REPORT ON SPECIALIST GROUP IN SEDIMENTOLOGY, ROBE FIELD CONFERENCE, 1973

by

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and

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South Australia —

DEPARTMENT OF MINES
SOUTH AUSTRALIA

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ABSTRACT

The 1973 Robe Field Conference of the Specialist Group in Sedimentology comprised informal lectures on carbonate deposition and the role of algae in carbonate precipitation in volcanic lakes of western Victoria, supratidal dolomites of Queensland, sedimentology of the Naracoorte Cave deposits, tectonic structures in Quaternary aeolianites of Victoria, and sea level changes during the Pleistocene. Field excursions were held to Lake Fellmongery at Robe, Quaternary shell beds south of Robe, the aeolianites and younger soil with midden exposed at Nora Creina, stranded beach ridges north of Robe, the section through Quaternary sediments (aeolianite with marine ingressions flanked by onlapping lacustrine marls) exposed in Drain L, and the Coorong. The Coorong lakes variously contain dolomite, aragonite, calcite and magnesite muds; algal mats are common in some. One contains dolomite pellets. The section exposed in Salt Creek reveals a marine transgressive shelly conglomerate truncating aeolianite.

INTRODUCTION

Following a decision by the Specialist Group in Sedimentology that the 1973 meeting should take the form of a field conference in the south-east of South Australia, approval was given for the authors to attend as Departmental delegates. The conference programme comprised six somewhat informal lectures on Sunday, 11th and Monday, 12th February, with field excursions on those days and also on Tuesday, 13th. The following account is a summary of the notes and field observations taken during the conference.

Localities visited are numbered as shown on locality maps 1 & 2.

NOTES ON LECTURES AND EXCURSIONS

Sunday, 11th February

Lakes and Carbonates in South-Eastern Australia

by J. Bowler (Australian National University)

Lake Keilambete, a circular lake about 1.5 km in diameter, centred 3 km north-west of Terang, Western Victoria, occupies a depression of volcanic origin. The lake sediments were being studied to determine the nature of the carbonates, the origin of the dolomite and their relationship to palaeohydrology.

The carbonate occurs in three physical forms: clay-sized lake muds, lacustrine ooids, and platy limestones from the lake margin. Dolomite occurs in all three sediment types, formed by the uptake of magnesium by aragonite.

Hydrologically, the lake is closed; terraces around the rim indicate former higher water levels, the level having dropped about 20m since the beginning of the century. The oldest sediments encountered in the lake, the Keilambete Sands, were dated at 29660 years. Near the top they contain interbedded white marls. The lake dried after the deposition of the sands, and residual salts were considered to have been flushed out. A fossil soil overlying the sands was dated at 20,500 years. The soil is disconformably overlapped by the Recent carbonate sediments.

All known modern ooids originate as aragonite. The ooids of Lake Keilambete now consist of high magnesium calcite or dolomite, suggesting that the dolomite forms by replacement of aragonite. The ooids are 0.2 mm in diameter, and show both faint radial and concentric structure. They have foreign nuclei. The platy limestones occur only at the lake margins, wedging out under water. That they originate from originally soft lime muds is indicated by a dropped

boulder which deformed the underlying sediment; the muds were then indurated. No dolomite is known from the lower part of the sequence; in the upper part dolomite content fluctuates, the beds with high dolomite content correlating with low water levels indicated by interbeds of beach sands. The associations of carbonate minerals indicate the paths followed in dolomitization; thus low and high magnesian calcite may coexist, or dolomite and low magnesian calcite, or aragonite and calcite, showing that dolomite formed from calcite inverted from aragonite. Aragonite appears to be preserved only in the presence of organic material.

Biological Activity and Carbonates in Lakes

by J. Dodson (Australian National University)

Lake Gnotuk, near Camperdown, is a lake similar to Lake Keilambete. Carbonate deposits occur on all rock surfaces up to 16 m above the present lake surface. The carbonate consists of aragonite deposited within the tubes of the green alga Enteromorpha nana, but the aragonite has been progressively changed to calcite in the upper parts of the exposed deposit. The green and red algae, and one genus of brown algae (Padina) are known to precipitate aragonite. Certain plants may photosynthesize under high pH ($\sim$10), using HCO_3^- which occurs rather than $CO_3^=$ under these conditions. The pH was shown to be higher inside the tubes than outside, and the aragonite is thus organically precipitated within the plant.

