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BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

Record 1972/132

GEOLOGICAL WORK IN ANTARCTICA 1971

by

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SUMMARY

In the 1970-71 summer field season, four geologists seconded from the Bureau of Mineral Resources (BMR) to the Australian National Antarctic Research Expedition (ANARE) worked in the northern ranges of the Prince Charles Mountains, MacRobertson Land, Antarctica. Their work extended the regional coverage of 1:250 000-scale geological mapping south to latitude 72°S.

The northern Prince Charles Mountains are almost wholly composed of a complex mixture of high-grade metamorphic rocks intruded by numerous granites and pegmatite dykes and by a few basic dykes. Most of the basement rocks are of unknown origin but some are obviously of sedimentary origin and others are obviously of igneous origin. Regional metamorphic conditions were evidently high-grade throughout the area with low pressures and high temperatures. Metamorphic grade decreases from the north, where granulite-facies rocks are extensively developed, to the south, where amphibolite-facies rocks predominate and granulite-facies assemblages are not seen.

In parts of the northern ranges, i.e., the Athos, Porthos, and Aramis Ranges, there are large discrete masses of charnockite or granulite-facies rocks and amphibolite-facies rocks, but elsewhere in these ranges these rock types are intermingled. The formation of the various rock types is related to local variations in water pressure (P_{H_2O}) during metamorphism. In some areas P_{H_2O} was sufficiently low for granulite-facies metamorphism, but elsewhere higher P_{H_2O} conditions induced upper amphibolite-facies metamorphism. Local mobilisation of acid gneisses, anatexis, migmatization, and metamorphic differentiation were commonly associated with these amphibolite-facies conditions. Winkler (1967) interprets the local variations in P_{H_2O} as indicating that the rocks had been subjected to high-grade metamorphism before the episode responsible for the present assemblages.

Three generations of basic dykes are distinguished. The youngest is unmetamorphosed, the oldest was affected by the main metamorphism, and the middle generation cross-cuts the major metamorphic foliation and boundaries, and has been metamorphosed under amphibolite-facies conditions. This late stage metamorphism has produced minor but widespread retrograde effects in the other metamorphic rocks.

The basement rocks of the Prince Charles Mountains are unconformably overlain by Permian sediments of the Amery Group near Beaver Lake, and are thus older than Permian, but no accurate determinations of the age of the basement rocks have been made.

INTRODUCTION

Four BMR geologists, Dr R.G. Dodson, Dr J. Smart, R.M. Hill and R.J. Tingey were members of the 1971 ANARE expedition to the Prince Charles Mountains in Eastern Antarctica. Clothing, equipment, and logistic support were provided by the Antarctic Division of the Department of Supply, and, in the field, transportation was by a Pilatus 'Turbo-Porter' fixed-wing aircraft and 3 Hughes 500 turbine-powered helicopters.

The expedition ship M.V. Nella Dan sailed from Melbourne on 12th December 1970 and arrived at the ice edge off Mawson ANARE base on 26th December 1970. Personnel and essential supplies were airlifted to Mawson base, and from there to the field base camp at Moore Pyramid in the northern Prince Charles Mountains. Fieldwork started on 12th January 1971 and finished on 7th February 1971.

The work done by the BMR geologists in the Prince Charles Mountains continued the 1:250 000 regional geological mapping of the region. This mapping was started in the 1969 summer field season, and at the end of the 1971 season the Prince Charles Mountains had been mapped to latitude 72°S. In 1971, as in previous expeditions, the BMR geologists operated a La Coste and Romberg geodetic gravity meter when opportunity arose. The results of this work will be presented elsewhere.

The geological and geophysical results of fieldwork in the Prince Charles Mountains will be presented on preliminary-edition maps of the standard BMR 1:250 000 geological series. The results of the 1971 fieldwork are arranged in this Record according to the five 1:250 000 Sheet areas but conclusions drawn from the fieldwork are generalized. Plate 1 (at the end of the Record) shows the outcrops visited in 1971 or mentioned in this Record.

EXPLORATION AND PREVIOUS GEOLOGICAL INVESTIGATIONS

The Prince Charles Mountains were first located in 1947 by U.S. Navy aircraft tak ng part in operation 'High Jump'. The first overland journey towards the Prince Charles Mountains was made in 1954 by an ANARE expedition which was led by R. Dovers, and included BMR geologist B. Stinear. Dovers' party went as far as Stinear Nunataks from where they sighted the main ranges of the Prince Charles Mountains.

After the establishment of the ANARE base at Mawson in 1954, aircraft that were based there flew reconnaissance and aerial-photography missions over the surrounding region including the Prince Charles Mountains. BMR geologist P. Crohn, a member of the 1955 and 1956 Mawson

ANARE expeditions, made two field trips into the Prince Charles Mountains and the results of his work were published in 1959 as volume III of the ANARE series A reports and as BMR Bulletin No. 52.

McLeod (1959) made observations and did field work in the Prince Charles Mountains during his stay at Mawson in 1958, as did Stinear in 1957. All work in the Prince Charles Mountains before 1961 was of a reconnaissance nature and the papers presented by McLeod and Trail to the 1963 SCAR-IUGS symposium in Cape Town summarized the work then completed (McLeod, 1964, Trail, 1964).

Formal geological mapping was not done in the Prince Charles Mountains between 1961 and 1969 when 1:250 000 regional mapping was started. Some results of the 1969 summer fieldwork were presented to the 1970 SCAR-IUGS Symposium on Antarctic Geology and Solid Earth Geophysics (Mond, 1972).

Soviet geologists have also worked in the Prince Charles Mountains since Soviet Antarctic bases were established for the 1956 International Geophysical Year. Their results have been published in papers presented to the 1963 and 1970 SCAR-IUGS Symposia on Antarctic Geology and Solid Earth Geophysics, and to the 1964 International Geological Congress.

AERIAL PHOTOGRAPHS AND MAPS

ANARE aircraft based at Mawson between 1954 and 1961 made numerous reconnaissance and aerial-photography flights into the Prince Charles Mountains. The photography, which was done with little or no ground control, was essentially for reconnaissance, and trimetrogon photographs of variable quality were produced. Few features have good vertical photography coverage, but most have oblique coverage, although the photographs of some outcrops in the Prince Charles Mountains are of little or no use. On the earliest photographs details of mountains and rock exposures are difficult to discern, but later photographs have less contrast between the dark rock features and the snow and ice features.

The Division of National Mapping produced 1:100 000 compilation sheets for the Prince Charles Mountains south to 72°S using the aerial-photographs mentioned and the results of ground survey work. These maps have been used in the field by geologists for compilation. Since 1969, field work has resulted in improved ground-survey control in the northern Prince Charles Mountains, and 1:250 000 topographic maps of the area will soon be published. They will be used as bases for regional geological maps.

METHODS OF WORK

The operations of the ANARE Prince Charles Mountains expeditions are under the direction of an expedition leader appointed by the Antarctic Division, Department of Supply. Dr D.J. Lugg was leader and medical officer of the 1971 expedition, which was a combined topographic and geological survey. Three two-man geological parties camped out at various mountains in the northern Prince Charles Mountains and were moved as necessary by the helicopters; the fourth geologist operated from the Moore Pyramid base-camp.

In the field the geologists made notes and collected specimens in the usual fashion and observation points were noted on 1:100 000 compilation sheets or on aerial photographs. Black and white, and colour photographs taken from the air, and on the ground, later proved to be most useful sources of information and illustration. In particular, bands or concentrations of similarly coloured rocks can be distinguished on colour photographs, and structural information about exposures covered by frost-disturbed rock debris (which is almost in situ) can be obtained.

Rock specimens collected in the field were examined in Canberra; some were thin-sectioned. In previous years, petrographic work on thin sections of Antarctic rocks was done under contract by Australian Mineral Development Laboratories (AMDEL), but petrographic work on the thin sections of specimens collected in the 1971 field season was done by the geologists who collected the specimens. X-ray diffraction and electron-probe analysis work was also done on some specimens.

The work was written up on a locality-by-locality basis, and the localities were grouped according to their 1:250 000 Sheet areas.

OBJECTIVES

The primary objectives of the 1971 geological fieldwork in the Prince Charles Mountains were: to continue the regional mapping of the Prince Charles Mountains, and to extend the coverage of this mapping south to latitude 72°S. The continuation of the regional gravity work was also planned.

These objectives were generally achieved despite the major setback caused by bad weather during the 1970 field season. Late in 1971 the ANARE field base camp will be transferred from Moore Pyramid in the northern Prince Charles Mountains to Mount Cresswell in the southern Prince Charles Mountains. Regional mapping of that area will start in the 1972 summer field season.

PHYSIOGRAPHY AND OUTCROP CONDITIONS

Observations in the Prince Charles Mountains in 1971 generally confirmed the descriptions of the physiographic conditions given in earlier works, notably by Crohn (1959) and Trail (1964).

Trail observed that, among mountains of more than 1000-m altitude, the proportion of those with broad summit plateaux decreased from south to north in the Prince Charles Mountains, and the ~~greater~~ proportion of those with jagged peaks increased from south to north. The incidence of jagged peaks can be correlated with the altitude of the ice plateau; it is probably related to factors (such as the severity of climate and the incident of high winds) that are themselves directly related to altitude. The more rugged topography is also relatable to the length of time the peaks have been exposed to subaerial erosion and free of permanent ice cover. The development of jagged peaks does not appear to be strongly controlled by lithology.

The previous extent of glacial action and glacial cover in the northern Prince Charles Mountains was discussed by both Crohn (1959) and Trail (1964), and is indicated by such features as concordant summit levels, bevelled surfaces and platforms on mountains, abandoned cirques, and moraine deposits formed during the retreat of local mountain glaciers. Glacial erratics are not commonly found on peaks in the northern Prince Charles Mountains, and this, together with the features previously mentioned, indicates that plateau glacial action, as distinct from local mountain glacial action, was mainly erosional. The apparent absence of striated pavements and the scarcity of roches moutonnees in the northern Prince Charles Mountains are probably also related to the length of time the mountains have been exposed to subaerial erosion, and, to a certain extent, to the rock types exposed.

Many peaks and nunataks in the northern Prince Charles Mountains are covered with a felsenmeer of locally derived rock fragments which have been slightly disturbed and broken from the solid rock by frost action. The rock fragments are normally fresh, and rock types and their distribution can be defined quite easily, but it is difficult to obtain structural information. Careful study of colour aerial photographs can give some structural information, and the strong contrast between the colours of the various exposed rocks and glacial till facilitates recognition of each type on the photographs.

The formation known as 'patterned ground' was described by Crohn (1959) and was seen at many localities visited by geologists during the 1971 field season. Patterned ground consists of polygonal rock accumulations, usually from 2 to 5 m wide with coarse fragments up to 40 cm, concentrated at the margins, with finer fragments in the centre. At Mount Meredith the action of summer melt water was observed in the process of forming a hummocky terrain resembling patterned ground; however, Washburn (1956) thinks that a number of processes, including frost heaving, meltwater action, and wind scouring, contribute to the formation of patterned ground.

GEOLOGY

The geology of the Prince Charles Mountains was briefly described by earlier workers (Crohn 1959). The youngest consolidated rocks, the Permian sediments of the Amery Group near Beaver Lake, were correlated by Mond (1972) with the Beacon Group sediments of the Ross Sea area. Underlying the Amery Group is a basement complex of presumed Precambrian age; this consists of a wide range of high-grade metamorphic rocks. During the field season the outcrops examined consisted mainly of basement metamorphic rocks, but some later-stage intrusives were seen.

The basement metamorphic rocks include coarse-grained, granular or granitic-textured charnockites, migmatites, banded gneisses, biotite-hornblende schists, and calcareous and pelitic rocks; they are intruded by granite, pegmatite, and basic dykes. Some of the basement rocks can be identified as having either a sedimentary or igneous origin, but most of them are of unknown origin. Certain bands of basic gneiss or foliated amphibolite within the basement gneisses are thought to be metamorphosed basic dykes or flows, but later basic dykes show up as unfoliated amphibolite bands that cross-cut the metamorphic foliation. The youngest basic rocks - possibly of Cretaceous age - are unmetamorphosed.

Moraines deposited by local mountain glaciers are presumed to be of recent age. At present the only ages known of rocks in the northern Prince Charles Mountains area are those of the Permian Amery Group and the Cretaceous alnoite dykes intruded into them (Walker & Mond 1971).

STINEAR NUNATAKS 1:250 000 SHEET AREA

During the 1971 field season, Hill was the only geologist to work in this area. His work at Depot Peak was greatly hindered by strong winds and generally unfavourable weather, but his observations confirm the account of the geology of Depot Peak given by Crohn (1959). Hill was unable to explore the whole of Depot Peak, but collected specimens of dark-coloured gneiss (7128/0248) and light-coloured gneiss (7128/0249). The darker gneiss was metamorphosed under granulite-facies conditions; the lighter gneiss shows slight signs of retrograde metamorphism. Hill's work and Crohn's earlier work indicate that both rock types have been folded together, but their relative ages are not apparent on the present evidence. Figure 1 shows the main mass of Depot Peak and the colour-contrast between the two rock types. On present evidence Crohn's theory of a recumbent-fold structure appears to be a reasonable structural interpretation of the outcrop pattern at Depot Peak.

CROHN MASSIF 1:250 000 SHEET AREA

Dodson was based at the Moore Pyramid field base camp during the 1971 season and examined outcrops within a radius of 20 nautical miles of the camp; early in the season he was assisted by other geologists. Hill mapped some mountains in the southern and western Sheet area.

The 1971 work filled in gaps in the coverage of earlier geological work in the area and generally confirmed the observations of the earlier workers (e.g. Crohn 1959), but new discoveries included the charnockite in the Crohn Massif/Thomas Nunataks/Mount Mervyn area and the unaltered basic dyke at Mount Kirkby. Data of the earlier workers is included with 1971 results in the summary of petrographic results (Appendix).

Mount Forecast, Mount Brown Cooper, and nunataks along the Bennett Escarpment

The Bennett Escarpment is a southeast-facing line of mountains, ice falls, and nunataks; it extends 25 km north-northeast from Mount Brown Cooper and appears to dam back the ice to the northwest. The mountains and nunataks of the escarpment have flat or gently undulating tops and most are bounded by steep cliffs on the southeast side. Northwest-facing slopes are gentle and usually snow-covered and they appear to merge into the ice plateau behind. Most north and northeast-facing slopes are steep and have moraine accumulations at their bases.

The more gentle slopes and the top surfaces of the mountains are covered with frost-shattered rock debris, which is almost in situ and accumulated in unsorted stone polygons. Undisturbed rock exposures are rare on these surfaces of the mountains and are virtually restricted to the almost inaccessible southeast-facing cliffs. Structural data can be obtained from these southeastern cliffs and, to a limited extent, from the study of the flatter surfaces from the air. As the various rock types commonly have contrasting colours, colour aerial photographs would probably yield many structural data.

Figure 1. Depot Peak, looking north from survey marker on top of central part of Depot Peak Neg. R.M.H.

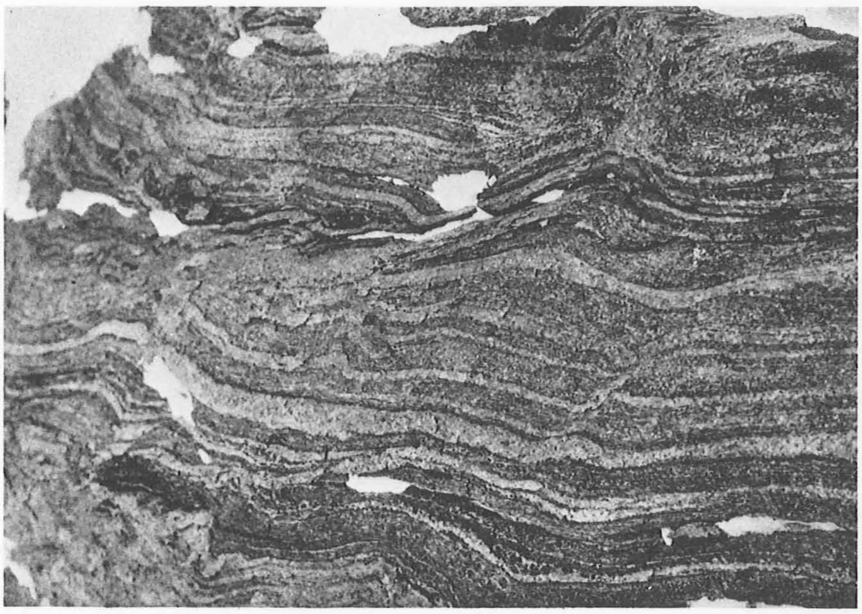


Figure 2. Typical banding in gneiss on Mount Forecast. The darker bands contain more hornblende and clinopyroxene than the pale bands, which consist predominantly of plagioclase and quartz. The photograph represents an area about 75 cm long Neg. GA 5036 R.M.H.

The rocks exposed are mostly banded gneisses ranging from acid quartzo-feldspathic gneisses with minor garnet, to basic hornblende-clinopyroxene-quartz-plagioclase gneiss. Black bands of biotite-clinopyroxene-plagioclase schist that cross-cut the banded gneisses were probably originally intruded as basic dykes. The exposures are complex with intense folding and much local migmatisation. Thin-section studies (Appendix) show that the metamorphic history of the rocks is probably complex and includes an upper amphibolite-facies metamorphism followed by a retrograde lower amphibolite/greenschist-facies metamorphism.

The major foliation of the rocks is generally parallel to the compositional banding and progressively changes strike and dip from 045°/65°SE in the north to 100°/ vertical in the south. Tight isoclinal folding is common but no regular pattern was recognised; there were probably several episodes of folding.

Mount Forecast, near the southern end of the escarpment, was examined in detail. Other mountains and nunataks visited in the area were found to have geological features similar to those seen at Mount Forecast.

Mount Forecast

The scarcity of outcrops on Mount Forecast hindered the observation of the structural relations and distribution of the various rock types. Lighter acid gneiss and darker mafic gneiss are interlayered in bands (Fig. 2) ranging from two or three millimetres to several metres thick. Coarse grained quartzo-feldspathic bands that have irregular intrusive margins occur parallel to the compositional banding and foliation of the gneisses, and appear to be folded with them. The banded metamorphic rocks have probably been folded several times but no coherent patterns of folding were identified. Within some of the bands a few small open folds (Fig. 3) were observed and, on a larger scale, the bands themselves are folded chaotically. Although many folds are isoclinal there is a wide range of fold styles, sizes, and orientations. The few fold plunges measured do not fall into any particular pattern.

Lines of black rubble that cross-cut the general foliation and trends of the banded gneisses consist of amphibolite and are the metamorphosed remnants of basic dykes (specimen 7128/0202).

Two rock specimens collected at Mount Forecast were examined in detail. Specimen 7128/0201, a banded gneiss with alternate white and greenish black bands is a hornblende-clinopyroxene-quartz-plagioclase gneiss with a metablastic texture. The hornblende has formed by alteration of pyroxene, and retrograde metamorphism has caused slight alteration of most mafic crystals to biotite or chlorite, or both. Cataclastic textures observed include mortar textures in plagioclase and quartz crystals, bent albite-twin lamellae, undulose extinction, and sutured crystal boundaries. Most crystals are aligned with their long axes in the plane of the gneissic foliation.

Specimen 7128/0202, which was collected from one of the cross-cutting bands of black rock, is a schistose rock with lepidoblastic texture, a few cataclastic textures, and the mineral assemblage hornblende-biotite-clinopyroxene-plagioclase. The composition, mineral assemblage, and field relations of the rock suggest that it is a metamorphosed basic dyke.

The mineral assemblages of both rocks indicate metamorphism under upper amphibolite-facies conditions, but the description of the thin section of specimen 7128/0201 indicates subsequent slight retrograde metamorphism and a possible earlier (pre-amphibolite) granulite-facies assemblage. Shearing stresses either during or after metamorphism have produced cataclastic textures.

The rocks exposed along the Bennett Escarpment have had a complex polymetamorphic history. A heterogeneous group of rocks of uncertain, but probable sedimentary origin, were metamorphosed and folded possibly several times before basic dykes were intruded. Subsequent amphibolite-facies metamorphism converted the basic dyke rocks to biotite-clinopyroxene-plagioclase schists, and had slight retrograde effects on other rocks.

Mount MacMahon

Mount MacMahon, in the southern part of the sheet area, is a round topped mountain with gently undulating slopes on most surfaces. Vertical cliffs on the western edge and parts of the southeastern faces of the southern extension of the mountain. The prevailing south-south-westerly wind has formed deep wind scours in the ice along the western side of the mountain, and deposited large snow drifts on the lower slopes and on low areas on the leeward side. A belt of moraine along the northern side of Mount MacMahon is continued into a north-northeasterly trending moraine tail.

The gently undulating slopes are covered with polygonal accumulations of unsorted angular rock debris formed from local rocks by frost action. Fragments generally range in size from one millimetre to about 30 cm, but boulders of four and five metres were seen. Although their

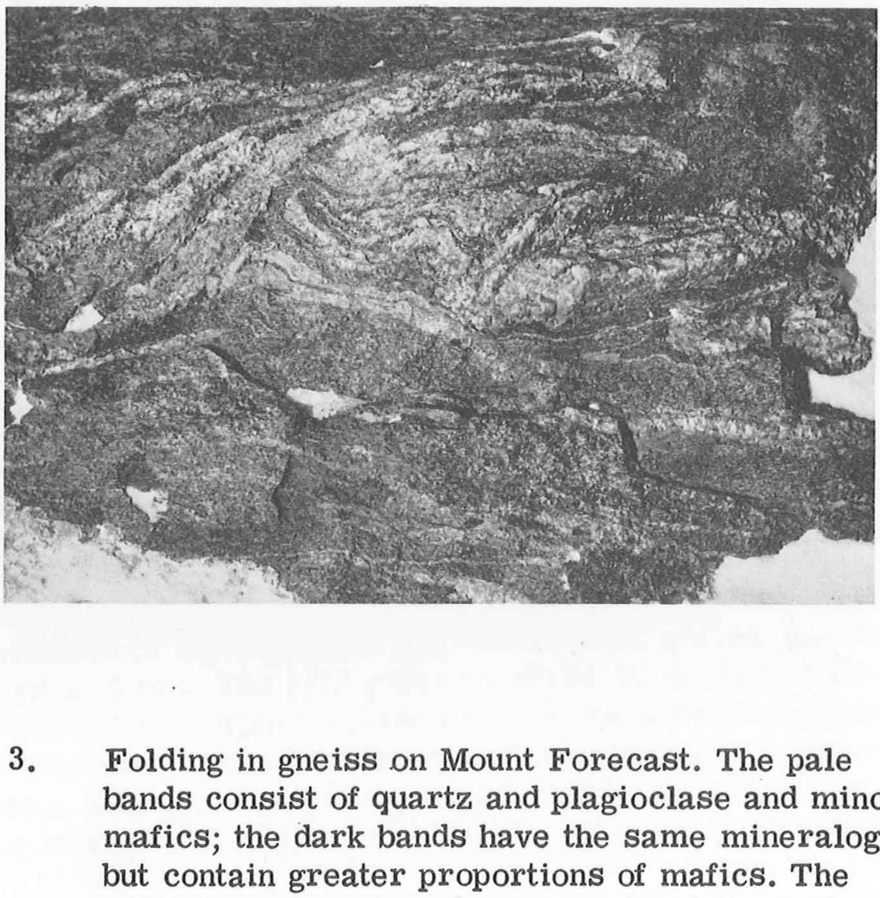


Figure 3. Folding in gneiss on Mount Forecast. The pale bands consist of quartz and plagioclase and minor mafics; the dark bands have the same mineralogy, but contain greater proportions of mafics. The photograph represents an area about 75 cm long Neg. GA 5058. R.M.H.

Figure 4. Pegmatite in banded garnet-bearing gneiss, Mount McMahon Neg. GA 5039 R.M.H.

size suggests they may be glacially transported erratics, their compositions were not sufficiently distinctive to allow identification of their origins.

The rocks exposed on Mount MacMahon show a well defined compositional banding similar to that seen at Mount Forecast, with alternating light acid bands and darker mafic bands. Where banding is on a large-scale it can be traced across the areas covered with rock debris. The major foliation and the parallel compositional banding strike about 070°; dips range from 70°N through vertical to 60°S.

The banded rocks at Mount MacMahon are invaded by essentially conformable lenticular bodies and dykes of coarse-grained granite-pegmatite (Fig. 4), and cross-cut by a few widely spaced bands of amphibolite. The granite-pegmatite dykes are up to 10 m thick and generally foliated parallel to the foliation of the enclosing country rocks. Bodies of massive granite are less common. Both the massive granite and the granite-pegmatite have wide ranges of grainsize and texture, and appear to grade laterally into garnet-bearing gneiss. Such gradation, which was also seen at Mount Meredith, is interpreted as showing that the dykes were formed by local anatexis.

The cross-cutting bands of amphibolite are probably the metamorphosed remnants of basic dykes emplaced after the main metamorphism of the banded rocks, but the small-scale foliations of the amphibolites were not measured and their relation to the foliation of the banded rocks is unknown.

