Geology of the Alice Springs Telegraph Station Historical Reserve

M. D. J. Derriman

Report 5
Cover photograph: Low hills of Alice Springs Granite surround the Alice Springs Telegraph Station in the valley of the Todd River.
Photograph by R.B. Thompson
Northern Territory Geological Survey
GEOLOGY of the
ALICE SPRINGS TELEGRAPH STATION
HISTORICAL RESERVE

M. D. J. DERRIMAN

REPORT 5

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SUMMARY

The Alice Springs Telegraph Station Historical Reserve and its proposed extensions (herein referred to as the Reserve) were mapped by the Northern Territory Geological Survey (NTGS) during 1985 as part of a resource assessment programme for National Parks and Conservation Reserves of the Northern Territory.

The Reserve lies on the southern margin of the Proterozoic Arunta Province, an extensive region of igneous and metamorphic rocks. Structurally the Reserve is divided into two blocks by the east-west Charles River Fault. South of the fault, the Alice Springs Block comprises the Emily Gap schist, Teppa Hill metamorphics, Sadadeen Range gneiss and Alice Springs Granite, and to the north, the Wigley Block comprises Charles River gneiss and 'unassigned gneiss'.

Within the Alice Springs Block, foliation of the Alice Springs Granite and Sadadeen Range gneiss has dominated the scenery, giving slabby continuous outcrops. Where the rocks are slightly or non-foliated jointing is the dominant factor controlling the land form, now seen as rugged terrain strewn with large rounded boulders. North of the Charles River Fault, where jointing is not so prominent, the topography is more rounded, with fewer large boulders strewn over the surface. Due to the varied lithologies (quartzofeldspathic gneiss and garnet-biotite gneiss) of the Charles River gneiss, a series of east-west ridges have developed.

The Charles River Fault is the main structural feature of the Reserve. It is a reverse fault which has thrust the Wigley Block up against the Alice Springs Block. Associated with the fault is a deformed zone comprising mylonite, retrograde schist and gneiss. The metamorphic grade is generally upper greenschist to amphibolite facies, with local retrogression to lower greenschist facies adjacent to the Charles River Fault. The metamorphic grade of the exposed rocks is higher north of the fault due to a previous greater depth of burial.

INTRODUCTION

General

The Telegraph Station Park was gazetted as a Historical Reserve on the 30th June, 1978 and is managed by the Conservation Commission of the Northern Territory. Westerly and northerly extensions are proposed so that the Reserve will have a common boundary with Simpson Gap National Park (Figure 1).

This report provides information on the geological and mineral potential of the Telegraph Station Historical Reserve for possible use in future management plans.

The geology of the Reserve was mapped during the period from July to October 1985 by the author using 1:15 000 scale coloured aerial photographs flown in 1980. Investigations included traverses and outcrop sampling. Thin section preparation was carried out by Pontifex and Associates, while Amdel carried out all whole-rock chemical analyses and some thin section preparation.

The aim was to produce a lithological map at 1:25 000 scale. At the scale of presentation, outcrop areas less than 15 square metres could not be clearly shown, and in such areas rock types are listed on the map in decreasing order of abundance.

Stratigraphic subdivisions and nomenclature are based upon work conducted by the Bureau of Mineral Resources (BMR) as shown on the Alice Springs Regional 1:100 000 geological map sheet which was published in 1983. The present report provides detailed lithological information on the various stratigraphic units (Table 1).

Location

The Telegraph Station Historical Reserve occupies an area of approximately 50 square kilometres on the northern fringe of Alice Springs. The Reserve straddles the Stuart Highway and extends 6 km north-south and 11 km east-west (Figure 1). This area occupies the central southern portion of the Alice Springs 1:100 000 map sheet.

Climate

The climate is arid, with most of the rainfall confined to the period November to March, when rainfall averages 35 mm per month. For the remainder of the year, the average per month is 12 mm.

Temperature variations follow a similar pattern to rainfall, with the highest temperatures occurring in the period November to March. Average daily temperatures during this period are around 34°C, frequently with maxima over 40°C. The remainder of the year is relatively cool, with average daily temperatures of 22°C. Night frost is general in winter.

Vegetation

The main vegetation types are the perennial drought-resistant plants, which remain in a generally dormant state throughout droughts and resume growth after periods of rain. Within the Reserve the main plant species are Acacia aneura (mulga tree), Acacia kempeana (Witchetty bush), Eucalyptus camaldulensis
Table 1 Stratigraphy of Alice Springs Telegraph Station Reserve.

<table>
<thead>
<tr>
<th>UNIT, MAPSYMBOL AND LITHOLOGY</th>
<th>FIELD RELATIONSHIP</th>
<th>DISTRIBUTION</th>
<th>ENVIRONMENT DURING FORMATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAINozoic QUATERNARY Alluvium (Qa)</td>
<td>Drainage channel alluvium</td>
<td>Throughout reserve in well defined channels</td>
<td>Terrestrial</td>
</tr>
<tr>
<td>Soil (Qr) Clayey and sandy soil</td>
<td>Adjacent to rock outcrop</td>
<td>Broad distribution over flat to undulating plains</td>
<td>Terrestrial</td>
</tr>
<tr>
<td>PALaeozoic CARBONIFEROUS Deformed Zone (d) Schist, gneiss, mylonite</td>
<td>Concordant contact with Charles River gneiss</td>
<td>Linear zone along Charles River Fault</td>
<td>Greenschist facies dynamothermal metamorphism</td>
</tr>
<tr>
<td>PROTEROZOIC LATE PROTEROZOIC</td>
<td>Intrusive into all Proterozoic stratigraphic units</td>
<td>N-S trending dykes, throughout Reserve</td>
<td>Hypabyssal</td>
</tr>
<tr>
<td>Stuart Dyke Swarm Dolerite</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MIDDLE PROTEROZOIC? Pegmatite and quartz veins (peg)</td>
<td>Intrusives confined mainly to metamorphic rocks south of the Charles River Fault</td>
<td>Veins confined mainly to southern part of Reserve</td>
<td>Hypabyssal</td>
</tr>
<tr>
<td>Unclassified mafics (Egb) Gabbronorite</td>
<td>Intrusives into Charles River gneiss</td>
<td>Restricted to northern part of Reserve</td>
<td>Plutonic</td>
</tr>
<tr>
<td>Alice Springs Granite (Ega) Granite</td>
<td>Intrusive into Sadadeen Range gneiss</td>
<td>Restricted to central-southern part of Reserve</td>
<td>Plutonic</td>
</tr>
<tr>
<td>EARLY PROTEROZOIC? HAYES METAMORPHIC COMPLEX Sadadeen Range gneiss (p€pd)</td>
<td>Interlayered with Alice Springs Granite</td>
<td>Southern part of Reserve, flanking Alice Springs Granite</td>
<td>Plutonic and metamorphic</td>
</tr>
<tr>
<td>Teppa Hill metamorphics (p€pt) Quartz-rich metasediment and amphibolite</td>
<td>Conformable contact with Sadadeen Range gneiss</td>
<td>Restricted to SW corner of Reserve</td>
<td>Sedimentary, hyabbyssal and metamorphic</td>
</tr>
<tr>
<td>Emily Gap schist (p€pe) Schist</td>
<td>Conformable contact with Sadadeen Range gneiss</td>
<td>SE corner of Reserve</td>
<td>Sedimentary and metamorphic</td>
</tr>
<tr>
<td>Unassigned gneiss (p€) Gneiss and amphibolite</td>
<td>Conformable contact with Charles River gneiss</td>
<td>NW corner of Reserve</td>
<td>Plutonic and metamorphic</td>
</tr>
<tr>
<td>Charles River gneiss (p€Eq) Gneiss and amphibolite</td>
<td>Faulted contact with units south of Charles River Fault</td>
<td>Major unit north of Charles River Fault</td>
<td>Sedimentary, plutonic and metamorphic</td>
</tr>
</tbody>
</table>

(river red gum), Hakea subera (corkwood trees) and Triodia spp. (spinifex grasses).

