GEOPEKO LIMITED
NORTH AUSTRALIA

CONGOWANA PROJECT

Report No : GJ 73/3

REPORT ON E.L. 220

to

THE NORTHERN TERRITORY MINES BRANCH
FOR THE YEAR ENDED 31st DECEMBER, 1972

by

R.E. LEES

CR 1973 01 08

JABIRU, N.T. APRIL, 1973
CONTENTS

INTRODUCTION 1
REGIONAL GEOLOGY 2
RANGER 44 2
CANNON HILL 3
RANGER 9 AREA 3
RAMIL WATERHOLE 3
COOLABORRIE STRATIGRAPHIC HOLE 4

APPENDICES

Appendix 1 Cannon Hill - B horizon Geochemistry Results
Appendix 2 Ramil Waterhole - B horizon Geochemistry Results
Appendix 3 Ramil Waterhole - Auger/Diamond Drill Logs
Appendix 4 Ramil Waterhole - Diamond Drill Log DDH PMF 2, Assay Results
Appendix 5 Coolaborri.Stratigraphic Hole - Diamond Drill Log DDH MB S/1, Assay Results
Appendix 6 Petrological Reports

LIST OF PLATES

Plate 1 Munmalary Composite Sheet East Alligator 3
Plate 2 Munmalary Composite Sheet East Alligator 2
Plate 3 Ranger 44 Magnetic Profiles
Plate 4 Cannon Hill Traverse Outcrop Geology
Plate 5 Cannon Hill Traverse Magnetic and Gravity Profiles
Plate 6 Ranger 9 Area Geochemical Profiles
Plate 7 Ranger 9 Area Magnetic and Gravity Profiles
Plate 8 Ramil Waterhole Grid Outcrop Geology
Plate 9 Ramil Waterhole Grid Magnetic and Gravity Profiles
INTRODUCTION

This report describes the results of investigations carried out within E.L. 220 during the year ending 31st December, 1972.

The exploration license contains an area of 1217 square kilometres and is located between the East Alligator River and the South Alligator River, approximately 200km, east of Darwin.

The Boundaries are shown on the accompanying Plates 1 and 2. Regional geological mapping was carried out in selected areas to determine the rock types present and their distribution in the E.L.

Detailed geological mapping, and geochemical and geophysical investigations were carried out in two areas - Cannon Hill and Ramil Waterhole. At the Ranger 9 locality, detailed investigations were suspended following heavy rain. A detailed geophysical investigation was carried out at the Ranger 44 locality. Two diamond drill holes were completed, one at the Ramil Waterhole locality, the other in the sedimentary basin north-north-west of Ramil Waterhole.
REGIONAL GEOLOGY

The regional geology of E.L. 220 is shown on Plates 1 and 2.

These present the results of geological mapping carried out prior to 31st December, 1972. Results of B.M.R. field investigations are included.

Outcrop is poor throughout most of the E.L. except for the Kambolgie Formation near the eastern boundary. Apart from the Kambolgie Formation, outcrops fall into three groups.

(1) In the western part of the E.L., outcrops are of granite-gneiss and schist which are Nanambu type lithologies. Also in this area, there are outcrops of bedded feldspathic quartzite.

(2) Towards the north-west corner there are outcrops of flat lying siltstone and sandstone which are possibly correlatives of the Lower Cretaceous Mullaman Beds.

(3) In the central and eastern part of the E.L., there are isolated outcrops of quartzite, cherty-quartzite, banded quartzite with ferruginous layers, quartz-muscovite schist and quartz-chlorite-muscovite schist.

RANGER 44

The Ranger 44 locality is on the flood plain of Magela Creek 11km west-south-west of Cahill's Crossing on the East Alligator River. Ranger 44 is a small isolated magnetic anomaly detected by an airborne survey. The grid origin (00/00) is at A.M.G. co-ordinates 269800E/8622900N approximately.

An auger drill hole at 300W/00 near the edge of the flood plain was terminated at 23.3m in alluvial sand.

