
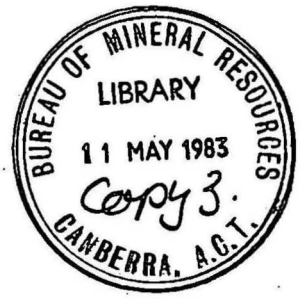


# BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

## RECORD

Record 1983/4

GEOLOGY OF THE MACDONNELL RANGES
1:100 000 SHEET AREA
NORTHERN TERRITORY

by

L.A. OFFE

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## SUMMARY

The MacDonnell Ranges Sheet area* is occupied by crystalline basement rocks of the Arunta Block nonconformably overlain to the south by sedimentary rocks of the Amadeus Basin. The Arunta rocks comprise a 20 km wide west-trending belt of amphibolite facies rocks faulted against poorly exposed granulite to the north along a major deformed zone. Deeper crustal segments are successively exposed across the Arunta area from south to north. These segments may have been brought to their present position by several faulting episodes at about 1600 m.y., 1050 m.y., and during the Palaeozoic Alice Springs Orogeny. The granulites in the north may be basement to the amphibolite facies rocks although no evidence is available to confirm this. The amphibolite facies rocks may be part of a sequence of metamorphosed and deformed sediments and acid igneous rocks. North of the Chewings Range the amphibolite facies rocks have been substantially affected by a metamorphic episode at 1053± 50 m.y., whereas in the Chewings Range and to the south they have only been slightly affected by this episode. This suggests that the rocks of the Chewings Range and to the south may have been at a higher crustal level than the amphibolite facies rocks further north during the 1053 m.y. metamorphic event or, alternatively, that the metamorphism was most intense in the north and decreased southwards.


*Hereafter all 1:100 000 Sheet areas referred to in this report will be in upper case titles.

## INTRODUCTION

MACDONNELL RANGES is bounded by latitudes 23°30'S and 24°00'S and longitudes 133°00'E and 133°30'E, about 30 km west of Alice Springs in the southern part of the Northern Territory. The Sheet area lies within the semi-arid region of central Australia. A bitumen road crosses the Sheet area in the northeast and gives access to the ranges to the south by means of station tracks. The southern part of the Sheet area is crossed by a bitumen road and a formed earth road which diverge just west of the settlement at Jay Creek at the eastern edge of the Sheet area, and extend to the west to Glen Helen Tourist Camp and Hermannsburg Mission respectively. Station tracks in the Alice Valley give access to the southern part of the rugged Chewings Range.

## PREVIOUS INVESTIGATIONS

In 1860 John McDouall Stuart (1861) led the first exploration party through the area. He followed the Hugh River through rugged ranges composed of gneiss, quartz, and igneous rock; these he called the MacDonnell Ranges. Early geological investigations of the area were mainly concerned with the sedimentary sequence (Amadeus Basin) in the southern part of the Sheet area and are summarised by Quinlan & Forman (1968). Reconnaissance mapping of the southern half of the Hermannsburg 1:250 000 Sheet (which includes MACDONNELL RANGES) was carried out during 1956 (Prichard & Quinlan, 1962). Regional surveys, which included the Sheet area, are reported by Forman & others (1967), and Forman & Shaw (1973). In 1967-69 and 1974-75, Jones studied the stratigraphy of the Pertnjara Group, the upper part of the Amadeus Basin sequence in the Sheet area (Jones, 1972; 1976); this work is incorporated in the present map.

Regional physiographic units are discussed by Mabbutt (1967), and Forman & others (1967).

## RECENT INVESTIGATIONS

From 1974 to 1980 geologists from the Bureau of Mineral Resources (BMR) in conjunction with geologists from Monash University in Victoria and a geologist from the Northern Territory Geological Survey, Alice Springs, mapped the crystalline basement rocks (Arunta Block) of the MacDonnell Ranges in MACDONNELL RANGES. The university study was confined to elucidating the structural evolution of the Chewings Range Quartzite (Wilkie, 1979; Mawer, 1980). BMR supplied logistic support for this study in 1974 and 1975.

This report presents the result of the basement mapping and should be read in conjunction with the 1981 preliminary edition of MACDONNELL RANGES (Sheet 5550).

## GEOPHYSICAL INVESTIGATIONS

Geophysical investigations prior to 1963 are discussed by Quinlan & Forman (1968). Regional interpretations of the large linear gravity features which cover the Amadeus Basin and the southern Arunta Block are presented by Forman & Shaw (1973), Anfiloff & Shaw (1973), Mathur (1976), and Wellman (1978).

## MAP PREPARATION

The geological map of the Amadeus Basin was prepared by updating and reducing to 1:100 000 scale the relevant part of the 1:50 000 scale compilation sheets used in the construction of the 1968 1:250 000 map of Hermannsburg. Amendments to these earlier compilations include the delineation of:

1) members of the Parke Siltstone, Hermannsburg Sandstone, and Brewer Conglomerate (Jones, 1972),
2) the Pioneer Sandstone (Preiss & others, 1978) and
3) the Julie Formation (Preiss & others, 1978).

The distribution of Cainozoic units was revised by photo interpretation, using 1973 colour aerial photographs.

Geological data on the crystalline basement in the northern half of the Sheet area were plotted on transparent overlays on colour aerial photographs which are at about 1:25 000 scale. Data were then transferred to controlled bases, reduced to 1:100 000 scale and redrawn. Colour aerial photographs, and black and white aerial photographs at 1:50 000 and 1:80 000 scale, cover the whole of the Sheet area, and are available from the Division of National Mapping.

## STRATIGRAPHY

### ARUNTA BLOCK

The oldest rocks of the region are Proterozoic or older, and belong to the crystalline* Arunta Block. They form the hills and ranges of the MacDonnell Ranges in the northern half of the Sheet area.

Shaw & Stewart (1975 a) erected a stratigraphic framework for the Arunta Block based on the recognition of three major divisions which are correlated lithologically from one area to another.

Division 1: Granulites of felsic and mafic composition, lesser amounts of pelitic and calcareous rocks.

Division 2: Greenschist facies slate, schist, metasandstone, and calc-silicate rock with locally basic flows and sills. Pass into higher-grade metamorphic equivalents.

Division 3: Quartzite, shale, limestone, dolomite, and porphyry sills. Pass into high-grade metamorphic equivalents.

Although these divisions are not necessarily chronostratigraphic, and in many places the relationships between the different divisions are not readily interpreted, Shaw & Stewart (1975 a) consider that division 1 is the oldest and division 3 the youngest and that all three divisions are probably separated by major unconformities.

This framework has been used extensively in recent accounts of Arunta geology (Stewart, 1981; Offe & Shaw, 1983; Shaw & Langworthy, in preparation; Stewart & others, in preparation). However, there are problems in applying the classification to the rocks in MACDONNELL RANGES.

Five rock groupings have been recognised in the part of the Arunta Block that crops out in MACDONNELL RANGES:

1. Granulites in the northern part of the sheet.
2. Feldspathic gneisses and interlayered amphibolite south of the granulites but north of the Chewings Range.
3. Metasediments, amphibolite, and granitic units in the Chewings Range area and to the south.
4. Igneous plugs and dykes.
5. Mylonites and fault rocks.

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* Metamorphic rock names used in this report are field terms based on mineral composition and texture and are defined by Shaw & others (1979, p417-425).

The granulite units p€mn and p€sa, which comprise group 1 above, form part of the belt of division 1 granulites that extends from the Strangways Range, northeast of MACDONNELL RANGES, to the Ehrenberg Range, west of MACDONNELL RANGES. The group 3 rocks, metamorphosed quartz-rich sediments Pqt and Pj, psammo-pelitic and pelitic sediments Pv, Ps, and Psm, calcareous rocks Pcs, amphibolite Pa, and granitic units Pab, $Pab_1$, Pab?, Pal, Paf, Pp, and Pf can be assigned to division 3 because they contain rock types similar to those characterising division 3 elsewhere. They are also part of the Iwupataka Metamorphic Complex (Shaw & others, 1979), which in neighbouring ALICE SPRINGS, appears to non⌒conformably overlie rocks assigned to division 2 (Offe & Shaw, 1983). Although Shaw & others (1979, Fig. B1) assigned some of the feldspathic units that fall into group 2 above to division 2, they recognised that these units differ from the pelitic rocks that characterise division 2 elsewhere. Shaw & others (1979) suggest that this difference is caused either by (1) a sedimentary facies variation, (2) two separate subdivisions of division 2, the lower being more quartzofeldspathic, or (3) metamorphic grade. The units concerned, p€b, p€p, Pw, and Px, have been metamorphosed to upper amphibolite facies and in many places they are migmatitic. Rocks of unequivocal sedimentary origin (e.g. quartz-rich or highly calcareous or aluminous rocks) are rare. Compositionally, these feldspathic units are similar to the granitic units of division 3 which crop out to the south, and as no major structural break occurs between these two groups of rocks it is possible that they are one and the same. Indeed, Marjoribanks (1975a, p34) concluded that west of the area in HERMANNSBURG, the migmatitic units north of the Chewings Range developed from "felsic gneiss containing minor metasedimentary bands" similar to the gneiss flanking and to the south of the Chewings Range.

Because assignment of the feldspathic units of the MacDonnell Ranges, within the framework of Shaw & Stewart (1975a), is uncertain, their divisions have not been used and feldspathic units p€b and p€p and the interlayered amphibolite p€a are given Precambrian symbols. Although no isotopic data are available Offe & Shaw (1983) suggest that unit Pw is Middle Proterozoic because it is similar in its compositional homogeneity to a Middle Proterozoic granitic body which crops out to the east in the Alice Springs 1:250 000 Sheet area. A Proterozoic symbol is also used for the migmatitic unit Px which owes its character to a late Proterozoic event.

Tectonic Zones

The Arunta Block has been subdivided into Northern, Central, and Southern Tectonic Zones (Shaw & Stewart, 1975b; Shaw & others, 1979) which are generally characterised by distinct stratigraphic sequences and, metamorphic and structural histories. These tectonic zones are not to be confused with the stratigraphic divisions. The Arunta Block in MACDONNELL RANGES falls mainly within the Southern Tectonic Zone but includes a small portion of the Central Tectonic Zone (Fig. 1). The two zones are separated by a west-trending band of intensely deformed rocks.

Rocks of the Central Tectonic Zone are poorly exposed and crop out in the northern part of MACDONNELL RANGES. The rocks contain assemblages and minerals diagnostic of upper amphibolite-granulite facies e.g., sillimanite + K-feldspar, orthopyroxene, brown hornblende. This high-grade event has been dated elsewhere at about 1800 m.y. (Black, 1975; Shaw & others, 1979; Black & others, in preparation). Component units of this zone within MACDONNELL RANGES are p€m and p€sa (corresponding to the green horizontally cross-hatched zone on the General Geology and Tectonic Sketch alongside the preliminary geological map of MACDONNELL RANGES; hereafter refered to as Tectonic Sketch). The units correspond with the Mount Hay/Mount Chapple Zone of Marjoribanks (1975a,b) in HERMANNSBURG.

Rocks of the Southern Tectonic Zone have been affected by two main folding episodes which pre-date the Palaeozoic Alice Springs Orogeny (Forman & others, 1967) and are correlated with the Chewings and Ormiston Phases of deformation first recognised in HERMANNSBURG and described in detail by Marjoribanks (1975a). Other, possibly local, folding episodes occurred prior to the Chewings Phase (Marjoribanks, 1975a; Shaw & others, 1979), between the Chewings and Ormiston Phases (Shaw & others, 1979; Offe & Shaw, 1983), and following the Ormiston Phase (Marjoribanks, 1975a; Shaw & others, 1979). Metamorphism associated with the Chewings and Ormiston Phases of deformation has been dated* at 1586±69 m.y. and 1053±50 m.y. (Rb-Sr whole-rock method; Marjoribanks & Black, 1974) respectively. Components of the Southern Tectonic Zone within MACDONNELL RANGES are the 1) largely feldspathic units p€b, p€p, Ew, Ex, and amphibolite p€a (shown as the green diagonally cross-hatched zone on the Tectonic Sketch); these units correspond roughly with the Ormiston Zone

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* All Rb-Sr isotopic dates calculated on a Rb decay constant of $1.39 \times 10^{-11}$ $yr^{-1}$ have been recalculated using $1.42 \times 10^{-11}$ $yr^{-1}$.

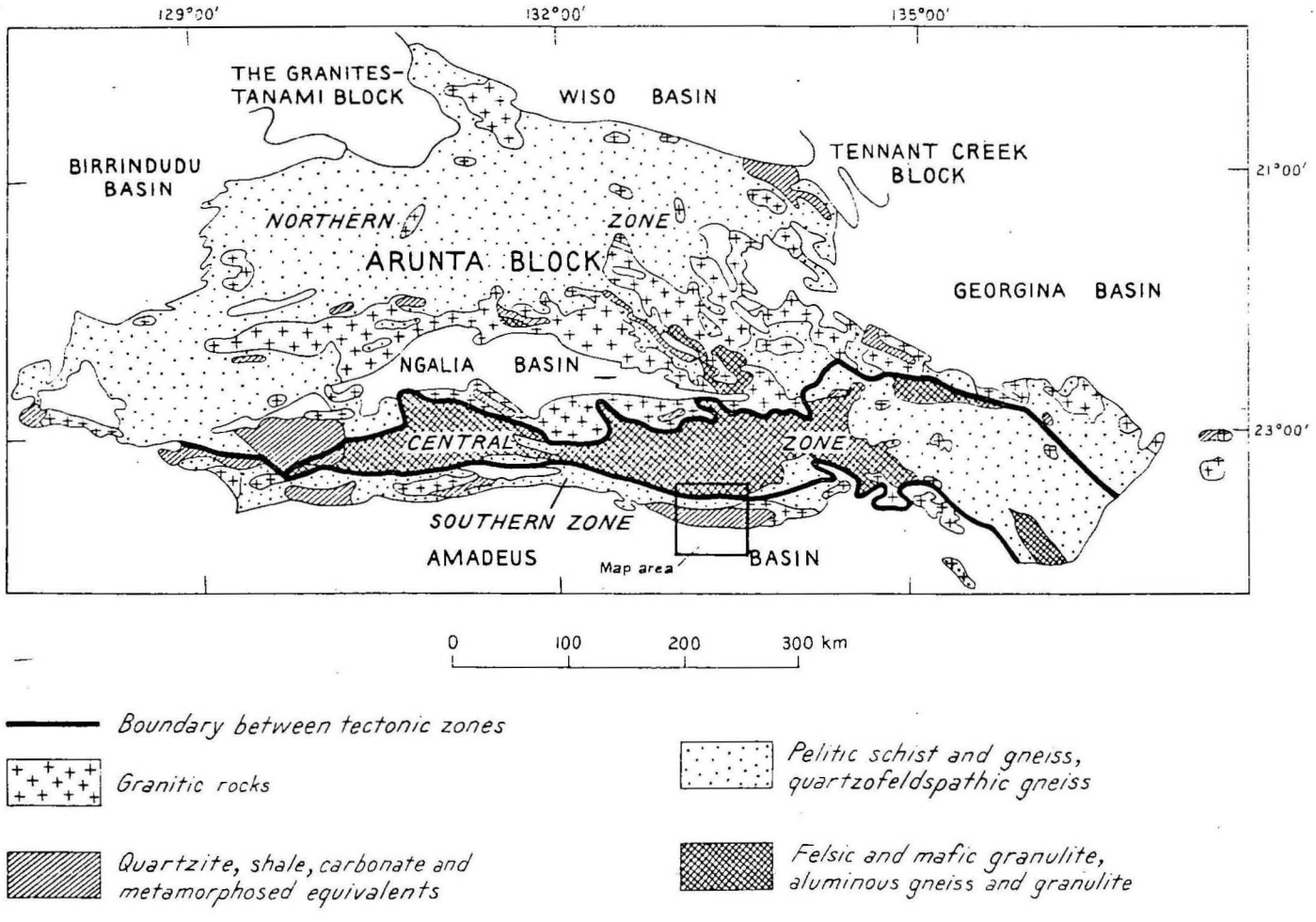


Fig 1 Tectonic zones of the Arunta Block

described by Marjoribanks (1975a,b) in HERMANNSBURG, and (2) metasedimentary units Ev,Es, Ej, Ecs, Esm, and Eqt, amphibolite Ea, (shown as the green stippled zone on the Tectonic Sketch) and granitic units Eab, $Eab_1$, Eab?, Eal, Eaf, Ep and Ef (the brown cross-hatched zone on the Tectonic Sketch); these units correspond roughly with the Chewings Zone described by Marjoribanks (1975a,b) in HERMANNSBURG.