Mulga trees up to 7 m high occur on flatish areas adjacent to the granitic and gneissic hills, where they occur on medium to coarse textured red soils. Witchetty bushes are more common on slightly elevated ground above the flats, where the water supply is more erratic. They may grow as high as 2.5 m.

Stands of river red gums up to 10 m high occur along the banks of the Charles and Todd Rivers, while away from the rivers, sparsely distributed corkwood trees up to 5 m high are interspersed with mulga and witchetty bushes.

Ground cover consists of sparse grasses, with isolated patches of spinifex.

Geomorphology

The geomorphology of the Reserve can be divided into two units separated by the trace of the Charles River Fault trending approximately east-west through the area.

South of the fault, foliation within the Alice Springs Granite and Sadadeen Range gneiss has dominated the geomorphological development giving slabby continuous outcrops. Where the rocks are slightly to nonfoliated, jointing is the dominant controlling factor, resulting in rugged terrain strewn with large rounded boulders. In areas which contain foliated rocks, outcrops are more continuous and slab-like, particularly in the Teppa Hill metamorphics, Sadadeen Range gneiss and the periphery of the Alice Springs Granite.
North of the Charles River Fault, where jointing is not as prominent, topography is more rounded, with fewer large boulders strewn over the surface. Due to differential weathering of lithologies within the Charles River gneiss, a series of east-west ridges have developed, the ridges consisting of the more resilient quartzofeldspathic gneiss with intervening valleys of biotite gneiss and garnet-biotite gneiss. The valleys of the Charles and Todd Rivers are shallow and narrow except around the Telegraph Station where the latter has widened to a small flat-floored basin.

Soils
Very thin soils (Plate 1) are poorly developed on the rugged slopes of the granitic and gneissic hills which are mainly bare rock with pockets of soil.

Between the hills, red clayey sands with well developed profiles occur. The extent of the soils is influenced by rocks which were weathered and leached during an earlier, more humid erosion cycle.

PREVIOUS WORK
Geological investigations of the region have been carried out intermittently since the late Nineteenth Century when East noted the Arunta Basement on a trip to the Harts Range in 1889. Mawson and Madigan introduced the term 'Arunta Complex' in 1930 for rock 'vastly older than the Heavitree Quartzite'. The first major investigation of the region was a land research study carried out by Perry of the CSIRO in 1963, part of which included the investigation by Quinlan and Ryan (Perry, 1963) on the geology.

In 1964, the Bureau of Mineral Resources, Canberra, began mapping in the vicinity of Alice Springs as part of their regional programme over the Arunta Province. The mapping was continued until 1979 by various workers and results were published in 1983 by Offe and Shaw. The stratigraphic sub-divisions developed will be used in this report. In the early 1960's the BMR flew regional gravity and magnetic traverses which culminated in the production of 1:250,000 geophysical maps of the Alice Springs Region.

Several detailed studies have been carried out for the proposed Todd river dam which was to be sited approximately 400 m upstream from the Old Alice Springs Telegraph Station. The first study by Faulks (1965) included detailed mapping and the drilling of several holes. More recently, Freeman (1981) carried out detailed mapping and selective geochemical sampling at a scale of 1:2 500, centred on the area of proposed inundation.

A preliminary geological report of the Telegraph Station Historical Reserve by Horsfall (1982) included aerial photo interpretation, geological traverses and selective outcrop sampling.

From mid-1982 until mid-1984 the Railway Investigation Unit of the Northern Territory Geological Survey carried out a feasibility study (Alkemade, 1984) for the proposed Darwin-Alice Springs line. The study involved geological mapping of the route at 1:5 000, diamond drilling and rock stability tests, in a north-south corridor west of the Stuart Highway.

From June to October in 1983 and 1984, Obee and White (1985) studied various mylonite zones associated with the dominant east-west faulting. Part of that study involved the mylonites of the Charles River Fault.

REGIONAL GEOLOGICAL SETTING
The Telegraph Station Historical Reserve lies on the southern margin of the Arunta Province (map, end pocket), a region of igneous and metamorphic rocks first deposited, intruded and metamorphosed between 2300 and 1750 million years ago (Ma), and which extends northwards for 300 km and for 800 km in an east-west direction. The rocks of the Arunta Province have been placed into three broad lithological groupings, called divisions, with the rocks within each division being tentatively regarded as stratigraphic correlatives.

Division 1 rocks crop out principally in the central tectonic zone of which the Narrib block is a part (Figure 2) and are characterised by felsic and mafic rocks which typically have been metamorphosed to granulite facies. These rocks have been interpreted by the BMR (Shaw and others, 1979, p.11) as a metamorphosed sequence of acid and basic volcanics, with small proportions of volcanioclastic rocks, and of intercalated pelitic and calcareous sediments. Division 1 rocks have undergone multiple folding and migmatisation and are considered to form the basement to the other rock sequences in the Arunta Province. Division 2 rocks in the northern and central tectonic zones consist mainly of metamorphosed mudstone, metamorphosed sandstone and calcareous rocks which have a higher degree of sedimentary reworking, contain less felsic material, and have a smaller proportion of meta-igneous rocks than Division 1. In the southern tectonic zone, near Alice Springs, Division 2 rocks are more quartzofeldspathic (incuding orthogneiss) and are thought to represent a sedimentary facies transitional with Division 1. The youngest rocks of the sequence, Division 3, consist of weakly metamorphosed shallow-water sediments, which, west of Alice Springs, consist of a local basal metaconglomerate overlayer by metasandstone, overlain by quartzite intercalated with schist. The rocks within the Reserve have been assigned to Division 2, and have been intruded by granite, gabbronite, dolerite and pegmatite.
Structurally, the Reserve is divided into two blocks by the Charles River Fault, which has a strike length of approximately 50 km (Figure 2). North of the fault, the Wigley Block comprises Charles River gneiss and 'unassigned' gneiss', while to the south, the Alice Springs Block comprises Emily Gap schist, Teppa Hill metamorphics and Sadadeen Range gneiss. The metamorphically higher-grade Wigley Block has been thrust up over the Alice Springs Block due to movement on the Charles River Fault, a high-angle reverse fault.

