APPENDIX III
Petrographic Descriptions

Pontifex & Associates Pty. Ltd.

TELEPHONE (08) 332 6744
FAX (08) 332 5062

26 KENSINGTON ROAD, ROSE PARK
SOUTH AUSTRALIA 5067
A.C.N. 007 521 084

P.O. BOX 91, KENT TOWN
SOUTH AUSTRALIA 5071

MINERALOGICAL REPORT NO. 6677

August 11, 1994

TO : Andrew Mackie
PNC Exploration (Aust) Pty Ltd
16th Floor, Royal Exchange Bldg
56 Pitt St
SYDNEY NSW 2000

YOUR REFERENCE : Order No. 2386

MATERIAL : Rock Samples

IDENTIFICATION : 5641, 5642, 5649, 5650, 5652

WORK REQUESTED : Thin section preparation, petrographic description and report.

SAMPLES & SECTIONS : Returned to you with this report.

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INTRODUCTION

Five rock samples are described in this report from normal thin sections. Each individual description provides a rock name and includes comments on genesis, and comparisons within the suite as seemed appropriate.

The presence of minor extremely small euhedral crystals in the hydrothermal-hematite-quartz-breccias 5649 and 5650 may be of interest. These are too small, and too altered to positively identify optically, but some have the morphology and optical properties similar to apatite (but the alteration to the ultrafine decussate phyllosilicate is not typical of apatite). It is suggested that these may be rare earth and/or uraniferous-related phases, but investigation by SEM in polished thin section would be required to investigate this possibility.

INDIVIDUAL DESCRIPTIONS

5641

Coarse poikiloblastic-andalusite, potash-felspar, biotite schist. Minor fine granular quartz > muscovite > sillimanite in schistose biotite foliae between the lenticular poikiloblasts.

At least 60% of this rock consists of a loosepacked aggregate of subhedral to 'lenticular' crystals of andalusite (30%) and of k-spar (30%), which are optically continuous over dimensions of 1mm to 6mm. These crystals are 'strongly' poikiloblastic as manifest by being crowded with abundant small (0.1mm) inclusions of mostly quartz and biotite, some of which are joined in short trains. Also, the boundaries of these crystals are poorly defined, largely because of the inclusions grading imperceptibly across the crystal faces, into the adjacent rock.

Areas between these crystals consist of undulating quite coarse, composite foliae of mostly biotite, but incorporating subordinate fine granular quartz, also minor muscovite. The biotite contains numerous minute inclusions of zircon, each with a pleochroic halo.

Accessory very small shredded lenses of fibrolitic sillimanite occur partly along the boundaries of several of the coarse andalusite crystals.

The genesis of this rock suggests a contact metamorphic component, with the co-existence of essential andalusite and k-spar, indicative of low pressure.

5642

'Black shale', incorporating numerous random small porphyroblastic crystals of andalusite which are completely retrograded to sericite. Incorporating a central thin bed of laminated siltstone (without andalusite).

This thin section includes a central bed about 10mm thick of dark grey laminated siltstone, between an 'upper' and 'lower' bed, each with a minimum thickness of 20mm, of black shale crowded with small (1mm) white crystals.

The siltstone is laminated, and consists of abundant (70%) quartz silt and 'grains; of sericite of this same fine size, and minor fine muscovite, all fairly evenly dispersed through a matrix of indefinite 'clay-sericite', which is clouded by dark carbonaceous dust.

The black shale beds are dominated by quite compact, extremely fine, similarly oriented clay sericite, densely clouded by ultrafine carbonaceous material, and shredded stringers/threads of the same carbonaceous material, also with minor dispersed quartz silt. Minor very small muscovite flakes are scattered, also trace very small tourmaline grains.

The white porphyroblastic crystals consist of andalusite, completely retrograded to sericite. These are more or less randomly scattered to form up to 35% of each of the black shale beds. Most of these measure about 1mm in section, and are up to 3mm long.

Zoning within the pseudomorphous sericite includes some carbonaceous zones, indicating the andalusite variety of chiastolite.

