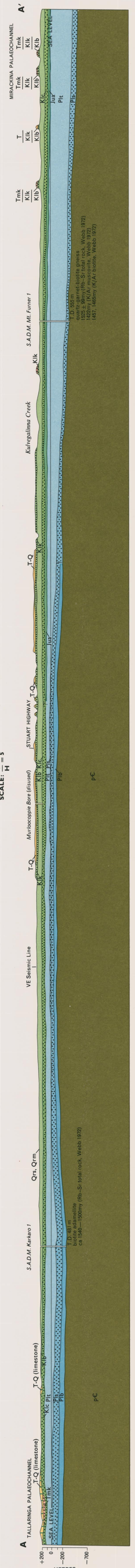
MURLOOCOPPIE

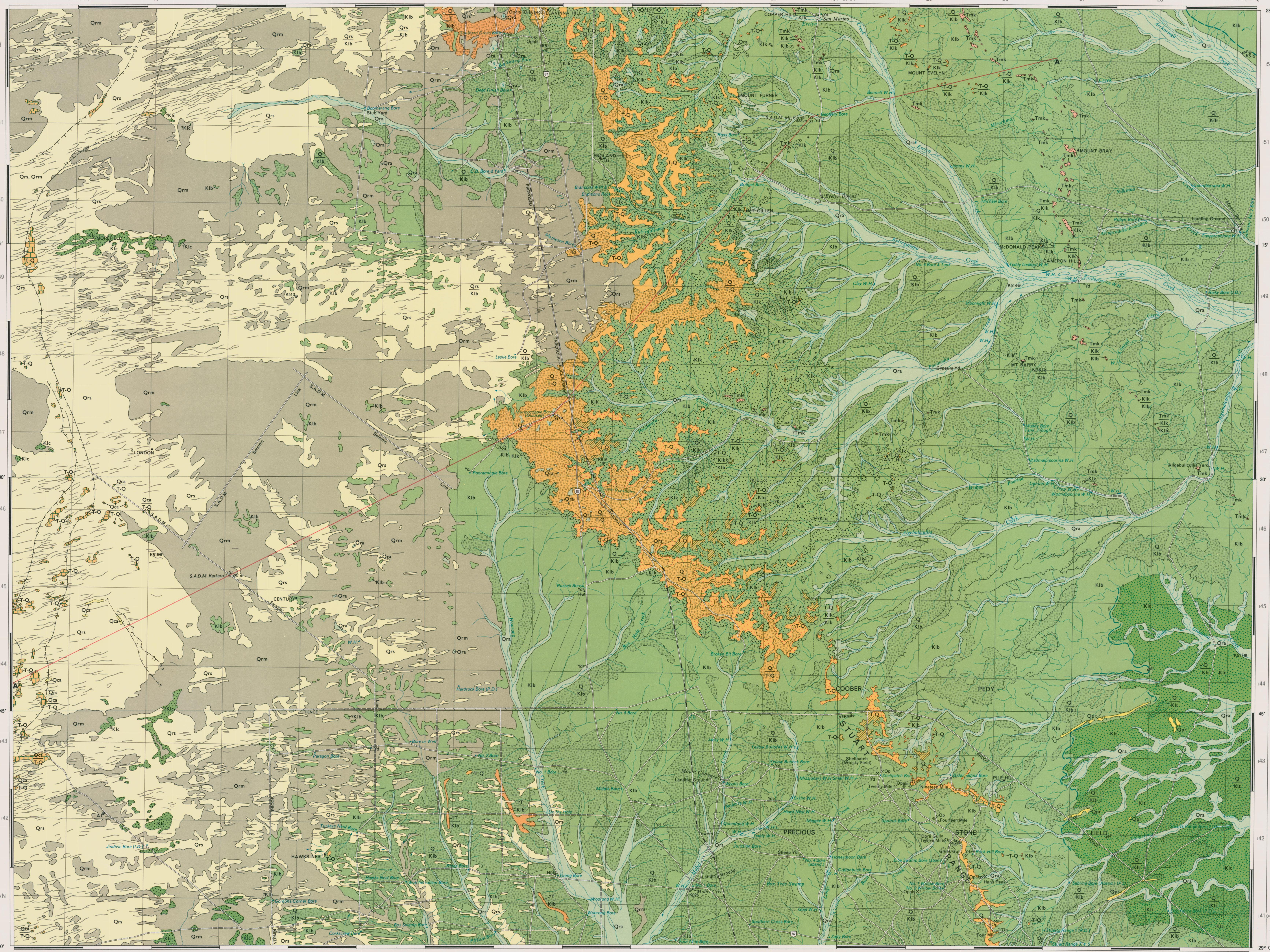
GEOLOGICAL SURVEY OF SOUTH AUSTRALIA
DEPARTMENT OF MINES ADELAIDE

AUSTRALIA 1:250 000

S.A. GEOLOGICAL ATLAS SERIES SHEET SH 53-2 ZONE 5

FIRST EDITION 1976





REFERENCE

CAINOZOIC

QUATERNARY — PLEISTOCENE-RECENT

Qra Fluviatile silts, sands and gravels of modern drainage channels, flood plain areas and claypans.

Qrs Yellow-red aeolian quartz sands of the Great Victoria Desert. Generally fixed by vegetation and covered by dense growth of mulga trees. Derived in part from underlying Qrm. Boundaries between these two units are often diffuse and subjective. Underlain at a shallow depth by Cretaceous units.

Qrm Shallow red-clayey, sandy soils often associated with dense mulga growth. Includes thin superficial spreads of maghemitic gravel (buckshot gravel).

Outwash fans and slope deposits incised by modern drainage probably equivalent in part to POORAKA FORMATION.

Q Undifferentiated Quaternary overlying older units. Extensive silcrete gibber lags overlying red-brown to grey clayey, silty and sandy soils and weathering products derived from underlying Cretaceous. Probably includes POORAKA FORMATION and CALLABONNA CLAY in part. Boundary very diffuse denoting merely a lessening in thickness of superficial cover.

Qca Pale coloured platy to nodular calcrete. Generally occurs as a thin veneer over T–Q and Cretaceous units in the Great Victoria Desert.

Low scarps covered with gypseous silts, pale coloured fragmentary material and undifferentiated Quaternary (Q), representing deflated remnants of the "Gypsite surface" (Pleistocene).

Qpr Gypsite. Massive gypsum crusts and associated gypseous silts overlying gypsum-impregnated Cretaceous rocks. May be associated with a multicoloured jasper silicification.

CAINOZOIC SEDIMENTS AND PALAEOSOLS OF THE STUART RANGE

TERTIARY — PLIOCENE

T-Q MT. WILLOUGHBY and MANGATITJA LIMESTONE EQUIVALENTS: Pale coloured, soft, silty limestone and dense (dolomitic) limestone, often with irregular, milky, chalcedonic silicification. Pisolitic and concretionary habit in part. Lower portion earthy and fragmental with clastic material. Basal part may contain ferruginous material probably reworked from underlying unit.

T-Q DOONBARA FORMATION EQUIVALENT: Ferruginous and calcareous rocks. Dark, red-brown sandy and silty fragmentary rocks incorporating reworked silcretes, silcretes and Cretaceous shales. Variably lateritic and pisolitic. Patchily silicified to form red, brown and cream "jasper-breccia silcrete". (Soil stratigraphic unit, in part.)

Heavily ferruginised rocks derived entirely from Cretaceous units (soil stratigraphic unit).

Silcrete of older units reworked within red-brown fragmental rocks, described above. Some red-brown sandstone with silcrete clasts. Patchily silicified to give conglomeratic silcrete with red-brown matrix. Grey conglomeratic silcrete may develop within this unit.

?MIOCENE

Tms Unnamed: Widespread, strongly silicified medium to coarse clayey sands bearing polished silcrete pebbles. Usually occurs as a massive, grey columnar, sandy or "conglomeratic" silcrete. Reworked into the overlying T–Q unit. Schematic section only.

Tmk MIRACKINA CONGLOMERATE: Channel fills. Coarse conglomerate with rounded and polished silcrete and quartz clasts. Fine to coarse grained, cross-bedded and massive impure, quartz sands. Minor siltstones, shales and pure quartz sands. Upper part silicified to a massive columnar grey silcrete, porcellanitic shale or conglomeratic silcrete, and may be heavily ferruginised.

?OLIGOCENE

Tsi Silcrete. Small remnants of massive homogeneous buff to dark grey silcrete. Angular quartz grains in a dense siliceous matrix. Generally broken down and reworked into younger units.

T Undifferentiated Tertiary units as described above comprising Tsi, Tmk and T–Q in varying proportions.

Unconformity.

SUCCESSION IN GREAT ARTESIAN BASIN

MESOZOIC — CRETACEOUS

ALBIAN

Klo OODNADATTA FORMATION: Grey and greenish-grey shales, claystones and siltstones. Very minor, feldspathic, sandy siltstones and silty fossiliferous limestone. Generally strongly bleached and altered in outcrop.

Klk COORIKIANA SANDSTONE MEMBER: Fine to coarse grained, kaolinitic, feldspathic, micaceous, glauconitic quartz sandstones. Varies from massive, gritty sandstone to fine grained, fissile sandstone. Interbeds of sandy siltstone and silty shale. Sandstones often cross-bedded and/or strongly bioturbated. Coarser units often silicified and/or ferruginised.

APTIAN

Klb BULLDOG SHALE: Blue-grey and grey claystones and shales (very dark grey when fresh). Lenses of fine grained silty sandstone, particularly near upper and lower boundaries. Lenses and concretions of fossiliferous limestone common. Scattered Adelaidean cobbles and boulders throughout. Generally strongly altered, bleached and gypsified in outcrop.

Klt Unnamed unit transitional between the BULLDOG SHALE and CADNA-OWIE FORMATION. Dark chocolate-brown claystones with "cone-in-cone" limestones and thin lenticular conglomeratic, sandy interbeds. Persistent brown-weathering limestone horizon marks the top in the Giddi Giddinna—Oolgelima area. Characterised by lag boulder fields.

NEOCOMIAN

Klc CADNA-OWIE FORMATION: Very fine to medium grained impure quartz sandstones with micaceous siltstone and shale. Thin calcareous sandstones, "cone-in-cone" limestones and coarse pebbly quartz sandstones, in part ferruginised. Coarse sandstones with rounded and smoothed exotic (Adelaidean) boulders.

Transgressive disconformity.

IN SUBSURFACE ONLY

JURASSIC

Jua ALGEBUCKINA SANDSTONE: Poorly cemented, white to pale brown, fine to coarse grained quartz sandstone, kaolinitic in the lower part, with pebble horizons. Minor siltstone and shale.

Unconformity.

SUCCESSION IN ARCKARINGA BASIN

IN SUBSURFACE ONLY

PALAEOZOIC — PERMIAN

ARTINSKIAN

Plt MOUNT TOONDINA FORMATION: Upper part, interbedded sandstone, siltstone, coals and carbonaceous shales, minor calcareous or pyritic sandstone. Lower part, pale to dark grey non-carbonaceous, partly calcareous, clayey sandstones, siltstones and shales.

SAKMARIAN

Pls STUART RANGE FORMATION: Greenish-grey, sandy to silty claystone (marine).

Plb BOORTHANNA FORMATION: Upper part, conglomeratic sandstone displaying graded bedding. Lower part, pebbly to cobbly claystone (reworked marine glacigene sediments).

PRECAMBRIAN

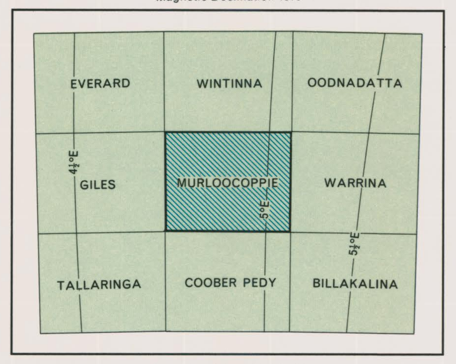
p€ Undifferentiated basement rocks including adamellites and acid gneisses of Gawler Craton. Section only.

GEOLOGICAL BOUNDARIES
- ACCURATE
- APPROXIMATE

STRIKE AND DIP OF BEDDING
LINEAMENT
TYPE SECTION LOCALITY
FOSSIL LOCALITY
- MACROFOSSIL (MOLLUSCS)
- FOSSIL WOOD
- MICROFOSSIL

GEOLOGICAL SECTION A A′
MAIN ROAD
SECONDARY ROAD
TRACK
NATIONAL ROUTE NUMBER 87
TOPOGRAPHIC DEPRESSION
BOUNDARY FENCE
CONTROL POINT, ASTRONOMICAL
EPHEMERAL STREAM
SWAMP
CLAYPAN
BORE
WELL W.
TANK T
WATERHOLE W.H.
STRATIGRAPHIC BORE St.
MINE

