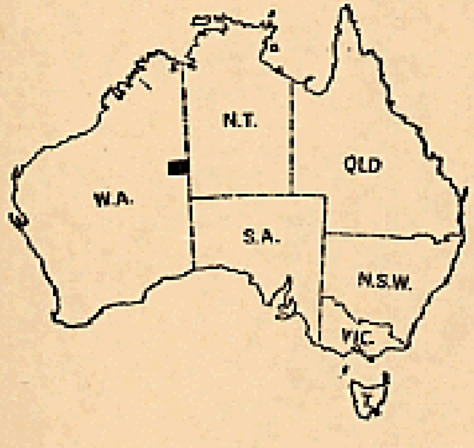
1 : 250,000 GEOLOGICAL SERIES—EXPLANATORY NOTES

MACDONALD

WESTERN AUSTRALIA



SHEET SF/52-14 INTERNATIONAL INDEX

COMMONWEALTH OF AUSTRALIA

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Compiled by A. T. Wells

Issued under the authority of the Hon. David Fairbairn,
Minister for National Development

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS
CANBERRA 1968

COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT
MINISTER: THE HON. DAVID FAIRBAIRN, D.F.C., M.P.
SECRETARY: R. W. BOSWELL, O.B.E.

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS
DIRECTOR: J. M. RAYNER, O.B.E.

GEOLOGICAL BRANCH
ASSISTANT DIRECTOR: N. H. FISHER

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Explanatory Notes on the Macdonald Geological Sheet

The Macdonald Sheet area lies in Western Australia between latitudes 23° and 24° south and longitudes 127° 30′ and 129° east. Its eastern boundary is the Northern Territory border. The closest point of settlement is Giles Meteorological Station, about 135 miles by road from the southern boundary. Two roads, both constructed by the Weapons Research Establishment (which operates the Giles Station), cross the Sheet area. The road in the south-eastern corner runs from Giles to Sandy Blight Junction to the east and then continues eastwards to Alice Springs. The road cutting the northeastern corner continues from Sandy Blight Junction and runs westwards to the Canning Stock Route in the Great Sandy Desert and eventually to Talgarno on the Western Australian coast.

The geology of the Sheet area was originally compiled on uncontrolled photoscale mosaics supplied by the Western Australian Lands Department and the geological map was issued as a preliminary edition in 1964. The Sheet was later recompiled by transferring the geological information plotted on air-photographs on to controlled photoscale compilations supplied by the Division of National Mapping. Aerial photography by the Western Australian Lands Department is at 1 : 40,000 scale and there is complete vertical coverage.

The Macdonald Sheet area lies on the southern fringes of the Great Sandy Desert. The average annual rainfall is about 8 inches; and for comparison it is interesting to note that 58 percent of Western Australia receives less than 10 inches average annual rainfall. The largest proportion of rain generally falls in the summer months. In January the normal daily maximum temperature is close to 100° F. and the normal minimum between 70° and 75° F. The normal daily maximum temperature in July is 70° F. and normal minimum between 40° and 45° F. The average frost-free period is about 300 days per annum, the average annual evaporation about 190 inches, and the average hours of sunshine about 300 for January and 275 for July.

There is no settlement or industry within the Sheet area. Part of the area is an aboriginal reserve administered by the Western Australian Government. A petroleum exploration permit, P.E. 153H, is currently held by Beach General Exploration Pty Ltd. The title is subject to an agreement between Beach General Exploration Pty Ltd and Australian Aquitaine Petroleum Pty Ltd. Hackathorn Oils Ltd retain an interest.

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Most of the area is covered by sand plains and dunes which are covered by spinifex and sparsely distributed low shrubs. There are no large stands of trees; trees of any size are usually confined to the short watercourses near the larger ranges. The largest trees are desert oaks (*Casuarina decaisneana*) which are scattered through the sand dunes and concentrated in a few small groves. One of the largest groves of desert oaks occurs south of the Bonython Range.

Previous Investigations

Until the geological mapping programme by the Bureau of Mineral Resources in 1960, which covered the Macdonald Sheet area and the Rawlinson Sheet area to the south, there had been no systematic attempt to map the geology and determine the stratigraphic succession. Most of the early investigations of the area were by exploratory and prospecting expeditions, and some of their reports include brief descriptions of outcrops within the area.

In 1889, W. H. Tietkins (1891) travelled from Alice Springs to the Western Australian border and then around Lake Macdonald. In 1897, D. W. Carnegie (1898) journeyed south along the Northern Territory border and then moved west immediately north of the Rawlinson Range. W. R. Murray prospected along the border during an exploration trip in 1901 (Murray, 1904), and R. T. Maurice prospected in the area in 1902 (Murray, op. cit); only minor mineralization was found. An aerial expedition led by D. Mackay (1934), and temporarily based on Docker Creek near the western end of the Petermann Ranges, surveyed the area in 1930. In 1958 Frome Broken Hill Co. Pty Ltd (Gillespie, 1959) made the first attempt to study the geology of the area. They measured about 12 sections and traversed the eastern half of the Rawlinson Sheet area and the southeastern corner of the Macdonald Sheet area. In 1960 both Sheet areas were mapped by a field party from the Bureau of Mineral Resources (Wells et al., 1964). In 1962 the Macdonald Sheet area was covered by a regional helicopter gravity survey (Lonsdale & Flavelle, 1963).

