---|---|---|---|---|
| 2019 | detailed geochemistry | Aaron Davies | NA | 16 |
| | *Hand-shovel sampling of soil at 15-20 cm depth, 200-3000 m long sampling profiles with 40 m distance between the profiles* | | | |

| | | | | |
|---|---|---|---|---|
| 2019 | detailed geophysics | Aaron Davies | geophysical anomaly | 20, 21 |
| | *Electromagnetic ground survey in 2019 suggests that the known ore bodies continue along strike to the east and west from the known parts. More electromagnetic ground survey in 2021.* | | | |

| | | | | |
|---|---|---|---|---|
| 2018-2018 | resource assessment | NA | mineral occurrences | 20 |
| | *Extensive ore-grade sections from parts not included into the mineral resource defined by Dragon Mining, mainly from the areas between the ore bodies reported by Dragon Mining.* | | | |
| | ***Intersections*** | | | |
| | HoleID | L66K1DD002 | | |
| | From-To | NA | | |
| | Length | 13m | | |
| | gold | 15,8ppm | | |
| | cobalt | 0,11% | | |
| | HoleID | L66K1DD004 | | |
| | From-To | NA | | |
| | Length | 5,5m | | |
| | gold | 18,5ppm | | |
| | cobalt | 0,52% | | |

| | | | | |
|---|---|---|---|---|
| 2018 | ore deposit evaluation | NA | mineral occurrences | 20, 21, 22 |
| | *Reassessment of the deposit with the aim in only underground mining at Juomasuo: prefeasibility, permitting* | | | |

| | | | | |
|---|---|---|---|---|
| 2018 | core drilling | NA | NA | 20 |
| | ***Intersections*** | | | |
| | HoleID | L66K1DD002 | | |
| | From-To | 35 | | |
| | Length | 230m | | |
| | gold | 4ppm | | |
| | cobalt | 0,13% | | |
| | *Comments* | *including 31 m from 198 m: 6.3 ppm Au, 0.24 % Co*<br>*including 13 m from 135 m: 15.8 ppm Au, 0.11 % Co*<br>*including 20 m from 159 m: 7.6 ppm Au, 0.09 % Co* | | |

## Dragon Mining Oy

| Years | Activity type | Geologist | Exploration result | Ref |
|---|---|---|---|---|
| 2012-2012 | regional geophysics | Matti Talikka | geophysical anomaly | 2, 3, 4, 5 |
| | *Helicoper-borne VTEM and magnetic survey over all Dragon Mining tenements in Kuusamo* | | | |

| | | | | |
|---|---|---|---|---|
| 2011-2013 | ore deposit evaluation | NA | key geological features | 34 |
| | *Environmental assessment* | | | |

| | | | | |
|---|---|---|---|---|
| 2010-2012 | core drilling systematic | Matti Talikka | mineral resource defined | 2, 3, 4, 5, 9 |
| | *Extensive diamond drilling, significantly larger resources defined* | | | |
| | ***Intersections*** | | | |
| | HoleID | NA | | |
| | From-To | NA | | |
| | Length | 7,2m | | |
| | gold | 8,76ppm | | |
| | HoleID | NA | | |
| | From-To | NA | | |
| | Length | 10m | | |
| | gold | 10,75ppm | | |
| | HoleID | NA | | |
| | From-To | NA | | |
| | Length | 10,6m | | |
| | gold | 16,54ppm | | |
| | HoleID | NA | | |
| | From-To | NA | | |
| | Length | 10,2m | | |
| | gold | 9,53ppm | | |

| | | | | |
|---|---|---|---|---|
| 2010-2014 | ore beneficiation tests | Matti Talikka | mineral resource defined | 2, 3, 4, 5 |
| | *Metallurgical test work, environmental studies, and EIA report.* | | | |

## Polar Mining Oy

| Years | Activity type | Geologist | Exploration result | Ref |
|---|---|---|---|---|
| 2003-2009 | core drilling | Matti Talikka | mineral resource defined | 3, 4, 6 |
| | *The deposit is roughly concentric, with an Au-Co ore body in the centre eveloped by a Co(-Au) ore body* | | | |

## Outokumpu Oy

| Years | Activity type | Geologist | Exploration result | Ref |
|---|---|---|---|---|
| 1992-1992 | mining pilot | NA | mineral reserve defined | 15 |

| | | | | |
|---|---|---|---|---|
| 1991-2003 | core drilling | NA | mineral resource indicated | 10, 15 |
| | *Diamond drilling for 7000 m, in profiles 12.5 m apart in 1991. More drilling in 1992* | | | |
| | ***Intersections*** | | | |
| | HoleID | KS/JS-056 | | |
| | From-To | 57 | | |
| | Length | 8m | | |
| | gold | 48,85ppm | | |
| | HoleID | KS/JS-057 | | |
| | From-To | 76,3 | | |
| | Length | 3,7m | | |
| | gold | 426,98ppm | | |
| | HoleID | KS/JS-10 | | |
| | From-To | 97,5 | | |
| | Length | 19,6m | | |

| | | |
|---|---|---|
| | gold | 63,7ppm |
| | HoleID | KS/JS-21 |
| | From-To | 177,2 |
| | Length | 19,2m |
| | gold | 179,52ppm |

## Geological Survey of Finland

| Years | Activity type | Geologist | Exploration result | Ref |
|---|---|---|---|---|
| 1989-1989 | regional geochemistry | Heikki Pankka. | geochemical anomaly | 14, 26, 27, 29, 30, 31 |
| | *Country-wide till-geochemical survey* | | | |

| | | | | |
|---|---|---|---|---|
| 1989-1989 | ore deposit evaluation | Jyrki Parkkinen | NA | 32 |
| | *Preliminary feasibility study* | | | |

| | | | | |
|---|---|---|---|---|
| 1985-1989 | core drilling | Heikki Pankka | mineral resource defined | 26 |
| | *Core drilling (reconnaissance drilling): 44 diamond-drill holes, total 7241 m.* | | | |
| | ***Intersections*** | | | |
| | HoleID | NA | | |
| | From-To | NA | | |
| | Length | 24m | | |
| | gold | 3,7ppm | | |
| | cobalt | 1980ppm | | |
| | copper | 230ppm | | |

| | | | | |
|---|---|---|---|---|
| 1984-1984 | regional geophysics | NA | key geological features | 1, 14, 26, 27, 29, 30, 31, 38 |
| | *Low-altitude airborne magnetic, electromagnetic and radiometric survey* | | | |

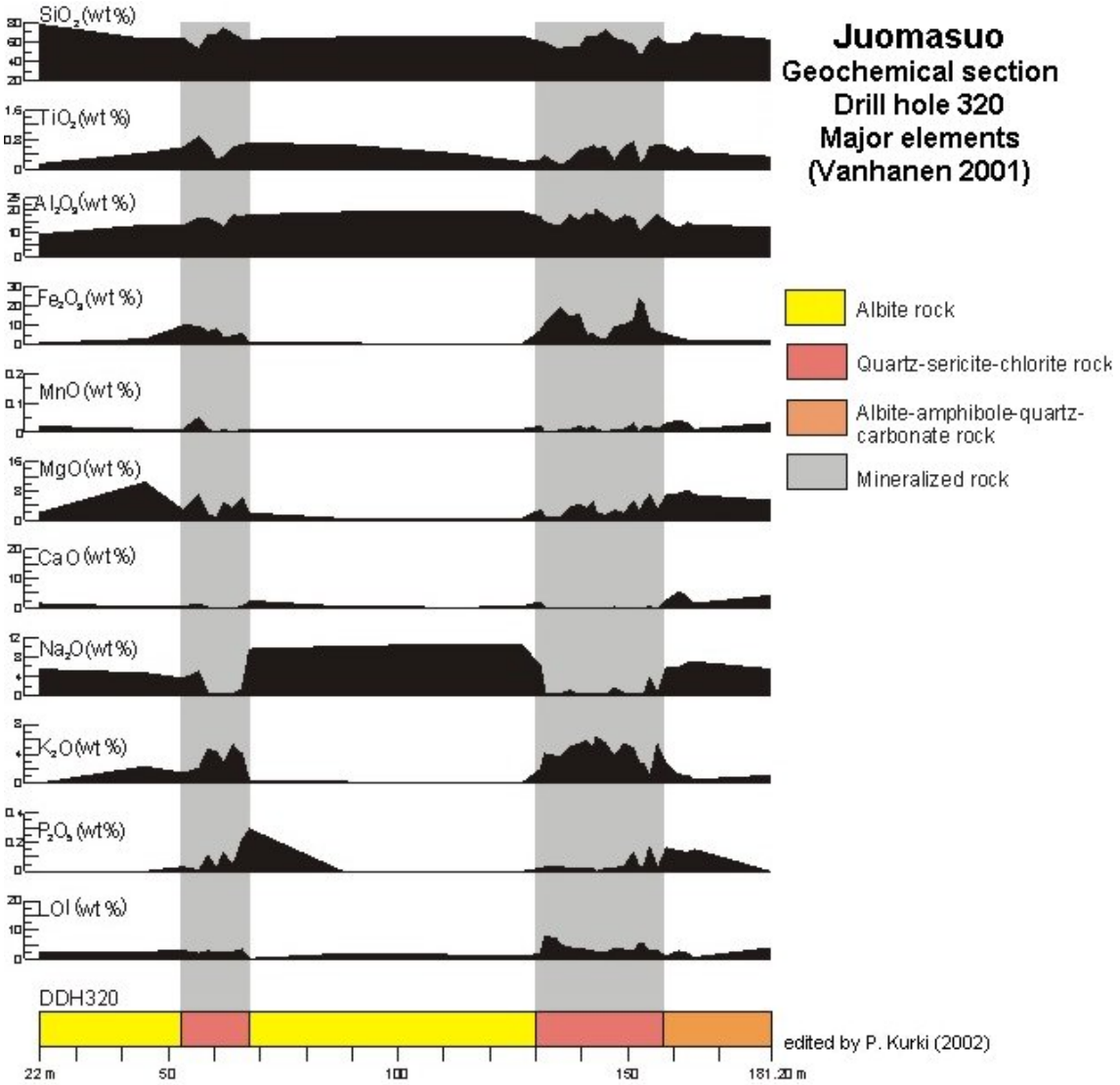
| | | | | |
|---|---|---|---|---|
| 1983-1989 | detailed geophysics | Heikki Pankka | geophysical anomaly | 1, 27, 31, 38 |
| | *Distinct uranium gamma-ray and electric anomalies, defined by low-altitude airborne survey data, and slingram, IP and VLF ground anomalies.* | | | |

| | | | | |
|---|---|---|---|---|
| 1983-1989 | detailed geology | Heikki Pankka, Erkki Vanhanen | mineral occurrences | 1, 14, 26, 27, 29, 30, 31, 38 |
| | *Deposit discovery* | | | |

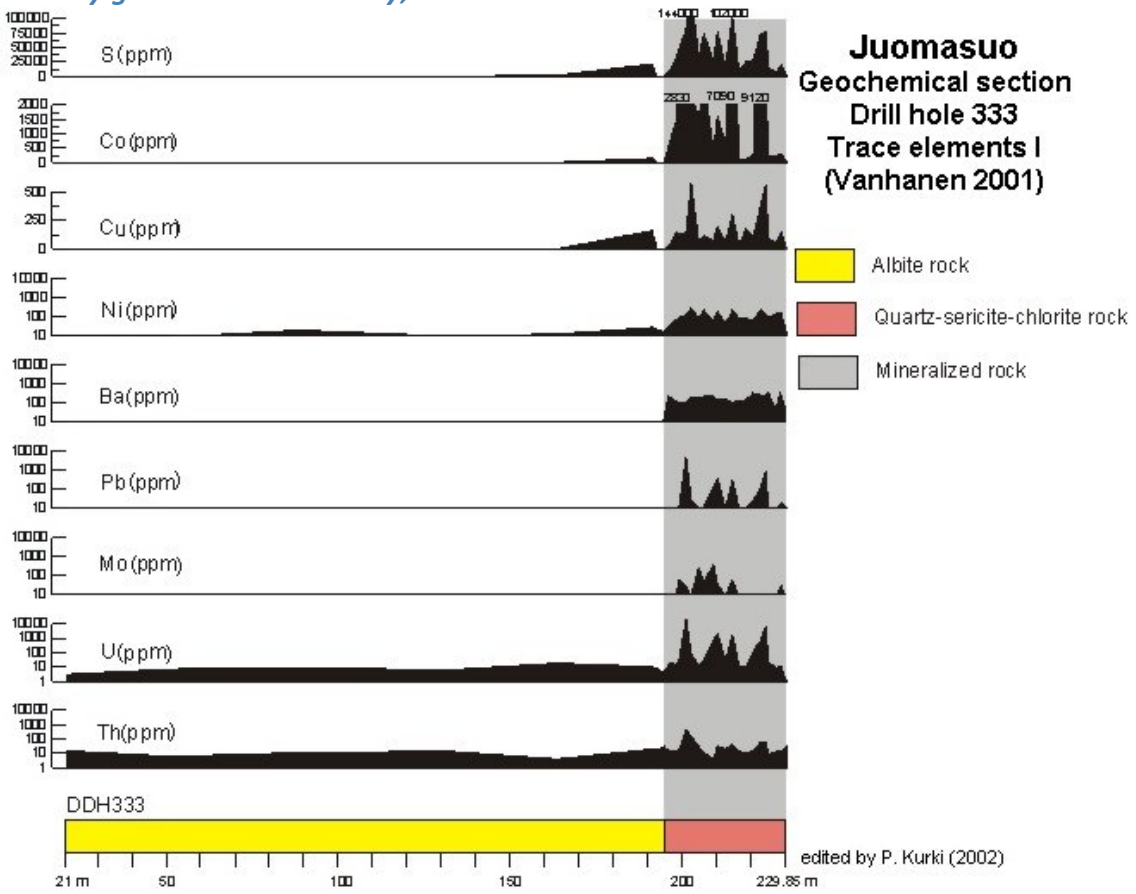
| | | | | |
|---|---|---|---|---|
| 1983-1989 | detailed geochemistry | Heikki Pankka, Erkki Vanhanen | geochemical anomaly | 26, 27, 30, 31, 38 |
| | *Elements enriched in the ore: Ag, As, Au, Ba, Bi, Co, Cu, Fe, K, Li, LREE, Mo, Ni, Pb, Rb, S, Se, Te, Th, U, V, W, Y (Vanhanen 2001). Primary dispersion; Au, U, W, Te and Se show significant positive correlation; the Te anomaly extends beyond Au anomaly* | | | |