Specimens of light acid gneiss, darker acid gneiss, and amphibolite were examined in detail. The acid gneisses (7128/0206, 0209, 0217) contain garnet and microcline porphyroblasts and are granular to saccharoidal. In thin section they are seen to have a granoblastic texture, on which is superimposed a lepidoblastic texture manifested by the alignment of biotite crystals, are widespread. Cataclastic structures, notably mortar textures in quartz and plagioclase crystals.

The average mode (visual estimate) of the acid gneiss specimens is opaques 1%, chlorite 1%, muscovite (sericite) 3%, biotite 5%, garnet 7%, plagioclase (An_{30-38}) 15%, microcline 30%, and quartz 40%. Alteration of some plagioclase to sericite and replacement of biotite by chlorite are possibly the results of retrograde metamorphism.

The darker-coloured acid gneisses - specimens 7128/0210, 0215 - contain the assemblage biotite-hypersthene-plagioclase-quartz. A visual estimate of the mode is minor-hornblende, opaques 3%, biotite

7%, hypersthene 10%, plagioclase (An_{48}) 27%, and quartz 53%. Alignment of the biotite crystals gives the rock a lepidoblastic texture, and signs of retrograde metamorphism include the alteration of hypersthene to hornblende, the formation of biotite, and minor cataclastic textures. The rocks are best classed as slightly retrograde biotite charnockites.

Two specimens (7128/0211, 0214) of amphibolite were examined; they are classed as biotite-hypersthene-augite-hornblende-plagioclase schists. They are black rocks and consist of biotite 7%, augite 14%, hypersthene 14% hornblende 24%, and plagioclase (An_{48}) 40%. The rimming of hornblende crystals with grains of opaque minerals and small flecks of biotite may be a result of retrograde metamorphism; the partial alteration of hypersthene to hornblende shows that the conversion of the basic igneous assemblage to amphibolite did not reach equilibrium. Field evidence indicates that the emplacement of the basic dykes postdated the main metamorphism of the banded gneisses.

The country rocks intruded by the basic dykes have mineral assemblages that indicate hornblende-granulite facies (Winkler 1967) or amphibolite-granulite transition facies (Turner, 1968) metamorphism. This metamorphism was followed by the emplacement of the basic dykes, which have subsequently been altered to amphibolites by amphibolite-facies metamorphism. The origins of the country rocks before metamorphism are obscure.

Husky Massif

Husky Massif is a 5-km-long north-south-trending curved rock mass that is concave to the southeast and stands at least 200 m higher than the surrounding plateau. On most days it is capped and distinguished by a small orographic standing-wave cloud.

The main southern mass of Husky Massif has a gently undulating upper surface covered with rock debris and snow drifts and merges with the jagged, razor-backed, northern ridge of the mountain. Undisturbed and in situ rocks are well exposed in the cliff faces that bound the massif on most sides. Arcuate ridges of moraine immediately east of Husky Massif record stages in the movement of local mountain glaciers, and a long moraine tail to the northeast of the mountain indicates the present-day ice-movement direction.

In the northern part of the cliffs on the east side of Husky Massif, fairly massive, even-grained granulites are exposed. They have a poorly developed, only locally discernible foliation that strikes 130° and dips 45°NE. Medium to coarse-grained garnet-bearing granitic rocks exposed in the

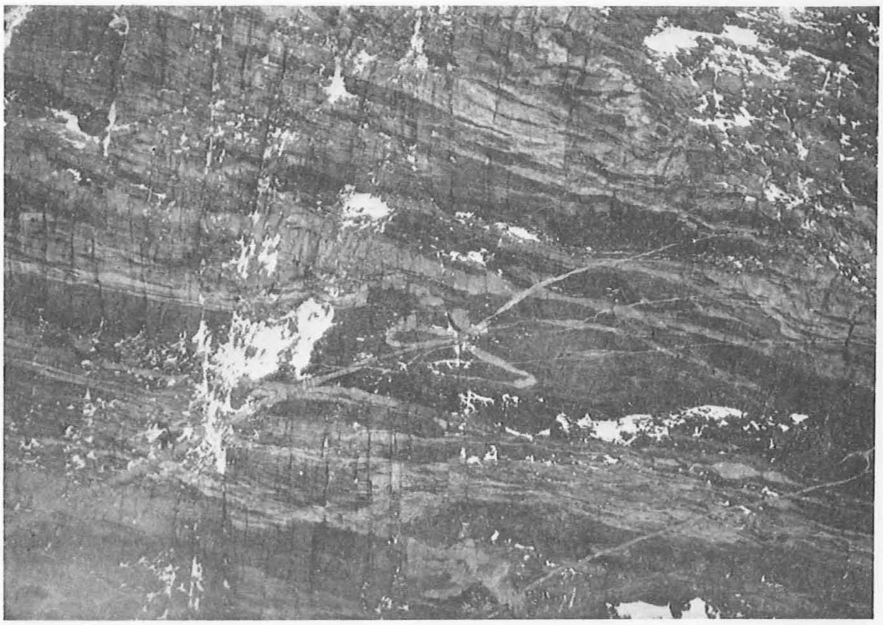


Figure 5. Aerial photograph of vertical cliff face on western edge of Husky Massif showing leucocratic bands in gneiss and cross-cutting pegmatites Neg. GA 5035 R.M.H.

central and southern parts of the east side of the massif have a weak foliation that strikes 060° and dips 45°SE. Foliated, banded garnet-hornblende-quartz-feldspar gneisses are irregularly folded around these granitic rocks.

The granitic and gneissic rocks are cross-cut by bands of amphibolite that were presumably originally intruded as basic dykes, and these are in turn cross-cut by dykes of muscovite-quartz-feldspar pegmatite, which is locally biotite-bearing.

The western cliffs of Husky Massif were only viewed from the air and consist of banded rocks cross-cut by randomly oriented light-coloured dykes (Fig. 5).

A visual estimate of the composition of the even-grained granulite (Specimen 7128/0231) from the northern part of Husky Massif is opaques 1%, hypersthene 4%, plagioclase 15%, perthitic potash feldspar 35%, and quartz 45%. The rock is not significantly altered, but cataclastic textures - sutured crystal margins, undulose extinction, and bent twin lamellae - are common. The mineral assemblage and the cataclastic textures are characteristic of rocks metamorphosed under low-P_{H_2O} granulite-facies conditions.

The garnet-bearing granite (specimen 7128/0232) of the southern part of Husky Massif also has characteristics of granulite-facies rocks and has been intensely crushed, sheared, and granulated. An estimate of the rock composition is garnet 5%, plagioclase 15%, quartz 30%, and perthitic microcline and potash feldspar 50%, but minor biotite is associated with the garnet and minor sericite has been formed by the alteration of feldspars. Although the mineral assemblage is not diagnostic the rock is sufficiently characteristic to be classed as a granulite.

The biotite observed in the garnet-bearing granitic rocks is probably a retrograde product, but primary biotite was seen in some rocks at Husky Massif. Other rocks contain hornblende, and the presence of primary hydrous minerals shows that P_{H_2O} was locally sufficient for hornblende-granulite-facies assemblages to be produced, although the bulk of Husky Massif was subject to granulite-facies metamorphism. The light-coloured dykes on the west face of Husky Massif are probably granite or acid pegmatite and may have formed from magma produced where P_{H_2O} was sufficient for anatexis.

The geological history of Husky dome is probably similar to that of Mount Forecast and Mount McMahon; a series of rocks of generally unknown origin have been subjected to high grade metamorphism, intruded by basic dykes, and later metamorphosed under amphibolite-facies conditions.

Harvey Ridge

Harvey ridge, about 5 km east of Husky Massif, is a 7 km-long razor-backed ridge aligned northeast-southwest. Wind-scours are developed on both long sides of the ridge and at the north end there is a small accumulation of moraine.

From the air Harvey Ridge appears to be an almost homogeneous rock mass. Landings were made at the northern and southern tips of the ridge, and granitic rocks were found at both places. A typical specimen (7128/0235) collected from the north end of Harvey Ridge is fine to medium-grained, greyish pink, and weakly foliated. The foliation strikes 085° and dips 60°N. The composition of the rock is visually estimated to be garnet 1%, biotite 2%, plagioclase 17%, quartz 30%, and microcline 50%. Many microcline crystals are xenoblastic and the plagioclase commonly has sutured boundaries and mortar textures. Both the composition and texture of the rock are similar to those of the garnet-bearing granitic rock (specimen 7128/0232) collected at Husky Massif.

Mount Dowie, Kilfoyle Nunataks, Mount Kizaki, and Edwards Nunatak

These small mountains and nunataks of the Aramis Range are in a line between Mount Bewsher and Mount Maguire to the southwest and Mount Hollingshead (Beaver Lake Sheet area) to the northeast. Crohn (1959) visited Mount Bewsher and Mount Hollingshead in 1956 and J. Bain examined Mount Bewsher and Mount Maguire in the 1970 field season. Their work established that the rocks at Mount Bewsher and at Mount Hollingshead include some paragneisses.

The outcrops are mostly flat-topped and bounded by steep slopes and cliffs. Some of the smaller ones, for example, Kilfoyle Nunatak, have a well formed pyramidal shape. Snow drifts on southern and western slopes of the outcrops commonly provide good access to the mountain tops. As is common in the northern Prince Charles Mountains the mountain tops are covered with rock fragments up to 40 cm accumulated in unsorted polygonal heaps (Fig. 6), and undisturbed in situ outcrops, which are rare on the mountain tops, are best seen in cliff faces or on steep slopes. Aerial inspection of these mountains and nunataks showed that they consist of similar rocks with a common foliation striking northeast and dipping on average 70°SE. However, the strike measured at Mount Dowie was 060° and dips ranged from vertical to 70°NW. The major rock type found is a vaguely banded, weakly foliated garnet-quartz-feldspar gneiss with a few

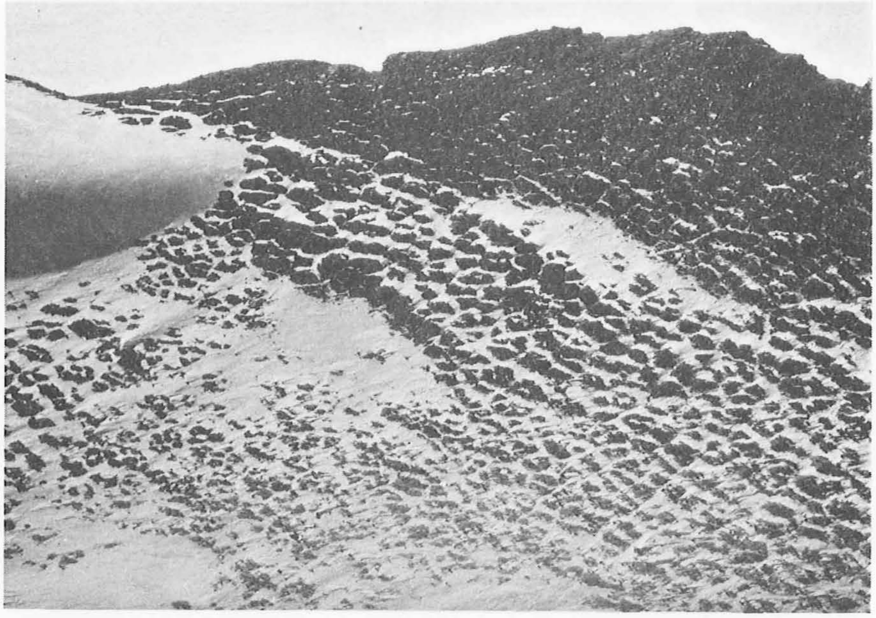


Figure 6. Unsorted stone polygons on top of Mount Dowie
Neg. GA 5041 R.M.H.

more-mafic bands containing hornblende. Randomly orientated pinkish white dykes of quartz-feldspar pegmatite intrude the country rocks.

Rocks resembling the gneisses of these outcrops were reported by Crohn at Mount Bewsher and Mount Hollingshead, by Bain at Mount Bewsher, and by Hill at Husky Dome and Harvey Ridge. Metamorphic conditions throughout the area were probably high-grade, but local variations in P_{H_2O} caused the local formation of granulite-facies, hornblende-granulite-facies and amphibolite-facies rock types.

Mountains in the Athos and Porthos Ranges visited by Dodson

Dodson visited a number of mountains in the Athos and Porthos Ranges up to 20 nautical miles from the Moore Pyramid field base camp. Some of these mountains are large - Crohn Massif is 25 km^2 - and flat-topped, but there are many jagged peaks and ridges in these ranges (Trail 1964). The flat mountain tops are mostly covered with frost-shattered rock debris arranged into unsorted polygonal accumulations; undisturbed rock exposures are rare. The steep slopes and vertical cliffs at the sides of the mountains are the best places for the examination of undisturbed in situ rocks.

The glacial geology of the Prince Charles Mountains was the subject of a paper by Trail (Trail 1964). The relatively close spacing of the peaks in the Athos and Porthos Ranges facilitates the recognition of concordant summit levels. Notable features of the area are the large moraine fields with prominent arcuate lines of rock debris, each of which mark a former limit of local mountain glaciers.

The 1971 work in the Athos and Porthos Ranges completed the reconnaissance survey of these mountains. The results agree generally with earlier work, although a hitherto unsuspected body of charnockite was discovered in the Crohn Massif-Thomas Nunataks-Mount Mervyn area. During the 1971 field season the following localities were visited: Corry Massif, Crohn Massif, Cutcliffe Peaks, Mount Bechervaise, Mount Gavaghan, Mount Kirkby, Mount Little, Mount Mervyn, Mount Starlight, Thomas Nunataks, Webster Peaks, and Whelan Nunataks. Of these Mount Bechervaise and Mount Kirkby were previously visited by Crohn in 1956 (Crohn 1959) and Mount Mervyn was examined in 1970 by J. Bain.

At most of these localities the rocks are strongly banded and well foliated, with crystals and mineral aggregations elongated parallel to and defining the major foliation. Many large pegmatite and granitic veins are conformable with this foliation. The metamorphic rock types seen were generally high-grade amphibolite or granulite-facies grade.

The most abundant rocks in the Athos and Porthos ranges are quartzo-feldspathic gneisses and migmatites; banded gneisses and basic rocks are generally subordinate. The quartzo-feldspathic rocks are commonly leucocratic, foliated, slightly banded, and have a granular saccharoidal texture, but they locally grade into migmatites with diffuse banding. Quartz and feldspar crystals and aggregates are elongated parallel to and define the foliation. Biotite, garnet, and hornblende crystals are locally concentrated in seams parallel to the foliation. This segregation of mafic and felsic minerals is typical of migmatitic rocks and is probably a product of local anatexis during metamorphism. The rocks have been severely strained and deformed during or since formation, and cataclastic effects, such as the stretching and breaking of quartz and feldspar grains, sutured crystal boundaries, bent crystals, and undulose extinction, are widely developed. Although the common assemblage of garnet-oligoclase-microcline-quartz is not diagnostic, high-grade metamorphic conditions are indicated by the presence of sillimanite in some aluminous assemblages. The occurrence of hydrous minerals such as biotite and hornblende, and the local formation of migmatites show that during metamorphism P_{H_2O} was generally sufficient for hornblende-granulite or upper amphibolite-facies metamorphism. Minor retrograde effects, attributed to a late-stage lower-grade metamorphism, include the chloritization of biotite, garnet, and hornblende.

Dark-coloured well foliated banded gneisses, which are generally subordinate to the quartzo-feldspathic rocks of the area, consist essentially of alternating bands of felsic and of basic minerals. The banding is well defined and parallel to the foliation. A typical specimen (7128/0023) from Mount Little contains green hornblende, pale green diopside, quartz, and plagioclase segregated into alternate mafic and felsic-rich layers, and has a xenomorphic texture with locally intergrown quartz and plagioclase. The dark bands that alternate with bands of pinkish white quartzo-feldspathic migmatite on the southeastern slopes of Cutcliffe Peak consist of coarse-grained, xenomorphic rocks composed of green hornblende, diopside, hypersthene, andesine, and quartz. At other localities mafic bands also include reddish brown biotite and abundant accessory apatite. The mineral assemblages of these basic rocks indicate metamorphism under hornblende-granulite or upper amphibolite facies, but the origins of the rocks have not been clearly established. At some localities the regularity of the banding suggests that the basic rocks were originally lava flows or sills, but elsewhere the basic bands may be metamorphosed impure limestones.

At Mount Kirkby, Dodson examined some apparently unmetamorphosed basalt dykes, most of which are about 1 m thick and almost vertical. Some were traced laterally for considerable distances. The dyke rock is dark and porphyritic, and has a basaltic texture with euhedral augite phenocrysts set in a fine-grained groundmass. Metamorphosed dykes were reported by Crohn from the Porthos Range but none were seen in 1971.

Pegmatite and granite dykes are common in the Athos and Porthos ranges and are generally parallel to the major foliation of the metamorphic rocks. In some places the dykes grade into the quartzo-feldspathic gneisses, and in others they appear to be responsible for the growth of augen and lenses of quartz and feldspar within the gneisses. Some of the pegmatites and granites have intrusive characteristics, and others appear to be the product of local mobilization of acid gneisses. Their main constituents are quartz and feldspar, with garnet and biotite as accessory minerals. Perthitic feldspars are common and myrmekites are produced by interaction between plagioclase and potash feldspar.

Many of the rocks examined from the northernmost part of the Prince Charles Mountains show such common features of granulite-facies rocks as perthitic feldspars and cataclastic effects, but do not have diagnostic mineral assemblages. Charnockites and associated rocks were discovered at Crohn Massif, Mount Gavaghan, Mount Mervyn, Thomas Nunataks, and Whelan Nunatak. Charnockite here is used as a field term and refers to an even, medium to coarse-grained brownish rock with granitic or granoblastic texture; typically it contains brown-stained feldspars, blue-grey quartz, and hypersthene.

The charnockites are commonly well jointed rocks, and the outcrops at Crohn Massif closely resemble those in the Frammes Mountains near Mawson base. Specimen 7128/0003 collected from Crohn Massif is composed of a mosaic of interlocking quartz and oligoclase crystals, with hypersthene, minor green hornblende, small amounts of ilmenite and apatite, and rare zircon and sphene. The quartz shows undulose extinction and the hypersthene is partly replaced by hornblende.

The contact between the charnockites and associated banded gneisses at Crohn Massif is sharp and probably intrusive. Banding in the gneisses is prominent and steeply dipping, and the rocks range in colour from dark brown to light grey or grey-brown. Specimen 7128/0001, a light grey gneiss, is microbanded with layers about 5 mm wide. The constituent minerals, hypersthene, biotite, plagioclase, orthoclase, and quartz, have well defined preferred orientation and in thin section show such signs of stress and cataclasis as corroded crystal margins, bent crystals, and undulose extinction. Retrograde metamorphism may be the cause of the presence of clinozoisite and the alteration of biotite to chlorite, but the presence of hypersthene indicates original hypersthene-granulite-facies metamorphism. Small biotite shreds scattered through the rock have a preferred orientation parallel to the banding and foliation of the rock, and appear to postdate the hypersthene from which they have, at least in part, been formed by retrograde metamorphism.

The origin of most of the rocks seen in the Athos and Porthos ranges in 1971 is not easy to determine. Regular banding of some gneisses may indicate original bedding, but elsewhere banding may be due to metamorphic segregation. Crystalline limestones were noted at a number of localities in the northern Prince Charles Mountains by Crohn (1959), and the Mount Wishart marble and calc-silicate outcrop was examined in 1970. On Corry Massif a line of white-grey boulders is the surface indication of a bed of crystalline limestone within the massif. The marble (7128/0026) consists of calcite, forsterite, and minor quantities of microcline, and antigorite which partly replaces forsterite. Certain basic gneisses may have been formed from impure limestones, but the mineral assemblages could have been derived by the metamorphism of basic igneous rocks and evidence available is not diagnostic. Sillimanite-bearing, cordierite-bearing, and garnet-rich rocks noted at a number of places are probably metamorphosed aluminous pelitic sediments.

Metamorphism in the area was high-grade with local zones of hypersthene granulite, low-P_{H_2O} metamorphism within widespread hornblende-granulite or upper amphibolite-facies conditions. Later lower-grade metamorphic events have caused minor retrograde effects including alteration of hypersthene to hornblende and biotite, and the chloritization of biotite. The geological history of the area is probably similar to that of the Mount Forecast/Mount McMahon/Husky Massif area.

BEAVER LAKE 1:250 000 SHEET AREA

Work in this area during the 1971 field season aimed at the completion of the regional mapping of the Sheet area and was therefore concentrated in the southern and western parts of the area; the fieldwork was done by Smart.

No sedimentary rocks were found during the 1971 field season and, apart from basic dykes at Manning Massif and Taylor Platform, only high-grade metamorphics rocks were mapped. Granulite-facies rocks predominate in the Manning Massif/Amery Peaks/White Massif/Thomson Massif/Mount Afflick areas, but in the Brochlehurst Ridge/Taylor Platform/O'Leary Ridges area metamorphic rocks are mostly amphibolite-facies grade. This is consistent with other observations in the northern Prince Charles mountains which indicate a decrease in the grade of metamorphism southwards from the Athos, Porthos, and Aramis Ranges. Minor retrograde metamorphic effects commonly seen in the rocks are attributed to a late-stage lower amphibolite-facies metamorphism.

Smart distinguished four areas, each of which has a characteristic suite of rocks: 1. Manning Massif, Amery Peaks, and parts of White Massif having charnockite and associated rocks (specimens 7129/0101-109 0137-9); 2. northern White Massif/Thomson Massif/Mount Abbs/Mount Grimsley area having granitised gneisses (specimens 7128/0122, 0123, 0141, 0142, 0045, 0046); 3. Allison Ridge/McLean Ridge/Mount Afflick/Mount Bunt/Mount Butterworth/Mount Ormay/Mount Trott area having biotite-bearing gneiss (specimens 7128/0110, 0115, 0118-0121, 0124, 0125); 4. Brocklehurst Ridge/ Taylor Platform/O'Leary Ridges area having garnet-biotite gneiss with granite and pegmatite veins and dykes and cross-cutting amphibolites and basic dykes (specimens 7128/0126-0136).

Manning Massif, Amery Peaks, and parts of White Massif

This area is characterised by rocks that can be classed as charnockites or have close affinities to charnock tes.

The area was first visited by Crohn in 1956 and briefly described in BMR Bulletin 52. Geologists of the 1969 and 1970 Prince Charles Mountains expeditions visited the area and worked around Amery Peaks, Loewe Massif, and Manning Massif. Petrographic descriptions of the rocks collected in 1969 and 1970 were made by AMDEL; their reports are held in the technical files of the Geological Branch, BMR, and the information is summarized in the Appendix. Crohn noted that hypersthene-bearing rocks similar to the hypersthene-bearing Mawson 'granite' occurred at Mount Loewe, and the 1969, 1970, and 1971 work confirmed the presence of charnockites and associated hypersthene-granulite-facies rocks in the Amery peaks/Loewe Massif/Manning Massif area.

Large rock surfaces are exposed in the cliffs bordering White Massif and Mount McKenzie and at the summit of Mount Seaton. Smaller exposures were found at Martin Ridge, on the southern flank of Murray Dome, and on the southwest end of Manning Massif, but most rock features in the area are covered with felsenmeer of frost-shattered but locally derived rock debris and snowfields of varying extent.

In the northwestern part of the Manning Massif/Amery Peaks area the rocks have a large-scale compositional banding, which is most obvious when viewed from the air but is not easily distinguished on the ground. The bands consist of a limited range of rock types, the commonest of which is grey-brown-weathering, medium to coarse grained, non-porphyritic granulite, but darker basic rocks are widely distributed. A dolerite dyke cross-cuts the basement rocks in the southwest corner of Manning Massif.

In the granulite (e.g. 7128/0108, 0109) large crystals of bluish grey quartz and yellowish brown feldspar make up the bulk of the rock, with small grains of quartz, feldspar, and mafic minerals occupying intersititial spaces. Orthopyroxene is present in small amounts as broken up relict crystals commonly altered to biotite and opaques, and garnet is present in some rocks e.g. 7128/0101. The feldspars have strong exsolution textures, such as perthite, antiperthite, and hypersolvus types, and in some rocks the identity of the original feldspar is obscured (e.g. 7128/0138).

Associated with the granulite are generally similar-looking rocks (7128/0105, 0107) that are garnet-bearing but lack hypersthene. These rocks locally weather a distinctive red colour and are classed as garnet granulites.

Lines or pods, lenses, schieren, and veins of foliated basic rocks are scattered through the granulite, and are thought to be the metamorphosed remnants of basic dykes. They (e.g. 7128/0104, 0106) are basic granulites, commonly with hypersthene, quartz, plagioclase, and potash feldspar, but specimen 7128/0139 from the eastern side of Martin ridge contains both orthopyroxenes and clinopyroxene. The metamorphic rocks of the Amery Peaks/Manning Massif area are lacking in hydrous minerals and have been metamorphosed under orthopyroxene-granulite-facies conditions. Slight alteration of hypersthene and garnet to biotite is the only sign of possible retrograde metamorphism seen in the rocks, and is attributed to a late-stage low-grade metamorphism.

The major foliation of the rocks in the area generally strikes between 090° and 135° and dips north at angles greater than 45°. Recent faulting of the metamorphic sequence was not detected, but irregular pseudotachylyte veins, which are commonly about 5 mm thick, are thought to be infilled faults. Two sets were distinguished: one sub-horizontal, the other striking 045° and dipping northwest between 20° and 30°.