The igneous rocks were intruded during at least three periods. The Alice Springs Granite appears to have a sill-like relationship with the Sadadeen Range gneiss and occupies an area of approximately 12 square kilometres south of the Charles River Fault which has cut off any adjacent northern extension. A slice of granite exposed to the north of the Blatherskite Range, outside the Reserve, has been interpreted as an overthrust slice of this granite. Several small mafic intrusions crop out within the Charles River gneiss, the largest of which, 0.15 square kilometres, is located adjacent to Wigley's waterhole. Prominent white outcrops of pegmatite and vein quartz, confined mainly to the Alice Springs Block, are randomly oriented and can be up to 60 m in width. Dolerite dykes of the Stuart Dyke Swarm occur extensively within both blocks and are oriented approximately north-south. The dykes have been dated as 897±9 million years by Black and others (1980). This represents an older age limit for the unconformably overlying Heavitree Quartzite, the basal formation of the Amadeus Basin sequence.

During the Carboniferous Alice Springs Orogeny (335-312 million years ago), movement along the Charles River Fault resulted in formation of linear...
deformed zone. This deformed zone is up to 300 km wide and several kilometres long, with the southern margin defined by a zone of mylonites. Pervasive sausurisisation accompanied widespread metamorphism associated with this orogeny.

STRATIGRAPHY

EARLY PROTEROZOIC

Charles River gneiss (p-q)

The Charles River gneiss is an east-west trending metamorphic assemblage occurring in the northern half of the Reserve. The boundaries are faulted, except in the west, where the gneiss is in conformable contact with the 'unassigned gneiss'. The reference area is located 10 km north of Alice Springs, grid reference 846882 (Alice Springs 1:100 000 geological map), and the rocks were defined as banded garnet-biotite gneiss, quartzofeldspathic gneiss and amphibolite by Shaw and others (1979). Within the Reserve, the Charles River gneiss consists dominantly of garnet-biotite gneiss and quartzofeldspathic gneiss with lesser biotite gneiss, garnet gneiss, amphibolite and biotite-garnet-tremolite gneiss. Garnet-biotite gneiss (Plate 2), often with a banded appearance, is the major rock type, with the other rock types occurring as lenses within it. Lenses of garnet-biotite gneiss also occur locally within the quartzofeldspathic gneiss.

The quartzofeldspathic gneiss and garnet-bearing quartzofeldspathic gneiss have a blocky, pale orange outcrop appearance, similar to that of a granitic terrain. They form east-west ridges due to their more resistant nature, the ridges being up to 8 m high. The quartzofeldspathic gneiss consists of pink to orange K-feldspar (25-45%), white plagioclase (25-40%) and colourless quartz (30%), with minor to trace amounts of biotite, muscovite, garnet, epidote, apatite, chlorite, and opaques. The quartzofeldspathic gneiss grades laterally into garnet-bearing quartzofeldspathic gneiss.

The biotite gneiss and garnet-biotite gneiss have a well developed foliation due to the presence of platy minerals such as mica. These gneisses form less prominent ridges up to 5 m high, between the dominant quartzofeldspathic ridges. The biotite gneiss consists of white K-feldspar (40-53%), clear quartz (35-40%) and dark grey biotite (greater than 10%) with minor to trace amounts of plagioclase, epidote and opaques. Garnet-biotite gneiss is similar and in addition contains red-brown garnets. Alignment of the crystals imparts a banded dark grey, light grey appearance to the gneisses.

One kilometre west of the Charles River Bridge is an occurrence of biotite-garnet-tremolite gneiss which forms isolated patches of outcrop, up to 0.5 m in height and several metres in diameter. This rock type has a silvery-grey sheen imparted by flakey crystals of biotite (30%) and tremolite (35%) interspersed with red-brown

Plate 2 Garnet-biotite gneiss; note large red-brown garnets.

Plate 3 Typical amphibolite outcrop with white feldspar laths visible in a black amphibolite matrix.
garnets (35%) up to 1 cm in across. This gneiss has a prominent foliation which dips steeply to the NW.

Amphibolites generally form recessive units between the gneissic ridges. They have a blocky appearance with a 'salt and pepper' colouration (Plate 3), due to the presence of equigranular white plagioclase (25-40%) and green-grey hornblende (50-70%) with minor to trace amounts of quartz, chlorite, zircon and apatite. Individual hornblende and plagioclase crystals are up to 2 mm in diameter.

Partial melting of the Charles River gneiss to the east of Wigley's Waterhole has resulted in the formation of migmatites. Migmatites are dark grey and white banded rocks resulting from the segregation of mineral phases. These bands are locally highly contorted and form 'gut-like' masses known as pytgmatic folds.

**Unassigned gneiss (pC)**
The unassigned gneiss crops out in the NW corner of the Reserve (Figure 3) and has a conformable contact (Shaw and others, 1979) with the Charles River gneiss. The reference area is located 10 km NE of Simpsons Gap (GR 775849) and contains banded biotite gneiss and quartzofeldspathic gneiss. Within the Reserve the unassigned gneiss consists of garnet-biotite gneiss (Plate 4), biotite gneiss, porphyroblastic gneiss and quartzofeldspathic gneiss with lesser amphibolite. The unassigned gneiss is a conformably layered sequence of
gneisses containing lenses of amphibolite. Within the unassigned gneiss the biotite gneiss is banded, with individual grey and white bands up to several centimetres wide.

The porphyroblastic gneiss (Plate 5) is the only rock type that differs from those occurring within the Charles River gneiss and thus is diagnostic of the unassigned gneiss. It is also distinguished from the Charles River Gneiss by a scarcity of migmatises. This gneiss consists of white K-feldspar porphyroblasts (45%) up to 7 cm in diameter in a matrix of quartz (30%), plagioclase (20%) and minor biotite (5%). The porphyroblastic gneiss forms small ridges up to 2 m high trending NE-SW.

Emily Gap schist (pœpe)
The Emily Gap schist crops out as a series of low rounded hills in the east of the Reserve (Figure 2). The reference area occurs 5 km east of Alice Springs (GR 905800) where it comprises biotite schist and muscovite schist with lesser quartzite, amphibolite and quartzofeldspathic gneiss (Appendix 1). The biotite and muscovite-biotite schists cannot be separated at the scale of mapping and so are classified together. Within the schists are local lenses of quartzite, amphibolite and quartzofeldspathic gneiss.

The biotite and muscovite-biotite gneisses have a prominent foliation that dips steeply to the west. The biotite schist has a dark grey sheen imparted by the alignment of biotite flakes and consists of quartz grains (45-50%) up to 1 cm in diameter in a matrix of dark grey biotite (>10%) and plagioclase (30-40%). This gneiss grades laterally into muscovite-biotite schists with the occurrence of light grey flakes of muscovite. Together, the schists form small rounded hills up to 3 m high.