Rocks of the Southern Tectonic Zone are divided into (1) the feldspathic gneisses and interlayered amphibolite north of the Chewings Range and (2) metasediments, amphibolite, and granitic units in the Chewings Range area and to the south. The rocks of (1) were largely affected by the metamorphic episode associated with the Ormiston Phase of deformation, whereas the rocks of (2) are largely unaffected by this metamorphic episode. The boundary between the two areas is gradational.

(1) North of the Chewings Range and south of the Central Tectonic Zone the Chewings Phase of deformation and associated metamorphism produced a layer-parallel foliation. Metamorphic grade reached upper amphibolite facies resulting in local development of small crosscutting granite masses which merge into thin concordant quartzofeldspathic layers in the gneisses. Green hornblende is widespread. The later Ormiston Phase of deformation and associated metamorphism resulted in generally open to close folds (Figs. 2 & 3), and generated further crosscutting granite and pegmatite veins. The later veins cut the concordant quartzofeldspathic layers as well as the earlier small granite masses.

(2) In the Chewings Range area and to the south the Chewings Phase produced tight to isoclinal folds (Figs. 4 & 5) with a strong axial-plane foliation. The folded surfaces are recognised as colour laminations in unit Eqt (Fig. 5) and compositional layering in units Es and Ej (Fig. 4). Amphibolite facies assemblages produced at this time include staurolite + garnet, and kyanite + muscovite. Later folds associated with the Ormiston Phase fold the foliation (Fig. 6) and are commonly more open and upright; there is little development of a new axial-plane fabric. Kinks and crenulations occur locally. The interference pattern and the style of the two major fold phases is illustrated schematically in the cross-section across the Chewings Range on the preliminary geological map of MACDONNELL RANGES.

Fig. 2 Folded layered gneiss. Note boudinaged amphibolite in bottom right hand of photograph. GR 300886 (Negative GB/1312).

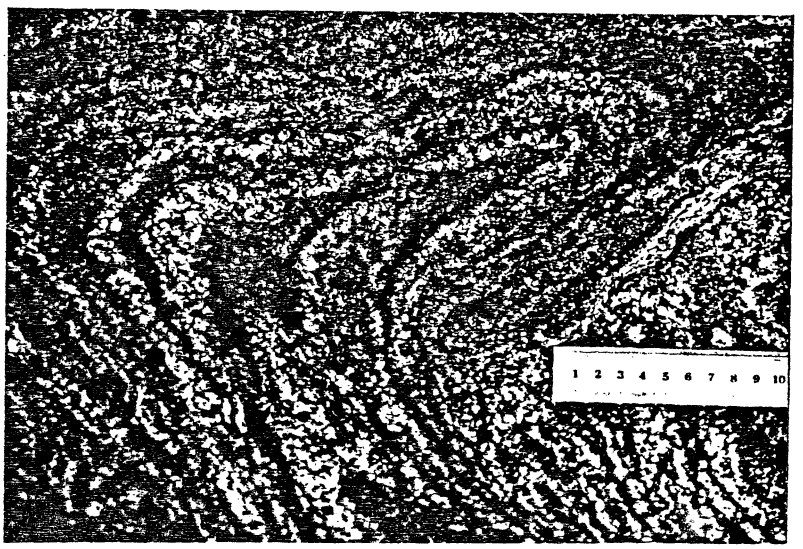


Fig. 3 Ormiston Phase fold superposed on early tight fold in biotite gneiss. Scale in centimetres. GR 295902 (Negative GB/1328).

Fig. 4 Isoclinally folded micaceous quartz-rich metasediment. Strong axial-plane fabric. Scale in centimetres. GR 386696 (Negative GB/852).

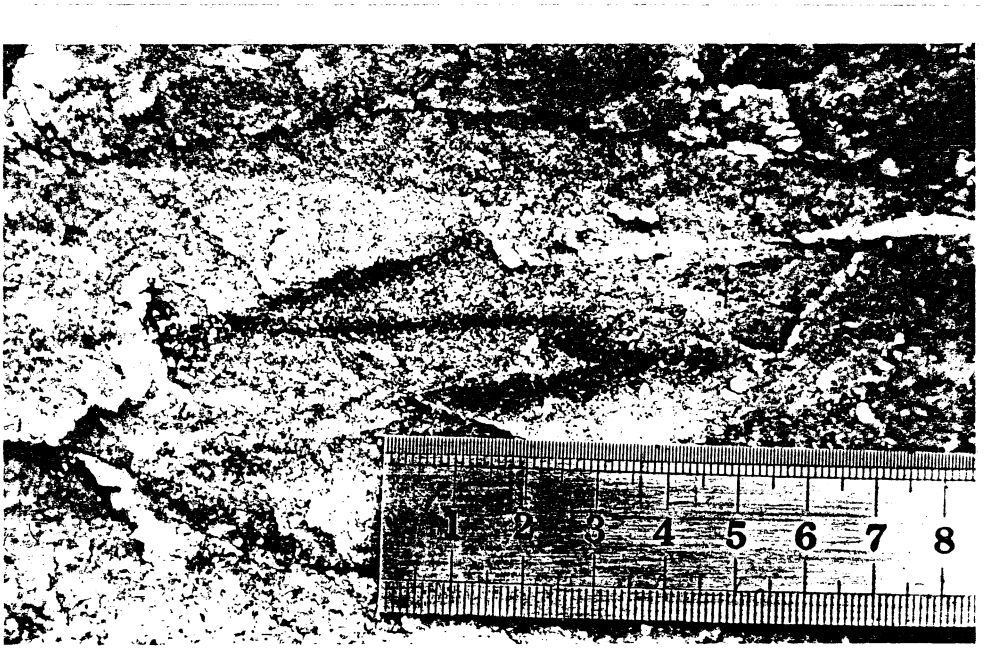


Fig. 5 Colour laminations outline isoclinal folds in fine-grained metaquartzite (specimen F021). Scale in centimetres. GR 212718 (Negative GB/855).

Fig. 6 Large-scale reclined fold. Base of photograph about 0.5 km across. GR 402759 (Negative GB/155).

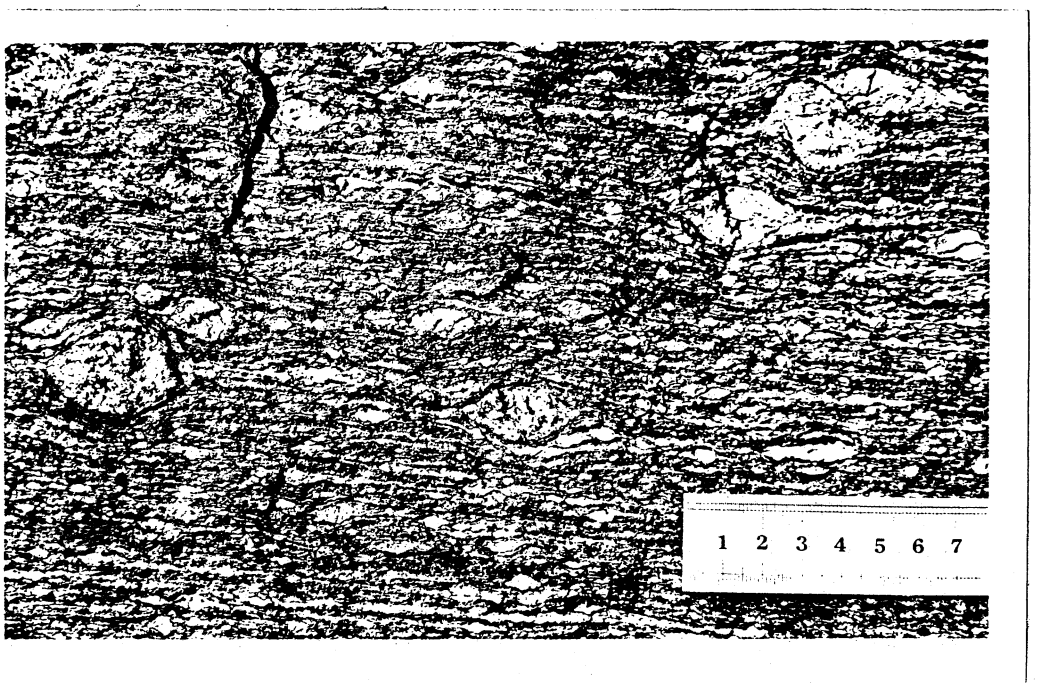


Fig. 7 Feldspar augen in a fine-grained mylonitic matrix (specimen G023). Scale in centimetres. GR 994930 (Negative GB/1315).

The Central and Southern Tectonic Zones are separated by the Redbank Deformed Zone. Marjoribanks & Black (1974) suggest movement on this zone started during the Chewings Phase of deformation. The rocks are intensely deformed and are characterised by a mylonitic foliation (Fig. 7) which parallels the axial-plane of rare, tight mesoscopic folds (e.g., at GR 967913 where a small area of deformed rocks has been included in unit Ex). Metamorphic conditions prior to and during deformation are indicated by the stability of hornblende in gneiss and by migmatisation of gneiss - including the segregation and coarsening of quartz and feldspar grains in some cases to produce a banded rock. During intense deformation in the Redbank Deformed Zone, hornblende and feldspars generally resisted plastic deformation whereas the quartz was typically highly strained (e.g., GR's 257902 and 963936: specimen G019*). During the Ormiston Phase of deformation the mylonitic foliation was folded and intruded locally by pegmatite and granite veins (e.g., GR 986927). At GR 257901 no folds were observed but late pegmatite veins and irregular granite patches intrude strongly foliated gneiss and strongly foliated intrusive granite. During this second event recrystallisation of minerals may have been widespread. Re-activation occurred during the Palaeozoic Alice Springs Orogeny with the formation of linear fault zones consisting of schist and mylonite.

Details of units

Central Tectonic Zone: Granulites.

Granulite units occur in the northern part of MACDONNELL RANGES and may be the oldest rocks in the Sheet area.

Unit pCmn consists of homogeneous mafic granulite, and is lithologically similar to rocks in the Mount Hay massif to the northwest. Contacts with other rock types in the Sheet area are not exposed; farther west the granulite is separated from amphibolite facies rocks to the south by the Redbank Deformed Zone (Marjoribanks & Black, 1974).

The mafic granulite is massive, grey but weathering dark brown, medium-grained granuloblastic, and consists** of labradorite (80%), orthopyroxene and clinopyroxene (together 20%), and accessory opaque grains (specimen F113). The

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* Petrographic data recorded in APPENDIX.

**Percentages shown are visual estimates only.

pyroxenes weather to dark brown spots. Glikson (1974; 1976) described amphibolite, anorthosite (over 80% calcic plagioclase), thin acid segregations, minor garnet gneiss, and acid aplite within the mafic granulite of the Mount Hay massif to the northwest.

Unit pCsa consists of mafic granulite, garnet-sillimanite gneiss, and felsic granulite; it crops out in the northeast of the Sheet area. Two larger outcrops occur at GR 239923 and near Blackhill Dam at GR 390950. Contacts with other units are not exposed, but the Redbank Deformed Zone and coincident Palaeozoic faults separate pCsa from amphibolite facies rocks to the south. Unit pCsa contains similar rock types to the Adla Granulite which crops out in BURT to the northeast.

The mafic granulite is massive, dark brown on weathered surfaces, dark greenish-grey on fresh surfaces, fine or medium-grained, and consists of labradorite (45 to 50%), orthopyroxene and pale green clinopyroxene (together 40 to 46%), brownish-green hornblende (2 to 15%), opaque grains (up to 2%), and accessory reddish-brown biotite (specimens F111, G014). The texture is granoblastic, and pyroxene-hornblende aggregates outline a weak foliation. The garnet-sillimanite gneiss is medium-grained; a strongly foliated specimen (G015), collected alongside mafic granulite, consists of plagioclase and potash feldspar (together 45%), quartz (40%), sillimanite (7%), biotite (6%), garnet (2%), and accessory opaque grains and zircon. Dark, fine to medium-grained felsic granulite occurs at GR 239923 where it consists of plagioclase (35%), quartz (35%), garnet (15%), reddish-brown biotite and brownish-green and green hornblende (together 8%), orthopyroxene and clinopyroxene (together 7%), and accessory apatite, zircon, and opaque grains (specimen G002).

Southern Tectonic Zone: (1) Feldspathic gneisses and interlayered amphibolite.

The units forming the moderate to high terrain between the northern plain and the Chewings Range are commonly feldspathic, and contain only a small amount of rocks of unequivocal sedimentary origin i.e., quartz-rich or highly calcareous or aluminous rocks. The larger bodies of amphibolite have been outlined and symbolised on the map. The origin of the feldspathic parts of these units is not known but possible precursors are hypabyssal sills/ small plutons or volcaniclastic rocks. These units, which may be equivalent or older than the metasediments and granitic units of the Chewings Range area and to the south, were metamorphosed during the metamorphic episodes associated with the Chewings and Ormiston Phases of Deformation at 1586±69 m.y. and 1053±50 m.y. respectively.

Unit pЄb has poorly defined, mostly photo-interpreted boundaries. It occurs throughout the northern part of the Sheet area and commonly forms the lower hills, slopes, and valleys between ridges of lighter coloured more quartzofeldspathic units. Unit pЄb has a greenish brown photo-colour. The unit grades across strike into deformed gneisses of the Redbank Deformed Zone Err, and migmatitic gneisses Ex.

Biotite gneiss, garnet-biotite gneiss, and amphibolite are the most common rock types. Banding in the biotite gneiss is outlined by quartzofeldspathic layers about 5 mm wide alternating with thin biotite-rich layers. Garnet-biotite gneiss is widespread and locally contains sillimanite (specimens K21, K23, K26, K40). At specimen localities K27 and K36 the gneiss is quartz-rich (about 70 percent) and contains accessory garnet. Amphibolite and calc-silicate rocks (Table 1 & 2) form layers 1 to 15 metres thick; the thinner layers are boudinaged. Muscovite-biotite gneiss, biotite-bearing quartzofeldspathic gneiss, granitic gneiss, and porphyroblastic gneiss occur in small amounts. Unit pЄb is commonly migmatitic.

Unit pЄp consists dominantly of porphyroblastic gneiss and occurs in two areas north of the Chewings Range. At GR 295885 the gneiss consists of closely packed white feldspars up to 20 mm long within a medium-grained matrix containing biotite. To the east at GR 400855 the gneiss consists of scattered feldspar augen up to 20 mm long in a matrix containing muscovite and a lesser amount of biotite.

Unit pЄa consists of amphibolite generally as thin elongate bodies and plugs and typically with a dark brown-light green mottled photo-colour. Elongate bodies are generally conformable with the surrounding gneisses, and less than 100 m wide.

