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Bureau of Mineral Resources, Geology and Geophysics,
Department of Minerals and Energy,
Canberra, Australia.

Geologists seconded from the Bureau of Mineral Resources to the Australian National Antarctic Research Expedition (ANARE) have been mapping the Prince Charles Mountains at 1:250 000 scale in summer field seasons since the 1968-69 austral summer. The Prince Charles Mountains north of latitude 72°S were mapped in the 1968-69, 1969-70, and 1970-71 seasons; the southern Prince Charles Mountains were mapped in the 1971-72 and 1972-73 seasons. Transport in the field is by Hughes 500 helicopter and Pilatus Porter fixed wing aircraft. ANARE field operations in the Prince Charles Mountains are multidisciplinary; geological mapping, topographic surveying and glaciology are the major activities, but minor programs of geophysics, biology, photography, and medical research have been completed. In addition to mapping, the geologists have made gravity meter and barometer readings, and collected lichens.

Reconnaissance trimetrogan aerial photography of the Prince Charles Mountains was flown in the 1950's and 1960's, but has proved to be of limited use for geological mapping. Maps prepared from this photography have been found to be planimetric only. Systematic vertical aerial photography of the southern Prince Charles Mountains was flown in the 1972-73 season. Excellent photographs, some of them in colour, were obtained, and are being used for photogeological interpretation. Improved base maps should result from use of the new photography.

Soviet Antarctic Expedition parties worked in the Prince Charles Mountains in the 1971-72 and 1972-73 seasons, and some have visited the Australian base camp. Australians have visited Soviet camps during the

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field season, and have held interesting and informative discussions. Further contacts were made during the visit of Professor Ravich and Dr Grikurov, of the Research Institute of Arctic and Antarctic Geology, Ministry of Geology, Leningrad, USSR, to Canberra in August 1973.

Reconnaissance geological exploration of the Prince Charles Mountains was reported by Crohn (1959), McLeod (1964), Ruker (1963), and Trail (1964 a,b). The results of Australian reconnaissance mapping were summarized by Cradock (1972), who showed that the Prince Charles Mountains consisted of a basement metamorphic complex with a small enclave of Permian sediments near Beaver Lake. Cradock indicated a decrease in metamorphic grade from north to south through the mountains, and showed a few granite intrusions in the southern Prince Charles Mountains. Soloviev (1972) reported Soviet mapping in the southern Prince Charles Mountains, and described low-grade jaspilitic rocks from Mount Ruker.

In the 1968-69 field season a few areas of high-grade basement rocks in the northern Prince Charles Mountains were examined, and sediments of the Amery Group were mapped in detail near Radok Lake (Mond, 1972). Kemp (1973) examined spores from the sediments, and concluded that they were of Upper Permian age. Coal samples were analysed by Bennett & Taylor (1972), and White (1973) examined plant fossil samples. The Amery Group exposure around Beaver Lake is the lowest area of exposed rock in the Prince Charles Mountains; the rock surface is planed off at about 200 m, and Beaver Lake itself is brackish and tidal. More recent mapping has shown that Permian sediments are not exposed elsewhere in the Prince Charles Mountains, although fragments of Permian rocks have been found in moraine at Mount Rymill in the southern Prince Charles Mountains (Ruker, 1963). Evidently Permian sediments occur only at low topographic levels in the Prince Charles Mountains.

Mapping of the basement metamorphic complex continued in the Prince Charles Mountains north of 72°S during the 1969-70 and 1970-71 field seasons. At the end of the 1970-71 season, mapping of the northern part of the Prince Charles Mountains was virtually completed and compilation of the 1:250 000 geological maps was started. In 1972 preliminary edition geological maps of the northern Prince Charles Mountains and nearby Stinear Nunataks were issued.

The northern Prince Charles Mountains geological surveys have confirmed the presence of metamorphosed pelites and limestones in the gneisses of the basement. It has been established that there is a decrease in metamorphic grade from the Athos, Porthos, and northeast Aramis Ranges, where granulite facies mineral assemblages predominate, southwards to the Mount Meredith/Mount Lanyon/Mount Woinarski area, where metasediments of the upper amphibolite facies show many signs of anatexis during metamorphism. Metabasic rocks in the Fisher Massif area have amphibolite facies mineral assemblages, but have not been affected by anatexis, presumably because of their composition.

The presence of sillimanite and the absence of kyanite in metamorphosed pelites in the northern Prince Charles Mountains-Stinear Nunataks area indicate that high-temperature and moderate-pressure metamorphic conditions prevailed; no eclogite-facies assemblages were seen in metabasic rocks.

The metamorphic basement rocks are intersected by basic dykes, some of which are completely amphibolitized. Unaltered basic dykes have also been found, and Cretaceous alnöite dykes (110 m.y.) intrude the Permian sediments at Radok Lake (Mond, 1972). Basic boudins and bands in the basement gneiss are thought to be, at least in part, remnants of very early basic intrusives.

