SOUTH AUSTRALIA

DEPARTMENT OF MINES AND ENERGY

OPEN FILE ENVELOPE NO. 8288

EL 1054, TUCKEY AREA, POLDA BASIN

Compilation of technical data from CRAE Mineral exploration boreholes 83KD-1 and 83KD-1A, Tuckey area, Polda Basin.

Submitted by

CRA Exploration Pty Ltd & SADME

1988

ENVELOPE 8288

TENEMENT: EL 1054; Tuckey area, Polda Basin.

TENEMENT HOLDER: CRA Exploration Pty Ltd.

CONTENTS

env8288

END OF CONTENTS

Memorandum to DME docket 369/89: author M. Griffiths, May 1990.

Re: Open-file Envelope 8288 - exploration data related to CRAE mineral exploration boreholes 83 KD-1 & 83 KD-1A, EL 1054, Polda Basin, South Australia.

ABSTRACT

Tuckey EL 1054 in which the subject boreholes were drilled covered the eastern portion of some previous CRAE tenements (ELs 670, 687 and 688) which were taken out in 1980 to explore for economic lignite deposits within the Polda Basin. By mid-1982 regional gravity surveys and extensive open-hole rotary drilling in these earlier tenements had outlined a quite substantial potential lignite resource, having reserves generally comparable to those mapped for the nearby Lock Coalfield. However, the majority of lignite seams discovered by CRAE occur below 200 metres depth and are sparsely distributed over a wide area of the basin, and so were deemed by the company not to constitute a mineable deposit.

Following the surrender of an adjacent Polda Basin offshore petroleum exploration permit in early 1983, data became available concerning the existence of 1700 metres of massive and interbedded halite in Lower Palaeozoic sediments intersected by Australian Occidental's Mercury 1 well, drilled in January 1982. When they became aware of this in late 1983, CRAE switched emphasis from refining their eastern Polda Basin coal exploration programme within the Tuckey EL 1054 area, acquired in late 1982, to a search for commercial potash in association with thick evaporite sequences possibly developed in the onshore Polda region. The new project at the outset was greatly facilitated by SADME, who in mid-1983 had shot a 17km reflection seismic traverse near the northern basin boundary fault in the Tuckey area, to investigate the cause of a prominent local gravity low. Interpreted results indicated the presence of thick pre-Permian sediments underlying the previously drilled Permian to Miocene section of the basin, in what became designated the Kilroo sub-basin.

Investigative deep rotary drilling by CRAE commenced on 19th December 1983 with borehole 83KD-1. Unfortunately this had to be abandoned at 336 metres depth in mid-January, after the Christmas period work break, owing to insurmountable lost circulation problems. The rig was skidded 7 metres to the SE and a second borehole 83KD-1A was collared on 20th January 1984. Here rotary and then diamond drilling was successful in reaching a total depth of 1398 metres: the hole was continuously cored over the objective zone from 515 metres depth (as HQ to 665 metres, then NQ to TD). 83KD-1A was geophysically logged with natural gamma, caliper, long and short-spaced density, neutron, sonic and drift logs to 596 metres, at the completion of rotary mud drilling, and with natural gamma, neutron, SP and a suite of resistivity logs from 596 to 1384

metres (stopping short of TD owing to insufficient logging cable). Caliper and short-spaced density logs were only obtained down to 701 metres due to a blockage in the hole. Drilling ceased on 10th March 1984, after penetrating 90 metres of massive basalt.

Overall the hole intersected 301 metres of Tertiary sands, clays and lignite, 282 metres of Jurassic sands, grits and minor coal, 22 metres of Permo-Carboniferous diamictite and 793 metres of Late Proterozoic argillaceous re-beds and basalts (the last unit being newly defined as the Kilroo Formation). No evaporitic sediments were encountered. Stratigraphic correlation of the Kilroo Formation with the bottom-hole sequences in the offshore Polda Basin wells, plus data from other holes in the Officer Basin, suggests that evaporites, if present, would occur below the basalts in the Kilroo sub-basin (i.e. deeper than 1400 metres at the most prospective locality). However, on the evidence gained by drilling CRAE felt that there was no cetainty of evaporites existing at depth in the eastern Polda Basin, and that further work to test the model was economically unjustified. Accordingly they relinquished EL 1054 in April 1985.

Subsequent work by SADME has involved K-Ar geochronology and geochemical analysis of the basalt lithotypes cored in CRAE 83KD-1A. This has revealed that at least some of the sediments and interbedded basalts in the hole are of Adelaidean age, rather than the previously assumed early Palaeozoic age. This feature adds support to the idea of the Polda Basin being an aulacogen of the Adelaide Geosyncline, although most tectonic evidence available from the region fails to reinforce such a concept.

CRA EXPLORATION PTY. LIMITED

FIFTH QUARTERLY REPORT ON TUCKEY E.L. 1054, SOUTH AUSTRALIA, FOR THE PERIOD ENDING 18TH JANUARY, 1984.

AUTHOR: A.K. SCOTT

COPIES TO: CRAE LIBRARY
SADME

DATE: 29TH FEBRUARY, 1984

SUBMITTED BY: P.L. [illegible] for A.K. Scott.

ACCEPTED BY: [illegible]

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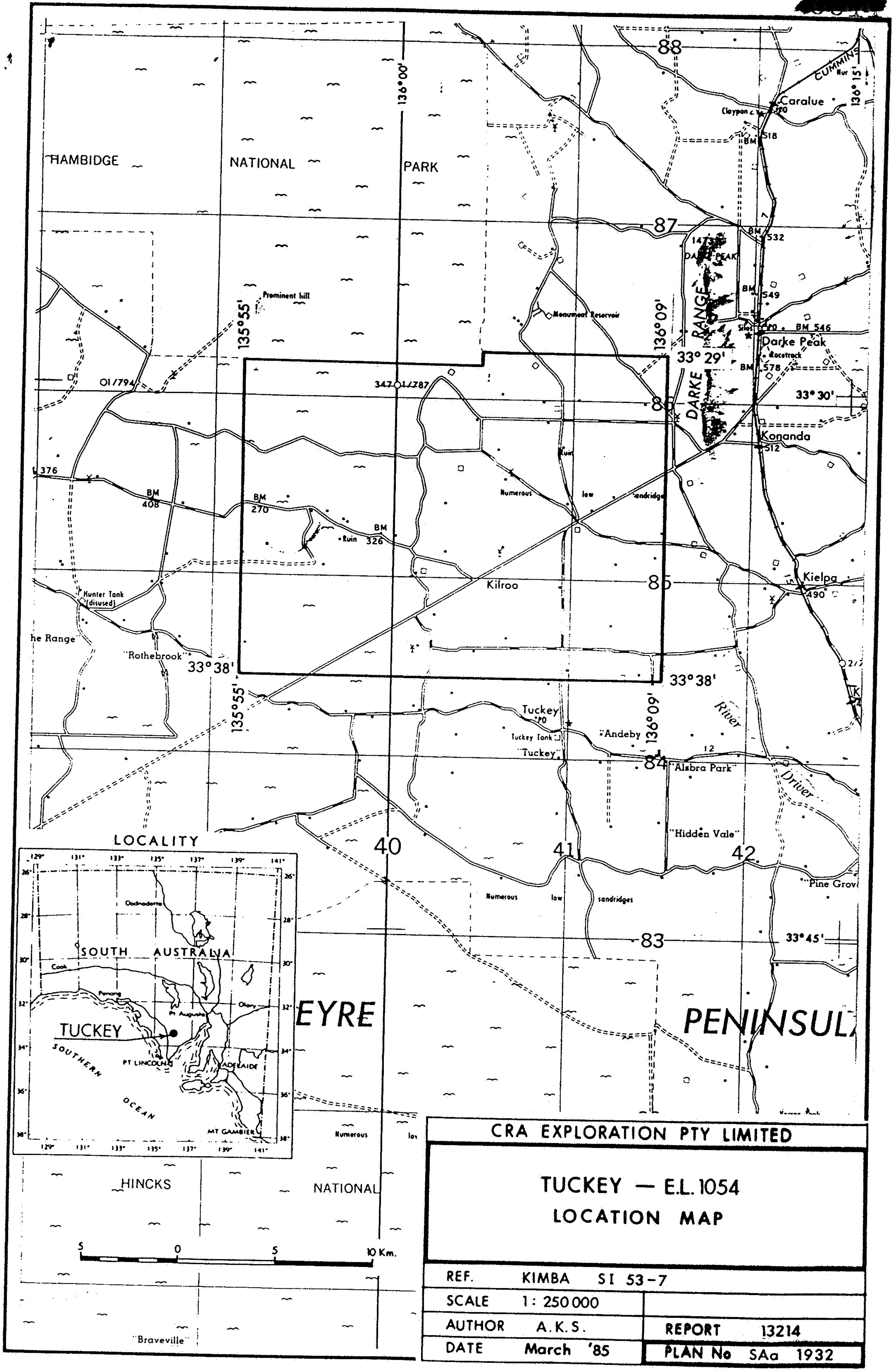


CRA EXPLORATION PTY LIMITED

TUCKEY — E.L. 1054
LOCATION MAP

REF.	KIMBA SI 53-7		
SCALE	1: 250 000		
AUTHOR	A.K.S.	REPORT	13214
DATE	March '85	PLAN No	SAa 1932

1. SUMMARY

The structure of the eastern, or Kilroo, sub-basin of the Polda Basin has been reasonably well defined by a recent SADME seismic traverse which shows a narrow trough bounded on the north by a series of faults and on the south by a shallower shelf. The sub-basin is believed to contain about 450 m of Tertiary and Jurassic sediments and at least 550 m of Permian and pre-Permian rocks, some of which may be evaporites.

By analogy with the oil well Mercury No. 1 drilled 170 km to the west in the offshore part of the Polda Basin, it is hoped that massive halite, with associated potash, exists beneath the Permian in the Kilroo sub-basin, and drilling has commenced to search for such a sequence.

The initial hole was abandoned at 336 m after intersecting 115 m of probable Miocene clay, 186 m of Eocene (Poelpena Formation) sands and silts, including 5.5 m of lignite at 199 m, and 35 m of probable Jurassic silts and sands. There is reasonable correlation between the stratigraphy interpreted from the seismic section and that intersected in the hole.

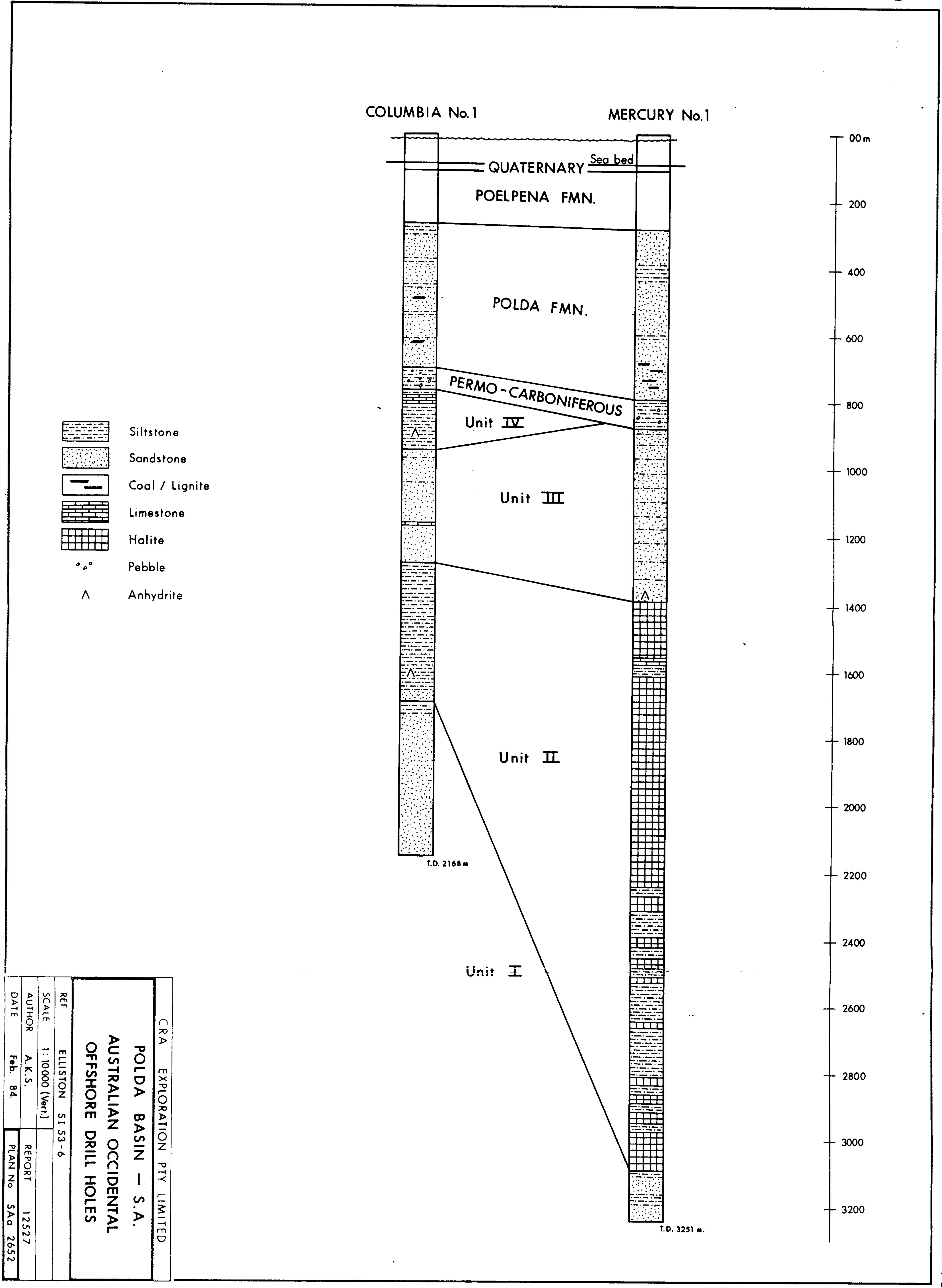
A second hole is about to be commenced.

2. INTRODUCTION

E.L. 1054 of 355 km² was granted on 19th October, 1982, and covers part of the Polda Basin on the Eyre Peninsula (see plan no. SAa 1932). It is part of an earlier E.L. of 600 km² (no. 687) that was held by CRAE from 11th August, 1980, to 19th October, 1982.

In 1980 and 1981 CRAE drilled several rotary holes in E.L. 687 in the search for coal and lignite and discovered about 76 Mt of Eocene lignite above a depth of 200 m (see CRAE report no. 10307 for further details).

The Polda Basin is a narrow east-west trending trough containing 800-1000 m of Tertiary, Jurassic, Permian and probable early Palaeozoic sediments onshore, and a greater thickness offshore. Its onshore length is about 130 km and its width varies from about 8 to 20 km. A narrowing of the basin in the vicinity of the ETSA coal deposit (110 Mt of Jurassic coal) separates an eastern sub-basin 60 km long from a western sub-basin which extends well off-shore (see plan no. SAa 2361).



COLUMBIA No.1
MERCURY No.1
Sea bed
QUATERNARY
POELPENA FMN.
POLDA FMN.
PERMO - CARBONIFEROUS
Unit IV
Unit III
Unit II
Unit I
T.D. 2168 m
T.D. 3251 m.
00 m
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
2800
3000
3200
Siltstone
Sandstone
Coal / Lignite
Limestone
Halite
Pebble
Anhydrite
CRA EXPLORATION PTY LIMITED
POLDA BASIN — S.A.
AUSTRALIAN OCCIDENTAL
OFFSHORE DRILL HOLES
REF ELLISTON SI 53-6
SCALE 1:10000 (Vert.)
AUTHOR A.K.S.
DATE Feb. 84.
REPORT 12527
PLAN No SAa 2652

00009

[redacted]

TABLE 1

STRATIGRAPHY OF THE POLDA BASIN

AGE			NAME	ROCK UNIT	THICKNESS (metres)	LITHOLOGY	STRATIGRAPHIC RELATIONS	EXPRESSION
CAINOZOIC	QUATERNARY	Pleistocene		Bridgewater Formation	30 m	Sand, off-white, cemented calcareous, clay interbeds	Uppermost unit in sequence	Outcrops west of Lock and in cliffs Drill Holes
CAINOZOIC	QUATERNARY	?		Undifferentiated	6-7 m	Clay, vari-coloured, calcareous	Underlies Bridgewater Formation	
CAINOZOIC	TERTIARY	Middle Miocene		Undifferentiated	70 m	Green to grey clay & carbonaceous clays. Grey poorly sorted coarse sand & carbonaceous sand	Relationships unknown. Correlated with Munno Para Clay.	Many holes in Polda Trough
CAINOZOIC	TERTIARY	Middle Eocene		Poelpena Formation	Greater than 200 m	Grey, dark grey & brown coarse sand & lignite. Very carbonaceous	Unconformably on Jurassic. Overlain unconformably by ?Miocene or Quaternary	Many holes in Polda Trough - absent on southern edge. 81L41C cored hole.
MESOZOIC		Upper Jurassic		Polda Formation	Greater than 160 m	Dark grey to black very carbonaceous fine sand, silt & lignite and very coarse grey sands	Unconformably on Permian & Precambrian. Unconformably overlain by Tertiary in Polda Basin, conformably by Cretaceous on Ceduna Terrace	Many drill holes in Polda Trough
PALAEOZOIC		Permian		Boorthanna Formation	180 m	Pyritic diamictite & clay	Unconformably on Archaean & Proterozoic. Unconformably overlain by Jurassic	Polda No. 1 stratigraphic drill hole. Tuckey No. 1 stratigraphic drill hole. 80L30C cored hole.
PROTEROZOIC		Adelaidean		Corunna Conglomerate	Exceeds 200 m	Conglomerate, sandstone & shale	Unconformably on Lincoln Complex. Unconformably overlain by Permian, Jurassic & Tertiary	
PROTEROZOIC		Carpentarian	Lincoln Complex			Granite, gneiss, migmatite, granulite, augen gneiss, quartzo-feldspathic gneiss. Synkimban Orogeny granites. Basic intrusives.	Overlain unconformably Corunna Conglomerate. Underlain by Hutchison Group	Southeast and northeast of Lock
PROTEROZOIC		Nullaginian	Hutchison Group	Middleback Formation Warrow Quartzite		Metasiltstone, schist, iron formation, marble & quartzite	Overlain by Lincoln complex & underlain unconformably by Sleaford Complex	Outcrops southeast of Lock. May occur in drill holes
		Lower Proterozoic & Archaean	Sleaford Complex	Widbey Granite Kiana Granite	?	Granite, granite gneiss, schist, granulite metasediments, basic intrusives	Overlain unconformably by Hutchison Group	Outcrops north & south of Lock. May occur in drill holes

It has been known for some years that the Polda Basin contains sediments of Tertiary, Jurassic and Permian age, but not until the drilling of Columbia No. 1 and Mercury No. 1 by Australian Occidental Pty. Ltd. in 1982 was it established that a substantial pre-Permian sequence exists, at least in the offshore part. In Mercury No. 1, drilled on a dome, this older sequence contains 1700 m of halite with interbedded red shales, and may be equivalent to the Cambrian Observatory Hill beds intersected in Wilkinson No. 1 in the Tallaringa Trough.

Although a bromine profile of the salt intersection in Mercury No. 1 was inconclusive, it was felt that the mere presence of the salt was sufficient justification to initiate a potash search in the basin. It was planned to drill a hole in the western sub-basin in 1984, while SADME drilled a stratigraphic hole in the eastern sub-basin. However, the imposition of certain restrictions on E.L. 1054 and the cancellation of SADME's proposed hole made it necessary for CRAE to drill its first hole in the eastern sub-basin.

Fortunately SADME completed a 17 km long seismic traverse, known as the Kilroo seismic section, in the eastern sub-basin, most of it within E.L. 1054, in mid-1983 and results were made available in October and November that year. This clearly defined the basin structure and allowed a drill site to be chosen with confidence. Drilling commenced late in December, 1983, and was in progress at the end of the period covered by this report.

3. GEOLOGY

3.1 Stratigraphy

There are no outcrops of Tertiary, Jurassic or Permian rocks in the Polda Basin, but they are known from a large number of drill holes, the more important being Polda 1, Polda 8 and Lock 1 (drilled by SADME); 80L30C, 81L41C and 81LRM64 (drilled by CRAE, report no. 10307), RWF16 and RWF21 (drilled by Esso Australia Ltd., envelope 3783) and the two oil wells mentioned earlier. A summary of the stratigraphy appears in Table 1.

The Tertiary consists of grey clays and poorly sorted sands probably of Middle Miocene age and a Middle Eocene unit, the Poelpena Formation, of carbonaceous sands and lignite. Total Tertiary thickness is over 200 m in places. The Upper Jurassic Polda Formation, of fine and coarse sands, carbonaceous mudstone and lignite is at least 160 m thick onshore but is 500 m thick in Mercury No. 1.

Pre-Jurassic clays, sandstones and diamictites have been dated as late Carbonaceous-early Permian and have been given the name Coolardie Formation. This formation is at least 180 m thick (Lock 1) and is equated with the Boorthanna Formation in the Arckaringa Basin and the Cape Jervis Beds in the Troubridge Basin (Cooper, Harris and Meyer, 1982).

Subsurface information below the Permian is sketchy and is available only from the two offshore holes Columbia No. 1 and Mercury No. 1. Summary logs of these two holes are given in Appendix I and graphic logs in plan no. SAa 2652. The former penetrated 1 400 m of shales and sandstones with minor limestone and dolomite, whilst the latter intersected 500 m of calcareous red-brown siltstone overlying 1 700 m of halite and red siltstones and bottoming in 150 m of calcareous sandstone. It is thought that this sequence may be equivalent to the Observatory Hill Beds of Cambrian age in the Officer Basin. Onshore there are exposures of arkosic sandstone, grit and conglomerate, known as the Corunna Conglomerate, which are usually assigned to the Adelaidean although their age is uncertain. Carpentarian granites and gneisses, and metasediments of the Hutchison Group, crop out in places around the margins of the basin and are presumed to form the floor of the basin.

? Blue Range Beds

3.2 Structure

The Polda Basin is believed to have formed as a result of partial rifting during the separation of the Australian and Antarctic plates at some stage in the Palaeozoic.

As mentioned earlier, the Polda Basin is divided into two sub-basins by a narrow shelf west of Lock. The eastern sub-basin, henceforth called the Kilroo Sub-basin, has a sharp northern boundary defined by a series of faults interpreted from regional and detailed gravity and from drilling (CRAE report no. 10307). The throw on this fault is in the order of 1 000 m, and its location is shown on plan no. SAa 2361. The sub-basin shelves more gently to the south.

The Kilroo seismic traverse provided some very useful information as well as confirming the existing structural interpretation. The final processed data is shown on plan no. SAa 2653 and the geological interpretation on an overlay (plan no. SAa 2654). Shot points are shown on the regional plan (no. SAa 2361) and in more detail on plan no. SAa 2655.

Interpretation of the seismic data was carried out by SADME and also by CRA Oil Group geologists. The Miocene-Eocene boundary is tentatively drawn at a strong reflection although its true location is not known. The Eocene-Jurassic boundary is reasonably well defined from palynology carried out on Tuckey 1, 80LRM4 and 81L41C, although it is not defined by any obvious reflector. The reflection just above the base of the Tertiary is almost certainly due to the lignite seam encountered in 80LRM5, 81L41C and 80LRM64 (15 m thick in 81L41C). The boundary between the relatively unconsolidated Jurassic sediments and the hard Permian diamictites is probably the next major reflector, as shown, and this is supported by the small-scale arcuate reflections in the vicinity of shot point 430 that are believed to be characteristic of reflection patterns off large boulders lying in a less dense matrix.

The high speed of the next unit (3600-3800 m/s) may be caused by the presence of dense carbonates as in the Observatory Hill Beds elsewhere, although this speed is more characteristic of the Boorthanna Formation diamictites in the Tallaringa Trough (Milton, 1975). The significance of the strong reflector below this interval is unknown, especially as the next interval has a velocity around 2900-3300 m/s which is well below the speed expected for crystalline basement (over 5 000 m/s).

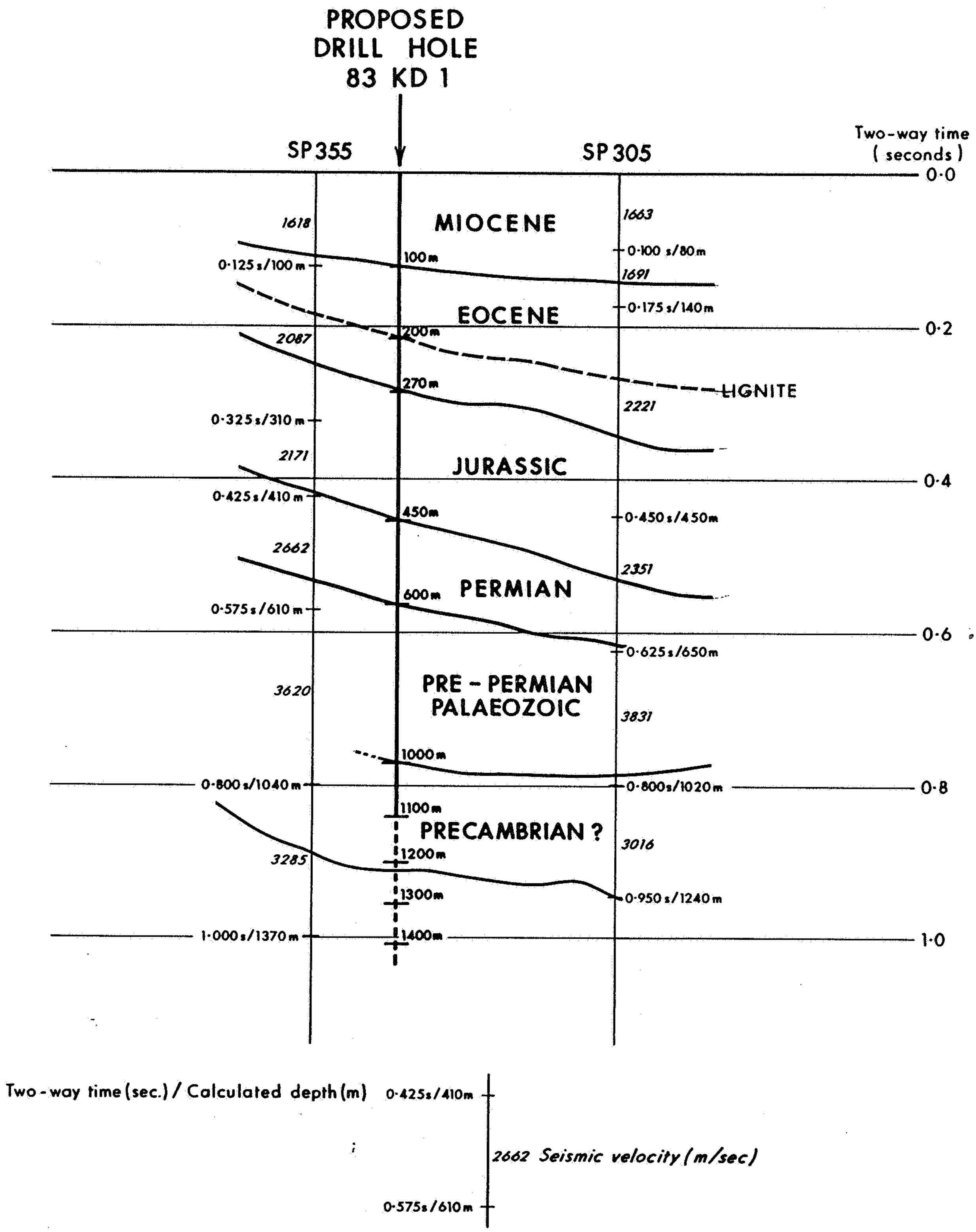
3.3 Halite

Occidental offshore hole Mercury No. 1 is known to have been drilled on a salt dome (from their own seismic work) and this almost certainly explains the thick (1 700 m) intersection of halite and interbedded halite and siltstone that was obtained between 1 400 and 3 100 m. CRAE carried out bromine in halite analyses on 5 m composite samples over the whole of the salt-bearing interval but the results were inconclusive. (See Appendix II for assays). Values ranged from 8 to 400 ppm Br but no trends were evident. It is believed that the rather erratic Br distribution is a result of remobilisation of the salt, a feature that would be in accordance with the interpreted diapir.