INDEX TO ADJOINING SHEETS



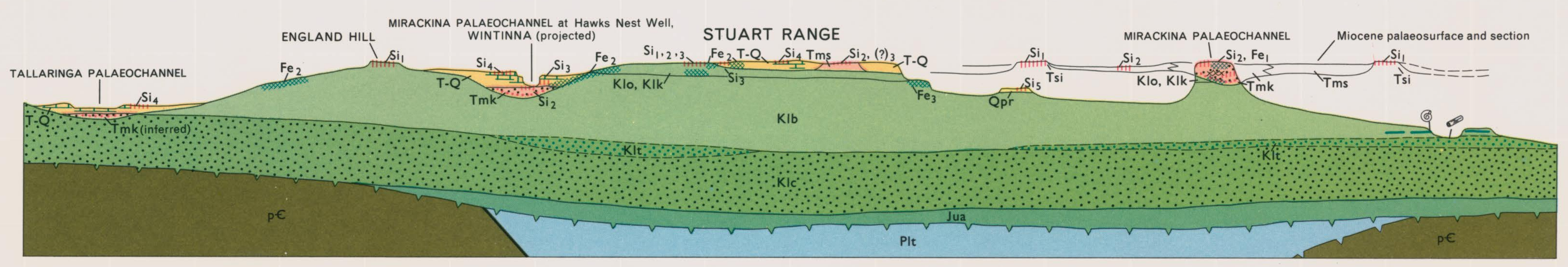
SCALE

KILOMETRES 5 0 5 10 15 20 25 KILOMETRES

MILES 2 1 0 2 4 6 8 10 12 14 16 18 20 MILES

PRINTED IN AUSTRALIA
A. B. JAMES, GOVERNMENT PRINTER
SOUTH AUSTRALIA

SCHEMATIC SECTION
SHOWING STRATIGRAPHIC AND PALAEOSOL RELATIONSHIPS

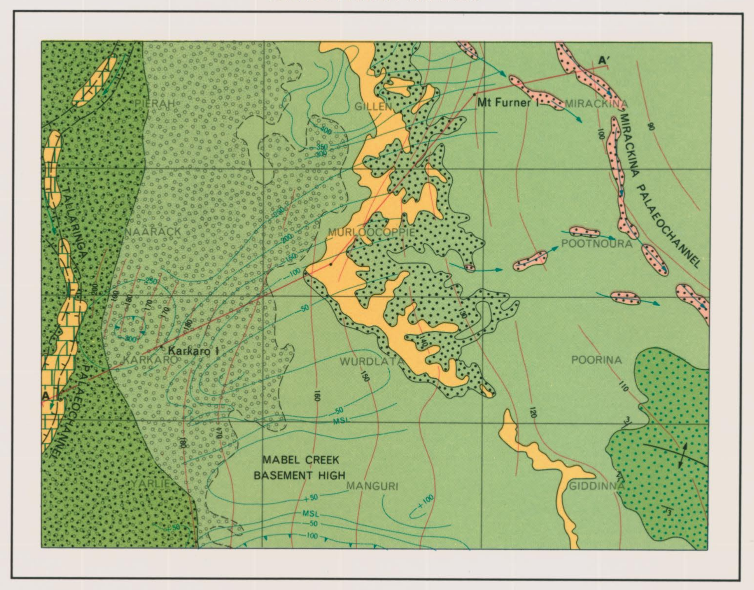


Ferruginisation and possible silicification associated with gypsite profile development .... Fe_3, Si_5
Disconformity
Chalcedonic silicification within T–Q limestones .... Si_4
Disconformity in part
Synformational ferruginisation and later porcellanitic silicification of Doonbara Formation equivalents .... Si_3, Fe_2
Disconformity
Variable ferruginisation and massive "grey billy" silicification of Tms and Tmk .... Si_2, Fe_1
Disconformity
Massive "grey billy" silicification equivalent to the "Silcrete of the Cordillo Surface" (?Oligocene) .... Si_1
Silicification
Ferruginisation
Superimposition of profiles .... (e.g.) $Si_{1,2,3}$
Silcrete (Si_1) clasts
Cross-bedding
Fault (diagrammatic)
Unconformity, disconformity

Note: Stratigraphic relationships between various silicification and ferruginisation phases are not fully understood, although disconformities as indicated have been established.

Copies of this map may be obtained from the Geological Survey of South Australia, Department of Mines, Adelaide, or the Bureau of Mineral Resources, Geology and Geophysics, Canberra, A.C.T. Printed for the Geological Survey of South Australia as a contribution to the Geological Map Series of the Commonwealth.

STRUCTURAL SKETCH



Quaternary (overlying Cretaceous)
Tertiary—Quaternary
- Plio-Pleistocene
- Pliocene
- Mio-Pliocene

Cretaceous
- Oodnadatta Formation
- Bulldog Shale and transitional unit
- Cadna-owie Formation

Structure contours (metres, relative to mean sea level)
- Seismic basement (modified from Milton, 1971)
- Top of Cadna-owie Formation ("C" seismic horizon)

Palaeo-drainage (Miocene to Pleistocene)
Interpreted Bulldog Shale—Cadna-owie Formation boundary
Anticline
Attitude of bedding
Geological Section A A′

Geological compilation by G. M. Pitt, B.Sc.

Geological mapping by G. M. Pitt and L. C. Barnes, B.Sc. (Hons.).

B. P. Thomson, M.Sc., Supervising Geologist, Regional Geology Division.

Map preparation by Cartographic Division, Department of Mines, S.A.

Compiled under the direction of B. P. Webb, M.Sc., Government Geologist, Director of Mines.

Issued under the authority of the Honourable H. R. Hudson, B.Ec., M.P., Minister of Mines and Energy.

Published 1976.

MURLOOCOPPIE

SOUTH AUSTRALIA

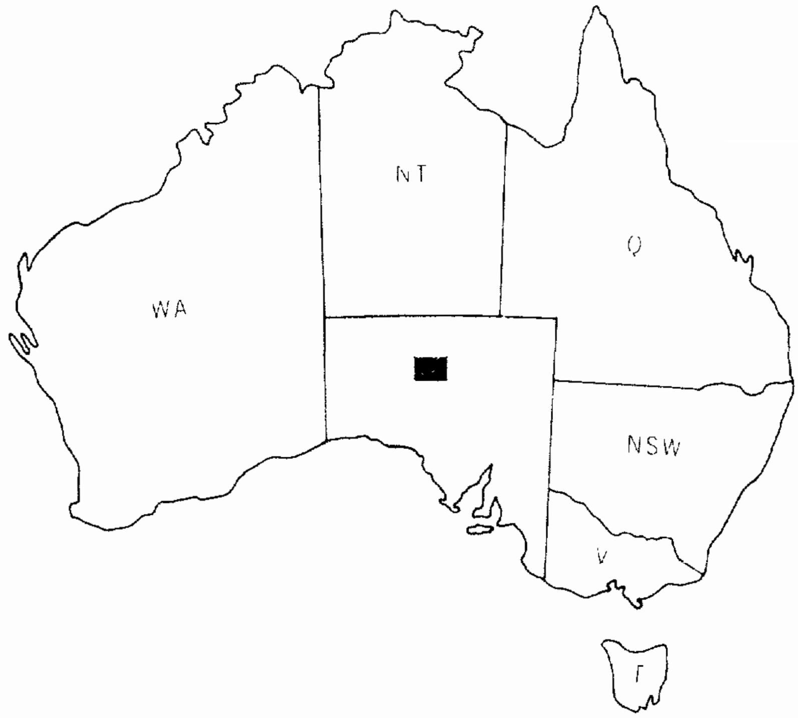
Explanatory Notes

1 : 250 000 Geological Series—Sheet SH/53-2

Geological Survey of South Australia

MURLOOCOPPIE

SOUTH AUSTRALIA



Explanatory Notes

1 : 250 000 Geological Series—Sheet SH/53–2

Geological Survey of South Australia

DEPARTMENT OF MINES AND ENERGY, STATE OF SOUTH AUSTRALIA
GEOLOGICAL SURVEY OF SOUTH AUSTRALIA

1:250 000 GEOLOGICAL SERIES—EXPLANATORY NOTES

MURLOOCOPPIE

SOUTH AUSTRALIA

SHEET SH/53-2 INTERNATIONAL INDEX

COMPILED BY G. M. PITT

DEPARTMENT OF MINES AND ENERGY, SOUTH AUSTRALIA

MINISTER: THE HON. H. R. HUDSON, M.P.

DIRECTOR-GENERAL: B. P. WEBB

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Explanatory Notes for the MURLOOCOPPIE 1:250 000 Geological Map

Compiled by G. M. Pitt

INTRODUCTION

The MURLOOCOPPIE 1:250 000 sheet lies between Coober Pedy and Oodnadatta in the central Far-North of South Australia, and is bounded by latitudes 28°S and 29°S and longitudes 133°30′E and 135°00′E (see Fig. 1). The area is occupied by six pastoral stations, stocked with sheep and cattle: Mable Creek and Mount Clarence south of the vermin-proof 'dog fence', and Mount Willoughby, Evelyn Downs, Mount Barry and Copper Hill to the north. The eastern extremity of the Great Victoria Desert occupies the western one-third of the sheet and is uninhabited. The important opal mining town of Coober Pedy lies 1·5 km south of the southeastern corner of the sheet area.

The main access route is the Stuart Highway, which proceeds westerly from Coober Pedy, then north through the central portion of MURLOOCOPPIE.

The recent program of mapping was begun in 1972 with a reconnaissance field trip and supporting helicopter survey using a Bell 47G helicopter (September-November 1972), which covered MURLOOCOPPIE and adjacent areas. Follow-up fieldwork was conducted throughout 1973 and much of 1974, by L. C. Barnes and the writer, during which time, mapping was carried out on both MURLOOCOPPIE and WINTINNA.

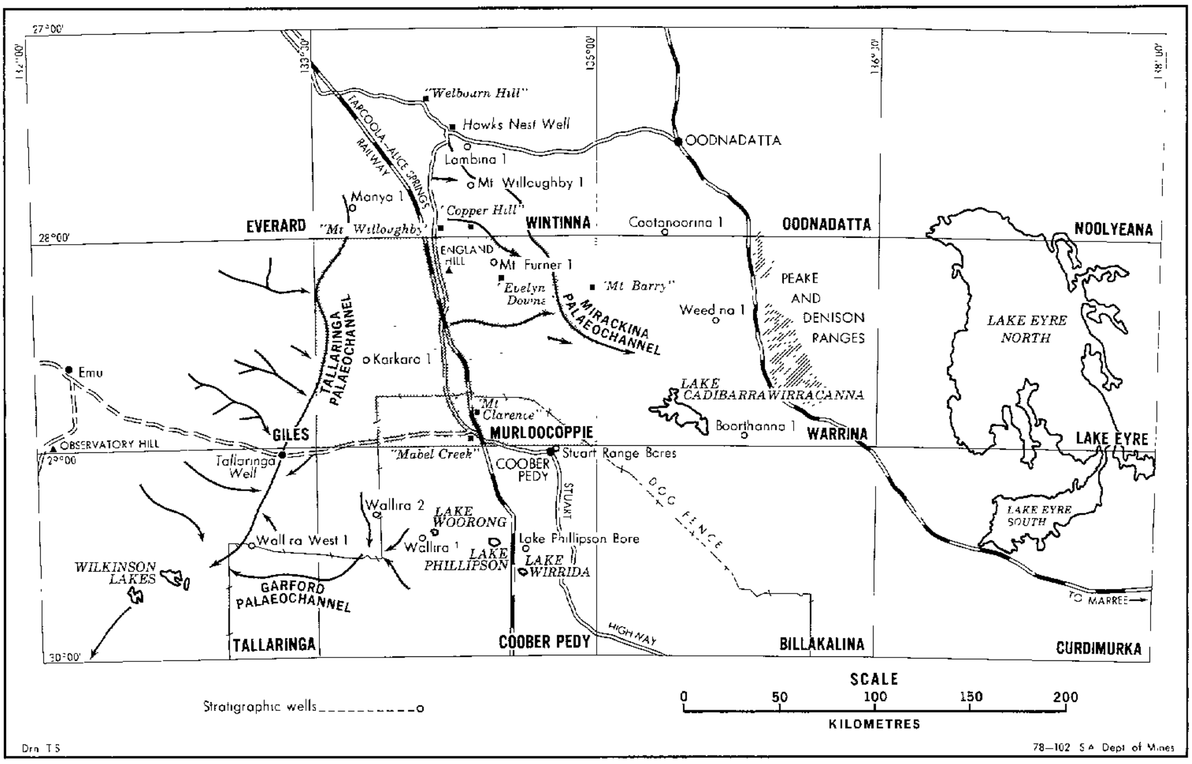

Fig. 1—Locality map of MURLOOCOPPIE showing palaeodrainage systems

Department of Lands RC-9 aerial photography (Surveys 709, 710 and 711; scale 1:79 200) was used for recording field data and photointerpretation. Later photography, surveys 1501 and 1500, at a scale of 1:87 500, has also become available, and relevant LANDSAT-1 satellite imagery has been found useful in the interpretation of Tertiary palaeodrainage features.

Access south of the 'dog fence' is good, particularly in the outlying opal mining areas. To the north, in the central northern 'breakaway' (scarp) areas of the Stuart Range, cross-country traversing was slow and difficult. In the Great Victoria Desert, work was hindered by the thick growth of Mulga trees *(Acacia aneura)* on semi-consolidated dunes, and although limited traversing was undertaken, data was most effectively gathered along the few tracks and seismic lines present, and from localities visited by the helicopter.

A detailed report of the mapping and geology of this sheet is available in Pitt (1976).

HISTORICAL AND PREVIOUS INVESTIGATIONS

According to Tindale (1940), the area under discussion was traditionally occupied by the Antakiringa tribe prior to European settlement although signs of their presence are now rare. During field mapping however, two stone pattern sites were located, both on Pootnoura Creek. Elsewhere, quarry sites have been noted where even-grained, sandy variants of the Mirackina Conglomerate, now silicified to an orthoquartzite, have been used to make stone implements. The opaline 'jelly-potch' of chalcedonic limestone was also a favoured lithology and occurrences of flakings are widespread.

The first European to explore the area was Stuart (see Stuart, 1858) on the first of his attempts to traverse Australia. He was followed by Ross in 1874 (Ross, 1875) who examined a great deal of the WINTINNA-MURLOOCOPPIE-COOBER PEDY area. His work is of significance in the naming of many of the geographical features in the area.

From 1882 to 1892 the area was included in a trigonometrical survey between Oodnadatta and the Western Australian border (Carruthers, 1892). As well as naming many other features, Carruthers renamed many of those of Ross's.

The first geological survey of the region was conducted by Brown (1890), to be followed by the Elder expedition of 1891-1892 (Streich, 1893). In 1902, Maurice and Murray (Murray, 1904) traversed the eastern Great Victoria Desert, *en route* locating Tallaringa, a native well. Their geological observations in this area are of some interest and importance.

Subsequent regional geological work was carried out by Brown (1905) and Jack (1915 and 1931).

Maps by Stuart (1858), Brough Smythe (1873), Ross (1875), Brown (1884), Everett (1866, South Australian portion), Brown (1890), Carruthers (1892), Brown (1899, northwestern portion), Murray (1904) and Jack (1915, 1931) illustrate the development of geographic and geological knowledge of the region.

Recent regional studies include Forbes (1961) and Rochow (1963).

Studies pioneering the detailed geological mapping and stratigraphy of the Cainozoic of northern South Australia have great relevance to the geology of MURLOOCOPPIE. Important among these are reports by: Callen (1975, 1976, and 1977), Firman (1970 and 1971), Freytag (1966), Freytag *et al.* (1967), Jessup and Norris (1971), Major (1972, 1973 a and 1973 b), Nichol (1971 a), Smale (1973), Stephens (1971), Stirton *et al.* (1961), Wopfner (1967, 1972 and 1974), Wopfner, Callen and Harris (1974) and Wopfner and Twidale (1969).