The light grey quartzites have a blocky appearance and form conformable lenses up to 0.5 m wide (Plate 6) within the schists. Locally they are compressed into oval shaped lenses known as boudins, which indicate that the quartzites behave more competently to applied stresses than did the schists. The quartzites contain pre-
Plate 6 Emily Gap schist; interlayered schist and white quartzite (boudinaged).

Plate 7 Sadadeen Range gneiss; interlayered foliated biotite augen gneiss and massive quartzofeldspathic gneiss.
dominant quartz with minor trace muscovite, biotite and sericite.

The amphibolite lenses within the Emily Gap schist are concordant with the schists and have a dark grey blocky appearance and a weakly developed foliation. The local occurrence of quartzofeldspathic gneiss is discordant and forms small isolated outcrops up to 0.5 m in diameter.

**Teppa Hill metamorphics (p9pt)**
The Teppa Hill metamorphics are a suite of northerly trending metasediments and amphibolites which occur as a series of low rounded hills in the SW corner of the Reserve (Figure 3). The suite is bounded by the Charles River Fault in the north and is in conformable contact with the Sadadeen Range gneiss in the east and west. The reference area is located approximately 3 km west (GR 818785 to GR 826792) of Alice Springs.

The dominant metasediment is a quartz rich rock containing bands of meta-arkose, biotite schist and muscovite-biotite schist. The metasediments form north-south striking ridges up to 5 m in height, with jointing producing a blocky outcrop appearance. The minor schists have a more foliated appearance because they are richer in micas. The metasediments are fine grained, pale grey rocks consisting predominantly of quartz with minor feldspar and muscovite, the muscovite providing a surface sheen.

The amphibolites are blocky, dark grey rocks and generally have a conformable contact with the metasediments. They form ridges up to 2 m in height and have a north-south trend.

**Sadadeen Range gneiss (p9pt)**
The Sadadeen Range gneiss occurs south of the Charles River Fault (Figure 3) and consists of low ridges with flaggy rock outcrop. Shaw and others (1979) nominated a reference area at GR 865775, describing it as being dominantly orthogneiss, herein referred to as a biotite augen gneiss of igneous derivation. Within the Reserve, the Sadadeen Range gneiss is dominantly a biotite orthogneiss (Plate 7) with minor interlayered quartzofeldspathic gneiss, muscovite gneiss, quartzite, meta-arkose, hornblende gneiss, biotite schist, muscovite-biotite schist and epidote-feldspar rock.

The augen-bearing biotite orthogneiss forms ridges 5 m high with a north-south trend. The rocks are grey to light grey with a streaked appearance due to alignment of biotite flakes with the foliation dipping steeply (up to 80 degrees) to the west. They consist of white feldspar augens (megacrysts) up to 2 × 1 cm, flattened parallel to the foliation in a matrix of quartz, biotite and feldspar grains up to 5 mm in diameter.

The quartzofeldspathic gneiss forms conformable layers and contrasts with the augen-bearing biotite orthogneiss by having a blocky appearance (Plate 7). It

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**Plate 8** A typical outcrop of Alice Springs Granite illustrating the surface weathering.
contains quartz (20-45%), K-feldspar (25-45%) and plagioclase (15-50%) with minor to trace biotite, muscovite, epidote, zircon and opaques. The rock type grades into muscovite gneiss, which has a similar outcrop pattern.

The quartzite occurs as thin bands up to 5 cm thick with a blocky appearance and pale grey colouration. The rock locally contains trace muscovite, imparting a slight foliation.

Meta-arkose occurs as low ridges up to 0.5 m high and with a north-south trend. It is a cream-coloured rock with a blocky appearance and consists of K-feldspar (50%), quartz (47%) with minor plagioclase and biotite.

The hornblende gneiss occurs to the east of the Alice Springs Granite as a discontinuous lens up to 40 m wide. It is a pale grey rock with dark grey concentrations of hornblende imparting a streaked appearance. The gneiss consists of white plagioclase (63%), green-grey hornblende (20%), white K-feldspar (15%) with traces of apatite and rare opaque minerals.

Muscovite-biotite schist and biotite schist form small ridges up to 3 m high and display a prominent foliation dipping steeply to the west. They grade into one another and occur as lenses within the augen bearing biotite orthogneiss. When viewed in thin section these rocks can be seen to contain quartz (40%), muscovite (up to 15%), biotite (up to 20%), plagioclase (15%) and minor K-feldspar.

Epidote-feldspar rock occurs west of the Alice Springs Granite as a cluster of hills 250 m in diameter, with individual hills having a vertical relief of up to 5 m. It consists of a mass of pink K-feldspar crystals (50%) in a matrix of green epidote (45%) and minor plagioclase.

Plate 9 Pervasive green epidote alteration of the pink and white Alice Springs Granite.

PEGMATITE (peg)

Pegmatites occur as veins which have resisted erosion and now stand out conspicuously as white ridges up to 1.5 m high and up to several hundred metres in length and are most common south of the Charles River Fault. The largest pegmatite vein is 60 m wide and over 400 m long and occurs near the eastern boundary of the Alice Springs Granite (GR 829832).

The pegmatites are mainly composed of equal amounts of quartz and feldspar with or without biotite, muscovite, magnetite, garnet and epidote. Preferential weathering of the feldspars has given the rock a rough surface. Boundaries of the pegmatites are usually sharp, but within the granite they are often diffuse.

The pegmatites are locally cut by the dolerites of the Stuart Dyke Swarm, and according to Shaw and others (1979) the metamorphic event accompanying the Ormiston phase of deformation may have homogenised the Jessie Gap gneiss (Figure 3) and generated the pegmatite veins marginal to the gneiss, and near the Alice Springs township.

VEIN QUARTZ

The quartz veins (Plate 11) are spatially related to the pegmatite veins, with one often merging into the other. They occur as broken lines of rounded white boulders up to 1.5 m in diameter, and are randomly oriented with respect to the pegmatites. Freeman (1981) reported several in the area east of the Telegraph Station as being ferruginous, vuggy and discordant to the foliation of the host rock. Because of their distribution, appearance and composition, it is considered they were emplaced with the pegmatite veins.
Plate 10 Contact of dark gabbronorite in foreground with pale quartzofeldspathic gneiss in background.

Plate 11 Quartz vein aligned with foliation of Sadadeen Range gneiss.
LATE PROTEROZOIC

Stuart Dyke Swarm
The Stuart Dyke Swarm (Black and others, 1980) is a suite of near-vertical to vertical dolerite dykes (Plate 12) up to 4 m wide and several hundred metres long. They usually occur as small ridges up to 1.5 m high with the exception of a large dyke (20 m wide and 1500 m long) which occurs on a ridge with a vertical relief of up to 10 m.

The dark grey dolerites consist of plagioclase (60-70%) and clinopyroxene (15-37%) with minor magnetite and traces of biotite, orthopyroxene and epidote. The epidote also occurs as a thin veneer coating some joint surfaces. The margins of the dykes are often foliated and deformed (Plate 12) as seen at Wigley’s Waterhole (GR 858861).