A ground magnetic survey was carried out and profiles of results are shown on Plate 3.
CANNON HILL

The Cannon Hill traverse is on an Arnhem Highway survey 9km south-west of Cannon Hill.

Surface scree was mapped and auger cuttings were geologically logged. Results are shown on Plate 4.

Auger drilling was carried out at 75 to 100 feet spacings along the highway survey. Samples collected from the B horizon were analysed for Uranium, Copper, Lead, Phosphorus, Manganese, Titanium and Nickel. Results are tabulated in Appendix 1.

Gravity and magnetics were read along the traverse. Profiles of results are shown on Plate 5.

RANGER 9 AREA

The Ranger 9 traverse origin (00/00) is located 13km south of Ramil Waterhole at A.M.G. co-ordinates 240400E/8617400N approximately. The traverse extends along that northing from 24200E to 250000E.

Auger drilling was carried out on the western two-thirds of the traverse. Drilling was suspended following heavy rain. B horizon samples were analysed for Uranium, Copper Lead, Phosphorus, Titanium and Manganese. Results are presented on Plate 6.

Gravity and magnetics were read along the traverse. Profiles of results are shown on Plate 7.

RAMIL WATERHOLE

The Ramil Waterhole grid origin (00/00) is located at A.M.G. co-ordinates 249700E/8634600N 5km north-north-east of Ramil Waterhole.

Geological mapping of scree was carried out on the grid. On traverse 00N, auger cuttings were geologically logged. Results are shown on Plate 8.

Auger drilling was carried out on the 00N traverse. B horizon samples were assayed for Uranium, Copper, Lead, Phosphorus, Titanium and Nickel. Results are tabulated in Appendix 2.
Five auger/diamond drill holes were completed. The holes were drilled with 4½ inch augers, cased off, and core was taken from the bottom of the hole. Drill logs are included in Appendix 3.

Magnetics and gravity were read on traverse 00N. Profiles of results are shown on Plate 9.

A diamond drill hole was sited to test the positive magnetic feature which occurs immediately east of the grid origin. The diamond drill log is included in Appendix 4.

**COOLABORRIE STRATIGRAPHIC HOLE ✓**

Diamond drill hole MB 5/1 is located 6km north-north-west of Ramil Waterhole, at A.M.G. co-ordinates 245350E/8636100N approximately. The hole was designed to test the stratigraphic sequence in the basin of probable Lower Cretaceous Mullaman Beds. The diamond drill log is included in Appendix 5.
APPENDIX 6: GEOLOGICAL REPORTS
CENTRAL MINERALOGICAL SERVICES

SAMPLE REPORT (Mineralogy, Petrology, Ore Microscopy)

Job No. 272/8/31 Date Received: 26-2-73
Reference: C4 6 1400
Sample No. C6 4150
Nature of Sample: D. O. Core

DESCRIPTION

SECTION No. 11124

ea. Hand Specimen:

Fine-grained, biotitic, quartzofeldspathic schist.

b. Microscopic:

Essentially a muscovite-biotite-quartz schist with subordinate K-feldspar.

The main mineral is relatively fine, granular quartz (average grain size < 0.2 mm); it is possible that the subrounded grains are relics of sedimentary features and that the quartz has undergone little recrystallization.

Muscovite is more abundant than biotite; both are well-liniedated and interleaved, forming semi-continuous layers. The K-feldspar (orthoclase) occurs with quartz, but only comprises 5-10% of the rock.

Detrital grains of zircon, garnet, spathite and other heavy minerals are scattered through the rock.

R. R. Fender, M.Sc.
CENTRAL MINERALOGICAL SERVICES

SAMPLE REPORT (Mineralogy, Petrology, Ore Microscopy)

Job No: 22/2/31 Date Received: 26-3-73
Reference: G3 4451
Sample No. G3 4451
Nature of Sample: Gb0, Core

DESCRIPTION SECTION No. 1125
a. Hand Specimen:

Green, crystalline rock? amphibolite.

b. Microscopic:

This is an ortho-amphibolite; it is a thermally metamorphosed, recrystallized fresh igneous rock. Relict textures/fabrics indicate that the original rock may have been a gabbro.