Excursions to features near Robe

(Locality 1)

The Chara swamp at Robe contains the fibrous white calcareous remains of Chara in the uppermost 5cm, overlying pale grey calcareous muds with gastropods and Chara fibres.

The adjacent Lake Fellmongery (Locality 2) was the subject of C.S.I.R.O. investigations into the behaviour of base metal ions in natural carbonate precipitates in the presence of bacterially generated sulphide. All base metal concentrations were very low, however, but an interesting side-light was the discovery of monohydrocalcite ($CaCO_3H_2O$) beach rock (Pl.1a). The limestones fringing the lake are of algal origin, and have become indurated where exposed high on the beach.

Beach ridges almost parallel to the present coast line of Guichen Bay were observed about 4 miles (6 km) north of Robe, (Locality 3). Sprigg (1952) recorded "more than 80" beach ridges stranded across a width of about 6 miles (9 km). Sea level is thought not to have varied greatly during the formation of these essentially aeolian ridges.

South of Robe, on the Nora Creina road, a roadside pit (locality 4) was examined. The exposed sub-Recent shell beds (Pl.2a) were formed during the last marine transgression in an interdune lagoon. The beds consist of stratified bivalves (including oysters) and minute gastropods. At Nora Creina Bay, (Locality 5), coastal exposures of the cavernous aeolian calcarenites were examined (Pl. 1c). An ancient kitchen midden is exposed in the coastal cliff above the aeolian limestones. (Pl.1b).

Monday 12th February

The Drain L Section

A section through the Woakwine Range dune (Pl.2b) and the lagoonal sediments to the east is exposed in the drain L cutting, (locality 6) as described by Sprigg (1952) and Hossfeld (1950). Aeolian calcarenite alternates with up to three thin beds of coarse calcareous sediments, including conglomerates

with flint and calcrete pebbles mixed with marine molluscs (Pls. 2c,3a). A truncation of the calcarenite by these very near-shore marine sediments was observed near the base of the exposure (Pl.1d). To the east of the Woakwine Range, the cross-bedded aeolianites are overlapped by lagoonal sediments, (locality 7). Just below this contact, an interbed of Anadara and oyster deposits was seen overlying eroded cross-bedded cemented aeolianite (Pl.4a).

The onlapping lagoonal sediments are banded pale grey marls (Pl.3b) with abundant Coxiella, a small turreted gastropod characteristic of hypersaline environments. The upper surface of the calcarenite is erosional and karst-like, with a dark brown peaty fossil soil developed on it. The marls overlie this soil (Pl.4b). The basin floor is seen to undulate across this section towards locality 8.

A small lake, (locality 9), east of Lake Hawdon is fringed at its eastern margin by a gypseous lunette, composed of very fine floury sediment, devoid of sedimentary structures. J. Bowler suggested that such an aeolian feature forms on the leeward side of a lake by successive draping of layers to build up a mound, not by typical aeolian foresets.

Supratidal Dolomites

by P. Cook, Bureau of Mineral Resources

Supratidal dolomites, found in such carbonate-depositing areas as the Bahamas, Persian Gulf, are rare in Australia. The dolomite described here is formed in Broad Sound, Queensland, in an estuarine complex, but it is not abundant. The muds are mainly terrigenous, often with a thin veneer of algal mats. Eh, pH and concentrations of Mg, Ca, K, PO_4 and base metals in pore waters were measured. Sea water has an Mg/Ca ratio of about 3:1, but in the pore waters, it is as high as 6 to 7:1. Gypsum is precipitated leading

to a reduction of Ca, which produces ideal conditions for dolomitization. Calcareous concretions, at least 2800 years old, are known in one area, and these show an increase in dolomite content towards the margins, suggesting that dolomitization has taken place. The Broad Sound dolomite has an Mg content intermediate between normal dolomite ($Ca_{50}Mg_{50}$) and high magnesian calcite ($Ca_{75}Mg_{25}$); it thus bridges what was thought to be a miscibility gap.

