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DIAMOND DRILLING AT JOHNNIE'S REWARD

GOLD AND BASE METAL PROSPECT, EL3026

STRANGWAYS RANGE, CENTRAL AUSTRALIA

AUGUST, 1983

ALCOA OF AUSTRALIA LIMITED
Exploration Department

11 MAY 1985

R G Chuck
March 1984
SUMMARY

Johnnie's Reward gold and base metals prospect is located within Alcoa's EL 3026 in the Precambrian Arunta Complex 75km north-east of Alice Springs. Three diamond drill holes were drilled in August 1983 to test at depth anomalous gold, silver and base metal values recorded from surface sampling during an earlier phase of the exploration programme.

Gold and base metal mineralisation occurs below the surface, and includes the following intersections:

<table>
<thead>
<tr>
<th>Depth</th>
<th>Average Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>5m</td>
<td>3.34 g/t Au</td>
</tr>
<tr>
<td>6m</td>
<td>2.53 g/t Au</td>
</tr>
<tr>
<td>50m</td>
<td>0.91 g/t Au</td>
</tr>
</tbody>
</table>

Base metal values are variable, but do not approach ore grades. Data are insufficient to delineate even low grade bodies of gold and base metal mineralisation at this stage, but extensions of known mineralisation probably occur down-dip and/or down-plunge.

The host sequence consists of quartz-biotite-garnet gneisses which are intruded by mafic sills. One sill, which probably replaces an original carbonate horizon, is pyroxene and magnetite rich, and partly alters the gneisses to quartz-feldspar pegmatoids. The others are similar, but are plagioclase-rich and pyroxene-poor, and cause very little alteration. Mineralisation appears to be associated only with the magnetite-pyroxenite sill and the gneisses immediately below it. The entire sequence has been regionally metamorphosed to amphibolite grade.

There are two styles of mineralisation. Gold-silver-copper-lead-zinc mineralisation of variable grade and association is hosted by parts of the magnetite-pyroxenite sill rocks. This is accompanied by pyrite, chalcopyrite and magnetite, but no other metalliferous minerals are visible. The second type of mineralisation occurs in the footwall gneisses, and consists of gold and copper only. The best gold intersections, including those stated above, are of this type, and it is believed that there is potential for large tonnages of this mineralisation.

Further drilling plus along-strike surface investigations are recommended for the Johnnie's Reward Prospect.

Six kilometres south of Johnnie's Reward, at a similar stratigraphic level, quartz veining in epidote gneisses and calc-silicate marbles reportedly produced significant gold values from a drill hole some years ago. This area is known as the Mark Hill Prospect, and although surface sampling during this programme failed to detect anomalous gold in the quartz veins, further testing by drilling is recommended.

DESCRIPTORS: NT, SF 53 14, JOHNNIE'S REWARD, DIAMOND DRILLING, EL 3026, PRECIOUS METALS, BASE METALS, ARUNTA.
RECOMMENDATIONS

1. EL 3026 be retained until the expiry of the second twelve-month term and renewed for a third term with the required 50% area reduction as shown on Figure 1.1.

2. The following unsampled portions of drill core should be sampled and assayed for Au, Ag, Cu, Pb and Zn:

   E058-001 : 37–64m
   E058-001 : 98–131m

(see Note below)

3. Field inspection and surface rock sampling of the northern strike extension of the Johnnie's Reward pyroxenite sill and immediate footwall should be undertaken, as well as reconnaissance traversing and sampling of footwall gneisses and mafic "marker" sills elsewhere in the area to the north and north-west of Johnnie's Reward.

4. Previous aeromagnetic maps (BMR) should be examined to determine their suitability for delineating and tracing the pyroxenite sill at Johnnie's Reward. Depending on the results of this work, additional airborne magnetic surveying may be warranted.

5. Two diamond drill holes, totalling approximately 350m, should be drilled at Johnnie's Reward. The first (±220m) should be collared north-east of E058-002 and drilled to obtain a deeper intersection of the mafic sill and mineralised footwall gneisses obtained in that hole. The north-easterly plunge of mineralisation shown on Figure 2.3 should be considered in planning this drill hole. A second hole should be sited to the north of E058-002, to test the mafic sill and footwall gneisses on the northern side of the fault shown on Figure 2.3.

6. One core or reverse-circulation drill hole should be drilled to approximately 200m to test the Mark Hill Prospect in the area of the cross-section shown on Figure 4.1.

Note: Sampling and assaying of these sections of E058-001 drill core was completed during November 1983. Assays appear in E058-001 drill log, Appendix 1.
1. INTRODUCTION

This report documents a programme of diamond drilling undertaken at the Johnnie's Reward Prospect in the Southern Cross Bore area of EL 3026, Strangways Range, NT. This programme follows regional and detailed geological mapping carried out for Alcoa by the author in May 1983, the results of which are recorded in the first Annual Report for EL 3026 (Chuck, 1983). The objective of this drilling programme was to test in the subsurface anomalous gold, silver and base metal values located in and around a gossan at Johnnie's Reward.

1.1 Location

EL 3026 covers 488.25km² of the Arunta Complex approximately 75km north-east of Alice Springs. The boundaries of the Exploration Licence are shown on Figure 1.1.

1.2 Logistics of Fieldwork

The drilling programme was carried out during the second half of August 1983 by Rockdrill Drilling Contractors using a Longyear 44 demountable diamond drilling rig. Three holes were drilled at Johnnie's Reward (total depth 370.90m), a Mineral Claim pegged to cover the prospect (see location on Figures 1.2 and 1.3), and a geological and geochemical traverse made over the Mark Hill Prospect, 6.5km to the south of Johnnie's Reward (Figure 1.3). Full logistics appear below:

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of holes drilled</td>
<td>3</td>
</tr>
<tr>
<td>Rotary drilling</td>
<td>8.65</td>
</tr>
<tr>
<td>HQ coring</td>
<td>39.05</td>
</tr>
<tr>
<td>NQ coring</td>
<td>323.20</td>
</tr>
<tr>
<td>Total metres drilled</td>
<td>370.90</td>
</tr>
<tr>
<td>Number of 1.0m samples collected</td>
<td>201</td>
</tr>
<tr>
<td>Number of samples assayed</td>
<td>201</td>
</tr>
<tr>
<td>Number of petrological samples taken</td>
<td>12</td>
</tr>
<tr>
<td>Number of surface samples taken (Mark Hill)</td>
<td>11</td>
</tr>
<tr>
<td>Number of surface samples assayed (Mark Hill)</td>
<td>11</td>
</tr>
</tbody>
</table>

Additional details of location, drilling and surveys for each drill hole are contained in Hole Completion Reports in Appendix 1.
2. GEOLOGY

2.1 Geological Setting of Johnnie's Reward Prospect

Johnnie's Reward Prospect is located in an amphibolite-grade metasedimentary sequence named by Shaw et al (1979) as the Cadney Metamorphics. These in turn belong to the younger of two groups of metamorphic rocks comprising the Strangways Metamorphic Complex. Both groups suffered regional metamorphism at around 1.8 Ga.

The Cadney Metamorphics contain predominantly carbonate and calc-silicate rocks, but in the vicinity of Johnnie's Reward there is a very thick sequence of felsic and siliceous gneisses. The prospect is located in a stratabound pyroxenite zone near the top of this gneissic sequence.

A more detailed account of the regional and local geology, including 1:20 000, 1:5000 and 1:500 geological maps can be found in the first Annual Report for EL 3026 (Chuck, 1983).

2.2 Host Sequence

The vertical sequence at Johnnie's Reward, established using data from this drilling programme, is shown on Figure 2.1. In essence it consists of a host gneiss sequence containing two stratabound pyroxene-rich horizons interpreted to be mafic sills. The lower of these contains remnant carbonate-rich zones suggesting replacement of a pre-existing carbonate horizon. It is rich in magnetite and sulphides, and is surrounded by zones of feldspathic pegmatoid and altered gneiss. The upper horizon lacks magnetite and sulphide, and is associated with far less alteration. Drill sections for each hole are shown on Figure 2.2 (see Appendix 3).

Footwall gneiss:

| Petrological description | Appendix 2: E058002/124.73/0.10
| Photomicrographs          | Appendix 2: Figure 3 a and b
| Mineralogy                | Quartz 75%, garnet 20%, biotite 5%, plus minor sillimanite, kyanite, chloropyrite, pyrite and magnetite.

Pink to red garnets up to 2-5mm in diameter, plus smaller clusters of biotite, are set in a matrix of quartz grains 2-3mm in diameter. A weak foliation is sometimes present. In thin section this foliation is reflected by a weak preferred orientation of biotite clusters which sometimes incorporate aligned kyanite and sillimanite crystals. Quartz grains show strain. In E058-001 the upper 10m of the footwall gneiss contains up to about 4% disseminated pyrite and chloropyrite parallelling the foliation (grades 0.2% Cu).

Footwall alteration zone:

| Petrological description | Appendix 2: E058-001/83.40/0.08
|Photomicrographs          | E058-002/97.72/0.18
| Mineralogy               | Appendix 2: Figure 2 a and b
| Variable; feldspathic pegmatoid to chloritised version of footwall gneiss.

This zone of altered footwall gneiss is present in all three drill sections separating the unaltered footwall gneisses and the magnetite-pyroxene zone.
HANGINGWALL GNEISS (>35m): quartz-garnet-biotite-(sillimanite-kyanite) gneiss; semi-pelitic sediment metamorphosed to amphibolite grade.

MAFIC 'MARKER' (12-18m): labradorite-pyroxene-magnetite-hornblende rock, metamorphosed to granulite grade.

HANGINGWALL ALTERATION ZONE (2-35m): pegmatoid containing deformed microcline with quartz, mica and sericite.

MAGNETITE-PYROXENITE (8-43m): predominantly diopside, with magnetite, sulphides and carbonate veins; tremolite in part, especially near and at surface.

FOOTWALL ALTERATION ZONE (2-7m): microcline-mica pegmatoid; chloritised quartz-garnet-biotite gneiss.

FOOTWALL GNEISS (>45m): quartz-garnet-biotite-(sillimanite-kyanite) gneiss; semi-pelitic sediment metamorphosed to amphibolite grade; upper 10m sulphide-bearing in E058-001.

Vertical sequence, Johnnie's Reward Prospect
The nature of this zone varies from a feldspatic pegmatoid, containing coarse microcline-perthite and quartz-sericite-biotite-plagioclase assemblages in finer grained 'shear zones' between crystals, to chloritised, silicified or feldspathised versions of footwall gneiss. Magnetite may also be present. Garnets in these lithologies are heavily chloritised, and both types show evidence of strong deformation both within and between (quartz/feldspar) crystals.

