

KSL EXPLORATION (YUKON) LIMITED

LOCATION OF DRILL HOLE PETROGRAPHIC SAMPLES

| <u>Sample No.</u> | <u>Drill Hole</u> | <u>DH Depth (m)</u> | <u>Field description</u> |
|-------------------|---|---------------------|---|
| KP01 | DDH04-01 | 68.90 | Wavy schist (meta-tuff) |
| KP02 | DDH04-01 | 146.40 | Grey chlorite-sericite-quartz schist |
| KP03 | DDH04-02 | 83.21 | Meta-quartz eye porphyry |
| KP04 | DDH04-02 | 106.00 | Green alteration |
| KP05 | DDH04-02 | 126.40 | 20cm band in sheared sericite-chlorite-quartz schist |
| KP06 | DDH04-02 | 214.20 | Carbonate-altered chlorite schist with veining & sulphides |
| KP07 | DDH04-02 | 227.60 | Carbonate-altered chlorite schist with pyritic selvage to veins with "hematite" core |
| KP08 | DDH04-04 | 43.45 | Pink quartzite |
| KP09 | DDH04-04 | 122.95 | Blotchy chlorite alteration in quartz-mica schist with 5 cm quartz vein |
| KP10 | DDH04-05 | 54.55 | Ribbon banded mica-quartz schist |
| KP11 | DDH04-05 | 69.70 | Schistose quartz-feldspar porphyry |
| KP12 | DDH04-05 | 117.50 | Actinolite(?biotite) ribbon banded sericite-chlorite-quartz schist |
| KP13 | DDH04-05 | 131.05 | Chlorite-veined silicified/silica-altered chlorite-quartz schist |
| KP14 | DDH04-05 | 163.60 | Chlorite schist with (?2) generations of carbonate veining |
| KP15 | DDH04-05 | 176.15 | Massive silica-altered quartz-feldspar porphyry |
| KP16 | DDH04-05 | 237.09 | Veined silica-altered quartz-feldspar porphyry (c. 1.5m below "gold-arsenic vein"(ref M3961 |
| KP17 | DDH04-05 | 285.40 | Chlorite-veined siliceous porphyry |
| KP18 | DDH04-05 | 291.00 | Thin vein in siliceous porphyry below arsenopyrite vein (ref Sample M396262) |
| KP19 | Surface outcrop sample - Eureka Creek property, southern end, some 300m N of Black Hills Ck road. | | |

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Petrological examination of nineteen drill core samples
from the Klondike Goldfield, Yukon, Canada,

Report No: R1/81/1369

21 October 2004

For: Klondike Source Limited

Dr B.J. Barron
Consulting Petrologist

SUMMARY and CONCLUSIONS

Samples KP-1 to KP-7

These samples are from diamond cored holes some 300 m apart. They have undergone strong metamorphic recrystallisation that largely obscures fine grained relict textures and primary mineralogy.

The two samples KP-1 [01-68.0] and KP-3 [02-83.21] retain poorly preserved relict ?phenocrysts (blastophenocrysts) of albitised plagioclase \pm K-feldspar and quartz. The fine compositional layering in KP-01, and abundant fine grained K-feldspar suggests a ?tuffaceous protolith, while KP-03 equally may have a protolith of ?shallow intrusive porphyry or ?tuff.

On the other hand, sample KP-06 [02-214.2] is compositionally layered with limy (epidote-rich) components and could have calc-silicate sedimentary protolith. Sample KP-07 [02-227.6] also is partly limy, but is the only sample that contains significant foliated amphibole (?actinolite) indicating a possible basic volcanic protolith. Flattened ?vesicle sites are a possible relict feature in this sample. Domains of brittle fracture and microbrecciation (fluidised milled microbreccia) contain angular fragments with rotated foliation directions. Such brecciation may accompany introduction of mineralised hydrothermal fluids. The albite-?actinolite assemblage indicates a regional metamorphic grade of upper greenschist facies. This seems low in view of the strong recrystallisation and intense deformation of most samples.

Sample KP-02 [01-146.4] lacks recognisable relict textures, but relict ?detrital heavy ?detrital minerals (tourmaline, zircon, apatite and titanite oxides) suggest a fine grained volcanoclastic sedimentary protolith.

The samples KP-04 [02-106.0] and KP-05 [02-126.4] are deposits of hydrothermal vein quartz that are mainly granoblastic and recrystallised. They are now brittle-fractured and tectonically brecciated. The breccia matrix of KP-04 is a foliated branching network of 'sericite-muscovite', while that of sample KP-05

contains fine grained 'sericite', ?carbonaceous dust (possibly reflecting a strongly reducing fluid – no carbonate) and dusty sulphides. In very late fractures are carbonate (indicating a change to oxidising fluids) and chlorite. Sample KP-05 contains patchy adularia intergrown with vein quartz, possibly reflecting availability of both potash and silica from the altered ?acidic igneous host rocks.

Retrograde alteration assemblages amongst albite, 'sericite', adularia (or microcline), quartz, kaolinite, chlorite reflect penetration of late fluids with near neutral pH at variable temperatures (probably < 150°C). Lowest temperature moderately acidic fluids were associated with minor clay alteration (kaolinite and smectite).

Traces of comb quartz are preserved in a late undeformed vein in sample KP-05. Very late carbonate (mainly calcite)-hematite veins post date recrystallised quartz-albite-carbonate veins in sample KP-07.

Minor sulphides are present in KP-01, KP-03, KP-05, KP-06 and KP-07 (see table).

Samples KP-08 [04-43.45] and KP-09 [04-122.95]

These samples, from a diamond drill hole about 600-800 m from the previous group, are strongly recrystallised and multiply deformed metamorphic rocks that retain distinct compositional layering. They may be identified as 'sericite-muscovite'-albite-quartz schist/'sericite-muscovite' schist. In the latter mica defines a foliation (?S₁) that is further deformed by a strong strain slip (or crenulation) foliation (S₂). The foliation is not so well defined in quartzofeldspathic domains that contain sparse, recognisable ?blastophenocrysts of albitised plagioclase, and probably have volcanoclastic (or tuffaceous) protolith.

The pink colour in KP-8 [04-43.45] is due to dusty hematite in recrystallised quartz.

Veins in these samples are discontinuous, recrystallised and lensed, with minor 'chlorite-sericite' flakes, rare carbonated ?amphibole clusters (KP-08), albite and traces of oxidised ?sulphides.

Samples KP-10 to KP-18

The group of samples KP-10 to KP-18 is from one diamond drill hole [DDH04-05] from 54.4 m to 291 m down hole. Most of these samples contain recognisable relict 'phenocrysts' (blastophenocrysts) of plagioclase. Samples KP-15 [05-176.15], KP-16 [05-237.09] and KP-17 [05-285.4] also contain K-feldspar blastophenocrysts, while once-phenocrystic quartz can be recognised in ?KP-11 [05-69.7], KP-16 [05-237.09] and KP-17 [05-285.4]. Relict primary (but degraded) biotite flakes occur in KP-10 [05-54.55], possibly KP-15 and KP-17. These crystals confirm a primary acidic igneous contribution, and most samples could have had a volcanoclastic protolith. Sample KP-16 could have had a quartz- and feldspar- 'porphyritic' protolith of intrusive (or volcanoclastic) origin. Fine grained relict textures preserved in KP-17 suggest a ?vitric tuffaceous protolith.

Patchy retrograde alteration in this group is to assemblages amongst the following phases; 'sericite', chlorite, carbonate, smectite, kaolinite ± epidote, indicating similar ?hydrothermal fluid conditions to samples in the previous group. Fine grained secondary K-feldspar in KP-16 and KP-17 reflects their K-feldspar-rich protoliths.

Very late veinlets are undeformed but reflect very low temperature fluids. These comprise carbonate-kaolinite and some adularia ± chlorite ± quartz albite and minor sulphides (KP-10 [05-54.55], KP-13 [05-131.05], KP-15 [05-176.15], KP-16 [05-237.09], KP-18 [05-291.00]). Sample KP-14 [05-163.6] contains vein-like patches of strained quartz and separate coarse apatite ± green (?interlayer chlorite-muscovite) mica. Late carbonate veinlets in some samples mainly are calcite. Sample KP-16 has undergone late fine grained K-feldspar ?hydrothermal alteration and even later patchy alteration and veining by chlorite and carbonate. The sample contains traces of sulphides. It is also cut by a conspicuous quartz and feldspar-bearing vein that lacks sulphides in the present section.

Sample KP-19 (Eureka Creek)

The sample KP-19 (Eureka Creek) is an intensely recrystallised, deformed and foliated quartzite. It contains only minor 'sericite-muscovite' flakes also defining the prominent foliation.

It contains too much quartz to have an intrusive protolith, but could represent an intensely silicified ?acidic (?volcanic, ?igneous) protolith. It contains sparse oxidised ?feldspar crystal sites, and contains sites of minor oxidised sulphides. Kaolinite and hematite in this sample most likely are due to near surface weathering/oxidation.