Large vertical joints and fractures are particularly well developed at the western edge of Mount McKenzie, where they strike 090° parallel to the banding and foliation of the rocks. In the Amery Peaks jointing is on a smaller scale; neighbouring joints are about 60 cm apart and generally strike 160°. The close jointing of the rocks controls the tabular shape of most rock fragments in the area.

Figure 7. White Massif - northern side showing banded gneisses Neg. R.J.T.

Near the southwestern end of Manning Massif, the metamorphic rocks are intruded by an olivine-basalt dyke (specimen 7128/0140). The basalt is slightly altered but not metamorphosed, and may be the same age as the Lower Cretaceous alnoite dykes which intrude the Amery Group sediments at Radok Lake and Beaver Lake (Mond, 1972; Walker & Mond, 1971).

Thomson Massif/Mount Abbs/Mount Grimsley/White Massif area

In this area prominently banded rocks, which commonly strike about 070° and dip at angles more than 40°, are extensively invaded by large, mostly concordant dykes of granite and pegmatite. Most mountain surfaces are masked by rock debris, but solid rock is well exposed in the cliffs that bound Mount Abbs, Thomson Massif, and White Massif.

The banded country rocks include a wide range of types from medium to coarse-grained granite gneiss on the north side of Thomson Massif, to medium-grained leucocratic gneiss at Mount Abbs, to pelitic gneiss at White Massif. Charnockite constitutes the major part of White Massif, but banded gneiss is exposed on the north face (Fig. 7).

Pelitic gneiss (7128/0046) from the north side of White Massif contains cordierite, garnet, and fox-red biotite; nearby pegmatite (7128/0045) contains hypersthene.

Granulite-facies assemblages are seen in most of the specimens of banded gneiss from Mount Abbs (7128/0122), 123) and Thomson Massif (7128/0141, 0142). Most of the rocks have the typical 'rolled-out' look of granulites, but the Thomson Massif rocks are more granular and coarser-grained than the banded and foliated Mount Abbs rocks. In all rocks examined, potash feldspars show perthitic and hypersolvus exsolution effects, and cataclastic textures such as mortar texture and undulose extinction of quartz are common. Garnet and hypersthene are seen in the Thomson Massif rocks, which are therefore classed as garnet granulites. Garnet is absent from the Mount Abbs rocks. The mafic minerals are generally broken and altered to amphibole, biotite, or chlorite.

Prominent light-coloured veins, pods, and lenses of granite and pegmatite are interleaved with the banded gneiss and range in thickness and type from granite veins up to 0.25 m thick at Mount Abbs to coarse-grained pegmatite sills 4.0 m wide at Thomson Massif. They consist of quartz and potash feldspar with minor biotite and garnet, and, as in the gneissic rocks, the mafic minerals are slightly altered. In places the acid intrusives grade along strike into bands of acid gneiss or granulite and have probably formed as a result of the mobilization of these rocks. Water necessary for such anatexis may have been derived from rocks that now have anhydrous granulite-facies assemblages. Similarly, water for the hypersthene pegmatite found on the north side of White Massif could have been derived from the rocks that were converted to charnockite by the granulite-facies metamorphism.

Allison Ridge - McLean Ridge - Mount Afflick - Mount Bunt - Mount Butterworth - Mount Ormay - Mount Trott area

Most rocks in this part of the Aramis Range are dark well foliated biotite-bearing and easily weathered, but bands of more resistant quartz-rich, biotite-poor rocks protrude through the biotite-rich rocks and form prominent ridges and summits. There are good exposures of these harder rocks at Mount Bunt and on the summit ridges of Mount Afflick and Mount Trott, but outcrops of the biotite-rich rocks are rare. The softer rocks were found only as fragments and debris in the felsenmeeren that cover the lower slopes and low-relief outcrops of the area and completely mantle Allison Ridge, McLean Ridge, Mount Butterworth, and Mount Ormay.

Prominent ridges are formed at Mount Afflick by bands of greyish granular-textured charnockitic rock that strikes 090° and dips 80°N. Similar-looking rocks form prominent ridges on nunataks in the area and on the southern part of Mount Bunt. The charnockitic rock (specimen 7128/0125) consists of minor garnet, biotite, hypersthene, plagioclase, exsolved and perthitic potash feldspars, and quartz, and has cataclastic textures, such as mortar texture and strain polarization in quartz and feldspar crystals. Minor alteration of garnet and hypersthene to biotite, and alteration of biotite to chlorite are possibly retrograde metamorphic effects.

On Mount Trott, bands of leucocratic garnet gneiss (specimens 7128/0110, 0111, 0114, 0120) form prominent ridges. Superficially the rocks resemble the foliated charnockitic rocks, but garnet takes the place of the hypersthene. The leucocratic garnet gneiss was possibly derived from more aluminous sediments than those from which it is believed the hypersthene-rich rocks were derived.

The dark softer rocks of the area generally consist of minor opaques, from 5% to 10% biotite, up to 15% garnet and orthopyroxene, and plagioclase, potash feldspar, and quartz. The hypersthene and biotite in the rocks show only slight signs of a reaction relationship (probably resulting from late-stage retrograde metamorphism), and appear to be in equilibrium, a characteristic of hornblende-granulite-facies rocks. In some sections biotite flakes cross-cut hypersthene crystals; they were formed slightly later during the main metamorphism. Cataclastic textures are not common in the biotite-rich dark-coloured rocks.

The origins of most of the rocks examined are obscure, but locally there are bands with mineral assemblages that indicate the original composition of the rock. Specimen 3978 (Crohn, 1959) from Baseline Nunataks and specimen 7128/0124 from Mount Bunt contain the assemblage sillimanite-biotite-garnet-cordierite-plagioclase-orthoclase-quartz and were derived from alumina-rich pelitic sediments. The grey-green calc-silicate (7128/0115) collected at Mount Trott consists of diopside and calcite 75%, plagioclase, spinel, and magnetite, and is believed to be a metamorphosed impure limestone.

Brocklehurst Ridge - O'Leary Ridges - Taylor Platform

This area, in the southwestern part of the Beaver Lake 1:250 000 Sheet area, is characterized by garnet-biotite-bearing rocks intruded by granite and pegmatite veins and dykes. The most significant rock features are at Mount Beck, Brocklehurst Ridge, O'Leary Ridges, and Raylor Platform, but good exposures were seen only at Taylor Platform and on the north-western tip of O'Leary Ridges. Detailed observations were made at Taylor Platform.

Taylor Platform mainly consists of dark well foliated biotite and garnet-bearing banded gneiss whose mafic mineral content ranges from 5% to 25% and averages about 10%. Typical gneiss (specimens 7128/0131, 0133, 0135) from Taylor Platform contains garnet, biotite, plagioclase, potash feldspar, and quartz, but locally there are bands of pelitic and more basic rocks. In the banded gneiss, biotite, the most abundant mafic mineral, occurs in two distinct forms: the predominant form comprises medium-sized slightly altered flakes parallel to the rock foliation; the less common type forms smaller unaltered flakes generally aligned at right-angles to the foliation.

The pre-metamorphism nature of garnet-biotite gneiss is not known, but the pelitic gneiss (specimen 7128/0132), which contains the assemblage sillimanite-garnet-cordierite-biotite-plagioclase-quartz, was formed by the upper amphibolite or hornblende-granulite-facies metamorphism of argillaceous sediment. The presence of biotite in the assemblage indicates that moderate P_{H_2O} was effective during metamorphism.

A band of dark amphibolite that cuts across the general trend of the banded gneiss at the northeastern tip of Taylor Platform is probably a metamorphosed basic dyke. Specimen 7128/0127 contains the assemblage sphene-hornblende-augite-plagioclase. The hornblende replaces pyroxenes, and its presence, together with sphene, indicates amphibolite-facies metamorphism. Exposure of the amphibolite is poor and it was not possible to determine the relation between the foliations of the amphibolite and those of the banded gneiss. The foliation and small-scale compositional banding of the rock are well developed parallel to one another.

The granite and pegmatite veins that intrude the banded gneiss were examined at the northeastern end of Taylor Platform, and similar rocks were seen during aerial inspection of O'Leary Ridges and other rock features of the area. At Taylor Platform the granite veins, which are up to 0.5 m thick, are generally concordant with the banded gneiss, but locally they branch and form anastomosing veins enclosing blocks of country rock. Reaction zones are commonly seen in the banded gneiss along the margins of the granites. The granitic rocks are slightly foliated, and in specimen 7128/0134, which consists of minor garnet, biotite, plagioclase, potash feldspar, and quartz, the foliation is defined by aligned biotite crystals. Alteration of mafic minerals and sericitisation of feldspars are probably late-stage retrograde metamorphic effects.

Elsewhere in the Prince Charles Mountains, granite veins were traced laterally into acid gneiss bands and appear to be derived from the mobilization of the acid gneiss. Any relation between the granite veins and bands of acid gneiss at Taylor Platform is obscured by poor outcrop but the presence of broken garnet crystals in the granite and the upper amphibolite mineral assemblages of the country rocks suggest that the granite magma could have been formed by anatexis.

The pegmatites at Taylor Platform range in thickness from about 2 to 15 m. Thus they are thicker than the granite veins and are notably discordant with the foliation of the country rocks (at angles up to 30°). Contacts with the banded gneiss lack the reaction zones characteristic of the granite veins. A few composite dykes with coarse-grained biotite granite cores and outer pegmatite zones were seen. The pegmatites are generally foliated, with prominent lenses and ribbons of felsic minerals aligned parallel to and defining the foliation, and consist mostly of large crystals of potash feldspar, plagioclase, and quartz, with minor biotite and garnet. Exsolution effects in feldspars, alteration of biotite to chlorite, and the break ng up and alteration of the garnet crystals may be results of retrograde metamorphism.

Like the granites, the pegmatites are thought to be products of anatexis. A definite cross-cutting relation between the granite veins and the pegmatite dykes was not seen, but in the composite dykes the granite cores are locally invaded by small stringers of pegmatite. In the composite dykes, at least the pegmatites postdate the granite and have been intruded along the margins of existing granite veins. Composite dykes seen at Armonini Nunatak in the Mount Hicks 1:250 000 sheet area were also formed in this way.

At Taylor Platform an unmetamorphosed tholeiitic dolerite dyke (specimen 7128/0126) trends 155°, cross-cutting the gneisses and acid intrusive rocks. The age of the dyke rock is not known but it is probably related to the dyke in the southwest corner of Manning Massif (7128/0140). The Lower Cretaceous alnoite dykes that invade the Amery Group sediments at Radok Lake, 35 km east of Taylor Platform, are the nearest accurately dated unmetamorphosed basic intrusive rocks.

The most significant features of the metamorphic rocks of the Taylor Platform area are the absence of hypersthene, the widespread occurrence of garnet and biotite, and the limited exsolution in the feldspars. These features are typical of cordierite-amphibolite-facies (Winkler 1967) metamorphism, but later metamorphism has converted basic rocks to amphibolite and caused the retrograde alteration of mafic minerals and the sericitisation of feldspars.

Metamorphic geology of the areas of Beaver Lake Sheet examined in 1971

In the Manning Massif/Amery Peaks/White Massif area, the northern White Massif/Thomson Massif/Mount Abbs/Mount Grimsley area, and the Allison Ridge /McLean Ridge/Mount Afflick/Mount Bunt/Mount Butterworth/Mount Ormay/Mount Trott area, hypersthene is present in many mineral assemblages and is commonly only slightly altered to biotite and chlorite. The charnockites, garnet gneisses, and basic granulites of the Manning Massif/Amery Peaks/White Massif area are typically poorly foliated, massive, and slightly banded rocks that contain garnet, orthopyroxene, strongly exsolved feldspars, and quartz, with minor biotite, but in the banded gneisses of the other areas biotite co-exists in equilibrium with hypersthene or garnet or both. Cataclastic textures are particularly well developed in the Manning Massif/Amery Peaks/White Massif rocks, but are less well developed in the biotite-bearing rocks of the other areas. By contrast the rocks at Taylor Platform typically lack hypersthene, but contain biotite, garnet, plagioclase, potash feldspar, and quartz and do not have cataclastic textures. Granite and pegmatite dykes invade the rocks of the northern White Massif/Thomson Massif/Mount Abbs/Mount Grimsley area and the Brocklehurst Ridge/O'Leary Ridges/Taylor Platform area.

Metamorphic conditions in the areas characterised by hypersthene-bearing rocks were high-grade with low P_{H_2O}, causing the formation of charnockites and hypersthene granulites in the Manning Massif/Amery Peaks/White Massif area and slightly higher P_{H_2O} conditions causing formation of hornblende-granulite or upper amphibolite-facies rocks elsewhere. Locally, P_{H_2O}, was sufficient for anatexis. In the Taylor Platform area metamorphic conditions were lower grade and cordierite-amphibolite-facies assemblage rocks were formed. Cataclastic effects can be correlated with anhydrous mineral assemblages and low P_{H_2O} conditions during metamorphism, but they are less well developed in rocks with primary biotite which were formed with higher P_{H_2O} during metamorphism. The biotite and the fluid phases in these rocks probably accomodated the stresses that caused the cataclastic effects in the anhydrous mineral assemblages.

Retrograde metamorphic effects such as alteration of mafic minerals to chlorite or biotite, or both, and sericitisation of feldspars are widespread, and are probably related to the late metamorphism.

MOUNT HICKS 1:250 000 SHEET AREA

Only a few outcrops on the western side of the Prince Charles Mountains occur within the Mount Hicks Sheet area. During the 1971 season, work was confined to the Mount Hicks 'B' 1:100 000 Sheet area and was done by Hill, who visited Chapman Nunatak, Mount Thomas, and Wall Peak, and Tingey, who inspected Mount Hay, Mount Reu, and Clague Ridge, and examined Armonini Nunatak in detail.

Before 1971 no geological work had been done in the Sheet area, the nearest work being that by Crohn (1959), and that by Bain (Mount Bewsher) and Tingey (Mount Woinarski) in 1970. The only existing aerial photographs of the rock features of the Mount Hicks Sheet area are westward-looking obliques taken on a run from Mount Bewsher to Mount Johnston. They are of little use for photogeological work as the eastern slopes of the rock features are almost all covered with rubble or snowfields.

Rock exposures in the area are neither large nor continuous. Most of the rocks exposed are moderate to high-grade regionally metamorphosed gneiss with amphibolite-facies mineral assemblages invaded by anatectic granite and pegmatite dykes. A summary of the petrological studies made to date is given in the Appendix.

Rock faces are commonly exposed in wind scours in the plateau ice on the southern and western sides of the mountains. Regional ice movement in the area is from west to east. A recent drop of the plateau ice level has resulted in the exposure of cliffs on the northern and southern sides of some mountains. Although a general idea of regional trends can be obtained by a rapid examination of the area, detailed structural data were hard to obtain as almost all outcrops have been disturbed to some extent by frost action.

Mount Hicks and Chapman Nunatak

Strong winds and high-level drift severely limited work at these places and only hurried visits were possible.

Mount Hicks is steep-sided and has an undulating top covered with snowfields and rock debris. Rock fragments have accumulated on the plateau ice near the southeastern corner of Mount Hicks and at the north-eastern corner of Chapman Nunatak, a small but spectacular precipitous feature with two prominent peaks.

At both Mount Hicks and Chapman Nunatak, solid rock is best exposed in cliff faces, where the weakly foliated granitic country rocks are intruded by thick, randomly orientated dykes of very coarse-grained quartz-feldspar pegmatite.

The granitic country rocks at Chapman Nunatak strike 120° and dip 70°N. A typical specimen (7128/0236) has poorly developed gneissic banding and is a greyish pink colour. In thin section it is seen to have a slight lepidoblastic texture and consists of microcline and quartz with minor plagioclase, biotite, and opaques. This mineral assemblage is not diagnostic of any particular metamorphic facies but it is thought that it is a product of high-grade upper amphibolite-facies or granulite-facies metamorphism.

Mount Thomas

Mount Thomas consists of several separate mound-shaped outcrops which have gently undulating surfaces and merge with the surrounding plateau ice. The mountain is largely covered with snow and rock debris; the only outcrops located were in small cliff faces developed in wind scours at the mountain sides. Rock debris has accumulated on the ice along the northern edge of Mount Thomas.

As at Mount Hicks and Chapman Nunatak, randomly orientated dykes of coarse-grained acid pegmatite intrude the country rocks at Mount Thomas. On the northwestern tip the country rocks include foliated quartzite and amphibolite. The quartzite (7128/0237) strikes 160° and dips 70°W, and consists mainly of quartz and garnet with minor plagioclase, biotite, apatite, and opaques. The quartz has sutured boundaries and undulose extinction and the rock is moderately garnet-rich and thought to be a metamorphosed aluminous quartzite. From field relations the amphibolite (7128/0238) is thought to be a metamorphosed basic dyke.

In the central part of Mount Thomas the country rocks are massive, greyish brown, and spotted with garnets. Specimen 7128/0037 consists of granulated and exsolved feldspars, with quartz, biotite, garnet, and abundant accessory apatite. The garnets are broken and slightly altered, but the biotite is fresh. Mortar textures, bent twin lamellae, and undulose extinction in micas and quartz are some of the cataclastic textures evident in this rock.

Rocks from Mount Thomas have been metamorphosed under high-grade conditions and have undergone considerable cataclasis. After the main metamorphism the rocks were intruded by basic dykes, which have been altered by subsequent metamorphism to amphibolite.

Wall Peak, Simon Ridge and Gorman Crags

This group of steep-sided nunataks in the northeast corner of the Mount Hicks 1:250 000 Sheet area lies within a circular area of radius 4 km. Simon Ridge and Gorman Crags are jagged, razor-back ridges and the other features are pyramidal. The prevailing southwest wind has formed extensive and deep wind scours in the ice on the windward sides of the hills and deposited large snowdrifts on the leeward sides. Near the nunataks the plateau ice is intensely crevassed.

Although most slopes are covered with rock debris, large areas of undisturbed rock outcrop were discovered. Many of the rocks in this area have a saccharoidal crumbly texture resulting from the loosening of individual grains by frost action. Notable indications of chemical weathering include caliche deposits on certain basic rocks and copper staining (malachite) on rocks at Wall Peak.

The metamorphic rocks have a common major foliation, which strikes 045° and dips vertically, and they are intruded by large dykes of coarse-grained pegmatite. Rock types observed include garnet-biotite-plagioclase-quartz gneiss, granite gneiss, and amphibolites whose field occurrence indicates that they are metamorphosed basic dyke rocks.

Wall Peak

Wall Peak consists of banded gneissic rock intruded by pods and lenses of massive medium-grained white garnetiferous granitic rocks. The granitic rocks are mostly concordant but some are transgressive. Within the banded gneiss a few bodies of intensely fractured basic rocks may be remnants of basic dykes intruded before the metamorphism, but their precise field relations are not known.

The banding in the gneissic rock is probably due more to metamorphic segregation than to original sedimentary layering. Bands rich in plagioclase, potash feldspar, and quartz alternate with biotite-rich bands, which also contain garnet, plagioclase, potash feldspar, and quartz. Minor amounts of zircon, chlorite, muscovite, and opaques are widely distributed throughout the rock particularly in the mafic bands. In thin section (7128/0222) biotite flakes in the mafic bands are unaltered, but elsewhere, especially in the middle of the felsic bands, extensive alteration of biotite to chlorite has occurred. Feldspar exsolution phenomena were not seen.

The medium-grained granitic rocks, which intrude the banded gneiss, are studded with garnet crystals, and are composed of garnet plagioclase, potash feldspar, and quartz, with minor biotite zircon chlorite and opaques. In the thin section of specimen 7128/0224 large porphyroblasts of potash feldspar, slightly smaller plagioclase porphyroblasts, large crystals of quartz, and a few broken garnet, porphyroblasts were observed. Cataclastic features, including sutured potash feldspar crystal margins, rimming of the larger feldspar grains with small grains of quartz and feldspar, mortar structures, and undulose extinction in quartz, are common and widespread through the section.

The Wall Peak granitic rocks, like the intrusive acid igneous described elsewhere in this Record, are probably the product of analysis during regional metamorphism. Cataclastic textures show that the rocks have been subjected to stress. The mineral assemblage of the banded gneissic rock are not diagnostic of any particular facies, but metamorphic segregation and anatexis are typical of upper amphibolite-facies rocks. Minor alteration of mafic minerals and sericitisation of feldspar in the gneissic and granitic rocks may be retrograde metamorphic effects.

Mount Hay

At Mount Hay thick whitish grey pegmatite or granite dykes are concordantly intruded into the coarsely banded country rocks. A dark vein that cross-cuts the dykes and the banded country rocks is presumed to be a late-stage basic intrusive.

Only a brief visit to Mount Hay was possible and no in situ rock was examined. The rocks on the ground included mafic dark-brown-weathering types and lighter red types generally similar to those at Armonini Nunatak.

Mount Reu

At Mount Reu large rock faces are exposed only in the deep and inaccessible wind scour on the northwest side of the mountain.

White to grey pegmatite or granite dykes intrude the banded country rocks discordantly and, locally, concordantly. The dominant country rock is a light-coloured gneiss with prominent dark bands (Fig. 8).

Clague Ridge

As at Mount Reu the best exposures at Clague Ridge are on the northwest side. White veins and dykes invade the gneiss to form a complex and confused pattern. Dark banding in the gneiss can be distinguished, but no folding or foliation is discernible.

Armonini Nunatak area

The small nunatak north of Armonini Nunataka was inspected from the air. It consists of banded gneissic rocks invaded by light-coloured pegmatite and granite dykes.

Armonini Nunatak itself consists of three small peaks grouped in a triangle with a northwest-trending ridge joining the two easterly peaks. The third peak is also elongated towards the northwest. All eastern slopes of Armonini Nunatak are rounded and covered with rock debris and snow, but cliff faces are developed on the western and certain north-facing and south-facing sides.

From the air Armonini Nunatak looks much like Clague Ridge or Mount Reu in that whitish pink dykes cut across steeply dipping banded rocks that strike northeast. The compositional banding is best seen in cliff faces but can be easily distinguished in the felsenmeer on other slopes (Fig. 9).

Figure 8. Stereo pair. Banded and folded gneisses at Mount Reu cross-cut by acid dykes
Neg. GA 5925, 5927

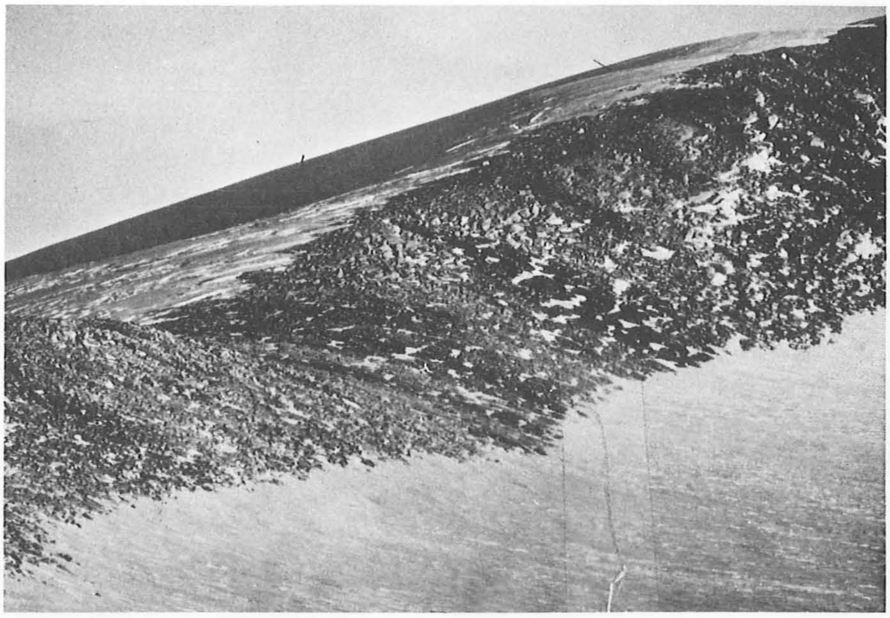


Figure 9. Banding in gneisses on eastern peak of Armonini Nunatak shows up in frost disturbed rubble Neg. GA 5930

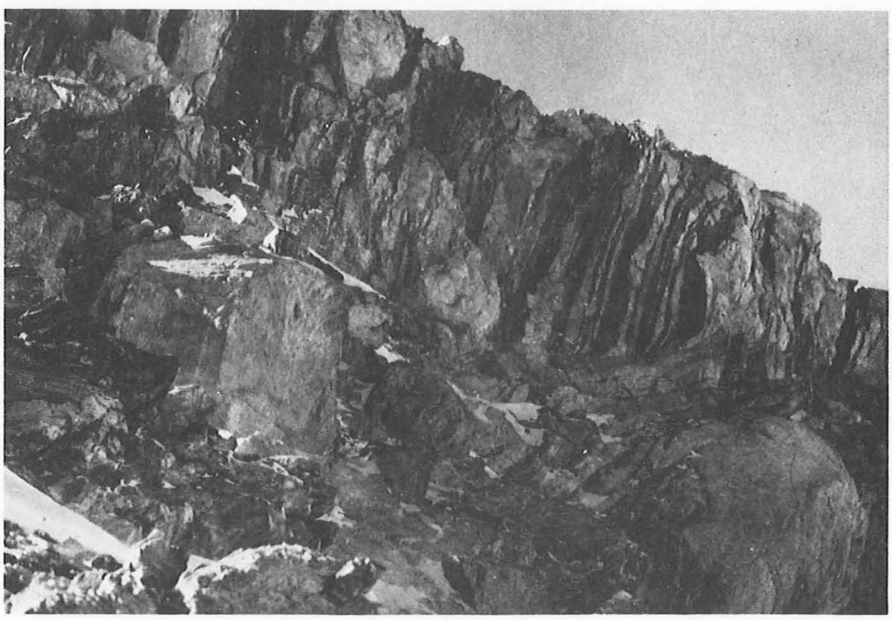


Figure 10. Banding in gneisses on western peak, Armonini Nunatak Neg. GA 5926

The largest cliff faces are not readily accessible, but small rock faces were found among the frost-loosened rock debris that covers the more gentle slopes. On the eastern peaks the banding is probably coarser (Fig. 9) but less well defined than that on the western peak where dark and light bands are sharply defined (Fig. 10). The rocks strike at between 40° and 50°, and dips range considerably. Small-scale tight folds (Fig.11), small shears, and minor flexures were also observed.