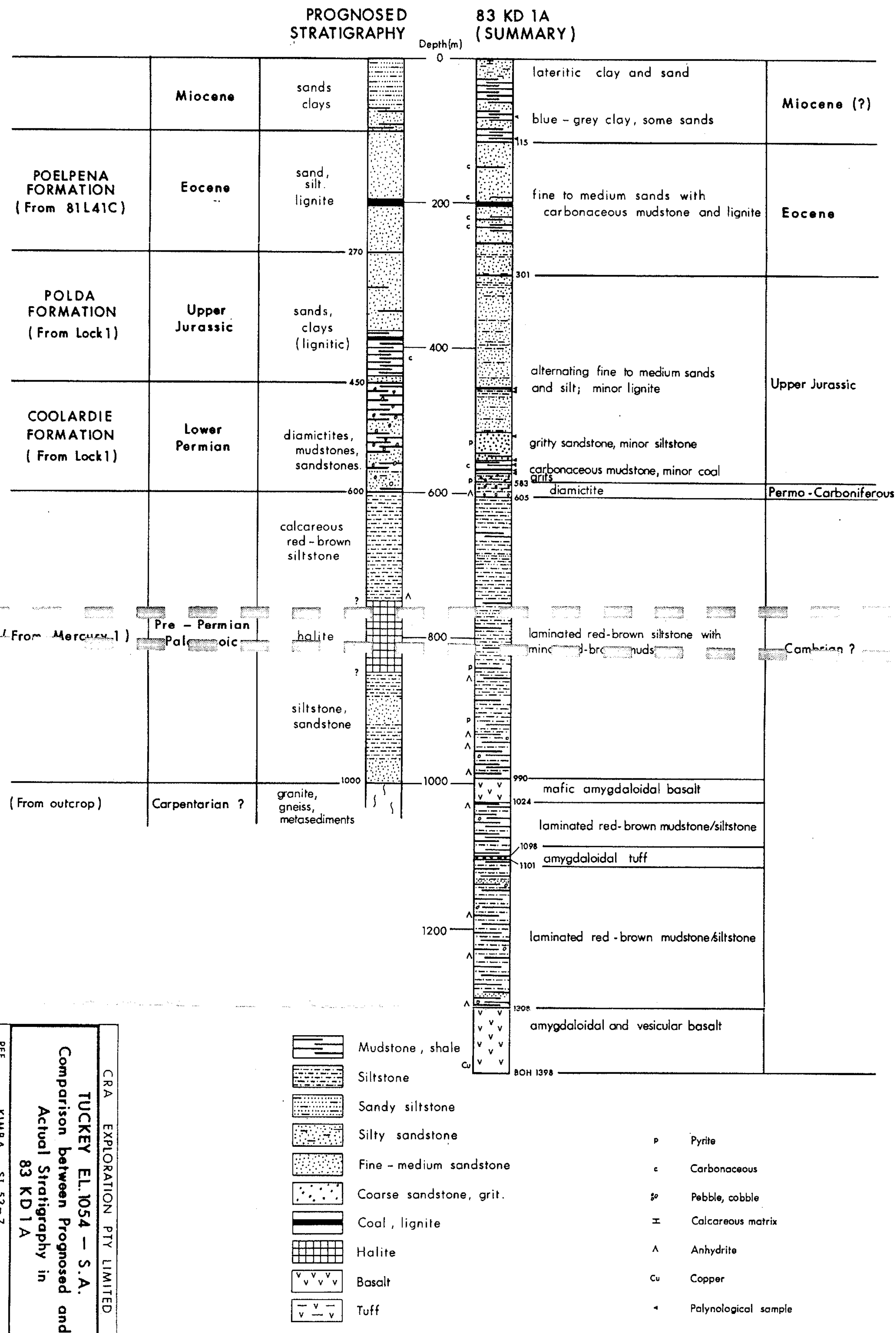
4. DRILLING

4.1 Site Selection

The latitude of 83KD1 was selected entirely on the basis of the Kilroo seismic section. If potash-bearing evaporites exist in the basin, they will probably occur in the pre-Permian depocentre, which is most likely to coincide with the deepest part of the basin, near the northern bounding fault. This was refined by the interpretation of a possible small sub-basin beneath the Permian at shot point 340. Long-



CRA EXPLORATION PTY LIMITED	
TUCKEY E.L.1054 — S.A. **Kilroo Seismic Section.** **Depth Calculations for Proposed Drill Hole 83 KD1**	
REFERENCE KIMBA SI 53-7	
SCALE 1 : 25000 (H)	
AUTHOR A.K.S.	REPORT 12527
DATE Nov. 83	PLAN No SAa 2656



CRA EXPLORATION PTY LIMITED

TUCKEY EL.1054 – S.A.
Comparison between Prognosed and Actual Stratigraphy in 83 KD 1A

REF	KIMBA SI 53-7		
SCALE	1 : 5000	REPORT	12673
AUTHOR	A. K. S.		
DATE	Feb. 84	PLAN No	SAa 2657

itudinally, the seismic traverse is approximately in the middle of the Kilroo sub-basin, and close to a small sub-basin interpreted from a detailed gravity traverse carried out in 1980 by CRAE (see CRAE report no. 10307). Furthermore, it was believed that a significant potash deposit would be detectable over a strike length of several km. The hole was therefore sited on the seismic section at SP~~340~~ 338 where at least a small amount of stratigraphic control was available.

4.2 Prognosed Geology

Depths to the reflectors that would be encountered in 83KD1 were calculated from the velocity scans at SP305 and SP355, (shown in boxes at the top of the seismic section). Calculations and depths are shown on plan no. SAa 2656. It should be remembered that the calculated depths are only approximate because the velocity intervals do not coincide with reflectors in every case, and also because velocities vary from place to place due to natural variations in the physical properties of the rocks.

From plan no. SAa 2654, the expected stratigraphy and depths are as follows:

Miocene	0 - 100
Eocene	100 - 270
Jurassic	270 - 450
Permian	450 - 600
Pre-Permian	600 - 1 000
Precambrian (?)	1 000+

Plan no. SAa 2657 shows this in graphic form.

4.3 Planning

The general drilling plan was to drill a large diameter (say 150 mm) hole with blade and/or roller bit down to the Permian diamictites and case off in hard rock between 450 and 500 m. Diamond coring would then commence in HQ size and continue to about 800 m where the HQ rods would remain in the hole as casing while coring was taken to final depth (about 1 100 m) in NQ. The hole would be geophysically logged at the completion of rotary drilling and again at final depth.

The selection of drilling muds was a major item in the planning stages. A high viscosity, high solids bentonite/polymer mud was considered suitable for the rotary section where wall stability in soft shales and friable sands was of utmost importance. For the cored section of the hole, Baroid Australia was engaged to supply a mud programme (see Appendix III) and an on-site engineer. The basis of the drilling mud for this section was to be a saturated KCl fluid which would be expected to provide almost full recovery of potash-bearing core, although halite might suffer partial dissolution. An oil-based mud is normally regarded as the best medium for obtaining complete recovery of potash, but the cost of such a system for a hole of this size would be in the vicinity of $50 000. This was regarded as excessive for a one-off exploration hole in a relatively unknown basin.

The drilling contract was awarded to F.A. Kelly Pty. Limited primarily because of the availability of a Warman 1500 rig which would be capable of continuing to 1400 or 1500 m if the need arose. Most other contractors in the same price range were offering Longyear 44 machines, the uprated version of which is rated at about 1 200 m in NQ.

4.4 Drilling Operations

For budgetary reasons the hole was commenced at short notice on December 19, 1983, although it was known that a three-week break was to be taken from Christmas to mid-January, 1984. The hole progressed to 336 m by 21st December, where a hard band was encountered. Many problems with mud breakdown had also been experienced. It was thus decided to circulate a heavy mud and cease drilling until mid-January, as there was insufficient time to carry out drilling, logging and casing before Christmas.

Operations recommenced on 17th January, 1984. On re-entry, it was found that a clay unit between the surface casing (set to 37 m) and 115 m had expanded and filled the hole. Circulation was lost on re-drilling through this material, and the problem of mud breakdown was again experienced. It was then decided to abandon the hole, and a new hole, 83~~84~~KD1A, was collared 10 m away on 20th January.

4.5 Geology of Drill Hole

Samples were collected at 2 m intervals, although the slow rate of penetration caused grinding of the shale and silt units, so that very little of these lithologies reached surface in recognisable chips.

A summary graphic log, as compared with the expected stratigraphy, is presented on plan no. SAa 2657, and a summary log is given below. Since the hole is in its early stages, the detailed log of this section of the hole will be given in the next quarterly report so that a complete log will be presented therein.

Miocene (?)	0 - 26	Lateritic clayey sand
	26 - 56	Lateritic clay. Base of oxidation at 56 m
	56 -115	Blue-grey clay, with minor sandy interbeds
Eocene (Poelpena Fm)	115 -199	Fine-medium sands with minor coarse sand and carbonaceous mudstone
	199 -204.5	Lignite
	204.5-301	Medium sands with minor siltstone, carbonaceous shale and lignite
Upper Jurassic (Polda Fm)	301 -336	Interbedded siltstone and fine to medium sands

Note: Formation boundaries are tentative at present.

4.6 Discussion

The base of the blue-grey clay at 115 m is reasonably close to the strong reflector estimated to lie at about 100 m. Whether this is in fact the Miocene/Eocene boundary is open to question.

The 5.5 m thick band of lignite at 199 m coincided very well with its estimated depth (200 m).

The Eocene/Jurassic boundary is very tentative at this stage. It is based on the appearance of the first of several compact, rather hard, carbonaceous shales.

Palynological examination of cuttings may help to locate these boundaries more accurately.

[illegible] per A.K. Scott.

A.K. SCOTT

AKS/pw

EXPENDITURE

Expenditure for the period ended 31st January, 1984, the nearest accounting period was $55 531.00, as listed below.

	$
Drilling	40 151
Payroll	6 768
Supplies	2 855
Vehicle	602
Travel	213
Property	462
Tenements	608
Contractors	1
Overheads	3 871
	$55 531

STATION 850		
TIME	VRMS	VINT
0	1600	1685
175	1685	2512
225	1900	2510
400	2188	2400
600	2261	4546
2002	4000	

STATION 805		
TIME	VRMS	VINT
0	1600	1753
225	1753	2667
400	2200	2776
575	2390	4489
2000	4002	

STATION 755		
TIME	VRMS	VINT
0	1600	2001
250	2001	2449
400	2180	1872
500	2122	4081
550	2368	2622
675	2417	4602
2000	4000	

STATION 705		
TIME	VRMS	VINT
0	1600	1884
225	1884	1790
300	1861	2934
350	2049	2564
500	2216	3005
650	2421	3034
775	2530	4698
2000	4000	

STATION 655		
TIME	VRMS	VINT
0	1600	1681
175	1681	2361
400	2091	2784
625	2364	3044
775	2510	4705
2000	4022	

STATION 605		
TIME	VRMS	VINT
0	1600	1838
200	1838	2141
325	1960	2885
350	2040	2350
425	2098	2728
500	2204	2346
575	2223	2967
725	2396	3702
900	2700	4809
2000	4000	

STATION 555		
TIME	VRMS	VINT
0	1600	1903
225	1903	2284
325	2028	2363
400	2095	2578
500	2200	2830
700	2397	4639
2000	4000	

STATION 505		
TIME	VRMS	VINT
0	1600	2036
300	2036	2688
550	2355	2773
650	2424	4278
725	2676	4585
2000	4000	

STATION 455		
TIME	VRMS	VINT
0	1650	1800
100	1800	2131
250	2005	1894
350	1974	2993
500	2327	3729
625	2667	3987
925	3156	4604
2000	4000	

STATION 405		
TIME	VRMS	VINT
0	1600	1700
100	1700	1996
250	1883	2279
350	2004	2083
400	2014	3184
625	2499	2965
900	2650	4832
2000	4000	

STATION 355		
TIME	VRMS	VINT
0	1600	1618
125	1618	2087
325	1920	2171
425	1982	2662
575	2180	3620
800	2665	3285
1000	2800	4915
2000	4000	

STATION 305		
TIME	VRMS	VINT
0	1600	1663
100	1663	1691
175	1675	2221
450	2026	2351
625	2122	3831
800	2594	3016
950	2665	4904
2000	4000	

STATION 255		
TIME	VRMS	VINT
0	1600	1640
150	1640	1949
250	1770	1876
450	1818	3347
575	2241	3216
850	2597	4779
2000	4000	

STATION 206		
TIME	VRMS	VINT
0	1950	2091
200	2091	2452
250	2168	2905
975	2735	4910
2000	4000	

SOUTH AUSTRALIAN

DEPARTMENT OF MINES AND ENERGY

SURVEY : POLDA BASIN

AREA : 83-001

LINE : 1

SP : 180 - 846

FINAL STACK

NORTH

RECORDING PARAMETERS

RECORDED BY : DME

INSTRUMENTS : INPUT/OUTPUT DHR 1632
24 CHANNEL

RECORD LENGTH : 2 SECS.

RECORDING FILTER : 500/OUT

SPREAD DIAGRAM :

TR.1 TR.24
* I---------------------- I

SHOT PATTERN :

* I <-----------575M-----------> I
* I <-----------575M-----------> I
* I <-----------575M-----------> I

DATE RECORDED : 1983

GEOPHONE TYPE : SINGLE/MARK PRODUCTS L25E 40 HZ.

NUMBER OF GROUPS : 24

COVERAGE : 600%.

GROUP INTERVAL : 25 M.

SHOT INTERVAL : 50 M.

SPREAD PATTERN : 0 -- 50 -- 625

ENERGY SOURCE : 1 KG. ANZITE BLUE

SOURCE DEPTH : 20 M. AVERAGE

SURVEY DATUM : 0 METRES A.H.D.

PROCESSING SEQUENCE

[1] REFORMAT FROM SEGB
RESAMPLE TO 2 MS. SAMPLE RATE

[2] PREFILTER (DESIGNED AND APPLIED IN F-K DOMAIN

[3] PREDICTIVE DECONVOLUTION :
GAP = 20 MSEC.
120 MSEC. OPERATOR
0.1% WHITE NOISE ADDED
2 GATES (LENGTH = 800 MSEC.

[4] DATUM STATIC CORRECTIONS USING DIGICON'S STATICS
(PROCESSING DATUM = 100 M.

[5] COMMON DEPTH POINT GATHER

[6] VELOCITY ANALYSIS BEFORE RESIDUAL STATICS

[7] RESIDUAL STATICS COMPUTATION AND APPLICATION

[8] VELOCITY ANALYSIS AFTER RESIDUAL STATICS

[9] NORMAL MOVEOUT CORRECTION

[10] PRE-STACK MUTE (COMPUTER GENERATED STRETCH MUTE

[11] TIME VARIANT EQUALIZATION (WINDOW LENGTH 500 MS.)

[12] COMMON DEPTH POINT STACK 6 FOLD

[13] DIGITAL BANDPASS FILTER :

TIME (SECONDS)	BANDPASS/SLOPE (DB/OCTAVE)
0.0	20/18 100/36 HZ
0.6	15/18-80/36 HZ
1.4	15/18-70/36 HZ
1.6	25/18-72/36 HZ

[14] TIME VARIANT EQUALIZATION (WINDOW LENGTH 100 MS.)

PROCESSED BY : DIGITAL EXPLORATION LTD.

DIGICON, BRISBANE

QUALITY CONTROL CHECK

8288-1

GEOPHYSICIST : RICK SLACK
SUPERVISOR : KEN ALLEN

DATE : OCTOBER 1983

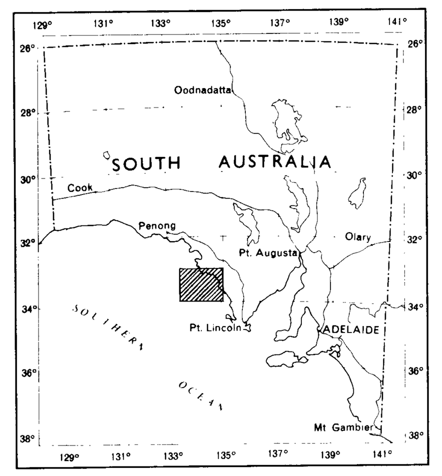
HORIZONTAL SCALE : 50 TRACES/INCH
VERTICAL SCALE : 5 INCHES/SEC
POLARITY : NORMAL RELATIVE TO FIELD RECORDING

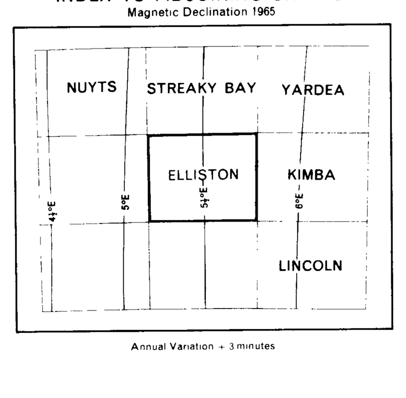
Scale 1 : 25 000

TUCKEY E.L. 1054 - KILROO SEISMIC SECTION Report 12527

ELLISTON
GEOLOGICAL SURVEY OF SOUTH AUSTRALIA
DEPARTMENT OF MINES, ADELAIDE

KIMBA
GEOLOGICAL SURVEY OF SOUTH AUSTRALIA
DEPARTMENT OF MINES, ADELAIDE





CROWN COPYRIGHT RESERVED

SCALE

1:250,000

MILES 2 0 2 4 6 8 10 12 14 16 18 20 MILES

KILOMETRES 5 0 5 10 15 20 25 KILOMETRES

Published 1971

BOUGUER ANOMALY MAP

Density 2.67 gm/cm^3

Compiled by I. S. Rowan, Geophysicist, R. A. Gerdes, Assistant Senior Geophysicist.

Map preparation by Cartographic Division, S.A. Department of Mines.

Printed for the Geological Survey of South Australia as a contribution to the Geophysical Atlas of Australia.

This map was compiled from gravity readings taken by the South Australian Department of Mines. Acknowledgement is made of the Bureau of Mineral Resources whose Isogal stations provided references to absolute gravity values. The Bouguer results are gravity values adjusted for latitude and elevation obtained from barometric levelling referred to S.A. Department of Lands Bench Marks (elevation correction 0·060 milligals/foot). Results reduced by the Exploration Geophysics Section, S.A. Department of Mines. D. McPharlin, B.Sc. Senior Geophysicist.

G. F. Whitten, M.Sc., Supervising Geologist, Exploration Services Division.

Compiled under the direction of L. W. Parkin, Government Geologist, Director of Mines.

Issued under the authority of the Honourable D. A. Dunstan, M.P., Minister of Development and Mines.

LEGEND

Bouguer Anomaly Contours (contour interval 2 milligals) .... +20

Gravity Anomaly:

- High ....
- Low ....

Gravity Station:

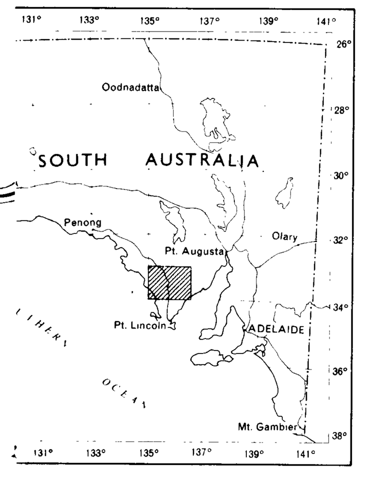
- S.A. Department of Mines ....
- S.A. Department of Mines (marked) ....
- B.M.R. ....

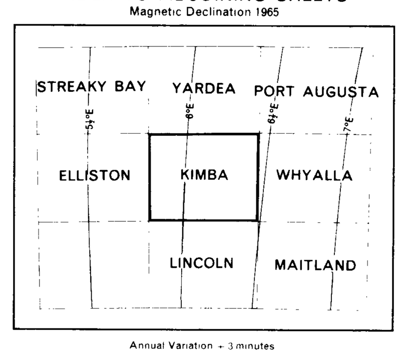
Road, Track ....

Railway ....

Watercourse, Playa ....

Vermin Proof Fence ....





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Copies of this map may be obtained from the Geological Survey of South Australia, Department of Mines, Adelaide, or the Bureau of Mineral Resources, Geology and Geophysics, Canberra, A.C.T.

KEY TO DRILLHOLES

Colton 1, Mucka Cudla 1, Polda 1, Lock 1, Tuckey 1	SADME Stratigraphic holes.
81 LRM 41	CRAE (report No. 10307)
RWF 3	ESSO AUST. LTD. (SADME env. 3783)
Gemini 1A	OUTBACK OIL N.L.
Mercury 1, Columbia 1	AUSTRALIAN OCCIDENTAL P/L

Ꝑu	CORUNNA CONGLOMERATE Arkosic sandstone, grit, conglomerate.	ADELAIDEAN
+ +	Granite, gneiss.	CARPENTARIAN
Ꝑm	HUTCHISON GROUP Metasediments	CARPENTARIAN

- F U/D — Interpreted Fault
- CRAE Gravity Traverse (1980)
- SADME Seismic Traverse
- —?— Sea-level contour on Pre-Cambrian Surface
- SADME Gravity Traverse (1978)
- CRAE Gravity Traverse (1983)

80
8288-2

CRA EXPLORATION PTY. LIMITED.	
POLDA BASIN — S.A. GEOLOGY, GEOPHYSICS & DRILL HOLES	
Ref ELLISTON SI 53-6, KIMBA SI 53-7	
Scale 1 : 250000	
Author A.K.S	Report No. 12673
Date Jan. 1984	Plan No. SAa 2361

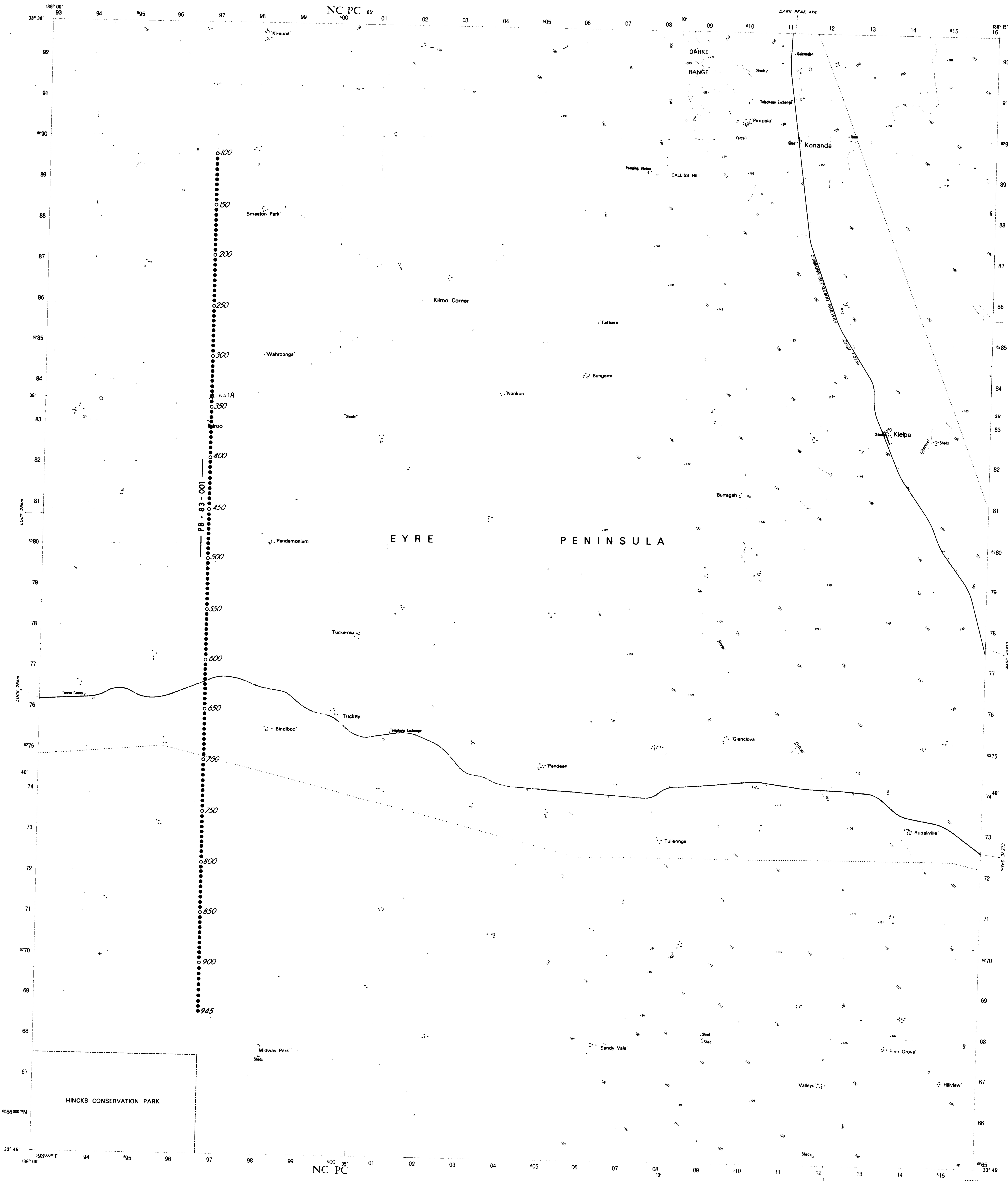
1:50 000 TOPOGRAPHIC SERIES

KIELPA

SOUTH AUSTRALIA

6130 — IV

FIRST EDITION



AUTHORITY ...... Issued under the authority of the Minister of Lands. Prepared under the direction of the Surveyor General. Crown Copyright Reserved

PRODUCTION ...... In compliance with National Mapping standards by the Department of Lands.

PROJECTION ...... Transverse Mercator Projection. Australian Geodetic Datum, 1966

GRID ...... Australian Map Grid Zone 53, Central Meridian 135°E.

ELEVATION ...... Australian Height Datum. Elevations in metres.

CONTROL ...... Triangulation and Traverse by the Division of National Mapping, the Royal Australian Survey Corps and the South Australian Department of Lands.

DETAIL ...... Aerial Photography, Svy. S A 2170. January,1978.

PHOTOLITHOGRAPHY D.J Woolman, Government Printer, 1980.

SCALE 1:50 000

METRES 1000 0 1 2 3 4 5 KILOMETRES

CONTOUR INTERVAL 10 METRES

The representation of a road on this map is no evidence of the existence of a right of way

WORLD GEODETIC SYSTEM

To convert World Geodetic System 1972 to Australian Geodetic Datum 1966 coordinates on which this map is based: Increase the numerical value of latitudes by 5.0" equivalent to 155 m. Decrease the numerical value of longitudes by 4.4" equivalent to 113 m. To obtain heights above mean sea level decrease satellite heights by 4 m.

GRID REFERENCE

GRID ZONE DESIGNATION 53H 100 000 METRE SQUARE IDENTIFICATION NC PC 600	TO GIVE A STANDARD REFERENCE ON THIS SHEET TO NEAREST 100 METRES	
	SAMPLE POINT Tennis Courts	
	1 Read letters identifying 100 000 metre square in which the point lies	NC
	2 Locate first VERTICAL grid line to LEFT of point and read LARGE figures labelling the line in either the top or bottom margin, or on the line itself	93
	3 Estimate tenths from grid line to point	8
IGNORE the SMALLER figures of any grid number; these are for finding the full co-ordinates. Use ONLY the LARGER figures of the grid number, example: 6266000mN	4 Locate first HORIZONTAL grid line BELOW point and read LARGE figures labelling the line in either the left or right margin, or on the line itself	76
	5 Estimate tenths from grid line to point	3
	SAMPLE REFERENCE	NC938763
	If reporting beyond 18° in any direction, prefix Grid Zone Designation, as	53HNC938763

Before giving a grid reference, civilian users should state the number and name of this map.

G.N. T.N. M.N.

Grid Convergence 0°37'

Grid Magnetic Angle 7°00'

The relationship between True North, Grid North and Magnetic North is shown diagrammatically for the centre of this map. Magnetic Value is correct for 1975. Annual Change is 01' Easterly

Built-up area; Parks, recreation areas.
Road, sealed surface, two or more lanes; National route marker
Road, sealed surface, one lane.
Road, unsealed surface, two or more lanes; Bridge
Road, unsealed surface, one lane. Gate; Cattle grid
Vehicular track.
Railway, multiple track; Station, Siding.
Railway, single track, Cutting, Embankment.
Building; Post office; Police station, School
Hospital; Church; Mine; Windmill
Fence; Quarry.
Power transmission line; Levee or bank.

Survey beacon. Spot
Rock, bare or awash. Reef
Lake, perennial. Watercourse
Lake, intermittent. Land subject to inundation
Lake, mainly dry. Land subject to occasional flooding
Dam or waterhole on watercourse; Tank or small dam
Contours; Depression contours.
Sand. Sand ridges.
Pine plantation. Orchard or vineyard
Windbreak.
Trees and scrub, scattered
Trees and scrub, medium, dense.

INDEX TO HUNDREDS

	DARKE	PASCOE
BOONERDO	SMEATON 6130-IV	
MURLONG	RUDALL	

ADJOINING SHEETS

HAMBIDGE 6031-II	DARKE 6131-III	CARAPPEE 6131-II
PALKAGEE 6030-I	KIELPA 6130-IV	RUDALL 6130-I
NICHOLLS 6030-II	HINCKS 6130-III	VERRAN 6130-II

JWP EJ

●●●●●●●○●●●●●●● Seismic Line

—— PB - 83 - 001 —— Seismic Line Number

600 Shot Point Number

8288-3

CRA EXPLORATION PTY. LIMITED.

TUCKEY E.L.1054 — S.A.

KILROO SEISMIC SECTION SHOT POINTS

Ref. :	KIMBA SI 53 — 7		
Scale	1 : 50 000		
Author	A. K. S.	Report No.	12527
Date.	Feb. 84.	Plan No.	SAa 2655

8288-4

CRA EXPLORATION PTY LIMITED	
TUCKEY E.L.1054 – S.A.	
KILROO SEISMIC SECTION INTERPRETATION	
Ref KIMBA SI 53-7	
Scale 1 : 25000	
Author A K S	Report No 12527
Date Feb 1984	Plan No SAa 2654

REFERENCES

Cooper, B.J., Harris, W.K. & Meyer, G.M., 1982 — The Late Palaeozoic Coolardie Formation, Polda Basin. G.S.S.A. Quart. Geol. Notes, No. 81.

Milton, B.E. 1975 — Reconnaissance Seismic Exploration, Southwest Arckaringa Basin, S.A., 1974. G.S.S.A. Quart. Geol. Notes, No. 53.

LOCATION

Kimba SI 53-7 1:250 000

KEYWORDS

Coal, Halite, Potash, Basin, Drill-rotary, Geophys-seismic.