SUMMARY TABLE

KP-01 to KP-07

| SAMPLE NUMBER | ROCK TYPE | PRIMARY MINERALOGY | METAMORPHIC MINERALOGY | RETROGRADE ALTERATION MINERALOGY | VEIN SULPHIDES |
|---------------|--|---|--|---|--|
| KP-01 | Strongly recrystallised, finely compositionally layered felsic ?tuff containing once-phenocrystic K-feldspar, plagioclase and ?quartz. Late veinlets. | Kfs, pl, ?qtz (?blasto-phenocrysts) | Qtz, Kfs, 'ser-mu'. | ?Kfs, ka, qtz. | Qtz, ka, he. Minor dissem. sulphides. |
| KP-02 | Mica-quartz schist, some carbonate-bearing layers. Possible fine grained acidic volcanoclastic/?sedimentary protolith. No veins. | Tm, zr, sp-lx, ap. ?Kfs. | Qtz, ?mu, cc, Kfs, ab. | | |
| KP-03 | Strongly recrystallised, weakly ?pyrite mineralised, once-K-feldspar, biotite (-plagioclase) porphyritic, acidic ?shallow ?intrusive/?tuffaceous rock. | Kfs, bi, pl, ?qtz. (?blasto-phenocrysts) Ti-ox, | 'Ser', chl, Kfs, qtz, 'ser'. | Ab, mc, 'ser', chl, sp-lx. | Minor dissem. sulphides ?py. |
| KP-04 | Deposit of strongly recrystallised quartz that is brittle fractured ?tectonically brecciated and set in a network of foliated 'sericite-muscovite'. | ?Ap, Ti-ox. | Qtz, 'ser-mu'. | Cc, chl, ka, 'ser', ?ap, sp-lx. | |
| KP-05 | Partly recrystallised, fractured and brecciated deposit of hydrothermal vein quartz. Patchy adularia. Late 'sericite', carbonaceous dust and sulphides in fractures/veinlets. Chlorite \pm carbonate in very late fractures. | Ti-ox. | Sp-lx. | 'Ser', ad. Qtz, Kfs fraction cut by late cc-chl. Even later very fine ?C-sulphides, \pm 'ser'. Some qtz-chl-sulphides post date cc. | Qtz. Some comb quartz, cc, chl, Kfs. Late undeformed qtz vein. |
| KP-06 | Strongly recrystallised deformed and foliated, finely compositionally layered epidote-chlorite-quartz schist. Minor carbonate, sulphides. ?Calc-silicate sedimentary (or volcanoclastic) protolith. Veinlets. | | Qtz, ep, chl, cc (sp, ap). | | Cc patches, lenses. Qtz-cc-minor sulphides. |
| KP-07 | Fine grained, recrystallised, foliated, deformed quartz-epidote-?actinolite schist. Late brittle fracture, microbrecciation (milled microbreccia). Late carbonate veins. ?Strongly ?vesicular basic volcanic protolith. | | Act, chl, ep, sp. (?vesicle sites), qtz, ab, chl, ep \pm cc. | | Qtz, ab, cc. Cc, he (undeformed). Trace dissem. sulphides. |

KP-08 to KP-09

| SAMPLE NUMBER | ROCK TYPE | PRIMARY MINERALOGY | METAMORPHIC MINERALOGY | RETROGRADE ALTERATION MINERALOGY | VEIN SULPHIDES |
|---------------|---|---------------------------------|---------------------------------------|----------------------------------|--|
| KP-08 | Strongly recrystallised, multiply deformed, compositionally layered 'sericite-muscovite'-albite-quartz schist/'sericite-muscovite' schist. Lensed veins. | Pl (blastophenocrysts). | Qtz, ab, 'ser-mu', he, ep, zr, sp-lx. | Chl, cc. | Qtz, ab, micas, chl's, carbonated amph. |
| KP-09 | Strongly recrystallised, multiply deformed, compositionally layered, quartz- 'muscovite-sericite' schist with some relict albitised plagioclase. (?Volcaniclastic protolith). | Pl, blasto-phenocrysts. ?Ti-ox. | Ab, sp-lx. | 'Ser'. | Qtz, minor ab, micas. Late cc, chl. Minor dissem. sulphides. |

KP-10 to KP-18

| SAMPLE NUMBER | ROCK TYPE | PRIMARY MINERALOGY | METAMORPHIC MINERALOGY | RETROGRADE ALTERATION MINERALOGY | VEIN SULPHIDES |
|---------------|---|---|--|----------------------------------|--|
| KP-10 | Strongly recrystallised, deformed 'muscovite-sericite'-albite quartz schist with narrow deformed layering. Quartzofeldspathic ?volcaniclastic protolith. Late veinlets. | Pl, bi, (?blasto-phenocrysts) ?Ti-ox, sp, ap, zr. | Ab, qtz, 'ser-mu'. | Chl, cc, sp-lx. | Late cc-ka-ad in fractures \pm sulphides. |
| KP-11 | Albite-'muscovite-(sericite)'-quartz schist. Some plagioclase ?blasto-phenocrysts. ?Porphyritic igneous or volcaniclastic protolith. | Pl, ?qtz, ?blasto-phenocrysts. | Ab, qtz, chl, ?ser-musc'. Possible previous amph. | 'Ser', cc, qtz, ka, sulphides. | ?Qtz. |
| KP-12 | 'Muscovite-sericite'-biotite-albite-quartz schist. Plagioclase ?blasto-phenocrysts, disseminated titanian oxides. | Pl (?blasto-phenocrysts). ?Ti-ox, ap. | Ab, qtz, green bi, ep, cc, 'musc-ser', sp-lx. All. | 'Ser', ?sm, chl. | Qtz. Small veinlets are cc, sulphides. |
| KP-13 | Chlorite-'muscovite-sericite'-albite-quartz schist. Plagioclase ?blasto-phenocrysts. ?Igneous or volcaniclastic protolith. | Pl (?blasto-phenocrysts), ?ti-ox, zr, ap. | Ab, qtz, 'sericite-muscovite', chl, 'ser-chl'. | 'Ser', ep, cc, sp-lx. | Late thin veinlets are structurally oriented. Undeformed qtz (prismatic) interstitial cc, chl, ad \pm sulphides. Undeformed late qtz, cc, chl, \pm sp, ad. |
| KP-14 | Multiply deformed mica-chlorite schist. Mafic ?volcanic protolith. Early quartz veinlets. Patches of quartz and apatite. Late carbonate veinlets. | Ti-ox. | 'Ser' (or ?pyr, par etc.), chl, sp, cc. Green biotite. | Sp-lx. | Qtz, ap, Cc. Ap-green mica. Late cc. |

| SAMPLE NUMBER | ROCK TYPE | PRIMARY MINERALOGY | METAMORPHIC MINERALOGY | RETROGRADE ALTERATION MINERALOGY | VEIN SULPHIDES |
|---------------|--|--|---|--|--|
| KP-15 | K-feldspar-albite-'muscovite'-quartz schist that could have had a volcanoclastic (rather than intrusive igneous) protolith. Some vein-like aggregates are quartz-K-feldspar, albite, sulphides. | Pl, Kfs (?blasto-phenocrysts) ?bi, Ti-ox, zr. | 'Ser-mu', ab, mc. Qtz, ab, Kfs, 'ser-mu'. | 'Ser' cc, ep. | Qtz, Kfs \pm ab, minor sulphides. |
| KP-16 | 'Muscovite-sericite'-K-feldspar-albite-quartz-chlorite schist. Altered feldspar- and quartz blastophenocrysts. Late fine grained K-feldspar, very late chlorite-carbonate. Quartz-feldspar vein. | Pl, qtz, Kfs, (?blasto-phenocrysts) Ti-ox, ap, zr. | 'Ser', ab, mc. Qtz, ?'ser-mu'. | 'Ser', sp-lx, Kfs. Chl (-sm). | Cc, (undeformed), Qtz, Kfs, (mc), cc. Late chl. Sparse py. |
| KP-17 | Strongly recrystallised ?vitric tuff containing feldspar-porphyrific lithic and crystal fragments. Brittle fractures contain late chlorite, carbonate, some sulphides. | Pl, Kfs, qtz (?blasto-phenocrysts), bi, zr, ap. Ti-ox. | Ab, Kfs, 'ser-mu', qtz. | 'Ser', cc, chl, sp, Kfs, sm, 'fcs', sp-lx. | Dissem. sulphides. |
| KP-18 | Albite-'sericite-muscovite' schist, relict plagioclase ?phenocrysts in lithic ?fragments and ?layers. Possible volcanoclastic protolith. | Pl (?blasto-phenocrysts), Ti-ox, zr, ap. | Qtz, ab, 'ser-musc' cc, ?altered ?Kfs. | 'Ser', cc, sp-lx. | Qtz, cc, ab. Minor sulphides. Late fractures contain cc, 'ser', chl. |

KP-19

| SAMPLE NUMBER | ROCK TYPE | PRIMARY MINERALOGY | METAMORPHIC MINERALOGY | RETROGRADE ALTERATION MINERALOGY | VEIN SULPHIDES |
|---------------|---|--------------------|------------------------|----------------------------------|--------------------------------|
| KP-19 | Intensely recrystallised, deformed, foliated quartzite. Partly oxidised (weathered). May have silicified acidic volcanic protolith. Lacks normal heavy detrital grains. | ?Ti-ox. ?Fsp. | Qtz ('ser-musc'). | Sp-lx, ka, he. | Minor ?sulphides now oxidised. |

Abbreviations

Ab = albite, act = actinolite, ad = adularia, all = allanite, amph = amphibole, ap = apatite, bi = biotite, cc = carbonate, chl = chlorite, ep = epidote, fcs = fuchsite, fsp = feldspar, he = hematite, ka = kaolinite, Kfs = K-feldspar, lx = leucosene, mc = microcline, mu = muscovite, ox = oxide, par = paragonite, pl = plagioclase, py = pyrite, pyr = pyrophyllite, qtz = quartz, 'ser' = sericite (\pm other colourless birefringent layer silicates), sp = sphene (or titanite), zr = zircon.

