DEPARTMENT OF NATIONAL RESOURCES

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

Record 1977/16

GEOLOGICAL WORK IN ANTARCTICA - 1974/75

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SUMMARY

During the 1974-1975 Antarctic summer field season two geologists of the Bureau of Mineral Resources (BMR) seconded to the Australian National Antarctic Research Expedition (ANARE) visited nine outcrops in Enderby Land, and six outcrops in the Mawson Coast and Framnes Mountains area, and made traverses on Macquarie Island.

Current and previous work in Enderby Land indicates that the exposed rocks consist predominantly of quartzo-feldspathic to basic granulite-facies metamorphics possibly of Archaean age. The quartzo-feldspathic rocks are generally banded and ultimately of non-plutonic origin (possibly intermediate to acid volcanics), and contain minor and highly variable amounts of orthopyroxene and clinopyroxene, garnet, biotite, and hornblende and, at the main peak of Newman Nunataks, up to 40 percent by volume of magnetite in banded ironstone. Rocks of pelitic derivation are relatively rare. Plagioclase-pyroxene pyriclasities with minor hornblende, garnet, and biotite are interlayered with the quartzo-feldspathic gneiss at several places and may represent original sills or flows. Elsewhere discordant dyke-like bodies of mafic gneiss are interpreted as metamorphosed basic dykes.

In the Robert Glacier-Rayner Peak area the rocks have undergone high-pressure granulite-facies metamorphism characterized by garnet and clinopyroxene replacing orthopyroxene and plagioclase. Localized retrograde metamorphism from granulite facies to amphibolite facies is widespread.

The high-grade metamorphics are locally intruded by tholeiitic dolerite dykes; in some areas these are unmetamorphosed; but elsewhere they are metamorphosed to greenschist or amphibolite facies. Dykes, veins, and lenses of massive quartz-feldspar pegmatite have given K-Ar ages of 500-600 m.y.

Foliation trends, mostly parallel to compositional layering in the rocks, are variable over the area investigated, and suggest large-scale folding having a wavelength greater than 1 km. A shallow synclinal structure was recognized at the main peak of Newman Nunataks. Other structural features such as small-scale (wavelength 10-100 cm) folding, crenulation cleavage,

and parasitic dragfolds were observed only locally, as were lineations caused by the parallel arrangement of minerals or elongated mineral aggregates. Two generations of folding were recognized at Rippon Depot.

Because of the difficulties encountered in the field and the large distances between outcrops it is recommended that future geological work in eastern Enderby Land be concentrated in the unvisited areas of the Dismal Mountains and the better-exposed areas in the Napier Mountains.

The northern part of Macquarie Island is composed of tectonic slices and intrusives of serpentinized peridotite and gabbro, dyke swarms, basalt lava flows, volcanic breccia, and minor sediments that have been metamorphosed to greenschist facies. The rest of the island is faulted against the northern part and consists mostly of relatively fresh basaltic lava, pillow lava, and volcanic breccia cut by dolerite dykes. Macquarie Island is generally considered to be an emergent part of the Macquarie mid-ocean ridge.

INTRODUCTION

ANARE summer field operations moved to Enderby Land in the 1974-75 season; the main activities programmed were surveying, aerial photography, and glaciology; geological work was a minor part of the program. Bad weather and the destruction of the fixed-wing aircraft on 23 January 1975 prevented completion of the aerial photography program.

Two BMR geologists, P.E. Pieters and D. Wyborn, were seconded to the ANARE Enderby Land party led by G. MacKinnon of the Antarctic Division, Department of Science. The geologists were attached to field survey parties; their work was thus restricted to geological observations adjacent to Trigonometric Stations. A base camp was established at Knuckey Peaks in southeastern Enderby Land, and field parties moved from place to place by Hughes 500 helicopters. Nine localities were occupied by the geologists in eastern and central Enderby Land (Fig. 1), but the main outcrops, which are in western Enderby Land, were not visited. Geological observations were also made along the Mawson Coast, inland from Mawson, and on Macquarie Island.

Thin sections of rocks collected in the 1974-75 and previous seasons were examined, and descriptions are summarized in Appendix I. Descriptions of localities visited by the authors in 1974/75 are discussed in alphabetical order according to 1:250 000 Sheet areas. All compass bearings in this Record are corrected to true north. Elevations are given in metres above sea level.

PREVIOUS WORK

Although Enderby Land was one of the earliest-sighted parts of the Antarctic it remains one of the least explored, because of poor access to the coast and inclement weather.

The following summary tabulates the geological work carried out in Enderby Land and western Kemp Land.

1930 - Sir Douglas Mawson of the British, Australian, and New Zealand Antarctic Research Expedition (BANZARE) briefly investigated rocks at Proclamation Island, and collected specimens which were examined by Tilley (1937).

1954 - Members of the first ANARE party at Mawson made a coastal exploratory trip to King Edward VIII Gulf (Stinear, 1956)

1955/56 - P.W. Crohn reconnoitred the coastline from Mawson to King Edward VIII Gulf by dog sledge, and was also positioned by Beaver aircraft at King Edward VIII Gulf and Amundsen Bay (Crohn, 1959).

1957 - Members of the Soviet Antarctic Expedition briefly visited the Oygarden Group (Ravich & Voronov, 1958),

1958 - I.R. McLeod travelled by dog sledge from Amundsen Bay to Mawson, and flew from Mawson to several places in the Tula Mountains (eg. Mount Riiser Larsen), Perov Nunataks, and Nye Mountains (McLeod, 1959).

1960 - R.A. Ruker travelled by dog sledge from near Cape Batterbee via Aker Peaks and Napier Mountains to Edward VIII Gulf, and visited the Amundsen Bay/Casey Bay area (Ruker, 1963).

1962 - Geologists of the Eighth Soviet Antarctic Expedition resumed geological work in Enderby Land, and this probably continued each year until 1970 (Kamenev, 1970a).

1965 - ANARE geologists carried out helicopter traverses in the sector south to west of Edward VIII Gulf as far as Mount Pascoe and visited a few outcrops around Magnet Bay (Trail et al., 1967).

GEOMORPHOLOGY, GLACIOLOGY

Enderby Land largely is a 300 km-wide promontory which extends north almost to 65°50' at Cape Batterbee; it forms one of the most northerly protrusions of eastern Antarctica (Fig. 1). The promontory is bounded by Amundsen Bay to the west and by Edward VIII Gulf to the east.

From the coast to the central part of Enderby Land the level of the terrain rises gradually to a roughly circular plateau with heights up to 2000 m near Young Nunataks. To the south the elevations fall to about

1100 m (eg. 1135 m near McLeod Nunataks), and further south the East Antarctic Plateau reaches a height of about 4000 m.

Most of Enderby Land maintains an independent ice sheet drained by the Wilma, Robert, and Seaton Glaciers to the east and the Beaver and Auster Glaciers to the west. A much smaller ice cap, forming the King Edward Plateau, is drained by the Rippon and Seaton Glaciers.

Evidence of glacial erosion was observed at two places. In the Oygarden Group most of the islands have flat concordant summit levels of (Plate 1) of about 110 m (Hansen, 1946), and at Leckie Range in the western part of Kemp Land there are U-shaped valleys and extensive high-level moraine terraces (McLeod, 1959). According to Trail et al. (1967) a buried cirque appears to be outlined by a ridge system at Mount Kernot, and Bird Ridge has the form of a 7 km-diameter cirque.

Ice and snow conditions are variable over Enderby Land. For example, in the Napier Mountains the land surface is covered with ice and hard snow, the mountains are relatively free of snow accumulations, and sastrugi are generally poorly developed. On the other hand, farther east in the area of the Nicholas and Schwartz Ranges extensive areas and mountains such as Mount Mueller and Mount Storegutt are largely covered by little compacted snow (Plate 4). Sastrugi are small or absent, and blue ice is not exposed. Trail et al. (1967) consider that the snow accumulation in this area is caused by the diversion of the north-flowing katabatic wind by the northward-rising slope of the ice sheet. The katabatic wind probably follows the depression of the Wilma and Robert Glaciers, and exposes blue ice at Mount Kernot and Rayner Peak. At Knuckey Peaks blue ice is not exposed, and much snow drift is deposited by strong easterly winds.

All glaciers in Enderby Land drain into large coastal embayments and cause local depressions in the regional ice sheet. They may be located on major structural or geological features, although there is no direct evidence for this.

The distribution of outcrops in Enderby Land is uneven, the larger by far the greatest number of outcrops being in the westernmost part around Amundsen and Casey Bays in the Tula, Scott, Raggatt, and Nye Mountains. In the rest of Enderby Land outcrops are widely scattered and small.

Plate 1. Summit plateaux on islands of the Oygarden Group and on coastal exposures at the south of Edward VIII Gulf (Neg. GB 767)

Plate 2. View of Mount Maines (right) and Mount Elkins (centre rear) from Mount Breckinridge (Neg. GB/886).

The mountains and nunataks visited during the 1974-75 Enderby Land season are, with a few exceptions, rugged and steep-sided, and rise high above the ice level (Plate 2). North of the central part of Enderby Land, in the Napier Mountains, Mount Maines and Mount Elkins rise about 400-500 m above the ice level; both are steep, and Mount Elkins has a spiky ridge outline caused by vertical foliation and jointing (Plate 2). The peaks of eastern Enderby Land tend to be lower (less than 400 m) above the ice level. The main mountain of Newman Nunataks is one of the rare peaks with a smooth outline and a broad summit. The top of the mountain is covered by angular pebble and boulder scree sorted into patterned ground (Plate 5).

NOMENCLATURE

Following the 23rd International Geological Congress in 1968 the International Union of Geological Sciences (IUGS) set up a Subcommission on the Systematics of Igneous Rocks. Working Groups on the Nomenclature of Charnockitic Rocks and of Granulites reported their results in 1971 to 1973 (Behr et al., 1971; Tobi, 1971; Torske & Tobi, 1972; Mehnert, 1972; de Waard, 1973; Winkler & Sen, 1973). General agreement as to the nomenclature of rocks containing both hypersthene and quartz was not reached by the working groups. Tobi (1971) and de Waard (1973) insist on using the same nomenclature for both igneous and metamorphic rocks because of their convergence at deep crustal levels. Winkler & Sen (1973) propose different but closely related nomenclature for igneous and metamorphic rocks containing both hypersthene and quartz; thus, a charnockitic granulite is a metamorphic rock with the same mineral assemblage as the igneous charnockite. Winkler & Sen's metamorphic nomenclature makes it uncertain whether the rock is a charnockite (or granite) which has been metamorphosed and possesses a gneissosity, or whether the rock was originally of a non-plutonic origin (sediment or volcanic) and has been metamorphosed to give the appropriate mineral assemblage.

Holland (1900) used the name 'charnockite series' for 'great masses of rock whose two leading characteristics are a granulitic structure and the invariable presence of a rhombic pyroxene among the constituents'.

From this it is implied that the charnockite series is the orthopyroxene-bearing equivalent of the igneous series granite, adamellite, granodiorite, tonalite.

At the localities visited in Enderby Land during 1974-5 the hypersthene-quartz-bearing rocks are well banded and interbedded with pelitic, mafic, or jaspilitic rocks, leaving no doubt that they were of sedimentary or volcanic origin. Nowhere were intrusive contacts or migmatite zones observed. The nomenclature used in this report is based on the terms adopted for metamorphic rocks; no reference is made to terms used by Holland (1900) and others to describe the 'charnockite series'. Thus, most foliated and banded rocks are referred to as gneiss with the appropriate mineral assemblage stated in order of increasing abundance. A few of the rocks collected have a granulose texture resulting from the predominance of nearly equidimensional minerals, and are termed granofels. Rocks with a few or no mafic minerals are termed leucogneiss or leucogranofels.

There is general agreement within the IUGS working groups that metabasic rocks of granulite-grade metamorphism containing pyroxene and plagioclase with little or no quartz be called pyriclasites. This term will be used here. Ultramafic rocks are generally almost monomineralic, so the predominant mineral will form the basis of the rock name - e.g. clino-pyroxene-bearing bronzitite.

Enderbite. The term enderbite was introduced by Tilley (1936) to describe rocks composed of quartz, antiperthite, and hypersthene collected by the British, Australian and New Zealand Antarctic Research Expedition (BANZARE) in 1929-31 from Proclamation Island on the northern tip of Enderby Land. Enderbite has been firmly implanted in the literature to describe rocks of tonalitic domposition in the charnockite series. It is thus an igneous term and will not be used in this report. Rocks with the same mineral composition as enderbite have been found at a number of localities, but it is almost certain that they are not of igneous origin so they will be termed hypersthene-plagioclase-quartz gneisses. In fact Tilley (1937) described a great variety of rocks from a very small area, so it is quite probable that the Proclamation Island rocks were interbanded and not of plutonic igneous character. Thus, enderbite from the type locality may not be a member of the charnockite series at all. Kamenev (1970b) believes that enderbites from Enderby Land are a product of soda-metasomatism at the beginning of production of charnockites. We have no evidence for this origin.

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Mount Breckinridge (Fig. 2)

Mount Breckinridge in the Napier Mountains is about 2000 m high, and protrudes about 600 m above the ice plateau. It is about 1.5 km long and oriented approximately north-south. The northern end is a narrow knife-edge ridge with cliffs on the eastern side of a 70^{o} ice slope on the western side. South of the trig station the ridge drops to a sloping area of outcrop and felsenmeer about 800 x 500 m. The trig commands spectacular views of the surrounding mountains, as shown in Plate 2.

The dominant rock type is pyroxene-perthite-quartz gneiss consisting of quartz, microcline perthite, hyperthene and/or augite, and minor opaques, biotite, apatite, and zircon. Local retrogressive metamorphism is indicated by rims of green hornblende around augite crystals and well-developed tartan twinning in perthite. Interbedded with the gneisses are slightly darker bands or pyriclasite, composed (sample 7583/0226) of plagioclase, two pyroxenes, and minor biotite, hornblende, and opaques, and rare, very dark bands consisting of augite, magnetite (20%), hornblende, plagioclase, and abundant apatite (7%) and zircon (4%). The zircon grains are up to 1.5 mm across, and have metamorphic overgrowths. The zircon-rich bands may represent original sedimentary concentrations of heavy minerals derived from a basic source. Also present are a few aluminous pelitic bands containing sillimanite and corundum (sample 7583/0233).

In the Napier Mountains around Mount Breckinridge and Mount Bennett the foliation generally dips to the west. At Mount Breckinridge the foliation dips consistently to the west at between 30^{o} and 55^{o}, though dips were steeper at the southeast end of the mountain.

Mount Breckinridge is cut by a series of parallel zones of retrograde schist (Fig. 2) which strike approximately parallel to the gneiss foliation but dip to the west at a shallower angle (20-25^{o}). In the schist, original granulite-grade pyroxenes have been altered to blue-green

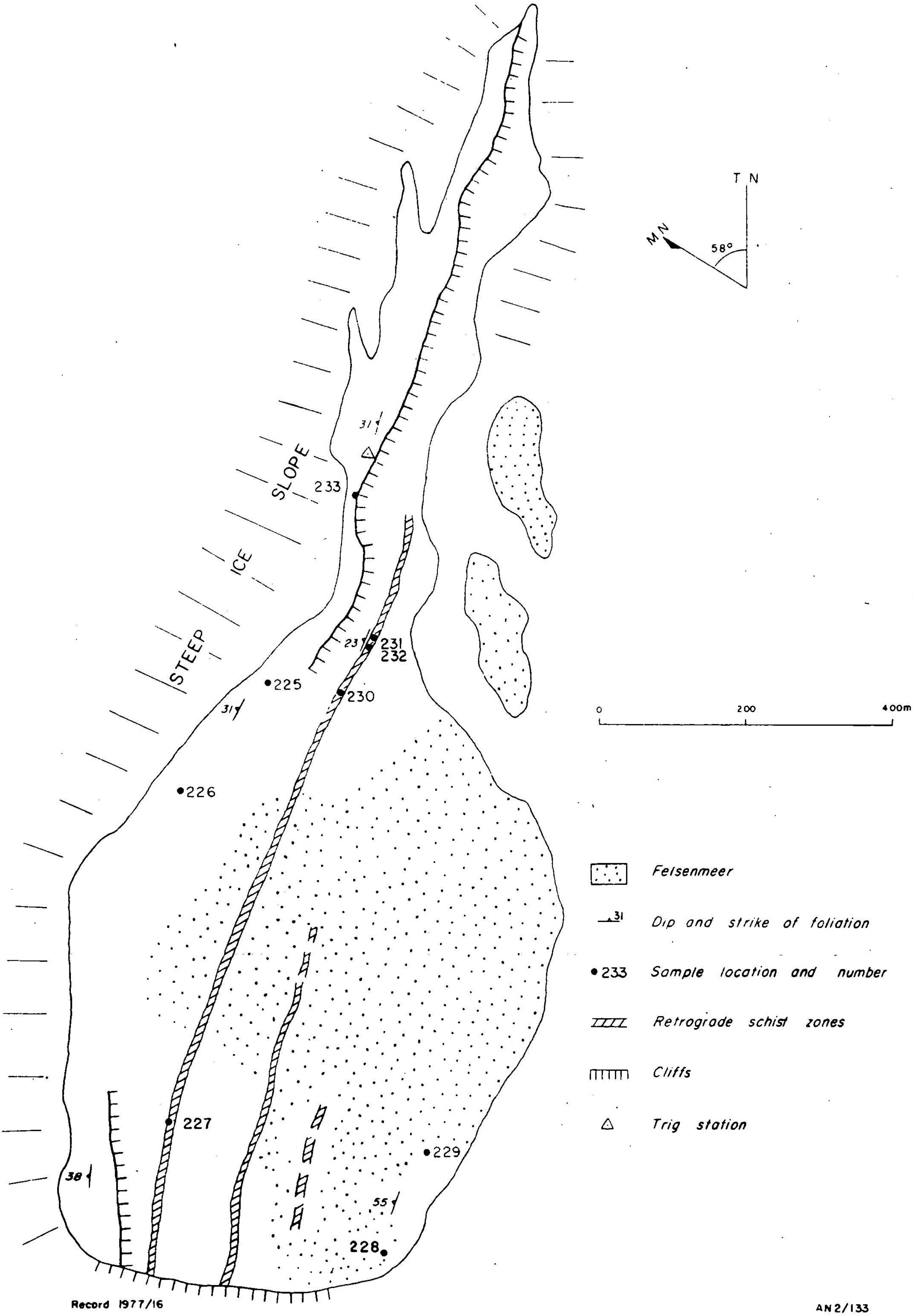

Figure 2 Sketch Map of Mount Breckinridge

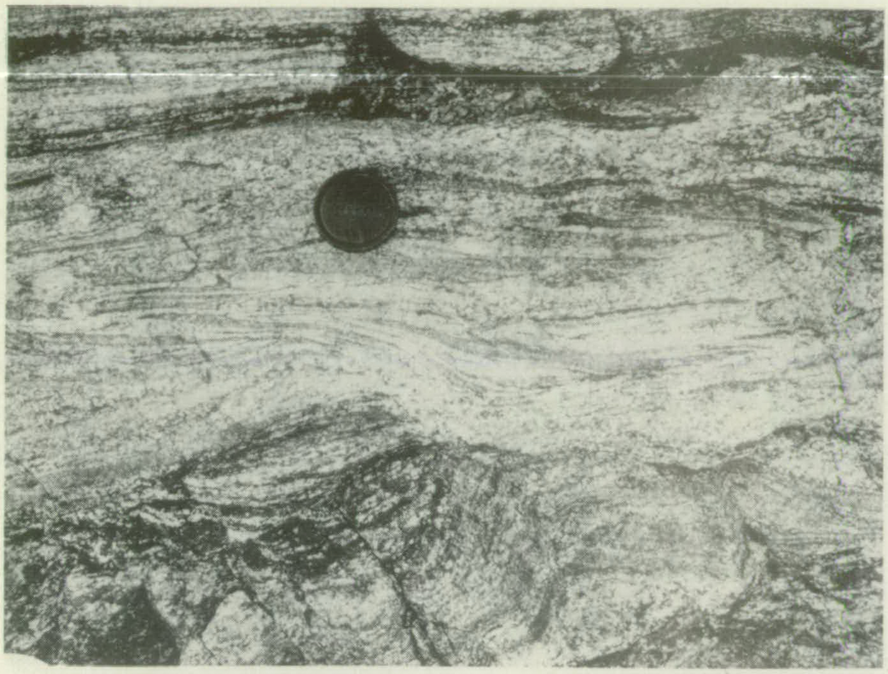

Plate 3. Retrogressed schist zone - Mount Breckinridge (Neg. GB/888).

Plate 4. General view of Mount Mueller (left), unnamed peak, and Mount Storegutt (right) from easternmost nunatak of the Mount Mueller group (Neg. GB/878). Arrow shows Trig. station.

hornblende and aggregates of fine biotite. Sample 7583/0230 contains intergrown quartz and hornblende pseudomorphing pyroxene in a manner similar to that reported by Griffin & Heier (1969). Plate 7 shows a typical retrograde schist zone.

An unmetamorphosed porphyritic dolerite dyke (sample 7583/0228) about 0.3 m across crops out in the southeastern corner of Mount Breckinridge.

The retrograde metamorphism at Mount Breckinridge may be related to the emplacement of the Vernadsky Massif, a porphyroblastic granosyenite intrusive mapped by Kamenev (1969) in the nearby Mount Bennett/Armstrong Peak area. (Kamenev used the term 'massif' to describe a pluton - the Vernadsky 'Massif' is not an exposed rock mass and therefore not a massif in the usual sense.) Ruker (1963) reported hornblende-feldspar-quartz rocks with a poor schistosity at Armstrong Peak which could be interpreted as an outcrop of the 'Massif'. Gneisses at Mount Bennett (Ruker 1963) contain biotite and garnet but apparently do not contain hypersthene and may, like the rocks at Mount Breckinridge, be retrogressed.

AKER PEAKS 1:250 000 SHEET SQ39-40/11

Aker Peaks (See locality map, Fig. 1.)