The two major components are hornblende and enstatite, with minor quartz and accessory sphene.

The hornblende occurs as randomly-oriented acicular to prismatic crystals and clusters. Interstitial areas, comprising about 35% of the rock, consist of assemblages of subhedral enstatite crystals, generally untarnished, with minor intergrown quartz.

Small patches of granular sphene occur throughout and have probably formed from primary ilmenite. Although no primary minerals have survived, the present mineral assemblage and relict fabric indicate the basic igneous origin of the rock.

H. W. Fender, M.Bi.

Date 27-2-73

IDENTIFICATION

G3 4451
Ortho-amphibolite.
CENTRAL MINERALOGICAL SERVICES

SAMPLE REPORT (Mineralogy, Petrology, Ore Microscopy)

Job No. G13 73/2/31       Date Received: 28-2-73
Reference: File: G 1400
Sample No.: 68 4553
Nature of Sample: D.D. Core

DESCRIPTION

SECTION No. 11127

a. Hand Specimen:

Fine-grained micaceous metaquartzite or schist.

d. Microscopic:

A fine-grained, feldspathic, micaceous metaquartzite; because of the high proportion of granular quartz the term metaquartzite is preferable to that of schist.

The rock consists dominantly of fine (0.05-0.3mm) interlocking to granular quartz grains, with occasional orthoclase and oligoclase grains; these minerals are recrystallized.

The mica consist of well-lined, interlaced thin flakes of muscovite and chlorite, forming thin, discontinuous layers. Detrital grains of zircon, apatite and opaque are scattered through the rock.

A thin, irregular vein of edulia cuts the rock, suggesting minor K-dystexanite.

The original rock was an argillaceous, feldspathic sandstone or silt sandstone.
CENTRAL MINERALOGICAL SERVICES

SAMPLE REPORT (Mineralogy, Petrology, Ore Microscopy)

Job No. C59 73/2/31  
Date Received: 23-2-73

Reference G5 8 1400

Sample No. G5 4032

Nature of Sample: D.D. Core

DESCRIPTION

<table>
<thead>
<tr>
<th>SECTION No.</th>
<th>11120</th>
</tr>
</thead>
</table>

a. Hand Specimen:

Medium/coarsely-crystalline dark green rock.

b. Microscopic:

This rock closely resembles G5 4151, and doubtless has the same origin and history. It is an ortho-amphibolite, which has a coarser fabric and a higher proportion of hornblende than G5 4151, reflecting similar trends in the original rock.

The dominant component is pale (Fe-poor) hornblende as large porphyroblasts, irregular patches, with numerous small inclusions of plagioclase, opaque and granular sphen.

The plagioclase occurs interstitially as interlocking patches of twinned and unzoned endzone, with very minor included quartz. Granular patches of sphen are fairly common; some are up to 1 mm. in size.

The mineral assemblage and relict fabric indicate derivation from a coarse-grained basic igneous rock by thermal metamorphism and recrystallization.

H. E. Fender, M.Sc.

Review Page
CENTRAL MINERALOGICAL SERVICES

SAMPLE REPORT (Mineralogy, Petrology, Ore Microscopy)

Job No. 832 73/2/23  Date Received: 26.2.73
Reference: 81.4 6 4338
Sample No.: 83 4077
Nature of Sample: B.D., Core
DESCRIPTION

SECTION No. 11111

a. Hand Specimen:

Silvery micaceous, chloritic schist.

b. Microscopic:

This is a staurolite-garnet-biotite-muscovite-quartz schist. It thus belongs to the almandine-epidote facies of regional metamorphism, and was originally a pelitic rock.

The rock is banded with quartz-rich bands alternating with micaceous bands. The staurolite occurs as very occasional large, porphyroblastic crystals, and garnet is only poorly-developed, as small scattered crystals, mainly in the quartzose layers.

Massive, well-foliated coarse flakes are conspicuous, with interleaved dark biotite; this also occurs as poikiloblastic patches with random orientation.

In the muscovite layers, mosaics of plagioclase occur (probably calcic oligoclase). Detrital heavy-mineral grains include apatite, tourmaline, zircon and sphene.