Naracoorte Cave Deposits

by K. Moriarty, Flinders University

The fossiliferous Naracoorte Cave occurs at the boundary between the Miocene Naracoorte Limestone and aeolianite. The cave apparently formed during a higher sea level. Vertical collapse holes are thought to have been entrances where animals had fallen in. The sediments are partly cross bedded sands and clays thought to have been derived from an ancient soil, and are nearly 5 m deep in places. Fossil remains include those of Diprotodon, kangaroos and a bird typical of alpine conditions.

Tectonic Structures in Quaternary Aeolianites

by O.P. Singleton, University of Melbourne

This talk was chiefly an illustration with colour slides of tectonic meso-scale folds in aeolianites from Victoria. These occur in addition to sedimentary structures such as cross-bedding with very thick foresets, and fluted surfaces of uncertain origin. The folds are displayed as kinks in the more highly cemented laminae. The kinking appears to be related to a nearby major fault, and is visible as a series of steeply kink bands. Vertical en echelon fractures were also seen.

Dunes and Sea Level Changes

by B.G. Thom. (Australian National University)

This was a suggestion of possible correlations between the various members of the dune system and periods of high sea-level during the Pleistocene as recorded in the Northern Hemisphere. The Robe dune might, for example, be about 60,000 years old (early Wisconsin) and the Avenue Range dunes, further inland, over 250,000 years (Kansan-Nebraskan).

Tuesday, 13th February

Excursion to the Coorong lakes

Outcrops of ?Palaeozoic granite with very coarse feldspar phenocrysts and metasedimentary xenoliths were examined briefly at "The Granites" beach, (Locality 10).

At locality 11, where a causeway in the old road crosses the lagoon 6 km south of "Cantara", the magnesian calcite and dolomite lake sediments were examined. A hole 45 cm deep revealed several alternations of sand and shell beds below the top 15-20 cm of lagoonal carbonate muds. It was suggested that the molluscan shell beds, frequently with articulated valves, represented an environment more like that of the open lagoon in the north of the Coorong, and that the environment has since become progressively more restricted.

The small dolomite lake at locality 12 is flanked by indurated slabs around the exposed margin (Pl.51), overlying dolomite mud. Above these lithified areas again, there is a narrow band of very thin partly dehydrated wrinkled algal mats. The elongated lake immediately to the north contains hydromagnesite sediment and isolated areas of algal mats; in addition to the promontory described by Walter, Golubic and Preiss (in prep.), small areas of crenulated and globular mats (Pl.6a) were noted along the

southern margin of the lake, and partly exposed on its shore (Pl.5a) The development of the crenulated morphology on mud-cracked polygons was well displayed. Algal mats (only the stratiform variety)also occur in the lake at locality 14, but here the stromatolites which were formed several years ago have been subjected to continuous erosion and burrowing, and have now been almost totally destroyed. The turbidity of the lake on this particular day prevented examination of the newer algal mats growing on the lake floor.

Time did not permit more than cursory examination of the halite precipitating lagoon (locality 15) and the adjacent dolomite and magnesite lake (locality 16) but the latter contains dolomite pellets on its eastern shore (locality 17). The lake surface is covered by an alternating sequence of pellets and laminated carbonate muds, the uppermost layer of which is a 5 mm thick flat algal mat. (Pl.6b). This sequence has apparently overlapped older pelletal beds which are now exposed only at the lake margin.

A section through a transgressive sequence is well exposed in Salt Creek, several hundred metres upstream from the Ranger's homestead (locality 18). The cross-bedded aeolian calcarenite is overlain with erosional contact by a transgressive pebbly shell bed. (Pl.7b). Possible solution holes in the upper surface of the calcarenite are also filled with shelly conglomerate (Pl.7a). The basal transgressive layer passes upwards into finer, cross bedded shelly calcarenite, and then flat bedded calcarenites. We were unable to observe the relationship between this transgressive unit and the aeolianite of the ridges to the north and south of Salt Creek. Therefore it is not known whether the transgressive unit post-dates the formation of the dune ridges, or represents a marine intercalation during aeolian deposition.

