

Department of Mines
South Australia

FUTURE OIL EXPLORATION, ST. VINCENT

GULF REGION

by

W. Johnson, B.Sc. (Hons)

Senior Geologist

URANIUM & TELLUR SECTION

CONTENTS

	Page
Abstract	1
Introduction	1
Previous Work	1
Yorke Peninsula	2
St. Vincent Basin	2
Kangaroo Island	3
Bibliography	3
Geology	4
Yorke Peninsula	5
St. Vincent Basin	8
Kangaroo Island and Fleurieu Peninsula	8
Oil Prospects	9
Yorke Peninsula	9
St. Vincent Basin	12
Kangaroo Island	14
Future Investigations	14
Yorke Peninsula	14
St. Vincent Basin	15
Kangaroo Island	15
Conclusions and Recommendations	15
Conclusions	15
Recommendations	16

P.M. 680/59

Dept. Book No 40/58

G.S. No 1512

U & I No 35

17
14th April, 1959

FUTURE OIL EXPLORATION, ST. VINCENT
GULF REGION.

ABSTRACT

The geology of the St. Vincent Gulf region is discussed with particular reference to the possibility of the accumulation of commercial deposits of petroleum or natural gas. Recent evidence has shown that thick successions of Cambrian marine rocks occur on Yorke Peninsula and Kangaroo Island and a moderate thickness of Tertiary rocks occur west of Adelaide and probably out under the waters of St. Vincent Gulf.

Petroleum or natural gas traces have been discovered in Permian and Cambrian rocks on Yorke Peninsula and it is concluded that the petroleum prospects are sufficiently strong as to warrant further investigations here, on Kangaroo Island and of the Tertiary of the St. Vincent Basin. Geophysical work, mapping and limited structure drilling are recommended as a first step.

INTRODUCTION

The finding of natural petroleum traces in Cambrian Silurian limestone in a bore on Wilkeson Station north of Port Augusta in 1925 stimulated interest in the oil prospects of areas containing Cambrian rocks in other parts of the state. The only areas not held under Oil Exploration Licences at the time were Yorke Peninsula, St. Vincent Basin and Kangaroo Island. As a matter of Government policy these areas were withheld from the public and investigations were commenced by the Department of Mines.

Attention was initially confined to Yorke Peninsula where flatly dipping Cambrian limestones were known to outcrop extensively. The work done included reconnaissance mapping, geophysical surveys, and the drilling of three stratigraphic bores. It is now pertinent to review the work completed, to discuss the prospects of finding commercial petroleum, and to suggest the most profitable avenues for future investigations.

ST. VINCENT GULF

The St. Vincent Gulf region has been the subject of intermittent geological investigation from the earliest days of the State's history. Activity has been concentrated in the vicinity of Adelaide and other parts of the area have received less attention.

As the region is divided naturally into three distinct geographical provinces it is convenient to consider previous geological work in each separately. There have been few geological discussions of the region as a whole.

YORKE PENINSULA

This is the only area which has been specifically investigated for its oil prospects.

Investigations of the modern period commenced with a reconnaissance geological survey by D. King (King 1956) and concurrently with the drilling of the first stratigraphic drill hole near Clinton on the eastern coast of northern Yorke Peninsula.

Prior to King's activity geological investigation had been confined to examinations of small areas and individual mineral prospects. King produced a reconnaissance geological map and a report which, in addition to giving the first comprehensive account of the geology, collated the pre-existing borelogs and literature.

Subsequently mapping by R. Horvitz and palaeontological examinations by R. Lally have modified King's stratigraphy without lessening the value of his basic data.

Following King's work geophysical surveys were commenced in the vicinity of Gurrulilla and Minlaton where extensive outcrops of Cambrian limestone were known. The sites for stratigraphic drill holes were selected near Minlaton and Stansbury as a result of this geophysical work, and these were completed at 3261 feet and 1970 feet depths respectively.

Published and unpublished geological reports issued since 1956 are included in the bibliography below. The most important of these is the chapter by Lally and Horvitz in the "Geology of South Australia."

