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BLOODS RANGE, N.T.

Sheet SG/53—3
International Index
COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT
BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

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BLOODS RANGE, N.T.

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Compiled by D. J. Forman

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Minister for National Development.

1966
Explanatory Notes on the Bloods Range Geological Sheet

Compiled by D. J. Forman

The Bloods Range 1:250,000 Sheet area occupies part of the south-west portion of the Amadeus Basin, near the south-west corner of the Northern Territory. It lies between longitudes 129° and 130° 30' E and latitudes 24° and 25° S.

The area is covered by air-photographs at a scale of 1:46,500. In 1957 the Division of National Mapping produced, at a scale of approximately 1:63,360, uncontrolled photo mosaics of the twelve 1-mile areas within the Sheet area. In 1960 the Division produced topographic base maps at photo-scale of the 1-mile areas from air-photographs, with astrofixes for control.

Part of the area lies within an aboriginal reserve, but there are no permanent inhabitants. Access is by the vehicle track, from Ayers Rock tourist resort to Giles Meteorological Station, which passes through the Petermann Ranges (Fig. 1). The area is undeveloped except at Livingstone Pass, where several bores have been drilled for water.

The climate is arid, with an annual rainfall of less than 10 inches. The winter months of May to September inclusive are cool and the climate is pleasant, but the summer months, particularly December and January, are hot and unpleasant. Humidity is low and dew forms only after rain.

Geological Investigations

Mapping of the area had not been attempted before 1962. A number of exploring and prospecting expeditions have visited the area since Giles in 1872 (Giles, 1889), but few of these contributed substantially to geological knowledge.

During 1902 R. T. Maurice (Murray, 1904) passed through the area and recorded gypsum and dolomitic limestone at Mount Murray. F. R. George (1907) led a government prospecting expedition to the Petermann Ranges and Bloods Range in 1905. He produced a geological sketch plan showing the granite and quartzite exposures along their route. In 1926 H. Basedow accompanied D. Mackay on an expedition to the Petermann
Ranges and Bloods Range and made a geological report on the Petermann Ranges (Basedow, 1929). In 1936 H. A. Ellis accompanied a private expedition through the Petermann Ranges in search of Lasseter’s Reef (Ellis, 1937). In 1951 G. F. Joklik (1952) accompanied a similar expedition and made geological notes in the Petermann Ranges and Bloods Range Sheet areas. Frome Broken Hill Co. Pty Ltd (Gillespie, 1959) carried out the most extensive survey of the area between Souths Range and the Petermann Ranges in 1958.

In October 1960 the geophysical section of the Bureau of Mineral Resources flew an aeromagnetic traverse from Alice Springs to Giles (Goodeve, 1961), and in 1962 a helicopter gravity party visited the area during a reconnaissance gravity survey of the Amadeus Basin (Lonsdale & Flavelle, 1963). In 1960-61 the Institut Français du Pétreole prepared a photogeological map of the Bloods Range Sheet area at a scale of 1:250,000 (Scanvic, 1961). In 1962 a field party from the Geological Branch of the Bureau of Mineral Resources mapped the whole of the outcrop area of the Bloods Range Sheet (Forman, 1965).

![Physiographic Divisions - Bloods Range 1:250,000 Sheet](image)

**DRAINAGE AND TOPOGRAPHY**

The area is one of sandy desert broken by mountain ranges in the south and salt lakes in the north (see Fig. 1). The drainage is internal.
The mountain ranges and hills stand up to 3300 feet above sea level and 1300 feet above the surrounding plain; Bloods Range and the Petermann Ranges are typical examples.

The sandy desert consists of sand plain and dunes supporting spinifex, desert oaks, and light scrub. The dunes, most of which trend east to east-north-east, are up to 40 feet high and are of the longitudinal, mesh and braided type. Low ridges, hills, and peaks of rock occur within the areas of sand dunes.