**Magnetite pyroxenite:**

- **petrological descriptions**
  
  Appendix 2 : E058-002/87.15/0.10  
  E058-003/39.57/0.10  
  E058-003/52.35/0.10

- **photomicrographs**
  
  Appendix 2 : Figure 5 a and b,  
  6 a and b

- **mineralogy**
  
  generally diopside rich (>80%) with magnetite (up to 30%), quartz and sometimes pyrite and chalcopyrite; tremolite replaces diopside in some zones and at surface.

Pale to olive green diopside occurs as intergrown subrounded to subhedral grains up to several millimetres diameter, with interstitial to coarsely grouped magnetite and pyrite. Carbonate stringers are abundant in some sections, and alter nearby diopside to actinolite. Tremolite, which occurs at and near surface, and presumably represents altered diopside, is pale brown and can be extremely coarsely crystalline. Variably siliceous. Forsterite-bearing carbonate sections occur in E058-002, accompanied by magnetite, phlogopite, spinel and diopside, and probably represent remnants of original carbonate metasediments.

**Hangingwall alteration zone:**

- **petrological description**
  
  Appendix 2 : E058-003/27.27/0.10

- **photomicrograph**
  
  Appendix 2 : Figure 4 a and b

- **mineralogy**
  
  varies from feldspatic and siliceous gneiss to microcline-perthite pegmatoid.

This alteration zone is similar to the footwall one and varies from unaltered quartz-garnet-biotite gneiss, through feldspatic and siliceous gneiss, to highly feldspatic pegmatoid no longer recognisable as gneiss. The mineralogy of the pegmatoid is the same as for the footwall alteration: pink microcline-perthite segregations often surrounded by foliated biotite and sericite (ex-sillimanite) suggestive of greisen.

**Mafic 'marker':**

- **petrological description**
  
  Appendix 2 : E058-001/31.35/0.07  
  E058-002/37.34/0.08

- **photomicrograph**
  
  Appendix 2 : Figure 1 a and b

- **mineralogy**
  
  plagioclase (labradorite to andesine) 60%, diopside 20%, hypersthene 10%, magnetite 5%, hornblende (retrogressed pyroxene) 5-10%.
This rock is generally a dark, heavy, fine-grained one which forms a good marker both in drill core and at surface, where it weathers to a brown but extremely hard outcrop or subcrop. Plagioclase crystals show strain in thin section, and chlorite veinlets show alteration of adjacent rock to actinolite, carbonate and epidote. Apart from the feldspar content, the mineralogy of this marker (and similar ones elsewhere in the gneiss sequence) resembles that of the magnetite pyroxenite, and along strike from Johnnie's Reward that unit also becomes plagioclase-rich. In E058-002 the mafic 'marker' appears to have produced a 2-3m thick alteration zone in the underlying hangingwall gneisses (petrological sample E058-002/45.4/0.10, Appendix 2). In this zone garnets of the gneiss have been almost completely altered to chlorite, and sillimanite and kyanite to muscovite.

**Hangingwall gneiss:**

<table>
<thead>
<tr>
<th>Petrological Description</th>
<th>Appendix 2: E058-003/25.30/0.10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mineralogy</td>
<td>Quartz 70%, garnet 15%, biotite 5%, sillimanite 5%, kyanite 5%, accessory zircon.</td>
</tr>
</tbody>
</table>

These gneisses are very similar in all respects to the footwall gneisses. They generally exhibit a weak foliation as an alignment of biotite and internal strain within quartz grains. Garnets are sometimes partially altered to biotite and chlorite.

### 2.3 Structure

The host sequence at Johnnie's Reward Prospect dips to the east, but east-west faulting has formed two separate blocks in the immediate area of the gossan. These are outlined on Figure 2.3 (Appendix 3).

The southerly block, in which drill holes E058-001 and E058-003 are situated, dips at angles of between 50 and 60° to 110° true. E058-002 intersected the northern block some 30° off the true dip direction, and apparent dips, as calculated from surface to drill-hole correlations, are around 43° east. True dip in this block is probably about 47° towards 100° true. Partly interpretive structure contours for the top surface of the pyroxenite-magnetite zone in each block are plotted on Figure 2.3 (Appendix 3).

The orientation of lineations and fold axes in the gossan area, which consistently dip at about 35° to the north-east, may suggest that mineralisation, if introduced or remobilised during deformation, plunges in that direction. It is difficult however to demonstrate such a plunge with the intersections obtained by this drilling programme. A north-easterly plunge is indicated by the deeper intersection of E058-002 in respect to E058-001, but these two holes are separated by a fault which almost certainly lowered the northern (E058-002) block, and thus may be totally responsible for the apparent plunge.

In the southern block, the surface trace of mineralisation in the E058-001 and E058-002 intersections (see Figure 2.3) appears to represent a southerly plunge. However, it is considered more likely that these two mineralised zones cannot be correlated, and that the E058-003 intersection represents the down-plunge extension of the Johnnie's Reward Gossan which E058-001 failed to intersect because it was drilled below this plunging mineralisation.

The strike of the mineralisation plunge in the northern block cannot be accurately determined with current information. Its trace on Figure 2.3 has been estimated using the E058-002 intersection, projected back to the Johnnie's Reward Gossan. The effect of the fault immediately to the north of the gossan is unknown.
3. **MINERALISATION**

All three drill holes in this programme intersected zones of rock both within and below the magnetite-pyroxenite horizon which contain anomalous concentrations of gold, silver and base metals. The most significant of these intersections are listed in Table 3.1, and complete geochemical results for all core samples analysed appear on drill logs in Appendix 1.

3.1 **Lithological and Mineralogical Associations**

The most consistently mineralised lithologies at Johnnie's Reward are the tremolite-diopside-magnetite assemblages of the magnetite pyroxenite horizon. This association is well illustrated on Figure 3.1, but applies more strictly to silver and the base metals than to gold, which, although anomalous in the pyroxenite, attains some of its highest concentrations in altered and unaltered gneiss in a zone at least 20m thick directly below the pyroxenite in E058-002. Lithologies stratigraphically above the magnetite pyroxenite including those of the altered and unaltered hangingwall gneiss, and the mafic 'marker,' are unmineralised where sampled.

Footwall gold mineralisation is virtually absent in the southernmost sections (E058-001 and E058-003), although not all core from this zone was sampled in those holes.

Mineralogical associations of the mineralisation are poorly understood, mainly because very few metal-bearing mineral species are visible in the core even under binocular microscope. Exceptions are magnetite and pyrite, which are ubiquitous within the pyroxenite, and are often accompanied by variably coarse-grained chalcopyrite. Disseminated pyrite and chalcopyrite are also common in parts of the footwall gneiss, especially the upper 10m intersected in E058-001. This zone however returned only slightly anomalous copper, gold and silver values (maximum 0.06 ppm Au, 0.3 ppm Ag, 0.20% Cu), whereas equivalent footwall gneisses in E058-002, which contained much less visible sulphide, hosted some of the best gold intersections (eg 5m @ 3.34 ppm Au). It would appear unlikely therefore that gold occurs in or associated with visible pyrite. The lack of correlation between gold and copper, and gold and specific gravity (see 3.2) would further suggest that gold is not associated either with chalcopyrite or magnetite.

3.2 **Metal Associations**

The geochemical plot for hole E058-002 (Figure 3.1) shows a weak positive correlation between the base metals and specific gravity, but silver, and more particularly gold, exhibit a more independent distribution. Pearson correlation coefficients were calculated in an effort to find geochemical associations between gold and the other metals and specific gravity. These are listed in Table 3.2, and suggest that there are no significant positive or negative correlations.
<table>
<thead>
<tr>
<th>Hole No.</th>
<th>Interval</th>
<th>Drilled width</th>
<th>Averaged metal values</th>
<th>Host lithologies</th>
</tr>
</thead>
<tbody>
<tr>
<td>E058-001</td>
<td>73 - 78m</td>
<td>5m</td>
<td>0.04ppm Au</td>
<td>magnetite pyroxenite</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2.06ppm Ag</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.27% Cu</td>
<td></td>
</tr>
<tr>
<td></td>
<td>93 - 96m</td>
<td>3m</td>
<td>0.23ppm Ag</td>
<td>footwall gneiss</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.13% Cu</td>
<td></td>
</tr>
<tr>
<td>E058-002</td>
<td>73 - 94m</td>
<td>21m</td>
<td>0.14ppm Au</td>
<td>magnetite pyroxenite</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>5.11ppm Ag</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.31% Cu</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.40% Pb</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.28% Zn</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.99% Cu+Pb+Zn)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>75 - 125m</td>
<td>50m</td>
<td>0.91ppm Au</td>
<td>magnetite pyroxenite and footwall gneiss</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1.28ppm Ag</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.12% Pb</td>
<td></td>
</tr>
<tr>
<td></td>
<td>98 - 103m</td>
<td>5m</td>
<td>3.34ppm Au</td>
<td>altered and unaltered footwall gneiss</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>1.28ppm Ag</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.12% Pb</td>
<td></td>
</tr>
<tr>
<td></td>
<td>109 - 115m</td>
<td>6m</td>
<td>2.53ppm Au</td>
<td>unaltered footwall gneiss</td>
</tr>
<tr>
<td>E058-003</td>
<td>29 - 54m</td>
<td>25m</td>
<td>0.12ppm Au</td>
<td>magnetite-diopside-tremolite rock</td>
</tr>
<tr>
<td></td>
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<td></td>
<td>4.20ppm Ag</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.47% Cu</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.26% Pb</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.20% Zn</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.93% Cu+Pb+Zn)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>35 - 43m</td>
<td>8m</td>
<td>0.12ppm Au</td>
<td>tremolite-diopside-magnetite</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>6.24ppm Ag</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.73% Cu</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.32% Pb</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.41% Zn</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(1.46% Cu+Pb+Zn)</td>
<td></td>
</tr>
</tbody>
</table>

**Table 3.1 : Significant intersections, Johnnie's Reward Prospect**
<table>
<thead>
<tr>
<th>Element pair</th>
<th>Correlation coefficient</th>
<th>Number of samples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Au and Ag</td>
<td>+ 0.08</td>
<td>101</td>
</tr>
<tr>
<td>Au and Cu</td>
<td>+ 0.31</td>
<td>42</td>
</tr>
<tr>
<td>Au and Pb</td>
<td>- 0.27</td>
<td>42</td>
</tr>
<tr>
<td>Au and Zn</td>
<td>+ 0.08</td>
<td>42</td>
</tr>
<tr>
<td>Au and S.G.</td>
<td>- 0.10</td>
<td>52</td>
</tr>
</tbody>
</table>