St. Vincent Basin

Included in this region is a strip down the eastern shore of Yorke Peninsula, the water covered area of Gulf St. Vincent, the continental part of the St. Vincent Basin and the Willunga and Willunga sub-basins of eastern region.

Until a large part of the region has been mapped incidentally as part of the programme to elucidate the geology

of the southern part of the Adelaide Geosyncline.

The main Departmental geological reports are those of Miles on the Adelaide Plains Basin (Miles 1952), Sprigg on the Adelaide metropolitan area (Sprigg, 1954) Cochrane on the Willunga Basin (Cochrane 1956), Campana, Glaessner and Whittle (1955), and Campana, Wilson and Whittle (1953). Apart from these very little has been written on the post-Cambrian geology of the region. A number of papers have been published on the Tertiary of the St. Vincent Gulf region, the most important being those of Glaessner and Ludbrook.

KANGAROO ISLAND

Sprigg's map of the island (Kingscote 4 mile military sheet) is the only comprehensive geological work in the region. His concept of the geology has been much modified by unpublished investigations of Thomson and Kelly.

BIBLIOGRAPHY

Only the more important references are listed here.

Publications or reports marked with an asterisk contain extensive bibliographies.

*MILES, G.S. 1952. R.G. & TECHNICAL, G. . 1954.

The Geology and Geology of Adelaide and Suburbs.
Dept. of Mines, South Aust., Bull 32.

GILBERT, R.G. 1953.

The Geology of the Jarvis and Yankalilla Military Sheets.
Dept. of Mines, South Aust. Report of Inv.No. 3

1955

The Geology of the Guelter Military Sheet.
Dept. of Mines, South Aust. Report of Inv. No.4

*WILSON, . . . 1956

The Geology and Hydrology of the Willunga Basin.
Dept. of Mines, South Aust. Report of Inv. No.6

WILSON, B. 1956

The Cambrian in South Australia.
Proc. 29. Int. Geol. Congress Vol II pp 91-117.

1957

Progress Report on Cambrian Correlation with in the Willunga Stratigraphic Series.
Dept. of Mines. File 111/5/12.

1958

Geological note on Cambrian of Kangaroo Island.
Letter to the Director of Mines Dept. of Mines
Pocket no. 339/58

- * GLASSBORO, H.E., & PERKIN, L.C. (Eds.) 1959. The Geology of South Australia. Journ. Geol. Soc. Aust. Vol. 5, Pt. 2, 1957. pp. 163.
- HARRIS, J.C. & HILTON, R.A. 1957. Report on Seismic Reflection and Refraction Tests, Lower Yorke Peninsula. Dept. of Mines, South Aust. Report 45/60 Unpublished.
- * KING, B. 1956. Report on a Reconnaissance Geological Survey of the Proterozoic-Cambrian Succession of Yorke Peninsula with Reference to Oil Exploration in the Cambrian System. Dept. of Mines, South Aust. Unpublished report on file 22 11/5/12.
- LUDWIG, R.N. 1956. The Permian Sequence in Minlaton No. 1 Bore. Dept. of Mines, South Aust. Report
- * MILLER, R.N. 1952. Geology and Underground Water Resources of the Adelaide Plains Area. Dept. of Mines, South Aust. Bull 27.
- SEARLE, E.C. 1957. Reconnaissance Gravity Survey, Lower Yorke Peninsula. Dept. of Mines, South Aust. Report 44/63.
- THOMAS, B.P. 1959. Notes on the Cambrian of Kangaroo Island. Unpublished report. Dept. of Mines South Aust.

GEOLOGY

The region discussed in this report has an underlying geological unity in that it is part of the extensive Adelaide geosyncline and its border zones. Geologically it can be subdivided into three distinct provinces.

The most westerly of these is the old Precambrian nucleus of Yorke Peninsula with its relatively thin but wide sedge of Proterozoic and Cambrian sediments. The easterly border of this province can be taken as the structural lineaments, thrust and normal faults or unconformities, which trend meridionally down the east coast of Yorke Peninsula. This easterly border cannot everywhere be traced with certainty because of the thin veneer of Permian and Tertiary rocks. It is not by any means a regular one.

