APPENDIX 4

Petrographic Descriptions for Three Surface Cambrian Rock Samples, Gowrie Park, NW Tasmania

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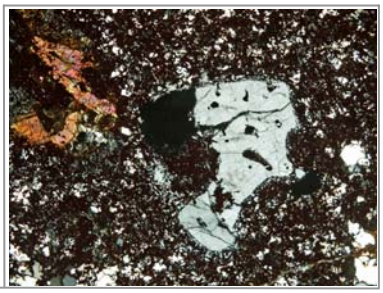
Petrographic Descriptions for Three Surface Cambrian Rock Samples, Gowrie Park, NW Tasmania

REPORT #	**3348**
CLIENT	**Newcrest Mining Ltd**
ORDER NO	**Memo, K. Morrison**
CONTACT	**Mr Joel Kitto (Newcrest Mining Ltd) / Mr Ken Morrison (K.C. Morrison Pty Ltd)**
REPORT BY	**Dr Douglas R Mason**
SIGNED	
	for Mason Geoscience Pty Ltd
DATE	**13 November 2007**



Petrographic Descriptions for Three Surface Cambrian Rock Samples, Gowrie Park, NW Tasmania

SUMMARY

1. Rock Samples

- A collection of 3 surface rock samples has been studied using optical petrographic and mineragraphic methods, supplemented by staining of section offcuts for 3 samples.

2. Brief Results

- A summary of rock names and mineralogy is provided in TABLE 1.

- *Primary rock types*

  – **Felsic porphyries** are identified as dacite porphyry (NTR072) and rhyolite porphyry (NTR085). They were originally composed of varied proportions of phenocrysts (plagioclase, quartz, minor ferromagnesians, accessory minerals including Fe-Ti oxide and zircon) in a fine-grained groundmass (plagioclase, K-feldspar, quartz). A shallow intrusive mode of emplacement is suggested for all samples, because of the moderate proportion of phenocrysts, general absence of flow textures, and holocrystalline groundmass textures.

  – **Felsic ash-crystal ?tuff/?tuffite** is identified in one sample (NTR077). It was composed of abundant non-welded randomly oriented glassy ash shards, accompanied by lesser crystal fragments (plagioclase, quartz, ilmenite, apatite, trace zircon).

- *Alteration*

  – **Propylitic-type hydrothermal alteration** is observed in dacite porphyry sample NTR072, which has suffered replacement by chlorite + sericite + albite + minor K-feldspar + leucoxene + rutile + pyrite.

  – **Pervasive alteration of ?tuff/?tuffite** (sample NTR077) has generated very fine-grained replacement assemblage of K-feldspar + albite + minor chlorite + sericite + trace leucoxene/?rutile + pyrite. Much of the primary texture was preserved, including shard shapes.

- *Weathering*

  – **Low- to high-intensity weathering** has affected most samples. In the more strongly weathered rocks, fine-grained goethite and intergrown clays have replaced all precursor feldspar but some primary minerals and textures are preserved. Alteration pyrite is partly preserved in altered dacite porphyry sample NTR072, confirming sulphide formed as part of the alteration assemblage. Weathering is absent from the altered ?tuff/?tuffite, where the alteration assemblage including trace pyrite is unaffected by oxidation.

TABLE 1: SUMMARY OF ROCK NAMES AND MINERALOGY

SAMPLE	ROCK NAME	MINERALOGY*			
		Primary**	**Alteration*****	**Veins**	**Weathering**
NTR072	Medium-intensity albite-sericite-chlorite altered dacite porphyry	Kf, qtz, zir	Chl, ser, alb, Kf, leu, rut, py	-	Goe
NTR077	Albite-K-feldspar-chlorite altered felsic ash-crystal ?tuff/?tuffite	Qtz, ilm, apa, zir	Kf, alb, chl, ser, leu/?rut, py	-	-
NTR085	Partly weathered rhyolite porphyry	Kf, qtz, pla, ?bio, zir	?Ser	-	Goe, cla

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.

***: Earlier parageneses are separated from later parageneses by a semicolon.

Mineral abbreviations

Alb = albite; apa = apatite; bio = biotite; chl = chlorite; cla = clay minerals; goe = goethite; ilm = ilmenite; Kf = K-feldspar; lep = lepidocrocite; leu = leucoxene (indeterminate Ti-mineral); mt = magnetite; pla = plagioclase; py = pyrite; qtz = quartz; rut = rutile; ser = sericite; tou = tourmaline; zir = zircon; ?min = uncertain mineral identification.