For Australian Aquitaine Petroleum Pty Ltd, Wilson & Gates (1965) made a field survey of the area held under P.E. 153H, and Lenon & Hammons (1965) an aeromagetic survey.

The geology of the whole of the Amadeus Basin, the western part of which is included in the Macdonald Sheet area, is described by Wells, Forman, Ranford, & Cook (1968, in press).

PHYSIOGRAPHY

The Macdonald Sheet area is characterized by its senile landscape and internal drainage. The area is part of a broad interior plateau which is about 1500 feet above sea level. The highest point is the summit of the Sir Frederick Range, which is 2269 feet above sea level. Three main physiographic divisions have been recognized: sand plain with longitudinal dunes, low ranges and isolated hills, and salt lakes (Fig. 1).

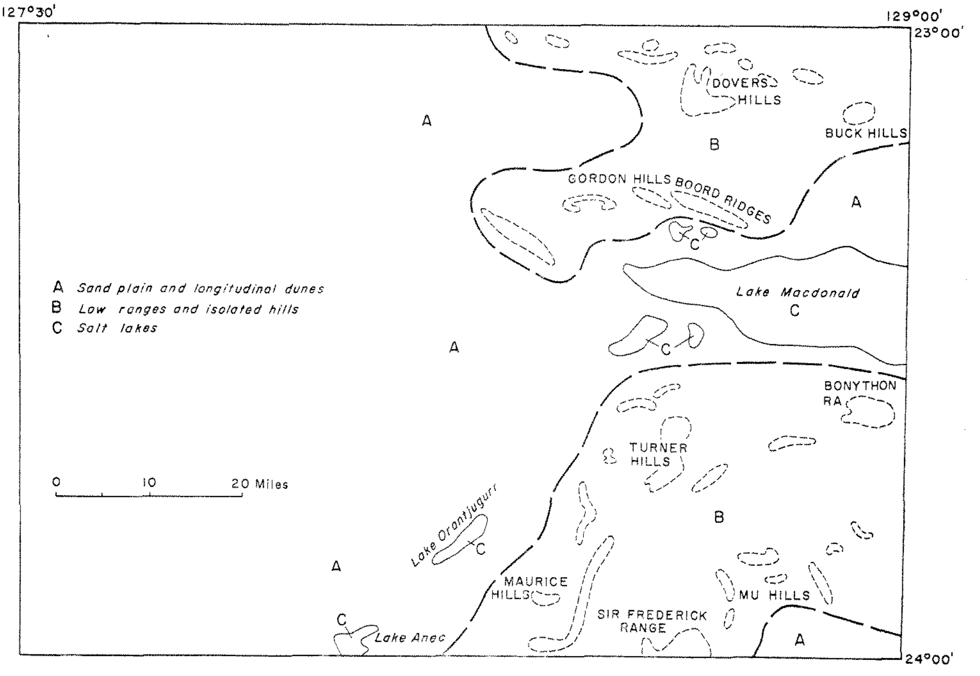

Fig. 1. Physiographic divisions

The sand plain with its long sinuous east-west sand dunes covers practically all of the western half of the Sheet area. The dunes rise about 60 feet above the level of the sand plain and are fixed by a sparse to fairly dense cover of spinifex and small shrubs. Drainage channels are few and poorly defined. Much of the area is underlain by Permian sediments, which in places protrude through the sand cover as low isolated hills and mounds. The main reason for the existence of sand plains in this region is the presence of an easily eroded bedrock of Permian sediments.

The areas of outcrop of sediments of the Amadeus Basin and the Precambrian rocks of the northern margin of the Basin form low ranges and hills with intervening areas invariably of sand plain, on which there may or may not be longitudinal dunes. The sediments form strike ridges of hogbacks and cuestas as well as more rounded hills; the flat-lying Permian sediments form mesas and buttes. Drainage is restricted to small creeks in the immediate vicinity of the ranges and hills.

Lake Macdonald is a large salt lake which is a centre of internal drainage. Its surface is about 1400 feet above sea level. Drainage into the lake is mostly subsurface, with very few small surface channels visible around its margins. In 1960, when the area was mapped, the water level near the southern margin of Lake Macdonald was about 4 inches below the surface. The distribution and structure of rocks about Lake Macdonald suggest that the major part of the lake may be underlain by the Bitter Springs Formation. Southwest of Lake Macdonald are two smaller salt lakes, Lakes Anec and Orantjugurr.

STRATIGRAPHY

The stratigraphy of the Macdonald Sheet area is summarized in Table 1, and the facies changes between formations and their spatial relationships are indicated in this table and in the rock relationship diagram on the geological map. The Proterozoic and Palaeozoic sediments preserved in the Macdonald Sheet area are included in the western extremity of the Amadeus Basin. Large thicknesses of unfossiliferous carbonate rocks, sandstone, and siltstone are overlain unconformably by fossiliferous Ordovician outliers, and on the basis of stratigraphical position and lithological correlation they are regarded as Proterozoic. They rest unconformably on a basement of Precambrian crystalline rocks in the northeastern part of the Sheet area. Thin Permian continental glacial deposits, which are marginal to the marine sediments of the Canning Basin, crop out mainly in the west.