Lake Amadeus and Lake Neale are salt lakes and centres of internal drainage. The area is about 1500 feet above sea level. The lakes hold water for short periods after heavy rain. The Hull River and Chirnside and Shaw Creeks flow northwards towards the lakes, but flood out in sand plain to the south of the lakes.

STRATIGRAPHY

The southern half of the Sheet area contains igneous, metamorphic, and sedimentary rocks of Precambrian age and the northern half contains unaltered Upper Proterozoic and Palaeozoic sediments of the Amadeus Basin. Tertiary and Quaternary Sediments cover much of the area. The stratigraphy is summarized in Table 1.

PRECAMBRIAN

Rock units of Precambrian age which have not been further subdivided on a time-rock basis are the Mount Harris Basalt, Bloods Range Beds, Olia Gneiss, Pottotu Granite Complex and other granitic bodies, and areas of porphyroblastic schist derived from either the Bloods Range Beds or the Mount Harris Basalt. These rocks crop out in the south of the Sheet area and form part of the south-west margin of the Amadeus Basin.

The Mount Harris Basalt and Bloods Range Beds are the oldest ‘sediments’ in the area and comprise basic and acid volcanic sediments and sandstone, siltstone, shale, and conglomerate, which have been metamorphosed and granitized in varying degrees to form slate, phyllite, schist, amphibolite, quartz-epidote rock, quartzite, schistose gneiss, gneiss, and granite. Pebbles in the conglomerate are of gneiss, porphyry, and quartzite, indicating the presence of an older metamorphic and igneous basement which does not crop out within the area.