The coastal province is by far the largest in area. It is the St. Vincent Basin proper, including that portion lying under the shallow waters of the Gulf. It is characterized by a varying succession of Tertiary and Quaternary marine, continental and glacial sediments ranging in age from Eocene to Recent. The known maximum thickness of the sediments is over 2,000 feet

in the vicinity of Adelaide, and quite probably thicker sections occur in sea covered parts of the Basin.

The basement of the Tertiary basin most probably consists of Cambrian or late Proterozoic rocks with a sporadic covering of Permian glauconitic sediments. Tertiary sediments are in contact with similar rocks around the edge of the Basin.

The limits of the Basin to the west, north and east are well defined but in the south the waters of the gulf introduce a doubt. The marine Tertiary near Kingscote, on Kangaroo Island appears to be its southern boundary. It seems likely that most of the Basin is underlain by such moderately folded older sediments and it would be legitimate to separate it as a geological province connecting the stable shelf of Yorke Peninsula to the highly folded mobile belt of the Adelaide Hills with its nuclei of Precambrian metasediments. The eastern boundary of the province and the Basin is irregular with tilted wedges of basement indenting it from north to south. These wedges are bounded by arcuate faults and small sub-basins are formed on their depressed surfaces.

The third or most easterly province is the strongly folded and somewhat metamorphosed Adelaide geosynclinal belt. This extends north, south-west and east on to Kangaroo Island. In the sediments are steeply dipping and metamorphosed it is not a favourable area for oil occurrence and apart from its influence on structures in the other two provinces is of little direct interest in the search for oil.

YORKE PENINSULA

The geology of the peninsula is briefly described by Bailey and Lewis in a chapter of the "Geology of South Australia" (Glennie & Lewis 1955). Of chief importance is the distribution, strikingly different from that of the Cambrian and younger sediments.

Cambrian sediments occur in a restricted area between Clinton and South Hummock in the north and discontinuously in a contorted area extending from Urunga and Mt. St. in middle Yorke Peninsula, southwards to Warracott, thence northwards through Adelaide and similar to the east of Mount.

In the South Hummocks area up to 1500 feet of fossiliferous limestone and argillaceous limestone, together with Preterozoic clastic sediments, have been strongly folded in a long narrow anticline formed by or associated with thrusting from the east.

The large arcuate strip of Cambrian is known only from sporadic outcrops and a number of bores. The Minlton Stratigraphic Bore drilled by the Department penetrated 250' feet of Cambrian sediments, consisting of a total of 2108 feet in three carbonate formations, separated by 393 feet of clastic sediments, including a conglomerate and an evaporite.

A summary of the Cambrian intersected in the bore is

Virranipa Limestone	109'
Unnamed continental ? clastic formation	393'
Parana Limestone	946'
Halpura Limestone	1053'
Total	2501'

The limestones are all marine and fossiliferous and the Halpura and Virranipa Limestones have a considerable secondary porosity. The attitude of the bedding planes in the drill core is horizontal.

Southward of Warraculla the Cambrian is covered by superficial deposits and by a variable thickness of Permian and Tertiary beds. Northward also, both ends of the arc outcrops of Cambrian are fragmentary and as the sediments thin out as they transition on the volcanic rocks.

Recent unpublished mapping by Crawford has indicated a thrust fault or other disjoining lineament trending south-westerly between Tertiary and Permian. This feature would account in part for the anomalous nature of the sediments penetrated in the Minlton Stratigraphic Bore. These are 150 feet of apparently horizontal red and ochreate shales, siltstones, and coarse bedded sandstone beneath Permian glauconitic sediments. The age of the red beds could not be fixed with any certainty. They may represent a series variation of the red clastics intersected in the Minlton Stratigraphic Bore. Their age is of

importance in its bearing on the oil prospects of the area.

Delineation of structure in the outcropping Cambrian sediments near Curramulka is rendered difficult by an extensive cover of superficial sand and travertine. However Crawford has mapped a broad syncline plunging flatly to the south through Curramulka and another tighter, narrower, syncline to the northwest, also south plunging.

If Crawford's mapping is correct then the Minlaton Stratigraphic zone was placed on the axis of the Curramulka Syncline. Anticlines concomitant with the synclines can only be inferred as they have not been observed on the ground. As a consequence it is not possible to determine if structures with closure exist in the area.

