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RECORD 1973/47

PROGRESS REPORT ON GEOLOGICAL MAPPING OF THE NORTHWESTERN PART OF THE EROMANGA BASIN, NORTHERN TERRITORY

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A. Mond and A.N. Yeates

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CONTENTS

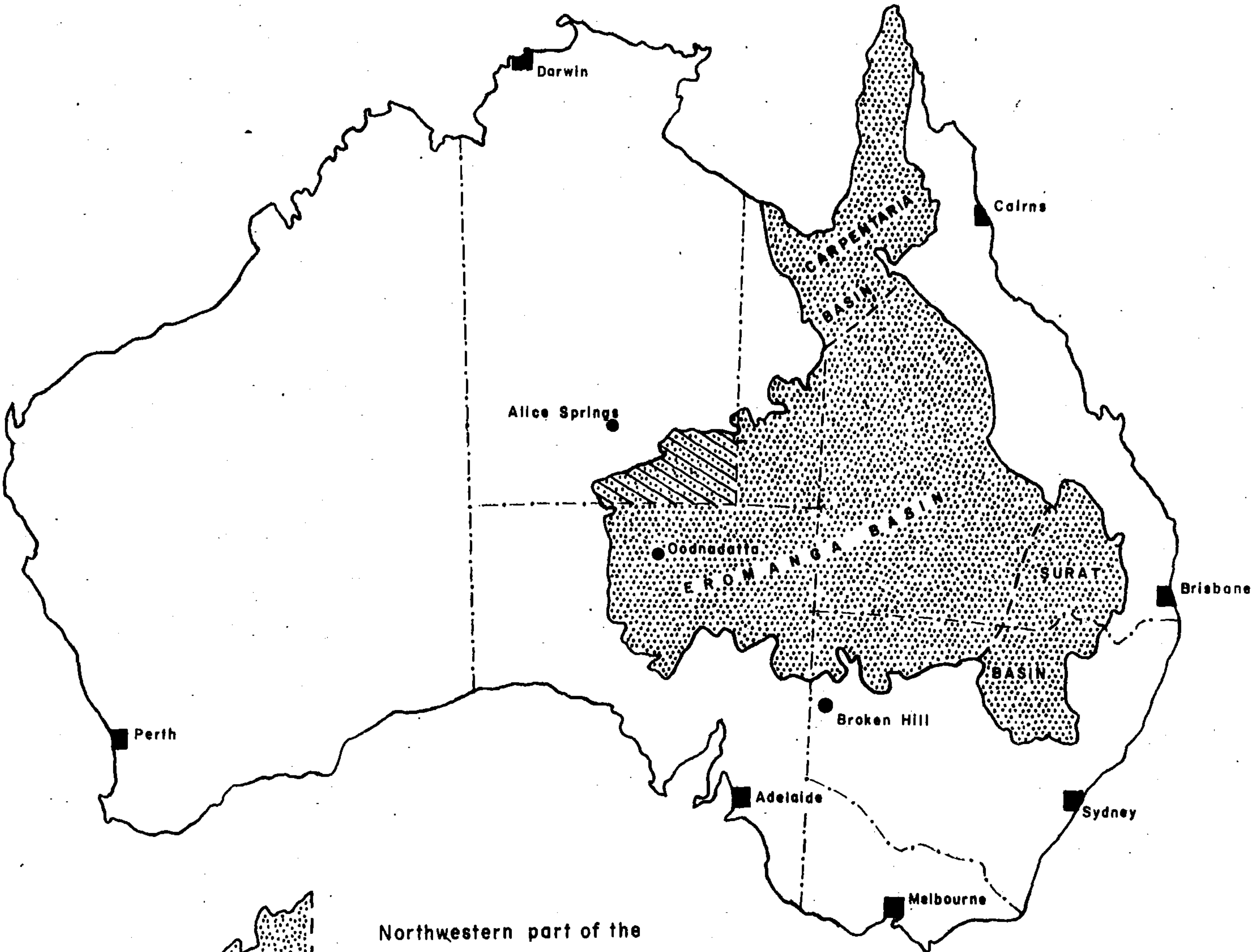
<u>CONTENTS</u>

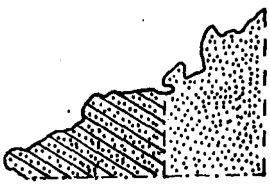
<u>MAPS</u>

SUMMARY

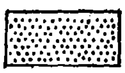
During 1971 the Simpson Desert North and Simpson Desert South 1:250 000 Sheet areas in the Northern Territory portion of the northwestern Eromanga Basin were geologically mapped.

The Tarlton Formation, previously regarded as ?Triassic, was shown to consist of Permian Crown Point Formation plus Jurassic to ?Lower Cretaceous De Souza Sandstone. The Rumbalara Shale appears to be mainly restricted to the type area, the other Cretaceous rocks previously mapped as Rumbalara Shale being units of the Rolling Downs Group.





Northwestern part of the Eromanga Basin. Diagonal lines show area mapped in 1971.



Great Artesian Basin

FIG. I Location map showing the northwestern part of the Eromanga Basin and the area mapped in relation to the Great Artesian Basin.

To accompany Record 1973/47 AUS 2/234

INTRODUCTION

This Record presents the results of geological mapping and of a geological reconnaissance survey in the northwestern part of the Eromanga Basin in the period June to October 1971. The objectives of 1971 field work were to map the Simpson Desert South and Simpson Desert North 1:250 000 Sheet areas, and to establish correlation of the Permian and younger units in the Northern Territory part of the Eromanga Basin. The main aim was to cover as large an area as possible to get some ideas about the area of exposure of the individual units, quality of outcrops, and their accessibility. In less than two months the survey covered an area of about 100 000 km^2, almost half of it by ground traverses. As a result the conclusions outlined below are tentative only and further field work is necessary before they can be confirmed.

The Eromanga Basin was named by Mott (1952) who divided the Great Artesian Basin into three separate depositional and tectonic basins - Carpentaria, Eromanga, and Surat. The Eromanga Basin, which represents the western part of the Great Artesian Basin, covers a large part of western Queensland and extends into the Northern Territory, South Australia, and New South Wales (Fig. 1). Stratigraphic units of the Eromanga Basin change gradually northwards across the Euroka Arch into units within the Carpentaria Basin, and to the east across the Nebine Ridge and Cunnamulla Shelf into units of the Surat Basin. For mapping purposes BMR has arbitrarily divided the Eromanga Basin into central, northern, northwestern, and southwestern parts. The area surveyed in 1971 covered the Northern Territory portion of the northwestern part. In this area the Eromanga Basin consists of Jurassic to Upper Cretaceous rocks which are underlain by Permian rocks of the Pedirka Basin and overlain by Cainozoic sediments of the Lake Eyre Basin.

Situation and access

The northwestern part of the Eromanga Basin is sparsely populated. Cattle stations occupy most of the basin in western Queensland, and these are serviced by the townships of Birdsville, Betoota, Bedourie (administrative centre of the Diamantina Shire), and Boulia. This part of the basin can be reached by road from Brisbane via Winton. Main roads are well graded, but unsurfaced and sandy in part. In good weather, tracks between stations provide good access to the country, and the gravel-covered area is easily traversed by four-wheel-drive vehicles. The channel country is more difficult to traverse and during the wet season roads and tracks become boggy and most rivers and creeks are impassable. There are scheduled fortnightly flights from Brisbane and Mount Isa to Birdsville, Betoota, Bedourie and Boulia. In addition, at most stations there is a dry-weather airstrip suitable for small aircraft.

In the Northern Territory most of the area is occupied by the Simpson Desert. The largest settlement is at Finke, a small railway station on the Alice Springs/Port Augusta railway. Small sidings like Rumbalara have been constructed at intervals of about 16 km along the railway. Except for a few cattle stations along the western margin, the rest of the area is uninhabited. The main highway between Adelaide and Alice Springs runs north-south about 60 km west of the surveyed area. Main access from the highway is the road from Kulgera to Finke. Several roads and cattle station tracks connect homesteads to main access road, railway sidings, and various wells, bores, and dams. Access to the Simpson Desert is from Finke via Crown Point and Andado stations to North Bore. From North Bore one track runs north to Alice Springs via Highway Bore and Allambi Station. Another track runs from North Bore east via East Bore and Poodinittera Hill to the southern part of the Simpson Desert South 1:250 000 Sheet area. This track has been maintained by Geosurveys of Australia as the main access to their survey area (OP 177). On the northern side of the Simpson Desert, access is by tracks along the Hale, Plenty, and Hay Rivers. The tracks can be reached from the road that connects Alice Springs with western Queensland via Tobermory and Glenormiston. These tracks, however, run only for a limited distance; they are seldom used and very sandy in places. Access to the rest of the Simpson Desert area, although possible by four-wheel-drive vehicles, presents a number of logistic problems such as fuel, water, and food supply. The most convenient means of transport is by helicopter.

Previous work

With the exception of the Simpson Desert South and Simpson Desert North 1:250 000 Sheet areas, the whole northwestern Eromanga Basin has been mapped by BMR at 1:250 000 scale. Description of previous work, from early discovery expeditions to geological mapping and geophysical exploration has been covered in the Explanatory Notes and 1:250 000 Sheet Series (Smith, 1963, 1965; Stewart, 1968; Shaw, 1968; Shaw & Milligan, 1969; Wells, 1969; Cook, 1969). In the last few years there has been little activity in the surveyed area. In the south, in the McDills and Simpson Desert South Sheet areas, geophysical work has been carried out by Geosurveys of Australia (Williams, 1971; Geosurveys, 1971), and most recently farther east by Reef Oil. In the northern part of the surveyed area, along the Plenty River, geophysical exploration was carried out in 1971 by Central Pacific Minerals.

Time spent in area and means of transport

The field work consisted of three stages:

(1) Shallow stratigraphic drilling
(2) Geological reconnaissance and mapping using helicopter
(3) Ground traverses.