STRUCTURE

The Proterozoic and Palaeozoic sediments are contained within a structural depression about 450 miles long and 100 miles wide, termed the Amadeus Basin. All rocks older than the Heavitree Quartzite are regarded as basement rock, and their structural relationships have not been studied. The porphyritic dacite and rhyolite and minor sediments probably lie unconformably between the gneiss and the Heavitree Quartzite in the core of an eroded anticline.

The northern margin of the Amadeus Basin is marked by the unconformity between the Heavitree Quartzite and the older Precambrian rocks. The Proterozoic and Palaeozoic sediments of the basin are folded and faulted, and the mechanism and expression of the deformation may be explained by the presence of mobile beds in the Bitter Springs Formation. The incompetent folding in this formation has resulted in a décollement in the succession because the structurally weak beds of shale, siltstone, and evaporites in the Bitter Springs Formation were incapable of transmitting stress from the overlying units. The structure of the Heavitree Quartzite at the base of the sequence may be different from that of the units overlying the Bitter Springs Formation.

The major faults trend west and north. The fault planes do not crop out and their presence has been deduced from stratigraphic relationships. The Mu Fault and the Buck Fault trend west. Along the Mu Fault the Maurice Formation is thrown against the Bitter Springs Formation, and possible Ligertwood Beds on the upthrown side dip northwards at 40°. The Buck Fault has downthrown the Bitter Springs Formation against the Precambrian crystalline igneous and metamorphic rocks.

The Sir Frederick Fault trends north-south and continues southwards on to the Rawlinson Sheet area. Outcrops are discontinuous on both sides of the fault and consequently a precise interpretation of the structure is difficult. The stratigraphy and structure of the section to the east and west of the fault suggest that faulting followed folding, with both transcurrent and hinge faulting contributing to their present attitude.