KP-01 to KP-07 (From two diamond drill holes some 300m apart)

Sample No. KP-01 [01-68.0]

Rock Type Strongly recrystallised 'muscovite-sericite' schist that is finely compositionally layered. It contains once-phenocrystic K-feldspar, plagioclase and possibly quartz, and could have had a felsic tuffaceous protolith. Late narrow veinlets are unoriented, undeformed subprismatic quartz with interstitial low birefringent clay and patchy limonitic oxides.

Hand Specimen A fine to medium grained sample with a distinct fine compositional layering. The layers mainly are less than 3 mm thickness and are more or less alternating mid grey to very pale yellow-brown. K-feldspar staining gave strong positive results for many narrow layers and also for sparsely disseminated medium grained crystal sites.

Thin Section This sample has undergone strong metamorphic recrystallisation. Nevertheless, it retains a clear compositional layered relict texture and more or less evenly disseminated, once phenocrystic K-feldspar cleavage fragments.

The recognisable K-feldspar cleavage fragments have a sparse but more or less even distribution throughout the present section, accounting for about 10% of the sample. The K-feldspar grains mainly lie within the size range 0.6 mm up to about 1.5 mm and have subhedral prismatic shapes, but some appear to be broken. The relict K-feldspar grains are quite heavily clouded by dusty solid inclusions, and show narrow irregular rims of fine grained secondary K-feldspar, mainly microcline. Elsewhere are sparse prismatic subhedral crystals of plagioclase up to about 1.8 mm long that are now albite. These show brittle fracture, narrow quartz veins and partial recrystallisation. Similar sized somewhat rounded and embayed shapes of some patches of recrystallised granular quartz once could have been sparse resorbed quartz phenocrysts.

The poorly defined crystal detritus is set throughout a compositionally layered rock matrix fraction in which layering thickness varies from about 0.3 mm up to more than 1 cm. This fraction has a granular to granoblastic texture

and variable grain size from less than 0.05 mm up to about 0.25 mm. The layering is defined by variable proportions of the three phases quartz, K-feldspar and near-colourless birefringent layer silicates (?sericite-muscovite' flakes) that are very weakly pleochroic, very pale green to colourless. The thickest layer in the present section is dominated by recrystallised layer silicates, defining a weak wavy slaty cleavage ?S₁, that is further deformed by a second or strain slip foliation (S₂). The sample contains accessory small disseminated ?sulphides now converted to limonitic oxides.

The sample has undergone patchy partial low grade alteration of feldspars to clouded pale brown low birefringent clay (mainly ?kaolinite). Also present are poorly defined veinlets of undeformed subprismatic quartz that occurs as unoriented subprismatic crystals up to about 0.4 mm long. The quartz is intergrown with voids filled with low birefringent clay ± minor patchy hematite.

An approximate overall modal mineralogy is as follows; quartz 45% K-feldspar 20%; albite 15%, 'muscovite-sericite' 20%; and accessory sphene-leucoxene granules and zircon.

This sample may be identified as a strongly recrystallised 'muscovite-sericite' schist that is finely compositionally layered. It contains once-?phenocrystic K-feldspar, plagioclase and possibly quartz, and could have had a ?felsic tuffaceous protolith. Late narrow veinlets are unoriented, undeformed subprismatic quartz with interstitial low birefringent clay and patchy limonitic oxides.

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|-------------------|---|
| <u>Sample No.</u> | KP-02 [01-146.4] |
| <u>Rock Type</u> | Mica- quartz- schist that lacks chlorite in the present section. It contains moderately abundant, fine grained relict heavy detrital grains, and most likely had a fine grained, acidic volcanic-sedimentary protolith with some carbonate-bearing ?primary layers. It lacks conspicuous veins. |

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| <u>Hand Specimen</u> | A fine grained, strongly foliated mid green-grey drill core sample in which certain fracture-located veinlets react strongly with cold dilute HCl indicating calcite. Distribution of these patches possibly marks a primary layering (bedding) which is at shallow angle to the distinct foliation direction (S ₁). A weak |
|----------------------|---|

crenulation (?S₂) deforms S₁. K-feldspar staining gave very weak positive results for sparse, very small spongy patches.

Thin Section

Strong metamorphic recrystallisation largely has obscured primary textures and mineralogy in this sample. Nevertheless, the rock contains about 5% of fine grained accessory ?detrital phases, some of which are olive green tourmaline, zircon, almost opaque to translucent sphene-leucoxene that replaces previous titanian oxides (one of these reaches 0.5 mm grain size), and apatite (up to 0.2 mm grain size).

The sample now comprises granoblastic quartz-rich domains that are narrow and lensed and cut by subparallel wavy trails rich in foliated mica flakes. It has an average grain size of about 0.25 mm.

A very approximate overall modal mineralogy is as follows: quartz 60%; mica 30%; carbonate 7%; and relict fine grained titanian oxides ~ 3%. Accessory phases comprise tourmaline, zircon, apatite and albite.

The granoblastic quartz-rich domains are almost monomineralic, with rare clouded grains of K-feldspar. Mica-rich domains comprise dense aggregates of mainly subparallel ragged mica flakes with an average length of about 0.2 mm. Mica flakes are very pale greenish yellow, and most likely are muscovite. Patches of granular carbonate have a restricted distribution that suggests primary layering probably is at a shallow angle to the prominent foliation direction. Recrystallised carbonate grains reach 1.3 mm grain size. Accessory K-feldspar grains (microcline) reach about 3 mm grain size and are poikiloblastic enclosing carbonate, quartz and mica.

This sample may be identified as a mica- quartz- schist that lacks chlorite in the present section. It contains moderately abundant, fine grained relict heavy detrital grains, and most likely had a fine grained, acidic volcanic-sedimentary protolith with some carbonate-bearing (limy) ?primary layers. It lacks conspicuous veins.

Sample No.

KP-03 [02-83.21]

Rock Type

Strongly recrystallised, weakly pyrite mineralised, quartzofeldspathic sample that contains more or less evenly disseminated medium grained blastophenocrysts of K-feldspar and biotite, as well as subordinate plagioclase, set throughout a fine grained K-feldspar-rich rock matrix fraction. The sample could have had a porphyritic shallow intrusive protolith or else is a crystal/lithic tuff of acidic (to trachytic) primary composition.

Hand Specimen

A fine grained, pale grey to pale brown (limonitic oxide-stained) drill core sample that contains abundant, more or less evenly disseminated unoriented dark grey crystal sites that are medium grained and elongate. Also present are poor outlines of abundant medium grained pale grey feldspar crystal sites. K-feldspar staining gave very strong positive results for the abundant fine grained rock matrix fraction and also for some prismatic crystal sites. The sample shows a weak foliation.

Thin Section

This sample has undergone strong metamorphic recrystallisation, obscuring primary mineralogy and textures in the finer grained rock matrix fraction. Nevertheless, there are preserved about 20% of more or less evenly disseminated sites of phenocryst and glomeroporphyritic aggregates mainly within the size range 0.7 mm up to about 2.5 mm. K-feldspar and biotite are approximately equally abundant with subordinate plagioclase. K-feldspar crystals now are mainly microcline, some of which retain broken angular shapes. Plagioclase prisms are albitised and lightly dusted with wispy 'sericite'. Some show poorly defined relict compositional zoning marked by narrow zones rich in K-feldspar. Coarse ragged biotite flakes are partly altered to interlayer chlorite and some form aggregates of unoriented flakes up to about 2 mm across. Sparse sites of partly altered titanite reach about 0.6 mm grain size and have anhedral irregular shapes. They are now converted to clouded sphene-leucoxene. The sample once could have contained phenocrystic quartz, but now comprises strongly recrystallised monomineralic patches.

The abundant rock matrix fraction comprises intergrown, exceptionally fine grained (less than 0.05 mm grain size) patches of K-feldspar and

coarser grained granular recrystallised quartz (up to about 0.15 mm grain size). In the K-feldspar-rich fraction, there are domains in which igneous K-feldspar and albite microlites may be preserved. This fraction now comprises dominant K-feldspar, abundant patchy quartz and subordinate wispy 'sericite' flakes. The latter defines a weak foliation direction.

This sample contains sparse unevenly disseminated sulphides that are partly oxidised and comprise mainly ?pyrite. They account for less than 2% of the present section area. Also present is a barely recognisable discontinuous deformed recrystallised granular quartz veinlet that reaches about 1 mm across.

This sample may be identified as a strongly recrystallised, weakly ?pyrite mineralised, rather massive sample that contains more or less evenly disseminated medium grained phenocrysts of K-feldspar and biotite, as well as subordinate plagioclase, set throughout a fine grained K-feldspar-rich rock matrix fraction. The sample could have had a porphyritic shallow intrusive protolith, or else is a crystal/lithic tuff of acidic (to ?trachytic) primary composition.

Sample No. KP-04 [02-106.00]

Rock Type Deposit of strongly recrystallised quartz that is brittle fractured, ?tectonically brecciated and set in a network of branching 'sericite'/?muscovite-rich domains defining a wavy foliation. The sample lacks recognisable relict textures. Very late patchy secondary alteration is to carbonate, some chlorite and traces of ?kaolinite \pm exceptionally fine grained ?'sericite'.

Hand Specimen A fine grained, pale grey, siliceous, deformed, foliated and fragmental sample for which K-feldspar gave weak results for fine grained irregular clusters, intergrown with pale grey quartz. The branching foliation bends around siliceous domains of ?fragments.

