GEOLOGY OF THE SHACKLETON RANGE: III. THE BLAIKLOCK GLACIER GROUP

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ABSTRACT. The Blaiklock Glacier Group of sandstones and conglomerates is the youngest major rock group in the Shackleton Range. The sediments appear to have been locally derived from the Percambrian basement complex on which they rest unconformably and they are considered to be of Cambro-Ordovician age by the evidence of fossiliferous erratics. The anticlinal structure of the group is related to the Ross orogeny and the rocks are correlated, where possible, with equivalent sedimentary strata in the Transantarctic Mountains and western Dronning Maud Land.

THE Shackleton Range (lat. 80° 07′–80° 50′ S, long. 31°–19° W) lies east of the Filchner Ice Shelf at the head of the Weddell Sea. The greater part of the range is formed of basement rocks, gneisses, schists and amphibolites of the Shackleton Range Metamorphic Complex (Clarkson, 1982), and a group of low-grade, dynamically metamorphosed arenaceous rocks, the Turnpike Bluff Group, crops out along the southern margin of the range (Clarkson, 1983). The Blaiklock Glacier Group is exposed in the north-western part of the range (Fig. 1) in northern Otter Highlands, along the western flank of Haskard Highlands and in outliers at the north-western end of Wedge Ridge, in Stratton Glacier and at The Dragons Back.

These sedimentary rocks were first described by Stephenson (1966) as the "Blaiklock Beds", which he subdivided into a "lower group" and an "upper group" but which, after a consideration of more precise stratigraphical terminology (American Commission on Stratigraphic Nomenclature, 1961), have been re-named the "Blaiklock Glacier Group", subdivided into the "Mount Provender Formation" and the "Otter Highlands Formation", respectively (Clarkson, 1972). The Mount Provender Formation is exposed along the western flank of Haskard Highlands north of lat. 80° 28′ S and on a nunatak in Stratton Glacier 6 km west of Lister Heights. The Otter Highlands Formation is exposed in the northern part of Otter Highlands north of lat. 80° 39′ S, on the nunatak at the north-western end of Wedge Ridge, and on The Dragons Back and two small nearby nunataks.

MOUNT PROVENDER FORMATION

Type locality. The outcrop through the moraine west of Mount Provender, lat. 80° 24′ S, long. 30° 05′ W.

At the type locality, two small crags up to 5 m high are composed of sedimentary breccias or conglomerates and sandstones, and to the east of these crags in very poor ground-level exposure fine-grained sandstones abut against green hornblendic gneisses. Farther south-east, on the western end of Mount Gass, fine- and coarse-grained sandstones with some pebbly horizons overlie schists in similarly poor exposure. At both these localities the position of the contact between the sedimentary and metamorphic rocks is clear but the poor exposure prohibits satisfactory examination. However, the contact is considered to be an unconformity due to the parallelism between the contact and the strike of the bedding in the overlying strata, and due to the absence of any evidence of faulting, e.g. a fault breccia or fault-plane erosion. Thus, the Mount Provender Formation rests unconformably on gneisses and schists of the Shackleton Range Metamorphic Complex.

No type section is given here for this formation as there is great variation of rock types over very short lateral distances and because the exposure is so limited. These lateral variations may be due to unexposed faulting or to the original sedimentary environment.

The greatest thickness of the Mount Provender Formation is at the western end of Mount Gass, although the exposure is poor and it cannot be measured directly. However, from an