PHYSIOGRAPHY

The physiographic divisions of MURLOOCOPPIE are closely allied to the Tertiary and early Quaternary geology of the area. With this in mind, the area is divisible into five distinct zones (see Fig. 2).

Stuart Range. The plateau region of the Stuart Range is the major topographic feature on MURLOOCOPPIE, extending from north to southeast across the central portion of the map area. The range forms the major drainage divide between the drainage east into the catchment of Lakes Eyre and Cadibarrawirracanna, and that south and west into Lakes Phillipson, Wirrida and Woorong, and the Great Victoria Desert (Fig. 2). Barnes and Pitt (1976 a, Fig. 1) suggest the range has been a major divide since at least the mid-Tertiary.

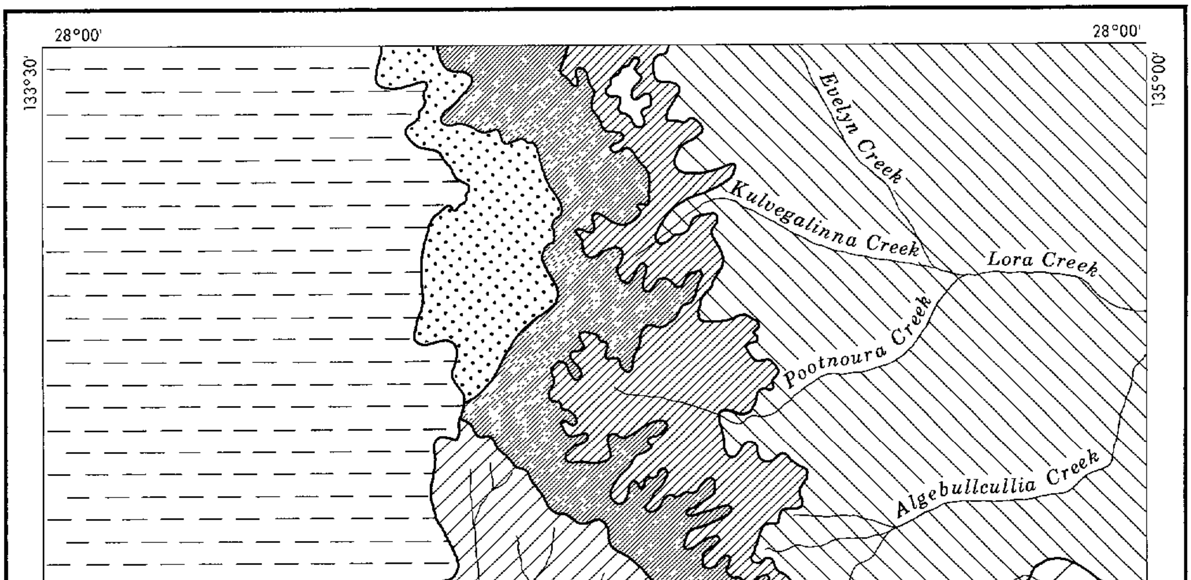

Fig. 2—Physiographic divisions on MURLOOCOPPIE

Gravity survey barometric levels show the plateau in northern MURLOOCOPPIE to be relatively level at about 270-280 m above mean sea level (M.S.L.). From here it dips gently towards Coober Pedy, dropping to about 240-250 m above M.S.L. England Hill, the highest point on the sheet area, rises above the plateau to an altitude of about 310 metres.

Stuart Range scarp area. The 'breakaway' area forming the dissected eastern edge of the Stuart Range is characterised by complex mesa areas and steep, high scarps. Although cross-country travel is often slow and tortuous, the area is ideal for detailed examination of numerous vertical cliff sections through the Tertiary duricrusts and deeply weathered, softer Cretaceous units.

Southern gibber plains. This zone comprises the gently undulating plains of the south-facing watershed, which drains the southwestern side of the Stuart Range. In general, breakaway scarps are rarely developed on this side of the plateau.

Transitional area. This is defined where the characteristics of the gibber plain gradually become subordinate to the red, sandy soils and dunes, with heavy mulga growth, of the Great Victoria Desert.

Eastern gibber plains. East of the Stuart Range and its scarp areas, the country consists of wide, rolling, open plains covered by gypseous soils and lag deposits of silicrete gibbers. The monotony of these plains is punctuated by rare isolated mesas, remnants of the Stuart Range tableland.

The Oolgelima plains are distinguished by a thick gibber lag composed entirely of Precambrian lithologies, and devoid of silcrete clasts. Boulders up to 2 m across occur littered across the surface, and are derived from the underlying Cretaceous.

Creeks draining the Stuart Range, 'breakaway' and eastern gibber plains develop into wide, braided ephemeral rivers, supporting a growth of river red gum (*Eucalyptus camaldulensis*) in the 'breakaway' areas with gidgee (*Acacia cambagei*) becoming common towards the plains. After rare seasons of good rainfall, such as 1972-74, waterholes are common and wildlife prolific.

The Great Victoria Desert. This zone occupies the western one-third of MURLOOCOPPIE. It is formed largely of unconsolidated, but essentially non-mobile, sand dunes, overlying a compacted red-clay, sandy soil with rare outcrops of Tertiary limestones and Cretaceous rocks. Individual dunes may be up to 10-15 m high and many kilometres long. The desert is generally thickly covered by mulga (*Acacia aneura* and *Acacia linophylla*) rendering cross-country traversing difficult. Although mulga is the main agent in fixing the dunes, both the interdunal flats and the dunes themselves are covered in a profusion of native grasses, flowering bushes and shrubs, and wildflowers, during good seasons.

A major factor in the physiography of this area is the presence of the Tallaringa palaeodrainage system (Barnes and Pitt, 1976 b), an Eocene to ? late Pleistocene drainage system (see Fig. 1). It is now inactive and infilled with unconsolidated dune sand, but still retains some topographic expression.

STRATIGRAPHY

Only early Cretaceous and Cainozoic units occur in outcrop on MURLOOCOPPIE. Older rocks, specifically the late Jurassic of the Great Artesian Basin, the Permian of the Arckaringa Basin and Precambrian crystalline basement are present in the subsurface and have been intersected in Department of Mines (SADM) stratigraphic wells Karkaro 1 and Mount Furner 1.

A summary of the stratigraphy of MURLOOCOPPIE is given in Table 1, together with thicknesses intersected in the above stratigraphic wells. The reader is

TABLE 1

STRATIGRAPHY

Age		Stratigraphic Unit, Primary Reference (s)	Map Symbol	Thickness (m)	Lithology	Remarks
QUATERNARY	Holocene	Alluvium	Qra		Fluviatile muds sands and gravels.	Occupies modern drainage channels, flood plains and minor claypans.
		Sand	Qrs		Yellow-red aeolian quartz sands. Medium to fine-grained unconsolidated.	Seif dunes and sand spreads of the Great Victoria Desert. Partially fixed by vegetation.
		Red-brown soils (Major, 1973 b)	Qrm		Shallow red-brown clayey—sandy soils.	Characterised by the growth of thick stands of mulga. Underlies the sands of the Great Victoria Desert.
	Pleistocene to Holocene	Undifferentiated Quaternary	Q		Red-brown to grey, silty to sandy soils and weathering products with a surface lag of silcrete gibber.	Derived from breakdown of underlying units. Often gypseous due to reworking of gypsite.
		Calcrete	Qca	<0·1 to 1·0	White to pale coloured platy to nodular calcrete.	Superficial deposits veneering outcrop on western MURLOOCOPPIE. Regional correlations unknown.
		Gypsite	Qpr		Massive gypsum crusts and associated gypseous silts.	Preservation of original gypsite crust is rare. Usually eroded and reworked into younger units.
		Disconformity				
TERTIARY	Pliocene to Pleistocene	Chalcedonic limestone (Mangatitja, Mt Willoughby Limestone equivalent: Major, 1973 a, Nichol, 1971 a)	T-Q	<4	Cream to light grey, variably chalcedonic limestone. Lower portion often fragmentary and earthy.	Fresh water or brackish lake deposit. Remnants occupy the Tallaringa Palaeochannel and are characterised by the growth of a red-flowering *Dodonaea*.
		Doonbara Formation equivalent (Wopfner, 1974)	T-Q	<4	Red-brown, silty to sandy, friable ferruginous rocks. Variably pisolitic, lateritic and/or calcareous. Often silicified, producing a jasper breccia.	One of the major rock types forming the cap of the Stuart Range plateau. Developed as a partly alluviated and reworked pelaeosol under moist, humid (oxidising) conditions.
		Disconformity				
	Miocene to Pliocene (? late Miocene)	Mirackina Conglomerate (Barnes and Pitt, 1976 a)	Tmk	2-15	Channel-confined deposits of silcrete clast-bearing conglomerates, sands and silts. Variably silicified and/or ferruginised.	Occupies the Mirackina Palaeochannel and tributaries, an exhumed Tertiary palaeodrainage system. No fossils have been found, apart from silicified wood.
		Unnamed widespread silicified sands (Barnes and Pitt, 1976 c)	Tms	1-5	Widespread, relatively thin, polished silcrete pebble-bearing sands or silty sands. Often massively silicified.	Extensive sandy equivalent to the channel-confined Mirackina Conglomerate. Invariably occurs as a massive silcrete on MURLOOCOPPIE—elsewhere may be more thickly developed and only partially silicified as at Mt Sarah (DALHOUSIE).
		Erosional disconformity				

		Erosional disconformity						
	?Oligocene	Silcrete (Wopfner, 1974)	Tsi		Quartzose silcrete of the duricrust profile (Wopfner, 1974): 'greybilly' silcrete.	Rare isolated remnants only: these are usually broken down and incorporated into younger units in part. Otherwise present only as clasts in Tmk and Tms.		
		Erosional unconformity						
CRETACEOUS	Albian	Oodnadatta Formation (Freytag, 1966)	Klo		Grey to greenish grey claystones and siltstones.	Generally strongly bleached and altered in outcrop. Minimal outcrop occurs on MURLOOCOPPIE. Marine.		
CRETACEOUS	Albian	Coorikiana Sandstone Member (Freytag, 1966)	Klk	10-14	Fine to coarse-grained, clean, micaceous glauconitic and/or kaolinitic sandstones, variably massive, fissile and/or cross-bedded, with silty interbeds.	Basal member of the Oodnadatta Formation. Often extensively bioturbated and may be strongly ferruginised. Marine.		
							Intersections in Stratigraphic Wells Thickness in m	
							Mt Furner 1	Karkaro 1
CRETACEOUS	Aptian	Bulldog Shale (Freytag, 1966)	Klb	120	Dark grey, silty shale, variably carbonaceous, pyritic or glauconitic, with a scattering of Precambrian cobbles and boulders. Some fossiliferous limestone or concretion horizons, often well-developed near base.	Usually deeply weathered to a light grey or off-white. Thickness increases to some 400 m in centre of the Great Artesian Basin. Base in *Giddinna* area taken as a major brown-weathering, fossiliferous limestone horizon. Marine.	60	42
CRETACEOUS	Aptian	Unnamed transitional unit (Pitt, 1976 and this paper)	Klt	?10+	Largely 'shale, dark grey, organic-rich . . . with partings of quartz sand, very fine-grained, pale grey, silty and micaceous' (Lindsay, 1975) with lenses of conglomeratic sands and 'cone-in-cone' limestones. Gypseous throughout, and may be somewhat glauconitic.	On MURLOOCOPPIE outcrops only in *Giddinna* area where it is characterised by a remarkable 'boulder field'—a heavy boulder lag developed on soft gypseous soils. Restricted marine.	Not recognised	Not recognised
CRETACEOUS	Neocomian	Cadna-owie Formation (Wopfner, *et al.*, 1970)	Klc		Grey to off-white, finely micaceous, pebbly to cobbly, medium to fine-grained quartz sandstone. Becomes fine-grained in the upper portion with micaceous siltstone and claystone interbeds.	Major aquifer of the Great Artesian Basin in this region. Transitional marine.	44	28
		Transgressive disconformity. Units below occur subsurface only						
JURASSIC	Late	Algebuckina Sandstone (Wopfner *et al.*, 1970)	Jua		White to pale grey, medium-grained to conglomeratic, kaolinitic, quartz sandstone. Planar, angular cross-bedding, often well developed with pebble conglomerate layers at base of sets.	Basal unit to the Great Artesian Basin in this region. Fluviatile.	27	Not intersected

		Unconformity					
PERMIAN	Artinskian	Mt Toondina Formation (Townsend and Ludbrook, 1975)	Plt	Upper unit: interbedded sandstones, siltstones, coals and carbonaceous shales. Minor calcareous and/or pyritic sandstones. Lower unit: pale to dark grey, non-carbonaceous, sometimes calcareous, clayey sandstones, siltstones, and interbedded shales.	Arckaringa Basin sediments Lacustrine, fluviatile	390	230
PERMIAN	Sakmarian	Stuart Range Formation (Townsend and Ludbrook, 1975)	Pls	Greenish-grey, sandy to silty claystone.	Restricted marine.	27	104
PERMIAN	Sakmarian	Boorthanna Formation (Townsend and Ludbrook, 1975)	Plb	Upper unit: pebbly to bouldery sandstone graded bedding often well developed. Lower unit: pebbly to cobbly claystone.	Lower unit: reworked glacigene material deposited under fluvial and partial marine conditions.	Not intersected	61
		Unconformity					
?DEVONIAN		Cootanoorina Formation (Townsend and Ludbrook, 1975)	?D	Dense, pale grey dolomite, shales and dolomitic sandstones. Some evaporites.	Restricted to Boorthanna and Wintinna Troughs. Intersected in Weedina 1, Boorthanna 1 and Mt Willoughby 1.	Not intersected	
		Unconformity					
CARPENTARIAN		Crystalline basement (Thomson, 1974)	P:	Granite and granitic gneiss of the Gawler Craton, dated at 1 529±99 Ma from a 5-sample Rb-Sr isochron from Mt Furner core material (Webb, 1972).		T.D. 549	T.D. 472

referred to Townsend (1976) for a detailed description of units older than early Cretaceous.