Thin Section This sample has undergone strong metamorphic recrystallisation, and a strong wavy branching foliation bends around somewhat

irregular to lensed siliceous patches or fragments. The latter account for about 70% of the present section area and mainly are about 5 mm to 1 cm across.

The competent quartz rich domains (or fragments) have a granoblastic texture with a variable grain size mainly within the range 0.1 mm up to 0.5 mm. Mutual quartz grain boundaries are commonly triple junctions. The quartz is clouded with abundant dusty solid and fluid inclusions. These domains also contain minor wispy flakes of near colourless birefringent mica located along the mutual quartz grain boundaries. Also present are minor patches of pale green chlorite and anhedral late patchy carbonate.

The quartz-rich domains are separated by a matrix fraction rich in ragged 'sericite' that bends around the fragments and defines the wavy, branching foliation. Pale green minerals in this sample are minor chlorite and possibly near colourless birefringent layer silicate flakes that are most likely 'sericite' or muscovite with some interlayer chlorite. To identify this layer silicate accurately, x-ray diffraction is available if required.

Accessory phases are apatite (mainly within quartz-rich domains) and minor dusty sphene-leucoxene.

An approximate overall modal mineralogy is as follows: quartz 60%; 'sericite' \pm muscovite etc. 30%; chlorite 5%; K-feldspar ~ 2%; carbonate < 3%; and accessory apatite and sphene-leucoxene. Small patches of low birefringent clay (?kaolinite) also are present.

The sample may be described as a deposit of strongly recrystallised quartz that is brittle fractured, ?tectonically brecciated and set in a network of branching 'sericite'/?muscovite-rich domains defining a wavy foliation. The sample lacks recognisable relict textures. Very late patchy secondary alteration is to carbonate, some chlorite and traces of ?kaolinite \pm exceptionally fine grained ?'sericite'.

Sample No. KP-05 [02-126.4]

Rock Type Partly recrystallised, fractured and brecciated deposit of hydrothermal vein quartz, partly intergrown with patchy

adularia. Alteration and fractures partly are filled with very fine grained 'sericite'. Wavy discontinuous and branching trails of wispy fine grained carbonaceous material and sulphides cut across the quartz-rich fractions (fragments), and partly are intergrown with wispy 'sericite' that helps define the wavy foliation direction. Very late fractures are filled with almost monomineralic pale green chlorite and undeformed carbonate. Rare disseminated pyritic sulphides reach 0.2 mm grain size.

Hand Specimen

A friable, deformed, fine grained sample that comprises irregular, pale grey, quartz-rich domains or fragments, that are set in a black carbonaceous wispy and irregular rock matrix fraction. K-feldspar staining gave strong positive results for this irregularly distributed phase that occurs throughout quartz-rich patches, along fractures and as small fragments in dark grey interstitial domains.

Thin Section

This sample has undergone strong metamorphic recrystallisation, brittle fracture, quartz veining and foliation, as well as weak sulphide mineralisation. Recognisable relict textures are not preserved in irregular shaped quartz-rich domains (or fragments), some of which contain patches of medium to quite coarse grained hydrothermal vein quartz. This reaches 1 mm grain size and granular to subprismatic relict vein textures are poorly preserved. The quartz commonly shows strain shadows, domains of brittle fracture, domains of very fine grained recrystallisation and penetration of fine grained wispy 'sericite' along brittle fractures. In some domains are late patches of vein quartz that retain clear subprismatic comb quartz crystals that are normal to the vein length, and in some domains have euhedral terminations into late patches of interstitial clouded carbonate \pm pale green chlorite. A late vein quartz lacks metamorphic recrystallisation. In still other domains quartz is intergrown with moderately abundant patchy K-feldspar, most of which appears to be mottled adularia with some typical rhombic shaped subhedral cross sections through crystals.

The quartz \pm K-feldspar-rich fraction is cut by late patches and veinlets of fine grained clouded (?iron-bearing) carbonate and pale grey chlorite. In

turn these phases are intergrown with and cut by an even later network (breccia matrix) of weakly but irregularly foliated and branching dusty opaque domains dominated by ?carbonaceous material and patchy vein fine grained sulphides. In some domains this fraction also contains abundant wispy ?‘sericite’. Discontinuous brittle fractures are filled with patchy granular quartz, pale green chlorite and sulphides, all of which post date previous carbonate. Rare patches set in wispy fine grained ‘sericite’ are clouded sphene-leucoxene that replaces previous titanian oxides. This suggests presence of some relict primary igneous material.

This is a complex sample that lacks recognisable primary relict textures. It has the following approximate modal mineralogy: quartz 60%; K-feldspar 7%; chlorite 5%; ‘sericite’ 5%; carbonate 8%; carbon 12% and about 3% sulphides with accessory sphene-leucoxene.

This sample may be described as a partly recrystallised, fractured and brecciated deposit of hydrothermal vein quartz, partly intergrown with patchy adularia. Alteration and fractures partly are filled with very fine grained ?‘sericite’. Wavy discontinuous and branching trails of wispy fine grained ?carbonaceous material and sulphides cut across the quartz-rich fractions (fragments) and are partly intergrown with wispy ‘sericite’ that helps define the wavy foliation direction. Very late fractures are filled with almost monomineralic pale green chlorite and undeformed carbonate. Rare disseminated pyritic sulphides reach 0.2 mm grain size.

Sample No. KP-06 [02-214.2]

Rock Type Strongly recrystallised and deformed, finely compositionally layered and distinctly foliated epidote-chlorite-quartz schist with minor patchy carbonate (mainly calcite) and accessory sulphides. The sample could have had a calc-silicate sedimentary (or volcanoclastic) protolith. Veins have mainly granular to poikiloblastic texture and some demonstrate chevron folding.

Hand Specimen A fine to medium grained, distinctly foliated sample with conspicuous lensed domains of mid yellow-green and dark green-grey fractions. Also

present are irregular discontinuous pale grey veinlets and patches associated with patchy sulphides. K-feldspar staining proved negative.

Thin Section

This sample is distinctly recrystallised with a granoblastic to distinctly foliated texture and variable grain size up to about 0.6 mm but with an average grain size of about 0.1 mm. Rare vein-like patches of poikilitic carbonate reach 1.5 mm grain size. The sample is distinctly compositionally layered and layers are typically lensed. The lensed layers vary in thickness from less than 1 mm up to about 1 cm.

The compositional layering is marked by variable proportions of quartz, epidote, chlorite and sphene (titanite). The quartz is granular to granoblastic and commonly forms strained grains and aggregates. Epidote also forms granular aggregates and occurs as subprismatic crystals, particularly in domains rich in green chlorite that defines a wavy foliation. Some vein-like patches and lenses of carbonate (strong reactions of cold dilute HCl – calcite) are late and poikiloblastic, enclosing quartz and epidote \pm sphene.

The most quartz-poor layers have the following approximate modal mineralogy: chlorite 55%; epidote 30%; sphene 10%; and quartz < 5%; and accessory apatite. Quartz-rich lenses and layers have the following modal mineralogy: quartz 75%; chlorite 15%; epidote 5%; and sphene < 5%. In some quartz-rich domains patches of carbonate are interstitial to granular quartz. Green chlorite also forms some vein-like patches.

The sample contains minor patchy disseminated sulphides mainly associated with quartz- carbonate (?recrystallised veins).

This sample comprises strongly recrystallised and deformed, finely compositionally layered and distinctly foliated, epidote- chlorite- quartz- schist with minor patchy carbonate (mainly calcite) and accessory sulphides. The sample could have had a calc-silicate sedimentary (or volcanoclastic) protolith. Veins have mainly granular to poikiloblastic texture and some demonstrate chevron folding.

Sample No.

KP-07 [02-227.6]

Rock Type

Fine grained, recrystallised, foliated and deformed quartz-epidote- chlorite- actinolite schist that has undergone late brittle fracture and microbrecciation (milled microbreccia) and very late carbonate veining that is not recrystallised. The sample could have had strongly vesicular basic volcanic protolith.

Hand Specimen

A fine grained, mid green-grey drill core sample that is distinctly foliated and is partly brittle fractured and brecciated. It is cut by a conspicuous, irregular white carbonate vein up to about 5 mm across and reacts strongly with cold dilute HCl indicating calcite. The vein has a deformed and lensed central zone that is mid red-brown (possibly dusty hematite). K-feldspar staining of the offcut proved negative.

Thin Section

This is a recrystallised and foliated metamorphic rock that is rather fine grained (average grain size is about 0.05 mm but with granoblastic patches reaching 0.3 mm grain size). The majority of this sample is a mat of fine grained pale green, almost fibrous actinolitic amphibole intergrown with chlorite and moderately abundant granular epidote and sphene. This fraction encloses subrounded but flattened to irregular patches, some of which resemble vesicle sites. These are filled with aggregates of granular quartz intergrown with subordinate albite with minor wispy chlorite and epidote \pm carbonate. ?Vesicle sites once could have accounted for almost 30% of some domains.

This lithology now is brittle fractured and microbrecciated, and some lithic fragments show a wavy foliation defined by fibrous actinolitic amphibole. Orientations of the wavy foliation varies in some adjacent fragments. The fragments are set throughout a somewhat meagre matrix of almost fluidised milled breccia, where angular crystal and lithic fragments account for about 25% of the breccia fraction, set in an exceptionally fine grained milled rock matrix fraction of low birefringent pale green chlorite, epidote granules, clouded sphene-leucoxene dust and minor fibrous actinolite.

