Appendix 5
Petrology Reports
Mason Geoscience

Report 3145
Petrographic Descriptions for Six Drill Core
Rock Samples from Drill Hole NCT005

Report 3185
Petrographic Descriptions for Two Drill Core
Rock Samples from Drill Hole NCT008

(See Digital File EL20_2003_200605_07_Appendix5.pdf)

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Petrographic Descriptions for Six Drill Core Rock Samples from Drill Hole NCT005 (Mt Read Volcanics, Tasmania)

REPORT # **3145**

CLIENT **Newcrest Mining Limited – SE Australia Exploration**

ORDER NO **NML E 12684**

CONTACT **Mr N. Fitzpatrick / Mr I. Tedder**

REPORT BY **Dr Douglas R Mason**

SIGNED

for Mason Geoscience Pty Ltd

DATE **5 January 2006**

Petrographic Descriptions for Six Drill Core Rock Samples from Drill Hole NCT005 (Mt Read Volcanics, Tasmania)

SUMMARY

1. Rock Samples

- A suite of 6 drill core rock samples from drill hole NCT005 (Mt Read Volcanics, Tasmania) has been studied using routine optical petrographic methods, supplemented by mineragraphic observations for some samples and staining of all section offcuts for K-feldspar.

2. Brief Results

- A summary of rock names and mineralogy is provided in TABLE 1.
- *Primary rock types*
  - **Dacite porphyry** represents the primary rock type in all samples. It was originally composed of sparsely scattered glomerocrystic phenocrysts of plagioclase, accompanied by minor ferromagnesians and accessory Fe-Ti oxide (magnetite, ilmenite), apatite and zircon, in a holocrystalline fine-grained massive groundmass dominated by plagioclase and quartz. A weakly oxidised calc-alkaline magmatic association is inferred, and the textures are consistent with a shallow intrusive mode of emplacement.
- *Fracturing, veining and alteration*
  - **Brittle deformation and invasion by hydrothermal fluid** has affected all samples, producing zoned alteration assemblages attributable to decreasing fluid/rock ratios from inner to outer assemblages.
  - **Highest fluid volumes** have invaded sample NCT005, 531.4m, in which high-intensity alteration of wallrock has generated the pervasive alteration assemblage of albite + quartz + pyrite + trace rutile + native gold, and fractures and thin veinlets have been filled by K-feldspar + quartz + albite + calcite + pyrite + sericite + native gold. The bright yellow colour of the native gold suggests it has moderate fineness (ie low to moderate Ag content), and its occurrence both in vein fillings and in altered wallrock suggests that deposition of gold occurred both in response to vein crystallisation processes and reaction processes between host rock and mineralising fluid.
  - **Outboard from the gold-bearing mineralisation**, strong pervasive alteration has generated albite + quartz + sericite + dolomite + trace leucoxene/rutile (NCT005, 574.0m).
  - **At greater distances**, alteration assemblages of albite, quartz, chlorite, sericite, trace hematite and rutile and pyrite are developed, with preservation of primary magnetite in outermost assemblages. The presence of trace hematite produces a reddish brown colour pervasively through the rock.

TABLE 1: SUMMARY OF ROCK NAMES AND MINERALOGY

SAMPLE	ROCK NAME	MINERALOGY*		
		Primary**	**Alteration**	**Veins / fracture fillings**
NCT005, 84.3m	Thinly fractured and medium-intensity albite-chlorite-sericite-hematite altered meta-?dacite porphyry	Mt, zir	Alb, qtz, chl, ser, hem, rut	Chl, ser
NCT005, 189.0m	Fractured and thinly quartz-carbonate veined medium-intensity albite-chlorite-sericite-hematite altered meta-?dacite porphyry	Mt, zir	Alb, qtz, ser, chl, hem, rut, py	(see below)
	Fracture fillings	-	-	Ser, chl, hem, py
	Quartz-carbonate veinlets	-	-	Qtz, cal, chl, hem
NCT005, 277.7m	Thinly quartz-chlorite veined and medium-intensity albite-chlorite-sericite-hematite altered meta-?dacite porphyry	Mt, apa, zir	Alb, qtz, ser, chl, hem, rut	Qtz, chl, alb
NCT005, 517.5m	Medium-intensity albite-carbonate-sericite-sulphide altered meta-?dacite porphyry	-	Alb, qtz, dol, ser, leu/rut, opq(?py)	-
NCT005, 531.4m	Feldspar-carbonate-quartz-sulphide-gold veined and high-intensity albite-quartz-pyrite-gold altered meta-?dacite porphyry	-	Alb, qtz, py, rut, gld	Kf, qtz, alb, cal, py, ser, gld
NCT005, 574.0m	Medium- to high-intensity albite-sericite altered meta-?dacite porphyry	Zir	Alb, qtz, ser, dol, leu/rut	-

NOTES

*: Minerals are listed in each paragenesis according to approximate decreasing abundance.

**: Only primary minerals currently present in the rock are listed. Others may have been present, but are altered.

Mineral abbreviations

Alb = albite; apa = apatite; cal = calcite; chl = chlorite; dol = dolomite; gld = native gold; hem = hematite; Kf = K-feldspar; leu = leucoxene; mt = magnetite; opq = undifferentiated opaques (possible mineral in brackets); py = pyrite; qtz = quartz; rut = rutile; ser = sericite; zir = zircon.

1 INTRODUCTION

A suite of 6 drill core rock samples, including 2 pre-prepared thin sections, was received from Mr Nicholas Fitzpatrick (Newcrest Mining Limited – SE Australia Exploration, Cadia via Orange, NSW) on 7 December 2005.

It was indicated that the samples originate from an exploration project hosted by the Mt Read Volcanics in Tasmania. Particular requests were:

i) Prepare a thin section for each sample without one already.

ii) Polished thin sections may be appropriate for some samples.

iii) Report on mineralogy, alteration and paragenesis.

iv) Return the sections, offcuts and two copies of the report to Mr Ian Tedder at the Cadia Office of Newcrest Mining Limited.

Purchase Order NML E 12684 accompanied the samples and letter of request.

Excerpts from this report were provided by email to Mr Fitzpatrick and Mr Tedder on 23 December 2005. This report contains the full results of this work.

2 METHODS

The samples were examined in hand specimen and marked for thin section preparation. It was noted that some samples responded positively to the hand magnet, suggesting minor magnetite may be present. For those samples it was considered appropriate to obtain polished thin sections in order to clarify the nature of the magnetic phase.

At Mason Geoscience Pty Ltd conventional transmitted polarised light microscopy was used to prepare the routine petrographic descriptions. Additional mineragraphic observations are provided where a polished thin section is available. Paragenetic stages of development of each rock are indicated in the mineral modal list, where each mineral is assigned to a numerical paragenesis (paragenesis 1 is earliest; paragenesis 2 overprints 1; paragenesis 3 overprints both 2 and 1; etc). The paragenetic stages display relative timing within each sample, and are not meant to be directly equated between samples although this may be correct for some samples.

Preliminary petrographic observations suggested that K-feldspar was present in one sample (NCT005, 531.4m), and it appeared possible that some K-feldspar might also occur in the fine-grained felsic mosaic in other samples. For confirmation, each section offcut was stained for K-feldspar using the conventional sodium cobaltinitrite method. Each offcut was etched in HF for ~10 seconds, rinsed in water, covered with freshly made saturated solution of sodium cobaltinitrite for ~30 seconds, and finally rinsed. This procedure generates a bright yellow stain where K-feldspar occurs in the rock. The results are provided in TABLE 2, and are also given under Hand Specimen description in the individual petrographic descriptions.

Discussion of the results confirmed that a selection of colour photomicrographs should be included to illustrate magnetite and the mineralised veins. These are given in APPENDIX 1.

TABLE 2: RESULTS OF STAINING FOR K-FELDSPAR

SAMPLE	RESULT*	COMMENT
NCT005, 84.3m	Negative	K-feldspar is absent.
NCT005, 189.0m	Negative	K-feldspar is absent.
NCT005, 277.7m	Negative	K-feldspar is absent.
NCT005, 517.5m	Negative	K-feldspar is absent.
NCT005, 531.4m	Positive	K-feldspar occurs in moderate abundance as small ragged grains concentrated along variably oriented thin veinlets and fracture seals.
NCT005, 574.0m	Negative	K-feldspar is absent.

*: Positive = Yellow stain for K-feldspar observed in stained section offcut under binocular microscope.
Negative = No yellow stain for K-feldspar observed in stained section offcut under binocular microscope.

3 PETROGRAPHIC DESCRIPTIONS

The petrographic descriptions are provided in the following pages. A combined petrographic and mineragraphic description is provided where a polished thin section is available.