1 INTRODUCTION

A suite of 3 rock samples was received from Mr Ken Morrison (K.C. Morrison Pty Ltd, Fern Tree, Tasmania) on behalf of Mr Joel Kitto (Newcrest Mining Ltd, via Orange, NSW) on 10 October 2007.

Background information was provided by the Mr Morrison:

> 'The 3 rock samples … are from Newcrest Mining's exploration work within Cambrian correlates of the Mt Read Volcanics near Gowrie Park in NW Tasmania. Some are quite weathered and may be difficult to work with, but are the best we could get and are of key interest to our understanding of prospectivity in the area.'

Particular requests were:

i) To prepare a polished thin section and combined petrographic and mineragraphic description for each sample, including mineralogy, rock types, alteration and where possible paragenesis.

ii) Include photomicrographs to illustrate the main features.

iii) Send final reports and thin sections with remnant samples to Joel Kitto, Newcrest Mining Ltd, 1460 Cadia Road, via Orange, NSW 2800.

iv) Provide a copy of the report by email or CD to Mr Morrison.

Excerpts from this report were provided by email to Mr Kitto and Mr Morrison on 12 November 2007. This report contains the full results of this work.

2 METHODS

At Mason Geoscience Pty Ltd the rock samples were examined in hand sample and marked for thin section preparation. The polished thin sections were obtained from an external commercial laboratory. 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. Selected photomicrographs are included with the descriptions.

Preliminary petrographic observations suggested that K-feldspar was present in some samples. For confirmation, 3 section offcuts (NTR072, NTR077, NTR085) were 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.

TABLE 2: RESULTS OF STAINING FOR K-FELDSPAR

SAMPLE	RESULT*	COMMENT
NTR072	Positive	Moderately abundant K-feldspar occurs throughout the fine-grained groundmass.
NTR077	Positive	Moderately abundant K-feldspar occurs as small ragged patches distributed irregularly through the fine-grained matrix.
NTR085	Positive	Abundant K-feldspar occurs uniformly throughout the fine-grained groundmass.

*: 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 AND MINERAGRAPHIC DESCRIPTIONS

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

SAMPLE : NTR072 (Gowrie Park, NW Tasmania)

SECTION NO : NTR072 (449790mE, 5406463mN – AMG66_55)

HAND SPECIMEN : The surface rock sample represents a fine-grained, drab greenish rock with faint yellowish tinge, containing small (~1-2 mm) moderately abundant pale cream to grey phenocrysts weakly aligned in a flow foliation. Weathering has generated a reddish brown ferruginous stain around the active weathering surface, but most of the rock is relatively fresh.

The section offcut accepted a positive stain for K-feldspar, indicating moderately abundant K-feldspar occurs throughout the fine-grained groundmass.

ROCK NAME : Medium-intensity albite-sericite-chlorite altered dacite porphyry

PETROGRAPHY AND MINERAGRAPHY :

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

Mineral	Vol %	Origin
Quartz	1	Igneous phenocrysts 1
Felsic groundmass (K-feldspar, quartz)	49	Igneous groundmass 1
Zircon	Tr	Igneous 1
Chlorite	20	Alteration 2
Sericite	15	Alteration 2
Albite	10	Alteration 2 (after plag phenocrysts 1)
Leucoxene	Tr	Alteration 2
K-feldspar	3	Alteration 2
Rutile	Tr	Alteration 2
Pyrite	Tr	Relict alteration 2
Goethite	Tr	Weathering 3 (after ?pyrite 2)

In polished thin section, this sample displays a relatively well-preserved porphyritic igneous texture with weak flow foliation, modified by selective pervasive alteration and weak weathering.

Feldspar is moderately abundant and occurs in different forms:

i) Albite occurs as optically continuous twinned replacements of plagioclase phenocrysts ~1-3 mm long, partly aligned in the trace of a flow structure.

ii) A small amount of K-feldspar occurs as ragged replacement patches with albite after plagioclase phenocrysts.

iii) Much feldspar occurs in the groundmass, where it forms equant anhedral grains possibly of K-feldspar (confirmed by staining). Some clear grains appear to be quartz.

Sericite occurs in significant amount as fine-grained diffuse replacement patches in the albite- and K-feldspar-altered plagioclase phenocryst sites. Sericite is mostly absent from the groundmass.