CARPENTARIAN

SADM Karkaro 1 and Mount Furner 1 entered granitic and gneissic basement at 472 m and 549 m respectively. These basement rocks represent the northern extremity of the Gawler Craton. A five-sample Rb-Sr isochron was obtained from Mount Furner 1 giving an age of 1525 ± 99 Ma.*

(?) DEVONIAN

A sequence of dense dolomites, with minor grey shales and dolomitic sandstones has been defined as the *Cootanoorina Formation* (Townsend and Ludbrook, 1975), from intersections made in Weedina 1, Mount Willoughby 1 and Cootanoorina 1 on WINTINNA and WARRINA. The unit is responsible for marked positive gravity features and is restricted to the Wintinna and Boorthanna Troughs, which are marginal to the Arckaringa Basin. The Cootanoorina Formation may not occur in the subsurface on MURLOOCOPPIE, or, if at all, only on the extreme northwestern and northeastern corners.

PERMIAN

The Early Permian of the Arckaringa Basin has been divided into three units defined by Townsend and Ludbrook (1975): the Boorthanna Formation, Stuart Range Formation and Mount Toondina Formation.

The lowermost unit, the *Boorthanna Formation,* unconformably overlies the Cootanoorina Formation. Two sub-units may be distinguished: a lower diamictite (equivalent to the Permian rocks outcropping along the margin of the Peake and Denison Ranges) and an upper conglomerate. The conglomerate displays graded bedding possibly attributable to turbidity currents.

Intersections in stratigraphic wells suggest that the lower diamictite is restricted to marginal troughs of the Arckaringa Basin whereas the upper conglomerate laps onto the western and southeastern parts of the central platform area of the Arckaringa Basin, but is absent over the central to northeastern part of the platform. Thus, with respect to MURLOOCOPPIE, the Boorthanna Formation is probably present only in the far west and northwest of the sheet.

Townsend and Ludbrook (1975), give an age of Lower Sakmarian for the Boorthanna Formation, based on determinations by Balme (1964), Ludbrook (1961, 1967 a, 1967 b) and Harris and McGowran (in Thornton 1970, 1971 and Townsend 1970, 1971, 1976).

The *Stuart Range Formation* consists predominantly of a homogeneous green-grey claystone. The unit has very distinctive lithological and electric log characteristics. It is interpreted as having been deposited under restricted marine conditions. It apparently conformably overlies the Boorthanna Formation on western MURLOOCOPPIE, and elsewhere on the sheet rests directly on crystalline basement.

The formation is considered to be Sakmarian-Artinskian in age (Townsend and Ludbrook, 1975).

Conformably overlying the Stuart Range Formation, the *Mount Toondina Formation* is divisible into a lower non-carbonaceous unit of sandstones, shales and siltstones and an upper unit containing sandstones, siltstones, coals, carbonaceous

* A. W. Webb, 1972. Amdel-SADM Geochronology Project 1/1/122, Prog. Rep. 9 (unpublished).

shales with some pyritic and calcareous sandstones. This upper unit has been the target for exploratory work by private companies, and large reserves of coal within it are already proven at Lake Phillipson.

On MURLOOCOPPIE, private company exploration has to date shown that pre-late Jurassic erosion has stripped the Mount Toondina Formation in many areas, although some remnants of the coal-bearing upper unit are still present (see for example, McLean, 1975). Townsend and Ludbrook (1975) suggest a Sakmarian to Artinskian age for this formation.

JURASSIC

Unconformably overlying the Permian sediments, the *Algebuckina Sandstone* forms the basal unit of the Great Artesian Basin in this region.

The unit was defined by Wopfner *et al.* (1970) as a terrestial-fluviatile sequence consisting of medium-grained to conglomeratic, kaolinitic arenite beds, with well-developed angular, planar, current bedding. It is of limited extent on MURLOOCOPPIE and occurs in the subsurface on the eastern half of the sheet only.

On the basis of fossil plant and palynological determinations by Harris (1962 and 1970, also in Wopfner *et al.*, 1970), the Algebuckina Sandstone is regarded as Late Jurassic.

CRETACEOUS

The *Cadna-owie Formation* overlies the Algebuckina Sandstone, the boundary being marked according to Wopfner *et al.* (1970), by a transgressive disconformity. Wopfner *et al.* (1970), have defined it as a sequence of transitional and shallow marine sands underlying the marine Bulldog Shale.

It typically consists of a fine to medium-grained quartz sandstone, but in the upper portions fine-grained sandstones or sandy, micaceous siltstones may be present. The unit may contain thin coal bands and often has a high content of pebbles and boulders derived from Proterozoic rocks. The origin of these clasts is discussed in Wopfner *et al.* (1970).

The Cadna-owie formation may outcrop in the Great Victoria Desert, along the western margin of MURLOOCOPPIE, as shown on the accompanying map sheet. However, due to poor access and lack of outcrop, it is now considered equally possible that the Cretaceous rocks in this area may belong to the unnamed transitional unit described below.

The formation is considered to be Neocomian to early Aptian on the basis of palynological and foraminiferal evidence (Harris 1965, Wopfner *et al.* 1970, Ludbrook 1966, 1967 a).

The Cadna-owie Formation underlies the Bulldog Shale throughout the sheet area, and much of it, particularly in the southeast, may be correlated with the deltaic Mount Anna Sandstone Member.

In the southeastern corner of MURLOOCOPPIE, an *unnamed transitional unit* has been mapped, which is gradational both lithologically and stratigraphically, between the underlying Cretaceous-Jurassic sandstones and the overlying Bulldog Shale.

In this area it consists largely of dark, chocolate-brown mudstones, interbedded with conglomeratic sandy lenses and 'cone-in-cone' limestone. Though distinguished from the Bulldog Shale on the map sheet and legend, it is probably best regarded as a basal member of that unit. Lithological equivalents have been recognised at the Andamooka and Stuart Creek opal fields, tentatively identified in the subsurface in the Stuart Range and also in Stuart Range No. 3 drill hole (the unnamed transitional beds of Ludbrook, 1967 a).

The base of the unit is marked by a sharp contact with the Cretaceous-Jurassic sands. Its top, in MURLOOCOPPIE, is selected at a persistent, brown-weathering limestone; elsewhere however, this limestone is absent, and definition of the top must be made on the basis of the lithological characteristics described above. Clasts weathering out of the unit notably include fossiliferous Devonian quartzites (personal communication, R. B. Flint, S.A. Dept. of Mines).

Drill hole intersections documented by Mason (1975 b) suggest the maximum thickness of the unit is some 25 m (it would appear the upper part of this 25 m, in Stuart Range No. 3, was assigned by Ludbrook (1967 a) to the Marree Formation proper). The latter is equivalent to, and encompasses both the Bulldog Shale and the Oodnadatta Formation, discussed below.

A fauna containing abundant *Textularia anacooraensis* and other foraminifera was recorded by Lindsay (1975) from a sample of this transitional unit, indicative, according to Ludbrook (1966), of the lowermost Aptian. Lindsay (1975) also notes '. . . the degree of diversity of the foraminiferal microfauna suggests at least a partially marine environment of deposition, but the lack of other fossils, the wholly agglutinated assemblage and the organic-rich lithology indicate restricted and/or marginal marine conditions'.

Regarding then, the unnamed transitional unit as a basal member of the Bulldog Shale, the remainder of the latter forms the majority of Cretaceous outcrop on MURLOOCOPPIE. When fresh, the *Bulldog Shale* is a dark grey, fossiliferous, silty, variably carbonaceous, pyritic or glauconitic shale. However, it is usually seen in outcrop as a deeply weathered, light grey to off-white shale, occasionally silty or sandy. Fossiliferous concretionary limestones form beds, particularly in the lower part of the unit. Clasts of quartzites and rarely other lithologies occur sporadically. As a result of Tertiary silicification(s), the shale may be silicified to a cream or multicoloured porcellanite, or bleached and ferruginised red, orange or purple, as in the Mount Gillen area.

In general, only the basal member of the conformably overlying *Oodnadatta Formation,* that is, the *Coorikiana Sandstone Member,* is preserved above the Bulldog Shale. This member consists predominantly of fine to medium-grained massive to cross-bedded sandstone with rare interbeds of grit. Bioturbation, worm tubes and similar structures are extremely common. The presence of glauconite is only recorded in the subsurface, but may be the source material for surficial ferruginisation of coarser sands.

The member is perhaps the most prominent of a number of thin sandy intercalations, which occur sporadically within the early Cretaceous sequence.

Within the Stuart Range escarpment, the passage upwards from Bulldog Shale into Coorikiana Member is gradual, and this, allied with the strong alteration of both and the coarsening of the Bulldog Shale in the Coober Pedy area, hinders their identification and mutual distinction, in some areas. The base of the Coorikiana Member in this area is therefore chosen at the lowermost grit bed; a lithology not typical of the underlying Bulldog Shale. Few remnants of the rest of the Oodnadatta Formation have been observed above the Coorikiana Member in the Stuart Range, but where present it consists of deeply weathered and bleached shales indistinguishable from the Bulldog Shale.

The early Cretaceous shale sequence is therefore best regarded as a shallow-marine, shale and silty to sandy shale sequence, with occasional fine to coarse-grained sands and sandy limestone intercalations, of which the Coorikiana Member is a major, but by no means unique, example. An abundant shelly fauna from the early Cretaceous units indicates an Albian age for the Oodnadatta Formation, a transitional Albian to Aptian age for the Coorikiana Member, and an Aptian age for the Bulldog Shale (Ludbrook, 1966).

TERTIARY TO EARLY QUATERNARY

With the exception of the Tallaringa Palaeochannel, Tertiary sediments and duricrusts are confined to the Stuart Range and outliers. The rocks capping this dissected plateau consist of a complex of sediments and duricrusts whose ages range from (?)Oligocene to late Pleistocene. A recent approach to the problem of Tertiary duricrusts and their relationship to regional stratigraphy has been made by Callen *et al.* (1978), and a preliminary synthesis of Tertiary duricrusts and their stratigraphic relationships in the Stuart Range, derived from the work reported herein, is contained in Barnes and Pitt (1976 d).

The earliest known Tertiary rock unit in the area is a silcrete now preserved only in the form of clasts in younger units. It may be equivalent to the *'Silcrete of the Cordillo Surface'* (Wopfner, 1974). The 'Silcrete of the Cordillo Surface' is of probable Oligocene age and throughout northern South Australia affects the Paleocene to Eocene Eyre Formation (Wopfner *et al.*, 1974), and according to Wopfner (1964), older units from Cretaceous to Precambrian. As the Eyre Formation has not been recognised on MURLOOCOPPIE, post-Eyre Formation silcrete-related (see Callen, 1975, p. 30) alteration (bleaching and silicification) of the exposed Cretaceous rocks is therefore the first event of Tertiary age preserved in the geological record in the area.

The *Mirackina Conglomerate* represents a major fluvial phase, post-dating the early Tertiary silicification of the Eyre Formation, and consists of a sequence of conglomerates containing silcrete, quartz and shale clasts, massive to cross-bedded sandstones and some shale. Sediment for this unit was derived from erosion of pre-existing silcrete, Eyre Formation, bleached Cretaceous shales, and Cretaceous sandstones. The top of the unit is massively silicified to a 'greybilly' silcrete, similar to clasts contained within it.

The distribution of the unit strongly suggests deposition within a large palaeodrainage system, composed of a number of tributaries and a main channel: the Mirackina Palaeochannel, which is over 200 km long (Barnes and Pitt, 1976 a).

The *unnamed* (?)Miocene sands on MURLOOCOPPIE (*Mount Sarah Sandstone* equivalent, Barnes and Pitt, 1976 c) are regarded as the interdistributary or colluvial equivalent of the channel-confined, fluviatile Mirackina Conglomerate. It consists of thin, widespread clayey sands containing cobbles and polished pebbles of silcrete. These sands, on MURLOOCOPPIE, are massively silicified and form the most prominent silcretes on that sheet.

In the absence of palaeontological evidence, a possible age for the Mirackina Conglomerate and the Mount Sarah Sandstone has been deduced from lithology and field observations. The presence of silcrete clasts, derived from the 'Silcrete of the Cordillo Surface', suggests a post-Oligocene age, whilst the stratigraphic position beneath the Pliocene or Early Pleistocene Doonbara Formation and its equivalents (see later) suggests a pre-Pliocene age. The Mirackina Conglomerate and the Mount Sarah Sandstone are thus likely to be of Miocene or Pliocene age. Possible regional stratigraphic and age relationships of the Mirackina Conglomerate and the Mount Sarah Sandstone are also discussed in Callen *et al.*, 1977.

Within the lower reaches of the Tallaringa Palaeodrainage system, on TALLARINGA and COOBER PEDY, drilling has revealed (Benbow *et al.*, 1978) channel-confined, Eocene deposits composed of lignitic sands (Pidinga Formation) and overlying dolomitic and palygorskitic clays of possible Miocene age (Garford Beds). These sediments lap out 'upstream' and have not yet been recorded north of Tallaringa Well, i.e., on MURLOOCOPPIE, though they may well be present. If so, they would represent possible estuarine and lacustrine time-equivalents of the Mirackina Conglomerate and Mount Sarah Sandstone of the Stuart Range.

Post-dating and unconformably overlying the Mirackina Conglomerate and equivalents is a friable, red, ferruginous, clastic rock, which ranges from a laterite (even of a pisolitic habit) to ferruginous or calcareous sands, silts and clays. This unit, equated with Wopfner's *Doonbara Formation* (see Wopfner, 1974), forms a major portion of the complex of rock units of different ages, which cap the Stuart Range plateau. Silicification occurring within it is irregular, and has produced a brittle 'jasper breccia' or 'puddingstone'.

It is thought that this unit developed as a ferruginous colluvial mantle from the break-down of underlying rocks under humid conditions. Minor mass movement served to transport some of the debris into local depressions, which detailed work has shown to be remnants of the palaeodrainage system within which the Mirackina Conglomerate was previously deposited. The Doonbara Formation in this area must thus be regarded as a palaeosol in part, with a variable sedimentary aspect.

Within the abovementioned depressions, and after the development of the Doonbara Formation, carbonate deposition took place in a restricted lacustrine environment (again usually confined to the local depressions) resulting in the formation of chalcedonic limestones now mapped as the *Mount Willoughby and Mangatitja Limestones* (Nichol, 1971a and Major, 1973a).

Limestones of this type have also been recorded in the Tallaringa Palaeochannel and while as yet they have not been accurately dated, they are believed to be Late Pliocene to Middle Pleistocene in age.

SUMMARY OF TERTIARY EVENTS

The following comments are intended to be explanatory to the schematic section on the accompanying MURLOOCOPPIE sheet.