Some elongate deformed patches are discontinuous ?quartz-rich veinlets now comprising granular recrystallised granoblastic quartz intergrown with minor albite and late carbonate. The rock is cut by a late irregular carbonate vein that is not recrystallised. The vein contains anhedral patchy carbonate up to 2 mm grain size and a narrow central zone of fine grained carbonate that is clouded with dusty hematite. This is the red-brown central fraction of the white carbonate vein in the present drill core hand specimen. Traces of sulphides occur in the milled microbreccia but the late carbonate vein with oxidized central core, lacks sulphides.

This sample may be described as a fine grained, recrystallised, foliated and deformed quartz- epidote- chlorite- actinolite schist that has undergone late brittle fracture and microbrecciation (milled microbreccia) and very late carbonate veining that is not recrystallised. The sample could have had strongly vesicular basic volcanic protolith.

KP-08 to KP-09 (From diamond cored hole about 800-900m from KP-1 to KP-7 samples) Some different schist lithologies.

Sample No. KP-08 [04-43.45]

Rock Type Strongly recrystallised, multiply deformed, compositionally layered, 'sericite-muscovite'-albite-quartz schist/'sericite-muscovite' schist. Discontinuous lensed ?veins now are parallel to the foliation. These contain dominant quartz with minor albite, micas and carbonated ?amphibole crystal sites.

Hand Specimen A fine to medium grained, strongly foliated and deformed drill core sample that comprises distinct compositional layers of siliceous red-brown ?hematite-bearing material and mid yellow-brown, strongly foliated micaceous domains. These domains are partly separated by a discontinuous pale grey to white lensed quartz-rich ?vein. K-feldspar staining proved negative.

Thin Section This is a strongly recrystallised and foliated metamorphic rock that lacks clear recognisable relict textures. It is distinctly compositionally layered on a fine scale (metamorphic differentiation) and a coarser scale (up to several centimetres), possibly representing a primary layering.

The quartz rich fraction, (pink-brown fraction of the drill core sample) has a granoblastic texture, with a grain size mainly within the range 0.1 mm up to 0.3 mm. Rare grains reach 0.6 mm. In this fraction wavy trails of ragged near colourless birefringent silicates define a good foliation.

This fraction has the following approximate overall modal mineralogy: quartz 60%; albite 20%; ?'sericite-muscovite' 20%; and accessory dusty hematite ?epidote granules, zircon, sphene and late (retrograde) chlorite and carbonate. Sparse albite grains that reach about 1 mm grain size, have central cores crowded with solid inclusions. These grains could represent relict primary plagioclase.

Part of the sample comprises a compositional layer of almost monomineralic, colourless birefringent layer silicates (?sericite/muscovite') that define a wavy foliation direction that is further deformed by a second or strain slip foliation, almost normal to the wavy ?first foliation. This second or strain slip foliation is parallel to the prominent wavy foliation (also defined by colourless mica flakes) in the quartzofeldspathic fraction. In this fraction accessory fine grained sphene-leucoxene is developed and rare patches of granular quartz are associated with clusters of spongy unoriented acicular ?amphibole crystal sites that are now retrograded to clouded (?iron-bearing) fine grained carbonate.

The discontinuous pale grey vein-like layer of the hand specimen comprises almost monomineralic granular recrystallised quartz. This deformed ?vein reaches about 4 mm across in the present section. It contains minor wispy interlayer chlorite 'sericite' flakes, carbonate-degraded spongy subhedral amphibole crystals sites, accessory patches of granular albite and traces of oxidised ?sulphides.

The sample may be described as a multiply deformed, strongly recrystallised, compositionally layered, ?'sericite-muscovite'-albite-quartz schist/?'sericite'-muscovite schist. Discontinuous lensed ?veins now are parallel to the foliation. These contain dominant quartz with minor albite, micas and carbonated ?amphibole crystal sites.

Note: The pink to red-brown colour of the quartzofeldspathic fraction is due to dusty red-brown hematite.

Sample No. KP-09 [04-122.95]

Rock Type Strongly recrystallised, multiply deformed, compositionally layered, quartz-‘muscovite-sericite’ schist with some deformed ?veins. Late veins and patches contain carbonate \pm chlorite. The sample contains relict albitised plagioclase crystals that are clouded with wispy very fine grained ‘sericite’.

Hand Specimen A fine grained pale grey sample with some mid green-grey to mid grey patches. A conspicuous but discontinuous layering shows strong folding and deformation. The drill core is cut by fractures and some discontinuous multiply deformed layering in some fragments sharply terminates at their margins. The strong deformation may be characteristic of the hinge area of larger folds where space restrictions apply. K-feldspar staining proved negative and the sample contains only traces of sulphides.

Thin Section This is a strongly recrystallised metamorphic sample that is compositionally layered, multiply deformed, partly fractured and brecciated. The narrow compositional layering has variable thickness (maximum is about 3 mm), and is defined by variable proportions of quartzofeldspathic granoblastic (competent) components, and discontinuous lensed layers rich in colourless birefringent layer silicates. The latter is largely a metamorphic layering. In granoblastic domains grain size is variable from about 0.1 mm up to about 0.4 mm while mica flakes have an average length of about 0.2 mm.

The sample lacks recognisable textures but sparse relict grains of albitised plagioclase are moderately clouded with abundant wispy ‘sericite’ flakes. Some of these grains reach almost 1 mm grain size. Abundant fine grained clouded sphene-leucoxene aggregates, mainly in mica rich domains probably represent titanian oxide crystal sites. These two phases, together with the distinct compositional layering, suggest a volcanoclastic protolith.

Elsewhere are deformed, folded and discontinuous quartz-rich layers up to about 2 mm thick that are most likely recrystallised quartz veins. These contain only minor accessory albite and wispy micas.

The intense deformation in this sample is reflected in mica rich domains where oriented mica flakes define a foliation that is deformed by a second or strain slip foliation parallel to which are distinct fractures. This second or strain slip foliation is the axial plane structure to the folded layering. There is also some evidence that an early folding may have been isoclinal and then further deformed by the axial plane strain slip foliation.

A very approximate overall modal mineralogy is as follows: quartz 55%; ?‘muscovite-sericite’ 40%; albite 5%; and accessory sphene, apatite, epidote, chlorite, carbonate and sulphides.

The sample is cut by late discontinuous fractures and veinlets of granular carbonate that is not strongly recrystallised. Some carbonate patches and veinlets are intergrown with minor chlorite. Accessory patchy sulphides are note particularly associated with these late veinlets. Some occur in sites of relict albitised plagioclase crystals.

This sample may be identified as a strongly recrystallised, compositionally layered, multiply deformed quartz-‘muscovite-sericite’-quartz schist with some deformed ?veins. Late veins and patches contain carbonate \pm chlorite. The sample contains relict albitised plagioclase crystals that are clouded with wispy very fine grained ‘sericite’.

KP-10 to KP-18 (All from one diamond drill hole, from 54.5 to 291 metres down hole).

Sample No.

KP-10 [05-54.55]

Rock Type

Strongly recrystallised and deformed ‘muscovite-sericite’-albite-quartz schist with conspicuous narrow deformed layering. The sample could have had a quartzofeldspathic ?volcaniclastic protolith. It is cut by late narrow discontinuous cryptic veinlets and patches of carbonate \pm

very fine grained ?kaolinite and small subhedral crystals of ?adularia.

Hand Specimen

A fine to medium grained, strongly foliated drill core sample with conspicuous narrow discontinuous folded and deformed layering. Siliceous lensed and microfolded layering alternate with micaceous layers. K-feldspar staining gave positive results for minor irregular disseminated grains and trails of grains parallel to a strain slip foliation, defining the axial plane to microfolds.

Thin Section

This sample has undergone strong metamorphic recrystallisation that accompanies development of microfolds and foliation (at least two episodes of deformation). Most relict textures are obscured but the sample retains sparse, ?once- phenocrystic plagioclase crystals and aggregates up to about 1.5 mm grain size that are albitised but retain fine 'sericite'-clouded central zones. Some plagioclase crystals retain elongate prismatic shapes. Most are now somewhat irregular and intergrown with recrystallised margins. Also present are degraded but unoriented ragged biotite microphenocryst sites, some of which reach about 0.9 mm long. These are now converted to retrograde chlorite \pm carbonate and fine grained sphene-leucoxene granules. In some domains there are aggregates of small (< 0.1 mm grain size) titanian oxide granules now converted to sphene-leucoxene, as well as ?relict detrital grains of sphene, apatite and zircon. These ?relict detrital grains are less than 0.1 mm grain size.

The sample has undergone intense metamorphic recrystallisation, and comprises quartz-rich granoblastic domains (with variable grain size mainly within the range 0.05 mm up to 0.35 mm). Much of the granoblastic felsic fraction comprises an intergrowth of quartz and albite. The quartz-rich domains are lensed and discontinuous, and some define kink or strain slip folds. The strain slip foliation is best defined in mica-rich domains, where ragged flakes commonly reach 0.4 mm long.

Some fractures, both parallel to the wavy foliation and also axial plane to microfolds, contain discontinuous trails of late (undeformed) carbonate \pm kaolinite infill. Some of these veinlets are coated with small crystals with adularia and host aggregates of sulphides.

An approximate overall modal mineralogy is as follow: quartz 55%; ‘muscovite-sericite’ 20%; albite 20%; chlorite ~ 5%; with accessory apatite, sphene and zircon.

