CONFIDENTIAL REPORT.

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

REPT.BK.NO. 85/19

FORAMINIFERAL BIOFACIES ANALYSIS OF RECENT SEDIMENTS FROM TOURVILLE BAY, NEAR CEDUNA, S.A.

- PRELIMINARY REPORT -

GEOLOGICAL SURVEY

by

KAREN LABLACK
BIOSTRATIGRAPHY

APRIL, 1985

DME.142/83
Biostrat Rept.No. 1/85

CONTENTS | PAGE

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

REPT.BK.NO. 85/19
DME NO. 142/83
BIOSTRAT
REPT NO. 1/85
DISK NO. 6

FORAMINIFERAL BIOFACIES ANALYSIS OF RECENT SEDIMENTS FROM TOURVILLE BAY NEAR CEDUNA, S.A. - PRELIMINARY REPORT

ABSTRACT

Thirteen samples of sediments were studied, representing the top 2 cm of vibro-cores from a variety of environments around Tourville Bay. Facies include: intertidal to subtidal sand flat, intertidal mudflat, back-beach ridge, tidal channel, mangrove, and supratidal samphire flat. Relative abundances of foraminifera were determined for the 0.125 - 0.25 mm sediment size fraction. Foraminiferal distribution patterns give an approximate indication of ecological conditions and sedimentary environment.

INTRODUCTION

An understanding of present sedimentary facies and patterns of foraminiferal distribution is essential if any interpretation of these features in more ancient sediments and rock sequences is to be attempted. Also, in order to study the sedimentological history of Tourville Bay, it needs to be investigated to what extent foraminiferal associations relate to particular sedimentary environments. The first step has been to look at the most recent foraminiferal relationships with sedimentological facies. This will be followed by a study of whether any of these relationships can be used reliably to interpret sedimentary facies changes downhole.

PHYSICAL FEATURES

Tourville Bay is an embayment on the west coast of South Australia, located about 15 km west of Ceduna, at longitude 133°20' - 133°33'E, and latitude 32°05' - 32°10'S (Fig. 1). The embayment is defined for most of its perimeter by the margins of an eroded calcrete surface of the upper Glanville Formation

(Fig. 2). The underlying softer Bridgewater Formation calcarenites are often seen to be eroding preferentially, causing undermining, collapse, and retreat of the Glanville pavement. The calcrete pavement is consistently found to have an elevation of approximately 2 m above present mean sea level (A.P. Belperio, SADME, personal communication, Jan. 1985) in contrast to other known Pleistocene 'sea levels' around the world which show averages of between 1 and 6 m (Hails, Belperio and Gostin, 1984). The Glanville Formation represents marginal marine or shallow estuarine sedimentation of the Late Pleistocene, and forms the basal surface upon which Holocene sediments rest within the embayment. Channels and banks could well be relict features of Glanville times. Davenport Creek could be a persistent channel from the Pleistocene. An extensive area to the northeast behind Nardia landing was once Glanville supratidal flat, and it is also unlikely that any tidal waters now reach this area.

In Tourville Bay, sediments are controlled predominantly by tidal movements. Being a relatively sheltered region, only small wind-generated waves are active, and ocean swell and surf are not transmitted into the bay. The general direction of incoming wave and wind energy tends to be from the southwest (the bay opens to the southeast). The sheltered nature of the embayment and mesotidal range has led to a series of tidally-determined facies developing (see facies descriptions). A low relict surface exists within the embayment ranging from subtidal to high supratidal zone. Deeply incised tidal channels (up to one or two metres deep) permit the main tidal influx, and extend up into shallow (~10 cm) channels of the mid supratidal region conveying very high to storm-tidal flows.

Most of the bay is flushed with normal marine to slightly hypersaline waters and temperatures are warmer than ocean waters due to the aridity of the area and the shallowness of the bay. There is no apparent fresh-water inflow but rainfall may be responsible for the wetting of supratidal zones, and depending on the accumulated salts, they may be hypersaline to hyposaline. Seepage of underground water, either from the hinterland or from marine waters (depending on the flux situation), may also be responsible for dampness in high supratidal zones.

PREVIOUS WORK AND ACKNOWLEDGEMENTS

Few studies have been carried out in South Australia on Recent foraminifera. J.H. Cann and J.M. Lindsay have offered invaluable advice on identification of foraminifera: J.M. Lindsay checked and extensively edited this report. A.P. Belperio (in Belperio *et al.*, 1983; in Hails *et al.*, 1983; personal communication) is currently working on sedimentological studies of South Australian coastal regions, and has been extremely helpful on related matters. Parr (1932a,b; 1945), Albani (1968, 1979), Howchin and Parr (1938), Belperio and Murray-Wallace (1984), McKenzie (1962), Chapman and Parr (1935), Chapman (1941), Betjeman (1969), Collins (1958), and Quilty (1977), have been useful references as background for Australian conditions and faunas. Other authors such as Barker (1960), Murray (1971, 1973, 1976), Boltovskoy and Wright (1976), Cushman and Leavitt (1929), Hansen and Lykke-Anderson (1976), Lindsay and Harris (1973), and Rose and Lidz (1977), were referred to when identifying foraminifera and comparing their distribution patterns. Butler *et al.* (1977) have documented South Australian mangrove environments.