SAMPLE : NCT005, 84.3m (Mt Read Volcanics, Tasmania)

SECTION NO : NCT005, 84.3m

HAND SPECIMEN : The drill core sample represents a fine-grained massive dull reddish grey rock, through which are uniformly scattered small paler grey grains (altered feldspar crystals).

The sample responds positively to the hand magnet, suggesting minor magnetite is distributed throughout.

The section offcut failed to accept the stain for K-feldspar, confirming it is absent.

ROCK NAME : Thinly fractured and medium-intensity albite-chlorite-sericite-hematite altered meta-?dacite porphyry

PETROGRAPHY AND MINERAGRAPHY :

A visual estimate of the modal mineral abundances gives the following:

Mineral	Vol %	Origin
Zircon	Tr	Igneous 1
Albite	2	Alteration 2 (after plagioclase phenos. 1)
Felsic mosaic (albite, quartz)	86	Alteration 2 (after groundmass 1)
Chlorite	5	Alteration 2 / fracture filling 2
Sericite	3	Alteration 2 / fracture filling 2
Magnetite	2	Relict igneous 1 / ?alteration 2
Hematite	1	Alteration 2
Rutile	Tr	Alteration 2

In polished thin section, this sample displays a partly-preserved sparsely porphyritic igneous texture, modified by thin fracturing and alteration.

Much of the rock is composed of a massive fine-grained felsic mosaic composed of equant anhedral quartz grains which enclose small randomly oriented subhedral albite-altered plagioclase laths. The texture is reminiscent of rapidly cooled (quenched) groundmass in felsic igneous rock. The absence of stain in reaction with sodium cobaltinitrite confirms that K-feldspar is absent.

Albite occurs in minor amount as optically continuous replacements of blocky prismatic plagioclase prisms, and glomerocrystic aggregates of those crystals. They clearly have suffered no deformation since crystallisation, except where cut by thin sealed fractures (see below).

Magnetite occurs in two forms:

i) Large equant crystals of inferred primary igneous origin are sparsely scattered through the rock. In places they have suffered partial replacement by fine-grained pleochroic green chlorite and traces of hematite. Some magnetite crystals have suffered truncation by variably oriented thin fractures (see below), confirming the earlier origin of the magnetite.

ii) Tiny euhedral magnetite crystals are sparsely but uniformly distributed through the rock.

Hematite occurs in minor amount as small bladed flakes which tend to be concentrated along microfractures, especially where they intersect and disrupt primary magnetite crystals.

Small euhedral zircon crystals are very sparsely scattered through the rock. In places they occur in close association with the relict large magnetite crystals.

Small subhedral rutile crystals are concentrated in uncommon small aggregates, which appear to represent thoroughly altered primary Fe-Ti oxide crystals (probably ?ilmenite).

Cutting the rock are thin fracture seals. They display varied orientations, and are filled mostly by fine-grained concentrations of green chlorite and colourless sericite. In many fractures, the phyllosilicate flakes display a preferred orientation, suggesting that fracturing and fracture sealing occurred more-or-less synchronously.

INTERPRETATION :

This sample is considered to have formed as a coherent felsic igneous rock of broadly dacitic bulk composition. It was originally composed of sparsely scattered phenocrysts (plagioclase >> magnetite > ?ilmenite > zircon) in a holocrystalline groundmass of quenched quartz + plagioclase. Particular textural features support a shallow intrusive (possibly cryptodomal) mode of emplacement: massive texture, moderate abundance of phenocrysts which are non-fragmented. A calc-alkaline magmatic association is inferred, and the presence of both primary magnetite and ?ilmenite suggest that the magma was weakly oxidised.

Subsequent fracturing and invasion by a relatively small volume of hydrothermal fluid resulted in filling of the fractures by chlorite + sericite, and weak pervasive alteration of the host rock by albite + trace chlorite + sericite + hematite + rutile.

SAMPLE : NCT005, 189.0m (Mt Read Volcanics, Tasmania)

SECTION NO : NCT005, 189.0m

HAND SPECIMEN : The drill core sample represents fine-grained, massive, dark reddish grey rock which is cut by a closely-spaced network of variably oriented thin dark green fractures. Uncommon lustrous blocky sulphide crystals (pyrite) also occur in some of the fracture fillings, and uncommon white patches also occur in some fractures.

The sample responds weakly to the hand magnet, suggesting minor magnetite is present throughout the rock.

The section offcut failed to accept the stain for K-feldspar, suggesting it is absent.

ROCK NAME : Fractured and thinly quartz-carbonate veined medium-intensity albite-chlorite-sericite-hematite altered meta-?dacite porphyry

PETROGRAPHY AND MINERAGRAPHY :

A visual estimate of the modal mineral abundances gives the following:

Mineral	Vol %	Origin
Fractured and medium-intensity albite-chlorite-sericite-hematite altered meta-?dacite porphyry		
Zircon	Tr	Igneous 1
Magnetite	<1	Relict igneous 1
Albite	80	Alteration 2 (after plagioclase phenos. 1)
Felsic mosaic (quartz, albite)	5	Alteration 2 (after igneous groundmass 1)
Sericite	10	Alteration 2 / fracture filling 2
Chlorite	3	Alteration 2 / fracture filling 2
Hematite	Tr	Alteration 2 / fracture filling 2
Rutile	Tr	Alteration 2
Pyrite	Tr	Alteration 2 / fracture filling 2
Quartz-carbonate veinlets		
Quartz	79	Veinlet filling 2
Carbonate (calcite)	20	Veinlet filling 2
Chlorite	Tr	Veinlet filling 2
Hematite	Tr	Veinlet filling 2

In polished thin section, this sample displays a partly-preserved massive porphyritic igneous texture in host rock, and granular space-filling textures in minor thin veinlets.

Fractured and medium-intensity albite-chlorite-sericite-hematite altered meta-?dacite porphyry retains its primary massive porphyritic igneous texture. Plagioclase formed sparsely scattered blocky prismatic crystals (phenocrysts) and glomerocrystic aggregates. The plagioclase crystals are notable for their euhedral crystal forms; none display any fracturing or brittle fragmentation textures. All have suffered replacement by optically continuous albite.

Much of the rock is composed of a massive felsic mosaic. Small equant anhedral grains of clear quartz and albite-altered plagioclase are distinguishable, and small plagioclase laths are observed as inclusions in the slightly larger quartz grains. These textures are unmistakably igneous in origin.

Magnetite occurs in two forms:

i) Some occurs as larger equant subhedral crystals ~0.2-0.4 mm in size, sparsely and irregularly scattered through the rock. In places they are closely associated with plagioclase phenocrysts but

others occur discretely. Their size, shape and occurrence confirm that they represent relict primary igneous phenocrysts.

ii) Tiny magnetite crystals are sparsely sprinkled through the groundmass. These appear to represent a relict primary groundmass phase.

Sericite occurs in significant amount as tiny flecks sparsely distributed through the felsic mosaic, but most is concentrated along thin variably oriented fractures. In many of the sericite-sealed fractures, the sericite flecks display a preferred orientation suggesting that they formed with syn-deformation timing.

Chlorite occurs in minor amount as tiny pleochroic green flecks concentrated in scattered ragged patches (possibly altered ferromagnesian phenocrysts), and also as fillings in thin fractures. Like sericite, the chlorite in the sealed microfractures displays a preferred orientation.

Hematite is present in trace amount as minute (submicron-sized) reddish specks that sparsely pervade the felsic matrix, and also as minor small replacement patches in some of the large relict magnetite crystal sites.

Rutile occurs in trace amount as small subhedral crystals in small aggregates that appear to represent altered primary Fe-Ti oxide crystals (?ilmenite but none is preserved).

Pyrite is uncommon, forming small cubic crystals.

Zircon forms accessory small terminated prisms.

Quartz-carbonate veinlets are thin and locally appear to represent tension gashes between sericite-chlorite-filled fractures. The quartz forms small clear anhedral grains, and calcite forms larger subhedral to anhedral cleaved grains. In some veinlets, lineated calcite grains suggest vein formation with syn-deformation timing. Uncommon small chlorite flakes occur in the veinlets, and rare small lath-like hematite crystals also are identified.

INTERPRETATION :

This sample is considered to have formed as porphyritic igneous rock of broadly dacitic composition. It was composed of scattered phenocrysts (plagioclase >> ferromagnesians > magnetite > ilmenite > zircon) in a fine-grained massive holocrystalline groundmass of plagioclase, quartz and accessory magnetite. A moderately oxidised calc-alkaline magmatic affinity is inferred.

The rock suffered fracturing and invasion by a low to moderate volume of hydrothermal fluid. This generated the new alteration assemblage of albite + sericite + chlorite + trace hematite + rutile + pyrite. At this time, a network of thin brittle fractures were sealed by sericite + chlorite + trace pyrite, and wider tension gashes were filled by quartz + calcite + trace chlorite + hematite.