5649

Heterogeneous breccia, predominantly of massive hydrothermal quartz, (probably representing pervasive replacement). Scattered fine hematite (flakes) and muscovite, also coarse fragments, variably of quartz and/or clay-sericite (after felspar) ± hematite, muscovite, tourmaline - as possible pegmatoid. Cut by a vein of coarse sparry quartz. Trace extremely small possible rare earth and/or uraniferous (altered) crystals.

Macroscopically, this rock is seen as a massive heterogeneous, siliceous and partly ferruginous 'fragmental'. Petrographically, at least 65% of the whole rock is seen to consist of massive, hydrothermal quartz, as variably cryptocrystalline to microcrystalline mosaic, merging into random patchy veins of fine sparry quartz. This quartz also incorporates abundant randomly scattered hematitic flakes and small fine skeletal hematitic relicts, apparently after resorbed rock/mineral fragments. Minor clear small muscovite flakes are also scattered.

Random, more clearly defined (better preserved) fragments to 10mm size, consist of :

* rock fragments of composite quartz/clay-sericite (after felspar?), generally plus fine hematite, rarer muscovite and local tourmaline; of possible granitoid (?pegmatoid) derivation.
* fragments of internally heterogeneous clay-sericite composition ± minor fine hematite (possibly after coarse felspar)
* clast, possible a jasperoidal fragment, or possibly a hydrothermal band inherent to the silicification, composed of zoned chalcedonic-silica and extremely fine hematite.

A vein of coarse sparry quartz, clouded with fluid inclusions and with a rim rich in extremely fine hematite, cuts the whole rock.

Rare (1%) extremely small [10 μm to (rarely) 0.15mm] cubic to tabular shaped crystals, are scattered and rarely loosely clustered within the hydrothermal quartz. (Similar crystals occur in 5650). Some of these consist of 'alteration products', others are internally zoned and have optical properties resembling apatite. These could not be identified by optical microscopy, but they could be rare-earth phases, and/or uraniferous? SEM analysis (of a polished thin section) may resolve the identity of these crystals.

5650

Heterogeneous breccia, with abundant 'fragments' of fine to coarse hydrothermal quartz, also granular quartz and iron-stained clay-sericite (?after felspar). Also muscovite flakes and clusters may derived from granitoid pegmatoid (cf. 5649). Fairly extensive vein network of crystalline hematite through matrix. Accessory extremely fine crystals, as in 5649; possible rare earth or uraniferous composition.

Approximately 30% of this sample consists of a chaotic vein network of fine to moderately coarse crystalline hematite discontinuously through the matrix of a breccia.

About one half of the breccia fragments, on a scale of 2mm to 25mm, consist of quartz variably composite with / separate from a similar amount of massive indefinite clay-sericite (limonite stained). Minor muscovite as random flakes and local clusters also occur throughout.

Most of the quartz is clearly hydrothermal, as prismatic to sparry crystals, zoned with fluid inclusions and with surrounds of cryptocrystalline silica, some in (vein) aggregates, some single. Relatively irregularly granular quartz, and the patchy clay-sericite (which may be composite with quartz), also muscovite may have a granitoid genesis (possibly pegmatitic as suggested for 5649).

Rare euhedral crystals, tabulart to prismatic, 'square' and with rare hexagonal cross section, are associated with hydrothermal quartz and clay alteration. some of the crystals are altered, but they appear to be the same as noted in 5649, and likewise cannot be identified optically. [These may be rare-earth and/or uraniferous crystals.]

5655 **Quartz-porphyritic, microgranophyric, microgranite.**

About 75% of this rock consists of a massive essentially equigranular granitoid aggregate, average size about 1mm. About 2/3 of this aggregate consists of allotriomorphic crystals of k-spar which forms intricate microscopic, vermiform/graphic/myrmekitic intergrowths with quartz. The other approximate 1/3 of this aggregate consists of subhedral to even euhedral clear crystals of quartz, in this same size range, but may be considered as micro-phenocrysts.

There are also minor/accessory scattered flakes of ferruginised muscovite and of apparent secondarily oxidised magnetite. Minor possible ex-plagioclase crystals are camouflaged by iron-stained, clay-sericite-alteration products.

As noted therefore, there are apparent discrete hematite 'grains' and flakes scattered through this rock. Most of these seem to be oxidised primary phases, with some 'flakes' pseudomorphous after primary micas, but there may be accessory primary micaceous hematite as well.