<u>Drilling</u>. Shallow stratigraphic drilling was carried out in the Hay River Sheet area from 18 June to 12 August 1971 using a BMR Mayhew drilling rig to determine the thickness and extent of the Permian, Mesozoic, and Cainozoic rocks, to determine the nature of the basement, and to collect fresh material for palynological and lithological study. The results of the drilling are described

by Yeates (1971) who was a drill-site geologist and Burger & Mond (in prep.).

Helicopter reconnaissance. A Jet Ranger helicopter was used for geological reconnaissance and mapping. Fifty hours (flying time) were flown from 19 August to 9 September from North Bore which was used as a base camp and fuel depot. In this period outcrops in the Simpson Desert South, Simpson Desert North, Hay River, Mount Whelan, Tobermory, McDills, Hale River, Finke, and Rodinga 1:250 000 Sheet areas were visited.

Ground traverses. From 10 September to 6 October ground traverses were made using two short-wheel-base Toyotas. In September the party visited the Cretaceous and Tertiary outcrops in the vicinity of North Bore, in the area south of Andado homestead, and the Permian and younger units cropping out in the Finke Sheet area. In October A. Mond visited outcrops of the Cretaceous and Tertiary rocks in the northwestern corner of the Simpson Desert North Sheet area, and along the Plenty River, Hay River, and in the Lake Caroline area in the Hay River Sheet area.

DESCRIPTION OF STRATIGRAPHIC UNITS

Basement

Interpretation of the aeromagnetic data (Quilty & Milsom, 1964) shows that three types of basement can be recognized in the northwestern part of the Eromanga Basin. In the northern and eastern parts of the surveyed area the basement is interpreted to be Archaean and Lower Proterozoic rocks similar to those of the Arunta Block which are exposed to the northwest in the Harts Range. In the southwestern part the basement is thought to consist of Precambrian rocks similar to those of the Musgrave Block. The southeastern part of the surveyed area is characterized by low-intensity circular aeromagnetic anomalies which could indicate a basement of low-grade metamorphic rocks of low magnetic contrast. In this area the basement probably consists of a slightly metamorphosed sequence and interbedded volcanic rocks possibly of Lower Palaeozoic to Proterozoic age. A sequence of volcanic rocks intersected in Amerada Hale River 1 includes volcanic conglomerate, tuffaceous agglomerate, interbedded basalt with feldspathic dykes, and possible andesite sills.

During the 1971 field season basement rocks were encountered only in shallow stratigraphic holes BMR Hay River 1, 2, 3, and 4 and at Mount Winnecke in the Hay River Sheet area (Yeates, 1971). The basement in BMR Hay River 1 is identical with well sorted fine-grained slightly metamorphosed quartzite and siliceous siltstone exposed at Mount Winnecke, which belong to the Proterozoic Grant Bluff Formation (Smith, 1963). The basement rocks in BMR Hay River 2, 3, and 4 are biotite metaquartzite, biotite schist, and biotite gneiss of the Proterozoic Arunta Block (Yeates, 1971).

Pre-Permian

Devonian to Carboniferous sediments (Finke Group) in Amerada Hale River 1 and Cambrian to Carboniferous sediments in Amerada McDills 1 are apparently the eastern extension of the Amadeus Basin.

Crown Point Formation

Permian rocks crop out along the western, northern, and northeastern margin of the northwestern part of the Eromanga Basin (Fig. 2). In the west they are named the Crown Point Formation, in the north they have been partly mapped as the Tarlton Formation, and in the northeast they are unnamed and shown on the map (Mount Whelan Sheet area) as undifferentiated Permian.

Derivation of name, outcrop, distribution. The name 'Crown Point' is derived from the type locality, Crown Point, about 22 km northwest of Finke township in the Finke Sheet area. Originally the rocks of this unit were included by Chewings (1914) in his Finke River Sandstone and later referred to by Ward (1925) as the Crown Point Series. This name was revised (Wells et al., 1964) to the Crown Point Formation.

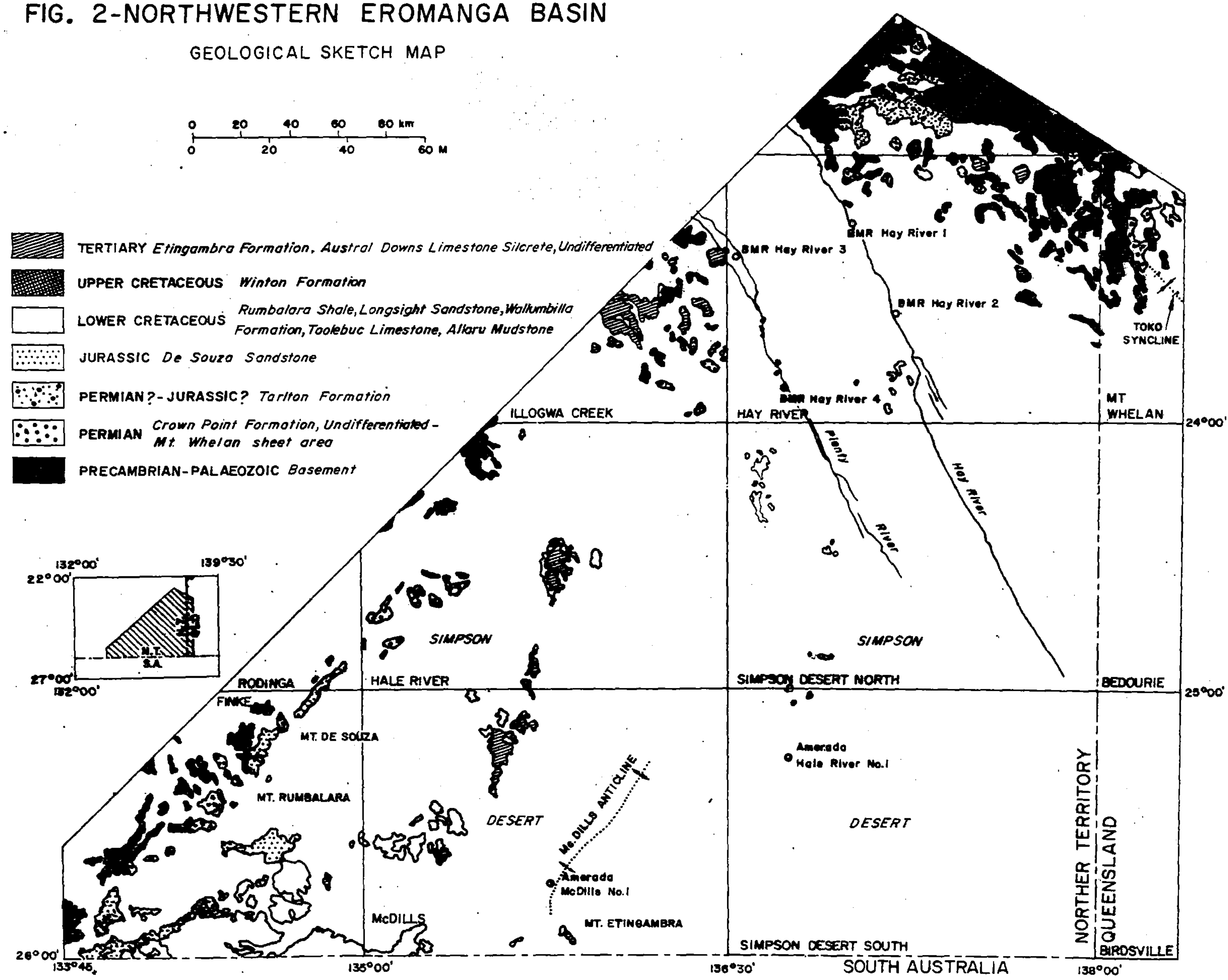
The Crown Point Formation crops out in a narrow belt which trends northeast across the central part of the Finke Sheet area to the southwestern corner of the Hale River Sheet area. Some of the rocks which crop out in this area (Mount Hakea, Point Eremophila, Fig. 3) were previously mapped as part of the Devonian to Carboniferous Langra Formation (Wells, 1969). The Langra Formation consists of fine and coarse sandstone and beds of conglomerate (with phenoclasts of granite and metamorphic rocks) interbedded with siltstone. The Langra Formation does not contain dispersed pebbles and cobbles which are typical of the Crown Point Formation. On aerial photographs the Crown Point Formation outcrop has a similar appearance to the Langra Formation.

The distribution of the Crown Point Formation in the subsurface is unknown. Drilling has indicated a Permian sequence beneath the Simpson Desert (Malcolms Bore, Amerada McDills 1, Amerada Hale River 1), but not all of it is necessarily part of the Crown Point Formation.

Lithology. The Crown Point Formation consists of sandstone, siltstone, 'tillite' and conglomerate, and some shale (Wells et al., 1970). Many outcrops are covered by mounds of rounded boulders and some of the phenoclasts of quartzite and quartz are up to 150 cm across. Smaller fragments of granite and schist occur in the residual gravels. Wells et al. (1970) observed that many of the quartzite boulders show impact markings and a few of the smaller fragments are striated. In outcrop the sandstone is generally medium to very coarse and is composed of quartz and feldspar grains set in a fine kaolinitic matrix. In Amerada McDills 1 (Wells et al., 1970) the sandstone is fine to medium, locally coarse-grained, partly pyritic and conglomeratic, and calcareous towards the base; the upper part of the sequence contains thin lenses of lignite. Mud clasts are present in the