Permian rocks are widely distributed over the southern half of Yorke Peninsula and have a known thickness of 1640 feet in a bore near Minlaton. They are mainly fluvioglacial clays or soft shales and sands. A minor marine episode is indicated by the discovery of 35 feet of marine sands and clays in the Minlaton Stratigraphic zone.

Fragments of grease like petroleum residues believed to be of natural origin, were discovered in Permian rocks in both the Minlaton and Stensbury Lenses. The source of this grease was not ascertained. An unconfirmed occurrence of inflammable gas and oil was reported in the Minlaton Oil Bore. More authentic was the gas recovered from the old oil exploration bore in Loc. 112, Hd. Borealy.

The Permian rocks appear to be everywhere horizontal or horizontally dipping and no geological structures have been observable in them. The fluvioglacial sands are water bearing.

A thin blanket of marine Tertiary covers the older rocks along the eastern coast of Yorke Peninsula and remnants of the same rock occur over most of the southern half of the Peninsula. The maximum thickness known occurs in cores in the Clinton area at the northern end. The coastal strip of Tertiary is considered to be the eastern side of the St. Vincent Basin. The rocks have a gentle dip and are probably very gently folded.

ST. VINCENT BASIN

The geology of the Basin is known solely from the exposures and bore information in its margins although the major part of Basin area is covered by the waters of the Gulf.

The known stratigraphy is summarized by Glaesener in a chapter of the Geology of South Australia (Glaesener and Parkin 1958).

The main features are that the succession commences with continental sand beds in the middle Eocene and continues through to the Pliocene, with evidence of alternating marine and continental conditions. Sands, clays, and friable marine limestones are common and a considerable number of lignite beds have been encountered in bores.

The thickest known succession of Tertiary is 2242 feet intersected in a bore at Woydon. Miles and others have shown that structurally the Adelaide Plains sub-basin consists of a series of step faulted blocks tilted southwards and possibly eastwards, with the blocks becoming deeper in a westerly direction. It is therefore quite probable that the thickest section of Tertiary is cut under the waters of the Gulf, south and west of Adelaide.

The geology of the borders of the St. Vincent Basin indicate that the Tertiary rocks could be underlain by Cambrian and Torian rocks but little can be said of their possible distribution and attitude. Comparatively gently folded Cambrian sediments are known on Yorke Peninsula and in Kangaroo Island and these may extend some distances under the western and southern margins of the Basin.

KANGAROO ISLAND CAMBRIAN AND TORIAN ROCKS

Recent unpublished work by Bailey and Thomson is a much modified the published Cambrian succession shown by Spry on the Kingscote 1:100,000 sheet.

This later work has resulted in an estimated thickness of unmet morphosed marine Cambrian limestones, shales, and sandstones exceeding 80,000 feet. Thomson in addition has shown that they are folded into a series of antiforms and

synclines with moderate dips and axial plunges. The sandstones are however well indurated and do not appear to be very permeable. Nevertheless the demonstration of this considerable area occupied by a thick succession of marine sediments with potential source and reservoir beds and structural traps is of importance in considering the petroleum possibilities of the St. Vincent Gulf region.

The southern half of Kangaroo Island has now been shown to consist of metamorphosed rocks of the Kimmantoo Group.

Unmetamorphosed marine Cambrian rocks form the northern border of the Adelaide Hills block on the Yankalilla 1 mile military sheet. Here they are strongly folded and contorted in a number of elongated tight anticlines and synclines and are strongly checked along certain major thrust faults.

OIL PROSPECTS

Once again it is convenient to consider the petroleum prospects of the St. Vincent Gulf region in terms of geographical provinces although if oil, or oil traces are discovered in any part of the region it will affect the prospect of other parts.

YORK PENINSULA

The prospects of finding oil on Yorke Peninsula have been discussed by King, using evidence available to him at the time. Since then the Enderby and Strenuous stratigraphic bores have been completed and some mapping (as yet unpublished) has been done by Stanford.