Quite large, poikiloblastic patches of magnetite are scattered through the rock.

H. W. Fendel, M.Sc.
Central Mineralogical Services

Sample Report (Mineralogy, Petrology, Ore Microscopy)

Job No: 23/2/73  Date Received: 26-2-73
Reference: 0.4.0 1396
Sample No: 93 4078
Nature of Sample: O.D. Core

Description: Section No. 11112

a. Hand Specimen:

Strongly folded quartz-mica schist.

b. Microscopic:

A garnet-biotite-muscovite-K feldspar-quartz schist. It shows tight folding, particularly accentuated by the muscovite flakes.

The main mineral is quartz, as fairly coarse mosaics, sometimes with small inclusions which follow the folding. Garnet is not abundant; it occurs as occasional, isolated, rounded crystals with chlorite rims. Muscovite, and minor dark olive green biotite, are interleaved. The K-feldspar forms small mosaics and is not abundant. The rock is similar in origin and grade to 93 4077.

Because of the presence of traces of sulphide, a polished section was prepared. This shows scattered magnetite crystals and occasional patches of chalcopyrite (up to 0.70 mm) and pyrite (up to 0.4 mm). No other sulphides were seen. The sulphides may be pre-metamorphic.

H. W. Funder, M.Sc.
CENTRAL MINERALOGICAL SERVICES

SAMPLE REPORT (Mineralogy, Petrology, Ore Microscopy)

Job No. C-13 76/2/73 Date Received: 25-2-73
Reference: G-133
Sample No.: 4079
Nature of Sample: O.D. Core

DESCRIPTION

SECTION No. 11113

a. Hand Specimen:

  Folded, fine-grained quartz-mica schist.

b. Microscopic:

  Garnet-biotite-muscovite-quartz-feldspar schist. It is fairly fine-grained,
  consisting of interlocking quartz grains, small flakes of biotite and muscovite and
  patches of cloudy K-feldspar.

  Garnet crystals are few and far between, as small granular patches and
  occasional larger crystals with chlorite rims.

  Apatite is a fairly conspicuous accessory, and occasional detrital heavy-
  mineral grains occur. Chlorite flakes are present, and represent altered biotite.

  The mineral assemblage indicates that this rock is probably transitional
  between the greenschist facies and the almandine-garnet-facies of regional
  metamorphism. The original rock was pelitic.

Date: 13-6-73

IDENTIFICATION

4079

Garnet - Mica - Quartz

Schist.
CENTRAL MINERALOGICAL SERVICES

SAMPLE REPORT (Mineralogy, Petrology, Ore Microscopy)

Job No. 33/4090
Date Received: 26-2-73
Reference 0.0 1959
Sample No. 33 4090
Nature of Sample: D.D. Core

DESCRIPTION

SECTION No. 7114

Fairly coarse-crystalline quartz-mica schist.

a. Hand Specimen:

b. Microscopic:

The rock closely resembles 33 4079 but is much more coarse-crystalline.

A few rounded garnet crystals are scattered through the rock, which is composed mainly of micas of quartz and oligoclase, with coarse flakes of muscovite and biotite. Whereas the muscovite is foliated, the biotite tends to lie across the foliation, as prismatic crystals with numerous pleochroic haloes. Chlorite flakes are present, as an alteration product of biotite.

One feature which is unusual is the presence, throughout the rock, of very numerous small, well-formed crystals of dark green tourmaline. These are probably metamorphic - postmetamorphic in origin.

This is a regionally-metamorphosed pelitic sediment, belonging to the upper part of the green-schist facies.
CENTRAL MINERALOGICAL SERVICES

SAMPLE REPORT (Mineralogy, Petrology, Ore Microscopy)

Job No. 218 73/2/23  Date Received: 26-2-73
Reference  G.N. G 1398
Sample No. GG 4081
Nature of Sample: D.B. Core

DESCRIPTION  SECTION No. 11115

a. Hand Specimen:

Garnet-steaurolite-mica schist.

b. Microscopic:

Steaurolite is abundant and very well-developed in this garnet-steaurolite-
muscovite-biotite schist.