## Figures

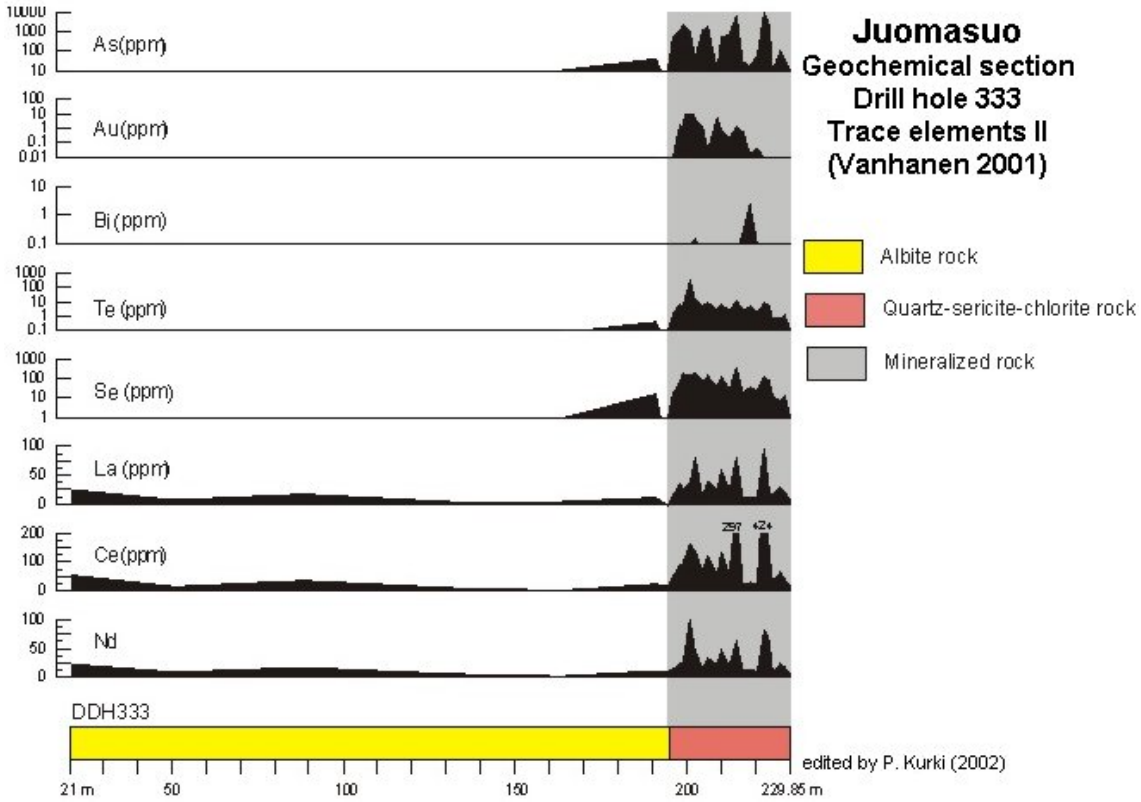
### *Primary geochemical anomaly; major elements:*



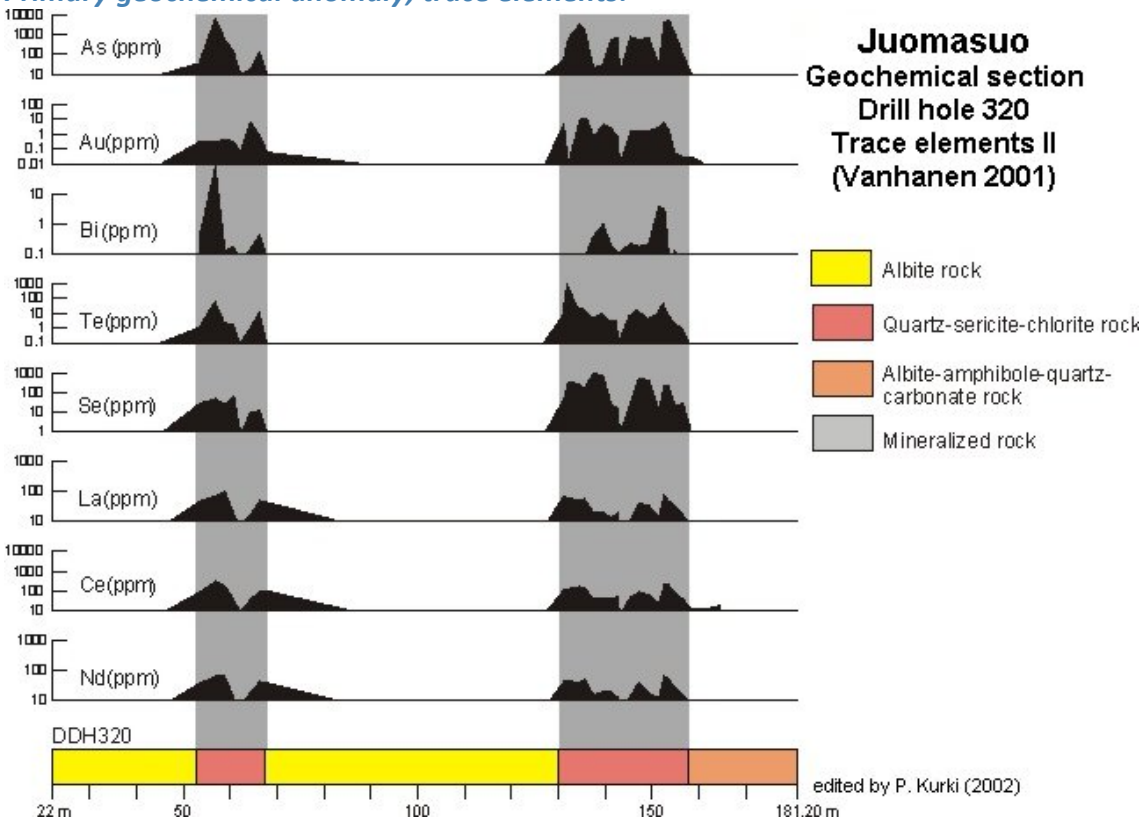
### *Primary geochemical anomaly; trace elements:*



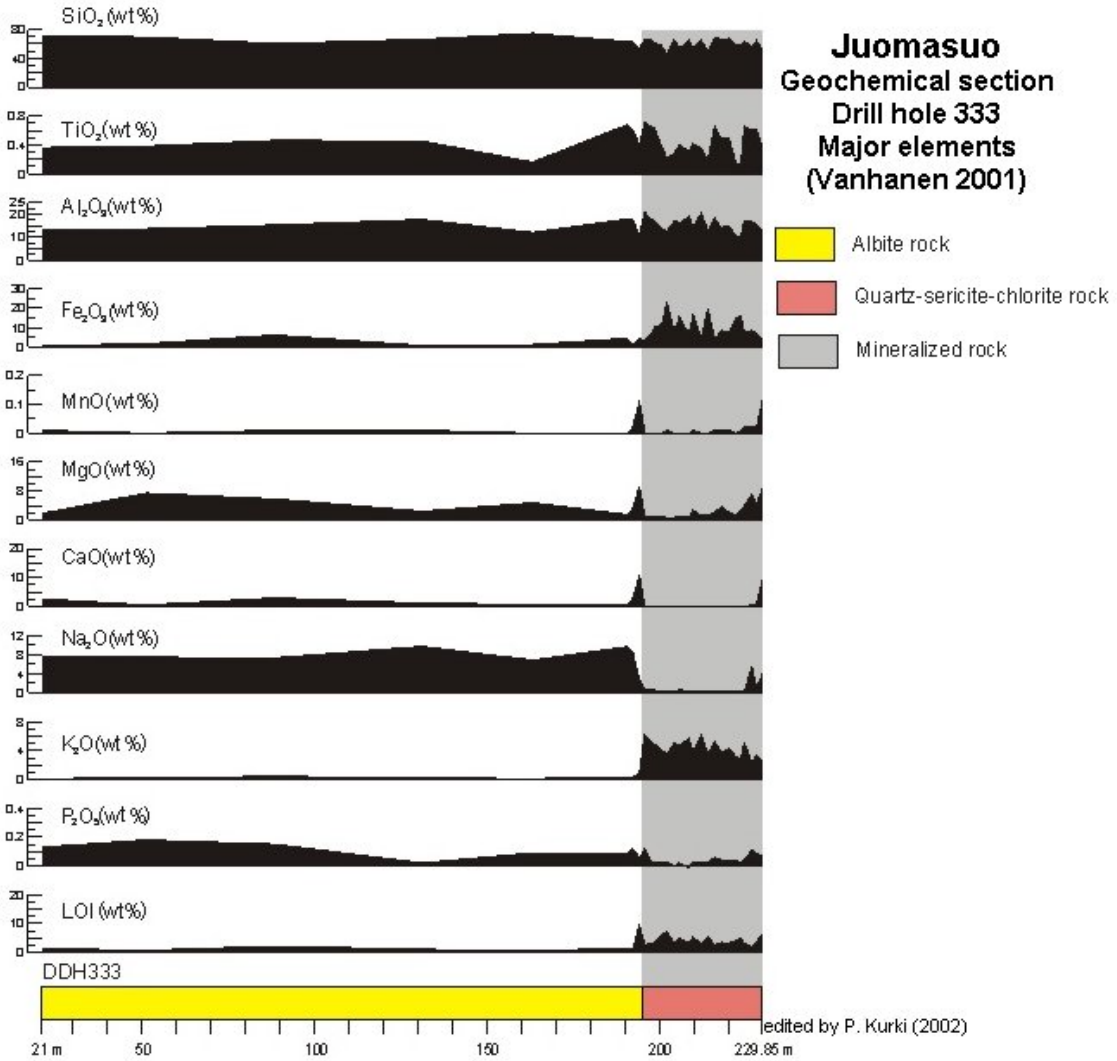

### *Primary geochemical anomaly; trace elements:*



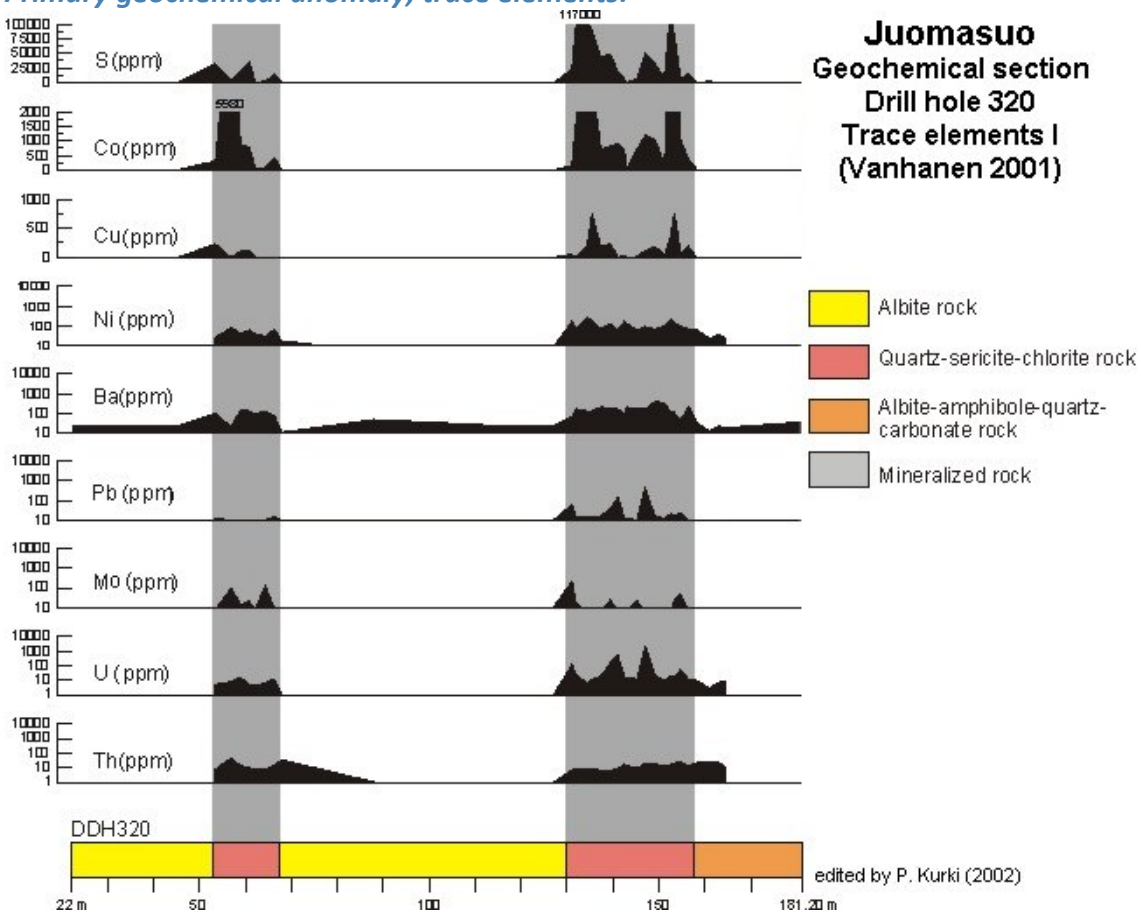
### *Primary geochemical anomaly; trace elements:*



### *Primary geochemical anomaly; major elements:*



### *Primary geochemical anomaly; trace elements:*



# RESOURCES AND RESERVES

## Most recent

| Type: | Company: | Year: | Date: | Calc Method: | Reference: |
|---|---|---|---|---|---|
| UNFC | Geological Survey of Finland | 2021 | 5.2.2021 | UNFC Code, reclassified | 12, 34 |
| | *Comments: This resource is for TREO. It is only published in an 2013 environmental permit application. It is not included into any CRIRSCO-compliant resource published by the company exploring the deposit. The data covers both the Au-Co and Co ore types as the total resource was known in 31 Dec 2012; hence the tonnage is less than in the 2013 JORC-compliant resource for Au and Co.* | | | | |
| | **Category:** | **343** | | | |
| | **Tonnage:** | **5,616 Mt** | | | |
| | rare earth oxide | 302 ppm | | | |
| | **Cutoff:** | **cobalt** | | | |
| | *Comments: This is of UNFC category defined as 'Remaining products not developed from identified projects or prospective projects may become developable in the future as technological or environmental-socio-economic conditions change. Some or all of these estimates may never be developed due to physical and/or environmental-socio-economic constraints.* | | | | |

| Type: | Company: | Year: | Date: | Calc Method: | Reference: |
|---|---|---|---|---|---|
| Resource | Latitude 66 Cobalt Oy | 2020 | NA | JORC code | 17, 18, 19 |
| | *Comments: In GTK´s Mineral deposite database K1, K2 and K3 are three separate minerale deposits. K1 = Juomasuo. K2 = Hangaslampi. K3 = Pohjasvaara. 200 ppm Co cut-off has been used for K1 and 0.5 ppm Au cut-off has been used for K2 and K3. This results in total amount of 20.6 t of Au and 16 500 t of Co in 25.71 Mt of ore in K1, K2 and K3.* | | | | |
| | **Category:** | **Indicated mineral resource** | | | |
| | **Tonnage:** | **9,6 Mt** | | | |
| | cobalt | 840 ppm | | | |
| | gold | 1,4 ppm | | | |
| | **Cutoff:** | **cobalt 200 ppm** | | | |
| | **Category:** | **Inferred mineral resource** | | | |
| | **Tonnage:** | **14,6 Mt** | | | |
| | cobalt | 520 ppm | | | |
| | gold | 0,2 ppm | | | |
| | **Cutoff:** | **cobalt 200 ppm** | | | |
| | **Category:** | **Indicated and inferred mineral resource** | | | |
| | **Tonnage:** | **24,2 Mt** | | | |
| | gold | 0,676 ppm | | | |
| | cobalt | 646,942 ppm | | | |
| | **Cutoff:** | **cobalt 200 ppm** | | | |