Table 3.2 : Pearson correlation coefficients

Twelve samples, representing both mineralised and unmineralised lithologies, were re-analysed for a range of additional metals. Results are listed in Table 3.3.
Specific gravity (g/cm³) vs. depth (m):
- Average: 2.66
- Average: 3.80
- Average: 3.07

Zinc concentration (2.30% Zn):
- Copper:
- Lead:

Metal concentrations (ppm):
- Gold (Au): 14.6 ppm
- Silver (Ag): 6.7 ppm

Lithology:
- Quartz-felspar invaded gneiss
- Magnetite-tramolite-diolite-sulphide rock
- Biotite-magnetite-quartz assemblage
- Quartz-garnet-biotite gneiss (footwall gneiss)
- Magnetite-pyrozoenite
- Footwall alteration zone

Stratigraphic horizon:
- Hangingwall alteration zone

Geochemical profiles E058-002

Fig 3.1
<table>
<thead>
<tr>
<th>Sample number</th>
<th>Au</th>
<th>Ag</th>
<th>Cu</th>
<th>Pb</th>
<th>Zn</th>
<th>Ni</th>
<th>Cr</th>
<th>Sn</th>
<th>W</th>
<th>Co</th>
<th>Mo</th>
<th>Pt</th>
<th>Stratigraphic horizon</th>
</tr>
</thead>
<tbody>
<tr>
<td>E058-002/ 76/1.0</td>
<td>0.03</td>
<td>2.2</td>
<td>2000</td>
<td>500</td>
<td>300</td>
<td>4</td>
<td>45</td>
<td>&lt;10</td>
<td>&lt;2</td>
<td>42</td>
<td>24</td>
<td>&lt;0.01</td>
<td>magnetite pyroxenite</td>
</tr>
<tr>
<td>E058-002/ 86/1.0</td>
<td>0.23</td>
<td>10.6</td>
<td>2150</td>
<td>3900</td>
<td>2.3%</td>
<td>3</td>
<td>18</td>
<td>&lt;10</td>
<td>2</td>
<td>96</td>
<td>16</td>
<td>&lt;0.01</td>
<td>magnetite-pyroxenite</td>
</tr>
<tr>
<td>E058-002/ 96/1.0</td>
<td>1.40</td>
<td>2.1</td>
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<td>5100</td>
<td>6500</td>
<td>1.1%</td>
<td>&lt;1</td>
<td>70</td>
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Table 3.3: Results of additional metal analyses (all values in ppm unless indicated)
4. MARK HILL PROSPECT

The Mark Hill Prospect is located 6.5km south of Johnnie's Reward Prospect in EL 3026. It was shown to Alcoa geologists by J Vitosky in August 1983. Vitosky drilled one percussion hole into the prospect some years ago and reported economically significant intersections of gold mineralisation. A geological/geochemical traverse was completed over a section of the prospect during this programme with the objectives of confirming the presence of gold mineralisation and estimating potential ore tonnages.

The Mark Hill area occurs within a succession of steeply east-dipping siliceous and calc-silicate metasediments which pass into meta-quartzites to the north, probably terminating just south of Johnnie's Reward at an inferred fault near Southern Cross Bore (see Chuck, 1983, Plates 1, 2 and 4). It is possible that these rocks lie at a similar stratigraphic level to the host gneisses at Johnnie's Reward.

The prospect consists of a number of bold quartz veins intruding a sequence of well-banded epidote-quartz gneisses and minor marble horizons. These veins are regionally strata-bound, but locally cut across bedding of the host metasedimentary sequence. They form a zone up to 150m thick and about 200-300m in length, thinning rapidly towards each end. The most prominent of these veins are up to 10-12m thick, but between them are numerous thinner veins and stringers which together represent a zone of intense silicification in comparison to the 'normal' marble and calc-silicate sequence. At Mark Hill this silicification is expressed as quite steep positive topography.

The measured profile (Figure 4.1) passes through the thickest part of the silicified zone which occurs towards its northern end. North of this section quartz veins appear to thin rapidly and change strike direction from north (parallel to the sequence) to north-east. The profile shows a zone of quartz veining some 150m thick dipping at about 70° to the east. There are three major quartz veins, but nearly all the country rock between these veins is heavily intruded by thinner veins and stringers, with perhaps 30-40% of the entire zone being intrusive quartz. Eleven rock-chip samples from both massive veins and intervening veined gneiss were collected and analysed for gold, silver, copper, lead and zinc.

Geochemical results (Figure 4.1) failed to locate the gold mineralisation reported by Vitosky, and no samples contained gold values above detection limit. Silver and base metal values are also low, except for sample 105024, which contained 6.4ppm Ag, 98ppm Cu, and 300ppm Pb. This sample represents a semi-continuous rock-chip over the uppermost thick quartz vein, which is approximately 12-13m thick. These values fall within the range of silver and lead values found in mineralised rocks at Johnnie's Reward.

Approximate potential tonnage at Mark Hill, assuming bulk mining of the silicified zone to 200m below surface, is around 15 million tonnes. If gold mineralisation is present, but for some reason has escaped detection by this sampling traverse, grades in the quartz veins would need to be at least 10g/t to allow bulk mining the entire zone at around 3gm/t. Vitosky reported grades of up to 17 dwts (approximately 29g/t).

Further appraisal of this prospect is contained in Section 5 of this report.
GEOCHEMICAL ANALYSES (ppm)

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<th>Pb</th>
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**KEY**
- Scree.
- Epidote-quartz gneiss, well banded.
- Quartz reef, often containing specular hematite.
- Gneiss with abundant strata-bound quartz reef.
- Silicified and quartz-veined fine-grained epidote-bearing gneiss.

**TRAVERSE AZIMUTH 075° TRUE**

**Plan Nº E58-83-11**

**Fig 4.1**
REFERENCES


"Geological report on 1:100 000-scale mapping of the south-eastern Arunta Block, Northern Territory." BMR Record 1979/47.
APPENDIX 1

DRILL LOGS AND GEOCHEMICAL ANALYSES
DESCRIPTIVE GEOLOGIC LOG

HOLE NUMBER

SOUTHERN CROSS BORE, NT
EL 3026
419700 EAST 7440418 NORTH A.M.G. ZONE 53
05/01/03
12/08/03
131.00
35
35
2
ALICE SPRINGS BRANCH MINES DEPARTMENT CORE STORE
R G CHUCK

SOUTHERN CROSS BORE
ROCKDRIL
LONGYEAR 44
3.0
150
N
0

0.00 TO 3.10 M ROTARY (AIR), 150MM DIAMETER
3.10 TO 131.00 M CORED, NO MM DIAMETER
0.0/50 /270, 130/56 /

TO TEST AT DEPTH GOSAUSOS ZONE OF JOHNNIE'S REWARD PROSPECT.

0-64.65M : QUARTZ-BIOTITE-CHLORITE-GARNET GNEISS;
64.65-86.42M : PEGMATOID AND TROMOLITE-MAGNETITE
ROCK; 86.42-97.00M : QUARTZ-BIOTITE-GARNET GNEISS
PLUS SULPHIDE; 97.00-131.00M : QUARTZ-BIOTITE-
GARNET GNEISS;
MINOR PYRITE AND CHALCOPYRITE ASSOCIATED WITH
MAGNETITE-RICH ZONES OF TROMOLITIC ROCK AND IN TOP
12M OF FOOTWALL GNEISSES.

THIS HOLE PROBABLY DRILLED BELOW MAIN NORTH-EAST-PLUNGING
 MINERALISED ZONE.
OVERALL CORE RECOVERY 98.23%.
OVERBURDEN, DRILLED WITH ROTARY.

QUARTZ-BIOTITE GARNET GNEISS

AREAS CONTAIN COARSELY CRYSTALLINE OFTEN PINK-STAINED FELDSPAR, AND MINOR CHLORITE AND CALCITE- RICH ZONES WHERE QTZ-FELDSPAR GARNET ARE LESS ABUNDANT, AND GARNET ARE CUT BY TINY CHLORITE VEINLETS. A MOD TO WEAK FOLIATION IS COMMONLY PRESENT OFTEN AT HIGH CPA.

MINOR MAGNETITE, ESPECIALLY IN CARBONATE ZONES.

BIOTITE-RICH (QUARTZ-POOR) SECTIONS COKE POORLY AND APPEAR TO BE PARTLY SERPENTINI SED. TRACE PYRITE AND CHALCOPYRITE.

QUARTZ-BIOTITE CHLORITE GNEISS.

QUARTZ 40-50%, CHLORITE 30-40%, GARNET MINOR (~1%).

TEXTURE MEDIUM TO COARSELY CRYSTALLINE, UNFOLIATED.

QUARTZ VEIN

Euhedral crystals on base.

26.50.10-37.00.MEIBES

'AFIC MARKER'

PLAGIOCLASE 60%, DIOPSIDE 20%, HYPERSTENNE 10%, MAGNETITE 5%.

HORNBLende 5%, FINE GRAINED WITH A WEAK FOLIATION DEFINED BY DARK PLATEY DIOPSIDE, CPA = 40-50 DEGREES.

PETROLOGICAL SAMPLE, TYPICAL 'AFIC MARKER' ROCK.

QUARTZ-GARNET-BIOTITE GNEISS

COARSE SEGREGATIONS OF FELDSPAR THROUGHOUT.

QUARTZ (70%), GARNET (15%), B IOTITE (15%) ASSEMBLAGE, FINE GRAINED, UNFOLIATED TO WEAKLY FOLIATED BY HANDS OF LIGHT BROWN BIOTITE, SOMETIMES CHLORITE.

LESS GARNETIFEROUS, MORE QUARTZOSE.

QUARTZOSE AND FELDSPAR QUARTZ-BIOTITE-FELDSPAR ASSEMBLAGE - TEXTURE VARIES FROM COARSELY GRANULAR (PORPHYROPLASTS OF
QUARTZ AND PINK FELDSPAR WITH ONLY MINOR BIOTITE) TO MORE SCHISTOSE BIOTITE-QUARTZ SECTIONS. FELDSPAR PORPHYROBLASTS ARE 0.5-1CM DIAMETER AND INTERGUARD WITH QUARTZ, MAGNETITE AND GARNET ABSENT FROM BOTH TEXTURAL TYPES, EXCEPT IN BASAL

CUBE IN THIS LITHOLOGY SOLID AND GENERALLY (3 FRACTURES PER METRE), MINOR PINKISH FELDSPAR IN COARSE SEGREGATIONS IN TOP HALF OF THIS INTERVAL.