FIG. 2-NORTHWESTERN EROMANGA BASIN

GEOLOGICAL SKETCH MAP



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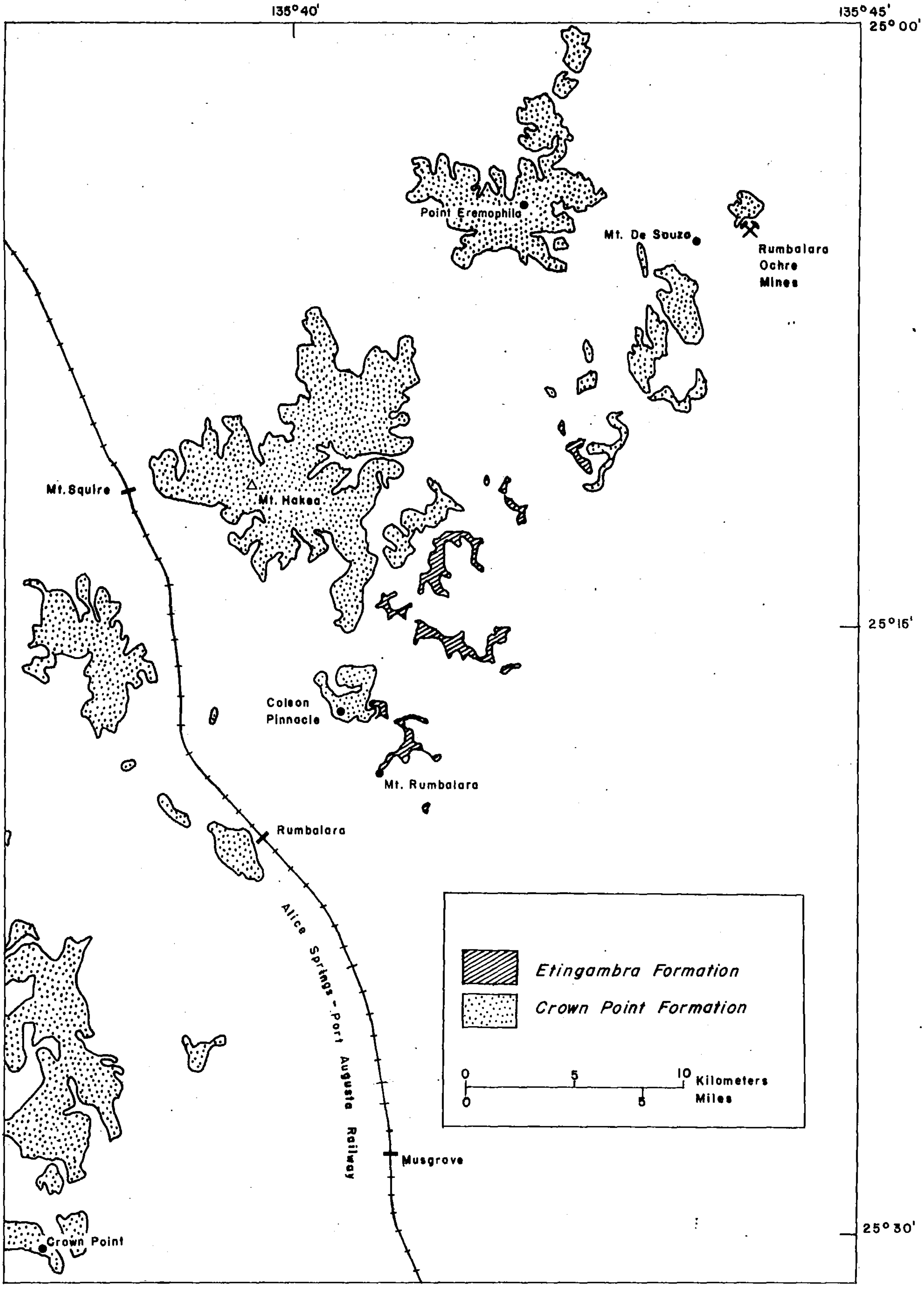


FIG. 3 Revised distribution of the Crown Point and Etingambra Formations in the northeastern part of the Finke 1:250,000 sheet area.

To accompany Record 1973/47 G53/A6/16

sandstone both in the well section and in outcrop. The dominant sedimentary structure is parallel lamination in the siltstone and shale which are interbedded with the sandstone throughout the sequence. The conglomeratic shale in the basal part of the formation contains phenoclasts of chert and metamorphic rocks. Large slump structures, convolute lamination, ripple marks (Fig. 4), well developed cross-stratification and scour-and-fill contacts are common.

The 'tillite' consists of rounded and faceted pebbles, cobbles, and boulders dispersed in bedded clayey sandstone and siltstone (Fig. 5). About 5 km west-northwest of Rumbalara railway siding about 60 m of tillite crops out in a few mesas. It consists of yellowish brown medium-grained sandstone with pebbles, cobbles, and boulders scattered throughout the sequence. In this report the term 'tillite' is used with reservation. It is possible that rather than tillite these rocks represent glacio-lacustrine and/or glacio-fluvial sediments.

Relations. The Crown Point Formation unconformably overlies the Devonian to Carboniferous Finke Group.

Conditions of deposition. According to Wells et al. (1970) the Crown Point Formation is composed mainly of erosion products formed during a period of continental glaciation. No marine fossils have been found in the Crown Point Formation. The sediments were probably transported by glaciers and deposited in a fluvial and lacustrine environment.

Thickness. In outcrop, west-northwest of the Rumbalara railway siding, the Crown Point Formation is about 60 m thick. In Amerada McDills 1 it is about 200 m thick, in Amerada Hale River 1 it is 116 m thick.

Age. Palynological examination of samples from water-bores (Balme, 1959; Evans, 1964) and petroleum exploration wells (Magnier, 1964a, b) indicates a Lower Permian (Sakmarian-Artinskian) age.

Undifferentiated Permian rocks

Pebble and boulder sediments, mostly unconsolidated, have been described from the Mount Whelan Sheet area (Reynolds, 1968). They occupy hollows in the Toomba Range, form scree along the western side of the trough of the Toko Syncline, and are scattered on the surface between Pollys Lookout and Sun Hill. The pebbles appear to be locally derived from pre-Permian Palaeozoic rocks and markings on some of them suggest a glacial or fluvio-glacial origin. For this reason Reynolds (1968) mapped these rocks as ?Permian.

The Toomba Range area was visited in 1971. A brief examination suggested that the rocks mapped as ?Permian could be ground moraine-type. However, the very short time spent in this area was not enough for any definite conclusions to be made. Similar rocks have been described from the northern Mount Whelan and from the Glenormiston Sheet areas (Condon & Smith, 1959; Reynolds, 1968).

Tarlton Formation

Derivation of name, outcrop, distribution. The Tarlton Formation was named and defined by Condon & Smith (1959). The name is derived from the Tarlton Range in the Tobermory Sheet area. The formation crops out in numerous mesas in the southern Tobermory Sheet area and the northern Hay River Sheet area. The type section is in the Tarlton Range, 18 km south of Tarlton Downs homestead.

Lithology. In the type section (Condon & Smith, 1959) the Tarlton Formation consists of 1 m of claystone with faceted, polished, and striated boulders and cobbles, overlain by 20 m of cross-bedded, coarse-grained sandstone, siltstone, and thin beds of pebble conglomerate. In most localities the base is not exposed and the lowest exposure is a pebble or cobble conglomerate, succeeded by silty sandstone and sandy siltstone.

In the Hay River Sheet area (Smith, 1960) the formation consists of medium to coarse cross-bedded silty quartz sandstone, succeeded by white and brown (weathered) siltstone containing fossil wood and leaves. There are no boulder beds in the Hay River Sheet area, but some thin beds of pebble and cobble conglomerate have been mapped; for the most part the formation there consists of rocks identical with those in the upper parts of the sequence in the Tobermory Sheet area.

In 1971 several outcrops in the southern part of the Tobermory Sheet area mapped as Tarlton Formation were briefly visited. At most places only the upper part, quartzose sandstone and siltstone, is exposed, but south of Tarlton Downs homestead the lower part is present. At this locality it consists of conglomerate with faceted and polished boulders and cobbles in a clayey matrix, and it closely resembles the Crown Point Formation. It is unconformably overlain by a coarse-grained cross-bedded quartzose sandstone identical with the De Souza Sandstone. The high-angle cross-bedding is of moderate scale (0.5 to 1 m). Similar observations were made at Mount Ewing. Here rocks mapped as Tarlton Formation appear to consist of the Crown Point Formation which is represented by fine to medium kaolinitic sandstone and siltstone, unconformably overlain by coarse-grained quartzose sandstone of the De Souza Sandstone. At a few other places only the equivalent of the De Souza Sandstone crops out. It is medium to coarse quartzose sandstone which is cross-bedded, micaceous, commonly conglomeratic, and generally weathers reddish brown or dark brown.

Relations. The Tarlton Formation lies unconformably on Cambrian to Lower Ordovician or Precambrian units (Smith, 1963; 1965). The upper limit is an erosion surface.

Conditions of deposition. Condon & Smith (1959) interpreted basal boulder and cobble beds as fluvio-glacial. The overlying sandstone and siltstone were deposited in a fluvial environment according to Smith et al. (1961).

Thickness. The thickness of the Tarlton Formation ranges from 6 to 30 m in the Hay River Sheet area. The thickest section

Figure 4. Asymmetric ripple marks in the Crown Point Formation, 3 km west of Crown Point, Finke Sheet area (Neg. No.M/1265).

