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DEPARTMENT OF MINES
SOUTH AUSTRALIA

MIOCENE MARINE TRANSGRESSIONS ON Mutooroo, OLARY, AT THE NORTHERN MARGIN OF THE MURRAY BASIN

Tricentrol Aust. Ltd., E.L. 63

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PALAEONTOLOGY SECTION

Rept.Bk.No.779
G.S. No. 5278
DM. NO. E.L. 63
Pal.Rept.No. 14/73

19th November, 1973

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PLANS

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ABSTRACT

Four samples of cuttings from two bores provide the first record of marine deposition at the northern margin of the Murray Basin near "Mutooroo". At depths between 94.5 m and 127.5 m two marine units of glauconitic clay sand and minor limestone are separated by a regressive non-marine carbonaceous sand. The upper marine unit carries Lepidocyclina howchini which, as along the River Murray, is probably lower Balcombian, Early to Middle Miocene. On less certain foraminiferal evidence the lower marine unit is probably Batesfordian, late Early Miocene. Two of the marine samples yield similar microfloras which suggest Balcombian to possibly Batesfordian age. There is a microfloral link with the Etadunna Formation. The regressive episode was relatively brief. The lowest sample also contains clay with abundant siderite pellets, and fragments of weathered phyllitic rock, both suggesting proximity to bedrock at this depth.

INTRODUCTION

Four samples of rotary drilled cuttings were submitted for palaeontological examination by Tricentrol Aust. Ltd. from their recent exploration programme for sedimentary uranium on the northern margin of the Murray Basin in Exploration Licence 63, Mutooroo, OLARY (Fig. 1). The samples were supplied as from:-

borehole MT 6	at 115 m;
borehole MT 30	at 94.5 - 96 m, 105 - 106.5 m, 126 - 127.5 m.

Locations of these bores are shown on Fig. 1 in relation to the approximate edge of the Murray Basin as inferred from the distribution of outcropping Precambrian rocks on OLARY (Forbes et al., 1973) and from geophysical interpretations by Gerdes (1973).

The samples are the first fossiliferous material received from this northern margin of the Murray Basin. The nearest bore treated by Ludbrook (1961) was Canopus No. 1, 82 km to the south (48 km south of "Oakvale" H.S., Fig. 1).

Three of the samples yielded both marine microfaunas (foraminifera) and palynomorphs (spores, pollen and microplankton). This has provided a further valuable opportunity for cross-correlation and firmer dating of these biostratigraphic systems (McGowran, Lindsay and Harris, 1971).

DESCRIPTION OF SAMPLES AND MICROFAUNAL LISTS

Relative abundance of species is indicated thus:

V	(very rare, 1 to 2 specimens encountered)
R	(rare, 3 - 5)
F	(frequent, 6 - 10)
C	(common, 11 - 25)
A	(abundant, 25+)

Borehole MT 6

Cuttings from 115 m, sample F 57/73

Fossiliferous clay, silt, and sand, with some cementation to limestone and calcareous siltstone; greenish brown and grey, ferruginous, glauconitic (common pellets, aggregates, foram. fillings) pyritic (aggregates, foram. fillings) quartzose (silt, very fine grained sand, some coarser) micaceous.

Common mollusc, echinoid, bryozoal fragments; rarer ostracodes, fish otoliths, brachiopod and coral fragments.

The echinoid *Fibularia gregata* Tate. (V)

Foraminifera are abundant and varied, including:

Planktonic forms:

Globigerina aff. *falconensis* Blow	(V)
G. praebulloides subspp.	(C)
G. aff. *officinalis* Subbotina	(C)
G. angustiumbilicata (Bolli)	(R)
Globigerinoides sp. (high spired)	(V)

Benthonic forms:

Cibicides pseudoungerianus (Cushman)	(V)
C. refulgens Montfort	(V)
C. opacus Carter	(R)
Quinqueloculina vulgaris d'Orbigny	(C)
Triloculina collinsi Carter	(R)
Pyrgo aff. *sarsi* (Schlumberger)	(V)
Pararotalia verriculata (Howchin and Parr)	(C)
Amphistegina lessoni d'Orbigny	(C)
Notorotalia howchini (Chapman, Parr and Collins)	(C)
N. sp.	(C)
Anomalinoides procolligera Carter	(V)
A. macraglabra (Finlay)	(R)
Discorbinella bouana (d'Orbigny)	(F)
D. scopos (Finlay)	(F)
Astrononion aff. *centroplax* Carter	(V)
Escornebovina aff. *cuvillieri* Butt	(V)
Cassidulina laevigata d'Orbigny	(V)