King reached the conclusion that oil prospects in the Cambrian on Yorke Peninsula are poor, basing his opinion mainly on (King 1916 p.35)

"(a) insufficient thickness (of Cambrian)

(b) evidence that Cambrian formations comprised a land surface during much of the Palaeozoic Era.

(c) absence of known trap structures."

Elsewhere he notes the absence of porosity in the Cambrian rocks.

The drilling and mapping completed since King's report was compiled, have shown a greatly increased thickness of Cambrian marine rocks, positive evidence of oil in the Cambrian

sediments, porosity and the possibility of closed structures in the Cambrian limestone. With this fresh evidence it is necessary to review the prospects for the occurrence of oil on the Peninsula and the information yielded by the Minlaton Stratigraphic Bore is most important.

King has shown that north of Curramulka Cambrian sediments on the Peninsula are too thin to harbour accumulations of oil and hence discussion in this report is confined to the area south of Curramulka.

Recapitulating the sequence in this bore we have, from the top down,

PREMIAN	0' to 615'	Sands, clays and boulder clays with marine beds from 500' to 566'. TOTAL 615'.
LOWER MIDDLE CAMBRIAN	615' to 724'	<u>Microclea Limestone</u> : Dark blue-grey fossiliferous limestone. TOTAL 109'.
"	724' to 1087'6"	<u>Red beds and evaporites</u> : Grey limestone, purple and grey shale with inter-bedded crystalline gypsum. TOTAL 363'6".
"	1087'6" to 1117'	<u>Conglomerate</u> : Pebbles are fossiliferous limestone in chocolate argillite matrix. TOTAL 29'6"
"	1117' to 1177'	<u>Chocolate and grey shales</u> : TOTAL 60'
LOWER CAMBRIAN	1177' to 2123'	<u>Farara Limestone</u> : Grey and pink fossiliferous limestone. TOTAL 946'
"	2123' to 3176'	<u>Mulgara Limestone</u> : Light and dark grey massive limestone. TOTAL 1053'.
"	3176' to 3261'	<u>Sound quartzite</u> TOTAL 85'.

The total thickness of Cambrian sediments (omitting the sound quartzite) penetrated is 2501 feet. South of the Minlaton bore an even greater thickness may be present. The Farara limestone outcrops at Curramulka and occurs at depth in the Minlaton bore, thus showing a northward dip. The present land surface and by inference, the Permian land surface, both truncate the up dip edges of the formations and unless a change in regional dip reverses the trend, formations higher in the Cambrian than the Microclea Limestone (e.g. Boxin, Bay Formation of Kangaroo Island, Lake Frome Group of Northern Territory) should occur beneath the Permian cover south of the Minlaton Bore. There is thus an

adequate thickness of Cambrian for oil accumulation in the Currumulla area. Thick source beds and competent cap beds have also been demonstrated by the bore.

As regards reservoir beds the limestones show secondary porosity which is abundant in certain parts of the Kulpura Limestone and in the lower part of the Wirroolpa Limestone. The sandstones in the clastic sequence of the Cambrian appear to be tight and non-permeable. The Permian sequence in both the Minlaton and Stanbury bores begins with a coarse water bearing bed and this must be looked on as a potential reservoir for petroleum accumulation.

Reliable direct evidence of the presence of natural petroleum in the Currumulla area is confined to grease fragments obtained in the Permian sands in the Minlaton and Stanbury bores and to the gas obtained from the old oil exploration bore on Section 112, R2. Jersey. Gas and oil was also reported from the old Minlaton oil exploration bore but the authenticity of the report cannot be attested. Non-occurrence of oil traces in the Cambrian of the Minlaton Bore can be somewhat discounted as this bore was diamond drilled and no formation testing was attempted.

The grease in the Permian could either be residues of oil migrated from the Cambrian or of residues of Permian oil. Ludbrook (1936) has shown that part of the Permian on York Peninsula is marine and the relatively minute traces of oil could have had their origin in these marine beds.

Source cap and reservoir beds and authenticated oil traces having been demonstrated it remains to discuss the possibility of traps.