The main mountain at Aker Peaks is surrounded by a deep windscour, and rises with precipitous cliffs out of the ice plateau to a narrow, strongly dissected crestal ridge. At smaller nearby nunataks the ice is domed over the rock and broken up near the crest, so that small outcrops of rock are exposed during the summer.

A small nunatak about 1 km southeast of the main mountain consisted mainly of massive medium to dark brown pyriclasite in which faint layering and banding are locally visible. Anti-perthite is the most common felsic mineral; potassium feldspar is rare, and quartz absent. Orthopyroxene (hypersthene) is typically more abundant than clinopyroxene. Minor opaques, mostly magnetite, are present, and zircon and apatite are common accessories. Specimen 7583/0024 contains secondary biotite, and pyroxene is retrogressively altered to greenish pleochroic hornblende.

The dark brown rocks of the main mountain of Aker Peaks probably have a similar composition. From a distance they appear to be poorly foliated and to have an average strike of north-south and dips of about 60° east.

They are intersected by widely spaced joints which impart a crude blocky appearance. Ruker (1963) visited the northern end of the main mountain of Aker Peaks, and observed 'charnockitic' gneiss which is locally finely banded as the result of concentrations of biotite. The rock is cut by numerous veins and intensely jointed; the average strike is northwest with dips between 30° and 50° northeast.

Martin Island

Ruker (1963) described hypersthene-quartz-antiperthite gneiss and pyriclasite from Martin Island. In the 1974-75 season an ANARE biologist (D. Rounsevell) collected samples of similar rock from widely scattered localities there. Rounsevell described the rock as interlayered dark and light rocks dipping generally west at about 60° to 70°.

The hypersthene-quartz-antiperthite gneiss contains minor opaques, zircon, and apatite, and grades into a plagioclase leucogneiss which has no hypersthene (samples 7583/0285 and 7583/0291). The pyriclastes range from felsic types with minor garnet (7583/0286) through hornblende-bearing and biotite-bearing plagioclase-pyroxene types to magnesium-rich ultramafic rocks composed of enstatite, augite, phlogopite, and cummingtonite (7583/0281).

Mount Mueller and adjacent nunataks (Fig. 3)

Mount Mueller is about 1450 m high and some 300 m above the nearby ice plateau on the northern side and 400 m on the southern side. Figure 3 shows the distribution of outcrops in the area, and Plate 4, a general view looking west-northwest from the most easterly outcrop, shows a general view of Mount Mueller. The trig station is at an elevation of 1180 m.

Although Trail & Wallis (in McLeod et al., 1966) collected samples of garnet-bearing gneiss (6528/0190), felsic pyriclasite (6528/0191), and dolerite (65280194) from Mount Mueller the dominant rock type is pale red-brown weathered, foliated even-grained hypersthene-antiperthite-quartz gneiss exposed as massive slabs, rough surfaces, and cliffs. The gneiss has an average grainsize of about 1 mm, and fresh samples (7583/0201 and 7583/0221) are yellow-brown and consist of quartz, antiperthite (An_{30}),

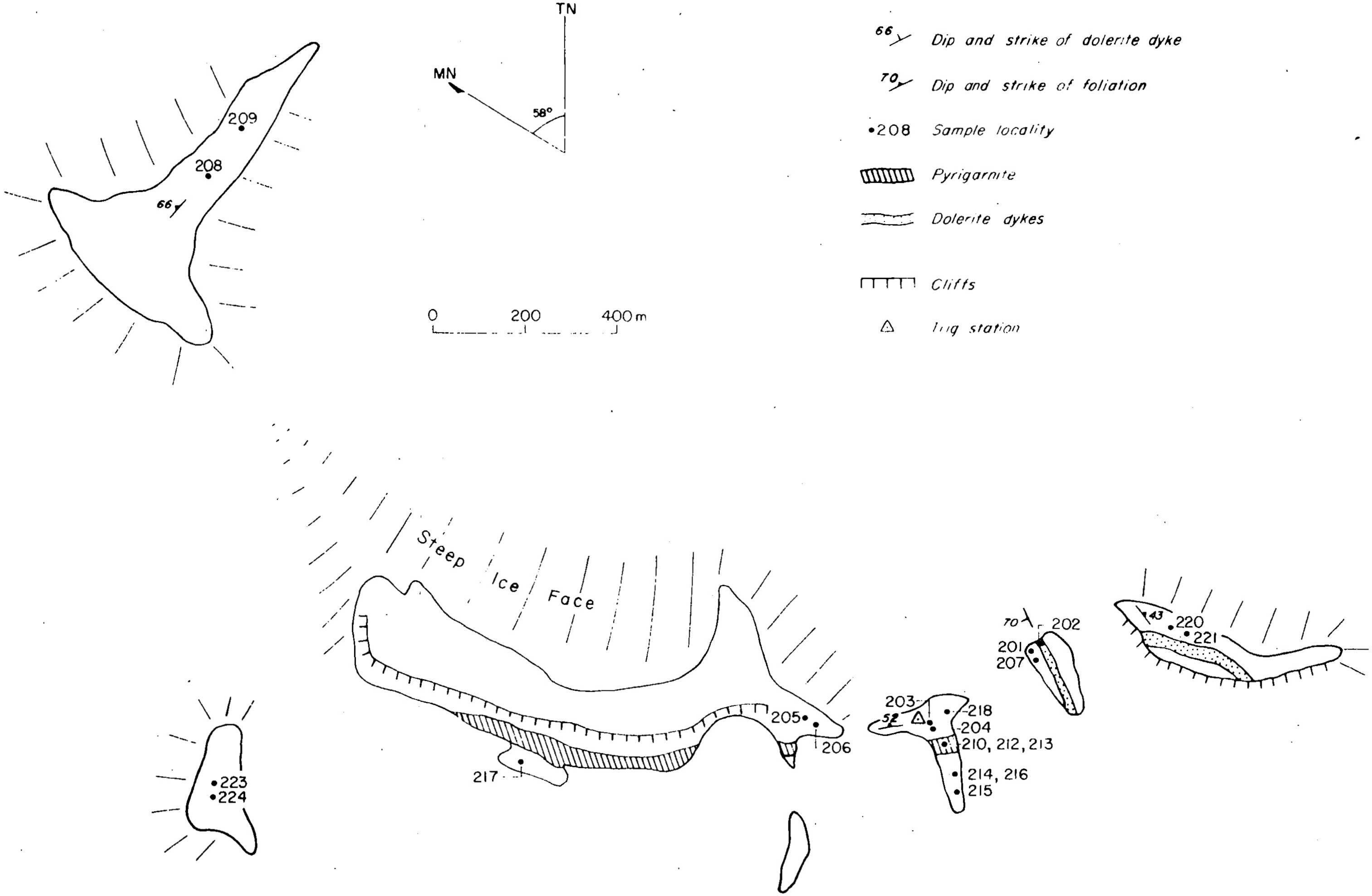

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Fig. 3 Sketch map of Mount Mueller

hypersthene, and minor opaques, biotite, apatite, and zircon. Interbedded and gradational with the antiperthite gneiss are pyriclasite, garnet-bearing gneiss, and rarer pelitic and magnetite-rich bands.

The pyriclasite is well foliated, concordant, and darker than the antiperthite gneiss. It is composed dominantly of plagioclase, commonly reverse-zoned betweed An_{30} and An_{70}, and in one sample (7583/0217) up to An_{90}. Hypersthene, augite, and brown hornblende are abundant, and biotite, perthite, and quartz are also present in minor amounts in some samples.

Dark red-brown pyrigarnite (term defined by Mehnert, 1972) forms a conspicuous outcrop on the southern side of Mount Mueller (Fig. 3). Outcrops of the pyrigarnite are rubbly because of close jointing, and are commonly encrusted with sulphate minerals. X-ray diffraction analyses have shown that yellow coatings consist of jarosite/natrojarosite, green coatings are aluminite, and white coating consist mainly of hexahydrite and bloedite. Subhedral garnet crystals averaging 2 mm across constitutes up to 95 percent (sample 7583/0210), but more commonly 40-50 percent, of the pyrigarnite. The remainder of the rock consists of quartz, hypersthene, biotite, plagioclase, perthite, and opaques.

A few bands of pelitic biotite-rich schist are interbedded with the pyrigarnite. Sample 7583/0206, a silica-poor aluminous rock, consists of biotite, cordierite, sillimanite, and corundum. Pelitic cordierite-bearing garnetiferous gneiss also occurs at a nunatak 10 km north-northwest of Mount Mueller (McLeod et al., 1966).

Sample 7583/0208 from a lens about 2 m wide and 50 m long inter-banded with antiperthite gneiss and pyriclasite, in the nunatak north-west of Mount Mueller has jaspilitic affinities, and consists of quartz, magnetite (15%), augite, apatite (5%), and hypersthene. A similar rock was collected from Cook Nunataks by McLeod et al. (1966) about 20 km south-southwest of Mount Mueller. Leucogneiss from Mount Storegutt 5 km northwest of Mount Mueller, described by McLeod et al. (1966), differs from that at Mount Mueller in that perthite, rather than antiperthite, is the dominant feldspar.

Discordant pegmatite lenses within the metamorphic rocks at Mount Mueller range up to about 1 m across and 4 m long, and their mineral assem-blages appear to be closely related to, and are probably controlled by, the host-rock composition; pegmatites in felsic gneisses consist of quartz, perthite, biotite, and plagioclase; those from more mafic gneisses (7583/0216) contain more plagioclase, locally antiperthitic, and also hypersthene. A pegmatite (7583/0224) in a pyriclasite host-rock contains hypersthene, garnet, antiperthite, cordierite, and biotite. The relation between the composition of the pegmatites and the host-rock is interpreted as indicating that the pegmatites antedate, or are spychronous with, the metamorphism of the host rock - i.e. they may be mobilizate products of metamorphism. A K-Ar date on biotite from a Mount Mueller pegmatite gave an age of 580 $\pm$ 12 m.y.. (see Appendix 2). This age is probably younger than the metamorphism, however, as Krylov (1970) has obtained Rb-Sr ages of between 1500 and 2000 m.y. for rocks from Enderby Land. The K-Ar age is similar to ages obtained from other Gondwanaland pegmatites considered to have been associated with a thermal event related to the preliminary rifting of the supercontinent (Crawford, 1974).

The youngest rocks seen at Mount Mueller are two unmetamorphosed dolerite dykes (Fig. 3). Only one of them is accessible; it is about 7 m wide, dips 70° W, strikes 164°, and is composed of rare augite microphenocrysts about 2 mm across scattered in a grey groundmass of subhedral zoned (An_{50} to An_{25}) plagioclase laths about 0.5 mm across moulded onto partly uralitized augite and minor opaques. Quartz is an uncommon interstitial mineral. The dyke has a prominent chilled margin about 100 mm wide. The rock is probably suitable for dating by the K-Ar method, and may also be suitable for palaeomagnetic work. McLeod et al. (1966) described dolerite at both Mount Storegutt and McLeod Nunataks.

Mount Mueller and surrounding nunatkas (Fig. 3) form the northwestern limb of a northeast-plunging anticline. Foliation on the nunatak northwest of Mount Mueller dips northwest at 66°, at Mount Mueller trig it dips north at 52°, and on the nunatak east of Mount Mueller it dips east-northeast at 43°. Rare tight folds within the gneisses probably represent drag folds on the limbs of major folds.

Newman Nunataks (Fig. 4)

Geological fieldwork in the Napier Mountains was restricted to the largest of the Newman Nunataks. It is a rounded flat-topped mountain not as high above the plateau ice as others in the area, and consists of two east-west aligned peaks of about equal size separated by an ice-covered saddle. The highest point of the western peak is about 2010 m, and

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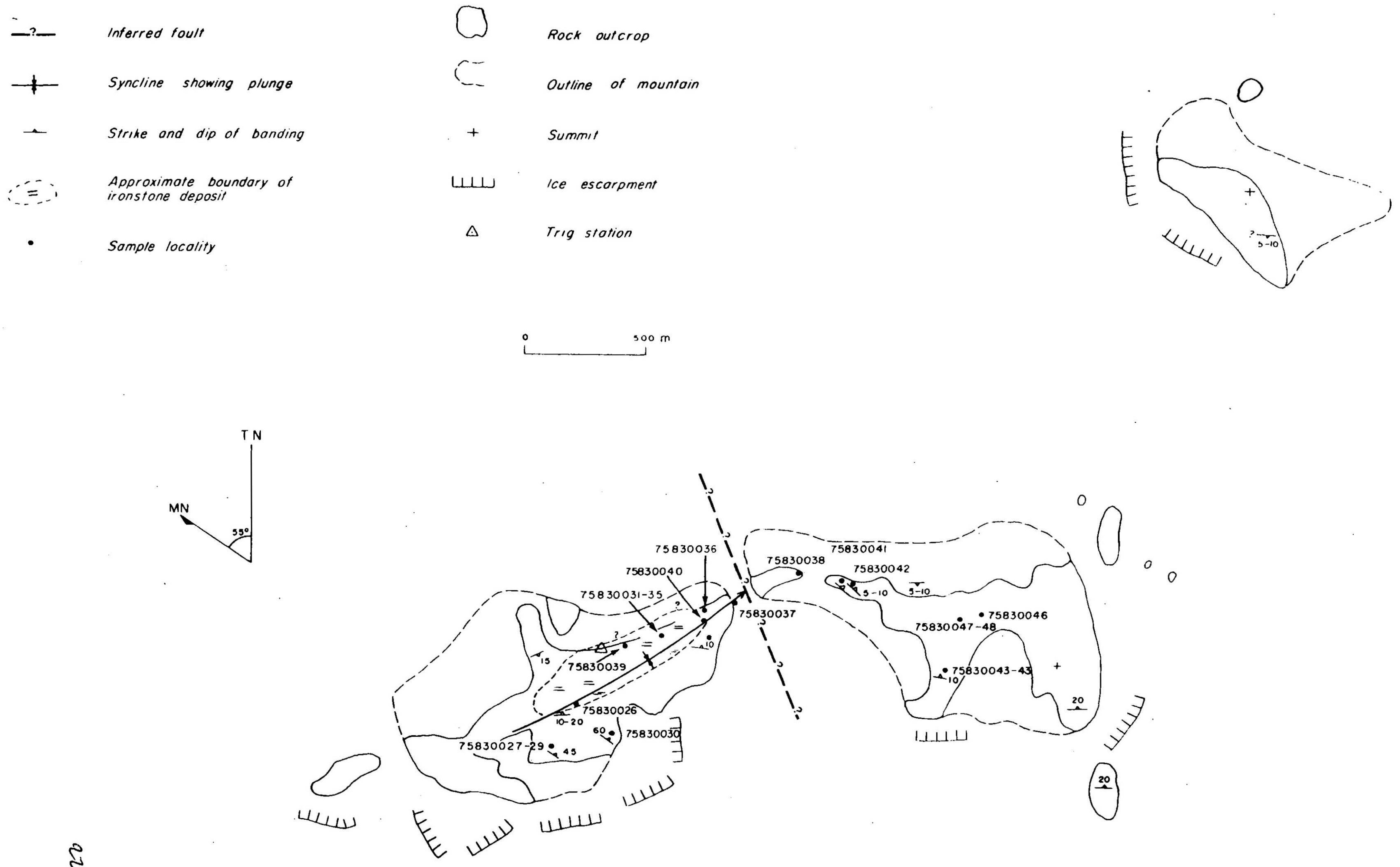

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Fig 4 Sketch map of main outcrop of Newman Nunataks the eastern peak is slightly higher; the northern flanks of both peaks are steeper than the southern. Both peaks have undulating summits mostly covered with angular rock fragments from 1 to 50 cm across. The rubble is sorted, especially on top of the western peak, into patterned ground consisting of shallow (20 to 80 cm deep) roughly circular depressions between 2 and 5 m across (Plate 5). There are deep windscours along the southern foot of the mountain. The smooth outline of the main mountain of Newman Nunataks, which contrasts with the ragged, spiky, protruding (up to 500 m above the plateau ice) other outcrops of the Napier Mountains (e.g. Mount Elkins, Mount Maines), is probably due to the influence of shallow dipping to subhorizontal foliation at Newman Nunataks. It is possible, however, that the Newman Nunataks may have been planed by glacial erosion.

The predominant rock type at the locality visited is feldspar-quartz gneiss with variable amounts of pyroxene and locally minor garnet. At the western peak these rocks are overlain by ironstone. The feldspar-quartz gneiss ranges from light to medium grey; at a few places it is interlayered with whitish or silverish phlogopite pyroxenite. Two float specimens of cordierite-bearing metapelite found at the eastern peak indicate that other rock types may be interlayered with the feldspar-quartz gneiss. Pyroxene is concentrated locally in thin discontinuous bands or streaks and in irregular randomly distributed clusters. Gneissic banding is parallel to contacts with other rock types; the more felsic rocks are generally massive or coarsely banded. The feldspar-quartz gneiss contains perthitic microcline or orthoclase and antiperthite (An_{24-32}). The pyroxene is commonly hypersthene, and small amounts of clinopyroxene. Garnet is uncommon except in some gneisses of the eastern peak, and primary biotite is rare. Opaques (mostly magnetite), zircon, and apatite are accessory.

Many specimens of gneiss show slight retrograde metamorphic effects; pyroxene is commonly rimmed and/or intergrown with colourless to greensish clinoamphibole, and some of the garnet is replaced by biotite or chlorite along borders or cracks. A few rocks contain clinozoisite which may have formed from feldspar, and locally the feldspar is slightly sericitized.

The gneiss is commonly granoblastic, and grainsizes range from 0.5 to 1.5 mm. Some rocks show a microscopically penetrative foliation caused by parallel alignment of single or composite quartz grains (e.g. 7583/0030) or by very fine alternating bands enriched in felsic and mafic

Plate 5. Camp site on top of main outcrop of Newman Nunataks. The flat summit is covered by small humps of angular scree arranged into patterned ground (Neg. GB/776).

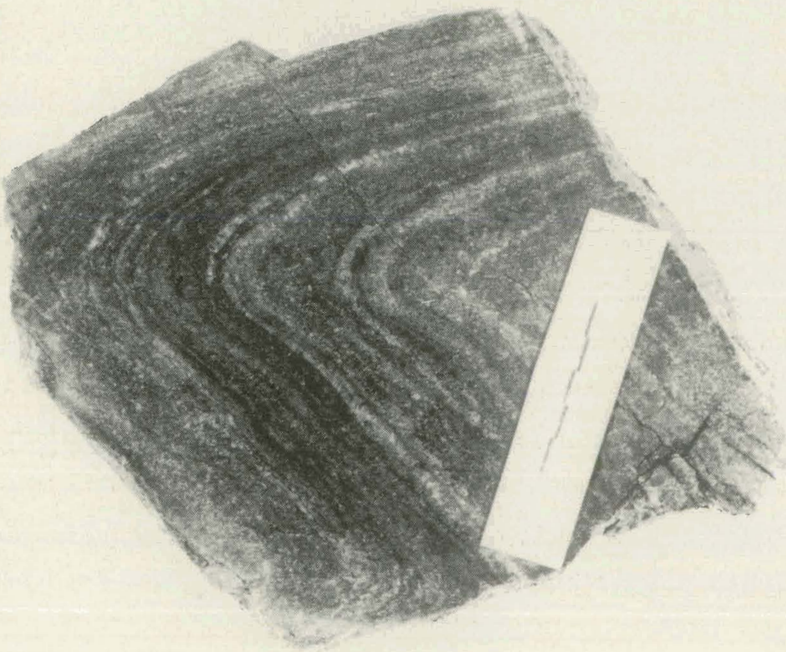

Plate 6. Main outcrop of Newman Nunataks. Thin, discontinuous, folded bands of magnetite and thicker bands of quartz-hypersthene-(magnetite) (Neg. GB/999)

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minerals (e.g. 7583/0041). Microscopic fracturing occurs locally, more or less perpendicular to the foliation. The rare pyroxenite layers are made up of enstatite (up to 85%), phlogopite, variable amounts of plagioclase and accessory zircon and sphene. Cordierite-bearing aluminous metapelites collected from loose debris also contain quartz, orthopyroxene, and opaques (e.g. 7583/0047). The codierite is commonly slightly altered to pinite and quartz.

The ironstone from the western peak is dark reddish brown to almost black, and consists mainly of thin, discontinuous, irregular, and commonly folded bands of magnetite and dark grey to bluish pods of quartz (Plate 6). The quartz bands are between 2 mm and 7 cm wide and up to 20 cm long, and commonly contain variable amounts of othhopyroxene - locally this mineral makes up the bulk of the rock (e.g. 7583/0025). Both the quartz and the pyroxene are granoblastic to granuloblastic, and their grainsizes are between 0.5 and 2.0 mm. The magnetite occurs in bands or irregular elongated patches up to 10 mm wide, as large skeletal grains, medium to small equant grains, and minute rounded grains in quartz and along cleavage planes of pyroxene. In the bands and patches it is commonly poikiloblastic, most of the inclusions being quartz. From thin sections it was estimated that the ironstone contains as much as 40 percent by volume of magnetite; analyses of ten random samples show values of total iron between 30 and 40 percent (Table 1).

Rims of clinopyroxene or greenish, colourless, or blue clino-amphiboles around hypersthene constitute evidence for retrograde metamorphism. In two ironstone samples, riebeckite and its fibrous variety crocidolite (7583/0041) are intergrown with each other, and are associated with greenish and colourless clinoamphiboles.

At several places the banding of the feldspar-quartz gneiss and ironstone is deformed into small-scale, generally tight to isoclinal and asymmetrical to recumbent folds with amplitudes between 10 and 60 cm. The folding is not accompanied by cleavage (contrast Rippon Depot) and local solitary asymmetrical folds are interpreted as shear flexures.

Superimposed on the small-scale folding is large-scale open folding (wave length of at least 200 m) which is expressed at the western peak by a shallow, easterly-plunging syncline with ironstone overlying feldspar-quartz gneiss.