QUARTZ-BIOTITE-GARNET GNEISS, GARNETS IN SEGREGATIONS 2-15 MM ACROSS AND CONSTITUTE UP TO 25-30% OF THE ROCK, QUARTZ AND BIOTITE FORM A FINER-GRAINED MATRIX AND OF APPROXIMATELY EQUAL PROPORTIONS, MINOR QUARTZ AND PINK FELDSPAR SEGREGATIONS UP TO SEVERAL CM THROUGHOUT (AS FOR ABOVE UNIT).

QUARTZ-BIOTITE-GARNET GNEISS, SIMILAR TO ABOVE, BUT QUARTZ MORE ABUNDANT THAN BIOTITE, AND GARNET IS LESS ABUNDANT (42%)

QUARTZ-BIOTITE-GARNET GNEISS, SIMILAR TO UNIT ABOVE, BUT CONTAINS UP TO 30-40% GARNET AS LARGE OVOID SEGREGATIONS UP TO 3CM DIAMETER, AND LESS QUARTZ. SOME SECTIONS ARE MORE FOLIATED, WITH LARGE QUARTZ-FELDSPAR PORPHYROBLASTS SET IN FOLIATED BIOTITE; FELDSPAR IS PINK AND FORMS CENTRE OF THESE SURROUNDED BY CLEAR TO MILKY QUARTZ.

ARBOUR COARSE GARNET PORPHYROBLASTS.

PEGMATOID CONTAINS PINK FELDSPAR 50-70%, QUARTZ 30-50%, AND MINOR VARIABLE AMOUNTS OF BIOTITE IN IRREGULAR PATCHES. QUARTZ GENERALLY OCCURS AS IRREGULAR LINKS OR DISCRETE PATCHES WITHIN FELDSPARIC AREAS.

QUARTZ-BIOTITE GNEISS WITH IRREGULAR PEGMATOID PATCHES.

MINOR FELDSPARIC AREAS.

ALTERED AND WEATHERED GNEISS WITH PEGMATOID.

PREDOMINANTLY PEGMATOID.

TREMOLITE-MAGNETITE-QUARTZ ROCK.

TREMOLITE IS FAKE OLIVE-DROWN BLADED CRYSSTALLINE, IDENTIFIED IN THIN SECTION OF SURFACE SAMPLES, AND FORMS THE BULK OF
THE ROCK, MAGNETITE IS DISTRIBUTED THROUGHOUT AS POORLY DEFINED FOLIAE, AND ACCOUNTS FOR AROUND 30% OF THE ROCK. QUARTZ IS RARE (5%) AND OCCURS IN A SIMILAR MANNER TO MAGNETITE - IN POORLY DEFINED LAYERS PARALLEL TO FOLIATION. 0.1M PEGMATOID ON TOP. 0.2M PEGMATOID AT BASE.

PEGMATOID:
ORTHoclase-qtz-biotite assemblage with minor pale green soft (2-3) suayf serpentine-like mineral. Texture consists of unfoliated void to massive patches of pink feldspars set in a qtz matrix which also contains irregular biotite masses. feldspars and qtz comprise about 40% each, and biotite 20%. Predominantly biotite (40-50%) and quartz, poorly foliated (altered country rock).

MAINLY FRACTURED BIOTITE-QUARTZ ROCK.

TREMOlITE-MAGNETITE ROCK
MINOR QUARTZ AND SULPHIDES. SIMILAR TO UNIT ABOVE OVERLAYING PEGMATOID, LESS QUARTZ. MAGNETITE SHOWS A WEAK TO MODERATE FOLIATION WITH A CDA OF ABOUT 50 DEGREES. QUARTZ CONTENT VARIES FROM 40-50% IN SMALL SECTIONS NEAR THE TOP, TO 75% IN REMAINDER. MAGNETITE CONTENT VARIES FROM ABOUT 30 TO 50%, AND SMALL SECTIONS CONTAIN POSSIBLY 75% MAGNETITE. CHALCOPYRITE AND PYRITE FAVOUR THE MAGNETITE-RICH ZONES. CHALCOPYRITE IS DOMINANT, AND OCCURS AS IRREGULAR PATCHES ROUGHLY PARALLEL TO THE BANDING OF THE MAGNETITE.

AS ABOVE, WEAK BANDING PARALLEL TO CORE.

THIS SAMPLE CONTAINS MAGNETITE. SULPHIDE ROCK ZONE: RICHEST SECTIONS CONTAIN 70% MAGNETITE (5% CHALCOPYRITE).

QUARTZ-MAGNETITE ROCK
MAGNETITE OCCURS AS GRAINS (1MM FORMING THIN FOLIAE WITHIN CRYSTALLINE QTZ. MAGNETITE (10%) USUALLY, MINOR BANDS OF F-G CHLORITE W RAfts OF Biotite (CHLORITE IS OBVIOUSLY AFTER Biotite). ONE 1CM SECTION OF PURE QTZ. SCATTERED F-G EUVIFERAL PYRITE AND CHALCOPYRITE IN MAGNETITE-QUARTZ AND CHLORITE ZONES. BOTH (1%).

TOP 60CM IS TREMOlITIC. REMAINDER QUARTZ-MAGNETITE.
SULPHIDES RARE, MAGNETITE (10%).

0.01 0.4 640 15 145
QUARTZ-BIOTITE "Pegmatoid"

This rock contains varying amounts of coarsely crystalline white quartz, some pink, possibly potash feldspar, with irregular and often large biotite segregations, often coarsely crystalline, plus coarse patches of a pale green mineral (hardness 4-5), possibly apatite, basal 40cm biotite-rich and negligible quartz.

Predominantly as above.

0.02 0.4 850 66 165
BLD BLD 33 220 185
BLD BLD 27 150 72

Pegmatoid.

This rock consists of clear to pink double-cleavage feldspar (pink colouration appears to be a staining) with quartz and biotite in irregular patches. Texture is very coarse grained (pegmatoid) and non-foliated. Rare acicular needle crystals of clear, Fe, illite, and biotite matrix. This mineral probably apatite.

Biotite garnet gneiss.

Grain size around 2-3mm, with garnets often 2-5mm in a matrix of quartz which contains smaller biotite clusters. Quartz 60-70%, garnet 20-30%, biotite 10% but considerable variation. Texture usually crystalline to weakly foliated, CDA 30 degrees approximately.

Apatite common in top 45cm as masses up to 4cm across. Trace very fine grains pyrite and chalcopyrite.

0.02 0.2 1100 25 84
BLD BLD 160 18 66
BLD BLD 265 22 82
BLD BLD 220 14 66
BLD BLD 66 12 66

Apatite common, especially in more quartzose zones.

Pyrite-rich (approximately 2-4%) in some sections, particularly in very fine grained 7biotite-rich foliated zones. Minor chalcopyrite.

0.06 0.2 1050 15 88
BLD BLD 350 15 78
BLD BLD 0.2 120 9 70
BLD BLD 850 15 78
BLD BLD 0.2 1050 15 88

Sulphide-rich bands in gneissic sections: pyrite and chalcopyrite closely associated and sometimes intergrown.

0.06 0.2 1150 20 80
BLD BLD 0.2 820 6 56
BLD BLD 170 4 32
SULPHIDES ABSENT EXCEPT FOR 5CM PAND AT 112.45M WHICH CONTAINS 5% CHALCOPYRITE ALONG FOLIATION. LITHOLOGIES BELOW 97M ESSENTIALLY THE SAME, WITH VARIATION IN GARNET CONTENT WITHIN A MATRIX OF QUARTZ AND BIOTITE. A WEAK FOLIATION IS PRESENT IN PLACES, WITH CBA 30-45 DEGREES. HIGHLY GARNETIFEROUS AREAS GENERALLY UNFOLIATED.
HOLE NUMBER: E05B/0001

Summary of Lithological Units

0.00 TO 3.10 METRES  OVERBURDEN, DRILLED WITH ROTARY.
3.10 TO 22.70 METRES  QUARTZ-BIOTITE GARNET GNEISS
22.70 TO 26.25 METRES  QUARTZ-BIOTITE CHLORITE GNEISS.
26.25 TO 26.50 METRES  QUARTZ VEIN
26.50 TO 37.90 METRES  'MAFIC MARKER'
37.00 TO 64.65 METRES  QUARTZ-GARNET-BIOTITE GNEISS
64.65 TO 67.10 METRES  PEGMATOID
67.10 TO 68.05 METRES  TREVOLITE-MAGNETITE-QUARTZ ROCK.
68.05 TO 72.90 METRES  PEGMATOID.
72.90 TO 79.56 METRES  TREVOLITE-MAGNETITE ROCK
79.56 TO 80.80 METRES  TREVOLITE-MAGNETITE ROCK
80.70 TO 83.15 METRES  QUARTZ-MAGNETITE ROCK
83.15 TO 86.42 METRES  QUARTZ-BIOTITE 'PEGMATOID'
86.42 TO 131.00 METRES  QUARTZ-BIOTITE-GARNET GNEISS.
SOUTHERN CROSS BORE, NT
EL 3026
41971A EAST 744056 NORTH A.M.G. ZONE 53
12/08/83
19/08/83
126.45
93
93
6
1
NT MINES BRANCH, ALICE SPRINGS, CORE STORE
R G CHUCK

SOUTHERN CROSS BORE
ROCKDRILL
LONGYEAR 44

0000.00 TO 3.0 M ROTARY (AIR) , 150MM DIAMETER
3.0 TO 29.7 M CORED , HQ NM DIAMETER
28.9 TO 126.5 M CORED , NQ NM DIAMETER

000/60 /316, 120/67 /

TO TEST DOWN-PLUNGE FROM SURFACE GOSSAN, JOHNNIE'S
REWARD PROSPECT.

0-24.84M : HANGINGWALL QUARTZ-BIOTITE-GARNET GNEISS
24.84-46.45M : METAMORPHOSED FINE GRAINED MAFIC ROCK
46.45-54.93M : QUARTZ-BIOTITE-GARNET-FELDSPAR GNEISS
54.93-72.65M : QUARTZ-FELDSPAR INVADED GNEISS
72.65-94.10M : MAGNETITE-TREMOLITE-BIOPISDE-ZULPHIDE
94.10-99.30M : BIOTITE-MAGNETITE-QUARTZ ASSEMBLAGE
99.30-126.45M : FOOTWALL QUARTZ-GARNET-BIOTITE
GNEISSES.