The Olia Gneiss comprises fine to medium-grained gneiss, schistose gneiss, and porphyroblastic gneiss, and some schist, quartzite, and granite. The gneiss passes gradationally into granite, and into schist and porphyroblastic schist which have been derived from the Bloods Range Beds and Mount Harris Basalt.
<table>
<thead>
<tr>
<th>Age</th>
<th>Rock Unit and Symbols</th>
<th>Thickness (feet)</th>
<th>Lithology</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quaternary</td>
<td>Qc</td>
<td></td>
<td>Aeolian Sand.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Qa</td>
<td></td>
<td>Alluvium.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ql</td>
<td></td>
<td>Evaporites.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Q1</td>
<td></td>
<td>Travertine.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>T</td>
<td></td>
<td>Sandstone.</td>
<td></td>
</tr>
<tr>
<td>Ordovician</td>
<td>Undifferentiated (O)</td>
<td>50</td>
<td>White sandstone, pipe rock, conglomerate, dolomite, siltstone.</td>
<td>Stable shelf. Some marine fossils.</td>
</tr>
<tr>
<td>Cambrian</td>
<td>Cleland Sandstone (Cc)</td>
<td>0-2000</td>
<td>Cross-bedded sandstone and pebbly sandstone, siltstone.</td>
<td>Deltaic to paralic (unstable shelf).</td>
</tr>
<tr>
<td></td>
<td>Mount Currie Conglomerate (Pzc)</td>
<td>?</td>
<td>Conglomerate.</td>
<td>Unstable shelf, continental adjacent to south-west margin, Basin</td>
</tr>
<tr>
<td>Upper</td>
<td>Winnall Beds (Buw)</td>
<td>2000</td>
<td>Brown and white sandstone, pebbly sandstone, siltstone.</td>
<td>Moderately unstable shelf.</td>
</tr>
<tr>
<td>Horizon</td>
<td>Upper Proterozoic continued.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
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<td>---</td>
</tr>
<tr>
<td>Dean Quartzite (Bu)</td>
<td>1,000–1,500</td>
<td>Quartzite, conglomeratic quartzite, sandstone.</td>
<td>Stable shelf deposit. Degree of metamorphism variable.</td>
<td></td>
</tr>
<tr>
<td>Pocheyu Granite Complex (pCo)</td>
<td></td>
<td>Very coarse porphyritic granite, fine and medium-grained granite, gneiss, amphibolite, quartz-epidote rock, schist, quartzite.</td>
<td>Granite is metasomatically emplaced.</td>
<td></td>
</tr>
<tr>
<td>(pCg)</td>
<td></td>
<td>Coarse porphyritic granite, medium-grained granite.</td>
<td>Coarse granite metasomatically emplaced. Medium grained granite intrudes Mount Harris Basalt.</td>
<td></td>
</tr>
<tr>
<td>Olia Gneiss (pCn)</td>
<td></td>
<td>Fine to medium-grained gneiss, schistose gneiss, porphyroblastic gneiss, granite, schist, quartzite.</td>
<td>Gradational into schist of the Bloods Range Beds, porphyroblastic schist, and granite.</td>
<td></td>
</tr>
<tr>
<td>(pC)</td>
<td></td>
<td>Granite, schist, gneiss.</td>
<td>Outcrops too weathered to identify,</td>
<td></td>
</tr>
<tr>
<td>(pCm)</td>
<td></td>
<td>Porphyroblastic schists, quartz-feldspar porphyry.</td>
<td>Schists derived from Bloods Range Beds and Mount Harris Basalt by granitization. Porphyry an original constituent both.</td>
<td></td>
</tr>
<tr>
<td>(pCp)</td>
<td></td>
<td>Quartz-feldspar porphyry.</td>
<td>Original constituent of Bloods Range Beds and Mount Harris Basalt, or intrusive into them.</td>
<td></td>
</tr>
<tr>
<td>Bloods Range Beds (pCb)</td>
<td>?</td>
<td>Sandstone, siltstone, shale, arkose, tuff, agglomerate, basalt, acid porphyry.</td>
<td>Partly metamorphosed.</td>
<td></td>
</tr>
<tr>
<td>Mount Harris Basalt (pCh)</td>
<td></td>
<td>Epidotized amygdaloidal basalt, tuff, agglomerate, quartzite.</td>
<td>Quartz-feldspar porphyry?</td>
<td></td>
</tr>
</tbody>
</table>
The largest body of granite in the area forms part of the Pottoyu Granite Complex and crops out south of the Petermann Ranges. The complex contains very coarsely porphyritic granite and fine and medium-grained granite with up to 50 percent of gneiss, amphibolite, quartz-epidote rock, schist, porphyroblastic schist, and quartzite, with which it has gradational and intrusive contacts. Age determination on the Complex by P. Leggo (Forman, 1965) gives an apparent total rock age of 1200 million years and biotite and microcline apparent ages of 600 million years. Smaller bodies of granite occur in the Petermann Ranges and farther north. These have gradational contacts with the Mount Harris Basalt, the Bloods Range Beds, and the Upper Proterozoic Dean Quartzite, and one granite is intrusive into the Mount Harris Basalt.

Two Upper Proterozoic formations, the Dean Quartzite and Pinyinna Beds, are recumbently infolded with the older rocks and have been metamorphosed. The granite, gneiss, and porphyroblastic schist were formed during this period of recumbent folding late in the Upper Proterozoic.

**Upper Proterozoic**

The Upper Proterozoic sediments at the base of the Amadeus Basin succession are the *Dean Quartzite, Pinyinna Beds, Bitter Springs Formation, Inindia Beds, and Winnall Beds.*

The Dean Quartzite and Pinyinna Beds crop out in the south of the Sheet area, where they are infolded with the older Precambrian rocks and metamorphosed to a degree which varies in intensity with the amount of infolding and tectonic loading which they have undergone. The Dean Quartzite overlies the Bloods Range Beds and Mount Harris Basalt unconformably in Bloods Range, but in the Petermann Ranges the Quartzite and underlying rocks have been metamorphosed and partly granitized, so that the schistose quartzite is in contact with granite, gneiss, schist, or porphyroblastic schist.

The Pinyinna Beds are correlated with the Bitter Springs Formation, which crops out on the northern part of the Sheet area: the Beds are the infolded and generally metamorphosed portion of the Bitter Springs Formation on the southern part of the Sheet area. At Pinyinna Range the Pinyinna Beds are overlain unconformably by the Mount Currie Conglomerate.