SAMPLING

Thirteen vibro-cores had been taken previously by A.P. Belperio across intertidal and supratidal environments in Tourville Bay. Only the top 2 cm of sediment from these holes were used in this study. The following table lists vibro-core hole numbers, and the present environment of each site (see also Fig. 3).

TABLE 1

VC 60:	Offshore sea-grass bank (exposed at low tide).
VC 61:	Tidal sand flat; may have *Zostera* adjacent to it.
VC 62:	Beach face in front of mangroves.
VC 111:	Tidal creek bank within mangroves.
VC 110:	Tidal creek bank in samphire zone.
VC 83:	Relict beach ridge; halfway up seaward face.
VC 84:	Supratidal flat (Glanville Formation flats).
VC 63:	Mangrove/tidal flat boundary.
VC 64:	Up a tidal creek; just in mangroves.
VC 65:	Up a tidal creek; in samphire zone.
VC 77:	Supratidal salt pan.
VC 78:	Supratidal salt pan; with small tidal creek nearby.
VC 81:	Mangroves being engulfed by mobile aeolian sand dunes (top 10 cm of this sand).

DESCRIPTION OF SEDIMENTARY ENVIRONMENTS ENCOUNTERED AT TOURVILLE BAY

1. Subtidal environments

No samples were taken from these areas and only a general description can be given. Sea grasses are present, as is evident from the airphoto and from seaweed on the beaches. Deep tidal channels within mangrove-forested areas were seen to have grasses growing in them.

2. Sand flats

These are found in intertidal to subtidal areas where currents are strong enough to permit sorting of the sands. Megaripples covered with minor ripples constitute mobile sand flats in these areas.

3. Mud flats

These comprise areas where lower energy regimes exist and which often show colonisation by *Sarcocornia quinqueflora* mounds and young mangroves. Disarticulated shells of *Katelysia* spp. lie convex up, and are covered with algae. Rich algal floras exist just below the surface, stabilising the mud; and the poorly sorted sediments are strongly bioturbated.

4. Back-beach ridges

Platforms exist that are elevated above the high tide mark by about 30 cm. These can consist of bleached and damaged *Katelysia* shells, and banks of storm-deposited seaweeds. The bank may be backed by a beach ridge of wind blown sand that is stabilised by primary salt-tolerant vegetation such as is common in coastal successions. The shelly platforms may be bypassed, in which case high tide mark may be backed immediately by seaweed banks and back-beach dunes.

More than one dune may exist, aligned approximately parallel to the present beach, but variations can indicate a shift of the beach front with progradation of the coastline.

Beach ridges which formed early in the Holocene show where former beaches existed prior to the formation of a major 'peninsula' east of Nardia landing by the development of sand ridge, supratidal and mangrove areas.

5. Tidal channels

These may be one or two metres deep where they enter mangrove marshes, and they meander up into the mid-supratidal area. The development of the meanders creates a facies of its own, comprising fine sand and mud with a notable amount of organic matter (seaweed and algae) matting the sediment. Small ridges develop on the margins of the channels, behind which muds accumulate at the top of the sequence.

6. Mangroves

Mangroves (*Avicennia mariana*) closely follow the tidal creeks (eastern Tourville Bay), or may form woodlands (western Tourville Bay) in the low intertidal zone. Sediments tend to be mainly fine-grained, but coarser material from tidal channels also accumulates. Oxidation is promoted by the 'root' systems of the trees, and by extensive bioturbation.

7. Mid and upper supratidal zones - Samphire zone

The absence of mangroves as defined by tidal range marks the beginning of this region, on flats behind the mangroves. Very high tides and storm surges may reach this area. *Sclerostegia arbuxula* dominates in bushes ~1 m high in the wetter areas, ranging down to ~10 cm high in the very driest supratidal zones. Salt pans, bare of vegetation except for algal mats, are common. Fine silts and clays are commonly deposited along with windblown material.

PROCEDURES

Samples from the top 2 cm of Tourville Bay vibro-cores were collected and prepared for foraminiferal work. The samples were first washed free of clay and silt-sized material. Foraminifera were then concentrated by flotation, using carbon tetrachloride. The floated fraction was sieved into five size-grades: >1.0 mm, 1.0-0.5 mm, 0.5-0.25 mm, 0.25-0.125 mm, and <0.125 mm.

A floated and sized fraction was sprinkled over a gridded tray and all foraminifera were picked from squares chosen at random. Picking ceased when a minimum of 250 specimens were collected from totally picked squares. Faunas were sorted into groups to at least family level, and often to species level.

Specimens were counted. Any group constituting more than 5% of a fauna was considered not to be rare. Dominant groups comprised 20% or more. Groups comprising less than 5% were usually combined together as 'others'. Results for the fraction 0.25-0.125 mm are shown in 'pie diagrams' in Figure 3.