Steaurolite occurs as typical porphyroblasts, with good external crystal form
but full of inclusions of quartz and mica. The garnet occurs in a similar fashion, as
porphyroblasts with inclusions.

The quartz occurs as mosaic, with a few patches of K-feldspar. The muscovite
tends to have random orientation around the steaurolite and garnet crystals, in
pressure shadows, but elsewhere is well-oriented and is interleaved with dark
brown biotite. Occasional plagioclase patches also occur, and are largely sericitised.

The rock belongs to the amphibolite facies of regional metamorphism.

H. W. Fender, M.Sc.
CENTRAL MINERALOGICAL SERVICES

SAMPLE REPORT (Mineralogy, Petrology, Ore Microscopy)

Job No. 588 73/3/33  Date Received: 25-2-73
Reference.  O.N. 6 1399
Sample No. 68 4062
Nature of Sample: O.D. Core

DESCRIPTION

SECTION No. 11116

a. Hand Specimen:

Medium-grained garnet-mica schist.

b. Microscopic:

This is a staurolite-muscovite-plagioclase-quartz schist, with minor Kyanite.

Porphyroblasts of staurolite, full of inclusions, are abundant throughout.
There are also porphyroblastic lenses of oligoclase, cradled with crystals of staurolite, muscovite and magnetite.

Muscovite occurs partly as foliated layers, and partly as stout flakes orientated perpendicularly to the generally schistose structure. The quartz generally forms discrete lenses and layers of mosaics separating the micaceous layers. Biotite is fairly sparse and is partly chloritised.

The Kyanite occurs as small, poorly developed crystals in accessory amounts and is therefore not part of the classification.

Small tourmaline crystals are scattered through the rock and are metamorphic.

H. W. Fender, M.Sc.
CENTRAL MINERALOGICAL SERVICES

SAMPLE REPORT (Mineralogy, Petrology, Ore Microscopy)

Job No. C29 22/2/73 Date Received: 28-2-73
Reference: C.N. 8 1399
Sample No.: 83 4083
Nature of Sample: D.D. Core

DESCRIPTION SECTION No. 11117

Fine-grained quartz-mica schist, with minor traces of chalcopyrite.

b. Microscopic:

A muscovite-chlorite-quartz-feldspar schist. The fabric of the rock is finely granular, and the schistosity fairly poorly developed, because the main components are quartz and feldspar, as fine mosaic.

Both orthoclase and untwinned plagioclase occur, as small brownish patches (due to dusty iron oxide inclusions) with quartz, and form about 40% of the rock. The micas are muscovite and chlorite, as small interleaved flakes with subparallel orientation, forming folded streaks and threads.

Small, rounded apatite grains are relatively common, and detrital grains of biotite occur. Some, rather dark brown (? oxidised) epidote has developed along the chlorite cleavage planes.

The rock belongs to the greenbiotite facies.

Both chalcopyrite and pyrite were seen, in traces.

H. W. Fender, M.Sc.
CENTRAL MINERALOGICAL SERVICES

SAMPLE REPORT (Mineralogy, Petrology, Ore Microscopy)

Job No. C08 22/2/23  Date Received: 26-0-73
Reference G.42 0 1393
Sample No. 22 4086
Nature of Sample: D.D.Core

DESCRIPTION  SECTION No.  11116

a. Hand Specimen:

Fine-grained, dark-green, ? amphibolitic rock, with sulphide traces.

b. Microscopic:

This fine-grained amphibolite is almost certainly a para-amphibolite,
ias of sedimentary origin.

It is very simple in its mineral assemblage, consisting dominantly of
quartz and hornblende, with minor sodic plagioclase and traces of pyrite.

The quartz occurs as small mosaic intergrown with small, prismatic hornblende
crystals, and as parallel streaks and vein-like bodies which probably are recrystallised
pre-metamorphic veins. Small granular patches of sapphire are present, as well as
irregular patches of opaques (including sulphides). Whilst there is little direct
evidence of a sedimentary origin, the paucity of feldspar, abundance of quartz and
absence of relict igneous textures all suggest a sedimentary origin.