FIRST ATTEMPT TO DRILL THIS HOLE WAS BY ROTARY (0-2.95CM)
AND THEN HQ. CAVITY HIT AT 27.05M. SECOND ATTEMPT WITH HQ
DEVIATED FROM OLD HOLE AT 6M AND HIT SAND-FILLED CAVITY AT
25.90M, AND STOPPED AT 26.55M. NEW HOLE COMMISSIONED 3M WEST,
DRILLED TO 29.76M IN HQ, THEN REMAINDER IN NQ. CORE
RETIRED. 0-27.05M HQ FROM FIRST ATTEMPT. FIRST HOLE, 28.90
HQ FROM SECOND HOLE, 28.9-TOTAL DEPTH HQ SECOND HOLE.
OBERBURDEN, DRILLED WITH ROLLER HIT.

12.25.10...23.04.2EIBES
QUARTZ-BIODITE-GRANITE GNEISS
QTA 30-60%, BIOTITE 20-30%. GARNET 20-30%. POSS SILLIMANITE
AS CLEAR TO UNITIFIED-ORIGIN ACINAR CRYSTALS, WEAKLY
FOLIATED IN PARTS. CB 25-30 DEG. APPROX 25% OF THIS UNIT IS
FELDSPARIC, WHERE SECTIONS OF THE CORE UP TO 35CM LONG
CONTAIN COARSELY CRYSTALLINE AREAS OF PINKISH TO CLEAR
FELDSPAR, SOMETIMES WITH REMNANT GNEISS WITHIN. THIS
FELDSPARIC ROCK IS SIMILAR TO THE PEGMATOID OF DRILL HOLE
E058-0001 TO 12M, APPROXIMATELY 8 FRACUTURES PER METER, AND
BELOW THIS THE CORE IS MORE SOLID - 3 FRACUTURES PER METER
OR LESS.

487/01.02.92
QUARTZ-FELDSPAR PEGMATOID, WITH TRACE BIOTITE. GRANULAR
TEXTURE, GRAINS UP TO APPROXIMATELY 5MM DIAMETER. FELDSPAR
CLEAR TO WEAKLY PINK. QUARTZ AND FELDSPAR IN APPROXIMATELY
EQUAL PROPORTIONS.

12.45/02.03
PREDOMINANTLY PEGMATOID.

12.20/02.10
PREDOMINANTLY PEGMATOID.

20.05/01.05
PREDOMINANTLY PEGMATOID.

24.06.10...44.35.0EIBES
21.0 PLIOZOIC-DIOPTASE-HYPERSTHENE-HORNBLende ROCK
(SEE PETROLOGICAL SAMPLE 37.34/0.0E) CONTAINING MINOR
FINE IRREGULAR PATCHES OF FYRITE AND CHALCOPSIDE, OFTEN
CLOSELY ASSOCIATED WITH MAGNETITE.
LIGHT GREEN MINERAL, POSSIBLY DIOPTASE, BECOMES MORE COMMON
AFTER ABOUT 25M. QUARTZ AND/OR PLIOZOIC ARE ENRICHED IN
SOME SECTIONS AFTER 37M.

E058-0002/034.00/01.00
TRAC CHALCOBYRITE
BLD BLD 82 46 56 2.90
E058-0002/035.00/01.00
TRAC CHALCOBYRITE
BLD BLD 155 56 48 3.00
E058-0002/037.00/01.00
TRAC CHALCOBYRITE, INCLUDING BAND OF DISSEMINATED CHALCO-
PYRITE AT 36.49M.
BLD BLD 115 25 40 3.00
E058-0002/037.34/00.0E
PETROLOGICAL SAMPLE: LABRADORITE-HYPERSTHENE-DIOPTASE-
HORNBLende ROCK.

E058-0002/038.00/01.00
BLD BLD 24 21 44 2.90
E058-0002/039.00/01.00
BLD BLD 17 17 46 2.90
E058-0002/042.00/01.00
BLD BLD 310 28 84 3.00
E058-0002/043.00/01.00
BLD BLD 25 36 66 3.00
46.45/02.60
THIS SECTION MORE GRANULAR AND QUARTZISE: MAY REPRESENT SOME
FORM OF MARGIN TO INTRUSIVE; RARE GARNETS MAY SUGGEST
AFFINITIES WITH GNEISSIC COUNTRY ROCK.

E058-0002/044.00/01.00
BLD BLD 19 18 96 2.75
E058-0002/045.00/01.00
BLD BLD 14 5 70 2.65
E058-0002/045.40/01.00
PETROLOGICAL SAMPLE: QUARTZ (90%)-MUSCOVITE-BIOTITE-
CHLORITE ASSEMBLAGE. TRANSITION ZONE BETWEEN MAFIC MARKER
AND GNEISS.
QUARTZ-DIOTITE-GARNET-FELDSPAR GNEISS.
Mineralogy varies considerably; some sections are more siliceous and coarsely feldspathic, moderately developed foliation throughout, except in highly feldspathised areas. CBA 30-35 degrees.

QUARTZ-FELDSPAR-BIOTITE-DIORITE ASSEMBLAGE
(Quartz-Feldspar invaded Qtz-Biotite-Garnet Gneiss?). Mineralogy and texture of this unit change throughout from almost normal gneiss to pegmatoid, highly siliceous biotitic rock w/o garnet, to white feldspathic/quartz section. No garnets continue beyond base of this unit until the footwall gneiss.

PREDOMINANTLY PEGMATOID (Coarsely Crystalline Feldspar, Quartz, Zapatite and Biotite), with minor foliated biotite-garnet-quartz-sillimanite gneiss.

PREDOMINANTLY UNALTERED GNEISS.

QUARTZ-INVADED GNEISS: Fragments of normal garnet-biotite gneiss up to 5mm across, fragmented and set in a matrix of quartz and in places large masses of fine-medium grained biotite occur. Gneiss fragments show emplacements of matrix quartz. White-clear vaguely acicular mineral (Hardness 4-5) occurs within biotite-rich zones.

MINOR RED-STAINED FELDSPAR WITH QUARTZ-RICH ZONE.

PREDOMINANTLY QUARTZ, WITH VARYING AMOUNTS OF BIOTITE AND FRAGMENTED EMBAYED GARNET (AS FOR ABOVE), AND RARE PALE GREEN APTMITE. Biotite forms highly foliated but irregular masses. Quartz contains two roughly perpendicular fracture sets. Feldspar possibly present in quartzose areas.

SIMILAR TO ABOVE, BUT GENERALLY FINER GRAINED AND CONTAINS MORE BIOTITE. Garnetiferous fragments are also finer-grained and are composite garnet-chlorite rather than just garnet as above. Base defined as last presence of garnet, and there is a 20-30m transition zone which contains magnetite.
MAGNETITE-TREMOLITE AND/OR DIOPSIDE ROCK
CONT PYRITE, CHALCOPYRITE AND MOLYBDENITE. UK TO MOD FOLIATION IN PLACES: CBA 40-60 DEG. MAGNETITE CONTENT GENERALLY ABOUT 15-20% AND UP TO 30-35%. TOTAL SULPHIDE CONTENT REACHES 4-8% IN PARTS. BASE DEFINED BY DECREASE IN TREMOLITE, THEN MAGNETITE, AND INCREASE IN BIDITE AND OCCURRENCE GARNET.
SOLID CORE, 3-4 FRACTURES PER METRE.
PYRITE AND CHALCOPYRITE IN BASAL 0.4M.
FINE TO COARSE PYRITE, FINELY DISSEMINATED CHALCOPYRITE.
3-5% TOTAL SULPHIDE. PALE GREEN NEEDLE-LIKE ?FATITE.
PATCHES OF CRYSTALLINE CALCITE. TRACE PYROHOTITE 3-5%.
MINOR GARNET. COARSE VEIN-LIKE MASS OF PYRITE WITH MINOR CHALCOPYRITE PARALLEL TO FOLIATION.
SPOTTED CALCITE-MAGNETITE-GARNET ROCK. CALCITE FORMS MATRIX AND MAGNETITE-GARNET SPOTS ACCOUNT FOR 40% OR LESS.
POSSIBLY REPRESENTS ORIGINAL CARBONATE ROCK (IE UNREPLACED COUNTRY ROCK). SEE PETROLOGICAL SAMPLE 75.72/0.12.
PETROLOGICAL SAMPLE - CALCITE-MAGNETITE-GARNET ROCK.
TRACE CHALCOPYRITE AND PYRITE.
1-2% VEIN-FORM PYRITE.
4-5% FINELY DISSEMINATED SULPHIDE, MAINLY PYRITE CONTAINS CARBONATE.
FINE GRAINED AND MAGNETITE-RICH
SPOTTED CALC-SILICATE AS ABOVE (CALCITE-MAGNETITE-GARNET ASSEMBLAGE). GRADUALLY UPPER AND LOWER CONTACTS OVER 10-20CM.
SULPHIDES ABSENT
MAGNETITE AROUND 50-60%, TREMOLITE FINE GRAINED, CALCITE THROUGHOUT IN MATRIX AND AS VEINS UP TO 3MM WIDE.
MAGNETITE (20%), TREMOLITE FINE GRAINED, ABUNDANT FINELY DISSEMINATED PYRITE AND CHALCOPYRITE. COARSER CHALCOPYRITE HOSTED BY CALCITE VEIN, SULPHIDES 5% OR MORE.
COARSELY CRYSTALLINE TREMOLITE, MINOR ?CHLORITE IN FOLIAE, PYRITE AND CHALCOPYRITE.
PETROLOGICAL SAMPLE: FINE GRAINED DIOPSIDE-MAGNETITE-SULPHIDE ROCK.
DIOPSIDE ROCK GIVES WAY TO QUARTZ-GARNET-BIDITE IN VERY COARSE AUGEN-LIKE TEXTURE CONSISTING OF SUB-ROUNDED TO OVAL QUARTZ MASSES 3-5CM ACROSS SURROUNDED BY COARSE BIDITE, GARNET OCCURS IN MASSES INVADED AND BROKEN BY QUARTZ MATRIX. SULPHIDES ABSENT TO RARE.
TOP 0.5M AS ABOVE, REMAINDER FINELY CRYSTALLINE TREMOLITE.
FINELY DISSEMINATED PYRITE 2.4%.
COARSE TREMOLITE GRADING DOWNWARDS TO TREMOLITE-DIOTITE-
GARNET-CHLORITE ROCK SHOWING DEFORMED FOLIATION. WEAKLY
PYRITIC.

FINELY CRYSTALLINE TREMOLITE-MAGNETITE ROCK WITH MINOR
PATCHES OF QUARTZ CONTAINING FRAGMENTED GARNET. TRACE
PYRITE.

TREMOLITE-MAGNETITE WITH CALCITE IN MATRIX AND THIN
STRINGERS, AND GLASS GARNET SCATTERED THROUGHOUT.
(1% PYRITE.)