TABLE 1. STRATIGRAPHY OF THE MACDONALD SHEET AREA

Period	*Stratigraphic unit and map symbol*	*Distribution*	*Lithology*	*Thickness (feet)*	*Topography*	*Fossils*	*Stratigraphic relationships*	*Water supply*	*Correlations*
QUATERNARY	Qs	Most extensive in west.	Aeolian sand.	Superficial	Low plains. Numerous braided dunes.			Shallow.	
	Qa	Mainly next to larger ranges and salt lakes in east.	Alluvium.	Superficial	Low plains, small floodcuts, claypans, and scree slopes of ranges.			Perhaps good shallow water in lower-lying areas.	
	Qt	Lakes Macdonald, Anec, and Orantjugurr and small saltpans.	Evaporites.	Not known	Flat floor of salt lakes and saltpans.			Salt.	
	Ql	Fringing salt lakes and in low-lying areas near northern margin.	Travertine.	Not known	Low plains with numerous irregular small hummocks.				
TERTIARY	T	5 miles north-west of Sir Frederick Range.	Sandstone.	Not known	Small low mound.	Numerous dicotyledonous impressions and one fruit—?*Ficus* sp.	Unconformable on Bitter Springs Formation.		
PERMIAN	P	Isolated outcrops mainly in southwest.	Sandstone and siltstone.	Not known	Small scattered hills.		Unconformable on Maurice Formation and Proterozoic to ?Lower Palaeozoic sediments.	Probably good quality.	
	Buck Formation Pb	Widespread scattered outcrops except southeast.	Poorly sorted coarse sandstone, conglomerate with tillitic texture, siltstone, striated and faceted erratics.	137+	Rarely mesas and buttes, mostly low rounded hills.		Unconformable on most older formations.	Probably good quality.	Grant Formation Braeside Tillite, and Paterson Formation of Canning Basin.
	Ligertwood Beds Pzl	Near major faults in south-east.	Lower unit of pebble, cobble, and boulder conglomerate with dolomite fragments; upper of conglomerate with sandstone fragments, conglomeratic sandstone, coarse sandstone and breccia. Units may be disconformable.	?2000	Low hills.		Unconformable on Bitter Springs Formation, and probably most older formations.		
ORDOVICIAN	O	7 miles north-west of Sir Frederick Range.	Mottled pink and white calcarenite, sandstone with pipe rock.	10	Low mounds almost obscured by travertine and sand.	Pelecypods, gastropods, brachiopods, trilobites, echinoderm ossicles, conodonts.	?Unconformable on Bitter Springs and Carnegie Formations.		Stokes Siltstone.
PROTEROZOIC TO LOWER PALAEOZOIC?	Maurice Formation Pza	Maurice Hills, White Range and northern side of Sir Frederick Range.	Cross-bedded quartz sandstone, quartz grey-wacke, fine micaceous siltstone, sandstone. Abundant clay pellets; heavy mineral concentrations.	?7000+	Lower sandstone forms ridges; otherwise poor outcrops.		Conformable on Ellis Sandstone and Sir Frederick Conglomerate; top eroded or unconformable under Permian and Ligertwood Beds.	Prospects probably mostly poor.	Upper part of Winnall Beds.
	Sir Frederick Conglomerate Pzs	Sir Frederick Range and Mu Hills.	Pebble, cobble, and boulder conglomerate with phenoclasts mainly silicified quartz sandstone and some quartz-mica schist.	At least 4000+	Prominent hills with characteristic rounded profiles and even slopes.		Conformable between Carnegie Formation and Maurice Formation. Interfingers with Ellis Sandstone. Locally unconformably overlain by Ligertwood Beds.	Good prospects if permeability not destroyed by secondary cement.	Lower part of Winnall Beds.
	Ellis Sandstone Pze	Maurice Hills, Emery Range, Gordon Hills, Turner Hills.	Kaolinitic quartz sandstone, and minor interbedded calcareous sandstone and siltstone. Cross-bedded, clay pellets, a few rounded quartzite pebbles. Heavy mineral concentrations.	About 2000	Strike ridges or prominent ranges.		Conformable between Carnegie Formation or Boord Formation and Maurice Formation.	Probably good prospects.	Lower part of Winnall Beds.
PROTEROZOIC	Carnegie Formation Puc	Scattered outcrops throughout southeast.	Quartz greywacke, sandstone, siltstone, shale. Heavy mineral concentrations.	About 5000	Low hills and beds of clay-pans.		Disconformable on Bitter Springs Formation, conformable below Ellis Sandstone and Sir Frederick Conglomerate. Interfingers with Boord Formation. Locally unconformably overlain by Ligertwood Beds and Permian sediments.	Prospects probably poor.	Areyonga Formation, Inindia Beds.
	Boord Formation Puo	Boord Ridges and to the west, and between Bonython Range and Emery Range.	Calcarenite, calcilutite, dolomite, limestone, dolomitic limestone, with interbedded siltstone. Abundant stromatolites. Pebble, cobble, and boulder conglomerate with tillitic texture and breccia and sandstone near base.	2800	Alluvial flats. Limestone and dolomite form low strike ridges.		Disconformable on Bitter Springs Formation; conformable below Ellis Sandstone. Interfingers with Carnegie Formation. Locally unconformably overlain by Permian and Ordovician sediments.	Poor prospects except in lower sandstone.	Areyonga Formation, Inindia Beds.
	Bitter Springs Formation Pub	Largest outcrop forms Bonython Range.	Dolomite with chert bands and nodules. Minor limestone, calcilutite, and gypsiferous siltstone.	1200	Low mounds and rarely large ranges.	Stromatolites.	?Conformable on Heavitree Quartzite; disconformable under Carnegie and Boord Formations. Locally unconformably overlain by Permian sediments.	Poor prospects.	Pinyinna Beds.
	Heavitree Quartzite Puh	Dovers Hills and vicinity in northeast.	Quartz sandstone, shale, siltstone, some fine conglomerate. Basal pebble conglomerate.	About 400 exposed	Strike ridges and hills.		?Conformable under Bitter Springs Formation; unconformable over older rocks. Locally unconformably overlain by Permian sediments.	Probably good if sandstone not silicified at depth.	
OLDER PRECAMBRIAN	pGs	Buck Hills, Dovers Hills, and farther northwest in the northeast.	Quartz-feldspar porphyry, low-grade metamorphics, siltstone, chert, conglomerate, acid igneous rocks, dolerite, schist.		Low mounds or base of scarps.		Unconformable below Heavitree Quartzite and Buck Formation.		May be continuation of Arunta Complex.
	pGg		Granite and some aplite.				Interrelationships not studied.		
	PG	Mount Tietkins and to the south.	Gneiss and quartzite, dolerite, schist.						

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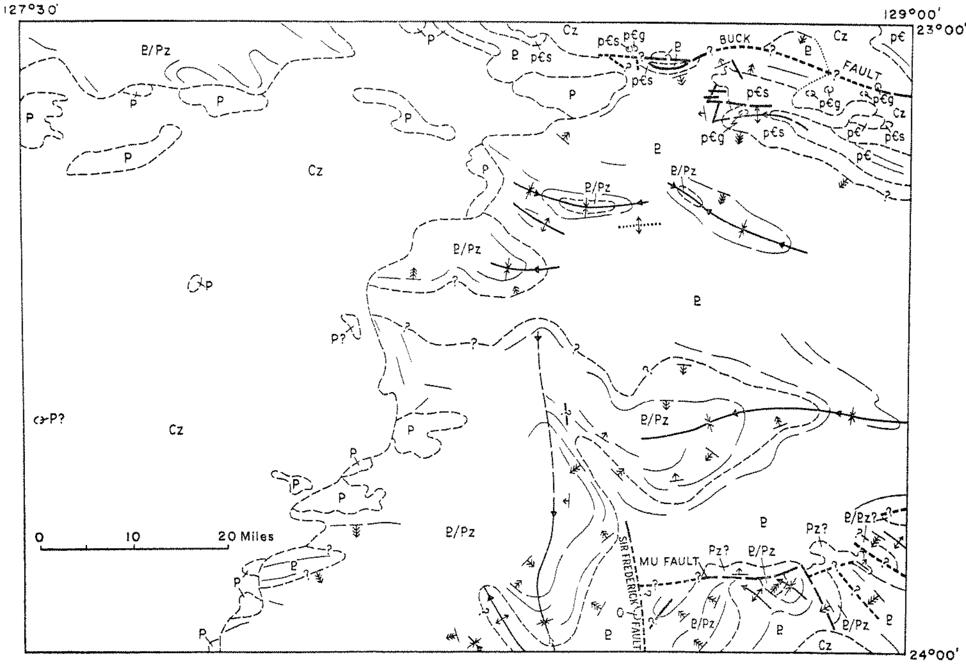

Fig. 2. Structural interpretation

A structural interpretation of the area is shown in Figure 2. The beds dip from 15° to 80° on the flanks of the regional folds. The folds trend in two general directions; one westerly, parallel to the margin of the Amadeus Basin, and the other northerly. The northerly trending structures probably developed soon after the others.