In the 1971-72 season a geological reconnaissance of the southern Prince Charles Mountains was completed. Fuchsite-bearing quartzite found at Mount Stinear is correlated with similar quartzite at Mount Menzies (Trail, 1964b), and confirms the extent of the Menzies Series as shown by

Soloviev (1972). Metamorphic grades in the southern Prince Charles Mountains range from lower greenschist facies at Mount Rubin and Mount Dummett to upper amphibolite facies at Mount Cresswell, Mount Johns, and the central Mawson Escarpment. Remnants of possible granulite facies rocks were mapped at Mount Newton.

Lower amphibolite facies metamorphism at high pressures and moderate temperatures produced kyanite-staurolite assemblages in metapelites, and blue-green hornblende in amphibolites, at Mount Menzies, Mount Scherger, and Mount Stinear. Muscovite granite intrusions at Mount Scherger have converted part of the kyanite to sillimanite; elsewhere retrograde metamorphism is evident. For example, at Mount Menzies kyanite-staurolite assemblages have been partly converted to greenschist facies assemblages containing chlorite, chloritoid, sericite, and possibly pyrophyllite. Chloritoid-bearing greenschist facies metapelites mapped at the southern end of Mount Newton are considered to be retrograde equivalents of the nearby higher-grade metasediments that contain garnet, cordierite, and sillimanite, and are preserved as rafts within an injection gneiss.

The 1971-72 mapping thus showed that (1) the Menzies Series (Soloviev, 1972) extends at least as far as Mount Stinear; (2) kyanite-staurolite grade metamorphism took place in the southern Prince Charles Mountains; and (3) evidence of polymetamorphism is widespread.

These results provided a basis for the 1972-73 field season, when an extensive program of geological mapping was undertaken in the southern Prince Charles Mountains. Geologists attached to ANARE visited all outcrops in the southern Prince Charles Mountains, and obtained a large collection of rock samples. Final results of laboratory investigations are not yet (November, 1973) available, but field observations showed that the Menzies Series is more widely distributed, and the range of metamorphic grades greater, than previously demonstrated. Locally the geology is complicated by intrusions, anatexis, and polymetamorphism.

GLACIATION

Trail (1964a) described the glacial geology at the Prince Charles Mountains in detail, and concluded that the exposure of the Prince Charles Mountains was due to the effectiveness of the Lambert Glacier-Amery Ice Shelf ice drainage system. He observed that 1) most mountains in the southern Prince Charles Mountains - that is, south of latitude 72°S - have broad summit plateaux mostly bounded by cliffs or steep slopes; and 2) the ratio of mountains with 'broad-plateau' summits to those with 'small-area' summits decreases northwards through the Prince Charles Mountains.

Concordant summit levels in the northern Prince Charles Mountains were illustrated by Trail (1964a), and interpreted by Crohn (1959) as remnants of an old erosion surface. Trail (1964a) regarded plateau summits in the souther Prince Charles Mountains as remains of a pre-glaciation erosion surface that had been glaciated.

Recent mapping has shown that most summit levels in the southern Prince Charles Mountains are roughly concordant, and confirmed that they have been glaciated. It is not known if the concordant summits are remnants of an old glacial erosion surface, but glacial striae, roches moutonnees, and moraine deposits are widespread. The striae indicate that ancient ice flow was approximately parallel to present-day flow in the Lambert Glacier—Amery Ice Shelf ice drainage system. Vertical cliffs bounding many mountains in the southern Prince Charles Mountains were probably formed during rapid, and possibly recent, depression of the regional base level of ice erosion. The base-level depression accompanied a rise of the continent relative to the sea and was probably associated with a reduction of the size of the local ice cap.

The magnitude of the ice level depression in the Lambert Glacier—Amery Ice Shelf area is indicated, for example, by the preservation of glacial striae on top of Mount Stinear 800 m higher than present ice level.

Recent retreat of permanent ice cover on mountain summits is demonstrated by the glacial striae preserved in soft rocks, and by pockets of moraine that retain their soft clay fraction. These would not survive long under present conditions, as summer weather is mild in the Prince Charles Mountains and chemical weathering and melt stream action is locally evident.

Glacial striae have not been recognized in the northern Prince Charles Mountains; roches moutonnees are locally preserved. As jagged peaks constitute the main remnants of the erosion surface postulated by Crohn (1959), preservation of glaciation phenomena associated with the erosion surface is less likely than in the southern Prince Charles Mountains, where large areas of the old glaciated surface are preserved.

The Lambert Glacier—Amery Ice Shelf drainage system is evidently not a recent feature, and probably developed along a major structural trend. Soloviev (1972) shows faults concealed by some glaciers in the area, but at present little is known of the subglacial structure and morphology.

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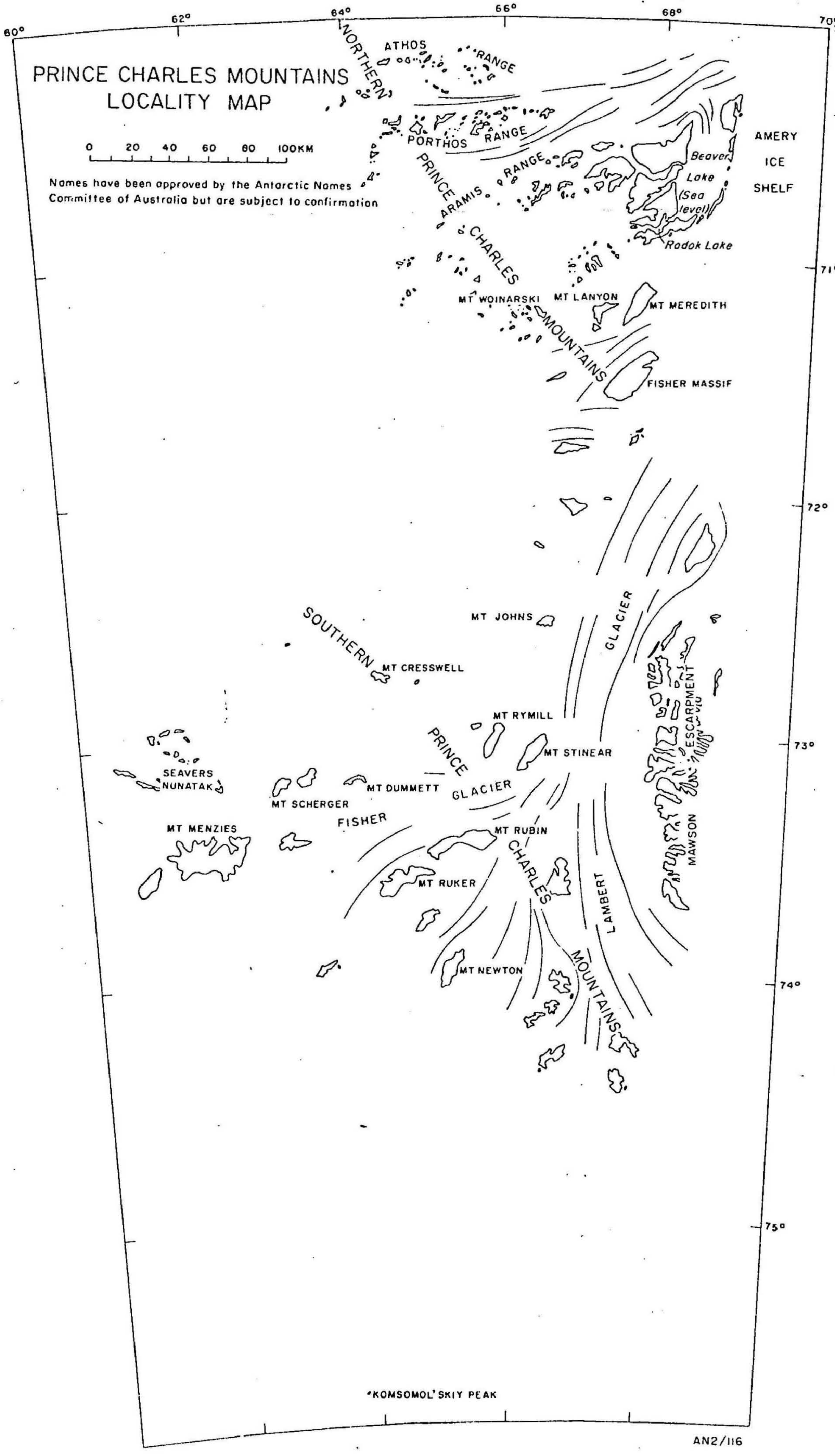

PRINCE CHARLES MOUNTAINS
LOCALITY MAP
0 20 40 60 80 100KM
Names have been approved by the Antarctic Names Committee of Australia but are subject to confirmation
60°
62°
64°
66°
68°
70°
71°
72°
73°
74°
75°
NORTHERN
ATHOS
RANGE
PORTHOS
RANGE
ARAMIS
RANGE
PRINCE
CHARLES
MOUNTAINS
AMERY
ICE
SHELF
Beaver Lake (Sea level)
Radok Lake
MT WOINARSKI
MT LANYON
MT MEREDITH
FISHER MASSIF
SOUTHERN
MT JOHNS
MT CRESSWELL
GLACIER
MT RYMILL
PRINCE
MT STINEAR
ESCARPMENT
SEAVERS NUNATAK
MT DUMMETT
MT SCHERGER
GLACIER
FISHER
MT MENZIES
MT RUBIN
MT RUKER
CHARLES
LAMBERT
MAWSON
MT NEWTON
MOUNTAINS
KOMSOMOL'SKIY PEAK
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