Up to 20% of this rock consists of individual quartz phenocrysts, ranging in size from 1mm to 4mm, characteristically subrounded and embayed.

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P.O. BOX 91, KENT TOWN
SOUTH AUSTRALIA 5071

MINERALOGICAL REPORT NO. 6704

September 20, 1994

TO : A. Mackie
PNC Exploration (Aust) Pty Ltd
1sr Floor, Royal Exchange Building
56 Pitt St
SYDNEY NSW 2000

YOUR REFERENCE : Order No. 0010

MATERIAL : 6 Rock Samples

IDENTIFICATION : 4523 to 4526
45658, 4574, 5683

WORK REQUESTED : Thin section preparation, petrographic description and report, with comments as specified.

SAMPLES & SECTIONS : Returned to you with this report.

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SUMMARY COMMENTS

Six rock samples are described in this report from normal thin sections. The first three (4523, 24 and 26) are virtually unmetamorphosed and include silicified rhyolite (4523), micaceous-limonitic siltstone with quartz veins and limonite-lined fractures (4524) and a less micaceous limonitic quartz sandstone, very fine to fine grained, (4526). Sample 4563 is a massive megacrystic biotite granodiorite with microcline megacrysts and sericitised plagioclase, also accessory opaque oxides, apatite and zircon.

Sample 5474 consists of low-temperature hydrothermal quartz with limonite at least partly after carbonate.

The only metamorphic rock in this suite is 5683 which is a quartz-free biotite-muscovite schist with lenses of sillimanite and abundant granular probable apatite as grains to 2 mm long. This was apparently a phosphatic claystone and represents high amphibolite-facies metamorphism.

INDIVIDUAL DESCRIPTIONS

4523 **Quartz-sericite-limonite leucoxene altered probable rhyolite with an elongate xenolith; (or probably an ignimbrite with sparse fiamme).**

This massive dark red altered porphyritic rock is seen in thin section to have sparse quartz phenocryst to 1 mm diameter, with optically continuous overgrowths, and sericitised felspar phenocrysts of similar size. The groundmass has been altered to granular quartz with radially disposed small inclusions in some areas, suggesting former microspherulitic devitrification. More randomly oriented limonitised microlites are also common and there are limonite-leucoxene pseudomorphs after elongate biotite flakes. Leucoxene has also replaced scattered microphenocrysts of titanomagnetite.

A limonite-rich lens, which is otherwise similar to the host rock, is poorly defined by has a size of about 15 x 3 mm. This may be an xenolith in a massive rhyolite, or seemingly less likely, it may represent an original fiamme in a totally welded ignimbrite.

4524

Foliated micaceous claystone, mostly limonitised with zones of small reduction spots and limonite ± quartz-lined fractures leading into tension-gash quartz veins.

Bands in this sample on roughly a centimetre-scale, have contacts emphasised by limonite ± quartz-lined fractures which are at a high angle to a possible bedding parallel schistosity which is defined by detrital muscovite flakes and matrix sericite.

Basically however, the rock is a relatively uniform micaceous quartz siltstone with a sericite-limonite matrix. It has irregular patches away from the limonite-lined fractures which have abundant small reduction spots, occurring singly or as composite patches 0.2 to 2 mm in diameter. In these spots the sericite is quite evident, largely because of the lack of limonite.

In one area the limonite lined fractures pass into vein at a high angle to those forming the parallel set mentioned above, and into tension-gash quartz veins to 7 x 3 mm, enclosing fragments of siltstone to 2 mm long.

4526

Limonitised micaceous very fine to fine-grained quartz sandstone, with subparallel quartz veins and limonite-lined fractures.

Like sample 4524, this is a red limonitic massive rock. In thin section it has a similar detrital assemblage with quartz considerably more abundant than detrital white mica.

The grainsize indicates a very fine to fine grained sandstone (0.05 to 0.2 mm grainsize). However in this sample the detrital muscovite is poorly oriented and there are no reduction spots so that the orientation of bedding, or of any possible bedding parallel schistosity, is not clear. Where sericite is evident, it appears to be decussate and there is possibly no foliation in this sample.