Globocassidulina subglobosa (Brady)	(F)
Sigmoilopsis lapidigera (Howchin and Parr)	(R)
Dorothia parri Cushman	(C)

Borehole MT 30

Cuttings from 94.5 - 96.0 m, sample F 71/73

At least three lithologies are represented:

1. Glauconitic fossiliferous silty clay to marl, calcarenitic, greenish grey and brown, quartzose (silt, sand), pyritic.
2. Glauconitic fossiliferous limestone (part saccharoidal) to siltstone, quartzose (very fine to very coarse sand).
3. Gravelly quartz sand, with subrounded lithic gravel to 8 mm; minor pyritic cementation.

Bryozoal, echinoid, mollusc fragments; ostracode valves; a coral fragment; foraminifera are common, including:

Planktonic forms:

Globigerina woodi connecta Jenkins	(V)
G. praebulloides subspp.	(F)
G. aff. *officinalis*	(R)

Benthonic forms:

Lepidocyclina howchini Chapman and Crespin	(F)
Pararotalia verriculata	(A)
Gypsina howchini Chapman	(R)
Sphaerogypsina globula (Reuss) large	(R)
Notorotalia howchini	(F)
N. sp.	(V)
Sigmoilopsis lapidigera	(V)

Tritaxia victoriensis (Cushman)	(V)
Svratkina perlata (Andreae)	(V)
Tubulogenerina mooraboolensis (Cushman)	(V)

Cuttings from 105.0 - 106.5 m, sample F 72/73.

Gravelly quartz sand, silty, some clay bands; grey, carbonaceous (black woody fragments common) pyritic; minor cementation to pyritic sandstone; common pyritized woody fragments; gravel to 8 mm.

No foraminifera or other animal remains were recovered.

Cuttings from 126.0 - 127.5 m, sample F 70/73.

A number of lithologies are represented:

1. Clay, dark grey, pyritic, fossiliferous (including well-preserved pyrite-filled small foraminifera) carbonaceous.
2. Marl, grey to brown, finely shelly, glauconitic (pellets, foram.fillings) quartzose (silt, sand).
3. Limestone - siltstone, brown glauconitic, quartz-bearing, fossiliferous, pyritic.
4. Quartz sand, grey to brown, fine and silty to coarse and gravelly, pyritic.
5. Clay, off-white, non-calcareous, with abundant brown siderite pellet aggregates.
6. Clay, silvery grey, micaceous, non-calcareous, fragments of ?completely weathered bedrock phyllite.

Bryozoal, echinoid, mollusc fragments; ostracode valves.

Foraminifera are common and include:

Planktonic forms:

Globigerina praebulloides	(F)
G. aff. *officinalis*	(R)
G. angustiumbilicata	(V)

Benthonic forms:

Pararotalia verriculata	(A)
Globocassidulina subglobosa	(C)
Cassidulina laevigata	(V)
Cibicides pseudoungerianus	(C)
C. refulgens	(F)
Heterolepa subhaidingeri (Parr)	(V)
Notorotalia howchini	(C)
Porosorotalia aff. *crassimara* (Carter)	(V)
Elphidium howchini (Cushman)	(R)
Discorbinella bouecana	(R)
Anomalinoides procolligera	(V)
Baggina philippinensis (Cushman)	(V)
Tubulogenerina mooraboolensis	(V)
Reussella ensiformis (Chapman)	(V)
Textularia sagittula	(V)
Dorothia parri	(F)