LIST OF PLANS

Plan No.	Title	Scale
SAa 1932	Tuckey E.L. 1054 Location Map	1:250 000
SAa 2361	Tuckey E.L. 1054 Polda Basin - S.A. Geology, Geophysics and Drill-Holes	1:250 000
SAa 2652	Polda Basin. Australian Occidental Offshore Drillholes	1: 10 000
SAa 2653	Tuckey E.L. 1054. Kilroo Seismic Section	1: 25 000
SAa 2654	Tuckey E.L. 1054. Kilroo Seismic Section. Interpretation	1: 25 000
SAa 2655	Tuckey E.L. 1054. Kilroo Seismic Traverse. Shot Points.	1: 50 000
SAa 2656	Tuckey E.L. 1054. Kilroo Seismic Section. Depth Calculations for Proposed Hole 83KD1.	1: 25 000
SAa 2657	Tuckey E.L. 1054. Comparison between Prognosed and Actual Stratigraphy in 83KD1.	1: 5 000

LIST OF TABLES

LIST OF APPENDICES

APPENDIX I

SUMMARY LOGS OF MERCURY NO. 1 AND COLUMBIA NO. 1

MERCURY NO. 1

Australian Occidental Pty. Ltd. (Petroleum Division)

Lat. 33° 33' 47.5" S
Long. 134° 14' 14.0" E

November '81 - February '82

Total Depth - 3 251 m
Water Depth - 77 m

RKB 16 m above sea level
Sea bed at depth of 93 m below RKB

Quaternary	93- 110 m	
Poelpena Fm.	110- 288 m	
Polda Fm.	288- 799 m	Claystone, sst, lst with minor coal 660-770 m. Best coal 3 m @ 740 m
Permo-Carb.	799- 886 m	Claystone, conglomerate, shale
Pre-Permian:		
Unit III	886-1393 m	Calc. red bed sequence as interbedded stst and sst (sandier near base). Trace anhydrite at base.
Unit II	1393-3100 m	Massive clear light orange-brown halite with minor shale and dolomitic interbeds. 1393-1556 Halite 95% 1556-1609 Lst, shale. Halite nil. 1609-2255 Halite 95% 2255-2538 Shale interbeds. Halite 50% 2538-2824 Dolomitic stst. Halite 5% 2824-2978 Stst interbeds. Halite 60% 2978-3100 Halite 90%. Stst interbeds
Unit I	3100-3251 m	Well sorted sst with calc cement. Some silty zones.

COLUMBIA NO. 1

Australian Occidental Pty. Ltd.

Lat. 33° 29' 38.9" S
Long. 133° 53' 4.5" E

February-April '82

Total Depth - 2 168 m
Water Depth - 74 m

RKB 17 m above sea level
Sea bed at depth of 91 m below RKB

Quaternary	91-	112 m	
Poelpena Fm.	112-(?)270 m		
Polda Fm.	(?)270-	706 m	Stst, becoming sandier towards base. Bottom 150 m mainly sst. Minor coal in lower two-thirds.
Permo-Carb.	706-	771 m	Boulder clay, stst.
Pre-Permian:			
Unit IV	771-	954 m	Mainly stst with minor sst interbeds. Dol. and lst. interbeds 771-830 m. Minor anhydrite 900 m.
Unit III	954-	1286 m	Silty sst and stst 954-1060 m. Mainly sst 1060-1286 m except for lst 1165-1175 m and stst 1175-1195 m.
Unit II	1286-	1701 m	Stst with very minor dol. and lst. 1286-1674 m. Sst 1674-1701 m. Anhydrite 1610 m.
Unit I	1701-	2168 m	Stst 1701-1735 Sst 1735-1997 Stst 1997-2168

APPENDIX II

BROMINE IN HALITE ANALYSES FROM MERCURY NO. 1

[redacted]

amdel 164 samples Re-analysed

Analysis code B1/1 Report AC 5759/83

Order B 0504 Results in ppm

Sample		% Halite	Br
951150	1345	2.50	360
951151	1355	2.20	320
951152	1365	2.80	430
951153	1375	2.50	420
951154	1385	2.00	370
951155 <1400	1395	2.50	390
951156		6.30	280
951157		7.10	230
951158		7.20	240
951159		6.60	190
951160		8.60	270
951161		9.50	270
951162		6.30	220
951163		7.70	260
951164		7.20	240
951165		74.3	10
951166		76.6	10
951167		83.2	15
951168		61.7	15
951169		87.4	35
951170		87.6	10
951171		86.8	110
951172		87.2	10
951173		89.1	15
951174		90.9	15
951175		82.1	20
951176		78.0	20
951177		67.4	400
951178		80.4	25
951179		89.3	15
951180		91.2	20
951181		90.5	50
951182		92.9	50
951183		91.2	40
951184		52.8	80
951185		39.1	85
951186		96.0	15
951187		51.7	65
951188		21.0	160
951189		18.0	190
Detn limit			(5)

[redacted]
U0027

Analysis code B1/1 Report AC 5759/83 Page 2

Order B 0604 Results in ppm

Sample	% Halite	Br
951190	24.4	210
951191	27.2	210
951192	18.0	280
951193	34.5	130
951194	85.2	15
951195	77.1	35
951196	47.6	35
951197	88.6	15
951198	88.8	10
951199	77.8	15
951200	90.4	10
951201	82.9	15
951202	65.5	35
951203	56.5	60
951204	50.7	25
951205	44.5	40
951206	90.5	15
951207	85.1	10
951208	75.3	10
951209	70.4	20
951210	79.7	20
951211	84.1	10
951212	78.6	20
951213	82.1	5
951214	87.7	55
951215	92.3	15
951216	49.4	35
951217	76.6	25
951218	88.4	15
951219	87.8	20
951220	91.9	20
951221	92.4	15
951222	93.5	30
951223	89.2	10
951224	93.7	20
951225	93.7	10
951226	85.7	130
951227	77.7	20
951228	90.6	5
951229	89.7	10

Detn limit (5)

amdel

Analysis code B1/1   Report AC 5759/83

Order B 0604   Results in ppm

Sample	% Halite	Br
951230	88.1	15
951231	88.7	15
951232	89.1	10
951233	87.2	10
951234	90.8	5
951235	89.0	15
951236	87.9	<5
951237	89.0	10
951238	73.8	35
951239	87.2	15
951240	84.7	10
951241	65.8	10
951242	85.0	20
951243	90.0	25
951244	88.9	25
951245	92.2	20
951246	87.3	20
951247	88.8	15
951248	82.2	20
951249	76.7	10
951250	82.0	10
951251	83.8	20
951252	88.8	15
951253	90.7	5
951254	85.0	15
951255	92.0	15
951256	92.5	5
951257	94.2	5
951258	93.3	15
951259	88.9	<5
951260	91.7	15
951261	91.2	5
951262	92.0	15
951263	85.0	5
951264	91.2	5
951265	84.7	5
951266	94.1	15
951267	91.1	110
951268	90.2	10
951269	93.3	5
Detn limit		(5)

amdel

Analysis code B1/1 Report AC 5759/83 Page 4

Order B 0604 Results in ppm

Sample	% Halite	Br
951270	96.4	5
951271	94.9	5
951272	92.0	10
951273	88.2	5
951274	89.0	5
951275	92.5	10
951276	91.2	5
951277	91.0	5
951278	93.1	<5
951279	92.8	10
951280	100.1	<5
951281	87.3	5
951282	92.1	5
951283	83.0	20
951284	89.5	5
951285	85.2	5
951286	87.7	15
951287	89.7	5
951288	93.9	5
951289	94.6	10
951290	90.5	10
951291	91.0	5
951292	90.9	15
951293	91.4	10
951294	93.0	15
951295	94.9	5
951296	95.5	10
951297	92.0	5
951298	92.8	15
951299	91.2	10
951300	91.6	15
951301	88.9	<5
951302	89.0	60
951303	88.9	10
951304	88.6	20
951305	80.3	20
951306	78.5	5
951307	83.6	15
951308	91.8	5
951309	85.5	20
Detn limit		(5)

[redacted]

00030

amdel

Analysis code B1/1 Report AC 5759/83 Page 5

Order B 0604 Results in ppm

Assayed by Comlabs.

Sample	Comlabs	% Halite	Br	Comlabs
951310		82.9	15	
951311		88.5	15	
951312		82.6	5	
951313		73.6	10	
951314		84.2	10	
951315		87.2	20	
951316		82.5	20	
951317		89.8	10	
951318 <2220		90.2	5	
951319		22.6	150	
951320		46.4	40	
951321		36.0	60	
951322	23.6	34.3	130	160
951323	36.9	48.3	40	35
951324	-	61.7	35	-
951325	85.4	84.2	5	12
951326	77.4	78.9	10	12
951327	87.4	93.4	5	8
951328	86.5	88.3	10	8
951329	88.0	90.1	<5	8
951330	26.0	28.6	15	60
951331	10.2	11.4	200	170
951332	9.25	10.2	230	150
951333	25.9	31.4	90	60
951334	13.1	13.3	150	100
951335	9.50	10.4	230	140
951336	-	10.3	150	-
951337	6.85	6.80	200	-
951338		10.5	150	
951339		10.6	150	
951340		10.1	150	
951341		24.0	55	
951342		28.2	75	
951343		13.2	140	
951344		11.7	180	
951345		14.3	100	
951346		18.2	85	
951347		12.8	180	
951348		10.9	170	
951349		10.5	140	
Detn limit			(5)	

amdel

Analysis code B1/1 Report AC 5759/83 Page 6

Order B 0604 Results in ppm

Sample	% Halite	Br
951350	4.10	140
951351	13.6	180
951352	10.2	190
951353	8.30	130
951354	9.80	140
951355	9.70	140
951356	9.90	140
951357	11.8	140
951358	11.8	120
951359	8.60	170
951360	10.7	170
951361	7.50	130
951362	7.50	90
951363	7.40	110
951364	7.10	170
951365	6.70	95
951366	13.8	130
951367	10.7	220
951368	9.40	170
951369	8.10	170
951370	10.1	90
951371	8.60	180
951372	10.1	220
951373	13.3	190
951374	18.5	210
951375	7.90	180
951376	39.5	35
951377 < 1520	58.0	15
951378	42.0	45
951379	46.9	45
951380	26.6	60
951381	22.8	65
951382	18.3	110
951383	33.6	60
951384	32.8	120
951385	16.1	150
951386	13.8	170
951387	16.9	130
951388	11.8	250
951389	9.20	230
Detn limit		(5)

amdel

Analysis code B1/1 Report AC 5759/83 Page 7

Order B 0604 Results in ppm

Sample	% Halite	Br
951390	7.80	200
951391	7.70	210
951392	7.10	260
951393	17.2	130
951394	9.00	170
951395	8.60	120
951396	6.00	130
951397	6.00	210
951398	7.30	240
951399	7.90	210
951400	8.60	210
951401	7.50	250
951402	11.0	250
951403	19.3	240
951404	10.9	230
951405	9.70	250
951406	11.2	230
951407	8.50	190
951408	6.40	220
951409	10.8	260
951410	7.90	310
951411	7.00	280
951412	8.40	240
951413	9.40	220
951414	5.70	210
951415	6.20	230
951416	8.00	240
951417	7.00	190
951418	7.10	190
951419	8.00	110
951420	7.40	210
951421	8.00	230
951422	7.80	230
951423	10.9	150
951424	11.5	180
951425	8.50	170
951426	8.50	210
951427	5.20	180
951428	8.60	220
951429	6.70	220
Detn limit		(5)

[redacted]

00033

amdel

Analysis code B1/1 Report AC 5759/83 Page 8

Order B 0604 Results in ppm

Sample	% Halite	Br
951430	9.40	190
951431	8.80	210
951432	8.90	230
951433	7.80	230
951434	8.20	210
951435	10.7	200
951436	11.1	250
951437	16.7	250
951438	12.9	260
951439	9.70	210
951440	9.50	180
951441	6.30	150
951442	13.9	250
951443	12.9	200
951444	9.40	210
951445	12.0	210
951446	12.0	190
951447	43.3	30
951448	15.2	130
951449	82.2	5
951450	22.4	80
951451	43.4	25
951452	22.6	70
951453	18.3	110
951454	14.7	130
951455	9.90	210
951456	11.4	230
951457	25.0	150
951458	88.2	20
951459	89.3	20
951460	91.3	5
951461	78.0	25
951462	64.6	20
951463	69.8	90
951464	72.9	25
951465	81.5	30
951466	70.2	20
951467	51.5	55
951468	54.3	20
951469	65.9	25
Detn limit		(5)

[redacted]

00034

amdel

Analysis code B1/1 Report AC 5759/83 Page 9

Order B 0604 Results in ppm

Sample		% Halite	Br
951470		10.3	100
951471		72.0	10
951472		64.5	25
951473		27.1	70
951474		31.4	60
951475		49.2	40
951476		53.6	30
951477		76.0	20
951478		73.9	20
951479		78.5	15
951480		81.6	10
951481		84.7	110
951482		82.3	10
951483		80.8	15
951484		77.2	<5
951485		62.8	15
951486		86.5	5
951487		72.6	<5
951488		85.0	55
951489		37.7	45
951490		70.8	10
951491		77.2	<5
951492	3095	71.7	10
~~M1 1572.5 1575~~		~~71.1~~	~~230~~
Detn limit			(5)

00035 [redacted]

COMLABS Pty. Ltd.
COMPUTERISED ANALYTICAL LABORATORIES

Head Office and
Central Laboratory
305 SOUTH ROAD,
MILE END SOUTH
STH. AUST. 5031
TEL.: (08) 43 5722
TELEX: AA89323

NATA REGISTERED No. 1526

REF.: COM 831707

R REF.: DPO B0609-0610

Mr. A. Scott,
CRA Exploration Pty Ltd,
P.O. Box 254,
NORWOOD SA 5067,

12.9.83

Dear Tony,

RE: JOB COM 831707

Enclosed are the assays for the samples delivered to our laboratory on the 10th August 1983.

Yours sincerely,
COMLABS PTY LTD

per :

c.c.: NORWOOD

COMLABS Pty. Ltd.
COMPUTERISED ANALYTICAL LABORATORIES

ANALYTICAL REPORT

JOB COM831707 O/N : B 0609-0610

Results in ppm

SAMPLE	Br	%K	Li	B	I	%Salt Recovered
951322	160	0.14	<1	10	<10	23.6
951323	35	0.05	<1	<10	<10	36.9
951324	I.S.	I.S.	I.S.	I.S.	I.S.	I.S.
951325	12	0.01	<1	20	10	85.4
951326	12	0.01	<1	20	<10	77.4
951327	8	0.01	<1	50	<10	87.4
951328	8	0.01	<1	<10	10	86.5
951329	8	0.01	<1	<10	<10	88.0
951330	60	0.07	<1	<10	10	26.0
951331	170	0.18	<1	<10	<10	10.2
951332	150	0.20	<1	<10	<10	9.25
951333	60	0.11	<1	50	<10	25.9
951334	100	0.07	<1	20	12	13.1
951335	140	0.18	<1	<10	<10	9.50
951336	I.S.	I.S.	I.S.	I.S.	I.S.	I.S.
951337	I.S.	0.20	<1	<50	I.S.	6.85

NOTE: Results expressed as ppm in salt

Method of Analysis : Br I : XRF
Li K : AAS6
B : COL10

APPENDIX III

DRILLING FLUIDS PROGRAMME FOR 83KD1

C.R.A. EXPLORATION

RECOMMENDED MUD PROGRAM
FOR POTASH DRILLING
SOUTH AUSTRALIA

Prepared by: John Quayle
John Knox

December 1983.

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C.R.A. EXPLORATION

POTASH DRILLING

INTRODUCTION

C.R.A. Exploration is proposing to drill a 1,200 metre hole in the Polda Basin of South Australia to explore for evapourites and in particular, deposits of Potash. Previous offshore exploration in the Polda Basin has encountered thick sections of Halite and it is understood that the geological section may be similar to an area of the Officer Basin recently drilled by Comalco.

One of the priorities of this drilling program will be to obtain 100% core recovery so that a thorough economic and geological evaluation may be made of the area. Potash deposits are notoriously difficult to successfully core, mainly because it is unusual to find a single salt deposit of pure KCl. Generally speaking, the potash will contain traces of magnesium or other minerals and because of the varying solubility of the magnesium and potassium chloride it becomes difficult to maintain 100% core recovery and avoid large washed out hole sections in the evapourites.

If the hole can be drilled quickly it may be possible to have good core recovery but the problem of washed out hole gives greater potential for snapped rods and resulting delays in fishing, etc. The only way 100% core recovery can be guaranteed is to use an invert emulsion oil mud with the water phase saturated with CALCIUM CHLORIDE. This method has been used very successfully and provided a continuous drilling program can be maintained and the mud re-used, costs do not become excessive. On an exploration hole oil mud costs become prohibitively expensive and it will be necessary to use a saturated KCl/brine in the initial exploration stage.

In Australia, Potassium Chloride is available in two grades:-

1. Agricultural grade which is approximately 99% KCl but is slow to dissolve and coarse crystalline.

/Cont...

C.R.A. EXPLORATION

POTASH DRILLING

INTRODUCTION (Cont)

2. Industrial grade which is 99.6% pure KCl and is easily dissolved because of it's finely crystalline nature.

We would recommend that the agricultural grade be used as close to saturation point as possible because of the cost advantages. Agricultural grade Muriate of Potash is readily available in Adelaide but the industrial grade has to be imported and is more expensive. We would suggest that a small amount of industrial grade KCl be carried in suspension by the mud system in order to prevent leaching of the core through undersaturation of the mud. The importance of saturation of the KCl brine cannot be overemphasized and every attempt should be made to have a super-saturated system in the hole. It is expected the temperature gradient in this are will be low so the varying solubility due to temperature will be low.

We have recommended the use of Hydroxyethyl cellulose (HEC) as the primary viscosifying polymer in this mud system. HEC is a synthetic cellulosic material and is completely resistant to bacterial break down. It is non-ionic and it is not affected by varying concentrations of electrolytes or by trace elements such as boron or chromium. A cheaper material such as guar gum (sold under various trade names) can be used but it is subject to bacterial attack even in a saturated brine. It's major disadvantage is that it tends to coagulate and settle out in the bottom of the tanks in a semi-solid state. This happened on the Comalco drilling program when some left over mud stocks were being used and the end result was the material had to be dug out of the mud tanks. XC POLYMER could be used in this system but it is more expensive and the gel strengths it develops tends to suspend the cuttings and lead to sludge build up in the rods.

/Cont...

C.R.A. EXPLORATION

POTASH DRILLING

INTRODUCTION (Cont)

DEXTRID has also been programmed to reduce filtrate loss and to eliminate dispersion of shales and clays in the borehole. It would be possible to drill with just KCl/HEC but every attempt should be made to reduce hole washout when drilling deep coreholes in sedimentary systems. All too often a hole is lost when rods snap in a washed out hole through vibration and rod rattle.

C.R.A. EXPLORATION

POTASH DRILLING

CASING PROGRAM AND LITHOLOGY

1. Precollar 5" diameter to 500 metres, set HW casing.

2. Diamond Coring

   500 - 800 metres - HQWL size
   800 - 1,200 metres - NQWL size

LITHOLOGY

0 - 500 metres - Tertiary - Jurasic - Siltstones, Coal

500 - 1,200 metres - Cambrian - Shales, Sandstones, Limestones, Halite

[redacted]

00044

NL Baroid

RECOMMENDED MUD PROGRAM

Company C.R.A. EXPLORTION

Date DECEMBER 6, 1983

Well Name and Number

Proposed Depth 1,200 metres

Location South Australia County Onshore State South Australia

Casing: Surf. HW @ 500 metres Inter. HW @ 800 metres Prod.

RECOMMENDED MUD PROPERTIES

DEPTH Metres	WEIGHT ppg	VISCOSITY SEC	FILTRATE ml		TREATMENT
0-500m	Precollar, set HW casing				
HQWL Hole					
500-800m	9.68	33-35	6-8cc	10+	In fresh water mix 0.75 lbs/bbl HEC then add 2 lbs/bbl DEXTRID then add coarse grade KCl until nearly saturated - approximately 85 lbs/bbl. Then add fine grade KCl (Potassium Chloride) approximately 14 lbs/bbl - this will super-saturate and give maximum protection when encountering the potash formation. Add 0.75 lb/bbl CAUSTIC SODA to raise pH to 10 +.
NQWL Hole					
800-1200m		as above			

99 lbs/bbl KCL

KCL = 280-285000 ppm

KCL = 24-25%.

Estimated cost for mud materials: $5,954.55

Recommended Program Based Upon Cost estimate based on Baroid experience in the Officer Basin on Comalco Exploration drilling.

C.R.A. EXPLORATION

POTASH DRILLING

RECOMMENDED MUD PROGRAM

After precollaring and setting casing we recommend drilling into the Cambrian Transition zone with a saturated KCl/HEC (Hydroxyethyl cellulose) mud with additions of DEXTRID for shale and filtration control.

We recommend that the pH of the mud be raised to around 10.0 with CAUSTIC SODA. This will minimize corrosion.

We would also recommend that the HEC be hydrated in fresh water before adding to the brine, this has proven to be more economical and effective than adding the HEC directly to the brine. DEXTRID is again recommended for extra filtration control and to improve borehole stability and core recovery. At all times the mud must be saturated with KCl to provide good core recovery and to eliminate washout in the Halite/Potash sections.

Suggested Mud Properties

Density	-	9.68 ppg (saturated)
Viscosity	-	33 - 35 sec/qt
API Filtrate	-	6 - 8 ccs
pH	-	10 +
Solids	-	Minimum
Yield Point	-	8 - 10 lbs/100 sq.ft.

It is anticipated that after the mud system has been formulated it will be easy to maintain and the simplicity of the system makes it possible for someone with very little training to run it effectively.

C.R.A. EXPLORATION

POTASH DRILLING

LOST CIRCULATION

Lost circulation is always a problem in any coring operation, and the slim hole nature of this program makes the use of lost circulation materials very limited.

Several approaches may be made and are as follows in order of priority:-

A. Add MICA (Fine) to the circulating system. MICA is about the only lost circulation material which can successfully be used without plugging up the pump and the core-barrel. This approach has very good success particularly if seepage losses are across a porous sandstone section.

   Each time the rods are pulled a slug of mud with a high concentration of MICA (50-60 lbs/100 gals) should be spotted across the thief zone so that the formation will not be broken down when running the rods back into the hole.

B. GUNK SQUEEZE

   A gunk squeeze is a method of curing lost circulation by the expanding effect of bentonite when it hydrates. The objective is to keep the bentonite from hydrating until it reaches the zone of lost circulation.

   Procedure

   Pour half a bag of QUIK GEL into eight gallons of diesel and mix throughly. Pour two gallons of diesel down the rods (76 mm in this case), followed by the "gunk" squeeze, then a further two gallons of diesel. This isolates the "gunk" from water contact to ensure the squeeze does not expand in drill rods.

/Cont...

C.R.A. EXPLORATION

POTASH DRILLING

LOST CIRCULATION (Cont)

B. GUNK SQUEEZE/Procedure (Cont)

Calculate the time required to pump the "gunk" down the rods.

$$\text{Time} = \frac{\text{Rod volume (gallons)}}{\text{Pump output (gallons/minute)}}$$

(in second gear the pump should have an output of approximately 10 imperial gallons/minute).

The inner tube should have been pulled prior to pouring "gunk" down the rods. Have the rods sitting just off bottom and stationary. Pump the "gunk" down the rods until the pump pressure gauge registers an increase of pressure (indicating the "gunk" has reached the bottom", raise the rods clear of the squeeze and shut off the pump. Allow enough time for the squeeze to expand, approximately 10 minutes. Set the inner tube, restart the pump and wash, or rotate if necessary through the gunk squeeze . When the rods are on bottom, check mud returns. If no returns are apparent, re-run "gunk sqeeze". When returns are evident, recommence drilling. If mud returns cannot be regained after running two "gunk squeezes" the loss zone is most likely to be a large fracture and drilling blind would be necessary. Six to eight pounds of HYSEAL could be added to the "gunk" to assist in regaining returns.

There are definite advantages in using a "gunk squeeze" if successful:-

i. Saves time. The whole process takes only an hour at the most compared with using cement which takes about 10 hours to harden.

ii. Easily prepared and spotted, requires no extra supervision.

/Cont...

C.R.A. EXPLORATION

POTASH DRILLING

LOST CIRCULATION (Cont)

B. GUNK SQUEEZE/Procedure (Cont)

iii. Cheap - half a sack of QUIK GEL and diesel to required amount.

iv. With retained returns, mud costs are reduced.

v. Stabilises formation reducing cave when tripping, thereby reducing bit costs and lost time getting back on bottom.

C. CEMENT

When all else fails with lost circulation it may be necessary to use quick setting cement in order to try to plug off the thief zone.

The advantage of Quick Setting Cement is that it requires little setting time and does not hold up progress. We would recommend that QUIK SET 30 or QUIK SET 60 be used rather than using QUIK SET 15, which may set prematurely in the rod string. If losses are severe it may be necessary to mix HYSEAL into the cement in order to help seal off the loss zone.

C.R.A. EXPLORATION

POTASH DRILLING

CEMENTING REQUIREMENTS

It will be the responsibility of the Baroid Mud Engineer on site to supervise the formulation and pumping of cement when casing is run and when the hole is abandoned.

On surface casing it is expected that normal Portland Construction Cement (Class A) will be used with 2% $CaCl_2$ being used as an accelerator. It will be the mud engineer's responsibility to weigh the mud and prepare the make up water with 2% $CaCl_2$. Slurry density is expected to be around 15.5 - 16.0 ppg, but this will be determined by discussions with the operator and the drilling contractor or drilling consultant.

In addition the mud engineer will advise drilling personnel on QUIK SET mixing procedures and supervise any other cementing requirements. Again we would emphasize the need for consultation with the operator, contractor and consultant so that the mud engineer has a clear idea of what is required.

C.R.A. EXPLORATION

POTASH DRILLING

COST ESTIMATES

It is assumed that the hole has been precollared to 500 metres and HW casing has been set at that point.

Volumes

500 - 800 metres HQWL hole

Casing Volume	-	4.5 m^3	29 bbls
Hole Volume	-	2.0 m^3	12 bbls
Surface Volume	-	6.0 m^3	38 bbls $\equiv$ 212 ft^3
Daily Maintenance	-	15.0 m^3	(8 days on hole)
TOTAL	-	27.5 m^3	

The above figure allows for a daily consumption of 1.875 m^3/day which is realistic for this type of drilling.

Materials Consumption

			500-800m Daily	800m-1200 Same
KCl (Coarse)	-	242 kg/m^3	10 Sx	
KCl (Fine)	-	40 kg/m^3	2 Sx	
HEC	-	2 kg/m^3	4kg ≈ 1/5 Sx.	
DEXTRID	-	6 kg/m^3	1 Sx	
CAUSTIC SODA	-	2 kg/m^3	1/5 Sx	
SODA ASH				
BARADEFOAM				
COAT 415				
TORQTRIM II if req.				

/Cont...

C.R.A. EXPLORATION

POTASH DRILLING

COST ESTIMATES (Cont)

Estimated Materials Required

PRODUCT	UNIT	UNIT COST	QUANTITY	COST A$
KCl (Coarse)	50 kg	$12.47	133 sxs	$1,658.51
KCl (Fine)	50 kg	28.90	22 sxs	635.80
HEC	25 kg	197.00	3 sxs	591.00
DEXTRID	50 lb	51.50	8 sxs	412.00
CAUSTIC SODA	40 kg	34.50	2 sxs	69.00
		TOTAL COST FOR INTERVAL		$3,366.31

800 - 1,200 metres NQWL Hole

Additional hole volume required - 20 m^3
Daily maintenance - 17 m^3 (9 days on hole)

TOTAL - 19 m^3

The above figure allows for 1.88 m^3/day maintenance.

Materials Consumption

KCl (Coarse) - 242 kg/m^3
KCl (Fine) - 40 kg/m^3
HEC - 2 kg/m^3
DEXTRID - 6 kg/m^3
CAUSTIC - 2 kg/m^3

/Cont...

C.R.A. EXPLORATION

POTASH DRILLING

COST ESTIMATES (Cont)

Estimated Materials Required

PRODUCT	UNIT	UNIT COST	QUANTITY	COST A$
KCl (Coarse)	50 kg	$12.47	92 sxs	$1,147.24
KCl (Fine)	50 kg	28.90	15 sxs	433.50
HEC	25 kg	197.00	2 sxs	394.00
DEXTRID	50 lb	51.50	5 sxs	257.50
CAUSTIC SODA	40 kg	34.50	1 sx	34.50
		TOTAL COST FOR INTERVAL		$2,266.74

Total Recommended Materials for one hole and Recommended Contingency items

PRODUCT	UNIT	UNIT COST	QUANTITY	COST A$
KCl (Coarse)	50 kg	$12.47	225 sxs	$2,805.75
KCl (Fine)	50 kg	28.90	37 sxs	1,069.30
HEC	25 kg	197.00	5 sxs	985.00
DEXTRID	50 lb	51.50	13 sxs	669.50
CAUSTIC	40 kg	34.50	3 sxs	103.50
BARADEFOAM	20 ltr	110.20	1 drm	110.20
MICA (Fine)	19 kg	14.31	10 sxs	143.10
HYSEAL	10 kg	13.64	5 sxs	68.20
		TOTAL ESTIMATED MATERIALS		$5.954.55

/Cont...

C.R.A. EXPLORATION

POTASH DRILLING

COST ESTIMATES (Cont)

1. All costs are based on a trouble free hole with no allowance for lost circulation.

2. Prices are based on delivery ex Adelaide warehouse.

3. All products will be shrink wrapped and palletized.

4. All products returned in a re-usable condition will be credited in full.

5. All prices quoted will remain firm for the duration of the hole.

CRA EXPLORATION PTY. LIMITED

SIXTH QUARTERLY REPORT ON
TUCKEY E.L. 1054, SOUTH AUSTRALIA,
FOR THE PERIOD ENDING 18TH APRIL, 1984.

AUTHOR: A.K. SCOTT

COPIES TO: CRAE LIBRARY
SADME

DATE: 30TH MAY, 1984

SUBMITTED BY: AK Scott

ACCEPTED BY: Kevin D Tickwell

CONTENTS

CONTENTS (cont.)

515 ; see log p113-114

? See P.3

1. SUMMARY

Following the abandonment of an earlier hole at 336 m, a new hole, cored from 596 m to total depth, was drilled to 1398 m in the eastern (or Kilroo) sub-basin of the Polda Trough. It intersected 301 m of Tertiary sands, clays and lignite, 282 m of Upper Jurassic sands, silts, grits and minor coal, 22 m of Permo-Carboniferous diamictite, and 793 m of argillaceous red beds and basalts of possible Cambrian age. No evaporitic sediments were intersected.