## Previous calculations

| Type: | Company: | Year: | Date: | Calc Method: | Reference: |
|---|---|---|---|---|---|
| Resource | Latitude 66 Cobalt Oy | 2020 | NA | JORC code | |

| | | |
|---|---|---|
| | *Comments: In this entry, 0.5 ppm Au cut-off has been used in all classes, which results 20.1 t of Au in 7.31 Mt of ore.* | |
| | **Category:** | **Indicated mineral resource** |
| | **Tonnage:** | **960000 t** |
| | cobalt | 520 ppm |
| | gold | 3,2 ppm |
| | **Cutoff:** | **gold 0,5 ppm** |
| | **Category:** | **Indicated mineral resource** |
| | **Tonnage:** | **340000 t** |
| | cobalt | 640 ppm |
| | gold | 2,2 ppm |
| | **Cutoff:** | **gold 0,5 ppm** |
| | **Category:** | **Indicated mineral resource** |
| | **Tonnage:** | **4,6 Mt** |
| | cobalt | 970 ppm |
| | gold | 2,9 ppm |
| | **Cutoff:** | **gold 0,5 ppm** |
| | **Category:** | **Inferred mineral resource** |
| | **Tonnage:** | **120000 t** |
| | cobalt | 560 ppm |
| | gold | 2 ppm |
| | **Cutoff:** | **gold 0,5 ppm** |
| | **Category:** | **Inferred mineral resource** |
| | **Tonnage:** | **1,2 Mt** |
| | cobalt | 470 ppm |
| | gold | 2,1 ppm |
| | **Cutoff:** | **gold 0,5 ppm** |
| | **Category:** | **Inferred mineral resource** |
| | **Tonnage:** | **90000 t** |
| | cobalt | 540 ppm |
| | gold | 1,7 ppm |
| | **Cutoff:** | **gold 0,5 ppm** |
| | **Category:** | **Indicated and inferred mineral resource** |
| | **Tonnage:** | **7310000 t** |
| | gold | 2,746 ppm |
| | cobalt | 801,45 ppm |
| | **Cutoff:** | **gold 0,5 ppm** |

| **Type:** | **Company:** | **Year:** | **Date:** | **Calc Method:** | **Reference:** |
|---|---|---|---|---|---|
| Resource | Dragon Mining Oy | 2013 | 1.9.2015 | JORC code | 4, 5, 34 |
| | *Comments: Dragon has published in Annual Report 2015 that mineral resource remains unchanged 1.9.2015*<br>*This Co-dominated ore envelopes the Au-rich ore at Juomasuo. So there are two types of ores AND two mutually excluding resources for the deposit, the 2.371 Mt gold-cobalt ore and the 5.04 Mt cobalt ore. The Cu content of the gold-cobalt ore is estimated to 0.03 % (Vanhanen 2001) and, according to the EIA report, the TREO is 444 ppm and U content 55 ppm.* | | | | |
| | **Category:** | **Measured mineral resource** | | | |
| | **Tonnage:** | **160000 t** | | | |
| | gold | 7,4 ppm | | | |
| | cobalt | 0,14 % | | | |
| | **Cutoff:** | **gold 1 ppm** | | | |
| | **Category:** | **Indicated mineral resource** | | | |
| | **Tonnage:** | **1389000 t** | | | |
| | gold | 4,6 ppm | | | |
| | cobalt | 0,14 % | | | |
| | **Cutoff:** | **gold 1 ppm** | | | |
| | **Category:** | **Inferred mineral resource** | | | |
| | **Tonnage:** | **822000 t** | | | |
| | gold | 3,9 ppm | | | |
| | cobalt | 0,1 % | | | |

| | | |
|---|---|---|
| | **Cutoff:** | **gold 1 ppm** |
| | **Category:** | **Measured, indicated and inferred mineral resource** |
| | **Tonnage:** | **2371000 t** |
| | cobalt | 0,126 % |
| | gold | 4,546 ppm |
| | **Cutoff:** | **gold 1 ppm** |
| | *Comments: Gold-cobalt ore body in the central part of the deposit* | |

| Type: | Company: | Year: | Date: | Calc Method: | Reference: |
|---|---|---|---|---|---|
| Resource | Dragon Mining Oy | 2013 | NA | JORC code | 3, 4, 5 |
| | *Comments: This Co-dominated ore envelopes the Au-rich ore at Juomasuo. So there are two types of ores AND two mutually excluding resources for the deposit. The Cu content of the ore is estimated to 0.03 % (Vanhanen 2001), and total REE is possibly between 0.02 and 0.2 %.* | | | | |
| | **Category:** | **Measured, indicated and inferred mineral resource** | | | |
| | **Tonnage:** | **3084000 t** | | | |
| | cobalt | 0,12 % | | | |
| | gold | 0,1 ppm | | | |
| | **Cutoff:** | **NA** | | | |

| Type: | Company: | Year: | Date: | Calc Method: | Reference: |
|---|---|---|---|---|---|
| Resource | Dragon Mining Oy | 2013 | 1.9.2015 | JORC code | 5 |
| | *Comments: Dragon has published in Annual Report 2015 that mineral resource remains unchanged 1.9.2015*<br>*The Co-dominated ore envelopes the Au-rich ore at Juomasuo. There are two types of ores; two mutually excluding resources for the deposit, the 2.371 Mt gold-cobalt ore and the 5.04 Mt cobalt ore. The Cu content of the Au-Co ore is estimated to 0.03 % (Vanhanen 2001) and, according to the EIA report, TREO is 278 ppm, U content 158 ppm, and Th content in the Au-Co ore 8.6 ppm and in Co ore 7.2 ppm.* | | | | |

| | | |
|---|---|---|
| | **Category:** | **Measured mineral resource** |
| | **Tonnage:** | **287000 t** |
| | cobalt | 0,12 % |
| | **Cutoff:** | **cobalt 0,05 %** |
| | **Category:** | **Indicated mineral resource** |
| | **Tonnage:** | **2845000 t** |
| | cobalt | 0,11 % |
| | **Cutoff:** | **cobalt 0,05 %** |
| | **Category:** | **Inferred mineral resource** |
| | **Tonnage:** | **1908000 t** |
| | cobalt | 0,12 % |
| | **Cutoff:** | **cobalt 0,05 %** |
| | **Category:** | **Measured, indicated and inferred mineral resource** |
| | **Tonnage:** | **5040000 t** |
| | cobalt | 0,114 % |
| | **Cutoff:** | **cobalt 0,05 %** |

| Type: | Company: | Year: | Date: | Calc Method: | Reference: |
|---|---|---|---|---|---|
| Resource | Polar Mining Oy | 2011 | NA | JORC code | 2 |
| | **Category:** | **NA** | | | |
| | **Tonnage:** | **1,403 Mt** | | | |
| | gold | 5,7 ppm | | | |
| | cobalt | 0,15 % | | | |
| | copper | 0,03 % | | | |
| | **Cutoff:** | **gold 0,5 ppm** | | | |

| Type: | Company: | Year: | Date: | Calc Method: | Reference: |
|---|---|---|---|---|---|
| Resource | Outokumpu Oy | 1990 | NA | NA | 7 |
| | *Comments: The Cu content of the ore is estimated to 0.03 % (Vanhanen 2001), and total REE is possibly between 0.02 and 0.2 %* | | | | |

| | | | | | |
|---|---|---|---|---|---|
| | **Category:** | **NA** | | | |
| | **Tonnage:** | **0,779 Mt** | | | |
| | gold | 4,2 ppm | | | |
| | **Cutoff:** | **gold 1 ppm** | | | |

| **Type:** | **Company:** | **Year:** | **Date:** | **Calc Method:** | **Reference:** |
|---|---|---|---|---|---|
| Resource | Geological Survey of Finland | 1989 | NA | Non-compliant resource estimate | 28 |
| | **Category:** | **NA** | | | |
| | **Tonnage:** | **0,7 Mt** | | | |
| | gold | 6 ppm | | | |
| | cobalt | 0,15 % | | | |
| | **Cutoff:** | **gold 1 ppm** | | | |

# MINING

## Juomasuo

**Easting EUREF:** 598681,704
**Northing EUREF:** 7353837,058
**Status:** Test mining
**Operating years:** 1992-1992
**Years in production:** 1
**Total ore mined:** 17645 t
**References:** 13, 33

### Total production:

| Product | Product measure |
|---|---|
| gold | 104,04 kg |
| cobalt | 24,68 t |

### Other materials:

| Material type | Material measure |
|---|---|
| Waste rock | 42590 t |

### Mining activity:

| Year | Ore mined | Ore processed | Activity type | Production | Other material |
|---|---|---|---|---|---|
| 1992 | 17645 t | 17635 t | open-pit mining | | |
| | | | | gold 104,04 kg<br>cobalt 24,68 t | Waste rock 42590 t |

## Figures

### *Open pit photo:*

Juomasuo open pit in June 2003. Photo Pasi Eilu.

# GEOLOGY

**Host rock:** Sericite quartzite, Mafic volcanic rock, Intermediate volcanic rock, Felsic volcanic rock, Silicate-siltstone
**Wall rock:** Ultramafic hypabyssal rock

## Sericite quartzite (Host rock)

**Rock type:** Host rock
**Proportion:** minor
**Grain size:** Fine grained 0.2 - 1 mm
**Color:** Greyish
**References:** 14, 15, 26, 27, 29, 30, 31, 36, 37, 38, 39, 40
**Comments:** Not clear what exactly is the primary rock type; possibly not just quartzite but also siltstone and various evaporitic rocks may be included into the precursors

**Ore minerals:**

| Mineral | Proportion | Mineral texture |
|---|---|---|
| Altaite | minor | |
| Calaverite | minor | |
| Chalcopyrite | minor | |
| Clausthalite | minor | |
| Cobaltite | minor | |
| Cobaltpentlandite | minor | |
| Frohbergite | minor | |
| Galena | minor | |
| Gold | minor | |
| | *Native gold is chiefly associated with Bi and Te minerals as inclusions in pyrite, cobaltite and uraninite, between silicates, and tiny Au-Bi-Te veinlets oriented parallel with foliation and enveloped by silicates. Fineness; 95–97% Au, 1–4% Ag, 1.6–1.8% Se, <0.14% Te* | |
| Ilmenite | minor | |
| Kawazulite | minor | |
| Linnaeite | minor | |
| Magnetite | minor | |
| Mattagamite | minor | |
| Melonite | minor | |
| Molybdenite | minor | |
| Pyrite | major | |
| Pyrrhotite | major | |
| Rucklidgeite | minor | |
| Rutile | minor | |
| Tellurobismuthite | minor | |
| Uraninite | minor | |

**Other minerals:**

| Mineral | Proportion | Mineral texture |
|---|---|---|
| Albite | present | |
| Amphibole | present | Alteration product |
| Biotite | present | |
| Chlorite | present | |
| Dolomite | present | |
| Phlogopite | present | Alteration product |
| Quartz | present | |
| Scheelite | present | |

| | | |
|---|---|---|
| Sericite | present | |
| Talc | present | Alteration product |
| Titanite | present | |

| Structures |
|---|
| Sheared |
| *Comments: NW-trending ductile shear zone which cuts across the regional, N-S to NE-trending Käylä-Konttiaho Anticline, especially, areas close to the contact between Sericite Quartzite and Greenstone II Formations are critical for mineralisation.* |
| Deformed |
| *Comments: At least two major folding stages. D1 is characterised by a major N-S trending antiform whose northern end is bended to the east due to D2; D2 is also presented by S2 foliation and a conjugate set of NW- and NE-trending, chiefly sinistral shear and fault zones. Only brittle deformation before 1.91 Ga. The deposit is in a doubly plunging anticlinorum.* |

| Textures |
|---|
| Porphyroblastic |
| *Comments: Dolomite porphyroblasst up to 2 cm in diameter* |
| Foliated |
| *Comments: Foliated, with the degree of foliation increasing towards the centre of the mineralisation. Only rocks rich in mica and chlorite are foliated. Intensely albitised rocks only show brittle deformation.* |
| Granoblastic |

| Alteration: | Distribution: | Degree: | Relation to mineralization: |
|---|---|---|---|
| albitic alteration | Pervasive | Strong | Pre |
| *Comments: Intense albitisation 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* | | | |
| carbonate alteration | Disseminated | Moderate | Pre |
| sulphidation | Disseminated | NA | Syn |
| biotite alteration | Disseminated | Weak | Syn |
| *Comments: Biot-Chl alteration relates to Co-dominated mineralisation stage* | | | |
| chloritic alteration | Disseminated | Moderate | Syn |
| *Comments: Biot-Chl alteration relates to Co-dominated mineralisation stage* | | | |
| sericitic alteration | Disseminated | Moderate | Syn |
| *Comments: Sericitisation relates to Au-dominated mineralisation stage* | | | |

## 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 | Syn |
| *Comments: Peak regional metamorphism at lower-amphibolite facies: staurolite porphyroblasts in Al-rich rocks, during D1?. This was followed by retrograde greenschist-facies metamorphism: sericitisation of staurolite, during D2?, related to NW-trending shear zones and gold mineralisation?; Quartz-albite-rutile ± carbonate, haematite, sericite, chlorite* | | | |

### Geological age:

| Geological era: | Max age - Minage (Ma): | Inferred age (Ma): | Age of mineralization: |
|---|---|---|---|
| Paleoproterozoic (2500-1600 Ma) | 1900-2050 | | N |
| Paleoproterozoic (2500-1600 Ma) | 1800-2500 | | N |