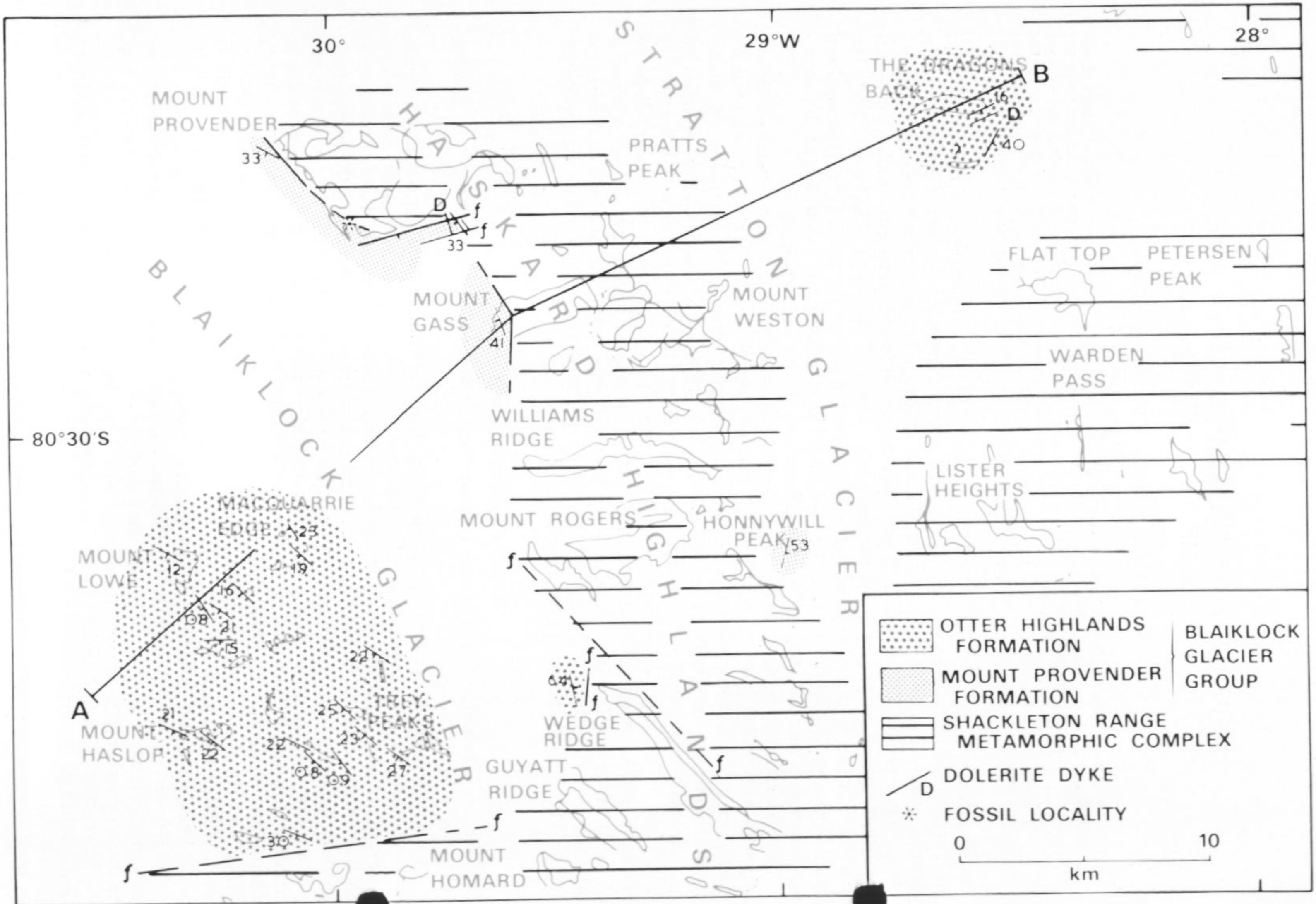

Fig. 1. Geological sketch map of the western part of the Shackleton Range, showing the position of the cross-section in Fig. 6.

average local dip of 47° to the south-west and a horizontal outcrop of 1 000 m along the dip, the minimum thickness of the formation is calculated at greater than 760 m as the top of the formation is not exposed. The regional dip of the formation is 40° to the south-west alongside Blaiklock Glacier and 56° to the east-south-east on the nunatak in Stratton Glacier.

Petrography

The Mount Provender Formation comprises reddish sandstones and siltstones and some conglomerates (Fig. 2). The finer-grained rocks are essentially quartz-sandstones with varying contents of metamorphic rock fragments (mostly quartzites) cemented by calcite, sericite, chlorite and haematite, the last mineral providing the red colour which is characteristic of

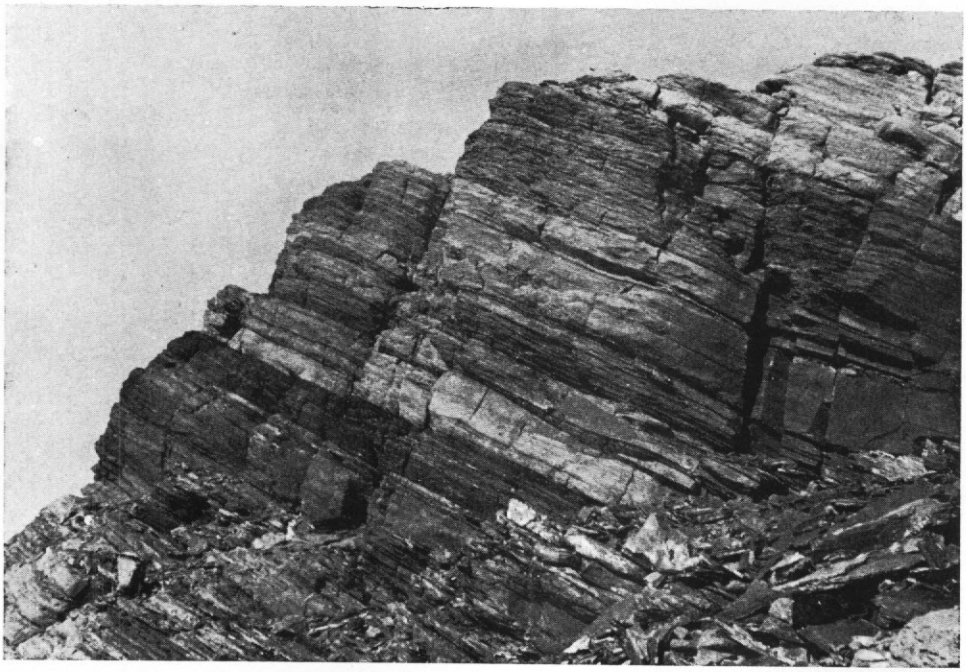

Fig. 2. Sandstones of the Mount Provender Formation at station Z.1039, 6.5 km south-east of Mount Provender in the northern Haskard Highlands.

this formation. In certain rocks the red colour is emphasized by as much as 24% of haematite which appears to have resulted from the alteration of detrital biotite (Fig. 3a). The coarser-grained rocks contain pebbles, cobbles and boulders of marble, quartzite and gneiss which are very similar to the underlying metamorphic rocks. One thin section of a sandstone (Z.1039.2) revealed a small fragment of slate (Fig. 3b), presumably derived from the Turnpike Bluff Group. Fragments of sedimentary rocks derived from lower strata of this formation are common at certain horizons.