The light-coloured banded rocks at Armonini Nunatak (7128/0310, 0313, 0316) are generally granular; their foliation is defined by the orientation of biotite flakes and the elongation of quartz and feldspar aggregates and crystals, that are more apparent in hand specimen than in thin section. The gneiss consists of plagioclase, quartz, and potash feldspar, with up to 10% biotite and, locally, minor muscovite. Isolated aggregates and crystals of garnet and amphibole were also seen.

Specimen 7128/0308 from the dark bands at Armonini Nunatak is an amphibolite with a foliation that can only be discerned in thin section, but the foliation in other amphibolites, e.g. 7128/0303, can only be seen in hand specimen. Greenish grey calc-silicate rock, such as specimen 7128/0300, consists almost entirely of clinopyroxene; it is believed to be a metamorphosed marl or impure limestone.

The most common rock at Armonini Nunatak is finely banded gneiss with alternating light and dark bands believed to be the product of metamorphic differentiation. The individual bands are between 2 and 5 cm thick, and the rock foliation is defined by the alignment of biotite flakes within and parallel to the banding. Specimens 7128/0301, 0309, 0315, 0318 are examples of banded gneiss.

Small nodules found among the banded gneisses at Armonini Nunatak commonly consist of one or two minerals and were formed by segregation during metamorphism. A pod seen on the southern side of the mountain (specimen 7128/0304) consists almost entirely of biotite and is cross-cut by a small pegmatite dyke.

Calc-silicate minerals were also found as small pods (specimen 7128/0312) in the felsic gneiss, in the noses of small folds, and in the dark bands. Specimen 7128/0312 consists almost wholly of diopside, but the rocks exposed in the nose of a small fold on the northern side of the northeastern peak of Armonini Nunatak contain a range of calc-silicate minerals, including garnet, diopside, wollastonite, calcite, quartz, scapolite, and epidote (specimens 7128/0317, 0419-21, 0423). The diopside pod was probably segregated at a late stage of metamorphism. However the suite of calc-silicate minerals in the fold suggests that at least part of the now metamorphosed rocks at Armonini Nunatak were of sedimentary origin.

White to pinkish brown dykes that invade the metamorphic rocks at Armonini Nunatak are, in places, discordant and shallow-dipping (Fig. 12); elsewhere they are concordant and steeply dipping. Transgressive dykes are probably more common at the eastern peaks than at the western peaks where small dykes injected between bands of mafic rock are probably anatectic. Complex dykes with granitic cores and pegmatitic margins appear to have been formed by the intrusion of pegmatite along the margins of an existing granite dyke (Fig. 13). Locally, dyke rocks are associated with drag folding in the country rocks (Fig. 14).

The dyke rocks (specimens 7128/0302, 0306, 0307, 0314) range in composition and texture from granite to pegmatite and consist essentially of quartz and feldspar with up to 10% biotite, and rare garnet and amphibole. Interaction between the dyke rocks and the gneissic rocks has resulted in the formation of selvages of mafic minerals along the dyke margins and the clots and aggregates of garnet and amphibole crystals that are widely scattered through the dykes indicate possible contamination of the dykes with country rock.

Specimen 7128/0311, a coarse-grained pegmatite, contains small sillimanite needles set among large quartz and feldspar crystals. In specimen 7128/0319, muscovite is partly replaced by corundum in a rock that consists almost wholly of andalusite but contains a few small needles of sillimanite. (This is the only recorded occurrence of andalusite in the Prince Charles Mountains).

Retrograde metamorphic effects were not seen in the thin sections of rocks from Armonini Nunatak, but the mineral assemblages of the gneisses and the presence of granite and pegmatite dykes of probable anatectic origin indicate upper amphibolite-facies metamorphism. Relatively high temperatures of metamorphism are indicated by the sillimanite in the rocks, and the andalusite and wollastonite indicate low pressures. The metamorphic rocks, which, as previously noted, are at least in part of sedimentary origin, have been metamorphosed under amphibolite-facies conditions, and have been intruded, probably contemporaneously or penecontemporaneously, by anatectic acid dyke rocks. No recognisable post metamorphism basic dykes were seen.

Large blocks of pink rock (specimen 7128/0305) up to 1 m across found in the moraine on the southeastern side of Armonini Nunatak consist of the soft zeolite mineral laumontite and were probably derived locally, for they are not likely to have survived prolonged ice transport. The occurrence of laumontite at Armonini Nunatak is problematical as it is a low-temperature zeolite mineral more characteristic of burial metamorphism than of regional metamorphism.

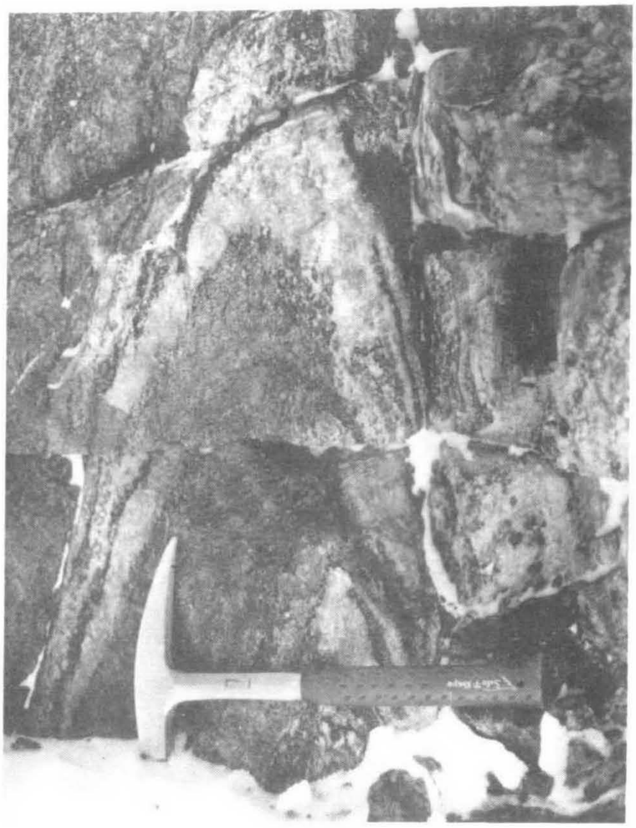


Figure 11. Fold nose in gneisses at Armonini Nunatak
Neg. GA 5928

Figure 12. Acid dyke cross-cuts gneissic rocks, Armonini Nunatak Neg. GA 5922

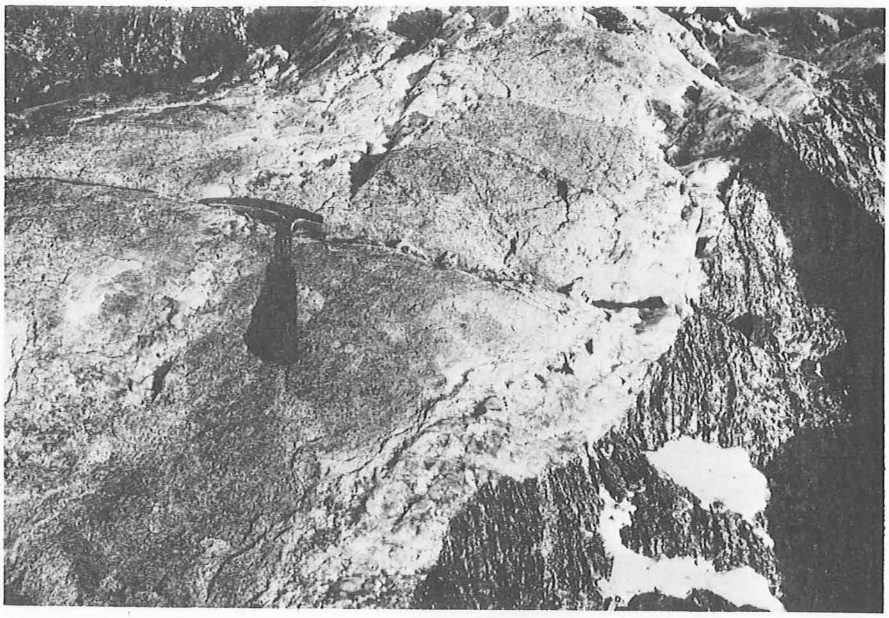


Figure 13. Complex granite and pegmatite dyke, Armonini Nunatak Neg. GA 5921

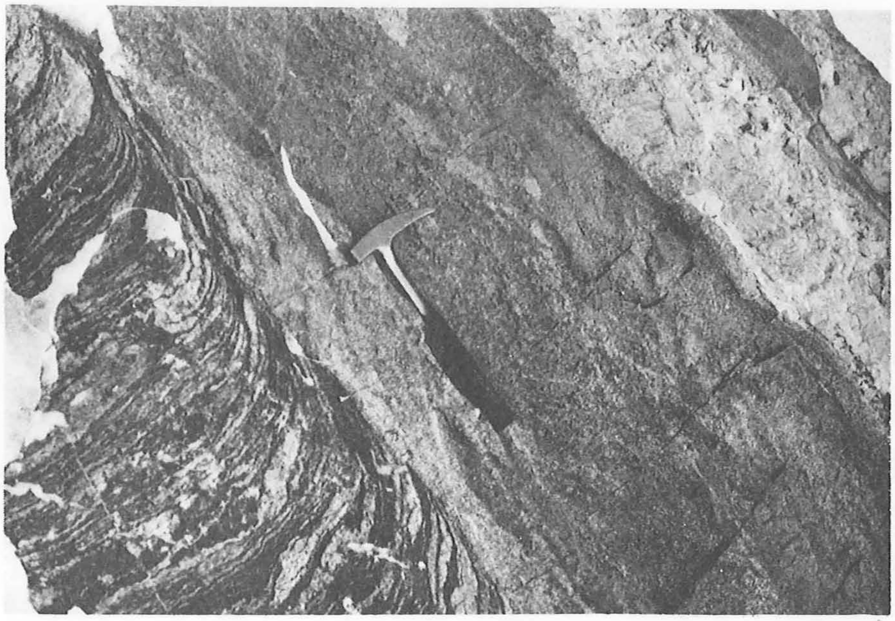


Figure 14. Drag folding at margin of intrusive dyke, Armonini Nunatak Neg. GA 5920

FISHER MASSIF 1:250 000 SHEET AREA

The Fisher Massif 1:250 000 Sheet area is characterised by large flat-topped mountains similar to those of the southern Prince Charles Mountains (Trail, 1964); jagged peaks of the type commonly seen in the northern ranges of the Prince Charles Mountains are proportionately rare. Fisher Massif is 30 km long and 12 km wide, and is flat-topped with steep to vertical sides. Mount Meredith, 22 km long and 6 km wide, is about 1000 m high and has steep cliff-like sides. Preservation of the almost vertical sides of the flat-topped mountains of the Fisher Massif area shows that the plateau ice level has been lowered rapidly in fairly recent times and moraine and erosion levels on the mountains indicate stages of this lowering. The main Lambert Glacier passes to the south of Fisher Massif, and a major tributary passes between Fisher Massif and Mount Meredith. Trail (1964) believes that the drainage efficiency of the Lambert Glacier/Amery Ice Shelf system is responsible for lowering the regional ice level and exposing the Prince Charles Mountains.

As a result of the generally lower altitude of the Sheet area, and the meteorological influence of the Amery Ice Shelf, the weather in the Fisher Massif Sheet area is generally considered to be less severe than that encountered in areas to the north. Even within the Sheet area, the weather is more clement in the southeast near the Amery Ice Shelf than in the northwestern and higher areas.

The Fisher Massif 1:250 000 Sheet area is only accessible by air and for this reason little work was done in the area before 1971. Stinear recorded some observations, and surveyors manning survey stations at Fisher Massif collected local rock specimens. The only geological field-work in the area before 1971 was done by Tingey in 1970 at Mount Woinarski, where banded gneiss is intruded by dykes of granite and pegmatite. Some of the banded gneiss is of sedimentary origin and was subject to cordierite-amphibolite-facies metamorphism.

During the 1971 season Tingey continued work in the Sheet area. He camped at Mount Gleeson and Mount Meredith and visited Mount Collins, Mount Lanyon, Milsson Rocks, and Schmitter Peak. Fisher Massif and Mount Willing were examined by Hill and Dodson, who also visited Nilsson Rocks and Mount Collins. In this account of the geological work done in the Fisher Massif 1:250 000 Sheet area during 1971, the various localities are discussed in alphabetical order.

Fisher Massif

Fisher Massif lies on the northwestern side of the junction of the Lambert glacier with the Amery Ice Shelf. It is a northeasterly-trending plateau bounded by steep cliffs on the northwestern side and more gentle slopes on the south-eastern side. The Lambert Glacier is eroding the southeastern edge of Fisher Massif and has formed vertical cliffs there. Preservation of erosion levels and moraine deposits on the southeastern slopes of Fisher Massif show that the erosive level of the Lambert Glacier has been rapidly lowered in geologically recent times.

In the central and southwestern parts of Fisher Massif the plateau profile is broken by a number of peaks separated by glacially eroded cirques and valleys; some of these are still occupied by local mountain glaciers that flow into the nearby major glaciers. Most of the peaks have been eroded from the plateau level that now makes up the bulk of the Massif, but some peaks are the eroded remnants of an higher plateau level.

During the 1971 field season Dodson and Hill were landed by helicopter at various places on Fisher Massif and were able to make a satisfactory geological reconnaissance.

From the north, Fisher Massif appears to consist of two differently coloured rock types; the bulk of the mountain is dark grey to black and the northeastern part of the plateau is brownish red. The flatter surfaces of the massif are covered by snowfields and by felsenmeer of locally derived frost-disturbed rocks, and solid rock exposures were rarely found. Detailed information on the structure of the massif was therefore not obtained, but the broad pattern of rock type distribution was established.

The dark rock is orthoamphibolite or metabasalt and the brownish-red rock, granite; a linear contact between the two types is well exposed on the western side of the granite. Mafic xenoliths resulting from contamination of the granite by the basalts are abundant and demonstrate the intrusive nature of the granite. The amphibolite (specimens 7129/0030, 0031, 0240, 0242) is generally fine-grained, but locally amygdales are preserved (Fig. 15).

Hornblende comprises up to 50% of the rocks and is presumed to be a replacement of pyroxene; biotite, quartz, and plagioclase are the other major constituents. The biotite appears to postdate but not replace the hornblende and is slightly altered to chlorite and epidote, probably

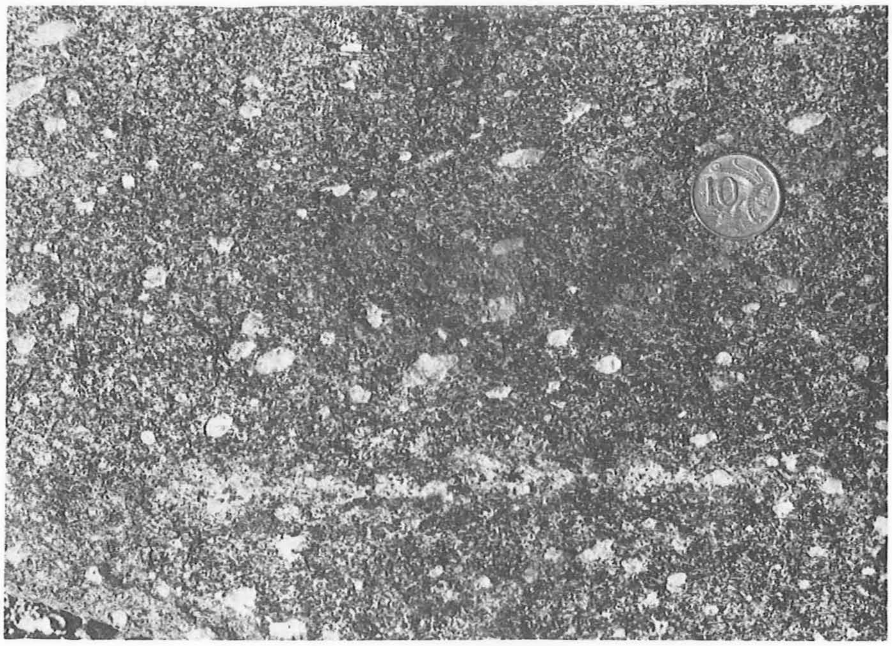


Figure 15. Amygdales in metabasalt, Fisher Massif
R.M.H.

as a result of retrograde metamorphism. Minor secondary calcite was observed and malachite staining was a common feature of exposed amphibolite surfaces. Small specks of sulphide minerals associated with this staining were observed in some places.

The amphibolites at Fisher Massif are believed to be the products of amphibolite-facies metamorphism of amygdaloidal basalt. Subsequent lower-grade metamorphism has had retrograde effects.

The brownish-weathering granitic rocks consist of a range of types whose individual compositions are determined by the extent of contamination by basalt. Specimens 7128/0028, 0029 are apparently uncontaminated biotite granite, but specimen 7128/0239 is a hybrid rock or tonalite composition and contains about 35% hornblende. Sphene is a widely distributed minor constituent of the granitic rocks.

Field evidence clearly shows that the granite is intrusive, but it has been metamorphosed since emplacement as is demonstrated by mortar textures, triple-point crystal junctions, bent crystals, and the alteration of certain minerals, e.g. ilmenite to sphene, and pyroxene to amphibole. Minor retrograde effects, such as alteration of biotite to epidote and chlorite, and the sericitisation of feldspars, are attributed to a subsequent lower-grade metamorphism which may in part be responsible for the observed cataclastic textures.

The geological history of Fisher Massif thus appears to be quite simple: a series of basalts was intruded by a small biotite granite pluton and the area was regionally metamorphosed to amphibolite-facies grade; later lower-grade metamorphism caused some retrograde metamorphic effects.

Mount Collins

Mount Collins, a narrow northeasterly-trending mountain about 5 km long and 1 km wide, has vertical cliffs on its northern and south-eastern sides. The cliffs at the highest point of the mountain - the southern corner - are about 400 m high. Examination of Mount Collins was restricted by difficulties of access and only 3 landings were made: Tingey was landed on the top of the mountain, Dodson at the northeastern corner, and Hill at the western end.

The available aerial photographs of Mount Collins show that massive light-coloured rocks are cross-cut by a network of black dykes. Fieldwork proved that the light-coloured rocks are medium to coarse-grained granitic types, and that the black dykes were originally intruded as basic dykes and have since been metamorphosed to amphibolite.

On the highest part of Mount Collins the granitic rocks are brownish-weathering and generally resemble the charnockitic rocks of the Mawson-Frammes Mountains area; mafic crystals are aligned to give an ill-defined foliation. In thin section (7128/0397) clinopyroxene, hornblende, and biotite, and minor sphene and iron ore are set in a matrix of quartz, orthoclase, microcline, and plagioclase. The clinopyroxene has a distinctive diallage parting and is extensively altered to hornblende and biotite. Possible altered relics of orthopyroxene were seen in the cores of some clusters of mafic minerals, but definite identification was not made. The rocks outcropping on the top of Mount Collins are believed to be retrograde two-pyroxene charnockites.

At the southwestern tip of Mount Collins, Hill recorded charnockites similar to those on the peak, but at the northeastern end of the mountain, Dodson mapped pinkish biotite granite with minor altered allanite and accessory iron ore and sphene. The slightly foliated granitic rocks at Mount Collins are believed to have been metamorphosed under amphibolite-facies conditions after an original granulite facies metamorphism.

Within the granitic rocks well cleaved lenses and streaks of amphibolite aligned parallel to the foliation are believed to be the remnants of basic dykes intruded before the amphibolite-facies metamorphism. Specimen 7128/0395 consists largely of orientated flakes of biotite, with hornblende, plagioclase, and quartz and some altered clinopyroxene relics.

Bands of unfoliated apparently unmetamorphosed black rock cut across the amphibolite lenses and across the foliation of the granitic rocks. The black rock, which looks like dolerite, retains such primary features as chilled margins but is almost completely converted to amphibolite (specimens 7128/0041, 0247, 0394, 0396). In some specimens (7128/0394, 96) relics of original pyroxene are present, but all specimens (7128/0041, 0247, 0394, 0396) are rich in hornblende and contain biotite, opaques, and plagioclase.

Mount Gleeson

Tingey camped for a few days at a site 5 km northeast of Mount Gleeson and visited some local peaks which are numbered on Figure 16 in the order in which they were visited.

Tingey's work at Mount Woinarski in 1970 was the only previous geological work done in the area. Mount Woinarski, about 12 km east of Mount Gleeson, consists of banded gneiss intruded by granite and pegmatite. The banded gneiss is migmatitic and has been metamorphosed to cordierite-amphibolite-facies grade.