The (?)Cambrian palaeoenvironment deduced from the core is thought to have been a large flat depression in a landscape of low relief where periodic shallow inundation by fresh water caused reworking of near surface sediment. Deep crustal fractures allowed occasional outpouring of basalt over a wide area.

From comparisons with the stratigraphy in Polda offshore hole Mercury No. 1 and in the Officer Basin, it is thought that the stratigraphic position of evaporites in the Kilroo Sub-basin is below the basalt intersected at the bottom of 83KD1A, although there is no certainty that evaporites actually exist in the sub-basin at all.

2. RECOMMENDATIONS

The following recommendations are made.

1. Wait for the results of the SADME age dating of the basalts to see whether they are in fact of Cambrian age.

2. Consider the value of an east-west seismic line to determine the shape of the sub-basin with more confidence.

3. Ascertain the practicability and economics of solution mining of potash at depths below 1400 m.

3. INTRODUCTION

E.L. 1054 of 355 km² was granted on 19th October, 1982, and covers part of the Polda Basin on the Eyre Peninsula (see plan no. SAa 1932). It was obtained to search for potash in the pre-Permian sediments of the eastern (or Kilroo) sub-basin of the Polda Basin.

The previous quarterly report (CRAE report no. 12527) contains details of the stratigraphy and structure of the Polda Basin and in particular of the Kilroo sub-basin. It also gives details of an important SADME seismic profile and its interpretation. On the basis of the seismic section and a thick pre-Permian halite sequence intersected offshore, a hole was planned to penetrate to Carpentarian basement in the Kilroo area. The hole, which was also described in the previous report, was abandoned at 336 m.

A new hole, 83KD1A, was drilled to a depth of 1398 m at the same location. During drilling, a brief re-appraisal of the Kilroo seismic data was undertaken by a consultant. This report describes the seismic re-interpretation, the geology of the drillhole and the implications arising therefrom.

4. SEISMIC INTERPRETATION

A consultant geophysicist, Mr. A. Mitchell, briefly re-assessed the Kilroo seismic data in order to make an estimate of the depth to basement.

He selected a fair event at 1.01 sec (estimated depth 1360 m) which turned out to be the top of the lower volcanic unit at 1308 m.

Another event was picked at about 1.36 sec but this was much less definite, and the possibility was admitted that it may be a multiple. If the event is real, it was calculated that its depth might be between 1920 and 2190 m, or perhaps deeper.

5. DRILLING

Details of site selection, prognosed geology and planning were set out in the previous quarterly report. The location of the hole is shown on plan no. SAa 2361.

It was intended to drill the hole to Precambrian basement, but during drilling it became evident that this might be at least 2000 m deep. The drilling budget was unable to meet the cost of such a deep hole so it was stopped at 1398 m after penetrating 90 m of basalt. This was approximately 300 m deeper than originally planned.

5.1 Drilling Operations

83KD1A was collared approximately 7 m away from 83KD1 on 20th January and was drilled to 120 m where 150 mm OD steel casing was set and cemented. Rotary mud drilling continued to 456 m, where a 3 m HQ core was cut to 459 m, and then resumed to 515 m, at which depth diamond drilling in HQ size commenced. Hard diamictite was struck at 593 m and 100 mm ID steel casing was set and cemented at 596 m after logging and reaming.

HQ coring continued to 616 m where the bentonite/polymer mud system was changed to a saturated KCl/polymer mix. At 665 m, core size was reduced from HQ to NQ with the HQ rods left in the hole as casing. The hole was completed in NQ size with the KCl/polymer mud, although the KCl concentration was gradually reduced to about 50% of saturation around 1000 m and then further reduced towards the end of the hole. The HQ rods were then withdrawn and the hole again logged.

5.2 Sample Recovery

Samples were collected at 2 m intervals for the rotary drilled section of the hole from surface to 515 m. The sample collection arrangement was poor and almost no sample return was obtained from shale formations.

Core recovery averaged 60% from 515 to 589 m, most of the losses occurring in friable Jurassic grits. Below 589 m core recovery was virtually 100%.

5.3 Other Investigations

The hole was geophysically logged at 596 m and 1398 m, and chemical analyses, specific gravity determinations and petrographic examinations were made on selected samples of core. In addition, SADME made palynological and coal quality studies and also completed a well shoot and vertical seismic profiling at the completion of drilling. SADME also intends to carry out K-Ar dating on the basalts.

5.4 Cost

The total cost of the drilling programme (including the abandoned hole) was about $212 000 which included supervision, overheads, analyses, logging, etc. The contractual drilling cost of 83KD1A was approximately $140 000 giving an overall cost per metre of $100.

6. GEOLOGY OF DRILL HOLE

6.1 Stratigraphy

83KD1A intersected 301 m of Tertiary, 282 m of Upper Jurassic and 22 m of Permo-Carboniferous sediments and 793 m of pre-Permian, possibly Cambrian, sediments and volcanics. The hole bottomed in basalt.

A summary log is given below and a summary graphic log together with the prognosed stratigraphy is shown in plan no. SAa 2657. A detailed composite borehole log is given on plan no. SAa 2805, and the detailed geological log is attached as Appendix V.

Summary Log, 83KD1A

Tertiary	0- 115	Clay, sand
	115- 301	Sand, lignite
Upper Jurassic	301- 583	Sand, carbonaceous mudstone, minor coal; grits at base
Permo-Carboniferous	583- 605	Diamictite
(?)Cambrian	605- 990	Laminated red-brown siltstone/mudstone
	990-1024	Altered amygdaloidal basalt
	1024-1098	Laminated red-brown mudstone/siltstone
	1098-1101	Amygdaloidal tuff
	1101-1308	Laminated red-brown mudstone/siltstone
	1308-1398	Altered amygdaloidal and vesicular basalt with minor copper mineralisation.

Detailed stratigraphy is described below. Much of the description of lithologies above 515 m is based on the geophysical logs, because of the poor sample recovery in this interval.

6.1.1 Tertiary

The Tertiary succession consists of two fairly distinct units. The upper one (0-115 m) is a sticky blue-grey clay with a few interbeds of fine rounded sand. Above the base of oxidation (56 m) the clays are lateritic and sandy. The age of this unit is not certain, but has tentatively been assigned to the Miocene by analogy with other holes in the basin, pending the outcome of the SADME palynological study.

The lower part of the Tertiary section (115-301 m approx.) consists of fine to medium, sub-angular to sub-rounded quartz sands, occasionally with a matrix of white clay, containing thin interbeds of coarse sands, clays, carbonaceous clays and lignite. The main lignite seam is 5.5 m thick at 199 m and correlates with the 15 m seam intersected at 222 m in an earlier CRAE drillhole (81L41C) 1700 m to the north, and with a 2 m intersection at 158 m in 81LRM64 500 m to the south. This unit is assumed to be equivalent to the Poelpena Formation of Eocene age.

The depth of the Tertiary/Jurassic boundary is somewhat conjectural but is based on the geophysical logs which show a distinct change from the mainly sandy Tertiary to a cyclic sand/silt sequence.

6.1.2 Jurassic

From 301 to 516.5 m, the Jurassic consists of many cycles of upwards-fining sand and silt, together with minor beds of carbonaceous mudstone and coal. The cycles, which vary in thickness from 10 to 20 m, have a fine to medium, occasionally coarse, base of sub-angular to rounded quartz sand grading into a silty top.

Several thin coal beds occur, the thickest of which is 1.5 m and lies at a depth of 456.8 m within a section of mudstone and carbonaceous mudstone. Analyses carried out by Amdel (for SADME) (see Appendix I) indicate that the coal is a sub-bituminous, high ash type, not unlike the coal in the deposit at Lock, 45 km to the west.

From 516.5 - 583.2 m, the Jurassic consists mainly of pyritic grits, gritty sandstones and siltstone except for a layer of mudstone, carbonaceous mudstone and minor coal from 555.4 - 573.3 m. The grits are poorly sorted, light grey and friable and contain angular to rounded grains varying in size from silt to pebbles. Lithologies are mainly clear quartz with some pale blue and milky quartz, and minor feldspar, ironstone, mica, diopsidic rock and gneiss. Framboidal pyrite is common.

The age of this unit is confirmed by palynology as Upper Jurassic, and it is therefore assigned to the Polda Formation.

6.1.3 Permo-Carboniferous

Two distinct Permo-Carboniferous lithotypes were intersected in 83KD1A. The upper one extends from 583.2-593.3 m and is a white, well sorted, very fine, thinly bedded kaolinitic sandstone containing occasional pebbles and bands of diamictite. Scouring of the sandstone is evident in places and pyrite framboids are common.

The lower lithotype, from 593.3-605.3 m, is a dark grey, hard, massive diamictite containing angular to rounded matrix-supported cobbles up to 6 cm across. The commonest cobble lithologies are pink (low biotite) granite and fine to medium white quartzite. Others are quartz-feldspar-biotite schist, gneissic granite, granodiorite, biotite quartzite, feldspar-biotite-garnet granofels, black siliceous slate, grey slate, quartz-feldspar-tourmaline schist, siltstone and sandstone. The bottom 0.3 m contains many clasts of red-brown siltstone.

These lithologies are very similar to Permo-Carboniferous diamictites of the Coolardie Formation intersected elsewhere in the Polda Basin.

6.1.4 (?)Cambrian

The (?)Cambrian consists of a monotonous sequence of laminated red-brown siltstone and shale with major intercalations of altered amygdaloidal basalt and tuff.

Petrographic examinations were made of 12 samples of drill core, and these are attached in Appendix II.

From 605.3 to 990.4 m the red beds are mainly micaceous siltstone containing some thin bands of fine sandy siltstone and thicker zones of darker brown mudstone. Pyrite framboids and blue-grey reduction zones occur from place to place. Thin veins of anhydrite, generally sub-vertical, occur sporadically throughout the core. Shallow water sedimentary structures are common and include cross-bedding, scour and fill, flame structures, dewatering channels, intraformational brecciation and slumping, graded bedding, dessication cracks and ripple marks.

From 1023.8 to 1097.95 m, the laminated sequence contains more mudstone than siltstone. Below about 1050 m, cyclic graded bedding is common: each cycle is 1-3 cm thick, and has a silty base (often with a few granules of granitic material in a tiny scour channel) which grades upward into mudstone. Dessication cracks, scour and fill structures and flame structures are common. Anhydrite veins occur throughout the section, and are especially abundant in the top 4 m just beneath the basalt flow.

A dark grey amygdaloidal tuff occurs at 1097.95-1100.6 m. It has a sharp basal contact, and a gradual change at the top into banded red beds. It contains flattened amygdales of anhydrite and calcite.

From 1100.6 to 1308.45 m the cyclic graded bed sequence of red beds contains approximately equal quantities of mudstone and siltstone, although there is an increase in the thickness and frequency of conglomeratic beds. There are a few thin beds of fine sandstone. This interval again contains anhydrite veins and nodules, and many sedimentary structures.

The basalt intervals at 990.4-1023.8 m and 1308.45-1398.2 m contain vesicular, amygdaloidal and massive basalt flows. The basalt mainly consists of sericitised and albitised plagioclase, chloritised pyroxene and oxidised magnetite. Amygdales are filled by prehnite or chlorite, or their alteration clays.

The upper basalt interval appears to consist of one amygdaloidal flow, whereas the lower interval contains about 10 individual flows, each characterised by a vesicular purplish-brown top, a medium to coarse grained amygdaloidal centre, and a finer grained massive basal section. Their thickness varies from 0.5 m to 24 m. Native Cu occurs disseminated and in veins around 1380 m, and large hematite grains are common below 1388 m.

The red bed/basalt sequence is tentatively ascribed a Cambrian age by analogy with similar sequences in the Officer Basin. It is hoped that K-Ar age dating of the basalts to be carried out by SADME will provide a definite age for this sequence.

6.2 Mineralisation

No evaporitic minerals were intersected in the hole, except for the veins of anhydrite which occur sporadically throughout the red beds.

The 5.5 m thick lignite intersection at 199 m is part of a known seam that was drilled and evaluated by CRAE in 1981 (see CRAE report no. 10307). The Jurassic coal intersection at 456.8 m is thin and of very poor quality. Analyses are given in Appendix I.

Native copper was noted in basalt between 1378.4 and 1382.5 m as disseminations, joint coatings and vein fillings. Maximum assay was 0.4% Cu over the interval 1378-1379 m.

In order to check for any unsuspected occurrences of metals, five samples of the grits at the base of the Jurassic and four samples of diamictite were assayed for U and Au but all values were below detection limit (see log sheets in Appendix V). Also, four samples of red beds, one of tuff and six of basalt were analysed for Cu, Pb, Zn, Ni, Co, Ag, U and Au. These assays are also given on the log sheets in Appendix V. Furthermore, 26 samples of basalt were analysed for the above elements plus Bi, Cr, Ba, Ce, Nb, Rb, Sn, V, Sr, Y, Zr and Ti as part of a SADME project to characterise the basalts geographically and chronologically by comparison with similar data from other basalt suites elsewhere in the state. These trace element analyses appear in Appendix III.

Specific gravity determinations were carried out on 10 samples of red bed mudstone/siltstone and 10 samples of basalt. A table of results is given in Appendix IV. For the mudstone/siltstone sequence, there appears to be significant change in s.g. around 900 m, the average above that depth being 2.51 and below being 2.68. For basalt, the average s.g. of the vesicular variety is 2.66, the amygdaloidal type 2.86 and the fine grained dense parts 3.00. It is estimated that these three sub-types occur in the ratio 1:7:2 in the drill core, thus giving an average s.g. for basalt of 2.87.

6.3 Geophysical Logging

The hole was logged at 596 m and again at total depth by Geoscience Associates Pty. Ltd.

At 596 m, before casing was set, the following tools were run: caliper, natural gamma, neutron, 30 cm density, 80 cm density, sonic and drift. At total depth the HQ casing was removed so that the hole was uncased below 596 m. Logs run below 596 m were natural gamma, neutron, self potential and resistivity (0.4 m and 1.6 m normal and 1.8 m lateral) to a depth of 1384 m (due to shortage of cable) and caliper and long and short spaced density to 701 m (due to hole blockage). All of these, except 0.4 m normal and 1.8 m lateral resistivity, are shown on the composite borehole log (plan no. SAa 2805).

7. INTERPRETATION OF DRILLING RESULTS

7.1 Re-interpretation of Seismic Section

On the basis of the lithological and palynological data derived from 83KD1A, the Kilroo seismic traverse (plan no. SAa 2653) can be re-interpreted. The new interpretation is shown on a transparent overlay (plan no. SAa 2654) to the section.

The main changes to the pre-drilling interpretation are:
(a) the increase in thickness of the Jurassic section and consequent thinning of the Permo-Carboniferous, and
(b) the recognition that the upper volcanic intersection (990-1024 m) is represented by the interval between the two strong reflections at about 0.77 and 0.80 seconds.

The position of the lower volcanic unit (the top of which was at 1308 m) is not obvious from the profile, and the depth to Precambrian basement is still unknown.

7.2 Depositional Environments

7.2.1 Tertiary

The clays, sands and lignite of the Tertiary sequence were deposited in a variety of environments including a possible marine barred basin, and non-marine fluviatile and paludal environments.

7.2.2 Jurassic

The alternating silts and sands in the upper three-quarters of the Jurassic section in 83KD1A appear to have characteristics of flysch-type sedimentation.

Deep marine conditions would have prevailed, with periodic rapid influxes of detritus. The grits and clays at the base of the Jurassic suggest initial basin development, with occasional still-stands providing swampy conditions of limited areal extent.

TABLE 1 STRATIGRAPHY OF THE POLDA BASIN

		AGE	NAME	ROCK UNIT	MAXIMUM THICKNESS (metres)	LITHOLOGY	STRATIGRAPHIC RELATIONS	EXPRESSION
CAINOZOIC	QUATERNARY	Pleistocene		Bridgewater Formation	30 m	Sand, off-white, cemented calcareous, clay interbeds	Uppermost unit in sequence	Outcrops west of Lock and in cliffs Drill holes
		?		Undifferentiated	6-7 m	Clay, vari-coloured, calcareous	Underlies Bridgewater Formation	
	TERTIARY	Middle Miocene		Undifferentiated	70 m	Green to grey clay & carbonaceous clays. Grey poorly sorted coarse sand & carbonaceous sand	Relationships unknown. Correlated with Munno Para Clay.	Many holes in Polda Trough
		Middle Eocene		Poelpena Formation	Greater than 200 m	Grey, dark grey & brown coarse sand & lignite. Very carbonaceous	Unconformably on Jurassic. Overlain unconformably by ?Miocene or Quaternary	Many holes in Polda Trough - absent on southern edge. 81L41C cored hole.
MESOZOIC		Upper Jurassic		Polda Formation	500 m	Dark grey to black very carbonaceous fine sand, silt & lignite and very coarse grey sands	Unconformably on Permain & Precambrian. Unconformably overlain by Tertiary	Many drill holes in Polda Trough
PALAEOZOIC		Permo-Carboniferous		Coolardie Formation	Greater than 180 m	Pyritic diamictite & clay	Unconformably on Archaean & Proterozoic. Unconformably overlain by Jurassic	Polda No. 1 stratigraphic drill hole. Tuckey No. 1 stratigraphic drill hole. 80L30C & 83KD1A cored holes.
		Lower Cambrian			2200 m	Red shales & silt-stones, massive halite, amygdaloidal basalts	Lower contact not observed. Unconformably overlain by Permo-Carboniferous	Mercury No. 1, Columbia No. 1, 83KD1A.
PROTEROZOIC		Adelaidean		Corunna Conglomerate	Exceeds 200 m	Conglomerate, sandstone & shale	Unconformably on Lincoln Complex. Unconformably overlain by Permian, Jurassic & Tertiary	
		Carpentarian	Lincoln Complex			Granite, gneiss, migmatite, granulite, augen gneiss, quartzo-feldspathic gneiss. Synkimban Orogeny granites. Basic intrusives.	Overlain unconformably Corunna Conglomerate. Underlain by Hutchison Group	Southeast and northeast of Lock
		Nullaginian	Hutchison Group	Middleback Formation Warrow Quartzite		Metasiltstone, schist, iron formation, marble & quartzite	Overlain by Lincoln complex & underlain unconformably by Sleaford Complex	Outcrops southeast of Lock. May occur in drill holes
		Lower Proterozoic & Archaean	Sleaford Complex	Widbey Granite Kiana Granite	?	Granite, granite gneiss, schist, granulite metasediments, basic intrusives	Overlain unconformably by Hutchison Group	Outcrops north & south of Lock. May occur in drill holes

7.2.3 Permo-Carboniferous

The fine grained laminated white sands in the top half of the sequence were probably deposited in a terminal glacial lake in which floating ice dumped pebbles and other detritus from time to time. The grey diamictite is a typical unsorted glacial deposit.

7.2.4 (?)Cambrian

The abundance of dessication cracks, fine scours and intraclasts of mudstone show that the red beds were deposited in very shallow water with frequent periods of emergence, whilst the absence of evaporite mineral casts strongly suggests that the water was non-marine. The depositional environment is envisaged as a large shallow inland lake in which intermittent inundation from both runoff and direct precipitation caused reworking of the upper few millimetres of sediment to produce a thin graded bed, followed by deposition of another few millimetres of fine detritus. After drying, the clayey surface layer cracked and was incorporated as intraclasts in the later overlying layer of sediment.

The basalts appear to have been extruded subaerially as evidenced by abundant vesicular, purplish-brown (oxidised) layers and lack of pillow structures. A flat topography is indicated by sub-horizontal layering in places and absence of brecciation on flow bottoms, whether they be basalt/basalt contacts or mudstone/basalt contacts. If the above two assumptions are correct, they imply that a large volume of lava spread over a fairly wide area, and this in turn suggests a deep seated source. The lack of brecciation and presence of tuffaceous sediments may also indicate considerable distance from the vent.

7.3 Geological History

A revised stratigraphic chart for the Polda Basin appears in Table 1.

Prior to (?)Cambrian sedimentation, the area must have had little topographic relief. A large inland depression then developed in which fine sediment (containing iron hydroxides?) was slowly deposited and then reworked during periods of intermittent inundation by fresh water. Although saline evaporite minerals were absent from the succession, gypsum must have been deposited in small amounts, to be subsequently altered by diagenesis to veins and nodules of anhydrite.

At various times during the (?)Cambrian deep fractures apparently tapped mantle magmas allowing extrusion of basalts over wide areas. Deuteric or later effects caused extensive alteration to the basalts and may have been accompanied by the introduction of native copper.

It is interesting to speculate whether these deep fractures were an early indication of an inherent weakness in this part of the earth's crust where the Polda Trough was later to form.

There is a large gap in the stratigraphic record until the Permo-Carboniferous when glacial activity was widespread, presumably on a terrain of high relief. The assumed uplift may have been the first significant event in the period of tectonic instability that culminated in the development of the later rift.

At the site of 83KD1A, the Permo-Carboniferous record of unsorted diamictites overlain by laminated lake sediments suggests the retreat of a glacier.

By the early Jurassic, isolated rift grabens such as the Polda and Robe-Penola Troughs had begun forming (Fraser and Tilbury, 1979). The chief structure in the Kilroo Sub-basin is the east-west fault marking its northern boundary. The seismic section (plan no. SAa 2653) suggests that the sub-basin is a half-graben. Continued faulting lead to the development of more extensive rift valleys parallel to the continental shelf, but the Polda was bypassed by this phase.

Initial sediment influx into the Polda rift valley consisted of a mixture of coarse and fine material of probable fluviatile origin together with the development of coal swamps in places. The bulk of Jurassic sedimentation, however, was a deep marine flysch facies of alternating silts, silty sands and sands, typical of rapidly filling deep troughs, although shallower facies were deposited locally.

Separation of the Australian and Antarctic plates was completed by the Eocene, at which time the Polda Trough was accumulating fluviatile and lacustrine sequences of sands, silts and lignite.

8. IMPLICATIONS FOR POTASH EXPLORATION

8.1 Regional Correlations

The pre-Permian red bed sequence intersected in 83KD1A appears very similar to the red beds in Mercury No. 1 between the Permian diamictites and massive halite, and also to the Trainor Hill Sandstone of the Officer Basin as found in the Marla area (e.g. in Byilkaoora No. 1) (Benbow and Pitt, 1979).

Further, the basalts in 83KD1A are almost identical to descriptions of basalts from the Kulyong Volcanics of the Officer Basin. The Kulyong Volcanics are generally believed to lie approximately at the boundary between the Observatory Hill Beds and the overlying Trainor Hill Sandstone.

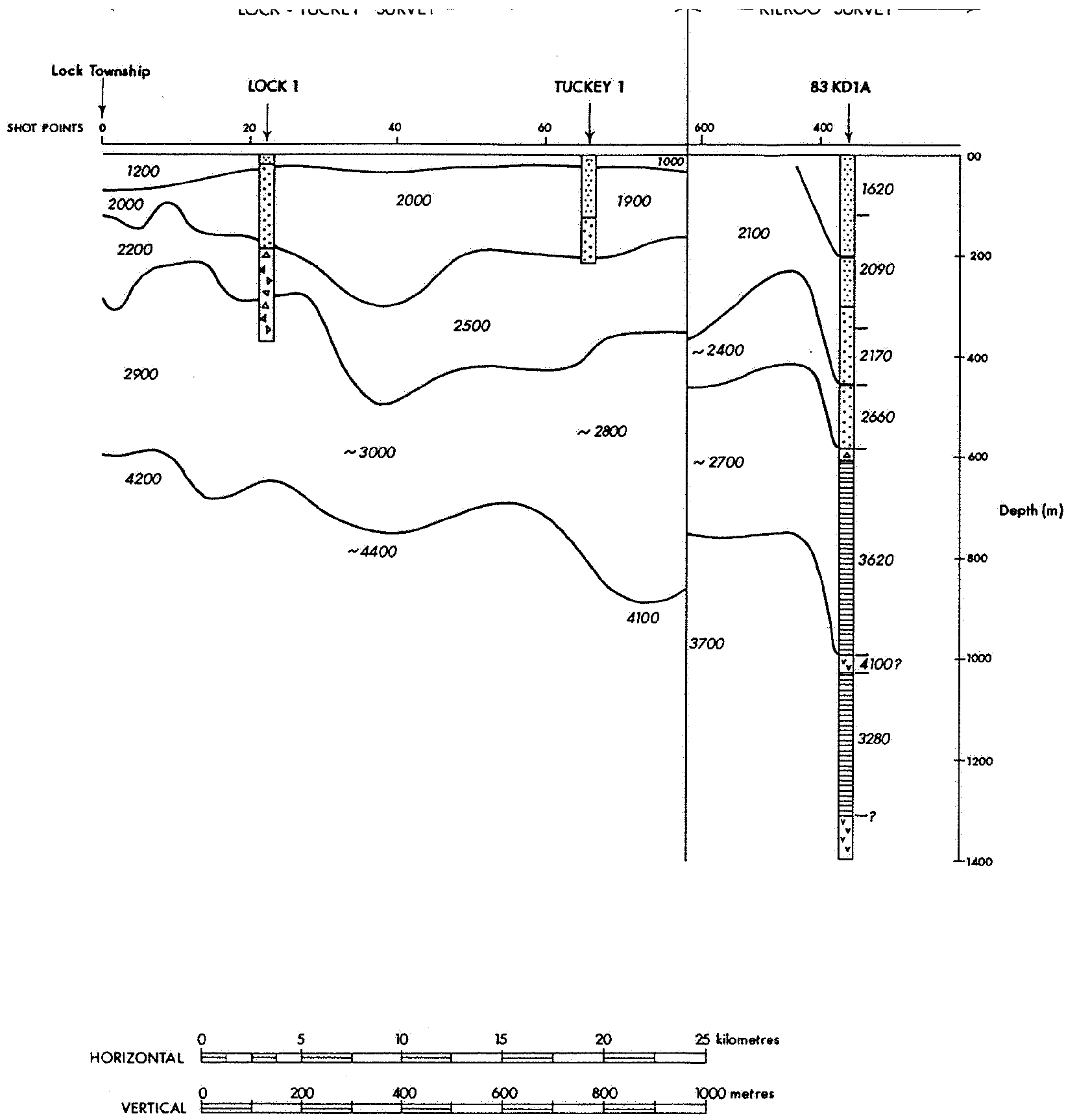
Thus, if the halite in Mercury No. 1 is assumed to be equivalent to the evaporites and carbonates of the Observatory Hill Beds, then the following regional correlation can be made.

Polda Basin		Officer Basin
Mercury No. 1	83KD1A	
Red Beds	Red Beds	Red Beds (Trainor Hill Sst)
	Basalt	Basalt (Kulyong Volcanics)
Evaporites	?	Evaporites (Observatory Hill Beds)

If these correlations are correct (and there is a large amount of supposition about them at the present time) then it is clear that 83KD1A was not drilled deep enough to determine whether the evaporite sequence is present or not beneath the basalt in the Kilroo Sub-basin.

8.2 Potash Potential

The stratigraphy of the Kilroo Sub-basin below 1400 m at the site of 83KD1A is not known. Two suggestions arising from a study of the seismic section are that the basalt may continue to the bottom of the basin at about 2300 m, or that Corunna Conglomerate may lie beneath the basalt with



LEGEND

- Coal or lignite
- Tertiary
- Jurassic
- Permo-Carboniferous
- Cambrian ? Basalt
- 2500 Calculated seismic velocity (m/sec)
- Interpreted reflection

CRA EXPLORATION PTY LIMITED

TUCKEY, EL 1054 — S.A. SEISMIC INTERPRETATION FROM LOCK TO KILROO

REF.	KIMBA SI 53-7		
SCALE	H: 1:250000 V: 1:10,000		
AUTHOR	AKS	REPORT	12673
DATE	1-6-84	PLAN No	SAa 2812

basement occurring somewhere between 1900 and 2200 m. Both of these suggestions are very tentative.

From the seismic section and from regional gravity, it is believed that 83KD1A was drilled in, or close to, the deepest part of the sub-basin, and therefore in the most favourable location for intersecting evaporites if they exist. Although the same stratigraphy is likely to be shallower in areas around the margin of the sub-basin, these areas are unlikely to be favourable for evaporite accumulation. Furthermore, a compilation of the SADME Kilroo seismic data and a 1976 SADME seismic traverse from Lock to Tuckey (McInerney, 1977) suggests that the pre-Permian stratigraphy rises about 400 m from Kilroo to Lock, but this still leaves the top of any evaporite sequence beneath the basalt at a depth no shallower than about 1000 m (see plan no. SAa 2812).

Although the quality of the 1976 seismic data is not good, and the interpretation was based on very limited drillhole information, there does seem to be some thinning of the pre-Permian sequence westwards towards a possible basement ridge in the Lock area (suggested by the regional gravity). If this is so, it would indicate that the ridge was a topographic feature during pre-Permian sedimentation, thus confirming that the geographic centre of the sub-basin was also the depocentre and likely site for evaporite accumulation.

9. CONCLUSION

Although there is no proof of age relationships yet available for the pre-Permian stratigraphy intersected in 83KD1A, there is reasonable circumstantial evidence to suggest that the stratigraphic position of an evaporite sequence in the Kilroo Sub-basin is beneath the basalt at the bottom of the hole. However, this is not to say that evaporites do exist in this sub-basin: they could be replaced by a thick sequence of basalt, Corunna Conglomerate or some other (unknown) unit.

If evaporites do exist, they are most likely to occur in the vicinity of 83KD1A and will be at a depth greater than 1400 m. They are unlikely to occur at shallower depths closer to the basin margins.

A.K. SCOTT

AKS/pw

EXPENDITURE

Expenditure for the period ended 30th April, 1984, the nearest accounting period was $160 073.00, as listed below.

		$
Drilling		123 696
Payroll		16 930
Supplies		2 807
Vehicle		3 486
Travel		2 162
Property		575
Contractors		3 213
Overheads		7 204
	Total	$160 073

REFERENCES

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Byilkaoora No. 1 Well Completion Report.
SADME Rept. Bk. No. 79/115.