The earliest Tertiary event of importance to the region was the deposition of the Late Paleocene to Eocene Eyre Formation (Wopfner *et al.*, 1974), and its subsequent silicification, probably during the Oligocene. The resultant silcrete was termed the 'Silcrete of the Cordillo Surface' by Wopfner (1974), and is, for ease of reference, informally numbered Si_1 on the schematic section. Eyre Formation has not been recorded on MURLOOCOPPIE (Si_1 clasts in later sediments are not recognisable Eyre Formation) and Si_1 alteration instead affected the Cretaceous units exposed at the time.

The next identifiable Tertiary event on MURLOOCOPPIE was a major fluvial phase involving erosion of the Cretaceous rocks and Si_1 silcrete, and the deposition of the Mirackina Conglomerate within an extensive drainage system. The occurrence of 'greybilly' silcrete clasts within the Mirackina Conglomerate, itself in turn capped by a 'greybilly' silcrete, demonstrates that a phase of silcrete genesis (Si_2) postdated this fluvial phase, and thus clearly shows that there were two distinct phases of 'greybilly' silcrete formation.

The silcrete relationships observed in the Mirackina Conglomerate, and discussed above, are also present in the Mount Sarah Sandstone. In the past, these relationships were interpreted as indicating reworking contemporaneous with silicification (for example Wopfner *et al.*, 1974), however Barnes and Pitt (1976c) believe that fluviatile processes on a scale much larger than just minor reworking, are implied.

At Hawks Nest Well (WINTINNA), Doonbara Formation is irregularly silicified into a 'jasper breccia' (Si_3) and overlies with a sharp contact, and contains boulders of, Mirackina Conglomerate (Barnes and Pitt, 1976 d, slide 52). This demonstrates that Si_3 is distinct from the prior silicifications Si_1 and Si_2.

A fourth, separately identifiable silicification (Si_4) is present in the form of chalcedonic veining and replacement within the Mount Willoughby and Mangatitja Limestones and equivalents. Field relationships of this silicification are not well understood, as the Mount Willoughby Limestone is largely conformable with the Doonbara Formation and Si_3 and Si_4 may be the same. Recent work around Coober Pedy, however, suggests Si_4 is significantly younger.

Ferruginisation has likewise been subdivided into a number of phases. It occurs both in the basal and uppermost portions of the Mirackina Conglomerate (Fe_1) and on petrographic evidence (Whitehead, 1974) predates the silicification (Si_2) of the conglomerate. The most distinctive ferruginisation is that associated with the Doonbara Formation and equivalents (Fe_2), the 'ferralitisation' of Wopfner (1974). Deposition and ferruginisation of the Doonbara Formation are here regarded as virtually contemporaneous.

The limitations to the ages of these silicifications and ferruginisations are clearly defined by reference to the ages of the various units in which they were developed, and/or reworked, as presented in Table 1.

QUATERNARY

Massive, crystalline, gypsum crusts, which would appear to resemble the 'gypsite' of Wopfner and Twidale (1967), occur only rarely on MURLOOCOPPIE. Field work has suggested that since about the mid-Pleistocene, gypsum has been continually recycled through all surficial units, with the irregular development of crusts and/or disseminated impregnations. The age of gypseous impregnations or crusts is therefore not definable, and conclusive identification of an original gypsite crust, if such existed, would be speculative.

Eastern MURLOOCOPPIE is characterised by deflated mesas or terrace levels, which were probably derived by reworking and lowering of a thick gypsum crust. The ill-defined scarps bounding these levels are mapped on the accompanying MURLOOCOPPIE sheet, and described in the legend. It should be noted however, that the 'Gypsite' of Wopfner and Twidale (1967), is not alluded to. Minor ferruginisation and silicification, which appears to be related to gypsum induration is here termed Fe_3 and Si_5.

Calcretes have only been recorded in the Great Victoria Desert, associated with outcropping limestones and Cretaceous units. They are rarely well developed and occur usually as thin veneers. There is little evidence available to relate them to calcretes elsewhere in the State, and the reservations expressed above, with respect to the stratigraphic unreliability of gypcretes, is considered to apply, as well, to calcretes.

A *red-brown clayey sand* of (?) sub-Recent age occurs throughout western MURLOOCOPPIE and underlies present-day *aeolian dune sands.* In some areas, a deepening in colour of the dune sand suggests derivation from the clayey sands, which outcrop in interdunal areas.

Recent work in the Coober Pedy area has studied the distribution of at least two Quaternary units, which until now, have not been recognised as distinct lithologies. While these units have not been defined on the MURLOOCOPPIE sheet, the older unit, a red-brown, gravelly to clayey gypsified and calcreted sand appears to be widespread on the southern Stuart Range. It is apparently derived by reworking of the Doonbara Formation, which it (often strongly) resembles. Previously it has been recorded in creeks incising the Stuart Range on northern MURLOOCOPPIE. Correlation with the Illeroo Pedoderm of Jessup and Norris (1971) is suggested.

The younger unit, consisting of silts and gravels with a prominent red-brown clay, may correlate with the Pooraka Formation (Firman, 1969) or Callabonna Clay (Firman, 1970).

STRUCTURE

Pre-Tertiary sediments on MURLOOCOPPIE represent portions of two major, largely undeformed, superimposed, sedimentary basins overlying the crystalline basement of the Gawler Craton. These are the Permian Arckaringa and the Mesozoic Great Artesian Basins.

The overall configuration of the Arckaringa Basin has been described and discussed by Townsend (1976). It consists of a central platform area, within which MURLOOCOPPIE is situated, surrounded on the northeastern and northern, eastern and southern sides by deeper troughs: the Wintinna, Boorthanna, Phillipson and Wallira Troughs respectively. The whole basin is some 200 to 300 km across.

Over most of the central platform area of the Arckaringa Basin, Permian sediments rest directly on basement, and are generally flat-lying and undeformed except where locally disturbed by faulting, as at Mount Toondina, on OODNADATTA.

In the Mable Creek area, the Mable Creek 'high' forms a basement ridge over which Permian is probably absent. In the northeastern and northwestern corners of the MURLOOCOPPIE sheet, the basement deepens towards the Wintinna and Boorthanna Troughs. (?)Devonian dolomite (the Cootanoorina Formation) is confined to these two troughs.

Unconformably overlying the Arckaringa Basin sediments are those of the Great Artesian Basin. Again, these units are virtually flat-lying and undeformed. In the Giddi Giddinna/Oolgelima area, however, dips of 3-5 degrees were recorded on outcropping sands and shales of the unnamed transitional unit. These dips outline a gentle west-plunging anticline, which exploratory drilling and structural contouring (Mason, 1975 b) show to be part of a dome. The comparative lack of weathering of units exposed within the anticline, and dips recorded on surrounding gypsite crusts suggest the structure is quite young and post-dates the most recent phase of deep weathering.

A major lineament, which forms an extension of the Karari Fault, extends from eastern TALLARINGA to Lake Eyre North, traversing the southeastern corner of MURLOOCOPPIE (Figure 1). This feature is visible on LANDSAT-1 imagery and is apparent on preliminary geological sheets of the area. It also has a pronounced effect on water quality in the Giddi Giddinna Creek due to enhanced local recharge (Mason, 1975 b).

GEOPHYSICAL SURVEYS

Most geophysical data available for the area has been obtained through systematic investigations, largely by the South Australian Department of Mines over the Arckaringa Basin. These surveys begun in 1961, led to intensive studies in

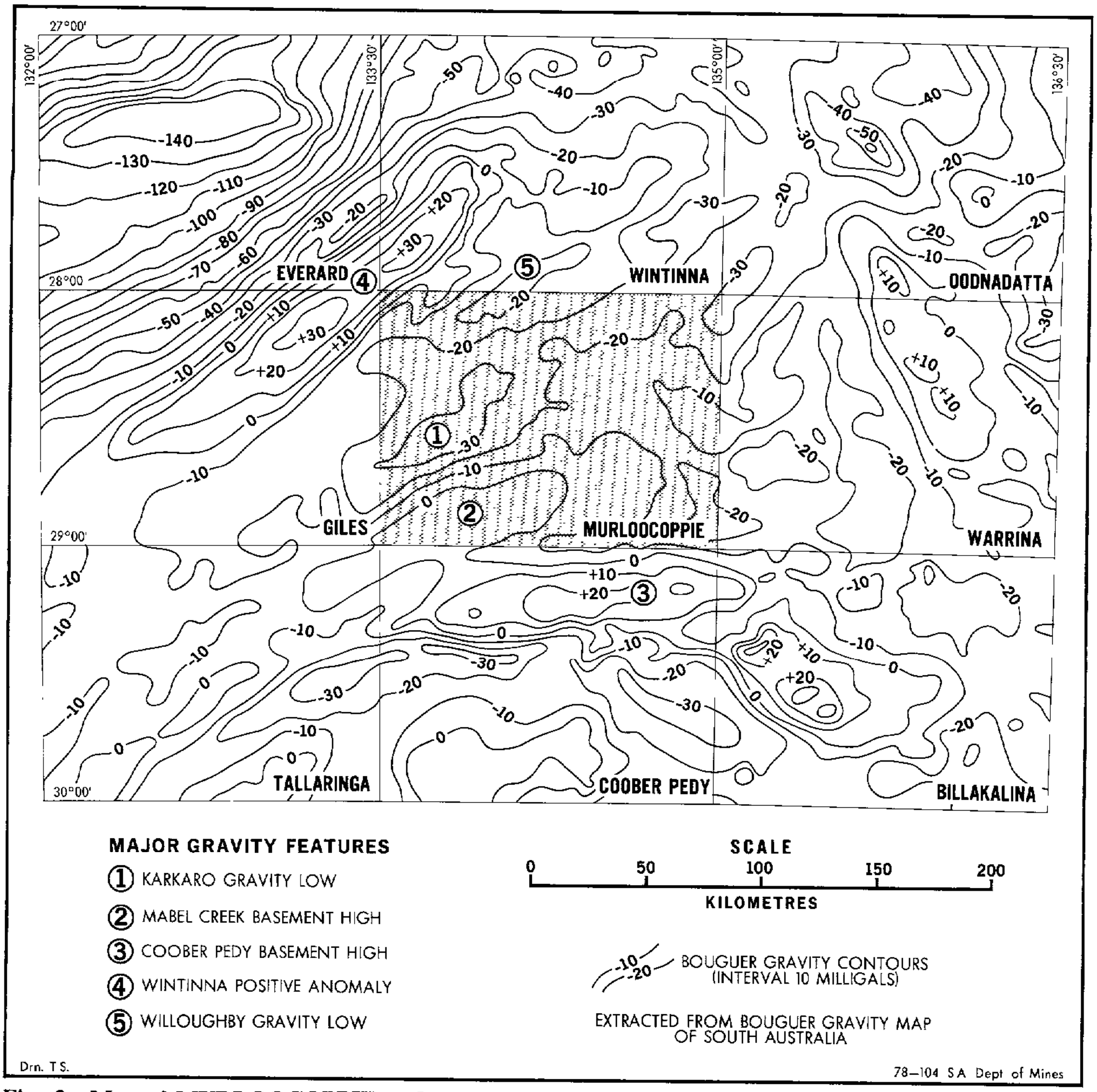

Fig. 3—Map of MURLOOCOPPIE and surrounding area showing regional Bouguer gravity anomaly contours

1968 and 1969, allied with the drilling of a number of stratigraphic wells, the results and implications of which are summarised by Townsend (1976). Seismic and other work conducted at this time is described by Milton (1969 a and 1970). Other reports dealing with this work are detailed below or appear in the bibliography.

AEROMAGNETIC

Aeromagnetic data over the sheet area have been compiled by the Geophysical Services Section of the South Australian Department of Mines from surveys by Delhi International (Aeroservices Corporation, 1961), the Department of Mines and Exoil N.L. Total magnetic intensity map coverage is available at a scale of 1:250 000 with a contour interval of 50 gammas. Refer also to the Total Magnetic Intensity Map of the State at a scale of 1:1 000 000 (Frith, 1976).

Detailing the aeromagnetic features of the sheet area is beyond the scope of these Notes, however, it may be noted that they reflect largely the relatively shallow, magnetic crystalline basement.

GRAVITY

Figure 3 is extracted from the South Australian Department of Mines 1:1 000 000 Bouguer Gravity Anomaly Map of South Australia (Coppin *et al.*, 1973). Information for this map in the area under discussion was compiled largely from departmental gravity surveys in 1968-1969 (Hall and Townsend, 1971; Nettleton, 1970). Major features are the Mabel Creek basement high (which shows as a marked gravity high), a gravity low in the Karkaro area, and the Willoughby gravity low, where some 1 200 m of Permian and Mesozoic sediments overlie basement.

SEISMIC

Detailed seismic investigations have been conducted over much of the Arckaringa Basin (Milton, 1964a and 1964b) with resultant basement contour interpretations being reported by Milton (1969a, 1972 and 1973). Preparatory seismic lines were shot for the drilling of stratigraphic wells SADM Karkaro 1 and Mount Furner 1 although the wells themselves were located on the basis of gravity data.

One recent practical application of the regional gravity surveys stemmed from the recognition of the Mabel Creek and Coober Pedy basement highs, and their probable presence as little as 30 m beneath the surface. These were subsequently investigated to detect areas of near-surface basement rocks as potential sources of aggregate for the Tarcoola-Alice Springs Railway, using shallow seismic techniques (Nelson, 1971a and 1971b). For details of shallow seismic investigations of bridge sites on this railway refer to Nelson (1973a and 1973b).

ECONOMIC GEOLOGY

OPAL

The important opal mining town of Coober Pedy lies 1·5 km south of the southeastern edge of the sheet area. Outlying opal fields, on MURLOOCOPPIE, include Shellpatch, Nineteen Mile, Fourteen Mile, Sixteen Mile and Hans Peak. The opal, which occurs in deeply weathered siltstones and shales of the Bulldog Shale, has poorly understood controls of deposition (See Hiern 1965a, 1965b, 1967a, 1967b; Ward 1915, 1917). Opal mining has also been attempted at England Hill and Eeavinna Hill in the far northern-central portion of the sheet, but with little success.

KAOLIN AND ALUNITE

Near Imbitcha Bore, on WINTINNA, Heath (1962) described kaolin deposits, which though of high grade, were uneconomic due to factors of isolation and difficult extraction. The deposit occurs in high cliffs bordering Arckaringa Creek, stratigraphically within, or adjacent to sands and siltstones of the thin Coorikiana Sandstone Member. Recent field mapping has shown this to be a relatively common relationship and it appears that the occurrence of veins of kaolin and/or alunite accumulation are stratigraphically controlled. This factor may have application regionally in the search for kaolin or alunite deposits.

