

**MINERALOGICAL REPORT No. 8630**

*by Alan C. Purvis, PhD*

February 14, 2005

**TO :**

Mr Gavin Otto  
Cameco Australia Pty Ltd  
PO Box 36921  
WINNELLIE NT 0821

**YOUR REFERENCE :**

Order No. 3729 (part)

**MATERIAL &  
IDENTIFICATION :**

Drill core samples  
GDD00D1

**WORK REQUESTED :**

Thin section preparation, description and report  
with photomicrographs and comments as  
specified.

**SAMPLES & SECTIONS :**

Returned to you separately, following this  
report.

**DIGITAL COPY :**

Document of text and separate directory of  
photographs on CD.

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## SUMMARY COMMENTS

This report presents descriptions of normal thin sections of twelve samples from Goomadeer drillhole GDD0001. The essential lithologies identified petrographically are listed in Table 1 below, together with alteration assemblages. Selected photomicrographs are integrated with most (but not all) individual descriptions, Fig Nos. 1 to 11.

The primary lithologies are mostly basement metamorphics and igneous rocks, including metasediments, massive and foliated granitoids (from diorite to monzogranite), pegmatites and mafic lithologies. The mafic lithologies include Oenpelli Dolerite (with olivine-bearing and quartz-bearing zones).

Alteration varies from weak to pervasive, with various types of fine white mica (illite, phengite and muscovite), also chlorite, (mostly intermediate or Mg-rich) and clays including kaolinite and smectites or vermiculite in some samples. The chlorite, especially Mg-rich chlorite, commonly replaces plagioclase as well as more typically replacing biotite and amphibole. Various carbonate species, prehnite, pumpellyite and epidote occur in some samples, also less widespread actinolite, and secondary K-spar. There is only relatively sparse secondary quartz. Accessory scattered ex-primary opaque oxide grains are commonly altered to leucoxene, anatase or rutile.

TSA data provided by Cameco are listed together with the field note above each of the individual petrographic descriptions. These notes and the alteration/mineral assemblages tabulated in Table 1 readily facilitate comparisons of the optical mineralogy with this TSA data.

Table 1: Alteration Characteristics of Drillhole Samples, Report No 8630

Drillhole	Depth	Lithology	Alteration Assemblages (most to least abundant)			Ex-oxide
GDD0001	50.5	Metasandstone	Kaolinite	Illite/sericite	Chlorite/vermiculite/smectite	Leucoxene
	66.6	Quartz feldspar-biotite granofels. Altered metasediment?	Chlorite	Illite/sericite	Smectite/vermiculite	Anatase
	77.9	Quartz feldspar-biotite granofels. Altered metasediment?	Sericite/illite/phengite	Clay-quartz		
	88.25	Pegmatite?	Sericite/illite	Smectite		Leucoxene
	102.7	Tonalite	Sericite/illite	Chlorite/smectite/vermiculite	Smectite-leucoxene	Anatase
	136.3	Granodiorite	Sericite/illite	Chlorite/smectite/vermiculite	Prehnite-pumpellyite-epidote	
	156.6	Monzogranite	Sericite/illite	Chlorite/smectite/vermiculite	Limonite/hematite	Leucoxene
	162.1	Granitoid	Albite-sericite	Limonite-chlorite-leucoxene	Epidote-hematite	
	170.9	Monzogranite	Clay-prehnite	Epidote, sericite		
	200.5	Granodiorite	Sericite-epidote	Chlorite	Muscovite	
		Vein 1	Muscovite-chlorite-calcite			
		Vein 2	Calcite-prehnite-limonite			
	204.3	Quartz monzonite	Clay-prehnite	Chlorite		
	248.5	Dolerite	Albite-chlorite-smectite	Sericite		
	278.6	Gneissic diorite	Chlorite-sericite-quartz	Chlorite-leucoxene-carbonate	Carbonate-quartz veins	

## INDIVIDUAL DESCRIPTIONS AND INTEGRATED PHOTOMICROGRAPHS

**GDD0001-0505: 50.5m**      **Probable metasandstone with abundant quartz and kaolinite-illite ± hematite patches partly ex-feldspar, partly ex-porphyroblasts. Partly altered biotite is also disseminated as well as minor oxidised opaque oxide, rimmed by leucoxene, and clay-leucoxene-altered grains.**