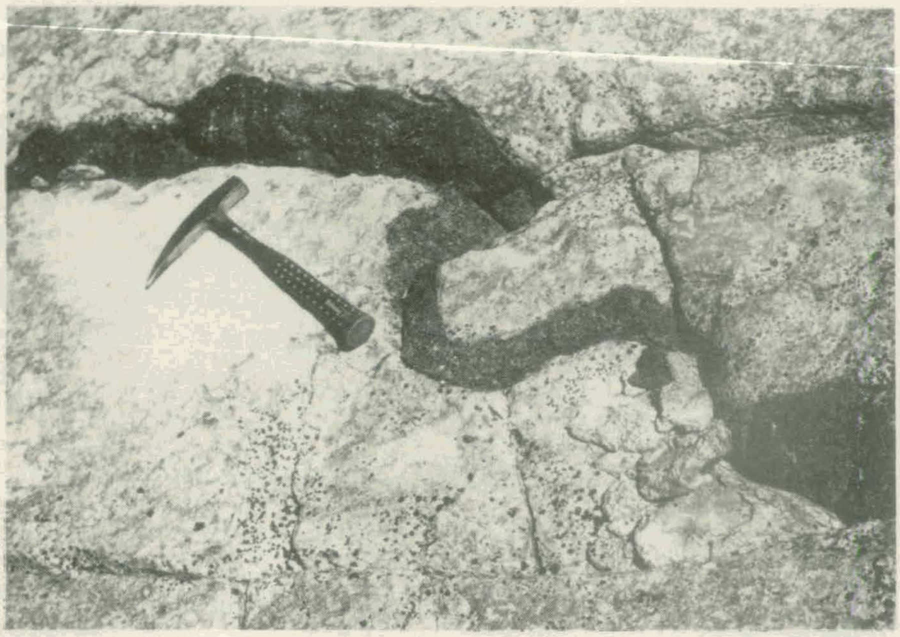

Plate 7. Rippon Depot. Thin folded layer of plagioclase-pyroxene gneiss between feldspar-quartz gneiss (Neg. GB/785).

Plate 8. Rippon Depot. Folded (pyroxene) - quartz-feldspar gneiss with crenulation cleavage (Neg. GB/795).

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Rippon Depot, west bank Rippon Glacier

Rippon Depot (066°41'S, 056°40'E) is a small nunatak at the confluence of the Seaton and Rippon Glaciers along the southern flank of King Edward Plateau. The outcrops in this area have characteristic rounded forms, and do not protrude much above the surface of either the plateau ice, or the glacier. Most of the exposed rocks are jointed subparallel to the surface of the outcrop in a manner reminiscent of crude exfoliation.

The most common rock in this area is granoblastic feldspar-quartz gneiss with grainsize between 0.6 and 2 mm. Fresh exposures are light grey to grey, but weathered surfaces are commonly stained by iron oxides to light brown, reddish, or yellowish. Foliation trends between 105 and 125°, and dips between 80°S and vertical. Quartz and feldspar are commonly in about equal proportions, but locally quartz is dominant and the rock composition approaches that of quartzite. Microcline-perthite or perthite are more abundant than plagioclase (An_{26-30}), and pyroxene is a minor (up to 5 %) but widespread constituent. Garnet is rare, and biotite occurs only locally. Orthopyroxene appears to be more abundant than clinopyroxene, and both are in places replaced in various degrees by a yellowish brown, slightly pleochroic clinoamphibole. Garnet is normally slightly porphyroblastic, and biotite occurs usually as parallel flakes. Some other micaceous material is thought to be an alteration product of garnet. Magnetite is the commonest opaque, and zircon and apatite are ubiquitous accessories. Quartz and feldspar are usually slightly strained.

Banding is widespread in the feldspar-quartz gneiss and is largely governed by the content and distribution of mafic minerals. In rocks with a low mafic content or finely disseminated mafic minerals the banding is massive or coarse; finer banding is caused by concentrations of mafic minerals, particularly pyroxene, into thin discontinuous bands, streaks, or trails, but also by differences in the proportions of quartz and feldspar, and alternation of different grainsizes.

Dark to almost black pyriclasite and related rocks are both concordant and discordant with the gneiss. The layers are up to 1 m thick (Plate 7), their contacts sharp, and their outcrops generally have been traced for at least 50 m. The pyriclasite is composed of pyroxene, plagioclase, and minor garnet and biotite. Pyroxene in some rocks has been retrogressively altered to hornblende, and the rock is thus more properly termed an amphibolite.

Foliation is deformed by small-scale symmetric to asymmetric, tight isoclinal folding with amplitudes ranging from 5 to 50 cm. This folding is accompanied locally by crenulation cleavage which is roughly perpendicular to the banding. (Plate 8). The banding and layering at a few places are transected by undeformed veins of quartz and minor feldspar 1 to 5 cm thick.

Rocks similar to those from Rippon Depot were reported by Trail et al. (1967) from other outcrops around Edward VIII Gulf. Light-coloured fine-grained granoblastic feldspar-quartz gneiss with minor hypersthene (specimen 6528/0127) from a small nunatak on the southern flank of the Seaton Glacier contains perthite, subordinate plagioclase (An_{32}) and hypersthene slightly altered to clinoamphibole and iddingsite. A small outcrop near the mouth of the Wilson Glacier (Trail et al., 1967) consists of light-coloured hypersthene-feldspar-quartz gneiss - in which (specimen 6528/0218) hypersthene is slightly altered to biotite and ?hornblende - interlayered with dark pyroxene-feldspar gneiss and pyroxene-garnet rock. Two-pyroxene pyriclasite with hornblende and biotite was collected from an outcrop near the junction of the Seaton and Wilson Glaciers. The Rippon Glacier/Seaton Glacier/Wilson Glacier area is apparently occupied by similar hypersthene-bearing quartz-rich metamorphic rocks that have undergone minor retrograde metamorphism.

OYGARDEN GROUP 1:250 000 SHEET SQ39-40/12

Jensen Island (lat. 66°32'S, long. 57°15'E)

Jensen Island is a roughly circular island about 50 m diameter and 10 m high 5 km offshore from King Edward Plateau. The island consists predominantly of slightly weathered pale yellow-brown gneiss dipping 70o west. The gneiss is equigranular with an average grainsize of about 0.5 mm, and is composed of quartz, antiperthite, hypersthene, augite, minor opaques, and apatite. Specimen 7583/0266 contains porphyroblasts of perthite and quartz about 2 mm across and abundant apatite and zircon associated with pyroxene-rich layers.

A basic dyke about 1 m thick which appears to antedate the granulite metamorphism, is thought to be the same age as the pyriclasite intrusives from Martin Island reported by Ruker (1963). It is composed of labradorite, hypersthene, brown hornblende, minor opaques, and rare garnet.

Most samples from Jensen Island show some signs of retrogression, commonly in the form of green hornblende near the rims of pyroxene grains, but one sample (7583/0270) has been completely altered to a lower amphibolite-grade assemblage; it is composed of biotite, pyroxene partly replaced by blue-green hornblende, and quartz. Pegmatites and quartz veins parallel to a prominent joint direction (strike 337^{o} dip 23^{o} east-northeast) in the gneiss may have been introduced during the retrogressive metamorphism. They are composed of quartz, pink microcline up to 100 mm across, biotite up to 20 mm across, and rare white mica also 20 mm across.

Samples of hypersthene-plagioclase gneiss similar to the pyroxene-antiperthite gneiss from Jensen Island were collected from nearby Cape Gotley (Ruker 1963) and Jagar Island (Trail et al., 1967).

McLEOD NUNTAKAS 1:250 000 SHEET SQ39-40/14

Knuckey Peaks (Fig. 5)

Knuckey Peaks, previously visited by McLeod in 1958, is a group of nunataks and one larger mountain spread out over an area of about 75 km^2. Geological investigations were restricted to the southern half of the main 2.5 km-long, 0.5 km-wide, north-northwest-elongated mountain. Its summit rises about 300 m above the plateau ice to 2125 m above m.s.l. The mostly snow-covered western flanks and the northern part of the eastern side of the mountain rise steeply from the ice plateau, but access is easy from the south-eastern side along the southern ridge. Plate 9 shows the steeply undulating summit ridge with three saddles. There is a deep windscour at the northern end of the mountain.

The most common rock type is fine to medium-grained gneiss composed of feldspar, quartz, pyroxene, and minor hornblende, biotite, and garnet. The rocks occur in several shades of grey and brown, weather to medium brown, and are either massive or banded, individual bands ranging from microscopic to very coarse. The banding is caused by concentrations of feldspar, quartz, or pyroxene (Plate 10), and to a lesser extent by slight

Plate 9. Summit ridge of main outcrop of Knuckey Peaks, looking north (Neg. GB/759).

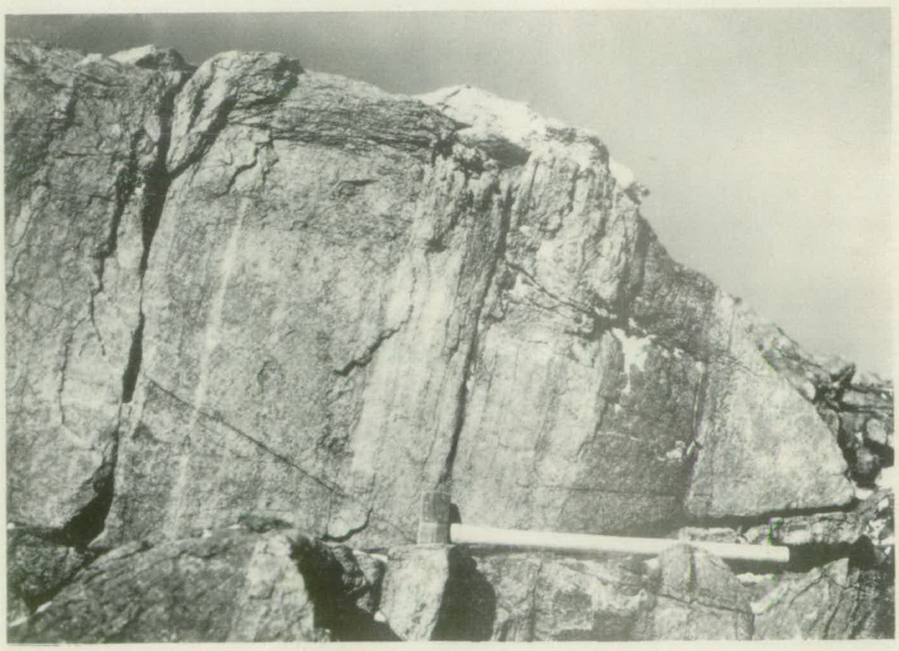


Plate 10. Main outcrop of Knuckey Peaks. Banding is the result of small changes in texture and pyroxene content. (Neg. GB/781).

changes in texture, in particular the grainsize of quartz. At several places quartz is bluish, and is much coarser (up to 20 mm diameter) than the other minerals, and gives the rocks a gritty appearance.

At a few places the pyroxene-quartz-feldspar gneiss is interlayered with or contains elongated pods of green to almost black, brittle, medium to very coarse-grained banded pyroxenite (Plate 11). Scree samples of the pyroxenite are locally covered with green coatings of unknown composition, encrustations of a whitish flour-like material, and scattered reddish patches of iron oxide. Lumps of pegmatite are scattered through the scree.

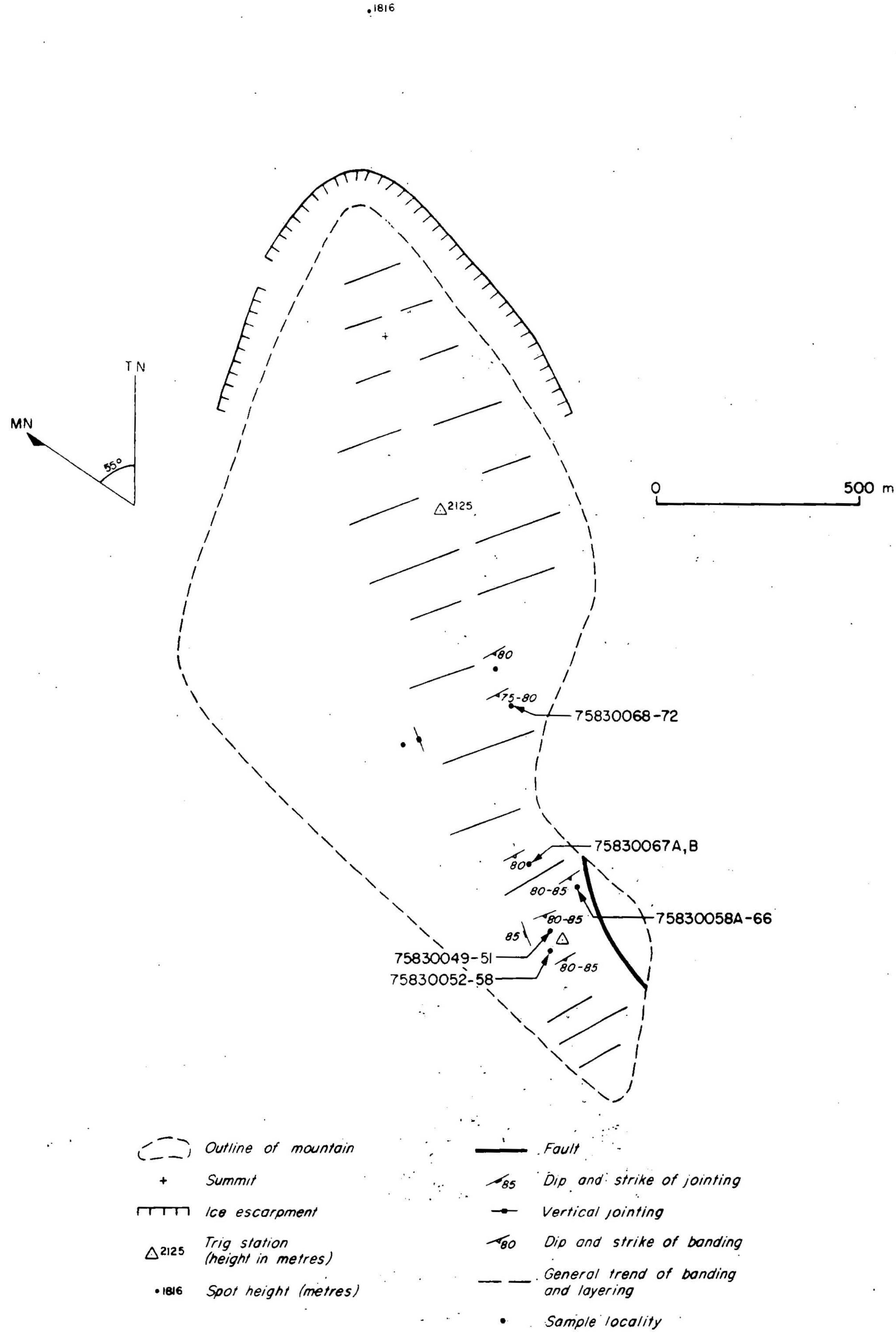
The pyroxene-quartz-feldspar gneiss is typically granoblastic, and grainsizes range from 0.5 to 2 mm. The felsic minerals are commonly microcline-perthite and/or orthoclase, quartz, plagioclase (An_{24-40}), and local antiperthite. Orthopyroxene, mostly hypersthene, is more common than augite, and enstatite coexists with colourless to pale or medium brown phlogopite in some samples (e.g. 7583/0059). Biotite and garnet are minor constituents of some more felsic gneisses, but account for the bulk of sample 7583/0056; clinoamphibole is another minor constituent. Magnetite is the most common opaque mineral. Zircon and apatite are common accessories, and tourmaline, rutile, and green spinel were observed in some rocks.

The pyroxenite consists of hypersthene, clinopyroxene, minor clinoamphibole (?hornblende), quartz, opaques, and apatite.

Foliation trends east-northeast and dips steeply (80-90^{o}) to the south. McLeod (1959) also measured steep dips to the north, and reported large-scale folding. Widely spaced (1-20 m) joints and shear zones 10 to 100 mm thick intersect the rocks. Although oriented in many directions these fractures have a predominant north-northeast trend, about perpendicular to the banding and layering; dips are commonly near vertical.

Plate 11. Main outcrop of Knuckey Peaks. A pyroxenite layer 3m thick between banded feldspar-quartz-pyroxene gneiss (Neg.GB/792).

Plate 12. Banded mafic and felsic gneiss - Doggers Nunataks. Vertical height of outcrop 150 m (Neg. GB/889).



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AN2/134

Fig. 5 Sketch map of main outcrop of Knuckey Peaks

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RAYNER PEAK 1:250 000 SHEET SQ39-40/15

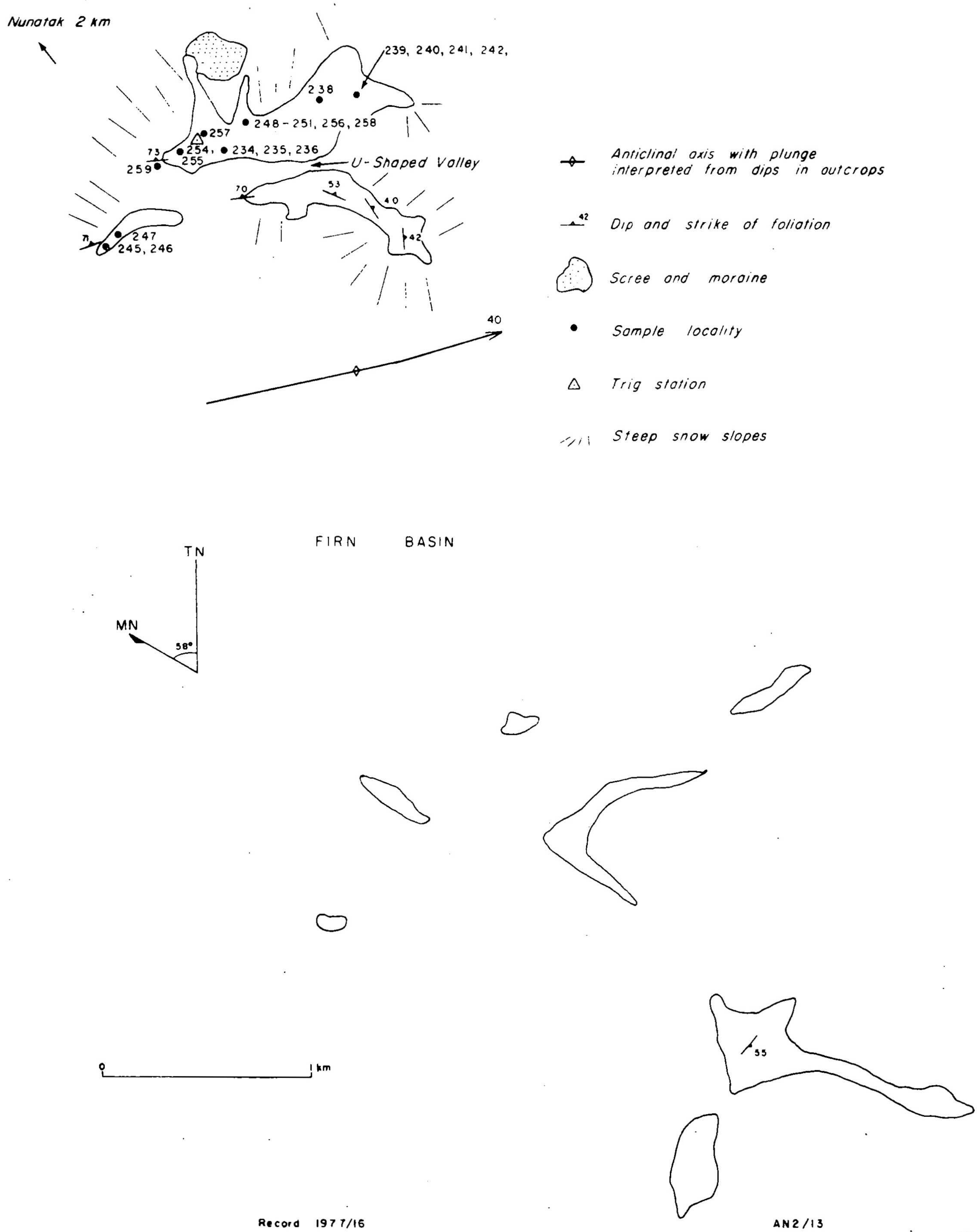
Doggers Nunataks (Fig. 6)

Doggers Nunataks comprise five outcrops over 1 km long and several smaller outcrops scattered over an area of about 50 km^2. Only the main outcrop was visited. It is about 1 km^2 in area, and is composed of two east-west elongated rock bands about 300 m apart, divided by a shallow snow basin and a U-shaped valley, possibly formed by a small eastwardflowing glacier. The northern rock band is about 50 m higher than the southern one, and is bounded on its north side by precipitous cliffs about 200 m high. Rock debris several hundred metres across has accumulated at the base of these cliffs. The southern rock band is bounded to the south by gentle snowcovered slopes (Fig. 6).

The most common rock type at Doggers Nunataks is medium-grained pale red-brown-weathering felsic gneiss which is interbanded with darker pyriclasites and greenish black ultramafic rocks (Plates 12 & 13). Contacts between light and dark bands are commonly sharp, but some are gradational. In a few places the felsic gneisses contain boudins of mafic gneiss.

The felsic gneiss consists mainly of quartz, orthoclase, and plagioclase with or without hypersthene. More leucocratic varieties generally contain more orthoclase than plagioclase but one sample (7583/0259), with minor hypersthene, contains no perthite and is composed almost entirely of quartz and antiperthite (An_{30}). Opaques and zircon are minor but ubiquitous accessories.