Chlorite occurs in two forms:

i) Some occurs as fine-grained dense bright green replacements of stumpy ferromagnesian phenocrysts ~0.4-1.0 mm long. The blocky crystal forms suggest they may have formed as ?pyroxene but none is preserved for confirmation.

ii) A significant amount of chlorite occurs as duller drab green dense replacement patches, variably distributed through the groundmass and around margins of feldspar and ferromagnesian phenocrysts.

Quartz phenocrysts are sparsely scattered through the rock. Some are equant and euhedral in form, but others have suffered severe magmatic resorption.

Rutile occurs in minor amount as dull brownish microcrystalline aggregates, apparently after primary Fe-Ti oxide microphenocrysts in close association with some of the ferromagnesian phenocrysts.

Zircon occurs as rare small terminated crystals in chlorite-altered ferromagnesian phenocrysts.

Pyrite occurs as uncommon small cubic crystals which occur in some of the chlorite-altered ferromagnesian crystal sites. All of the pyrite has suffered partial replacement around margins by goethite.

INTERPRETATION :

This sample is considered to have formed as a porphyritic igneous rock of dacitic composition. It was originally composed of a moderate proportion of weakly flow-aligned phenocrysts (plagioclase >> ferromagnesians >> Fe-Ti oxide >> zircon) in fine-grained holocrystalline groundmass (K-feldspar >> quartz). The groundmass appears to be dominated by small equant anhedral feldspar grains (possibly ?K-feldspar) with lesser quartz.

Selective hydrothermal alteration occurred at relatively low intensity, generating the new assemblage of albite + chlorite + sericite + minor K-feldspar + trace rutile + pyrite. In more detail, albite and K-feldspar formed as replacements of the primary plagioclase phenocrysts; chlorite formed as replacements of ferromagnesian microphenocrysts and also as ragged patches throughout the rock; and primary Fe-Ti oxide crystals were replaced by fine-grained rutile aggregates. A trace amount of pyrite formed as small crystals in the chlorite-altered ferromagnesian microphenocryst sites. In response to weathering, minor goethite formed as replacement rims around the pyrite crystals.