**Field Note:** *Foliated granitic gneiss; strong hematite alteration and minor sericite: TSA: Kaolinite*

Mineral	Vol %	Origin
Quartz	52	Partly detrital + metamorphic
Kaolinite	30	Derived from feldspar etc, and possible porphyroblasts Ex schistose biotite Metamorphic
Limonite/earthy hematite?	10	
Illite/sericite	5	
Biotite/chlorite/vermiculite/smectite	2	
Oxide/hematite	1	
Leucoxene	<1	Rimming oxide
Carbonate	<1	Small grains, secondary
Brown clay-leucoxene patches	trace	Replacing small grains?

There is abundant quartz in this thin section as apparently partly recrystallised detrital grains, some of which retain detrital cores and optically continuous overgrowths. The cores are mostly less than 0.5mm in diameter, indicating medium-grained sandstone, but rare grains have planar deformation lamellae, indicating low temperature deformation, and metamorphism seems to have amalgamated some detrital cores into grains as much as 1mm in diameter. The quartz is irregularly disseminated with some bands to 3 or 4mm wide largely composed of quartz and other bands with little or no quartz and abundant kaolinite ± illite. Within the clay-rich areas, grain boundaries are less clearly preserved, but it seems that limonite-free aggregates of kaolinite and/or illite have replaced possible feldspar grains to 0.5mm in diameter. Mostly kaolinite patches with minor to abundant limonite or earthy hematite are also abundant and define extremely irregular lenses and lamellae to 5mm wide. These seem to have a boxwork-like pattern but there is very little evidence on the nature of the original mineral(s). Larger patches of kaolinite and hematite, locally with illite or sericite, seem to have replaced porphyroblasts, but there is again no clear evidence as to the original mineral. The largest patch is 3mm in diameter and contains minor altered biotite. Foliated biotite is also disseminated but is fine-grained and seems to have been partly altered to chlorite and clays. Minor granular opaque oxide seems to have been altered to hematite and has narrow rims of leucoxene, with sparse separate patches of leucoxene also disseminated, mostly in kaolinite-rich areas. There are also dark brown clay patches rimmed by leucoxene but of uncertain origin.

Small grains of carbonate occur rarely and there is a carbonate vein at one end of the thin section.

**GDD0001-0666: 66.6m**

**Microgranular and foliated microcline-biotite-plagioclase aggregate with minor opaque oxide but no quartz.  
 Interpreted as possible metamorphosed potassic alteration zone affecting metasediment?**

**Field Note:** *Finely crystalline microgranite (?) with weak to moderate chlorite and hematite alteration, possibly foliation-controlled in part: TSA: Fe-Chlorite*

Mineral	Vol %	Origin
Microcline	77	Metamorphic
Fe-rich or intermediate chlorite	14	Ex-biotite (foliated)
Illite/sericite	6	Ex-plagioclase
Biotite/smectite/vermiculite	2	Ex-biotite
Oxide (hematite?)	1	Oxidised metamorphic
Anatase	trace	Ex-biotite

This sample is entirely free of quartz but has abundant microcline as a mosaic from 0.2mm to 1mm in grainsize. Foliated biotite to 0.5mm grainsize is evenly disseminated and largely replaced by green chlorite with minor anatase, but some areas contain flake with possibly residual biotite as well as clay interlaminated with or rimming the chlorite. Sericitised fine granular plagioclase occurs mostly towards one end of the thin section, but fine-grained opaque oxide is disseminated as small grains. This sample seems to have suffered potassic alteration, but the original lithology seems more likely to have been a metasediment rather than a granitoid.

**Fig 1**

**GDD001, 66.6m**

**0.45 mm**

Thin section (TS), Crossed nicols (Xnic). Feldspar-biotite granofels. An irregularly polygonal massive granuloblastic aggregate of quartz and weakly altered microcline, with intergranular weakly altered biotite throughout.