## Mafic volcanic rock (Host rock)

**Rock type:** Host rock
**Proportion:** major
**Grain size:** NA
**Color:** NA
**References:** 14, 26, 27, 29, 30, 31, 37, 38, 39, 40
**Comments:** Possibly the main host rock. Elements enriched related to mineralisation, Co ore: gain in As, Au, Co, Fe, K, Mo, S; loss in Na, Ca (except felsic volcs where gain), Mg, Si; Au-Co ore: gain in As, Au, Co, Fe, K, Mo, S; loss in Na, Ca, Mg, Si. The least mobile metals in all stages of alteration and mineralisation: Al, Nb, Ti, Zr, Ni

### Ore minerals:

| Mineral | Proportion | Mineral texture |
|---|---|---|
| Chalcopyrite | present | |
| Cobaltite | present | |
| Cobaltpentlandite | | |
| Gold | trace | |
| Molybdenite | present | |
| Pyrite | | |
| Pyrrhotite | minor | |
| Pyrrhotite | | |

### Other minerals:

| Mineral | Proportion | Mineral texture |
|---|---|---|
| Albite | major | |
| Biotite | major | |
| Chlorite | major | |
| Magnetite | | |
| Muscovite | | |
| | *Phengitic in composition* | |
| Quartz | | |
| Rutile | | |

| Textures |
|---|
| Foliated |

| |
|---|
| *Comments: Foliated, with the degree of foliation increasing towards the centre of the mineralisation. Only rocks rich in mica and chlorite are foliated. Intensely albitised rocks only show brittle deformation.* |

| Alteration: | Distribution: | Degree: | Relation to mineralization: |
|---|---|---|---|
| albitic alteration | Disseminated | Weak | Pre |
| albitic alteration | Disseminated | Weak | Pre |
| carbonate alteration | Disseminated | Weak | Pre |
| chloritic alteration | Disseminated | Moderate | Syn |
| *Comments: Relates to earlier, Co mineralisation* | | | |
| sulphidation | Disseminated | Moderate | Syn |
| *Comments: Two stages (Vasilopoulos et al. 2021): A reduced, metamorphic fluid was responsible for deposition of the pyrrhotite-dominant, Co-rich ore, whereas a relatively oxidized fluid deposited the pyrite-dominant Au–Co ore.* | | | |
| sericitic alteration | Disseminated | Moderate | Syn |
| *Comments: Sericitisation relates to the later, Au-Co mineralisation stage* | | | |
| biotite alteration | Disseminated | Moderate | Syn |
| *Comments: Biot-Chl alteration relates to Co-dominated, early, mineralisation stage* | | | |

### 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 | Syn | | |
| *Comments: Peak regional metamorphism at lower-amphibolite facies: staurolite porphyroblasts in Al-rich rocks, during D1?. This was followed by retrograde greenschist-facies metamorphism: sericitisation of staurolite, during D2?, related to NW-trending shear zones and gold mineralisation?* | | | | | |

### Geological age:

| Geological era: | Max age - Minage (Ma): | Inferred age (Ma): | Age of mineralization: |
|---|---|---|---|
| Paleoproterozoic (2500-1600 Ma) | 1900-2200 | | N |

## Intermediate volcanic rock (Host rock)

**Rock type:** Host rock
**Proportion:** present
**Grain size:** Fine grained 0.2 - 1 mm
**Color:** Grey
**References:** 40
**Comments:** Primary composition indirectly indicated by detailed mass balance evaluation and petrography

| Alteration: | Distribution: | Degree: | Relation to mineralization: |
|---|---|---|---|
| albitic alteration | Pervasive | Moderate | Pre |
| carbonate alteration | Disseminated | Moderate | Pre |
| sericitic alteration | Disseminated | Moderate | Syn |
| *Comments: Sericitisation relates to Au-dominated mineralisation stage* | | | |
| biotite alteration | Pervasive | Moderate | Syn |
| *Comments: Biot-Chl alteration relates to Co-dominated mineralisation stage* | | | |
| chloritic alteration | Pervasive | Moderate | Syn |

### Geological age:

| Geological era: | Max age - Minage (Ma): | Inferred age (Ma): | Age of mineralization: |
|---|---|---|---|
| Paleoproterozoic (2500-1600 Ma) | 1900-2200 | | N |

## Felsic volcanic rock (Host rock)

**Rock type:** Host rock
**Proportion:** minor
**Grain size:** Fine grained 0.2 - 1 mm
**Color:** Grey
**References:** 14, 26, 27, 29, 30, 31, 37, 38, 40

### Other minerals:

| Mineral | Proportion | Mineral texture |
|---|---|---|
| Albite | major | |
| Dolomite | minor | |
| Quartz | major | |
| Rutile | present | |

| Alteration: | Distribution: | Degree: | Relation to mineralization: |
|---|---|---|---|
| albitic alteration | Pervasive | Moderate | Pre |
| carbonate alteration | Pervasive | Weak | Pre |
| sericitic alteration | Disseminated | Moderate | Syn |
| *Comments: Sericitisation relates to Au-dominated mineralisation stage* | | | |
| biotite alteration | Pervasive | Moderate | Syn |
| *Comments: Biot-Chl alteration relates to Co-dominated mineralisation stage* | | | |
| chloritic alteration | Pervasive | Moderate | Syn |
| *Comments: Biot-Chl alteration relates to Co-dominated mineralisation stage* | | | |

### 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 | Syn | | |
| *Comments: Peak regional metamorphism at lower-amphibolite facies: staurolite porphyroblasts in Al-rich rocks, during D1?. This was followed by retrograde greenschist-facies metamorphism: sericitisation of staurolite, during D2?, related to NW-trending shear zones and gold mineralisation?* | | | | | |

### Geological age:

| Geological era: | Max age - Minage (Ma): | Inferred age (Ma): | Age of mineralization: |
|---|---|---|---|
| Paleoproterozoic (2500-1600 Ma) | 1900-2200 | | N |

## Silicate-siltstone (Host rock)

**Rock type:** Host rock
**Proportion:** minor
**Grain size:** Fine grained 0.2 - 1 mm

**Color:** Grey
**References:** 38, 40
**Comments:** Not clear what exactly is the primary rock type; possibly not just arkose quartzite but also siltstone and various evaporitic rocks may be included into the precursors, pale grey where albitised

**Other minerals:**

| Mineral | Proportion | Mineral texture |
|---|---|---|
| Albite | more than half | |
| Dolomite | minor | |
| Quartz | minor | |

| Textures |
|---|
| Porphyroblastic |
| *Comments: Idiomorphic ferrous dolomite porphyroblasts; possibly pseudomorphs after diagenetic halite grains?* |

| Alteration: | Distribution: | Degree: | Relation to mineralization: |
|---|---|---|---|
| albitic alteration | Pervasive | Strong | Pre |
| carbonate alteration | Disseminated | Moderate | Pre |
| sericitic alteration | Disseminated | Moderate | Syn |
| *Comments: Sericitisation relates to Au-dominated mineralisation stage* | | | |
| biotite alteration | Pervasive | Moderate | Syn |
| *Comments: Biot-Chl alteration relates to Co-dominated mineralisation stage* | | | |
| chloritic alteration | Pervasive | Moderate | Syn |
| *Comments: Biot-Chl alteration relates to Co-dominated mineralisation stage* | | | |

**Geological age:**

| Geological era: | Max age - Minage (Ma): | Inferred age (Ma): | Age of mineralization: |
|---|---|---|---|
| Paleoproterozoic (2500-1600 Ma) | 1900-2200 | | N |

## Ultramafic hypabyssal rock (Wall rock)

**Rock type:** Wall rock
**Proportion:** minor
**Grain size:** NA
**Color:** Dark coloured
**References:** 14, 26, 27, 29, 30, 31, 37, 38, 39, 40
**Comments:** The only primary rock type at Juomasuo not albitised nor hosting any ore

**Ore minerals:**

| Mineral | Proportion | Mineral texture |
|---|---|---|
| Pentlandite | present | |
| Pyrrhotite | minor | |

**Other minerals:**

| Mineral | Proportion | Mineral texture |
|---|---|---|
| Albite | present | |

| | |
|---|---|
| | *Proportions of all minerals vary according to degreee and type of alteration* |
| Amphibole | minor |
| Biotite | minor |
| Chlorite | major |
| Dolomite | minor |
| | *Proportions of all minerals vary according to degreee and type of alteration* |
| Magnetite | minor |
| | *Proportions of all minerals vary according to degreee and type of alteration* |
| Talc | major |

| **Textures** |
|---|
| Porphyroblastic |
| *Comments: Dolomite porphyryblasts up to 6 mm in diameter* |
| Foliated |
| *Comments: Foliated, with the degree of foliation increasing towards the centre of the mineralisation. Only rocks rich in mica and chlorite are foliated. Intensely albitised rocks only show brittle deformation.* |

| **Alteration:** | **Distribution:** | **Degree:** | **Relation to mineralization:** |
|---|---|---|---|
| chloritic alteration | Disseminated | Moderate | NA |
| biotite alteration | Disseminated | Moderate | NA |
| carbonate alteration | Disseminated | Moderate | |

## 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 | Syn | | |
| *Comments: Peak regional metamorphism at lower-amphibolite facies: staurolite porphyroblasts in Al-rich rocks, during D1?. This was followed by retrograde greenschist-facies metamorphism: sericitisation of staurolite, during D2?, related to NW-trending shear zones and gold mineralisation?; Chlorite-talc-tremolite-carbonate-albite-magnetite.* | | | | | |

## Geological age:

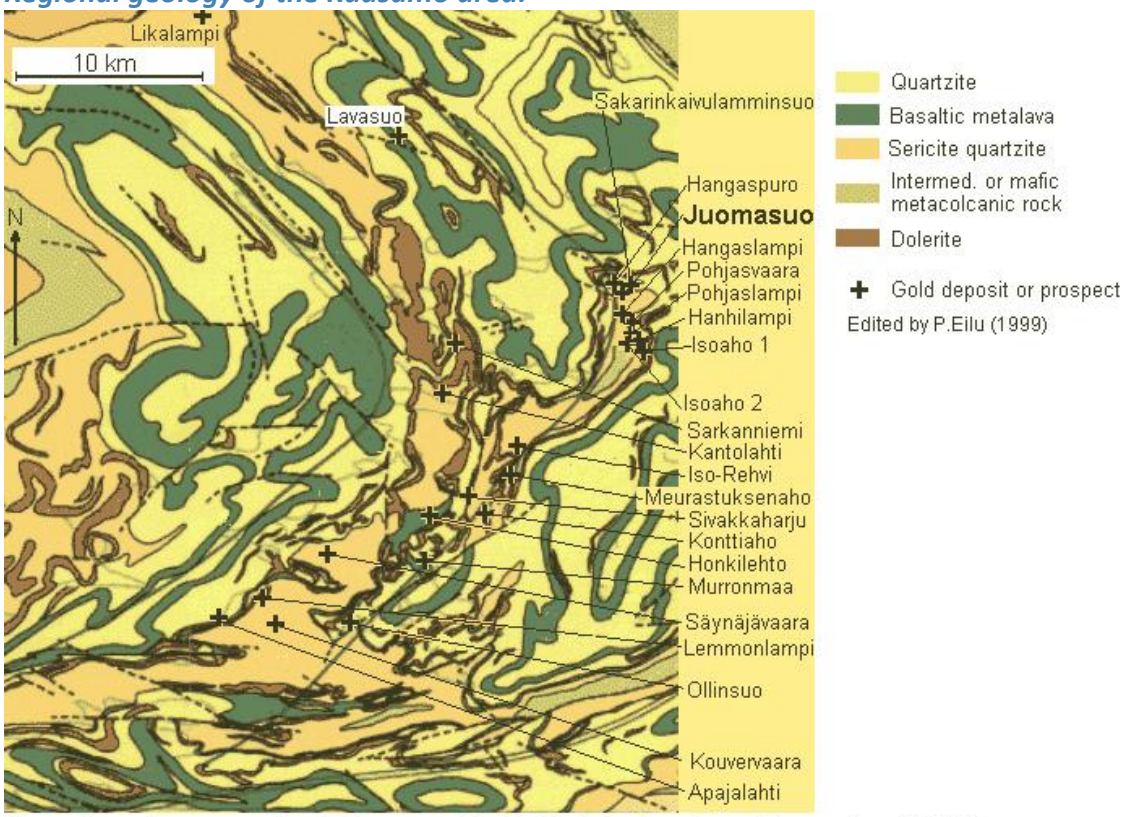
| **Geological era:** | **Max age - Minage (Ma):** | **Inferred age (Ma):** | **Age of mineralization:** |
|---|---|---|---|
| Paleoproterozoic (2500-1600 Ma) | 1800-2200 | | N |