BIOITITE-MAGNETITE-QUARTZ-CHLORITE ROCK
GRADING FROM BIOTITE AND MAGNETITE RICH (94.1-96.0%) TO QTZ
AND CHLORITE RICH (96.0-96.0%). CHALCOPYRITE AND PYRITE
COMMON THROUGHOUT. THIS ZONE APPEARS TO REPRESENT A TRANSIT-
IONAL ZONE BETWEEN TREMOLITE-MAGNETITE HORIZON ABOVE AND
CHLORITE FOOTWALL BELOW.

MINERAL CARBONATE VEINING NEAR TOP. GARNETS ARE CUT BY
NUMEROUS VEINLETS OF CHLORITE. SIMILAR TO SILICA-INVAD ED
CHLORITE ZONE ABOVE THE TREMOLITE-MAGNETITE HORIZON AND
CHLORITE MUSCOVITE INTERGROWTHS.

75% BIOTITE, REMAINING QUARTZ AND MAGNETITE. MINOR GARNET.

SIMILAR TO ABOVE BUT MORE QUARTZ AND MAGNETITE, LESS BIOTITE.

COARSELY AND FINELY DISSEMINATED CHALCOPYRITE AND PYRITE

GARNET AS FUNCTION OF SMALL CLASTS WITHIN MATRIX OF QUARTZ AND CHLORITE. MINOR
CHALCOPYRITE MAINLY IN GARNET-CHLORITE AREAS. SOME MASSIVE
BIOTITE, MAGNETITE RARE.

PETROLOGICAL SAMPLE OF FINE GRAINED SILICEOUS MATRIX WITH
FRAGMENTS OF GARNET-CHLORITE. MINOR MAGNETITE.

2-3% FINE TO MEDIUM DISSEMINATED CHALCOPYRITE.

AS ABOVE.

QUARTZ (60%)-GARNET (30%)-BIOITITE (10%) GNEISS
W DISSEMINATED CHALCOPYRITE. CHLORITE PRESENT IN AND WITH
GARNETS TO 104M, AND ABSENT BELOW THAT DEPTH. SOLID CORE
(2 FRAGMENTS PER METRE). GENERALLY LACKS FOLIATION, BUT SMALL
BIOTITIC SECTIONS ARE MODERATELY FOLIATED. CBA 50-60 DEGREES
CHALCOPYRITE OCCURS AS IRREGULAR DISSEMINATIONS 1-3MM ACROSS
IN QUARTZ AND GARNET SECTIONS. PYRITE SUBORDINATE TO RARE,
WITH SIMILAR HABIT, AND SOMETIMES OCCUPYING SMALL PARALLEL
FRACTURES IN QUARTZ.

NB REPEAT GOLD ASSAY SHOWN 4.60 AND 3.30.
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NB REPEAT GOLD ASSAY SHOWED 0.98.
NB TWO REPEAT GOLD ASSAYS SHOWED 8.90 AND 12.0.
NB REPEAT GOLD ASSAY SHOWED 2.20.
NB TWO REPEAT GOLD ASSAYS SHOWED 1.30.
NB TWO REPEAT GOLD ASSAYS SHOWED 3.45 AND 1.10.

PETROLOGICAL SAMPLE: TYPICAL QUARTZ-GARNET GNEISS WITH CHALCOPYRITE.
NB TWO REPEAT GOLD ASSAYS SHOWED 0.51 AND 0.59.
NB REPEAT GOLD ASSAY SHOWED 1.20.
END OF HOLE.
HOLE NUMBER: E058/0002

Summary of Lithological Units

0.00 TO 2.95 METRES OVERBURDEN, DRILLED WITH KOLLER BIT.
12.95 TO 24.04 METRES QUARTZ-BIOTITE-GARNET GNEISS
24.06 TO 45.45 METRES F-G PLAGIOCLASE-DIOPSIID - HYPERSTENE-HORNBLENDE ROCK
46.45 TO 54.93 METRES QUARTZ-BIOTITE-GARNET-FELDSPAR GNEISS.
54.93 TO 72.65 METRES QUARTZ-FELDSPAR-BIOTITE-GARNET ASSEMBLAGE
72.65 TO 94.10 METRES MAGNETITE-TREMOLITE AND/OR DIOPSIDE ROCK
94.10 TO 99.30 METRES Biotite-Magnetite-Quartz-Chlorite Rock
99.30 TO 126.45 METRES QUARTZ (60%)-GARNET (30%)-BIOTITE (10%) GNEISS
DESCRIPTIVE GEOLOGIC LOG

**HOLE NUMBER**

**PROJECT**

**TENEMENT**

**CO-ORDINATES**

**DATE COMMENCED**

**DATE COMPLETED**

**COLLAR P.L.**

**DEPTH IN METRES**

**NO. OF GEOCHEMICAL SAMPLES COLLECTED**

**NO. OF GEOCHEMICAL SAMPLES ASSAYED**

**NO. OF PETROLOGICAL SAMPLES**

**SAMPLE INTERVAL**

**DATE OF UNASSAYED SAMPLES/ CORE LOGGED BY**

**DEPTH TO WATER TABLE IN METRES**

**ESTIMATED WATER FLOW (LPM)**

**WATER USED (L)**

**ADDITIVES USED**

**LOCATION OF SUPPLY**

**CONTRACTOR**

**MACHINE USED**

**P.V.C CASING IN HOLE: METRES REMAINING**

**DIAMETER (MM)**

**HOLE CAPPED**

**STEEL CASING IN HOLE: METRES REMAINING**

**DIAMETER (MM)**

**HOLE CAPPED**

**HOLE TYPE**

**SURVEY DATA (DEPTH/DEPRESSION/AZIMUTH)**

**PURPOSE OF DRILL HOLE**

**SUMMARY OF RESULTS**

**ADDITIONAL COMMENTS**

---

SOUTHERN CROSS BORE, NT
EL 3926
419670 EAST 7440467 NORTH A.M.G. ZONE 53
20/08/83
24/08/83
113.45
02
82
4
1
NT MINES BRANCH, ALICE SPRINGS, CORE STORE
R & CHICK
SOUTHERN CROSS BORE
ROCKDRILL
LONGYEAR 44
150
N
0.0 TO 2.6 M ROTARY (AIR) 150MM DIAMETER
2.6 TO 14.9 M CORED HQ MM DIAMETER
14.9 TO 113.5 M CORED NQ MM DIAMETER

TO TEST BELOW GOSSANOUS ZONE OF JOHNNIE'S REWARD PROSPECT

0-27.14M HANGINGWALL QUARTZ-BIOTITE-GARNET GNEISS
27.14-28.45M PECMATOID
28.45-33.75M QUARTZITE TROMOLITE-MAGNETITE ROCK
33.75-77.00M TREMOLITE-MAGNETITE ROCK
77.00-86.00M GARNET-BIOTITE-QUARTZ-CHLORITE (ALTERED FOOTWALL GNEISS)
86.00-113.45M FOOTWALL QUARTZ-BIOTITE-GARNET GNEISS.

DRILLED TO 14.90M IN HR, CORE DISCARDED AFTER LOGGING.
QUARTZ-DIOPSID-GARNET GNEISS
WITH PEGMATOID SEPARATIONS AND GARNET-POOR HORIZONS.
DRILLED TO 14.90M WITH HQ, CORE DISCARDED TO THIS DEPTH.
CORE CONTAINS AROUND 5-8 FRACTURES PER METRE.
PEGMATOID, COARSELY CRYSTALLINE: QUARTZ 40%, FELDSPAR 40-
60%, BIORITE 10%
COARSE GARNET SEGREGATIONS UP TO 1CM DIAMETER. GARNET UP TO
60%, BIORITE 30-40%, MINOR QUARTZ.

PETROLOGICAL SAMPLE: QUARTZ-GARNET-BIORITE GNEISS WITH MORE
QUARTZ THAN MOST, AND TRACES OF GREEN CHLORITE.

COARSE GRAINED PEGMATOID
WITH FELDSPAR (PINK STAINED), QUARTZ, MINOR BIORITE, AND A
WHITE-CREAM UNIDENTIFIED MINERAL WHICH ALSO OCCURS IN
SEGREGATIONS OF 3-5CM THICK IN THE HANGINGWALL GNEISS
(SEE PETROLOGICAL SAMPLE).

PETROLOGICAL SAMPLE: PEGMATOID.

QUARTZ-TREMOLITE-MAGNETITE-SULPHIDE ASSEMBLAGE
QTZ MORE ABUNDANT THAN UNIT BELOW. ABUNDANT FINELY
DISSEMINATED CHALCOPYRITE AND PYRITE, POSSIBLE DIOPSIDE AS
DARK PLATEY SPECKS. VERY HARD DRILLING, 3-6 FRACTURES/M.
MAGNETITE BANDS SHOW CONSISTENT FOLIATION WITH CBA 35 DEG ON
AVERAGE. SULPHIDES OCCUR IN ALL OTHER MINERAL SEGREGATIONS.
VERY BROKEN GROUND FROM 28-29M. PEGMATOID OVERLIES COARSE
QUARTZ-MAGNETITE ROCK WITH CBA 45 DEG.
LESS BROKEN THAN ABOVE, QUARTZ AROUND 70%.
ABUNDANT FINELY DISSEMINATED CHALCOPYRITE ALIGNED ALONG
FOLIATION. SULPHIDES OXIDISED IN Voids WITHIN QUARTZ.
MORE TREMOLITE TOWARDS BASE.

TREMOLITE-MAGNETITE-DIOPSIDE ASSEMBLAGE
W SUBORDINATE QTZ, ACTINOLITE, GARNET, CALCITE AND SUL-
PHIDES (PYRITE AND CHALCOPYRITE) TREMOLITE TEXTURE VARIES
FROM COMPETITELY RARE COARSELY CRYSTALLINE TO F-G DIOPSIDE
AND PROPORTIONS OF TREMOLITE AND MAGNETITE VARY CONSIDER-
ABLY. ABOUT HALF THIS UNIT EXHIBITS A WEAK TO MODERATE
FOLIATION OF MAGNETITE BANDS, CBA USUALLY AROUND 30 DEGREES.
UPPER PART SILICEOUS, LOWER 0.25M CONTAINS COARSE BLADED
TREMOLITE, MAGNETITE LAYERS, AND QUARTZ.
15-20% QUARTZ-RICH, WITH FINELY DISSEMINATED CHALCOPYRITE.