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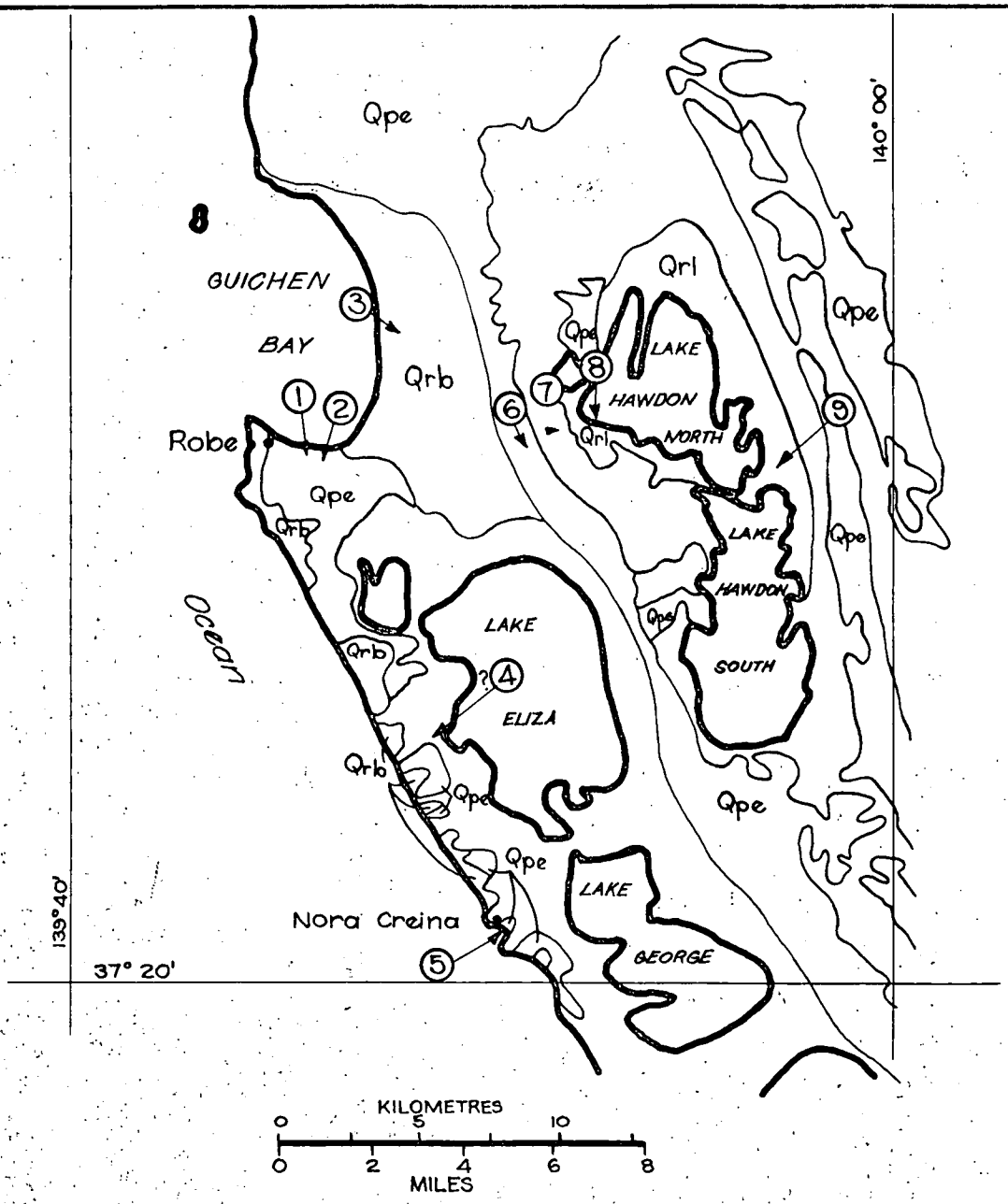


Qrb (Shown near Guichen Bay only) Beach ridged calcareous and siliceous dune sands.