# Figures

***Outcrop photo; early albitization of a sedimentary unit:***

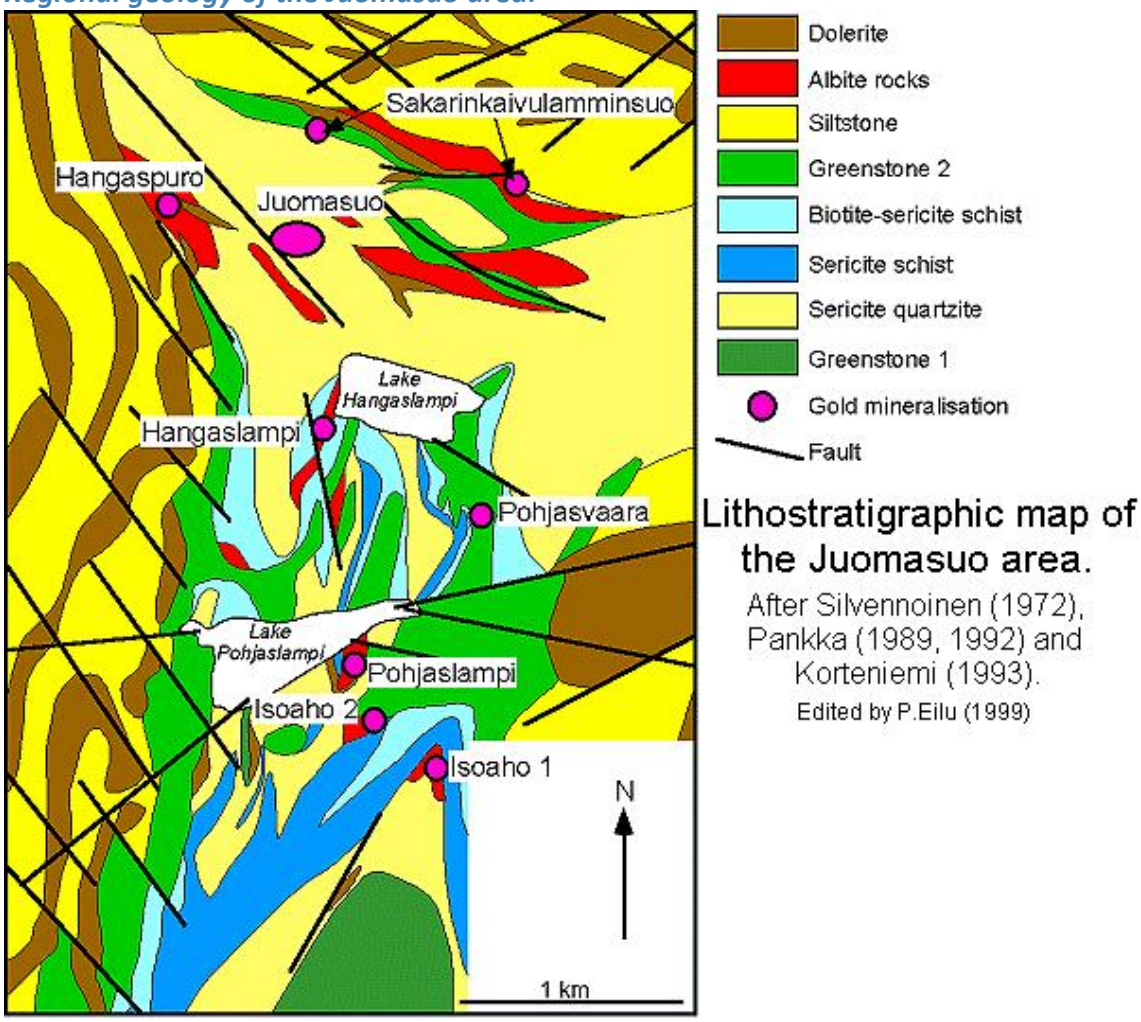
**Syndiagenetic(?), early albitisation of fine-grained sedimentary unit at Juomasuo. The compass plate is 11 cm long. Photo Pasi Eilu 16 May 2006.**

## *Regional geology of the Kuusamo area:*

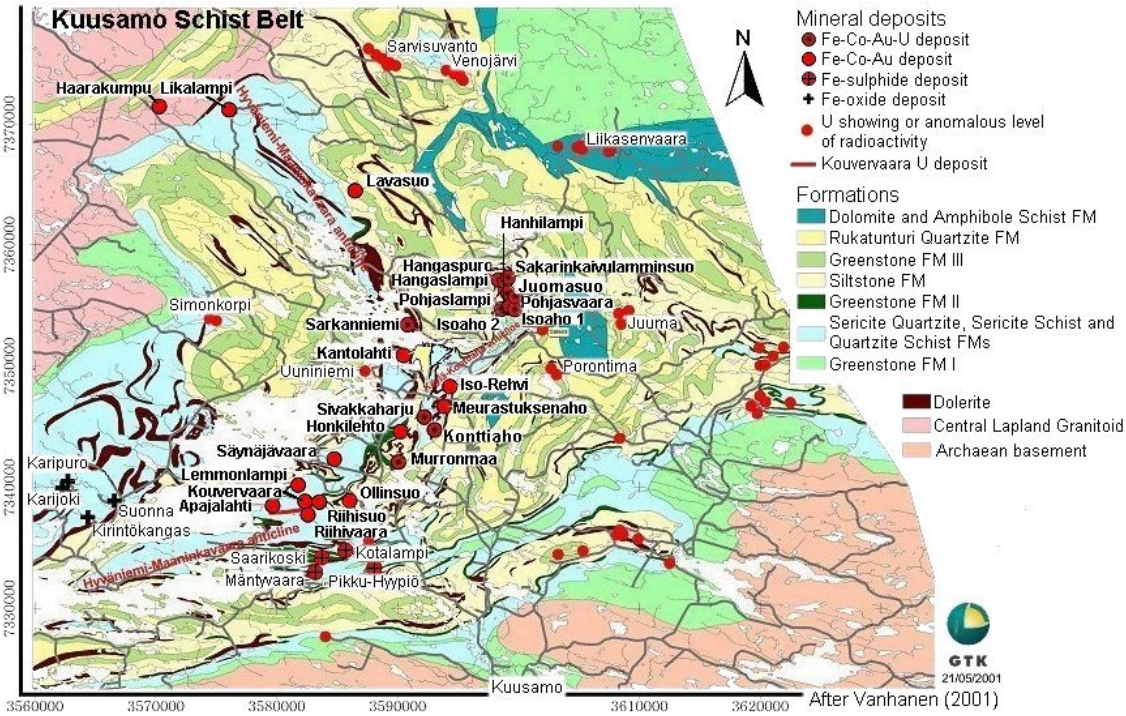



Deposits and prospects in the Kuusamo Schist Belt. Geology from Silvennoinen (1992).
Solid and dashed, curved lines indicate boundaries between lithological units, faults and shear zones

***Regional geology of the Juomasuo area:***



## *Mineral deposits of the Kuusamo area:*

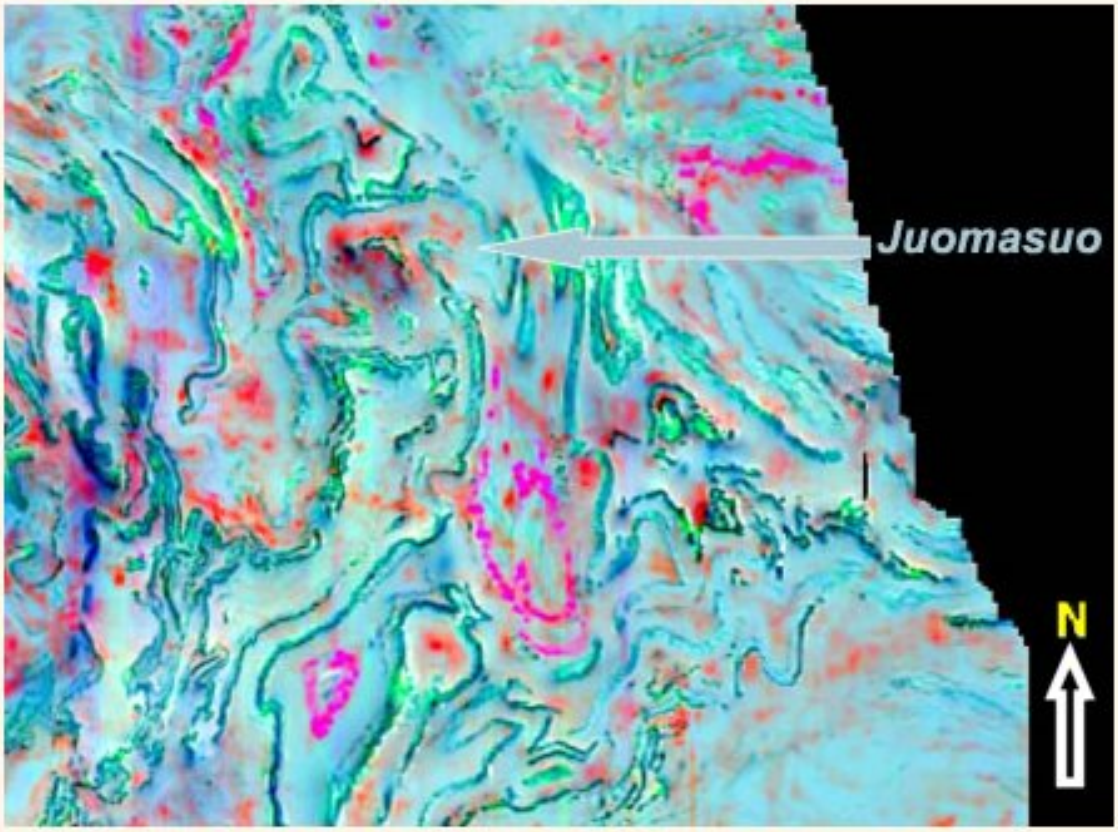


After Vanhanen (2001)

## *The proximal alteration in the sheared mafic(?) host rock:*

Juomasuo, Kuusamo. Proximal alteration and gold mineralisation in mafic(?) host rock. Mineral assemblage sericite - albite - chlorite - quartz - rutile - pyrrhotite ± biotite. Field of view 15 cm. Photo Jari Väätäinen.

### *Structure:*

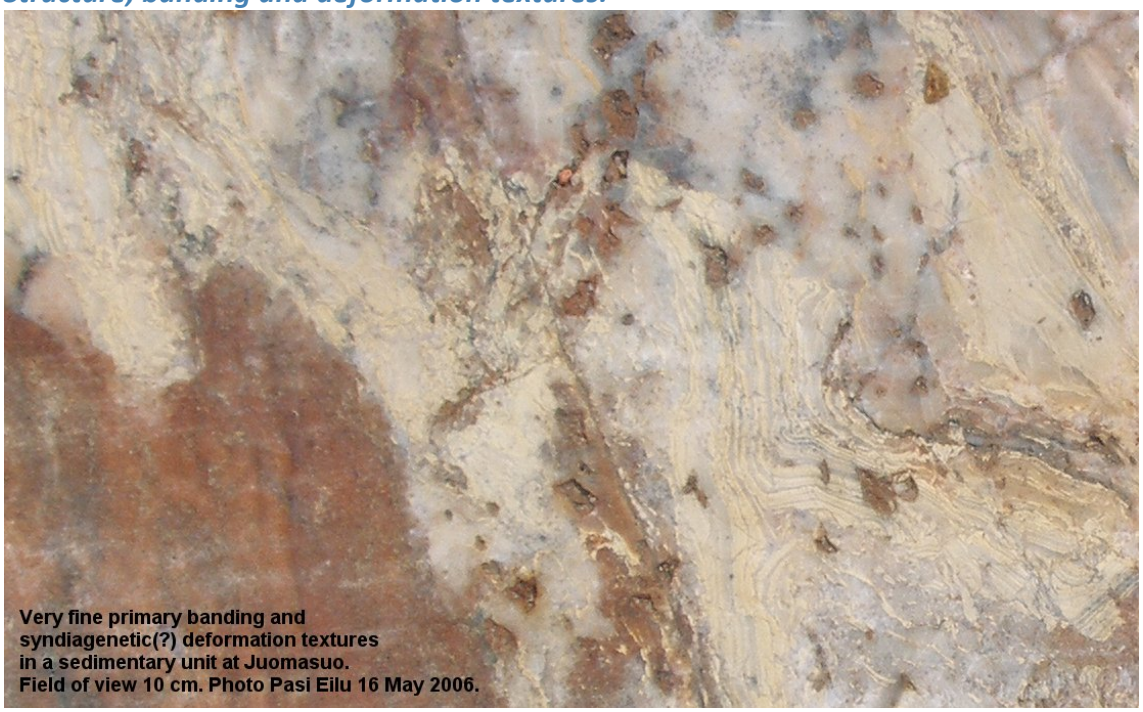



Juomasuo in a regional modified geophysical map.
From Goode (2004).

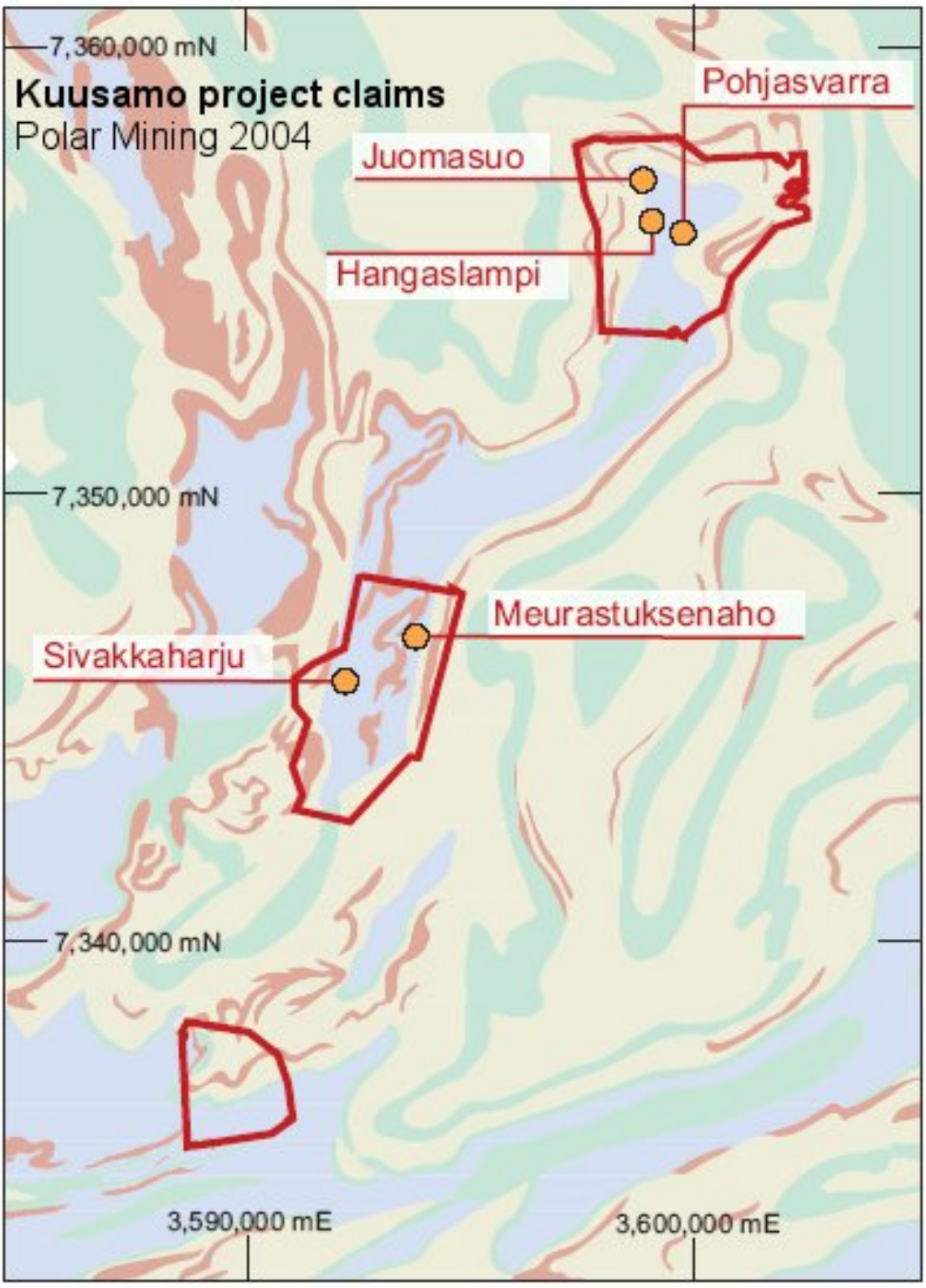
### *Structure; banding and deformation textures:*