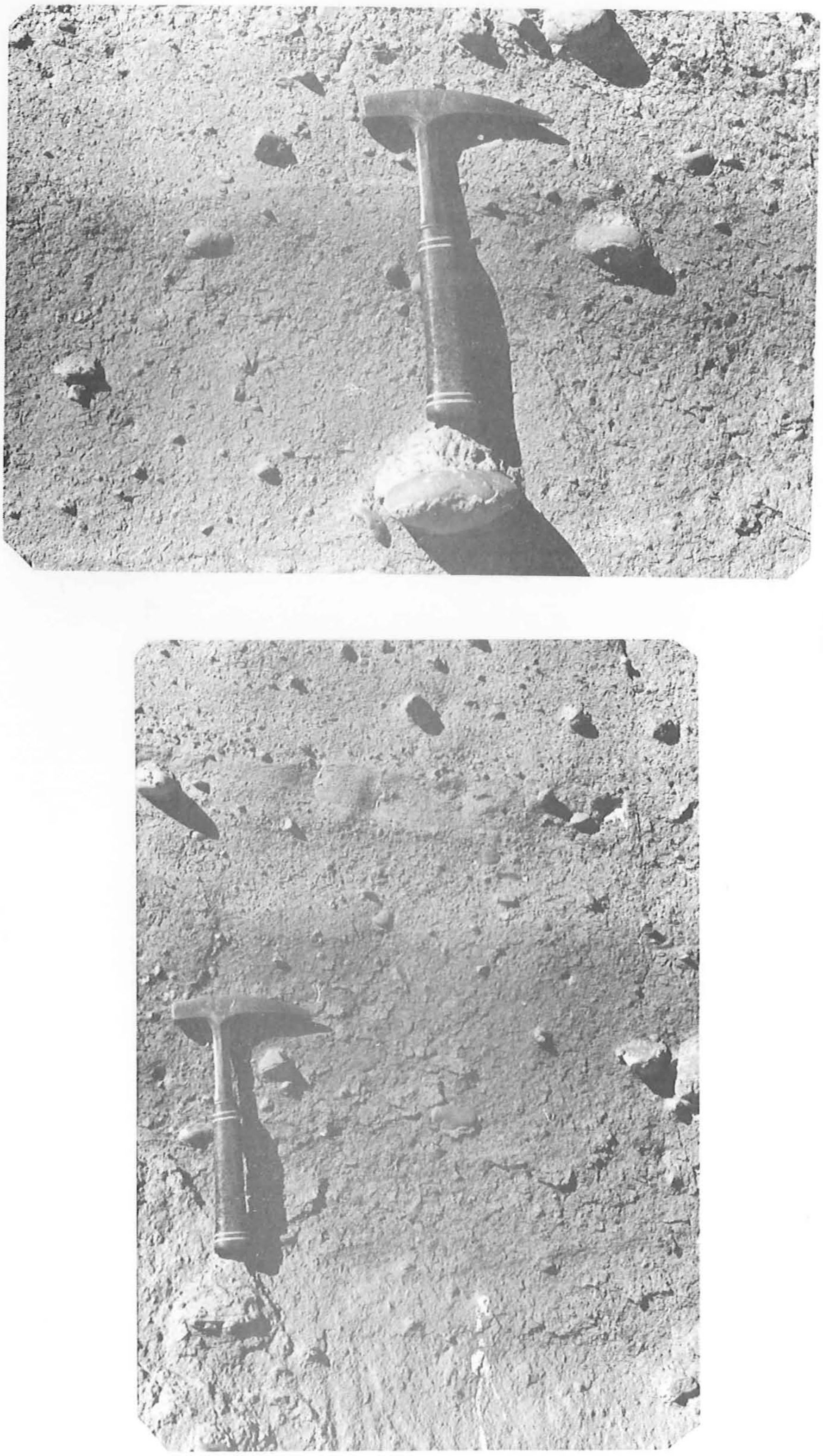


Figure 5. 'Tillite' in the Crown Point Formation, Finke River approximately 3 km southeast of Crown Point, Finke Sheet area. Neg.No.M/1265.

is 43 m at Mount Ewing in the Tobermory Sheet area, but most exposures are less than 22 m thick.

Age. Condon & Smith (1959) believed the formation to be of Permian age because of the fluvio-glacial origin and stratigraphic position. Subsequently, Smith et al. (1961) collected plant fossils from the upper part of the Tarlton Formation. This collection was examined by White (1961) who suggested a Triassic or Jurassic age. Based on this identification Smith (1963, 1965) placed the whole sequence in the Triassic.

The plant fossils collected by Smith et al. (1961) from the siltstone in the upper part of the Tarlton Formation were very poorly preserved. With the exception of one specimen, Lignifolium denmeadi, preservation of the impressions was unsatisfactory and identification was only tentative (White,1961). The type specimen L. denmeadi occurs in the Triassic Ipswich Coal Measures, the upper limits of the range of the species being unknown. Other species of the genus occur in Jurassic strata and therefore the age of this species can be stated to be Triassic or younger (White, 1957). Tentative identification of a few other specimens also suggest Triassic or Jurassic age for this collection (White, 1961). Smith (1963, 1965) disregarded a possible Jurassic age and without any discussion placed the whole sequence in the Triassic. However, the possibility that the lower part of the Tarlton Formation is fluvio-glacial and hence Permian was left open.

De Souza Sandstone

Derivation of name, outcrop, distribution. The De Souza Sandstone was named by Sullivan & Öpik (1951). The name is derived from the type locality at Mount De Souza in the Finke Sheet area. The formation crops out from southwest to northeast across the Finke Sheet area, in the southeastern corner of the Rodinga Sheet area, in the southwestern corner of the Hale River Sheet area, and possibly in the southeastern corner of the Illogwa Creek Sheet area. In the subsurface it has been recognized in the Finke, McDills, and Hale River Sheet areas. In the Simpson Desert South and Simpson Desert North Sheet areas the Jurassic to Lower Cretaceous sequence cannot be subdivided, but it probably comprises a thick sequence of the De Souza Sandstone overlain by a thin sequence of the Rumbalara Shale.

Lithology. The De Souza Sandstone consists of medium to coarse micaceous quartzose sandstone which is commonly conglomeratic. Where fresh it is white and friable; it generally weathers reddish brown or dark brown and the outcrops are covered by a crust rich in limonite. The sandstone is almost invariably cross-stratified, and the thickness of sets in places reaches 3 m (Fig. 6). The formation is most commonly composed essentially of quartzose sandstone which in places is rich in kaolin, and contains lenses and continuous beds of siltstone and shale.

Relations. The De Souza Sandstone rests unconformably on the Devonian to Carboniferous Finke Group or Permian Crown Point Formation (Wells et al., 1970).

Conditions of deposition. Cross-stratification, the size of sets, grainsize, and the lack of marine fossils indicate that the De Souza Sandstone was deposited in a fluvial environment. Wells et al. (1970) suggested that much of the sediment, particularly the conglomeratic fraction, was probably derived from the erosion of the Crown Point Formation or older units.

Thickness. The maximum thickness of the De Souza Sandstone in the type area is about 30 m. In water-bores it ranges from 15 to 90 m and the thickness increases towards the centre of the basin. The formation is 250 m thick in Amerada McDills 1, and 400 m thick in Amerada Hale River 1. In the Simpson Desert South and Simpson Desert North Sheet areas the De Souza Sandstone thickens from 200 m in the north to probably greater than 600 m in the south, assuming that the Rumbalara Shale and its probable lateral equivalent the Cadna-owie Formation do not thicken appreciably towards the centre of the basin.

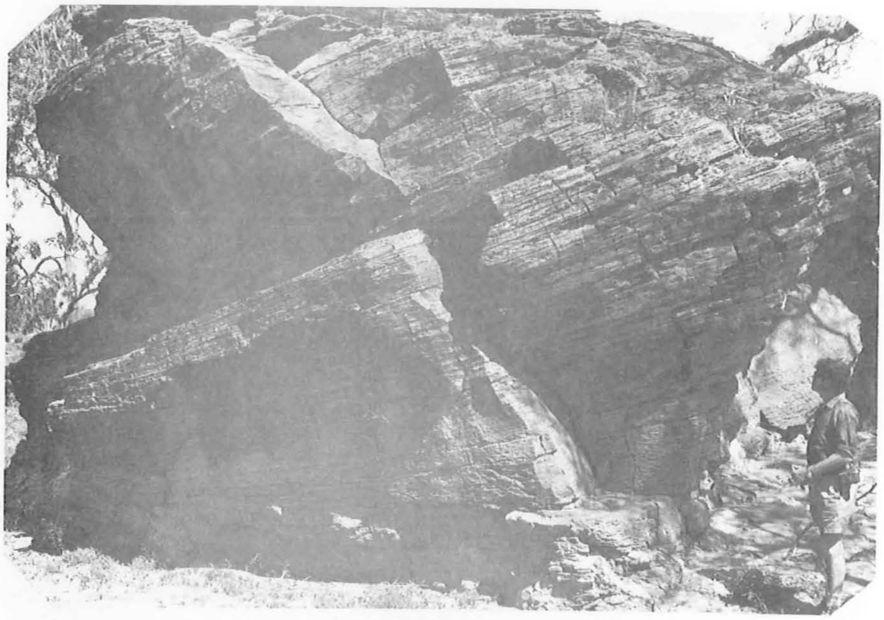
Age. The De Souza Sandstone contains only indeterminate plant fossils and the tentative Jurassic age is based on its similarity in lithology and stratigraphic position to the Algebuckina Sandstone in South Australia (Wells et al., 1970) which contains an Upper Jurassic to Lower Cretaceous flora (Harris, 1962).

Rumbalara Shale

Derivation of name, outcrop, distribution. The Rumbalara Shale was named by Sullivan & Öpik (1951). The name is derived from the type locality at the Rumbalara Ochre Mines (Finke Sheet area; Fig. 3).

Previously all post-De Souza Sandstone pre-Tertiary rocks which crop out in the Northern Territory portion of the northwestern part of the Eromanga Basin have been mapped as Rumbalara Shale. The 1971 reconnaissance work showed this to be incorrect. Only a minor part what has been mapped as the Rumbalara Shale belongs to this formation. The rest belong to the younger Cretaceous units of the Rolling Downs Group. As a result of this the outcrop distribution of the Rumbalara Shale appears to be limited to the Rumbalara Ochre Mines and to a narrow belt of outcrop extending southwest. The formation, although thin, was formed during a transition from terrestrial Jurassic deposition to marine Lower Cretaceous deposition and it is remarkably persistent over a large area. It is present in the subsurface of the whole northwestern part of the Eromanga Basin and represents the top part of the unnamed Jurassic to Lower Cretaceous sequence in the Simpson Desert South and Simpson Desert North Sheet areas (Yeates, in press; Mond, in press).