High magnification photography using a scanning electron microscope (SEM) was attempted for identification and taxonomic records, but due to difficulties in obtaining high resolution pictures, this technique has been postponed until later in the year.

INTERPRETATION OF RESULTS

J.H. Cann (Univ. of Adelaide, personal communication, Dec. 1984) has shown that patterns of relative abundance of foraminifera can be traced in different size fractions to yield information on the depth of deposition of the associated sediment. I am yet to establish facies relationships in this manner. The acute shortage of faunas in some size fractions has meant that only one comparison can be made at present, namely in the 0.25-0.125 mm fraction.

Murray (1973,1976) has suggested the physical environmental limits of various living genera. Based on this, some detail can be determined on the environments in which the living faunas thrived. Murray (1976) showed that there is a high correlation between the relative abundances of living and total assemblages for marshes, lagoons, and deltas, and hence it is reasonable to attempt to apply the same limits here. Complexities in interpretation arise where there are other species which although not dominant, form a sizeable percentage of a fauna. These must also be considered. Low diversity, common to all cores, can be recognised as a marginal-marine phenomenon.

Foraminiferal facies recognised

1. Dominant Miliolidae (*Quinqueloculina* spp. and *Triloculina* spp.)

Represented in VC 77, VC 110, VC 61, VC 65.

'Hypersaline (>32 parts per thousand) sandy sediment and vegetation, temperate, 0-40 m, inner shelf, normal marine, hypersaline lagoons'.

VC 77 has a large *Elphidium* component >VC 110 >VC 65 >VC 61 which has *Discorbis* sp. approximately equal to *Elphidium* sp. in abundance. *Discorbis* suggests normal marine conditions, presence of vegetation, 0-50 m depth. *Elphidium*, keeled (e.g. *E. crispum*), suggests 35-50 parts per thousand salinity, temperatures >15°C. *Elphidium*, unkeeled (e.g. *E. articulatum*), suggests 0-70 parts per thousand salinity, temperatures 1-30°C, sediment and vegetation controls. Common denominators seem to be vegetation and sediment, depths of 0-40 m, and temperatures of 15-30°C. The variation in secondary faunas may be due to the range of salinity from normal marine (32 parts per thousand) in VC 61 to hypersaline in VC 77. This correlates with the expected interpretation since VC 77 and VC 110 are in the mid to high supratidal zone, and VC 65 and 61 are subject to more consistent tidal flushings.

2. Dominant *Discorbis*

Associated with *Discorbis*-dominant samples are notable numbers of *Reussella* sp., *Bolivinella folia*, and *Cibicides* sp. VC 81, VC 62, VC 111, and VC 60 show this pattern and these conform to normal marine conditions as predicted. VC 81 contains faunas windblown from the marginal oceanic sediments. VC 111 shows good tidal flushing to achieve normal marine conditions. *Discorbis* faunas seem to correlate with normal marine zones.

3. Dominant *Elphidium*

Elphidium-dominant samples show a range from predominant *E. articulatum* to predominant *E. crispum*. Thus, VC 78 is dominantly *E. articulatum* with only rare *E. crispum*; VC 84 shows large percentages of both; VC 63 shows lower percentages but approximately equivalent numbers; VC 83 and VC 64 show *E. crispum* dominant, *Discorbis* sp. significant, and low *E. articulatum*.

These last two samples seem to be associated with close to normal marine conditions, with less *Discorbis* in the more hypersaline extremes.

CONCLUSIONS

For the present, a rough indication can be obtained from the foraminiferal distribution patterns as to the ecological conditions of the environment at Tourville Bay. Further work on more samples recently collected should clarify any associations.

Most of the samples may be grouped according to interpreted salinity of depositional environment, as follows:

Normal marine: VC 81, VC 60, VC 62, VC 111;

Slightly hypersaline: VC 64, VC 83;

More hypersaline: VC 78;

Hypersaline: VC 77, VC 110, VC 61, VC 65.

The emerging pattern of foraminiferal distribution appears to have some indirect correlation with sedimentological facies. Increasing hypersalinity seems to be directly proportional to the degree to which the region is flushed by tidal movements and hence the type of sedimentological facies that is deposited. Perhaps then, the foraminiferal pattern may be a much more sensitive indicator than the broad facies patterns that have been suggested. However, foraminiferal distributions are known to vary considerably within small areas, so a margin of error may exist.

PROBLEMS FOR FURTHER INVESTIGATION

1. Species identification: Use of SEM facilities should help clarify most of the difficulties encountered.

2. Reworked faunas: Further sampling of Recent sediments associated with Pleistocene rock outcrops will be examined in terms of what is being reworked from the Pleistocene and what indications of this are evident. Also it is hoped that the source of well-rounded specimens of foraminifera will be found by means of these samples.

3. Species variation: SEM photography will enable study in closer detail of the extreme amounts of variation seen in species such as *Discorbis dimidiatus*. Only then can accurate range charts and relative abundances be determined.