**Very fine primary banding and syndiagenetic(?) deformation textures in a sedimentary unit at Juomasuo. Field of view 10 cm. Photo Pasi Eilu 16 May 2006.**

### *Structure; banding and deformation textures:*




### *Regional geology:*




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

Quartzite, sericite quartzite

Orthoquartzite, phyllite, dolomite, arkose

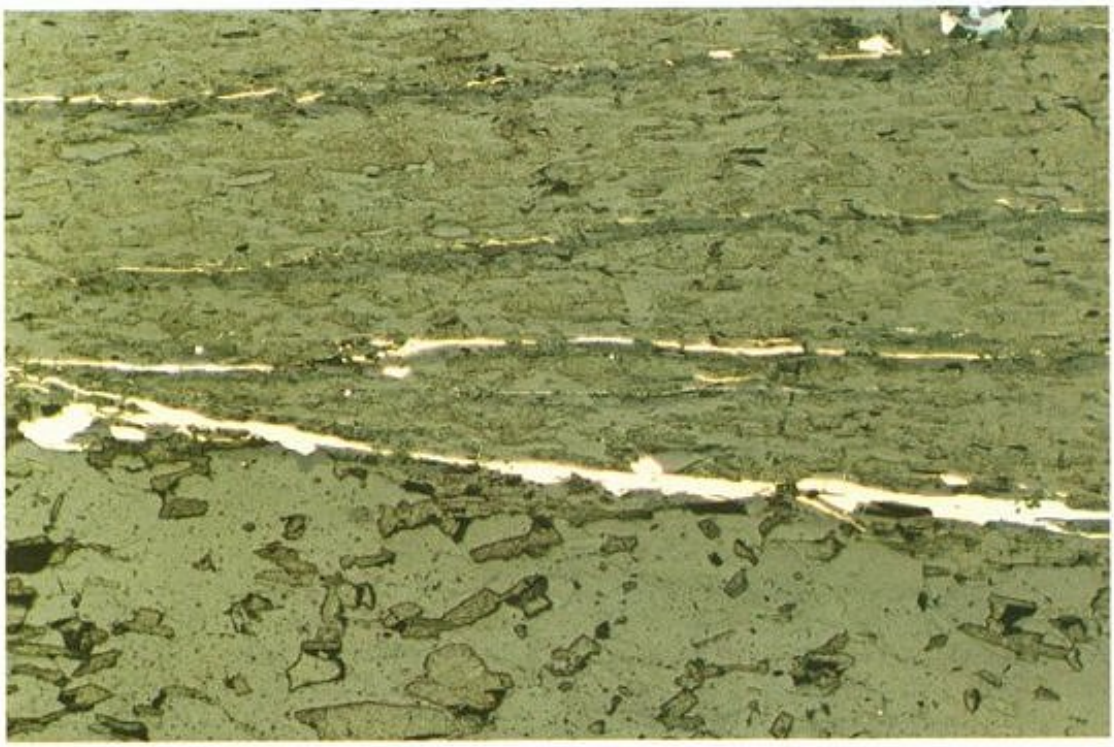
Mafic volcanics and tuff, basic and intermediate lava

Hornblendite, albite dolerite

### *Outcrop photo; early albitization of a sedimentary unit:*

**Syndiagenetic(?), early albitisation of fine-grained sedimentary unit at Juomasuo: the less altered dark grey rock turns reddish. The compass plate is 11 cm long. Photo Pasi Eilu 16 May 2006.**

### *Gold, tellurides and Bi minerals in sercite-quartz rock:*



Gold, tellurides and bismuth minerals as veinlets in a sericite-quartz rock, Juomasuo, Kuusamo. Field of view 0.75 mm.
(from Pankka et al. 1991)

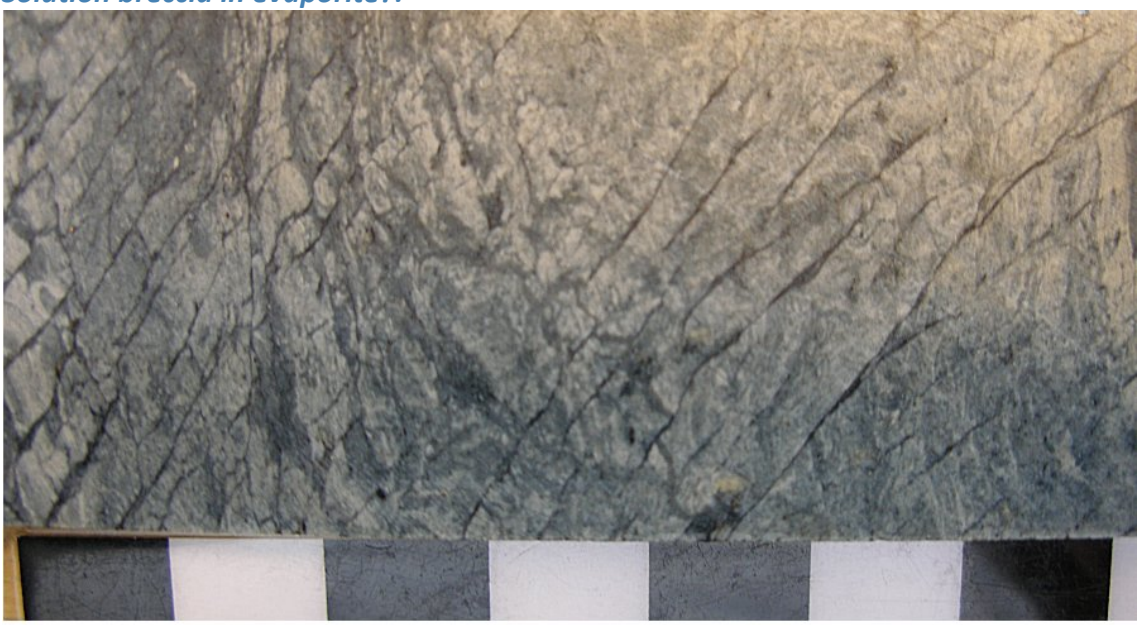
### *Possible halite replaced by carbonate:*


Juomasuo: Possible carbonated halite crystal in albitised arkosite.
Drill hole 4613R323, 32.30 m down-holde depth. Scale in cm. Photo Pasi Eilu.

### *Possible evaporitic solution breccia in metasilt:*

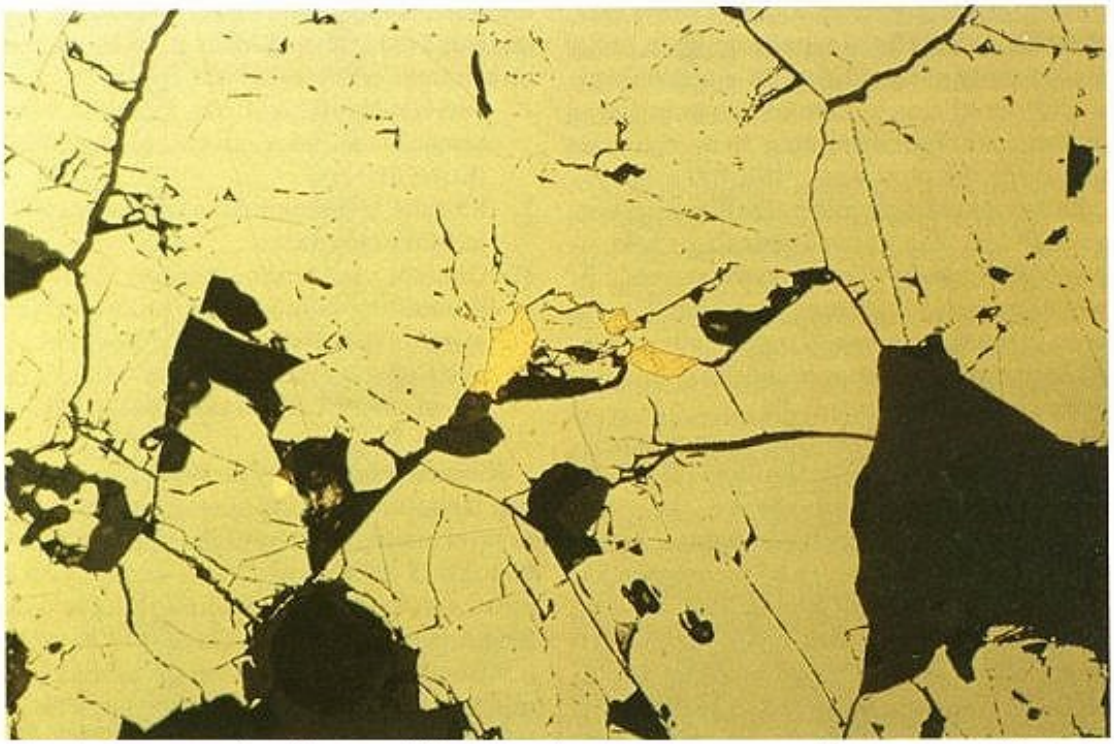
Juomasuo: Possible evaporitic solution breccia in metasilt. Sulphides + albite? + carbonate?
in breccia matrix. Drill hole 4613R323, 43.80 m down-holde depth. Scale in cm. Photo Pasi Eilu.

### *Solution breccia in evaporite?:*



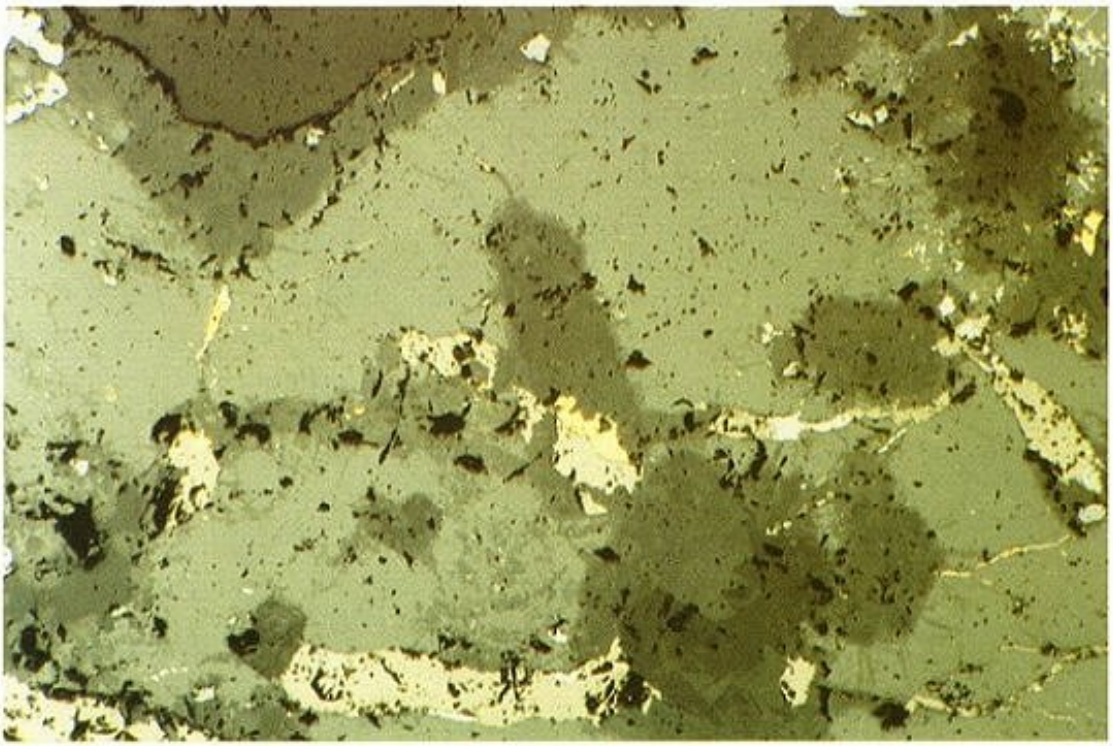
Juomasuo: Solution breccia in evaporite?
Drill hole 4613R323, 63.40 m down-holde depth. Scale in cm. Photo Pasi Eilu.

### *Native gold associated with pyrite:*



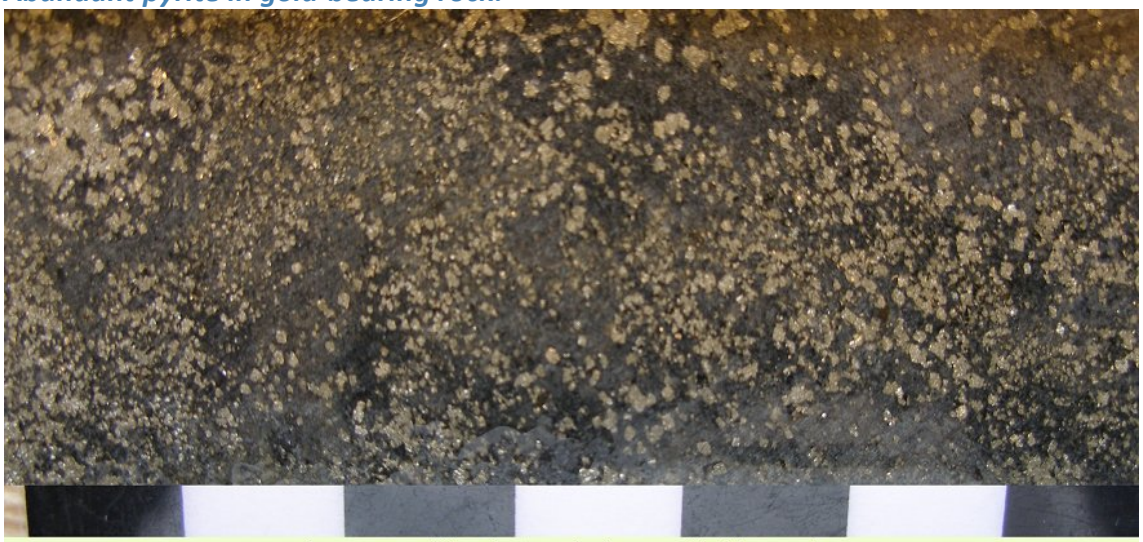
Inclusions of native gold in pyrite. Juomasuo, Kuusamo. Field of view 0.75 mm. From Pankka et al. (1991).