Fold etc. structures in the Cambrian have not been definitely proved by mapping owing to the paucity of outcrop of oil beds and the difficulty of distinguishing the limestone formations in the field. Stanford believes he has established a syncline plunging south with an axis near Currumulla and he is of the opinion that complementary anticlines accompany this syncline to the east and west. He also believes that there is a strong thrust fault trending south-south-west through the fold. Dips of 6° to 8° can be made out on the Kulpura limestone in a quarry near

Curramulka and dips are demonstrated by correlation between boreholes. Folding in the Cambrian is therefore considered to be present. No closed structures have been mapped nor does it seem likely that they can be mapped and it will be necessary to rely on seismic methods to determine structure.

Stratigraphic traps in the Cambrian, though a possibility, would be even more difficult to find than structural traps.

A third possibility is accumulation along the unconformity between the Cambrian and the Permian. This could either be due to tilted Cambrian reservoir beds cut off by Permian clays or Cambrian reservoir and source beds feeding into the basal fluvio-glacial sand, which occurs along the unconformity. Accumulation of oil by this means could probably only occur by alteration in altitude or fluid content of the Cambrian beds after deposition of the Permian. Otherwise, if the beds have maintained their present attitude since Permian times, it is almost certain that most of the oil in the Cambrian would have been dissipated at pre-Permian outcrops.

That changes in attitude since the Permian have occurred is proved by the observation of low amplitude folds in Tertiary rocks and tilting, faulting and folding in Tertiary or Quaternary land surfaces.

The prospects of finding petroleum indigenous to the Permian can also not be entirely discounted as at least 1600 feet of Permian is known and it is in part if not wholly marine. The presence-like traces of petroleum in the Permian may easily be found in oil in.

By locating all the known features on Yorke Peninsula it appears to be a reasonable prospect for oil exploration in the area south of Curramulka. Some thick Cambrian succession may be expected. Geological and other investigations are discussed later.

2. THE AREA

The greatest difficulty in discussing the petroleum prospects of this area is the total lack of information on the vast area hidden under the Gulf.

In the present continental part of the basin Tertiary/Quaternary sediments have an observed maximum thickness of 2242 feet. The succession consists of marine fossiliferous shell sands, limestones, and clays, and continental gravel sands and clays, with lignite beds. Therefore the Basin has source, reservoir, and cap beds, for both petroleum and natural gas. The other chief requisites of sufficient thickness of beds and structural or stratigraphic traps remain to be demonstrated.

West of the Para Fault near the Croydon bore is the only one to have reached Precambrian basement and it is impossible to be definite as to basement contours.

Structure contours on the top of the Pliocene marine beds have been published by Miles (1952). These show a regional dip of about 20 feet to the mile to the south west. Superimposed on this regional dip are a number of flat domes and basins and terraces.

Contours on the same horizon were redrawn by the writer using further information and isopachs of the Pliocene were also drawn. These confirm Miles general trends and show that the Pliocene thickens to the south west.

All structural contours drawn in the Adelaide Plains area suffers from lack of geoscientological control as similar lithologies make the correlation of Pliocene and Miocene difficult from descriptions of bore logs only.

However the indicated structures with small closure leads to hope that better closed structures could be found.

Bore density is relatively thick in the metropolitan area and the lack of oil shows in boreholes could be discouraging if it were not for the fact that few of the bores penetrate the Pliocene and thus not in the domal structures. All the bores end in the Miocene or Pliocene and there is abundant water has been circulating under artesian pressure for millions of years.

Summing up, the St. Vincent Basin warrants more investigation, particularly to find the thickest Tertiary section and to determine structure with more accuracy. Specific recommendations for investigation are made in a later section.

KANGAROO ISLAND

Conditions on the island approximate to those on Yorke Peninsula except that outcrops are more extensive and better exposed. Thomson and Dailly have demonstrated a great thickness of Cambrian marine rocks moderately folded and containing abundant source and cap beds. Investigations have been of a reconnaissance nature only and reservoir beds folded into closed structures have not yet been discovered.

On general grounds the oil prospects must be regarded as worth investigating and detailed mapping of the Borda, Cassini and Kingcote 1 mile sheets is suggested as a first step.

FURTHER INVESTIGATION

The investigations suggested here are regarded as those that are warranted on present evidence.