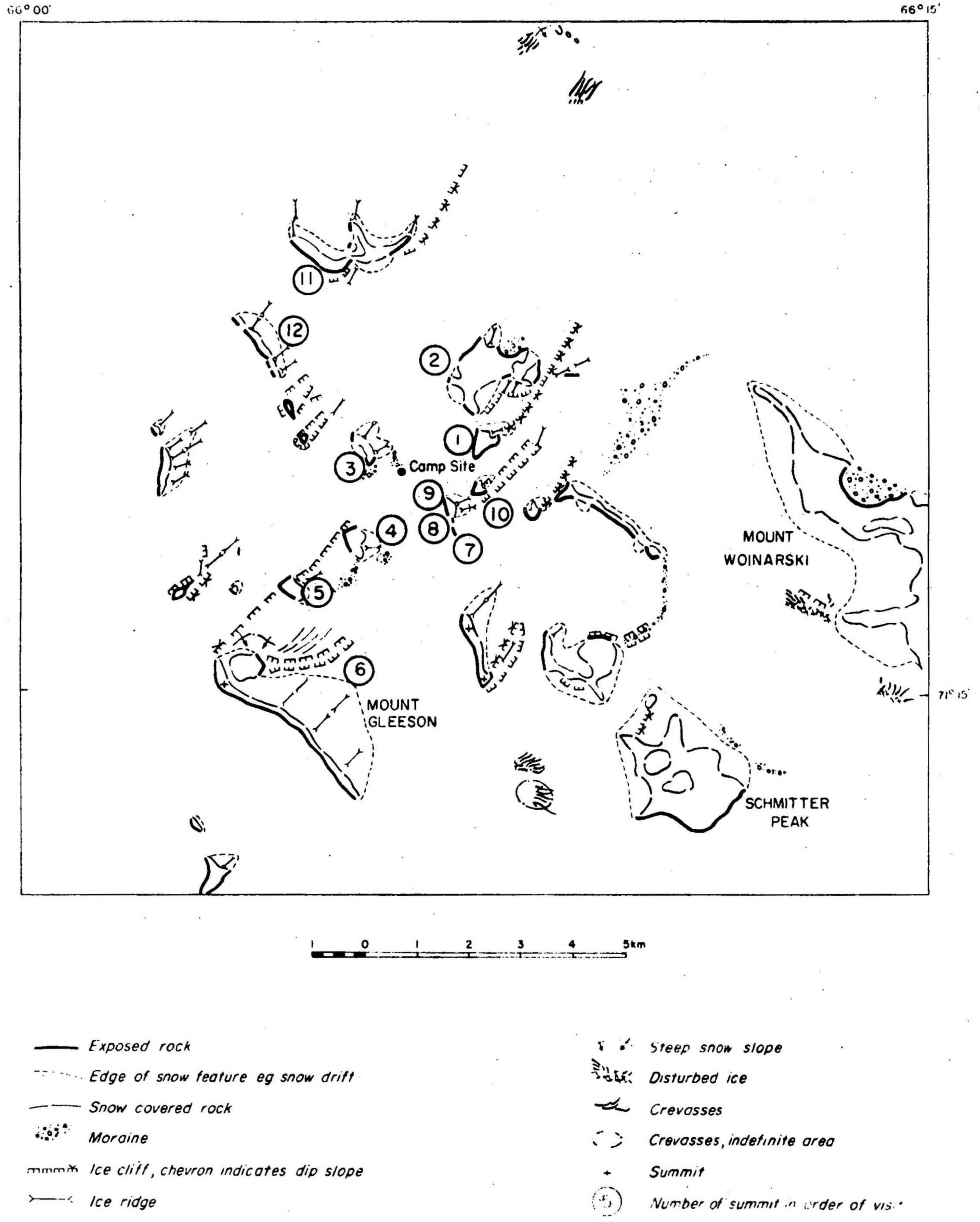


Fig. 16 Mount Gleeson Area

Fisher Massif 1:250,000

SR 41-42/15

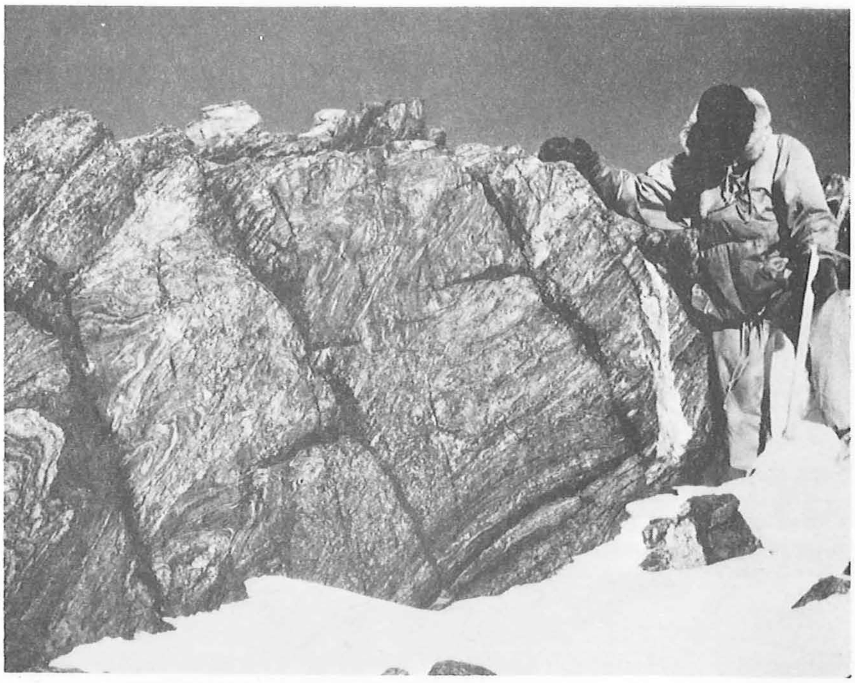


Figure 17. Mount Gleeson area. Peak 1 - folded metamorphic rocks GA 6170

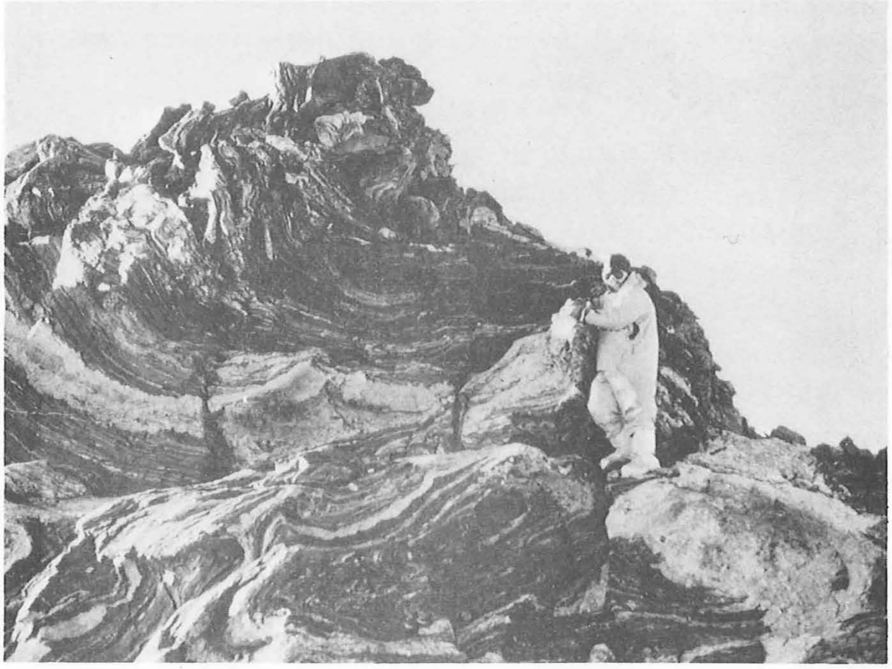


Figure 18. Mount Gleeson area. Peak 2 - contorted flat-lying folds and concordant intrusives in metamorphic rocks GA 6171

The available aerial photographs of the Mount Gleeson area are of little use for geological mapping, but the area was inspected from the air before and after completion of the fieldwork, and photographs were taken during the aerial inspections.

Owing to the complexity of the geology of the region, correlations could not be made between outcrops in the Mount Gleeson area. In general the geology of the Mount Gleeson area resembles that of the Mount Woinarski area: banded migmatites are invaded by pegmatite and granite intrusives, some of which may be post-metamorphic but most appear to be anactectic. Results of the examination of the thin sections of rocks collected in the Mount Gleeson area are summarized in the appropriate table in the Appendix.

Outcrops at the first peak visited (see Fig. 16) consist of isoclinally-folded black-purple banded gneiss in which feldspar augen and a few concordant diffuse-margined lenses of felsic minerals are developed. Pinkish white pegmatite and granite dykes cross-cut the folded gneiss (Fig. 17).

Extensive cliff faces are developed on the second peak visited in the Mount Gleeson area and exposure is good. In the central part of the mountain, contorted isoclinally-folded banded and foliated gneiss (Fig. 18) contains conformable lenses and bands of granite and acid pegmatite. In the noses of some folds, pods of dark green to black basic rock are segregated, but the specimen collected (7128/0322) proved to be too altered to be of much use for petrological work. The folded gneiss is progressively migmatised towards both ends of the peak, where there are extensive outcrops of granite with some remnants of gneissic banding. The wind-eroded (Fig. 19) outcrop at the western end of the peak consists of slightly foliated light-brownish-weathering biotite granite. A 1-m wide gouge on the eastern end of the main ridge of peak 2 is believed to be the surface expression of a weathered-out basic dyke. Elsewhere in the Prince Charles Mountains basic dykes have proved less resistant than their acid host rocks.

The rock types examined at the second peak (specimens 7128/0320-0326) included migmatized garnet-biotite gneiss, biotite granite, pegmatite, and amphibolite. Orthopyroxene was not seen in any rocks, but the amphibolite (specimen 7128/0323), which was collected from a band of dark basic gneiss, contains augite, plagioclase, quartz, and hornblende, with minor opaques. The absence of hypersthene, the presence of hornblende in some rocks, the ubiquity of biotite, the migmatitic effects in the rocks, and the conformable bands and lenses of granite and pegmatite among the gneisses, all indicate amphibolite-facies metamorphism accompanied by anatexis. Minor chlorite and muscovite are probably retrograde metamorphic products.

The third peak consists of some small but well exposed flat rock surfaces. The rocks are closely banded migmatites with large pink porphyroblasts intruded by biotite-quartz-feldspar granite and pegmatite dykes. No complex folding like that at the second peak was seen, but the dip of the rocks ranges from 30°E (005°) at the southern end of the outcrop to 15°NE (030°) at the northern end.

The fourth peak is small - about 50 m^2 and 10 to 15 m high - and is largely rubble covered. On the western face pinkish brown slightly banded migmatitic gneisses include a few streaks of dark mafic rock. Whitish pink pegmatites cross-cut the migmatites.

The migmatitic rocks are biotite-garnet gneisses (7128/0328), but the mafic rock (7128/0329) has the hornblende-granulite facies assemblage (biotite-hypersthene-hornblende), in which the hypersthene is unaltered and apparently stable. Scheumann (in Winkler 1967, p. 139) attributes the formation of granulite-facies assemblages in lenses within migmatites to multiple metamorphism.

The fifth peak in the Mount Gleeson area is rubble-covered and was only briefly visited. The underlying rocks appear to be biotite-rich migmatites, which are invaded by pinkish pegmatites.

Mount Gleeson was the sixth peak visited and its northeastern slopes consist of easterly-strik ng banded gneiss. The slopes are largely covered with rock debris but a few outcrops of solid rock were examined. The peak and the northwestern face of Mount Gleeson were not accessible, but inspection of the mountain from the air showed that these areas probably consist of the brownish to pink biotite granite that pegmatitic rocks that are also exposed on the upper northeastern slopes.

The lower part of the northeastern slopes of Mount Gleeson is covered by debris of various types of generally reddish brown to black, slightly migmatized, well foliated, banded gneissic rocks, which are composed of small lenses and bands of granitic rock between mafic bands. The gneisses (7128/0331-35) have amphibolite-facies mineral assemblages, although some are too coarse-grained for thin sections to include a representative mineral assemblage. The gneisses typically contain biotite, plagioclase (oligoclase-andesine composition), and a little microcline; traces of muscovite are believed to be retrograde metamorphism products.

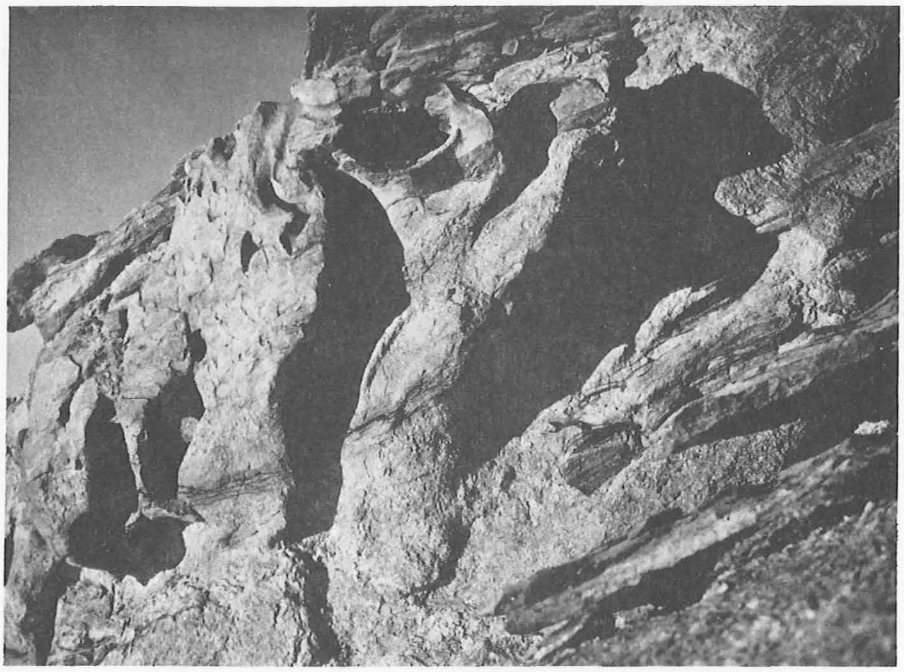


Figure 19. Mount Gleeson area. Peak 2 - wind-eroded granite GA 6162

Figure 20. Mount Gleeson - selvage of mafic minerals at margin of acid intrusive GA 6164

Figure 21. Mount Gleeson - basic dyke cross-cuts gneissic rocks and acid dyke GA 6158

CORRECTION

On the block from which these illustrations were printed the photographs were accidentally placed upside down

The banded gneisses are intruded by pegmatites and granites, most of which are conformable with the banding and foliation; coarse selvages of mafic minerals are developed near the contacts (Fig. 20). The acid intrusives and the gneisses were themselves intruded (Fig. 21) by a few widely scattered basic dykes, which were later metamorphosed to amphibolites (7128/0330). The metamorphic rocks at Mount Gleeson can be classed as slightly migmatised gneisses that were metamorphosed, probably at least twice, to amphibolite-facies grade. The granite that constitutes the peak upper slopes of the peak and western face is probably the product of local anatexis.

After Mount Gleeson a group of small peaks (7-10) to the south of the camp was visited. Mafic gneiss intruded by whitish pink granite and pegmatite dykes were seen in places, but elsewhere outcrops of slightly banded granite were observed. A sequence of rocks that may illustrate the conversion of banded gneiss to granite by migmatisation (Fig. 22) is exposed, although the banded gneiss may represent basic material that remained after anatexis and was later foliated. Specimens 7128/0336-0339 show the progression: mafic gneiss to migmatite to acid gneiss.

The eleventh peak is about 4 km north of the camp site and is mainly red. The bulk of the mountain consists of granite, but rocks illustrating the migmatisation of mafic gneiss through banded migmatite to granite were seen. In one stage of migmatisation - specimen 7128/0344- scattered feldspar porphyroblasts are developed in a mafic gneiss. The four specimens (7128/0341-0344) collected at the eleventh peak represent the major rock types; all contain some biotite and have mineral assemblages consistent with the upper amphibolite facies metamorphism and accompanying anatexis. The pinkish migmatitic-granitic rocks grade northwards into black and white banded rocks; these were not closely examined but appear to resemble banded rocks seen at the western peak of Armonini Nunatak.

Banded gneiss crops out also at the twelfth peak; it is intruded by generally conformable pinkish-weathering granitic dykes and veins. The gneiss consists of dark mafic bands and white felsic bands that appear to have been segregated during metamorphism. The mineral assemblages of specimens 7128/0345-0349 generally show that the metamorphism was of the upper amphibolite facies commonly associated with anatexis, but in specimen 7128/0346, a banded amphibolite, orthopyroxene has not been completely altered to hornblende.

The field relation, outcrops, and mineral assemblages of the rocks in the Mount Gleeson area indicate that the area underwent upper amphibolite-facies metamorphism accompanied by anatexis and migmatisation.

The anatexis was followed by or accompanied by the injection of granite and pegmatite intrusives; basic dykes were intruded later. A second phase of metamorphism converted the basic intrusive to amphibolite; the surrounding rocks were affected by minor retrograde metamorphism.

Mount Lanyon

Mount Lanyon consists largely of rubble-covered plateaux and gently rounded hills, but a few cliff faces are developed. From the air prominent rock bands can be seen in the hill sides and protruding through the rubble, and variations in the bed rocks show up as colour bands in the rubble cover. The dominant strike of the bands is about 075°.

A landing was made on the ice near the southern end of Mount Lanyon to examine the cliff face (Fig. 23). From a distance, complex folds can be seen, but in close-up, the cliff face appears to consist of regularly banded rocks dipping to the north. Minor faults, which are marked by pseudotachylyte veins, and folds were detected. The minor folding is probably isoclinal.

Granitic rocks, and banded and folded gneiss consisting of mafic and felsic bands were examined. The mafic minerals have a greenish tinge, and free calcite was seen in most specimens examined in the field; all (7128/0398-0402) contain hornblende and some calcite and sphene.

In the amphibolite (7128/0402) sphene occurs on the corroded margins of hornblende; in 7128/0399, a sheared amphibolite-granite hybrid rock, sphene replaces rutile; and in 7128/0401, an orthopyroxene-bearing, clinopyroxene and hornblende-rich calc-silicate, sphene has the needle-like form of rutile. The presence of orthopyroxene and rutile may indicate an early granulite-facies metamorphism, but the present mineral assemblages and the injection of acid magma into the banded rocks are characteristic of upper amphibolite-facies metamorphism. Replacement of hornblende with epidote in specimen 7128/0398 is believed to be a result of retrograde metamorphism.

Mount Meredith

Mount Meredith is a large flat-topped mountain, bounded on the southeastern side by cliffs up to 800 m high. Terrace levels on the mountain show the extent of past glacial action, and a long moraine tail has formed at the eastern end of the mountain (Fig. 24). Tingey camped at two places on Mount Meredith after inspecting the mountain from the air.

Figure 22. Mount Gleeson area - banded gneisses almost resorbed by granite magma to give migmatite GA 6168

Figure 23. Mount Lanyon - large-scale folding on southern face GA 6163

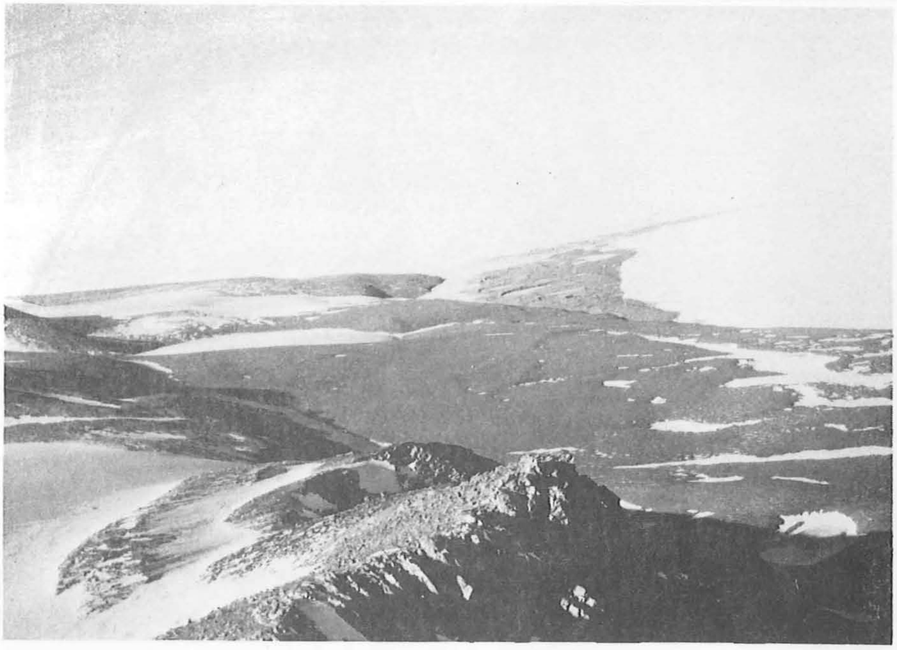


Figure 24. Mount Meredith - view east along southern face; note bevelled surfaces and moraine tail GA 6175

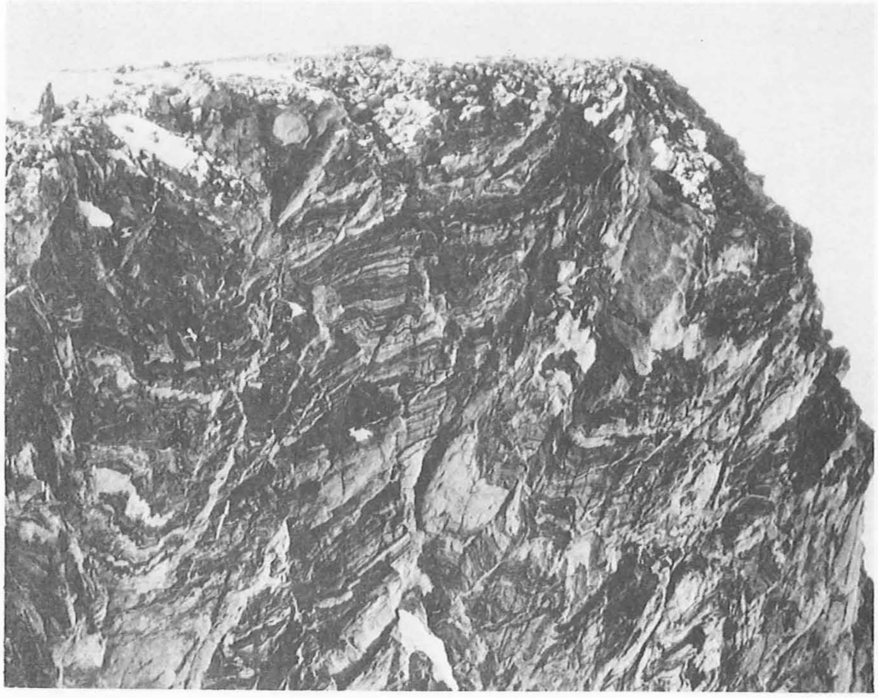


Figure 25. Mount Meredith - intensely folded metamorphic rocks intruded by granite dykes; note human figure on left GA 6159

Exposures of the northwestern side of Mount Meredith is poor but rock banding in the bedrock shows through the rubble cover. The cliff faces on the southeast side appear to consist of banded rocks, which Crohn (1959, p. 65 and plate 36) thought were sediments similar to the Amery Formation. The available aerial photographs of Mount Meredith were of little use for photogeological interpretation and were mainly used for locality identification.

On top of Mount Meredith, outcrop is patchy, but some idea of the rock relations can be worked out from the distribution of surface rubble and observations of the cliff faces. The dominant strike is about 240°, and cliff faces parallel to the strike give an impression of a fairly regularly banded mass of rocks. However, compact irregular folding is exposed in northwest-trending cliff faces (Fig. 25); the gneiss is intensely disturbed, isoclinally folded, and irregularly intruded by granite; the strike of the fold axial planes is about 240°, i.e. parallel to the length of Mount Meredith.

The rocks invaded by granite include: dark brown sillimanite-cordierite-biotite pelitic gneiss (Fig. 26, specimen 7128/0379); acid gneiss with scattered garnet crystals and aggregates; a crumbly saccharoidal-textured sillimanite-muscovite rock analagous to a sandstone in hand specimen (specimen 7128/0352); and, probably the commonest type, banded migmatitic biotite gneiss. In some host rocks pink feldspar augen are developed, but elsewhere the granite intrusions have had little apparent effect.

The granite intrusives are generally coarse to medium-grained and consist of quartz, orthoclase, and plagioclase, with minor biotite. Some contain scattered biotite-garnet crystal aggregates, and a few grade along strike into acid gneiss bands. Most granites are concordant, but locally dykes of reddish granite or aplite (specimen 7128/0358) cut across the general trend and obviously postdate the gneisses. A columnar-jointed amphibolite found at the east end of Mount Meredith was originally intruded into the gneisses as a basic dyke after the main metamorphism of those gneisses (specimen 7128/0362) (Fig. 27).

A quartzose rock, which forms narrow linear outcrops at several places on Mount Meredith and appears to be filling joints, is believed to be of concretionary origin (Fig. 28). At the eastern end of the mountain the rock is associated with medium-textured granitic dyke rocks, which are mainly brownish-weathering but are locally green with epidote.

The origins of most of the metamorphic rocks at Mount Meredith are not known, but some specimens have distinctive compositions. The calc-silicate gneiss (specimen 7128/0393) is the metamorphic derivative of an impure limestone and the cordierite-sillimanite assemblages (7128/0379) indicate derivation from aluminous pelitic sediments. At least some of the metamorphic rocks at Mount Meredith are considered to be of sedimentary origin.

The common cordierite-amphibolite-facies (Winkler 1967) mineral assemblages and the presence of extensive granite and pegmatite dykes indicate anatectic metamorphism. Some assemblages give more precise indications of the pressure and temperature conditions of metamorphism; in specimen 7128/0353 the assemblage sillimanite-potash feldspar-muscovite-quartz locates the conditions of metamorphism on the curve of the reaction:

$$\text{K-feldspar} + Al_2SiO_5 \rightleftharpoons \text{muscovite} + \text{quartz}$$

and indicates pressure of at least 3 kilobars and temperature of at least 650°C. The presence of the high-temperature/form of aluminium silicate, sillimanite, in pelitic rocks and the absence of the high-pressure form, kyanite, further fixes the pressure and temperature conditions. The absence of orthopyroxene and the widespread anatectic effects point to P_{H_2O} conditions too great for granulite-facies metamorphism.

The main metamorphism of the area was followed by amphibolite-facies metamorphism that converted basic intrusives to amphibolite and probably produced minor retrograde metamorphic effects, such as alteration of mafic minerals to chlorite and epidote, and feldspars to sericite. Emplacement of late-stage cross-cutting granite dykes may also be associated with this metamorphism.

The moraine tail at the eastern end of Mount Meredith was briefly inspected and found to consist largely of a veneer or rock debris lying on the glacier's surface (Fig. 29). The debris is absorbed into the glacier as a result of local melting caused by the high rate of absorption of solar-heat radiation of the dark-coloured debris. Small mountain glaciers on Mount Meredith supply debris to the moraine tail on the plateau ice.

In geologically recent times there were probably more glaciers on Mount Meredith supplying debris to the moraine tail, but some have disappeared completely and others have melted back from the edge of the mountain. The moraine tail retains the grey colour imparted by rock flour as it is not subject to water erosion. In contrast, moraine on the benches on the mountain side is being eroded by meltwater during the

Figure 26. Mount Meredith - high alumina cordierite-sillimanite gneiss cross-cut by small felsic band GA 6166

Figure 27. Mount Meredith - intrusive dolerite converted to amphibolite GA 6172

Figure 28. Mount Meredith - siliceous concretionary rock thought to be filling open joints GA 6167

Figure 29. Mount Meredith - detail of moraine tail at east end of mountain; note that rock sits on top of ice GA 6169

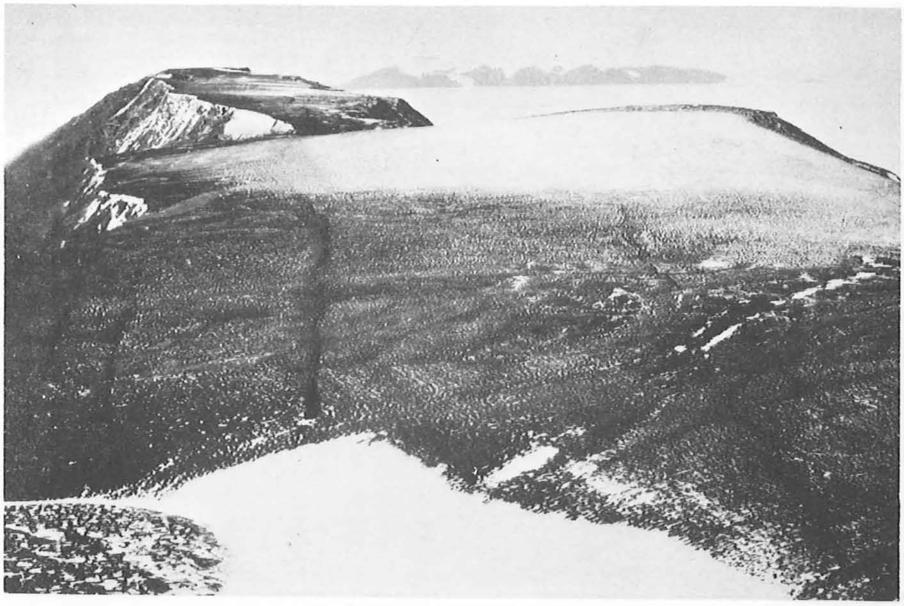


Figure 30. Metadolerites (black linear bands) intersect metagabbro at Mount Willing Neg GA 5028 R.M.H.

summer. Small melt streams and stream channels were commonly seen and the moraine is converted to hummocky deposits of rock fragments by the removal of clay and rock flour. As the clay is removed small rock fragments settle, but larger ones topple and roll down into the stream channels where they ultimately form a concentration of larger fragments. The result of this and allied processes is seen on higher and older terrace levels as a hummocky terrain consisting of roughly polygonal piles of rocks with coarser fragments concentrated at the edges.