Fraser, A.R. and Tilbury, L.A., 1979.
Structure and Stratigraphy of the Ceduna Terrace Region, Great Australian Bight Basin.
APEA Jour. Vol. 19, Pt. 1.

McInerney, P.M., 1977.
Seismic Refraction Investigations in the Polda Basin.
SADME Rept. Bk. No. 77/74.

LOCATION

Kimba SI 53-7 1:250 000

KEYWORDS

Coal, Potash, Basin, Drill-rotary, Geophys-seismic, Drill-diamond.

LIST OF PLANS

Plan No.	Title	Scale
SAa 1932	Tuckey E.L. 1054 Location Map	1:250 000
SAa 2361	Tuckey E.L. 1054 Polda Basin - S.A. Geology, Geophysics and Drillholes	1:250 000
SAa 2657	Tuckey E.L. 1054 Comparison between Prognosed and Actual Stratigraphy in 83KD1A	1: 5 000
SAa 2653	Tuckey E.L. 1054 Kilroo Seismic Section	1: 25 000
SAa 2654	Tuckey E.L. 1054 Kilroo Seismic Section. Interpretation	1: 25 000
SAa 2812	Tuckey E.L. 1054 Seismic Interpretation from Lock to Kilroo	1:250 000
SAa 2805	Tuckey E.L. 1054 Composite Borehole Log 83KD1A.	1: 500

LIST OF TABLES

LIST OF APPENDICES

APPENDIX I

COAL ANALYSES

[redacted]

00076

83 KD 1A

The Australian
Mineral Development
Laboratories

nington Street, Frewville,
South Australia 5063
Phone Adelaide 79 1662
Telex AA 82520

Please address all
correspondence to
P.O. Box 114 Eastwood
SA 5063
In reply quote:

amdel

13 March 1984

F1/16/0
6472/84

Department of Mines & Energy S.A,
PO Box 151,
EASTWOOD SA 5063

Attention: George Kwitko

REPORT F6472/84

CLIENT REFERENCE:	EX-135, 12/06/234
TITLE:	Coal quality and rank of seven coal samples from CRA KD-1A
SAMPLE IDENTIFICATION:	Samples 1-7
MATERIAL:	Coal
LOCALITY:	CRA KD-1A; Polda Basin
DATE RECEIVED:	23 February 1984
WORK REQUIRED:	Proximate analyses, ultimate analyses, specific energy and vitrinite reflectance

Investigation and Report by: Brian L. Watson

Chief - Fuels Section: Dr Brian G. Steveson

Manager, Mineral and Materials Sciences Division: Dr William G. Spence

Brian Hickman.

for Brian S. Hickman
Managing Director

cah

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Melbourne, Vic.
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Perth, W.A.
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Townsville
Queensland 4814
Telephone (077) 75 1377

TABLE 1: PROXIMATE ANALYSES

	Sample No.	Depth (m)	Moisture (%)	Volatile matter (%)	Fixed carbon (%)	Ash (%)
Jurassic	1	456.80-457.09	15.0	29.8	19.3	35.9
	2	457.09-457.30	7.1	22.3	8.4	62.2
	3	457.30-457.60	12.1	28.2	16.1	43.6
	4	457.60-458.01	11.8	29.2	15.9	43.1
	5	458.01-458.20	7.6	25.0	8.3	59.1
	6	458.20-458.40	12.9	30.6	16.2	40.3
Permo-carboniferous	7	568.20-568.60	21.5	27.1	24.3	27.1
	3&4*	457.30-458.01	11.4	-	-	-

* composited on an equal weight, as received basis

TABLE 2: ULTIMATE ANALYSES AND SPECIFIC ENERGY

Sample No	Depth (m)	C (%)	H (%)	S (%)	Cl (%)	Na (%)	Gross Specific Energy (MJ/kg)
3&4*	457.30-458.01	28.9	3.00	0.23	0.71	0.76	11.64
7	568.20-568.60	35.0	2.88	1.38	0.96	0.99	13.92

*Composited on an equal weight, as received basis

TABLE 3: VITRINITE REFLECTANCE MEASUREMENTS

Sample No	Depth (m)	Mean Maximum Reflectance (%)	Standard Deviation	Range	Number of Determinations
3&4*	457.30-458.01	0.26	0.03	0.21-0.35	42
7	568.20-568.60	0.29	0.04	0.21-0.36	41

*Composited on an equal weight, as received basis

APPENDIX II

PETROGRAPHIC EXAMINATIONS

V [redacted]

00080

Pontifex & Associates Pty. Ltd.

TEL. 332 6744
A.H. 31 3816

26 KENSINGTON ROAD, ROSE PARK
SOUTH AUSTRALIA

P.O. BOX 91, NORWOOD
SOUTH AUSTRALIA 5067

MINERALOGICAL REPORT NO. 4266

27th March, 1984

TO:

Mr. David Andrews
Mr. Tony Scott,
CRA Exploration Pty. Ltd.,
PO Box 254
NORWOOD SA 5067

COPY TO:

The Administrator,
CRA Exploration Pty. Ltd.,
PO Box 254
NORWOOD S.A 5067

The Manager,
Information Services
CRA Exploration Pty. Ltd.,
PO Box 656
FYSHWICK ACT 2069

YOUR REFERENCE: Order No. B0859

MATERIAL: Drill core

IDENTIFICATION:

1158223
1158224
1158225

WORK REQUESTED: Thin section, petrographic description

SAMPLES & SECTIONS: Returned to you with this report.

PONTIFEX & ASSOCIATES PTY. LTD.

MINERALOGY — PETROLOGY • GEOLOGY • SECTION PREPARATION

1158223 : strongly vesicular basalt;
vesicules filled by chlorite, sericitic clays
Depth and prehnite;
992.4 m rock also albitised and oxidised.

This core represents a relatively coarse basalt, gradational in texture to (subophitic) fine dolerite; it contains abundant vesicles (7 to 10% of the rock).

Albitised plagioclase laths 0.2 - 0.7 mm in length, are interlocked with vague common orientation to form the essential rock-forming aggregate, which contains scattered subophitic pyroxene grains (10 - 12%) about 0.3 mm in size, also small oxidised magnetite grains.

Vesicles have a random size to 10 mm in diameter. They are slightly irregular in shape, rimmed by chlorite, with in some vesicles a more sericitic clay interleaved with the chlorite. In-fillings of fibrous (rather than platy) prehnite occur in the larger vesicles, but appear to be partly to completely altered to a nearly isotropic brownish clay. There is a generalised parallelism of some of the more elongate vesicles (?flow orientation).

1158224 : coarse grained vesicular basalt (gradational to
micro-dolerite); abundant, highly irregular vesicles,
Depth more or less interstitial, filled by chlorite ±
1007.6 m trace prehnite.

This rock is broadly similar to 1158223, but is coarser crystalline. The essential aggregate of plagioclase laths, 0.2 to 1.2 mm. long, are relatively more randomly interlocked, and clouded by clay alteration, as well as albitised, and partly altered to fine prehnite. Pyroxene crystals (15%) to 1 mm, are scattered with a subophitic textural relationship. These are altered to chlorite with hematite on fractures, and grain boundaries. Opaque oxide grains are disseminated.

Vesicles in this rock are highly irregular, and more or less interstitial, with their margins defined by projecting plagioclase crystal faces. They are up to 4 mm in length and are filled by chlorite with very rare interleaved ?prehnite.

<u>1148225</u> : altered olivine-bearing basalt;
abundant vesicles filled with chloritic clays.

Depth
1022.8 m

This is a finer-grained basalt than 1158223 - 4, with smaller (0.2 to 0.8 mm), random felspar laths forming an aggregate studded with abundant pyroxene crystals 0.2 mm in size. The plagioclase is altered to albite and very fine sericite; the pyroxene is altered to chloritic-clays.

Clay-limonite pseudomorphs after olivine crystals (3 - 5%). Disseminated Fe $\pm$ Ti oxides are oxidised and very fine grained.

Irregular vesicles 0.5 - 5 mm in length have a vaguely layered distribution with the elongate vesicles showing a common (?flow) orientation, (although the felspar laths are not oriented). Fibrous yellow chloritic clays fill the vesicles with fractures filled by ?saponite.

[redacted]
00083

Pontifex & Associates Pty. Ltd.

TEL. 332 6744
A.H. 31 3816

26 KENSINGTON ROAD, ROSE PARK
SOUTH AUSTRALIA

P.O. BOX 91, NORWOOD
SOUTH AUSTRALIA 5067

MINERALOGICAL REPORT NO. 4270

5th April, 1984

TO: Mr. A.K. Scott,
CRA Exploration Pty. Ltd.,
PO Box 254
NORWOOD S.A. 5067

COPY TO: The Administrator,
CRA Exploration Pty. Ltd.,
PO Box 254
NORWOOD S.A 5067

The Manager,
Information Services,
CRA Exploration Ltd.,
PO Box 656
FYSHWICK ACT 2069

YOUR REFERENCE: Order No. B0619
A/C No. 4479

MATERIAL: Drill core samples

IDENTIFICATION: 1159017 to 1159025

WORK REQUESTED: Thin section preparation, petrographic description with comments as specified.

SAMPLES & SECTIONS: Returned to you with this report.

PONTIFEX & ASSOCIATES PTY. LTD.

COMMENTS

The core samples in this batch represent three essential lithologies.

1. Samples 1159017, 1159021, 1159023, 1159024, all represent a fine, commonly graded, thin bedded, sandstone-siltstone-claystone facies, dominated by detrital quartz-muscovite and microcline but including minor to abundant authigenic anhydrite, quartz and carbonate. These sequences may result from the repeated flooding of an ancient playa lake backswamp, or saline flood plain environment. The detritus is derived mainly from fine grained, micaceous metasediments. There is no tuffaceous component in any of these rocks.

2. Samples 1159018, 19, 20 and 25, are amygdaloidal basalts, with vesicles filled variously by chlorite, interlayered chlorite and sericite, carbonate, and prehnite, rarely with traces of pumpellyite and anhydrite. This assemblage indicates temperatures in the range 150 - 300°C, depending on pressure. One of these (1159020), was an olivine basalt, with the olivine now replaced by hematite and chlorite.

3. Samples 1159022 is a volcaniclastic fine sandstone with some admixed clastic detritus from facies (1), above, and small vesicle-shaped concretions mostly of anhydrite, but with less abundant carbonate, quartz and albite.

Objectively, based only on the petrography, the depositional environment of this sequence may be interpreted as one of broad mature streams, possibly ephemeral type, crossing a system of playa lakes or saline flood plains, with sporadic intercalated basaltic flows. Most of the sediments are derived from a metamorphic area of probably low-grade metasediments(quartz-biotite-muscovite ± chlorite ± microcline), but with sparse shallow-water carbonate

The volcaniclastic sediment 1159022 is probably an epiclastic facies, distal from the then main centre of volcanism.

Saline groundwaters were conceivably responsible for the deposition of sulphate, quartz/chalcedony, and some carbonate in the sediments, although the sulphate may be primary of evaporite genesis.

Burial metamorphism with temperatures of 150^{o}C plus, has then caused the formation of the anhydrite as now seen, also of some calcite and quartz in the sedimentary facies. The chlorite, and the prehnite ± pumpellyite ± chlorite ± calcite ± anhydrite assemblages in the basalts, have also most likely formed by percolating groundwaters rich in dissolved salts, becoming localised in voids, and interstitial areas, and finally crystallising the minerals during burial metamorphism.

**

1159017 : limonitic, micaceous and felspathic, fine quartz sandstone, with siltstone lenses and minor authigenic carbonate

Depth
613.7 m

This is a thin bedded micaceous sandstone, with a bedding foliation defined by strongly oriented flakes of detrital white mica (7 - 10% of the whole rock). Detrital grains of quartz and microcline in subequal proportions form the bulk of the rock, with a grain size of 0.1 to 0.2 mm. LImonite is common on grain boundaries.

Lenses of siltstone up to 2 mm thick occur in some parts of the sandstone. These are parallel to the bedding and have variously, sharp or diffuse contacts with the sandstone. They are richer in mica and limonite than the sand. Most of the siltstone bodies appear to be lenses but some appear to be fragments (intraclasts).

Authigenic carbonate (5 - 7%) occurs as patches about 1 mm in size, composed of one or two grains.

Accessory minerals include oxidised opaque grains and chlorite after biotite. There is no obvious volcanic detritus.

[redacted]

1159018 :

Depth
1370.9 m

coarse crystalline basalt or dolerite,
with interstitial areas filled by chlorite,
lesser clouded clinozoisite;
also accessory prehnite and trace pumpellyite

At least 50% of this rock consists of randomly and intimately interlocked laths of albitised, weakly chloritised and sericitised, plagioclase laths 0.5 - 2 mm in length, and about 30% consists of granular to subophitic clinopyroxene.

Opaque oxides (10%) are disseminated, and irregular, amoeboidal to skeletal intersticies between plagioclase laths are mostly occupied by extremely fine fibrous chlorite of apparent deuteric origin.
Clouded clinozoisite/epidote occurs in some of these interstitial areas with very minor prehnite and traces of pale green pumpellyite.
Rare replacement of plagioclase by prehnite occurs in some areas.

<u>1159019</u> : limonitised-glassy and vesicular basalt, vesicles filled by fibrous prehnite and trace pumpellyite

Depth
1384.6 m

The bulk of this rock consists of a densely limonitised glassy groundmass crowded with random very small felspar crystals (35%), and euhedral to skeletal clinopyroxene crystals (15%).

Numerous vesicles up to 8 mm in mean diameter, are lined by chlorite and filled by fibrous (rather than platy) prehnite. Small rosettes of pale green pumpellyite occur on the walls of some of the vesicles.

1159020 : vesicular olivine basalt,
intersticies and vesicles filled by
prehnite, calcite, chlorite and rare anhydrite;
fine hematite-chlorite pseudomorphs after
olivine (reddish metallic mineral)

Depth
1390.0 m

Field note : identify the reddish metallic mineral

About 40% of this rock consists of random, albitised plagioclase laths 0.2 - 2 mm long, aggregated with granular to subophitic pyroxene crystals (30%), and hematite-chlorite pseudomorphs after olivine crystals (7%).

The reddish material mentioned in your field note is probably the hematite in these pseudomorphs, although accessory disseminated magnetite is also hematised (oxidised).

Numerous irregular intersticies, mostly between plagioclase laths are filled by various mixtures of fine fibrous chlorite, rarer calcite, and prehnite, with rare calcite-anhydrite pseudomorphs of thin platy crystals (?gypsum).

Vesicles which are really enlarged intersticies, are filled mainly by fibrous prehnite and carbonate.

1159021 : micaceous-felspathic-limonitic siltstone grading into limonitic mudstone; minor, scattered small reduction spots, including a thick conformable vein or recrystallised bed of anhydrite

Depth 1025.0 m

Field note : identify the whitish translucent mineral

This sample has weakly graded beds of a finer clastic (more distal?) facies than that represented by samples 1159017 and 1159024.

Basically it consists of thin beds (0.2 to 1 mm) with silty bases grading into thicker limonitic mudstone, which may have originally been sideritic (?flood-plain/backswamp deposits). Muscovite, quartz and microcline are the main detrital minerals, with minor chlorite, possibly after biotite.

Relatively thicker siltstones(15 mm thick) occur at the top and bottom of the core sample. One of these thick siltstones is separated from the apparently overlying mudstone by a thick conformable vein (?? or recrystallised bed) of blocky anhydrite, which sends a thin irregular offshoot cutting across the whole siltstone-mudstone sequence. This anhydrite is presumably the "whitish translucent mineral" mentioned in your field notes.

1159022 : mixed volcaniclastic, and clastic-micaceous-felspathic siltstone to very fine sandstone; minor small ovoid nodules variously of anhydrite, calcite, lesser albite and quartz

Depth
1099·3 m

This rock is a very fine grained epiclastic sediment, despite its remarkable similarity in hand specimen to a vesicular basalt.

The main detrital component is variously chloritised, silicified and/or limonitised glassy volcanic fragments (but not shards), with minor quartz, plagioclase, microcline and white mica. The grain size is 0.03 - 0.1 mm - i.e. silt to very fine sand size.

The mica tends to be more altered (expanded across the cleavage and ?kaolinised) than in the sediments with no volcanic components. Rare larger limonitised clasts to 1.5 mm long are present.

Authigenic concretions form about 10% of the rock; they are 0.2 to 2 mm in maximum diameter, with a circular to elliptical shape and filled mainly by granular to bladed anhydrite and granular calcite. Minor quartz and albite occur in some of them, and rare detrital grains occur in some.

1159023 : disrupted, carbonate-rich, micaceous-felspathic-limonitic sandstone, siltstone and mudstone, with authigenic carbonate, anhydrite, quartz and rare adularia

Depth
1181.9 m

This sample represents a graded sandstone-siltstone-mudstone sequence, with disrupted sandstone layers, overlying a predominantly muddy unit incorporating abundant authigenic anhydrite, quartz and carbonate. The graded sequence is right way up, in relation to the "up" arrow on the sample.

This graded sequence occupied 15 mm of the thin section and has units 2 - 7 mm thick, with fine detrital muscovite, quartz, microcline, varying rapidly within each unit from a size of 0.2 mm (fine sand) to <0.1 mm (mud, fine silt).

The matrix is rich in carbonate, including scattered patches of authigenic carbonate, and scattered small blades of authigenic anhydrite. Large lenses of quartz (with some chalcedony in a spherulitic pattern) and anhydrite occur in sandy parts of the two uppermost, thickest units. Minor authigenic adularia occurs locally.

The disrupted mudstone unit has lenses and shreds of micaceous-limonitic mudstone 0.2 - 10 mm in length, in a clear matrix dominated by granular to bladed anhydrite with minor carbonate and granular to radiating quartz and/or chalcedony. The mudstone contains minor detrital muscovite, quartz and microcline silt.

[redacted]

1159024 : sequence of graded, quartz-muscovite-microcline, very fine sandstone-siltstone-claystone units, including greenish claystones, and accessory carbonates; minor authigenic anhydrite

Depth 1183.6 m

Field note : do the greenish bands contain tuffaceous material?

This sedimentary sequence consists of graded very fine sandstone-siltstone-claystone units 4 - 15 mm thick. The main detrital minerals are quartz, muscovite and microcline, with minor chlorite, accessory carbonate, and fine greenish clays in the finer grained units. There is no recognisable tuffaceous component.

The grading is right-way-up in relation to the "up" arrow on the sample, with a grain size variation from 0.1 mm (very fine sand) to less than 0.03 mm (fine silt-clay). A quartzofelspathic layer with minor chlorite and biotite, at the base of each unit is followed by a more micaceous layer with abundant muscovite, and minor biotite and chlorite, as thin, strongly oriented flakes, to 0.4 mm long. The quartz and felspar in this layer are about 0.05 mm in size (coarse silt). Opaque oxides are most abundant in these layers. with accessory leucoxene in the claystone layers.

Minor authigenic anhydrite occurs in the sandier layers. It has a bladed habit like that of the detrital micas but blockier, or a granular habit, when finer grained.

1159025 :

Depth
1330.4 m

flow-layered basalt
with vesicular schlieren containing chlorite, and/or sericite; disseminated oxidised opaque grains and oxidised pyroxenes

Despite the fine clastic, volcaniclastic layered appearance of this hand specimen, the rock is seen in hand specimen to be holocrystalline, manifest as a felted aggregate of small sericitised felspar laths 0.1 - 0.2 mm long, and subordinate pyroxene granules 0.05 - 0.1 mm in diameter, with a limonitised mesostasis.

The layers in this rock consist largely of discontinuous, thin elongate voids along schlieren, 0.5 to 2 mm thick, within the felted aggregate and filled by fibrous chlorite and/or sericite, with scattered oxidised opaque crystals (?pyrite). The vesicles are also lined by altered felspars and oxidised pyroxene crystals.

The schlieren were probably formed by shearing when the extrusive magma was very thick and viscous.

APPENDIX III

DRILLCORE ANALYSES

00096 [redacted]

COMLABS Pty. Ltd.

COMPUTERISED ANALYTICAL LABORATORIES

Head Office and
Central Laboratory
305 SOUTH ROAD,
MILE END SOUTH
STH. AUST. 5031
TEL.: (08) 43 5722
TELEX: AA89323

NATA REGISTERED No. 1526

UR REF.: COM 840503

OUR REF.: DPO B 0621

Mr. A. Scott,
CRA Exploration Pty Ltd,
31 Osmond Terrace,
NORWOOD SA 5067,

5.4.84

Dear Tony,

RE: JOB COM 840503

Enclosed are the assays for the samples delivered to our laboratory on the 20th March 1984.

Yours sincerely,
COMLABS PTY LTD

per :

P R Harvey

c.c.: NORWOOD
c.c.: FYSHWICK

COMLABS Pty. Ltd.
COMPUTERISED ANALYTICAL LABORATORIES

ANALYTICAL REPORT

JOB COM840503 O/N : B 0621

Results in ppm

SAMPLE	Cu	Pb	Zn	Ni	Co	Bi	Cr
1159026	18	6	65	48	28	<4	14
1159027	20	8	80	38	26	<4	6
1159028	24	6	38	38	26	<4	6
1159029	18	8	65	60	32	<4	6
1159030	14	4	65	48	24	<4	4
1159031	20	6	36	50	30	<4	6
1159032	26	4	120	70	34	<4	18
1159033	12	6	135	60	36	<4	12
1159034	12	6	85	38	28	<4	6
1159035	38	6	70	50	30	<4	6
1159036	26	4	90	60	38	<4	14
1159037	42	4	95	48	28	<4	8
1159038	16	6	32	36	22	<4	6
1159039	12	6	48	36	22	<4	6
1159040	12	4	65	34	20	<4	6
1159041	28	4	120	46	30	<4	8
1159042	14	6	120	38	26	<4	6
1159043	16	6	80	38	30	<4	8
1159044	20	6	55	46	32	<4	10
1159045	55	6	210	32	26	<4	6
1159046	55	4	65	36	28	<4	6
1159047	700	6	60	28	18	<4	6
1159048	24	4	75	40	28	<4	8
1159049	16	6	85	34	28	<4	8
1159050	32	6	75	32	28	<4	8

.../ 2

COMLABS Pty. Ltd.
COMPUTERISED ANALYTICAL LABORATORIES

ANALYTICAL REPORT

JOB COM840503 O/N : B 0621

Results in ppm

SAMPLE	Cu	Pb	Zn	Ni	Co	Bi	Cr
1159051	6	6	80	36	28	<4	8

Method of Analysis : Cu Pb Zn Ni Co Bi : AAS1
Cr : AAS2

.../ 3

COMLABS Pty. Ltd.
COMPUTERISED ANALYTICAL LABORATORIES

ANALYTICAL REPORT

JOB COM840503 O/N : B 0621

Results in ppm

SAMPLE	Ba	Ce	Nb	Rb	Sn	Ag	V
1159026	10	<20	8	8	<4	<1	200
1159027	<10	20	7	6	<4	<1	220
1159028	45	20	7	16	8	<1	170
1159029	<10	20	5	8	<4	<1	160
1159030	85	<20	6	38	4	<1	170
1159031	230	<20	6	55	<4	<1	180
1159032	50	<20	7	20	6	<1	200
1159033	65	20	10	22	4	<1	310
1159034	50	20	10	8	<4	<1	240
1159035	25	20	9	14	<4	<1	220
1159036	60	20	10	9	<4	<1	230
1159037	95	<20	10	32	<4	<1	210
1159038	300	30	10	85	<4	<1	200
1159039	170	<20	9	75	<4	<1	220
1159040	140	20	8	60	<4	<1	230
1159041	<10	<20	9	3	<4	<1	290
1159042	15	20	10	7	4	<1	250
1159043	15	20	10	6	<4	<1	260
1159044	<10	20	12	6	4	<1	260
1159045	20	20	10	10	8	<1	260
1159046	<10	20	10	2	4	<1	250
1159047	320	20	10	65	6	<1	240
1159048	15	20	10	8	6	<1	230
1159049	<10	20	9	6	<4	<1	270
1159050	45	20	12	10	<4	<1	230

.../ 4

COMLABS Pty. Ltd.
COMPUTERISED ANALYTICAL LABORATORIES

ANALYTICAL REPORT

JOB COM840503 O/N : B 0621

Results in ppm

SAMPLE	Ba	Ce	Nb	Rb	Sn	Ag	V
1159051	70	<20	9	20	<4	<1	240

Method of Analysis : Ba Ce Nb Rb Sn : XRF1
Ag V : AAS3

COMLABS Pty. Ltd.
COMPUTERISED ANALYTICAL LABORATORIES

ANALYTICAL REPORT

JOB COM840503 O/N : B 0621

Results in ppm

SAMPLE	Sr	U	Y	Zr	%Ti	Au
1159026	26	<4	12	70	0.70	0.05
1159027	44	<4	14	75	0.72	<0.01
1159028	90	<4	16	75	0.74	<0.01
1159029	38	<4	8	60	0.64	<0.01
1159030	125	<4	12	60	0.70	<0.01
1159031	150	<4	12	65	0.68	<0.01
1159032	100	<4	14	70	0.74	<0.01
1159033	75	<4	18	95	0.92	<0.01
1159034	55	<4	20	105	0.96	<0.01
1159035	75	<4	16	90	0.82	<0.01
1159036	90	<4	20	95	0.84	<0.01
1159037	120	<4	18	95	0.90	<0.01
1159038	230	<4	20	95	0.98	<0.01
1159039	220	<4	16	95	0.90	<0.01
1159040	220	<4	18	100	0.88	<0.01
1159041	70	<4	16	95	0.86	<0.01
1159042	55	<4	16	90	0.76	<0.01
1159043	65	<4	18	105	0.98	<0.01
1159044	38	<4	18	100	0.84	<0.01
1159045	65	<4	18	100	0.86	<0.01
1159046	32	<4	18	100	0.84	<0.01
1159047	180	<4	16	100	0.82	<0.01
1159048	75	<4	18	95	0.82	<0.01
1159049	46	<4	20	100	0.88	<0.01
1159050	125	<4	18	100	1.00	<0.01

.../ 6

COMLABS Pty. Ltd.
COMPUTERISED ANALYTICAL LABORATORIES

ANALYTICAL REPORT

JOB COM840503 O/N : B 0621

Results in ppm

SAMPLE	Sr	U	Y	Zr	%Ti	Au
1159051	115	<4	16	90	0.96	<0.01

Method of Analysis : Sr U Y Zr : XRF1
Ti : COL4
Au : FAS1

00103[redacted]

COMLABS Pty. Ltd.

COMPUTERISED ANALYTICAL LABORATORIES

Head Office and
Central Laboratory
305 SOUTH ROAD,
MILE END SOUTH
STH. AUST. 5031
TEL.: (08) 43 5722
TELEX: AA89323

NATA REGISTERED No. 1526

OUR REF.: COM 840662

YOUR REF.: DPO B 0622

Mr. A. Scott,
CRA Exploration Pty Ltd.,
P.O. Box 254,
NORWOOD SA 5067,

18.4.84

Dear Sir,

RE: JOB COM 840662

Enclosed are the assays for the samples delivered to our laboratory on the 6th April 1984.

Yours sincerely,
COMLABS PTY LTD

per :

c.c.: FYSHWICK
c.c.: NORWOOD

COMLABS Pty. Ltd.
COMPUTERISED ANALYTICAL LABORATORIES

ANALYTICAL REPORT

JOB COM840662 O/N : B 0622

Results in ppm

SAMPLE	U	Au
1159052	<4	<0.01
1159053	<4	<0.01
1159054	<4	<0.01
1159055	<4	<0.01
1159056	<4	<0.01
1159057	<4	<0.01
1159058	<4	<0.01
1159059	<4	<0.01
1159060	<4	<0.01
1159061	<4	<0.01
1159062	<4	<0.01
1159063	<4	<0.01
1159064	<4	<0.01
1159065	<4	<0.01
1159066	<4	<0.01
1159067	<4	<0.01
1159068	<4	<0.01
1159069	<4	<0.01
1159070	<4	<0.01
1159071	<4	<0.01

Method of Analysis : U : XRF1
Au : FAS1

COMLABS Pty. Ltd.
COMPUTERISED ANALYTICAL LABORATORIES

ANALYTICAL REPORT

JOB COM840662 O/N : B 0622

Results in ppm

SAMPLE	Cu	Pb	Zn	Ni	Co	Ag
1159061	20	8	46	42	16	<1
1159062	12	10	60	48	18	<1
1159063	390	6	160	100	36	<1
1159064	18	10	42	40	16	<1
1159065	12	16	65	44	18	<1
1159066	340	<4	85	48	26	<1
1159067	3800	6	90	40	24	<1
1159068	2900	6	100	32	22	<1
1159069	1950	8	110	32	22	<1
1159070	1850	6	80	30	24	<1
1159071	44	6	110	42	28	<1

Method of Analysis : Cu Pb Zn Ni Co : AAS1
Ag : AAS3

APPENDIX IV

SPECIFIC GRAVITY DETERMINATIONS

83KD1A - SPECIFIC GRAVITY DETERMINATIONS

Sample No.	Depth (m)	S.G.	Lithology
1159072	616	2.49	Laminated micaceous shale
1159073	692	2.61	Banded mudstone/siltstone (60/40)
1159074	693	2.43	Banded siltstone/sandy siltstone (40/60)
1159075	753	2.56	Laminated mudstone/siltstone (60/40)
1159076	756	2.42	Laminated siltstone
1159077	850	2.53	Banded mudstone/siltstone
1159078	950	2.66	Laminated mudstone/siltstone (70/30)
1159079	1053	2.67	Laminated siltstone/mudstone (50/50)
1159080	1154	2.68	Laminated mudstone/siltstone (60/40)
1159081	1271	2.69	Laminated mudstone/siltstone (50/50)
1159082 (2)	995	2.81	Amygdaloidal basalt
1159083 (3)	1014	2.97	F.-m.gr. massive basalt
1159084 (2)	1312	2.90	Amygdaloidal basalt
1159085 (1)	1326	2.56*	Purple vesicular basalt
1159086 (3)	1333	3.01	F.gr. banded dense basalt
1159087 (3)	1348	3.02	F.gr. massive basalt
1159088 (1)	1356	2.68*	Vesicular and amygdaloidal basalt
1159089 (2)	1372	2.89	M.gr. massive basalt
1159090 (1)	1386	2.73*	Purple vesicular and amygdaloidal basalt
1159091 (2)	1392	2.85	Massive amygdaloidal basalt.