SAMPLE : NCT005, 277.7m (Mt Read Volcanics, Tasmania)

SECTION NO : NCT005, 277.7m

HAND SPECIMEN : The drill core sample represents a fine-grained massive drab reddish grey rock, cut by variably oriented thin darker fractures.

The sample responds weakly to the hand magnet, suggesting minor magnetite is present.

The section offcut failed to accept the stain for K-feldspar, suggesting K-feldspar is absent.

ROCK NAME : Thinly quartz-chlorite veined and medium-intensity albite-chlorite-sericite-hematite altered meta-?dacite porphyry

PETROGRAPHY AND MINERAGRAPHY :

A visual estimate of the modal mineral abundances gives the following:

Mineral	Vol %	Origin
Medium-intensity albite-chlorite-sericite-hematite altered meta-?dacite porphyry		
Magnetite	<1	Relict igneous 1
Apatite	Tr	Relict igneous 1
Zircon	Tr	Relict igneous 1
Albite	5	Alteration 2 (after plagioclase phenos. 1)
Felsic mosaic (albite, quartz)	82	Alteration 2
Sericite	8	Alteration 2
Chlorite	3	Alteration 2
Hematite	Tr	Alteration 2
Rutile	Tr	Alteration 2
Quartz-chlorite veinlets		
Quartz	89	Veinlet filling 2
Chlorite	10	Veinlet filling 2
Albite	1	Veinlet filling 2

In polished thin section, this sample displays a sparsely porphyritic massive igneous texture, modified by pervasive alteration and minor thin veining.

Medium-intensity albite-chlorite-sericite-hematite altered meta-?dacite porphyry retains its primary massive sparsely porphyritic igneous texture. Plagioclase formed stumpy euhedral prisms, and glomerocrystic aggregates, scattered through the rock. All have been replaced by optically continuous albite.

Much of the rock is composed of a felsic mosaic dominated by equant anhedral albite and clear quartz grains. In places the plagioclase and quartz grains appear to be intergrown in quench texture.

Sericite is moderately abundant, forming tiny flecks that sparsely pervade the rock. In places they are concentrated along thin variably oriented fractures.

Chlorite occurs as dense green replacements of sparsely scattered blocky prismatic ferromagnesian crystals, and also as tiny flecks distributed sparsely through the rock.

Magnetite occurs as scattered blocky crystals ~0.4 mm in size. These appear to represent relict primary microphenocrysts. Tiny magnetite cubes are sparsely sprinkled through the felsic groundmass, and these also appear to represent relict primary crystals.

Hematite occurs in trace amount as minute reddish specks and small diffuse clouds that tend to occur in the albite grains of the altered groundmass.

Rutile is present in trace amount as small crystals concentrated in altered Fe-Ti oxide crystal sites (accessory ?ilmenite but none is preserved).

Apatite occurs in trace amount as stumpy clear prismatic crystals of microphenocrystic origin. Some occur discretely, but others occur in close association with altered ferromagnesian and magnetite phenocrysts.

Zircon is rare, forming small stumpy prisms commonly in close association with the magnetite phenocrysts.

Quartz-chlorite veinlets are uncommon. They display sharp contacts against host rock, but are variable and non-planar in orientation. They are filled mostly by clear anhedral quartz grains, dense ovoid aggregates of pleochroic green chlorite, and uncommon twinned albite grains.

INTERPRETATION :

This sample is considered to have formed as a porphyritic igneous rock of dacitic composition. It was originally composed of scattered minor phenocrysts (plagioclase > ferromagnesians >> magnetite = ilmenite > apatite = zircon) in a fine-grained massive felsic groundmass dominated by plagioclase and quartz. A calc-alkaline magmatic association is likely, and the presence of both magnetite and ilmenite suggest that the magma was only moderately oxidised.

Fracturing and invasion of the rock by a small volume of hydrothermal fluid resulted in filling of minor thin fractures by quartz + chlorite + albite, and selective pervasive replacement by albite + chlorite + sericite + trace hematite + rutile.

SAMPLE : NCT005, 517.5m (Mt Read Volcanics, Tasmania)

SECTION NO : NCT005, 517.5-517.55

HAND SPECIMEN : The drill core sample represents a fine-grained pale cream rock with sparsely scattered small very pale green patches.

The section offcut failed to accept the stain for K-feldspar, suggesting it is absent.

ROCK NAME : Medium-intensity albite-carbonate-sericite-sulphide altered meta-?dacite porphyry

PETROGRAPHY :

A visual estimate of the modal mineral abundances gives the following:

Mineral	Vol %	Origin
Albite	10	Alteration 2 (after plag phenos. 1)
Albite	54	Alteration 2 (after plag. groundmass 1)
Quartz	25	?Relict igneous 1 / alteration 2
Carbonate (dolomite)	5	Alteration 2
Sericite	5	Alteration 2
Leucoxene/rutile	<1	Alteration 2
Opaques (?pyrite)	Tr	Alteration 2

In thin section, this sample displays partly-preserved massive sparsely porphyritic igneous texture, modified by moderately strong pervasive alteration.

Plagioclase formed blocky prismatic crystals and glomerocrystic aggregates, but all have suffered complete replacement by optically continuous albite and flecks and patches of sericite.

Much of the rock is composed of a more-or-less equigranular mosaic of small anhedral albite grains (after primary plagioclase) and small clear quartz grains. The two phases tend to be intergrown in a texture reminiscent of quickly cooled groundmass of felsic intrusive rocks.

Carbonate (dolomite) occurs in moderate amount as small granular aggregates scattered through the rock.

Sericite forms tiny flecks sprinkled through the altered felsic groundmass and altered plagioclase phenocrysts, but it also tends to be concentrated in thin fracture fillings of varied orientations.

Leucoxene/rutile occurs in two forms: as turbid dark pseudomorphous replacements of blocky crystals (primary accessory Fe-Ti oxide minerals such as ?magnetite and ?ilmenite), and also as tiny turbid granules sprinkled through the altered groundmass (after tiny primary magnetite crystals observed in other samples of this suite).

Opaques occur in trace amount as cubic crystals (probably pyrite) sparsely disseminated through the rock.

INTERPRETATION :

This sample is considered to have formed as a sparsely porphyritic felsic igneous rock of broadly dacitic composition. It was originally composed of minor phenocrysts (plagioclase >> Fe-Ti oxides) in a fine-grained holocrystalline groundmass (plagioclase > quartz). It was texturally comparable with other inferred dacite porphyries in this suite.

The rock suffered invasion by a significant volume of hydrothermal fluid, resulting in pervasive replacement by albite + quartz + carbonate (dolomite) + sericite + trace leucoxene/rutile + opaques (?pyrite).

SAMPLE : NCT005, 531.4m (Mt Read Volcanics, Tasmania)

SECTION NO : NCT005, 531.4m

HAND SPECIMEN : The drill core sample represents a drab pale pinkish cream rock cut by thin paler pink fractures and thicker non-planar white veins. Lustrous cubic pyrite crystals are disseminated sparsely through the rock.

The section offcut accepted a positive yellow stain for K-feldspar, indicating it occurs in moderate amount concentrated along thin fractures.

ROCK NAME : Feldspar-carbonate-quartz-sulphide-gold veined and high-intensity albite-quartz-pyrite-gold altered meta-?dacite porphyry

PETROGRAPHY AND MINERAGRAPHY :

A visual estimate of the modal mineral abundances gives the following:

Mineral	Vol %	Origin
High-intensity albite-quartz-pyrite-gold altered meta-?dacite porphyry		
Albite	5	Alteration 2 (after plag phenocrysts 1)
Albite	71	Alteration 2 (after felsic groundmass 1)
Quartz	20	Alteration 2 (after felsic groundmass 1)
Pyrite	3	Alteration 2
Rutile	Tr	Alteration 2
Native gold	Tr	Alteration 2
Feldspar-carbonate-quartz-sulphide-gold veins		
K-feldspar	57	Vein filling 2
Quartz	25	Vein filling 2
Albite	2	Vein filling 2
Calcite	10	Vein filling 2
Pyrite	5	Vein filling 2
Sericite	1	Vein filling 2
Native gold	Tr	Vein filling 2

In polished thin section, this sample displays a poorly preserved sparsely porphyritic massive igneous texture, modified by veining and strong pervasive alteration.

High-intensity albite-quartz-pyrite-gold altered meta-?dacite porphyry contained sparsely scattered blocky prismatic plagioclase phenocrysts and glomerocrystic aggregates. All have been replaced by optically continuous albite. Much albite also occurs in the altered groundmass where it forms tiny anhedral grains with associated small quartz grains. Rutile forms tiny turbid granules sprinkled through the rock, but also is concentrated in larger blocky to angular crystal sites (accessory Fe-Ti oxide crystals).