Lithology. In weathered outcrops the Rumbalara Shale consists of soft white claystone and siltstone (Fig. 7) with hard bands of porcellanite and some sandstone. Most of the rocks are typically white, friable, leached, and commonly silicified and ferruginized. Yellow ochre is common at the base of the formation, especially round the Rumbalara Ochre Mines. Most exposures are covered



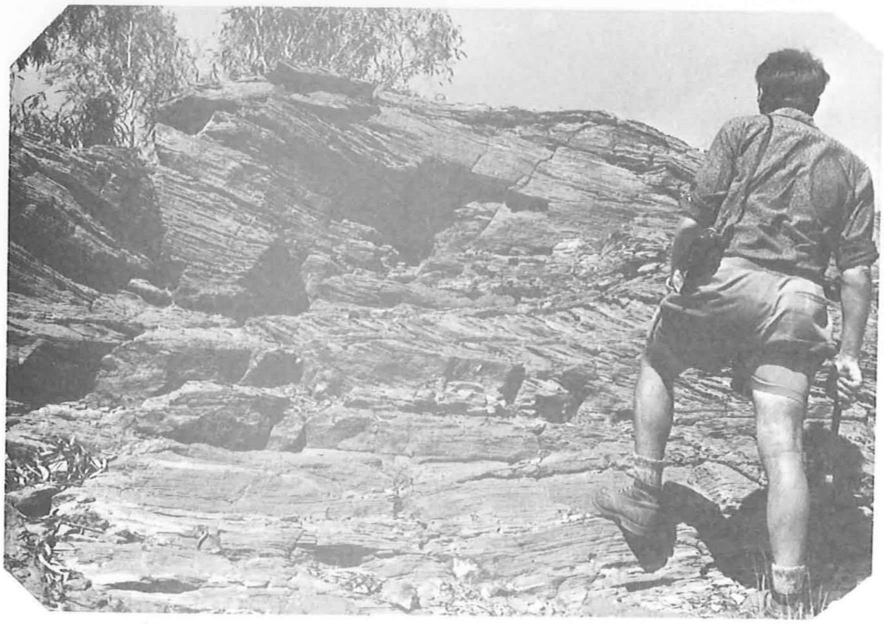


Figure 6. Cross-stratified sandstone in the De Souza Sandstone, 3 km north of Finke township, Finke Sheet area. (Neg.No.M/1265).

Figure 7. Siltstone in the Rumbalara Shale, Mount Rumbalara, Finke Sheet area (Neg. No.M/1265).

by a thick capping of silcrete (silicified Tertiary). Below the weathering profile rocks of the Rumbalara Shale are commonly bluish grey.

Relations. The Rumbalara Shale rests unconformably on the De Souza Sandstone. The top of the De Souza Sandstone has been eroded and cut-and-fill structures were observed by Wells et al. (1970) at the contact with the Rumbalara Shale.

Conditions of deposition. The presence of marine fossils indicates that the Rumbalara Shale was deposited in a marine environment at the beginning of a widespread transgression of the Lower Cretaceous sea.

Thickness. At the Rumbalara Ochre Mines the Rumbalara Shale is approximately 45 m thick (Sullivan & Öpik, 1951). Greater thicknesses were reported (Wells et al., 1970) from various water-bores and oil exploration wells (about 400 m in Amerada McDills 1). However, it seems that only the lowermost 30 to 40 m belongs to the Rumbalara Shale and the rest, as mentioned above, is probably part of the Rolling Downs Group.

Age. Lamellibranchs, crinoids, pelecypods, gastropods, sponges, Rhizocorallium, spores and pollens, and Foraminifera were recovered from the Rumbalara Shale and have been dated by Öpik (in Sullivan & Öpik, 1951), Skwarko (1962, 1966) and Terpstra & Evans (1963) as Aptian.

Longsight Sandstone

Derivation of name, outcrop, distribution. Towards the northern margin of the Eromanga Basin the Jurassic to Lower Cretaceous sequence was named the Longsight Sandstone by Casey (1959). The name is derived from Longsight Peak (27°30'S, 139°32'E) in the Boulia Sheet area. The type area is at Longsight Peak and on the south side of Eastern Creek. It crops out in the Queensland portion of the northwestern part of the Eromanga Basin in the Duchess, Urandangi, Boulia, Glenormiston, and Mount Whelan Sheet areas. In BMR Hay River 4 in the southwestern corner of the Hay River Sheet area, the section from 235 to 85 m is equated with the Longsight Sandstone (Burger & Mond, in prep.).

Lithology. In the type area the Longsight Sandstone consists of very fine to medium quartz sandstone, generally ferruginous and micaceous, with some conglomerate. In BMR Hay River 4 (Yeates, 1971) it consists mainly of well sorted fine to medium quartz sandstone with a lesser amount of clayey sandstone, carbonaceous sandstone, calcareous sandstone, micaceous quartz sandstone, mudstone, and thin lignite seams. In places it is pyritic and ferruginous.

Relations. The Longsight Sandstone rests unconformably on Precambrian and Lower Palaeozoic rocks (Silurian to Devonian). It is conformably overlain by the Wallumbilla Formation or the top is eroded.

Thickness. In BMR Hay River 4 the section regarded as the Longsight Sandstone is about 150 m thick. In the type area (Casey, 1959) the Longsight Sandstone is approximately 30 m thick but in the subsurface it is up to 60 m thick.

Age. The Longsight Sandstone contains Lower Cretaceous Foraminifera, macrofossils, and plants (Casey, 1959).

Rolling Downs Group

Most of the Cretaceous sedimentary rocks mapped in the McDills, Hale River, Hay River and partly in the Finke Sheet areas as the Rumbalara Shale belong to the Rolling Downs Group (Table 1). The distribution of the individual units is at the present time unknown. The Toolebuc Limestone has not been identified in outcrop, but the Wallumbilla Formation and the Allaru Mudstone crop out around Lake Caroline and along the Plenty River in the Hay River Sheet area as well as in the McDills and possibly in the Finke Sheet areas. Rocks that crop out around Lake Caroline and along the Plenty River are mostly fine to medium feldspathic sandstone, siltstone, and mudstone unconformably overlain by probable Tertiary coarse-grained quartzose sandstone. The rocks are weathered and the mudstone, in particular, is silicified. In the subsurface, rocks of the Wallumbilla Formation were penetrated in BMR Hay River 1, 2, and 4 where they consist of dark grey mudstone with some siltstone (Yeates, 1971). They contain Albian (unit K2b) spores and pollens (Burger & Mond, in prep.). Water-bore No. 2 along the Plenty River also penetrated about 80 m of fossiliferous sediments. These consist of weathered, pink, yellow, cream, and white claystone and mudstone, overlying dark grey siltstone which in turn overlies fine-grained grey glauconitic sandstone. Cuttings from the base of mudstone contain microfossils (Radiolaria, Foraminifera, spores, and pollens) which were described by Crespin & Evans (1962) and indicate a Lower Cretaceous (Albian) age.

The results of drilling and geophysical surveys indicate that all units of the Rolling Downs Group thin towards the northern margin of the Eromanga Basin (Mond, in press).

The Winton Formation crops out in the Simpson Desert South, Simpson Desert North, and McDills Sheet areas. In outcrop it consists of highly weathered very fine to medium lithic sandstone, silicified siltstone and mudstone, and weathered limestone. Samples examined by AMDEL (1972) show that the sandstone consists of about 70 percent lithic fragments, 25 percent quartz, and minor clay matrix and accessory minerals; extensive replacement by iron oxide is common. The rock fragments have been replaced by kaolin. The limestone is very fine-grained, pale pinkish orange, and has an irregular, somewhat nodular surface. It is composed almost entirely of very fine-grained calcite with traces of clay and a few detrital quartz grains.

Etingambra Formation

Derivation of name, outcrop, distribution. The Etingambra Formation was named by Wells et al. (1967). The name is derived from the type locality at Mount Etingambra in the southern part of the McDills Sheet area. The formation crops out throughout the whole Northern Territory part of the northwestern Eromanga Basin. In most places it forms cappings on mesas.

Lithology. The Etingambra Formation consists mainly of sandstone with some siltstone and lenses of conglomerate. The sandstone is medium to coarse and very coarse, poorly sorted, and moderately friable. Lenses and irregular beds and pockets of fine conglomerate are interbedded with the sandstone. The conglomerate is particularly well developed at Mount Etingambra where white to yellowish brown kaolinitic siltstone overlies the sandstone and conglomerate (Wells et al., 1967).

Relations. An unconformity separates the Etingambra Formation from older units. At Mount Etingambra the contact is a low-angle unconformity. The top of the Etingambra Formation has been eroded, silicified, and is at most places altered to silcrete. At East Bore in the McDills Sheet area there is a gradational relation between unaltered sedimentary rock and spheroidal boulders of surface silcrete. The various stages of development show fracturing and brecciation with filling by secondary silica and the development of spheroidal concretions.

Conditions of deposition. Wells et al. (1967) suggested a fluvial environment of deposition for this unit.

Thickness. The upper part of the Etingambra Formation has been eroded and on average the unit is about 5 m thick. However, it is about 9 m thick at Mount Etingambra, and up to 13 m thick in the northern McDills Sheet area.

Age. In South Australia, lithologically similar units in the same stratigraphic position contain Lower Tertiary plant fossils (Eyre Formation, Macumba Sandstone).

Undifferentiated Tertiary

Along the western and southern margins of dry lakes in the northwestern Simpson Desert North Sheet area, there are good exposures of green fine-grained sandstone, green and yellow mudstone and siltstone, and layers of gypsum. In places the sequence contains silcrete and ironstone layers. The relation of this sequence with the Tertiary Etingambra Formation is obscured by sand, but it is believed to be younger.

Fossils found in this unit (Prof. J.W. Warren, pers. comm., 1972) throw little light on the precise age or environment of deposition, although they include silicified wood, a pelecypod shell, two fragments of silicified bones, a coprolite, five shark teeth and one fragment of a lungfish toothplate. The fragments of the bone are believed to have come from a fairly sizeable animal such as turtle or perhaps a monosaur. The lungfish is probably of freshwater origin, but the shark teeth suggest marine conditions; all could be Tertiary or Cretaceous. Overall, the lithology and presence of fossils suggest correlation with the Etadunna Formation (Stirton et al., 1961) for which an Oligocene age was suggested based on a vertebrate fauna (Stirton et al., op. cit.). Ludbrook (1963) recorded Foraminifera from the basal part of the Etadunna Formation in a bore-hole drilled in the southeastern part of Lake Eyre North, and on the palynological evidence by Balme (in Ludbrook, 1963) it was thought to be no older than Miocene.