**GDD0001-0779: 77.9m** **Altered quartz-feldspar granofels, with a contact between altered plagioclase-quartz aggregate, with accessory microcline and opaque oxide, and a massive microcline-quartz-plagioclase rock, partly with sericite ex-plagioclase and partly with unidentified (?chloritic) clay  $\pm$  quartz > sericite ex-plagioclase. Possibly altered metasediment.**

**Field Note:** *Strongly altered granitoid with hematite and chlorite alteration, minor foliation in part: TSA: Phengite 0.53, Illite 0.47*

Mineral	Vol %				Origin
[Zone]	I	II	III	IV	
Quartz	30	28	17	18	Metamorphic
Sericite/illite/phengite?	65	7	20	3	Ex-plagioclase?
Clouded clay $\pm$ quartz?		60		20	Ex-plagioclase?
Microcline	3	<1	60	56	Metamorphic
Oxide	1	3	2	2	Metamorphic, oxidised
Limonite	1	1	1	1	Weathering?
Chlorite	trace		trace		Ex-biotite?

This sample has compositional layering, represented by a quartz-plagioclase-rich layer in zones I and II (with rare chlorite ex-biotite) and a microcline-rich layer in zones III and IV. The texture is essentially massive granular with rounded and amoeboid quartz grains from 0.2 to 1mm in diameter, altered plagioclase mostly as a micromosaic to 1mm grainsize and microcline commonly 1-1.5mm in grainsize. Minor granular opaque oxide is disseminated and seems to have been oxidised, with limonite-filled fractures in the sericite and clay aggregates apparently derived from feldspar. Cutting across the layering is a sharp but slightly irregular boundary between zones I and III on the one hand, and zones II and IV on the other. In zones I and II plagioclase has been altered to sericite or possible phengite or illite. However, in zones II and IV the plagioclase is mostly altered to brownish, clouded, weakly anisotropic clay of uncertain character with lamellae of sericite or illite partly along possible cleavage or twin planes and partly along fractures and grain boundaries. This sample may represent partly altered metasediment with some zones of potassic alteration as seen in the previous sample, but is unlikely to be of granitic origin.

## Fig 2

## Fig 3

## **GDD001, 77.9m**

0.45 mm

TS. Xnic. Similar altered feldspar-quartz granofels to that in Fig 1, with microcline > quartz and sericitised plagioclase in Fig 2, but sericite alteration NE half passing into isotropic dark probable chlorite in SW half, both replacing plagioclase, in Fig 3, which also has more abundant quartz.

**GDD0001-0882: 88.25m**      **Probable pegmatite with fresh microcline and quartz, sericitised plagioclase and smectite after biotite ± amphibole. Leucoxene has replaced titanite and there is minor opaque oxide and apatite**

**Field Note:** *Chloritic quartzofeldspathic rock. Possible remobilisate; Feldspars replaced by chlorite, minor hematite: TSA: Phengite 0.56; Montmorillonite: 0.44*

Mineral	Vol %	Origin
Microcline	32	Primary igneous
Sericite/phengite	42	Ex-plagioclase
Quartz	17	Primary igneous
Smectite + leucoxene	8	Ex-biotite, amphibole
Oxide	1	Oxidised
Leucoxene-quartz aggregate	<1	Ex-titanite
Apatite	trace	Accessory igneous

This sample seems to be a pegmatite and has inequigranular microcline to 15mm or more in grainsize as well as abundant sericitised inequigranular plagioclase. Some of the quartz is enclosed in feldspar in a crudely graphic pattern, but interstitial granular quartz is also common and as much as 6mm in grainsize. Decussate biotite to 2mm grainsize has been largely altered to green smectite but also contains leucoxene and patches of sericite and/or quartz, but there are also grains altered to smectite with less abundant leucoxene, possibly derived from granular to prismatic amphibole to 2mm grainsize. A small aggregate of leucoxene and quartz seems to have replaced titanite and there is very minor opaque oxide, usually accompanied by apatite, enclosed in altered biotite.