Qpe Aeolianite limestone - Bridgewater Formation.

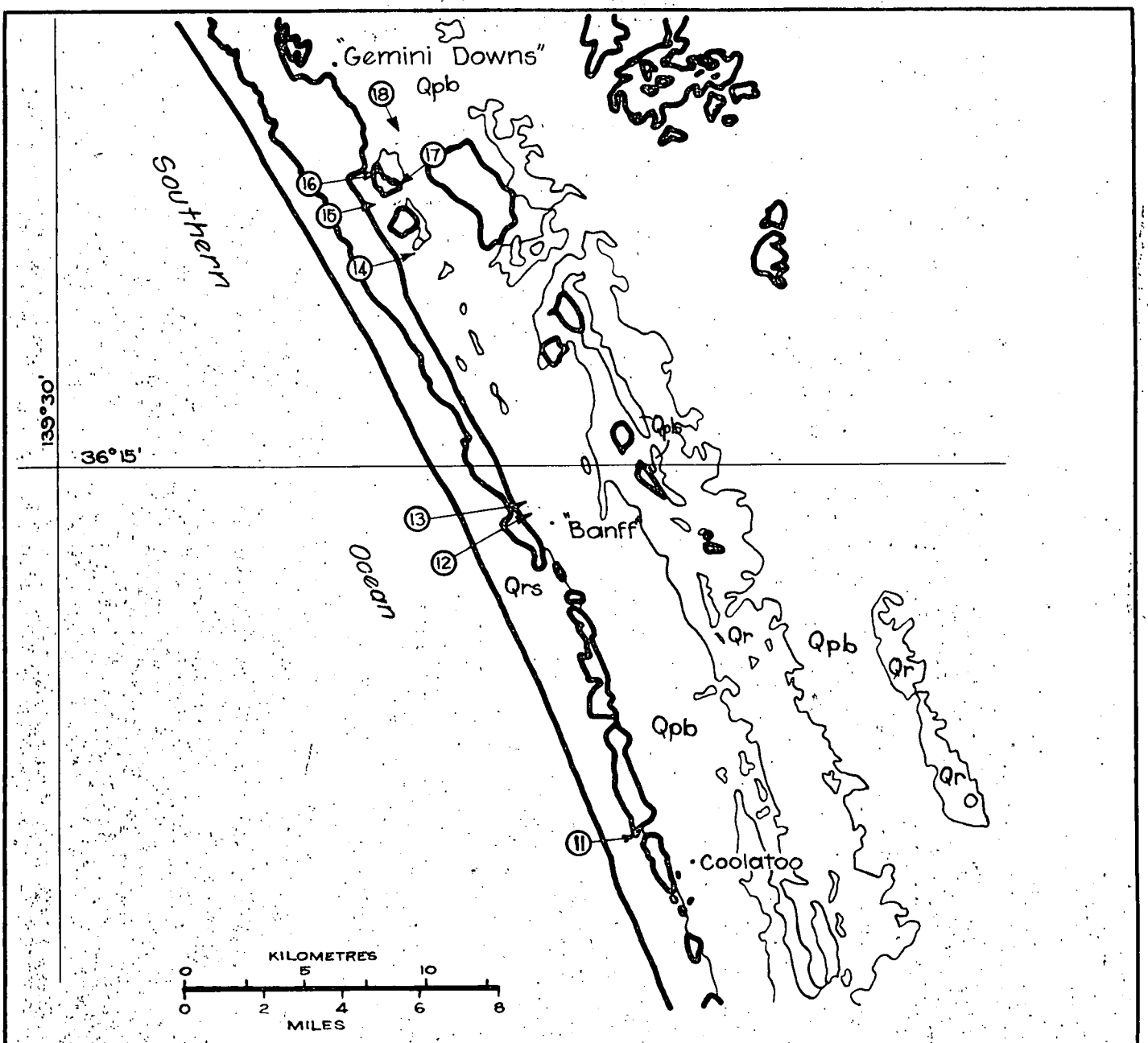
Qrl Lacustrine marls.