Traces of pyrite and chalcopyrite occur. The chalcopyrite ranges from
40% to 50% in size as irregular grains. The pyrite tends to be euhedral.
Sample Report (Mineralogy, Petrology, Ore Microscopy)

Job No. GDS 73/2/23  Date Received: 26-2-73
Reference: D. N. G 1398
Sample No.: G0 4085
Nature of Sample: D. O. Core
Description  Section No.: 11119

a. Hand Specimen:

Fine-grained, dark green amphibolite with conspicuous magnetite and traces of sulphide.

b. Microscopic:

A para-amphibolite, which must have originated from a fairly iron-rich sediment, because of the abundant magnetite.

The magnetite occurs as porphyroblastic crystals with occasional small inclusions, set in an orientated matrix of small, prismatic hornblende crystals and interstitial euhedral quartz. Finer, granular magnetite is also common throughout. The hornblende is a strongly pleochroic iron-rich variety.

Feldspar occurs in small amounts only, and there are traces of sphene. Occasional spilitic crystals are present, but no other minerals were seen.

There are quartz veins (? pegmatitic) with minor feldspar but otherwise barren.

In polished section, the magnetite crystals are conspicuous, measuring up to 1 mm in size. Smaller, elongate (parallel to schistosity) grains of ilmenite are common. Small patches (5 to 15%) of chalcopyrite are relatively common throughout.

M. W. Fender, M.Sc.
CENTRAL MINERALOGICAL SERVICES

SAMPLE REPORT (Mineralogy, Petrology, Ore Microscopy)

Job No. 63 73/62/23  Date Received: 26-2-73
Sample No. 63 4085
Nature of Sample: D.R. Core

DESCRIPTION  SECTION No.  11120

a. Hand Specimen:

Medium-grained quartzose, micaceous schist.

b. Microscopic:

This is a staurolite-muscovite-oligoclase-quartz schist, with some kyanite and magnetite. It is very similar to 63 4082. Minor sillimanite may also have been present but is altered to sericite.

The plagioclase (albite-oligoclase) forms large poikiloblastic patches, crowded with inclusions of all the other components and showing strong parallel orientation. Between these poikiloblasts are layers of mosaic quartz and streaks of foliated muscovite, with magnetite and minor chlorite. The staurolite crystals are typically porphyroblastic and are common; kyanite occurs as prismatic crystals, generally very small but with isolated larger ones.

The rock belongs to the amphibolite facies of regional metamorphism, and was probably sedimentary.

Date: 12-4-73

IDENTIFICATION

Staurolite - Muscovite - Oligoclase - Quartz Schist.

M. W. Fandor, M.Sc.
Coarsely-crystalline schist with appreciable magnetite.

b. Microscopic:

This rock appears to be contact-metamorphosed, at least in part, with a typical contact-metamorphic mineral assemblage and fabric.

The major minerals, which are mostly very coarsely-crystalline and randomly oriented, are staurolite, andalusite, untwinned plagioclase, biotite, magnetite, muscovite and quartz. Parts of the specimen (at one end) are foliated, schistose and are a quartz-mica schist, with magnetite and poikiloblastic, sericitised plagioclase. However, the bulk consists of the mineral assemblage listed above, separated from the schist by a thick band of quartz.

The coarsely-crystalline silicates are poikiloblastic, with many inclusions. Traces of green tourmaline and of kyanite are also present.

The staurolite is a regional metamorphic mineral and is thus out of place in the contact-metamorphic assemblage; it is thus a relic mineral.

H. G. Fender, M.Sc.
PETROLOGICAL EXAMINATION OF TWO DRILL-CORE SAMPLES

Sample: GG4098; TS 3624:

Rock Name:
Amphibolite

Hand Specimen:
This section of drill-core is composed of fine, even-grained, schistose rock. The dominant minerals are amphibole, quartz and/or feldspar, and the drill-core is a mottled green white colour. The grain size is of the order 0.1-0.5 mm. A few specks of sulphide, ?pyrite are present in some foliation planes.