**GDD0001-1027: 102.7m** **Altered biotite-hornblende tonalite with sericite/illite alteration of plagioclase, followed by adularia. Chlorite and smectite/vermiculite have replaced much of the biotite, with smectite also derived from amphibole and rutile ex-titanite. Apatite and zircon occur as accessories.**

**Field Note:** *Clay and hematite altered porphyritic granite, outer zone of shear zone; TSA: Illite: 0.58: Intermediate Chlorite: 0.42*

Mineral	Vol %	Origin
Quartz	30	Primary igneous
Sericite/illite + earthy hematite	38	Ex-feldspar
Chlorite-smectite/smectite/vermiculite, with lamellar leucoxene ± quartz, also minor fresh biotite	12	Fresh and altered biotite
Massive smectite-II with leucoxene	7	Ex-amphibole
K-spar (adularia)	10	Ex-feldspar
Rutile ± anatase	3	Ex-titanite
Apatite	<1	Accessory igneous
Zircon	trace	Accessory igneous

This seems to have been a relatively mafic tonalite but has abundant quartz to 4mm in grainsize as interlocking, largely interstitial grains. The feldspar, to 5mm grainsize, seems to have been initially altered to sericite or illite, with minor earthy hematite along fractures, but in some areas has been further altered along fractures and grain boundaries to nearly uniaxial adularia. Some of the biotite, which occurs as decussate aggregates to 4mm in grainsize, is fresh, but perhaps  $\frac{2}{3}$  of the biotite has been altered to smectite and chlorite (± vermiculite?) in various proportions, locally with lenses of quartz parallel to the cleavage. Pale greenish smectite with sparsely disseminated leucoxene seems to have replaced mostly granular amphibole to 4mm grainsize, with aggregates of rutile ± anatase derived from granular titanite to 4mm grainsize. Accessory apatite is common in fresh and altered biotite and in altered amphibole, with accessory zircon to 0.25mm grainsize.



**GDD0001-1363: 136.3m**      **Weakly altered hornblende-biotite granodiorite with titanite, allanite, opaque oxide apatite and zircon. Sericite, chlorite, clay minerals, prehnite, pumpellyite and epidote occur as secondary minerals and there is a carbonate vein.**

**Field Note:**    *Unaltered granite: TSA: Muscovite: 0.58; Prehnite 0.42*

Mineral	Vol %	Origin
Quartz	25	Igneous
Plagioclase	35	Igneous
Sericite/illite	10	Ex-plagioclase
Microcline	15	Igneous
Hornblende	6	Igneous
Biotite/chlorite/smectite	6	Fresh and altered igneous
Titanite	2	Igneous
Prehnite	1	Secondary minerals parallel
Pumpellyite	trace	to the cleavage in biotite
Epidote	trace	and in feldspar
Oxide	trace	} Igneous
Altered allanite	<1	
Apatite	trace	
Zircon	trace	
		Altered igneous
		Accessory igneous
		Accessory igneous

This is a relatively fresh hornblende-biotite granodiorite with partly sericitised plagioclase containing small patches of prehnite and/or epidote in some areas. The quartz and plagioclase are mostly less than 5mm in grainsize, with subhedral plagioclase and interstitial ragged grains of plagioclase, but microcline is as much as 10mm in grainsize and has small inclusions of strongly sericitised plagioclase. The hornblende is green, mostly granular and fresh, with rare chlorite in one grain, but the biotite seems to have chlorite-clay alteration and has lenses of prehnite and/or pumpellyite parallel to the cleavage. The biotite, hornblende and minor titanite are mostly less than 3mm in grainsize, with some zoning in the titanite. Zoning is also visible in altered allanite grains to 1.3mm long. Oxides, apatite and zircon are fine-grained with zircon to 0.15mm grainsize. A narrow carbonate vein is present.

**Fig 4**

**GDD01, 136.3m**

**0.18 mm**

TS. PPL. Part of a localised mafic aggregate with yellow-brown pleochroic hornblende, altered biotite and minor titanite as well a quartz and weakly clouded/sericitised plagioclase. The biotite has been partly altered to green chlorite but contains lenses of colourless prehnite and pale green pumpellyite.