① Locality number.

Based on PENOLA 1:253 440 geological map (R.C. Sprigg 1951)

	DEPARTMENT OF MINES — SOUTH AUSTRALIA	Scale: 1:253 440
Compiled: B.G.F.	LOCALITY MAP 1 SEDIMENTOLOGY FIELD CONFERENCE ROBE	Date: 8·3·1973
Drn.S.J.C. | Ckd.		Drg. No. S10161 Ke

300—6,72 C5552



Qrs Dune sand of Younghusband Peninsula.

Qr Interdunal deposits, partly lagoonal carbonates.

Qpb Aeolianite and shallow marine limestone - Bridgewater Formation.

⑫ Locality number.

Based on NARACOORTE 1:250 000 geological map (K.A. Rochow 1969)

	DEPARTMENT OF MINES — SOUTH AUSTRALIA	Scale: 1:250 000
Compiled: B. G. F.	LOCALITY MAP 2	Date: 8·3·1973
Drn. S.J.C. Ckd.	SEDIMENTOLOGY FIELD CONFERENCE ROBE	Drg. No. S10162 Ka

300—6.72 C5552

PLATE I

(a) Indurated monohydrocalcite limestone on eastern shore of Lake Fellmongery, Robe.

(b) Soil horizon with midden at foot level between cavernous aeolian calcarenite and overlying younger dune sands, Nora Creina Bay.

(c) Cavernous weathering in aeolian calcarenite, Nora Creina Bay.

(d) Intercalation of shelly conglomerate representing marine transgression in cross-bedded aeolian calcarenite, Drain L section.

PLATE 1

(a) Neg. No. 23150

(b) Neg. No. 23143

(c) Neg. No. 23124

(d) Neg. No. 23128

PLATE 2

(a) Stratified shell bed, approximately 11 km south of Robe, representing a marine transgression into an interdune corridor.

(b) The Drain L section through the Woakwine Range, showing cross-bedded aeolian calcarenite.

(c) Shelly conglomerate with flint and calcrete pebbles, intercalated in aeolian calcarenite, Drain L section.

PLATE 2

(a) Neg. No. 23121

(b) Neg. No. 23129

(c) Neg. No. 23127

PLATE 3

(a) Loose block showing contact between conglomerate and cross-bedded aeolianite, Drain L section.

(b) Banded lacustrine marls overlying weathered surface of aeolianite, Drain L section east of Woakwine Range.

PLATE 3

(a) Neg. No. 23125

(b) Neg. No. 23131

PLATE 4

(a) Anadara and oyster bed overlying weathered aeolianite, east of Woakwine Range, Drain L section.

(b) Banded lacustrine marls with Coxiella, overlying a peaty soil developed on weathered aeolian calcarenite, Drain L section.

PLATE 4

(a) Neg. No. 23130

(b) Neg. No. 23132

PLATE 5

(a) Exposed and partly eroded algal mats, southern margin of hydromagnesite lake, 16 km south of Salt Creek.

(b) Indurated beach rock on shore of the same lake.

PLATE 5

(a) Neg. No. 23157

(b) Neg. No. 23156

PLATE 6

(a) Globular algal mats, southern margin of the same lake as in Pl.5.

(b) Flat laminated algal mat overlying dark grey pelletal dolomite, 2 km south of Salt Creek.

PLATE 6

(a) Neg. No. 23158

(b) Neg. No. 23160

PLATE 7

(a) Indurated shell bed with transgressive basal pebbly conglomerate, overlying and filling cavities in cross-bedded aeolian calcarenite, Salt Creek section.

(b) General view of Salt Creek section, with cross-bedded calcarenite at night, overlain by shell beds, well stratified in the upper part of the section.

PLATE 7

(a) Neg. No. 23133

(b) Neg. No. 23134