Intrusion of medium-grained dolerite into the Sadadeen Range gneiss has resulted in a contact aureole 10 m wide surrounding the dolerite. The contact aureole is a granuloblastic quartz-feldspar rock resulting from the heat from the intruding dolerite. It consists of plagioclase (50%), K-feldspar (30%) and quartz (20%) with local mafic blebs (intergrowths of chlorite and epidote) and trace zircon. This rock is an alteration product of original Sadadeen Range gneiss.

CARBONIFEROUS

Deformed Zone (d)
The deformed zone is an E-W linear body up to 300 m wide with vertical relief of up to 10 m. This zone occurs adjacent to the Charles River Fault (Figure 4) and comprises interlayered mylonite, mylonitic gneiss and muscovite schist. Contacts between the rock types are gradational, with individual rock types occupying areas too small to be shown on the map.

Mylonites (Plate 13) develop in zones of intense strain and as such define the extent of the Charles River Fault. The mylonite zone is up to 20 m wide in places and comprises quartz (up to 50%), K-feldspar (15-45%), plagioclase (up to 55%) and magnetite (up to 35%) with traces of biotite, muscovite, chlorite and epidote. The individual quartz grains are usually pulled out

Plate 12 Contact of dark grey dolerite with light grey Charles River gneiss; note the foliated and deformed margin.

Plate 13 Mylonite zone associated with movement of the Charles River Fault.
into ribbons, with finegrained recrystallisation occurring around their margin. In contrast, the feldspar has developed fractures perpendicular to the foliation, the foliation being enhanced by the growth of tabular minerals. The grainsize of the mylonites is very fine, with individual grains being less than 1 mm in diameter.

Away from the zone of most intense strain, mylonitic gneisses and schists develop with the mineralogy being similar to that of the mylonites but slightly coarser grained. The foliated deformed zone rocks have a foliation dipping to the north at 40°-70°. (Plate 14)

**Altered rocks**

Pervasive saussuritisation has affected all rock types and represents retrograde alteration brought about by the Alice Springs Orogeny. This alteration is primarily a replacement of plagioclase by epidote and sericite (Plate 9).

**QUATERNARY**

**Clayey and Sandy Soil (Qr)**

The soils are red, and have developed adjacent to outcrops of metamorphic rocks. These soils are generally sandy, but locally have an increased clay content where adjacent to the rivers and streams; elsewhere soils are very thin.

**Alluvium (Qa)**

Pebble, sand, silt and clay are deposited in the major rivers and creeks. Most alluvium is medium-grained silty sand and is poorly sorted.

**STRUCTURE**

**Faulting**

Faulting within the Reserve (Figure 4) is dominated by east-west reverse faults, of which the Charles River Fault is the most dominant. This fault separates the Wigley Block in the north from the Alice Springs Block in the south (Figure 3). The Charles River Fault is a high-angle (40°-70°) reverse fault defined by a mylonite zone up to 20 m wide (Plate 13). The Charles River Fault has been offset in the west of the Reserve by NW-NE trending strike-slip faults (Figure 4). These faults show a sinistral sense of movement and are defined by zones of brecciation up to 3 m wide. Other strike-slip faults occur within the Reserve, but they do not merge with the Charles River Fault.

North of the Charles River Fault a series of east-west and NE-SW reverse faults are found but unlike the Charles River Fault they are not associated with a wide zone of mylonite development. These reverse faults are defined by narrow mylonite zones up to 5 m wide. At one locality a NE-trending strike-slip fault is offset by one of these northerly reverse faults.

The cross-cutting strike-slip faults and minor thrust faults occurred after the Alice Springs Orogeny, and indicate isostatic readjustment of the Alice Springs Block and Wigley Block due to sediment unloading caused by erosion.

**Folding**

Folding ranges from open, gently plunging folds to pytgmatic folds associated with the migmatites at Wigley’s...
Waterhole. A well developed regional foliation, which is best developed in biotite-rich units, is regarded as evidence of axial plane foliation developed in folds. Analysis of the folding was made using a total of 130 field measurements.

There are three major deformation events that are readily recognisable within the Alice Springs and Wigley Blocks (Shaw and Wells, 1983). The intensity of the deformations varies between the blocks. The deformational episodes are inferred to be the Aileron Event, Ormiston Event and Alice Springs Orogeny.

The Aileron Event (1700-1600 million years ago) affected both the Alice Springs and Wigley Blocks and produced tight folds accompanied by recrystallisation and development of an axial plane fabric (Shaw and Wells, 1969). The Emily Gap schist outlines a tight NW-plunging overturned synform, with lineation plunges varying from SW to NW across the fold. A NE-plunging overturned antiform within the Charles River gneiss (GR 840799) is a further example of deformation during the Aileron Event. This fold has lineation plunges varying from NW to NE across the fold.

The Ormiston Event (1100 to 1000 million years ago) produced open, upright folds, with westerly plunges and local migmatisation of the Charles River gneiss. The effects of this event are seen in the area west of Wigley's Waterhole. Several easterly plunging folds occur within the reserve, with shallow plunges of between 5° and 30°. The migmatites show well-developed pytymatic folding consisting of flow folded quartzofeldspathic layers within a biotite gneiss. The migmatites crop out east of Wigley's Waterhole.

The Alice Springs Orogeny (335 to 312 million years ago) produced mylonites, retrograde schists and gneisses within the Charles River Fault which dips steeply (40°-70°) to the north.

**Figure 4** Sketch map of faulting in Reserve showing directions of movement.

**Jointing**

Joints are well developed within all the quartzofeldspathic rock types (Plate 15), but less so in the more foliated rocks. Field analysis revealed four prominent joint trends, 280° (joint trends as magnetic bearings), 315°, 255° and 055° (Figure 5). Dips on the joints are usually steep (50°-70°), with the dip direction varying. Several conjugate joint sets occur, and indicate varying directions of major stress. The major joint sets trend 280°-355°, 315°-050°, 280°-050°, 355°-315° and 355°-050°. Major stress directions obtained from these conjugate sets indicate a north-south stress for the 315°-050° and 280°-050° sets, a NE-SW stress for the 280°-355° sets and a NW-SE stress for the 355°-050° set (Figure 4).

The Stuart Dyke Swarm trends predominantly 355°, with some dykes trending 315°. These trends indicate a major NE-SW stress direction. Epidote coats many of the joints, and was introduced as a hydrothermal fluid during the Alice Springs Orogeny. The N-S, NW-SE and NE-SW stress directions were in response to tectonic movement on the Charles River Fault, and the NE-SW stress direction provided a channelway for the intrusion of the Stuart Dyke Swarm and was later reactivated by the Alice Springs Orogeny.
Figure 5 Rose diagram of total joint set showing directional preferences (75 measurements).

METAMORPHISM

The Reserve contains rocks of three metamorphic facies. North of the Charles River Fault, the Charles River gneiss and ‘unassigned gneiss’ have been metamorphosed to amphibolite facies during the Aileron Event. South of the fault, Aileron Event metamorphism reached the upper greenschist to amphibolite facies. The Alice Springs Orogeny resulted in pervasive retrograde metamorphism to greenschist facies of rocks adjacent to the Charles River Fault, and locally away from the fault.