The contact between the Bitter Springs Formation and the Inindia Beds is not exposed. In the north the Inindia Beds consist of a sequence of siltstone, claystone, shale, and thin beds of chert, chert breccia, dolomite, and limestone. Farther south they are predominantly sandstone and siltstone in outcrop. At Souths Range the Inindia Beds are overlain unconformably by the Winnall Beds. Sandstone at the base of the Winnall Beds is 2000 feet thick in Souths Range, but the top of the formation is not exposed.
CAMBRIAN

The Mount Currie Conglomerate and the Cleland Sandstone both overlie the Upper Proterozoic formations unconformably and both contain fragments of metamorphic, igneous, and sedimentary rocks derived from the underlying formations, during the Petermann Ranges Orogeny. The Mount Currie Conglomerate occurs along the southern margin of the Basin between Pinyinna Range and the south-east corner of the Sheet area, and the Cleland Sandstone occurs farther north, where it was probably deposited in a deltaic to paralic environment.

ORDOVICIAN

The Ordovician sediments comprise the marine Larapinta Group in the north of the Sheet area and marine outliers of the Larapinta Group in the south. The marine outliers in the south have been mapped as 'undifferentiated Ordovician' as the rocks could not be matched with those of the formations in the Larapinta Group to the north.

ORDOVICIAN-DEVONIAN

The Mereenie Sandstone is a thick sandstone deposit of Upper Ordovician, Silurian, and Devonian age. The formation is unfossiliferous and probably continental in origin, except the basal beds, which contain Cruziana in the Lake Amadeus Sheet area (Ranford, Cook, & Wells, 1965).

DEVONIAN-CARBONIFEROUS

The Pernjara Formation was deposited within the Amadeus Basin during the Alice Springs Orogeny, which occurred along the northern margin of the Basin. About 20 feet of siltstone crops out at the base of the formation and the overlying rocks are concealed.

TERTIARY(?)

Thin continental piedmont deposits of conglomerate and sandstone occur adjacent to the high ranges and hills in the southern part of the Sheet area.

QUaternary

The greater part of the Sheet area is covered by superficial deposits of aeolian sand, alluvium, evaporites, and travertine. The evaporites form a thin crust on the surface of Lakes Neale and Amadeus, and the travertine occurs on the borders of the lakes and as islands within them.

STRUCTURE AND GEOLOGICAL HISTORY

The Mount Harris Basalt and Bloods Range Beds were laid down during a period of volcanic activity. These rocks were folded and eroded (but not metamorphosed) before the Dean Quartzite, Pinyinna Beds, and Bitter
Springs Formation—which are a conformable sequence—were deposited unconformably upon them in a comparatively stable-shelf marine environment. Deposition of the Bitter Springs Formation was halted by earth movements to the south of the area and elastics of the Inindia Beds were deposited. Glacigenic sediments occur in other parts of the Amadeus Basin in this interval.

Earth movements to the south were intensified after deposition of the Inindia Beds and some erosion occurred on the Bloods Range Sheet area before the Winnall Beds were deposited in a partly marine and partly continental environment.

A major orogeny, called the Petermann Ranges Orogeny, occurred after deposition of the Winnall Beds late in the Upper Proterozoic. During this orogeny the Mount Harris Basalt, Bloods Range Beds, Dean Quartzite, and Pinyinna Beds were folded along the south-west margin of the Amadeus Basin into a large-scale recumbent fold, overturned for 30 miles across the strike. The Inindia Beds and Winnall Beds were squeezed out of the recumbent fold with the plastic Pinyinna Beds and slid northwards on a décollement surface in the Pinyinna Beds and equivalent Bitter Springs Formation. The Inindia Beds and the Winnall Beds formed Jura-type folds over the décollement. Granitization and metamorphism of the Mount Harris Basalt, Bloods Range Beds, Dean Quartzite, and Pinyinna Beds took place along the southern margin during the orogeny.