The pyriclasites interbanded with the gneiss are typically composed of plagioclase (An_{40} to An_{60}), hypersthene, greenish brown hornblende, biotite, and minor calcite and opaques; sample 7583/0248 contains antiperthite and perthite. One pyriclasite band contains garnet nodules up to 10 cm across surrounded by a very fine-grained black symplectite composed of plagioclase (at least An_{60}), hypersthene, spinel, and opaques. Green & Ringwood (1967) state that the reverse of the reaction indicated by this corona (that is: orthopyroxene + anorthite + spinel   garnet) occurs at high pressure with a fall in temperature or at high temperature with a rise in pressure. It is therefore possible that the rocks at Doggers Nunatak have been metamorphosed at higher pressure than the present assemblage



Record 1977/16 AN2/13

Fig. 6 Sketch map of Doggers Nunataks

indicates, and that the garnet is a relic of the higher-pressure assemblage; in this respect they resemble rocks in the Robert Glacier/Rayner Peak/Mount Kernot area about 60 km to the northeast.

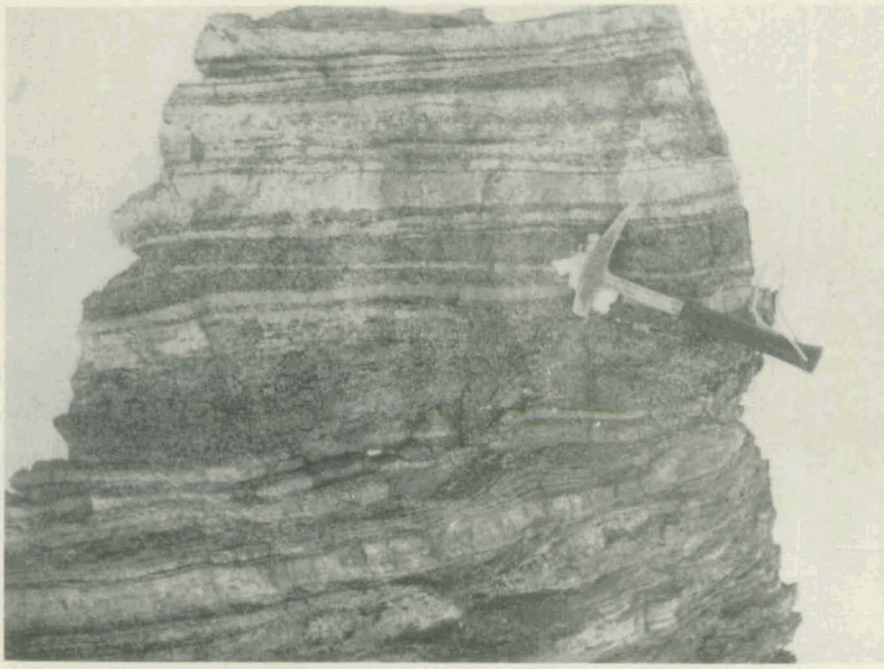


Plate 13. Banded mafic and felsic gneiss - Doggers Nunataks (Neg. GB/882)

Orthopyroxenite forms ultramafic segregations and pegmatoid bodies in interbanded mafic and felsic gneiss; these consist of hypersthene, bronzite or enstatite prisms with minor biotite, augite, hornblende, plagioclase, and perthite. Hornblendite, or more strictly olivine-pyroxene hornblendite (7583/0235 and 7583/0236), a greenish black band about 50 m southeast of the trig station; it consists of pale green hornblende (60%), bronzite, olivine (Fo_{80-90}), augite, and minor calcite, and is probably related to the abundant pyriclasites in the area.

At sample locality 242 (Fig. 6) a lens about 20 m x 10 m in a pyriclasite band is composed of crumbly granular even-grained enstatite with an average grainsize of about 1 mm. Along strike, and about 20 m east,

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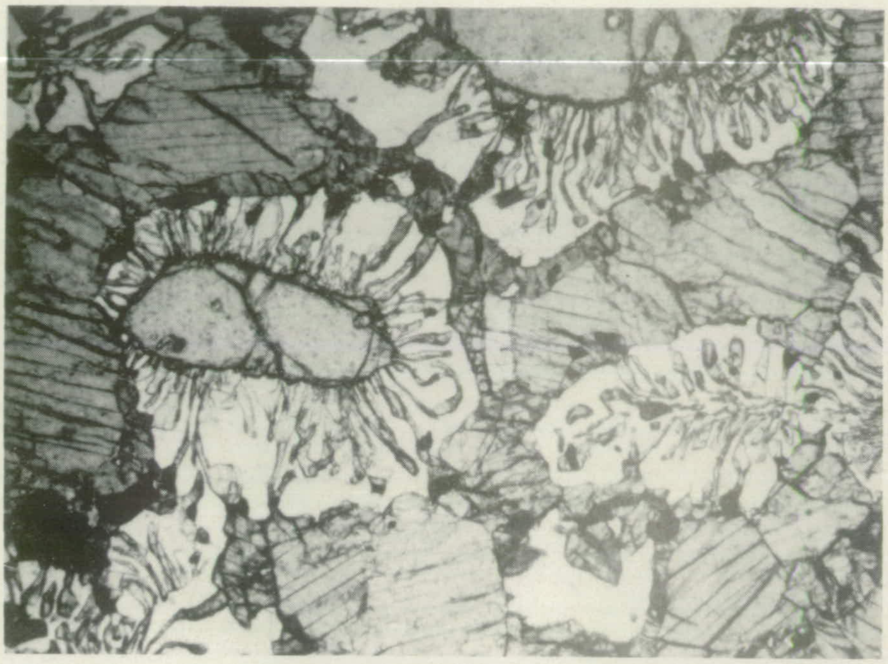

Plate 14. Else Nunatak. Symplectite of calcic plagioclase and orthopyroxene surrounding garnet in pyriclasite. Similar reaction rims occur in pyriclasite at Mount Kernot and Mount Rayner. 1 cm= 0.5 cm (Neg. GB/936).

Plate 15. Else Nunatak. Symplectite of calcic plagioclase and orthopyroxene surrounding garnet. Crossed nicols. 1 cm = 0.2 mm (Neg. GB/933).

another band contains enstatite crystals up to 30 cm long. Biotite from a pegmatite cutting this band was dated by the K-Ar method at 511 $\pm$ 10 my (Appendix 2), a date similar to that obtained from a specimen from Mount Mueller.

The main outcrops at Doggers Nunatak are on the northerly limb of a syncline that plunges 40° towards 075°. Gneissic banding dips north at about 70-73° near the trig station, but curves around to the southeast, generally following the line of outcrop and becoming shallower-dipping until at the southeast end of the main outcrop it strikes at 164° and dips 42° east. The folding is open and concentric with limbs at least 3 to 4 km across. No other fold episodes were recognized.

Rayner Peak (Fig. 7)

Rayner Peak is about 4 km long and 2 km wide (Plates 16 & 17) and, along with Mount Kernot and several nunataks, is located in the triangular area between the Rayner and Wilma Glaciers. With the exception of its southern flanks, Rayner Peak is steep-sided. The summit, a sharp ridge, rises to about 300 m above the plateau ice. Scree covers the base of the northern and eastern sides of the mountain, and a deep windscour bounds the eastern side of the higher northeastern part.

The most abundant rock type at Rayner Peak is cream, light grey, or reddish to pinkish banded garnetiferous feldspar-quartz gneiss interlayered with more mafic rocks including pyriclasites. The geology of Rayner Peak thus resembles that described by Trail et al. (1967) at Mount Kernot. Feldspars in the gneiss are microcline-perthite, perthite, and plagioclase (An_{24-30}), and less commonly antiperthite. Garnet (up to 2%) is the most abundant mafic mineral, and biotite and orthopyroxene and clinopyroxene are minor constituents. Magnetite is the most prominent opaque mineral; zircon and apatite are accessories.

The average grainsize of the felsic minerals is 0.5-0.6 mm, but ranges up to 3 cm. Garnet crystals are coarser, the average grainsize is 1-2 mm, the maximum grainsize is 10 mm. The texture of the felsic minerals is almost invariably granoblastic, but locally a weak foliation is defined by biotite flakes and, in places, by parallel stretched-out quartz aggregates. Quartz and feldspar are typically slightly to moderately strained; deformed twin lamellae are uncommon.

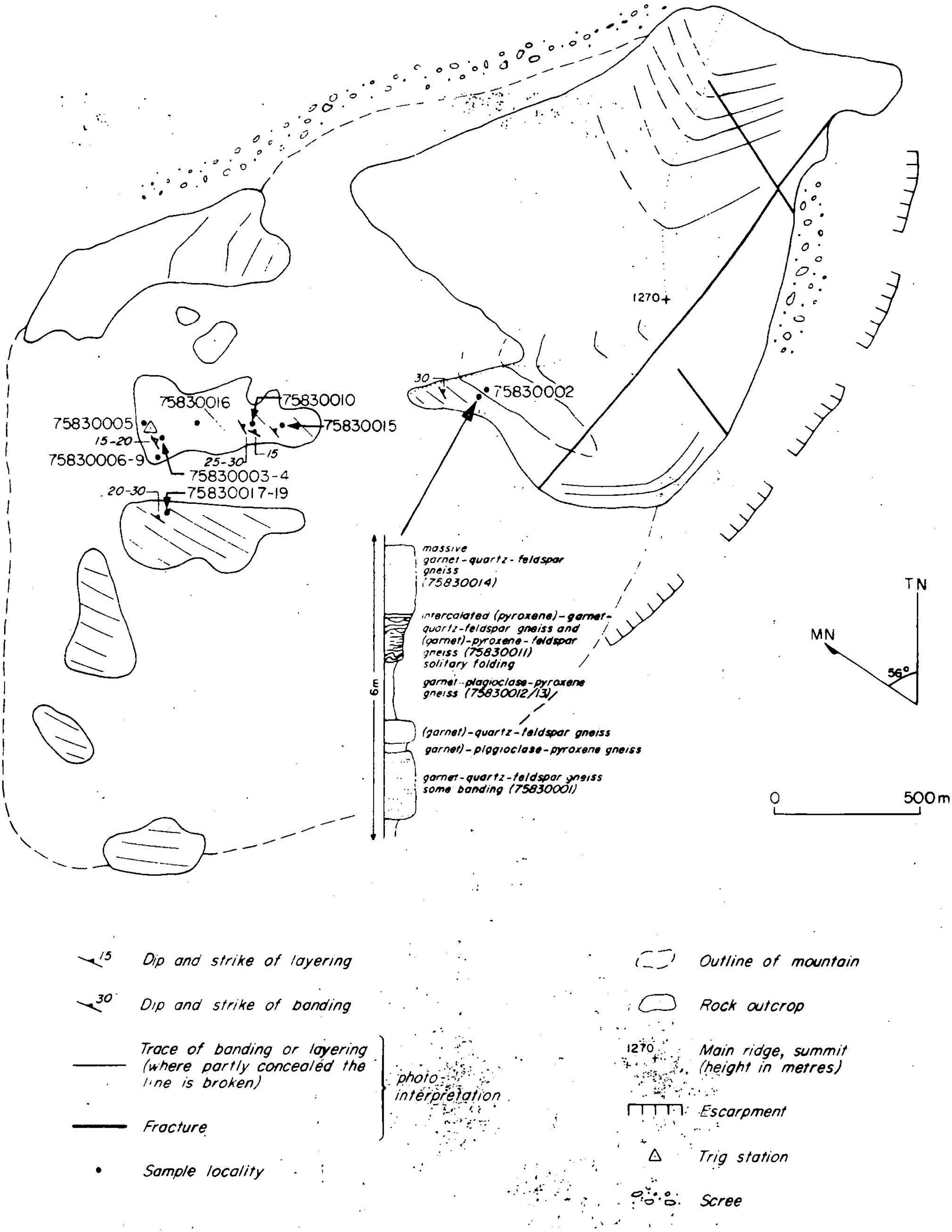

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Fig. 7 Sketch map of Rayner Peak

Plate 16. Rayner Peak looking south (Neg. GB/768).

Plate 17. Summit of Rayner Peak with 2-3 m-thick granulite facies metamorphosed basic dyke. Looking northeast (Neg. GB/985). Arrow shows dyke.

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The garnetiferous gneiss is generally banded or streaked because of variations in the relative proportions of quartz and feldspar, and the content of garnet, biotite, and pyroxene (Plate 18). Where garnet occurs in small amounts, or is randomly scattered, the rock is massive with layers up to 6 m thick, but elsewhere banding thicknesses range from a few millimetres to 100 cm. Bands may grade into one another or have straight, wavy, or irregularly deformed abrupt contacts. At some places the banding resembles cross-lamination and cut-and-fill structures in which garnet, pyroxene, and mica are commonly concentrated in discontinuous laminae or streaks.

Dark to almost black pyriclasite and other associated mafic rocks such as gneiss, biotite-garnet pyriclasite, two-pyroxene pyrigarnite, and pyroxene amphibolite are interlayered with the garnetiferous feldspar-quartz gneiss. The mafic gneisses are brittle and prone to weathering, and consequently do not stand out as much as the light-coloured gneiss. Weathered surfaces are commonly coated by dark ferruginous material.

The mafic gneiss is granoblastic and, although some is coarse-grained, grainsizes of 0.6-0.7 mm appear to be most common. Garnet up to 1 cm across accounts for up to about 60 percent (e.g. 7583/0008) of the rock in places and clinopyroxene (augite) is typically more abundant than orthopyroxene (hypersthene). Hornblende and biotite are mostly minor constituents, though hornblende is the most abundant mineral in some mafic gneiss (e.g. 7583/0002). Plagioclase (An_{40-60}) is the only common felsic mineral, and quartz is present as a minor constituent in some rocks. Accessory magnetite, zircon, and apatite are less abundant than in the feldspar-quartz gneiss. Some of the hornblende and biotite is secondary, partly replacing pyroxene (e.g. 7583/0008). Garnet is rimmed by plagioclase enclosing vermicular orthopyroxene (Plates 14 & 15). Similar reaction rims around garnets were described from Else Nunatak (McLeod et al., 1966) and at Mount Kernot (Trail et al., 1967), localities within 12 km of Rayner Peak, and also from northeast Uganda by McGregor (1962, p.62). De Waard (1967) considers that the rim is the product of the following reaction:

Orthopyroxene + anorthite → Clinopyroxene + garnet + quartz which he considered distinguished two subfacies of the granulite facies, namely, the lower-pressure hornblende-orthopyroxene-plagioclase subfacies and the high-pressure hornblende-clinopyroxene-garnet subfacies. Assuming that De

Waard's conclusions are correct, the reaction rims in the pyriclasites at Rayner Peak, Mount Kernot, and Else Nunatak show that the rocks have in part reverted from high-pressure subfacies to the low-pressure subfacies. Rocks collected from nunataks along both sides of the Robert Glacier and from Turbulence Bluffs by McLeod et al. (1966) also contain the high-pressure assemblage of garnet and clinopyroxene and little or no orthopyroxene.

Contacts between the quartz-feldspar and mafic gneisses are typically concordant but some mafic layers are discordant (Plate 18); some contacts are sharp, some gradational. The mafic gneisses are commonly massive; garnet-rich streaks outline a faint foliation.

Lenses of pegmatite up to at least 6 m long and 2 m wide, interlayered with both feldspar-quartz and mafic gneisses, consist of coarse (up to 3 cm) single or intergrown crystals of quartz and perthite interspersed with finer (average grainsize 0.5-0.6 mm) material consisting predominantly of feldspar.

A dyke at least 2 m thick near the summit of Rayner Peak (Plate 17) cuts obliquely across the foliation of the country rock at a high angle; it strikes about 050^{o} and dips southeast at 80^{o}. Samples collected previously (Trail et al., 1967; sample 6528/0213) are similar to the mafic gneiss.

The banding and layering at Rayner Peak strike between 135 and 175^{o}, dip between 15 to 45^{o} to the northeast, and generally appear to be undisturbed although folding has been observed locally (Plate 19). The folds are solitary, small-scale, tight to isoclinal, and overturned to recumbent with axial planes subparallel to the banding or layering; they probably represent shear flexures. According to Trail et al. (1967) a large fold plunges east at about 30^{o} near the western corner of Rayner Peak; a large isoclinal fold has been interpreted from airphotographs (Fig. 7) Trail et al. described lineations caused by parallel orientation of elongated quartz grains, biotite flakes, and small crenulations in the foliation. Some rocks show a faint fracturing normal to the foliation (e.g. 7583/0006); tension gashes parallel to this fracturing are filled with feldspar.

A moderately to widely spaced joint system cuts the rocks, but no preferred direction of joint attitude was identified.

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Plate 18. Rayner Peak. Resistant, weakly foliated quartz-feldspar-garnet gneiss (whitish to light grey), brittle plagioclase-pyroxene gneiss (drak grey), and locally irregularly banded garnet-pyroxene-quartz-feldspar gneiss (medium grey) (Neg GB/754).

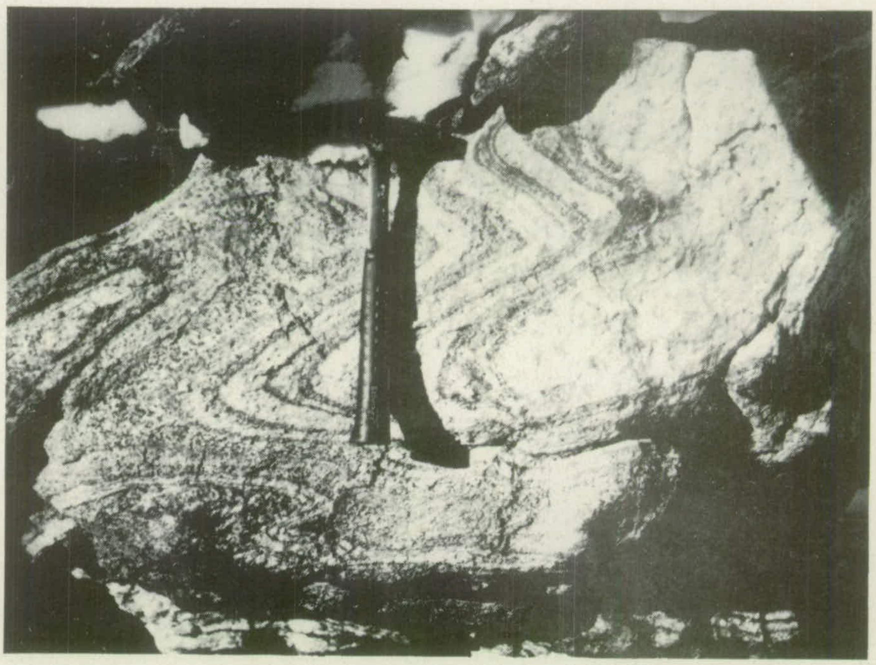

Plate 19. Rayner Peak. Folded (pyroxene)-garnet-quartz-feldspar gneiss (Neg. GB/770).

MAWSON 1:250 000 SHEET SQ 41-42/13

Kidson Island

The dominant rock type at Kidson Island, a roughly circular flat-topped island about 300 m across and 40 m high, is metamorphosed psammopelite composed of about 80 percent anhedral quartz with poikiloblasts of garnet up to 10 mm across. Also present are perthite, biotite, plagioclase (An_{30}), opaques, sillimanite, green spinel, and hypersthene. The iron-rich spinel is partly altered to opaques, and a surrounding reaction rim of sillimanite and hypersthene indicates that the high-temperature assemblage spinel + quartz has partly reverted to the lower-temperature assemblage hypersthene + sillimanite. Experimental work by Hensen & Green (1973) indicates temperatures above 950°C at low pressure, and 1100°C at 10 kb are required for spinel + quartz stability, and pressures above 9 kb for hypersthene + sillimanite stability. Hensen and Green concluded that sapphirine + quartz is a stable intermediate assemblage between spinel + quartz and hypersthene + sillimanite, but there is no sapphirine in the rocks from Kidson Island. It is probable that two unrelated metamorphic events have been recorded in the rocks, the first being a high-temperature, but not necessarily high-pressure, event producing spinel + quartz and the second being a high-pressure, moderate-temperature event producing hypersthene + sillimanite. The evidence for the first event has probably not been obliterated because of the lack of sufficient water in the system to catalyse the reactions to completion.

Interbanded with the psammopelite are rocks of more pelitic composition containing sillimanite, cordierite (in clots up to 30 mm across), biotite, opaques, and spinel.

The coarse-grained cordierite (7583/0262), contains inclusions of spinel, sillimanite, perthite, corundum, quartz, and opaques. The spinel is iron-rich, and partly altered to opaques and corundum; it is surrounded by concentric rims of sillimanite, small amounts of cordierite hypersthene and/or quartz and a broader rim of perthite, all included in coarse-grained, cordierite. The complex anhydrous reactions indicated by these rims must have taken place at very high temperatures (Hensen & Green, 1973).

The rocks at Kidson Island are intruded by aplite dykes, up to 0.5 m wide, composed of quartz, perthite, sillimanite, and minor opaques. The

Plate 20. Folded aplitic granite vein showing fold style on Kidson Island (Neg. GB/881).

aplites can be followed for hundreds of metres, and were introduced before a major fold episode (Plate 20). The folds are assymetrical and similar, and have small hinge areas; limbs are most commonly about 10 to 20 m across, and western limbs of anticlines generally longer than eastern limbs. Sixteen dips and strikes on an aplite vein plotted on a stereonet indicate that eastern limbs of anticlines strike at about 008° and dip 68°E, and that western limbs of anticlines strike at about 337° and dip 84°W; fold axes plunge 35° towards 172°, and axial planes dip 80°E and strike at 352°. The vergence of all the folds suggests that the island is situated on the western limb of a major anticline plunging 35° towards the south.

Ufs Island

This island was visited by a National Mapping Survey party, and a surveyor (S. Bennett) collected samples of leucocratic metasediments and mafic to ultramafic rocks from near the trig station. The metasediments (psammites and psammopelites) are composed of quartz, garnet, perthite, sillimanite, biotite, plagioclase (An_{30-40}), and minor opaques and zircon. One sample (7593/0295) also contains spinel, but the mineral is not in equilibrium with quartz as it is wholly enclosed in garnet.

The ultramafic rocks are composed of hypersthene or bronzite and/or augite, and minor hornblende, opaques, biotite, and spinel. The mafic rocks have a similar mafic assemblage, but also include plagioclase and quartz. Trail (1970) described the rock occupying most of Ufs Island as charnockite; it is therefore concluded that the samples collected by the surveyor were probably not in situ.