According to Vernon (1976, chpt. 1), the lower boundary of the amphibolite facies is taken as the first appearance of hornblende; therefore the units north of the Charles River Fault can be assigned an amphibolite grade. The mineral assemblages north of the Charles River Fault suggest maximum pressure/temperature conditions of approximately 500-600 megapascals and 650°C once prevailed, and that localised partial melting of the gneisses (Ormiston Event) produced the migmatites (Plate 16) in situ. According to Winkler (1967, chpt.3), if a normal geothermal gradient of 30°C/km, is assumed, then the original depth of burial for the Charles River gneiss was of the order of 20 km.

The diagnostic rock types south of the Charles River Fault, muscovite schist and amphibolite, indicate that prograde metamorphism reached lowermost amphibolite facies. The occurrence of quartzofeldspathic gneiss empirically supports this conclusion. However, the widespread occurrence of chlorite implies that a later retrograde metamorphism to greenschist facies has occurred. These two events are correlated with the Aileron Event (Black, Shaw and Stewart, 1983) and the Alice Springs Orogeny respectively. The general absence of migmatite-like rocks

Plate 15 Prominent jointing in Sadaeen Range gneiss.
Plate 16 Migmatite from Wigley’s Waterhole; note pygmatic folding and white patch of partially melted rock cross cutting the foliation.

implies that the rocks south of the Charles River Fault were unaffected by the Ormiston Event.

The mineral assemblages south of the Charles River Fault suggest maximum pressure/temperature conditions of approximately 350-400 megapascals and 450-550°C, indicating a depth of burial of the order of 15 to 18 km.

The Charles River Fault occurs as a 300 m wide deformed zone which consists mainly of mylonite, mylonitic gneiss and muscovite schist. Mineral assemblages in these rocks consist of quartz + plagioclase + K-feldspar + chlorite + biotite + epidote + muscovite + sericite with alteration of plagioclase to sericite and epidote and of biotite to chlorite. This assemblage implies that pressure/temperature conditions of 200 megapascals and 250-400°C were achieved, and are values characteristic of lower to middle greenschist facies. This retrograde event is correlated with the Alice Springs Orogeny (Shaw and others, 1979).

Analyses of seven amphibolite samples from the Alice Springs Telegraph Station Historical Reserve (Derriman, 1986) indicate that they originated from basic igneous rocks, possibly dykes or sills. Two dolerite samples were also collected to determine if there were any chemical differences between the common fine-grained dolerite and the rare medium grained dolerite which occurs at the western boundary of the Alice Springs Granite. Results indicate they are chemically similar, the differences are likely to be due to the enrichment in minerals such as magnetite and apatite.

GEOLOGICAL HISTORY

During the early Proterozoic (2300-2000 million years ago, Windrum, 1983) widespread subsidence is postulated to have resulted in the formation of a east-west trending trough. Deposition within this trough consisted of clays, silts, silty sands and minor calcareous sediments, while intermittent volcanic activity introduced lavas and ejectamenta. This sedimentation and volcanic activity was the precursor for the Charles River gneiss, unassigned gneiss, Emily Gap schist and Teppa Hill metamorphics. Several thick sills of intermediate composition (Sadadeen Range gneiss) intruded into the sediments and subsequently gouged out pieces of the host rock.

Subsequent metamorphism resulting from deep burial of the volcanics and sediments produced a sequence of meta-sedimentary and meta-igneous rocks. During this period granite was intruded (Alice Springs Granite) and the sequence was disrupted by folding and faulting. At deeper levels in the crust the heat dispersed when the granite was intruded, partially melting the minerals of the host rock resulting in the formation of migmatises, while nearer the surface pegmatites and quartz veins were intruded into the host rocks.

Dolerite dykes (Stuart Dyke Swarm) were intruded at about 897 million years ago (Black and others, 1980) into north-south trending joints, which resulted from an applied stress field, probably oriented NE-SW. The same authors deduce the Stuart Dyke Swarm places an older age limit for the unconformably overlying Haevtree Quartzite, the basal unit of the Amadesa basin sequence.

During the most recent metamorphic event, the Alice Springs Orogeny (335-312 million years ago, Armstrong and Stewart, 1975), movement on the Charles River Fault resulted in the development of an extensive deformed zone of mylonite and mylonitic gneisses which define a prominent scarp trending east-west across the Reserve. The scarp defines the boundary of the Alice Springs Block to the south and the Wilye Block to the north (Figure 3). Subsequent to the uplift, erosion of the sequence resulted in the present land surface and soil cover.

MINERAL POTENTIAL

Semi-precious minerals
Unakite (epidotized granite), an attractive rock consisting of epidote, feldspar and minor quartz, is widespread adjacent to the margins of the Alice Springs Granite. A similar rock, consisting entirely of epidote and feldspar, occurs 800 m west of the Alice Springs Granite within the Sadadeen Range gneiss.

Construction materials
The development of the Todd River sand is an aggregate source has been inhibited by environmental considerations.

Several areas towards the centre of the Alice Springs Granite may be considered as sources of aggregate. Drilling to 10 m indicated that in places the granite is relatively competent.

Groundwater
Limited groundwater resources are probably present within the Reserve, generally as small, irregular aquifers. The Reserve contains two semi-permanent waterholes, one at Wigley’s, the other at the site of the old Alice Springs Telegraph Station. Both waterholes are in the Todd River, with the waterhole at Wigley’s containing a relatively impermeable clayey layer beneath the river sands and gravels, while the waterhole at the Telegraph Station is underlain by rock.