COAL

Following the proving of considerable reserves of coal in the Mount Toondina Formation, at Lake Phillipson on COOBER PEDY, there has been some interest shown by mining companies in the Permian on MURLOOCOPPIE and adjacent areas. Over most of the sheet area however, conditions are not favourable, as much of the Permian has been stripped by pre-Jurassic erosion, or lies beneath a thickness of up to 200 m of Mesozoic rocks.

URANIUM

Although unevaluated, there is potential for uraniferous mineralisation in the sub-Tertiary, palaeodrainage systems on MURLOOCOPPIE. A small number of exposures of Mirackina Conglomerate, within the exhumed Mirackina Palaeochannel, were examined for radioactivity and rare anomalous counts were recorded. Although untested, these were regarded as being due to detrital radioactive minerals, as any secondary uranium mineralisation in the largely eroded Mirackina Palaeochannel would have been removed by leaching. In the Tallaringa Palaeochannel however, conditions may be more favourable: Plio-Pleistocene chalcedonic limestones left as terraces within the Tallaringa Palaeochannel and in other palaeochannels to the west, are probable correlatives of the Yeeleerie calcrete orebody hosts (Langford, 1974; Premoli, 1976). Eocene lignitic sands in the lower reaches of the Tallaringa Palaeodrainage system are similar in age, facies and geological setting to the uraniferous Eyre Formation of the Tarkarooloo (Lake Frome) Basin.

ENGINEERING GEOLOGY

Since 1969 the Department of Mines has been conducting engineering geological work for the Commonwealth Railways, along the route of the Tarcoola-Alice Springs Railway, which runs north-south through central MURLOOCOPPIE. Investigations have been carried out related to ballast supplies, foundation materials and engineering, bridge crossings and water supplies during the construction of the line. Reports prepared to the time of writing (not necessarily relating to MURLOOCOPPIE alone) include Hiern, 1970; Nelson, 1971; Firman, 1972; Paine, 1972; Nichol and Paine, 1972a and 1972b; Jeune, 1972a and 1972b; Carosone, 1972a, 1972b and 1972c; Smith, 1974; Selby, Jeune and McNally, 1975; and McNally, 1975.

Investigations relating to the re-routing of the Stuart Highway were reported by McNally, 1976.

GEOLOGICAL HISTORY

The development of the Permian Arckaringa Basin (see Townsend, 1976) commenced with the deposition of (?)Devonian carbonates (the Cootanoorina Formation) in fault-controlled troughs on a lower Proterozoic crystalline basement. Further faulting probably influenced the formation of marginal troughs and the general configuration of the basin became established by the early Permian.

Deposition of Early Permian sediments then followed with younger units becoming progressively more widespread. The sequence begins with the tillitic and conglomeratic Boorthanna Formation, followed by the fine-grained, marine Stuart Range Formation and finally the transitional marine to terrestial, coal bearing Mount Toondina Formation.

From the mid-Permian to late Jurassic, the Permian sediments were eroded with complete removal of the Mount Toondina Formation in some areas.

Deposition of the Mesozoic Great Artesian Basin sediments began with the fluviatile, Late Jurassic Algebuckina Sandstone. Marine influence under transgressive conditions is first reflected in the Cadna-owie Formation and Mount Anna Sandstone, which represent shoreline and shallow deltaic sediments. The overlying unnamed transitional unit probably represents near-shore mud-flat conditions. Subsequent deposition of the marine Bulldog Shale, Coorikiana Sandstone Member and Oodnadatta Formation appears to have taken place under relatively shallow water conditions, at least in this region, to judge from the nearly ubiquitous presence of bioturbation and trace fossils observed in the first two units.

The Tertiary history of the area is one of repeated phases of duricrust formation, erosion and terrestrial sedimentation. The first event recorded is the development of a deep weathering profile on peneplaned Cretaceous rocks accompanied by silcrete formation (Si_1) as a B soil horizon under arid conditions (Wopfner, 1974). Jessup and Norris (1971) dispute the genetic association of the deep bleaching and silcrete formation. The age of this silcrete, the 'Silcrete of the Cordillo Surface' (Wopfner, 1974) can only be established within wide limits. Field evidence shows that it post-dates the Palaeocene to Eocene Eyre Formation and pre-dates the mid-Miocene Etadunna Formation. The Eyre Formation itself is not present on MURLOOCOPPIE and appears never to have been deposited.

By the early Eocene, however, the Tallaringa palaeodrainage system had been formed, draining the region of the present-day easternmost Great Victoria Desert and southwestern Stuart Range into the eastern Eucla Basin. Eocene lignitic sands (Pidinga Formation) and (?)Miocene sands and clays (Garford Beds) were deposited in the lower reaches of the channel system.

During the (?)late Oligocene to Miocene, incision of the (?)Oligocene silcrete took place in the Stuart Range area, with the development of the Mirackina Palaeochannel and its tributaries. Erosion of Tertiary silcretes and Cretaceous shales and sandstones provided much of the sediment, which was deposited in the system as the Mirackina Conglomerate. The development of the south-flowing Tallaringa Palaeochannel was contemporaneous in part, and sediments which were time-equivalent to the Mirackina Conglomerate were deposited within it.

Following deposition of the Mirackina Conglomerate, ferruginisation of the base and top took place (Fe_1) to be followed by a major silicification (Si_2).

The pattern of late Tertiary clastic and carbonate deposition, although greatly reduced, clearly shows that after this silicification, the early-mid Tertiary palaeodrainage was still present in the form of shallow depressions. During the Pliocene, the land surface was exposed to erosion and soil formation characterised by 'ferralitisation' (ferruginisation, Fe_2) resulted (Wopfner, 1974), which may have taken place under warm, moist conditions. The fact that the land surface was slightly undulating resulted in minor mass movement and a somewhat thicker accumulation of the weathered debris in the local topographic depressions. Elsewhere, only a thin, *in situ,* ferruginous palaeosol was developed, or where the degree of local mass movement was somewhat greater, the Cretaceous shales were repeatedly exposed and strongly ferruginised. The resultant rock unit, which is thus both a palaeosol and sediment, is equated to the Doonbara Formation. The variations in lithology and thickness, which result from the undulatory local topography, can be seen on the Stuart Range today.

Probably by the late Pliocene, ponding of the drainage in these depressions had occurred, and deposition of lacustrine limestones; the Mangatitja and Mount Willoughby Limestones, took place.

The 'porcellanitic' or 'jasper-breccia' silicification of the Doonbara Formation and the chalcedonic or 'jelly-potch' silicification of the limestones are presumed to have occurred in the late Pliocene or early to middle Pleistocene. The interrelationship of these two silcretes (Si_3 and Si_4) is unknown.

Following contemporary deposition of equivalent limestones in the Tallaringa Palaeochannel, a mid-to-late Pleistocene reincision took place within this channel, exposing the limestone as terraces. Subsequent drier conditions resulted in the development of an (?)early Holocene red-clay, sandy soil and then the formation of the present-day, semi-mobile, longitudinal dunes of the Great Victoria Desert.

On eastern and southern MURLOOCOPPIE, during the Pleistocene and Holocene, reworking of the Doonbara Formation supplied material for younger, typically red-brown units such as the Illeroo Pedoderm. Gypsum (and more rarely, carbonate) impregnated these and the pre-existing rocks and palaeosols and gypsum crusts formed in some areas. Erosion caused reworking and lowering of the gypsum crusts, and also led to the exhumation and reversal of topography with respect to the Mirackina Palaeochannel, exposing it as a sinuous chain of mesa-tops, which now represent its course. (Rept. 76/95: July, 1976).

BIBLIOGRAPHY

Allchurch, P. D., Harris, W. K. and McGowran, B., 1973. Cootanoorina No. 1 Well. *Rep. Invest., geol. Surv. S. Aust.*, 25.

Anderson, E., 1949. The geology and hydrology of the area north and northwest of Tarcoola. Covered L.R.W.C. reconnaissance trip April-May 1949. S. Aust. Dept. Mines report 25/177 (unpublished).

Balme, B. E., 1964. The palynological record of Australian pre-Tertiary floras. *In: Ancient Pacific Floras.* University of Hawaii Press, pp. 48-80.

Barclay, C. J., 1975a. Exploration Lease 175 relinquishment report to Shell Development (Aust.) Pty. Ltd. S. Aust. Dept. Mines open file Env. 2613 (unpublished).

Barclay, C. J., 1975b. Exploration Lease 214 relinquishment report to Shell Development (Aust.) Pty. Ltd. S. Aust. Dept. Mines open file Env. 2663 (unpublished).

Barnes, L. C., 1974. WINTINNA map sheet, *Geological Atlas of South Australia,* 1:250 000 series. Geol. Surv. S. Aust. (preliminary edition).

Barnes, L. C. and Pitt, G. M., 1976a. The Mirackina Conglomerate. *Q. geol. Notes, geol. Surv. S. Aust.,* 59: 2-6.

Barnes, L. C. and Pitt, G. M., 1976b. The Tallaringa palaeodrainage system. *Q. geol. Notes, geol. Surv. S. Aust.,* 59: 7-10.

Barnes, L. C. and Pitt, G. M., 1976c. The Mount Sarah Sandstone. *Q. geol. Notes, geol. Surv. S. Aust.,* 62: 2-8.

Barnes, L. C. and Pitt, G. M., 1976d. Silcrete sediments and stratigraphy. S. Aust. Dept. Mines report 76/119 (unpublished).

Benbow, M. C., Pitt, G. M., Barnes, L. C., Harris, W. K. and Lindsay, J. M., 1978. Tallaringa palaeodrainage system. Drilling program: completion report. S. Aust. Dept. Mines report (in prep.).

Bleys, C., 1968. Review of Coober Pedy opal field water supply investigation for Engineering and Water Supply Department. S. Aust. Dept. Mines report 67/71 (unpublished).

Bonython, J., 1954. Statutory report on petroleum exploration surveys carried out by Santos Ltd. during July-October, 1954. S. Aust. Dept. Mines open file Env. 140 (unpublished).

Brown, H. Y. L., 1884. Annual report of the Government Geologist (for 1883). Gov. Printer, Adelaide.

Brown, H. Y. L., 1890. Report on journey from Warrina to Musgrave Ranges, *Parl. Pap. S. Aust.*, 45.

Brown, H. Y. L., 1899. *Geological Map of South Australia.* Surveyor General's Office, Adelaide. (Map in colour and four parts, scale 1 inch to 16 statute miles).

Brown, H. Y. L., 1905. Report on geological exploration in the north and northwest of S.A. *Parl. Pap. S. Aust., 71.*

Brunnschweiler, R. D., 1956. Progress reports to S.A.D.M. on oil exploration surveys carried out for Santos Ltd. by Geosurveys Aust. Ltd. for Nov., Dec., 1955. S. Aust. Dept. Mines open file Env. 138 (unpublished).

Bunting, J., van de Graff, W. J. E. and Jackson, M. J., 1974. Palaeodrainages and Cainozoic palaeogeography of the Eastern Goldfields, Gibson Desert, and Great Victoria Desert. *Annu. Rep. 1973, West. Aust. Dep. Mines,* pp. 87-92.

Callen, R. A., 1975. Stratigraphy, sedimentology and uranium deposits of Tertiary rocks, Lake Frome area, South Australia. University of Adelaide M.Sc. thesis (unpublished).

Callen, R. A., 1976. New late Cainozoic rock units and depositional environments, Lake Frome area, South Australia. *Trans. R. Soc. S. Aust.,* 100: 125-168.

Callen, R. A., 1977. Late Cainozoic environments of part of north-eastern South Australia. *J. geol. Soc. Aust.*, 24: 151-170.

Callen, R. A., Pitt, G. M. and Barnes, L. C., 1978. Silcretes and their stratigraphic significance in northern South Australia. S. Aust. Dept. Mines report (in prep.).

Carruthers, J., 1892. Triangulation of north-west portion of South Australia. *Parl. Pap. S. Aust.*, 179.

Carosone, F., 1972a. Groundwater investigations, Tarcoola-Alice Springs Railway. First progress report. S. Aust. Dept. Mines report 72/31 (unpublished).

Carosone, F., 1972b. Groundwater investigation, Tarcoola-Alice Springs Railway, Second progress report. S. Aust. Dept. Mines report 72/73 (unpublished).

Carosone, F., 1972c. Tarcoola-Alice Springs Railway water bores, Tarcoola-Mabel Creek section completion report. S. Aust. Dept. Mines report 72/156 (unpublished).

Cockshell, C. D., 1973. Progress reports on coal exploration drilling, Exploration Licences 15 and 39, Copper Hill area, South Australia, for Oilmin, Petromin and Transoil. S. Aust. Dept. Mines open file Env. 2173 (unpublished).

Conor, C. H. H. and Young, D. A., 1973. Ferricretes: their occurrence, formation and use in geological interpretation on Eateringinna. *Q. geol. Notes, geol. Surv. S. Aust.,* 47: 1-5.

Coppin, R. J., Hall, J. McG. and Milton, B. E. (Compilers), 1973. *Bouguer Gravity Anomaly Map,* scale 1:1 000 000. Geol. Surv. S. Aust., Gov. Printer, Adelaide.

Demaison, G., 1969. Stratigraphic drilling in the Arckaringa Sub-basin. *Q. geol. Notes, geol. Surv. S. Aust.*, 31: 4-8.

Everett, A., 1886. *Continental Australia from the most recent information supplied by the survey departments of the several colonies.* Department of Lands and Survey, Melbourne. (Note: this map is a coloured geological compilation of Australia, in six parts, prepared by Everett, under C. W. Langtree, in 1886. Scale: 50 statute miles to 1 inch).

Firman, J. B., 1969. Stratigraphy and landscape relations of soil materials near Adelaide, South Australia. *Trans. R. Soc. S. Aust.*, 93: 39-54.