Rumdoodle Peak (Masson Range)

Rumdoodle Peak, about 19 km south of Mawson, is part of the Masson Range. From a distance this part of the Masson Range has a characteristic brown colour - the main rock types exposed are brownish to greyish, generally medium to dark brown weathered charnockite and, locally, enderbite.

The charnockite and enderbite are either massive or weakly foliated. Faint discontinuous colour banding is caused by compositional changes, in particular by layers enriched in pyroxenes or felsic minerals. The banding is penetrative on outcrop scale, but rarely in a smaller scale.

In places the charnockite contains xenoliths, up to 30 cm long, composed of dark and fine-grained biotite-feldspar-quartz rock. Elsewhere it is intersected by small, irregular veins, lenses, or pods of typically bluish purple quartz with or without feldspar, which are generally randomly oriented but are locally subparallel to the foliation. The charnockite consists of partly antiperthitic plagioclase (An_{40-50}), microcline-perthite or perthite, quartz, and between 5 and 20 percent of mafic minerals, mainly hypersthene and, in some rocks, minor clinopyroxene and brownish mica (?biotite). In one sample pyroxene is slightly altered to hornblende.

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Most of the charnockites are medium-grained, some fine-grained and some coarse-grained; textures range from even-grained to porphyroblastic with brownish potassium feldspar porphyroblasts. Strained crystals and cataclastic features indicate late-stage deformation.

The banding of the charnockite trends between 085 and 105°, and dips between vertical and 80° north. The rocks are strongly jointed in places; near shear zones they are strongly shattered.

MOUNT HENDERSON 1:250 000 SHEET SQ 41-42/14

Macey Island

Macey Island (67°25'S, 063°50'E), a small island about 42 km east-northeast of Mawson and 12½ km north of Cape Daly, has a summit height of about 40 m. It is occupied by medium to dark grey, indistinctly banded quartz-feldspar gneiss. The banding is caused by layers enriched in mafic minerals, or by layers with slightly coarser texture, contrasting with finer-grained felsic layers. Sub-concordant lenses and veins, up to 15 cm thick, of quartz and minor feldspar locally cut the rock.

The quartz-feldspar gneiss consists of locally antiperthitic plagioclase (An_{60}), quartz, orthoclase or microcline with minor perthite, hypersthene, biotite, opaques (mostly magnetite), and accessory zircon and apatite. Garnet occurs in some rocks. The gneiss is mostly fine to medium-grained and even-grained with granoblastic grain contacts; the banding trends between 320 and 350° and dips westerly at between 65 and 80°. Various joint directions were measured, but the most prominent system, with open joints spaced 2 to 3 m apart, trends 085°, and has vertical or steep northerly dips.

MOUNT TWINTOP 1:250 000 SHEET SR 41-42/1

Mount Twintop

Mount Twintop (68°06'S, 062°20'E), a smooth-outlined rounded twin-peaked mountain about 60 km south-southwest of Mawson is elongated north-northwest, and has a 1465 m-high summit covered with angular scree. Boulder and pebble-size rock fragments along the flanks of the mountain were interpreted by McLeod (1959) as moraine. The western side of the mountain is covered by a large patch of blue ice.

A cursory examination of the rocks of Mount Twintop confirmed the observations of McLeod (1959) and Trail et al (1967) that the mountain consists of brownish to greyish-weathering, whitish to brownish grey banded pyroxene-quartz-feldspar gneiss. Banding is caused by alternating felsic and pyroxene-rich layers.

The gneiss is fine to medium-grained and mostly non-porphyritic. It is composed of perthite or microcline-perthite, quartz, and hypersthene. Antiperthic plagioclase (An_{50}) and minor biotite and garnet are present in some rocks. In porphyroblastic varieties feldspar, pyroxene, and/or oriented biotite are up to 10 mm long. Parallel elongated quartz segregations define a weak lineation. Narrow bands of biotite-garnet gneiss, quartz-feldspar gneiss, and hornblende-biotite gneiss are interlayered with the pyroxene-feldspar gneiss.

At the south-southwest peak the gneiss is obliquely intersected by a sub-concordant layer of medium to dark greyish brown weathered pyriclasite about 60 m thick and composed of plagioclase (An_{50}), pyroxene (mostly hypersthene but with minor clinopyroxene) and, in some samples, minor biotite and hornblende. Sample 7583/0104 contains apatite crystals up to 10 mm long. Along its contacts the pyriclasite is strongly sheared and crushed, and is stained by green secondary copper minerals (Trail et al., 1967).

Both the country rock and the pyriclasite are transected (Trail et al., 1967) by lenses of coarse bluish to violet quartz, with or without feldspar.

The regional strike of the banding and layering of the rocks is between 350 and 015^{o}, and dips are easterly at 60 to 70^{o}.

STRUCTURE

Foliation

Most rocks in Enderby Land show more or less pronounced banding or foliation caused by small changes of mineral composition or texture. The bands range in width from a few millimeters to tens of metres. Some are discontinuous, others persistent over hundreds of metres, and their contacts range from sharp to gradational or intercalated. In places, particularly in the garnetiferous gneiss of Rayner Peak, the banding is irregular, and resembles cross-lamination and cut-and-fill structures reminiscent of sedimentary features.

At many places layering is caused by a distinct change of lithology, acidic or intermediate gneiss contrasting with layers of mafic or ultramafic metamorphic rocks. The original nature of these layers is not clear; where they are parallel to the banding they may have been volcanic flows or sills, and where they cross-cut the banding they may have been dykes (e.g. at Rayner Peak, Mount Kernot, Martin Island, and Jensen Island).

The foliation at Rippon Depot is deformed by repetitive similar folds associated with a well-developed crenulation cleavage oriented perpendicular to the banding.

Lineation

Lineation is caused by parallel arrangement of minerals, mostly quartz, or by aggregates of elongated fine-grained minerals. Trail et al. (1967) described lineation at Rayner Peak marked by fine crenulations in quartzite.

Folding

Repetitive small-scale folding was observed only at Rippon Depot and locally at the main mountain of Newman Nunataks. The folds have amplitudes of the order of centimetres to about 1½ m, and are tight to isoclinal, overturned to recumbent; at Rippon Depot they are accompanied by an axial-plane crenulation cleavage, but cleavage is not seen at Newman Nunatkas. Solitary tight to isoclinal, overturned to recumbent small-scale folds appear to be common in banded acidic gneiss.

The small-scale folds are superimposed on a widespread, large-scale open fold system with, for example, a shallow eastward plunging synclinal structure at Newman Nunataks (Plate 10), and a large open fold reported by Trail et al. (1967) at Rayner Peak. Related broad synclines and anticlines may be interpreted from the distribution of strikes and dips; at Dogger Nunataks an anticline with limbs at least 5 km across plunges east-northeast at about 40°.

At Rayner Peak a large-scale isoclinal fold has been interpreted from aerial photographs. All the solitary small-scale folds can be interpreted as drag folds and minor flexures related to the broad-scale folding.

Only one folding episode has been recognized at most localities visited; however, the axial plane, crenulation cleavage at Rippon Depot is evidence of a second deformation phase.

Faulting

Because of restricted outcrop, no major faults were mapped, but fractures with small or no displacement were photo-interpreted at Rayner Peak, and a medium-size fault was mapped at Knuckey Peaks.

Jointing

Jointing is common in all rock types, but lack of sufficient measurements at each outcrop prevented systematic analysis; at several places (e.g. Knuckey Peaks) one of the preferred orientations is subvertical and perpendicular to the foliation.

At Rippon Depot jointing more or less parallel to the outcrop surface resembles crude exfoliation.

Fracturing was observed in several thin sections: in sample 7583/006 from Rayner Peak it is accompanied by feldspar-filled tension gashes.

METAMORPHIC REACTIONS

At Else Nunatak, Mount Kernot, and Rayner Peak coronas of calcic plagioclase containing vermicular growths of hypersthene surround garnet grains, and separate them from clinopyroxene. The reaction which has produced this texture is believed to be as follows:

garnet + clinopyroxene + quartz → anorthite + hypersthene

$$(Ca, Mg, Fe)_3Al_2Si_3)_{12} + Ca(Mg, Fe)Si_2O_6 + SiO_2 \rightarrow CaAl_2Si_2O_8 + 4(Mg, Fe)SiO_3.$$

The reaction could also involve jadeite ($NaAlSi_2O_6$) in the clinopyroxene, the jadeite reacting to form less calcic plagioclase. This reaction was recognised by MacGregor (1962, p. 22), and De Waard (1967) considers it signifies the limit of a high- and low-pressure subfacies of the granulite facies. The rocks from Else Nunatak, Mount Kernot, and Rayner Peak were originally in the higher-pressure clinopyroxene-garnet subfacies, and have in part reverted to the lower-pressure orthopyroxene-plagioclase subfacies.

In pyriclasite at Doggers Nunatak nodules of garnet up to 20 mm across are surrounded by a symplecite of hypersthene, plagioclase, green spinel, and magnetite. A reaction similar to that responsible for the corona growth has been duplicated by Green & Ringwood (1967). At a pressure of 14.6 kb in undersaturated alkali olivine basalt, the reaction observed was as follows:

$$2Ca_{0.5}(Fe,Mg)_{2.5}Al_2Si_3O_{12} \rightarrow CaAl_2Si_2O_8 + 4(Fe,Mg)SiO_3 + (Fe,Mg)Al_2O_4$$

garnet → anorthite + orthopyroxene + spinel.

However, this reaction involves garnet with a high grossular content, a composition unlikely in the Doggers Nunatak garnets. We conclude, therefore, that the corona is a product of reaction of the garnet with the major host-rock minerals, mainly clinopyroxene, but probably also hornblende:

garnet + clinopyroxene + hornblende →

anorthite + orthopyroxene + spinel + magnetite + water.

Quartz from Kidson Island (7583/0260) contains grains of iron-rich spinel surrounded by rims of sillimanite and hypersthene indicating the reaction:

$$(Mg,Fe)Al_2O_4 + 2SiO_2 \rightarrow (Mg,Fe)SiO_3 + Al_2SiO_5$$

spinel + quartz → hypersthene + sillimanite.

The assemblage hypersthene + sillimanite + quartz is very rare, and is known only in a few places - four other occurrences are known to us: from Lapland (Eskola, 1952), from the Anabar Massif, USSR (Lutus & Kopaneva, 1968), from the Aldan shield (Khlestov, 1964, and Marakushev & Kudryavtsev, 1965), and from Labrador (Morse & Talley, 1971).

Hensen & Green (1972) have synthesized coexisting spinel and quartz over a wide range of pressures and iron to magnesium ratios above 1000^{o}C. However, coexisting hypersthene and sillimanite was synthesized only at pressures above 9 kb between 800°C and 1050°C, and only in magnesium-rich rocks. Hensen & Green (1973) also found the assemblage sapphirine + sillimanite + garnet + quartz to be a stable intermediate assemblage between spinel + quartz and hypersthene + sillimanite + quartz. The lack of sapphirine in the rock from Kidson Island may be attributable to higher Fe^{2+} stabilizing hypersthene, as suggested by Chatterjee & Schreyer (1972, p. 60) or to higher Fe^{3+} increasing the stability field for hypersthene, as suggested by Hensen & Green. Alternatively, the rocks may have been affected by two separate metamorphic events, the first at high temperatures (1000°C or more) at an unknown pressure, and the second at 800° to 1000°C at about 9 kb pressure.

GEOLOGICAL HISTORY AND METAMORPHISM

The rocks mapped in Enderby Land commonly contain the assemblage orthopyroxene + quartz, which indicates that they have been metamorphosed to granulite facies conditions. High-pressure granulite metamorphism characterised by garnet and clinopyroxene has occurred in the Robert Glacier/Rayner Peak area, and may have extended southwest as far as Doggers Nunataks. Kamenev (1970a) refers to high-pressure 'eclogitic' schists in this region - presumably the high-pressure mafic granulites found by the authors. Elsewhere in Enderby Land medium to high-pressure metamorphism predominates, as garnet is much more abundant than cordierite (cf. northern Prince Charles Mountains).

Mostly small-scale retrogressive metamorphism is widespread in Enderby Land; in the Mount Breckinridge-Mount Bennett region it is probably caused by nearby granitic intrusions (Kamenev, 1970a). Retrogression to amphibolite grade can be recognised at McLeod Nunataks.

Two sets of basic dykes have been recognized: the older ones at Jensen Island, Martin Island, Mount Kernot, Rayner Peak, Turbulence Bluffs, and Leckie Range, have been metamorphosed to granulite grade, and antedate the high-pressure metamorphism in the Robert Glacier-Rayner Peak area. At Rayner Peak they commonly form sills or flows a fact that indicates that the banding in the country rock is not the result of differentiation during the high-pressure metamorphism, but existed before that event.

The younger dykes, at Mount Mueller, Mount Storegutt, Mount Breckinridge, McLeod Nunataks, and Perov Nunataks which are tholeiitic dolerites, postdate the granulite metamorphism. At Mounts Mueller, Breckinridge, and Storegutt the younger intrusives are virtually unmetamorphosed, but at Perov Nunataks and McLeod Nunataks they have been metamorphosed to greenschist and amphibolite grades, respectively. The amphibolite-grade metamorphism of the basic dyke at McLeod Nunataks is believed to have also been responsible for the retrogression in the granulites of that area.

Pegmatites from Mount Mueller and Doggers Nunataks have been dated at 500-600 m.y., but this is the age of a thermal event detected over wide areas of Gondwanaland (Crawford, 1974). It is not thought to be related to the date of emplacement of the pegmatites, as the pegmatites at Mount Mueller are related to granulite-grade metamorphism (orthopyroxene in pegmatites), and no granulites of 500-600 m.y. age are known from Gondwanaland.

MINERAL OCCURRENCES

Iron

Banded ironstone consisting mainly of quartz, magnetite, and hypersthene makes up the upper part of an easterly-plunging shallow synclinal structure, and is underlain by pyroxene-bearing feldspar-quartz gneiss at Newman Nunataks. The magnetite occurs in bands or irregular elongated patches up to 1 cm thick, and as skeletal grains, medium to small equant grains, and minute rounded grains in quartz, or along pyroxene cleavage planes. Within bands and patches the magnetite is massive, or encloses other minerals, particularly quartz. The results of analyses on ten samples of the ironstone are listed in Table 1.

The deposit is about 750 m long by 150 m wide and, based on a few widespread dip and strike measurements of the layering, its maximum depth may be 20 m. The average grade of total iron is probably at least 30 percent (Table 1). Magnetic anomalies, as for example, near Knuckey Peaks (P. Walter, BMR), personel communication, 1977) suggests the occurrence of other iron deposits but geological work in west Enderby Land by BMR geologists in 1976 and 1977 failed to discover other major outcrops of ironstone.

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TABLE 1

Total iron in 10 randomly collected samples of the main mountain of Newman Nunataks.

Sample No.	% Fe (total)
75830039A	38.0
B	32.0
C	36.6
D	30.3
E	30.0
F	25.7
G	36.7
75830040A	37.9
B	39.5
C	36.9

Analysis carried out by AMDL (Report An 3880/75).

Dark yellow-brown weathered rocks, stained by limonite and forming bands up to several meters thick in feldspar-quartz gneiss, were observed by Trail et al. (1967) at Mount Mueller, Mount Wallis, and Cook Nunataks. Stained rocks from Cook Nunataks contain 60 percent quartz and 40 percent magnetite. The magnetite is disseminated through the quartz, and in places it forms stringers up to 1 cm thick.

In the Amundsen Bay area Crohn (1959) observed several magnetite-rich bands, some between 50 and 60 cm thick, within predominantly quartzo-feldspathic gneiss. In places they contain more than 50 percent by weight of magnetite, the other constituents being quartz and hypersthene.

Because of the low grade of the ore, the remoteness of the locality, and the expense and difficulties which would be encountered in a mining operation in this region, the ironstone is of academic interest only - it cannot be considered even potentially economically viable at present.

Other minerals

Green ?copper coatings and stains were observed on rocks derived from layers of high-grade mafic and ultramafic metamorphics at Knuckey Peaks. Similar coatings are also associated with dolerite dykes at Mount Mueller.

McLeod (1959) found traces of copper as encrustations of chrysocolla and malachite at Amundsen Bay, Amphitheatre Lake, Perov Nunataks, Mount King, McLeod Nunataks and parts of the Tula Mountains; he also noted a few specks of chalcopyrite at Mount King.

Crohn (1959) reported dissemination specks of ilmenite, magnetite, pyrrhotite, and chalcopyrite in quartz-calcite veinlets from Alphard and Depot Islands in the Oygarden Group. In the same area quartzite, pegmatite, and vein quartz are superficially stained by secondary iron, manganese, and copper minerals.

Whitish salt encrustations on boulders from a pyroxenite layer at Knuckey Peaks are similar to those described by Tingey & England (1973) on basic metamorphics at Mount Menzies, Prince Charles Mountains. The salt was probably formed by freezing of saline solutions derived from nearby rocks on warmer days. X-ray diffraction analysis shows that the encrustations consist mainly of hexahydrite ($MgSO_4\ 6H_2O$).

At Mount Breckinridge a lens of dark rock about 20 cm thick, and at least 5 m long consists of about 30% magnetite, 7% apatite, and 4% zircon by volume (sample 7583/0226).

MACQUARIE ISLAND (Fig. 8)

Macquarie Island, a north-northwesterly aligned island in the southern part of the Tasman Sea is about 39 km long and up to 3 km wide. It forms a gently undulating plateau separated by cliffs as high as 200 m and steep slopes from a coastal platform. The platform is widest along the northern part of the west side of the island, and its lower parts are made up of young and old beaches, rock ledges and 'featherbeds'. Farther inland the higher ground is locally terraced. Mount Hamilton (433 m above m.s.l.) is the highest peak on the plateau. The smooth, rounded, low hills, and

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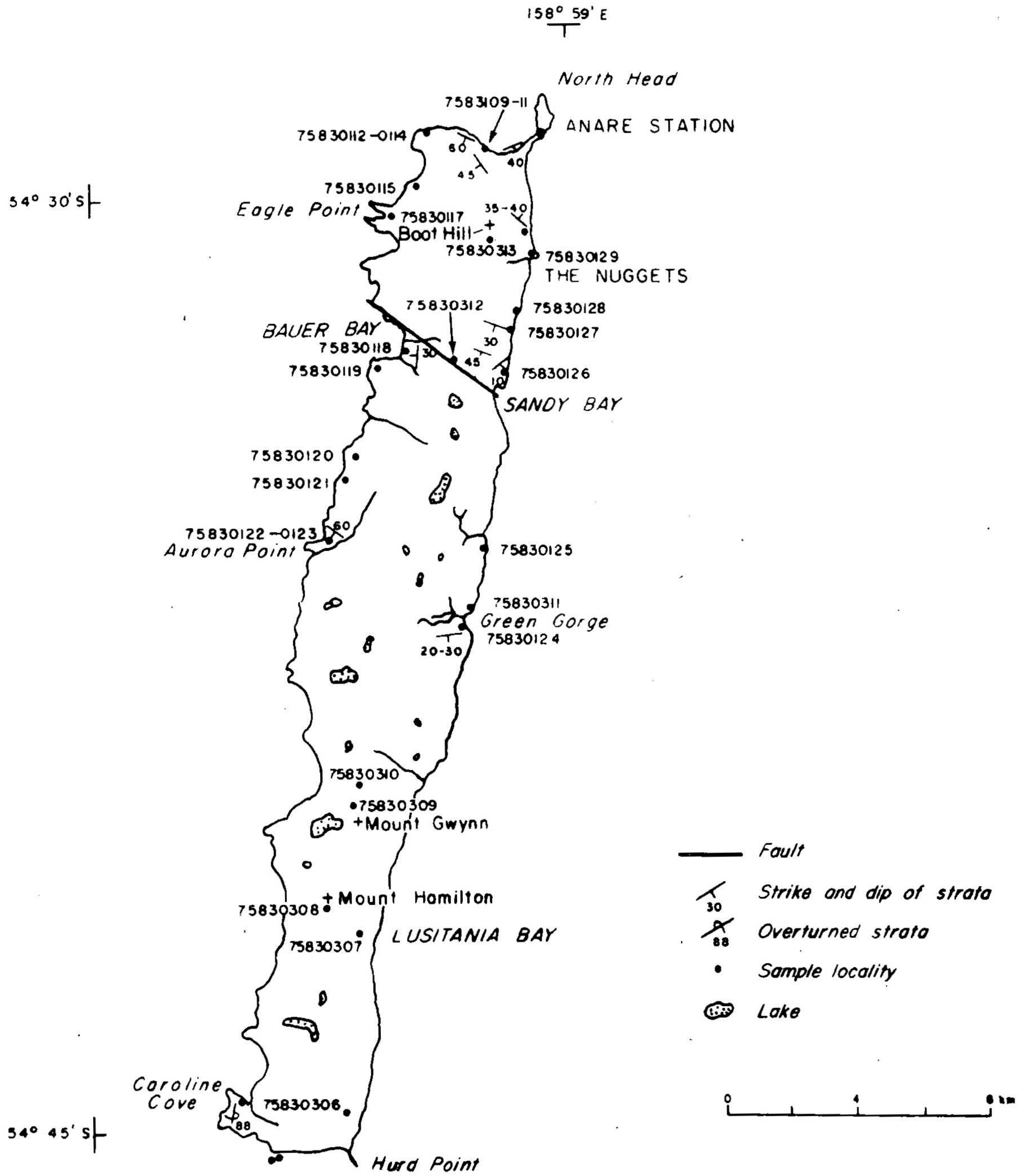

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Fig. 8 Macquarie Island

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numerous lakes and U-shaped valleys on the plateau indicate former glacial erosion, but other glacial features such as moraine debris, roches moutonnees, and striae have not been observed.

The west coast is exposed almost continuously to fierce westerly winds, and is consequently strongly embayed with rocky headlands, pebble beaches, and a number of jagged offshore rock reefs. By contrast the east coast is more sheltered and straighter and the plateau cliffs are close to the coast. The beaches of the east coast consist mostly of sand and small amounts of pebbles.