4. Limited faunas in >0.25 mm size fractions: Larger samples collected on a recent field trip to Tourville Bay should permit comparisons of these size fractions as in Figure 3.

Karen Lablack

Karen Lablack
Student Geologist
<u>Biostratigraphy Branch</u>

REFERENCES

Albani, A.D., 1968. Recent Foraminiferida from Port Hacking, New South Wales. *Contr. Cushman Fdn foramin. Res.*, 19:85-119.

Albani, A.D., 1979. *Recent Shallow Water Foraminiferida from New South Wales*. Handbook No. 3, Australian Marine Sciences Association, Sydney.

Barker, R.W., 1960. Taxonomic notes on the species figured by H.B. Brady in his 'Report on the Foraminifera dredged by H.M.S. *Challenger* during the years 1873-1876'. *Spec. Publ. Soc. Econ. Paleontol. Mineral.*, 9.

Belperio, A.P., Hails, J.R. and Gostin, V.A., 1983. A review of Holocene sea levels in South Australia. *In:* Hopley, D. (Ed.), *Australian Report for IGCP 61*, Monograph Series, Occasional Paper No. 3, James Cook University of North Queensland, pp. 37-47.

Belperio, A.P. and Murray-Wallace, C.V., 1984. Comment: Wardang Island - A refuge for *Marginopora vertebralis*? *Trans. R. Soc. S. Aust.*, 108:227-228.

Betjeman, K.J., 1969. Recent foraminifera from the western continental shelf of Western Australia. *Contr. Cushman Fdn foramin. Res.*, 20:119-138.

Boltovskoy, E. and Wright, R., 1976. *Recent Foraminifera*. Dr W. Junk b.v., The Hague.

Butler, A.J., Depers, A.M., McKillup, S.C. and Thomas, D.P., 1977. Distribution and sediments of mangrove forests in South Australia. *Trans. R. Soc. S. Aust.*, 101:35-44.

Chapman, F., 1941. Report on foraminiferal soundings and dredgings of the F.I.S. *Endeavour* along the continental shelf off the south-east coast of Australia. *Trans R. Soc. S. Aust.*, 65:145-211.

Chapman, F. and Parr, W.J., 1935. Foraminifera and ostracoda from soundings made by the trawler *Bonthorpe* in the Great Australian Bight. *J. R. Soc. W. Aust.*, 21:1-7.

Collins, A.C., 1958. Foraminifera. *Scient. Rep. Gt Barrier Reef Exped. 1928-29*, 6:335-437, pls 1-5.

Cushman, J.A. and Leavitt, D.H., 1929. On *Elphidium macellum* (Fichtel and Moll), *E. striato-punctatum* (Fichtel and Moll) and *E. crispum* (Linne). *Contr. Cushman Lab. foramin. Res.*, 5:18-23.

Hails, J.R., Belperio, A.P. and Gostin, V.A., 1983. Holocene sea levels of upper Spencer Gulf, South Australia. *In:* Hopley, D. (Ed.), *Australian Report for IGCP 61*, Monograph Series, Occasional Paper No. 3, James Cook University of North Queensland.

Hails, J.R., Belperio, A.P. and Gostin, V.A., 1984. Quaternary sea levels, northern Spencer Gulf, Australia. *Mar. Geol.*, 61:373-389.

Hansen, H.J. and Lykke-Anderson, A., 1976. Wall structure and classification of fossil and recent Elphidiid and Nonionid Foraminifera. *Fossils and Strata*, No. 10.

Howchin, W. and Parr, W.J., 1938. Notes on the geological features and foraminiferal fauna of the Metropolitan Abattoirs bore, Adelaide. *Trans. R. Soc. S. Aust.*, 62:287-317, pls 15-19.

Lindsay, J.M. and Harris, W.K., 1973. Fossiliferous marine and non-marine Cainozoic rocks from the eastern Eucla Basin, South Australia. *Mineral Resour. Rev., S. Aust.*, 138:29-42. [S. Aust. Dept Mines report 73/70 (unpublished)]

McKenzie, K.G., 1962. A record of Foraminifera from Oyster Harbour, near Albany, Western Australia. *J. R. Soc. West. Aust.*, 45:117-132.

Murray, J.W., 1971. Living foraminiferids of tidal marshes: A review. *J. foramin. Res.*, 1:153-161.

Murray, J.W., 1973. *Distribution and Ecology of Living Benthic Foraminiferids*. Heinemann Educational Books, London.

Murray, J.W., 1976. Living and dead benthic foraminiferal distributions. *In:* Hedley, R.H. and Adams, C.G. (Eds), *Foraminifera. Volume 2.* Academic Press, London, pp. 45-109.

Parr, W.J., 1932a. Victorian and South Australian shallow-water Foraminifera. Part I. *Proc. R. Soc. Vict.*, 44(N.S.):1-14, pl. 1.

Parr, W.J., 1932b. Victorian and South Australian shallow-water Foraminifera. Part II. *Proc. R. Soc. Vict.*, 44(N.S.):218-237.