Pyrite is disseminated through the rock as small to large cubic crystals. Some contain tiny inclusions of bright yellow native gold.

Feldspar-carbonate-quartz-sulphide-gold veins cut the rock in varied orientations and thicknesses. K-feldspar is abundant, forming equant subhedral to anhedral grains in granular aggregates. Locally, twinned albite grains occur in close association with the K-feldspar. Quartz forms clear anhedral grains. Calcite similarly forms clear anhedral grains, displaying the double refraction, cleavage and very high birefringence of this phase. Pyrite forms cubic crystals that tend to be concentrated along the thinner veinlets or fracture fillings. Sericite occurs in minor amount as dense aggregates of tiny flakes. Native gold occurs as bright yellow small inclusions <10 µm in size in some pyrite crystals and in nearby quartz grains.

INTERPRETATION :

This sample is considered to have formed as a massive sparsely porphyritic felsic igneous rock, possibly of dacitic composition comparable with other similar rocks in this suite. It contained minor phenocrysts and glomerocrystic aggregates of plagioclase. It also contained accessory phenocrysts of Fe-Ti oxide (?magnetite, ?ilmenite). Other phenocrysts may have been present (eg ?ferromagnesians) but have been destroyed by alteration.

Fracturing and invasion of the rock by a large volume of hydrothermal fluid resulted in filling of fractures by the assemblage K-feldspar + albite + quartz + calcite + pyrite + sericite + trace native gold, accompanied by strong pervasive replacement of the host rock by albite + quartz + minor pyrite + trace rutile + native gold.

SAMPLE : NCT005, 574.0m (Mt Read Volcanics, Tasmania)

SECTION NO : NCT005, 574.0-574.05

HAND SPECIMEN : The drill core sample represents a fine-grained, massive, pale pink rock containing tiny cream sparsely scattered grains (?leucoxene). Cutting the rock are minor thin discontinuous white fracture fillings of varied orientations.

The section offcut failed to accept the stain for K-feldspar, suggesting it is absent.

ROCK NAME : Medium- to high-intensity albite-sericite altered meta-?dacite porphyry

PETROGRAPHY :

A visual estimate of the modal mineral abundances gives the following:

Mineral	Vol %	Origin
Zircon	Tr	Primary igneous 1
Albite	10	Alteration 2 (after plagioclase phenos. 1)
Albite	42	Alteration 2 (after plagioclase gr'mass 1)
Quartz	20	Alteration 2 (after groundmass 1)
Sericite	24	Alteration 2
Carbonate (dolomite)	3	Alteration 2
Leucoxene/rutile	Tr	Alteration 2

In thin section, this sample displays a poorly-preserved sparsely porphyritic igneous texture, modified by strong pervasive alteration.

Plagioclase formed glomerocrystic phenocrystic aggregates scattered through the rock. All have been replaced by optically continuous albite and mats of very fine-grained sericite.

Much of the rock is composed of a more-or-less equigranular mosaic of albite grains and quartz grains. Tiny sericite flecks abundantly pervade the felsic matrix, and some sericite also tends to be concentrated in subparallel trails that define a weak structure (?foliation) through the rock.

Carbonate (dolomite as inferred from strong double refraction) forms scattered small granular aggregates.

Leucoxene/rutile occurs in two forms:

i) Most occurs as turbid dark brown cryptocrystalline replacements of blocky to anhedral crystal sites (primary Fe-Ti oxide grains). Some of these have been entrained in the trace of the weak foliation through the rock.

ii) A trace of leucoxene/rutile occurs as tiny granules sprinkled through the altered groundmass.

Zircon is rare, occurring as small euhedral prisms.

INTERPRETATION :

This sample is considered to have formed as a sparsely porphyritic felsic igneous rock of broadly dacitic composition. It was originally composed of phenocrysts (glomerocrystic plagioclase + accessory Fe-Ti oxide) in a fine-grained equigranular holocrystalline groundmass of plagioclase and quartz. The textures are consistent with a shallow intrusive body rather than an extrusive body.

Invasion of the rock by a significant volume of hydrothermal fluid resulted in strong pervasive replacement by the new assemblage of albite + quartz + sericite + minor dolomite + trace leucoxene/rutile.

APPENDIX 1: PHOTOMICROGRAPHS

Selected photomicrographs are provided in the following pages. They illustrate particular themes (TABLE 3).

TABLE 3: THEMES FOR PHOTOMICROGRAPHS

FIGS	THEME
1–4	Magnetite occurrence
5–6	Gold-mineralised veins

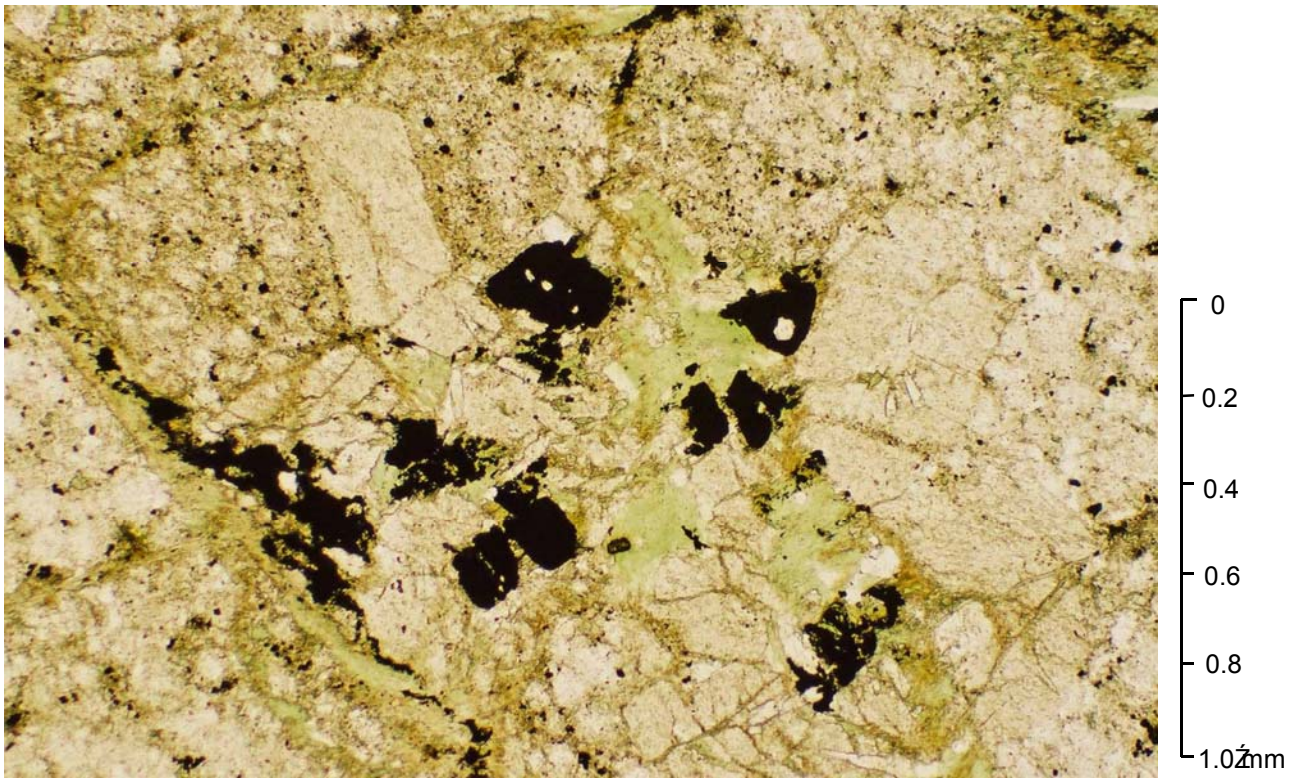

FIG. 1: SAMPLE NCT005, 84.3m (Transmitted plane polarised light, x5, Film 1 / Frame 13, Image F100013)
This view illustrates the occurrence of magnetite (dark equant crystals). Their size, shape and distribution are consistent with a primary igneous origin. The magnetite represents a relict primary phase, not an alteration phase.