**GDD0001-1566: 156.6m**      **Contact between coarser syenogranite/monzogranite and finer monzogranite with weakly to intensely sericite-limonite-altered plagioclase, chloritised biotite and oxidised opaque oxide rimmed by leucoxene. Minor titanite is present, suggesting an oxidised I-type magma.**

**Field Note:**    *Pervasively hematite altered finer grained quartz-feldspar granite, heavily fractured, with disseminated green sericite: TSA: Muscovite*

Mineral	Vol %	Origin
<b>[Coarse-grained part]</b>		
Microcline	65	Igneous
Quartz	30	Igneous
Sericite	10	Ex-plagioclase
Chlorite/smectite	4	Ex-biotite
Limonite/earthy hematite	1	In fractures
Titanite, apatite	<1	Accessory
Hematite	<1	Ex-magnetite
Leucoxene	trace	Rims on hematite
<b>[Fine-grained part]</b>		
Microcline	45	Igneous
Quartz	25	Igneous
Plagioclase	22	Igneous
Sericite	3	Ex-plagioclase
Chlorite ± clay	2	Ex-biotite
Limonite/earthy hematite	1	In fractures
Hematite	1	Ex-magnetite
Leucoxene, apatite, titanite, zircon	trace	Accessory igneous

This sample shows a contact between a coarser-grained, more microcline-rich granitoid, transitional from syenogranite towards monzogranite, and a finer-grained monzogranite with more abundant, less altered plagioclase than in the coarser-grained lithology. Both lithologies contain oxidised opaque oxide rimmed by leucoxene and minor titanite, indicating an oxidised I-type magma. The contact is sharp but is marked by a zone, about 1-3mm wide, rich in sericitised plagioclase and brown, limonite-clay-clouded fine granular feldspar, possibly albite, as well as limonite-filled fractures. There is also an obliquely crosscutting clay-limonite-quartz-filled vein that has cut both lithologies.

**The coarser-grained lithology** has partly elongate microcline grains to 7mm long, commonly parallel to the contact, as well as sericitised plagioclase with limonite-filled

fractures, inequigranular quartz to 6mm grainsize and oxidised opaque oxide, rimmed by leucoxene and partly veined by clay. Minor fine-grained titanite is disseminated and there is minor altered biotite, varying from chlorite-rich to clay-rich, as well as accessory apatite.

**The finer-grained domain** includes grains and aggregates of plagioclase, microcline and/or quartz from 1-2mm in grainsize but is mostly an inequigranular micromosaic of grains 0.1mm to 1mm in diameter. Small rounded quartz grains occur within and between feldspar grains, but larger quartz grains are also disseminated. The feldspar seems to be sodic and has weak to intense sericitisation, increasing towards the transitional zone referred to above. Very minor chloritised biotite is disseminated as well as oxidised opaque oxide, titanite, apatite and zircon. Minor limonite or earthy hematite occurs on fractures, partly within altered plagioclase.

**GDD0001-1621: 162.1m**      **Albite-sericite-hematite-chlorite-altered heterogeneous granitoid with iron-stained albite-filled fractures and veins indicating incipient fragmentation. Accessory opaque oxide, apatite and zircon are disseminated.**

**Field Note:**    *Pervasively hematite altered quartz-feldspar granite, weakly brecciated: TSA: Illite: 0/83, Epidote: 0.17*

Mineral	Vol %	Origin
Quartz	24	Primary magmatic
Albite-I, pale brown, ± sericite	37	Ex-plagioclase
Albite-II, orange-brown, limonite-stained to pale, partly clear crystals	10	In veins and fractures
Microcline, partly clouded	20	Primary magmatic
Limonite-chlorite-leucoxene aggregates	6	Ex-biotite
Epidote	2	Ex-feldspar, biotite
Allanite	<1	Altered primary
Hematite (granular)	<1	Altered primary
Apatite, zircon	accessory	Accessory igneous

This sample contains two large zones with abundant microcline, locally at least 10mm in maximum grainsize, but is elsewhere poor in or without K-spar. The abundant plagioclase has been altered to reddish, limonite or hematite-stained albite with minor sericite and sparsely disseminated granular epidote, with epidote also in and adjacent to limonite or hematite-flooded biotite flakes to 2mm long with some areas of clear chlorite, apparently iron-rich. Epidote also rims rare prisms of possibly altered allanite 1mm long.

Deeply limonite or hematite-stained albite also occurs in highly irregular fractures, mostly cutting quartz and albitised plagioclase, with some displacement along several of these fractures, suggesting incipient fragmentation. A more clearly defined vein widens out into a lens of columnar albite crystals with reddish staining along the vein margins and pale central zone. There are also very narrow iron-stained, albite-filled fractures. Minor fine-grained opaque oxide seems to have been oxidised to hematite and there are traces of apatite and zircon.