Parr, W.J., 1945. Recent foraminifera from Barwon Heads, Victoria. *Proc. R. Soc. Vict.*, 50(N.S.):189-228.

Quilty, P.G., 1977. Foraminifera of Hardy Inlet, southwestern Australia. *J.R. Soc. West. Aust.*, 59:79-90.

Rose, P.R. and Lidz, B., 1977. Diagnostic foraminiferal assemblages of shallow-water modern environments: South Florida and the Bahamas. *Sedimenta VI*, The University of Miami, Florida.

APPENDIX A

Species List

This list is by no means exhaustive and will be added to with further work. Taxa in this list, and in Appendix 2, are arranged in alphabetical order pending further systematic study.

Ammonia beccarii (Linne)
Bolivina earlandi Parr
B. sp.
Bolivinella folia (Parker and Jones)
Brizalina sp.
Bulimina sp.
Buliminoides sp.
Cibicides lobatulus (Walker and Jacob)
C. refulgens Montfort
C. sp.
Clavulina sp.
Cribrobulimina polystoma (Parker and Jones)
Discorbina mira (Cushman)
Discorbinella biconcava (Jones and Parker)
Discorbis dimidiatus (Jones and Parker)
D. sp.
Elphidium articulatum (d'Orbigny)
E. crispum (Linne)
E. jenseni Cushman
E. macelliformes McCulloch
E. rotatum Howchin and Parr
Eponides sp.
Fissurina sp.
Glabratella australensis (Heron-Allen and Earland)
Guttulina sp.
Lagena sp.
Lenticulina sp.
Marginopora sp.
Massilina milletti (Wiesner)
M. sp.
Miliolinella sp.
Nonion sp.
Nubecularia sp.

Pararotalia sp.
Patellina sp.
Peneroplis planatus (Fichtel and Moll)
Pileolina sp.
Planorbulina mediterranensis d'Orbigny
Quinqueloculina lamarckiana d'Orbigny
Q. poeyana d'Orbigny
Q. seminulum (Linne)
Q. subpolygona Parr
Q. tenagos Parker
Q. sp.
Rectobolivina columellaris (Brady)
R. sp.
Reussella sp.
Rosalina sp.
Rotalia perlucida Heron-Allen and Earland
Sigmavirgulina tortuosa (Brady)
Siphobrizalina sp.
Siphotextularia sp.
Spirillina sp.
Spiroloculina sp.
Textularia sp.
Trichohyalus sp.
Trifarina sp.
Triloculina affinis d'Orbigny
T. striatotrigonula Parker and Jones
T. trigonula (Lamarck)
T. sp.
Trochammina inflata (Montagu)
Turborotalia sp.
Uvigerinidae gen. et sp.
Vaginulina costata d'Orbigny
Vertebralina sp.

APPENDIX B

Total VC range chart, 0-2 cm

	81	*83*	*60*	*61*	*63*	*62*	*64*	*110*	*111*	*65*	*78*	*77*	*84*
Ammonia beccarii	X	X		X	X		X	X	X	X		X	X
Bolivina sp.	X		X	X	X		X			X	X	X	X
Bolivinella folia	X	X	X	X		X	X	X	X	X	X	X	X
Brizalina sp.	X	X		X	X	X	X	X	X	X	X	X	X
Buliminoides sp.									X	X		X	
Cibicides refulgens	X	X	X	X	X	X	X	X	X	X	X	X	X
C. sp.	X	X	X	X	X	X	X	X	X	X	X	X	X
Clavulina sp.				X		X							
Cribrobulimina polystoma		X	X	X									
Discorbinella biconcava	X	X	X	X	X	X	X	X	X	X	X	X	X
Discorbis sp. incl. *D. dimidiatus*	X	X	X	X	X	X	X	X	X	X	X	X	X
Elphidium articulatum		X	X	X	X	X	X	X	X	X	X	X	X
E. crispum	X	X	X	X	X	X	X	X	X	X	X	X	X
E. jenseni	X	X		X	X	X			X	X		X	
E. aff. *macellum*		X		X	X	X		X			X	X	X
E. rotatum	X				X								
E. sp.		X	X	X		X	X			X			
Eponides sp.	X	X						X					
Fissurina sp.	X						X			X			
Gaudryina sp.													X
Glabratella australensis			X										
G. sp.					X	X				X	X		
Guttulina sp.			X		X								
Lagenidae				X	X		X	X	X	X	X	X	
Lenticulina sp.					X								
Marginopora sp.		X	X			X		X	X				
Massilina milletti		X										X	
Miliolinella sp.		X										X	
Nonion sp.		X											X
Nubecularia sp.		X		X				X		X			
Patellina sp.		X											
Peneroplis planatus	X	X	X	X	X	X		X	X	X	X		X
Pileolina sp.	X		X		X								
Planorbulina mediterranensis		X	X		X								X