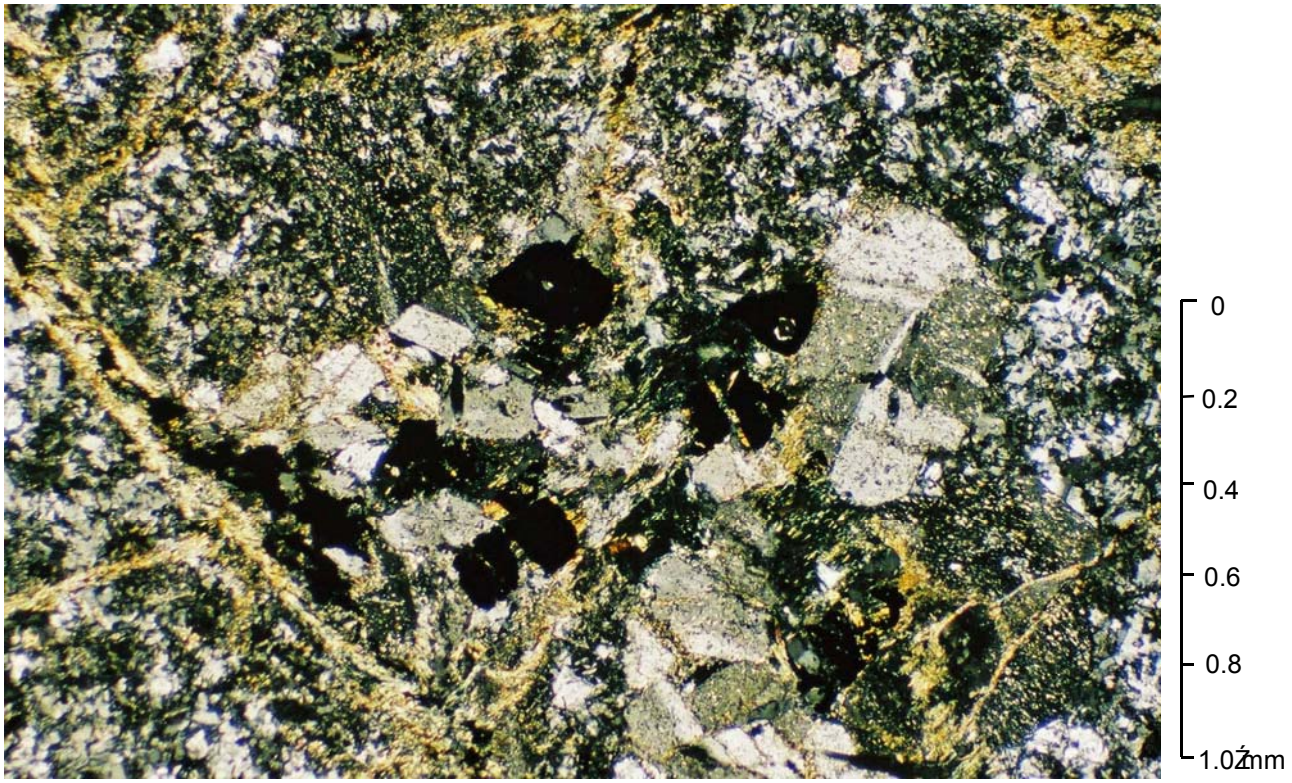

FIG. 2: SAMPLE NCT005, 84.3m (Transmitted light, crossed polarisers, x5, Film 1 / Frame 14, Image F100014)
This is the same field of view as FIG. 1 above. Note the occurrence of magnetite (dark equant crystals near centre) in close association with altered primary glomerocrystic plagioclase phenocrysts (twinned, grey to white).

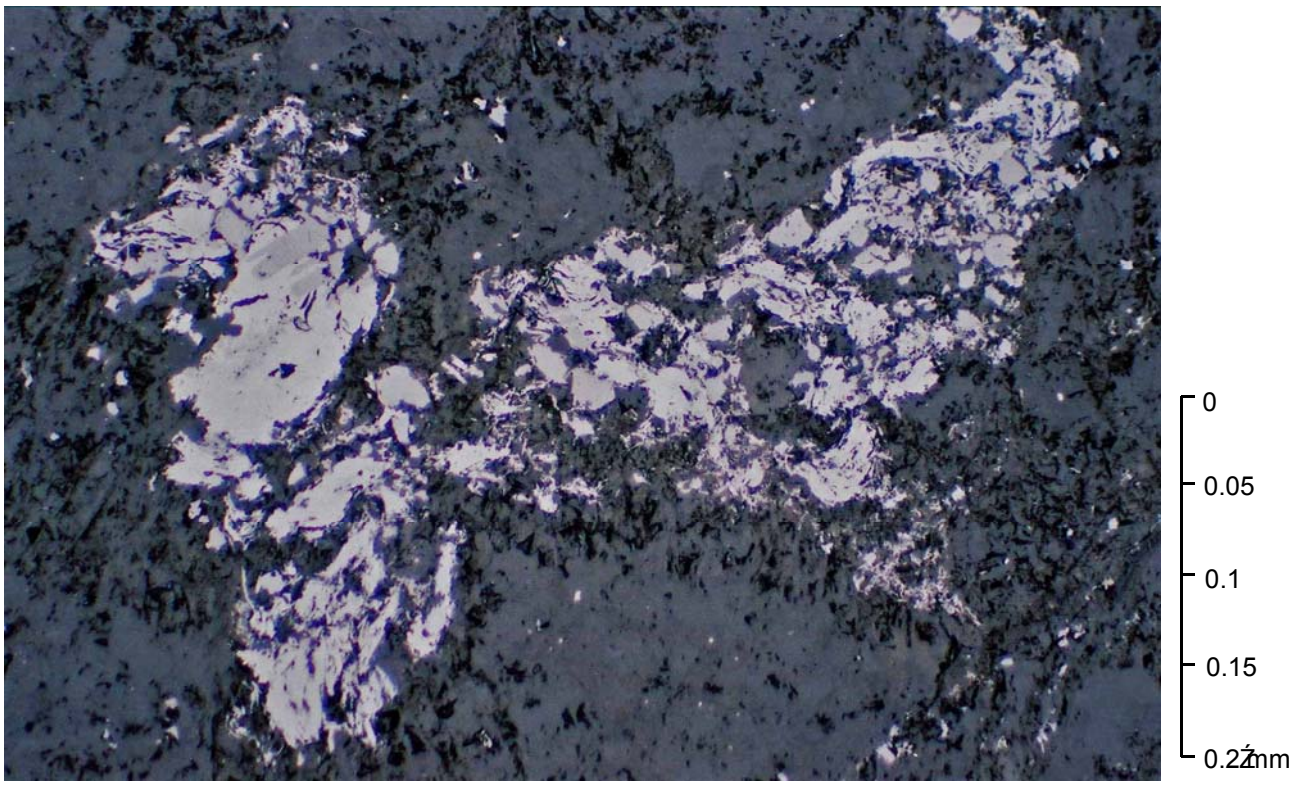

FIG. 3: SAMPLE NCT005, 84.3m (Reflected plane polarised light, x20, Film 1 / Frame 16, Image F100016)
This view illustrates an aggregate of primary magnetite, now almost completely replaced by fine-grained platy hematite (pale whitish grey) of alteration origin. A small amount of relict magnetite is preserved (small equant grains, pale to medium grey, within hematite).

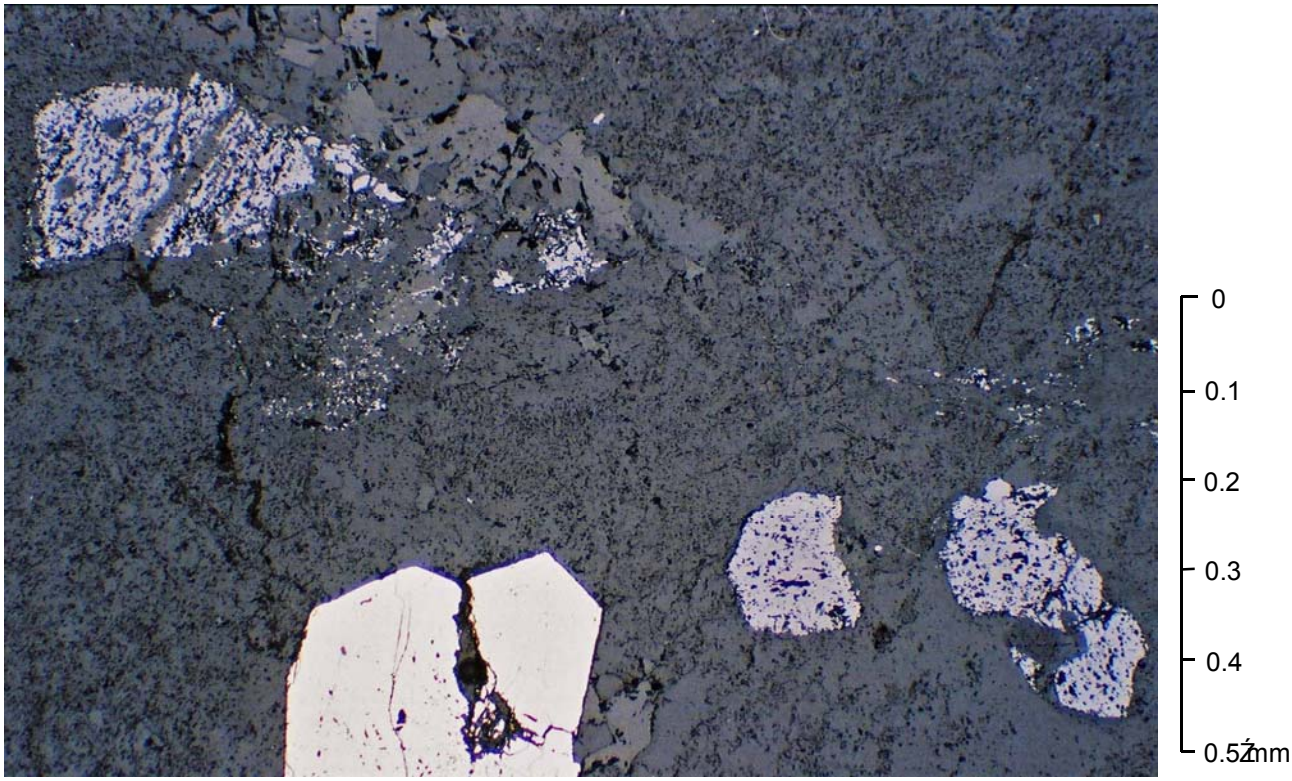

FIG. 4: SAMPLE NCT005, 531.4m (Reflected plane polarised light, x10, Film 1 / Frame 23, Image F100023)
This view from strongly altered rock captures some primary magnetite equant crystals (top left, lower right) which have suffered complete replacement by fine-grained dense microgranular mosaics of rutile (pale to medium grey).

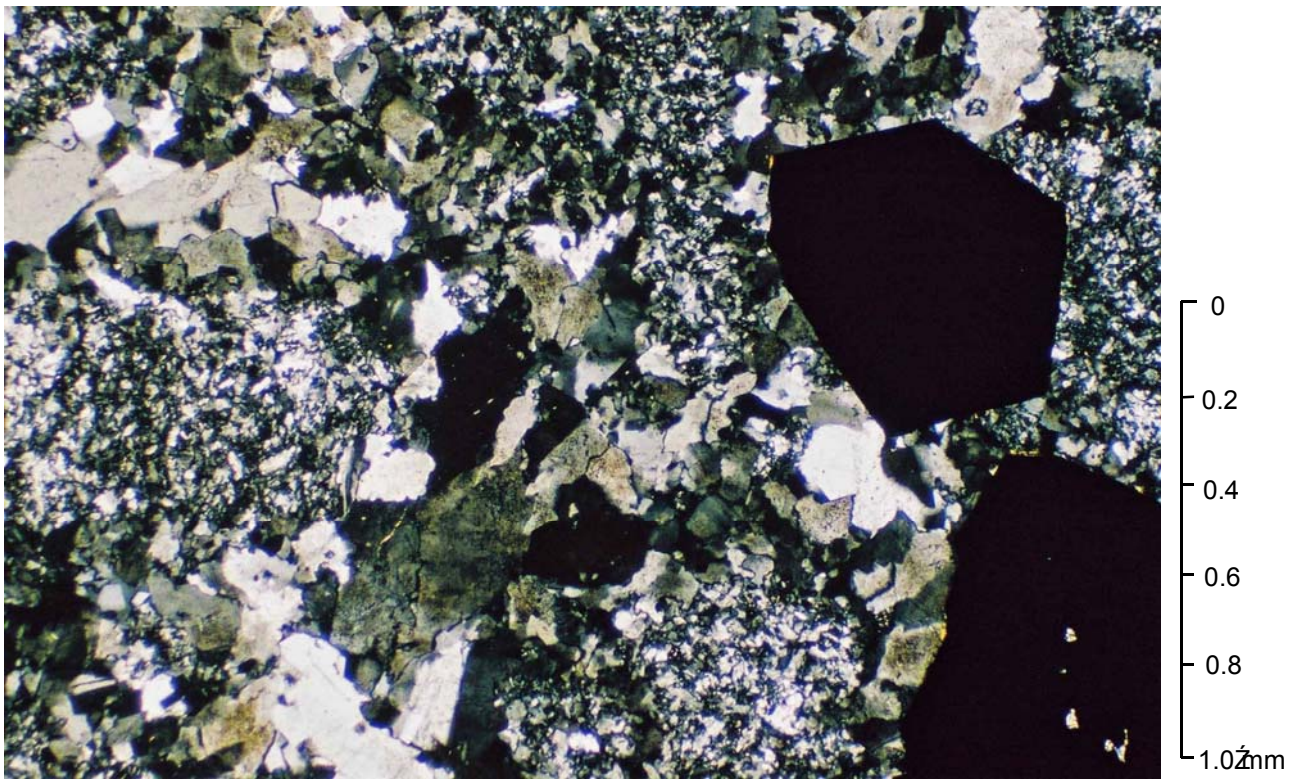

FIG. 5: SAMPLE NCT005, 531.4m (Transmitted light, crossed polarisers, x5, Film 1 / Frame 19, Image F100019)
This view illustrates the occurrence of irregularly oriented veinlets, here composed of anhedral grains of K-feldspar (dull grey, centre), quartz (white), and pyrite (opaque large blocky crystals at right).

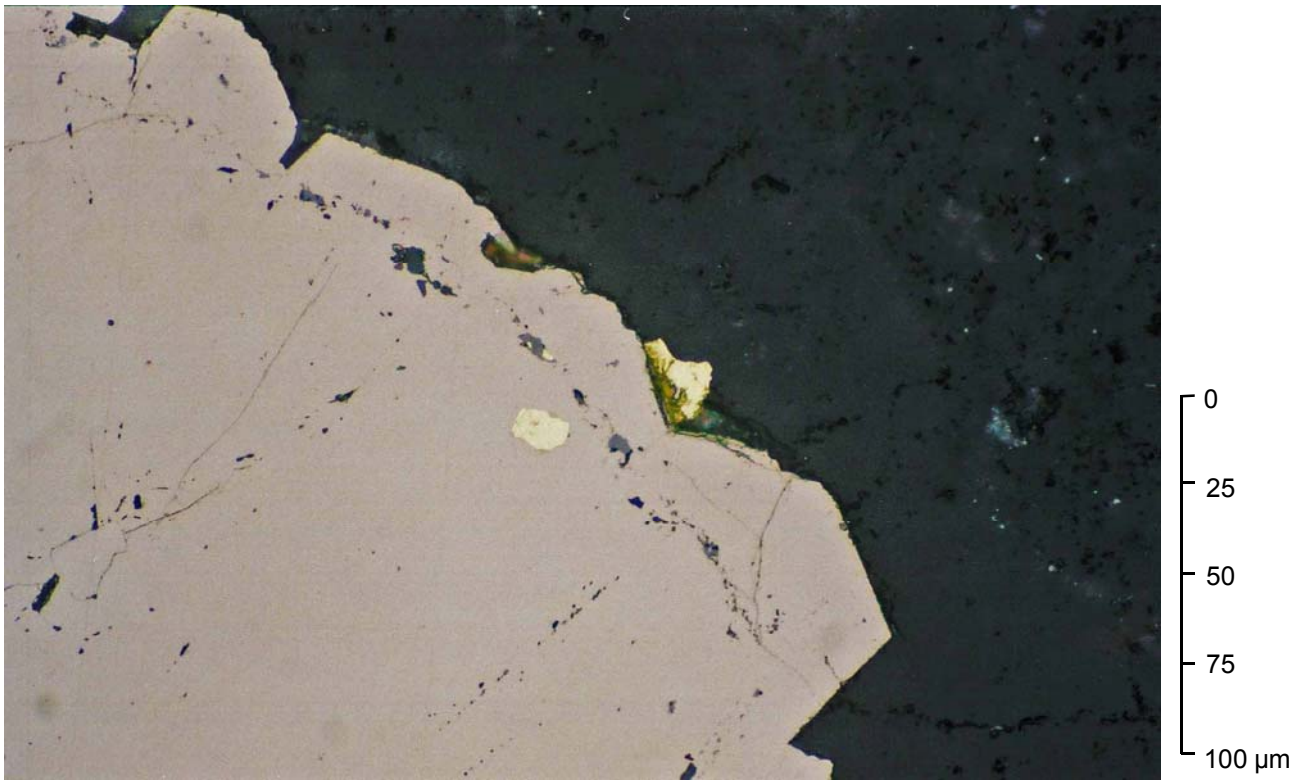

FIG. 6: SAMPLE NCT005, 531.4m (Reflected plane polarised light, x40, Film 1 / Frame 20, Image F100020)
This view was taken from within a vein composed of quartz, pyrite and native gold. Small grains of native gold (bright yellow, centre) formed as inclusions within pyrite (creamish white) and also at the edge of the pyrite crystal in vein quartz.