The age of the folding and faulting can be inferred by a comparison with the geological history of the rest of the Amadeus Basin. The presence of boulders of metamorphosed Dean Quartzite (equivalent of the Heavitree Quartzite along the southern margin of the Basin) in the Sir Frederick Conglomerate shows that the Dean Quartzite was folded and metamorphosed before the conglomerate was laid down. Faulting and folding affected the Carnegie Formation, Sir Frederick Conglomerate, Ellis Sandstone, and Maurice Formation before the Ordovician sediments were deposited. Hence three periods of folding have occurred: one in the Proterozoic, the second before the Ordovician sediments were deposited (Petermann Ranges Orogeny), and the third after the deposition of the Palaeozoic sediments (Alice Springs Orogeny).

Aeromagnetic Reconnaissance

A preliminary aeromagnetic survey in the western part of the Amadeus Basin carried out for Australian Aquitaine Petroleum Pty Ltd by Aeroservice Ltd (Lenon & Hammons, 1965) included the Macdonald Sheet area. The maximum estimated depths to magnetic basement are in the south and may be interpreted as indicating a sedimentary thickness of about 29,000 feet.

Gravity Survey

The Sheet area was included in a reconnaissance gravity survey using helicopters undertaken by the Bureau of Mineral Resources in 1962 (Lonsdale & Flavelle, 1963). Parts of two gravity units, the Amadeus Gravity Depression and the Barons Gravity Plateau, lap on to the Sheet area. The Amadeus Gravity Depression indicates the area underlain by thick sediments of the Amadeus Basin and occupies the southeastern third of the Sheet. It is only the western part of a large depression. The Bouguer anomalies suggest that the thickest part of the basin is to the east.

A shelf between the Amadeus Basin and the Canning Basin to the northwest and west with correspondingly thin sediments is indicated by the Barons Gravity Plateau, which occupies the remainder of the Sheet. Part of it is caused by granite, gneiss, and other rocks of Precambrian age which crop out in the northeast. Rocks of similar age and lithology probably underlie the Permian sediments in the west.

GEOLOGICAL HISTORY

Precambrian gneiss, quartzite, dolerite, schist, and granite, overlain by volcanic rocks and subordinate sediments, form the crystalline basement of the Amadeus Basin. The earliest sedimentation in the basin was the Proterozoic Heavitree Quartzite, which was deposited in a widespread shallow sea, unconformably on the basement. The Bitter Springs Formation followed conformably on the Heavitree Quartzite and the present of evaporites in the formation proved elsewhere in the Basin suggests that it was deposited in a restricted shallow marine basin.

Large areas to the south of the Sheet area were uplifted and became the source of most of the ensuing Proterozoic sediments. The coarser, poorly sorted, thicker sediments were deposited in the south in deltas and along the shores of a subsiding trough next to the provenance area (Carnegie Formation), and clastic, chemical, organic marine, and glacial deposits (Boord Formation) were deposited on the northern stable shelf. Boulders in the glacials indicate that all the older formations known in the area were being eroded at this time. Piedmont conglomerates (Sir Frederick Conglomerate) and interfingering shallow marine sands (Ellis Sandstone) were deposited conformably, again with the coarser deposits confined mostly to southern areas. The Proterozoic period of sedimentation was completed with the deposition of the Maurice Formation, which also shows a gradation from coarse to fine sediments from south to north. The formation was probably deposited in a fluviatile environment near the southern source area and in a shallow sea basinwards.

The Petermann Ranges Orogeny in the late Proterozoic or early Cambrian affected all the Proterozoic rocks, which were folded over a glide-plane in the incompetent beds of the Bitter Springs Formation near the base of the sequence. The folding in the sediments above this décollement surface is probably not reflected in the rocks below the Bitter Springs Formation.

The mountains formed during the Petermann Ranges Orogeny in the southern part of the Basin were the main provenance for Cambrian sediments; but they apparently did not reach the Macdonald Sheet area, and for the most part it probably remained a land mass in the Cambrian and Lower and Middle Ordovician. The late Ordovician marine transgression reached the area and limestone and sandstone were deposited unconformably on the Proterozoic rocks. These are the last known marine deposits. After regression of the sea continental deposits were laid down over large parts of the Amadeus Basin, but none of them have been positively identified in the Macdonald Sheet area. The Palaeozoic rocks were folded during the Devonian Alice Springs Orogeny.

Minor faulting and folding affected the sediments in the late Palaeozoic, and the Ligertwood Beds were deposited, mainly near the fault zones. In the Permian the area was subject to continental glaciation, and the fluvioglacial Buck Formation was deposited over a landscape with moderate relief.