0.02 BLD 62 8 62
0.02 BLD 70 12 90
0.02 BLD 110 20 125
0.02 BLD 26 11 76
0.05 0.5 1150 41 220
0.10 5.6 1350 200 450
0.12 4.5 9000 1400 500
0.08 2.2 8000 400 270
0.30 10.0 6700 3900 500
0.12 2.4 3600 980 530
0.34 4.9 5300 2000 700
FAVOURING QUARTZOSILICA AREAS, FAVOURING QUARTZOSILICA AREAS.

AROUND 25% DISSEMINATED PYRITE AND CHALCOPYRITE, ALSO MINOR

COARSE PYRITE SECTIONS IN TREMOLITE-QUARTZ-DIOPSIDE

ROCK.

COARSELY-BLACK CRYSTALLINE TREMOLITE, WITH RELATIVELY

COARSE VEIN-LIKE PYRITE AND CHALCOPYRITE, AND FINER-GRAINED

TREMOLITE-MAGNETITE ROCK DEVOID OF SULPHIDE.

COARSE CHALCOPYRITE-PYRITE MASSES 1-2CM DIAMETER IN

TREMOLITE-MAGNETITE-ACTINOLITE ROCK.

COARSE TO FINE GRAINED ACTINOLITE WITH MAGNETITE AND

SULPHIDES.

PETROLOGICAL SAMPLE OF TREMOLITE-MAGNETITE-SULPHIDE ROCK,

SIMILAR TO ABOVE (SEE PETROLOGICAL SAMPLE).

AS ABOVE.

MAINLY FINE-GRAINED TREMOLITE, MAGNETITE ONLY 10% AND

SEGREGATED IN BANDS (CBA 45 DEGREES) WITH SULPHIDES,

BIOTITE WITH GARNET AND MINOR MAGNETITE, PYRITE AND

CHALCOPYRITE.

LOWER PART OF THIS SAMPLE IS TREMOLITE-MAGNETITE AND

CONTAINS ABUNDANT FINELY DISSEMINATED PYRITE-CHALCOPYRITE.

50% MAGNETITE.

50% MAGNETITE/50% TREMOLITE, FINE GRAINED, MINOR CACILCITE

VEINS UP TO BMM WIDE.

MINOR GARNET AND CHLORITE NEAR BASE.

MAGNETITE 50-60%.

THIS SECTION IS MORE DIOPSIDE-RICH THAN REMAINDER OF THE

INTERVAL, AND ALSO CONTAINS MINOR TO COMMON CACILCITE

STRINGERS, IT PROBABLY REPRESENTS A MORE CALCIC PRE-

METAMORPHIC ROCK OR LESS COMPLETELY REPLACED MARBLE COUNTRY

ROCK.

VERY FINE GRAINED AND DIOPSIDE-RICH. TRADE EPIDOTE. PYRITE

ASSOCIATED WITH COARSE QUARTZ-EPIDOTE SEGREATION.

MINOR GARNET, REMAINDER IS TREMOLITE-MAGNETITE-DIOPSIDE-

PLAGIOCLASE OR QUARTZ, AND MINOR CACILCITE (SEE PETROLOGICAL

SAMPLE).

PETROLOGICAL SAMPLE TYPICAL OF 48.5-54.0M.

MINOR GARNET AS 1-2CM SEGREGATION SET IN QUARTZ. REMAINDER

OF ROCK AS FOR PETROLOGICAL SAMPLE.

MINOR GARNET, QUARTZ AND FINELY DISSEMINATED SULPHIDE.

MORE TREMOLITE AND QUARTZITE THAN INTERVAL ABOVE.

TRACE DISSEMINATED PYRITE AND CHALCOPYRITE.

50% QUARTZ, REMAINDER TREMOLITE AND MAGNETITE, WITH ONLY A

TRACE OF ACTINOLITE.

AS ABOVE, RARE FINELY DISSEMINATED CHALCOPYRITE AND PYRITE.

MORE QUARTZITE, (1% VERY FINELY DISSEMINATED SULPHIDE.

MINOR CHLORITE AND CACILCITE STRINGERS.

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LESS QUARTZ, MAINLY TROMOLITE-MAGNETITE.
AS ABOVE, TRACE DISSOCIATED PYRITE.
AS ABOVE.
VERY DIOPSIDE-RICH BETWEEN 66.4 AND 66.8M.
MINOR DIOTITE, REMAINDER (QUARTZ)-TROMOLITE-MAGNETITE.
LESS THAN 1% FINE CHALCOPYRITE AND PYRITE.
SECTIONS OF ALMOST PURE MAGNETITE WITH TRACE CHALCOPYRITE.
MINOR QUARTZ, TRACE CHALCOPYRITE.
VERY MAGNETITE-RICH, PYRITE AND CHALCOPYRITE AS VEINS UP TO 5MM WIDE, AND AS FINE DISSEMINATIONS.
AS ABOVE, MAGNETITE IN 5-10MM BANDS CDA 25 DEGREES, WITH COARSE CHALCOPYRITE.
AS ABOVE, PLUS MINOR GARNET AND QUARTZ.

GARNET-DIOTITE-QUARTZ-CHLORITE ASSEMBLAGE
W-abundant generally coarsely disseminated chalcopyrite and pyrite in places, texture varies from foliated to almost augen-texture involving large garnet masses 1-4cm diame surrounded by Qtz or diotite. Probably represents an altered zone between footwall gneiss and the tromolite-magnetite intrusive. Mineralogy, however, is similar to the footwall.
COARSE-GRAINED DIOTITE-GARNET ROCK WITH COARSE DISSEMINATIONS OF PYRITE AND CHALCOPYRITE.
DIOTITE-QUARTZ-GARNET ROCK OF FOLIATED TO AUGEN TEXTURE, MINOR CHALCOPYRITE.
QUARTZ-DIOTITE-GARNET-TROMOLITE-MAGNETITE ROCK, FINE GRAINED, FOLIATED, CDA 30 DEGREES, UP TO 5% FINELY DISSOCIATED CHALCOPYRITE.
QUARTZ-GRAINED-DIOTITE GNEISS, MORE SILICIC THAN SAMPLES ABOVE, WEAKLY TO UNFOLIATED, 2-4% FINELY DISSOCIATED SULPHIDE, MAINLY CHALCOPYRITE. REPEAT GOLD ASSAY 0.99.
COARSE-GRAINED GARNET-QUARTZ-DIOTITE ROCK, UNFOLIATED, MINOR PYRITE AND CHALCOPYRITE ASSOCIATED WITH MINOR MAGNETITE SEGREGATIONS IN GARNET MASS.
QUARTZ-GARNET-DIOTITE GNEISS
WITH CHLORIDE-QUARTZ-DIOTITE SECTIONS, GENERALLY UNFOLIATED AND MEDIUM TO COARSE-GRAINED, QUARTZ 60% APPROXIMATELY. GRADATIONAL UPPER CONTACT, WEAKLY FOLIATED AREAS HAVE CDA 30-40 DEGREES, GOOD CLEAVAGE, 2-B FRACTURES/MEET.
NO CHALCOPYRITE OR PYRITE.
LIMONITE JOINT WITH CDA 40 DEGREES FROM 87.5 TO 88.5M.
CHLORITE-QUARTZ-DIOTITE GNEISS. PLUS PATCHES OF 'NORMAL' QUARTZ-GARNET-DIOTITE GNEISS.

SMALL QUARTZ-FILLED FAULT.

END OF HOLE.
HOLE NUMBER: CSB9/003

Summary of Lithological Units

0.00 TO 27.14 METRES QUARTZ-BIOTITE-GARNET GNEISS
27.14 TO 28.45 METRES COARSE GRAINED PEGMATOID
28.45 TO 33.75 METRES QUARTZ-TREMOLITE-MAGNETITE-SULPHIDE ASSEMBLAGE
33.75 TO 77.00 METRES TREMOLITE-MAGNETITE-?BIOPSIDE ASSEMBLAGE
77.00 TO 86.00 METRES GARNET-BIOTITE-QUARTZ-CHLORITE ASSEMBLAGE
86.00 TO 113.45 METRES QUARTZ-GARNET-BIOTITE GNEISS
APPENDIX 2

PETROLOGICAL DESCRIPTIONS AND PHOTOMICROGRAPHS
THE PETROGRAPHY OF SAMPLES FROM DIAMOND DRILL HOLES 001, 002 AND 003, ARUNTA COMPLEX, N.T.

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11th October 1983
PETROGRAPHIC DESCRIPTIONS


The hand specimen is a dull grey, fine to medium-grained granular rock composed of plagioclase and pyroxene. It is not foliated, but is cut by roughly parallel, narrow chloritic zones.

In section, the rock is seen to be composed of plagioclase (60%), diopside (20%), hypersthene (10%), magnetite (5%), and hornblende (5%). The rock has suffered some deformation; many of the plagioclase grains show straining and kinking of twin planes. The grains have dentate to scalloped margins and, here and there, grains have been granulated to a very fine grain size. Plagioclase grain sizes range between 0.1 and 0.5 mm. The pyroxenes form sub-amoeboïd grains, showing strained extinction. Diopside is pale green, and hypersthene is pleochroic to pale pink. Olive-green hornblende has formed as a retrogressive product of the pyroxenes. Magnetite occurs as fine granules associated with pyroxene, and, in zones, as possibly introduced amoeboid grains.

The rock is cut by fine chloritic veins, 0.05 mm thick, which have caused an alteration zone up to 1 mm thick in which the pyroxenes and plagioclase are altered to actinolite, carbonate, and epidote.

The rock is a mafic, metamorphosed to granulite facies.

E058-001-83.40/0.08. Deformed granitoid.

The hand specimen consists of coarse but inequigranular pink feldspar that appears cut by sheared zones composed of fine quartz and biotite.

In section, very coarse microcline perthite, with grains measuring up to
20 mm across, occurs in aggregates of somewhat intergrown grains with
dentate margins. Commonly, a thin zone of fine sericite flakes occurs along
the margins.

The apparently sheared zones noted in the hand specimen are composed of
quartz, microcline, biotite, and plagioclase, with accessory zircon. This
material has been strongly sheared and granulated, with xenoblastic elongate
porphyroclasts of quartz and microcline, sometimes in aggregates measuring up
to 3 mm long, enclosed in a fine, granoblastic groundmass of quartz, microcline,
sericitized plagioclase, and biotite flakes, all of which have a grain size of
0.01 to 0.1 mm.

The rock appears to be a strongly deformed granitoid; its mineral assemblage
is too general to permit an appraisal of metamorphic grade.

E058-002-37.34/0.08. Hornblende-hypersthene-diopside-labradorite granulite.

The hand specimen is of a grey, inequigranular mafic rock composed of
feldspar, hornblende and pyroxene. It is cut by sub-parallel retrogressive
veins.