* Wax impregnated.

CALCULATIONS

Siltstone/Mudstone: 600- 900 m 2.51
900-1300 m 2.68

Basalt:	Vesicular (1)	2.66	@	10%	
	Amygdaloidal (2)	2.86	@	70%	Average = 2.87
	F/gr dense (3)	3.00	@	20%	

APPENDIX V

DETAILED GEOLOGICAL LOG OF 83KD1A

ROTARY DRILL CORE LOG

CO-ORDINATES
AZIMUTH
DRILLERS F.A. KELLY P/L (K. JOHNS, C. JOHNS)
COMMENCED 19.12.83
DEPTH 1398.2
HOLE No. 83 KD 1
RL COLLAR 108 m (approx)
INCLINATION VERTICAL
DRILL TYPE WARMAN 1500
COMPLETED 10.3.84
CASING LEFT
DPO No(s) B0621, B0622

DEPTH FROM (M)	DEPTH TO (M)	CORE REC. (M)	CORE SIZE	GRAPHIC LOG	CORE DESCRIPTION	SPECIAL FEATURES (WEATH., ALTERATION, FRACTURING, VEINING, MINERALIZATION)	SAMPLE No.	FROM (M)	TO (M)	REC (M)	ASSAY VALUES
0	2		200mm		Calcrete, sand.						
2	4		(8⅝")		Calcrete, red-bn clay, sand						
4	6				Red-bn lateritic clay, sand						
6	8				As above						
8	10				Buff, v.f.gr. sub-ang sand and clay. Some sand grains coated with red Fe oxides.						
10	12				As above, but redder.						
12	14				No sample. Hydropol caused flocculation of clays						
14	22				Buff and red clays. Minor f.gr. sand.						
22	24				V.f.gr. buff and red sands, and clay.						
24	32				F.gr. sub-ang. to sub-rd. sands, minor clay. Sand is qtz (many grains with red Fe oxide) and red and wh. felspar.						
32	34				Similar to above, but coarser grained.						
34	36				As above.						
36	42				Mottled lt. bn, yell, and red-bn clay; some qtz grains						
42	44				Pinkish, f.gr, lateritic sand and clay. Qtz and felspar grains common. Clay is mottled yell, bn, gy.						
44	48				As above.						
48	50				Mottled sandy clay Sand ~ 20%.						
50	56				As above.						
56	58				Gy-gn clay.						
58	64				As above.						
64	66				Lt. bn, f.gr, rd. to well rd. qtz sand.						
66	70				Lt. bn. sand. Hydropol curdled.						
70	72				As above No sample.						
72	78				Minor sample of blue-gy. clay.						
78	94				Dk blue-gy. clay, and dk. gy-blue clay						
94	96				F.gr, white, sub.rd.-rd., clean quartz sand, with v. minor white felspar.						
96	98				Sand and blue-gy. clay.						

CRAE 117
PLAN No M414

SUMMARY AND SPECIAL COMMENTS

LOGGED BY A K Scott DATE

SHEET 1 OF 13

KOTARY DRILL CORE LOG

CO-ORDINATES | AZIMUTH | DRILLERS | COMMENCED | DEPTH | HOLE No. 83 KD1

RL COLLAR | INCLINATION | DRILL TYPE | COMPLETED | CASING LEFT | DPO No(s).

DEPTH FROM (M)	DEPTH TO (M)	CORE REC. (M)	CORE SIZE	GRAPHIC LOG	CORE DESCRIPTION	SPECIAL FEATURES WEATH., ALTERATION, FRACTURING VEINING, MINERALIZATION	SAMPLE No.	FROM (M)	TO (M)	REC (M)	ASSAY VALUES
98	100				F-m. gr. white qtz sand with some blue-gy. clay						
100	102				Blue-gy. clay. Possibly minor sand.						
102	104		c		Blue-gy. to gy.-gn. clay; some yellowish.						
104	110		c	110	Black clay. Foetid odour. Carbonaceous.						
110	112				Blue-gy clay						
112	116				Gy. and lt. gy. clay.						
116	118				Clay and sand.						
118	130	140mm (5½")	c	120	F-m. gr., lt. bn., sub-ang. to sub-rd. qtz sand. Many grains are pale yellow. Minor c.gr. sand. Minor carbonaceous shale interbedded — water is v. dark brown.						
130	132			130	V.f.gr. sands and minor carb. shale.						
132	134		c		F-m.gr. sands, and minor carb. shale.						
134	144			140	F-c.gr. sands, most m.gr.						
144	146		c		F-m.gr., lt. bn., sub-ang. to sub-rd. sands. Minor carbonaceous shale.						
146	150			150	F.gr. sands. Possibly minor shale.						
150	154				M.gr., ang. to sub-rd., lt. bn. sands with minor felspar. V. minor shale.						
154	156				F-m.gr. sands; minor felspar.						
156	160			160	F-c.gr. sands with minor felspar. Minor lt. gy. shale.						
160	162				F.gr., lt. bn., sub-ang. to sub-rd. qtz sands; minor felspar.						
162	164				F-c.gr. sands						
164	166				V.f.gr., lt. bn., clean qtz sands.						
166	170			170	C.gr. sands; minor felspar.						
170	174				F.gr. sands.						
174	192			180, 190	M.gr sands, sub-ang. to sub-rd. Some gy. clay 186-188. (Drillers reported significant lignite occurrences between 160-200 m when redrilling 83 KD1A)						
192	194				C.gr. sands, nearly all qtz.						
194	200			200	M-c.gr. sands.						

SUMMARY AND SPECIAL COMMENTS

LOGGED BY A.K. Scott DATE

SHEET 2 OF 13

CRAE 117
PLAN No M414

DRILL CORE LOG

CO-ORDINATES ______ AZIMUTH ______ DRILLERS ______ COMMENCED ______ DEPTH ______ HOLE No. 83 KD 1

RL COLLAR ______ INCLINATION ______ DRILL TYPE ______ COMPLETED ______ CASING LEFT ______ DPO No(s) ______

DEPTH FROM (M)	TO (M)	CORE REC. (M)	CORE SIZE	GRAPHIC LOG	CORE DESCRIPTION	SPECIAL FEATURES WEATH., ALTERATION, FRACTURING VEINING, MINERALIZATION	SAMPLE No.	FROM (M)	TO (M)	REC (M)	ASSAY VALUES
200	204		c		M-c.gr. sands with carb. shale.						
204	206				M.-c.gr. sands with blue-gy. clay.						
206	214		210	P	M.-c.gr., lt. bn., sub-ang. to sub-rd. sand. Most qtz grains clear, some milky. Minor pyrite.						
214	224		220	P	F-m.gr. sand; otherwise as above.						
224	228				M.gr. sand.						
228	230		230		C.gr., sub-ang. to sub-rd., qtz. sand						
230	240		240		M.gr. sands.						
240	244				C.gr. sands.						
244	248				M.gr. clean sands.						
248	250		250		C.gr. sands.						
250	260		260		M.gr. sand in a matrix of white clay.						
260	268				M-c.gr. sand in matrix of white clay.						
268	270		270		F.gr. sand with minor white clay matrix.						
270	272				C.gr. sand with white clay matrix.						
272	276				M.gr. sand with matrix of white clay.						
276	280		280		White clay and v.f.gr. sand.						
280	282				M.gr. sand and white clay.						
282	298		290		M.gr. clean qtz sand.						
298	300		c 300		No sample, but probably carb. shale.						

SUMMARY AND SPECIAL COMMENTS

LOGGED BY A.K. SCOTT DATE ______

SHEET 3 OF 13

CRAE 117
PLAN No M414

DRILL CORE LOG

CO-ORDINATES ______ AZIMUTH ______ DRILLERS ______ COMMENCED ______ DEPTH ______ HOLE No. 83 KD 1

RL COLLAR ______ INCLINATION ______ DRILL TYPE ______ COMPLETED ______ CASING LEFT ______ DPO No(s) ______

DEPTH FROM (M)	DEPTH TO (M)	CORE REC. (M)	CORE SIZE	GRAPHIC LOG	CORE DESCRIPTION	SPECIAL FEATURES (WEATH., ALTERATION, FRACTURING, VEINING, MINERALIZATION)	SAMPLE No.	FROM (M)	TO (M)	REC (M)	ASSAY VALUES
300	302				F.gr. sand, possibly with white clay matrix.						
302	304				M.gr. sand with white clay.						
304	316		310		F.-m.gr. sand, probably with matrix of white clay.						
316	320		320		C.gr. sand and clay. Sand has about 30 % bluish milky qtz grains. Minor py						
320	322				No sample. Hard. Probably shale.						
322	326				as above.						
326	328				Blue shale.						
328	330		330		F.-m.gr., sub-rd., qtz sand with clayey matrix(?)						
330	336		c		No sample, but some carb. shale and blue shale cuttings obtained. Probably similar to 320-322. Hard at 336 m.						
336	356		340 c 350		Soft, f.-m.gr., sub-ang. to sub-rd. quartz sands with probable clay matrix. Contains thin interbeds of carb. and bn. shale up to 10 cm thick. One of these at 336 m. Sand/clay ratio uncertain but about 60/40.						
356	360		c 360		Soft, dk. bn. clay, with some sand, containing 5-10 cm thick interbeds of hard dk. bn. carb. shale.						
360	364				Gy-bn clay and f.gr. sand.						
364	366				F.-m.gr., sub-ang. to rd. white quartz sand.						
366	368				F.gr. sand and clay, 75/25. Thin bands hard shale						
368	372		370		Gy. clay (85 %) and f.-c.gr. sand (15 %).						
372	376		c		Dk. bn. clay.						
376	378				Dk. bn. clay and sand.						
378	382		380		F.-m.gr., lt gy., sub-ang. to sub-rd. quartz sand with occasional larger grains. Minor flspar.						
382	392		c 390		Dk. bn. clay.						
392	394				Dk. bn. shale and coal.						
394	396				Bn. shale						
396	398		c		F.gr. sand with thin beds of carb. shale.						
398	400		400		F.-m.gr., sub-ang. to rd. sand.						

SUMMARY AND SPECIAL COMMENTS: No drilling carried out between 22.12.83 and 16.1.84. On re-entering, hole had collapsed at top in expanding clay (0-118 m). New hole 83 KD 1A collared 10 m south.

LOGGED BY A.K. SCOTT DATE ______

SHEET 4 OF 13

CRAE 117
PLAN No M414

DRILL CORE LOG

CO-ORDINATES ______ AZIMUTH ______ DRILLERS ______ COMMENCED ______ DEPTH ______ HOLE No. 83 KD 1A

RL COLLAR ______ INCLINATION ______ DRILL TYPE ______ COMPLETED ______ CASING LEFT ______ DPO No(s) ______

DEPTH FROM (M)	DEPTH TO (M)	CORE REC. (M)	CORE SIZE	GRAPHIC LOG	CORE DESCRIPTION	SPECIAL FEATURES WEATH., ALTERATION, FRACTURING VEINING, MINERALIZATION	SAMPLE No.	FROM (M)	TO (M)	REC (M)	ASSAY VALUES
400	404				Bn. clay						
404	408				Bn. clay and sand.						
408	416		410		F.gr., sub-ang. to rd. sand with minor wh. felspar. Possibly some minor clay bands.						
416	418		420		F-c.gr (most f.-m.gr.) sub-ang. to sub-rd. sand with some bn. clay.						
418	420				Sand and clay						
420	428				F.gr., lt. bn., sub-ang to rd. quartz sands, with some wh. felspar. Minor clays						
428	430		430		M.gr. sub-ang. to sub-rd. qtz sand.						
430	456		c, c, 440, c, 450		Hard and slow. Nearly all return is m-c gr. sand, but very few chips of a dk. bn, hard, carb. shale also obtained. Some patches softer. In light of core at 456-459 this interval is likely to consist of alternating bands of gy. mst. and lignite or carb. shale.						
456	459		c, 460		Cored. Mainly dk. bn. carb. shale (or lignite) and gy. mst. 456.3 - 456.8: Dk. bn. carb. mst, containing flecks of black carb. matter. 456.8 - 458.35: Black to dk. bn. lignite with thin bands of dk. bn. carb. mst, and coal. 458.35 - 459.4: Lt. gy. interbedded mst. and sltst. F.gr. mica common.						
459	474		470		Very poor samples. Fairly hard. Much sand and occasional lignite fragments obtained.						
474	515		480, 490, 500		No samples obtained. Alternating hard and soft bands. When bit retrieved, all rollers had been lost. This section probably contains bands of siltstone, sandstone and a mixture of the two. Electric logs will aid in final interpretation						

CRAE 117
PLAN No M414

SUMMARY AND SPECIAL COMMENTS HQ coring commenced at 515

LOGGED BY F.K. SCOTT DATE ______

SHEET 5 OF 13

DIAMOND DRILL CORE LOG

CO-ORDINATES ______ AZIMUTH ______ DRILLERS ______ COMMENCED ______ DEPTH ______ HOLE No. 83 KD 1A

RL COLLAR ______ INCLINATION ______ DRILL TYPE ______ COMPLETED ______ CASING LEFT ______ DPO No(s) ______

DEPTH FROM (M)	DEPTH TO (M)	CORE REC. (M)	CORE SIZE	GRAPHIC LOG	CORE DESCRIPTION	SPECIAL FEATURES WEATH., ALTERATION, FRACTURING VEINING, MINERALIZATION	SAMPLE No.	FROM (M)	TO (M)	REC (M)	ASSAY VALUES (ppm) U	Au
515.0	517.0	0.28	HQ		515.0 - 555.4. Gritty sst. with interbeds							
517.0	520.0	2.29			of sltst. and silty sst.							
520.0	521.3	0.85			Mainly poorly bedded poorly sorted,							
521.3	524.4	2.31			lt. gy., friable gritty sst. Grains							
524.4	528.2	3.01			ang. to rd., but most sub-ang.							
528.2	531.0	2.23			to sub-rd. Size from f.gr. to		1159052	520.0	521.3	0.82	<4	<0.0
531.0	534.0	2.38			pebbles, but most m.-c. gr. Grain							
534.0	537.0	0.74			lithologies mainly clear qtz, but							
537.0	540.0	2.63			some pale blue and milky							
540.0	543.0	1.44			white; minor to common wh.							
543.0	544.3	0.74			felspar; minor black ironstone,							
544.3	548.0	1.00			black coal, white mica diopsidic							
548.0	550.3	1.27			rock. Large fragment (4 cm) of							
550.3	554.4	0.14			biotite - felspar - qtz gneiss at 534.7.		1159053	528.2	529.2	0.72	<4	<0.01
554.4	555.4	0.13			Pyrite framboids up to 5 cm very							
555.4	558.0	1.23			common.							
558.0	561.1	3.10			F.gr. silty sst. at 515.0 - 516.5 (?); 529.6 -							
561.1	562.0	0.89			531.7, 537.2 - 538.7, 548.0 - 549.5 (?).		1159054	532.0	535.0	1.50	<4	<0.01
562.0	565.0	3.05			Lt.-mid gy. laminated sltst. containing							
565.0	566.8	1.65			wisps of carb. matter at 521.3 - 523.4;							
566.8	567.4	0.60			524.3 - 525.6; 529.2 - 529.6; 543.5 (?) - 547.0 (?);							
567.4	569.9	2.09			550.2 - 555.4 plus other thin bands							
569.9	572.2	2.08			1-5 cm thick. Section 543.5 - 547.0							
572.2	575.3	3.00			contains part of large felspathic							
575.3	580.0	0.47			quartzite cobble at top also coaly							
580.0	583.0	1.31			bands, hard m.gr. felspathic zone,		1159055	542.0	544.0	0.80	<4	<0.01
583.0	586.0	1.42			a few bands of coarse ang.-rd.							
586.0	589.0	2.36			grit, and framboidal pyrite.							
589.0	592.0	3.09			At 547.1 is a thin band of coarse							
592.0	595.0	2.82			grit containing a 15 mm qtz. pebble.							
595.0	596.4	1.40			Bedding angles with LCA:							
596.4	598.0	1.89			75° at 519.4 in grit							
598.0	601.0	3.12			85° at 523.0 in sltst							
601.0	606.2	5.13			83° at 537.5 in sltst							
606.2	610.0	3.97			55° at 539.8 in grit							
610.0	616.0	6.10			87° at 550.4 in sltst.							
616.0	622.0	5.89										
622.0	628.0	6.16			555.4 - 573.3. Alternating carb. mst.							
628.0	634.0	6.06			(with minor coal) and non-carb.,							
634.0	640.0	6.00			lt. gy.- bn. mst.							
640.0	642.0	2.11			Hard, greasy, dk. bn. - bl., carb.							
642.0	646.0	3.88			mst. at 556.8 (?) - 559.7; 560.95 -							
646.0	652.0	6.07			561.25; 561.85 - 562.45; 563.1 - 564.1;							
652.0	658.0	6.05			568.1 - 569.1. Brittle black coal at							
658.0	664.0	6.00			568.3 - 568.7.							
664.0	665.1	0.96			Non-carb. mst. is soft and contains							
665.1	667.0	1.63	NQ		flakes and wisps of carb. material.							
667.0	673.0	5.87			An indurated section (by silicification?)							
673.0	679.0	6.03			occurs at 561.7 - 561.8.							
679.0	685.0	5.97										

SUMMARY AND SPECIAL COMMENTS ______

LOGGED BY A.K. SCOTT DATE ______

SHEET 6 OF 13

CRAE 117 PLAN No M414

DRILL CORE LOG

CO-ORDINATES ______ AZIMUTH ______ DRILLERS ______ COMMENCED ______ DEPTH ______ HOLE No. 83 KD 1A

RL COLLAR ______ INCLINATION ______ DRILL TYPE ______ COMPLETED ______ CASING LEFT ______ DPO No(s) ______

DEPTH FROM (M)	DEPTH TO (M)	CORE REC. (M)	CORE SIZE	GRAPHIC LOG	CORE DESCRIPTION	SPECIAL FEATURES WEATH., ALTERATION, FRACTURING VEINING, MINERALIZATION	SAMPLE No.	FROM (M)	TO (M)	REC (M)	Cu	Pb	Zn	Ni	Co	Ag	U	Au
685.0	691.0	5.92	NQ		573.3 – 583.2. Alternating pyritic stst.													
691.0	697.0	5.94			and grits.													
697.0	703.0	5.96			Laminated lt. and dk. gy. stst. with													
703.0	709.0	5.99			many small (1-10 mm) pyrite framboids													
709.0	715.0	5.95			and wisps of carb. matter, at													
715.0	721.0	5.99			573.3 – 574.2; 574.45 – 574.85; 582.7 –													
721.0	727.0	5.96			583.2.													
727.0	733.0	5.92			Remainder is mainly coarse, poorly													
733.0	739.0	6.09			sorted, ang. to sub-rd. lithic grit													
739.0	745.0	5.98			containing qtz, felspar, granite,													
745.0	751.0	6.02			ironstone, stst, quartzite.													
751.0	757.0	5.90																
757.0	763.0	6.03			583.2 – 593.3. White, well sorted, v. f. gr,		1159056	580.0	583.0	1.23							<4	<0.01
763.0	769.0	5.95			sub-ang. to rd., thinly bedded													
769.0	775.0	5.90			sst. containing bands of diamictite													
775.0	781.0	5.92			in places. Whiteness possibly due													
781.0	787.0	6.03			to kaolin. Pyrite framboids common.													
787.0	793.0	6.01			583.2 – 588.5: Mainly diamictite													
793.0	799.0	5.89			containing cobbles of granite,													
799.0	805.0	5.97			quartzite, mst, felspar-biotite schist													
805.0	811.0	5.96			up to 5 cm diameter in white sst. Also contains													
811.0	817.0	5.98			laminations of lt. gy. mst and		1159057	591.0	592.0	1.0							<4	<0.01
817.0	823.0	5.94			v. f. gr., scoured sst. Pyrite common.													
823.0	829.0	5.95			588.5 – 591.6: White, v. f. gr., laminated													
829.0	835.0	5.98			sst. with occasional small pebbles.													
835.0	841.0	5.94			Cross-bedded and scoured. Small		1159058	595.0	596.0								<4	<0.01
841.0	846.0	4.94			faults evident. Pyrite framboids													
846.0	850.0	4.07			up to 15 mm.													
850.0	856.0	5.95			591.6 – 593.3: Similar to top section													
856.0	862.0	6.05			but with more thin (1-3 mm) clay		1159059	599.0	600.0								<4	<0.01
862.0	868.0	6.01			bands.													
868.0	874.0	5.96																
874.0	880.0	5.97			593.3 – 605.3. Dk. gy. unsorted diamictite													
880.0	886.0	5.99			with matrix-supported cobbles up													
886.0	892.0	5.85			to 6 cm. Matrix contains much		1159060	604.4	605.4								<4	<0.01
892.0	898.0	5.91			silt-sized dk. gy. material and													
898.0	901.7	3.60			sand. Cobbles are generally sub-													
901.7	907.0	5.18			rd. but vary from ang. to rd.													
907.0	913.0	5.88			Commonest cobbles are m. – c. gr.													
913.0	919.0	6.00			pink granite with low biotite													
919.0	925.0	6.01			content, and f. – m. gr. white													
925.0	931.0	5.99			quartzite. Others are qtz-felspar-													
931.0	937.0	5.97			biotite schist, gneissic granite,		1159061	612.0	613.0		20	8	46	42	16	<1	<4	<0.01
937.0	941.8	4.78			granodiorite, biotite quartzite,													
941.8	943.0	1.18			felspar-biotite-garnet granofels,													
943.0	949.0	5.88			black siliceous slate, grey slate,	Two sub-horizontal												
949.0	955.0	5.90			f. gr. quartz-felspar-tourmaline(?)	veins of (?)anhydrite,												
955.0	960.0	4.90			schist, lt. gy. stst, f. gr. sst.	each 5 mm thick, at 597.0												
960.0	964.0	4.00																
964.0	970.0	5.91			The bottom 0.3 m contains many													

SUMMARY AND SPECIAL COMMENTS: HQ hole reamed out to 140 mm to 596, and 100 mm casing cemented in to this depth. Coring continued in HQ.

LOGGED BY AK Scott DATE ______

SHEET 7 OF 13

CRAE 117
PLAN No M 414

00116

DRILL CORE LOG

CO-ORDINATES ______ AZIMUTH ______ DRILLERS ______ COMMENCED ______ DEPTH ______ HOLE No. 83 KD 1A

RL COLLAR ______ INCLINATION ______ DRILL TYPE ______ COMPLETED ______ CASING LEFT ______ DPO No(s) ______

DEPTH FROM (M)	DEPTH TO (M)	CORE REC. (M)	CORE SIZE	GRAPHIC LOG	CORE DESCRIPTION	SPECIAL FEATURES (WEATH., ALTERATION, FRACTURING, VEINING, MINERALIZATION)	SAMPLE No.	FROM (M)	TO (M)	REC (M)	Cu	Pb	Zn	Ni	Co	Ag	U	Au
970.0	976.0	5.99	NQ		clasts of red-bn. stst (the underlying													
976.0	982.0	5.99			unit) Although there may be													
982.0	988.0	5.99			some slumping, the contact appears													
988.0	990.4	1.62			erosional.													
990.4	994.0	3.71																
994.0	1000.0	6.01			605.3 – 990.4. Laminated red-bn.													
1000.0	1006.0	6.03			micaceous stst, with increasing													
1006.0	1008.2	2.15			content of f.gr. sandy stst													
1008.2	1009.0	0.80			towards base. Contains bands up													
1009.0	1014.4	5.40			to 30 cm thick of lt. gy., dk. gy.,													
1014.4	1019.2	4.80			or cream micaceous stst and	Core parts easily on												
1019.2	1022.8	3.61			thin (1-30 mm) partings of blue-gy.	blue-gy. and blue-gn.												
1022.8	1027.0	4.22			or blue-gn. mst and laminae	mst partings and on												
1027.0	1033.0	6.05			of biotite. Reduction spots also blue-gy.	biotite laminae.												
1033.0	1039.0	5.95			Dk red-bn. mst also occurs in													
1039.0	1045.0	5.93			thin bands and thicker zones up to													
1045.0	1051.0	6.04			several metres (shown on detailed													
1051.0	1057.0	6.06			graphic log). Most of these													
1057.0	1063.0	5.95			disrupted by intraformational													
1063.0	1069.0	5.99			brecciation.													
1069.0	1074.2	5.20			Biotite flakes are prominent	Bedding angles												
1074.2	1078.0	3.80			throughout core. Pyrite framboids	generally 87°-88°												
1078.0	1084.0	5.97			1-5 mm diameter are common from	to LCA in top part												
1084.0	1090.0	6.05			605.3 – 635, 838-840; 854.6-854.9; 908.8-	of this section.												
1090.0	1096.0	5.96			912.0; 928.	At 800m, bedding												
1096.0	1097.0	0.92				angle is approx.												
1097.0	1099.4	2.38			Shallow water sedimentary structures	horizontal in stst,												
1099.4	1105.0	5.70			very common: cross-bedding, scour	but up to 65° to LCA												
1105.0	1111.0	5.94			and fill, flame structures, dewatering	in fine sandy silts												
1111.0	1117.0	6.00			structures, intraformational brecciation,													
1117.0	1123.0	6.00			graded bedding, desiccation cracks													
1123.0	1129.0	5.95			and ripple marks.													
1129.0	1133.8	4.78			Top 50 m or so (and several isolated	Thin (up to 2mm) calcite												
1133.8	1138.0	4.22			small patches below) contains small	veins 620-626, mostly												
1138.0	1144.0	6.05			voids (0.5-2mm) in the core	between 70° and 90°												
1144.0	1150.0	6.05			surface, or have calcite-filled	to LCA.												
1150.0	1155.1	5.08			cavities of the same shape. Shapes													
1155.1	1159.0	3.91			vary from rectangular (flat-lying)													
1159.0	1165.0	5.93			to squarish to triangular to	Sub-vertical veins												
1165.0	1171.0	6.02			indefinite. Most common shape	of semi-transparent,												
1171.0	1177.0	6.01			is squarish, about 1mm on edge.	white, non-calcareous												
1177.0	1183.0	5.99				material at 793, 803,												
1183.0	1189.0	6.04				806.5. Probably anhydrite.												
1189.0	1195.0	5.98			Sub-vertical breccia zones (usually													
1195.0	1198.0	2.94			with calcareous cement) occur at													
1198.0	1204.0	6.02			606.4-606.6; 636.1-636.7; 637.2-639.8;		1159062	970.0	971.0		12	10	60	48	18	<1	<4	<001
1204.0	1210.0	6.02				Sub-vertical veins												
1210.0	1216.0	5.87			At 818.2-825.3, laminae of detrital	of gy. clay occur												
1216.0	1219.7	2.72			hematite occur in red-bn., v.f.gr.,	sporadically, esp. 816.5												
1218.7	1222.0	3.30			thinly bedded silty sst.													

ASSAY VALUES (ppm)

CRAE 117
PLAN No M414

SUMMARY AND SPECIAL COMMENTS: HQ rods left in hole as casing (uncemented) to depth of 665. Coring continued in NQ. Mud changed to concentrated KCl/polymer at 616m.

LOGGED BY A.K SCOTT DATE ______

DRILL CORE LOG

CO-ORDINATES ______ AZIMUTH ______ DRILLERS ______ COMMENCED ______ DEPTH ______ HOLE No. 83 KD 1A

RL COLLAR ______ INCLINATION ______ DRILL TYPE ______ COMPLETED ______ CASING LEFT ______ DPO No(s). ______

DEPTH FROM (M)	DEPTH TO (M)	CORE REC. (M)	CORE SIZE	GRAPHIC LOG
1222.0	1225.6	3.64	NQ	
1225.6	1231.0	5.42		
1231.0	1237.0	6.05		
1237.0	1243.0	6.01		
1243.0	1249.0	6.00		
1249.0	1255.0	5.97		
1255.0	1257.3	2.30		
1257.3	1261.0	3.66		
1261.0	1267.0	6.05		
1267.0	1273.0	5.96		
1273.0	1279.0	5.95		
1279.0	1285.0	5.96		
1285.0	1291.0	6.09		
1291.0	1297.0	6.02		
1297.0	1303.0	5.96		
1303.0	1309.0	5.97		
1309.0	1315.0	6.08		
1315.0	1321.0	6.02		
1321.0	1323.2	2.20		
1323.2	1326.2	2.86		
1326.2	1328.5	2.27		
1328.5	1330.0	1.73		
1330.0	1332.6	2.61		
1332.6	1336.0	3.40		
1336.0	1342.0	6.00		
1342.0	1348.0	5.97		
1348.0	1349.6	1.63		
1349.6	1350.4	0.75		
1350.4	1352.8	2.40		
1352.8	1357.0	4.17		
1357.0	1360.8	3.80		
1360.8	1366.0	5.21		
1366.0	1372.0	6.01		
1372.0	1378.0	5.99		
1378.0	1384.0	6.04		
1384.0	1387.6	3.58		
1387.6	1391.8	4.10		
1391.8	1396.2	4.31		
1396.2	1398.2	2.01		
END OF HOLE				

CORE DESCRIPTION

Mst content increases downwards. Below 933, rock consists of thin alternating bands of mst and stst (approx 50/50), and many thin cgl. beds from 897. Below this depth, dewatering channels, graded bedding and dessication cracks very common.

Small anhydrite masses (1-5 mm) are common at places shown on graphic log.

Bottom 4 m contains more of the gy-gn mst bands than above.