ACKNOWLEDGEMENTS

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REFERENCES


### Appendix 1: Field Description of Lithologies

<table>
<thead>
<tr>
<th>Lithology</th>
<th>Structural Features</th>
<th>Textural Features</th>
<th>Weathering Features</th>
<th>Macro Features</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amphibolite (a)</td>
<td>Jointing/fracturing dominant; blocky appearance</td>
<td>Equigranular rock consisting of hornblend and plagioclase crystal up to 2 mm in diameter</td>
<td>'Salt and pepper' appearance due to weathering of plagioclase to clay and the relatively fresh appearance of hornblende.</td>
<td>Subdued outcrop due to low resistance to weathering</td>
<td>Valley forming lithology; See Plate 3</td>
</tr>
<tr>
<td>Meta-arkose (ak)</td>
<td>Jointing-fracturing prominent; blocky appearance; slight development of foliation</td>
<td>Equigranular rock consisting of quartz; K-feldspar and plagioclase, crystals up to 1 mm in diameter</td>
<td>Fresh rock has cream colouration; pale orange when weathered.</td>
<td>Low ridges up to 0.5 m in height with a N-S strike</td>
<td>Conformable with quartz-rich metasediment and augen bearing biotite orthogneiss</td>
</tr>
<tr>
<td>Biotite gneiss (b)</td>
<td>Foliation of rock is dominant due to presence of platy minerals.</td>
<td>Quartz and K-feldspar crystals up to 5 mm in diameter with intervening flakes of biotite (less than 1 mm)</td>
<td>Fresh rock is dark grey; with an orange/brown colouration imparted on weathering.</td>
<td>Ridges up to 5 m in height with an E-W strike</td>
<td>Bordered by higher quartzofeldspathic ridges; usually has a banded appearance</td>
</tr>
<tr>
<td>Undifferentiated</td>
<td>Near vertical foliation is dominant imparting a schistose appearance.</td>
<td>Highly strained rock with minerals flattened and stretched; grain size is usually up to 1 mm.</td>
<td>Fresh rock is dark grey due to iron-rich minerals; weathering produces an orange tint.</td>
<td>Dominant E-W scarp up to 10 m high.</td>
<td>Surface expression of Charles River Fault; See Plate 14</td>
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<tr>
<td>deformed rocks (d)</td>
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<tr>
<td>Epidote-feldspar</td>
<td>Jointing/fracturing prominent; slight development of foliation</td>
<td>Pink feldspar augen up to 2 cm long in a matrix of epidote; porphyritic rock</td>
<td>Pink/green mottled appearance on weathered surface</td>
<td>A cluster of hills 250 m in diameter; individual hills have a vertical relief of 5 m</td>
<td>Proximity of this lithology to faults may indicate metasomatic alteration of host rock</td>
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<td>rock (e)</td>
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<tr>
<td>Quartzofeldspathic</td>
<td>Jointing/fracturing dominant; blocky rounded outcrop</td>
<td>Slightly porphyritic rock with pink K-feldspar crystals up to 5 mm in a matrix of plagioclase and quartz (up to 2 mm)</td>
<td>Orange colouration imparted by weathering of the K-feldspar; where K-feldspar is sparse the rock has a grey colouration</td>
<td>E-W ridges up to 8 m high</td>
<td>Outcrop pattern similar to that of granitic terrain</td>
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<td>gneiss (f)</td>
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<tr>
<td>Granite (g)</td>
<td>Jointing/fracturing dominant in centre; foliation dominant at peripheries</td>
<td>Medium-grained granite, slightly porphyritic; quartz, K-feldspar and plagioclase crystals up to 10 mm.</td>
<td>Rounded orange boulders typical of granite terrain</td>
<td>Tors up to several metres in diameter.</td>
<td>See Plate 8</td>
</tr>
<tr>
<td>Gabbro/norite (gb)</td>
<td>Jointing/fracturing dominant; blocky appearance</td>
<td>Equigranular pyroxene and feldspar crystals up to 5 mm in diameter</td>
<td>Orange/brown surface due to weathering of pyroxenes; preferential weathering of feldspars results in pitted surface</td>
<td>Scattered boulders up to 0.5 m in diameter.</td>
<td>Forms semi-circular bodies north of Charles River Fault; See Plate 10</td>
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<tr>
<td>Rock Type</td>
<td>Description</td>
<td>Characteristics</td>
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<tr>
<td>Hornblende gneiss (h)</td>
<td>Foliation dominant resulting in slab-like outcrop</td>
<td>Pale grey colouration with dark grey, lensoidal</td>
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<td></td>
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<td>concentrations of hornblende</td>
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<tr>
<td>Quartz-rich metametadone (j)</td>
<td>Jointing-fracturing slightly dominant over foliation; micaceous minerals impart the foliation</td>
<td>Pale grey colouration, with a surface sheen imparted by micas</td>
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<tr>
<td>Granuloblastic quartz-feldspar rock (l)</td>
<td>Jointing/fracturing dominant, forming blocky outcrop</td>
<td>Green/pale grey colouration when fresh, orange colouration on weathered surface</td>
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<tr>
<td>Migmatite (mi)</td>
<td>Jointing/fracturing dominant forming rounded, blocky outcrop</td>
<td>Predominantly grey with narrow white bands up to 1 cm thick</td>
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<tr>
<td>Augen-bearing biotite orthogneiss (o)</td>
<td>Foliation is dominant and dips steeply to the W</td>
<td>Grey/light grey streaked appearance with intermixed white feldspar augen.</td>
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<tr>
<td>Porphyroblastic gneiss (p)</td>
<td>Jointing/fracturing slightly dominant producing subrounded outcrop</td>
<td>Orange/brown with large white porphyroblasts of K-feldspar</td>
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<tr>
<td>Muscovite-biotite schist (s)</td>
<td>Foliation dominant, dipping steeply to the W</td>
<td>Khaki sheen imparted by alignment of biotite and muscovite flakes</td>
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<tr>
<td>Biotite schist (sb)</td>
<td>Foliation dominant, dipping steeply to the W</td>
<td>Dark grey sheen imparted by alignment of biotite flakes</td>
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<tr>
<td>Biotite-garnet-tremolite gneiss (sf)</td>
<td>Foliation dominant dipping steeply to the NW</td>
<td>Silvery grey sheen imparted by biotite and tremolite, fresh surface is dark grey with intermixed brown garnets</td>
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<td>Slab-like outcrop up to 0.5 m high and several metres long</td>
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<td>Conformable lens with augen bearing biotite orthogneiss; usually has a banded appearance</td>
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<td>Ridges up to 5 m in height with a N-S strike</td>
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<td>Confined to SW corner of reserve conformable with augen bearing orthogneiss</td>
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<td></td>
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<td>Minor scarp (0.5 m high) adjacent to ridge containing dolerite dyke</td>
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<td></td>
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<td>Chilled margin adjacent to dolerite dyke</td>
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<td>Ridges up to 8 m in height with an E-W strike</td>
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<td>Ridges up to 5 m in height with a N-S strike</td>
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<td>Leucocratic and melanoocratic bands up to 3 cm wide; See Plate 16</td>
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<td></td>
<td></td>
<td>Slab-like outcrops</td>
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<tr>
<td>LITHOLOGY</td>
<td>STRUCTURAL FEATURES</td>
<td>TEXTURAL FEATURES</td>
<td>WEATHERING FEATURES</td>
<td>MACRO FEATURES</td>
<td>COMMENTS</td>
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<tr>
<td>Garnet-biotite gneiss (v)</td>
<td>Foliation dominant due to presence of platy minerals</td>
<td>Quartz and K-feldspar crystals up to 5 mm in diameter with intervening flakes of biotite and garnet (up to 1 mm)</td>
<td>Fresh rock is grey with intermixed augens of garnet</td>
<td>Ridges up to 5 m in height with an E-W strike</td>
<td>Bordered by higher quartzofeldspathic ridges; with a banded appearance</td>
</tr>
<tr>
<td>Garnet bearing quartzofeldspathic gneiss (vf)</td>
<td>Jointing/fracturing dominant, blocky rounded outcrop</td>
<td>Slightly porphyritic with pink feldspar crystals up to 5 mm in a matrix of a plagioclase, quartz and garnet (up to 2 mm)</td>
<td>Orange colouration imparted by presence of K-feldspar; where K-feldspar is sparse the rock has a grey colouration</td>
<td>E-W ridges up to 8 m high</td>
<td>Outcrop pattern similar to quartzofeldspathic gneiss</td>
</tr>
<tr>
<td>Muscovite gneiss (vm)</td>
<td>Foliation slightly dominant over jointing/fracturing</td>
<td>Equigranular rock consisting of quartz, feldspar and muscovite (up to 2 mm)</td>
<td>Pale grey colouration with a sheen imparted by muscovite</td>
<td>Low ridges up to 4 m high with a N-S strike</td>
<td>Conformable with enclosing augen-bearing biotite orthogneiss</td>
</tr>
<tr>
<td>Dolerite (do)</td>
<td>Jointing/fracturing dominant, blocky rounded outcrop</td>
<td>Aphanitic rock consisting of equigranular pyroxene and feldspar up to 1 mm</td>
<td>Dark grey colouration, orange on fracture/joint surfaces</td>
<td>Small ridges up to 1.5 m high and several kilometres long</td>
<td></td>
</tr>
<tr>
<td>Pegmatite (peg)</td>
<td>Jointing/fracturing dominant, blocky rounded outcrop</td>
<td>Coarse-grained rock with feldspar, quartz and mica grains up to 15 cm</td>
<td>Preferential weathering of feldspars imparts a rough texture, usually cream to pale grey colouration</td>
<td>Small ridges up to 1.5 m high and several kilometres long</td>
<td></td>
</tr>
<tr>
<td>Quartz (q)</td>
<td>Jointing/fracturing dominant, blocky rounded outcrop</td>
<td>Coarse-grained quartz with minor feldspar and mica</td>
<td>White to cream colouration</td>
<td>Small ridges up to 1.5 m high and several kilometres long</td>
<td></td>
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</tbody>
</table>
APPENDIX 2