Quinqueloculina spp.	X	X	X	X	X	X	X	X	X	X	X	X	X
Rectobolivina sp.	X	X				X							
Reussella sp.	X	X	X	X		X	X	X	X	X		X	X
Rosalina sp.	X	X		X	X	X			X		X		
Rotalia sp.	X	X			X								
Siphobrizalina sp.			X										
Siphotextularia sp.							X						
Spirillina sp.					X					X	X		
Spiroloculina sp.		X	X	X	X	X		X	X	X		X	X
Textularia sp.	X		X	X	X		X	X					
Trichohyalus sp.	X						X						
Triloculina spp.	X	X	X	X	X	X	X	X	X	X	X	X	X
Trochammina inflata					X		X	X	X	X			
Turborotalia sp.									X				
Uvigerinidae		X			X	X	X			X	X		
Vertebralina sp.										X		X	

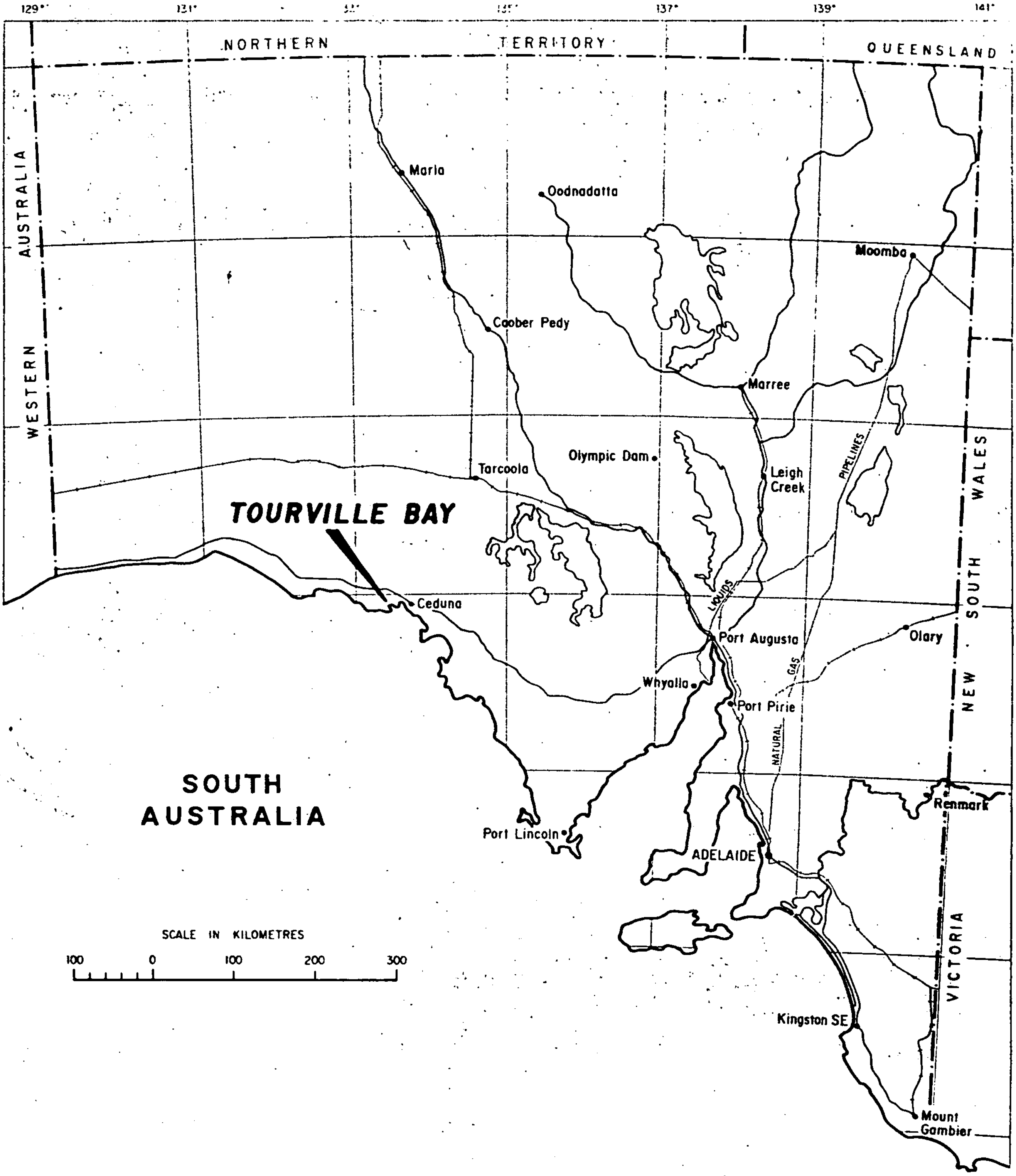


Fig......1

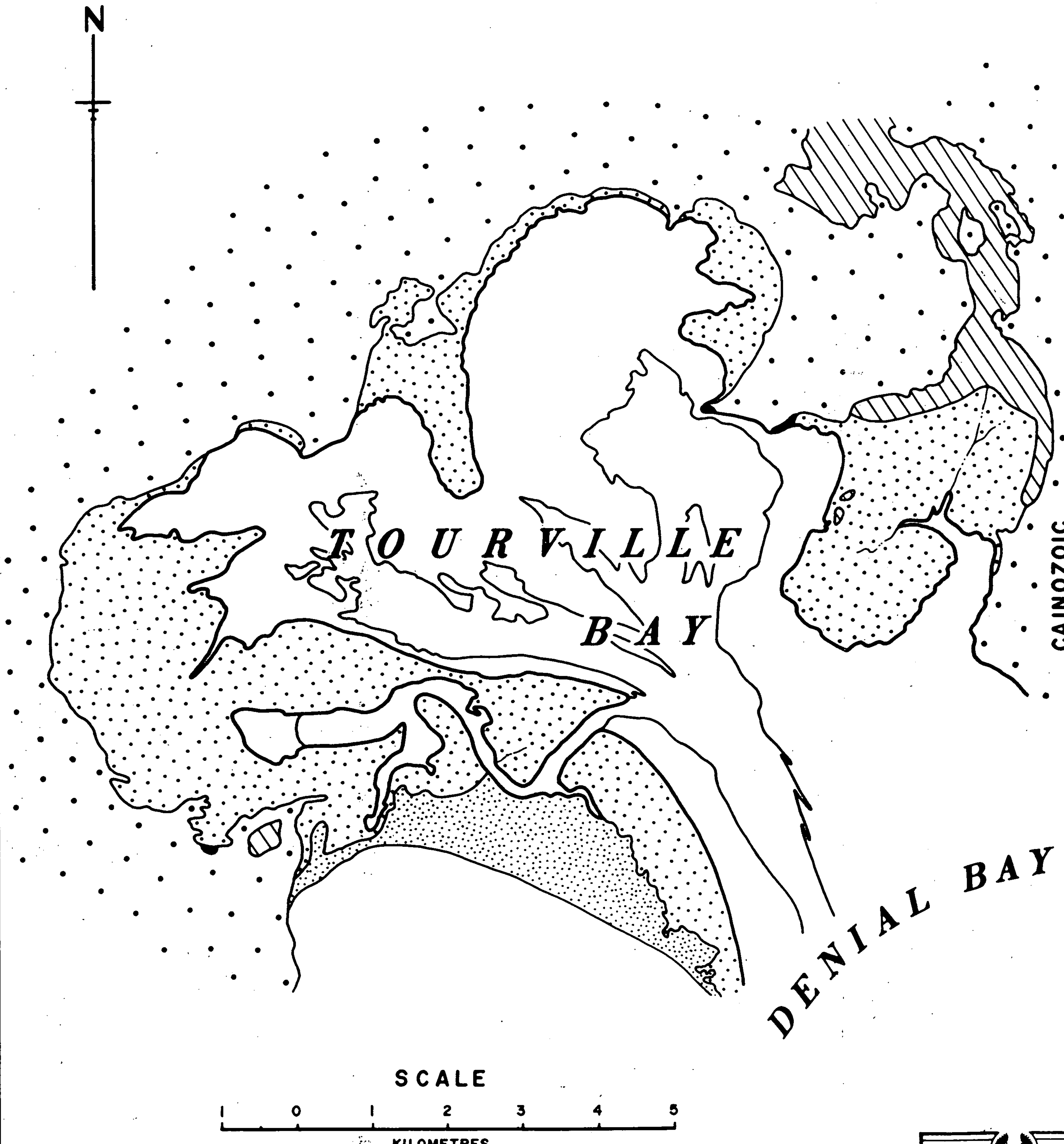
DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

SEDIMENTOLOGICAL / BIOFACIES STUDY - TOURVILLE BAY

LOCALITY PLAN

COMPILED K.L.	C.D.O. 21·6·85 DATE	
DRAWN R.H.	SCALE As shown	
DATE Mar. 1985	PLAN NUMBER	
CHECKED	S18095	

3765



LEGEND

After R. FLINT (CHARRA 1:100 000 Geological map in preparation)

CAINOZOIC — QUATERNARY

HOLOCENE

Qhe SEMAPHORE SAND: White - cream, quartz and shelly sands of beaches and mobile coastal dunes.

Qho ST. KILDA FORMATION: Estuarine shelly muds, shelly sands, sands and saline muds. Coarse shelly sands in stranded beach ridges.

Qhy YAMBA FORMATION: Crystalline selenite, gypsarenite and halite, and saline muds of coastal salinas. Associated gypsite lunettes.

PLEISTOCENE

Qpb, ***Qpb_u***: BRIDGEWATER FORMATION (Upper member): Soft, white-fawn, aeolian calcarenites with large tubular foresets. White silts contain abundant calcrete fragments and fossilised weevil and bee cocoons. White, patchy carbonate cement of the BAKARA CALCRETE forms soft, laminar and nodular calcretes and rhizoliths.

Qpg GLANVILLE FORMATION: Marine and estuarine shell beds (locally calcreted at top). Molluscs *Anadara trapezia* and *Euplica bidentata* and foraminifer *Marginopora vertebralis* are common.