### *Uraninite-gold-tellurides association:*



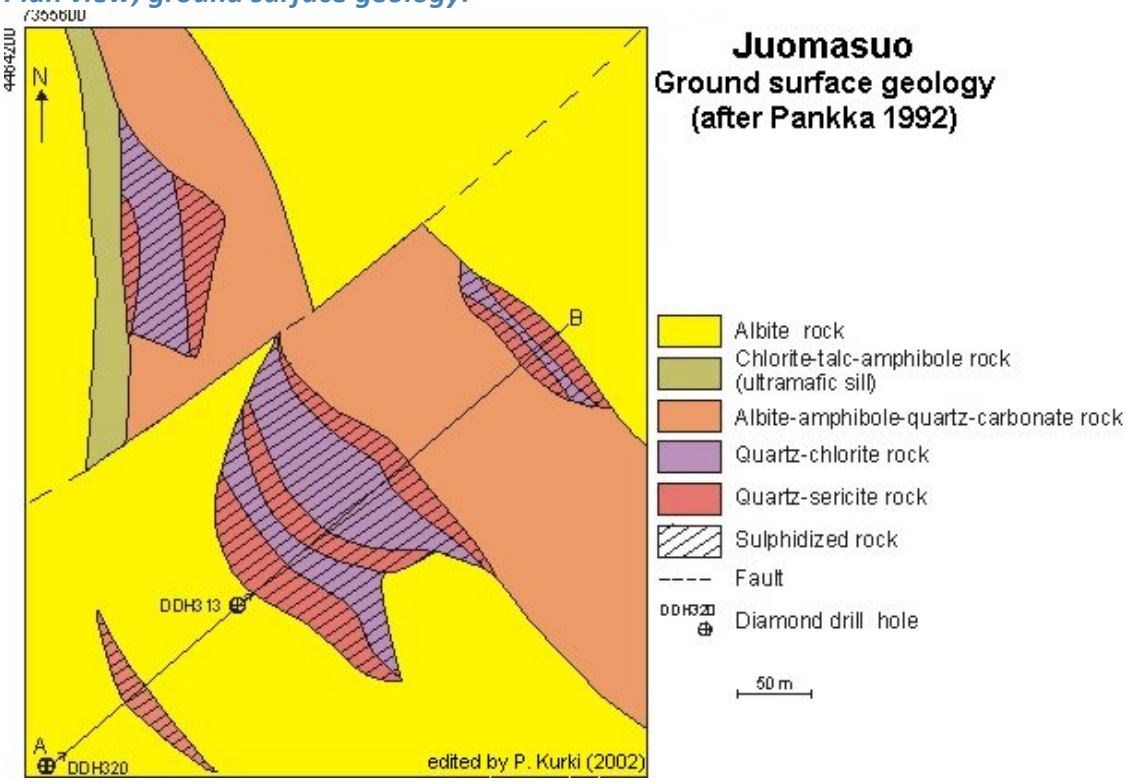
A partly decayed uraninite grain in which gold and tellurides have been enriched, Juomasuo, Kuusamo. Field of view 0.75 mm.
(from Pankka et al. 1991)

### *Abundant pyrite in gold-bearing rock:*

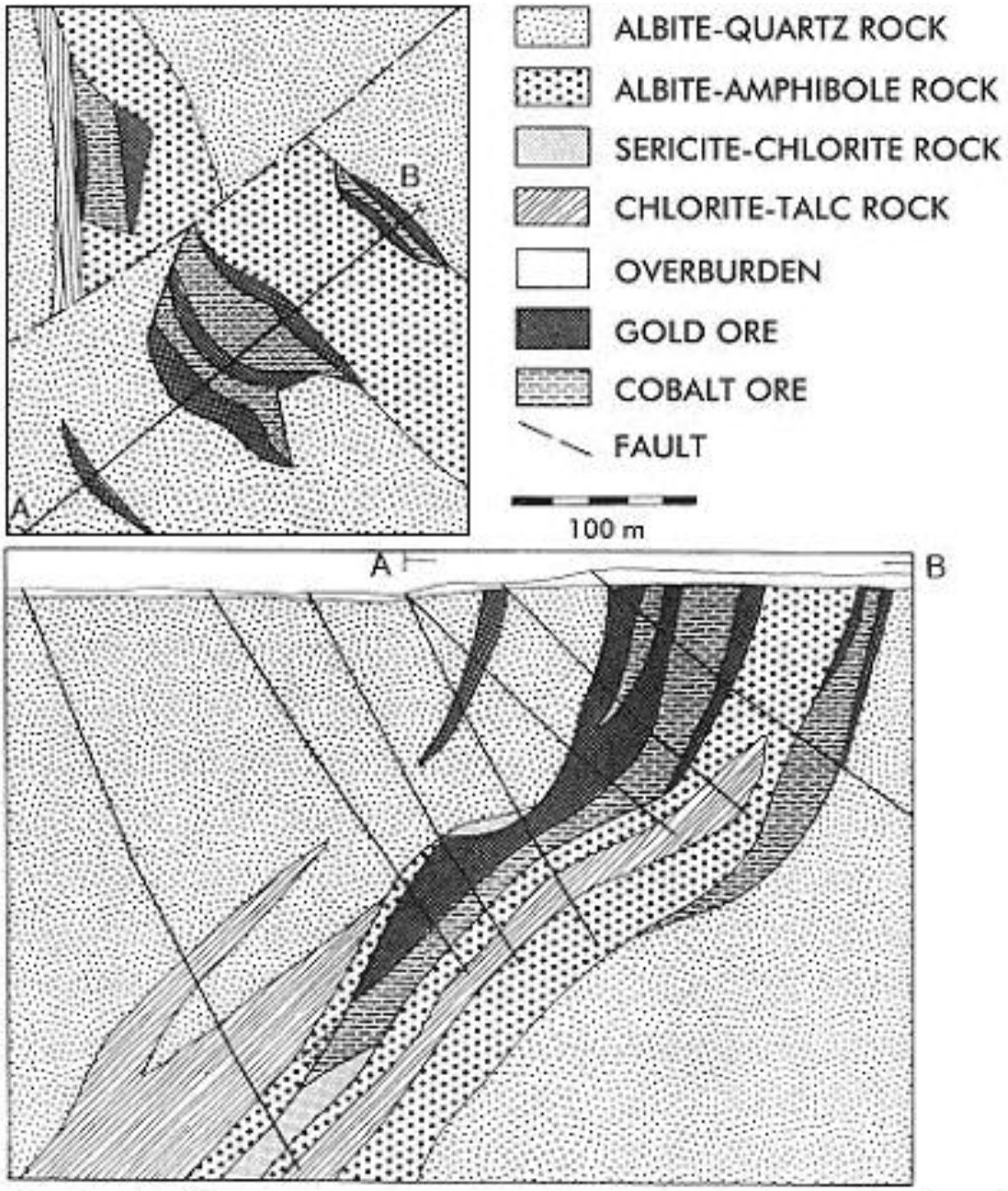


Juomasuo: Abundant pyrite in ore with 10 ppm Au.
Drill hole 4613R323, 33.85 m down-holde depth. Scale in cm. Photo Pasi Eilu.

### *Plan view; ground surface geology:*

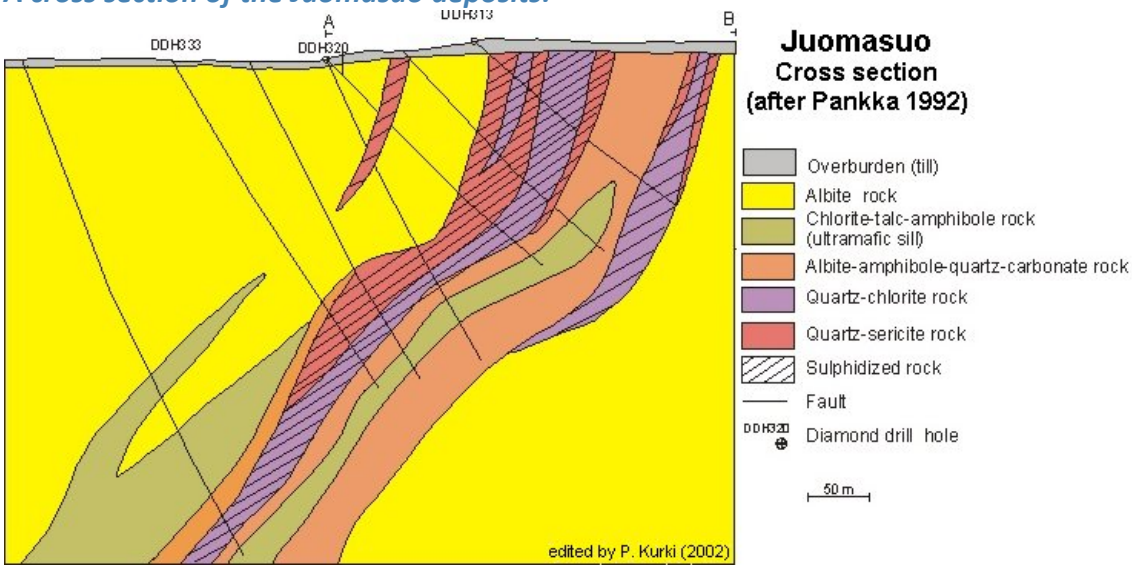


***Plan and vertical sections at Juomasuo based on 1991 data:***

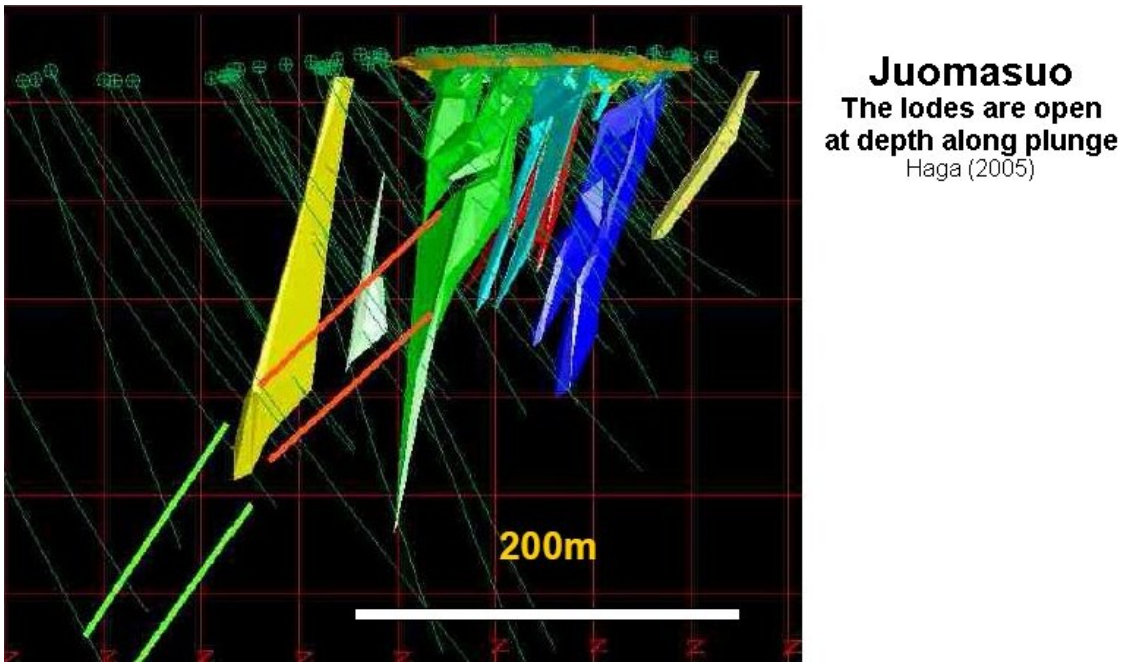



Geology of the Juomasuo Au-Co-U deposit. The map is based completely on the drilling data and the ground geophysics.
From Pankka (1992). Edited by P.Eilu (1999)