There are narrow subparallel lenticular quartz veins and some limonite lined fractures, including some subparallel to the quartz veins and some cross cutting relative to the quartz veins.

4563 5

Massive megacrystic granodiorite with microcline megacrysts and sericitised plagioclase.

Quartz	35%
Plagioclase	40-45%
Microcline	15%
Muscovite	7%
Biotite	tr
Oxide	tr
Apatite	tr
Zircon	tr

The hand specimen of this sample indicates a megacrystic granitoid with megacrysts of alkali felspar to 30 mm long. These are too large and too sparsely scattered to allow the mineralogy to be estimated from the thin section alone, and even in the hand specimen, there are portions of only four crystals, so that estimation of their abundance is difficult. The thin section also includes a roughly 8 mm-wide quartz vein, and the quartz in this vein has not been included in the estimated mineralogy given above. A more precise evaluation of the mineralogy could require the examination of a large area in outcrop, perhaps as large as a square metre.

In thin section the megacrysts are seen to be microcline and to have some crudely graphic inclusions of quartz and muscovite, as well as more normal inclusions of biotite, plagioclase and partly leucoxenised opaque oxide. The rest of the rock is rich in coarse albite-sericite-altered plagioclase laths from 1 to 10 mm long, with coarse interstitial quartz and unoriented pale magnesian biotite flakes to 3 mm long. There is some muscovite. Accessories include well-zoned zircons as well as apatite and partly leucoxenised opaque oxides. Some of these accessories are enclosed in biotite, but others occur in the plagioclase.

5474

Microgranular to sparry quartz with some crystal-line cavities and minor apparently residual carbonate. Apparently an oxidised hydrothermal quartz-carbonate rock.

Most of this sample is fine granular to prismatic quartz of low-temperature hydrothermal origin, with growth zoned in the quartz occupied by limonite. This passes into areas in which kernels of fine quartz occur in a limonite cement, albeit with the limonite not obviously after pyrite, and also into areas of coarse granular to prismatic quartz, locally lining large cavities. Some limonite, apparently after rhombohedral crystals of carbonate, occurs with the coarser quartz, which occurs as crystals from 0.4 to 2 mm in size.

Some of the finer quartz has small droplet-like inclusions of carbonate as well as or instead of limonite, which supports the idea that the limonite is after carbonate.

5683 **Biotite-muscovite-sillimanite schist with possible apatite, (?or possible corrundum).**

The bulk of this sample is coarse schistose biotite as flakes to 4 mm long with about 25% of the biotite at a high angle to the schistosity. There is also about 10% coarse muscovite locally as bent flakes to 6 mm long, apparently cross cutting the biotite, and 2-3% fibrolitic to fine prismatic sillimanite in lenses parallel to the schistosity.

A mineral which has low birefringence, high refractive index and is colourless, uniaxial negative, occurs as rounded grains and prisms. This mineral appears to be apatite although the refractive index appears to be too high for apatite and there is no twinning. Indeed, some of these grains have been veined by possible sericite and this suggests that they may be untwinned corundum, although they appear to be very soft (unless they are breaking up along fractures) and are most probably apatite. The identity of this possible corundum or apatite may require SEM or probe examination or X-Ray diffraction. Its softness and birefringence are really consistent only with apatite, however.

Small zircons are disseminated and these suggest a former claystone.

ANNUAL REPORT

EXPLORATION LICENCE 8373 (TI TREE)

PERIOD ENDING 24th FEBRUARY 1995

Fergusson River 1:250,000 Sheet
ACCOMPANYING PLANS

A MACKIE
PNC EXPLORATION (AUSTRALIA) PTY LTD
SYDNEY OFFICE

February 1995

130°30′ 130°32′30″ 130°35′ 130°37′30″ 130°40′ 130°42′30″ 130°45′ 130°47′30″ 130°50′ 130°52′30″

14°10′ 14°12′30″ 14°15′ 14°17′30″ 14°20′ 14°22′30″

8430000 mN 8425000 mN 8420000 mN 8415000 mN 8410000 mN

660000 mE 665000 mE 670000 mE 675000 mE 680000 mE 685000 mE 690000 mE 695000 mE 700000 mE 705000 mE

Job	2149
Area	Ti-Tree
Scale	1 : 50000
Sheet	500