Qpb_l BRIDGEWATER FORMATION (Lower Member): Cream-fawn, aeolian calcarenites and reddish-brown silts with abundant calcrete fragments. Land snail *Bothriembryon barretti* is common while *Exilibadistes sutilosa* is rare. Pervasive carbonate cement (RIPON CALCRETE) forms hard, massive, laminar and nodular calcretes and rhizoliths.

Fig.........2

DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA	COMPILED K.L.	C.D.O. DATE 24·6·85
SEDIMENTOLOGICAL / BIOFACIES STUDY - TOURVILLE BAY	DRAWN R.H.	SCALE As shown
APPROX. EXTENT OF LITHOLOGICAL UNITS ABOVE MID-TIDE LEVEL	DATE Mar. 1985 CHECKED	PLAN NUMBER 85-223

3765

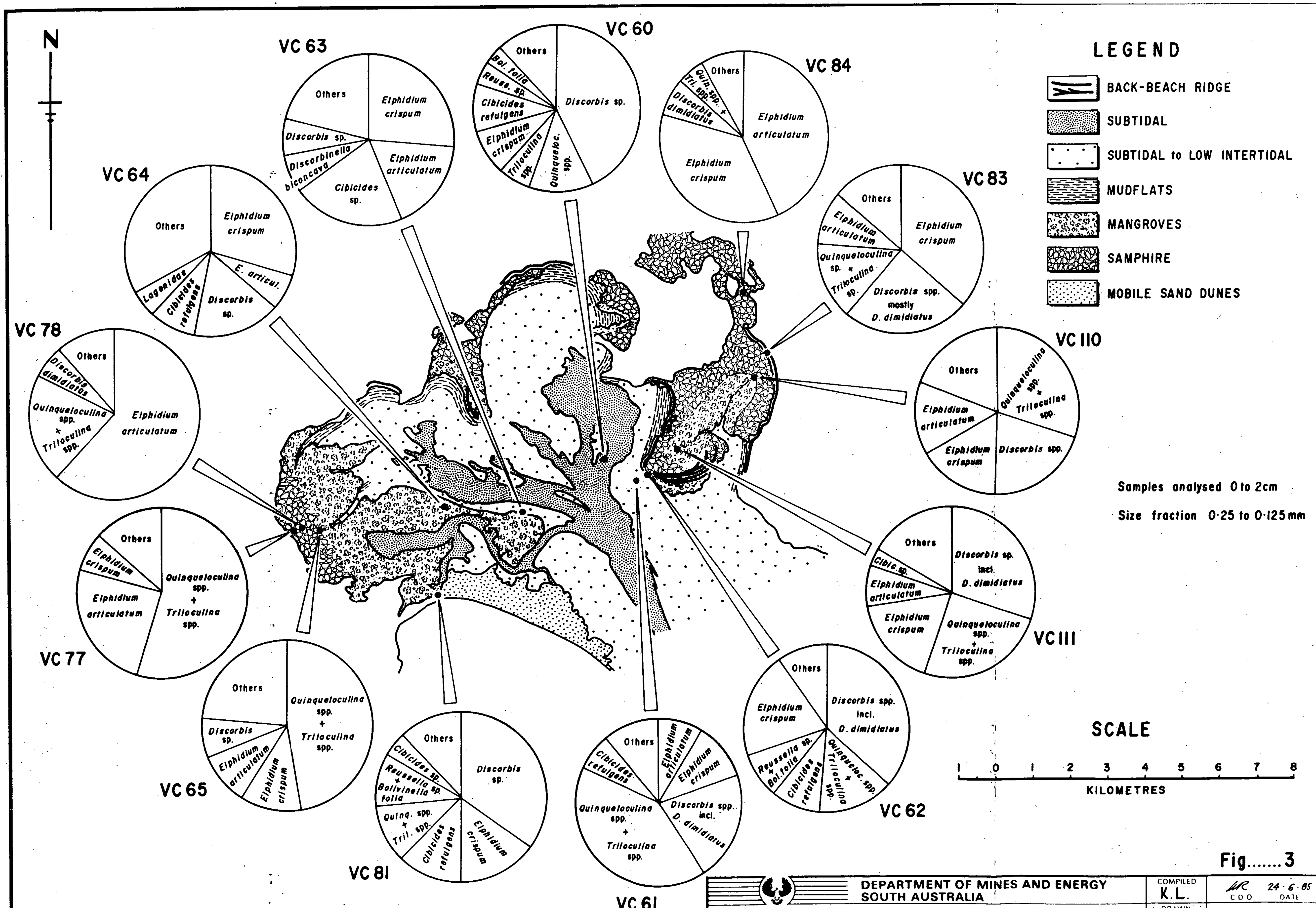


Fig.......3

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

SEDIMENTOLOGICAL / BIOFACIES STUDY - TOURVILLE BAY

LOCATION OF VIBROCORE HOLES
AND FOREMINIFERAL BIOFACIES ANALYSES

COMPILED K.L.	CDO DATE 24·6·85
DRAWN R.H.	SCALE As shown
DATE Mar.1985	PLAN NUMBER
CHECKED	85-224

3765