The area has been exposed to erosion since the Permian. Small areas of Tertiary sediments with plant remains were deposited in lakes. The most recent sediments include Tertiary pluvial deposits, and Quaternary evaporites, alluvium travertine, and sand and sand dunes during a more arid phase.

ECONOMIC GEOLOGY

No mineral deposits of economic significance are known.

Surface water occurs in a few semipermanent rockholes and native soaks.

Evaporites, mostly halite and gypsum, occur in Lakes Macdonald, Anec, and Orantjugurr, but their thickness is not known. They are too far from markets to be economic. Evaporites are known to occur in the Bitter Springs Formation in other parts of the Amadeus Basin and may also occur subsurface in the Macdonald Sheet area.

The petroleum prospects of the area are poor, mainly because the bulk of the sediments preserved are Proterozoic, and Lower Palaeozoic sediments only occur as small outliers. The only likely source rocks in the sedimentary sequence occur in the Bitter Springs Formation, but it cannot be seriously considered as a suitable prospect for petroleum exploration.

BIBLIOGRAPHY

CARNEGIE, D. W., 1898—SPINIFEX AND SAND. *London, Pearson.*

GILLESPIE, I., 1959—The southwest Amadeus Basin geological reconnaissance survey. *Rep. for Frome Broken Hill Co. Pty Ltd* 4300-G-23 (unpubl.).

GUPPY, D. J., LINDNER, A. W., RATTIGAN, J. H., and CASEY, J. N., 1958—The geology of the Fitzroy Basin, Western Australia. *Bur. Miner. Resour. Aust. Bull.* 36.

JOKLIK, G. F., 1955—The geology and mica fields of the Harts Range, central Australia. *Bur. Miner. Resour. Aust. Bull.* 26.

LENON, D. K., and HAMMONS, R. H., 1965—Aeromagnetic survey, Pollock Hills area, P.E. 152H and P.E. 153H, Western Australia. Part I, operational report, Aero Service Ltd. Part II, interpretation, Geophysical Associates Pty Ltd. For *Australian Aquitaine Petroleum Pty Ltd, B.M.R. file* 65/4619 (unpubl.).

LONSDALE, G. F., and FLAVELLE, A. J., 1963—Amadeus and south Canning Basins reconnaissance gravity survey using helicopters, N.T. and W.A. 1962. *Bur. Miner. Resour. Aust. Rec.* 1963/152 (unpubl.).

MACKAY, D., 1934—The Mackay Aerial Survey Expedition, central Australia. *Geogr. J.*, 84 (6).

MURRAY, W. R., 1904—Explorations by R. T. Maurice—Fowler's Bay to Cambridge Gulf. *S. Aust. parl. Pap.* 43.

TIETKINS, W. H., 1891—JOURNAL OF CENTRAL AUSTRALIAN EXPLORING EXPEDITION, with map and section. *Adelaide, Govt Printer.*

TRAVES, D. M., CASEY, J. N., and WELLS, A. T., 1956—The geology of the south-western Canning Basin, Western Australia. *Bur. Miner. Resour. Aust. Rep.* 29.

WELLS, A. T., FORMAN, D. J., and RANFORD, L. C., 1964—Geological reconnaissance of the Rawlinson and Macdonald 1:250,000 Sheet areas, Western Australia. *Bur. Miner. Resour. Aust. Rep.* 65.

WELLS, A. T., FORMAN, D. J., RANFORD, L. C., 1965—The geology of the north-western part of the Amadeus Basin, Northern Territory. *Bur. Miner. Resour. Aust. Rep.* 85.

WELLS, A. T., FORMAN, D. J., RANFORD, L. C., and COOK, P. J., 1968—The geology of the Amadeus Basin, central Australia. *Bur. Miner. Resour. Aust. Bull.* 100 (in press).

WHITE, Mary E., 1966—Report on 1965 plant fossil collections. *Bur. Miner. Resour. Aust. Rec.* 1966/111 (unpubl.).

WILSON, R. B., and GATES, A., 1965—Field report on the geology of P.E. 153 H, Western Australia. Field Report No. 16, Orantjugurr. *Australian Aquitaine Petroleum Pty Ltd* (unpubl.).