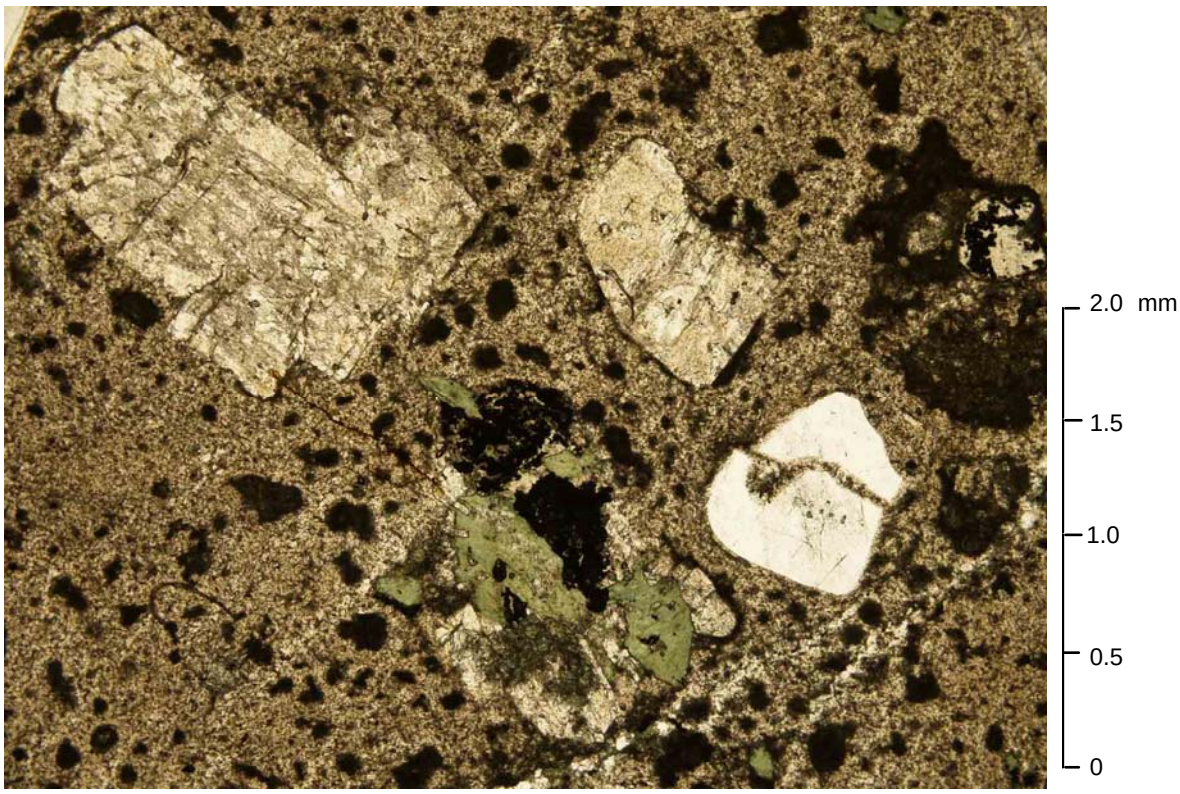


FIG. 3: SAMPLE NTR072 (Transmitted pale polarised light, Obj. x4, Image PB132016)
This view of dacite porphyry captures a quartz phenocryst (colourless, right), altered prismatic plagioclase phenocrysts (upper left, upper right), chlorite-altered small ferromagnesian phenocrysts (green), and leucoxene-altered Fe-Ti oxide microphenocryst (dark brown to black, centre, near chlorite-altered ferromagnesians). Alteration chlorite also forms the small to larger ragged dark patches.

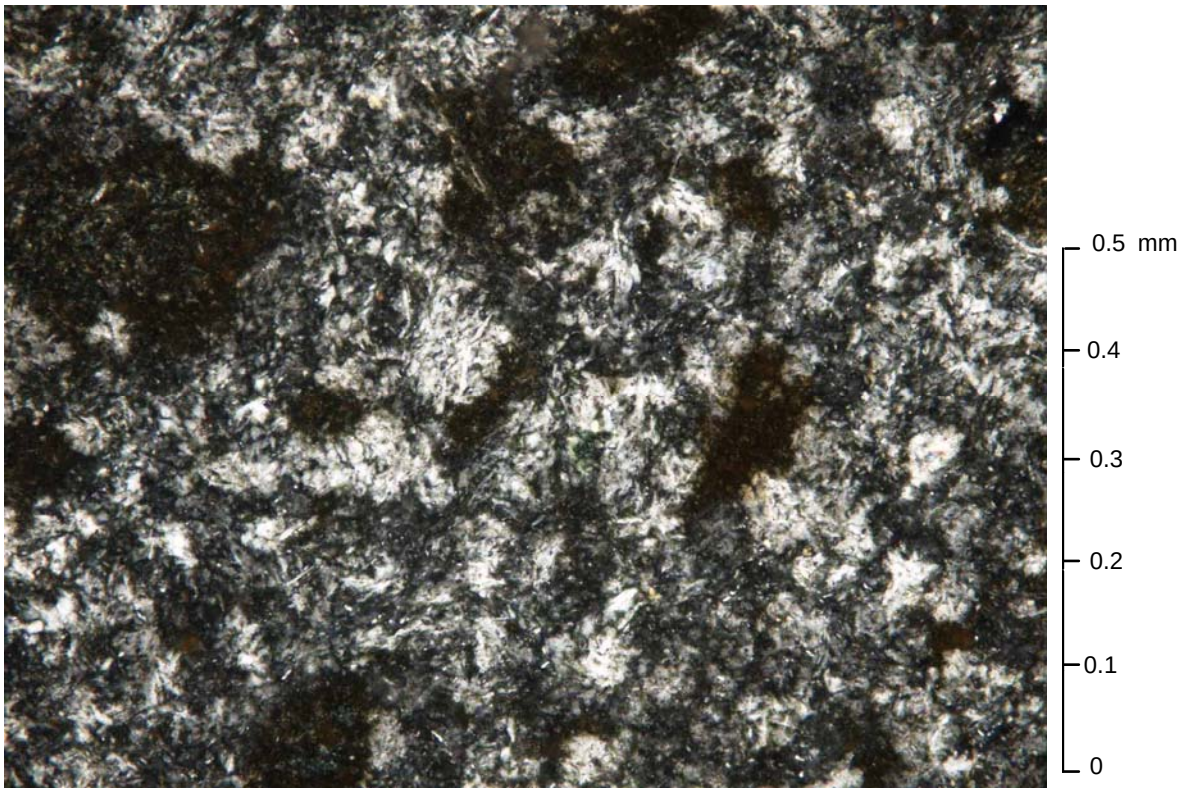


FIG. 4: SAMPLE NTR072 (Transmitted light, crossed polarisers, Obj. x4, Image PB132017)
This is a closer view of the groundmass, which retains its holocrystalline texture of anhedral K-feldspar grains (paler grey) enclosing tiny albite-altered plagioclase laths.