Mount Willing

Mount Willing, which was examined by Hill and Dodson, is an east-west-elongated plateau with a gently undulating top and vertical cliff faces. The nearby plateau ice is so intensely crevassed that overland access would be impossible. Before 1971 no effective work had been accomplished by Australian geologists at Mount Willing, but on geological maps presented at the 1970 SCAR-IUGS symposium on Antarctic geology, Soviet workers show Mount Willing as a metagabbro (D. Soloviev, 1972); details of the Soviet work are not known.

The top of Mount Willing is covered with frost-disturbed rock fragments and a few small snowfields; the best exposures of solid rock are in the inaccessible cliff faces on the mountain sides. The relation between the various rock types shows up clearly in the rubble and can be conveniently viewed from the air (Fig. 30).

Mount Willing is an almost homogeneous mass of dark grey to black gabbroic rock, cross-cut by randomly orientated widely spaced generally thin dykes of aplite and pegmatite, and vertically-dipping metamorphosed basic dykes aligned generally east-west. Within the gabbro there are widely scattered pods of coarser-grained gabbro and granodiorite. The relation between the acid and the metamorphosed basic dykes was not determined but the granodiorite lenses are thought to have been formed by differentiation during the emplacement of the gabbro.

The gabbros, granodiorite, and basic dykes have been metamorphosed under amphibolite-facies conditions, but the aplite appears to be comparatively unaltered. The metagabbro (7128/0227) retains its original ophitic texture and is composed mainly of augite, rimmed with tremolite and hornblende. The granodiorite (7128/0230) consists of relict microcline, quartz phenocrysts, and plagioclase, with minor biotite, sphene, apatite, and opaques. Microcline in this rock is corroded and granulated at the edges, and some quartz is broken into small grains. Specimen 7128/0229, an amphibolite from one of the metamorphosed basic dykes, consists largely of hornblende and plagioclase, with minor quartz and biotite, and contains only a few altered and unidentifiable remnants of original pyroxene.

The aplite (7128/0228) is of granitic composition and the only sign of possible metamorphism is the undulose extinction of some of the quartz and a few possible triple-point crystal junctions. Pegmatite (7128/0032-34) is generally too coarse-grained for detailed petrographic work, but it too appears to have been only slightly, if at all, affected by metamorphism. On nearby Fisher Massif there is clear evidence that granite was emplaced before the major metamorphic event but the evidence at Mount Willing is less clear.

A simplified version of the geological history of Mount Willing is considered to be:

Intrusion of gabbro; local differentiation and segregation of coarse-grained varieties and granodiorites.

Intrusion of dolerite dykes.

Amphibolite-facies metamorphism.

Possible intrusion of aplite and pegmatite dykes.

The intrusion of aplite and pegmatite may have taken place before the dolerite was intruded.

Nilsson Rocks

Nilsson Rocks comprises a group of hummocky (Fig. 31) ice-eroded rocks on the northwestern margin of the Lambert Glacier about 20 km south of Fisher Massif. The hummocky terrain resembles that developed by the action of Pleistocene glaciers in basement areas of North America and northern Europe and is obviously the result of recent glaciation. The rocks are elevated about 20 metres above the nearby ice surface and were probably exposed only recently. Nearby the plateau ice is spectacularly crevassed and contorted as tributary glaciers abut against the main stream of the Lambert Glacier; here, surface travel is impossible.

Hill was landed on the southeastern side of Nilsson rocks, and Dodson and Tingey examined an area near the southwestern corner. The small hills are well exposed although frost-shatter and heave effects were widespread, but the intervening valleys are filled with rubble, which is mainly locally derived but includes a few erratics.

The most common rock type at Nilsson Rocks is banded mafic gneiss; it contains bands of acid gneiss or granodiorite. In places, lenses of acid rock are sufficiently abundant to transform the gneiss to migmatite. The gneiss is irregularly banded and locally intensely folded (Fig. 32); in places it is intersected by pegmatite and granite dykes.

Figure 31. Nilsson Rocks - general view to show nummocky glacially eroded terrain GA 6161

Figure 32. Nilsson Rocks - detail of outcrop showing folded mafic gneiss with acid bands GA 6174

The mafic rocks (7128/0244, 403, 404) are varieties of amphibolite and biotite-plagioclase schist with local intercalations of calc-silicate schist (7128/0245). Felsic bands within the basic gneiss consist largely of plagioclase (7128/0405), but contain small aggregates of hornblende, tremolite, and greenish brown biotite. They are considered to be a product of anatexis of basic rocks, an origin also suggested by field relations. The mineral assemblages of the mafic and the felsic rocks are typical of amphibolite-facies conditions associated with anatexis. Abundance of hornblende and sphene and the absence of hypersthene show that granulite-facies conditions were not attained during metamorphism, and the absence of garnet in the rocks shows that the original rocks were probably alumina-poor. Widespread but minor amounts of chlorite, muscovite, and epidote are attributed to retrograde metamorphism under greenschist-facies conditions; some of the tremolite may also be retrograde.

The banded gneiss is cross-cut by pegmatites from 3 to 5 m thick and composed mainly of feldspar with minor quartz, garnet, and muscovite. The pegmatites were obviously emplaced after the main metamorphism and possibly before the retrograde metamorphism. The geological history of the Nilsson Rocks resembles that of Mount Willing, but no cross-cutting metamorphosed basic dykes were seen.

METAMORPHISM

This summary of the metamorphic geology of part of the northern Prince Charles Mountains incorporates the results of work by Crohn (1959) and other early workers. Crohn noted that the high-grade metamorphic basement rocks of the northern Prince Charles Mountains consist of metamorphosed sediments, granitic gneiss, and hybrid (i.e., banded) gneiss, intersected by numerous granite, pegmatite, quartz, and aplite veins and by a few basic dykes. Recent work has confirmed this observation.

The metamorphic history of the area is undoubtedly complex, and present mineral assemblages mainly indicate the conditions that persisted during the most recent major metamorphism, but a late-stage lower amphibolite-facies metamorphism has caused minor but widespread retrograde effects.

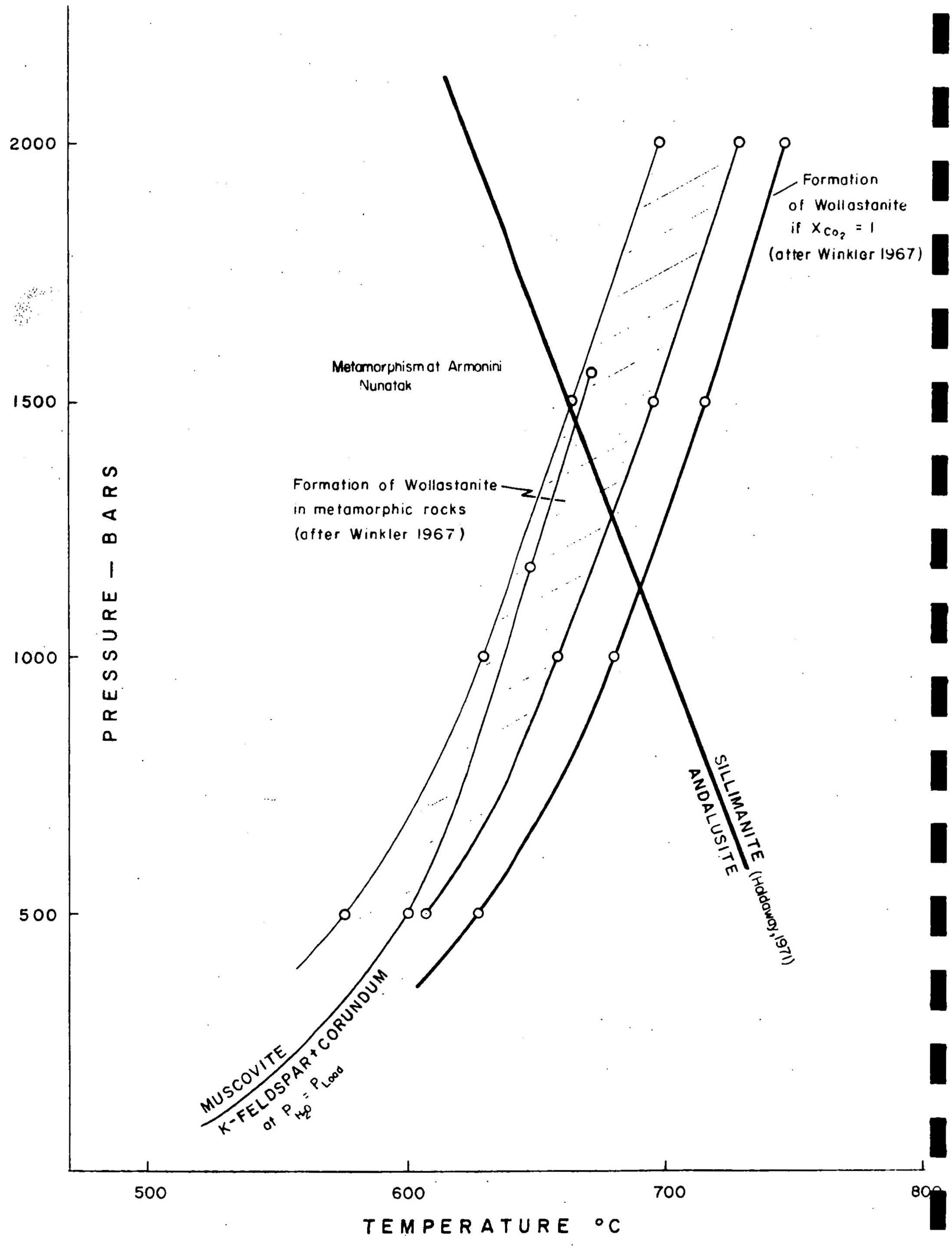
Many of the metamorphic basement rocks are of obscure origin, but the sedimentary origin of some is demonstrated by the widespread occurrence of rocks with high-alumina 'pelitic' assemblages (e.g., at Mount Meredith, Mount Woinarski, Mount Thomas, White Massif, Mount

Bechervaise) and with calcareous assemblages (e.g., at Nilsson Rocks, Mount Woinarski, Mount Hollingshead, Corry Massif, Mount Wishart). By contrast, Fisher Massif consists of basalt intruded by granite and later metamorphosed under amphibolite-facies conditions. Mount Willing is a metagabbro.

On the geological map of Antarctica published by the U.S. National Geographic Society (Craddock, 1972), the northern Prince Charles Mountains are represented as consisting of granulite-facies rocks. However, although there are some large areas where charnockitic and orthopyroxene-granulite-facies rocks predominate (e.g., Crohn Massif, Amery Peaks), migmatites and rocks with upper amphibolite-facies assemblages predominate in other large areas. In general the metamorphic grade decreases from the north, where granulite-facies rocks are widely developed in the Athos, Porthos, and Aramis Ranges, to the south, where amphibolites predominate and no granulite-facies rocks are found. Locally, rocks with orthopyroxene-granulite-facies assemblages are intimately associated with hornblende-granulite-facies rocks, migmatites, and amphibolite-facies rocks, and with pegmatite and granite. Distribution and association of the various rock types may be controlled by local variations of the water pressure (P_{H_2O}) effective during metamorphism, rather than by variations of either temperature or load pressure (P_s) conditions or both. The variations in the P_{H_2O} may reflect variations in the water content of the rocks before metamorphism; Winkler (1967) interprets granulite-facies assemblages and the water-content variations responsible for them as showing that the rocks had been subjected to earlier high-grade metamorphism and local dehydration.

The metamorphic basement rocks of the northern Prince Charles Mountains have a wide range of textures that are largely controlled by the presence or absence of certain minerals which are in turn related to P_{H_2O} conditions persisting during metamorphism. The charnockitic rocks are generally massive and unfoliated and the orthopyroxene-granulite-facies rocks are banded, poorly foliated, and granular textured. In these rocks cataclastic textures are commonly well developed but they are generally less well developed in the banded gneisses, granitic gneisses, and migmatites, and other rocks which contain hydrous minerals, such as biotite and hornblende. These foliated rocks were formed under higher-P_{H_2O} conditions than the anhydrous granulite-facies rocks. The development of cataclastic textures in rocks with generally anhydrous mineral assemblages may reflect the low plasticity of these rocks during metamorphism as compared to the plasticity of rocks metamorphosed under high-P_{H_2O} conditions.

FIG 33 - PRESSURE AND TEMPERATURE CONDITIONS DURING METAMORPHISM AT ARMONINI NUNATAK,



The rocks that contain hydrous mineral assemblages are notably more banded and foliated than the charnockitic and orthopyroxene-granulite-facies rocks, and are commonly associated with subconformable anatectic granite and pegmatite veins. At Fisher Massif and Mount Willing the rocks are of basic igneous origin, and anatexis did not start in response to amphibolite-facies metamorphism. Banding and foliation in the gneissic rocks are normally parallel, and are defined by the alignment of biotite crystals, hornblende crystals, and lenses and aggregates of felsic minerals. Metamorphic segregation in the banded gneissic rocks indicates anatexis during metamorphism, and in some banded rocks felsic bands that alternate with mafic bands appear to have been intruded into their present position.

Certain mineral assemblages in the rocks enable estimates to be made of the temperature and pressure conditions of metamorphism; some of these assemblages have been discussed. Estimates of pressure and temperature based upon the relative stability of the aluminium silicates kyanite-sillimanite and andalusite are imprecise as the determinations of the triple point of these minerals vary considerably (see Derrick, in prep.).

Specimen 7128/0352 from Mount Meredith contains muscovite and sillimanite in the interaction relation:

$$\text{Muscovite} + \text{quartz} \longrightarrow \text{K-Feldspar} + \text{sillimanite}$$

The intersection of the curve for this reaction with the curve for the onset of anatexis (Winkler, 1967, p. 177) shows that temperature during metamorphism was about 670°C, and pressure about 3 kb.

At Armonini Nunatak, rocks with carbonate-wollastonite-diopside-assemblages (7128/0419, 0420, 0421, 0423) occur close to a rock (7128/0319) with the disequilibrium assemblage andalusite-corundum-muscovite-sillimanite. From Figure 33, the pressure conditions during metamorphism are estimated at about 1.5 kb with temperatures about 670°C.

Some of the conformable pegmatite, granite, and aplite grade into foliated acid gneisses; they were probably emplaced during metamorphism as a result of local mobilisation. Cross-cutting but similar dyke rocks are attributed to later-stage intrusion of anatectic magma. The above estimates, the absence of kyanite, and the common occurrence of sillimanite in the pelitic assemblages, and the absence of eclogite-facies assemblages in metamorphosed basic rocks show that the basement rocks of the northern Prince Charles Mountains have been subjected to high-grade metamorphism under pressure conditions of not more than 5 kb and temperature conditions of the order of 670°C. Variations in the water content before metamorphism resulted in local variations of the water pressure effective during metamorphism; locally this caused anatexis, the formation of granulite-facies, amphibolite-facies, and migmatitic rocks. After the main metamorphism, basic dykes were intruded and subsequently converted to amphibolites by an amphibolite-facies metamorphism, which may be responsible for the widespread retrograde effects in other rocks.

STRUCTURE

Outcrops in the areas examined are isolated and local folding is complex. No coherent pattern of folding or faulting has been recognised in the basement rocks of the northern Prince Charles Mountains.

CONCLUSIONS

The geological work in the northern Prince Charles Mountains in 1971 showed that the grade of regional metamorphism decreases southward from the Athos, Porthos, and Aramis Ranges and the Amery Peaks/Loewe Massif/Manning Massif area, where charnockitic rocks and rocks with orthopyroxene-granulite-facies assemblages are widely developed, towards the Fisher Massif 1:250 000 Sheet area. Anatectic effects are widespread throughout the northern Prince Charles Mountains particularly in areas characterized by rocks with amphibolite-facies assemblages, but the special compositions of the rocks at Fisher Massif and Mount Willing prevented anatexis.

The origins of most metamorphic rocks in the northern Prince Charles Mountains is not known directly, but the widespread distribution of rocks of sedimentary origin indicated that a large part of the basement complex was of sedimentary origin. Metamorphic conditions in the area were low to moderate pressure (not more than 5 kb) and high temperature (670°C), and variations in water pressure (P_{H_2O}) controlled the local formation of granulite-facies rocks, amphibolite-facies rocks, and anatexis. The metamorphic conditions may be compared to the Abukuma-type metamorphism observed in Japan and reviewed by Winkler (1967). Abukuma-type metamorphism is correlated with high geothermal gradient, such as that associated with contemporary volcanism in Japan. An ancient high geothermal gradient in the Prince Charles Mountains area may have been associated with the production of basic lavas at Fisher Massif and the emplacement of the gabbro at Mount Willing.

RECOMMENDATIONS

Various factors severely limit the opportunities available for detailed work in the field, but the metamorphic basement rocks that constitute the bulk of the Prince Charles Mountains are suitable for detailed laboratory work. Petrological studies have already shown the complexity of the metamorphic history of the rocks, and indicated the origins of at least some of them and the conditions that existed during metamorphism; detailed chemical work might clarify some of these points.

The available aerial photography of the Prince Charles Mountains is unsuitable for geological mapping, but colour photography would greatly assist in the interpretation of the structure of outcrops now covered with locally derived frost-heaved rock fragments. The extra cost of the colour film would be small compared to the logistics costs involved in the operation of aircraft.

ACKNOWLEDGEMENTS

All geologists were greatly assisted in the field by members of the 1970 Mawson wintering party, notably A. Foster, S. Harbour, and T. Weatherson. The co-operation of the leader and all members of the 1970 Mawson party, and of Dr Lugg and the 1971 Prince Charles Mountains party is also gratefully acknowledged.

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APPENDIX 1

Summary of Petrographic Data

The data are arranged on the basis of 1:250 000 Sheet areas, and are drawn from a number of sources. In the following tables, figures in the columns for the individual minerals are estimates of the percentage of the rock comprised by that mineral. In some thin-section descriptions only the mineral assemblages are given; for these the presence of a certain mineral in a rock in significant amounts is indicated by a tick, traces are denoted by 'Tr', and doubtful identifications are denoted '?'.

SR41-42/6 STINEAR NUNATAKS

Specimen Number	Quartz	Orthoclase	Microcline	Undiff. K-Feldspar	Perthite	Plagioclase	% An	Chloritoid	Chlorite	Muscovite	Stilpnomelane	Biotite	Hornblende	Amphibole	Staurolite	Clinopyroxene	Orthopyroxene	Kyanite	Andalusite	Sillimanite	Cordierite	Garnet	Calcite	Wollastonite	Forsterite olivine	Epidote	Apatite	Sphene	Zircon	Opaques	Other Minerals	COMMENTS
ANARE NUNATAKS																																
7028/0273	50	23				8						5					Tr					12					Tr			2		Hornblende granulite facies
DEPOT PEAK																																
3975	✓	✓			✓	✓						✓								✓	✓	✓								✓		Probable granulite facies
7128/0248						45	49					Tr				10	30										5			10		Slightly retrograde basic granulite
7128/0249	40		20			30	38			Tr		3										6							Tr	1		Probable Hornblende granulite
GOWLETT PEAKS																																
7028/0485	40				20	12						5					10					12								2		Probable Hornblende granulite
MT FOX																																
7028/0277	30	15				15						8								10	5	20										Possible Granulite facies
7028/0278	50	15				25						5										5										
MT. MACEY																																
7028/0482	35	18										5								15	5	18								2	+SPINEL	Probable granulite facies
MT. SHAW																																
7028/0487	30					45				Tr		5										15								2	Plagioclase 13 antiperthite	Probable granulite facies
7028/0488	30				70																											Probable granulite facies
RIDDELL NUNATAKS																																
7028/0274	25	35				13						1										18					1			3		
7028/0276	50					25			Tr							2	8					7					1		3	4		Retrogressed granulite. Retrogress. only slight
STINEAR NUNATAKS																																
3976	Tr	✓										✓								✓	✓	✓										Probable granulite facies
3977	✓	✓																		✓	✓	✓								✓		
7028/0473	20					55						8					15															
7028/0476	35	30										3								6	5	20										
* WHITEOUT NUNATAKS																																
7028/0267	30					12						6								25										✓	?Cordierite	Very strongly sheared gneissic rock.
* ZEBRA PEAK																																
7028/0270	20					55						10					13													✓		Hornblende granulite facies
0271	30		65																			5								✓		Probable granulite.

* INFORMAL PLACE NAME

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Specimen Number	Quartz	Orthoclase	Microcline	Undiff. K-feldspar	Perthite	Plagioclase	% An	Chloritoid	Chlorite	Muscovite	Stilpnomelane	Biotite	Hornblende	Amphibole	Staurolite	Clinopyroxene	Orthopyroxene	Kyanite	Andalusite	Sillimanite	Cordierite	Garnet	Calcite	Wollastonite	Forsterite Olivine	Epidote	Apatite	Sphene	Zircon	Opaques	Other Minerals	COMMENTS
BRADLEY RIDGE																																
7028/0511	30		15			10						15								2	10	15										Probable Granulite facies
7028/0512	50		30																	10		10								✓		Very strongly sheared
CARTER PEAKS																																
7028 0009	40	25			✓	20						5															Tr		Tr	Tr		Biotite bearing gneiss Probably granulite
7028 0011	40				50	5						2										2					1			Tr		Probable garnet granulite
7028 0018	35		8		✓	25						5										25							Tr	Tr	+Rutile	Originally pelitic sediment Hornblende granulite facies
7028 0019	20				6	25						5								5	5	35							Tr		+Rutile	Originally pelitic sediment. Well granulated between garnet rich bands
7028 0021	40					30						5										25							Tr	Tr		Not diagnostic but probably high grade
7028 0024	30					20						30								4		15							Tr	1	?Cordierite	Felsic minerals tend to be granulated. Rock strongly banded
7028 0236	25					25						2								9	8	30							Tr	1		Rock well granulated Probable granulite formed from pelitic sediment
7028 0237	40					50						3					Tr			Tr		10							Tr	Tr		Rock shows cataclasis Granulite facies rock
7028 0239	65					5						Tr								20	4	5							Tr	1		Metamorphosed pelitic sed. Hornblende granulite facies
7028 0240	30				10	15						2								10		35							Tr	1		Granulated banded rock probably granulite facies
7028 0241						50						Tr	25			15	10													Tr		Basic granulite probable hornblende granulite
7028 0242	70	30 (Orthoclase–Plagioclase)										1																		1		Blastomylonite
CORRY MASSIF																																
7128 0004	✓					✓						✓					✓										✓			✓		Granulite - slightly retrograded.
7128 0005	✓	✓				✓						✓										✓					✓		Tr	✓		Probable granulite
7128 0006	✓		✓							✓		✓					✓						✓		✓		✓		Tr	✓		Probably Hornblende Granulite - much retrograded
7128 0026			✓											Tr																		Calc Silicate rock
7128 0027	✓		✓			✓						✓																		Tr		Gneissic granite – Probably granulite facies
CROHN MASSIF																																
7128 0001	✓	✓				✓						✓					✓										✓	Tr		Tr		Slightly retrogressed banded granulite facies rock
7128 0002	✓		✓			✓			Tr			✓															✓		Tr			Probably hornblende granulite facies rock.
7128 0003	✓					✓						✓					✓										✓	Tr	Tr	✓		Retrogressed Charnockite.
CUTCLIFFE PEAK																																
7128 0009	✓					✓	30						✓			✓	✓													✓		Amphibolite - probably dyke rock metamorphosed under hornblende granulite facies.
0010	✓	✓				✓	15		Tr			✓																✓	✓	✓		Medium grained granite
ELLYARD NUNATAK																																
7028 0026	30	12				20			Tr			5					✓					30								Tr	+ Rutile	Hornblende granulite facies or amphibolite facies. Slight retrograde alteration.