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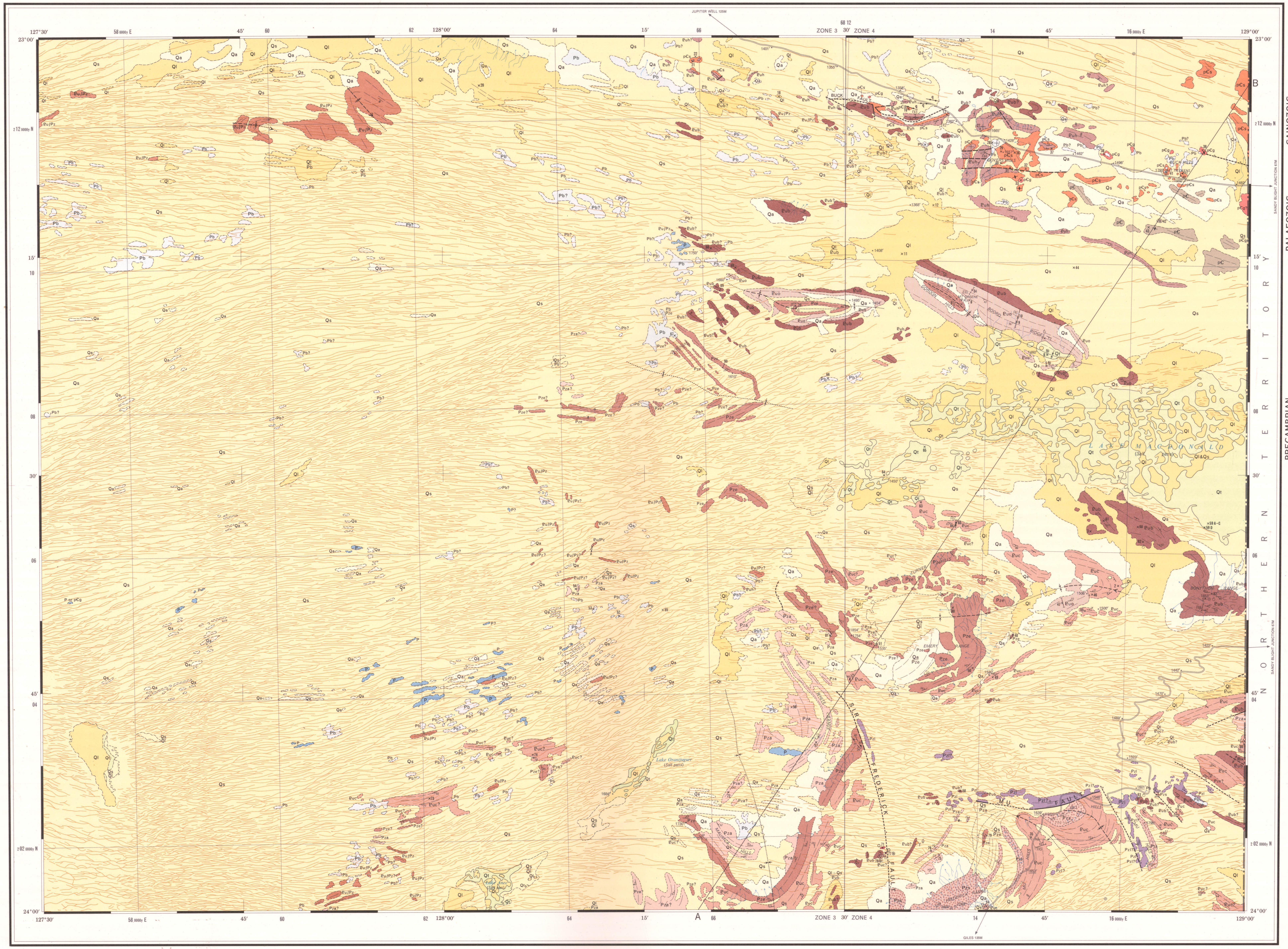


Reference

CAINOZOIC	QUATERNARY		Qs	Aeolian sand
			Qa	Alluvium
			Qt	Evaporites
			Ql	Travertine
	TERTIARY		T	Fossiliferous sandstone
PALAEOZOIC	PERMIAN		P	Sandstone and siltstone
		Buck Formation	Pb	Coarse sandstone, conglomerate with tillitic texture, siltstone, erratics
		Ligertwood Beds	Pzl	Conglomerate, conglomeratic sandstone, sandstone, breccia
	ORDOVICIAN		O	Fossiliferous mottled pink and white limestone; sandstone
	PROTEROZOIC TO LOWER PALAEOZOIC?	Maurice Formation	Pza	Quartz sandstone, quartz greywacke, micaceous siltstone, sandstone
		Sir Frederick Conglomerate	Pzs	Pebble, cobble, and boulder conglomerate, thin interbeds of sandstone
		Ellis Sandstone	Pze	Quartz sandstone, some interbedded calcareous sandstone, pebbly sandstone, siltstone
		Undifferentiated	Pu/Pz	Quartz greywacke, sandstone, siltstone
PRECAMBRIAN	PROTEROZOIC	Carnegie Formation	Puc	Quartz greywacke, sandstone, siltstone, shale
		Boord Formation	Puo	Calcarenite. calcilutite, dolomite, limestone and dolomitic limestone with stromatolites. Interbedded siltstone. Pebble, cobble and boulder conglomerate with tillitic texture, breccia and sandstone near base
		Bitter Springs Formation	Pub	Dolomite with chert bands and nodules. Limestone, calcilutite, siltstone Stromatolites
		Heavitree Quartzite	Puh	Quartz sandstone with shale, siltstone, fine conglomerate
			p€s	Quartz-feldspar porphyry, low-grade metasedimentary rocks, siltstone, chert, conglomerate, acid igneous rocks, dolerite, quartz-feldspar-mica schist.
			p€g	Granite and some aplite
			p€	Gneiss and quartzite, dolerite and quartz-feldspar-mica schist

Geological boundary

Anticline, showing plunge

Syncline, showing plunge

Fault

Where location of boundaries, folds and faults is approximate, line is broken; where inferred, queried; where concealed, boundaries and folds are dotted, faults are shown by short dashes