Macquarie Island is thought by Varne & Rubenach (1972) to be an emerged part of the crest of Macquarie Ridge; it is composed almost entirely of basaltic volcanic rocks and mafic and ultramafic intrusives. Mawson (1943) recognized two series of volcanics separated by a major east-west fault between Bauer Bay and Sandy Bay, the older series being in the north and the younger in the south. The volcanics are intruded by diorite and gabbro and smaller bodies of serpentinised ultramafics. Dolerite dykes are widespread over the island, particularly in the northern part, where dyke swarms are abundanent in the older volcanics.

The older volcanics are grey to brown, generally fine to medium-grained, and even-grained to strongly porphyritic, but subophitic (7583/0109) and intergranular (7583/0112) textures were also observed. They are layered, principally because of textural differences, on scales ranging between a few centimetres and massive, and locally intercalated with light-coloured fine-grained Miocene Globigerina limestone.

Plagioclase (An_{50-70}) is invariably the major constituent of the older volcanics, and occurs both as phenocrysts and in the groundmass as commonly albitized or saussuritized, corroded lath-shaped crystals. The most prominent, and possibly the only, primary mafic mineral is augite. It is typically colourless or pale green and occurs both as phenocrysts and in the groundmass, either rimmed, and/or intergrown with or locally almost completely altered to, pale to light green actinolite. Other minerals are chlorite, carbonate, prehnite, epidote/clinozoisite, zeolite, and opaques. Chlorite is mostly present as scaly aggregates, and prehnite and zeolite are restricted to veinlets. The opaques are magnetite, ilmenite, pyrite, and alteration products of sphene; sphene is a common accessory mineral.

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Plate 21. Steeply dipping pillow lava at Caroline Cove on Macquarie Island (Neg. GB/883).

The widespread albitization, the common occurrence of actinolite, and the presence of prehnite indicate that the volcanics were weakly metamorphosed to the lower-greenschist facies. The layering in the volcanics and sediments is gently tilted, but no preferred orientation of the strike was observed.

The younger volcanics are typically brownish, fine and even-grained or slightly porphyritic, amygdaloidal, and veined, and occur as brecciated, pillowed (Plate 21) or massive lavas locally seperated by thin beds of volcanically derived calcareous sandstone, siltstone, and mudstone. Sheared, dark fine-grained clastic sediments also occur between the pillows.

Plagioclase (An_{50-70}) is also the major constituent of the younger volcanics, and occurs, fresh or only slightly altered, as phenocrysts and groundmass laths. Augite, the second most abundant mineral, is, like the plagioclase, relatively unaltered but is mostly restricted to the groundmass. It is typically colourless or pale green, but some samples contain pale to medium-purple brown titanaugite. Sample 7583/0118 contains olivine pseudomorphs composed of serpentine and 'iddingsite'. Brown hornblende, some of it secondary, is present. Other constituents are chlorite, epidote/clinozoisite, and carbonate; the opaques are magnetite and rare pyrite; sphene is an uncommon accessory. The amygdules are filled with chlorite and zeolite, chlorite forming the outer rim. Veinlets are composed mostly of zeolite or epidote/clinozoisite.

The dolerite and basalt dykes were difficult to distinguish from the host rocks of the older volcanic series in the small coastal outcrops that were visited. In texture and composition the dyke rocks resemble the volcanic rocks of both the older and younger series. Some dolerites contain titanaugite, and may be related to titanaugite-bearing rocks of the younger volcanic series. Sample 7583/0309 from near Mount Gwynn contains needles of dark red-brown kaersutite up to 4 mm long and pink pleochroic titanaugite 1 mm across in a groundmass of plagioclase, orthoclase, spherulites, apatite needles, opaques, prehnite, and dark green amphibole. Some of the kaersutite appears to have replaced titanaugite.

The gabbroic intrusives were only cursorily investigated. Within an outcrop measuring 30 m by 50 m the gabbro consists of homogeneous and even-grained, finely layered, leucocratic, pegmatitic, and lineated variants. The layering is caused by alternating felsic and mafic bands; lineation is due to parallel orientation of augite. The rocks consist mostly of sericitized plagioclase (An_{50-56}) and augite and orthopyroxene both partly altered to colourless or greenish amphibole.

Ultramafic rocks are rare on Macquarie Island, the main exposure being at Eagle Point. Of two small outcrops visited on the plateau, one, south of Boot Hill, extends to the east over the escarpment towards the Nuggets, possibly along a fault line. A sample from above the Nuggets was identified as sheared serpentinized wehrlite composed of about 80 percent serpentine minerals, augite, olivine, and minor opaques. On the northern side of a low saddle about 1.2 km north of Mount Gwynn ultramafic rocks consist of a number of pods up to 20 m across, scattered over about 1000 m^2 in a basalt host. Sample 7583/0310 is a wehrlite composed of partly serpentinized olivine, augite, and serpentine minerals.

The nature and distribution of the volcanic and intrusive rocks of Macquarie Island indicate that they have been formed at a spreading zone in an oceanic environment. The unmetamorphosed lava and volcanically derived sediment of the younger volcanic series may represent an upper section of the oceanic crust, whereas the slightly metamorphosed older volcanics, dyke swarms, gabbro and diorite and ultramafics may represent an upfaulted segment of a lower section of oceanic crust (see Varne & Rubenach, 1972).

ACKNOWLEDGEMENTS

We were greatly assisted in the field by the Enderby Land expeditioners, particularly the surveyors of the Division of National Mapping, Department of National Resources. The base camp at Knuckey Peaks was established after numerous hardships by members of the Mawson wintering party. Logistic support was provided by the Antarctic Division, Department of Science.

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APPENDIX 1

Summary of thin section descriptions

The data are arranged according to 1:250 000 Sheet areas. Rock numbers prefixed 6528 are samples collected by McLeod, Trail, Cook, and Wallis in 1965. Four-figure numbers refer to samples collected by Ruker in 1960 and McLeod in 1958. Under the heading "Assemblage" minerals are listed in order of decreasing abundance, but under "Rock Name" the least abundant mineral is given first.

SQ 39-40/10 MOUNT CODRINGTON

SPECIMEN NUMBER	ASSEMBLAGE	ROCK NAME
Mount Breckinridge		
7583/0225	Quartz, microcline-perthite with about equal proportions of K and Na, augite (with reaction rims of blue-green hornblende), opaques, zircon	AUGITE-BEARING QUARTZ-PERTHITE GNEISS
7583/0226	Augite, opaques surrounded by dark green amphibole, plagioclase, abundant apatite (7%) and zircon (4%).	?METASEDIMENT WITH HEAVY MINERALS
7583/0227	Quartz, biotite, green hornblende, microcline perthite, sericitized plagioclase, minor apatite and zircon.	BIOTITE-HORNBLENDE-QUARTZ SCHIST
7583/0228	Plagioclase and augite phenocrysts in fine-grained groundmass of feldspar, hornblende, and opaques.	PORPHYRITIC MICRODOLERITE (UNMETAMORPHOSED)

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7583/0229	Quartz, microcline-perthite with about equal proportions of K and Na, hypersthene, opaques biotite, minor zircon and apatite.	HYPERSTHENE-PERTHITE-QUARTZ GNEISS.
7583/0230	Quartz, microcline-perthite, blue-green hornblende, biotite, plagioclase (An_{25}), opaques, apatite.	BIOTITE-HORNBLENDE-PERTHITE-QUARTZ SCHIST
7583/0231	Quartz, perthite, plagioclase (An_{30}), biotite, green hornblende (rarely with very pale cores), opaques, minor apatite.	HORNBLENDE-BIOTITE-PLAGIOCLASE-QUARTZ SCHIST
7583/0232	Biotite, sillimanite, corundum, sericite, plagioclase.	RETROGRESSED PELITIC GNEISS
7583/0233	Plagioclase, augite, green-brown hornblende, hypersthene, opaques, minor biotite.	PYRICLASITE

Mount Bennett

7265	Microcline-perthite, quartz, opaques, biotite, plagioclase, myrmekite, minor apatite and hornblende.	BIOTITE-QUARTZ-PERTHITE PERTHITE GNEISS

Mount Armstrong

7266	Microcline-perthite, quartz, brownish-green hornblende, plagioclase, biotite, myrmekite, minor apatite and opaques.	HORNBLENDE-QUARTZ-PERTHITE GNEISS

SQ39-40/11 AKER PEAKS
1:250 000 SHEET

Aker Peaks (small nunatak 1 km SE of main peak)

7583/0022	Plagioclase antiperthite (An_{54}, 55%) hypersthene (40%), biotite, clinopyroxene (minor), opaques, apatite, zircon.	PYRICLASITE

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7583/0023	Plagioclase antiperthite, hypersthene, clinopyroxene?, biotite (minor), opaques, zircon.	PYRICLASITE
7583/0024	Plagioclase antiperthite (sericitized, An_{54}), orthopyroxene (hypersthene), clinopyroxene, clinoamphibole (greenish pleochroism, after pyroxene), biotite (? after hornblende), opaques, apatite.	PYRICLASITE

Rippon Depot

7583/0021	Microcline perthite (locally intergrowths of quartz), quartz, plagioclase (sericitized), orthopyroxene (altered to yellowish brown clinoamphibole, minor), opaques, apatite.	FELDSPAR-QUARTZ GNEISS

Mount Pasco

6528/0087	Quartz, plagioclase (An_{30}), orthoclase perthite, hypersthene, mica (pale brown to light or medium brown plechroic, mostly after hypersthene), zircon, apatite.	PYROXENE-BEARING FELDSPAR-QUARTZ GNEISS
6528/0198	Microcline perthite, quartz, plagioclase (An_{26}), biotite (partly after hypersthene, also distinct flakes), iddingsite (after hypersthene), opaques, apatite.	BIOTITE-BEARING QUARTZ-FELDSPAR GNEISS

North side King Edward VIII iceshelf

6528/0216	Plagioclase (An_{50}, minor antiperthite), clinopyroxene, quartz, hornblende (after pyroxene), opaques, apatite.	PLAGIOCLASE-PYROXENE-QUARTZ GNEISS

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Central King Edward VIII Iceshelf

6528/0133	Microcline perthite, quartz, plagioclase (An_{26}, minor), garnet, biotite (partly intergrown with garnet), opaques.	BIOTITE-GARNET-BEARING QUARTZ FELDSPAR GNEISS

Cape Dalton

6528/0183	Microcline perthite (slightly sericitized), quartz, biotite, plagioclase (An_{24-26}, minor), zircon.	BIOTITE-BEARING QUARTZ-FELDSPAR PEGMATITE

Wilson Glacier

6528/0128	Quartz, plagioclase (An_{32}, slightly sericitized), potassium feldspar, orthopyroxene, biotite (after pyroxene), opaques, apatite, zircon.	PYROXENE-BEARING QUARTZ-FELDSPAR GNEISS

South Seaton Glacier

6528/0127	Potassium feldspar perthite, quartz, plagioclase (An_{26}, minor), orthopyroxene, clinoamphibole, iddingsite, biotite (last 3 minerals after pyroxene), opaques, apatite, zircon.	PYROXENE-BEARING QUARTZ-FELDSPAR GNEISS

Georges Island

6528/0129	Quartz, microcline perthite, plagioclase, (An_{26-28}, minor antiperthite) garnet (up to 8 mm diameter), biotite (partly after garnet), zircon, apatite.	QUARTZ-FELDSPAR GARNET GNEISS

Mount Mueller and adjacent nunataks

7583/0201	Quartz, antiperthite (An_{30}), hypersthene, opaques, biotite (retrograde), apatite.	ANTIPERTHITE GNEISS
7583/0202	Plagioclase (Zoned An_{50} to An_{25}), augite (partly uralitized) opaques, quartz.	DOLERITE
7583/0203	Antiperthite (An_{30}), hypersthene, quartz, garnet, biotite, opaques, apatite.	GARNET-BEARING HYPERSTHENE-ANTIPERTHITE GNEISS
7583/0204	Quartz, perthite, plagioclase (An_{35} - commonly antiperthitic), garnet.	GARNET-BEARING GNEISS
7583/0205	Quartz, biotite, perthite.	BIOTITE GNEISS
7583/0206	Biotite, cordierite, sillimanite, corundum, zircon.	PELITIC GNEISS
7583/0207	Biotite, plagioclase (An_{35}), hypersthene (reaction rim of biotite), opaques.	BIOTITE GNEISS
7583/0208	Quartz, augite, opaques (15%), apatite, hypersthene.	META-JASPILLITE?
7583/0209	Plagioclase (reverse zoned An_{60-70}), hypersthene, augite, brown hornblende, biotite, opaques.	PYRICLASITE
7583/0210	Garnet (95%), quartz, orthoclase, biotite.	PYRIGARNITE
7583/0212	Garnet (50%), quartz, hypersthene, opaques.	PYRIGARNITE

7583/0213	Garnet (40%), quartz, hypersthene, antiperthite, opaques, plagioclase.	PYRIGARNITE
7583/0214	Plagioclase (An_{50}), hypersthene, augite, quartz.	PYRICLASITE
7583/0215	Plagioclase (An_{60}), hypersthene, augite, biotite, perthite, opaques.	PYRICLASITE
7583/0216	Perthite, Plagioclase (An_{25}), quartz, hypersthene, opaques.	PEGMATITE
7583/0217	Hypersthene, augite, brown hornblende, plagioclase (reverse zoned An_{70}- An_{90}), biotite.	PYRICLASITE
7583/0218	Quartz, perthite, plagiocalse, zircon?, biotite, minor muscovite and chlorite.	PEGMATITE
7583/0220	Quartz, cordierite, antiperthite, biotite, garnet, hypersthene, opaques, perthite, rutile.	GARNET-CORDIERITE GNEISS
7583/0221	Plagioclase (antipertitic, An_{30}), quartz, hypersthene, opaques, minor apatite and zircon.	ANTIPERTHITE GRANOFELS
7583/0223	Plagioclase (An_{45}), hypersthene, biotite.	PYRICLASITE.
7583/0224	Hypersthene, garnet, plagioclase, cordierite, antiperthite, orthopyroxene - plagioclase - orthoclose vermicular intergrowths.	MAFIC PEGMATITE
6528/0190	Quartz, plagioclase, perthite, garnet, minor opaques, zircon, biotite.	GARNET-BEARING GNEISS

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6528/0191	Plagioclase (An_{65-70} reverse zoned), hypersthene, quartz, biotite.	FELSIC PYRICLASITE
6528/0194	Plagioclase (zoned An_{50} to An_{25}), uralitized augite, opaques, quartz.	DOLERITE
6528/0151	Quartz, garnet, perthite, minor biotite and zircon.	GARNET-BEARING GNEISS

Mount Storegutt

6528/0192	Quartz, perthite, minor opaques, hypersthene, biotite and plagioclase.	LEUCOGNEISS
6528/0193	Plagioclase (zoned An_{50-30}), uralitized augite, quartz, opaques.	DOLERITE
6528/0193	Plagioclase (zoned An_{50-30}), uralitized augite, quartz, opaques.	DOLERITE

Nunatak 10 km north of Mount Storegutt

6528/0195	Quartz, perthite, garnet, biotite, plagioclase (An_{20}), cordierite (partly pinnitized).	CORDIERITE, GARNET, GNEISS

Downer Glacier

6528/0134	Quartz, perthite, hypersthene (partly altered to biotite), opaques, biotite.	LEUCO-GNEISS
6528/0217	Perthite, quartz, plagioclase, minor biotite, opaques, hypersthene, zircon and apatite.	LEUCO-GNEISS

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Junction of Seaton & Wilson Glaciers

6528/0214	Augite, brown hornblende, hypersthene, plagioclase, biotite.	PYRICLASITE

Edward VIII Gulf

6528/0086	Antiperthite, augite, hypersthene, quartz, minor biotite and opaques.	PYRICLASITE

Martin Island

7583/0281	Enstatite, phlogopite, augite cumming- tonite, minor plagioclase.	Mg - RICH PYRICLASITE
7583/028s	Bronzite, biotite, plagioclase (An_{30-35} reverse zoning).	PYRICLASITE
7583/0283	Hypersthene, augite, plagioclase, minor opaques and biotite.	PYRICLASITE
7583/0284	Bronzite, augite, minor plagioclase, opaques.	PYRICLASITE
7583/0285	Quartz, plagioclase (An_{30}, commonly anti- perthitic), rare opaques.	PLAGIOCLASE LEUCOGNEISS
7583/0286	Antiperthitic plagioclase (An_{40}), hyper- sthene, opaques, garnet.	GARNET-BEARING PYRICLASITE
7583/0287	Quartz, plagioclase (An_{25-30}, reverse zoned, commonly antiperthitic), hypersthene minor opaques and apatite.	HYPERSTHENE-ANTIPER- THITE-QUARTZ GNEISS
7583/0288	Bronzite, cummingtonite, plagioclase.	CUMMINGONITE PYRICLASITE

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7583/0289	Plagioclase (An_{70}), cummingtonite ($2V_z$ =85^o), bronzite.	CUMMINGTONITE PYRICLASITE
7583/0290	Quartz, plagioclase (An_{30}, commonly antiperthitic), hypersthene, opaques, minor apatite and zircon.	HYPERSTHENE-FELDSPAR-QUARTZ GNEISS
7583/0291	Quartz, plagioclase (An_{30}), minor opaques.	PLAGIOCLASE LEUCOGNEISS
7583/0292	Quartz, plagioclase (An_{40}, rarely antiperthitic), hypersthene, apatite.	BANDED HYPERSTHENE-PLAGIOCLASE-QUARTZ GNEISS
7268	Hypersthene, plagioclase (reverse zoned, An_{30-50}) green brown hornblende, biotite minor opaques.	PYRICLASITE
7267	Antiperthite, quartz, hypersthene, opaques, minor zircon and apatite.	HYPERSTHENE-QUARTZ-ANTIPERTHITE GNEISS

<u>Abrupt Point</u>

6528/0130	Plagioclase (An_{35}), quartz, biotite, hypersthene (partly altered), minor zircon, apatite and opaques.	BIOTITE-BEARING HYPERSTHENE-QUARTZ-PLAGIOCLASE GNEISS
6528/0215	Plagioclase (reverse zoned, An_{50-60}), hypersthene augite, green-brown hornblende, opaques, quartz.	PYRICLASITE
6528/0131	Antiperthite, quartz, augite, opaques, hypersthene, garnet, minor apatite and zircon.	GARNET-BEARING TWO PYROXENE

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Wheeler Rocks

6528/0228	Perthite, quartz, plagioclase (An_{30}), brown hornblende, hypersthene, augite, opaques, apatite, zircon.	TWO-PYROXENE QUARTZ FELDSPAR GNEISS

20 km NE of Mount Mueller

6528/0132	Quartz, antiperthite, biotite, minor hornblende, opaques, apatite, zircon.	HORNBLENDE-BIOTITE GNEISS

West bank Rippon Glacier

6528/0188	Orthoclase perthite, quartz, clinopyroxene, plagioclase (An_{26}), orthopyroxene, clinoamphibole (light to medium greenish brown pleochroic, after pyroxene), mica (brownish, alteration product), opaques, zircon, apatite.	PYROXENE-QUARTZ-FELDSPAR GNEISS
6528/0189a	Hornblende (60%), plagioclase (An_{38}), orthopyroxene, biotite, zircon.	HORNBLENDE-RICH PYRICLASITE
6528/0189b	Hornblende (60%), plagioclase (An_{38}), orthopyroxene, biotite, zircon.	HORNBLENDE-RICH PYRICLASITE

Newman Nunataks

7583/0025	Hypersthene (60%), magnetite (30%, large skeletal grains), quartz (10%).	MAGNETITE RICH ORTHOPYROXENITE
7583/0026	Quartz, hypersthene, magnetite.	MAGNETITE-HYPERSTHENE QUARTZITE OR HYPERSTHENE IRON STONE.