Thin Section:
An optical estimate of the constituents gives the following:

<table>
<thead>
<tr>
<th></th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amphibole</td>
<td>55-65</td>
</tr>
<tr>
<td>Quartz</td>
<td>Trace</td>
</tr>
<tr>
<td>Feldspar (plagioclase)</td>
<td>30-35</td>
</tr>
<tr>
<td>Zircon</td>
<td>Trace</td>
</tr>
<tr>
<td>Apatite</td>
<td>Trace</td>
</tr>
<tr>
<td>Sphene</td>
<td>Trace</td>
</tr>
<tr>
<td>Chlorite</td>
<td>Trace</td>
</tr>
<tr>
<td>Sericite</td>
<td>Trace</td>
</tr>
<tr>
<td>Opaques (including pyrite)</td>
<td>Trace</td>
</tr>
</tbody>
</table>

The rock has a foliated texture and is composed principally of amphibole, feldspar and quartz. The amphibole is a green-brown pleochroic variety, fairly typical of regionally metamorphosed basic rocks of medium or higher grade. It occurs as aligned prismatic crystals up to 2 mm long. Many of the crystals are slightly poikiloblastic, containing inclusions of quartz, with rare apatite and ?feldspar, close to their cores.

Feldspar is the dominant felsic mineral. The feldspar (andesine) is largely untwinned and occurs as equant xenoblastic grains, which are typically in the size range 0.2-0.4 mm. Minor alteration to sericite and chlorite is widespread.

The quartz occurs as equant, subidioblastic and xenoblastic grains which are of similar size to those of feldspar.

Scattered through the rock there are granules of sphene. These granules are typically less than 0.05 mm across.

Trace amounts of apatite, biotite and zircon are present in the rock.

Opaques occur as discrete grains which are typically about 0.1 mm across, and also as 'smears', less than 0.05 mm wide, along a few foliation planes and infilling cracks. Pyrite appears to be the dominant opaque mineral.

This is a moderately high grade metamorphosed basic rock belonging to the amphibolite series.
SPECIFIC GRAVITY OF ROCK SAMPLES

1. INTRODUCTION

Two requests from Geopiko Ltd for specific gravity determination are covered in this report.

Order G1397 requested determinations on three samples according to code MO4.1.1 (i.e. by simple water immersion). This is covered by Amede Job No. MP3687/73.

Order G1402 requested determination on four samples, two by code MO4.1.1 (as above) and two by code MO4.1.2 (i.e. after wax coating, intended for porous samples). This is covered by Amede Job No. MP3688/73.

2. PROCEDURE

All samples were dried at 110°C in an oven and cooled in a desiccator.

The samples were then weighed in air and water, suspended on fine nylon thread, and the specific gravities were calculated.

The two samples requiring wax coating were weighed before and after application of the wax and the loss of weight in water was also determined. The specific gravities were calculated, making corrections for the added wax layer.

3. RESULTS

<table>
<thead>
<tr>
<th>Job</th>
<th>Sample</th>
<th>Method</th>
<th>SG</th>
</tr>
</thead>
<tbody>
<tr>
<td>MP3687/73</td>
<td>GG4060)</td>
<td>Uncoated</td>
<td>2.72</td>
</tr>
<tr>
<td></td>
<td>GG4061)</td>
<td>+</td>
<td>2.91</td>
</tr>
<tr>
<td></td>
<td>GG4062)</td>
<td></td>
<td>3.06</td>
</tr>
<tr>
<td>MP3688/73</td>
<td>GG4094)</td>
<td>Coated</td>
<td>1.76</td>
</tr>
<tr>
<td></td>
<td>GG4095)</td>
<td></td>
<td>1.69</td>
</tr>
<tr>
<td></td>
<td>GG4096)</td>
<td>Uncoated</td>
<td>3.08</td>
</tr>
<tr>
<td></td>
<td>GG4097)</td>
<td></td>
<td>2.64</td>
</tr>
</tbody>
</table>
This is a moderately high grade metamorphosed basic rock belonging to the amphibolite-facies.