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Specimen Number	Quartz	Orthoclase	Microcline	Undiff. K-Feldspar	Perthite	Plagioclase	% An	Chloritoid	Chlorite	Muscovite	Stilpnomelane	Biotite	Hornblende	Amphibole	Staurolite	Clinopyroxene	Orthopyroxene	Kyanite	Andalusite	Sillimanite	Cordierite	Garnet	Calcite	Wollastonite	Forsterite olivine	Epidote	Apatite	Sphene	Zircon	Opaques	Other Minerals	COMMENTS
FOALE NUNATAK																																
7028 0508	20					40			Tr	Tr		30										10					1					Probable Hornblende granulite
7028 0510	20		45			25						10					Tr										Tr		Tr			Acid vein rock in migmatite. Probable hornblende granulite.
HARRISS RIDGE																																
7028 0516	15					45						10					10					15					Tr					Probable granulite Hornblende granulite facies
7028 0517	20					50						10										15										Possible granulite but not diagnostic
HARVEY RIDGE																																
7128 0036	✓				✓																											Pegmatite rock
7128 0235	30		50			17				Tr		2										1							Tr	Tr		Probable granulite.
HUSKY DOME																																
7128 0231	45					50						Tr					4										Tr			1		Slightly retrogressed granulite. Very strained rock
7128 0232	30		50			15				Tr		Tr										5								Tr		Probable granulite. Cataclasis structures strongly developed.
MACKENZIE PEAK																																
7028 0465	30	40				10						8										10					1					Augen gneiss with garnet augen. Probable granulite facies.
MARTIN MASSIF																																
7028 0044	30		✓ (60 together)		✓	✓			Tr	Tr		Tr					2													Tr		Slightly retrogressed granulite facies rock.
7028 0045	40		✓ (55 together)			✓			Tr	Tr		Tr				2	3													Tr		Retrogressed 2 pyroxene granulite.
7028 0047	10					50						1	15			10	15										Tr			1		Probable basic dyke rock metamorphosed hornblende gran.
7028 0048	35				50	10			3	Tr		Tr					2										Tr		Tr	Tr		Retrogressed granulite possibly hornblende granulite.
7028 0050	20		20		✓	20						1	12			7	10										Tr			Tr		Slightly retrogressed Hornblende granulite
7028 0052			?			50						Tr	40			10											Tr			Tr		Basic rock metamorphosed under hornblende granulite f. conds.
7028 0053	35		?			50										15											Tr			2		Clinopyroxene granulite
7028 0056									Tr					40			25								30						5% SPINEL	Metamorphosed ultrabasic rock. Amphibolite facies.
7028 0059	40		✓ (60 together)		✓	✓			Tr			Tr															Tr		Tr	Tr		Retrogressed granulite.
7028 0060	20		? (75 together)		?	✓			Tr				Tr			5											Tr		Tr	2		Basic rock metamorphosed under high grade conditions
MOORE PYRAMID																																
7028 0417						35						2	60															2		2		Amphibolite
7028 0420	25	50				10						7	7														Tr		Tr			Amphibolite facies rock with well developed banding
7028 0423	20	15				50						12	8														Tr		Tr			Banded amphibolite facies rock
7028 0492						40	30					10	45														1	3		1		Banded amphibolite
7028 0493	40		35		✓	25				Tr		2															Tr		Tr	Tr		Slightly foliated acid migmatite
7028 0494	12		70									12															5					Augen gneiss

Specimen Number	Quartz	Orthoclase	Microcline	Undiff. K-Feldspar	Perthite	Plagioclase	% An	Chloritoid	Chlorite	Muscovite	Stilpnomelane	Biotite	Hornblende	Amphibole	Staurolite	Clinopyroxene	Orthopyroxene	Kyanite	Andalusite	Sillimanite	Cordierite	Garnet	Calcite	Wollastonite	Forsterite Olivine	Epidote	Apatite	Sphene	Zircon	Opaques	Other Minerals	COMMENTS
MOORE PYRAMID – continued																																
7028 0496	15		70									8	5														Tr		Tr	Tr		Amphibolite facies gneiss Biotite formed after hornblende
7028 0498	25		60			6						4	6																			Biotite hornblende felsic gneiss amphibolite facies
7028 0500	30	55				4						10	Tr														Tr		Tr	Tr		Biotite bearing felsic gneiss Amphibolite facies
MT. BAKKER																																
7028 0541	25	10				20						5								2	5	30								3		Metamorphosed pelite Hornblende granulite facies
MOUNT BECHERVAISE																																
3989	✓	✓				✓						✓								✓	✓	✓										Pelitic gneiss. Hornblende granulite facies
7128-0019	✓		✓			✓						✓										✓										Garnet biotite gneiss
7128 0020	✓	✓																		✓		✓										Sillimanite garnet gneiss. Sillim probably formed from garnets in cataclasis
MT. BEWSHER																																
3984	✓		✓	,	✓	✓	40			✓		.																				Pegmatite
7028 0083	25					55						10					10										Tr			Tr		Hornblende granulite facies
70280084	20	45				30						3					2										Tr			Tr		Hornblende granulite facies possibly retrogressed
70280085	35		40			20						3										1					Tr	Tr	Tr	1		Probable Hornblende granulite.
70280086	35		10			30						12	12			Tr											Tr		Tr	Tr		Banded gneiss possibly amphibolite
70280091	30	10				40			Tr			10					8										Tr		Tr	Tr		Hypersthene - biotite gneiss Hornblende granulite facies
70280092	45					55						1					1										Tr			Tr	?RUTILE	Acid band in banded rock. Possibly due to mm!c segregation. Granodiorite comp
70280092A						50						8	15			10	15													2		Basic band in banded rock Possibly mm'c segregation
70280098	3					45						Tr				15	30													5		2 pyroxene basic granulite facies rock with slight retrogression
70280099	25		55			15			Tr	Tr	Tr	Tr										7							Tr	Tr		Probable granulite with slight retrogression
70280102	✓				✓	✓				Tr	Tr	✓								✓	✓	✓							Tr	✓		Metamorphosed pelitic rock Hornblende granulite facies
70280103						40			1			.	30			20	10										Tr			1		Amphibolite - possibly metamorphosed basic igneous.
70280106	Tr					45			Tr	Tr	Tr	20	5			10	20													2		Basic gneiss - originally basic igneous rock
70280108	25				30	20						8										15					Tr			1		Biotite garnet gneiss
MOUNT CARTLEDGE																																
70280265	22	✓			30	30						6					8					5									Plagioclase is antiperthite	Probably Hornblende granulite facies
MOUNT DOVERS																																
7028 0518	40				30	4						7								7	1	12								.		Originally pelitic sediment Hornblende granulite facies
MOUNT EATHER																																
7028 0070	30			?10		50						2	Tr			4	6										Tr		Tr	3		2 pyroxene granulite. Hornblende granulite facies slight retrogression.
70280072	20			15		40						10	10			1	1										Tr		Tr	3		Retrogressed 2 pyroxene granulite.

Specimen Number	Quartz	Orthoclase	Microcline	Undiff. K-Feldspar	Perthite	Plagioclase	% An	Chloritoid	Chlorite	Muscovite	Stilpnomelane	Biotite	Hornblende	Amphibole	Staurolite	Clinopyroxene	Orthopyroxene	Kyanite	Andalusite	Sillimanite	Cordierite	Garnet	Calcite	Wollastonite	Forsterite olivine	Epidote	Apatite	Sphene	Zircon	Opaques	Other Minerals	COMMENTS
MOUNT EATHER (continued)																																
70280073						10			Tr				15			25	50						Tr							Tr		Metamorphosed ultrabasic Hornblende granulite facies
MT. EDWARD																																
70280263	50					35				Tr		15										4					1					Slightly retrogressed biotite garnet banded gneiss
MT. FORECAST																																
71280201	35					45	50					Tr	7			7											Tr			6		Retrogressed granulite
71280202						55	40					20	1			25													Tr	Tr		Basic gneiss Hornblende granulite facies.
MT. GARDNER																																
3979	✓				✓	✓	20					✓	✓			✓	✓										Tr			✓		Banded basic gneiss Hornblende granulite.
3481	Tr					✓	20					✓	✓			✓	✓															Basic band probably Amphibolite.
MT. GASTON																																
70280504						60						Tr	15				25													2		Metamorphosed dyke rock. Hornblende granulite facies
MT. CAVAGHAN																																
71280016	✓	✓				✓											✓										✓			✓		Charnockite
71280017						✓						✓	✓				✓										✓					Hornblende Granulite facies. Amphibolite
MT. JACKLYN																																
70280256	20	55				5						5					8					5					1					Sheared and crushed Hornblende granulite
MT. KIRKBY																																
71280007																																Unmetamorphosed basic dyke rock
71280008	✓		✓			✓				✓																						Slightly retrogressed microcline pegmatite
MT. LECKIE																																
70280076				10		40						30				12	8															Metamorphosed basic igneous rock. Hornblende granulite facies
70280078	35			30		30			Tr			Tr					5										Tr		Tr	Tr		Granulite or Charnockite.
MT. LITTLE																																
71280021	✓	✓				✓	10		Tr			✓	✓																	✓		Banded gneiss strongly sheared and retrogressed
71280022	✓	✓	✓			✓						✓																	✓	✓		Pegmatite
71280023	✓					✓	30						✓			✓														✓		Amphibolite
MT. McGRATH																																
70280112	✓					✓						✓																				Banded biotite gneiss from migmatite area
70280113	40	20				25						10										5							Tr	Tr		Biotite garnet gneiss from migmatite area
70280115						Tr						10				45	45															Ultramafic gneiss,
70280117	5					40						25					25															Basic gneiss Hornblende granulite facies
70280118						2						15				35	35														15% Talc	Retrogressed ultramafic gneiss
MT. MacMAHON																																
71280206	25		45			15			2	5		10																	Tr	2		Granite gneiss – Hornblende granulite facies
71280209	45		15		15	15				3												7										Garnet-Quartz-feldspar granofels.
71280210	45					30						5	2				15										Tr		Tr	3		Hypersthene plag schist Hornblende granulite facies

Specimen Number	Quartz	Orthoclase	Microcline	Undiff. K-Feldspar	Perthite	Plagioclase	% An	Chloritoid	Chlorite	Muscovite	Stilpnomelane	Biotite	Hornblende	Amphibole	Staurolite	Clinopyroxene	Orthopyroxene	Kyanite	Andalusite	Sillimanite	Cordierite	Garnet	Calcite	Wollastonite	Forsterite Olivine	Epidote	Apatite	Sphene	Zircon	Opaques	Other Minerals	COMMENTS
MT. Mac MAHON (continued)																																
7128 0211						35	48					10	35			10	10										Tr					Amphibolite. Hornblende granulite facies
7128 0214						45	46					5	20			14	14										Tr			2		Meta dolerite Hornblende granulite facies
7128 0215	60					25	46					7					7										Tr			Tr		Foliated Hypersthene biotite gneiss. Hornblende granulite f.
7128 0217	50		50			10	38		Tr			4										15					Tr		Tr	1		Garnet-biotite gneiss slight retrogression Hornblende granulite f.
MT. MERVYN																																
7128 0014	✓		✓			✓	30					✓										✓								✓		Biotite plagioclase gneiss
7128 0015	✓		✓			✓				✓		✓																				Pegmatite - slightly retrogressed
MT O'SHEA																																
7028 0462	35				45	3				Tr		2								4		5										Banded rock with alumina rich bands. Slightly retrograded Probable Granulite facies.
7028 0463	25	25			✓	15						15								2	8	8										Metamorphosed pelitic rock Hornblende granulite facies
MT. PETER																																
7028 0521	25	30				10						10								2	2	20										originally pelitic rock metamor; under Hornblende granulite f.
MT. SEEDSMAN																																
7028 0457	25				✓	40						18					15															Basic biotite hypersthene granulite. Hornblende granulite
7028 0458	30	50			✓	10						3										5										Garnet biotite migmatite
MT. STALKER																																
7028 0257	✓					✓						✓										✓										Sheared biotite garnet banded gneiss
7028 0259	22				40	20						2										16										Biotite garnet augen gneiss
MT. TURNBULL																																
7028 0432	25		10			45						5					5					10										Garnet granite gneiss Hornblende granulite facies
MT. WISHART																																
7028 0005	35					1						65								1		Tr					Tr		Tr		Tr Allanite	Biotite rich basic gneiss Probably original sediment
7028 0412	30					25						20									8	15								2		Banded gneiss of pelitic origin Probably amphibolite facies
7028 0413	40	20				10				25		3										2										Sheared pegmatite probably metamorphosed under amphibolite facies conditions.
7028 0522	25	30				30						5	Tr				10										Tr		Tr	Tr	Tr Allanite	Retrogressed granulite.
7028 0523	Tr					Tr																	90						Tr		5% Scapolite	Calc silicate rock
7028 0528	Tr					8						8*		2		60													Tr		25% Scapolite	*Biotite & phlogopite Calc silicate gneiss
7028 0531						30						15*				55																* Phlogopite. Calc Silicate
THOMAS NUNATAKS																																
7128 0012	✓		✓			✓						✓	✓																			Augen gneiss Probable Hornblende granulite
7128 0013	✓	✓				✓	25					✓															✓					Biotite plagioclase gneiss. Probable Hornblende gran.
VRANA PEAK																																
7028 0426	40				20	30						Tr					10												Tr			Granulite or Charnockite
7028 0427	35					45						Tr	20			20	10										3		1			Basic granulite Hornblende granulite facies

Specimen Number	Quartz	Orthoclase	Microcline	Undiff. K-Feldspar	Perthite	Plagioclase	% An	Chloritoid	Chlorite	Muscovite	Stilpnomelane	Biotite	Hornblende	Amphibole	Staurolite	Clinopyroxene	Orthopyroxene	Kyanite	Andalusite	Sillimanite	Cordierite	Garnet	Calcite	Wollastonite	Forsterite Olivine	Epidote	Apatite	Sphene	Zircon	Opaques	Other Minerals	COMMENTS
AMERY PEAKS																																
70280279	35			15	✓	30						6					12										Tr		Tr	2		Slightly retrogressed Charnockite. Gneissic texture
70280283																80							15								Tr Talc 3% Phlogopite	Calc Silicate
70280285	30			50					5	Tr		Tr					9						5						Tr	1		Sheared and retrogressed hypersthene granulite.
70280292	30				40	20						Tr					7										Tr		Tr	1		Slightly retrogressed Charnockite
70280293	35				40	20						Tr					5															Slightly retrogressed foliated hypersthene granulite.
70280294	10			20		40						1				12	8										2			7		Slightly retrogressed basic granulite facies rock.
70280295	25			35								Tr	2			3	12										Tr		Tr	3		Slightly retrogressed 2 pyrox granulite facies rock.
70280296						45										20									25		Tr			5		Olivine basalt. Possible greensch metamorphism
70280301		25			✓	40						25															1			6	4% Spinel	
70280312	35				45	20			Tr			Tr					1										Tr			1		Slightly retrogressed granulite facies rock.
70280313	25	30				35						Tr					5										Tr		Tr	5		Slightly retrogressed granulite
70280314	✓	✓				✓										✓	✓										Tr		Tr	✓		Mylonitized pyroxene granulite.
70280316						5						10				35	50													Tr		Metamorphosed ultrabasic ? Granulite facies
70280317	7	12				45						1	1			10	20										1			3		Slightly retrogressed basic granulite facies rock
71280101	✓	✓			✓	✓																✓										Garnet Qtz feldspar gneiss
71280104	✓	✓	✓			✓	25										40															Slightly retrogressed basic granulite facies rock. ?Metadolerite.
71280105	40	20	30		✓	10	30																									Granite gneiss
BASELINE NUNATAKS																																
347X	✓				✓	✓						✓									✓								Tr	1		Hornblende granulite facies gneiss of pelitic origin
FOX RIDGE																																
69280103	40				45	10						2										3								Tr		Biotite garnet gneiss shows cataclesis structures
69280105						30	60									40	25													5		2 pyroxene basic granulite
69280223	40				40	20						2										1					Tr		Tr	Tr		Augen gneiss
69280224	30		20			45	30					5										2					Tr		Tr	Tr		Augen gneiss
69280226A	10											Tr								40	10									10	1% Corundum 3% Rutile 20% Spinel	Spinel rich gneiss of pelitic origin
69280226B	35		30			Tr						1						Tr		10	10	15								2		Same rock as above but spinel poor band.
69280227	40		45		45	15	15			1		3														Tr				Tr		Slightly retrogressed augen gneiss

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Specimen Number	Quartz	Orthoclase	Microcline	Undiff. K-Feldspar	Perthite	Plagioclase	% An	Chloritoid	Chlorite	Muscovite	Stilpnomelane	Biotite	Hornblende	Amphibole	Staurolite	Clinopyroxene	Orthopyroxene	Kyanite	Andalusite	Sillimanite	Cordierite	Garnet	Calcite	Wollastonite	Forsterite Olivine	Epidote	Apatite	Sphene	Zircon	Opaques	Other Minerals	COMMENTS
FOX RIDGE										2						15									10							PHENOCRYSTS LAMPROPHYRE
69280225						✓								✓																		GROUNDMASS
69280228	40				45	15	15			1		3														Tr				Tr		Retrogressed high grade metamorphic
JETTY PENINSULA																																
69280155	45		25		✓	45			3	1												2	5						Tr	Tr	Tr Zeolite	Retrogressed quartz feldspar granulite. (Mineral ident. as altered feldspar may be cordierite)
69280156	10 to 50					20	50			3				Tr		10							Tr					Tr		Tr	5 to 40% SCAPOLITE	Slightly retrograde basic granulite or calc silicate.
69280157						30	45		→5	Tr		2	60	10														Tr		Tr		Slightly retrogressed amphibolite
LOEWE MASSIF (including Mt. Loewe)																																
3985	✓	✓				✓																				✓						Altered granite
3986						✓			✓							✓	✓															Basic band in charnockite now altered by retrograde mm.
70280043	20	35				30						10															2		Tr	3		Possibly retrograde charnockite K feldspar in large crystals now altered
70280254	25				30	25						5					10										Tr		Tr	1		Slightly retrogressed biotite charnockite
70280451	40				50	Tr														10										Tr	Tr Spinel	High
R7868	20				40	25						6					5										2		Tr	2		Biotite charnockite. Much cataclasis
MANNING MASSIF																																
69280229	30				20	35	40					5					10					1					Tr			Tr		Biotite charnockite. Shows cataclasis structure.
70280246	40					35						Tr					20					5					Tr			1		Slightly retrogressed granulite facies rock.
70280247						40						1	20			20	20													1		Slightly retrogressed hornblende granulite facies rock.
70280249	35				40	25						Tr																	Tr	1		Acid band in banded mafic? Probable high grade
70280250																90											2				10% Phlogopite	Calc Silicate
70280252	35				25	25			Tr			Tr					10						T				Tr		Tr	2		Slightly retrogressed granulite facies rock.
70280253	20				65	5			Tr	Tr							5						Tr						Tr	Tr		Slightly retrogressed banded granulite facies rock.
70280254	25				30	25			Tr			5					10										Tr		Tr	1		Slightly retrogressed biotite bearing charnockite
70280441	35			10		35							5			3	5										Tr			5		Retrogressed 2 pyroxene granulite facies rock.
70280442						60						30										10					Tr		Tr	Tr		Garnet biotite gneiss.
70280448	10					50						Tr				10	25										Tr			5		Slightly retrogressed two pyroxene granulite
71280138	40		10		30	15						Tr					5													Tr		Slightly retrogressed granulite facies rock.
71280139	10					40	35		Tr			Tr				15	25										Tr			Tr		Slightly retrogressed two pyroxene basic granulite

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Specimen Number	Quartz	Orthoclase	Microcline	Undiff. K-Feldspar	Perthite	Plagioclase	% An	Chloritoid	Chlorite	Muscovite	Stilpnomelane	Biotite	Hornblende	Amphibole	Staurolite	Clinopyroxene	Orthopyroxene	Kyanite	Andalusite	Sillimanite	Cordierite	Garnet	Calcite	Wollastonite	Forsterite Olivine	Epidote	Apatite	Sphene	Zircon	Opaques	Other Minerals	COMMENTS
MANNING MASSIF																																
71280140						55 {	48									15 / 20									Tr					10		Groundmass / Phenocrysts OLIVINE BASALT
MARTIN RIDGE																																
71280137	50				50							Tr					2												Tr	Tr	Tr Rutile	Retrogressed granulite.
MT. ABBS																																
71280122	50		5		40				Tr			Tr	Tr				5													Tr		Retrogressed hypersthene granulite
71280123	45				50							Tr					2													Tr		Retrogressed hypersthene granulite.
MT. AFFLICK																																
71280125	40		10	30	✓	10	30		2			3					5					Tr								Tr		Retrogressed biotite bearing hypersthene granulite.
MT. BUNT																																
71280124	30			10		10	30					10								Tr	20	15								Tr		Sillimanite garnet cordierite gneiss of pelitic origin. Hornblende granulite facies.
MT. HOLLINGSHEAD																																
3980	✓																					✓										Garnet bearing quartz dyke rock
3982						✓	30									✓															SPINEL	Calc Silicate.
MT. McCARTHY																																
69280043	3				15	80	35					Tr					5										Tr			Tr		Slightly retrogressed granulite.
69280044	45				25	25	35					Tr										3							Tr	1		Garnet bearing quartz feldspar granulite with well developed cataclasis textures.
69280045	20				20	40	44						2				10					7					Tr		Tr	2		Slightly retrograde hypersthene granulite.
69280050	5				10								2							15	40	30								Tr	Spinel Tr Rutile Tr	Aluminous garnet cordierite gneiss of pelitic origin. Hornblende granulite facies
69280053	10					5	50									25							35	10				2	Tr	Tr	15% SCAPOLITE	Calc Silicate
69280054	50				25	20	30			Tr		Tr					4													Tr	Rutile Tr	Slightly retrogressed hypersthene granulite.
69280055	40				40	18	45					Tr				2											Tr	Tr				Quartz feldspar gneiss with cataclasis and slight retrograde alteration.
69280056						40	65					3				45						10					Tr			Tr		Calc rich basic granulite facies rock with slight retrograde alteration. Possible Calc Silicate.
69280062						25	65						40			25	10													Tr		Amphibolite. Probably derived from basic igneous rock.
MT. McKENZIE																																
71280109	30		15		40	15	30					Tr					2													Tr		Retrogressed charnockite.
MT. TROTT																																
71280110	30			50	✓							5										15								Tr		Biotite garnet gneiss Cataclasis structures prominent.
71280111	40	30	5		✓	25	30															Tr								Tr		Granite gneiss from granite vein.
71280112	40		5	35	✓							7					10					3										Retrogressed garnet-hypersthene granulite facies rock.
71280113	35			5		40	38					10					20												Tr	Tr		Biotite-hypersthene granulite facies rock with cataclasis. Hornblende granulite facies
71280114	45	30	20		✓																	5								Tr		Foliated granite gneiss from banded sequence.
71280115						15	40									75														Tr	10% SPINEL	Calc Silicate
71280116	50			20		15	30					10					5					Tr								Tr		Garnet hypersthene biotite gneiss. Hypersthene granulite facies.

Specimen Number	Quartz	Orthoclase	Microcline	Undiff. K-Feldspar	Perthite	Plagioclase	% An	Chloritoid	Chlorite	Muscovite	Stilpnomelane	Biotite	Hornblende	Amphibole	Staurolite	Clinopyroxene	Orthopyroxene	Kyanite	Andalusite	Sillimanite	Cordierite	Garnet	Calcite	Wollastonite	Forsterite Olivine	Epidote	Apatite	Sphene	Zircon	Opaques	Other Minerals	COMMENTS
71280120	45			10	✓	25	30		5	Tr		5										5										Garnet gneiss. Biotite and chlorite pseudomorph another mineral. Possibly retrogressed rock.
71280121	15	10				35	38									25	10													5		Two Pyroxene granulite. Possibly metadolerite
MURRAY DOME																																
71280106	25		5			25	30					Tr					40													5		Slightly retrogressed basic granulite
71280107	40			45	✓	15	30															Tr								Tr		Leucocratic garnet gneiss. Granulite facies probable
71280108	30			15		25	30		Tr			Tr					25													5		Pyroxene granulite – Slight retrograde metamorphic effects
RADOK LAKE																																
69280064	40				60				Tr			Tr																	Tr	Tr		Probable granulite facies assemblage. Slight retrograde effts.
69280068	35					40	30					10		10													1		Tr	2		Amphibolite but probably retrograde granulite
69280070	60				35	2	30			Tr		Tr										3								Tr		Garnet bearing granulite now retrogressed
TAYLOR PLATFORM																																
71280126						50	40									35	5						Tr		Tr					Tr	Tr Glass	Tholeiitic basalt.
71280127	25					20	40						25			20							Tr					7		5	F Rutile	Amphibolite – metamorphosed basic igneous rock.
71280128	30				30	30			Tr			Tr										5										Garnet bearing granite gneiss. From pegmatite dyke
71280129	25		25	20		25						5										Tr							Tr	Tr		garnet bearing biotite granite from granite dyke.
71280131	45		10	25		15			Tr			5										Tr								Tr		Retrogressed biotite garnet gneiss, from biotite granite band.
71280132	25					20	35			Tr		20								Tr	20	5							Tr	Tr		Alumina rich gneiss of pelitic origin. Minor retrograde effects.
71280133	65			10		10	30		Tr	Tr		15										Tr								Tr		Garnet biotite gneiss with minor retrograde mm. effects.
71280134	40		10	25		15			Tr	Tr		10										Tr										Garnet biotite granite gneiss from granite band
71280135	45			20		20	28		Tr	Tr		10										Tr								Tr		Garnet biotite gneiss with minor retrograde effects.
71280136	30			40		20	30					Tr																		Tr		Biotite gneiss. Garnet in band spec. From granitic band
THOMSON MASSIF																																
71280141	40				30	20						Tr					Tr					5							Tr	Tr	Tr Rutile	Slightly retrograde charnockite. Very well developed cataclasis.
71280142	40			55													Tr					Tr							Tr			Sheared slightly retrogressed garnet bearing charnockite.
WHITE MASSIF																																
71280045	15					45	50					10					30															Hypersthene pegmatite from banded rocks on N. Side of Massif.
71280046	25	10				10						20									10	20							Tr	Tr		Cordierite biotite garnet gneiss of pelitic origin. Hornblende granulite facies.