SAMPLE : NTR077 (Gowrie Park, NW Tasmania)

SECTION NO : NTR077 (445349mE, 5409177mN – AMG66_55)

HAND SPECIMEN : The surface rock sample represents a fine-grained, massive, medium greenish-grey rock which contains small whitish grains (clastic particles) uniformly distributed.

The section offcut accepted a positive stain for K-feldspar, indicating moderately abundant K-feldspar occurs as small ragged patches distributed irregularly through the fine-grained matrix.

ROCK NAME : Albite-K-feldspar-chlorite altered felsic ash-crystal ?tuff/?tuffite

PETROGRAPHY AND MINERAGRAPHY :

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

Mineral	Vol %	Origin
Quartz	10	Primary crystal fragments 1
Ilmenite	Tr	Relict primary crystals 1
Apatite	Tr	Primary crystals 1
Zircon	Tr	Primary crystals 1
Feldspar (K-feldspar- mosaic)	44	Alteration 2
Feldspar (albitic mosaic)	20	Alteration 2
Chlorite	5	Alteration 2
Albite	15	Alteration 2 (after plagioclase particles 1)
Sericite	2	Alteration 2
Leucoxene/?rutile	1	Alteration 2
Pyrite	Tr	Alteration 2

In polished thin section, this sample displays a partly-preserved primary ash-crystal tuff or tuffite (ie reworked tuff) texture, without layering, partly modified by selective pervasive alteration effects.

Feldspar is abundant, and different textural types are distinguished:

i) Much feldspar occurs as a very fine-grained massive microcrystalline mosaic throughout much of the rock. This appears to represent alteration K-feldspar.

ii) Within the K-feldspar mosaic, somewhat coarser-grained ragged alteration patches of fine-grained twinned albite are developed. In many places, the albitic mosaic has pseudomorphously replaced randomly oriented shards ~0.2-0.4 mm in size which display the typical curved, cuspate and Y-shaped forms of glass shards.

iii) A significant amount of albite occurs as optically continuous replacements of small crystal fragments ~0.2-1.5 mm in size. Tiny sericite flecks form loose replacement clouds in some of these albite-altered feldspar crystal fragments.

Quartz occurs in moderate amount as magmatically resorbed crystals ~1-1.5 mm in size, and smaller angular crystal fragments ~0.2-0.8 mm in size. They are distributed uniformly throughout the rock without layering.

Chlorite occurs in minor amount as tiny flecks and small patches irregularly distributed through the altered ashy matrix.

Leucoxene/rutile is present in minor amount as turbid dull brownish microcrystalline aggregates scattered sparsely through the rock. Ilmenite forms minor small crystal fragments of relict primary origin. Similarly, small colourless prisms of primary apatite and small terminated prisms of zircon occur in trace amounts.

Pyrite occurs in trace amount as rare small disseminated crystals and small aggregates.

INTERPRETATION :

This sample formed as a volcanogenic deposit composed of abundant non-welded glassy ash shards and lesser crystal fragments (plagioclase > quartz >> ilmenite, apatite, zircon). It was derived from a felsic volcanic source, but whether it formed by direct deposition (ie tuff) or suffered minor subsequent reworking (ie tuffite) remains uncertain.

Subsequent alteration generated the fine-grained assemblage of K-feldspar + albite + chlorite + minor sericite + leucoxene/rutile + trace pyrite. In more detail, the ashy matrix was replaced by very fine-grained K-feldspar, slightly coarser-grained albite, and fine-grained chlorite. The shards were selectively replaced in part by albite. The plagioclase crystal fragments were replace by albite ± sericite. Primary crystal fragments of quartz, ilmenite, apatite and zircon survived.