Mason Geoscience Pty Ltd

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Petrographic Descriptions for Two Drill Core Rock Samples from Drill Hole NCT008 (Mt Read Volcanics, Tasmania)

REPORT #	**3185**
CLIENT	**Newcrest Mining Limited**
ORDER NO	**NML E 12686**
CONTACT	**Mr Nicholas Fitzpatrick**
REPORT BY	**Dr Douglas R Mason**
SIGNED	
	for Mason Geoscience Pty Ltd
DATE	**15 May 2006**

Petrographic Descriptions for Two Drill Core Rock Samples from Drill Hole NCT008 (Mt Read Volcanics, Tasmania)

SUMMARY

1. Rock Samples

- Two drill core rock samples from drill hole NCT008 (Mt Read Volcanics, Tasmania) have been studied using routine optical petrographic and mineragraphic methods.

2. Brief Results

- A summary of rock names and mineralogy is provided in TABLE 1.
- *Primary rock types*
  - **Felsic volcaniclastic rock** is inferred to be the primary rock for both samples. It is considered to have been initially composed of felsic lava fragments and crystal fragments (quartz >> Fe-Ti oxide >> zircon; possible ?feldspar) in fine matrix.
- *Metamorphism and alteration*
  - **Low-grade regional metamorphism** in the lower greenschist facies, with associated directed stress regime, affected the rocks causing ductile deformation, recrystallisation and alteration.
  - **Ductile deformation** caused elongation of lithic fragments in the trace of the strong foliation, strong elongation and replacement of primary Fe-Ti oxide crystals by rutile, and rotation and brittle pull-aparts of quartz crystals. Most of the primary quartz and zircon crystals survived this event.
  - **Pervasive replacement** of the rocks generated the strongly foliated assemblage of quartz + muscovite/sericite + minor carbonate (dolomite, calcite) + pyrite (with trace chalcopyrite, pyrrhotite inclusions) + rutile ± chlorite. Carbonate formed mainly as fillings in pull-aparts in quartz crystals, but also formed as scattered alteration grains. Pyrite formed as small anhedral grains, locally concentrated along foliation bands or in loose lenticular aggregates with associated carbonate, commonly with pressure shadows of sinuous quartz ± sericite ± chlorite. The textures and distribution of pyrite support the interpretation that it formed with **syn-peak deformation timing**, rather than as an earlier alteration event overprinted by metamorphism.
  - **Differences between the samples** are limited to differences in carbonate minerals (dolomite at 413.4m; calcite at 453m) and differences in phyllosilicate minerals (muscovite only at 413.4m; muscovite + chlorite at 453m). These differences suggest invasion by higher volume of metamorphic hydrothermal fluid at 413.4m, and lower volume at 453m. These mineralogical differences are reminiscent of low-grade metamorphic lode-gold environments, where dolomite + sericite without chlorite tend to occur proximally to structures where higher fluid/rock ratios prevail, whereas calcite + chlorite tend to occur distally where lower fluid/rock ratios occur.

TABLE 1: SUMMARY OF ROCK NAMES AND MINERALOGY

SAMPLE	ROCK NAME	MINERALOGY*			
		Primary**	**Metamorphic/ Alteration**	**Veins**	**Weath-ering**
NCT008, 413.4m	Low-intensity carbonate-sulphide altered schistose meta-felsic volcaniclastic rock	Qtz, zir	Mus/ser, qtz, car(dol), py, rut, cpy	-	-
NCT008, 453m	Low-intensity carbonate-sulphide altered schistose meta-felsic volcaniclastic rock	Qtz, zir	Mus/ser, qtz, chl, car(cal), py, rut, cpy, po	-	-

NOTES

*: Minerals are listed in each paragenesis according to approximate decreasing abundance.

**: Only primary minerals currently present in the rock are listed. Others may have been present, but are altered.

Mineral abbreviations

Cal = calcite; car = carbonate mineral (identified mineral in brackets); chl = chlorite; cpy = chalcopyrite; dol = dolomite; mus = muscovite (coarser-grained white mica); po = pyrrhotite; py = pyrite; qtz = quartz; rut = rutile; ser = sericite (finer-grained white mica); zir = zircon.

1 INTRODUCTION

A collection of 2 drill core rock samples was received from Mr Nicholas Fitzpatrick (Newcrest Mining Limited – SE Australia Exploration, Cadia via Orange, NSW) on 9 May 2006.

It was indicated that the samples originate from drill hole NCT008 in the Mt Read Volcanics, south of Queenstown, Tasmania. Particular requests were:

i) To prepare a thin section (or polished thin section) and petrographic description for each sample.

ii) To include sample mineralogy, alteration and paragenesis in the description.

iii) No photomicrographs are required.

Excerpts from this report were provided by email to Mr Fitzpatrick on 15 May 2006. This report contains the full results of this work.

2 METHODS

The samples were examined in hand specimen and marked for thin section preparation. Polished thin sections were considered appropriate for both samples, because of the presence of observable disseminated lustrous sulphides. The sections were obtained from an external commercial laboratory.

At Mason Geoscience Pty Ltd conventional transmitted polarised light microscopy was used to prepare the routine petrographic descriptions. Additional mineragraphic observations are provided where a polished thin section is available. Paragenetic stages of development of each rock are indicated in the mineral modal list, where each mineral is assigned to a numerical paragenesis (paragenesis 1 is earliest; paragenesis 2 overprints 1; paragenesis 3 overprints both 2 and 1; etc). The paragenetic stages display relative timing within each sample, and are not meant to be directly equated between samples although this may be correct for some samples.

3 PETROGRAPHIC AND MINERAGRAPHIC DESCRIPTIONS

The combined petrographic and mineragraphic descriptions are provided in the following pages.

SAMPLE : NCT008, 413.4m

LOCATION : Mt Read Volcanics, south of Queenstown, Tasmania

SECTION NO : NCT008, 413.4m

HAND SPECIMEN : The drill core rock slice represents a fine-grained, schistose, medium greenish grey rock in which millimetre-sized waxy paler grey quartz 'eyes' are scattered throughout. Small lustrous silvery pyrite grains are present in minor amount, locally forming small aggregates aligned in the trace of the foliation.

The section offcut bubbles weakly in small patches in reaction with dilute HCl, suggesting minor carbonate of dolomitic composition is present.

ROCK NAME : Low-intensity carbonate-sulphide altered schistose meta-felsic volcaniclastic rock

PETROGRAPHY AND MINERAGRAPHY :

A visual estimate of the modal mineral abundances gives the following:

Mineral	Vol %	Origin
Quartz	15	Primary crystals 1
Zircon	Tr	Primary crystals 1
Muscovite/sericite	49	Metamorphic 2
Quartz	30	Metamorphic 2
Carbonate (dolomite)	3	Metamorphic alteration 2
Pyrite (with trace chalcopyrite inclusions)	2	Metamorphic alteration 2
Rutile	Tr	Metamorphic 2

In polished thin section, this sample displays a partly-preserved primary fragmental texture that has suffered strong ductile deformation, recrystallisation and alteration.

White mica (muscovite) is abundant. It occurs as aligned small flakes and better-crystallised mats and lenses that are distributed throughout the rock but are concentrated in foliation-parallel mats. The muscovite/sericite mats wrap around quartz-rich patches (?relict felsic lithic fragments) and also wrap around relict quartz grains (see next).

Quartz is the other principal mineral, and different textural variants are distinguished:

i) Most quartz occurs as small ovoid grains <0.2 mm in size scattered through a quartz-rich mosaic composed of minute anhedral quartz grains. These types of quartz are considered to represent quartz of devitrification and metamorphic recrystallisation origin, most likely after primary felsic volcanic lithic fragments.

ii) A significant amount of quartz occurs as equant subhedral to angular crystals and crystal fragments which range widely in size from ~0.2 mm up to ~3 mm. The size and shape of the subhedral crystals is consistent with original crystallisation as phenocrysts in a felsic magma, but the presence of smaller angular shapes in some grains confirms that they formed as part of a fragmental deposit of volcaniclastic origin. Some of the quartz crystals are unstrained, but others are partly rotated or fully rotated into the trace of the foliation, and some display pull-apart structures and more severe local microbrecciation.

iii) A small amount of quartz occurs as sinuous bladed concentrations in pressure shadows marginal to some pyrite grains. This quartz clearly formed synchronous with ductile deformation.