Firman, J. B., 1970. Late Cainozoic stratigraphic units in the Great Artesian Basin, South Australia. *Q. geol. Notes, geol. Surv. S. Aust.*, 36: 1-4.
Firman, J. B., 1971. Regional stratigraphy of surficial deposits in the Great Artesian Basin and Frome Embayment in South Australia. S. Aust. Dept. Mines report 71/16 (unpublished).
Firman, J. B., 1972. Reconnaissance survey of ballast sources, Tarcoola-Alice Springs Railway, Mount Willoughby-Northern Territory Border. S. Aust. Dept. Mines report 72/7 (unpublished).
Forbes, B. G., 1961. A photogeological study of the Coober Pedy-Lake Eyre region. S. Aust. Dept. Mines report 52/142 (unpublished).
Forbes, B. G. (Compiler), 1975. KOPPERAMANNA, South Australia. *Explanatory Notes*, 1:250 000 *geological series.* Sheet SH/54-1. Geol. Surv. S. Aust.
Freeman, R. N., 1965. Oil Exploration Licence 34. Report to North Australian Petroleum Co. Ltd. S. Aust. Dept. Mines open file Env. 493 (unpublished).
Freytag, I. B., 1965. Mount Toondina Beds—Permian sediments in a probable piercement structure. *Trans. R. Soc. S. Aust.*, 89: 61-76.
Freytag, I. B., 1966. Proposed rock units for marine Lower Cretaceous sediments in the Oodnadatta region of Great Artesian Basin. *Q. geol. Notes, geol. Surv., S. Aust.*, 18: 3-7.
Freytag, I. B., 1967. Geological and geophysical investigations at Mount Toondina. *Min. Rev., Adelaide*, 120: 128-131.
Freytag, I. B., Heath, G. R. and Wopfner, H., 1967. OODNADATTA map sheet, *Geological Atlas of South Australia,* 1: 250 000 series. Geol. Surv. S. Aust.
Frith, N. H. J. (Compiler), 1976. *Total magnetic intensity map of South Australia*, scale 1:1 000 000. Geol. Surv. S. Aust., Gov. Printer, Adelaide.
Hall, J. McG., 1973. Seismic investigation of the Wintinna Trough, 1972. S. Aust. Dept. Mines report 73/181 (unpublished).
Hall, J. McG. and Townsend, I. J., 1971. Helicopter gravity survey of area marginal to the western Great Artesian Basin. *Mineral Resour. Rev., S. Aust.*, 130: 70-79.
Harris, W. K., 1962. Plant remains of Upper Jurassic to Lower Cretaceous age from Cadlareena military sheet. S. Aust. Dept. Mines report 55/128 (unpublished).
Harris, W. K., 1965. Palynological report 11/65, sample No. S 980. S. Aust. Dept. Mines report D.M. 478/64 (unpublished).
Harris, W. K., 1970. An Upper Jurassic microflora from the western margin of the Great Artesian Basin, South Australia, *Q. geol. Notes, geol. Surv. S. Aust.*, 5: 3-8.
Harris, W. K., 1977. Stuart Range No. 7. Palynology of sample at 156-158m. S. Aust. Dept. Mines report 77/41 (unpublished).
Harris, W. K. and McGowran, B., 1971. Mount Willoughby Limestone: palaeontological report on samples. S. Aust. Dept. Mines report 71/160 (unpublished).
Heath, G. R., 1964. Imbitcha clay deposit (on Arckaringa Station) *Min. Rev., Adelaide.*, 117: 38-42.
Herraman, P. D., 1976. Water well survey, MURLOOCOPPIE 1:250 000 sheet. S. Aust. Dept. Mines report 76/50 (unpublished).
Hiern, M. N., 1965a. Opal deposits at Coober Pedy. *Q. geol. Notes, geol. Surv. S. Aust.*, 13: 6-7.
Hiern, M. N., 1965b. Opal deposits in Australia. *Q. geol. Notes, geol. Surv. S. Aust.*, 16: 3-6.
Hiern, M. N., 1967a. Opal deposits in northern South Australia. *Min. Rev., Adelaide.*, 122: 37-39.
Hiern, M. N., 1967b. Coober Pedy opalfields. *Min. Rev., Adelaide,* 122: 5-27.
Hiern, M. N., 1968. Regional setting of South Australia ceramic clays. *Q. geol. Notes, geol. Surv. S. Aust.*, 25: 1-3.
Hiern, M. N., 1970. Reconnaissance survey of ballast sources, Tarcoola-Alice Springs, standard gauge railway. Tarcoola-Kulgera section. S. Aust. Dept. Mines report 70/191 (unpublished).
Jack, R. L., 1915. The geology and prospects of the region to the south of the Musgrave Ranges and the geology of the western portion of the Great Artesian Basin. *Bull. geol. Surv. S. Aust.*, 5.
Jack, R. L., 1931. Report on the geology of the region to the north and northwest of Tarcoola. *Bull. geol. Surv. S. Aust.*, 15.
Jeune, R. F., 1972a. Tarcoola-Alice Springs Railway—geological investigations for Long Creek and Mabel Creek crossing. S. Aust. Dept. Mines report to Commonwealth Railways 72/192 (unpublished).
Jeune, R. F., 1972b. Geological investigations, Tarcoola-Alice Springs Railway (Tarcoola to Robin Rise Section). S. Aust. Dept. Mines report to Commonwealth Railways 72/157 (unpublished).
Jessup, R. W. and Norris, R. M., 1971. Cainozoic stratigraphy of the Lake Eyre Basin and part of the arid region lying to the south. *J. geol. Soc. Aust.*, 18: 303-331.
Johns, R. K., 1964. Geology and mineral resources of the Andamooka-Torrens area. *Bull. geol. Surv. S. Aust.*, 41.
Johns, R. K., 1968. Investigation of Lakes Torrens and Gairdner. *Rep. Invest., geol. Surv. S. Aust.*, 31.
Johns, R. K. and Ludbrook, N. H., 1963. Investigation of Lake Eyre. *Rep. Invest., geol. Surv. S. Aust.*, 24.
Ker, D. S., 1963. Hydrology of the Great Artesian Basin in South Australia—a preliminary report. S. Aust. Dept. Mines report 57/52 (unpublished).
Krieg, G. W., 1971. Relict drainage in the Serpentine Lake area. *Q. geol. Notes, geol. Surv. S. Aust.*, 37: 1-2.
Krieg. G. W. (compiler), 1973. EVERARD, South Australia. *Explanatory Notes*, 1:250 000 *geological series.* Sheet SG/53-13. Geol. Surv. S. Aust.

Krieg, G. W. 1974. GILES map sheet (preliminary edition), *Geological Atlas of South Australia,* 1:250 000 series. Geol. Surv. S. Aust.

Krieg, G. W., 1974. TALLARINGA map sheet (preliminary edition), *Geological Atlas of South Australia,* 1:250 000 series. Geol. Surv. S. Aust.

Langford, F. F., 1974. A supergene origin for vein-type uranium ores in the light of the Western Australian calcrete-carnotite deposits. *Econ. Geol.,* 69: 516-526.

Langford-Smith, T. (Ed.), 1977. *Silcretes in Australia.* New England University Press (in press).

Langford-Smith, T. and Drury, G. H., 1965. Distribution, character and attitude of the duricrust in the northwest of New South Wales and the adjacent areas of Queensland. *Am. J. Sci.,* 263: 170-190.

Lindsay, J. M., 1975. Foraminiferal biostratigraphy of an Aptian marine shale from *Giddinna,* MURLOOCOPPIE 1:250 000 sheet. S. Aust. Dept. Mines report 75/126 (unpublished).

Ludbrook, N. H., 1961. Permian to Cretaceous subsurface stratigraphy between Lake Phillipson and the Peake and Denison Ranges. *Trans. R. Soc. S. Aust.,* 85: 67-80.

Ludbrook, N. H., 1966. Cretaceous biostratigraphy of the Great Artesian Basin in South Australia. *Bull. geol. Surv.* S. Aust., 40.

Ludbrook, N. H., 1967a. Stuart Range No. 3 bore, Coober Pedy, stratigraphy and micro-palaeontology. *Min. Rev., Adelaide.,* 122: 28-32.

Ludbrook, N. H., 1967b. Permian deposits of South Australia, and their fauna. *Trans. R. Soc. S. Aust.,* 91: 65-92.

Ludbrook, N. H., 1969. Permian of South Australia—a review. *Spec. Publ. geol. Soc. Aust.,* 2: 39-45.

McLean, C. H. J., 1975. Report of investigation for coal in the Arckaringa Basin. BP Minerals Pty. Ltd. S. Aust. Dept. Mines open file Env. 2454 (unpublished).

Madigan, G. T., 1936. The sand ridge deposits. *Geog. Rev.,* 26: 205-227.

Major, R. B., 1972. The Mangatitja Limestone. S. Aust. Dept. Mines report 72/205 (unpublished).

Major, R. B., 1973a. The Mangatitja Limestone. *Q. geol. Notes, geol. Surv. S. Aust.,* 47: 5-9.

Major, R. B., 1973b. Red sandy soils northwest province. *Q. geol. Notes, geol. Surv. S. Aust.,* 48: 4-7.

Mason, M. G., 1975a. Murloocoppie coal prospect. Australian Selection (Pty.) Ltd. S. Aust. Dept. Mines open file Env. 2556 (unpublished).

Mason, M. G., 1975b. Groundwater near Giddi Giddinna Creek, northeast of Coober Pedy, South Australia. *Q. geol. Notes, geol. Surv. S. Aust.,* 56: 2-6.

McGowran, B., 1969. Karkaro No. 1 stratigraphic borehole micropalaeontological study of Permian section. S. Aust. Dept. Mines report 69/61 (unpublished).

McNally, G. H., 1975. Tarcoola-Alice Springs Railway—geological investigations at bridge sites, Robin Rise to Marla Bore section. S. Aust. Dept. Mines report 75/48 (unpublished).

McNally, G. H., 1976. Engineering soils survey, Stuart Highway, Coober Pedy area (Four Mile diggings to vermin proof fence). S. Aust. Dept. Mines report 76/36 (unpublished).

McNally, G. H., 1977a. Coober Pedy town water supply. Completion report, Stuart Range bores 5 and 6. S. Aust. Dept. Mines report 77/59 (unpublished).

McNally, G. H., 1977b. Coober Pedy town water supply. Groundwater prospects and completion report Stuart Range bores 7-10. S. Aust. Dept. Mines report 77/77 (unpublished).

Milton, B. E. 1964. Report on Seismic refraction depth probes and profiles: Welbourn Hill to Coober Pedy. S. Aust. Dept. Mines report 59/104 (unpublished).

Milton, B. E., 1969a. Western Arckaringa Basin: depths to basement from seismic investigations. *Q. geol. Notes, geol. Surv. S. Aust.,* 32: 7-11.

Milton, B. E., 1969b. Geophysical investigations of basins marginal to the western Great Artesian Basin. *Aust. Pet. Explor. Ass. J.,* 9: 127-135.

Milton, B. E., 1970. Seismic operations. Western and central Arckaringa Basin, 1969. S. Aust. Dept. Mines report 70/2 (unpublished).

Milton, B. E., 1971. Experiments in the use of directed line sources in refraction profiling Arckaringa Basin—1971. *Aust. Soc. explor. Geophys. Bull.,* 2(4): 1-10.

Milton, B. E., 1972. Seismics survey—western and central Arckaringa Basin. *Mineral Resour. Rev., S. Aust.,* 132: 65-74.

Milton, B. E., 1973. Geophysical exploration of the Arckaringa Basin—1970. *Mineral Resour. Rev., S. Aust.,* 134: 62-76.

Milton, B. E., 1975. Reconnaissance seismic exploration—southwest Arckaringa Basin, South Australia—1974. *Q. geol. Notes, geol. Surv. S. Aust.,* 53: 3-9.

Milton, B. E. and Morony, G. K., 1975. A regional interpretation of 1:1 000 000 gravity and aeromagnetic maps of the Great Artesian Basin in South Australia. *Rep. Invest., geol. Surv. S. Aust.* 46.

Milton, B. E. and Thornton, R. C. N., 1970. Discovery of a dense Lower to Middle Palaeozoic dolomite in the northwest Arckaringa Basin. *Q. geol. Notes, geol. Surv. S. Aust.,* 36: 10-15.

Mollan, R. G., 1975. Completion report on a reconnaissance coal exploration programme, Exploration Lease 163, Arckaringa Basin. S. Aust. Dept. Mines open file Env. 2499 (unpublished).

Murray, W. R., 1904. Fowlers Bay to Rawlinson Ranges and Fowlers Bay to Cambridge Gulf. *Parl. Pap. S. Aust.* 43.

Nelson, R. G., 1971a. Tarcoola-Alice Springs railway ballast seismic survey. Report No. 1: the Perfection Well area in *Ingomar* and *McDouall* 1:63 360 areas. S. Aust. Dept. Mines report to Commonwealth Railways 71/57 (unpublished).

Nelson, R. G., 1971b. Tarcoola-Alice Springs Railway ballast seismics survey report No. 2 Robin Rise to Mabel Creek. S. Aust. Dept. Mines report to Commonwealth Railways 71/127 (unpublished).