Quaternary

Practically all of the area examined in 1971 is covered by extensive longitudinal sand dunes of the Simpson Desert. They run continuously for at least 160 km in places, at about 334°; individual dunes are up to 300 km long. They are very straight and evenly spaced, mostly about 400 m apart. A characteristic is the systematic opening of tuning-fork junctures to the south-southeast. The dunes vary in height from 10 to 30 m. They have serrated tops with live crests, and are asymmetric in cross-section, the western slopes averaging 15° and the eastern 25°. The most recent information about the composition, origin, and age of the Simpson Desert sand dunes is compiled in the Explanatory Notes on the Simpson Desert North Sheet area (Mond, in press).

FUTURE WORK

Permian

To establish the composition, distribution, and relationship of the Permian rocks in the northwestern Eromanga Basin it is necessary to re-investigate the Crown Point Formation in the Finke, Rodinga and Hale River Sheet areas, the Tarlton Formation in the Hay River and Tobermory Sheet areas, and the undifferentiated ?Permian in the Mount Whelan and Glenormiston Sheet areas.

A visit to the Permian localities in South Australia in the Oodnadatta Sheet area (Mount Dutton, Mount Toondina) would be valuable. At Mount Dutton in particular, the relation between the Mount Toondina Beds and the Algebuckina Sandstone seems to be the same as that between the Crown Point Formation and the De Souza Sandstone.

Jurassic to Lower Cretaceous

Re-mapping the Tarlton Formation would help to indicate the relations between the De Souza Sandstone, the Algebuckina Sandstone, and perhaps the Longsight Sandstone. It may also provide fossil material that would help to identify the Jurassic to Lower Cretaceous interval in the western Eromanga Basin. To understand the distribution and relation of the Longsight Sandstone more lithological and palaeontological information is needed. A continuously cored hole through the Longsight Sandstone, planned for 1973, should provide valuable information to assist this study in the Boulia Sheet area.

Lower to Upper Cretaceous

It is unlikely that mapping alone will provide sufficient information to establish the distribution and relations of the Lower to Upper Cretaceous units in the western part of the surveyed area (Finke, McDills, and Rodinga Sheet areas). Shallow stratigraphic drilling will probably be necessary to provide fresh material for palynological and lithological studies, supplemented by wire-line logging. Wire-line logging of water-bores in this area has not proved very helpful, mostly because of very poor quality of recording.

<table>
<tr><th colspan="2" rowspan="2">Age</th><th colspan="6">Northwestern Eromanga Basin</th><th colspan="2">Southwestern Eromanga Basin</th></tr>
<tr><th colspan="2">Vine, 1971 (northern part)</th><th>Wells et al., 1970 (western part)</th><th colspan="3">This Report</th><th colspan="2">Wopfner, 1969</th></tr>
<tr><td rowspan="8">MESOZOIC</td><td>Lower to Upper Cretaceous</td><td rowspan="5">Rolling Downs Group</td><td>Winton Formation</td><td rowspan="6">Rumbalara Shale</td><td rowspan="5">Rolling Downs Group</td><td colspan="2">Winton Formation</td><td rowspan="6">Neales River Group</td><td>Winton Formation</td></tr>
<tr><td rowspan="5">Lower Cretaceous</td><td>Allaru Mudstone</td><td colspan="2">Allaru Mudstone</td><td>Oodnadatta Formation</td></tr>
<tr><td>Toolebuc Limestone</td><td colspan="2">Toolebuc Limestone</td><td>Wooldridge Lst Mbr</td></tr>
<tr><td rowspan="2">Wallumbilla Formation.</td><td colspan="2" rowspan="2">Wallumbilla Formation</td><td>Coorikiana Member</td></tr>
<tr><td>Bulldog Shale</td></tr>
<tr><td colspan="2" rowspan="2">Longsight Sandstone</td><td colspan="2">?—?
Rumbalara Shale</td><td rowspan="3">Longsight Sandstone</td><td>Cadna-owie Formation</td></tr>
<tr><td rowspan="2">?Jurassic to Lower Cretaceous</td><td rowspan="2">De Souza Sandstone</td><td colspan="2" rowspan="2">De Souza Sandstone</td><td colspan="2" rowspan="2">Algebuckina Sandstone</td></tr>
<tr><td colspan="2" rowspan="2">Tarlton Formation</td></tr>
<tr><td>Plz</td><td>Permian</td><td>Crown Point Formation</td><td colspan="3">Crown Point Formation</td><td colspan="2">Mount Toondina Beds</td></tr>
</table>

Table 1. Comparison of stratigraphic nomenclature of the Permian to Cretaceous rocks in the western part of the Eromanga Basin, Northern Territory and South Australia.

Tertiary

A further study of the undifferentiated Tertiary rocks that crop out in the northwestern Simpson Desert North Sheet area will help to interpret the Upper Cretaceous to Tertiary interval in the Eromanga Basin. The recovery of several fossils by Prof. Warren is very promising and warrants detail investigation of this area as well as examination of rocks cropping out in the central Simpson Desert North Sheet area.

CONCLUSIONS

1. The apparent stratigraphy of the area, based on the reconnaissance, is given in Table 1. The stratigraphy of adjacent areas is shown for comparison.

2. The lower part of the Tarlton Formation in the Tobermory and Hay River Sheet areas and the undifferentiated Permian on the Mount Whelan Sheet area are believed to be Crown Point Formation or its equivalent. The units are lithologically identical, occur in the same stratigraphic position, and seem to have been deposited in a similar environment (fluvio-glacial, glacial). Some rocks that have been mapped (probably by photo-interpretation) in the Finke Sheet area as Langra Formation appear to be Crown Point Formation.

3. Rocks mapped in the Simpson Desert South and Simpson Desert North Sheet areas as the Jurassic to Lower Cretaceous sequence can be sub-divided into a lower part which can be correlated with the De Souza Sandstone and an upper part which can be correlated with the Rumbalara Shale or perhaps with the lower part of the Wallumbilla Formation.

4. The De Souza Sandstone is identical with the upper part of the Tarlton Formation. Poorly preserved plant remains recovered from the top part of the Tarlton Formation indicate an Upper Triassic to Jurassic age. Lithologically they are identical and their stratigraphic position is the same (i.e. between the Permian fluvio-glacial unit and the palaeontologically dated Lower Cretaceous). Further careful collecting may enable a closer palaeontological dating to be made.

5. The Rumbalara Shale outcrop is restricted to the Rumbalara Ochre Mines and to a narrow strip to the southwest. With the exception of the southwestern Finke Sheet area, where some outcrops could be Rumbalara Shale, the rest of the Mesozoic rocks mapped as Rumbalara Shale belong to the Rolling Downs Group. In the subsurface the Rumbalara Shale is part of the unnamed Jurassic to Lower Cretaceous sequence which is present throughout the whole of the surveyed area.

6. Towards the northern margin of the Eromanga Basin the Jurassic to Lower Cretaceous sequence cannot be subdivided and the whole sequence is equated with the Longsight Sandstone. However, at the present time there is little information about the composition and age of the Longsight Sandstone.

7. The Wallumbilla Formation and Allaru Mudstone are present around Lake Caroline, along the Plenty River in the Hay River Sheet area, and probably in the McDills and Finke Sheet areas. The Toolebuc Limestone has not been identified in outcrop and in the mapped area it is known only from Amerada Hale River 1. However, it crops out to the east in the Bedourie and Mount Whelan Sheet areas (Vine, 1971). The Winton Formation crops out in the Simpson Desert South, Simpson Desert North and McDills Sheet areas. Shallow stratigraphic drilling and geophysical exploration indicate that all these units thin towards the northern margin of the basin (Mond, in press).

8. The Etingambra Formation crops out throughout the whole northwestern Eromanga Basin. In most places it is silicified and forms mesa cappings.

9. Fossils collected from the sedimentary rocks in the northwestern Simpson Desert North Sheet area suggest the presence of Tertiary beds similar to the Etadunna Formation in South Australia. The other alternative is that they are Upper Cretaceous, but younger than the Winton Formation. Further collecting may provide more information on a poorly known Upper Cretaceous to Tertiary interval in the northwestern Eromanga Basin.

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APPENDIX

List of samples

Forty rock samples were petrographically examined in thin sections, ten of them were examined by X-ray diffraction, and four of these samples were also submitted for chemical analysis. The results and all thin sections are stored in the Bureau of Mineral Resources, Canberra. The samples are from the following stratigraphic units:

Horseshoe Bend Shale (Finke Group) -	71190011
Crown Point Formation -	71190004, 71190005, 71190007, 71190009, 71190010, 71190013, 71190016, 71190019, 71190020, 71190021, 71190022
Tarlton Formation -	71190014, 71190015, 71190023, 71190024, 71190025
Rumbalara Shale -	71190001, 71190002, 71190003, 71190008, 71190012, 71190017, 71190018, 71190026, 71190027
Winton Formation -	72190001 - 72190013
Quaternary -	71190006