7583/0027	Microcline perthite (sericitized, 70%), quartz (30%), minor mica (in small irregular patches, brownish green pleochroic), mica (colourless), opaques, zircon.	QUARTZ-FELDSPAR GNEISS
7583/0028	Quartz, plagioclase (sericitized), orthoclase, sphene, mica (pale to medium brown pleochroic), orthopyroxene, opaques, zircon.	FELDSPAR-QUARTZ GNEISS
7583/0029	Enstatite (85%), phlogopite (15%), feldspar, zircon.	PHLOGOPITE ORTHOPYROXENITE
7583/0030	Quartz, microcline perthite, orthoclase, plagioclase, garnet, orthopyroxene (minor) opaques, mica (colourless), biotite, mica (greenish), (all mica after garnet), zircon.	GARNET-BEARING QUARTZ-FELDSPAR GNEISS
7583/0031	Quartz, hypersthene (alteration to ? clino-pyroxene and/or colourless and greenish clinoamphibole), magnetite.	MAGNETITE-HYPERSTHENE QUARTZITE or HYPER-STHENE IRONSTONE.
7583/0032	Quartz, magnetite, riebeckite, termolite/actinolite, very fine fibrous amphibole, ? orthopyroxene.	MAGNETITE QUARTZITE or IRONSTONE
7583/0033	Biotite, hypersthene, plagioclase (An_{52}), clinopyroxene, microcline perthite.	BIOTITE PYRICLASITE
7583/0034	Plagioclase (An_{44}), clinopyroxene, hyper-sthene, quartz, opaques, colourless clinoamphibole (after pyroxene), biotite (alteration product), zircon.	GARNET-BEARING PYRICLASITE

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7583/0035	Quartz, magnetite, orthopyroxene, colourless amphibole and greenish amphibole (both after pyroxene), needle-like crystals in radial structure.	MAGNETITE QUARTZITE or IRONSTONE
7583/0036	Quartz, hypersthene, plagioclase antiperthite (sericitized) clinopyroxene, biotite, opaques, zircon.	FELDSPAR-PYROXENE-QUARTZ GNEISS
7583/0037	Quartz, microcline perthite (strongly sericitized), mica (pale to light brown pleochroic; in patches), biotite, orthopyroxene.	MICA-BEARING FELDSPAR-QUARTZ GNEISS
7583/0039H	Quartz, plagioclase (An_{26}, sericitized), mica (pale green or colourless to light or medium green pleochroic), garnet, clinozoisite (after ? plagioclase), chlorite (after garnet).	GARNET-BEARING FELDSPAR-QUARTZ GNEISS
7583/0039I	Quartz, plagioclase antiperthite, microcline perthite, orthopyroxene (minor), clinozoisite, colourless mica.	PYROXENE-BEARING QUARTZ-FELDSPAR GNEISS.
7583/0041	Plagioclase (An_{54}, some sericitized), orthopyroxene, clinopyroxene, biotite, clinoamphibole (pale green or colourless to medium (bluish) green pleochroic; after pyroxene), ?clinozoisite, opaques, zircon, apatite.	PYRICLASITE
7583/0042	Orthoclase, some microcline perthite, quartz, garnet, patches of very finegrained quartz and greenish? amphibole, colourless mica (minor), biotite, opaques, zircon.	GARNET-QUARTZ-FELDSPAR GNEISS

7583/0043	Plagioclase (An_{64}), clinopyroxene, hypersthene, clinoamphibole (greenish pleochroism, after pyroxene), opaques, apatite.	PYRICLASITE
7583/0044	Plagioclase (An_{58}), hypersthene, clinopyroxene, clinoamphibole (greenish pleochroism, after pyroxene), opaques, apatite.	PYRICLASITE
7583/0045	Plagioclase (An_{58}), phlogopite, enstatite sphene, zircon.	PHLOGOPITE PYRICLASITE
7583/0046	Microcline perthite, quartz, garnet, plagioclase (An_{26-28}), biotite (after garnet, minor), mica (greenish pleochroic).	GARNET-FELDSPAR-QUARTZ GNEISS
7583/0047	Quartz, cordierite (also cordierite/quartz intergrowths, alteration to pinnine and quartz), orthopyroxene, biotite (minor), opaques.	CORDIERITE-QUARTZ ROCK
7583/0048	Biotite, hypersthene, garnet, plagioclase (An_{40}), opaques, spinel, cordierite.	PELITE

SQ 39-40/12 OYGARDEN GROUP
1:250 000 SHEET

Jagar Islands

6528/0184	Quartz, plagioclase (An_{35}, commonly very antiperthitic), hypersthene, opaques, minor apatite.	HYPERSTHENE-ANTIPERTHITE-QUARTZ GNEISS
6528/0185	Phlogopite, hornblende, plagioclase, bronzite ($2V_x = 75^o$).	BIOTITE-BEARING HORNBLENDE PYRICLASITE

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6528/0186	Bronzite, hornblende, augite, minor plagioclase.	HORNBLENDE-BEARING PYRICLASITE
6528/0149	Plagioclase (An_{15}), quartz, spodumene?, muscovite.	?SPODUMENE PEGMATITE

Jensen Island (Lat. 66°32'S Long. 57°15'E)

7583/0266	Quartz, perthite, plagioclase, hypersthene, augite, apatite, zircon, opaques.	TWO-PYROXENE-QUARTZ-TWO-FELDSPAR GNEISS
7583/0267	Quartz, antiperthite, hypersthene, augite, opaques.	ANTIPERTHITE GNEISS
7583/0268	Quartz, antiperthite, hypersthene, augite, opaques, minor apatite.	ANTIPERTHITE GNEISS
7583/0269	Antiperthite, quartz, hypersthene, opaques, minor apatite.	ANTIPERTHITE GNEISS
7583/0270	Quartz, antiperthite, blue-green hornblende, biotite, plagioclase (sericitized), opaques, minor apatite, zircon, chlorite and sphene.	RETROGRESSED GNEISS (K METASOMATIZED?)
7583/0271	Plagioclase (An_{50}), hypersthene, brown hornblende, minor opaques, rare garnet surrounded by plagioclase.	METABASIC DYKE ROCK

Cape Gotley

7269	Quartz, perthite, hypersthene (partly altered) garnet, opaques, minor apatite and zircon.	GARNET-BEARING PERTHITE GNEISS
7271	Quartz, plagioclase (An_{25}), hypersthene, minor biotite opaques and apatite.	ANTIPERTHITE GNEISS

Kloa Point

7270	Quartz, muscovite, biotite, pinnite (after cordierite?), microcline, minor zircon and opaques.	META K-RICH PELITE (LOW-AMHIBOLITE GRADE)

SQ 39-40/14 McLEOD NUNATAKS
1:250 000 SHEET

Knuckey Peaks

7583/0049	Plagioclase (An_{38}), hornblende (mantling pyroxene), clinopyroxene, hypersthene, opaques, apatite, zircon.	PYRICLASITE
7583/0050	Orthoclase perthite, quartz, orthopyroxene, plagioclase (An_{30}), apatite, zircon, opaques, mica (pale brown to medium brown pleochroic).	PYROXENE-QUARTZ FELDSPAR GNEISS
7583/0051	Quartz, plagioclase (An_{20-28}), microcline (perthitic), biotite (parallel aligned), opaques, zircon, apatite.	BIOTITE QUARTZ-FELDSPAR GNEISS
7583/0053	Quartz, microcline perthite, plagioclase (An_{20-26}), biotite, clinoamphibole (light to medium green pleochroic), zircon, opaques, apatite.	BIOTITE QUARTZ-FELDSPAR GNEISS
7583/0054	Microcline perthite, quartz, plagioclase (An_{20}), biotite, colourless mica, opaques zircon.	BIOTITE QUARTZ-FELDSPAR GNEISS
7583/0055	as 7583/0054.	

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7583/0055A	Clinopyroxene, hypersthene, opaques, apatite.	PYROXENITE
7583/0058	Garnet, biotite, orthoclase (perthitic), plagioclase, opaques, zircon.	PYRIGARNITE
7583/0057	Microcline and orthoclase (minor perthitic), quartz, plagioclase, tourmaline, opaques, zircon.	QUARTZ-FELDSPAR GNEISS
7583/0058	Orthoclase perthite, plagioclase antiperthite (An_{20-26}), quartz, hypersthene (prominent twinning), opaques, zircon, apatite.	PYROXENE-QUARTZ-FELDSPAR GNEISS
7583/0059	Orthopyroxene (? enstatite, 70%), clinopyroxene, mica (colourless or pale brown to medium brown pleochroic, ?phlogopite), orthoclase, plagioclase, orange yellow mineral, opaques, zircon, apatite.	PYROXENITE
7583/0060	Orthopyroxene (? hypersthene), clinopyroxene, mica (colourless or pale brown to medium brown, ? phlogopite) opaques.	PYROXENITE
7583/0061	Clinopyroxene, orthopyroxene (hypersthene; both pyroxenes have prominent twinning), hornblende, opaques.	PYROXENITE
7583/0062	as 7583/0061	
7583/0062	Orthopyroxene (? hypersthene), quartz, opaques, apatite.	PYROXENITE

7583/0067A	Orthoclase perthite, quartz, plagioclase (An_{46}), garnet, opaques, mica (colourless), chlorite (after garnet), apatite.	GARNET QUARTZ-FELDSPAR GNEISS
7583/0068	Orthopyroxene (enstatite, 80%), phlogopite, plagioclase (An_{58}), opaques, apatite.	PHLOGOPITE ORTHOPYROXENITE
7583/0067B	Orthoclase, perthite, quartz, plagioclase, orthopyroxene, opaques, brownish yellow amphibole (after pyroxene and in veinlets zircon).	PYROXENE-QUARTZ-FELDSPAR GNEISS
7583/0069	Orthoclase perthite, quartz, hypersthene, plagioclase, opaques, zircon.	PYROXENE-QUARTZ-FELDSPAR GNEISS
7583/0070	Orthoclase perthite, quartz, hypersthene, plagioclase, yellowish orange clino-amphibole (after pyroxene), opaques, zircon, apatite.	PYROXENE-QUARTZ-FELDSPAR GNEISS
7583/0071	Orthoclase perthite, quartz, plagioclase (An_{26-30}), orthopyroxene (? enstatite), yellowish orange alteration (after pyroxene), opaques, zircon, apatite.	PYROXENE-QUARTZ-FELDSPAR GNEISS
7583/0072	Orthoclase perthite, quartz, ortho-pyroxene (minor), clinopyroxene, rutle (abundant slender needles in feldspar and quartz), apatite, zircon.	PYROXENE-QUARTZ-FELDSPAR GNEISS
4588 (Rock No. 8175)	Quartz, orthoclase (perthitic), plagioclase (An_{24-30}), biotite (minor), orthopyroxene colourless mica, opaques.	QUARTZ-FELDSPAR GNEISS
4589 (Rock No. 8176)	Orthopyroxene, clinopyroxene, ?spinel.	PYROXENITE

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4590 (Rock No 8177)	Colourless clinoamphibole, biotite (pale brown to light or medium brown pleochroic), quartz.	BIOTITE AMPHIBOLITE

McLeod Nunataks

4584	Plagioclase, augite, orthopyroxene, biotite, minor brownish green hornblende and opaques.	PYRICLASITE
4585	Hypersthene, minor quartz.	HYPERSTHENE PEGMATITE
4586	Quartz, microcline, perthite, antiperthite, biotite, blue-green hornblende, opaques, minor calcite, apatite and zircon.	RETROGRESSED GNEISS
4587	Plagioclase, augite, uralite, quartz, opaques, minor biotite and garnet.	META-DOLERITE

Perov Nunataks

4575	Hypersthene, augite biotite, opaques, green-brown hornblende, minor plagioclase	MAFIC PYRICLASITE
4576	Antiperthite, hypersthene, perthite, quartz, minor augite and opaques, rare biotite.	BANDED TWO-FELDSPAR GNEISS
4577	Enstatite, minor phlogopite and plagioclase.	ENSTATITE PEGMATITE
4578	Plagioclase, uralite, augite, hypersthene, minor biotite and opaques.	DOLERITE

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SQ 39-40/15 RAYNER PEAK
1:250 000 SHEET

Rayner Peak

7583/0001	Microcline perthite, quartz, plagioclase (An_{26}), garnet biotite (minor), opaques, zircon, apatite.	GARNET-BEARING QUARTZ-FELDSPAR GNEISS
7583/0002	Hornblende (pale to light brown pleochroic, 60%) clinopyroxene, orthopyroxene, minor biotite and plagioclase (An_{68}).	PYROXENE AMPHIBOLITE
7583/0003	Quartz (95%), biotite (parallel oriented), zircon, plagioclase (in tension gashes with medium yellowish brown mica), opaques, ? corundum.	BIOTITE-BEARING QUARTZITE
7583/0004	Plagioclase (An_{44}), hornblende, clinopyroxene (reaction rims of plagioclase and orthopyroxeme), orthopyroxene, biotite, opaques, apatite.	GARNET-BEARING PYRICLASITE
7583/0005	Quartz, microcline perthite, plagioclase (An_{26}), minor biotite.	ALASKITE
7583/0006	Quartz (90%), biotite (parallel oriented), plagioclase (An_{25}) both in tension gashes and discontinuous veinlets, garnet, zircon.	BIOTITE-GARNET-BEARING QUARTZITE
7583/0007	Microcline perthite, quartz, plagioclase (An_{26}), garnet, biotite (minor), opaques, zircon.	GARNET-BEARING QUARTZ-FELDSPAR GNEISS

7583/0008	Garnet (60%, reaction rims of plagioclase and orthopyroxene), clinopyroxene, hypersthene, plagioclase (An_{36}), opaques, minor hornblende and biotite.	TWO-PYROXENE PYRIGARNITE
7583/0009	Quartz, garnet, (reaction rims of plagioclase and orthopyroxene), clinopyroxene, hypersthene, minor plagioclase, hornblende and opaques.	TWO-PYROXENE PYRIGARNITE
7583/0010	Quartz, plagioclase (An_{10-30}), microcline, hypersthene, garnet hornblende (after pyroxene), biotite (minor), zircon, opaques.	HYPERSTHENE, GARNET-BEARING-QUARTZ-FELDSPAR GNEISS
7583/0011	Quartz, microcline (perthitic), plagioclase (An_{10-30}), garnet, biotite (weakly parallel oriented), white mica (minor).	GARNET-BEARING-QUARTZ-FELDSPAR GNEISS
7583/0012	Clinopyroxene (50%), plagioclase (An_{50}), garnet (reaction rims of plagioclase and orthopyroxene), quartz, orthopyroxene, opaques.	GARNET PYRICLASITE
7583/0013	Clinopyroxene (40%), plagioclase, biotite, (unstable), hornblende (same after pyroxene), hypersthene, opaques.	BIOTITE-GARNET PYRICLASITE
7583/0014	Plagioclase (An_{32}), microcline (perthitic) quartz, garnet, biotite, opaques, zircon.	GARNET-BEARING-QUARTZ-FELDSPAR GNEISS.
7583/0015	Potassium feldspar, plagioclase (antiperthitic), quartz, biotite, zircon, apatite, opaques.	BIOTITE-QUARTZ-FELDSPAR GNEISS

7583/0016	Microcline, quartz, plagioclase, minor garnet, and muscovite.	GARNET-BEARING-QUARTZ-FELDSPAR GNEISS
7583/0017	Quartz, plagioclase (An_{24-30}), microcline, garnet, biotite, opaques, zircon.	GARNET BIOTITE-BEARING FELDSPAR-QUARTZ GNEISS
7583/0018	Quartz, microcline (perthitic), plagioclase (An_{24-30}), garnet, zircon.	QUARTZ-FELDSPAR-GARNET GNEISS
7583/0019	Clinopyroxene, plagioclase (antiperthitic; reverse zoned, An_{35-40}), garnet reaction rims of plagioclase and orthopyroxene), opaques, quartz, biotite.	GARNET PYRICLASITE
6528/0213	Plagioclase (antiperthitic, An_{26-28}), clinopyroxene, garnet (some reaction rims of plagioclase and orthopyroxene), biotite, hornblende (after pyroxene, light to medium brown pleochroic) quartz, orthopyroxene, opaques, apatite.	GARNET PYRICLASITE

Mount Kernot

6528/0050	Quartz, microcline, plagioclase (An_{24}), garnet biotite.	GARNET-BEARING-QUARTZ-FELDSPAR GNEISS
6528/0051	Quartz, clinopyroxene, magnetite (15%), orthopyroxene, apatite.	PYROXENE MAGNETITE QUARTZITE
6528/0052	Orthopyroxene, clinopyroxene, hornblende, garnet, plagioclase (antiperthitic) orthoclase (perthitic), opaques, zircon, apatite (disequilibrium assemblage)	HORNBLENDE GARNET BEARING PYRICLASITE

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6528/0053	Plagioclase (antiperthitic, An_{24-30}), quartz, orthoclase (perthitic), clinopyroxene, biotite (light to medium greenish brown pleochroic), mica (colourless), apatite, opaques, zircon.	PYROXENE-BEARING-QUARTZ-FELDSPAR GNEISS
6528/0207	Clinopyroxene, plagioclase (An_{30}), minor opaques.	PYRICLASITE
6528/0208	Quartz, orthoclase, plagioclase, orthopyroxene, garnet, biotite, mica (colourless), carbonate, opaques, apatite, zircon	ORTHOPYROXENE, GARNET-BEARING-QUARTZ-FELDSPAR GNEISS

Edward Ridge

6528/0223	Brown-hornblende, plagioclase (An_{50-55}) reverse zoned) quartz, garnet, biotite minor opaques.	GARNET AMPHIBOLITE
6528/0222	Quartz, microcline, biotite, garnet, plagioclase, minor zircon, and chlorite.	GARNET-BEARING-BIOTITE SCHIST

Nunatak 35 km SW of Mount Storegutt

6528/0197	Augite, plagioclase (rare antiperthite), quartz, hypersthene.	PYRICLASITE

Else Nunatak

6528/0219	Quartz, plagioclase (rarely antiperthitic), hypersthene, brown hornblende, perthite, opaques, biotite, minor apatite and zircon.	HORNBLENDE-BEARING-PLAGIOCLASE GNEISS

6528/0220	Plagioclase (reverse zoned An_{40-55}), augite, hypersthene, garnet, quartz, green-brown hornblende, opaques (garnet + minor augite hypersthene + plagioclase).	PYRICLASITE

Robert Glacier

6528/0135	Plagioclase, quartz, hypersthene, green-brown hornblende, opaques, minor apatite and zircon.	HORNBLENDE-BEARING-HYPERSTHENE-PLAGIOCLASE-GNEISS.
6528/0209	Plagioclase (An_{30-35}, reverse zoned), augite, garnet, green-brown hornblende, opaques, biotite, minor hypersthene.	PYRICLASITE
6528/0210	Quartz, perthite, plagioclase, garnet, minor zircon.	GARNET-BEARING LEUCOGNEISS
6528/0211	Plagioclase (An_{40}), augite, quartz, rutile, minor apatite.	PYRICLASITE
6528/0212	Quartz, perthite, plagioclase (An_{30}), green-brown hornblende, minor garnet, augite, apatite and zircon.	HORNBLENDE-BIOTITE GNEISS

Doggers Nunataks

7583/0234	Augite, plagioclase (An_{40}), opaques, greenish-brown hornblende, biotite.	PYRICLASITE
7583/0235	Pale green hornblende, bronzite, olivine (about Fo_{80}), augite, calcite.	META-ULTRAMAFIC
7583/0236	Very pale green hornblende, bronzite, olivine (Fo_{80-90}) (absent in half of the thin section), augite, rare calcite.	META BANDED-ULTRAMAFIC

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7583/0238	Several large hypersthene crystals with inclusions of brownish-green hornblende, biotite and augite.	MAFIC PEGMATOID
7583/0239	Bronzite, augite, plagioclase, biotite, very pale green hornblende.	PYRICLASITE
7583/0240	Bronzite, biotite, pale green hornblende, augite, plagioclase.	PYRICLASITE
7583/0241	Hypersthene, biotite, augite, pale brownish green hornblende, plagioclase.	PYRICLASITE
7583/0242	Bronzite, minor biotite, plagioclase, augite.	ORTHOPYROXENITE
7583/0245	Antiperthite, hypersthene, augite, brown hornblende, opaques.	PYRICLASITE
7583/0246	Quartz, perthite, plagioclase (An_{15}), minor opaques and apatite.	LEUCOGNEISS
7583/0247	Augite, hypersthene, pale brownish-green hornblende, minor opaques, plagioclase and calcite.	PYRICLASITE
7583/0248	Augite, bronzite, plagioclase (An_{40}; commonly antiperthitic), perthite.	PYRICLASITE
7583/0249	Several large crystals of bronzite with inclusions and intergranular augite, biotite and plagioclase.	MAFIC PEGMATOID

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7583/0250	Perthite, garnet, ferro-hypersthene, plagioclase (An_{30}), opaques, spinel, biotite, rare quartz with rims of orthoclase, plagioclase surrounded by garnet or as inclusions in garnet.	IRON-RICH PYRICLASITE
7583/0251A	Elongated symplectitic intergrowth of plagioclase (at least An_{60}), orthopyroxene, opaques and spinel from a garnet nodule reaction rim, minor greenish biotite.	GARNET REACTION RIM
7583/0254	Biotite, augite, plagioclase, cummingtonite.	BIOTITE GNEISS
7583/0255	Hypersthene, plagioclase (An_{50}), biotite, augite.	PYRICLASITE
7583/0256	Plagioclase (An_{55}), brownish green hornblende, hypersthene, augite.	PYRICLASITE
7583/0257	Quartz, perthite, plagioclase, rare opaques and zircon.	LEUCOGNEISS
7583/0258	Hypersthene poikiloblasts with intergranular and included biotite, perthite and plagioclase.	ORTHOPYROXENITE
7583/0259	Quartz, plagioclase (An_{30}, commonly antiperthitic), minor hypersthene, rare opaques, biotite, apatite and zircon.	HYPERSTHENE-PLAGIOCLASE GNEISS

Watson Ridge

6528/0218	Quartz, perthite, plagioclase, hypersthene, opaques, biotite, zircon, apatite.	HYPERSTHENE-TWO-FELDSPAR GNEISS

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Turbulence Bluffs

6528/0224	Plagioclase, augite, green-brown hornblende, hypersthene, opaques, garnet.	GARNET-BEARING PYRICLASITE
6528/0225	Quartz, antiperthite, green hornblende, garnet, biotite, opaques, apatite.	GARNET-BEARING AMPHIBOLITE

Kvars Promontory

6528/0226	Quartz, plagioclase, hypersthene, green hornblende, garnet, opaques, apatite, zircon.	GARNET-BEARING HYPERSTHENE-PLAGIOCLASE GNEISS
6528/0227	Plagioclase, augite, hypersthene, green-brown hornblende, opaques, minor garnet and biotite.	PYRICLASITE

Nunatak 15 km NE of Twin Peaks (Cooks Nunatak?)

6528/0187	Opaques, quartz, augite, hypersthene, apatite.	META-JASPILLITE?