TABLE I

Distribution of spores, pollen and microplankton

	Bore and Depth in metres		
	MT 6 115 (Sample No. S2836)	MT 30 94.5-96 (Sample No. S2832)	MT 30 105-106.5 (Sample No. S2835)
Aglaoreidia sp.	x	x	
Araucariacites australis	x	x	
Alisporites sp.	x		x
Arecipites sp.	x		
Casuarinidites cainozoicus	x	x	x
Ceratosporites equalis	x	x	
Cyathidites minor	x	x	x
Dacrycarpites australiensis	x		x
Dictyophyllidites sp.	x	x	
Haloragacidites harrisii	x	x	x
Helciporites sp.	x	x	
Lycopodiumsporites sp.	x		
Lygistepollenites florinii	x	x	x
Laevigatosporites ovatus	x	x	x
Malvacipollis subtilis	x	x	
Myrtaceidites parvus	x	x	x
M. mesonesus	x	x	
Microcachryidites antarcticus	x	x	
Nothofagidites falcatus	x	x	
N. matauraensis	x	x	
Osmundacidites wellmanii	x	x	
Perinomonoletes sp.	x		
Phyllocladidites paleogenicus	x	x	x
Podocarpidites ellipticus	x		
P. spp.	x	x	x

Proteacidites annularis	X		
P. parvus	X	X	
P. symphyonemoides	X		
Rugulatisporites sp.	X		
Sapotaceoidaepollenites rotundus		X	
Stereisporites antiquasporites	X		
Todisporites sp.	X		
Triletes ornamentalis		X	
Tricolporites adelaidensis	X		
T. spp.	X	X	X
Verrucosisporites kopukuensis			X
Verrucatosporites sp.	X		
Tubulifloridites antipodica	X	X	
Milfordia sp. cf. *M. homeopunctata*	X		
Nothofagidites cf. *N. flemingii*	X		
Polycolporites reticulatus	X		
Microplankton			
Areoligera sp.	X		
Hystrichosphaeridium placacanthum	X		
Botryococcus sp. (fresh water)	X		
Cleistosphaeridium sp.	X	X	
"*Gymnodinium*" *australiense*	X	X	
Hystrichokolpoma rigaudae	X		
Leptodinium aff. *L. victorianum*	X		
Operculodinium sp.	X	X	
Pediastrum sp. (fresh water)	X		
Spiniferites ramosus	X	X	
Michystridium sp.	X		

DISCUSSION

Foraminiferal Evidence

<u>MT 6, 115 m</u>

Most of the planktonic forms are stratigraphically non-diagnostic. *Globigerinoides* sp. is no older than Early Miocene, and *Globigerina falconensis* should be no older than Zone N. 7 (Blow, 1969) late in the Early Miocene.

Escornebovina has not been recorded previously from Australia, but was described from the Early Miocene (Aquitanian) of Aquitaine, France (Butt, 1966; Berggren, 1971, p. 739). The upward limit of its range in Australia is not known.

Triloculina collinsi is large and well-developed. Its type locality (Carter, 1964) is the Balcombian stratotype at Fossil Beach, Balcombe Bay, Victoria, in the lower Balcombian below the *Orbulina* Datum. In the Murray Basin e.g. at Waikerie (Lindsay and Bonnett, 1973) the species ranges through the Murray Group only down to Finniss Clay equivalents or slightly below i.e. a lower limit of late Longfordian, Early Miocene. In the St. Vincent Basin (Lindsay, 1969, Fig. 6) the species as presently known is only recorded from the Munno Para Clay (Batesfordian - Balcombian, Early to Middle Miocene).

Sigmoilopsis lapidigera is likewise not known from below the Finniss Clay or the Munno Para Clay.

Carter (1964) noted the variant *Astrononion* aff. *centroplax* only from the lower part of the *Lepidocyclina* zone in Gippsland. At Mannum (Lindsay, 1968b) the form occurs up to basal Morgan Limestone; at Waikerie (Lindsay and Bonnett, 1973, p. 14) up to the *Lepidocyclina* zone; and at New Residence (Hd. Pyap; Lindsay, 1966) up to 9 m above the *Lepidocyclina* zone, in lower Morgan Limestone.

Pararotalia verriculata has an irregular final appearance along the River Murray between the *Lepidocyclina* zone and the Cadell Marl (Lindsay and Giles, 1973). It does not occur in any abundance above Finniss Clay at Waikerie, or above basal Morgan Limestone just below the *Lepidocyclina* zone at Morgan (Lindsay, 1968b; Lindsay and Giles, 1973). However, the sample from MT 30 at 94.5 - 96 m demonstrates that *P. verriculata* may occur in abundance with *L. howchini* in suitable facies.