***A cross section of the Juomasuo deposits:***

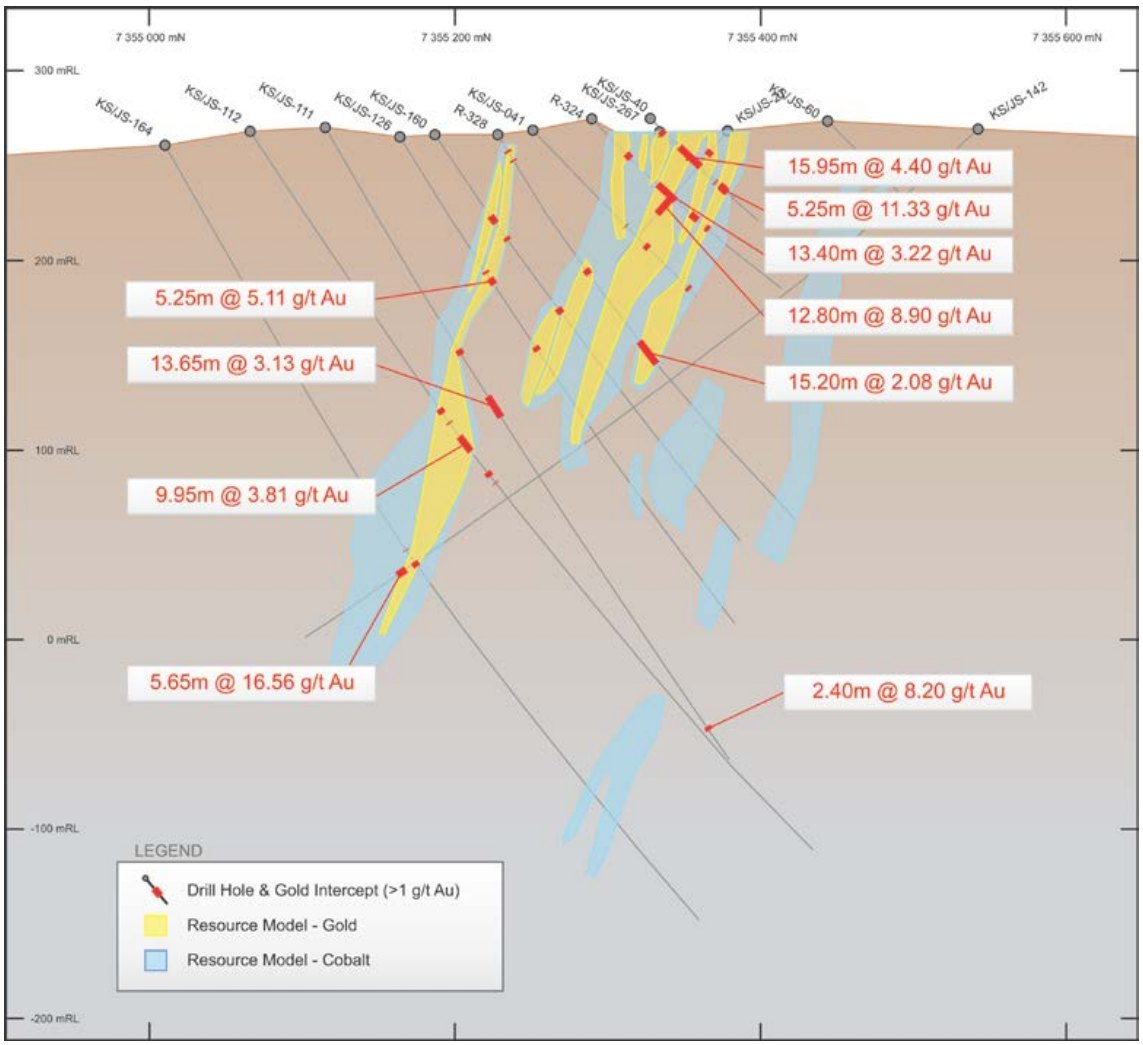



***3D model at Juomasuo in 2005:***



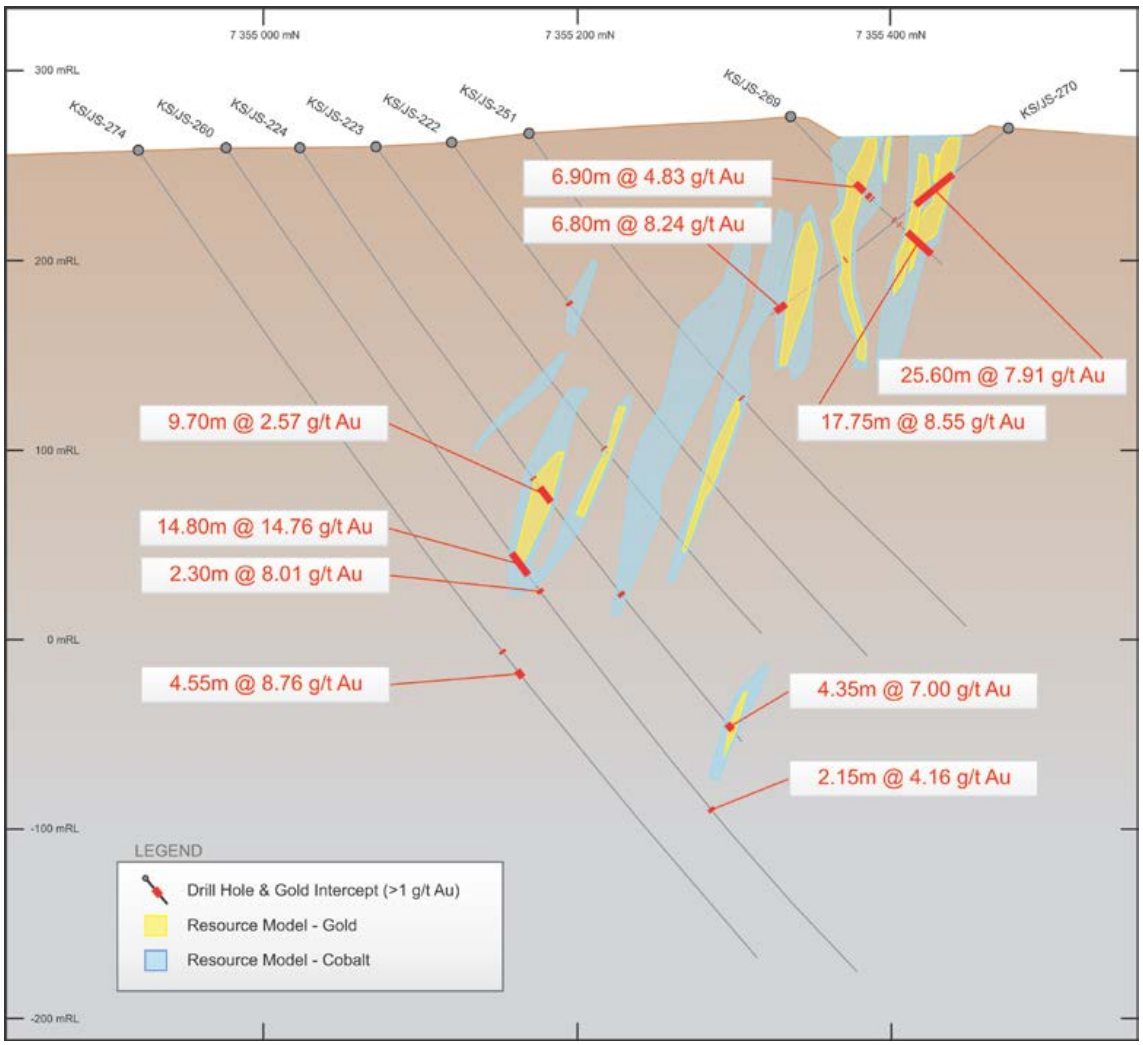

***Section across the Juomasuo ore bodies. From Dragon Mining media release of 28 March***

***2014:***



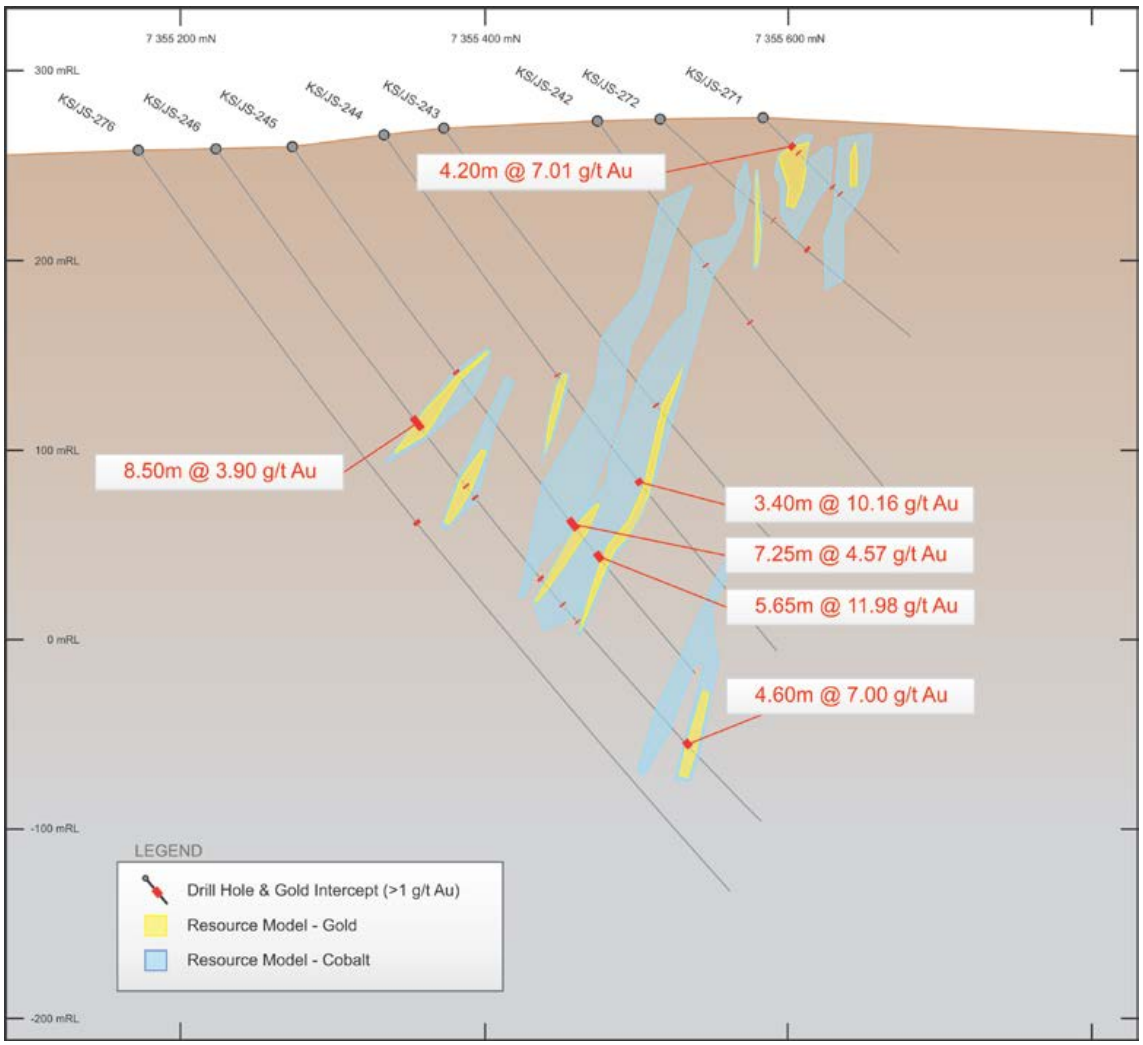

***Section across the Juomasuo ore bodies. From Dragon Mining media release of 28 March***

***2014:***

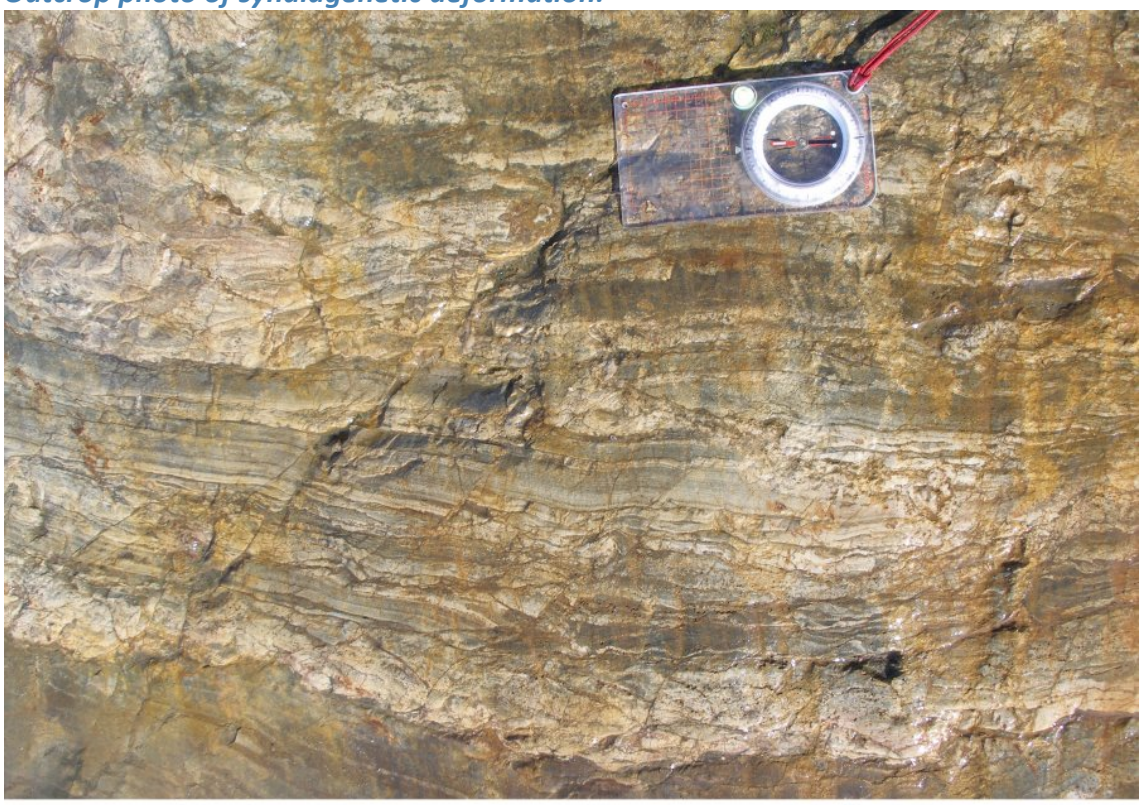



***Section across the Juomasuo ore bodies. From Dragon Mining media release of 28 March***

***2014:***


7 355 200 mN
7 355 400 mN
7 355 600 mN
300 mRL
200 mRL
100 mRL
0 mRL
-100 mRL
-200 mRL
KSIJS-276
KSIJS-246
KSIJS-245
KSIJS-244
KSIJS-243
KSIJS-242
KSIJS-272
KSIJS-271
4.20m @ 7.01 g/t Au
8.50m @ 3.90 g/t Au
3.40m @ 10.16 g/t Au
7.25m @ 4.57 g/t Au
5.65m @ 11.98 g/t Au
4.60m @ 7.00 g/t Au
LEGEND
Drill Hole & Gold Intercept (>1 g/t Au)
Resource Model - Gold
Resource Model - Cobalt

### *Outcrop photo of syndiagenetic deformation:*



**Fine primary banding and syndiagenetic(?), early deformation of fine-grained sedimentary unit at Juomasuo. The compass plate is 11 cm long. Photo Pasi Eilu 16 May 2006.**

### *Outcrop photo of syndiagenetic deformation:*

**Fine primary banding and syndiagenetic(?), early deformation of fine-grained sedimentary unit at Juomasuo. The compass plate is 11 cm long. Photo Pasi Eilu 16 May 2006.**

# REFERENCES

**1.** Arkimaa, H. 1997. The fingerprints of known gold occurences in the Kuusamo schist belt as shown by airborne gamma-ray spectrometric data. Geological Survey of Finland. Special Paper 23, 25-28. *http://tupa.gtk.fi/julkaisu/specialpaper/sp_023_pages_025_028.pdf*

**2.** Dragon Mining 2011. Press release 21 January 2011 *http://tupa.gtk.fi/karttasovellus/mdae/references/368_Juomasuo/368_DragonMining_PressRelease_21_01_2011.pdf*

**3.** Dragon Mining 2012. Media release 26 September 2012. *http://tupa.gtk.fi/karttasovellus/mdae/references/368_Juomasuo/368_DragonMining108_2012_09_26.pdf*

**4.** Dragon Mining 2014. Media release 8 April 2014. *http://tupa.gtk.fi/karttasovellus/mdae/references/368_Juomasuo/368_DragonMining132_2014_04_08.pdf*

**5.** Dragon Mining 2014.Annual Report 2013. 116 p. *http://tupa.gtk.fi/karttasovellus/mdae/references/325_Jokisivu/325_Dragon_Mining_2013_Annual_report.pdf*

**6.** Dragon Mining NL 2004. Quarterly Activities Report for the Quarter Ended 31st December 2003. Perth, Australia. 8 p.*http://tupa.gtk.fi/karttasovellus/mdae/references/284_Pampalo/2004(1).pdf*

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