In most of the rocks the grains and fragments are sub-angular to sub-rounded, although angular, rounded and even well-rounded grains occur. By the size and degree of angularity of the grains, some of these rocks could be called "grits" (Pettijohn, 1957), a term which has been used previously (Clarkson, 1972), but as there is usually some variation of these parameters in most specimens the more general terms sandstone and siltstone are preferred. The packing density of the rocks varies considerably and is reflected in the "cement" figures in the modal analyses (Table I).

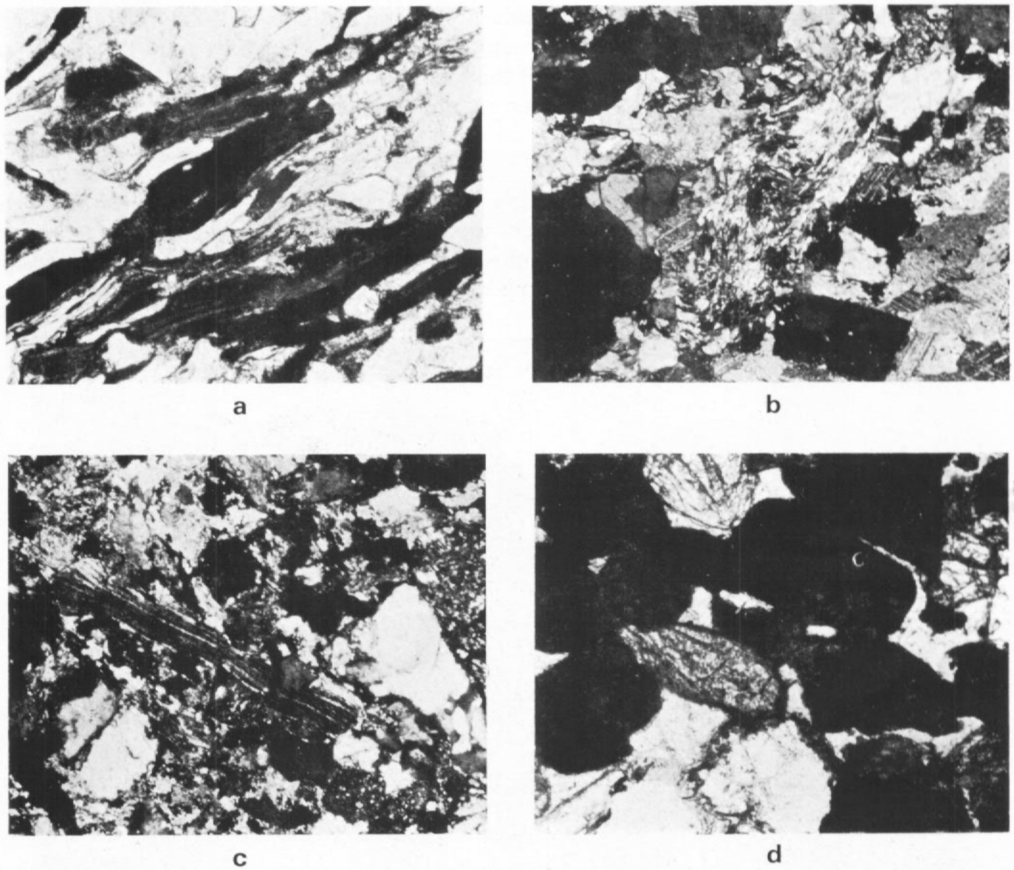

Fig. 3. a. Haematite resulting from the alteration of biotite in sandstone. Mount Provender Formation (Z.1006.7; ordinary light; ×100).
b. Fragment of slate in a pebble-conglomerate, Mount Provender Formation (Z.1039.2; X-nicols; ×25).
c. Sandstone with fan-shaped biotite due to pinching during diagenesis, Otter Highlands Formation (Z.819.5; X-nicols; ×30).
d. Ilmenite, haematite and garnet with some quartz and sphene in a heavy mineral horizon, Otter Highlands Formation (Z.841.6; ordinary light; ×100).

Sedimentary structures are comparatively rare in these rocks although some false bedding was found in the coarser sandstones. No macro-fossils have been found in the formation but one specimen (Z.555.2) from the nunatak in Stratton Glacier shows trace fossils on one bedding surface and the thin section is extensively bioturbated and contains some poorly defined burrows.

Microscopically, the sandstones comprise sub-angular to sub-rounded quartz grains (0.1–0.4 mm in diameter) with undulose extinction and some grains give a biaxial interference figure with a small optic axial angle. Quartzite fragments are common, usually as a recrystallized quartz mosaic, which may contain small orientated plates of muscovite and appear very similar to some fissile quartzites in the underlying basement complex. Other metamorphic rock types are rare, probably due to the relatively coarse grain-size of the basement rocks, although marble pebbles occur in some conglomeratic horizons. Most of the feldspar is untwinned and sericitized, and microcline is rare. Twinned plagioclase grains are present but no compositional determinations could be made, although acid plagioclase would be expected for grains derived