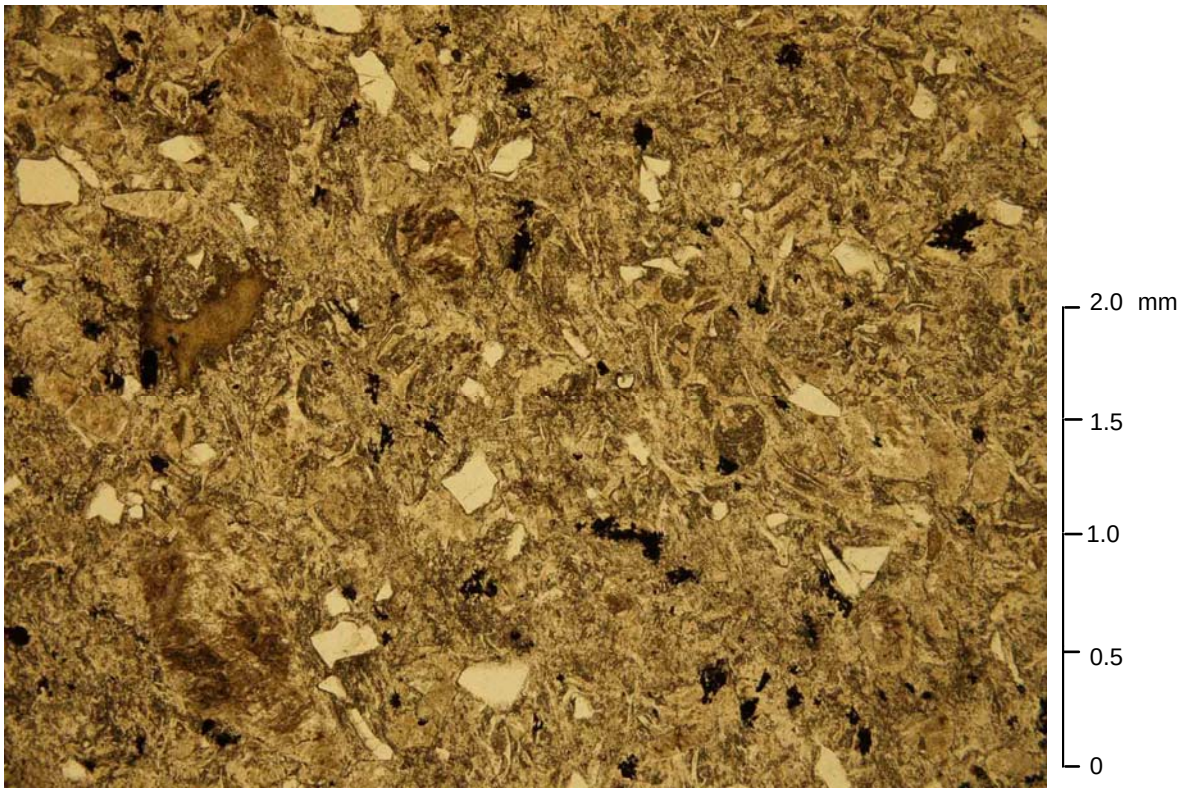


FIG. 5: SAMPLE NTR077 (Transmitted plane polarised light, Obj. x4, Image PB132018)
This view illustrates preservation of the abundant non-welded ash particles (paler cuspate fragments) distributed throughout the rock. Angular crystal fragments (colourless quartz, duller feldspar grains) lie in a very fine-grained alteration matrix (see next).