This sample may be identified as a strongly recrystallised and deformed ‘muscovite-sericite’-albite-quartz schist with conspicuous narrow deformed layering. The sample could have had a quartzofeldspathic ?volcaniclastic protolith. It is cut by late narrow discontinuous cryptic veinlets and patches of carbonate ± very fine grained ?kaolinite and small subhedral crystals of ?adularia.

Sample No. KP-11 [05-69.7]

Rock Type Albite- ‘muscovite-sericite’-quartz schist containing abundant fractured, deformed and degraded plagioclase blastophenocryst sites. The sample equally may represent a porphyritic igneous protolith but more likely is a recrystallised quartzofeldspathic volcaniclastic rock containing coarsely once- porphyritic crystal and lithic ?detrital grains.

Hand Specimen A fine grained, mid green-grey strongly foliated sample that contains abundant medium to quite coarse grained pale grey (?feldspar) crystal sites that could represent blastophenocrysts. The sample contains traces of sulphides and K-feldspar staining proved negative. The sample is not magnetic.

Thin Section As in previous samples, the present rock has undergone strong metamorphic recrystallisation and is strongly foliated and deformed. Nevertheless, there are preserved somewhat unevenly disseminated ?blastophenocrysts of plagioclase that are now albitised and quite heavily dusted with wispy ‘sericite’ ± patchy carbonate and small recrystallised quartz patches. Some of these grains retain subprismatic shapes while others once formed ??glomeroporphyritic aggregates. Some host patches of late (not recrystallised) fine grained carbonate, kaolinite and sulphides.

The blastophenocrysts occur in lensed felsic domains dominated by granular recrystallised quartz with a variable grain size up to about 0.4 mm. Some coarse albitised plagioclase prisms are brittle (tectonic) fractured with

recrystallised vein quartz filling tensional fractures. Recrystallised quartz-rich lenses commonly reach 4 mm long and up to 2 mm thickness. Some once could have been coarse phenocrystic quartz but these primary shapes now are lost. Other quartz-rich domains most likely are deformed quartz-rich veins that are lensed boudinaged and tightly folded.

The wavy deformed foliation once again is defined by a fraction rich in ragged mica flakes intergrown with degraded olive green chlorite \pm retrograde carbonate. The mica-rich fraction hosts irregularly disseminated titanian oxide granules now converted to clouded sphene-leucoxene, as well as ?once-detrital small grains of sphene, zircon and apatite. In some domains clouded ?chlorite could replace previous acicular amphibole.

This sample contains the following approximate modal mineralogy: quartz 40%; albite 20%; ‘muscovite-sericite’ 30%; ?degraded chlorite 10%; and patchy late carbonate < 5%. Accessory sphene-leucoxene, apatite and zircon, as well as sulphides are present.

This sample may be identified as an albite, ‘muscovite-sericite’-quartz schist containing abundant fractured, deformed and degraded plagioclase blastophenocryst sites. The sample equally may represent a porphyritic igneous protolith but more likely is a recrystallised quartzofeldspathic volcanoclastic rock, containing coarsely once porphyritic crystal and lithic detrital grains.

Sample No.

KP-12 [05-117.5]

Rock Type

‘Muscovite-sericite’-biotite-albite-quartz schist that contains moderately abundant medium grained albitised plagioclase ?blastophenocrysts and irregularly disseminated sites of fine grained granular titanian oxides, mainly associated with narrow discontinuous wavy trails of foliation-oriented micas. Small epidote granules possibly indicate presence of previously calcic plagioclase.

Hand Specimen

A fine to medium grained sample that is mainly pale grey and quartzofeldspathic. It is cut by a branching network of mid green-grey foliation planes, some of which appear to isolate brittle fractured, angular, pale grey siliceous fragments and/or sites of feldspar ?blastophenocrysts. Several narrow layers show staining by ?red-brown hematite. K-feldspar staining gave mainly negative results except for rare, very small patches. The sample contains traces of sulphides.

Thin Section

Once again this sample has undergone strong metamorphic recrystallisation and deformation. It retains about 15% of relatively coarse albitised plagioclase blastophenocrysts sites that commonly reach more than 2 mm grain size. These are more or less evenly disseminated throughout the sample. The relict crystal sites are marked by abundant dusty inclusions of wispy 'sericite', epidote and carbonate. Sites of smaller, relict mafic and oxide crystals (mainly less than 0.6 mm grain size) now are marked by aggregates of sphene-leucoxene granules set in 'sericite' and patches of retrograde ?smectite clay. The sample also contains accessory allanite with rims of yellow epidote added epitaxially in continuity with the host central grains. These sites, together with sparse small albitised ?microphenocryst sites are set in a granoblastic rock matrix of intergrown quartz and albite. These domains could represent lithic clasts or fragments. The outlines of these are lensed to somewhat rounded and rarely exceed 5 mm.

The quartzofeldspathic domains are set throughout a matrix of similarly granoblastic but slightly finer grained (0.05 mm up to about 0.1 mm grain size) intergrown quartz and albite that hosts moderately abundant granules of yellow epidote, accessory apatite, sphene-leucoxene granules and stout but ragged flakes of green biotite that define the wavy foliation. More abundant are wavy trails of near colourless birefringent layer silicates that also define the wavy foliation direction. In some domains the relatively coarse albitised plagioclase blastophenocrysts show brittle fracture and extension with infill of granular recrystallised quartz.

Late narrow veinlets of carbonate are discontinuous but subparallel to the wavy foliation. These rare veinlets reach about 0.2 mm thickness and host quite abundant pyritic sulphides. Small elongate patches of green chlorite also are retrograde.

A very approximate overall modal mineralogy is as follows: quartz 45%; albite 35%; biotite 10%; 'muscovite-sericite' 5%; epidote 5%; and accessory carbonate, chlorite, sphene-leucoxene, allanite, zircon, apatite and minor sulphides.

This sample may be described as a 'muscovite-sericite'-biotite-albite-quartz schist, that contains moderately abundant, medium grained albitised plagioclase ?blastophenocrysts and irregularly disseminated sites of fine grained granular titanian oxides, mainly associated with narrow discontinuous wavy trails of foliation-oriented micas. Small epidote granules possibly indicate presence of previously calcic plagioclase.

Sample No.

KP-13 [05-131.05]

Rock Type

Strongly recrystallised and multiply deformed, compositionally layered chlorite- 'muscovite-sericite'-albite-quartz schist that contains poorly defined albitised plagioclase ?blastophenocrysts. The sample may be derived from a porphyritic igneous or volcanoclastic protolith. The sample contains structurally oriented very thin, subparallel, late tensional fracture-located veinlets filled with assemblages amongst carbonate, chlorite, quartz and adularia, together with patchy sulphides. The veinlets mainly are subparallel to the second or strain slip foliation that is axial plane to the lensed and folded compositional layering.

Hand Specimen

A fine to medium grained, somewhat irregular compositionally layered, strongly foliated and deformed drill core sample with alternating discontinuous lensed and deformed pale grey felsic layers and subordinate narrow mid to dark green-grey micaceous layers that define the wavy foliation. K-feldspar staining gave strong positive results for subparallel discontinuous narrow veinlets that appear to be axial plane to microfolds and possibly subparallel to a second (strain slip or kink) foliation. Some veinlets are parallel to the deformed compositional layering/first foliation direction. Some veinlets contain fine grained sulphides.

Thin Section

This sample is quite similar both mineralogically and texturally to previous recrystallised, strongly deformed metamorphic samples. Irregularly disseminated medium grained albitised plagioclase ?blastophenocrysts mainly lie within the size range 0.2 mm up to 2 mm and are marked by aggregates of dusty 'sericite' \pm epidote and carbonate. Once again, relict oxide crystal sites once were titanian and very fine grained. These comprise trails of sphene-leucoxene granules mainly located in micaceous domains, together with rare grains of zircon and apatite crystals. The latter mainly are located in quartzofeldspathic domains and some reach 0.2 mm grain size.

The majority of this sample comprises a granoblastic recrystallised quartzofeldspathic mosaic with a variable grains size mainly within the range 0.06 mm up to 0.3 mm. This fraction is almost equally dominated by quartz and albite.

Subordinate mica-rich domains are dominated by very pale yellow birefringent layer silicates (? 'sericite-muscovite'), and these flakes have an average length of about 0.5 mm. The ragged flakes define a wavy foliation that is deformed by a second or strain slip foliation producing local kink folding. The micaceous fraction contains patchy green chlorite flakes, and some colourless mica flakes contain interlayer chlorite.

The sample is cut by a series of discontinuous subparallel narrow veinlets, most of which appear to be fracture-controlled and subparallel to the strain slip or second foliation direction. The widest of these reaches about 1 mm in the present section, and contains an undeformed late assemblage comprising sparse short prismatic quartz crystals with euhedral terminations into central zones filled with coarse grained carbonate. The carbonate is intergrown with patchy chlorite. Also present, particularly along grain margins and in some patches are clusters of rhombic adularia crystals. This assemblage hosts sparse patchy pyritic sulphides, some conjugate crosscutting veinlets that also contain late carbonate, quartz, chlorite and sphene \pm K-feldspar.

An overall modal mineralogy is as follows: quartz 35%; albite 30%; 'muscovite-sericite' 25%; chlorite ~ 3%; sphene-leucoxene ~ 2%; vein-located K-feldspar ~ 2%; carbonate ~ 3%; accessory sulphides, apatite and zircon.