Strike and dip of strata

Prevailing strike and dip of strata

Overturned strata

Horizontal strata

Dip < 15° } air-photo interpretation

Dip 15°–45°

Dip > 45°

Trend of bedding

Joint pattern

Strike and dip of foliation

Vertical foliation

Strike and dip of joints

Vertical joints

Macrofossil locality (marine)

Fossil locality (stromatolites)

Plant fossil locality

Quartz vein: q quartz

Measured section } text reference prefixed by M

Specimen locality

Sand dunes

Road

Trigonometrical station

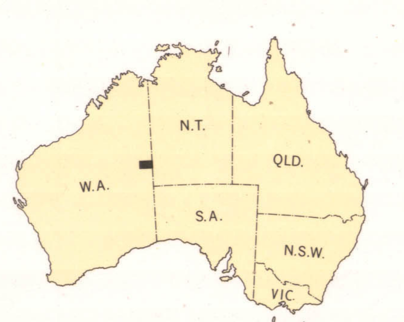
Astronomical station

•1710' Height in feet, instrument levelled } datum: mean sea level, Port Augusta

•1624' Height in feet, barometric

(PA) Position approximate

Published by the Bureau of Mineral Resources, Geology and Geophysics, Department of National Development. Issued under the authority of the Hon. David Fairbairn, Minister for National Development. Base map compiled by the Division of National Mapping, Department of National Development.
Aerial photography by the Department of Lands and Surveys, W.A.; complete vertical coverage of 1:40,000 scale.
Transverse Mercator Projection.



INDEX TO ADJOINING SHEETS

Showing Magnetic Declination

PERCIVAL SF 51-8	HELENA SF 52-5	STANSMORE SF 52-6	HIGHLAND ROCKS SF 52-7	MOUNT THEO SF 52-8
URAL SF 51-12	WILSON SF 52-9	WEBB SF 52-10	LAKE MACKAY SF 52-11	MOUNT DOREEN SF 52-12
MORRIS SF 51-16	RYAN SF 52-13	MACDONALD SF 52-14	MOUNT RENNIE SF 52-15	MOUNT LIEBIG SF 52-16
WARRI SG 51-4	COBB SG 52-1	RAWLINSON SG 52-2	BLOODS RANGE SG 52-3	LAKE AMADEUS SG 52-4
BROWNE SG 51-8	BENTLEY SG 52-5	SCOTT SG 52-6	PETERMANN RANGES SG 52-7	AYERS ROCK SG 52-8

ANNUAL CHANGE 1'E

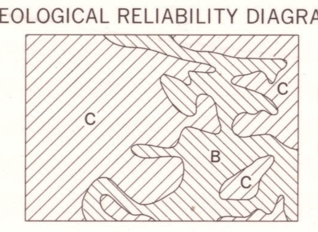
Scale 1:250,000

5 0 5 10 15 MILES

5 0 5 10 15 20 25 KILOMETRES

GREY NUMBERED LINES INDICATE THE 20,000 YARD TRANSVERSE MERCATOR GRID, ZONES 3 AND 4 (AUSTRALIA SERIES)

GEOLOGICAL RELIABILITY DIAGRAM



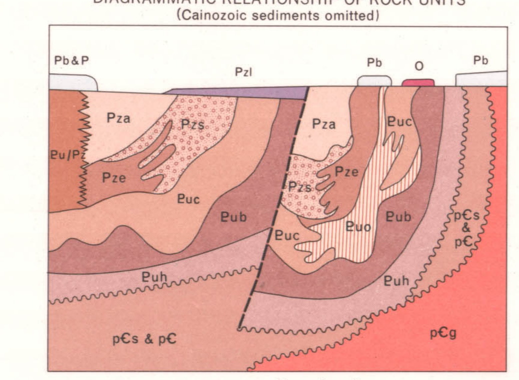
B Reconnaissance: Traverses and air-photo interpretation

C Sketchy: Air-photo interpretation

Geology, 1962, by: A. T. Wells, D. J. Forman and L. C. Ranford.
Compiled, 1966, by: A. T. Wells.
Cartography by: Geological Branch, B.M.R.
Drawn by: Austral Cartographic Service, Canberra, A.C.T.
Printed by: Mercury Press Pty. Ltd., Hobart

DIAGRAMMATIC RELATIONSHIP OF ROCK UNITS

(Cainozoic sediments omitted)

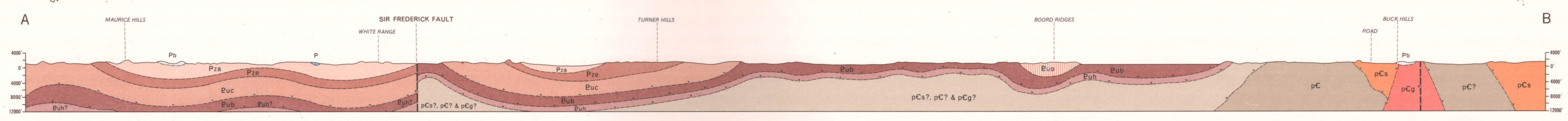


Unconformity

Section

Cainozoic sediments omitted from section

Scale: $\frac{V}{H} = 1$



FIRST EDITION 1968

MACDONALD

SHEET SF 52-14

Copies of this map may be obtained from the Bureau of Mineral Resources, Geology and Geophysics, Canberra, A.C.T., or the Geological Survey of Western Australia, Perth