### Fig5

### Fig 6

**GDD001, 162.1m**

0.18 mm

TS. Plane polarised light (PPL). Xnic. Fig 5 shows clear quartz NE quadrant and red dusted K-spar (SW quadrant) are separated by a large crystal of titanite (right hand side) partly enclosing an opaque grain of hematite rimmed by epidote. Another (central) clear grain of epidote occurs to the left of the titanite, with dark composite hematite and altered possible allanite (top left), partly rimmed by epidote. Fig 6 is the Xnic equivalent of Fig 5.

### Fig 7

**GDD001, 162.1m**

0.09 mm

TS. PPL. Brownish limonite-stained feldspar enclosing various minerals, including black-opaque hematite-chlorite ex-biotite (left hand side) enclosing apatite (AP), with apatite also on epidote (EP), some of which also rims hematite (right hand side). A single zircon curved crystal (Z) occurs between two opaque grains of hematite.

**GDD0001-1709: 170.9m**

**Porphyritic fine-grained monzogranite, leucocratic with biotite, opaque oxide, titanite and epidote/allanite. Weak alteration to sericite, clays and prehnite.**

**Field Note:** *Unaltered mafic granodiorite / tonalite*

Mineral	Vol %	Origin
Quartz	32	} Igneous, partly altered
Microcline	32	
Plagioclase	26	
Biotite + clay ± prehnite	3	
Epidote/allanite	2	} Primary/secondary?
Oxide ± titanite	2	
Sericite	4	Igneous
Apatite, zircon	trace	Secondary
		Accessory igneous

This sample is only weakly altered but is very leucocratic and has more abundant microcline than plagioclase, suggesting monzogranite. It also seems to be porphyritic with plagioclase to 3mm in grain size, occurring as single crystals or in aggregates with smaller grains of quartz and microcrystalline. The groundmass has abundant quartz as small rounded grains as well as anhedral microcline and plagioclase from 0.1mm to 1mm in grain size. Sericite is present in some of the plagioclase grains but is not abundant. Small grains and aggregates of biotite and opaque oxide are disseminated, partly in lenses to 2mm long. The biotite seems to be partly altered to clay, possibly chlorite-smectite, with rare prehnite parallel to the cleavage. Small grains of orange-coloured possible REE epidote also occur, as well as trace apatite and rare small crystals of zircon. Rare titanite is disseminated, partly rimming opaque oxide.

**GDD0001-2005: 200.5m**      **Weakly foliated quartz-rich granodiorite with albite-sericite-hematite-muscovite-epidote-chlorite alteration. An early muscovite-chlorite-carbonate vein with very minor prehnite is followed by a carbonate-limonite-prehnite vein.**

**Field Note:** *Coarsely crystalline granite pervasively hematite altered with coarse mica and quartz carbonate (calcite) within fracture: TSA: Illite: 0.6; Prehnite: 0.4*

Mineral	Vol %	Origin
Quartz	40	Igneous
Albite	40	Ex-plagioclase
Microcline	10	Igneous
Earthy hematite	4	In feldspar
Sericite, muscovite and epidote	2	In plagioclase
Chlorite, intermediate to iron-rich	2	Ex-biotite
Muscovite	<1	Ex-biotite
Granular hematite	2	Ex-magnetite
Iron-rich clay + hematite	1	Replacing irregular grains
Apatite, zircon	trace	Accessory
<b>[Vein-1]</b>		
Muscovite > iron-rich chlorite > calcite		In a planar fracture
<b>[Vein-2]</b>		
Calcite, prehnite and limonite/hematite		In a later narrow fracture

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This sample seems to be leucocratic granodiorite. It is weakly foliated due to a subparallel elongation of plagioclase grains to 8mm long, albitised with various proportions of earthy hematite, sericite, muscovite and epidote. Microcline grains to 6mm long are also partly parallel to this foliation and have diffuse patches of earthy hematite. Opaque oxide, to 1mm grainsize, are oxidised and partly fractured with chlorite along the fractures. Zoned pale to dark green (intermediate to iron-rich) chlorite has replaced very minor biotite, but this is unoriented. Very minor muscovite occurs in some of the altered biotite. Unidentified small grains have been altered to dark green clays with abundant hematite. Traces of apatite and very small zircon grains are attached to biotite and opaque oxide.