Carbonate occurs in minor amount as small blocky subhedral crystals and small aggregates of grains. Their moderately strong double refraction and weak bubbling in reaction to dilute HCl suggests they are dolomitic in composition, rather than calcite. Most of the carbonate forms aggregates in pull-apart gaps in quartz crystals, but some also forms scattered granular aggregates in the altered quartz-rich felsic ?fragment sites.

Pyrite is present in minor amount as small subhedral to anhedral grains, some with more lobate anhedral forms. All contain small gangue inclusions, as well as uncommon small inclusions of chalcopyrite. The pyrite is irregularly distributed through the rock, in both muscovite-rich mats and in quartz-rich ?lithic fragment sites, with local tendency to be loosely concentrated along foliation bands and to be closely associated with carbonate. All of the pyrite grains display non-deformed shapes; none display any degree of grain elongation or microfracturing. Many pyrite grains contain quartz-rich sinuous concentrations in pressure shadows at their ends.

Rutile occurs in trace amount as small subhedral blocky crystals and finer-grained dense aggregates that are concentrated in sparsely scattered lensoidal bodies. These are interpreted to represent deformed and recrystallised primary Fe-Ti oxide crystals (?Ti-magnetite, ?ilmenite).

Zircon occurs in trace amount as small stumpy prismatic crystals. They tend to occur in close association with the deformed and altered Fe-Ti oxide crystal sites, and also occur discretely elsewhere through the rock. Some display pull-apart or micro-brecciation structures.

INTERPRETATION :

This sample is considered to have formed as a volcaniclastic deposit composed of abundant felsic lithic fragments of possible acid lava origin, accompanied by crystals and crystal fragments (quartz, Fe-Ti oxide, zircon) derived from the lava. It is possible that feldspar also formed part of the crystal assemblage, but cannot now be recognised. The primary rock may be termed ‘volcaniclastic lithic-crystal breccia’.

The rock suffered strong ductile deformation, recrystallisation and low-intensity alteration in response to low-grade dynamic regional metamorphism in the lower greenschist facies. This event generated the new assemblage of muscovite + quartz + minor dolomite + pyrite + trace rutile + chalcopyrite. It is considered that carbonate and sulphide was introduced in the regional metamorphic fluid as part of this event. It is possible that the rock suffered some degree of alteration prior to the metamorphic event, but this cannot be distinguished through the strong metamorphic overprint. In more detail:

i) The matrix and lithic fragments suffered ductile deformation, recrystallisation and replacement by new muscovite + quartz + minor dolomite + pyrite.

ii) Sinuous quartz pressure shadows formed at margins of unstrained new pyrite grains.

iii) Primary Fe-Ti oxide crystals suffered ductile deformation, recrystallisation and replacement mainly by rutile.

iv) Quartz crystals were rotated into the foliation, and brittle pull-aparts were filled mainly by alteration dolomite.

It is notable that all pyrite is quite undeformed but contains pressure shadows of quartz. These observations support the interpretation that the pyrite nucleated and grew as part of the ductile metamorphic event. There is no petrographic evidence that the pyrite formed at an earlier time and suffered metamorphic overprinting. This stands in contrast with the grains of quartz, zircon and (altered) Fe-Ti oxide, all of which display the effects of metamorphic overprinting to a greater or lesser degree.

SAMPLE : NCT008, 453m

LOCATION : Mt Read Volcanics, south of Queenstown, Tasmania

SECTION NO : NCT008, 453m

HAND SPECIMEN : The drill core sample represents a fine-grained, schistose, pale grey rock with yellowish tinge, containing minor small (1-2 mm) waxy grey quartz grains. White grains and patches (carbonate) are intergrown with fragmented quartz grains elongated in the trace of the foliation.

The section offcut effervesces strongly in reaction with dilute HCl, suggesting minor calcite occurs in small patches associated with elongated and fragmented quartz grains.

ROCK NAME : Low-intensity carbonate-sulphide altered schistose meta-felsic volcaniclastic rock

PETROGRAPHY AND MINERAGRAPHY :

A visual estimate of the modal mineral abundances gives the following:

Mineral	Vol %	Origin
Quartz	15	Primary crystals 1
Zircon	Tr	Primary crystals 1
Muscovite/sericite	45	Metamorphic 2
Quartz	30	Metamorphic 2
Chlorite	5	Metamorphic 2
Carbonate (calcite)	2	Metamorphic alteration 2
Pyrite	2	Metamorphic alteration 2
Rutile	Tr	Metamorphic 2
Chalcopyrite (inclusions in pyrite)	Tr	Metamorphic alteration 2
Pyrrhotite (inclusions in pyrite)	Tr	Metamorphic alteration 2

In polished thin section, this sample displays a partly-preserved primary fragmental texture, severely modified by metamorphic deformation, recrystallisation and alteration.

White mica (muscovite/sericite) is abundant. Most forms small aligned flakes and dense mats whose strong preferred orientation defines the strong foliation through the rock. Although distributed throughout the rock, the denser white mica mats appear to define primary matrix areas. The foliated white mica mats wrap around relict primary quartz crystals and indistinct quartz-rich lithic fragments (see next).

Quartz is abundant, and different textural types are observed:

i) Most occurs as tiny anhedral grains that form microgranular mosaics in ovoid to lenticular areas considered to represent variably deformed primary felsic lithic fragments, most probably acid lava.

ii) A significant amount of quartz occurs as blocky euhedral crystals, subrounded crystals, magmatically corroded crystals, and angular crystal fragments that range in size from ~0.2 up to ~2 mm in size. Some display brittle pull-apart structures perpendicular to the foliation, with resulting partial entrainment of the quartz fragments in the trace of the foliation.

iii) A small amount of quartz occurs as sinuous concentrations in pressure shadows marginal to pyrite grains.

Chlorite is present in minor amount as small pleochroic green flakes and small mats aligned in the trace of the foliation. It sparsely pervades the quartz-sericite altered lithic fragments, it occurs locally in dense folia within some of the white mica-rich mats, and it also occurs as flakes and trails aligned within sinuous quartz in pressure shadows marginal to pyrite grains.

Carbonate (calcite) occurs in minor amount as ragged grains and aggregates that occur mainly in pull-apart structures perpendicular to foliation in quartz grains.

Pyrite occurs in minor amount as small to larger (~0.05-0.4 mm) subhedral to amoeboid anhedral grains scattered irregularly through the rock. In places they are loosely concentrated in particular foliation-parallel bands and in sparsely scattered rutile-altered primary Fe-Ti oxide grain sites. Chalcopyrite and pyrrhotite occur in trace amount as tiny inclusions in some pyrite grains.

Rutile occurs as small granules loosely concentrated in elongated lenses and trails up to ~2 mm long, inferred to represent deformed and altered primary Fe-Ti oxide grains.

Zircon is present as small stumpy euhedral crystals, commonly in close association with the (deformed and altered) primary Fe-Ti oxide grain sites.

INTERPRETATION :

This sample is considered to have formed as a primary fragmental deposit of volcaniclastic origin. It may have been composed mainly of lithic (acid lava) and crystal fragments (quartz, Fe-Ti oxide, zircon) in lesser fine matrix.

The rock has suffered ductile deformation, recrystallisation and alteration in response to a low-grade regional metamorphic event in the lower greenschist facies. This generated the new assemblage of quartz + muscovite + minor calcite + chlorite + pyrite (with trace chalcopyrite and pyrrhotite inclusions) + trace rutile. Particular effects included the following:

i) Lithic fragments and crystals were rotated into, and elongated within, the trace of the strong foliation.

ii) The lithic fragments were replaced by quartz + minor sericite + chlorite ± pyrite, while matrix was replaced by a dense mat of foliated muscovite + minor chlorite ± pyrite.

iii) Brittle pull-apart fractures in quartz crystals were filled by calcite.

iv) Pressure shadows of sinuous quartz + chlorite formed at margins of pyrite grains.

This rock shares a similar primary origin to the previous sample. Both are considered to have formed as primary fragmental volcaniclastic deposits of felsic lava fragments and crystal fragments, in fine matrix.

Although both samples have suffered comparable metamorphic effects, some differences are noted: the presence of calcite in this sample contrasted with dolomite in the previous sample, and the presence of chlorite in this sample and absence of chlorite in the previous sample. The slight mineralogical differences between the two samples may be attributed to slight differences in volumes of metamorphic hydrothermal fluid which accessed different parts of the rock body along the penetrative structure (foliation). These mineralogical differences are reminiscent of proximal and distal alteration assemblages in metamorphic lode-gold-type environments, where dolomite + sericite tends to form in the proximal environment with respect to structure at higher fluid/rock ratio, and calcite + chlorite tends to form in the distal environment. This suggests that sample NCT008, 413.4m formed proximally or at higher fluid/rock ratio, whereas NCT008, 453m formed more distally or at lower fluid/rock ratio.