The Petermann Ranges Orogeny produced a mountain chain along the southern margin late in the Upper Proterozoic. The Mount Currie Conglomerate was deposited adjacent to the northern flank of the mountain chain, probably in the Cambrian, and farther north the Cleland Sandstone was deposited in a deltaic and paralic environment marginal to the marine Cambrian sediments in the Basin.

By Ordovician time the mountain chain had been largely eroded and the Larapinta Group was deposited in the Amadeus Basin in a stable tectonic environment. The Ordovician sea also transgressed southwards and the marine outliers, equivalent to the Larapinta Group, were deposited over the eroded mountain belt in the southern half of the area.

Late in the Ordovician the area was uplifted and sedimentation in the Silurian and Devonian occurred in a continental environment. During this time the Mereenie Sandstone was deposited conformably on the Larapinta Group.

In the middle or upper Devonian the Alice Springs Orogeny occurred along the northern margin of the Amadeus Basin. During the Orogeny the Pernjara Formation was deposited and the sediments overlying the Bitter Springs Formation slid southwards over a décollement in the Bitter Springs Formation and were folded and thrust-faulted.
Subsequent weathering and erosion have produced the Tertiary and Quaternary sediments in the area.

ECONOMIC GEOLOGY

Underground Water

Ten bores for water have been drilled in alluvial deposits of the Livingstone Pass area (Youles, 1964; Forman, 1965). The bores were sunk to depths of 100-200 feet and yielded up to 1750 gallons per hour; total dissolved salts ranged between 318 and 5160 parts per million.

The alluvial area between the Petermann Ranges, especially along the Hull River, gives promise of shallow supplies of water. Water may also occur near the Hull River between the Petermann Ranges and its flood-out areas of Chirnside Creek and Shaw Creek.

Water obtained from bores near Lake Neale or Lake Amadeus would probably be salty. Water could be sought in permeable sandstones in the northern part of the Sheet area. The Mereenie Sandstone and the Winnall Beds would provide the best targets.

Petroleum Prospects

The structure and metamorphism of the rocks south of Bloods Range are unfavourable for the preservation of oil, but accumulations of oil could occur to the north within the Amadeus Basin sediments.

The Pertjara Formation, the Mereenie Sandstone, and the Cleland Sandstone are not potential source rocks. The marine sediments of the Larapinta Group could be considered as both source and reservoir rocks, but the prospects of petroleum accumulation in this Group on the Bloods Range Sheet area are negligible as it is widely exposed and all anticlines are breached to the Upper Proterozoic. The search for oil must be directed at source and reservoir rocks in the Upper Proterozoic succession within which the Bitter Springs Formation and Ininda Beds may contain source rocks; sandstone reservoirs and fracture porosity reservoirs may also be present.

No closed anticlinal structure or other suitable traps for oil have been mapped. Although petroleum may be present under the sand cover the prospects of the area are rated as poor.

Evaporites

Sheared and laminated gypsum crops out in the north-east of the Sheet area. The gypsum is thought to be of diapiric origin derived from evaporite beds in the Bitter Springs Formation. The area may warrant prospect drilling for potash.
Copper, Silver, Lead, Gold

Traces of copper, silver, lead, and gold have been found between Bloods Range and the Petermann Ranges. Malachite is fairly common in the Bloods Range Beds, but no large deposits of sufficient size to encourage prospecting have been found. Traces of copper, lead, silver, and gold have been found in a quartz vein intruding the Mount Harris Basalt at BR99, and a little malachite has been found elsewhere in the Mount Harris Basalt.

The structure of the Petermann Ranges is now known to be broadly similar to the structure at the Winnecke, Arltunga, and White Range gold fields to the east-north-east of Alice Springs, and for this reason it is possible that deposits of gold may occur in the Dean Quartzite in the Petermann Ranges.
REFERENCES