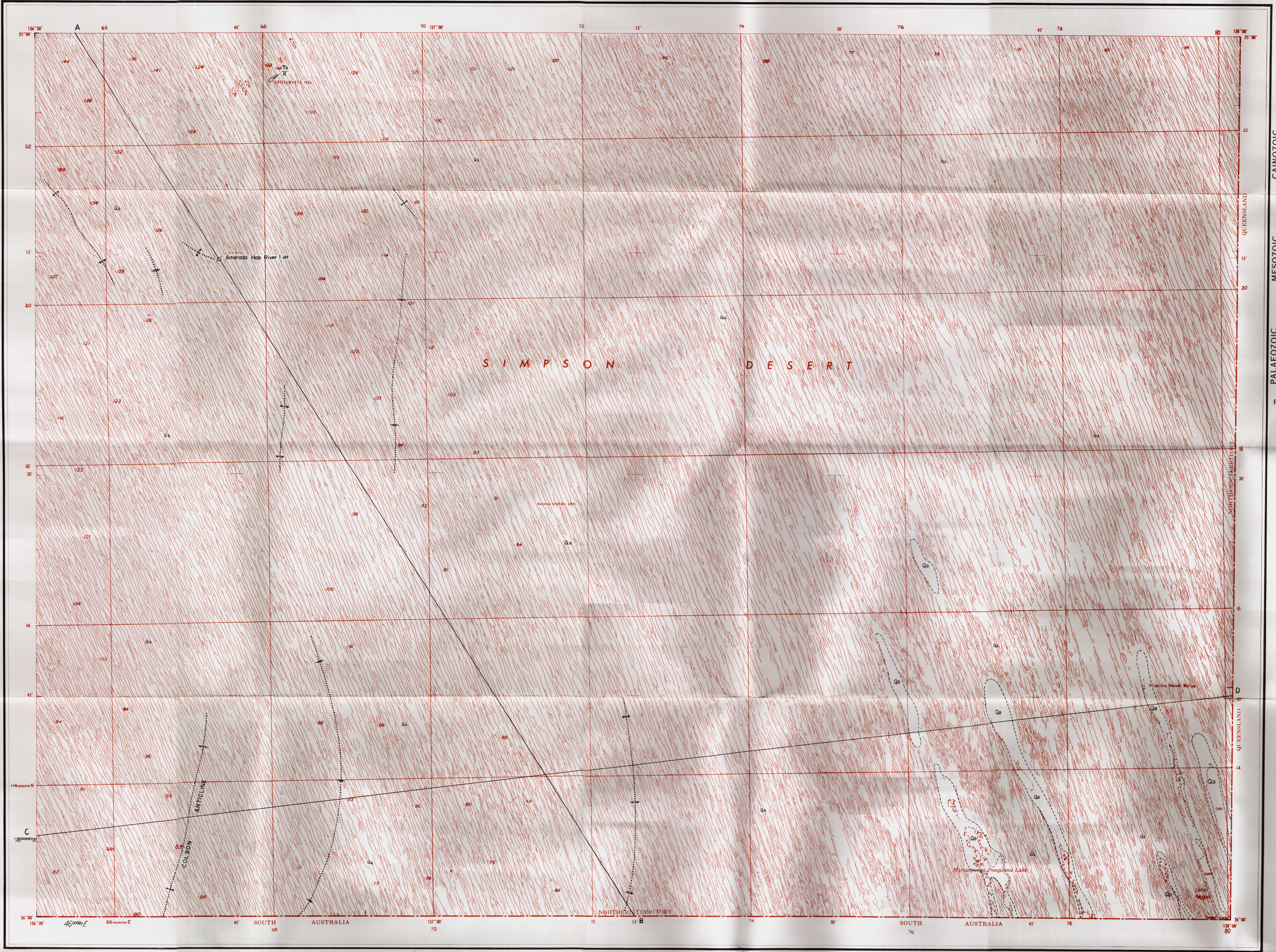
Thirteen rock samples from the Winton Formation (72190001-72190013) were submitted to the Australian Mineral Development Laboratories (AMDEL) for petrographic description and four of these specimens (72190007, 72190008, 72190012, 72190013) were also submitted for chemical analysis by direct reading emission spectrography. A preliminary examination of thin sections showed that many specimens were composed predominantly of clay and iron oxide and some showed a cloudiness suggesting the presence of opal. Because of the interest in weathering and weathering products, seven of these specimens (72190001, 72190002, 72190004-72190008) were examined by X-ray diffraction. It showed that kaolin is the predominant clay mineral, and that opal is present in the silicified specimens. It also disclosed the presence of alunite in three specimens and traces of gypsum in one. Results of the petrographic examination, X-ray diffraction, and chemical analyses are summarized in the report by AMDEL (1972).

AUSTRALIA 1:250,000 GEOLOGICAL SERIES

SIMPSON DESERT SOUTH

NORTHERN TERRITORY

SHEET SG 53-8



Reference

CAINOZOIC	QUATERNARY		Qa	Alluvial and lacustrine silt, clay, sand, some salt
			Qs	Aeolian sand
	TERTIARY		Ts	Silcrete
MESOZOIC	LOWER TO UPPER CRETACEOUS	Winton and Mackunda Formations	K	Mudstone, shale sandstone, siltstone, coal
	LOWER CRETACEOUS	Rolling Downs Group: Allaru Mudstone	Kla	Grey carbonaceous shale
		Rolling Downs Group: Toolebuc Limestone	Klo	Grey shale, greyish brown massive limestone
		Rolling Downs Group: Wallumbilla Formation	Klu	Dark grey glauconite and calcareous shale, siltstone, sandstone
		Cadna-owie Formation	Kle	Grey and white fine sandstone, grey shale
	JURASSIC		J	Sandstone, pebbly sandstone, some carbonaceous shale and coal
PALAEOZOIC	PERMIAN		P	Sandstone, siltstone, coal
	DEVONIAN TO CARBONIFEROUS		DC	Reddish grey shale, white micaceous sandstone
PRECAMBRIAN			pЄ	Gneiss, schist, volcanics, minor intrusions

Kla to pЄ: Section Only

- Geological boundary
- Fault (D, U indicates relative movement down or up)
- Anticline, Syncline: Interpreted from seismic data

Where location of boundaries and faults is approximate, line is broken; where concealed, folds are dotted

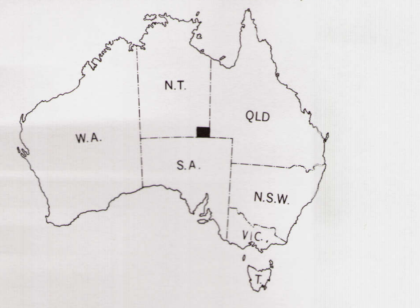
- Petroleum exploration well – dry abandoned
- Sand dunes
- ·64 Elevation in metres, approximate
- pa Position approximate

NOTE ON GRID COORDINATES

Brown ticks with black italic numbers (numbers shown only at SW corner of map and change of zone), indicate the 20,000 yard grid, Zone 5 (Australia Series), CLARKE 1858 SPHEROID. Transverse Mercator Projection

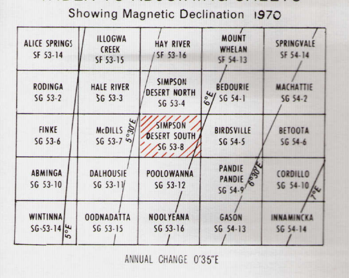
Brown numbered lines (with larger upright numbers), inside the neatline are 20,000 metre intervals of the superimposed Australian Map Grid, Zone 53 AUSTRALIAN NATIONAL SPHEROID. Transverse Mercator Projection

Compiled by the Bureau of Mineral Resources, Geology and Geophysics, Department of National Development. Issued under the authority of the Hon. Sir Reginald Swartz K.B.E., E.D., Minister for National Development. Base map compiled by the Division of National Mapping from aerial photography at 1:50,000 scale. Transverse Mercator Projection.



INDEX TO ADJOINING SHEETS

Showing Magnetic Declination 1970



Scale 1:250,000

Sections

Cainozoic sediments omitted

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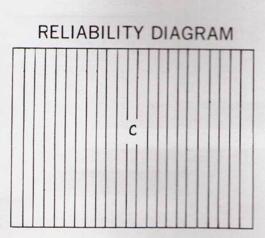
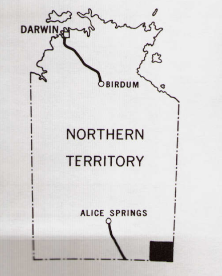
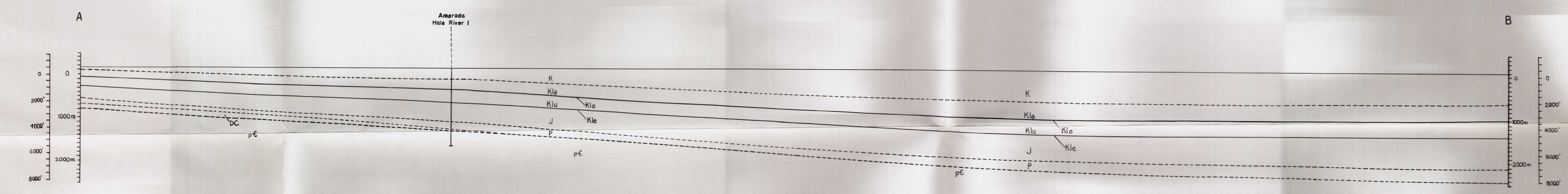
Compiled 1972 A.N. Yeates
Cartography by Geological Branch B.M.R.
Drawn by M. Steele

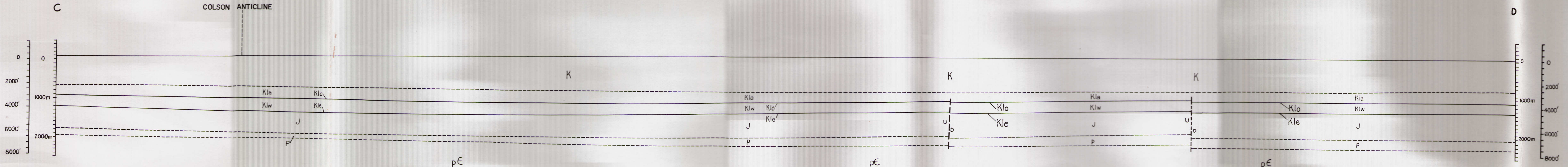
RELIABILITY DIAGRAM



Geology C General reconnaissance, few traverses; mainly air photo interpretation.