990.4 – 1023.8. Hard, m.gr., dk.gy, massive crystalline rock with a groundmass of epidote(?) - garnet(?) - magnetite - plagioclase(?) - white acicular mineral and dk.gn. softish mineral (pyrophyllite?). Latter mineral is very common and occurs throughout unit usually in rounded masses 1-5 mm across. Some parts, especially 991.0 – 997.5 and 1004.5 – 1007.0 are c.gr. and amygdaloidal having large (up to 1 cm) amygdales filled with pyrophyllite (?) or with a hard white – lt. gn. transparent mineral with radiating habit – possibly pectolite or a zeolite.

The unit contains several prominent veins of talc/serpentine/antigorite at 10-20° to LCA.

Top 1 cm is banded. bottom 1 m is f.gr., and orange-bn in bottom few cm. Unit is massive.

1023.8 – 1097.95. Laminated red-bn. mst and minor stst, the latter calcareous in places. Top 1 m rather indurated, and many sub-horizontal veins of white mineral (anhydrite?) 0.5 – 2 mm thick in top 4 m. From 1040 - 1060, more silty and mst/stst ≈ 50/50. Above 1040 and below 1060, mst/stst ≈ 70/30.

SPECIAL FEATURES (WEATH., ALTERATION, FRACTURING, VEINING, MINERALIZATION)

Below 965, several sub-vertical fractures occur.

Sub-vertical veins of anhydrite (about 1 mm thick) reasonably common below 909.

Gy-gn mst possibly pyrophyllite?

ASSAY VALUES (ppm)

SAMPLE No.	FROM (M)	TO (M)	REC (M)	Cu	Pb	Zn	Ni	Co	Ag	U	Au
1159026	992.0	993.0		18	6	65	48	28	<1	<4	0.05
1159027	997	998		20	8	80	38	26	<1	<4	<0.01
1159028	1002	1003		24	6	38	38	26	<1	<4	<0.01
1159029	1007	1008		18	8	65	60	32	<1	<4	<0.01
1159030	1012	1013		14	4	65	48	24	<1	<4	<0.01
1159031	1017	1018		20	6	36	50	30	<1	<4	<0.01
1159032	1022	1023		26	4	120	70	34	<1	<4	<0.01

SUMMARY AND SPECIAL COMMENTS ______

LOGGED BY A.K. SCOTT DATE ______

CRAE 117
PLAN No M414

DRILL CORE LOG

CO-ORDINATES ______ AZIMUTH ______ DRILLERS ______ COMMENCED ______ DEPTH ______ HOLE No. 83 KD 1A

RL COLLAR ______ INCLINATION ______ DRILL TYPE ______ COMPLETED ______ CASING LEFT ______ DPO No(s) ______

DEPTH FROM (M)	DEPTH TO (M)	CORE REC. (M)	CORE SIZE	GRAPHIC LOG	CORE DESCRIPTION	SPECIAL FEATURES WEATH., ALTERATION, FRACTURING VEINING, MINERALIZATION	SAMPLE No.	FROM (M)	TO (M)	REC (M)	Cu	Pb	Zn	Ni	Co	Ag	U	Au
					Below 1050, cyclic graded bedding common. Cycles generally 1-3 cm thick but some much thicker. Of each cycle, the lower part is lt. bn., sometimes weakly calcareous, and ~~not~~ occasionally with a little granitic cgl. at base in a scour channel; this grades into the upper part of dk. bn. mst. Sedimentary structures very common especially dewatering channels desiccation cracks, scour and fill channels.	Much fracturing 1096.2 - 1096.9 mostly sub-vertical. Fractures contain anhydrite.												
					Thin cgl. bands especially at 1041; 1045; 1049; 1054; 1066.5; 1075. F.gr., red-bn., silty sst. at 1041.6 - 1044.8. Anhydrite nodules at 1043; 1062; 1075.5. Small ovoids of anhydrite common below 1090 (see next unit).	At 1096 bedding generally at 90° to LCA												
					1097.95 - 1100.6. Dk. gy., f.gr. (silt sized) amygdaloidal tuff with few thin bn. mst. bands.		1159063	1099.0	1100.0		390	6	160	100	36	<1	<4	<0.01
					Base of unit has 6 cm of green stst. which then verges into dk. gy. rock containing a few very faint graded beds. Amygdales up to 4 mm are common and contain soft(?) compact, fibrous, radiating, colourless crystals with at least one good cleavage - zeolites?? They are flattened horizontally and occur mainly from 1100.0 up to 1098.2 but also into overlying mst. to about 1090. This zone also contains a few thin (1-5 mm) bn. mst. bands. Top of unit verges into graded beds of gy-bn mst./stst, which are probably tuffaceous up to about 1096 (because of greyer colour).													
					1100.6 - 1308.45. Laminated red-bn. stst/mst sequence (similar to 1023.8 - 1097.95) but about 50/50. Graded bedding common. Minor gy-gn. mst in thin bands. Very thin cgl. beds (usually < 5 mm thick) containing mostly granite pebbles, but a few anhydrite(?) also. Some silty sections weakly calcareous. Towards base, rock becomes harder	Fractures at 0-20° to LCA relatively common throughout this section. Filled with anhydrite or anhydrite/calcite mixture. Major fractures at 1133, 1141, 1144, 1152, 1155, 1160, 1170-3, 1178, 1183, 1189, 1192, 1215, 1216-8, 1224	1159064	1122.0	1123.0		18	10	42	40	16	<1	<4	<0.01

ASSAY VALUES (ppm)

SUMMARY AND SPECIAL COMMENTS ______

LOGGED BY A.K. SCOTT DATE ______

SHEET 10 OF 13

CRAE 117 PLAN No M414

DRILL CORE LOG

CO-ORDINATES ______ AZIMUTH ______ DRILLERS ______ COMMENCED ______ DEPTH ______ HOLE No. 83 KD 1A

RL COLLAR ______ INCLINATION ______ DRILL TYPE ______ COMPLETED ______ CASING LEFT ______ DPO No(s). ______

DEPTH FROM (M)	DEPTH TO (M)	CORE REC. (M)	CORE SIZE	GRAPHIC LOG	CORE DESCRIPTION	SPECIAL FEATURES WEATH., ALTERATION, FRACTURING VEINING, MINERALIZATION	SAMPLE No.	FROM (M)	TO (M)	REC (M)	Cu	Pb	Zn	Ni	Co	Ag	U	Au
					and contains sections of hard, v.f.gr., silicified (?) sandy stst. Also few beds of sst.	1129-33, 1244, 1245-7, 1274, 1300, 1305. at 30° to LCA at 1278.5, 1280, 1281.												
					Cgl. at 1111, 1119, 1139, 1140, 1171, 1210, 1228, 1248, 1250.5, 1255, 1269, 1275, 1279, 1286, 1296, 1297, 1299 and elsewhere.													
					Anhydrite at 1142.5, 1144, 1183.2, 1183.8 (both sub-horizontal veins) 1187, 1231, 1236-8 and 1245 (brecciated veins), 1262, 1274, 1289, 1302.5 and elsewhere.													
					Hard f.gr. silicified sandy stst at 1133.0 - 1133.5, 1135.7 - 1136.0, 1136.6 - 1137.6, 1144.2 - 1144.5, 1149.4 - 1150.0, 1213, 1226, 1233 - 1233.5, 1249, 1253, 1257.6 - 1258.3. Generally more common 1285 - 1297. Hard calcareous stst 1304.65 - 1304.4.													
					Very hard, f.gr., ang. to sub-rd. sst containing clear qtz and red jasper(?) at 1288, 1290 and 1293.4 - 1294.1. V.f.gr. silty sst 1246.8 - 1247.3.		1159065	1272.0	1273.0		12	16	65	44	18	<1	<4	<0.01
					Granular mixture of anhydrite, qtz (?) and mst. fragments 1181.7 - 1182.1.													
					Mst/stst ≈30/70 1117 - 1125 and 1131 - 1189.													
					Grains of granite and anhydrite (?) scattered through mst/stst 1300 - 1306.													
					1308.45 - 1398.2. Series of mafic volcanic flows, each with a top about 50 - 100 cm thick of dk. purplish-gy. vesicular and amygdaloidal rock, with prehnite, grading to a lower section of mid gy-gn., f. - m.gr. amygdaloidal or non-amygdaloidal rock. Individual flows are described below.		1159033	1309.0	1310.0		12	6	135	60	36	<1	<4	<0.01
					1308.45 - 1324.8. Mgr., massive, dk.gy. amygdaloidal volcanic, very similar to section 990.4 - 1023.8. Top 10 cm f.gr. with fragments and fillings of red-bn. mst. Most amygdales occur 1313 - 1321.	Sub-vertical fracture filled with soft talcy material at 1313.5. Soft red material in horizontal joint at 1314.4.	1159034	1314	1315		12	6	85	38	28	<1	<4	<0.01
					1324.8 - 1348.3: Abrupt change to dk. purplish-bn. vesicular rock, brecciated in places. Vesicles sub-rd. and generally 1-5 mm diameter (most about 2 mm). Most are empty		1159035	1319	1320		38	6	70	50	30	<1	<4	<0.01

ASSAY VALUES (ppm)

SUMMARY AND SPECIAL COMMENTS ______

LOGGED BY A.K. Scott DATE ______

DRILL CORE LOG

CO-ORDINATES | AZIMUTH | DRILLERS | COMMENCED | DEPTH | HOLE No. 83 KD 1A

RL COLLAR | INCLINATION | DRILL TYPE | COMPLETED | CASING LEFT | DPO No(s)

CORE DESCRIPTION

but some contain a zeolite. Large veins or vesicles contain prehnite, red jaspoidal(?) material or earthy dk. purple or dk. bn. material. At 1327.5, a change over 10 cm to a f.gr, dk gy. mafic rock, massive and amygdaloidal in upper part, weakly banded and non-amygdaloidal in lower part (dolerite). Amygdales are large (10–45 mm), flattened horizontally and generally several cm apart in vertical direction. Rare below 1330, none below 1333. Most contain a thin rim of white mineral and filling of prehnite but a few are empty save for a thin rim of soft dk.gn. mineral. Banding in lower part is 1–2 mm thick and rather irregular and indistinct. Possible cuprite(?) in bands.

1348.3 – 1350.2 : Sharp change to v. dk. gy. vesicular f.gr. volcanic, becoming gradually less vesicular 'till it resembles the above f.gr. section with few amygdales.

1350.2 – 1355.8 : Vesicular dk.gy-gn volcanic with much prehnite fully or partly filling cavities. Gradually becomes less vesicular and lighter in colour downwards.

1355.8 – 1359.5 : Change over 5 cm to dk. purplish-gy. vesicular/amygdaloidal volcanic with much prehnite. Gradual change to gy-gn amygdaloidal rock and then an abrupt change (at 70° to LCA) to a f.gr. non-amygdaloidal volcanic at 1358.5.

1359.5 – 1360.0 : Abrupt change to purplish-gy. amygdaloidal volcanic, then gradation to gy-gn amygdaloidal rock.

1360.0 – 1362.5 : Gradual change over 10 cm to dk.gy. vesicular and amygdaloidal volcanic, then gradual change to lighter, finer grained amygdaloidal rock.

1362.5 – 1364.45. Gradual change over 5 cm to dk. purplish-gy. vesicular/amygdaloidal volcanic. Gradual change to lighter amygdaloidal rock.

SPECIAL FEATURES (WEATH., ALTERATION, FRACTURING, VEINING, MINERALIZATION)

Rock contains several sub-vertical fractures. Vein of zeolite at 17° to LCA at 1334.

SAMPLE No.	FROM (M)	TO (M)	REC (M)	Cu	Pb	Zn	Ni	Co	Ag	U	Au
				ASSAY VALUES (ppm)							
1159036	1324	1325		26	4	90	60	38	<1	<4	<0.01
1159037	1329	1330		42	4	95	48	28	<1	<4	<0.01
1159038	1334	1335		16	6	32	36	22	<1	<4	<0.01
1159039	1339	1340		12	6	48	36	22	<1	<4	<0.01
1159040	1344	1345		12	4	65	34	20	<1	<4	<0.01
1159041	1349	1350		28	4	120	46	30	<1	<4	<0.01
1159042	1354	1355		14	6	120	38	26	<1	<4	<0.01
1159043	1359	1360		16	6	80	38	30	<1	<4	<0.01
1159044	1364	1365		20	6	55	46	32	<1	<4	<0.01
1159045	1369	1370		55	6	210	32	26	<1	<4	<0.01

SUMMARY AND SPECIAL COMMENTS

LOGGED BY A.K. SCOTT DATE

C.R.A. EXPLORATION PTY LIMITED

DRILL CORE LOG

00121

PROJECT East Polda Potash. Tuckey EL1102

CO-ORDINATES ______ AZIMUTH ______ DRILLERS ______ COMMENCED ______ DEPTH ______ HOLE No. 83 KD 1A

RL COLLAR ______ INCLINATION ______ DRILL TYPE ______ COMPLETED ______ CASING LEFT ______ DPO No(s) ______

DEPTH FROM (M) | TO (M) | CORE REC (M) | CORE SIZE | GRAPHIC LOG | CORE DESCRIPTION | SPECIAL FEATURES (WEATH., ALTERATION, FRACTURING, VEINING, MINERALIZATION)

CORE DESCRIPTION

1364.45 – 1384.5: Abrupt change to dk. purplish-gy, vesicular and amygdaloidal volcanic with prehnite in amygdales. Gradually becoming less vesicular and mid gy-gn in colour, although amygdales still common to about 1370.

Grains of native Cu disseminated throughout core from 1378.4 – 1382.5, with best around 1380.7. Also on joint surfaces and in veins with prehnite. Bulk content estimated as less than 0.5 % Cu.

1384.5 – 1398.2: Change over 5 cm to dk purplish-gy. vesicular and amygdaloidal volcanic although m.gr. and dk. gy-gn at 1384.8 – 1385.05 and 1385.15 – 1385.35. Below 1386, gradual change to mid gy-gn, m.gr. amygdaloidal volcanic.

Contains disseminated cuprite (?) 1388.3 – 1393.4 (estimated 1% cuprite) 1395.1 – 1395.3 (estimated 1-2% cuprite) and 1398.0 – 1398.2 (estimated 5% cuprite). "Cuprite" later found to be hematite with a metallic coppery lustre.

END OF HOLE

SPECIAL FEATURES

Pink alteration of felspar(?) common 1370 – 1384.

ASSAY VALUES (ppm)

SAMPLE No.	FROM (M)	TO (M)	REC (M)	Cu	Pb	Zn	Ni	Co	Ag	U	Au
1159046	1374	1375		55	4	65	36	28	<1	<4	<0.01
1159066	1377	1378		340	<4	85	48	26	<1	<4	<0.01
1159067	1378	1379		3800	6	90	40	24	<1	<4	<0.01
1159047	1379	1380		700	6	60	28	18	<1	<4	<0.01
1159068	1380	1381		2900	6	100	32	22	<1	<4	<0.01
1159069	1381	1382		1950	8	110	32	22	<1	<4	<0.01
1159070	1382	1383		1850	6	80	30	24	<1	<4	<0.01
1159071	1383	1384		44	6	110	42	28	<1	<4	<0.01
1159048	1384	1385		24	4	75	40	28	<1	<4	<0.01
1159049	1389	1390		16	6	85	34	28	<1	<4	<0.01
1159050	1394	1395		32	6	75	32	28	<1	<4	<0.01
1159051	1398.0	1398.2		6	6	80	36	28	<1	<4	<0.01

ABBREVIATIONS

sst	sandstone	qtz	quartz
stst	siltstone	v	very
mst	mudstone	f	fine
cgl	conglomerate	m	medium
		c	coarse
lt	light	gr	grained
dk	dark	ang	angular
gy	grey	rd	rounded
gn	green	carb	carbonaceous
wh	white		
bl	black		
bn	brown		

SUMMARY AND SPECIAL COMMENTS ______

LOGGED BY A.K. Scott DATE ______

SHEET 13 OF 13

CRAE 117 PLAN No. M414

CRA EXPLORATION PTY. LIMITED

Report No. 12673
Plan No. SAa 2805

8288-5a

COMPOSITE BOREHOLE LOG

83 KD 1A

Tenement : TUCKEY E.L.1054 - S.A.
1:250000 Sheet : KIMBA SI 53-7
Location : LAT. 33° 34' 58"
LONG. 136° 02' 37"
Commenced : 20 JANUARY 1984
Completed : 10 MARCH 1984
Geological log : A.K. SCOTT
Geophysical log : GEOSCIENCE ASSOC. P/L
Vertical Scale 1 : 500

Mudstone, Shale
Siltstone
Sandy Siltstone
Silty Sandstone
Fine to Medium Sandstone
Coarse Sandstone
Grit
Coal, Lignite
Amygdaloidal & Vesicular Volcanic
Volcanic
Tuff

p Pyrite
° Pebble, Cobble
h Hematite
Cu Copper
c Carbonaceous
∧ Anhydrite
Calcareous Matrix

8288-5b

COMPOSITE BOREHOLE LOG
83 KD 1A

Report No. 12673
Plan No. SAa2805

[redacted]

00122

CRA EXPLORATION PTY. LIMITED

NINTH QUARTERLY & FINAL REPORT ON TUCKEY E.L. 1054, SOUTH AUSTRALIA, FOR THE PERIOD ENDING 18TH JANUARY, 1985.

AUTHOR: P. LEWIS

COPIES TO: CIS CANBERRA
SADME

DATE: 25TH MARCH, 1985

SUBMITTED BY:

ACCEPTED BY:

[redacted]
00123

CONTENTS

[redacted]

09124

1. SUMMARY

Tuckey E.L. 1054 covers part of, one of three tenements which were taken out to explore for economic lignite deposits within the Polda Basin. Interest in the area was generated by the Lock Coalfield in the central part of the basin and the reported lignitic intervals in previous company, SADME and water bores drilled within the basin. An assessment of this data outlined prospective areas to be tested by drilling. In addition detailed gravity data was obtained over the northern margin fault in an attempt to define the basement topography.

Seventy two rotary mud holes (including three partially cored holes) for a total of 7922 m were drilled by CRAE in the Polda Basin. Sixteen open holes and two partially cored holes were drilled within Tuckey E.L. 1054. The thickest lignite intersections made by CRAE occur in this area being a 15.3 m seam from 221 m in 81LRM41C and an 8.9 m seam from 60 m in 80LRM5C. The results of drilling in the area have indicated a potential lignite resource of 220 million tonnes, of which 140 million tonnes occurs below 200 m. The quality of the lignite is comparable to other South Australian lignites. The depth of the lignite precludes further exploration for a mineable resource at present.

The intersection of halite in Lower Palaeozoic sequences in Mercury No. 1 drilled in the offshore Polda Basin generated interest in the Tuckey area for potash associated with similar evaporitic sequences. A 17 km seismic traverse complete over the Polda Basin within the Tuckey area indicated the presence of Pre-Permian sediments. A 1398 m rotary mud/diamond drill hole intersected 793 m of ?Cambrian argillaceous red beds and basalts.

No evaporitic sediments were intersected. Stratigraphic correlation of this sequence with holes drilled in the offshore Polda Basin and in Officer Basin suggest that evaporites if present would occur below the basalts at the base of the hole. There is no certainty that evaporites exist in this part of the basin. Further exploration for potash is not justified on present results.

2. INTRODUCTION

Tuckey E.L. 1054 was granted to CRA Exploration Pty. Limited on 19th October, 1982. The term of the licence was extended to 36 months on 19th October, 1984. The licence covers an area of 355 square kilometres over the eastern part of the Polda Basin (plan SAa 1932) and coincides with the northern retained portion of E.L. 687 previously held by CRAE.

3. CONCLUSIONS

The results of drilling by CRAE within Tuckey E.L. 1054 have indicated a potential lignite resource of 220 million tonnes. However, the depth to and quality of the lignite precludes further exploration of this resource at present.

The potash potential of the eastern onshore part of the Polda Basin remains untested. However, if evaporitic sequences are present they would occur below 1000 m on the basin margin and 1400 m in the centre of the basin. If potash was associated with such sequences it is most likely to occur in the deepest part of the basin (Scott 1984b). The presence of the basalts in the sequence downgrades the potential of the area. The cost of further exploration for potash below 1400 m in this area is not considered justified at present.

4. WORK CARRIED OUT

4.1 Coal Exploration

4.1.1 Data Evaluation

All open file data on the onshore portion of the Polda Basin was reviewed. Data from 211 drill holes (Company, SADME and water bore) was summarised noting the depth to and thickness of reported carbonaceous/lignite intervals and basement lithologies. This data was compiled onto 1:250 000 base plans and used to define target areas for drill testing (Flitcroft, 1980).

4.1.2 1980 Gravity Survey

Gravity data was acquired at 113 stations along two traverses (station spacing 500 m) across the eastern end of the Polda Basin in an attempt to define the basement topography. Qualitative interpretation of the data indicated a sub-basin adjacent to the northern margin fault. The location of the traverses, survey specifications, data listings, profiles and interpretation occur in Flitcroft, 1980.

4.1.3 <u>1981 Gravity Survey</u>

Following the first phase of drilling Geoterrex Pty. Limited were contracted to complete a gravity survey over the northern margin fault. Gravity data was acquired at 130 stations along five 5 km traverses. Interpretation of the data indicated the fault is near vertical within the Tuckey E.L. but dips 45°-60° to the south to the west of the licence. Throw on the fault is interpreted to be around 1000 m. Survey specifications, data listings, location of traverses and interpretation of the data occur in McBain, 1981.

4.1.4 <u>Drilling</u>

Two drilling programmes were completed to assess the lignite potential of the Polda Basin tenements. The first comprising 42 holes (including two partially cored holes) was completed by Thompson Drilling during August-October, 1980, and the second comprising 30 holes (including one partially cored hole) was completed by W.L. Sides and Sons during May-July, 1981. Sixteen open holes and two partially cored holes were completed in the area covered by Tuckey E.L. 1054.

4.1.4.1 <u>Drill Hole Results</u>

Lignite was intersected in eight holes drilled within Tuckey E.L. 1054, the thickest intersections being a 15.3 m seam from 221 m in 81LRM41C and an 8.9 m seam from 60 m in 80LRM5C. The results of the drilling completed around these holes have indicated a potential lignite resource of 220 million tonnes of which 140 million tonnes occurs below 200 m of cover. The lignite occurs in narrow zones roughly parallel to the northern margin fault, the shallow lignite occurring on the upthrown side of the fault. Both lignite occurrences remain open to the east. Detailed drill logs, cross sections and a full evaluation of the drilling programmes occur in Flitcroft, 1980 and 1982.

4.1.4.2 Lignite Analyses

Samples of the lignite intersected in holes 80LRM5C and 81LRM41C were submitted for proximate and ultimate analyses. The lignites have high moisture, moderate to high ash, and moderately high sodium, chlorine and sulphur contents. The lignites are comparable to the Tertiary lignites of the north St. Vincent Basin and Kingston areas. Full analyses are presented in Flitcroft, 1982.

4.1.4.3 Geochemistry

Samples of the basement and selected samples of the cover sediments were analysed for copper, lead, zinc, cobalt, gold, silver and molybdenum by AAS techniques and tin, tungsten, uranium and tantalum by XRF techniques. No anomalous assays worthy of follow up were returned. Full assay results occur in Flitcroft, 1982.

4.1.3.4 Palynology

Palynological examination of three core samples of the lignite in 80LRM5C indicated an Eocene age. A report on all age determinations is presented in Appendix IV of Flitcroft, 1982.

4.1.5 Downhole Geophysics

All holes drilled in the 1980 and 1981 drilling programmes were geophysically logged by Geoex Pty. Limited for caliper, natural gamma, neutron, short and long spaced density, resistance and self potential. Downhole geophysical logs occur in Flitcroft, 1980 and 1982.

4.1.6 Geophysical Surveys

Gravity and experimental seismic and E.M. surveys were conducted along a 3 km north south traverse through drill holes 81LRM41-80LRM5-81LRM42. Gravity readings were taken at 40 m intervals from 400 mN to 3000 mN. The survey specific-ations, data listings, profiles and interpretation occur in Flitcroft, 1981. The results were consistent with those obtained from the earlier surveys.

An experimental seismic reflection survey was conducted by the SADME from 650 mN to 1700 mN. All data and results are held by the SADME.

An experimental E.M. survey was conducted by Geoterrex along the traverse from 200 mN to 2700 mN using the 'maxi-probe' EMR-16 system developed by Geoprobe Limited. The apparent resistivities and an interpretation report occur in Flitcroft, 1981.

4.2 Potash Exploration

4.2.1 Data Evaluation

Thick sequences of ?Lower Palaeozoic sediments were intersected in two oil exploration wells (Mercury No. 1, Columbia No. 1) drilled by Australian Occidental Pty. Ltd. in the offshore Polda Basin. Mercury No. 1 which was drilled on an interpreted salt dome intersected 1700 m of interbedded halite and red siltstones. Five metre composite samples were taken from this interval and submitted for bromine in salt analyses. Bromine values ranged from 8-400 ppm but no trends were evident. Full analyses were presented in Appendix II of Scott, 1984a.

Although the bromine profile of the salt intersection in Mercury No. 1 was inconclusive the presence of the salt indicated exploration of the onshore portion of the Polda Basin for potash associated with similar sequences was warranted.

The SADME initially planned to drill a stratigraphic hole in the eastern part of the Polda Basin. A 17 km seismic traverse was completed by the SADME mainly within Tuckey E.L. 1054 to provide better definition of the bottom of the basin and to site the drill hole. With the SADME stratigraphic hole being drilled in the eastern part of the Polda Basin, CRAE planned to drill a hole in the western part of the basin. The SADME drill hole was later cancelled and CRAE decided to drill the first hole in the eastern part of the basin. An interpretation of the stratigraphy and structure of this part of the basin was made from available drill hole data, gravity data and the SADME seismic section (Scott, 1984a). A hole was proposed to test an interpreted sub-basin marginal to the deepest part of the basin.

4.2.2 Drilling

The drilling was completed by F.A. Kelly Pty. Ltd. during the period December, 1983 - March, 1984, using a Warman 1500 drill rig. The initial drill hole 83KD1 was abandoned at 336 m due to problems with lost circulation and swelling clays. Drill hole 83KD1A sited approximately 7 m away from 83KD1 was completed at 1398 m after penetrating 90 m of basalt. The hole intersected 301 m of Tertiary sands, clays and lignite, 282 m of Jurassic sands, grits and minor coal, 22 m of Permo-Carboniferous diamictite and 793 m of ?Cambrian argillaceous red beds and basalts. No evaporitic sediments were intersected. Detailed descriptions of the stratigraphy intersected in the drill hole occur in Scott, 1984b. Stratigraphic correlation of this sequence with that in holes drilled in the offshore Polda Basin and the Officer Basin suggests that evaporites, if present, would occur below the basalts. However, there is no certainty that evaporites exist in this part of the basin.

Selected samples of the Jurassic grits, Permian diamictite and ?Cambrian red-beds, tuffs and basalts were analysed for selected elements. Native copper occurs in the basalt between 1378.4 m and 1382.5 m. Maximum copper assay over this interval was 4000 ppm. Full assay results, detailed drill log, petrological descriptions and discussion of the drilling programme occur in Scott, 1984a and 1984b.

4.2.3 Downhole Geophysics

The drill hole was geophysically logged by Geoscience Associates Pty. Ltd. Natural gamma, caliper, long (80 cm) and short (30 cm) spaced density, neutron, sonic and drift logs were obtained to 596 m at the completion of the rotary mud drilling. Natural gamma, neutron, self potential and resistivity (0.4 m and 1.6 m normal and 1.8 m lateral) logs were obtained from 596 m to 1384m. Caliper and short spaced density logs were only obtained to 701 m due to a blockage in the hole. All geophysical logs except the 0.4 m normal and 1.8 m lateral logs are shown on plan SAa 2805, in Scott, 1984b.

Paul Lewis

P. LEWIS

PL/pw

EXPENDITURE

Expenditure for the period ended 31st January, 1985, the nearest accounting period was $1202.00, as listed below.

		$
Payroll		1287
Supplies		4
Tenement		662
Contractors		-1431
Overheads		680
	Total	$1202

REFERENCES

Flitcroft, M.J.N. 1980 — First Quarterly Report on Polda Basin, South Australia. McLachlan E.L. 670 For The Period Ending October 7, 1980, Tuckey E.L. 687, Sheringa E.L. 688 For The Period Ending November 11, 1980. CRAE Report No. 10307.

Flitcroft, M.J.N. 1981 — Fourth Quarterly Report on Polda Basin, South Australia. McLachlan E.L. 670 For The Period Ending July 7, 1981, Tuckey E.L. 687, Sheringa E.L. 688 For The Period Ending August 11, 1981. CRAE Report No. 10307

Flitcroft, M.J.N. 1982 — Sixth Quarterly Report on Polda Basin, South Australia. McLachlan E.L. 670 For The Period Ending January 7, 1982, Tuckey E.L. 687, Sheringa E.L. 688 For The Period Ending February 11, 1982. CRAE Report No. 10307

McBain, D.R. 1981 — Third Quarterly Report on Polda Basin, South Australia. McLachlan E.L. 670 For The Period Ending April 7, 1981, Tuckey E.L. 687, Sheringa E.L. 688 For The Period Ending May 11, 1981. CRAE Report No. 10307

Scott, A.K. 1984a — Fifth Quarterly Report on Tuckey E.L. 1054, South Australia, For The Period Ending 18th January, 1984. CRAE Report No. 12527

Scott, A.K. 1984b — Sixth Quarterly Report on Tuckey E.L. 1054, South Australia, For The Period Ending 18th April, 1984. CRAE Report No. 12675

LOCATION

Kimba SI 53-07 1:250 000 sheet

KEYWORDS

History

LIST OF PLANS

Plan No.	Title	Scale
SAa 1932	Tuckey E.L. 1054 Location Map	1:250 000

[redacted]

00133

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

REPT. BK. NO. 87/52

WELL VELOCITY SURVEY FOR DRILL HOLE C.R.A.E. KD#1A E.L.1054, POLDA BASIN

OIL, GAS AND COAL DIVISION

By

L.P. HOUGH

FEBRUARY, 1987

DME.