The main vein (1) is at 20-30° to the foliation and is largely filled with unoriented coarse-grained muscovite together with interstitial iron-rich chlorite. Small lenses of prehnite occur adjacent to the vein and there are also patches of carbonate in and adjacent to the vein. A smaller vein (2) contains minor prehnite as well as carbonate and limonite or earthy hematite.

### **Fig 8**

### **Fig 9**

### **GDD001, 200.5m**

0.45 mm

Fig 8 : TS. PPL. Fig 9 : Xnic. (x20) Quartzofeldspathic gneiss, with clear quartz in left half of Fig 8, reddened feldspar (in right half). Central crosscutting composite vein with muscovite (coloured in Xnic photo #9) and dark (Fig 9) chlorite. Also carrying a single crystal of tatanite (circled).

**GDD0001-2043: 204.3m**     **Heterogeneous quartz syenite to quartz monzonite with coarser-grained quartz-poor to quartz-free segregations. Altered biotite is disseminated as well as opaque oxide, titanite, apatite and zircon.**

**Field Note:**     *Relatively unaltered vaguely foliated granite granitic gneiss or possibly migmatitic texture within granite*

Mineral	Vol %	Origin
Quartz	17	Igneous
Microcline	50	
Plagioclase	24	
Clays, prehnite, chlorite	5	Ex-biotite
Oxide	3	
Titanite	1	Igneous
Apatite, zircon	trace	Accessory igneous

This sample is mostly fine-grained and inequigranular but has parallel lenses and layers of coarser-grained material, partly 5mm or more in thickness, mostly towards one end of the thin section. The overall composition is transitional from quartz syenite to quartz monzonite. The coarser-grained material is mostly richer in microcline than the finer-grained material, but has little or no quartz and does not seem to represent a typical leucosome as seen in normal migmatites. The plagioclase throughout has weak sericite alteration. The maximum grain size in the coarser layers and lenses varies from 1.5mm to 3mm, whereas the fine-grained areas have grains less than 1mm in diameter and 15-25% quartz in different areas. Rare weakly sericitised plagioclase phenocrysts occur to 2mm in diameter. Small flakes of former biotite show clay-chlorite alteration and have prehnite parallel to the cleavage, but are unoriented. Small grains of opaque oxide are disseminated as well as microcrystalline titanite, with titanite rarely rimming opaque oxide. Accessories are sparse and very fine-grained, including apatite and zircon.

The coarser material may represent magmatic segregations but may have been recrystallised. It is not clear why these are quartz-poor or quartz-free.

**GDD0001-2485: 248.45m**      **Partly altered dolerite with albite and chlorite ± smectite largely replacing ex-plagioclase, also interstitial patches of chlorite-smectite.**

**Field Note:**    *Unaltered dolerite: TSA: Null.*

Mineral	Vol %	Origin
Clinopyroxene	33	Igneous
Albite	38	Mostly ex-plagioclase
Fe-chlorite-smectite	20	
Sericite	3	
Oxide	5	Igneous
Quartz	1	Late magmatic
Apatite	trace	Late magmatic

This dolerite has fresh clinopyroxene, opaque oxide and quartz but has totally altered plagioclase and small areas of interstitial material composed of probably interlayered chlorite-smectite. The clinopyroxene is granular to subophitic and 0.2mm to 1.5mm in grain size, with skeletal opaque oxide to 1mm grain size. Plagioclase laths to 4mm long have been altered to albite and minor to abundant dark green, iron-rich clay, probably chlorite in some areas and chlorite-smectite in others. Very minor late magmatic quartz is disseminated and there is accessory apatite as needles to 0.5mm long in and adjacent to areas of quartz and of chlorite-smectite.

## Fig 10

## Fig 11

## **GDD001, 248.5m**

0.18 mm

TS. Fig 10 PPL, Fig 11 Xnic. (x50). Altered dolerite. Random laths of plagioclase (clouded in Fig 10), altered to albite ± minor chlorite, commonly with interstitial pale green chlorite-smectite between. Khaki-yellowish green and brown patches are mostly smectite-altered plagioclase, as described. Clinopyroxene in this sample is granular to sub-ophitic and relatively fresh, minor example with blue interference colours circled in SW quadrant Fig 11.