The absence of *Sherbornina cuneimarginata* in appropriate facies is considered significant. It is restricted to the Longfordian (Carter, 1964) and ranges up to within Finniss Clay equivalents at Waikerie (Lindsay and Bonnett, 1973) to the top of Mannum Formation at Mannum and to the level of Finniss Clay at Morgan (Lindsay, 1968b).

The absence of *Cibicides vortex* Dorreen is also considered to be significant, and suggestive of post-Longfordian age (Lindsay, 1969, Fig. 6).

Thus only *Escornebovina* might suggest a Longfordian age although its upper limit is not known: the other foraminifera discussed above could all be as young as the lower Balcombian *Lepidocyclina* zone at the stratigraphic level of basal Morgan Limestone. A Batesfordian age is possible.

<u>MT. 30, 94.5 - 96 m</u>

The presence of *Lepidocyclina howchini* is the most stratigraphically significant feature of this microfauna. Lindsay and Giles (1973) showed that the *Lepidocyclina* zone in the western Murray Basin around the River Murray has a limited vertical extent of only a few metres, low in Morgan Limestone, and an age of early Balcombian, late Early Miocene or early Middle Miocene, on planktonic foraminiferal evidence (*Praeorbulina glomerosa curva* Zone). The present record of *Lepidocyclina* is the first from the northern margin of the Murray Basin and the associated foraminifera, though lacking diagnostic planktonic forms, do not indicate a different age. Diachronism seems to be minor, if present, but the lithology is more marly glauconitic and quartzose than basal Morgan Limestone of the Riverlands. The age of this sample need not be much different from that of the sample from MT 6 described above.

The nearest previous record of *L. howchini* is from A.O.C. North Renmark No. 1 Well (Ludbrook, 1963; Bureau of Mineral Resources, 1964) 160 km to the south, and by coincidence also at a depth of 94.5 - 97.5 m. The species was not found in Canopus No. 1 bore, in the northern Murray Basin, by Ludbrook (1961).

MT 30, 105 - 106.5 m

This sample represents a regressive, non-marine interval between transgressive marine episodes above and below. There is no direct faunal evidence of its age, but the ages of the marine episodes seem little different and the regressive interval must have been relatively brief.

MT 30, 126 - 127.5 m

The planktonic forms are not diagnostic. The benthonic assemblage has a Miocene aspect. The absence of typically Longfordian benthonic species *Astrononion centroplax* and *Sherbornina cuneimarginata* is regarded as significant. This, together with the presence of *Cibicides refulgens* and not *C. vortex*, suggests a post-Longfordian age.

On the other hand, this sample is from 30 m below the one with *Lepidocyclina* (probable early Balcombian) and is also separated from it by a regressive, non-marine interval. A Batesfordian age, in the later part of the Early Miocene, seems reasonable for that part of the sample which yielded the marine microfauna. No palynological preparation was made.

Tertiary clays with abundant siderite pelletal aggregates are known only from immediately over weathered bedrock in the Murray Basin (Lindsay, 1968a) the St. Vincent Basin (Lindsay, 1969, p. 30) and the eastern Eucla Basin (Lindsay and Harris, 1973). In each of these areas they underlie Eocene strata. However, age apart, the abundant siderite pellets suggest proximity to bedrock, as do the fragments of probable completely weathered phyllitic bedrock.

Palynological Evidence

The elements of the microfloras derived from onshore sources (spores and pollen) are essentially similar except that the sample from MT 30 at 105 - 106.5 m has a much reduced species number in comparison with the other samples. The organic residue of this sample consisted mainly of woody tissue and cuticle with few spores or pollen. Nevertheless this sample did not contain any marine elements (microplankton) and it is therefore entirely of non-marine origin. The other samples do, however, contain a varied microplankton component. The sample from MT 6 is more diverse but this reflects a more favourable biofacies. Two species *Pediastrum* sp. and *Botryococcus* sp., are derived from fresh water sources (e.g. rivers, creeks). The remainder of the microplankton assemblage is entirely marine.