Sample: GC 1909: TS 3024:

Rock Name:
Acid gneiss

Hand Specimen:
A gneissic rock composed largely of quartz, feldspar and mica. Small 'eyes' of feldspar up to 5 mm across occur. Staining with sodium cobaltinitrite revealed the presence of small quantities of potash feldspar.

Thin section:
An optical estimate of the constituents gives the following:

<table>
<thead>
<tr>
<th>Constituent</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quartz</td>
<td>40</td>
</tr>
<tr>
<td>Plagioclase</td>
<td>40-50</td>
</tr>
<tr>
<td>Feldspar</td>
<td>5-10</td>
</tr>
<tr>
<td>Biotite/chlorite</td>
<td>1-2</td>
</tr>
<tr>
<td>Muscovite</td>
<td>5-8</td>
</tr>
<tr>
<td>Zircon</td>
<td>Trace</td>
</tr>
<tr>
<td>Apatite</td>
<td>Trace</td>
</tr>
<tr>
<td>Opaques</td>
<td>Trace</td>
</tr>
</tbody>
</table>

The rock is largely composed of quartz, feldspar and mica. Grain size is very variable with quartz and feldspar ranging from over 5 mm down to 0.04 mm. Mica grains are commonly in the range 0.1-1.0 mm. The texture is complexly gneissic and is largely the product of metamorphic recrystallization. Several stages of metamorphism are indicated.

Two varieties of plagioclase are present. One is oligoclase, the other albite. Of these, albite is by far the most abundant and in many places has replaced pre-existing feldspar. Plagioclase occurs as large grains up to 6 mm in length, elongate but with markedly irregular outlines and containing abundant sericite/muscovite inclusions. The pattern of inclusions in some grains suggests a primary schistosity in the rock, now largely obliterated. Many of these grains show well displayed deformed twinning, curved twin planes being very marked in some grains. Other grains are superficially similar but contain not only inclusions of mica, but also of quartz and other plagioclase. Smaller, more equant grains (0.05-0.3 mm) have recrystallized following cataclasis. Weathering and other alteration is not marked.

Potassium feldspar occurs in untwinned grains of irregular shape up to 3 mm long. Some grains contain abundant white mica inclusions. Potassic feldspar has also been affected by the late stage cataclasis with the development of small, sub-equant grains.

The greater part of the quartz occurs as sub-equant grains due to late stage recrystallization; however, large irregular grains carrying inclusions of mica and chlorite do remain from the earlier development of the rock.
Biotite occurs in three forms: (a) as small, randomly oriented inclusions in quartz and feldspar, (b) as small (to 0.1 mm) aligned grains in the larger feldspar grains (the alignment of these grains is quite different, but variable in direction, from the main foliation), (c) as larger grains up to 1 mm long in aggregates which define the main foliation of the rock. The aggregates wrap around the larger feldspar grains.

Biotite shows less tendency to alignment. Much of it occurs in small clusters which show pleochroic haloes across grain boundaries. Elsewhere it occurs as discrete grains. The aggregates measure up to 3 mm in length, single crystals, 0.08-0.1 mm. Part of the biotite is chloritized and there are small patches composed wholly of chlorite which may have been derived from biotite.

Apatite, epidote and zircon are present in accessory amounts.

This rock has the composition of a granodiorite and is of low-moderate metamorphic grade, as indicated by coexisting muscovite and K-feldspars. There is no clear indication in the specimen as to whether it was once an igneous or a sedimentary rock. An early foliation S2, is shown by the trains of mica and other inclusions in the early formed feldspars. The metamorphic event was followed by a later event which has produced the now dominant foliation S2. The initial stage of development appears to have been dynamic metamorphism with cataclasis and recrystallization or annealing of the crushed minerals. The time relationships of the albitionization are not clear; it may have occurred either before during the latest dynamic stage or recrystallization. This last process does not appear to have imposed the major foliation on the rock.
CR 73/108
CONTINUATION ON MICROFICHE NO. 2
PLATE 1 to 5
CR 73/108
CONTINUATION ON MICROFICHE NO.3
PLATE 6 to 9