Nelson, R. G., 1973a. Tarcoola-Alice Springs Railway—seismic investigations of bridge sites Northern Territory border to Alice Springs. S. Aust. Dept. Mines report to Commonwealth Railways 73/278 (unpublished).
Nelson, R. G., 1973b. Tarcoola-Alice Springs Railway—seismic investigations of bridge sites: Wintinna Hill to Northern Territory border. S. Aust. Dept. Mines report to Commonwealth Railways 71/127 (unpublished).
Nelson, R. G., 1973a. Tarcoola-Alice Springs Railway—seismic investigations of bridge sites northern territory border to Alice Springs. S. Aust. Dept. Mines report to Commonwealth Railways 73/278 (unpublished).
Nelson, R. G., 1973b. Tarcoola-Alice Springs Railway—seismic investigations of bridge sites: Wintinna Hill to Northern Territory border. S. Aust. Dept. Mines report to Commonwealth Railways 73/277 (unpublished).
Nichol, D., 1971a. The Mount Willoughby Limestone. *Q. geol. Notes, geol. Surv. S. Aust.,* 39: 5-8.
Nichol, D., 1971b. Tarcoola-Alice Springs Railway ballast supplies. Mabel Creek-Marla Bore section. S. Aust. Dept. Mines report to Commonwealth Railways 71/81 (unpublished).
Nichol, D., 1972. Tarcoola-Alice Springs standard gauge railway ballast supplies. Utah Bore dolerite deposit. S. Aust. Dept. Mines report to Commonwealth Railways 72/184 (unpublished).
Nichol, D. and Pain, A. M., 1972a. Progress report on Tarcoola-Alice Springs Railway—ballast supplies—limestone deposit Mount Willoughby H.S. area. S. Aust. Dept. Mines report to Commonwealth Railways 72/16 (unpublished).
Nichol, D. and Pain, A. M., 1972b. Tarcoola-Alice Springs standard gauge railway ballast supplies—site investigation Ethel Well. S. Aust. Dept. Mines report to Commonwealth Railways 72/183 (unpublished).
Pain, A. M., 1972. Tarcoola-Alice Springs Railway ballast supplies Tarcoola-Mabel Creek Station. S. Aust. Dept. Mines report to Commonwealth Railways 72/171 (unpublished).
Pitt, G. M., 1976. Report of geology, MURLOOCOPPIE 1:250 000 area. S. Aust. Dept. Mines report 76/64 (unpublished).
Premoli, C., 1976. Formation of and prospecting for uraniferous calcrete. Aust. Min., 68(4): 13-16.
Roberts, D. C., 1976. Seismic refraction survey of the Tallaringa Palaeochannel, August, 1976. S. Aust. Dept. Mines report 76/153 (unpublished).
Rochow, K. A., 1963. Notes on a reconnaissance survey of the southwestern margins of the Great Artesian Basin with a re-evaluation of available bore information. S. Aust. Dept. Mines report 57/97 (unpublished).
Ross, J., 1875. Mr. J. Ross's Explorations. *Parl. Pap. S. Aust.,* 67.
Sanders, C. C., 1973. Hydrology of a calcrete deposit on Paroo Station, Wiluna, and surrounding area. *Annu. Rep. 1972, West. Aust. Dep. Mines,* pp. 61-72.
Selby, J., Jeune, R. F. and McNally, G. H., 1975. Tarcoola-Alice Springs Railway—Geological investigations, Robin Rise to Marla Bore. S. Aust. Dept. Mines report 75/42 (unpublished).
Smale, D., 1973. Silcretes and associated silica diagenesis in southern Africa and Australia. *J. sedim. Petrol.* 43: 1077-1089.
Smith, P. C., 1974. Tarcoola-Alice Springs Railway (Robin Rise to Wintinna Hill section). Progress report No. 5. S. Aust. Dept. Mines report to Commonwealth Railways 74/12 (unpublished).
Smith, P. C., 1976. Tarcoola-Alice Springs Railway groundwater completion report. Second tender, progress report No. 7. S. Aust. Dept. Mines report to Commonwealth Railways 76/65 (unpublished).
Smythe, R. B., 1873. First sketch of a geological map of Australia. Department of Mines, Melbourne. (Scale 1:7 000 000).
Smith, V. Z. and Associates, Ltd., Scherp, H. S. and Collins, G. M., 1964. Aerial geology and structural interpretation of MURLOOCOPPIE and Coober Pedy area, Australia. S. Aust. Dept. Mines open file Env. 351 (unpublished).
Sprigg, R. C. and Staff, 1958. the Great Artesian Basin in South Australia. *In:* Glaessner M. F. and Parkin L. W. (Eds.), The Geology of South Australia. *J. geol.* Soc. Aust., 5: 88-101.
Stadter, M. H., 1972. Re-interpretation of structural contour plan of 'C' horizon (top of Cadna-owie Formation) western Great Artesian Basin. S. Aust. Dept. Mines report 72/29 (unpublished).
Stephens, C. G., 1971. Laterite and silcrete in Australia: a study of the genetic relationships of laterite and silcrete and their companion materials, and their collective significance in the formation of the weathered mantle, soils, relief and drainage of the Australian continent. *Geoderma,* 5: 5-52.
Stirton, R. A., Tedford, R. H. and Miller, A. H., 1961. Cainozoic stratigraphy and vertabrate palaeontology of the Tirari Desert, South Australia. *Rec. S. Aust. Mus.,* 14: 16-61.
Streich, V., 1893. Geological observations taken on the Sir Thomas Elder Expedition 1891. *Trans. R. Soc. S. Aust.,* 16: 74-115.
Stuart, J., McD., 1858. Mr. Stuart's Exploration. *Parl. Pap. S. Aust.,* 114.
Threadgill, B., 1922. *South Australian Land Exploration* 1856-1880. Board of Governors of the Public Library, Museum and Art Gallery of South Australia, Adelaide.
Tindale, N. B., 1940. Results of the Harvard-Adelaide Universities anthropological expedition, 1938-1939. Distribution of Australian Aboriginal Tribes: a field survey. *Trans. R. Soc. S. Aust.,* 64: 140-231.
Thomson, B. P., 1974. Regional geology of the Gawler Craton. S. Aust. Dept. Mines report 74/137 (unpublished).

Thornton, R. C. N., 1970. Lambina No. 1 well completion report. S. Aust. Dept. Mines report 70/79 (unpublished).
Thornton, R. C. N., 1971. Mount Willoughby No. 1 well completion report, S. Aust. Dept. Mines report 71/37 (unpublished).
Thornton, R. C. N., 1975. Manya No. 1 and Marla No. 1 well completion report. S. Aust. Dept. Mines report 75/106 (unpublished).
Townsend, I. J., 1970. Stratigraphic drilling programme 1969. Western Arckaringa Basin. S. Aust. Dept. Mines report 70/40 (unpublished).
Townsend, I. J., 1971. Wallira West No. 1 well completion report. S. Aust. Dept. Mines report 71/170 (unpublished).
Townsend, I. J., 1976. A synthesis of stratigraphic drilling in the Arckaringa Basin 1969-1971. *Rep. Invest., Geol. Surv. S. Aust.*, 45.
Townsend, I. J. and Ludbrook, N. H., 1975. Revision of Permian and Devonian nomenclature of four formations in and below the Arckaringa Basin. *Q. geol. Notes, geol. Surv. S. Aust.*, 54: 2-5.
Turner, A. R., 1970. The geochronology of the younger granites of the Gawler Block and its northwest margin. Amdel Project 1/1/122, progress report No. 3 (unpublished).
Ward, L. K., 1915. Opal. *In* General Notes, *Min. Rev.*, Adelaide, 25: 36-44.
Ward, L. K., 1917. Notes on the Stuart's Range opal field. *Min. Rev.*, Adelaide, 22: 13.
Warne, S. B., 1972a. Bore sample analysis, Gawler Craton, northern section, Mount Christie and Mount Woods. S. Aust. Dept. Mines open file Env. 1880 (unpublished).
Warne, S. B., 1972b. Bore and well spoil samples obtained by D. Ker, 1963. Western Stuart Shelf area. S. Aust. Dept. Mines open file Env. 1880 (unpublished).
Warne, S. B., 1972c. Bore sample analysis, Arckaringa Basin, Great Artesian Basin, Lake Phillipson Trough. S. Aust. Dept. Mines open file Env. 1880 (unpublished).
Whitehead, S., 1974. Description of conglomerate silcretes and channel deposits from MURLOOCOPPIE sheet. Amdel report MP 358/75 (unpublished).
Whitehouse, F. W., 1954. The geology of the Queensland portion of the Great Australian Artesian Basin: Appendix G. *In:* Artesian water supplies in Queensland, Dept. Co-ordinator General of Public Works. *Parl. Pap.* A, 56-1955, Brisbane.
Williams, A. F., 1970a. Geological reconnaissance of portion of the TALLARINGA sheet area. S. Aust. Dept. Mines report 70/75 (unpublished).
Williams, A. F., 1970b. Reconnaissance of the lower boundaries of the Bulldog Shale and the Coorikiana Sandstone in the western portion of the Great Artesian Basin. S. Aust. Dept. Mines report 70/113 (unpublished).
Williams, A. F., 1972. Celestite occurrences in the western Great Artesian Basin, South Australia. *Q. geol. Notes, geol. Surv. S. Aust.*, 43: 1-4.
Wopfner, H., 1960. On some structural development in the central part of the Great Artesian Basin. *Trans. R. Soc. S. Aust.*, 83: 179-193.
Wopfner, H., 1964. Tertiary duricrust profile on Upper Proterozoic sediments, Granite Downs area. *Q. geol. Notes, geol. Surv. S. Aust.*, 12: 1-3.
Wopfner, H., 1967. Some observations on Cainozoic land surface in the Officer Basin. *Q. geol. Notes, geol. Surv. S. Aust.*, 23: 3-8.
Wopfner, H., 1969. Mesozoic Era. *In*: Parkin L. W. (Ed.), *Handbook of South Australian Geology*. Geol. Surv. S. Aust., Gov. Printer, Adelaide, pp. 133-171.
Wopfner, H., 1970. Permian palaeogeography and depositional environment of the Arckaringa Basin, South Australia. *Papers and Proceedings Second International Gondwana Symposium*, South Africa.
Wopfner, H., 1972. Maghemite from Cainozoic sediments at Hallet Cove. *Q. geol. Notes, geol. Surv. S. Aust.* 43: 5-8.
Wopfner, H., 1974. Post-Eocene history and stratigraphy of northeastern South Australia. *Trans. R. Soc. S. Aust.*, 98: 1-12.
Wopfner, H., Callen, R. and Harris, W. K., 1974. The Lower Tertiary Eyre Formation of the southwestern great Artesian Basin. *J. geol. Soc. Aust.* 21: 17-51.
Wopfner, H., Freytag, I. B. and Heath G. R., 1970. Basal Jurassic-Cretaceous rocks of western Great Artesian Basin, South Australia. Stratigraphy of environment. *Bull. Am. Ass. Petrol. Geol.* 54: 383-416.
Wopfner, H. and Heath, G. R., 1963. New observations on the basal Creta-Jurassic Sandstone in the Mount Anna region, South Australia. *Aust. J.Sci.*, 26.
Wopfner, H. and Milton, B. E., 1971. Proposal for the drilling of four stratigraphic wells in the Arckaringa and western Great Artesian Basins. S. Aust. Dept. Mines report 71/53 (unpublished).
Wopfner, H. and Twidale, C. R., 1969. Geomorphological history of the Lake Eyre Basin. *In*: J. N. Jennings, and J. A. Mabbut (Eds.), *Landform studies from Australia and New Guinea*. Aust. National University Press, Canberra.

APPENDIX

HYDROGEOLOGY OF MURLOOCOPPIE 1:250 000 SHEET

By

P. C. Smith

Hydrogeology Section

Groundwater on the MURLOOCOPPIE 1:250 000 sheet is obtained from three distinct aquifer systems:

- Algebuckina Sandstone/Cadna-owie Formation, which underlies at varying depths most of the sheet.
- Bulldog Shale, which conformably overlies the Algebuckina Sandstone/Cadna-owie Formation and crops out over an extensive area of the sheet. It is an aquifer in the central northern portion.
- Quaternary alluvial sediments associated with modern drainage lines, particularly in the northeast corner of the sheet, e.g. adjacent to Lora, Evelyn and Pootnoura Creeks.

ALGEBUCKINA SANDSTONE/CADNA-OWIE FORMATION

These formations are the dominant aquifer system tapped for stock water in the mapped area. The Algebuckina Sandstone occurs in the subsurface only whilst the Cadna-owie Formation crops out along the western side of the sheet.

Commonly, only the Cadna-owie Formation is developed as an aquifer, because of the relatively small yields required for stock watering.

Although this aquifer system is overlain by the Bulldog Shale for most of the sheet (a potentially good confining bed) the aquifer is generally unconfined (except near the eastern margin of the area). This is thought to be caused by the paucity of recharge to the aquifer, which leads to incomplete saturation of the sediments, i.e. the potentially confined aquifer is mainly at atmospheric pressure.

Water quality is extremely variable and salinities range up to 17 000 mg/*l* (sheep can tolerate water up to 12 000 mg/*l* and cattle up to 10 000 mg/*l*).

Because of the non-saturated nature of the sediments and their depth in the central and eastern portions of the sheet, water levels are as low as 125 m below ground level. To the west where the Cadna-owie discontinuously crops out, water levels are higher, and may lie at depths of only 20 m.

On the eastern margin of the sheet, where the aquifer becomes confined a standing water level at a depth of 0·6 m has been recorded in Johnson No. 2 Bore. Just to the east, on WARRINA, Rasberry Creek Bore is a flowing well.

Recharge is thought to occur on the western margin of the sheet via the outcropping Cadna-owie Formation. Another potential recharge mechanism is through interconnected fractures within the Bulldog Shale from surface drainage features including creeks, clay pans and depressions. (Mason, 1975b). Recharge also occurs to the east, on the western margin of the Peake and Denison Ranges, where both formations outcrop.

BULLDOG SHALE

This formation is used as an aquifer in the northern central region of MURLOOCOPPIE, where a relatively shallow (20 to 30 m) and extensive fracture zone is fed by local recharge from surface drainage areas. Wells such as Matheson, Big Swamp and C.B. Bores obtain groundwater at shallow depth from this formation.

Water quality is excellent, from 100 to some 1 000 mg/*l*, with standing water levels between 10 and 30 m. Yields, however, are relatively low, generally less than 0·5 *l*/sec.

An interesting phenomenon, associated with groundwater derived from the Bulldog Shale, is the high nitrate (up to 80 mg/*l*) value recorded from some wells. This is almost twice the World Health Organisation upper limit of 45 mg/*l* for drinking purposes. The high nitrate, in shallow groundwater, is thought to be derived from the leaching of nitrogenous nodules, associated with the roots of mulga plants.

QUATERNARY ALLUVIALS

As an unconfined aquifer, this group of sediments is only exploited in the northeast portion of the sheet.

Usually large diameter wells adjacent to, or within surface drainage features are used, because of relative low yields and high standing water levels. Some holes are completed within the upper, weathered profile of the Bulldog Shale.

Salinity is extremely variable, between 200 and 30 000 mg/*l*, and standing water levels are normally less than 10 m.

Recharge is derived locally from rainfall and surface runoff.

COOBER PEDY TOWN WATER SUPPLY

As a result of the lithostratigraphic and structural interpretations made during the work described herein, and subsequent private company exploratory work (Mason, 1975a, 1975b), in the Oolgelima-Giddi Giddinna Creek area, an area of low salinity groundwater was recognised in the shallowly subcropping Cadna-owie Formation. This is believed to be due to the dilution effect of local surface recharge, through joints in the thin (0-20 m), overlying unnamed transitional unit.

In view of the difficulties (particularly low capacity) of the present Coober Pedy town water supply, exploratory and development drilling is at present taking place to establish a water supply of higher capacity, but still of acceptable quality. The work to date is described in McNally, 1977a and 1977b.