PRELIMINARY EDITION 1972

SUBJECT TO AMENDMENT

SIMPSON DESERT SOUTH

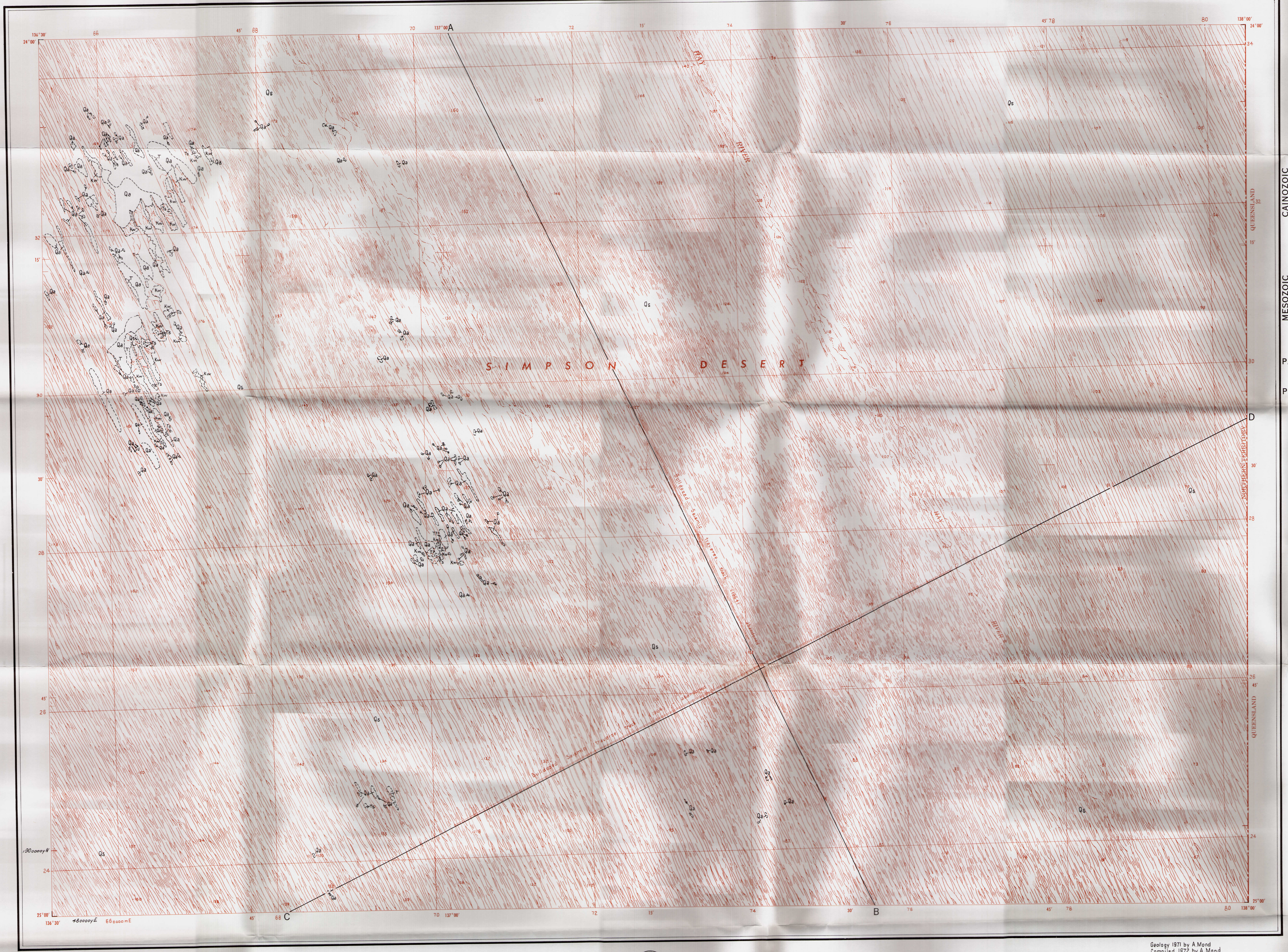
SHEET SG 53-8

AUSTRALIA 1:250,000 GEOLOGICAL SERIES

SIMPSON DESERT NORTH

NORTHERN TERRITORY

SHEET SG 53-4



Reference

CAINOZOIC	QUATERNARY		Qa	Alluvial sand, lacustrine silt and clay; some salt
			Qs	Aeolian sand, minor alluvium along rivers
	TERTIARY		T	Fine-grained sandstone, siltstone, gypsum, some limestone
			Ts	Coarse-grained sandstone, commonly silicified
MESOZOIC	LOWER TO UPPER CRETACEOUS	Rolling Downs Group: Winton Formation	Kw	Labile sandstone, siltstone, mudstone, calcareous in part; some coal
	LOWER CRETACEOUS	Rolling Downs Group: Allaru Mudstone	Kla	Dark grey mudstone
		Rolling Downs Group: Toolebuc Limestone	Klo	Grey calcareous mudstone, greyish brown limestone
		Rolling Downs Group: Wallumbilla Formation	Klu	Dark grey mudstone, glauconitic labile sandstone and siltstone, calcareous in part, minor pyrite
	JURASSIC TO LOWER CRETACEOUS		Jk	Sandstone, pebbly sandstone, some carbonaceous siltstone, coal
PALAEOZOIC	PERMIAN		P	Sandstone, siltstone, conglomerate, coal
PRECAMBRIAN	PROTEROZOIC		E	Gneiss, schist, volcanics, probably basalt and pyroclastics

Kla, Klo, Klu, Jk, P, E: Section only

Geological boundary

Fault

Where location of boundaries and faults is approximate, line is broken; where inferred, queried

Sand dunes

Seismic traverse track

Astronomical station

·116 Elevation in metres, approximate

Compiled by the Bureau of Mineral Resources, Geology and Geophysics, Department of National Development. Issued under the authority of the Hon. Sir Reginald Swartz K.B.E., E.D., Minister for National Development. Base map compiled by Division of National Mapping from aerial photography at 1:50,000 Scale. Transverse Mercator Projection

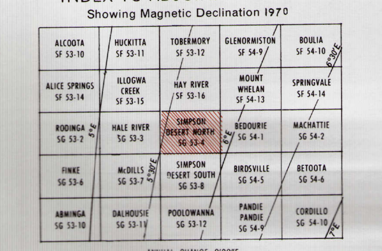
NOTE ON GRID COORDINATES

Brown ticks with black italic numbers (numbers shown only at SW corner of map and change of zone), indicate the 20,000 yard grid, Zone 5 (Australia Series), CLARKE 1858 SPHEROID. Transverse Mercator Projection

Brown numbered lines (with larger upright numbers), inside the neatline are 20,000 metre intervals of the superimposed Australian Map Grid, Zone 53 AUSTRALIAN NATIONAL SPHEROID. Transverse Mercator Projection

INDEX TO ADJOINING SHEETS

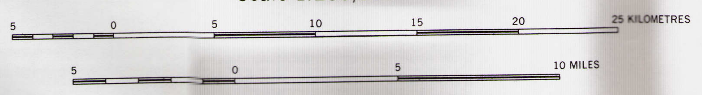
Showing Magnetic Declination 1970



ALCOOTA SF 53-10	HUCKITTA SF 53-11	TOBERMORY SF 53-12	GLENORMISTON SF 54-9	BOULIA SF 54-10
ALICE SPRINGS SF 53-14	ILLOGWA CREEK SF 53-15	HAY RIVER SF 53-16	MOUNT WHELAN SF 54-13	SPRINGVALE SF 54-14
RODINGA SG 53-2	HALE RIVER SG 53-3	SIMPSON DESERT NORTH SG 53-4	BEDOURIE SG 54-1	MACHATTIE SG 54-2
FINKE SG 53-6	McDILLS SG 53-7	SIMPSON DESERT SOUTH SG 53-8	BIRDSVILLE SG 54-5	BETOOTA SG 54-6
ABMINGA SG 53-10	DALHOUSIE SG 53-11	POOLOWANNA SG 53-12	PANDIE PANDIE SG 54-9	CORDILLO SG 54-10

ANNUAL CHANGE 0°30'E

Scale 1:250,000

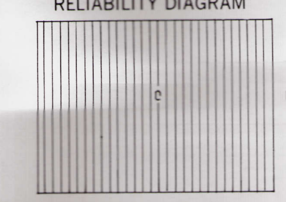


Sections

Cainozoic sediments omitted

Scale: $\frac{V}{H} = 4$

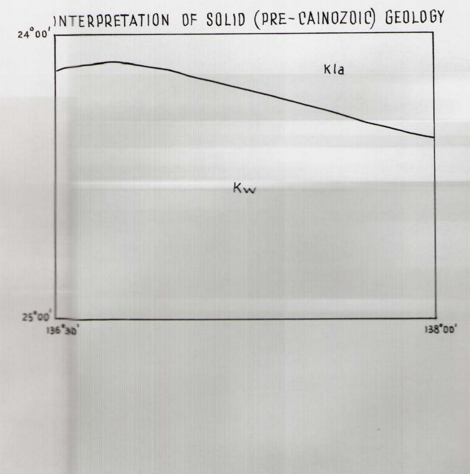
RELIABILITY DIAGRAM



Geology C General reconnaissance for traverses, mainly air-photo interpretation

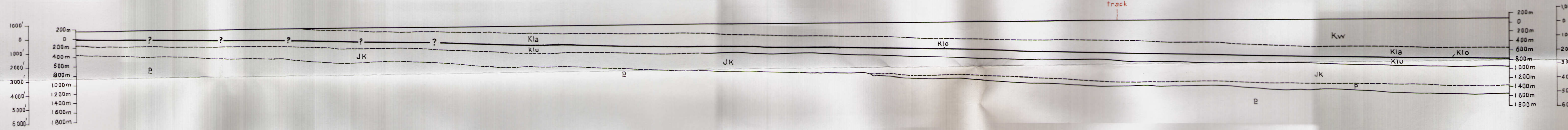
Geology 1971 by A. Mond
Compiled 1972 by A. Mond
Cartography by Geological Branch BMR
Drawn 1972 D. Green
Printed by Mercury–Walch Pty Ltd., Hobart, Australia

INTERPRETATION OF SOLID (PRE-CAINOZOIC) GEOLOGY



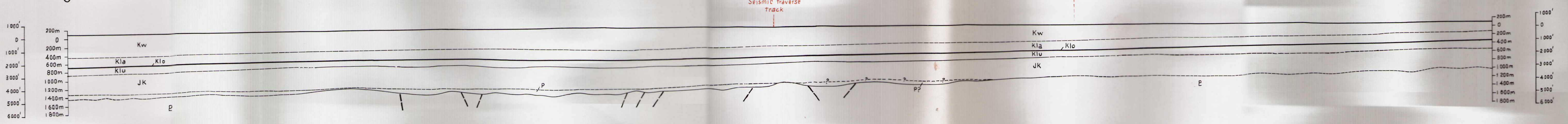
A

B



C

D



PRELIMINARY EDITION 1972

SUBJECT TO AMENDMENT

SIMPSON DESERT NORTH

SHEET SG 53-4