This sample may be described as a strongly recrystallised and multiply deformed, compositionally layered chlorite- 'muscovite-sericite'-albite-quartz schist that contains poorly defined albitised plagioclase ?blastophenocrysts. The sample may be derived from a porphyritic igneous or volcanoclastic protolith. The sample contains structurally oriented very thin, subparallel, late tensional fracture-located veinlets filled with assemblages amongst carbonate, chlorite, quartz and adularia, together with patchy sulphides. The veinlets mainly are subparallel to the second or strain slip foliation that is axial plane to the lensed and folded compositional layering.

Sample No. KP-14 [05-163.6]

Rock Type Multiply deformed, mica- chlorite schist that could have had a fine grained mafic ?volcanic protolith containing significant fine grained titanite oxides. The rock is cut by early quartz veinlets, as well as separate patches of quite coarse grained quartz and apatite. Late veinlets comprise carbonate.

Hand Specimen A fine grained dark green-grey drill core sample that is very strongly foliated and is cut by conspicuous narrow branching white veinlets that cut across the foliation direction and react strongly with cold dilute HCl indicating calcite.

Thin Section Recognisable relict textures are not preserved in this fine grained multiply deformed and strongly foliated sample. The sample consists mainly of layer silicates that are thin and wispy, and generally less than 0.1 mm grain size. There are poorly preserved sites of previous titanite oxides (less than 0.25 mm grain size) now marked by aggregates of clouded and dusty sphene-leucoxene. These sites have a somewhat uneven distribution and account for about 5% of the present section area.

A very approximate overall modal mineralogy for this sample is as follows: near colourless birefringent mica (? 'sericite', ?pyrophyllite,

?paragonite etc.) 65%; chlorite 20%; sphene 5%; carbonate 10%; and accessory apatite and quartz.

The near colourless birefringent mica defines the strong foliation that is defined by a second of strain slip foliation producing microkinks. This mica is intergrown with foliated green chlorite, and subordinate green birefringent (?interlayer) mica. Sphene-leucoxene granules possibly represent sites of previous titanian oxides indicating that the protolith was probably quite fine grained.

The sample contains discontinuous vein-like patches of quartz, some of which are associated with green biotite flakes. One of these reaches about 1 mm grain size. Elsewhere are similar sized patches of apatite. Both these phases occupy minor extensional domains.

The sample is cut by late veins, containing clouded carbonate that is not strongly recrystallised. The carbonate forms in branching irregular domains, some of which follows fractures and cleavage surfaces. The sample lacks sulphides.

This sample may be described as a multiply deformed, mica-chlorite schist that could have had a fine grained mafic ?volcanic parent containing significant fine grained titanian oxides. The rock is cut by early quartz veinlets, as well as separate patches of quite coarse grained quartz and apatite.

Sample No. KP-15 [05-176.15]

Rock Type 'Sericite-muscovite'- K-feldspar- albite- quartz schist. It could have had a volcanoclastic rather than intrusive igneous protolith, since many medium grained ?plagioclase ?blastophenocrysts have broken irregular shapes.

Hand Specimen A fine grained, pale green-grey to mid green-grey sample that contains moderately abundant, conspicuous, medium to quite coarse grained pale grey feldspar crystal sites. It is cut by a somewhat wavy foliation. K-feldspar staining gave strong positive results for some crystal sites and abundant small vein-like patches. The sample contains patchy disseminated fine grained sulphides.

Thin Section

This sample has undergone strong metamorphic recrystallisation and abundant near-colourless ragged birefringent mica flakes define a wavy (deformed) foliation. Nevertheless, the sample contains about 30% of feldspar (and possibly quartz) ?blastophenocryst sites, that mainly lie within the size range 0.3 mm up to 1 mm. Rare aggregates reach more than 2 mm. These crystals are dominated by albitised plagioclase, some of which have broken angular shapes. Most are clouded with 'sericite', carbonate and traces of epidote. Others are patchy K-feldspar, some of which is microcline. Elsewhere are microcline crystals that have undergone brittle fracture and partial fine recrystallisation. The sample once could have contained igneous ?biotite, since albitised plagioclase blastophenocrysts contain skeletal remains of a layer silicate now marked by subparallel trails of sphene-leucoxene granules and wispy sericite. Still other sites once could have been fine grained titanian oxides now converted to translucent sphene-leucoxene. Zircon is accessory.

The barely recognisable coarse crystal sites are set throughout a matrix of fine grained recrystallised granoblastic quartz and albite \pm K-feldspar, intergrown with trails of ragged near colourless mica flakes ('sericite-muscovite') defining the wavy foliation. The latter commonly reach 0.5 mm long. The average grain size of the granoblastic quartz-rich rock matrix fraction is about 0.15 mm. Also in some domains K-feldspar (microcline) appears to partly replace albite. Some K-feldspar (now also microcline) retains somewhat rhombic crystal shapes, possibly indicating previous ??adularia.

In some recrystallised domains are vein-like aggregates of granular quartz and K-feldspar (microcline) reaching 0.8 mm grain size, and similar patches together with albite, host spongy pyritic sulphides up to about 2 mm grain size. Some of the wispy K-feldspar of the hand specimen follows the wavy foliation direction.

This sample has the following approximate overall modal mineralogy: quartz 40%; mica 25%; albite 20%; K-feldspar 15%; and accessory sphene/leucoxene, zircon and apatite. Also present is minor interstitial carbonate. Late pyritic sulphides also are accessory.

This sample may be identified as a 'sericite-muscovite'- K-feldspar- albite- quartz schist. It could have had a volcanoclastic rather than intrusive igneous protolith since many medium grained ?plagioclase ?blastophenocrysts have broken irregular shapes.

Sample No.

KP-16 [05-237.09]

Rock Type

This sample may be described as a chlorite- 'muscovite-sericite'- albite- K-feldspar- quartz- schist containing conspicuous medium grained blastophenocrysts of altered feldspars and quartz. It is largely recrystallised, multiply deformed, and has undergone late fine grained K-feldspar ?hydrothermal alteration and even later patchy alteration and veining by chlorite and carbonate. The sample contains traces of sulphides. This sample could have had a quartz- and feldspar- 'porphyritic' protolith of intrusive (or volcanoclastic) origin. It is cut by a conspicuous quartz and feldspar-bearing vein that lacks sulphides in the present section.

Hand Specimen

A fine grained pale to mid green-grey strongly foliated and deformed drill core sample that contains conspicuous disseminated medium grained pale grey feldspar ?phenocryst sites. The drill core is cut by a conspicuous white quartz-rich vein, that reaches 5 mm across and is offset by a narrow brittle fracture. The vein is more or less parallel to the wavy foliation and the offset fracture is normal to the vein. A second narrow veinlet subparallel to the fracture is partly void. This vein reaches only about 1 mm across. K-feldspar staining gave strong positive results for some parallel wispy domains that are lensed and discontinuous but parallel to the wavy foliation.

Thin Section

This sample has undergone strong metamorphic recrystallisation and multiple deformation in which there are clear domains of foliated 'sericite', further deformed by a second or strain slip foliation producing microkink folding. Nevertheless, there is quite well preserved, a once ?porphyritic ?igneous texture marked by abundant medium to coarse grained blastophenocrysts and

glomeroporphyritic aggregates of almost equally abundant plagioclase and quartz with subordinate K-feldspar. These relict phenocryst sites mainly are in the size range 1 mm up to 2 mm and with some aggregates that reach 3 mm across. Phenocrystic plagioclase retains subhedral prismatic shapes but is mainly albitised and clouded with dusty 'sericite'. Some grains also show alteration to patchy carbonate and clouded pale brown ?smectite clay. Once-phenocrystic quartz retains some magmatically rounded and embayed shapes but also shows strain shadows and partly recrystallised margins. Barely recognisable sites of previous phenocrystic K-feldspar now are converted to fine grained aggregates of secondary microcline.

The sample has an uneven distribution of fine grained titanite crystal sites now converted to translucent aggregates of sphene-leucoxene dust. Possible mafic crystal sites also containing some patchy sphene-leucoxene once could have had a grain size of about 0.3 mm.

The rather poorly preserved blastophenocryst sites are set in a fine grained, strongly recrystallised matrix fraction comprising lensed quartz-rich granoblastic domains separated by near colourless mica-rich domains that define the deformed foliation. This mica is partly altered to aggregates of extremely fine grained granular K-feldspar (see staining of offcut). This K-feldspar (less than 0.05 mm grain size) occurs in wavy domains that parallel kink folding defined by partly replaced metamorphic mica. In many albitised plagioclase crystal sites, late patchy chlorite (-smectite) is developed. Minor discontinuous veinlets of carbonate also are undeformed.

The sample is cut by a conspicuous quartz-rich vein, up to 5 mm across in the present section. It is more or less parallel to the wavy foliation and is dominated by granular recrystallised quartz with an average grain size of about 0.4 mm. The quartz hosts anhedral patches of granular K-feldspar (now microcline), some of which is poikiloblastic enclosing abundant small quartz blebs. The quartz contains local small patches of interstitial carbonate. The sample lacks significant sulphides. Branching narrow discontinuous veinlets of olive green chlorite post date (cut across) the earlier K-feldspar alteration.

An approximate overall modal mineralogy for the host rock (not veins) is as follows: quartz 35%; K-feldspar 30%; albite 15%; mica birefringent

near colourless layer silicates 15%; chlorite 5%; and accessory sphene-leucoxene, apatite, zircon and disseminated sulphides. Sparse spongy pyrite crystals are associated with patches of poorly crystallised fine grained chlorite and carbonate (\pm quartz).