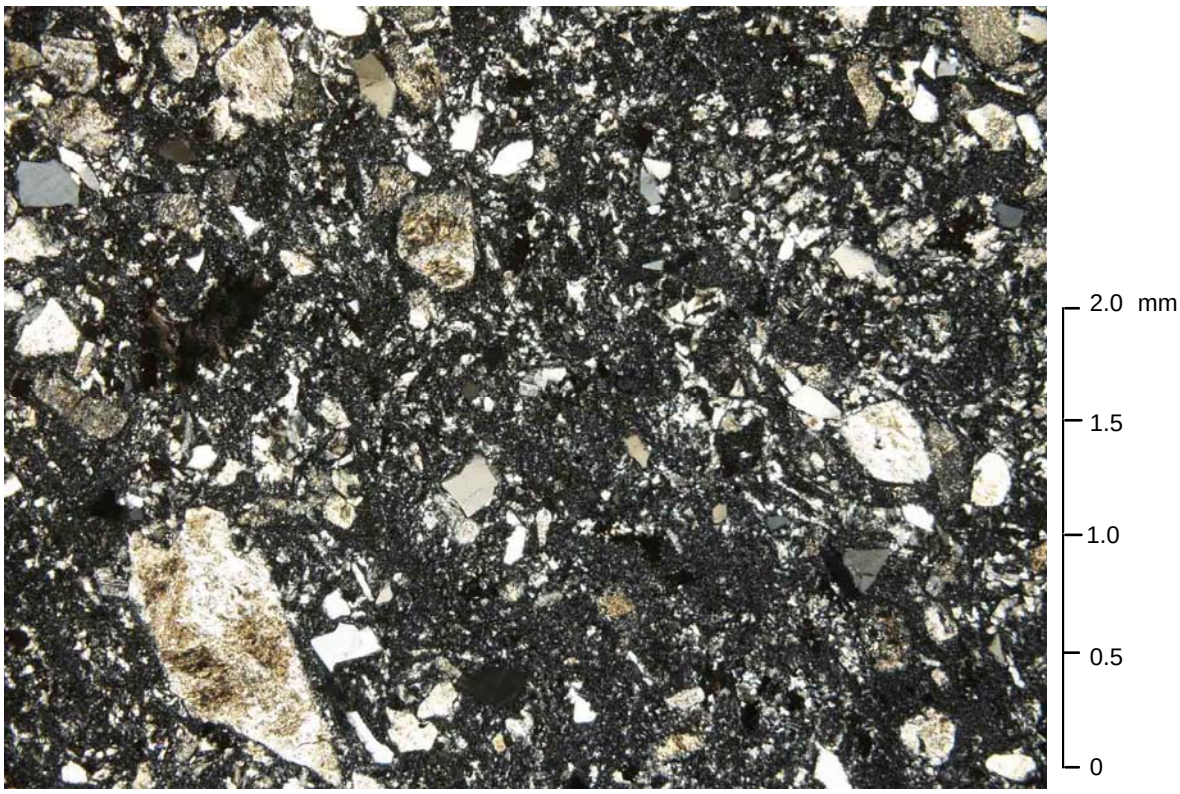


FIG. 6: SAMPLE NTR077 (Transmitted light, crossed polarisers, Obj. x4, Image PB132019)
This is the same field of view as FIG. 5 above. Larger crystal fragments of fresh quartz and altered feldspar are readily distinguished. Note that the shards are selectively replaced by fine-grained albite (whiter matrix patches) and lie in very fine-grained K-feldspar and minor chlorite (dull grey).

SAMPLE : NTR085 (Gowrie Park, NW Tasmania)

SECTION NO : NTR085 (445498mE, 5408977mN – AMG66_55)

HAND SPECIMEN : The surface rock sample represents a fine-grained, massive, pale cream rock containing sparsely scattered small equant translucent grey quartz crystals. Weathering has generated yellowish brown oxidation rim around the active weathering surfaces, and along thin fractures through the rock.

The section offcut accepted a positive stain for K-feldspar, indicating abundant K-feldspar occurs uniformly throughout the fine-grained groundmass.

ROCK NAME : Partly weathered rhyolite porphyry

PETROGRAPHY AND MINERAGRAPHY :

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

Mineral	**Vol %**	**Origin**
Quartz	10	Igneous phenocrysts 1
Plagioclase	5	Igneous microphenocrysts 1
Feldspar mosaic (mainly K-feldspar)	61	Igneous groundmass 1
Quartz	20	Igneous groundmass 1
Biotite (includes ?sericite)	2	Igneous groundmass 1 / ?alteration 2
Zircon	Tr	Igneous 1
Goethite/clays	2 (0-10)	Weathering 2

In polished thin section, this sample displays a partly-preserved massive porphyritic igneous texture, modified in places by weathering.

Feldspar is abundant, and different textural types are distinguished:

i) Much feldspar occurs throughout the groundmass as small equant anhedral untwinned grains, probably K-feldspar (confirmed by staining).

ii) Euhedral twinned blocky prismatic plagioclase phenocrysts are present in minor amount.

Quartz occurs in two forms:

i) Some occurs as larger equant blocky crystals (phenocrysts) ~0.4-2.0 mm in size. Most are euhedral without magmatic resorption.

ii) In the groundmass, small equant microphenocrysts are present, with additional quartz occurring as indistinct micrographic intergrowths in the anhedral K-feldspar grains.

Biotite may be present in minor amount as small flakes in the groundmass. It is weakly pleochroic from pale yellow to colourless in freshest parts of the rock, but is destroyed by weathering elsewhere. It may have been modified by sericitic alteration but this remains uncertain.