In section, the rock is seen to be texturally and mineralogically very
similar to 001-31.35/0.07. The main difference is the larger amount of olive-
green hornblende present — up to 10%. It occurs in bands 4 to 5 mm thick,
and appears to have retrogressively altered clinopyroxène. Like 001-31.35/0.07,
the rock is cut by carbonate and chlorite veins. The rock is a mafic that has
been metamorphosed to the granulite facies.


The hand specimen is a pale grey, fine to medium-grained rock with a
gneissic foliation, containing quartz, sericite, biotite and minor garnet.

In section, the rock is seen to be composed of quartz (80%), biotite (5%), muscovite (5%) and chlorite (5%), together with minor amounts of garnet, sillimanite and kyanite. The rock has a foliation marked by lenticulate stringers of biotite and muscovite, separated by quartz. Quartz forms xenoblastic, elongate, strained grains up to 2 by 0.5 mm in size; their elongation is parallel to the foliation. Partly chloritized biotite forms sub-parallel flakes. Muscovite occurs as segregations of fine flakes, which are a retrogressive alteration product of sillimanite and kyanite, some of which remains. Small knots of chlorite enclosing relic garnet, range up to 1 mm across; here, the chlorite is an alteration produce of garnet prophyroblasts.

The rock is a semi-pelite, metamorphosed to the amphibolite facies; retrogressive metamorphism has mostly altered sillimanite and garnet to muscovite and chlorite, respectively.

EO58-002-078.72/0.12 Diopside-forsterite marble.

The hand specimen is of a pale grey rock mottled with black. Xenoblastic porphyroblasts of olivine are enclosed in a matrix of fine calcite. The olivine, in places, is partly altered to red iddingsite. There is a rough foliation along the axis of the core.

In section, the rock is seen to be composed of calcite (85%), forsterite (10%) and magnetite (5%), together with minor diopside and phlogopite, and accessory green spinel and sulphide. Forsterite forms sub-amoeboïd porphyroblasts up to 5 mm across; it is partly altered to bowlingite and, in places, iddingsite. Diopside forms small porphyroblasts. Phlogopite occurs as ragged colourless flakes. Magnetite and the green spinel are xenoblastic. All occur in a matrix of amoeboïd to granular carbonate grains 0.05 to 0.2 mm in size. The rock was a slightly siliceous dolomitic carbonate that was metamorphosed to amphibolite facies.
The hand specimen is a grey, massive rock composed mostly of granular pyroxene, with minor pyrite. At the lower end of the core sample, the rock is cut by carbonate veining which has caused the pyroxene to be replaced by amphibole in a thin zone either side of the vein. What appears to be a few andradite garnets are present in the vein and the alteration zone. Unfortunately, these veins and the alteration zone were not included in the thin section.

In section, the rock is seen to be composed of diopside (95%), and pyrite (about 5%). The diopside forms rounded to somewhat intergrown grains that range between 0.1 and 3 mm in size. Pyrite occurs as granulat to interstitial grains up to 0.5 mm across. The rock is cut by a swarm of sub-parallel carbonate veins 0.01 to 0.1 mm thick; in addition to carbonate, they also contain pyrite. Diopside has been altered to actinolite in the immediate vicinity of the veins.

The rock is a pyroxenite, possibly metamorphosed. However, it should be compared to 003-52.35/0.10, which is a magnetite pyroxenite, and which appears to have preserved its primary igneous texture.

The hand specimen is of a grey rock, strongly magnetic in places, in which somewhat elongate segregations of green chlorite that enclose relics of pink garnet, are enclosed in a matrix of quartz.

In section, the rock is seen to be composed of quartz (70%), magnetite (5%), chlorite (5%), and garnet (15%), with minor biotite. A rough foliation is marked by magnetite, which occurs as strongly elongate, roughly parallel
grains up to 1.5 by 0.1 mm in size. Quartz forms a matrix of amoeboid, very strongly strained grains with serrated boundaries; the grains measure 0.2 to 2 mm in size. Garnet occurs as xenoblastic, partly chloritized porphyroblasts in segregations up to 5 mm across. Chlorite is also common as thin coronas around magnetite with, in places, biotite and garnet. In places there are a few segregations, measuring up to 0.5 mm across, composed of very fine-grained quartz and chlorite.

The rock appears to have been a somewhat ferruginous and aluminous sediment that has been metamorphosed to the amphibolite facies.


The hand specimen is of a pinkish-grey, medium to coarse-grained rock composed of quartz, biotite and garnet. Minor sulphide occurs as segregations. Only a slight foliation can be seen.

In section, the rock is seen to be composed of quartz (75%), garnet (20%) and biotite (5%), with minor amounts of sillimanite and kyanite, and accessory magnetite and chalcopyrite. The rock is inequigranular and xenoblastic, grainsizes ranging between 0.1 and 2 mm. A slight foliation is present, marked by the preferred orientation of the biotite flakes. Quartz is amoeboid, strongly strained, and commonly shows mosaic sub-structure. Garnet forms rounded, sub-amoeboid, slightly polikiloblastic grains. Sillimanite and kyanite form sub-prismatic grains, sometimes in parallel growth with biotite. Magnetite and chalcopyrite tend to be intergrown, as xenoblastic grains associated with biotite.

The rock is semi-pelitic, metamorphosed to the amphibolite facies.
E058-003-25.30/0.10 Sillimanite-kyanite-garnet-quartz gneiss.

The hand specimen is of a pale grey medium to fine-grained rock containing porphyroblasts of pink garnet enclosed in a foliated matrix of quartz and biotite.

The rock is composed of quartz (70%), garnet (15%), biotite (5%), sillimanite (5%), and kyanite (5%). Zircon is accessory. Garnet forms xenoblastic porphyroblasts measuring up to 3 mm across; they are partly altered to biotite and chlorite. Biotite forms fine flakes with a rough preferred orientation; their sizes are about 0.2 mm across. The biotite flakes tend to occur in foliae along with equally small sub-prismatic crystals of kyanite and sillimanite. Quartz forms a matrix of strained, somewhat intergrown grains ranging between 0.05 and 2 mm in size.

E058-003-27.27/0.10 Deformed granitoid.

The hand specimen is a mottled pink and grey rock in which segregations of coarse pink feldspar are enclosed in a quartz-mica matrix.

The section is cut across a feldspar segregation into the matrix. The segregation consists of xenoblastic grains of microcline-perthite ranging between 0.5 and 6 mm across. On the boundary of the segregation is a strongly foliated zone about 5 mm thick composed of biotite flakes measuring up to 0.5 mm long enclosing strongly sericitized crystals of sillimanite (about 1 mm in size), with some quartz. The remainder of the rock consists of quartz, muscovite, biotite, albite and microcline.

The rock looks as though it is a deformed and somewhat greisenized granitoid.
E058-003-39.57/0.10 Sulphide-bearing tremolite-quartz gneiss.

The hand specimen is a pale creamish-grey rock speckled with pyrite and chalcopyrite, and formed of quartz with subordinate tremolite. There appear to be two foliations; one marked by an elongation of tremolite and stringers of sulphide, the other by an apparent shear fabric.

In section, the rock is seen to consist of quartz (75%), tremolite (20%), and sulphide (5%), with minor diopside and chlorite. Quartz occurs as lenticular, elongate, strongly strained grains up to 2 mm long. It shows a strong preferred orientation. Tremolite forms xenoblastic grains, commonly associated with ameoboid sulphide in bands up to 4 mm wide running at a high angle to the quartz foliation. A few grains of diopside, somewhat altered to limonite, are present.

The writer is not sure what the original rock type was.

E058-003-52.35/0.10 Magnetite pyroxenite.

The hand specimen is a massive, greenish-grey, strongly magnetic rock composed of fine granular pyroxene with interstitial magnetite.

In section the rock is seen to be composed of diopside (85%) and magnetite (15%). Diopside forms subhedral, somewhat rounded and occasionally amoeboid grains 0.2 to 0.5 mm in size. Magnetite is interstitial and, in places, forms a supporting "cement" to the diopside grains. The rock is cut by parallel, very thin veins of carbonate. Diopside is partly replaced by small amounts of pale green actinolite and pale brown smectite.

The rock is a pyroxenite, and probably related to 002-087.15/0.10.
The Petrography of Samples from Diamond Drill Holes 001, 002, and 003, Arunta Complex, N.T.

Addendum:

Illustrations of Some Rock Types

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W R Morgan
Director
24th October 1983

Introduction

At the request of Mr R G Chuck, the writer has prepared coloured photomicrographs of six of the samples described in his petrographic report of 11th October, 1983. The samples were nominated by Mr Chuck. The writer is most grateful to Dr A Kemp, of AMDEL, for use of his photomicroscope facilities.
THE ILLUSTRATIONS

A: Ordinary light

B: Crossed nicols

Fig. 1. E058-001-31.35/0.07. Hornblende-hypersthene-diopside-labradorite granulite. Olive-green hornblende in lower left; pink hypersthene in centre left (ordinary light). Width of field: 2.5 mm.
A: Ordinary light

B: Crossed nicols

Fig. 2. E058-002-97.72/0.18. Magnetite-garnet-quartz gneiss. Partly chloritized garnet on left of photograph. Note the magnetite foliation to the right. Width of field: 2.5 mm.
A: Ordinary light

B: Crossed nicols

Fig. 3. E058-002-124.73/0.10. Kyanite-sillimanite-biotite-garnet-quartz gneiss. Garnet porphyroblast on right; lineated biotite with some sillimanite on left. Width of field: 2.5 mm.
A: Ordinary light

B: Crossed nicols

Fig. 4. E508-003-27.2/1.0. ?Deformed granitoid. Coarse microcline at upper right. Biotite with strongly sericitized sericite in belt running diagonally across the centre. Quartz and muscovite to left. Width of field: approximately 10 mm. (Photograph taken using the Bertrand lens as objective).
A: Ordinary light

B: Crossed nicols

Fig. 5. E058-003-39.57/01. Sulphide-bearing tremolite-quartz gneiss. The opaque mineral is sulphide, and has tremolite associated with it. The tremolite-sulphide foliation noted in the report is vertical, whereas the quartz shear fabric runs diagonally across the photograph (see right side of Fig. 5B). Width of field: 2.5 mm.
A: Ordinary light

B: Crossed nicols

Fig. 6. E058-003-52.35/0.10. Magnetite pyroxenite. Note the cumulus diopside and post-cumulus magnetite. Width of field: 2.5 mm.
APPENDIX 3
PLANS

Figure 1.3 1:20 000 Geological Map, Southern Cross Bore Area
Figure 2.2 Drill Sections. E058-001 – E058-003
Figure 2.3 Johnnie's Reward Prospect – Structure