This sample may be described as a chlorite- 'muscovite-sericite'- albite- K-feldspar- quartz- schist containing conspicuous medium grained blastophenocrysts of altered feldspars and quartz. It is largely recrystallised, multiply deformed, and has undergone late fine grained K-feldspar ?hydrothermal alteration and even later patchy alteration and veining by chlorite and carbonate. The sample contains traces of sulphides. This sample could have had a quartz- and feldspar- 'porphyritic' protolith of intrusive (or volcanoclastic) origin. It is cut by a conspicuous quartz and feldspar-bearing vein that lacks sulphides in the present section.

Sample No. KP-17 [05-285.4]

Rock Type ?Vitric tuff containing unsorted feldspar- porphyritic lithic and crystal fragments. It has undergone strong metamorphic recrystallisation mainly of quartz-rich domains, and is cut by brittle fractures filled with secondary chlorite, carbonate and some sulphides.

Hand Specimen A fine grained, pale grey, rather massive drill core sample that contains poor sparse outlines of medium grained ?feldspar crystal sites. It is cut by a network of very narrow branching brittle fractures, some of which contain carbonate that reacts strongly with cold dilute HCl indicating calcite. K-feldspar staining gave very strong positive results for most of this fine grained sample. In some domains K-feldspar staining may define previous outlines of glass shards and small pumiceous fragments.

Thin Section This is a strongly feldspathic sample that is mainly fine grained and partly recrystallised (partly granoblastic texture). Nevertheless, it retains recognisable sites of blastophenocrysts, as well as once-porphyritic ?igneous fragments. Recognisable phenocryst sites account for about 25% of the section area, and possible porphyritic lithic fragments account for a further 10% of the present section area. Feldspar phenocryst sites retain stout subhedral shapes, and are mainly albitised plagioclase that is lightly dusted with 'sericite' and patchy carbonate. Once-

phenocrystic K-feldspar now is a complex intergrowth of albite and K-feldspar. Some K-feldspar patches also occur in plagioclase prisms. Sites of possible quartz phenocrysts retain resorbed rounded outlines, but are now composite recrystallised grains.

Outlines of lithic fragments are angular and irregular, and in the present section are mainly less than 3 mm across. Some retain recognisable plagioclase-porphyritic texture, and these prisms are set in a recrystallised somewhat granoblastic rock matrix or groundmass fraction, rich in quartz. In some of these fragments there are recognisable sites of previous once-phenocrystic ?biotite now converted to fine grained olive green chlorite and interlayer ?‘sericite’ ± sphene granules. In the groundmass of these fragmental patches the granular quartz is intergrown with pale green birefringent mica and albite.

The abundant rock matrix fraction comprises dense irregular spongy patches of fine grained K-feldspar (see offcut) intergrown with patches of coarser grained (mainly about 0.15 mm) granular granoblastic recrystallised quartz with subordinate albite. Albite grains tend to be subprismatic (some could be relict ?igneous ?microlites). Also present are sparse crystal sites now converted to very fine grained wispy birefringent clay (?smectite).

The sample contains minor birefringent layer silicates that are pale green (possibly chrome-bearing (?fuchsite)). The sample contains disseminated pyritic sulphides mainly associated with secondary chlorite or along late fractures partly filled with granular to granoblastic weakly recrystallised carbonate (most likely calcite since it reacts with cold dilute HCl).

The sample is cut by late branching narrow fractures mainly filled with carbonate ± chlorite, wispy ‘sericite’ and pyritic sulphides. Elsewhere clusters of sulphides are associated with chlorite.

This sample has the following approximate overall modal mineralogy: K-feldspar 60%; albite 10%; quartz 20%; mica 5%; chlorite 3%; carbonate 2%; and accessory zircon, apatite and sphene-leucoxene replacing sparse oxide granules. Also sparse disseminated sulphides.

This sample may be identified as a ?vitric tuff containing unsorted feldspar porphyritic lithic and crystal fragments. It has undergone strong metamorphic recrystallisation mainly of quartz-rich domains, and has is cut by brittle fractures filled with secondary chlorite, carbonate and some sulphides.

Sample No. KP-18 [05-291.00]

Rock Type Albite-‘sericite-muscovite’-quartz schist containing poorly defined, medium grained, albitised plagioclase ?blastophenocrysts, possibly in relict fragments and ?layers. These may indicate a volcanoclastic rather than intrusive protolith.

Hand Specimen A fine grained, foliated and deformed drill core sample with a conspicuous narrow lensed compositional layering. The layers vary from mid green-grey to pale grey and some are pale red-brown. The rock is cut by a somewhat diffuse white quartz-rich vein, part of which reacts with cold dilute HCl indicating calcite. Elsewhere are patches and veinlets, also of calcite. The sample contains minor pyritic sulphides that appear to be restricted to one compositional layer. K-feldspar staining proved negative.

Thin Section This sample is a strongly recrystallised metamorphic rock with a distinct wavy foliation. It has a narrow lensed compositional layering mainly defined by layers that are alternately rich and poor in near colourless birefringent layer silicates that define the wavy foliation direction. Some lensed domains once could have been lithic fragments.

Competent quartzofeldspathic layers mainly have granoblastic texture with a variable grain size from about 0.1 mm up to about 0.6 mm. In this fraction quartz predominates with subdominant albite. This fraction also encloses sparse medium grained somewhat spongy subhedral prisms of albitised plagioclase containing abundant wispy ‘sericite’ ± carbonate. These crystal sites, up to about 0.9 mm long, once could have been phenocrysts but now are rather ragged and spongy with partly recrystallised margins. Some lenses resemble flattened ?intrusive ?porphyry fragments, containing up to 40% of partly recrystallised and albitised

plagioclase blastophenocrysts. Quartzofeldspathic layers mainly reach about 2 mm maximum thickness and account for about 40% of the section area.

Most of the sample comprises a recrystallised mica rich fraction with an average grain size of about 0.2 mm. Ragged mica ('sericite-muscovite') flakes are near colourless and birefringent. These are intergrown with subordinate granular to granoblastic quartz, albitised plagioclase, patches of ?retrograde carbonate and fine grained 'sericite'-altered ?feldspar. The mica rich fraction contains unevenly disseminated fine grained titanian oxide crystal sites, most of which are less than 0.2 mm grain size and comprise aggregates of clouded sphene-leucoxene. Most are less than 0.05 mm grain size. Also present are accessory equant zircon crystals and apatite.

A conspicuous but diffuse vein that reaches about 5 mm across in the present section, comprises abundant recrystallised but strained quartz grains with an average grain size of about 0.35 mm. Quartz is intergrown with patchy interstitial carbonate and contains sparse spongy albite crystals up to about 0.8 mm grain size. The vein contains only traces of sulphides. The rock is cut by late narrow fractures that are branching and discontinuous. They also contain carbonate, as well as some wispy 'sericite' and minor green chlorite. Clusters of subhedral pyritic sulphide crystals and aggregates occur in discontinuous lensed patches or ?veinlets, but these account for less than 1% of the section area.

An overall modal mineralogy is as follows: quartz 40%; albite 15%; 'sericite'-muscovite ~ 25%; carbonate 15%; chlorite < 5%; and accessory zircon, apatite, sphene and sulphides.

This sample may be identified as an albite-'sericite-muscovite'-quartz schist containing poorly defined, medium grained, albitised plagioclase ?blastophenocrysts, possibly in relict fragments and ?layers. These may indicate a volcanoclastic rather than intrusive protolith.

KP-19 (Eureka Creek)**Sample No.**

KP-19

Rock Type

Intensely deformed and recrystallised, fine grained foliated quartzite. It has undergone partial near surface oxidation and weathering. It is unlikely to have had an intrusive igneous protolith, but could have had a silicified acidic volcanic parent. It lacks normal relict heavy detrital grains, and therefore is unlikely to have a quartz-rich sedimentary protolith.

Hand Specimen

A fine grained siliceous but foliated sample that is pale brown-grey and irregularly stained by red-brown hematite on exposed surfaces. Red-brown hematite also stains irregular fractures.

Thin Section

This sample is a very strongly deformed and foliated siliceous rock that lacks recognisable relict textures. It comprises elongate lensed recrystallised and strained domains of quartz with an average grain size of about 0.3 mm, but with some grains that reach 1 mm long and up to 0.4 mm thickness in the present section. The quartz grains have sutured irregular mutual grain boundaries, and are distinctly strained. They also have domains of fine grained subgrain growth due to tectonic recrystallisation. They enclose wispy elongate colourless birefringent mica flakes that help to define the distinct foliation direction. They also enclose clusters of fine grained dusty sphene-leucoxene granules but are possibly sites of previous titanite oxides. Still other crystal sites also are elongate but somewhat irregular and now are converted to yellow limonitic oxide-stained low birefringent clay (?kaolinite). These sites once could have contained a feldspar but no unaltered feldspars remain. Some sites that are now converted to dense patches of limonitic oxides once could have contained sulphides.

An approximate overall modal mineralogy is as follows: quartz 75%; ?feldspar crystal sites (now converted to limonitic oxide stained clay) 15%; 'sericite-muscovite' flakes < 5%; dusty oxide crystal sites (now ?sphene-leucoxene) < 5%; and possibly minor degraded sulphides.

This sample may be identified as an intensely recrystallised, strongly deformed and foliated, fine grained quartzite. It has undergone partial near surface oxidation and weathering. It is unlikely to have had an intrusive protolith, but could have had a silicified acidic parent. It lacks normal relict heavy detrital grains and therefore is unlikely to have a quartz-rich sedimentary protolith.