Some bodies mapped or photo-interpreted as amphibolite may prove to be calc-silicate rock. The only specimen collected (G012) is an epidote-veined rock consisting of actinolite and clinopyroxene.

The Old Hamilton Downs Gneiss (Ew) is a homogeneous biotite-bearing granitic gneiss which crops out north of the Chewings Range for a west-trending strike length of at least 30 km. Photo-pattern is typical of a granite terrain; the unit is jointed.

Contacts between the Old Hamilton Downs Gneiss and neighbouring units are mainly photo-interpreted. The southern contact with the correlative of the Burt Bluff Gneiss (Eab?) is partly faulted and may elsewhere be intrusive as suggested at GR 377820 where fairly homogeneous massive biotite-bearing granitic

Table 1: Amphibolite compositions, p€b

| Specimen No. | Amphibole | Plagioclase | Biotite | Clinopyroxene | Other |
|---|---|---|---|---|---|
| K29 | 19 | 40 | - | 40 | opaque grains, apatite, calcite, muscovite |
| K30 | 20 | 75 | accessory | - | scapolite, clinozoisite calcite, chlorite |
| K43 | 70 | 29 | - | accessory | epidote |

Table 2: Calc-silicate rock compositions, p€b

| Specimen No. | Amphibole | Plagioclase | Quartz | Garnet | Biotite | Clinopyroxene | Other |
|---|---|---|---|---|---|---|---|
| J077 | 55 | 25 | 16 | 2 | 2 | - | apatite, zircon, opaque grains |
| J079B | 58 | 10 | 20 | 10 | - | - | opaque grains, apatite |
| K24 | 60 | 25 | 14 | accessory | - | 1 | opaque grains |
| K25 | 10 | 17 | 40 | 30 | second-ary | 2 | opaque grains |
| K28 | 25 | 40 | 25 | accessory | 5 | 5 | apatite, opaque grains, zircon |
| K41 | - | 10-60 | 20-40 | 10-30 | - | 10-20 | scapolite sphene, calcite, epidote |
| K42 | 25 | 34 | 40 | accessory | - | - | opaque grains, sphene, epidote |

gneiss (Ew) is in discordant contact with porphyroblastic biotite gneiss (Eab?). To the north the Old Hamilton Downs Gneiss grades into migmatitic gneiss (Ex).

The Old Hamilton Downs Gneiss is medium-grained and contains about 5 to 10% (visually estimated) biotite. Muscovite is also present in the eastern part of the unit. Feldspar augen are locally abundant. Pegmatite veins generally parallel the foliation in the gneiss.

The unit is foliated and in the east contains mesoscopic northwest-plunging folds.

The Old Hamilton Downs Gneiss may be of intrusive origin because composition is homogeneous. The foliation shared by the Old Hamilton Downs Gneiss and neighbouring units is disrupted at the northern margin by mobilisate generated during the Late Proterozoic thermal event associated with the Ormiston Phase of deformation. This suggests that intrusion pre-dates the Late Proterozoic thermal event.

Unit Ex is characterised by leucocratic migmatitic gneisses and forms hills and ridges along the northern margin of the MacDonnell Ranges. The extent and outline of unit Ex is tentative because boundaries are based mainly on photo-interpretation. Unit Ex typically has moderate to high relief, generally is light orange in colour, and has a photo-pattern characteristic of granite terrain. In contrast the neighbouring unit pCb generally forms the lower hills, slopes, and valleys, and is commonly darker in colour than Ex because of the abundance of rock types such as biotite and garnet-biotite gneiss, and amphibolite. The boundary between unit Ex and the Redbank Deformed Zone, Err, and the Old Hamilton Downs Gneiss, Ew, was drawn on the basis that unit Ex generally has a lighter photo-colour. Boundaries between the three units Ex, Err, and pCb, are commonly transitional. Migmatitic rocks occur in all three units, but within unit Ex they are generally the dominant rock type and are typically leucocratic. Pods of monzonite composition at GR 319902 are enveloped by granitic rock of unit Ex. A southwest-trending poorly exposed medium-grained norite dyke intrudes unit Ex at GR 383910 (specimen J064).

Unit Ex consists mainly of leucocratic migmatitic gneisses composed of quartzofeldspathic gneiss, biotite gneiss, and lesser amounts of muscovite-biotite gneiss, granitic gneiss, porphyroblastic gneiss, garnet-biotite gneiss, garnet-sillimanite gneiss, hornblende gneiss, and amphibolite. Quartz and feldspar commonly form concordant medium to coarse-grained lenses and layers within the gneiss as well as discordant veins. Some concordant layers merge with crosscutting veins and elsewhere there is a distinct truncation between the two. Some of the crosscutting veins contain traces of disseminated magnetite.

The gneisses consist principally of microcline and plagioclase (together 45 to 70%) and quartz (18 to 50%). Biotite is common, but generally forms less than 10 percent of the rocks. Green and bluish-green hornblende is a normal accessory (specimens F100, F108, G025, J003, J055, J056, J063, J073B, J080, K31, K33, K45). Specimens G025 and J073B both contain a small amount of sillimanite and garnet and in the case of J073B a trace of green spinel also.

In the areas around GR's 385910 (specimen J063) and 322901 (specimen J073B) a granitoid different in appearance from other rock types of unit Ex, consists of grey translucent feldspar crystals, in places oval-shaped and up to 20 mm long, in a medium-grained matrix of microcline, plagioclase, quartz, and biotite aggregates. Accessory hornblende occurs at GR 385910 (J063); accessory sillimanite, garnet, and traces of green spinel occur at GR 322901 (J073B). Similar rocks to these occur at GR's 347914 and 324915 within unit Err but are either too small to show on the map or too deformed to include in unit Ex and are thus discussed in unit Err.

Unit Ex contains numerous amphibolite lenses too small to show at 1:100 000 scale. These lenses are commonly boundinaged and locally have discordant contacts with the enclosing gneisses. Layers are up to 4 metres thick.

A metre wide layer of fine-grained metaquartzite crops out at GR 233887 and contains about 15 percent sillimanite (specimen K32). Bluish-grey fine-grained xenoliths of garnet and garnet-sillimanite quartz-rich gneiss (specimens J066, 067) at GR 384912 are up to one metre long and are enveloped by a gneiss similar in appearance to specimens J063 and J073B, but containing abundant biotite (20%), sillimanite (9%), and garnet (3%) (specimen J065). Dark schlieren and boudinaged biotite-rich layers occur locally. Biotite schist is rare.

Southern Tectonic Zone: (2a) Metasediments and interlayered amphibolite.

The following units consist mostly of quartz and/or mica-rich rocks or calc-silicate rock and are considered to be primarily of sedimentary origin. Unit Ev is well-layered and has been included in this grouping. The metasediments and interlayered amphibolite may be equivalent to or younger than the units described in the preceeding section. The earliest recognisable metamorphic event in this area is associated with the Chewings Phase of deformation at 1586 $\pm$ 69 m.y. The deformation resulted in the formation of

tight to isoclinal folds with a well developed axial-plane foliation. During the later Ormiston Phase of deformation at 1053±50 m.y. this foliation was folded. These later folds are more open; crenulation cleavage and kink folds occur in some units such as Ej and Eqt.

The nature of many of the contacts between metasedimentary units and those between metasedimentary and granitic units (see (2b) following) is not clear. Contacts are commonly paralleled by a pronounced foliation. At some contacts the rocks are fine-grained and schistose suggesting a fault.

Unit Esm consists dominantly of schist and underlies many of the valleys within the Chewings Range. It is probably more widespread than indicated on the map.

This unit forms concordant layers and lenses within the metasedimentary unit Eqt. Contacts with granitic units Ep and Ef are concordant where examined but air-photo interpretation reveals marked discordances in several places (e.g., GR 345783). Muscovite schist (e.g., specimen J022) is the most common rock type present. Other rock types are garnet-muscovite schist, staurolite-garnet schist, staurolite schist, muscovite-biotite schist, biotite schist, and quartz-rich metasediments which include metaquartzite, and micaceous metaquartzite. Quartzofeldspathic schist, which occurs interlayered with these rock types in the area around GR 100805, may be derived by deformation of a granitic rock such as the nearby unit Ef which crops out to the north.

Unit Es is a recessive unit which groups together rocks that are commonly micaceous and quartz-rich within and beside the Chewings Range. Quartz-rich, but less micaceous layers are symbolised Ej (see below).

Unit Es appears to be in concordant contact with most other metasedimentary rocks (Ej, Eqt). Granite and rare pegmatite occur as veins or fill tension gashes in unit Es. Interfingering contacts are common between unit Es and the granitic units and suggest a metamorphosed lit par lit relationship. Metasediments of unit Es also locally contain interlayered granitic units too small to show at map scale (e.g., GR's 432704, 060696, 143702, 083696, between 020708 and 962730, 020815 and 100820, 960850 and 980844). Discordant contacts between metasediments of unit Es and granitic units (e.g., GR 142703) are rarely preserved. Enclaves of unit Es occur within both granitic units Eal and Eaf at GR's 360706 and 130712 respectively; a large raft of unit Es straddles the contact between units Ef and Eab? north of the Chewings Range at GR 155832.

The unit consists mainly of schistose two-mica gneiss but includes lesser amounts of metamorphosed micaceous quartzite, quartz-rich metasedimentary layers (too thin to show as separate units), schist, and rare calc-silicate rock. Garnet occurs as an accessory in gneiss (specimen F070) at GR 130697. However, this gneiss is highly feldspathic (about 62% microcline and plagioclase together) and may be part of a granitic layer. Garnet also occurs in micaceous quartz schist (specimen F010) at GR 290694, and muscovite-bearing metaquartzite (specimen J016) at GR 965852. The metasedimentary raft at GR 155832 (specimen J106) is a fine-grained schistose garnet-bearing quartz-rich gneiss. Calc-silicate rock at GR's 414731 (specimen J041) and 963847 (specimen J112) consists of green hornblende, quartz, microcline, plagioclase, epidote, clinozoisite, chlorite, sericite, and accessory sphene.

Unit Ej is characterised by well-layered quartz-rich metasediments and forms low hills and ridges.

Unit Ej grades across and along strike into units Es and Eqt. Granitic units (porphyroblastic, quartzofeldspathic, and granitic gneisses) flank parts of the unit and porphyroblastic gneiss is in places interlayered with unit Ej (e.g., GR 145698, D. Clarke*, personal communication, 1974; and GR 212705). A layer of unit Ej, about 20 to 30 m thick in places, projects into the Burt Bluff Gneiss in the east part of the Sheet area; the lithological boundary parallels the foliation which appears to be shared by both the metasedimentary and granitic units.

Probably the most common rock type of unit Ej is recrystallised micaceous quartz-rich sandstone. Specimen J044 (GR 430710) the only specimen collected may be typical; it consists of quartz (65%), microcline and plagioclase (together about 18%), muscovite (15%), and opaque grains (2%). Other common constituents of this unit are muscovite schist, metaquartzite, and micaceous gneiss.

South and southeast of Mount Conway, unit Ej forms discontinuous layers, mainly within unit Es, and consists of fine to medium-grained schistose muscovite gneiss containing thin metaquartzite and calc-silicate layers (specimens J049,50), medium-grained recrystallised muscovite quartz-rich sandstone, fine-grained sericitic metaquartzite, and muscovite schist containing minor biotite and opaque grains. Concordant and slightly discordant quartz veins are common.

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* Formerly Northern Territory Geological Survey.

Northeast of Mount Conway unit Ej consists of fine-grained sericitic metaquartzite (specimen J038). The well-layered nature of the rocks here distinguish them from the neighbouring massive unit Eqt.

In the central part of the Sheet area, south of the Chewings Range, unit Ej consists of schist, biotite-muscovite gneiss, and metaquartzite (specimen F074). Quartz veins are present.

Within unit Ep south of the Chewings Range, in the western half of the Sheet area, unit Ej forms discrete layers consisting of orange-coloured fine-grained well-parted muscovite gneiss, highly deformed schistose metaquartzite (specimen K10), and muscovite schist.

On the northern side of the Chewings Range, unit Ej consists of well-layered biotite-muscovite schist, biotite schist, and metaquartzite (specimens J011, J109).

In the Chewings Range in the extreme west of the Sheet area, unit Ej consists of well-layered muscovite-quartz schist, and muscovite-biotite schist.

Unit Eqt consists of metaquartzite, well-parted micaceous quartz-rich metasediments, and schist, and makes up the greater part of the rugged hills and ridges of the Chewings Range.

Metasedimentary units such as Es, Esm, and Ej all appear to have concordant contacts with unit Eqt. Granitic units Ep, Eaf, Ef, and Eal partly or wholly envelope bodies of unit Eqt; elsewhere the contacts appear to be concordant. In places the granitic units become highly schistose adjacent to unit Eqt. Quartz veins are common in the metaquartzite of unit Eqt.

Massive metaquartzite is the most distinctive rock type of unit Eqt. It typically consists of medium-grained elongate and strained quartz grains and accessory interstitial muscovite, opaque grains, tourmaline, and kyanite (specimens F50, J094, J095). Micaceous quartz-rich metasediments are generally well-parted and locally flaggy and consist of fine to medium-grained quartz ($\geq$ 85%), and lesser amounts of muscovite, kyanite, and opaque grains (specimens F021, K01, K10). Sericitic quartz-rich schist underlies scree-covered valleys, and locally contains boudinaged layers of metaquartzite.

Unit Ecs consists of calc-silicate rock and is distinguished at GR 145682 where it is intruded by granodiorite Eg and probably also by the granitic unit Ep which crops out nearby. Thin layers and lenses of calc-silicate rock also occur within units Es, Ej, and pЄb.

The calc-silicate rock ranges from coarse-grained, dark brown weathered to medium-grained and schistose. The schistose type consists mainly of tremolite and talc (specimen F063). Dark xenoliths within granodiorite Eg consist of quartz (30%), biotite (30%), scapolite (25%), hornblende (10%), and epidote, sphene, and opaque grains (specimen F065).

Unit Ev consists of garnet-biotite gneiss and crops out north of the Chewings Range where it has a well-layered brown-coloured photo-pattern. It was only briefly examined, but appears to contain concordant contacts with amphibolite and the enclosing quartzofeldspathic unit Ef. The unit is cut by pegmatite dykes.

Unit Ea consists of amphibolite that generally forms thin conformable elongate bodies and small plugs that have a typically dark brown - light green mottled photo-colour. A large amphibolite body which straddles the western map boundary south of the Chewings Range, about 9 km long by 1 km wide, was investigated by O'Sullivan & others (1972). It is mainly fine to coarse-grained and consists of different amounts of actinolite, tremolite, chlorite, epidote, and plagioclase. Narrow conformable layers of chlorite schist, serpentinite, and chlorite-serpentine schist, commonly about 3 metres thick, occur mainly in the southern part of the body and coincide with magnetic anomalies.

Southern Tectonic Zone: (2b) Granitic units.

The following units are considered to be of igneous origin because they are homogeneous on a large scale and all have granitic compositions. Some units contain xenoliths or envelope metasedimentary units but intrusive contacts are rarely preserved. The granitic units may be equivalent to or younger than the feldspathic units further north. The earliest metamorphism recognised is associated with the Chewings Phase of deformation at 1586 $\pm$ 69 m.y. During this time many of the granitic units were strongly foliated. The later Ormiston Phase of deformation folded this foliation but there appears to be little associated axial-plane fabric developed.

The Burt Bluff Gneiss (Eab, $Eab_1$) is the distinctive biotite-bearing large-feldspar orthogneiss and laminated granitic gneiss which crops out in the eastern part of the Sheet area and extends into adjacent ALICE SPRINGS. The unit forms low hills and has an air photo-pattern characteristic of granite terrain.

Poorly exposed interlayered biotite-bearing orthogneiss and metasediments, northwest of units Pab/Pj-Ps contact (GR 464699) suggest that the Burt Bluff Gneiss is intrusive (lit par lit) into the metasediments. Xenoliths within unit Pab are rare.

The Burt Bluff Gneiss is characterised by strongly foliated and lineated biotite-bearing granitic gneiss containing feldspar augen and laths up to 20 mm long (Pab). A small number of thin quartzofeldspathic layers occur within the gneiss. In the extreme eastern part of the Sheet area dips are shallow and leucocratic (C.I.$\leq$ 5), laminated, biotite and muscovite-bearing granitic gneiss ($Pab_1$) overlies the darker biotite-bearing granitic gneiss and forms a large part of the outcrop area.

A correlate of the Burt Bluff Gneiss (Pab?), a schistose biotite-bearing augen gneiss, crops out within and to the north of the Chewings Range and extends into ALICE SPRINGS. In the west it grades into leucocratic quartzofeldspathic gneiss and partly contains a large metamorphosed quartz-rich sedimentary raft (specimen locality J106). To the north the Burt Bluff Gneiss correlate may be in part faulted against and elsewhere have an intrusive contact with the Old Hamilton Downs Gneiss; the contact is mainly photo-interpreted. An intrusive contact is suggested at GR 377820 where massive biotite-bearing granitic gneiss (Old Hamilton Downs Gneiss) is in discordant contact with porphyroblastic biotite gneiss typical of the Burt Bluff correlate. Adjacent to the Chewings Range the correlate becomes mylonitic (J. Fitzgerald*, personal communication, 1975); C. Mawer* ( personal communication, 1978) considers the contact with the Chewings Range to be faulted. Xenoliths are common in the correlate in ALICE SPRINGS (Shaw & others, 1979). Pegmatites intrude the correlate.

The correlate is commonly schistose and contains feldspar augen up to 20 mm long. Three specimens (F094, J034, J035), near the margin of this unit, consist of microcline and plagioclase (up to 60%), quartz (30 to 38%), biotite (up to 13%), and accessory apatite, sphene, and opaque grains. Secondary epidote, sericite, and chlorite are derived by alteration of the feldspar and biotite. Specimens J034 and J035 are strongly deformed; feldspar grains are fractured in J034 and strained quartz ribbons occur in J035.

Unit Pal is a jointed, laminated, fine to medium-grained granitic gneiss which crops out as low hills immediately west of Mount Conway in the east part of the Sheet area. The unit has a photo-pattern typical of granite terrain. It is distinguished from the adjacent granitic unit Pp by the lack of megacrysts.

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* Formerly Monash University, Victoria.

Contact with surrounding units is generally concordant. Discordance has only been noted at locality GR 276708. Eal envelopes metasedimentary bodies Es and Eqt.

This unit is distinctive from surrounding granitic units because it is commonly light coloured in outcrop and generally laminated, the layers 1 to 2 mm thick. No specimen has been examined petrographically. Muscovite and biotite are common constituents of the rock and range in total content up to about 10 percent. In places the gneiss contains an abundance of one mica only. Opaque grains occur in small amounts. Pegmatite and quartz veins cut the gneiss locally. Specimen F026 collected from the western end of the unit may be a metasedimentary relic. It grades into laminated granitic gneiss but is itself relatively quartz-rich.

Unit Eaf is a large body of leucocratic quartzofeldspathic gneiss about 30 km long which forms low to moderately high hills south of the Chewings Range. The unit is relatively uniform in composition, well-jointed, and distinguished from surrounding units by its lighter orange weathered colour.

The unit generally has concordant contacts with surrounding units, but in places contains elongate bodies of schistose biotite-muscovite gneiss (Es: GR 130711), micaceous metaquartzite (Eqt: GR 170718), amphibolite (Ea: GR 187736), and biotite gneiss (GR 032710). At GR 213718 the leucocratic gneiss appears to truncate micaceous metaquartzite layers (Eqt). Porphyroblastic gneiss (Ep) at GR 032738 contains leucocratic xenoliths which may be derived from unit Eaf. The foliation clearly cuts the contact between large leucocratic blocks and the porphyroblastic host. Unit Eaf locally contains concordant quartz and pegmatite veins.

The gneiss is fine or medium-grained, typically leucocratic, and consists of microcline and plagioclase (together 59 to 64%), quartz (30 to 35%), muscovite (1 to 5%), and accessory biotite, garnet, and opaque grains, and secondary epidote, clinozoisite, and muscovite (specimens F031, F043B, F087). Feldspar grains up to 45 mm long are rare. Adjacent to one dolerite dyke of the Stuart Dyke Swarm feldspar laths are common and the foliation is less pronounced. Limonite pseudomorphs (up to 6 mm long sides) after pyrite occur on a joint face at GR 161743.

Unit Ep consists mainly of porphyroblastic gneiss and forms a large area of valleys and low hills south of, and partly within, the Chewings Range. On the northern edge of the Chewings Range (GR 200810) an area having a photo-pattern typical of granite terrain has been included in unit Ep. The unit is distinguished from surrounding granitic units such as Eal, and Eaf which are fairly even-grained.

Unit Ep generally has concordant contacts with neighbouring units. However, discordance occurs locally between units Ep and Eal at GR 276707, and augen gneiss (related to unit Ep but interlayered with metasediments and therefore included with unit Es) and metasediment within unit Es at GR 142703. Xenoliths (Fig. 8) occur sparsely throughout the unit (for example GR's 029749, 030738, 109689, 116771, 178695, 302725), are elongate up to 2 metres, and consist of fine-grained muscovite or more commonly biotite-bearing assemblages. Unit Ep is locally cut by granite and aplite veins.

The unit consists of porphyroblastic gneiss and subordinate granitic and quartzofeldspathic gneisses, but includes amphibolite and metasedimentary layers and lenses which are too small to outline at 1:100 000 scale. At GR 143702 micaceous gneiss, similar to rocks of unit Es, is interlayered with porphyroblastic gneiss layers about 5 metres thick. Amphibolite layers range from about 0.5 to 3 metres thick, and in places are schistose and partly or wholly altered to biotite schist. Some amphibolite layers end with ragged discordant boundaries.

The southern band of unit Ep between Reedy Hole and Ellery Creek Big Hole consists mainly of biotite and muscovite-biotite-bearing schistose gneiss which contains white or pink feldspar augen up to 30, rarely 40 mm long (Fig. 8). Schistose garnet-muscovite gneiss lenses occur within augen gneiss and micaceous gneiss at GR 128697.

Immediately to the south of the Chewings Range an east-west trending band of unit Ep extends from near Brinkley Bluff to the western edge of the Sheet area. It consists mainly of biotite-bearing gneiss containing white feldspar porphyroblasts up to 50 mm long. The feldspars are stubby, lath-like, oval, or augen in shape. Accessory muscovite occurs locally with biotite in the gneiss (specimen K11). Some parts of the gneiss grade into medium to coarse-grained leucocratic granitic gneiss with sparse feldspar porphyroblasts. This gneiss also contains muscovite or biotite (less than 10 percent), opaque grains, and locally accessory hornblende (specimens K02, K04). Quartzofeldspathic gneiss is subordinate but widespread, generally fine to medium-grained, locally laminated, and contains biotite, muscovite (together less than 10 percent), and opaque grains (specimens K05, K08). Rare feldspar porphyroblasts are up to 40 mm long. Quartzofeldspathic layers range up to at least 15 m thick, but some form thin, discordant dyke-like bodies which, in places, lens out along strike (Figs. 9 & 10; GR 250743). Elsewhere, such as at GR 972778, quartzofeldspathic gneiss envelopes lenses of schistose porphyroblastic gneiss. Hornblende gneiss

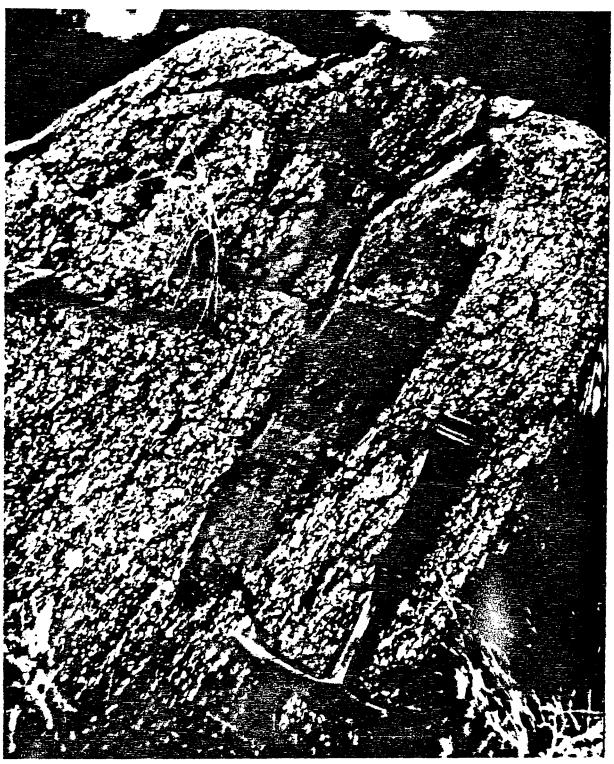

Fig. 8 Schistose augen gneiss containing elongate dark xenolith (specimen F022). GR 178695 (Negative GB/823).

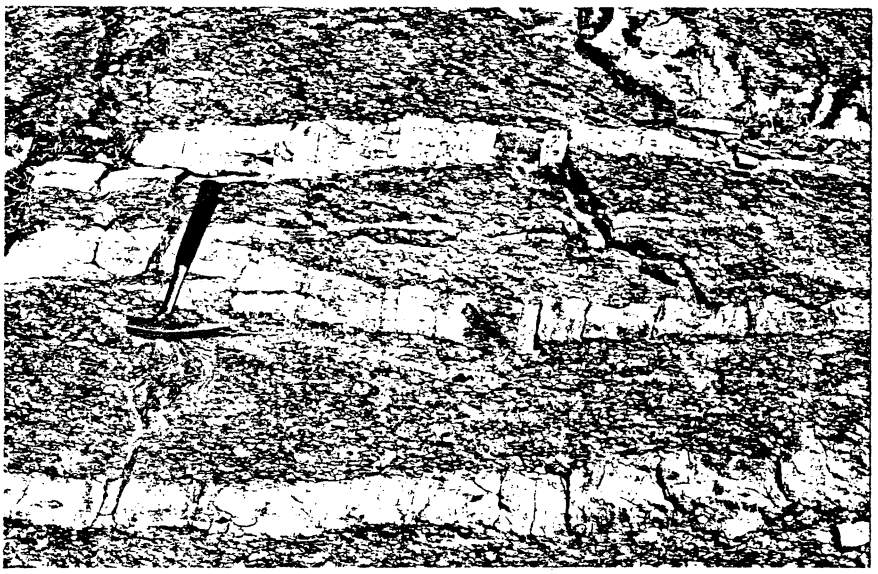

Fig. 9 Slightly discordant dyke-like bodies of quartzofeldspathic gneiss within schistose porphyroblastic gneiss. GR 250745 (Negative GB/2407).

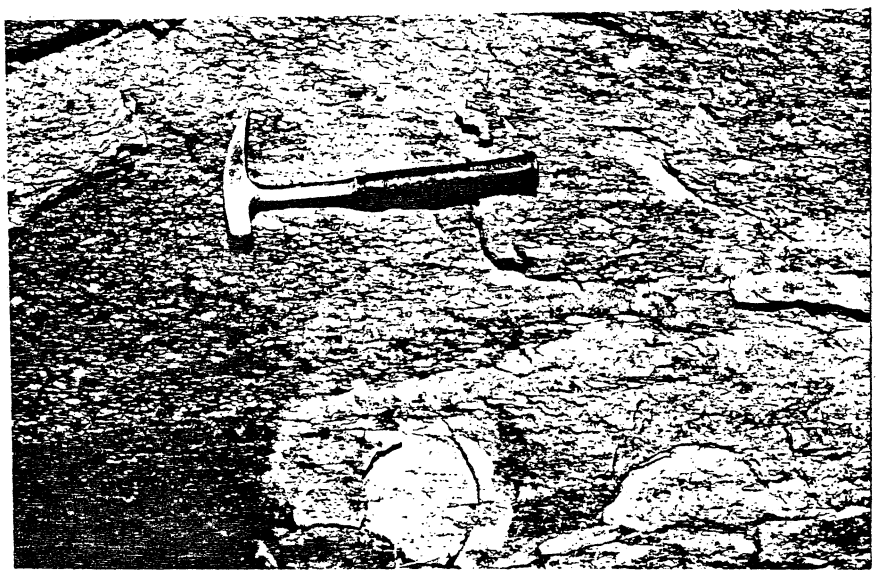

Fig. 10 Slightly discordant contact between quartzofeldspathic gneiss and porphyroblastic gneiss. GR 250745 (Negative GB/2414).

forms layers only a few metres thick at GR's 186759, and 034769. On the northern edge of the Chewings Range the unit consists of large subhedral microcline and plagioclase (together 60%), quartz (30%), and aggregates of biotite, sericite, epidote, chlorite, opaque grains, and sphene (specimen J033). Quartz also occurs in aggregates up to 6 mm long. Not all coarse feldspars are oriented with their long axes parallel to the foliation.

Throughout this unit feldspar is commonly altered to epidote and sericite, and biotite to chlorite. Joint and fracture faces are commonly coated with epidote. In places the augen gneiss, containing biotite and muscovite, becomes finer-grained and grades into muscovite-biotite schist adjacent to unit Pqt (V. Hirsinger*, personal communication, 1975).

It is not known whether the porphyroblastic, granitic, and quartzofeldspathic gneisses are all of the same age. The granitic gneiss appears to be a variant of the prophyroblastic gneiss as no sharp boundaries between the two types have been seen; the quartzofeldspathic gneiss may be a later, finer-grained intrusive phase because the gneiss forms slightly discordant dyke-like bodies within the other rock types.

Unit Pf consists mainly of quartzofeldspathic gneiss and forms light-coloured low undulating hills north of the Chewings Range, and a small number of elongate bodies south of the Chewings Range near Ellery Creek.

North of the Chewings Range the unit has gradational contacts with migmatitic gneisses Px, deformed rocks Prr, and schistose large-feldspar orthogneiss Pab?. Contacts between unit Pf and metasedimentary units Ps, Pj, Pv, Psm, and Pqt, and amphibolite Pa are relatively sharp. Locally unit Pf partly or wholly encloses metasedimentary units. Some interlayering of quartzofeldspathic gneiss and metasediments occurs at and near the contacts. Although thin amphibolite layers occur within the unit only the larger plug-like bodies are of sufficient size to be delineated. Pegmatite dykes and rare medium-grained biotite granite intrude the unit. South of the Chewings Range unit Pf is interlayered with metasediments Pj and Pqt and enveloped by the granitic unit Pp.

Biotite-bearing quartzofeldspathic gneiss is the dominant rock type and leucocratic biotite-muscovite gneiss is locally abundant. These rock types grade into, or are interlayered with, biotite-bearing granitic gneiss and biotite gneiss. Most rock types mentioned are medium-grained and commonly contain microcline megacrysts which range in length from 5 to 35 mm.

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* Formerly Monash University, Victoria.

Specimens of unit Pf (J005, J008, J010, J023, J030, J120) have a fairly uniform composition consisting of microcline and plagioclase (together 55 to 65%), quartz (25 to 35%), biotite (5 to 10%), and various amounts of muscovite, apatite, sphene, hornblende, opaque grains, allanite, and secondary epidote, sericite, clinozoisite, and chlorite. Specimen J121 is strongly deformed and contains abundant secondary minerals. Epidote is conspicuous along faults.

Igneous plugs and dykes: Several small igneous plugs and a generally north-trending dyke swarm intrude the gneisses in MACDONNELL RANGES.

Unit Pg comprises small bodies of poorly exposed granite and granodiorite. At GR 205681 granite is nonconformably overlain by the Heavitree Quartzite to the south, but flanked on other sides by scree. About 6 km to the west at GR 145685 granodiorite intrudes calc-silicate rock Pcs which is itself within unit Pp. North of the Chewings Range at GR 366915 foliated granite crops out and is surrounded by deformed gneisses of the Redbank Deformed Zone.

Clarke (personal communication, 1975) describes the granite underlying the Heavitree Quartzite at GR 205681 as weathered, strongly foliated, and containing biotite and muscovite. Half a kilometre to the northwest the granite is medium-grained, not as strongly foliated, and muscovite is absent. Granodiorite intruding calc-silicate rock (Pcs) at GR 145685 contains oval-shaped feldspar grains up to 20 mm long. It consists of sericitised andesine (50%), quartz (40%), biotite (8%), and minor garnet, sphene, epidote, and opaque grains (specimen F065). No potash feldspar was recognised. Foliated granite north of the Chewings Range is medium-grained and chloritised biotite occurs as scattered aggregates throughout the rock (specimen G027).

Although these bodies of granite and granodiorite appear to be younger than the surrounding rocks an intrusive relationship was only observed between granodiorite and calc-silicate rock at GR 145685.

In the northeast of the Sheet area at GR 442900 fine-grained tonalite (dr: labelled diorite on MACDONNELL RANGES) crops out within strongly deformed gneiss. The tonalite contains dark, very fine-grained mafic xenoliths up to 15 mm long. Nearby at GR 436899 medium to coarse-grained tonalite crops out within deformed gneiss, but contains no xenoliths. The tonalite at both localities is undeformed.

Tonalite consists of plagioclase (up to 60 to 70%), quartz (21 to 23%), biotite (3 to 8%), green and secondary bluish-green hornblende (up to 5%), and minor microcline, clinopyroxene, garnet, apatite, zircon, epidote, and opaque grains (specimens F107A, B, F109). Dark xenoliths at GR 442900 consist

of andesine (50%), pale green and colourless clinopyroxene (30%), brownish-green, green, and some secondary bluish-green hornblende (20%), and a small amount of biotite (specimen F107B).

The tonalite is undeformed and therefore post-dates the earlier deformation which affected the rocks of the Redbank Deformed Zone.

Quartz monzonite at GR 319902 is fine to medium or medium-grained and occurs as several elongate pods ranging from less than one metre long to several metres long, enveloped by granitic rock of unit Ex. The quartz monzonite contains small dark xenoliths.

Quartz monzonite consists of plagioclase and perthitic potash feldspar (together 55 to 59%), green hornblende (20 to 36%), light green clinopyroxene (2 to 10%), quartz (5%), biotite (1 to 5%), opaque grains (1%), and accessory apatite (specimens J074A, B).

The intrusive relationship between the quartz monzonite and the enclosing granitic rock is not clear.

The Stuart Dyke Swarm is the youngest known intrusive in the southern Arunta Block. The unit incorporates all known fine to medium-grained dolerite dykes in MACDONNELL RANGES. The dykes generally trend north-south and are up to 10 m wide. They are nonconformably overlain by the Heavitree Quartzite.

The dykes are ophitic to sub-ophitic textured; minerals are partly altered to greenschist facies minerals including actinolite, epidote, sericite, chlorite, carbonate, and possibly talc and serpentine. The primary minerals are plagioclase and clinopyroxene with minor opaque grains ( as in specimen F003). Othopyroxene may be present in specimen G010 and olivine and minor biotite are constituents of specimens J047 and D3008.

Black & others (1980) obtained an Rb-Sr age for the Stuart Dyke Swarm of 897 $\pm$ 9 m.y. from specimen D3008.

The Stuart Dyke Swarm is tentatively correlated with slightly altered gabbro and norite bodies which crop out in the southern Arunta Block east of the Sheet area ( Black & others, 1980; Offe & Shaw, in preparation). Black & others (1980) suggest that east-west trending dolerite dykes west of the Sheet area may be of equivalent age to the Stuart Dyke Swarm. Medium-grained norite at GR 383910 in the northern part of the Sheet area trends roughly northeast and intrudes the migmatitic unit Ex. It contains a relict igneous texture consisting of randomly orientated plagioclase laths up to 15 mm long (55%),

generally fine equant grains of green hornblende (30%), orthopyroxene (12%), opaque grains (3%), and accessory biotite (specimen J064). It is similar in composition to the norite bodies which intrude the southern Arunta Block to the east.

Mylonites and fault rocks: In MACDONNELL RANGES there are two possibly three ages of faults. Marjoribanks & Black (1974) concluded that movement on the Redbank Deformed Zone (Err) began at about the time of the Chewings Phase of deformation because folds within the zone have a similar style to folds recognised as a product of the Chewings Phase to the south (Marjoribanks, 1975a p. 68). Later faulting may have occurred just after the Ormiston Phase of deformation because some folds identified as Ormiston Phase are cut by faults which in turn are cut by dolerite of the Stuart Dyke Swarm. Palaeozoic faults associated with the Alice Springs Orogeny cut all basement structures including the Stuart Dyke Swarm; this event was accompanied by retrogression of minerals to greenschist facies assemblages.

A marked discordance between trends in units Es and Ej at about GR 436733 is caused by a low angle eastward-dipping fault (not marked on Preliminary map). The fault appears to be folded and is cut by later faults to the north and south.

Rocks of the Redbank Deformed Zone (Err) crop out along the northern margin of the MacDonnell Ranges. On air-photos they have a streaky appearance; most boundaries with neighbouring units are based on photo-interpretation.

Rock types making up the Redbank Deformed Zone are typically strongly deformed and commonly derived from biotite gneiss and porphyroblastic gneiss. Migmatitic gneiss is widespread; concordant and discordant granite veins (quartzofeldspathic mobilisate) cut the gneiss.

Porphyroblastic gneiss commonly consists of feldspar porphyroblasts up to 45 mm and rarely 60 mm long, in a dark streaked fine-grained matrix (Fig. 7) containing hornblende and biotite (specimens G018, G023, J068, J085).

Biotite gneiss and migmatitic gneiss generally consist of microcline, plagioclase, quartz, biotite, and green or bluish-green hornblende, and accessory sphene, apatite, opaque grains, epidote, zircon, and allanite (specimens F106, G004, G021, J086, K35, K49). Granite veins (mobilisate) where present, are generally deformed. For example granite veins intruding gneiss at specimen locality G019 consist of plagioclase, perthitic microcline, quartz, biotite, and accessory allanite, zircon, apatite, and opaque grains. The rock has a mylonitic fabric; some quartz has recrystallised to form strain-free aggregates.

Granitoid at GR 347914 is similar in appearance to granitoid in unit Ex except that it is deformed; it consists of translucent brown, highly flattened feldspar porphyroblasts in a dark grey fine-grained matrix. Similar but less strongly deformed granitoid crops out at GR 324915 (specimen J082) where it contains amphibolite xenoliths (specimen J083). At GR 419910 (specimen K039) a metamorphosed porphyritic granitic rock crops out within a sequence of biotite gneiss, migmatitic gneiss, and quartzofeldspathic gneiss.

Amphibolite lenses and layers occur throughout the unit. Minor rock types are garnet-hornblende gneiss, garnet-biotite gneiss, and muscovite-biotite gneiss.

At GR 422915 quartz-rich gneiss consists of quartz (83%), biotite (9%), sillimanite (8%), and accessory cordierite, garnet, zircon, and opaque grains (specimen K046). A nearby mafic unit consists of colourless pyroxene (45%), cordierite (25%), garnet (15%), orange-brown biotite (10%), quartz (5%), accessory opaque and reddish grains (specimen K047). Mottled purple-brown and white rock adjacent to the mafic unit consists of sillimanite (25%), cordierite (25%), garnet (20%), quartz (20%), orange-brown biotite (10%) and accessory opaque grains (specimen K048).

Unit Pzr consists of muscovite schist and mylonite and forms thin linear fault zones throughout the Arunta Block. Some of these fault zones are considered to be re-activated from earlier basement deformed zones. Mylonite is grey-brown, brown, or black and contains felspar, quartz, epidote, and sphene in a fine-grained matrix composed of quartz, epidote, sericite, biotite, and ?chlorite (specimens G003, K034). Quartz has recrystallized to strain-free grains at specimen locality K034. A 20 m wide zone of biotite-hornblende gneiss at GR 325916 is cut by fractures filled by black fine-grained opaque grains (specimen J087). Because the muscovite schist and mylonite contain retrogressive greenschist facies assemblages the fault zones are considered related to the Alice Springs Orogeny. Retrogressive metamorphism which accompanied the Alice Spring Orogeny in the Arltunga Nappe Complex to the east has been isotopically dated at early Carboniferous (Armstrong & Stewart, 1975).

## AMADEUS BASIN

Units of the Arunta Block are nonconformably overlain to the south by Late Proterozoic to Palaeozoic sediments of the Amadeus Basin sequence. The stratigraphy of the sequence is summarised in Table 3 and has been modified from Quinlan & Forman (1968) using the later work of Wells & others (1970), Jones

Table 3: Stratigraphy of the Amadeus Basin sequence

| | Rock unit | Lithology | Fossils | Relationships |
|---|---|---|---|---|
| DEVONIAN — Pertnjara Group | Brewer Conglomerate Db | Conglomerate containing sedimentary clasts; minor sandstone | | Unconformably overlies Jay Creek Limestone, Goyder Formation, Pacoota Sandstone, Horn Valley Siltstone, Stairway Sandstone, Mereenie Sandstone, and part of Ljiltera Member. Conformably overlies part of Ljiltera Member. Conformably overlain by Undandita Member |
| | Undandita Member Du | Cross-bedded conglomeratic green to brown lithic sandstone containing sedimentary and crystalline clasts | | Conformably overlies Ljiltera Member and Brewer Conglomerate. Interfingering contacts. Poorly exposed; low hills mainly composed of weathered-out clasts |
| | Hermannsburg Sandstone Dr | Cross-bedded green to brown lithic sandstone with rare pebbles | | Unconformably overlies Mereenie Sandstone. Locally disconformably overlies Harajica Sandstone Member. Conformably overlain by Ljiltera Member |
| | Ljiltera Member De | Cross-bedded green to brown pebbly lithic sandstone | | Unconformably overlies Mereenie Sandstone, Pacoota Sandstone, and Goyder Formation. Conformably overlies Harajica Sandstone Member and Hermannsburg Sandstone. Conformably and unconformably overlain by Brewer Conglomerate. Conformably overlain by Undandita Member. |

| Rock unit | Lithology | Fossils | Relationships |
|---|---|---|---|
| Parke Siltstone | | | |
| Harajica Sandstone Member Dj | Cross-bedded lithic sandstone with rare metasedimentary pebbles; rare laminated sandstone and sandy siltstone | Fish plates occur in this Member west of the Sheet area | Disconformably overlies Mereenie Sandstone. Conformably and locally disconformably overlain by Hermannsburg Sandstone. Conformably overlain by Ljiltera Member |
| Mereenie Sandstone Pzm | Brown fine quartz sandstone, very thickly current bedded | Trace fossils | Unconformably overlies Pacoota Sandstone, Stairway Sandstone, and Stokes Siltstone. Disconformably overlain by Harajica Sandstone Member, Ljiltera Member, and Brewer Conglomerate |
| Stokes Siltstone Ot | Dark red and purple siltstone; shale with thin limestone beds | Brachiopods, trilobites, gastropods, pelecypods, echinoderms, nautiloids, conodonts, trace fossils | Conformably overlies Stairway Sandstone. Unconformably overlain by Mereenie Sandstone |
| Stairway Sandstone Os | Pale brown fine and medium silty quartz sandstone; quartz sandstone | Trilobites, brachiopods, pelecypods, gastropods, nautiloids, sponge spicules trace fossils, microfossils | Conformably overlies Horn Valley Siltsone and is overlain by Stokes Siltstone. Unconformably overlain by Mereenie Sandstone and Brewer conglomerate. |
| Horn Valley Siltstone Oh | Siltstone with thin fossiliferous limestone beds, and some thin sandstone beds | Trilobites, brachiopods, pelecypods, nautiloids, ostracods, conodonts, graptolites, gastropods | Conformably overlies Pacoota Sandstone and is overlain by Stairway Sandstone. Unconformably overlain by Brewer Conglomerate |
| Pacoota Sandstone €Op | Pale brown fine and medium quartz sandstone; kaolinitic and silty quartz sandstone; micaceous siltstone | Trilobites, brachiopods, pelecypods, gastropods, ribeiroids, nautiloids, trace fossils | Conformably overlies Goyder Formation and is overlain by Horn Valley Siltstone. Unconformably overlain by Brewer Conglomerate and Ljiltera Member |

ORDOVICIAN — Larapinta Group

PRECAMBRIAN — CAMBRIAN — Pertaoorrta Group

| Rock unit | Lithology | Fossils | Relationships |
|---|---|---|---|
| Goyder Formation €g | Pale brown fine to medium kaolinitic quartz sandstone, commonly micaceous; limestone; siltstone | Trilobites, gastropods, hyolithids, stromatolites | Conformably overlies Jay Creek Limestone and is overlain by Pacoota Sandstone. Unconformably overlain by Brewer Conglomerate and Ljiltera Member |
| Jay Creek Limestone €j | Blue-grey, yellow-brown dolomitic limestone and limestone; minor interbeds of shale | Stromatolites, Girvanella, trilobites | Conformably overlies Hugh River Shale and is overlain by Goyder Formation. Unconformably overlain by Brewer Conglomerate |
| Hugh River Shale €l | Grey or black shale; thin interbeds of limestone, silty sandstone, siltstone | | Conformably overlies Arumbera Sandstone and is overlain by Jay Creek Limestone |
| Arumbera Sandstone PCa | Red-brown medium very silty sandstone; purple-red micaceous siltstone | Lowermost part contains soft-bodied metazoan fossils (not known in this Sheet); upper part contains trace fossils | Conformably overlies Julie Formation and is overlain by Hugh River Shale |
| Julie Formation Puj | Dolomite; limestone; lenses of sandstone and calcareous sandstone | Poorly preserved stromatolites | Conformably overlies Pertatataka Formation and is overlain by Arumbera Sandstone |
| Pertatataka Formation Pup | Red, green, siltstone; shale | | Conformably overlies Pioneer Sandstone and is overlain by Julie Formation |
| Pioneer Sandstone Pux | Cross-bedded white to brown feldspathic sandstone; dolomite; minor conglomerate | | Inferred disconformity with underlying Areyonga Formation. Unconformably overlies Bitter Springs Formation. Conformably overlain by Pertatataka Formation |
| Areyonga Formation Pua | Diamictite; sandstone; dolomitic arkose; conglomerate, dolomite; dolomitic silty shale | | Disconformably overlies Bitter Springs Formation. Inferred disconformity with overlying Pioneer Sandstone. |

| Rock unit | Lithology | Fossils | Relationships |
|---|---|---|---|
| Bitter Springs Formation Pub | Dark grey dolomitic and cherty limestone; shale, siltstone | Stromatolites | Conformably overlies Heavitree Quartzite. Disconformably overlain by Areyonga Formation |
| Heavitree Quartzite Puh | White, pale brown, purple, medium and coarse quartzite and silicified silty quartz sandstone; silicified sandstone; siltstone | | Nonconformably overlies Arunta Block |

(1972, 1976), Wells (1976), and Preiss & others (1978). For further details on the stratigraphy the reader is referred to references cited here and in PREVIOUS INVESTIGATIONS. The cross-section shown on the map, extending over the Missionary Plain Syncline, is based on the interpretation of data and seismic sections presented by Hickey & Nettleton (1967), and Froelick & Krieg (1969).

## CAINOZOIC

Cainozoic cover is extensive in the Missionary Plain area in the south and also on the northern side of the MacDonnell Ranges.

Both chalcedonic capped sediments (unit Tw) and ferricrete (unit Tlf) are confined to the northern part of the Sheet where they form eroded remnants of earlier weathering profiles. Unit Tw is more abundant and widespread than Tlf and forms flat-topped hills up to 20 m high composed of a chalcedonic layer capping buff-coloured, friable, possibly calcareous sediment. A sample (G013B) collected from the sediment below the chalcedony contains 760 ppm $P_2O_5$ (AMDEL, 1977).

Unit Czc is mainly distributed throughout the southern half of the Sheet area and forms the remnants of earlier alluvial and colluvial fans, now dissected and in places partly reworked by present day drainage systems. Photo-pattern is distinct and typified by reddish-brown dendritic-shaped sheets which cap ridges and hills between present day drainage channels. Mulga thickets are in places concentrated along the eroded margins of the sheets. Some eroded fans south of the Chewings Range have been examined and here consist of red alluvium littered with cobbles and pebbles of metaquartzite and quartz. In the extreme southern part of the Sheet most of the unit has been eroded and only a thin veneer of partly reworked reddish-brown sand remains. Here the unit is symbolised Qs.

## GEOLOGICAL HISTORY OF ARUNTA BLOCK

Because of the lack of isotopic age data on rock units from the area, metamorphic overprinting of sedimentary and igneous contacts, and transposition during periods of folding, the geological history of the Arunta Block area outlined below is highly interpretative. The history can be summarised as follows:

Pre 1586 m.y. - deposition of pelitic and psammo-pelitic sediments (Psm, Ps, Pv), quartz-rich sediments (Pqt, Pj), and a small amount of calcareous sediment (Pcs, some Pa), and intrusion or extrusion of generally thin mafic and ultramafic layers (some Pa) on a basement of dominantly felsic and mafic volcanics (pCmn, pCsa). The basement may have been metamorphosed under granulite facies conditions at about 1800 m.y. prior to deposition of the overlying units. The overlying sediments were lithified.

About 1586 m.y. - sequence metamorphosed and tightly folded, syntectonic granitic units (Pab, $Pab_1$, Pab?, Pal, Paf, Pp, Pf, Pw) intruded into the upper crust. Late reverse faulting including partial uplift of the northern block (Central Tectonic Zone) over the southern block (Southern Tectonic Zone) along the Redbank Deformed Zone (Prr).

About 1053 m.y. - more open folding accompanied by metamorphism and migmatisation at depth. Units pCb, pCp, Pw, Px, and pCa may be derived by metamorphism (including migmatisation) of a mixture of metasediments, metamorphosed grantic units, and metamorphosed mafic igneous rocks at a deeper crustal level than units Psm, Ps, Pv, Pqt, Pj, Pcs, Pa, Pab, $Pab_1$, Pab?, Pal, Paf, Pp, and Pf. Late faulting.

About 897 m.y. - intrusion of dolerite of the Stuart Dyke Swarm.

Devonian to Carboniferous - faulting including re-activation along earlier faults (e.g., Redbank Deformed Zone). Granulite basement (Central Tectonic Zone) and migmatitic rocks between the Redbank Deformed Zone and the Chewings Range (part of Southern Tectonic Zone) were uplifted close to their present day crustal position. Retrogressive metamorphism occurred locally especially along fault zones.

Cainozoic - mild uplift of the Arunta Block is inferred from the widespread dissection of colluvial and alluvial sheets south of the MacDonnell Ranges.

## ECONOMIC GEOLOGY

### Chromium and tungsten

A regional survey carried out by CRA Exploration Pty Ltd (O'Sullivan, & others, 1972) over a large part of the basement in the Sheet area, failed to find any significant concentrations of copper, nickel, other base metals, or uranium. The survey however did locate and map a large mafic body (Ea) in the west of the Sheet area south of the Chewings Range (GR 980800). Although nickel and copper were present only in low concentrations, finely disseminated chromite grains were recognised in many ultramafic layers. Irregular veinlets and blebs of scheelite were noted in rare feldspathic layers within the mafic body and in discordant aplite and pegmatite veins which cut both the mafic body and surrounding gneisses.

### Uranium

Recently, uranium exploration has concentrated on the poorly outcropping Undandita Member (Du) of the Brewer Conglomerate in the southern half of the Sheet area; exploratory work east of the Sheet area has shown this unit to be host to uranium mineralisation (Thomas, 1975; Australian Atomic Energy Commission, 1976; Battey & Hawkins, 1978). Greenish-grey sediments of the Undandita Member are considered to hold the greatest potential for uranium mineralisation and have been delineated at depth in the eastern part of the Sheet area (Thomas, 1975). West of Mueller Creek the boundaries of the greenish-grey sediments are diffuse and difficult to define. Minor carbonaceous sandstone and rare uranium minerals have been intersected in drill section (Uranerz, 1977) in the Sheet area.

### Water

Most of the water required for the pastoral industry is captured and stored in earth dams constructed on drainage channels.

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# APPENDIX

## Petrographic Data

Mineral percentages are visual estimates. Specimen numbers are abbreviated on the map face and in the preceding text thus:

| | | |
|---|---|---|
| 73933008 | - | D3008 |
| 75930026 | - | F026 |
| 76930014 | - | G014 |
| 79930055 | - | J055 |
| 80930002 | - | K02 |

| Specimen | Grid reference | Assemblage | Comments |
|---|---|---|---|
| 73933008 | 451823 | Labradorite (52%), clinopyroxene (30%), olivine (15%), opaque grains, biotite, and a small amount of muscovite, quartz, and calcite. | Subophitic texture. Medium-grained dolerite. |
| 75930003 | 345698 | Light green clinopyroxene (54%), plagioclase (45%), and opaque grains (1%). | Fine-grained dolerite. Plagioclase altered to muscovite, epidote, and ?chlorite. Subophitic texture. |
| 75930008 | 401695 | Plagioclase and partly perthitic microcline (together 64%), quartz (35%), and a small amount of opaque grains, sphene, biotite, and secondary muscovite, chlorite, and epidote. | Fine to medium-grained quartzofeldspathic gneiss. |
| 75930010 | 290694 | Quartz (74%), muscovite and biotite (together 25%), and garnet (1%). | Garnet-biotite-muscovite-quartz schist. Anastomosing texture; quartz forms fairly even-grained aggregates. Garnet up to 2mm across. |
| 75930021 | 209718 | Quartz (92%), kyanite (5%), muscovite and opaques grains (together 3%). | Fine-grained metaquartzite. Penetrative schistosity outlined by elongate quartz and aligned kyanite prisms and muscovite flakes. |

| Specimen | Grid reference | Assemblage | Comments |
|---|---|---|---|
| 75930022 | 177695 | Perthitic microcline and strongly sericitised plagioclase (together 59%), quartz (30%), biotite (8%), muscovite (2%), and a small amount of garnet, opaque grains, epidote, clinozoisite, apatite, and chlorite. | Augen gneiss. Fine to medium-grained. |
| 75930026 | 276705 | Quartz (60%), microcline and plagioclase (together 38%), and a small amount of epidote, opaque grains, muscovite, biotite, and sphene. | Fine-grained quartzofeldspathic gneiss. |
| 7590031 | 228736 | Microcline and plagioclase (together 59%), quartz (35%), muscovite (1%), and secondary epidote, chlorite, and muscovite (together 5%). | Medium-grained leucocratic quartzofeldspathic gneiss. |
| 75930043B | 187740 | Microcline and plagioclase (together 63%), quartz (30%), muscovite (2%), and secondary muscovite, biotite, epidote, and opaque grains (together 5%). | Medium-grained leucocratic quartzofeldspathic gneiss. |
| 75930046 | 188757 | Quartz (60%), ?microcline and sericitised feldspar (together 30%), poikilitic bluish-green hornblende (5%), biotite (5%), and a small amount of sphene, apatite, epidote, and opaque grains. | Fine to medium-grained hornblende gneiss. Bimodal grain-size distribution. |
| 75930050 | 172777 | Strained quartz (99%), and a small amount of muscovite, kyanite, tourmaline, and opaque grains. | Medium-grained metaquartzite. |

| Specimen | Grid reference | Assemblage | Comments |
|---|---|---|---|
| 75930054 | 110771 | Quartz (55%), microcline and plagioclase (together 23%), epidote (20%), and a small amount of muscovite, opaque grains, and calcite. | Fine-grained calc-silicate gneiss. (Not marked on Preliminary map). |
| 75930063 | 143683 | Tremolite (70%), chlorite (29%), talc, and opaque grains. | Medium-grained chlorite-tremolite schist. |
| 75930065 | 143683 | Contact between<br>1) Sericitised andesine (50%), quartz (40%), biotite (8%), and a small amount of garnet, sphene, epidote, and opaque grains.<br>2) Quartz (30%), biotite (30%), scapolite (25%), bluish-green hornblende (10%), and a small amount of sphene, epidote, and opaque grains. | Orthogneiss; granodiorite composition. Andesine laths up to 4 mm long.<br><br>Fine-grained calc-silicate rock. |
| 75930067 | 142685 | Plagioclase and microcline (together 61%), quartz (35%), chloritised biotite (3%), opaque grains (1%), and a small amount of apatite, garnet, muscovite, epidote, clinozoisite, and allanite with epidote rims. | Medium-grained orthogneiss. Feldspar partly altered to sericite and epidote. |
| 75930070 | 130697 | Perthitic microcline and plagioclase (together 62%), quartz (35%), muscovite (3%), and a small amount of garnet, biotite, apatite, and epidote. | Medium-grained leucocratic garnet-muscovite-bearing quartzofeldspathic gneiss. Plagioclase grains partly sericitised. |

| Specimen | Grid reference | Assemblage | Comments |
|---|---|---|---|
| 75930074 | 115698 | Strained quartz (98%), and muscovite (2%). | Medium-grained metaquartzite. |
| 75930082 | 021773 | Pale green actinolite partly rimmed by tremolite (together 85%), and clinozoisite (15%). | Medium-grained amphibolite. (Not marked on Preliminary map). |
| 75930085 | 984780 | Brown-stained calcium carbonate with microcline, quartz, muscovite, biotite, epidote, and opaque inclusions. | Calcrete. |
| 75930087 | 983761 | Plagioclase and subordinate microcline (together 64%), quartz (30%), muscovite (5%), and a small amount of garnet, epidote, clinozoisite, and biotite. | Medium-grained leucocratic garnet-muscovite-bearing quartzofeldspathic gneiss. Plagioclase partly sericitised. |
| 75930088 | 095791 | Microcline and partly sericitised plagioclase (together 65%), quartz (34%), and a small amount of opaque grains, biotite, epidote, and allanite metamict. | Fine to medium-grained quartzofeldspathic gneiss. Bi-modal grain size distribution. |
| 75930094 | 440780 | Microcline and highly sericitised plagioclase (together 60%), quartz (38%), biotite (2%), and a small amount of secondary chlorite. | Medium-grained quartzofeldspathic gneiss. |
| 75930100 | 446866 | Andesine (partly antiperthitic; 65%), quartz (23%), biotite (partly altered to chlorite; 10%), and accessory green hornblende, sphene, apatite, zircon, and opaque grains. | Medium-grained granodioritic gneiss. |

| Specimen | Grid reference | Assemblage | Comments |
|---|---|---|---|
| 75930103 | 459919 | Orthoclase and plagioclase (together 40%), quartz (35%), green hornblende and secondary bluish-green hornblende (together 15%), garnet (10%), and accessory allanite with orange metamict rims. | Medium-grained garnet-hornblende gneiss. Aggregates of fairly equigranular quartz. Feldspar is coarser-grained than the quartz and has recrystallised margins. (Not marked on Preliminary map). |
| 75930104 | 438917 | Perthitic microcline, plagioclase, quartz, with lesser amounts of bluish-green hornblende, sphene, chlorite, and epidote. | Mylonised gneiss. Lenticular aggregates of recrystallised fine-grained quartz. Feldspar occurs as fractured and deformed medium-sized grains. |
| 75930106 | 445901 | Plagioclase and microcline (together 70%), strained quartz (30%), and a small amount of opaque grains, biotite, and green hornblende. | Medium-grained mylonised quartzo-feldspathic gneiss. |
| 75930107A | 442900 | Antiperthitic plagioclase and subordinate microcline (together 70%), quartz (22%), biotite (5%), green hornblende, garnet, and pyroxene (together 3%), and accessory zircon, and apatite. | Fine-grained metamorphosed tonalite. Contains aggregates of medium-grained quartz. |

| Specimen | Grid reference | Assemblage | Comments |
|---|---|---|---|
| 75930107B | 442900 | Contact between<br>1) Andesine/labradorite (70%), quartz (23%), brownish-green hornblende and secondary bluish-green hornblende (together 3%), biotite (3%), colourless clinopyroxene (rimmed by bluish-green hornblende; 1%), and accessory opaque grains, and zircon.<br>2) Andesine (50%), pale green and colourless pyroxene (30%), brownish-green, green, and some secondary bluish-green hornblende (20%), and a small amount of biotite. | Fine-grained metamorphosed tonalite.<br>Very fine-grained mafic xenolith. |
| 75930108 | 433897 | Perthitic microcline and subordinate plagioclase (together 70%), strained quartz (30%), and a small amount of bluish-green hornblende, biotite, and opaque grains. | Medium-grained deformed quartzofeldspathic gneiss. |
| 75930109 | 435899 | Plagioclase (65%), quartz (21%), biotite (8%), green hornblende (5%), garnet and clinopyroxene (together 1%), and accessory apatite, epidote, zircon, and opaque grains. | Medium to coarse-grained metamorphosed tonalite. Subhedral feldspar laths up to 6 mm long. |
| 75930111 | 392954 | Labradorite (45%), orthopyroxene and pale green clinopyroxene (together 40%), brownish-green hornblende (15%), and accessory reddish-brown biotite, and opaque grains. | Medium-grained mafic granulite (granulite facies - granuloblastic texure). |

| Specimen | Grid reference | Assemblage | Comments |
|---|---|---|---|
| 75930113 | 259991 | Labradorite (80%), orthopyroxene and clinopyroxene (together 20%), and accessory opaque grains. | Medium-grained mafic granulite (granulite facies - granuloblastic texture). |
| 76930002 | 239923 | Plagioclase (35%), quartz (35%) garnet (15%), reddish-brown biotite and brownish-green and green hornblende (together 8%), orthopyroxene and clinopyroxene (together 7%), and accessory apatite, zircon, and opaque grains. | Fine-grained felsic granulite (granulite facies - granuloblastic texture) containing some medium-sized grains of feldspar and quartz. |
| 76930003 | 257901 | Rounded grains and aggregates of quartz, plagioclase, epidote and sphene in a fine-grained matrix of quartz, epidote, sericite, and ?chlorite. | Mylonite. |
| 76930004 | 256897 | Deformed perthitic orthoclase and plagioclase (together 55%), lenticular strained quartz (35%), and small amounts of green and bluish-green hornblende, biotite, apatite, sphene, zircon, and opaque grains. | Mylonised biotite-hornblende gneiss. |
| 76930005 | 252872 | Perthitic orthoclase and plagioclase (together 63%), lenticular strained quartz (36%), and accessory biotite, and bluish-green hornblende. | Medium-grained mylonised quartzofeldspathic gneiss. |

| Specimen | Grid reference | Assemblage | Comments |
|---|---|---|---|
| 76930006 | 150911 | Plagioclase and perthitic orthoclase (together 58%), quartz (35%), a small amount of green and bluish-green hornblende, and lesser amounts of biotite, garnet, apatite, zircon, and opaque grains. | Medium-grained mylonised garnet-hornblende gneiss. Quartz recrystallised (annealed fabric). |
| 76930007 | 071878 | Light green hornblende (65%), plagioclase (35%), and rare pyroxene. | Medium-grained amphibolite. |
| 76930008 | 065871 | Deformed perthitic microcline and plagioclase (together 62%), quartz (35%), and a small amount of garnet, biotite, muscovite, and opaque grains. | Medium-grained mylonised quartzofeldspathic gneiss. Quartz forms lenticular strained aggregates. Quartz has sutured grain boundaries. |
| 76930009 | 055857 | Quartz (60%), plagioclase and microcline (together 28%), muscovite (10%), epidote (2%), and accessory biotite, and sphene. | Fine-grained muscovite schist. Quartz recrystallised (annealed fabric). |
| 76930010 | 050848 | Highly sericitised and saussuritised plagioclase, pyroxene highly altered to actionolite, and opaque grains (1%). | Mafic dyke. Subophitic texture. |
| 76930011 | 021849 | Perthitic microcline and plagioclase (together 64%), quartz (30%), biotite and bluish-green hornblende (together 5%), and a small amount of sphene, apatite, and opaque grains. | Fine-grained hornblende gneiss. |

| Specimen | Grid reference | Assemblage | Comments |
|---|---|---|---|
| 76930012 | 021852 | Light green actinotite (70%), colourless clinopyroxene (30%), and accessory apatite. | Medium-grained amphibolite. Vein containing epidote, clinozoisite, and accessory calcite. |
| 76930013A | 010983 | Fine-grained quartz with irregular grain boundaries. Spherulites of chalcedony up to .4mm across. | Silcrete. |
| 76930014 | 412988 | Labradorite (50%), orthopyroxene and pale green clinopyroxene (together 46%), slightly brownish-green hornblende (2%), and opaque grains (2%). | Fine-grained mafic granulite (granulite facies - granuloblastic texture). Some secondary actinolite along fractures. |
| 76930015 | 412988 | Plagioclase and potash feldspar (together 45%), quartz (40%), sillimanite (7%), biotite (6%), garnet (2%), and accessory opaque grains and zircon. | Medium-grained garnet-biotite-sillimanite gneiss. |
| 76930018 | 962936 | Antiperthite and microcline (together 55%), quartz (30%), green and bluish-green hornblende (8%), biotite (7%), and accessory apatite, sphene, opaque grains, and allanite and associated metamict. | Medium-grained mylonised biotite-hornblende gneiss. Some aggregates of fine-grained recrystallised quartz (annealed fabric). |

| Specimen | Grid reference | Assemblage | Comments |
|---|---|---|---|
| 76930019 | 963936 | Plagioclase and perthitic microcline (together 62%), quartz (35%), biotite (2%), and a small amount of allanite and associated metamict, zircon, apatite, and opaque grains. | Medium-grained mylonised biotite gneiss. Some aggregates of fine-grained recrystallised quartz (annealed fabric). |
| 76930020 | 970905 | Green hornblende cores with thin rim of secondary greenish-blue hornblende (together 65%), clinozoisite and epidote (together 28%), quartz (5%), and opaque grains (2%). | Medium-grained amphibolite. |
| 76930021 | 970905 | Deformed plagioclase grains (50%), lensoid strained quartz (35%), green and a small amount of bluish-green hornblende (together 15%), and accessory sphene. | Medium-grained mylonised hornblende gneiss. |
| 76930022 | 990930 | Quartz (65%), clinozoisite and subordinate epidote (together 35%), and accessory muscovite, sphene, and zircon. | Fine-grained. Quartz recrystallised (annealed fabric). |
| 76930023 | 994930 | Antiperthitic plagioclase (49%), quartz (35%), green and bluish-green hornblende and biotite (together 15%), garnet (1%), and accessory apatite and opaque grains. | Medium-grained mylonised garnet-hornblende-biotite gneiss. Quartz recrystallised (annealed fabric). |

| Specimen | Grid reference | Assemblage | Comments |
|---|---|---|---|
| 76930025 | 300880 | Plagioclase and perthitic microcline (together 66%), strained quartz (30%), biotite (2%), sillimanite (1%), and a small amount of garnet, muscovite, zircon, and opaque grains. | Medium-grained garnet-sillimanite - biotite gneiss. |
| 76930027 | 369916 | Microcline and plagioclase (together 66%), strained quartz (25%), partly chloritised biotite (6%), opaque grains (2%), and a small amount of apatite, tourmaline, sphene, allanite, epidote, and zircon. | Medium-grained granitic gneiss. |
| 79930003 | 247859 | Plagioclase and subordinate perthitic microcline (together 58%), quartz (35%), brown and green biotite (5%), muscovite (1%), and epidote (1%). | Strongly deformed medium-grained granitic gneiss. |
| 79930005 | 154826 | Plagioclase and perthitic microcline (together 65%), quartz (30%), biotite (5%), accessory muscovite, and opaque grains. | Biotite-bearing granitic gneiss containing coarse microcline megacrysts. |
| 7993007 | 141826 | Microcline and subordinate plagioclase (together 62%), quartz (30%), biotite (7%), muscovite (1%), accessory epidote, apatite, opaque grains, and zircon. | Medium-grained muscovite-biotite gneiss. |

| Specimen | Grid reference | Assemblage | Comments |
|---|---|---|---|
| 7993008 | 131841 | Microcline and subordinate plagioclase (together 60%), quartz (30%), biotite (10%), accessory epidote, muscovite, and apatite. | Fine to medium-grained biotite gneiss. |
| 79930010 | 076813 | Plagioclase and microcline (together 55%), quartz (32%), biotite (8%), epidote and sericite (together 5%). | Quartz grains elongate and strained. Schistose quartzofeldspathic gneiss. |
| 79930011 | 076810 | Quartz (45%), plagioclase and untwinned feldspar (together 40%), muscovite (12%), and biotite (3%). | Biotite-muscovite schist. |
| 79930016 | 965852 | Quartz (80%), muscovite (10%), feldspar (7%), opaque grains (3%), accessory garnet, epidote, apatite, and zircon. | Fine to medium-grained muscovite-bearing metaquartzite. |
| 79930022 | 005854 | Quartz (80%), muscovite (20%), accessory feldspar, epidote, apatite, biotite, and opaque grains. | Muscovite schist. |
| 79930023 | 024841 | Perthitic microcline and subordinate plagioclase (together 60%), quartz (30%), biotite (8%), bluish-green hornblende (2%), minor epidote and clinozoisite, accessory apatite, sphene, and opaque grains. | Deformed hornblende-biotite gneiss. |

| Specimen | Grid reference | Assemblage | Comments |
|---|---|---|---|
| 79930025 | 005825 | Sericitised plagioclase and untwinned feldspar (together 57%), quartz (30%), bluish-green hornblende (10%), epidote (3%), accessory chlorite, sphene, and apatite. | Fine-grained hornblende gneiss. |
| 79930030 | 028816 | Plagioclase and microcline (together 65%), quartz (25%), biotite (10%), accessory epidote, muscovite, sericite, apatite, and opaque grains. | Fine to medium-grained biotite gneiss. Megacrysts of microcline. |
| 79930033 | 199812 | Microcline and subordinate plagioclase (together 60%), quartz (30%), and aggregates of biotite, sericite, epidote, chlorite, opaque grains, and sphene. | Large microcline-bearing gneiss. |
| 79930034 | 261809 | Perthitic microcline and plagioclase (together 40%), quartz (30%), and layers rich in epidote, biotite, and sericite; minor sphene. | Feldspar grains fractured. Strongly deformed fine to medium grained gneiss. |
| 79930035 | 286819 | Perthitic microcline and subordinate plagioclase (together 57%), quartz (30%), brown and green biotite (13%), accessory apatite, opaque grains, epidote, and sericite. | Quartz ribbons strained Strongly deformed medium-grained biotite gneiss. |
| 79930036 | 317785 | Quartz (97%), muscovite (3%), accessory opaque grains. | Quartz grains elongate, strained, and fractured Fine-grained meta-quartzite. |

| Specimen | Grid reference | Assemblage | Comments |
|---|---|---|---|
| 79930038 | 412738 | Quartz (95%), muscovite (5%), accessory chloritised biotite, tourmaline, and opaque grains. | Fold. Minor muscovite re-orientated parallel to axial-plane. Folded layering outlined by rich and poor concentrations of muscovite and accessory minerals. |
| 79930040 | 414731 | Quartz (50%), microcline and ?plagioclase (together 25%), epidote, biotite, chlorite, sphene, sericite, and accessory opaque grains. | Fine-grained gneiss. |
| 79930041 | 414731 | Green hornblende (33%), microcline and plagioclase (together 30%), epidote and clinozoisite (together 22%), quartz (13%), chlorite (2%), accessory sphene. | Fine-grained calc-silicate rock. |
| 79930044 | 430710 | Quartz (65%), microcline and plagioclase (together ?18%), muscovite (15%), and opaque grains (2%). | Muscovite kink folded. Fine-grained muscovite schist. |
| 79930047 | 432705 | Labradorite (50%), clinopyroxene (35%), olivine partly altered to ?iddingsite (10%), reddish-brown biotite, ?talc, and ?serpentine (together 3%), and opaque grains (2%). | Dolerite. Ophitic texture. |
| 79930049 | 471700 | Quartz (90%), epidote (6%), muscovite (4%), accessory biotite. | Medium-grained metamorphosed calcareous quartz sandstone. |

| Specimen | Grid reference | Assemblage | Comments |
|---|---|---|---|
| 79930050 | 471700 | Quartz (50%), epidote and clinozoisite (together 46%), muscovite, chlorite, biotite, sphene, sericitised plagioclase, and opaque grains. | Fine-grained calc-silicate rock. |
| 79930053 | 462747 | Microcline and untwinned ?plagioclase (together 55%), quartz (37%), muscovite (8%), accessory opaque grains. | Medium-grained schistose muscovite gneiss. |
| 79930055 | 379904 | Layered<br>1. Perthitic microcline, plagioclase, quartz, biotite, bluish-green hornblende, accessory apatite, sphene, opaque grains, and zircon.<br>2. Perthitic microcline, plagioclase, and quartz. | Quartz grains elongate and strained. Layered medium-grained mylonised hornblende-biotite gneiss and quartzofeldspathic gneiss. |
| 79930056 | 379904 | Plagioclase and microcline (together 45%), quartz (35%), biotite (13%), epidote and clinozoisite (together 5%), hornblende (2%), accessory muscovite, apatite, sphene, and opaque grains. | Mylonised fine to medium-grained hornblende-biotite gneiss. |
| 79930063 | 385910 | Microcline and plagioclase (together 60%), quartz (37%), biotite (3%), accessory bluish-green hornblende, sphene, apatite, and opaque grains. | Large feldspar-bearing quartzofeldspathic gneiss. Coarse alkali feldspar. |

| Specimen | Grid reference | Assemblage | Comments |
|---|---|---|---|
| 79930064 | 383910 | Plagioclase (55%), green hornblende (30%), orthopyroxene (12%), opaque grains (3%), accessory biotite. | Relict? igneous texture; randomly orientated plagioclase laths. Medium-grained partly recrystallised? norite. |
| 79930065 | 384912 | Quartz (38%), plagioclase and microcline (together 30%), biotite (20%), sillimanite (9%), garnet (3%), accessory opaque grains. | Medium-grained garnet-sillimanite-biotite gneiss. |
| 79930066 | 384912 | Quartz (60%), plagioclase (35%), garnet (4%), opaque grains (1%), accessory biotite. | Fine-grained garnet-plagioclase-quartz gneiss. |
| 79930067 | 384912 | Quartz (75%), biotite (14%), sillimanite (10%), garnet (1%), accessory opaque grains, and zircon. | Strongly deformed garnet-sillimanite-biotite-quartz gneiss. |
| 79930068 | 385915 | Plagioclase and microcline (together 49%), quartz (25%), green and bluish-green hornblende (15%), biotite (10%), opaque grains (1%), accessory sphene, apatite, and allanite. | Medium-grained biotite-hornblende gneiss. |
| 79930070 | 279907 | Layered<br>1. Plagioclase and microcline (together 55%), quartz (35%), bluish-green hornblende (5%), biotite (4%), sphene (1%), accessory opaque grains.<br>2. Plagioclase, microcline, and quartz. | Mylonised medium-grained biotite-hornblende gneiss and coarse-grained quartzofeldspathic gneiss. |

| Specimen | Grid reference | Assemblage | Comments |
|---|---|---|---|
| 79930071 | 286909 | Plagioclase and perthitic microcline (together 50%), quartz (38%), bluish-green hornblende (10%), biotite and opaque grains (together 2%), accessory apatite, and zircon. | Mylonised biotite-hornblende gneiss. Quartzofeldspathic bands within gneiss are also deformed. |
| 79930073B | 322901 | Microcline and subordinate plagioclase (together 62%), quartz (35%), biotite (2%), accessory sillimanite, garnet, opaque grains, and trace green spinel, and zircon. | Medium-grained quartzofeldspathic gneiss. |
| 79930074A | 319902 | Plagioclase and perthitic microcline (together 59%), green hornblende (20%), light green clinopyroxene (10%), biotite (5%), quartz (5%), opaque grains (1%). | Fine to medium-grained meta-quartz monzonite. |
| 79930074B | 319902 | Plagioclase and perthite (together 55%), green hornblende (36%), quartz (5%), light green clinopyroxene (2%), biotite (1%), opaque grains (1%), accessory apatite. | Some simple twinning of perthite. Medium-grained meta-quartz monzonite. |
| 79930077 | 321907 | Green hornblende (55%), plagioclase (25%), quartz (16%), garnet (2%), biotite (2%), accessory apatite, zircon, and opaque grains. | Medium-grained calc-silicate rock? |
| 79930078B | 321907 | Antiperthite and microcline (together 40%), quartz (40%), bluish-green hornblende and biotite (together 20%), accessory garnet, epidote, opaque grains, and zircon. | Quartz grains elongate and strained. Mylonised hornblende-biotite gneiss. |

| Specimen | Grid reference | Assemblage | Comments |
|---|---|---|---|
| 79930079A | 321907 | Rounded grains of light green hornblende up to 0.7 mm long, plagioclase up to 4.5 mm long, and epidote up to 0.2 mm long in a very fine matrix of ?epidote granules, biotite flakes and ?actinolite. | Mylonite. |
| 79930079B | 321908 | Green hornblende (58%), quartz (20%), plagioclase (10%) poikilitic garnet (10%), opaque grains (2%), accessory apatite. | Fine to medium-grained calc-silicate rock. |
| 79930080 | 321908 | Layered<br>1. Plagioclase and perthitic microcline (together 45%), quartz (40%), biotite and green hornblende (together 15%), accessory epidote, sphene, apatite, and opaque grains.<br>2. Plagioclase and microcline (together 70%), and quartz (30%) | Mylonised hornblende-biotite gneiss and quartzofeldspathic gneiss. |
| 79930082 | 324915 | Antiperthite and microcline (together 50%), quartz (35%), biotite (9%), hornblende (6%), accessory apatite, epidote, clinozoisite, and opaque grains. | Metamorphosed porphyritic granodiorite. |
| 79930083 | 324915 | Green hornblende (45%), plagioclase (35%), biotite (10%), quartz (8%), sphene (1%), accessory colourless clinopyroxene, and opaque grains. | Fine-grained amphibolite. |

| Specimen | Grid reference | Assemblage | Comments |
|---|---|---|---|
| 79930085 | 324915 | Perthitic microcline and subordinate plagioclase (together 40%), quartz (35%), epidote and clinozoisite (together 9%), biotite (8%), muscovite (7%), sphene (1%), accessory apatite, zircon, and opaque grains. | Microcline grains up to 6 mm long. Porphyroblastic schistose gneiss. |
| 79930086 | 325916 | Layered<br>1. Perthitic microcline and antiperthite (together 45%), quartz (40%), green and bluish-green hornblende (10%), biotite (5%), accessory apatite, sphene, and opaque grains.<br>2. Microcline and plagioclase (together 60%), and quartz (40%). | Ribbons of strained quartz wrap around fractured feldspars. Mylonised biotite-hornblende gneiss and quartzofeldspathic gneiss. |
| 79930087 | 325916 | Plagioclase and untwinned feldspar (together 45%), quartz (30%), green hornblende, biotite and opaque grains (together 25%), accessory garnet, and apatite. | Fractured medium-grained garnet-biotite-hornblende gneiss. |
| 79930094 | 433759 | Quartz (99%), accessory muscovite, opaque grains, and colourless fine grains. | Quartz grains elongate and strained. Fine to medium-grained metaquartzite. |
| 79930095 | 437764 | Quartz (99%), accessory muscovite and ?tourmaline. | Quartz grains elongate and strained. Medium-grained metaquartzite. |

| Specimen | Grid reference | Assemblage | Comments |
|---|---|---|---|
| 79930104 | 174828 | Perthitic microcline and subordinate plagioclase (together 60%), quartz (30%), biotite (10%), accessory muscovite, sericite, apatite, epidote, and zircon. | Microcline grains up to 6 mm long. Biotite-bearing granitic gneiss. (Not marked on Preliminary map). |
| 79930106 | 155832 | Quartz (70%), feldspar (20%), muscovite (6%), biotite (4%), accessory garnet, and apatite. | Fine-grained schistose garnet-biotite-muscovite gneiss. |
| 79930109 | 076809 | Quartz (87%), feldspar (10%), biotite (2%), accessory muscovite, apatite, opaque grains, and zircon. | Fine-grained metaquartzite. |
| 79930110 | 963845 | Perthitic microcline and sericitised feldspar (together 65%), quartz (30%), muscovite (4%), accessory biotite, epidote, and ?sphene. | Schistose medium-grained granitic gneiss. |
| 79930111 | 963847 | Perthitic microcline (38%), sericitised untwinned feldspar (25%), quartz (30%), brown and green biotite, bluish-green hornblende, sphene, epidote, clinozoisite (together 7%), accessory apatite, muscovite, sericite, opaque grains, allanite, and zircon. | Medium-grained quartzofeldspathic gneiss. |

| Specimen | Grid reference | Assemblage | Comments |
|---|---|---|---|
| 79930112 | 963847 | Epidote, chlorite, and sericite (together 50%), dark green hornblende (25%), quartz (25%), accessory sphene, and plagioclase. | Fine-grained calc-silicate rock. |
| 79930119 | 024841 | Green hornblende (60%), plagioclase (37%), epidote (3%), accessory sphene, and opaque grains. | Fine-grained amphibolite. |
| 79930120 | 009820 | Perthitic microcline (60%), quartz (35%), biotite (5%), accessory chlorite, epidote, muscovite, apatite, allanite, and opaque grains. | Some microcline grains up to 5 mm long. Strongly foliated porphyroblastic granitic gneiss. |
| 79930121 | 009821 | Perthite and subordinate plagioclase (together 35%), quartz (35%), epidote, muscovite, and sericite (together 30%), accessory biotite, and sphene. | Deformed and retrogressed fine to medium-grained granitic gneiss. |
| 79930123 | 023811 | Microcline and plagioclase (together 64%), quartz (30%), biotite (6%), accessory apatite, chlorite, muscovite, epidote, and opaque grains. | Biotite-bearing fine to medium-grained granitic gneiss. |
| 79930124 | 115820 | Quartz (80%), plagioclase and untwinned feldspar (together 10%), biotite (8%), muscovite (2%), accessory garnet, apatite, chlorite, and opaque grains. | Fine-grained schistose garnet-bearing quartz-rich gneiss. |

| Specimen | Grid reference | Assemblage | Comments |
|---|---|---|---|
| 80930001 | 301731 | Quartz (98%), opaque grains, accessory muscovite and colourless fine-grained prisms. | Quartz grains elongate and strained. Fine to medium-grained metaquartzite. (Not marked on Preliminary map). |
| 80930002 | 309748 | Microcline and sericitised feldspar (together 54%), quartz (40%), chloritised biotite (5%), sphene (1%), accessory opaque grains, epidote, and apatite. | Some quartz aggregates. Fine to medium-grained quartzofeldspathic gneiss. |
| 80930003 | 236757 | Quartz (97%), muscovite (3%), accessory opaque grains, tourmaline, and zircon. | Quartz grains elongate and strained. Medium-grained metaquartzite. |
| 8093004 | 235755 | Microcline and sericistised feldspar (together 50%), quartz (35%), biotite, chlorite, and epidote (together 15%), accessory green hornblende, sphene, and opaque grains. | Lenses rich in quartz or feldspar and secondary minerals such as epidote and chlorite. Deformed and retrogressed granitic gneiss. |
| 8093005 | 223771 | Microcline and untwinned feldspar (together 50%), quartz (40%), biotite (10%), accessory opaque grains, apatite, sphene, and epidote. | Fine-grained biotite-bearing quartzo-feldspathic gneiss. |
| 80930006 | 245740 | Bluish-green and green hornblende (55%), untwinned feldspar? (25%), voids in slide (20%), accessory biotite and epidote. | Amphibolite schist. |

| Specimen | Grid reference | Assemblage | Comments |
|---|---|---|---|
| 80930007 | 048758 | Labradorite (55%), clinopyroxene (25%), olivine (18%), opaque grains (2%), brown hornblende, accessory secondary calcite, actinolite, sericite, and chlorite. | Ophitic to subophitic texture. Medium-grained dolerite. |
| 80930008 | 036778 | Perthitic microcline and plagioclase (together 60%), quartz (38%), accessory biotite, muscovite, epidote, and sphene. | Fine-grained quartzo-feldspathic gneiss. |
| 80930009 | 037787 | Microcline, plagioclase and untwinned feldspar (together 55%), quartz (35%), biotite (10%), accessory muscovite, apatite, opaque grains, and zircon. | Fine-grained biotite gneiss. |
| 80930010 | 037785 | Quartz (85%), and muscovite (15%). | Fine-grained muscovite-bearing metaquartzite. |
| 80930011 | 962775 | Antiperthitic plagioclase and microcline (together 60%), quartz (28%), biotite (10%), epidote (2%), accessory sphene, apatite, zircon, muscovite, opaque grains, and allanite. | Coarse feldspar laths partly altered to secondary greenish-brown biotite, sericite, and epidote. Porphyroblastic gneiss. |
| 80930015 | 134707 | Plagioclase, microcline and weathered? feldspar (together 56%), quartz (35%), epidote (5%), chloritised biotite (3%), muscovite (1%), accessory sphene, calcite, and opaque grains. | Fine to medium-grained retrogressed muscovi biotite gneiss. (Mislabelled F15 on Preliminary map). |

| Specimen | Grid reference | Assemblage | Comments |
|---|---|---|---|
| 80930016 | 142701 | Microcline and sericitised plagioclase (together 50%), quartz (35%), muscovite (13%), biotite (2%), accessory epidote, clinozoisite, garnet, and opaque grains. | Medium-grained schistose biotite-muscovite gneiss. |
| 80930017 | 452730 | Andesine/labradorite (45%), clinopyroxene (30%), olivine (22%), opaque grains (3%), secondary sericite, chlorite, and ?actinolite. | Subophitic texture. Medium-grained dolerite. |
| 80930021 | 176895 | Plagioclase and untwinned alkali feldspar (together 55%), quartz (35%), biotite (8%), garnet (2%), accessory sillimanite and zircon. | Medium-grained sillimanite-garnet-biotite gneiss. |
| 80930022 | 176898 | Plagioclase and subordinate microcline (together 55%), quartz (37%), biotite (8%), accessory apatite and zircon. | Quartz elongate and strained. Some quartz ribbons. Feldspar grains up to 4 mm long. Matrix grains <1 mm long. Partial post-strain recrystallisation. Mylonite. |
| 80930023 | 176901 | Plagioclase and untwinned alkali feldspar (together 47%), quartz (45%), biotite (7%), garnet (1%), accessory sillimanite, apatite, and opaque grains. | Quartz generally finer-grained than feldspar and partly recrystallised following strain. Medium-grained sillimanite-garnet-biotite gneiss. |

| Specimen | Grid reference | Assemblage | Comments |
|---|---|---|---|
| 80930024 | 176901 | Green hornblende (60%), plagioclase (25%), quartz (14%), colourless clinopyroxene (1%), accessory garnet and opaque grains. | Medium-grained calc-silicate rock. |
| 80930025 | 176901 | Quartz (40%), garnet (30%), plagioclase (17%), hornblende (10%), colourless clinopyroxene (2%) partly altered to orange biotite and green hornblende, opaque grains (1%), accessory apatite. | Medium-grained calc-silicate rock. |
| 80930026 | 176903 | Quartz (55%), plagioclase and perthitic potassium feldspar (together 35%), reddish-brown biotite (7%), sillimanite (2%), garnet (1%). | Medium-grained garnet-sillimanite-biotite gneiss. |
| 80930027 | 176903 | Quartz (70%), antiperthitic plagioclase and untwinned alkali feldspar (together 25%), biotite (5%), accessory garnet, apatite, zircon, and opaque grains. | Medium-grained garnet, biotite, and feldspar-bearing metaquartzite. |
| 80930028 | 176903 | Plagioclase (40%), hornblende partly rimmed by ?tremolite (25%), quartz (25%), altered pyroxene (5%), orange-brown biotite (5%), accessory garnet, apatite, opaque grains, and zircon. | Medium-grained hornblende gneiss. |
| 80930029 | 176903 | Pale green clinopyroxene (40%), plagioclase (40%), brownish-green hornblende (19%), opaque grains (1%), accessory apatite, and secondary calcite, muscovite, and green hornblende. | Medium-grained metamorphosed gabbroic rock. |

| Specimen | Grid reference | Assemblage | Comments |
|---|---|---|---|
| 80930030 | 177905 | Plagioclase (75%), light green amphibole (20%), scapolite, clinozoisite, calcite, biotite, chlorite, and minor greenish-blue amphibole. | Clinozoisite, biotite, chlorite, and calcite interstitial to the medium-grained plagioclase and amphibole. |
| 80930031 | 233888 | Perthitic microcline (50%), quartz (50%), accessory biotite, muscovite, opaque grains, and zircon. | Post-strain recrystallisation of quartz. Mylonised quartzofeldspathic gneiss. |
| 80930032 | 233887 | Quartz (85%), ?sillimanite (15%), accessory muscovite, opaque grains, and epidote. | Very fine-grained sillimanite-bearing metaquartzite. |
| 80930033 | 231879 | Microcline and subordinate plagioclase (together 57%), quartz (35%), biotite (5%), green hornblende (3%), accessory sphene, apatite, and opaque grains. | Coarse feldspars are fractured and have deformed twin lamellae. Some interstitial ribbon quartz. Deformed hornblende and biotite-bearing porphyroblastic gneiss. |
| 80930034 | 232890 | Perthite and antiperthitic plagioclase grains up to 3 mm long in a very fine matrix of quartz, epidote, and biotite. Accessory sphene and zircon. | Post-strain recrystallisation of quartz. Feldspars partly altered to muscovite. Mylonite. |
| 80930035 | 230899 | Antiperthitic plagioclase and subordinate microcline (together 55%), quartz (35%), biotite (7%), bluish-green hornblende (3%), accessory apatite and sphene which partly rims opaque grains. | Medium-grained hornblende biotite gneiss. |

| Specimen | Grid reference | Assemblage | Comments |
|---|---|---|---|
| 80930036 | 266897 | Quartz (70%), plagioclase and subordinate untwinned feldspar (together 18%), biotite (12%), accessory garnet, opaque grains, and zircon. | Quartz ribbons; some marginal recrystallisation. Medium-grained mylonised garnet, biotite, and feldspar-bearing metaquartzite. |
| 80930037 | 269892 | Antiperthitic plagioclase and perthitic microcline (together 55%), quartz (40%), biotite (5%), accessory garnet, muscovite, apatite, and opaque grains. | Feldspars are fractured and have deformed twin lamellae. Quartz grains elongate and strained but have undergone some marginal post-strain recrystallisation. Deformed garnet and biotite-bearing quartzofeldspathic gneiss. |
| 80930039 | 419910 | Perthitic microcline and subordinate plagioclase (together 61%), quartz (35%), biotite (3%), opaque grains (1%), accessory apatite. | Some elongate aggregates of polygonal quartz. Generally fine-grained but some coarser feldspar. Meta-porphyry. |
| 80930040 | 412894 | Quartz (55%), plagioclase, microcline, and untwinned alkali feldspar (together 35%), biotite (8%), sillimanite (2%), accessory garnet and zircon. | Medium-grained garnet-sillimanite-biotite gneiss. |

| Specimen | Grid reference | Assemblage | Comments |
|---|---|---|---|
| 80930041 | 411889 | Quartz (20 to 40%), plagioclase (10 to 60%), garnet (10 to 30%), pale green clinopyroxene (10 to 20%), accessory scapolite, sphene, calcite, and vein epidote. | Fine-grained calc-silicate rock. |
| 80930042 | 411890 | Quartz (40%), antiperthitic plagioclase (34%), bluish-green hornblende (25%), opaque grains (1%), accessory garnet, sphene (which rims some opaque grains), and epidote. | Medium-grained garnet-hornblende gneiss. |
| 80930043 | 411890 | Green amphibole with some colourless tremolite rims (70%), plagioclase (29%), accessory colourless clinopyroxene and epidote. | Medium-grained amphibolite. |
| 80930044 | 412899 | Microcline and subordinate sodic plagioclase (together 60%), quartz (35%), biotite (5%), accessory opaque grains, apatite, sphene, zircon, allanite metamict, and epidote. | Coarse felspar grains are subhedral. Metamorphosed porphyritic granite. |
| 80930045 | 415902 | Microcline and plagioclase (together 55%), quartz (40%), biotite (5%), accessory bluish-green hornblende, apatite, sphene, zircon, opaque grains, and allanite. | Quartz grains elongate and strained. Medium-grained quartzofeldspathic gneiss. |
| 80930046 | 422915 | Quartz (83%), biotite (9%), sillimanite (8%), accessory cordierite, garnet, zircon, and opaque grains. | Medium-grained garnet, cordierite, sillimanite, biotite -bearing metaquartzite. |

| Specimen | Grid reference | Assemblage | Comments |
|---|---|---|---|
| 80930047 | 422915 | Colourless pyroxene (possible ortho: 45%), cordierite (25%), garnet (15%), orange-brown biotite (10%), quartz (5%), accessory opaque and reddish grains. | No apparent retrogressive minerals. Medium-grained. |
| 80930048 | 422915 | Sillimanite (25%), cordierite (25%), garnet (20%), quartz (20%), orange-brown biotite (10%), accessory opaque grains. | Fine to medium-grained. |
| 80930049 | 428918 | Microcline and plagioclase (together 55%), quartz (35%), biotite (8%), bluish-green hornblende (1%), epidote (1%), accessory sphene, apatite, and allanite metamict rimmed by epidote. | Quartz grains elongate and strained. Deformed hornblende-biotite gneiss. |