Localities of geological interest

Locality numbers correspond to those on the accompanying 1:25 000 geological map.

Locality 1 — GR 889859. Seismic recording stations are located in the Reserve and form part of a geophone array to record earth tremors. This station is located within quartzofeldspathic gneiss. A lens of amphibolite can be seen a few metres to the north.

Locality 2 — GR 888852. Approximately 400 m south of the recording station is a prominent east trending ridge. The ridge comprises mylonite, gneiss and schist. These rock types form part of a deformed zone, associated with movement along the Charles River Fault.

Locality 3 — GR 859859. In the vicinity of Wigley's Waterhole migmatites crop out. Migmatites are banded rocks consisting of alternating pale (leucosomes) and dark (melanosomes) layers, with the pale layers often being highly contorted, forming a 'gut-like' mass. The migmatites resulted from the partial melting of minerals at depth, during periods of increased thermal activity.

Locality 4 — GR 859852 to GR 859856. This 500 m section along the western bank of the Todd River includes the various lithologies of the Charles River gneiss, the deformed zone and Alice Springs Granite. The layered metamorphic sequence of the Charles River gneiss begins with quartzofeldspathic gneiss, and grades into biotite gneiss, amphibolite and garnet-biotite gneiss as you move southwards. Near the southern end of the traverse, the deformed zone of the Charles River Fault crops out which marks the transition from the Charles River gneiss to the Alice Springs Granite.

Locality 5 — GR 866853. Approximately 550 m east of locality 4 is a typical outcrop of the Stuart Dyke Swarm. This dyke is up to 2 m wide and occurs within a well foliated garnet-biotite gneiss. The dolerite occurs as dark brown rounded boulders up to 1 m in diameter.

Locality 6 — GR 855858. Between the former Stuart Highway and Wigley's Waterhole a large mafic intrusion is exposed. The intrusion is a gabbro-norite, which occurs as dark grey, sub-rounded boulders. The gabbronorite has in turn been intruded by pegmatite veins and (pale outcrop with irregular surface) dolerite dykes. The contact of the gabbro-norite with the quartzofeldspathic gneiss is marked by a chilled margin, a finer grained zone up to 0.5 m wide, which has resulted from more rapid cooling of the intrusion in close contact with the country rock.

Locality 7 — GR 840844. Approximately 100 m NE of the Charles River Bridge, adjacent to the former Stuart Highway, is a road-cutting exposing mylonite. The mylonite is a rock which has been highly strained. It is associated with the Charles River Fault and now consists of quartz grains pulled out into ribbons, with fine-grained recrystallisation around their margin, less deformed feldspar grains and Fe oxides. The fine-grained (0.1-1 mm) nature of the minerals imparts a dark appearance to the rock.

Locality 8 — GR 838842. The road-cutting directly south of the Charles River Bridge exposes Alice Springs Granite, which in turn has been intruded by very coarse-grained phases called pegmatites. The granite is cut by numerous faults and joints which vary in attitude from near-horizontal to near-vertical. Some joint surfaces are veneered with epidote, with local slickenside features. The granite is porphyritic and consists of quartz, plagioclase, K-feldspar and biotite ± muscovite, epidote and magnetite.

Locality 9 — GR 872816. At this locality the eastern contact of the Alice Springs Granite with the Sadadeen Range gradational. In places the granite and gneiss have been epidotized, producing a distinctive pink and green rock known as unakite.

Locality 10 — GR 869832. Intense epidotisation (sau-surtisation) of the Alice Springs Granite at this locality is due to the introduction of Ca and Fe rich fluids via faults or joints, causing metasomatism of the granite. The original igneous texture of the granite is preserved in the distribution of feldspar phenocrysts.

Locality 11 — GR 829835. The western contact of the Alice Springs Granite is marked by a dolerite dyke up to 30 m wide and 1 km long which is assigned to the Stuart Dyke Swarm. The dolerite forms the top of a northerly trending ridge and is medium-grained. The margins of the dyke have a chilled margin up to 2 m wide. The northern edge of the dyke abuts against the Charles River Fault but does not continue on the other side, indicating that movement along the fault post-dates intrusion of the dyke.

Locality 12 — GR 820831. Approximately 500m NW of the Charles River Bridge is a lens of biotite-garnet-tremolite gneiss. Individual garnet megacrysts are up to 1 cm in diameter and the tremolite and biotite, which constitute the matrix of the rock, impart a foliation to the rock. This lens is bounded to the south by amphibolite and to the north by garnet-biotite gneiss.

Locality 13 — GR 815848. A SW-trending fold axis occurs at this locality, within a garnet-biotite gneiss. It is the axis of an open fold, with the limbs, in part, being offset by later faulting.

Locality 14 — GR 832860. In the central-northern portion of the reserve (1.2 km west of the Stuart Highway), boudins of amphibolite occur within garnet-biotite gneiss. The boudins probably represent an original mafic dyke/sill which has been disrupted by later tectonism.

Locality 15 — GR 893844. In the SE corner of the reserve, within the Emily Gap schist, there is an example of a rock which behaved differently to tectonic stresses. At this locality, boudins of quartzite occur within highly deformed schists. The quartzite is a more competent unit and hence has a greater resistance to applied stresses.

Locality 16 — GR 797855. In the NW corner of the reserve is a gneiss, with porphyroblasts up to several centimetres in diameter. The porphyroblasts are composed of interlocking K-feldspar crystals.