TABLE 1. MODAL ANALYSES OF ROCKS OF THE BLAIKLOCK GLACIER GROUP

	Mount Provender Formation														Otter Highlands Formation																					
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
Quartz	28.3	32.3	42.1	36.6	39.5	22.8	41.2	41.0	14.7	54.6	3.9	20.4	31.5	35.3	39.8	48.4	42.2	41.7	48.7	43.1	43.2	42.3	36.5	40.9	75.8	57.7	38.4	75.3	73.0	30.4	17.5	23.4	14.0	43.8	48.5	23.8
Feldspar	1.4	0.9	1.2	5.6	3.0	2.3	2.3	3.0	0.6	0.6	0.1	0.5	1.8	2.1	15.0	13.5	5.3	7.6	22.0	19.2	6.5	3.4	2.6	12.7	5.6	4.7	19.1	7.2	3.8	10.2	3.5	1.1	0.0	8.6	9.9	4.9
Cement	23.9	33.9	41.0	24.7	22.6	30.6	31.1	30.5	33.1	37.8	22.8	28.6	30.1	30.9	32.3	31.5	23.0	36.6	20.7	15.8	22.0	32.1	34.7	23.3	12.5	12.1	27.1	7.9	8.7	23.8	19.6	27.7	8.9	22.1	22.8	23.7
Fragments	35.5	0.2	n.d.	8.0	n.d.	20.2	3.0	5.3	35.3	n.d.	70.4	35.9	[illegible]	10.8	[illegible]	1.5	26.7	0.3	5.1	17.7	23.4	14.9	tr.	11.1	3.6	20.7	8.4	7.6	11.3	2.9	—	—	72.3	12.0	9.8	1.0
Micas	10.4	28.1	4.3	22.7	9.8	20.9	19.3	17.9	15.3	2.3	2.8	10.0	13.7	15.1	9.9	4.3	1.8	12.1	1.6	1.7	2.1	5.2	23.5	2.4	0.6	0.6	3.3	0.3	0.6	—	—	—	1.3	4.0	4.5	—
Garnet, sphene, etc.	0.5	3.7	2.9	2.4	1.0	3.2	3.1	2.5	1.0	4.7	tr.	4.7	2.5	2.5	2.1	0.8	1.0	1.7	1.9	2.5	2.7	2.1	2.7	9.6	1.9	4.2	3.7	1.7	2.6	—	—	—	3.5	9.4	4.5	—
Haematite laths	n.d.	0.9	8.5	n.d.	24.2	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Garnet	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	24.0	37.2	30.4	—	—	—	30.5
Haematite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1.8	8.2	4.9	—	—	—	5.0
Ilmenite	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1.8	7.6	6.6	—	—	—	5.3
Sphene	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.5	2.1	1.3	—	—	—	1.3
Epidote	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1.6	1.9	3.1	—	—	—	2.2
Muscovite and zircon	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3.0	2.4	1.5	—	—	—	2.3
Q (quartz)	37	49	71	49	51	33	60	59	22	88	5	29	45	51	59	71	55	66	61	51	56	62	56	53	87	66	53	82	80	40	22	32	15	56	63	31
F (feldspar)	2	1	2	7	4	3	3	4	1	1	0	1	2	2	22	20	7	12	28	23	8	5	4	17	6	5	26	8	4	13	4	2	0	11	13	7
M (rock fragments)	61	50	27	44	45	64	37	37	77	11	95	70	[illegible]	46	[illegible]	9	38	22	11	26	36	33	40	30	7	29	21	10	16	47	74	66	85	33	24	62

tr. Trace.

n.d. Not determined.

Terminology according to Pettijohn (1957).

1. Z.555.1 Fine-grained sandstone.
2. Z.555.2 Coarse siltstone.
3. Z.1006.4 Coarse siltstone.
4. Z.1006.5 Fine-grained sandstone.
5. Z.1006.7 Coarse siltstone.
6. Z.1035.3 Coarse siltstone.
7. Z.1035.5 Coarse siltstone.
8. Z.1035.6 Coarse siltstone.
9. Z.1039.7 Fine-grained sandstone.
10. Z.1039.11 Siltstone.
11. Z.555.3 Pebble-conglomerate.
12. Z.1039.2 Pebble-conglomerate.
13. Average, analyses 1–12.
14. Average, analyses 1–10.
15. Z.736.1 Fine-grained sandstone.
16. Z.736.7 Fine-grained sandstone.
17. Z.737.1 Medium-grained sandstone.
18. Z.738.1 Coarse siltstone.
19. Z.738.2 Fine-grained sandstone.
20. Z.807.2 Medium-grained sandstone.
21. Z.809.2 Medium-grained sandstone.
22. Z.809.11 Medium-grained sandstone.
23. Z.819.6 Siltstone.
24. Z.824.1 Medium-grained sandstone.
25. Z.841.1 Fine-grained sandstone.
26. Z.841.3 Medium-grained sandstone.
27. Z.841.4 Medium-grained sandstone.
28. Z.841.5 Medium-grained sandstone.
29. Z.841.8 Fine-grained sandstone.
30. Z.823.2 Fine-grained sandstone.
31. Z.841.6 Fine-grained sandstone.
32. Z.841.7 Fine-grained sandstone.
33. Z.841.2 Pebble-conglomerate.
34. Average, analyses 15–33.
35. Average, analyses 15–29.
36. Average, analyses 30–32.

from the gneisses of the Shackleton Range Metamorphic Complex. Muscovite is the commoner mica with rare grains of olive-green biotite. In most thin sections any biotite is extensively altered to chlorite or haematite and some specimens (Z.1006.7; Table I) contain up to 24% of this haematite. Accessory minerals include brown sphene, colourless or yellow epidote, pale pink garnet, zircon and ilmenite. Calcite is usually the major cementing agent but sericite, chlorite and haematite are locally important, the last two minerals forming the green- and red-coloured sandstones, respectively.

Otter Highlands Formation

Type locality. The north-east face of MacQuarrie Edge, lat. 80° 32′ S, long 30° 03′ W.

The type section (Z.841) is measured 254 m up the face of MacQuarrie Edge and comprises some of the lowest exposed strata of the Otter Highlands Formation (Table II). It is lithologically representative of the formation although conglomerates are less common higher in the succession. The base of the formation is hidden beneath Blaiklock Glacier but the nunatak outlier at the north-western end of Wedge Ridge abuts against schists of the basement complex, although the actual contact is obscured by debris and is presumed to be a fault trending approximately north–south. The top of the formation is not known and the outcrops in the

Table II. Type section, Otter Highlands Formation
(Station Z.841, east face of MacQuarrie Edge, lat. 80° 32′ 06″ S, long. 30° 02′ 30″ W)

Conglomerates and sandstones Dip 20° to 228° Conglomerate horizons up to 4 m thick contain pebbles of white quartz and red quartzite up to 15 cm in diameter. The upper and lower boundaries of the conglomerates are sharp but they are not always constant and some beds are lenticular on a large scale. Sedimentary structures are rare. The sandstones are often pebbly and current bedded, and may be flaggy or massive.	44 m
Massive sandstones Dip 26° to 233° Very similar to the massive sandstones below and, although some horizons tend towards conglomerate, they are distinct from the true conglomerates above.	62 m
Flaggy sandstones Badly weathered, light and dark green flaggy sandstones; distorted bedding is common.	19 m
Massive sandstones Pale to dark green sandstones, often banded; current bedding is common but other sedimentary structures are rare. Small white quartz pebbles are abundant and the rock is almost conglomeratic in places. Some horizons are flaggy and the whole unit is well jointed. Heavy mineral horizons are less common than below.	26 m
Flaggy sandstones Poorly exposed. Some thin irregular horizons contain rounded brown fissile pebbles of fine-grained massive sandstone. Heavy mineral horizons are common, usually flaggy but some are massive.	47 m
Calcareous sandstones Massive calcareous sandstones as below.	5 m
Sandstones Numerous varieties as below.	10 m
Calcareous sandstones Dip 24° to 239° Knobbly weathering, white spotted and pale-coloured calcareous sandstones, massive but poorly jointed.	15 m
Sandstones Dip 19° to 235° Pale to dark green sandstone, sometimes banded; both flaggy and massive horizons occur. False-bedding structures are common.	26 m
Total thickness of type section	254 m

Otter Highlands and at The Dragons Back presumably have subglacial fault contacts with the Shackleton Range Metamorphic Complex. No marker horizons have been observed in the Otter Highlands so that correlation between outcrops is not possible and any major faulting cannot be detected. As no major faults were seen, the estimated minimum thickness for the formation of more than 5 300 m (based on the rock exposure over a distance of 12.6 km along the regional dip of 25° to the south-west in the Otter Highlands) could be in error. The rocks at the Dragons Back dip between 15° to the south-east and 40° to the east-south-east, whereas those in the nunatak at the north-western end of Wedge Ridge have a dip of 64° to the east-north-east which is considered anomalous due to their proximity to a presumed fault.

Petrography

The Otter Highlands Formation comprises greenish sandstones, siltstones and some conglomerates. The conglomerates are virtually confined to the lowest horizons of the formation at MacQuarrie Edge, Trey Peaks and the outlier at the north-western end of Wedge Ridge (Fig. 4), and contain mainly quartzite pebbles with some pebbles of other metamorphic rocks. The sandstones and siltstones are very similar apart from their grain-size, comprising sub-angular to sub-rounded quartz grains and quartzite fragments with subordinate feldspars, micas and heavy minerals cemented by calcite, chlorite, sericite and epidote. Certain horizons are extremely rich in heavy minerals and contain up to 37% garnet. The characteristic green colour of these rocks is due to authigenic chlorite and epidote.

Fig. 4. Conglomerate of the Otter Highlands Formation at station Z.567 on the nunatak at the north-western end of Wedge Ridge in Haskard Highlands.

Sedimentary structures are very common, particularly false bedding, and often obscure the true bedding. Graded bedding was found in some sections and the heavy mineral horizons form a density grading. No fossils of any description have been found in these rocks, possibly due to the extensive re-working of the sediments. The packing density of the rocks varies as indicated by the "cement" percentages in the modal analyses (Table I).

Quartz, the principal constituent of these rocks, occurs as sub-angular to sub-rounded grains (0.1–0.7 mm in diameter) and is generally less severely strained than many of the grains in the Mount Provender Formation. Rock fragments are mostly of quartzite with some of schist, although a few marble pebbles occur in the coarser conglomerates. Some of the lowest exposed strata, at MacQuarrie Edge and Trey Peaks, contain sedimentary fragments (up to 2 cm long) of purple siltstone, presumably derived from the lower formation; they possibly indicate that these horizons are near the base of the formation.

Feldspar is generally more abundant in this formation; untwinned feldspar predominates but there is some polysynthetically twinned andesine; microcline and microperthitic types are also present. Muscovite is present in all the thin sections examined but biotite (Fig. 3c), almost always altered to chlorite or occasionally to haematite, is rare or absent. Accessory minerals include pale pink garnet, brown sphene, zircon, epidote, ilmenite, haematite and very rare grains of zoned tourmaline (pale blue cores with brown rims). Sub-angular to rounded or well-rounded grains of garnet up to 4 mm in diameter are the principal constituent of the heavy mineral horizons (Fig. 3d) and may comprise up to 37% of the rock (Table I). Chlorite, epidote, calcite and sericite are the main cementing agents and the first two provide the characteristic green colour of these rocks.

Intermediate Strata

In a moraine about 4 km east of Mount Provender, Stephenson (1966) found fossiliferous shale erratics, which he ascribed to unexposed intermediate strata hidden beneath Blaiklock Glacier. In 1970, similar erratics were collected from the moraine about 3 km south of Mount Provender. The inarticulate brachiopods preserved on these erratics have been identified as obolids, possibly belonging to the genus *Lingulella*, which ranges in age from Lower Cambrian to Middle Ordovician (Thomson, 1972).

These erratics are quartz siltstones comprising sub-angular to rounded grains of quartz (up to 0.1 mm in diameter) with subordinate microcline, untwinned feldspar and (?) albite. Muscovite is common with accessory biotite and iron ore. Calcite, with some chlorite and sericite, is the principal cement. Although this rock type has not been found *in situ* in the Shackleton Range, it is considered to be sufficiently similar to exposed sedimentary rocks of the Blaiklock Glacier Group to be regarded as intermediate strata of the same group. By structural implication, the parent strata would lie beneath Blaiklock and Stratton Glaciers. Thus, the Blaiklock Glacier Group is most likely Lower Palaeozoic and probably Cambro-Ordovician in age, if the source of the erratic material has been correctly inferred.

A dolerite dyke intruding the sandstones at The Dragons Back has been dated at 297 ± 12 Ma (Rex, 1971) and this provides the only other evidence for the age of the group.

Provenance and Sedimentation

The clastic content of the Blaiklock Glacier Group indicates a metamorphic terrain for the sediment source, the nearest being the basement rocks of the Shackleton Range Metamorphic Complex and the slates and quartzites of the Turnpike Bluff Group. Thus it seems likely that the group has a local origin, although it is not possible to determine the direction of sediment transport. It appears that the Otter Highlands Formation contains a greater proportion of fragments of high-grade metamorphic rocks than the Mount Provender Formation, as is shown by the greater abundance of garnet and other metamorphic minerals in the upper formation. Similarly, the Mount Provender Formation contains less feldspar (Table I), probably indicating a source area partly within the Turnpike Bluff Group which is notably less feldspathic than the basement complex. Therefore, the source area of the Blaiklock Glacier Group appears to be the hinterland of the Shackleton Range, although its limits were probably considerably greater than the present margins of the range.

The modal analyses (Table I) demonstrate the broad differences between the two formations and these are further shown on the Q–F–M diagram (Fig. 5). The most obvious distinctions between these formations are emphasized by the averages which show the Otter Highlands Formation to be richer in quartz, feldspar and heavy minerals. This is not so obvious in Fig. 5

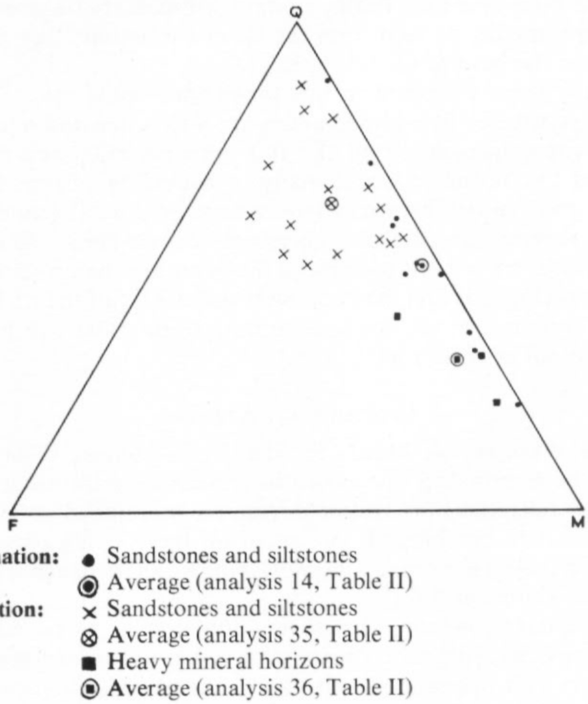

Fig. 5. Q–F–M diagram of modal analyses of sandstones and siltstone from the Blaiklock Glacier Group.

where the main distinctions are the quartz and feldspar contents. Comparison of individual analyses reveals slight compositional overlap between the two formations but this is not a stratigraphical gradation. In the field the two formations are readily distinguished, in general, by the red colour of the Mount Provender Formation and the green colour of the Otter Highlands Formation.

The red colour of the Mount Provender Formation is indicative of oxidizing conditions during the early sedimentation of the group but, except at a few horizons, these had changed by the time the Otter Highlands Formation was deposited. The association of conglomerate and sandstone at the base of the lower formation may indicate proximity to the source area and Stephenson (1966) suggested a possible scree origin for these conglomerates. However, if the red beds imply an arid climate, the conglomerates could equally well have resulted from wadi-type rivers cutting through partly lithified sandstones which would also account for the preponderance of sedimentary fragments at certain horizons.

If the shale erratics are representative of the hidden intermediate strata, they could indicate stable conditions followed by a rejuvenation of the landscape which gave rise to the conglomerates towards the base of the upper formation (Stephenson, 1966). Both the occurrence of red shale fragments in the upper formation and the shallower dip of these rocks support the possibility of rejuvenation of the landscape and the exposure to erosion of the lower formation. The monotony of the succeeding strata suggests a return to stable conditions and derivation of sediment from a single source, and the abundance of sedimentary structures (such as false bedding) and the concentration of heavy minerals indicate considerable re-working of the sediment in a deltaic environment.

Thus, the Blaiklock Glacier Group appears to have been deposited in shallow water, initially in oxidizing conditions, prior to the uplift and rejuvenation of the source area and the continuation of sedimentation in a deltatic environment.

STRUCTURE

The discovery of sedimentary outliers east of Haskard Highlands has necessitated revision of Stephenson's (1966) concept of the group being simply tilted to the south-west. The south-easterly dip of the eastern outliers suggests an anticline (Fig. 6) and the stereographic plot of poles to bedding planes (Fig. 7) indicates a fold plunging gently southward. The evidence is comparatively sparse and no account is taken of faulting which, although not observed in the field, possibly exists.

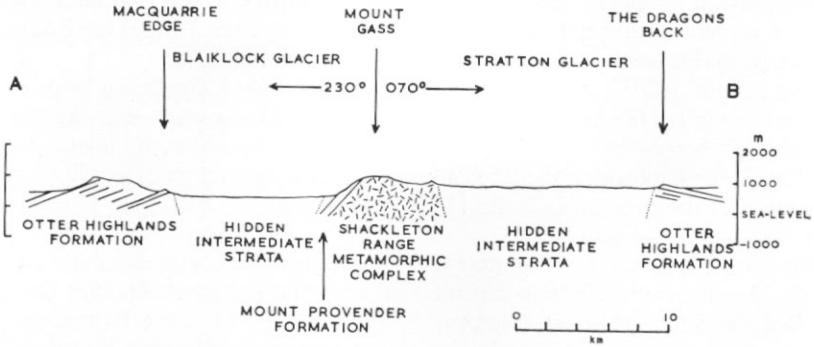

Fig. 6. Cross-section through the Blaiklock Glacier Group. The position of the section is shown in Fig. 1.

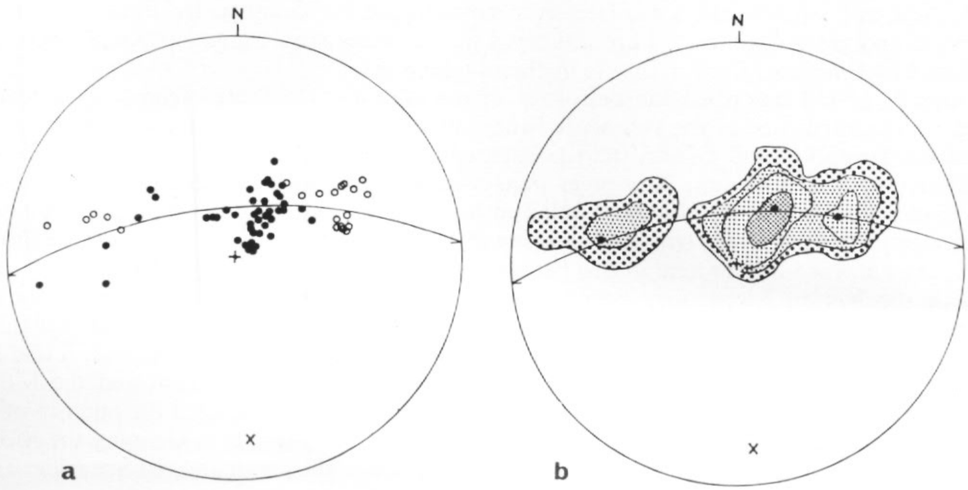

Fig. 7. Stereogram of poles to bedding planes in the Blaiklock Glacier Group. The fold axis (×) plunges at 19° in a direction 175°.

a. Mount Provender Formation (○) and Otter Highlands Formation (●).

b. Contours at 0, 5, 10 and 20% per 1% unit area. The solid circles indicate maxima.

The importance of this fold trend is its parallelism to the trend of the Ross orogeny (Craddock, 1970) formed during the late Cambrian to Ordovician. If this folding is a result of the Ross orogeny, it supports the "erratic" palaeontological evidence for the age of the Blaiklock Glacier Group. Unfortunately, it is not possible to relate more closely the ages of the rocks and the folding to suggest an age limit for the Ross orogeny in this area.

Regional Correlation

The Blaiklock Glacier Group has been correlated with different sequences by different authors but these pre-date the publication of the probable Cambro-Ordovician age of the group (Thomson, 1972), and consequently the ages of the correlatives vary widely. Clarkson (1972) suggested that the closest equivalents of the group are the Lower Palaeozoic rocks of the Neptune Range in the Pensacola Mountains and the Urfjell Group in Kirwanveggen. These two sequences are still considered the closest equivalents but more detailed comparisons may now be drawn.

The Urfjell Group appears to be lithologically comparable to the Blaiklock Glacier Group and there are no volcanic horizons; it had a near-shore depositional environment and the sediment was probably derived from a granitic–metamorphic terrain to the south-south-west (Aucamp and others, 1971). The only major difference between the two groups is the absence of red beds in the Urfjell Group. Aucamp and others (1971) suggested that the group is related to the Lower Palaeozoic–Permo-Carboniferous folded sequence of the lower Beacon Supergroup (Taylor Group), although the closest correlatives geographically would be the Blaiklock Glacier Group and the Neptune Group. This implies that the Blaiklock Glacier Group may be younger than Cambro-Ordovician.

In the Pensacola Mountains, Williams (1969) compared the Dover Sandstone (and possibly the Heiser Sandstone and the Elbow Formation) with the Blaiklock Glacier Group and with the lower Beacon Supergroup of Victoria Land. The age of these formations (? Middle Palaeozoic) seems too young to correlate with the Blaiklock Glacier Group, although comparison between the red beds of the Elbow Formation and the Mount Provender Formation is tempting, particularly as red beds are virtually unknown elsewhere in Antarctica (Williams, 1969). There is less lithological similarity between the Blaiklock Glacier Group and the Wiens Formation, and equivalents of the Nelson Limestone and the Gambacorta Formation (rhyolite flows and pyroclastic rocks) are unknown in the Shackleton Range, although their ages (Middle Cambrian to ? Cambrian) are in closer agreement.

Fourcade (1969) described the petrology of ten specimens collected from the Argentina Range to the north-east of the Pensacola Mountains. Some of these he compared with quartzites of the Turnpike Bluff Group and the Patuxent Formation, and others he compared with the Blaiklock Glacier Group. Both types were collected from both localities ("Santa Fe Peak" and "San Rafael Nunatak") but their relationships are not known. Schmidt and Ford (1966) mentioned interbedded quartzite and siltstone in the Mount Spann area (? "Santa Fe Peak") which are not known elsewhere in the Pensacola Mountains but which are presumed to lie beneath the Nelson Limestone, although their relationship to the Patuxent Formation is unknown. The Nelson Limestone occurs in the Mount Ferrara area (? "San Rafael Nunatak") (Schmidt and Ford, 1966) and boulders of an earlier Cambrian limestone have been found in a moraine near Mount Spann (Webers, 1971). Schmidt and Ford (1969) showed the Mount Spann and Mount Ferrara areas as "? Patuxent Formation" and restricted the outcrop of the Nelson Limestone to the Schneider Hills but this is apparently due to re-defining the Mount Ferrara area (Schmidt and Ford, 1966) as Mount Ferrara in the north and the Schneider Hills in the south (Schmidt and Ford, 1969). The positions given by Fourcade (1969) suggest that "Sante Fe Peak" is Mount Spann but that "San Rafael Nunatak" lies 20 km to the east of Mount Ferrara (Schmidt and Ford, 1969) in an area of no exposure. Thus the (?) pre-Nelson Limestone sedimentary rocks may be equivalent to the Blaiklock Glacier Group.

It is difficult to make reliable correlations between any of these unfossiliferous sequences or to relate them accurately to the Transantarctic Mountains which have been described as extending as far as Kirwanveggen in Dronning Maud Land (Neethling, 1971) and into the Ellsworth Mountains which have apparently been moved from the Weddell Sea to their present position by transform faulting (Schopf, 1969; Clarkson and Brook, 1977). However, it is possible that, whereas the Nelson Limestone, Shackleton Limestone and their calcereous equivalents as far away as Victoria Land represent shallow-water facies of Cambrian age (Palmer, 1970) in the Ross geosyncline, the Blaiklock Glacier Group and possibly the Urfjell Group are contemporaneous epicontinental deposits at the margins of the geosyncline.

Conclusions

The Blaiklock Glacier Group comprises a thick sequence of sandstones with minor conglomerates which, on the basis of colour, structure and geographical distribution, are subdivided into the lower (reddish) Mount Provender Formation and the upper (greenish) Otter Highlands Formation. Supposed intermediate strata are represented by shale erratics containing Cambro-Ordovician inarticulate brachiopods on which the age of the group is based. The clastic content of the rocks indicates a metamorphic source area which was presumably the Shackleton Range Metamorphic Complex and, to a lesser extent, the Turnpike Bluff Group. Oxidation of biotite to haematite suggests an arid climate during the deposition of the Mount Provender Formation followed by rejuvenation of the landscape and deltaic sedimentation of the Otter Highlands Formation. The major structure of the group is a broad anticline plunging southward, parallel to the trend of the Ross orogeny, suggesting that the rocks were affected during the folding of the Ross geosyncline in the late Cambrian to early Ordovician. Thus it seems likely that the group is an epicontinental deposit marginal to the Ross geosyncline, equivalent in age to the Lower Palaeozoic (pre-Neptune Group) rocks of the Pensacola Mountains but similar in lithology, and possibly in age, to the Urfjell Group in Kirwanveggen.

Acknowledgements

We wish to thank Professors F. W. Shotton and A. Williams for providing facilities in the Department of Geological Sciences, University of Birmingham, Dr R. J. Adie for advice during the preparation of this paper and Dr M. R. A. Thomson for much useful discussion. We are grateful to all our field companions and, above all, to the US Navy squadron VXE-6 without whose transport facilities this work would not have been done.

MS received 10 November 1976

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