Specimen Number	Quartz	Orthoclase	Microcline	Undiff. K-Feldspar	Perthite	Plagioclase	% An	Chloritoid	Chlorite	Muscovite	Stilpnomelane	Biotite	Hornblende	Amphibole	Staurolite	Clinopyroxene	Orthopyroxene	Kyanite	Andalusite	Sillimanite	Cordierite	Garnet	Calcite	Wollastonite	Forsterite Olivine	Epidote	Apatite	Sphene	Zircon	Opaques	Other Minerals	COMMENTS
ARMONINI NUNATAK																																
7128/0300	✓					✓	32						Tr			✓							Tr					✓		Tr		Mafic gneiss
7128/0301	✓	✓				✓	30			Tr		✓										✓							Tr	Tr		Biotite rich banded rock
0302	✓	✓	✓			✓			Tr	Tr		✓																				Slightly foliated granite
0303	15		5			30						15	30														Tr		Tr	Tr		Amphibolite
0304	12									Tr		85															Tr		Tr			Biotite rich segregation.
0305																															LAUMONTITE	Large boulders in moraine. Probably local derivation.
0306	20	10	40			10	30		Tr	Tr		12	✓									Tr					Tr			Tr		Foliated granite
0307	35	20	15			10			5	Tr		10											Tr				Tr		Tr	Tr		Granitic dyke rock. Biotite slightly altered to chlorite.
0308	✓	✓				✓	38		Tr			✓															✓		Tr	Tr		Banded gneiss. Mafic bands have amphibolite composition. Biotite altered to chlorite.
0309	✓	✓	✓			✓			Tr	Tr		✓															Tr		Tr			Banded biotite rich gneiss
0310	55		40		✓					Tr																				Tr		Foliated granite
0311	40		40		✓	10				Tr		Tr								✓		3										Pegmatitic segregation.
0312						Tr								Tr		Diops 90							Tr									Basic segregation in lens within gneisses
0313	20	35			✓	40				5																						Slightly foliated granitic gneiss.
0314	40					15			Tr	Tr		10																				Foliated biotite granite from dyke. Biotite altered to chlorite.
0315	30			30		10			Tr			15	8									Tr	✓					4	Tr	3		Sphene rich banded rock. Sphene formed by alteration of Ilmenite. Hornblende altered to Biotite.
0316	25	20	20			5			Tr	Tr		20															Tr	Tr	Tr	5		Acid gneiss with minor alteration of biotite to chlorite.
0317	✓													✓								✓	✓									Quartz-calcite garnet rock found in calc silicate nodule.
0318	30			30		15			Tr		~~10~~	10										Tr					Tr		Tr			Strongly banded foliated gneiss with biotite altered to chlorite.
0319						25				15									50			-									CORUNDUM 10%	Pegmatite segregation in gneiss. Assemblage unusual. May be good P/T indicator
7128/0419	✓																						✓	✓								All collected from calc silicate nodule on North side of mountain
0420	✓															Diops. ✓						✓	✓			Tr						(as above)
0421	✓					✓										Diops ✓						✓	✓			Tr						(as above)
0423	✓															Diops ✓						✓	✓	✓								(as above)
CHAPMAN NUNATAK																																
7128/0236	35		45			10	30					7																		3		Granite gneiss

Specimen Number	Quartz	Orthoclase	Microcline	Undiff. K-Feldspar	Perthite	Plagioclase	% An	Chloritoid	Chlorite	Muscovite	Stilpnomelane	Biotite	Hornblende	Amphibole	Staurolite	Clinopyroxene	Orthopyroxene	Kyanite	Andalusite	Sillimanite	Cordierite	Garnet	Calcite	Wollastonite	Forsterite Olivine	Epidote	Apatite	Sphene	Zircon	Opaques	Other Minerals	COMMENTS
MOUNT THOMAS																																
7128/0037	30			50	✓	5						5										5							Tr	Tr		Foliated garnet-biotite gneiss
7128/0237	55																					35					Tr			Tr		Metaquartzite
WALL PEAK																																
7128/0222	45		10			20			1			15										5							1	3		Black and white banded gneiss
7128/0224	30			30		20			Tr			5										10							Tr	Tr		Garnet plagioclase-K-feldspar Quartz granofels

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Specimen Number	Quartz	Orthoclase	Microcline	Undiff. K-Feldspar	Perthite	Plagioclase	% An	Chloritoid	Chlorite	Muscovite	Stilpnomelane	Biotite	Hornblende	Amphibole	Staurolite	Clinopyroxene	Orthopyroxene	Kyanite	Andalusite	Sillimanite	Cordierite	Garnet	Calcite	Wollastonite	Forsterite Olivine	Epidote	Apatite	Sphene	Zircon	Opaques	Other Minerals	COMMENTS
FISHER MASSIF																																
7128/0028	✓			✓		✓			Tr	Tr		✓											Tr					✓	✓	✓		Biotite granite
0029	✓			✓		✓			Tr	Tr		✓											Tr					✓	✓	✓		Finer grained Biotite granite.
0030	✓			✓		✓	30						✓																	✓		Amphibolite. Hornblende crystals contain inclusions like pyroxene
0031	✓					✓	30			Tr			✓													Tr				✓		Amphibolite
0038	✓					✓	2					✓	✓															✓		✓		Possible amphibolite xenolith in granite
0039	✓					✓	35						✓															✓		✓		Amphibolite
7128/0239	40					15	43			Tr		1	35													2		4		3		Metamorphosed tonalite. Probably a hybrid rock.
0240	20					13	50					10	50													2				5		Metamorphosed amygdaloidal basalt now amphibolite
0242	35					5						2	50													2				5		Amphibolite – metabasalt.
MOUNT COLLINS																																
7128/0041	✓			✓		✓	15					✓	✓													✓						Epidote rich amphibolite. Contains Pyroxene relicts.
0042	✓	✓	✓		✓	✓						✓															Tr		Tr	✓	Possible Rutile	Metamorphosed Granite.
0043	✓		✓	✓	✓	✓				Tr		✓	✓														✓		Tr	✓	Possible Rutile	Hybrid rock with mafic rich and poor layers. Hornblende sphene and biotite may replace Diopside
7128/0246	5		40		✓	10				Tr		10	10	✓		✓													2	5		Retrograde 2 pyroxene charnockite
0247						35	38			Tr		7	50										Tr				1		Tr	7		Metamorphosed dyke rock – Amphibolite
0394	✓					✓	45					✓	✓	✓		✓	✓						✓							✓		Metamorphosed dyke rock – Amphibolite
0395	✓			✓		✓						✓	✓				✓						✓				✓		✓	✓		Amphibolite. Relict pyroxenes.
0396	✓			✓		✓	32					✓	✓			✓							Tr						Tr	✓		Metamorphosed dyke rock – Amphibolite.
0397	✓					✓						✓				✓							Tr				Tr		Tr	Tr		Retrograde 2 pyroxene charnockite.
MOUNT GLEESON AREA																																
7128/0320	25	10	30	✓		20			Tr			5																	Tr	Tr		Biotite granite from dyke.
0321	40		30			20			3	3		4				Tr			Tr				Tr							5		Pegmatite with sillimanite.
0322	Tr					Tr			✓	✓																	Tr	Tr	Tr			Altered basic pod.
0323	20			10		10	40		10			✓	35	5												5				5		Amphibolite invaded by pegmatite dyke. Biotite selvage near dyke
0324	35			25	✓	15	10			Tr		15										Tr								Tr		Banded migmatite.
0325	35			25		20	30		Tr			15																	Tr	Tr		Augen gneiss.
0326	35			25		20	30			Tr		15										Tr					Tr		Tr	Tr		Augen gneiss

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Specimen Number	Quartz	Orthoclase	Microcline	Undiff. K-Feldspar	Perthite	Plagioclase	%An	Chloritoid	Chlorite	Muscovite	Stilpnomelane	Biotite	Hornblende	Amphibole	Staurolite	Clinopyroxene	Orthopyroxene	Kyanite	Andalusite	Sillimanite	Cordierite	Garnet	Calcite	Wollastonite	Forsterite Olivine	Epidote	Apatite	Sphene	Zircon	Opaques	Other Minerals	COMMENTS
MOUNT GLEESON AREA (contd)																																
7/23/0327	30			30		25	35			Tr		10										Tr							Tr	Tr		Augen gneiss
0328	30	20	15			20	33					10																				Biotite gneiss.
0329	20			20		15	50					5					10													Tr		Specular basic rock, Possibly retrogressed basic intrusive
0330	15			5		15				Tr		5					20													5		Amphibolite from metamorphosed basic dyke.
0331	25	25	5			10	30			Tr		✓										5					Tr		Tr	Tr		~~Coarse~~ Biotite-garnet Augen Gneiss
0332	35		35			20	30			Tr		10															Tr		Tr	Tr		Coarse grained biotite garnet gneiss
0333	✓					✓	35		Tr	Tr		✓																				Selvage at gneiss pegmatite contact.
0334	✓					✓	47					✓															Tr					Banded mafic gneiss
0335	30					25	33			Tr		30															Tr		Tr	Tr		Biotite rich mafic gneiss from close to edge of pegmatite.
0336	20					25	60					10	30																	Tr		Mafic band in migmatite.
0337	50					15	30					15																		Tr		Biotite gneiss
0339	33					20	33					15																		Tr		Biotite gneiss
0340	25					15	32			Tr		15																	Tr	5		Augen gneiss
0341	25					15	30		5	Tr		10										5								Tr		Banded migmatite. Biotite altered to chlorite.
0343	20					20	55			Tr		35	20													✓	Tr		Tr	Tr		Biotite rich amphibolite. Hornblende altered to Biotite.
0344	20					20	37		Tr	Tr		30										5					Tr		Tr	Tr		Mafic gneiss with Quartz augen.
0345	25					30	36			Tr		15										5							Tr	Tr		Banded mafic gneiss
0346	5					30	55			Tr		20	20	5			15										✓		Tr	Tr		Specular microbanded mafic gneiss
0347	✓					✓				Tr												✓										Acid pegmatite
0348	25					30	36			Tr		15																	Tr	Tr		Banded gneiss
0349	20					20	34			Tr		10																	Tr	Tr		Banded gneiss.
0410	✓					✓	32			Tr		✓																	Tr	✓		Augen gneiss
MOUNT KANYON																																
7/23-0398	✓	✓				✓							✓										✓			✓		✓				Sphene rich retrogressed amphibolite. Hornblende altered to epidote.
0399	✓		✓										✓										✓				✓		✓	✓		Calc silicate gneiss
0401	✓	✓	✓	✓		✓	30		Tr			✓	✓	✓		✓	✓						✓					✓		✓	RUTILE ILMENITE	Sphene rich calc silicate gneiss mainly Diopside. Sphene formed after Rutile and Ilmenite

Specimen Number	Quartz	Orthoclase	Microcline	Undiff. K-Feldspar	Perthite	Plagioclase	% An	Chloritoid	Chlorite	Muscovite	Stilpnomelane	Biotite	Hornblende	Amphibole	Staurolite	Clinopyroxene	Orthopyroxene	Kyanite	Andalusite	Sillimanite	Cordierite	Garnet	Calcite	Wollastonite	Forsterite Olivine	Epidote	Apatite	Sphene	Zircon	Opaques	Other Minerals	COMMENTS
MOUNT LANYON – CONT'D																																
7128/0402	✓		✓			✓	32						✓	✓									Tr					✓	✓	✓		Finely banded greenish coloured rock with abundant sphene.
MOUNT MEREDITH																																
7128/0352	25		20	20		20	20		2	5		5								3							Tr			Tr		Possible metaquartzite. Muscovite and Sillimanite in reaction relationship.
0353	25		35	20		5			5	5		5																	Tr	Tr		Acid gneiss. Biotite altered to chlorite and muscovite
0354	20		40	10		5	32		5	5		5																		Tr		Intrusive dyke rock. Biotite altered to chlorite and muscovite.
0355	20					25	60			5		15	35														Tr		·			Amphibolite. Biotite altered to muscovite and epidote. Hornblende fresh.
0356	✓	✓				✓	60			Tr		✓														Tr			Tr	Tr		Biotite gneiss. Biotite altered to epidote. Orthoclase sericitised.
0357	✓			✓		✓	42			Tr		✓										✓				✓				Tr		Banded garnet-biotite gneiss
0358	✓			✓		✓	30		✓	✓		✓														Tr				Tr		Biotite granite dyke rock. Biotite partly altered to chlorite.
0359	✓			✓		✓	32		✓	Tr		✓										✓							Tr	Tr		Biotite bearing acid gneiss. Biotite partly altered to chlorite opaques and muscovite.
0360	✓					✓	40					✓										✓							Tr			Garnet bearing banded biotite gneiss. Anatectic effects apparent.
0361	✓		✓			✓	30			✓		✓								✓		✓				✓			Tr	Tr		Banded gneiss with Biotite-garnet sillimanite bands and felsic bands. Biotite partly altered to muscovite.
0362	✓					✓	54			Tr		✓	✓	✓												Tr			Tr	Tr		Amphibolite – metamorphosed dyke rock. Hornblende altered to biotite. Biotite altered to epidote
0364	✓	✓	✓			✓			✓	✓		✓										✓	✓							Tr		Altered granite from dyke. Mafics altered to muscovite. Orthoclase sericitised.
0365	✓		✓	✓		✓						✓										✓										Garnet bearing sheared granite from dyke.
0366	✓		✓	✓		✓			Tr			✓														Tr	Tr		Tr	Tr		Banded biotite gneiss
0367	✓	✓				✓	34					✓	✓													Tr	Tr	Tr	Tr	Tr		Amphibolite from foliated basic pod. Biotite probably formed from Hornblende.
0368	✓	✓	✓			✓	32			✓		✓										✓				Tr			Tr	Tr		Garnet bearing granite. In field clots and segregations of biotite and garnet.
0369	✓	✓				✓	42			Tr		✓	✓													Tr	Tr		Tr	Tr		Amphibolite. From basic band in banded gneiss. Hornblende altered to Biotite. Biotite altered to muscovite.
0370	✓	Tr	✓			✓	33		Tr	Tr		Tr																	Tr	Tr		Granite from dyke
0371	✓	✓	✓			✓				✓												✓								Tr		Garnet bearing altered granite dyke rock. Plagioclase very altered.
0372	✓		✓			✓	54						✓	✓			✓										Tr		Tr	Tr		FLOAT SPECIMEN. Garnet seen in hand specimen but not in T/S. Orthopyroxene replaced by Hornblende.
0373						✓	52					Tr	✓															✓	Tr	Tr		FLOAT SPECIMEN. Sphene rich amphibolite.
0374	✓	✓	✓			✓			Tr	✓		✓										✓				Tr			Tr	Tr		Biotite garnet bearing foliated acid gneiss.
0375	✓	✓	✓			✓			Tr	✓		✓										✓				Tr			Tr	Tr		Garnet biotite bearing granite. Garnet altered to Biotite
0376	✓	✓	✓			✓	28		Tr	Tr		✓																	Tr	Tr		Biotite granite from dyke rock.

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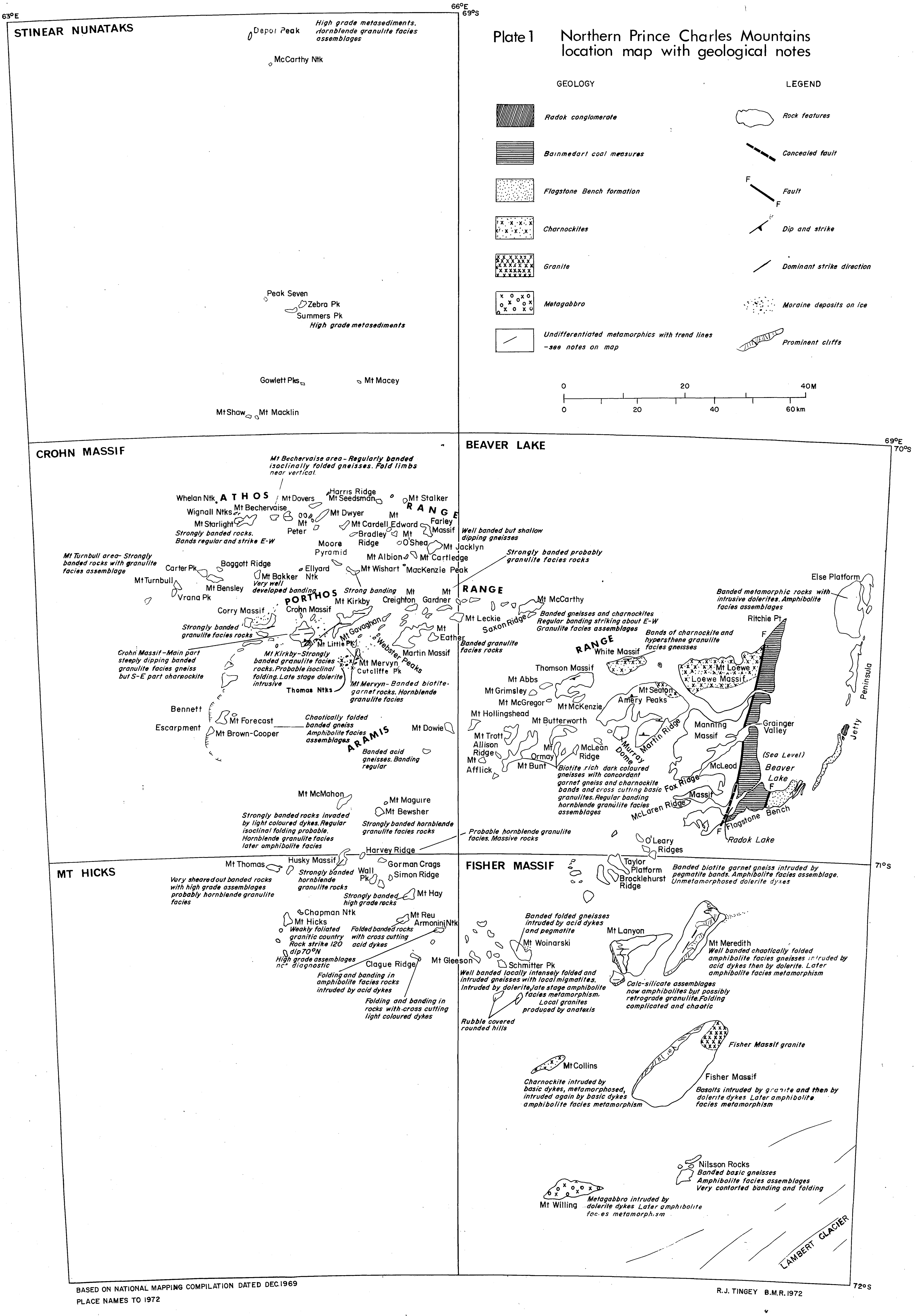
Specimen Number	Quartz	Orthoclase	Microcline	Undiff. K-Feldspar	Perthite	Plagioclase	% An	Chloritoid	Chlorite	Muscovite	Stilpnomelane	Biotite	Hornblende	Amphibole	Staurolite	Clinopyroxene	Orthopyroxene	Kyanite	Andalusite	Sillimanite	Cordierite	Garnet	Calcite	Wollastonite	Forsterite olivine	Epidote	Apatite	Sphene	Zircon	Opaques	Other Minerals	COMMENTS
MOUNT MEREDITH - continued																																
7128/0377	✓	✓				✓	42		Tr	Tr		✓										✓					Tr		Tr	Tr		Foliated acid gneiss. Along strike from 7128/0374
0378	✓	✓	✓			✓			Tr	Tr		✓										✓					Tr		Tr	Tr		Garnet-biotite bearing acid gneiss. Garnet altered to biotite and chlorite
0379	✓		✓			✓				Tr		✓								✓	✓	✓							Tr	Tr		Dark brown pelitic gneiss. Biotite partly altered to muscovite
0380	✓	✓				✓	40					✓										✓							Tr	Tr		Banded garnet-biotite gneiss. Mafic band sample.
0381	✓			✓								✓																				Crushed sheared quartz feldspar rock. Not found in outcrop. Possible erratic
0382	✓		✓							Tr																						Concretionary rock possibly infilling joint or fault plane.
0383	Tr					✓	58					✓	✓																	Tr		Basic pod. Amphibolite. Rock from face, extensively invaded by granite veins.
0384	✓	✓	✓			✓	46					✓								✓		✓							Tr	Tr		Specimen of banded gneiss. Possible pelitic composition.
0385	✓					✓			Tr	Tr		✓								?		✓							Tr	Tr		Crushed and sheared rock from near intrusive contact.
0388	✓	✓	✓			✓	32					✓																	Tr	Tr		Biotite granite FLOAT
0390	✓	✓	✓			✓			Tr	Tr		✓																	Tr	Tr		Spotted granite with biotite-garnet clots
0391	✓	✓	✓			✓			✓	Tr		✓														?Tr			Tr	Tr		White Granite from east end of mountain. Rock is sheared.
0392	✓		✓	✓		✓			Tr	✓		✓										✓	Tr						Tr	Tr		Sheared banded gneiss. Biotite fairly fresh.
0393	✓	✓				✓				Tr						✓						✓	Tr						Tr	Tr		Mafic band from banded gneiss. Possibly calc-silicate.
MOUNT WILLING																																
7128-0032	✓					✓				Tr		✓																		Tr		Pegmatite
0033	✓					✓			Tr			✓																		Tr		Pegmatite
0034	✓											✓																				Quartz rich core of pegmatite
0227						45	42					5	7	20		10											5			8		Meta gabbro. Augite replaced by hornblende and tremolite.
0228	35		45		✓	10	30					5																	Tr	Tr		Aplite dyke rock. Slightly sheared and metamorphosed.
0229	5					45	43					5	35														Tr			10		Amphibolite from metamorphosed basic dyke.
0230	45		10			30	32					13															Tr	2		Tr		Metamorphosed acid dyke rock. Granodiorite composition.
MOUNT WOINASKI																																
7028/0613	10					30						15	Tr			10	30															Basic granulite with pyroxenes altered to biotite and hornblende. Probable altered lava.
0615	10		80			Tr			Tr			10																				Felsic band associated with 7128/0613. Probably anatectic.
0618	15		20			5						25								2	15	10										Mafic gneiss of pelitic origin
0620	15		50			15						15										5										Banded garnet biotite gneiss.

Specimen Number	Quartz	Orthoclase	Microcline	Undiff. K-Feldspar	Perthite	Plagioclase	% An	Chloritoid	Chlorite	Muscovite	Stilpnomelane	Biotite	Hornblende	Amphibole	Staurolite	Clinopyroxene	Orthopyroxene	Kyanite	Andalusite	Sillimanite	Cordierite	Garnet	Calcite	Wollastonite	Forsterite Olivine	Epidote	Apatite	Sphene	Zircon	Opaques	Other Minerals	COMMENTS
MOUNT WOINASKI - continued																																
7028/0622	20	10	30	10		15						10										5								Tr		Weakly foliated garnet bearing granite from dyke. Garnet altering to biotite.
0623	20		40			15						20										5							Tr	Tr		Banded migmatite.
0630	25					25			Tr	Tr		20								5	25	10							Tr	Tr		Banded mafic gneiss of pelitic origin.
0633	✓			✓		✓				✓						✓						✓	✓	✓				✓			? Clinozoisite. ? Scapolite	Calc silicate rock from fold nose.
NILSSON ROCKS																																
7128/0244	8					40	36		Tr			25	25														Tr			2		Amphibolite layer from banded rock.
0245	8					35	54						5			40										1	Tr	10		1	Ilmenite	Calc silicate gneiss. Diopside and sphene concentrated in layers.
0403						✓	42						✓	✓													Tr	Tr	Tr	Tr		Amphibolite layer from banded gneiss.
0404	✓					✓			Tr			✓														Tr	Tr		Tr	Tr		Banded gneiss
0405	✓	✓				✓	42						✓	✓														Tr	Tr	Tr		Acid gneiss with scattered mafics. Hornblende contains inclusions like schiller inclusion of pyroxene.
SCHMITTER PEAK																																
7128/0350	30	15		25		15	32		Tr	5		10																	Tr	Tr		Banded biotite bearing acid gneiss. Biotite altered to chlorite. Feldspar sericitised.



BASED ON NATIONAL MAPPING COMPILATION DATED DEC.1969
PLACE NAMES TO 1972

R.J. TINGEY B.M.R.1972

To accompany Record 1972/132

AN/2/102