Zircon occurs in trace amount as rare small terminated prisms.

Goethite occurs in most parts of the rock, forming a diffuse cryptocrystalline yellow-brown stain. In thin fractures, dense dark red goethite forms a colloform space filling deposit.

INTERPRETATION :

This sample formed as a felsic igneous rock, originally composed of a moderate proportion of phenocrysts (quartz > plagioclase >> zircon) in a fine-grained holocrystalline groundmass (K-feldspar >> quartz > biotite). A rhyolitic composition is inferred from the mineralogy, and a shallow intrusive mode of emplacement is considered likely given the significant proportion of phenocrysts, lack of flow texture, and holocrystalline groundmass.

It remains uncertain whether the rock suffered alteration, but weathering has affected much of the rock producing new goethite pervasively and along fracture seals.

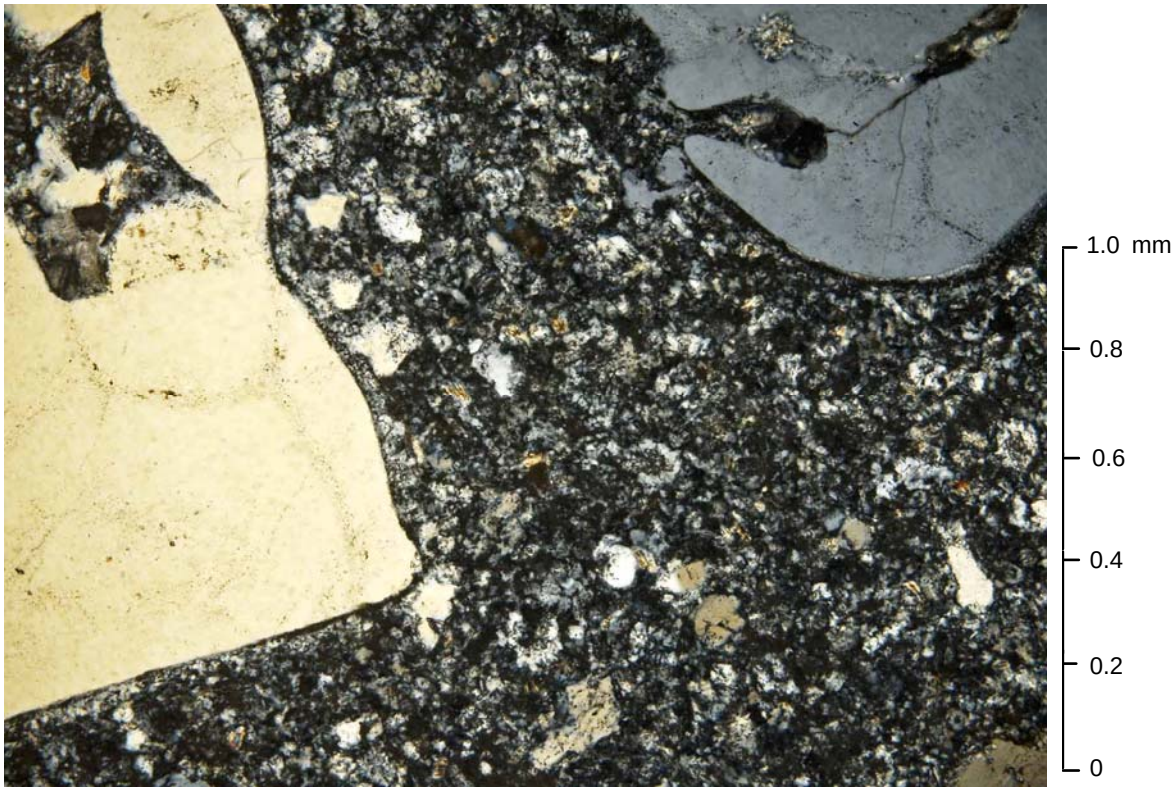


FIG. 7: SAMPLE NTR085 (Transmitted light, crossed polarisers, Obj. x10, Image PB132023)
This view of rhyolite porphyry captures parts of two quartz phenocrysts (pale yellow, left; grey, top right) in holocrystalline groundmass composed of anhedral K-feldspar grains (dull grey) and interstitial quartz (mostly white). Tiny phyllosilicate flakes (yellow to reddish colours) possibly represent relict primary biotite flakes.