Neogene spore-pollen sequences in Australia are not well documented although Harris (1971) and Stover & Partridge (1973) have proposed biostratigraphic schemes for this part of the Tertiary. The situation is complicated by regional differences in the floras, a feature that is not so apparent in earlier assemblages. Thus there are considerable difficulties in correlation between the Gippsland Basin and the Murray Basin.

In general terms the microfloras described here resemble those from the lower part of the Muddy Creek Marl in western Victoria (Balcombian, Middle Miocene; Wade, 1964, p. 281; Harris, 1971; Spencer-Jones, 1971) the Munno Para Clay from the St. Vincent Basin (Batesfordian - Balcombian, Early to Middle Miocene; Lindsay, 1969) and the Finniss Clay at Morgan in the Murray Basin (late Longfordian, Early Miocene; Lindsay, 1968b). The microplankton element however favours a correlation with the Balcombian or possibly Batesfordian Stage. In particular the species *"G." australiense*, is known only from the Munno Para Clay, and the Balcombe Clay (type Balcombian) at Balcombe Bay, Victoria. *H. placacanthum* has also only been recorded from the Balcombe Clay (Deflandre & Cookson, 1955). Cookson (1953) has recorded *Pediastrum* sp. from the Cootabarlow Bore in what is now interpreted as basal Etadunna Formation, and from Werona, Victoria (?Late Tertiary). The genus is also frequent in the Munno Para Clay, and in the basal clays of the Etadunna Formation in the Great Artesian Basin. Thus the evidence from palynomorphs favours a correlation with the Balcombian and possibly Batesfordian Stage. The assemblages described here probably correlate with a late *Proteacidites tuberculatus* zone - early *Triporopollenites bellus* zone of Stover & Partridge (1973) in the Gippsland Basin or part of the *Acacia* microflora of Harris (1971) in the Otway Basin.

STRATIGRAPHIC CONCLUSIONS

Only rotary cuttings are available, and their proneness to down-hole contamination precludes confident demarcation of lithology and biostratigraphy. However the middle sample from MT 30 is significantly different from the others, lacks a microfauna, and is apparently not spoilt by downhole contamination. The marine microfaunas and the microfloras are internally consistent.

The *Lepidocyclina howchini* zone is noteworthy in borehole MT 30 at 94.5 - 96 m, and extends the known occurrence northwards from the Riverlands to the northern margin of the Murray Basin. Diachronism, if present, appears to be only minor, so that the same age probably applies viz. late Early Miocene or early Middle Miocene, as concluded by Lindsay and Giles (1973) for the Riverlands exposures. Elements of the associated microfloras from the Mutooroo area provide links in turn with the non-marine Etadunna Formation of the Frome Embayment north of the Olary Ridge.

The non-marine regressive sand in MT 30 at 105 - 106.5 m is intercalated between marine units above and below of probable early Balcombian and Batesfordian age respectively. The sand therefore represents a regressive episode of relatively short duration probably late in the Early Miocene. It is a distinct unit that is not correlated either with Renmark Beds, or with the Knight Formation of the Gambier Embayment.

Clay, with abundant siderite pellets, and fragments of weathered phyllitic rock, in the lowest sample from MT 30,suggest proximity to bedrock and imply that no other marine episodes intervene.

The marine sample from MT 6 at 115 m does not correspond exactly with either of the two marine samples in MT 30 but is of similar age. It has microfaunal characteristics which in part are probably due to slight difference in stratigraphic level e.g. the absence of *Lepidocyclina howchini;* and in part could result from different depositional environment e.g. the presence of common miliolids *(Quinqueloculina vulgaris, Triloculina collinsi)* together with *Amphistegina lessoni* and slightly more diverse planktonic foraminifera. However the microfloras are essentially similar, with only local biofacies variation. Examination of series of samples (preferably including cores) from both bores would be needed for more precise correlation between them.