YORKE PENINSULA

The lack of outcrop in the promising area south of Curramulka discourages surface mapping. Crawford is of the opinion that more detailed work than he has done would yield little more of the geology. Although he has mapped structure in the Cambrian south of Curramulka the anticlines to the west and east of his central syncline are at present too hypothetical to warrant sitting a stratigraphic bore hole on them.

The structure could be delineated by shallow drilling to pick up the red beds of the elastic sequence as these are of distinctive appearance and readily distinguishable from the limestones. This may be less expensive than seismic survey. South of the old oil exploration bore in sec. 112, 6d. Lonsay, Permian sands totally obscure the Cambrian and in this area geophysical methods must be used. Early tests of the seismic method (Storin and Hilton 1937) have shown that refraction work can get results and to find a target for drilling in this area it must be used. Seismic survey could profitably be directed towards

- (a) delineating pre-Permian topography with the object of finding unconformity traps and traps in the basal Permian Glauco-lacustrine

(b) structure in the non carbonate clastics south of the Minlaton Bore.

As it is an expensive method it might be advisable to wait to see if structure drilling and painstaking detailed mapping can bring results further north.

ST. VINCENT BASIN

The first objective in investigation must be to find the thickest succession of Tertiary rocks. From existing data this would appear to be to the southwest of Adelaide out under the Gulf, but the area along the coast north of the Gawler River is practically devoid of boreholes and should be tested.

Preliminary gravity traverses are suggested, followed by seismic testing of selected areas, to confirm the gravity data and to determine a closed structure on which to site a deep test bore.

Search for a structure could be aided by critical re-appraisal of the palaeontology of fossiliferous strata in existing boreholes.

REMARKS

Detailed mapping of the unmetamorphosed Cambrian occupying the northern half of the island is first required and no other investigation is suggested at this time.

GENERAL CONCLUSIONS

CONCLUSIONS

The St. Vincent Gulf region is underlain by fossiliferous marine Cambrian, Devonian and Tertiary rocks in which there is a possibility of the accumulation of commercial deposits of petroleum.

On Yorke Peninsula traces of petroleum have been discovered in Permian coals and overlain a moderate thickness of marine Cambrian limestone and natural gas has been recovered from the limestone near the outcrop.

Source, reservoir, and cap beds occur in the Cambrian and they appear to have been moderately folded with the consequent possibility of the existence of structural traps. Traps may also

occur at the unconformity between Permian and Cambrian and within the Permian. It is concluded that the prospects of finding petroleum are sufficiently encouraging to warrant further investigation on Yorke Peninsula in the Curramulka area.

In the St. Vincent Basin there is no positive evidence of petroleum or natural gas. Source, reservoir and cap beds occur but may not be in sufficient thickness. Here again prospects are sufficiently encouraging to warrant further investigations. These will almost certainly need to be extended out into the Gulf St. Vincent.

On Kangaroo Island a thick series of folded Cambrian marine sediments are known and on general grounds should be further investigated.

RECOMMENDATIONS:

The investigations recommended are:-

YORKE PENINSULA

1. Detailed examination of the area of outcrop of the clastic red bed sequence in the Cambrian south of Curramulka.
2. Structure drilling of this area should detailed mapping prove abortive.

3. Seismic survey of the area to be directed towards two aims

(a) structure delineation in the Cambrian.

(b) determination of highs in the Permian or pre-Permian topography.

Test directed towards (a) may prove more successful in the area south of the inlet. Stratigraphic bore where clastic sediments in the Cambrian sequence above the irregular limestone, may be expected to occur.

4. Test drilling of structure selected by (a) or (b).

ST. VINCENT BASIN

1. Gravity survey of the eastern landward margin of the basin to determine thickest section of the basin.

2. Extend gravity survey seawards if land results indicate that the thickest section is under the shelf.

3. Seismic work to delineate a structure on which to drill a test hole.

4. Test drilling of a structure or of the deepest section for stratigraphic purposes.

KANGAROO ISLAND

1. Map on a scale of 1 mile to 1 inch the Cassini, Borda and Kingscote 1 mile sheets.

RECEIVED
10/4/59

W. J. Johnson
JOHNSON
OFFICE GEOLOGICAL
AND A MINING SECTION