Leckie Range

4592	Plagioclase (An_{40}), quartz, biotite, hypersthene, calcite, opaques, minor zircon and apatite.	HYPERSTHENE-PLAGIOCLASE GNEISS
4593	Enstatite, minor cummingtonite.	ORTHOPYROXENITE
4594	Plagioclase, hypersthene, biotite, augite, greenish brown hornblende, opaques, apatite.	METABASIC DYKE

Mount Channon

4591	Antiperthite (reverse zoned), hypersthene, augite, opaques, quartz, minor apatite and zircon.	PYRICLASITE
4834	Quartz, perthite, plagioclase, garnet, biotite, opaques, minor apatite and zircon.	GARNET-BIOTITE GNEISS

SQ 41-42/13 MAWSON
1:250 000 SHEET

Mawson

7583/0265	Enstatite, phlogopite.	Mg-RICH ORTHOPYROXENITE
7583/0273	Quartz, perthite, plagioclase (An_{40}), hypersthene, opaques, minor zircon and apatite.	CHARNOKITE

Welch Island

7583/0264	Quartz, diopside, scapolite, calcite.	META-CARBONATE-RICH QUARTZITE (XENOLITH)

Kidson Island

7583/0260	Quartz, perthite, garnet, biotite, plagioclase, opaques, sillimanite, spinel, hypersthene, chlorite. (opaques and spinel surrounded by reaction rims of sillimanite and hypersthene).	PSAMMOPELITE (UNEQUILIBRATED)
7583/0261	Quartz, perthite, sillimanite, minor opaques.	META-APLITE

7583/0262	Cordierite, spinel, opaques, sillimanite, perthite, corundum, minor quartz and hypersthene.	Mg-RICH META-SEDIMENT
7583/0263	Sillimanite, cordierite, minor opaques, biotite and spinel.	Al-RICH META-SEDIMENT

Ufs Island

7583/0293	Quartz, perthite, garnet, biotite, sillimanite, minor plagioclase and zircon.	META-PSAMMOPELITE
7583/0294	Quartz, garnet, opaques, plagioclase, biotite, zircon.	META-PSAMMITE
7583/0295	Perthite, garnet, quartz, plagioclase (An_{40}), sillimanite, opaques, biotite, spinel.	META-PSAMMOPELITE
7583/0296	Antiperthite, quartz, garnet, biotite, minor opaques and zircon.	GARNET-BEARING GNEISS
7583/0297	Quartz, plagioclase, perthite, minor garnet, rare muscovite and zircon.	GARNET-BEARING LEUCOGNEISS
7583/0298	Hypersthene, quartz, augite, minor calcite, opaques, apatite and blue-green hornblende.	QUARTZ-RICH PYROXENITE
7583/0299	Hypersthene, quartz, opaques.	QUARTZ-RICH ORTHOPYROXENITE
7583/0300	Greenish-brown hornblende, hypersthene, augite, minor plagioclase (An_{65}) and opaques.	PYROXENE-BEARING HORNBLENDITE

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7583/0301	Bronzite, augite, minor biotite, opaques and pale greenish brown hornblende.	PYROXENITE
7583/0302	Bronzite, minor augite, plagioclase (An_{40}), hornblende (pale brownish-green), biotite and opaques.	PYROXENITE
7583/0303	Plagioclase (An_{60}), hypersthene, biotite, opaques.	PYRICLASITE
7583/0304	Quartz, biotite, opaques.	CATACLASITE
7583/0305	Augite, minor spinel and opaques.	CLINOPYROXENITE

Rumdoodle Peak (Masson Range)

7583/0080	Plagioclase, orthoclase (perthitic), hypersthene, clinopyroxene, quartz, opaques, apatite.	GNEISSIC CHARNOCKITE
7583/0081	Plagioclase (An_{50}), hypersthene, orthoclase (perthitic), quartz, clinopyroxene, opaques, apatite (common accessory), zircon.	GNEISSIC CHARNOCKITE
7583/0082	Plagioclase (An_{50}), orthopyroxene, quartz, orthoclase, clinopyroxene, opaques, apatite, zircon.	GNEISSIC CHARNOCKITE
7583/0083	Orthoclase perthite, quartz, hypersthene, plagioclase, opaques, zircon.	GNEISSIC CHARNOCKITE
7583/0084	Orthoclase perthite, quartz, plagioclase hypersthene, opaques, zircon, apatite.	GNEISSIC CHARNOCKITE

7583/0085	Plagioclase (An_{44}), orthopyroxene, mica (pale brown to medium brown pleochroic), quartz, opaques, apatite, zircon, dark xenolith of v.f.gr quartz, feldspar, pyroxene rock.	GNEISSIC CHARNOCKITE
7583/0086	Plagioclase (antiperthitic), quartz, orthoclase (perthitic), orthopyroxene, clinopyroxene, mica (pale brown to medium brown pleochroic), opaques, apatite, zircon.	PYROXENE-BEARING QUARTZ-FELDSPAR GNEISS
7583/0087	Orthoclase perthite, quartz, garnet, plagioclase, ?spinel (with garnet), rutile (numerous needles), zircon, biotite (after garnet).	GARNET-QUARTZ-FELDSPAR GNEISS
7583/0088	Microcline perthite, quartz, plagioclase (An_{24-28}), mica (pale to medium brown pleochroic), opaques, zircon.	LEUCOGNEISS
7583/0089	Orthoclase perthite, quartz, mica (colour less or pale brown to medium brown pleochroic), garnet, opaques, zircon.	GARNET-BEARING QUARTZ-FELDSPAR GNEISS
7583/0090	Quartz, plagioclase (sericitized), garnet.	GARNET-FELDSPAR-QUARTZ GNEISS
7583/0091	Clinopyroxene (95%), orthoclase perthite, brownish mineral (alteration), opaques, zircon.	PYROXENITE
7583/0092	Quartz, orthoclase perthite, garnet, mica (colourless or pale brown to medium brown pleochroic), opaques, zircon.	GARNET-FELDSPAR-QUARTZ GNEISS

7583/0093	Plagioclase (An_{40}), hornblende, orthopyroxene, clinopyroxene, biotite, opaques, apatite.	PYRICLASITE
7583/0094	Plagioclase, quartz, clinopyroxene (porphyroblasts up to 2 cm diameter), orthopyroxene, ?potassium feldspar, biotite, opaques, zircon, apatite.	PORPHYROBLASTIC PYRICLASITE
7583/0095	Plagioclase (An_{24-28}), orthoclase, perthite, quartz, opaques, apatite, zircon.	QUARTZ-FELDSPAR GNEISS

<u>Macey Island</u>

7583/0096	Plagioclase (An_{44}), quartz, orthoclase (perthitic), hypersthene, biotite, garnet, opaques, zircon, apatite.	PYROXENE-BIOTITE GARNET-BEARING QUARTZ-FELDSPAR GNEISS
7583/0097	Plagioclase (An_{54-60}, antiperthitic), quartz, orthoclase, hypersthene, biotite, opaques.	HYPERSTHENE-BEARING QUARTZ-FELDSPAR GNEISS
7583/0098	Plagioclase (An_{40}), orthoclase (perthitic), quartz, hypersthene, biotite, opaques, zircon, apatite.	HYPERSTHENE-QUARTZ-FELDSPAR GNEISS
7583/0099	Plagioclase (An_{48}), quartz, orthoclase, hypersthene, biotite, garnet, opaques, apatite, zircon.	HYPERSTHENE-QUARTZ-FELDSPAR GNEISS
7583/0100	Quartz (98%), feldspar.	QUARTZITE.

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Mount Twintop

7583/0074	Orthoclase perthite, quartz, plagioclase (antiperthitic, An_{50}), biotite, hypersthene, garnet (minor), opaques, pale to medium orange yellow amphibole (after pyroxene), zircon.	BIOTITE-GARNET-HYPERSTHENE BEARING QUARTZ-FELDSPAR GNEISS
7583/0075	Orthoclase perthite (alteration to carbonate and sericite), quartz, plagioclase (An_{24-28}), opaques.	QUARTZ-FELDSPAR GNEISS
7583/0076	Microcline (perthitic), biotite (parallel aligned), quartz, plagioclase (An_{24-28}), zircon, apatite, opaques.	QUARTZ-BIOTITE-FELDSPAR GNEISS
7583/0077	Quartz, plagioclase (An_{40}), hypersthene, biotite, opaques, zircon.	BIOTITE BEARING HYPERSTHENE-FELDSPAR-QUARTZ GNEISS
7583/0078	Quartz (95%), plagioclase; one small patch with hypersthene, garnet, mica (colourless or pale brown to light or medium brown), opaques.	QUARTZ PEGMATITE
7583/0079	Orthopyroxene (? enstatite), phlogopite, plagioclase, colourless amphibole (minor), opaques, apatite, zircon.	PHLOGOPITE PYRICLASITE
7583/0101	Orthoclase perthite, quartz, plagioclase (antiperthitic), hypersthene, opaques, zircon.	HYPERSTHENE-QUARTZ-FELDSPAR GNEISS

7583/0102	Orthoclase perthite, quartz, plagioclase (An_{24}), hypersthene, biotite, opaques, zircon, apatite.	HYPERSTHENE-QUARTZ-FELDSPAR GNEISS
7583/0103	Plagioclase (An_{50}), hypersthene, hornblende, biotite, opaques, zircon, apatite.	HORNBLENDE PYRICLASITE
7583/0104	Hypersthene, clinopyroxene, biotite, apatite (crystals up to 1 cm diameter), opaques, zircon.	PYROXENITE
7583/0105	Plagioclase (An_{36}), orthoclase (perthitic), quartz, biotite, hornblende, opaques, apatite, zircon.	BIOTITE-HORNBLENDE-QUARTZ-FELDSPAR GNEISS
7583/0106	Quartz, orthoclase, plagioclase, garnet, opaques, zircon.	GARNET-QUARTZ-FELDSPAR-GNEISS

MACQUARIE ISLAND
1:50 000 SHEET

7583/0109	Plagioclase (An_{68}, locally albitized) augite, actinolite (after augite), chlorite (secondary), sphene, veinlet with prehnite and zeolite; subophitic, intergranular, fine-grained.	ALTERED BASALT
7583/0110	Plagioclase (An_{58}, phenocrysts normally zoned), actinolite (after augite), augite, opaques (always associated with actinolite), sphene (alteration to leucoxene), veinlet with chalcedony; porphyritic, phenocrysts up to 1 cm, fine-grained and intergranular matrix.	ALTERED PORPHYRITIC BASALT

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7583/0112	Plagioclase (albitized, saussuritized), augite, chlorite (secondary), sphene (alteration to leucoxene), opaques (pyrite), veinlet with prehnite and possible fibrous actinolite; intergranular, fine-grained.	ALTERED BASALT
7583/0113	Plagioclase (An_{52}), augite, actinolite/tremolite (after pyroxene), orthopyroxene, sphene.	GABBRO
7583/0114	Plagioclase (An_{54}), orthopyroxene, augite, (long axes parallel oriented).	LEUCO GABBRO
7583/0115	Plagioclase (partly albitized), chlorite (after augite), augite (locally in radial clusters), epidote/clinozoisite, opaques, (? ilmenite), veinlet with chalcedony; fine-grained.	ALTERED BASALT
7583/0117	Plagioclase (partly albitized), augite (pale purple brown), chlorite, epidite/clinozoisite, ilmenite, veinlet with zeolite; fine-grained.	ALTERED BASALT
7583/0118	Plagioclase, titanaugite, olivine (completely replaced by serpentine and iddingsite), secondary: chlorite, serpentine, iddingsite, magnetite; fine-grained.	BRECCIATED BASALT
7583/0119	Plagioclase (An_{50}), augite, chlorite (in patches), hornblende (partly after augite), carbonate, epidote, opaques, amygdules with zeolite; fine-grained, slightly porphyritic.	PORPHYRITIC AMYGDALOIDAL BASALT

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7583/0120	Plagioclase (An_{50}), titanaugite, chlorite, epidote, opaques, amygdules and veinlets with zeolite; fine-grained	BRECCIATED AMYGDALOIDAL BASALT
7583/0121	Plagioclase (An_{60} for phenocrysts, in matrix slightly more sodic), augite, chlorite, opaques, amygdules with zeolite; fine-grained, slightly porphyritic	BRECCIATED, PORPHYRITIC AMYGDALOIDAL BASALT
7583/0122	Plagioclase (An_{60}), augite, chlorite, opaques, prehnite porphyritic, fine-grained matrix.	BRECCIATED, PORPHYRITIC BASALT
7583/0123	Plagioclase (An_{58}), augite (pale purple brown), chlorite, hornblende, sphene, opaques; fine-grained.	BASALT
7583/0124	Plagioclase (An_{50-60}, normally zoned phenocrysts) augite (pale purple brown), chlorite, biotite, opaques; fine-grained matrix, porphyritic.	PORPHYRITIC BASALT
7583/0125	Plagioclase (An_{60}), augite, chlorite, opaques, amygdules with zeolite and chlorite; porphyritic, fine-grained matrix.	PORPHYRITIC, AMYGDALOIDAL BASALT
7583/0126	Plagioclase (An_{50}), actinolite (after augite), chlorite, augite (remnants), opaques (including ilmenite), epidote; fine-grained.	ALTERED BASALT
7583/0127	Plagioclase (An_{50}), augite, actinolite (after augite), veinlet with epidote/clinozoisite, sphene, opaques; medium-grained.	FINE GABBRO

7583/0128	Plagioclase, augite, hornblende (after augite), opaques (in clusters), carbonate, veinlet with epidote/clinozoisite; medium to coarse-grained.	GABBRO
7583/0129	Glass (60%, devitrified), numerous tiny granules of iron oxide, plagioclase (An_{60}), chlorite, augite, carbonate, epidote, amygdules with zeolite and chlorite; intersertal, porphyritic.	SELVAGE OF PILLOW LAVA BASALT
7583/0130	Plagioclase (An_{56}), actinolite (after augite), augite, chlorite, opaques (including ilmenite), veinlet with carbonate; porphyritic, fine-grained matrix.	ALTERED, PORPHYRITIC BASALT

Caroline Cove

7583/0306	Rock fragments of basalt, hornblende dolerite and augite gabbro with a calcite cement.	GRADED VOLCANICLASTIC ARENITE

Raine Point

7583/0307	Plagioclase, augite, opaques, chlorite, epidote	BASALT (THOLEIITIC)

Mount Hamilton

7583/0308	Plagioclase phenocrysts (zoned An_{80}-An_{60}) in a groundmass of plagioclase, augite, zeolites, opaques and chlorite.	PORPHYRITIC BASALT

Mt. Gwynn

7583/0309	Phenocrysts of kaersutite and titanaugite in a groundmass of altered orthoclase and plagioclase, spherulites, apatite, opaques, prehnite and dark green amphibole.	TRACHYBASALT
7583/0310	Partly serpentized olivine, augite, serpentine minerals.	WEHRLITE

Green Gorge

7583/0311	Augite, plagioclase, opaques, zeolites, chlorite.	DOLERITE

NW of Sandy Bay

7583/0312	Plagioclase (An_{70}), augite partly altered to brown hornblende, green and brown hornblendes, opaques, sphene.	GABBRO

S. of Boot Hill

7583/0313	Serpentine minerals, augite, olivine, opaques.	SHEARED SERPENTINIZED WEHRLITE

Appendix 2

GEOCHRONOLOGY REPORT AND DATA

Sample No. 7583/0243 - Biotite from quartz-biotite pegmatite, Doggers Nunataks.

1. CLIENT BMR FILE NO. 2/1/0 JOB NO. 76/76

2. ANALYTICAL DATA

K-Ar: K^{40} = 0.0119 atom %; λ_β = 4.72 x 10^{-10}/yr; λ_e = 0.584 x 10^{-10}/yr

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% K: 7.57 % Atmospheric Ar^{40}:1.1 Radiogenic Ar^{40}/K^{40}: 0.034268
7.61

Age: 511 ± 10 million years

3. PETROGRAPHY

An extremely coarse-grained biotite-rich rock. In view of the texture and simple mineralogy of this rock and the ease in preparing a biotite concentrate, no thin section was cut.

Sample No. 7583/0219 - Biotite from quartz-biotite pegmatite, Mount Mueller

1. CLIENT BMR FILE NO. 2/1/0 JOB NO. AN 76/76

2. ANALYTICAL DATA

K-Ar: K^{40} = 0.0119 atom %; λ_β = 4.72 x 10^{-10}/yr; λ_e = 0.584 x 10^{-10}/yr

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% K: 7.33 % Atmospheric Ar^{40}: 1.7 Radiogenic Ar^{40}/K^{40}: 0.039703
7.33

Age: 580 ± 12 million years

3. PETROGRAPHY

A relatively fine-grained part of this sample was sectioned; the rock consists of approximately subequal amounts of biotite and quartz with accessory opaques. Most crystals are between 0.4 and 0.8 mm in size but some patches have a grainsize of about 0.2 mm.

The biotite is green-brown and strongly pleochroic; there is only a small amount of somewhat ragged and altered biotite and no difficulties will be encountered in preparing a concentrate for geochronology.

APPENDIX 3 - GEOLOGISTS' MOVEMENTS

1974

December

7	Departure of Nella Dan from Melbourne at 1500 hrs.
14	First iceberg sighted, and Nella Dan reached 60°S.
20	Passed iceberg Alley (40 n miles from Mawson).
21	Nella Dan tied up along fast ice about 50 km from Mawson at 1000 hrs; unloading started. Three helicopters and Pilatus Porter helped with unloading. Weather until now reasonably good: most days cloudy but generally little or moderate wind and low to moderate swell.
22	Left mooring place for King Edward VIII Gulf late in the evening.
24	Ship moored between pack ice about 110 km northeast of Rippon Depot. Wyborn and surveyor flown to Mount Mueller, and Pieters and Surveyor to Rayner Peak.
25 & 26	Most personnel and equipment flown from Nella Dan to Knuckey Peaks basecamp.
28	Pieters and surveyor picked up from Rayner Peak and flown to a minor massif of Aker Peaks via Rippon Depot. This locality proved unsuitable for surveying purposes but geological work was carried out.
29	Pieters and surveyor flown from Aker Peaks to the main massif of Newman Nunataks. Between 21st and evening of 29 December the weather at Rayner Peak, Mount Mueller, and the northern parts of Kemp Land and Enderby Land was generally very good with blue skies and winds between 10 and 25 knots from the south.
30 to 9 Jan 1975	Bad weather over all of eastern Enderby Land. A break in the weather on 4 January allowed Pieters and surveyor to be resupplied, but variable weather on 5 January caused the helicopters to turn back from their planned pick-up of Wyborn and surveyor from Mount Mueller.

10 Jan Wyborn and surveyor moved to Mount Breckinridge.

11 Pieters and surveyor flown from Newman Nunataks to main massif of Knuckey Peaks.

13 Wyborn and surveyor picked up from Mount Breckinridge. Because of the approach of bad weather the party could not be positioned at Mount Channon, and had to stay at Knuckey Peaks base camp.

15 Wyborn and surveyor flown to Doggers Nunataks as low cloud prevented landing on Mount Channon. Excellent weather and no other priorities would have allowed Pieters to carry out a helicopter reconnaissance, and although this was radioed to base camp the pilots did not receive the message.

16 Pieters flew from main massif of Knuckey Peaks to Knuckey Peaks basecamp with the purpose of moving to Mount Cook with another surveyor. However, strong turbulent winds and shortage of fuel prevented a landing even at the foot of the mountain. Between 10 and 16 January the weather was variable. Sunny days alternated with gloomy days, but at Knuckey Peaks there was always drift accompanying a 10-30 knot wind from the east.

17-24 Bad weather all over Enderby Land and Kemp Land. Winds from the east and southeast reached 70 knots.

23 Pilatus Porter blown out of its achors in strong winds at Guam, near Mawson, and wrecked.

25 Weather cleared up, and all field parties including Wyborn and surveyor were flown to Knucky Peaks basecamp. It was decided to cease fieldwork, and to pull out of Knuckey Peaks base as quickly as possible because of adverse weather and shortage of aircraft. The tractor train was recalled from Sandercock Nunataks to evacuate as many people as possible.

26 The OIC and most supporting personnel at Knuckey Peaks basecamp flew to Rippon Depot, and eventually Mawson, leaving the tractor train crew and field teams to dismantle and clean up the base camp.

28 At 0100 hrs the tractor train left Knuckey Peaks base camp with 14 people on board including the 2 geologists. (Between 24 and 28 January the weather was variable at Knuckey Peaks with heavy drift hampering the dismantling of base camp).

31	Wyborn and surveyors flown to Mawson from tractor train.
2 Feb	Wyborn and surveyor flown to Kidson Island. Pieters, with tractor train, arrived at Mount Twintops where he collected rock samples.
3	Pieters, with tractor train, arrived at Rumdoodle Peak where he carried out some geological work.
4	Wyborn and surveyor moved to Welch Island. Pieters, with tractor train, arrived at Mawson. During the tractor trip between 28 January and 4 February very good weather was experienced with mostly clear sunny days. The minimum temperature was - 38^{o}C.
7	Pieters and surveyor flown to Macey Island.
11	Nella Dan arrived at Mawson. Pieters and surveyor flown to Mawson; Wyborn and surveyor flown to Mawson.
12-16	Unloading and backloading the Nella Dan.
17	Nella Dan departed Mawson for King Edward VIII Gulf.
19	Arrived at Jensen Island (new name) near Cape Boothby.
20	Two helicopters sling 44 drums of fuel to Rippon Depot. Wyborn carried out geological work on Jensen Island. Pieters asked for permission to fly to Rippon Depot (and possibly Martin Island) to carry out gravity readings with both gravity meters. These readings would have completed the loop Mawson-Knuckey Peaks - Martin Island (Rippon Depot) - Mawson, and, with Rippon Depot and Martin Island tied in firmly, these would have been ideal starting points for next season's gravity work. Pieters also wanted to recover rocks from Rippon Depot which were for unknown reasons not loaded on the helicopters at an earlier stage. Pieters' request was rejected, but most of the rock samples were recovered by other personnel.
	Between 4 and 20 February the weather was variable, with strong winds associated with a deep low on 7, 8, and 9 February. Extreme wind velocities of over 100 knots were experienced at Welch Island by Wyborn and surveyor, whose tent ripped and collapsed under the strain.

10b

21	Nella Dan arrived at Iceberg Alley. Two helicopters crashed into each other while winding up in order to fly to Mawson.
26	Nella Dan arrived at Casey.
27	Short visit to Casey; Pieters and Wyborn sampled cordierite-bearing rocks. Left Casey for Macquarie Island.
March 6	Arrived at Macquarie Island. Weather between 20 February and 6 March was rather good with light winds and a low swell, but generally a clouded sky.
March 7	Unloading commenced. Pieters and Wyborn set off for 3 day's field trip; Pieters covering the north part and Wyborn the south part of the island.
10	Left Macquarie Island for Melbourne.
15	Arrived Melbourne 0800 hrs.

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