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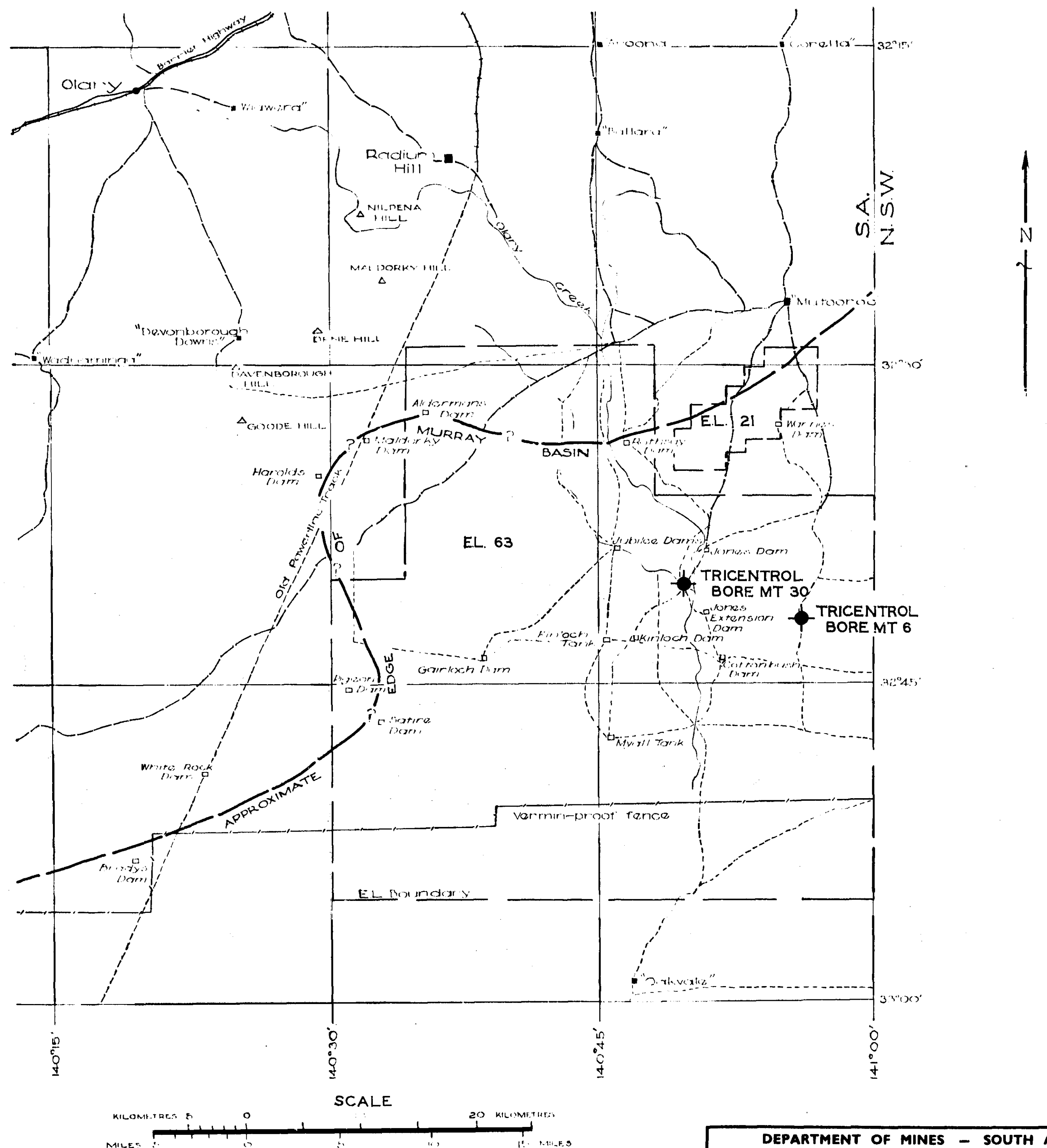

LEGEND

Main road
Secondary road
Track
Creek

DEPARTMENT OF MINES – SOUTH AUSTRALIA			
NORTHERN MARGIN OF MURRAY BASIN TRICENTROL BORE MT 30 AND MT6 LOCALITY PLAN			
PALAEONTOLOGY SECTION	GEOLOGIST	Drn. J.M.E.	SCALE: 1:250 000
		Ted.	73–744
		Ckd.	
Director of Mines		Exd.	DATE: