OIL SHALE POTENTIAL OF THE ARCKARINGA REGION.

P S MOORE

DELHI PETROLEUM PTY LTD

APRIL 1982

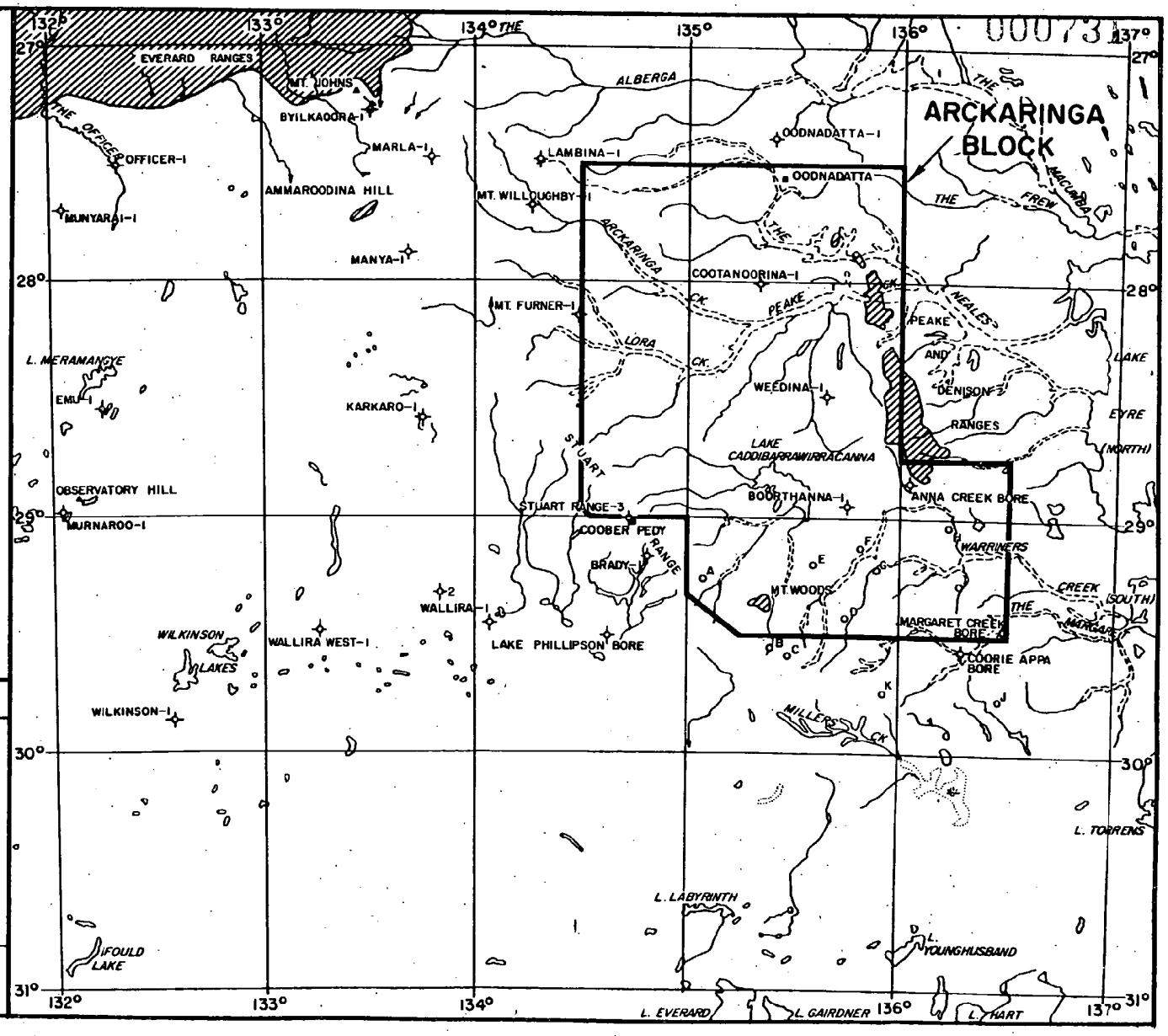
OIL SHALE POTENTIAL OF THE ARCKARINGA REGION

P.S. Moore
Delhi Petroleum Pty. Ltd.
April, 1982

INTRODUCTION

During 1981, a study of the hydrocarbon potential of the Arckaringa Block (Fig. 1) was conducted (Moore, 1982a, b). Part of this study involved sample analysis of core and cuttings from Cootanoorina No. 1, Weedina No. 1 and Boorthanna No. 1. Grain mounts were prepared by Cook (1981) at the University of Wollongong, who reported the presence of very high quality oil shale in some samples. Several horizons may be present, however the main zone corresponds approximately with the top of the Early Permian Stuart Range Formation.

This report summarizes the data available at present, and recommends further study of this most interesting zone.



MINERAL HOLES					
C, MT. WOODS-1	A, SELTRUST PMW-15	B, NEWMONT SR-4
F, SDA-9	D, WARRINER CREEK-1	E, NEWMONT SR-2
I, NEWMONT SR-12	G, SDA-5	H, NEWMONT SR-13/2
	J, NEWMONT SR-6	K, NEWMONT SR-1

DELHI PETROLEUM PTY. LTD.

ARCKARINGA BLOCK
PEL 5&6 S.A.

LOCATION MAP

SCALE 1:2,500,000

KILOMETRES 50 0 50 100

MILES 50 0 50

Drawing Number XG-0686	SIMPLE CONIC PROJECTION	Drafted, Date D.R.OWEN, 8/81
	Contour Interval, N/A.	Chief Draftsman
Figure 1	Datum, N/A.	
	Chief Geologist.	Date AUG. 1981
	Interpretation. P.S. MOORE	

RT-10

STRATIGRAPHY OF OIL SHALES IN THE ARCKARINGA BLOCK

The Permian sequence in the Arckaringa Basin is divided into three formations - the coal-bearing Mt. Toondina Formation, the marine shaly Stuart Range Formation and the sandy, glacigene Boorthanna Formation (Moore, 1982a, b; Townsend, 1976). In the Boorthanna Trough, the basal part of the Boorthanna Formation may be quite shaly (Enclosure 1).

The main oil shale horizon is a tasmanitid zone, occurring "close to the base of the Mt. Toondina Formation in Boorthanna 1 and close to the top of the Stuart Range Formation in Weedina 1". (Cook, 1981, p.11). No core samples contain tasmanites. It is not possible to infer the thickness or the lateral continuity of these beds at this stage.

In addition, a cuttings sample from the Boorthanna Formation in Weedina No. 1 yielded a high oil shale potential. This sample could be a separate horizon or could represent cavings from higher in the well.

The samples which showed oil shale potential are:

Weedina No. 1

1.	2100' (640 m)	Stuart Range Formation	(cuttings)
2.	2200' (671 m)	Boorthanna Formation	(cuttings)

Boorthanna No. 1

3.	1870' (568 m)	Mt. Toondina Formation	(cuttings)
4.	1950' (593 m)	Mt. Toondina Formation	(cuttings)

A considerable stratigraphic range is suggested, with the oil shale facies occurring adjacent to the marine/non-marine boundary, near the base of the Mt. Toondina Formation.

Obviously more sampling is needed in order to establish the thickness and extent of the oil shale facies in these wells.

OTHER REPORTS OF OIL SHALE IN THE BOORTHANNA TROUGH

Many drill holes have been sunk in the southern part of the Boorthanna Trough, looking for shallow Permian coal or Precambrian mineralization (Scholefield, in press). The oil shale potential of some Permian units was first recognised by Getty Oil. Allen (1980, p. 2) reported that "an intersection of oil shale in SR-6 within Permian sediments has been noted during stratigraphic re-logging of holes. This intersection is currently being evaluated."

In the subsequent final report on the area by Getty Oil, Catley et al. (1981, p. 1) reported that "an occurrence of oil shale in Permian sediments was investigated; however values were low". The area was recommended for relinquishment.

Following Allen (1980), no further mention was made of oil shale in SR-6. Indeed, the stratigraphy of Newmont SR-6 as shown on the Billa Kallina 1:250,000 sheet (Ambrose et al., 1980) comprises Cretaceous Bulldog Shale overlying Proterozoic sediments. No Permian is indicated, and it is suggested here that Allen (1980, p. 2) misquoted the well which contained oil shale.

Analyses of potential oil shales were actually carried out on SR-1 and SR-12 (Catley et al., 1981, Appendix VII). The analyses are shown in Table 1. Negligible potential is indicated.

Newmont SR-1

Location: EL 304 at 29° 45' 00" S, 135° 55' 15" E

Stratigraphy:		
Bulldog Shale	0' - 207'	(0 - 63m)
Cadna-Owie Fm.	207' - 305'	(63 - 93m)
Stuart Range Fm.	305' - 471'	(93 - 143.6m)
Boorthanna Fm.	471' - 518'	(143.6-158m)
Proterozoic	518' - 561'	(158 - 171m)
Interval Analysed for Oil Shale:	420' - 460'	(128 - 140m)

Newmont SR-12

Location: EL 535 at 29° 18' 00" S, 136° 30' 00" E

Stratigraphy:		
Bulldog Shale	0' - 131'	(0 - 40m)
Cadna-Owie Fm.	131' - 269'	(40 - 82.1m)
Stuart Range Fm.	269' - 649'	(82.1 - 197.8m)
Boorthanna Fm.	649' -1309'	(197.8 - 399m)
Interval Analysed for Oil Shale:	352' - 392'	(99 - 119.5m)

Other shallow wells

No formal reports exist regarding further exploration for oil shale in the area. However, potential near the top of the Stuart Range Formation has been recognised by CRA, as well as Getty Oil. As the author understands it, the present situation is that Mr. Paul Lewis from CRA is sampling old holes for their oil shale potential. One well believed to be included in the sampling programme is Warriner Creek No. 1.

OIL SHALE YIELD

Catley et.al. (1981) reported low yields, generally in the range of 5-15 litres/tonne, for shales in SR-1 and SR-12.

Although no analyses have been conducted on oil shales discovered by Delhi Petroleum Pty. Ltd., Cook (1981 P17), from microscopic examination, reports that "some of the grains found in the cuttings samples would yield 300+ litres/tonne of an oil of relatively high quality". This yield is almost an order of magnitude higher than the average for the Julia Creek deposit, and the oil extract is predicted to be of much higher quality. Cook (pers. comm.) is extremely enthusiastic about the discovery.

Table 1. Oil Shale Analyses of Newmont SR-1 and SR-4, by Getty Oil.

Drill Hole	Interval (m)	Samples No.	Oil Yield (litre/tonne)
SR 1	128-129	52051	1.5-5.0
	129-130	52	5-15
	130-131	53	5-15
	131-132	54	5-15
	132-133	55	5-15
	133-134	56	5-15
	134-135	57	5-15
	135-136	58	>15
	136-137	59	5-15
	137-138	52060	>15
	138-139	61	>15
	139-140	62	5-15
SR12	99-100	52063	5-15
	100-101	64	5-15
	101-102	65	5-15
	102-103	66	5-15
	103-104	67	5-15
	104-105	68	5-15
	105-106	69	5-15
	106-107	52070	5-15
	107-108	71	5-15
	108-109	72	5-15
	109-110	73	5-15
	110-111	74	5-15
	111-112	75	5-15
	112-113	76	5-15
	113-114	77	5-15
	114-115	78	>15
	115-116	79	5-15
	116-117	52080	5-15
	117-118	81	5-15
	118-119	82	>15
	119-119.5	83	5-15

OVERBURDEN RATIO

Since the thickness of the oil shale horizon(s) is not known, it is impossible to prepare overburden to extract ratio maps.

Regardless of oil shale thickness and quality, it is likely that an overburden thickness of more than 100m will be prohibitive to mining. Shallow areas of Stuart Range Formation subcrop occur south of Boorthanna No. 1. Enclosure 2 summarises all existing public data in the region, and maps the overburden thickness above the top of the Stuart Range Formation. Sources of data are Scholefield (in prep.), Ambrose et.al. (1980) and Barclay (1974).

The final interpretation of the "Depth to Stuart Range Formation" map is that of the present author. Disagreement with previous workers is expressed over several points:

(a) I am not convinced that Scholefield's (in prep.) western horst block really exists, especially since it is based on poor data recovered from SCH001.

(b) I do not agree with Shell's interpretation of their electric logs in the Cootanoorina - Weedina area (Barclay, 1974). It is in disagreement with our seismic interpretation of the region, and gives very shallow depths of burial for the Stuart Range Formation in this region.

For the purpose of completeness, Barclay's (1974) interpretation of SDA 10-15 is listed on Enclosure 2. The author's interpretation of the area is that the Boorthanna Trough is a half-graben, strongly faulted on the eastern side, along the edge of the Peake and Dennison Ranges. Duff Creek No. 1 supports this interpretation and suggests that none of the SDA 10-15 wells penetrated the base of the Mt. Toondina Formation.

Enclosure 2 shows that the Stuart Range Formation can be intersected at shallow depth over a large area south of Boorthanna No. 1.

PROSPECTIVE AREAS

The area south of Boorthanna No. 1, where the top of the Stuart Range Formation is less than 100m below ground level, is considered to be potential. However, much of this area is presently held under licence. The remaining available prospective areas are shown in Enclosure 2.

The eastern area near Margaret Creek bore is the smallest of the two potential areas. The only well in the prospective zone is SR-12, which yielded low oil shale yields. This area is considered to be the least prospective of the two. In addition, there is very little opportunity to gain additional information about the area without taking out an exploration licence.

The western area is quite large, extending from SR-2 in the north, to south of SDA-3. There are seven wells in the block and another seven adjacent which could be analysed for oil shale potential. This is the block which should be investigated.

In all of these southern areas, it appears that the Cretaceous Eromanga Basin sequence rests directly on the Stuart Range Formation. Thus, at this stage, it is not possible to tell whether the horizon of interest is preserved, not developed or removed by erosion.

CONCLUSIONS AND RECOMMENDATIONS

Oil shales of extremely high quality have been intersected in Weedina No. 1 and Boorthanna No. 1 in the Arckaringa Basin. The main target horizon appears to approximate the top of the Stuart Range Formation.

The stratigraphic position, thickness and extent of the oil shales is poorly known or unknown.

There are a large number of mineral holes available which could supply useful data on the area.

The Stuart Range Formation is overlain unconformably by Cretaceous sediments in much of the shallow southern area. It is not known whether the oil shale horizon is developed and preserved in this area.

The stratigraphy of the prospective area south of Boorthanna-1 has been outlined by Scholefield (in prep.), Barclay (1974) and Catley et. al. (1981). However, these reports contain contradictions, and highlight the fact that the geology of the area is very poorly understood.

Two prospective areas not presently under licence are outlined. The larger, western area seems the most prospective (Enclosure 1).

If there is interest in this prospect, a series of wells are available which could be sampled for their oil shale potential. They are Warriner Creek-1, SDA-6, SDA-7, SDA-8, SDA-3, SCH001, SDA-9 and SR-2. The aim of this sampling would be to assess the merits of eventually taking out a licence in the area. It is considered that no further evaluation of the block would be necessary or warranted if the tests on these wells were unsuccessful.

REFERENCES

Allen, J.M., 1980. Exploration licences 475, 521, 535, 556, 564, 556, 564, 623 and 624, Stuart Range area: report for quarterly period ending 30th Sept. 1980, for Getty Oil. S.A. Dept. Mines & Energy Env., 3804 (unpubl.) (DPPL 100/ACB/10)

Ambrose, G.J., Flint, R.B., and Benbow, M.C., 1980. Billa Kallina 1:250,000 Geological Series, SH53/7. S.A. Dept. Mines & Energy

Barclay, C.J., 1974. Relinquishment report, May 1974, Exploration Licence 108, for Shell Development (Australia) Pty. Ltd. S.A. Dept. Mines & Energy Env., 2388 (unpubl.)

Catley, D., Edgecombe, D., Lea, W., and White, R., 1981. Final report to 31/3/1981. Stuart Range Getty-Santos Joint Venture EL's 475, 521, 535, 556, 564, 623 and 624. S.A. Dept. Mines & Energy Env., 3804 (DPPL 100/ACG/11)

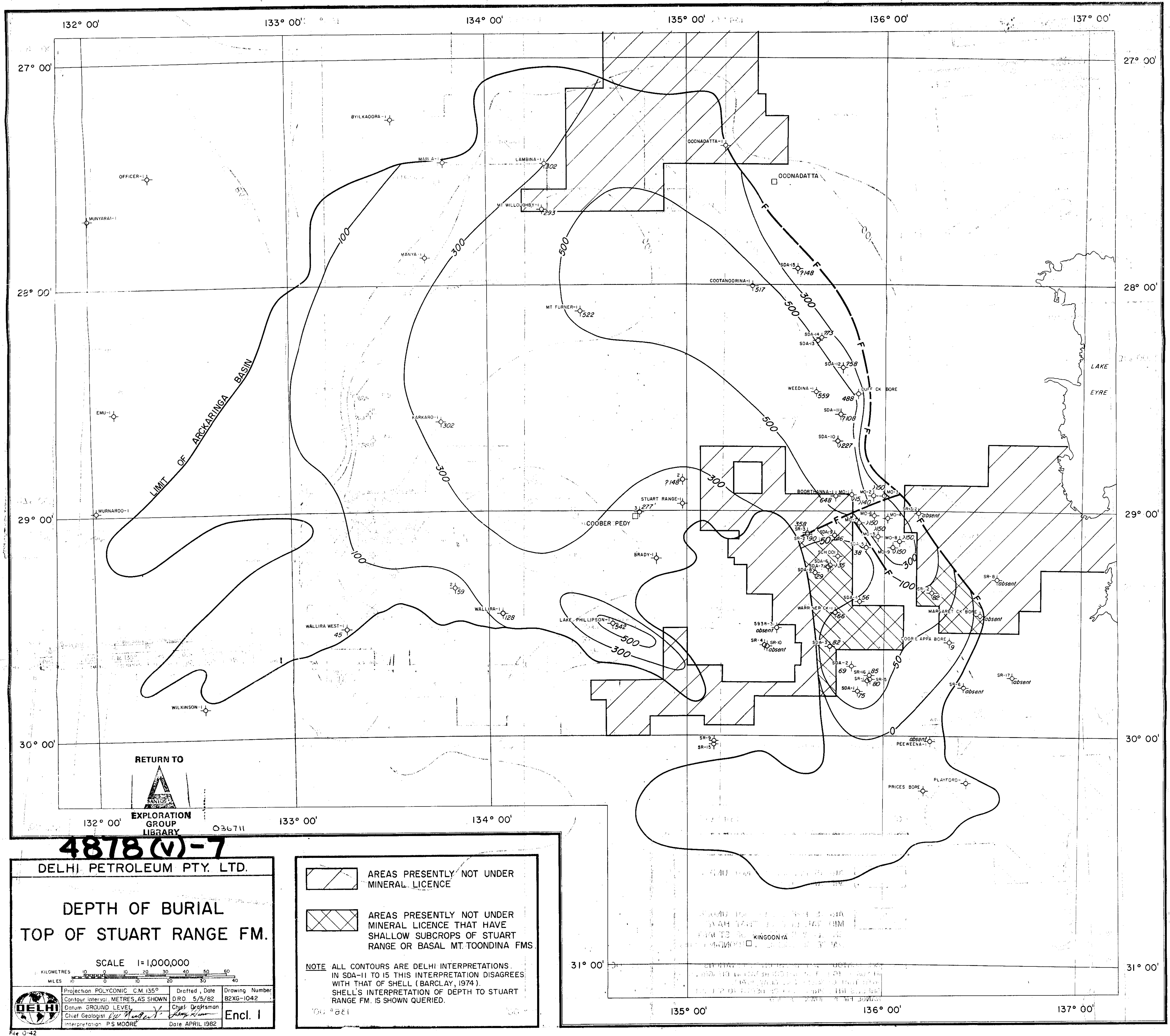
Cook, A.C., 1981. The organic petrology of samples from a selected group of wells in or near the Arckaringa Block. Delhi Petroleum Pty. Ltd. (unpubl.)

Moore, P.S., 1982a. Hydrocarbon potential of the Arckaringa region, Central South Australia. APEA Journal, 22(1).

Moore, P.S., 1982b. Geology and hydrocarbon prospects of the Arckaringa Block, PEL 5 & 6, South Australia. Delhi Petroleum Pty. Ltd. (unpubl.)

Scholefield, T., in press. Arckaringa Basin coal investigation. S.A. Dept. Mines & Energy Rept. Bk.

Townsend, I.J., 1976. Stratigraphic drilling in the Arckaringa Basin, 1969-1971. S.A. Dept. Mines & Energy Rept. Invest., 45.


132° 00'
133° 00'
134° 00'
135° 00'
136° 00'
137° 00'
27° 00'
28° 00'
29° 00'
30° 00'
31° 00'
BYILKAOORA-1
OODNADATTA-1
OODNADATTA
MARLA-1
LAMBINA-1
302
OFFICER-1
MT WILLOUGHBY-1
293
MUNYARAI-1
MANYA-1
COOTANOORINA-1
517
MT FURNER-1
522
SDA-15
?148
SDA-14
?73
SDA-13
SDA-12
?58
WEEDINA-1
559
488
DUFF CK BORE
SDA-11
?108
SDA-10
?227
EMU-1
KARKARO-1
302
LIMIT OF ARCKARINGA BASIN
LAKE
EYRE
?148
STUART RANGE-1
277
COOBER PEDY
BOORTHANNA-1
648
MURNAROO-1
BRADY-1
WALLIRA-1
128
59
WALLIRA WEST-1
45
LAKE PHILLIPSON-1
542
WILKINSON-1
WARRINER CK-1
66
SDA-3
82
SDA-2
69
SDA-1
75
absent
COORIE APPA BORE
9
MARGARET CK BORE
SR-8
SR-17
SR-6
SR-9
SR-13
PEEWEENA-1
PRICES BORE
PLAYFORD-1
KINGOONYA
100
300
500
50
0
F
RETURN TO
EXPLORATION GROUP LIBRARY
036711

4878 (V)-7

DELHI PETROLEUM PTY. LTD.

DEPTH OF BURIAL
TOP OF STUART RANGE FM.

SCALE 1:1,000,000

Projection POLYCONIC C.M. 135°	Drafted, Date D.R.O. 5/5/82	Drawing Number 82XG-1042
Contour interval METRES, AS SHOWN		
Datum GROUND LEVEL	Chief Draftsman	Encl. 1
Chief Geologist		
Interpretation P.S MOORE	Date APRIL 1982	

AREAS PRESENTLY NOT UNDER MINERAL LICENCE

AREAS PRESENTLY NOT UNDER MINERAL LICENCE THAT HAVE SHALLOW SUBCROPS OF STUART RANGE OR BASAL MT. TOONDINA FMS.

NOTE ALL CONTOURS ARE DELHI INTERPRETATIONS. IN SDA-11 TO 15 THIS INTERPRETATION DISAGREES WITH THAT OF SHELL (BARCLAY, 1974). SHELL'S INTERPRETATION OF DEPTH TO STUART RANGE FM. IS SHOWN QUERIED.