[redacted]

00134

CONTENTS

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

REPT. BK. NO. 87/52
D.M.E. NO.
NEC-4

WELL VELOCITY SURVEY FOR DRILL HOLE C.R.A.E. KD#1A E.L. 1054, POLDA BASIN

INTRODUCTION

A check shot velocity survey was conducted by S.A.D.M.E. as part of a normal geophysical logging programme performed for CRAE by GEOSCIENCE ASSOC. PTY LTD. of Adelaide in drill hole CRAE KD#1A on March 15th 1984.

The drill hole is located on S.A.D.M.E. seismic line PB83-001 at shot point 338 (see FIGS 1 & 2) within exploration licence area 1054 which covers part of the onshore section of the Polda Basin.

The survey was undertaken to provide a correlation between the 1983 seismic reflection profile, and the lithological and geophysical borehole logs, and to determine overall average formation velocities.

Drilling was terminated at 1398 metres depth below ground surface (elevation 110.251 A.H.D.) and the well geophone was lowered to a maximum depth of 1380 m due to insufficient logging cable.

PROCEDURE

A wall locking geophone was lowered to pre-determined depths using electric logging cable supplied by the GEOSCIENCE ASSOC PTY LTD. logging unit. The logging cable was coupled to a portable 6 channel OYO $\mathrm{M^{c}}$SEIS 150 recording seismograph unit.

The energy source ranged from Anzomex "A" boosters (25 gms) up to Anzite Blue (2 kgs). If a preamplifier had been in place on the well geophone it is considered that the charge size could have been reduced considerably from the 2 kilogram size. Most shots were detonated in the mud pit (18 metres offset from the well head) although 4 records were taken at 50 and 100 m offsets (see Fig. 2).

Results were produced as hard paper copies and also as a timeable video display.

Trace 1 on all records represents the time to a reference geophone located at the top of the well, trace 2 is available as an uphole geophone at the shot point but was not utilized and trace 3-6 inclusive displays the signal of the down hole geophone at different amplifer gain settings.

Thirty-two (32) poor-fair records were taken at twenty one (21) levels in the hole, 12 records being rejected. The well geophone was located at levels chosen to coincide with significant formation boundaries selected from a study of the drill core and cutting sumaries. Geophysical logs were only available from surface to 605 metres at the time of the survey. Intermediate shots were also taken resulting in a maximum subsurface sample interval of 190 metres. Results of the survey are tabulated in TABLE 1. Records were taken both when running in the hole and also on the way up from total depth.

COMPUTATIONS

Values of slant arrival times to the downhole geophone were first corrected to the vertical and secondly corrected to the 100 metre A.H.D. seismic datum by the application of datum statics, see Table 1.

Datum corrections were estimated from results of a refraction spread recorded at the well site Fig. 3 and also from analysis of uphole times recorded along the seismic line in the near vicinity.

An average velocity to datum from surface was estimated at 725 m/sec.

Average velocities to depth and interval velocities between geophone locations were then calculated see TABLE 2. Average formation velocities can be estimated from the plot of corrected times versus depth, FIG. 4, and these can be compared with the interval velocities calculated in Table 2.

Two power curves of the form $y = ax^b$ where:
Y = depth
a,b = are constants
x = time
were fitted to the data points by linear regression see FIG. 5.

RESULTS

On the basis of the average formation velocities calculated by linear regression (fig 4), five (5) velocity zones were identified. These are listed below with their corresponding depth range and for comparison the geological time horizons are also given.

DEPTH (BELOW DATUM)	VELOCITY (M/S)	DEPTH (BELOW DATUM)	GEOLOGICAL AGE
0		0	
90	V_0 1584	104.75	MIOCENE
230	V_1 1761	290.75	EOCENE
506	V_2 2143	572.75	JURASSIC
670	V_3 3098	594.75	PERMIAN
T.D.	V_4 4599	T.D.	CAMBRIAN?

It is obvious that the velocity zones do not compare exactly with the geological time zone boundaries but have a more favourable correlation with geological events with the time zones.

A greater number of sample points in the well would clarify this situation further but basically velocity V_0 = 1484 ms corresponds to the Miocene sequence of clays and sands. Velocity V_1 of 1761 m/sec is correlated with the basal Miocene or possibly the top of the Eocene unit down to a depth of approximately 230 metres below datum. From 230 to about 506 metres below datum the formation velocity is 2143 m/sec. This depth range includes both the basal Eocene and the upper sequence of the Jurassic time zone. A lithological change at about 506 m within the Jurassic sequence causes the V_4 layer velocity of 3098 m/sec. This velocity appears to continue through the Permian formation and into the upper red bed sequence to a depth of approximately 670 m below datum. Below this level the velocity is 4599 m/sec to the total depth of the hole.

These figures of formation velocity are regarded as more reliable than the individual interval velocities calculated between separate data points as tabled in Table 2 and displayed in Fig. 5. Of particular note is the apparent lack of velocity contrast at the top of the Jurassic and Permian sequences.

Two power curves of the form $y = ax^b$
where y = depth (m)
x = time (secs)
a,b are constants
were fitted to the time-depth points (FIG. 5).

These depth functions:-

1. $Z = 1024\ t^{1.11}$ fits the time-depth points down to 505 m. (near base of Jurassic)

2. $Z = 1525\ t^{1.75}$ fits the time-depth points from 505 m - T.D. allow quick prediction of depth from seismic reflection times.

A correlation between the seismic section profile over the drill hole and geological horizons intersected is provided in FIG 6 where check shot times are plotted on the section.

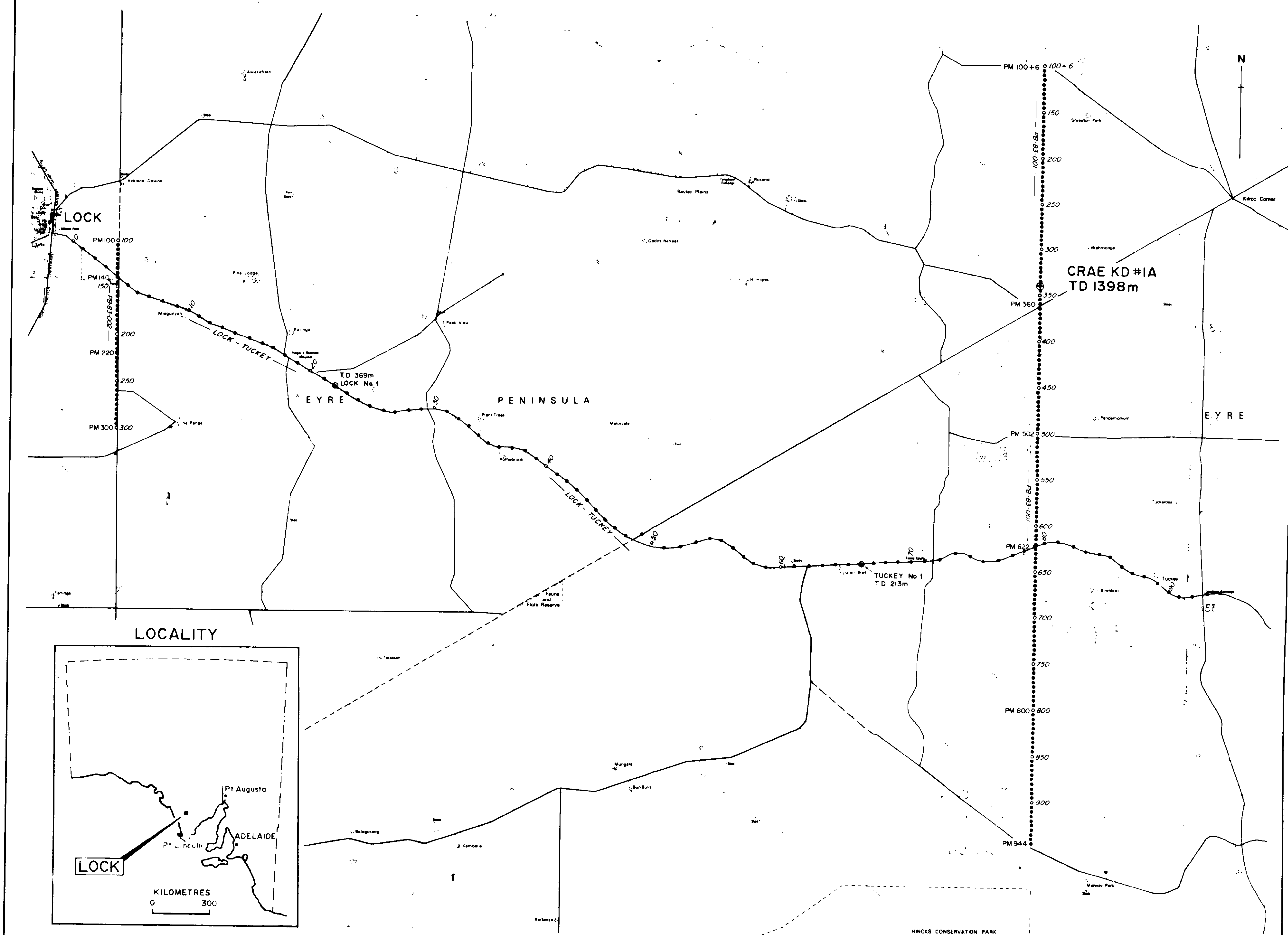
A good correlation between seismic events and geological formations is apparent.

CONCLUSIONS AND RECOMMENDATIONS

Results obtained during the well velocity survey are considered reliable and have enabled a good tie between geological horizons intersected in the drill hole KD#1A and the seismic section PB83-001.

With the good correlation between geological formation and seismic velocity a sound basis for interpretation of future seismic work is now provided for this part of the Polda Basin.

It is recommended further work be conducted westward in the basin to provide a clearer picture of the geology and the seismic velocity distribution, particularly with regard to the Permian and Jurassic formations.



REFERENCE

S.A.D.M.E.

LOCK - TUCKEY 1977 Report Book 77/74

Refraction 61m trace interval
Various shot intervals

PB-83-001
PB-83-002 1983 600%

Reflection 25m trace interval
50m shot interval

LEGEND

●●●●●●●●●	Seismic line
-PB-83-002-	Seismic line number
600	Shot point number

SCALE

METRES 1000 0 1 2 3 4 5 KILOMETRES

FIG. 1

DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA

WELL VELOCITY SURVEY FOR DRILLHOLE
C.R.A.E KD#1A EL 1054, POLDA BASIN
WELL NO. 6130004SW00135
LOCALITY PLAN

COMPILED	L.H
DRAWN	J.W
DATE	Nov '83
CHECKED	
C.D.O.	LWR
DATE	11-3-87
SCALE	1:50 000
PLAN NUMBER	86-818

8288-6

4271

[redacted]

00140 [redacted]

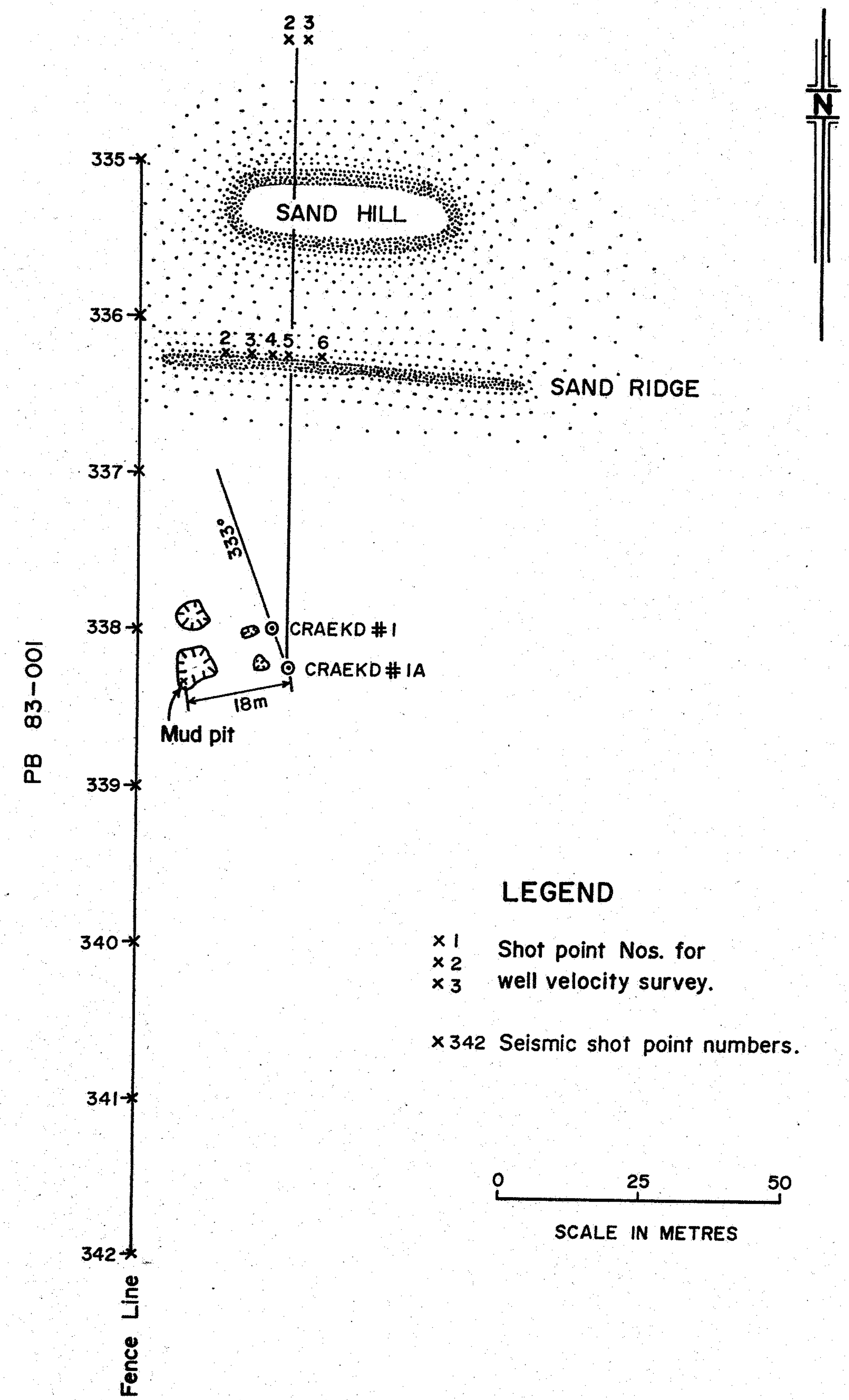
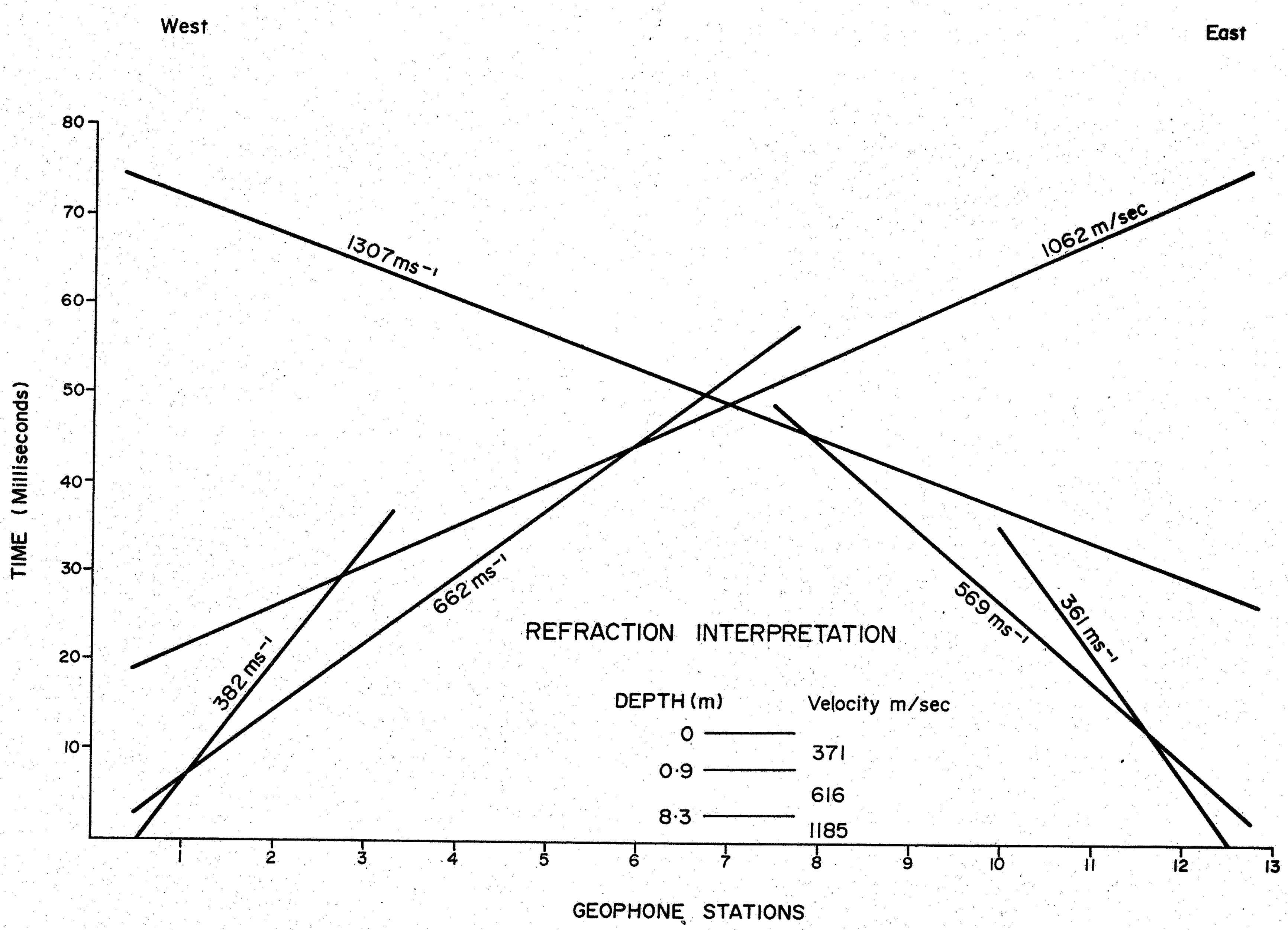


FIG. 2

DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA	COMPILED L.P. Hough	C.D.O. DATE 10·3·87
WELL VELOCITY SURVEY FOR DRILLHOLE C.R.A.E. KDIA EL 1054, POLDA BASIN **WELL SITE DIAGRAM**	DRAWN T. McKenzie	SCALE
	DATE Jan '87	PLAN NUMBER
	CHECKED	**S19012**

4271



DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

WELL VELOCITY SURVEY
FOR DRILLHOLE C.R.A.E. KD1A EL 1054 POLDA BASIN

SEISMIC REFRACTION ANALYSIS

COMPILED L.P.Hough	C.D.O. 11.3.87 DATE
DRAWN T.McK.	SCALE
DATE Jan. 87	
CHECKED	PLAN NUMBER S19013

FIG. 3

00142 [redacted]

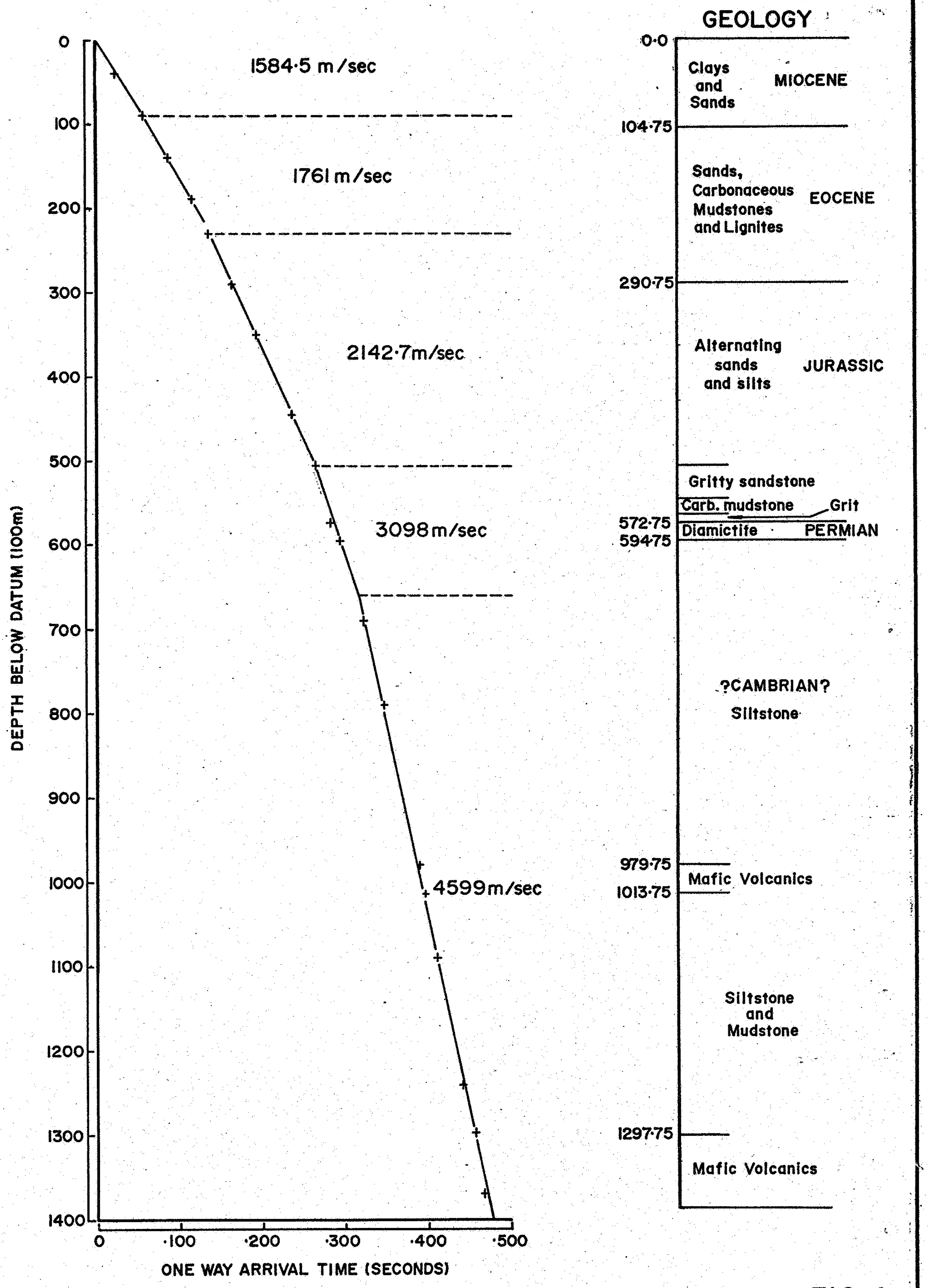


FIG. 4

DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA

WELL VELOCITY SURVEY
FOR DRILLHOLE C.R.A.E. KD#1A EL 1054 POLDA BASIN
TIME VERSUS DEPTH CURVE

COMPILED L.P. Hough	C.D.O.	DATE 11·3·87
DRAWN J.W.	SCALE	
DATE Jan '87	PLAN NUMBER S19014	
CHECKED		

[redacted]

00143

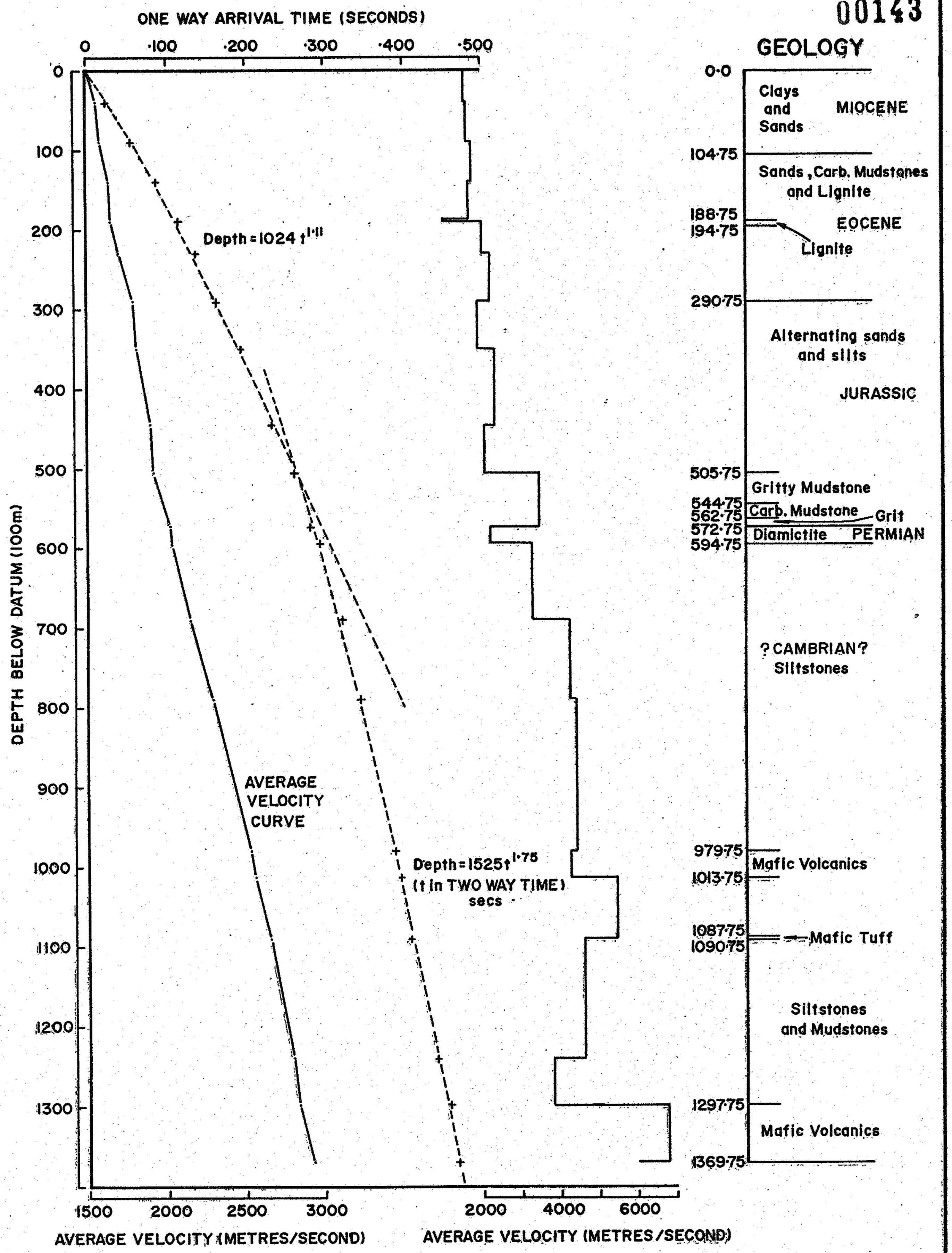


FIG. 5

DEPARTMENT OF MINES AND ENERGY SOUTH AUSTRALIA	COMPILED L.P. Hough	C.D.O. 11·3·87 DATE
WELL VELOCITY SURVEY FOR DRILLHOLE CRAE. KD#IA EL 1054 POLDA BASIN **POWER CURVE FIT OF TIME VERSUS DEPTH**	DRAWN J.W.	SCALE
	DATE Jan '87	PLAN NUMBER
	CHECKED	S19015

1174

SOUTH AUSTRALIAN
DEPARTMENT OF MINES AND ENERGY

SURVEY : POLDA BASIN

AREA : 83-001

LINE : 1

SP : 180 846

FINAL STACK

NORTH

RECORDING PARAMETERS

RECORDED BY : DME

INSTRUMENTS : INPUT/OUTPUT DHR 1632
24 CHANNEL

RECORD LENGTH : 2 SECS

RECORDING FILTER : 500/OUT

SPREAD DIAGRAM :

TR 1 TR.24

SHOT PATTERN :

I <----- 575M- ----> I
I <----- 575M- ----> I
I <----- 575M- ----> I

DATE RECORDED : 1983

GEOPHONE TYPE : SINGLE/MARK PRODUCTS
L25E 40 Hz

NUMBER OF GROUPS : 24

COVERAGE : 600%

GROUP INTERVAL : 25 M.

SHOT INTERVAL : 50 M

SPREAD PATTERN : 0 50 625

ENERGY SOURCE : 1 KG. ANZITE BLUE

SOURCE DEPTH : 20 M. AVERAGE

SURVEY DATUM : 0 METRES A.H.D.

PROCESSING SEQUENCE

[1] REFORMAT FROM SEGY
RESAMPLE TO 2 MS. SAMPLE RATE

[2] PREFILTER (DESIGNED AND APPLIED IN F-K DOMAIN)

[3] PREDICTIVE DECONVOLUTION :
GAP = 20 MSEC.
120 MSEC. OPERATOR
0.1% WHITE NOISE ADDED
2 GATES (LENGTH 800 MSEC.

[4] DATUM STATIC CORRECTIONS USING DIGICON'S STATICSG
(PROCESSING DATUM = 100 M.

[5] COMMON DEPTH POINT GATHER

[6] VELOCITY ANALYSIS BEFORE RESIDUAL STATICS

[7] RESIDUAL STATICS COMPUTATION AND APPLICATION

[8] VELOCITY ANALYSIS AFTER RESIDUAL STATICS

[9] NORMAL MOVEOUT CORRECTION

[10] PRE-STACK MUTE (COMPUTER GENERATED STRETCH MUTE

[11] TIME VARIANT EQUALIZATION (WINDOW LENGTH 500 MS

[12] COMMON DEPTH POINT STACK 6 FOLD

[13] DIGITAL BANDPASS FILTER :

TIME (SECOND)	BANDPASS/SLOPE (DB/OCTAVE)
0.0	20/18 100/36 HZ
0.6	15/18-80/36 HZ
1.4	15/18-70/36 HZ
1.6	25/18 70/36 HZ

[14] TIME VARIANT EQUALIZATION (WINDOW LENGTH 100 MS.

PROCESSED BY : DIGITAL EXPLORATION LTD.

DIGICON. BRISBANE

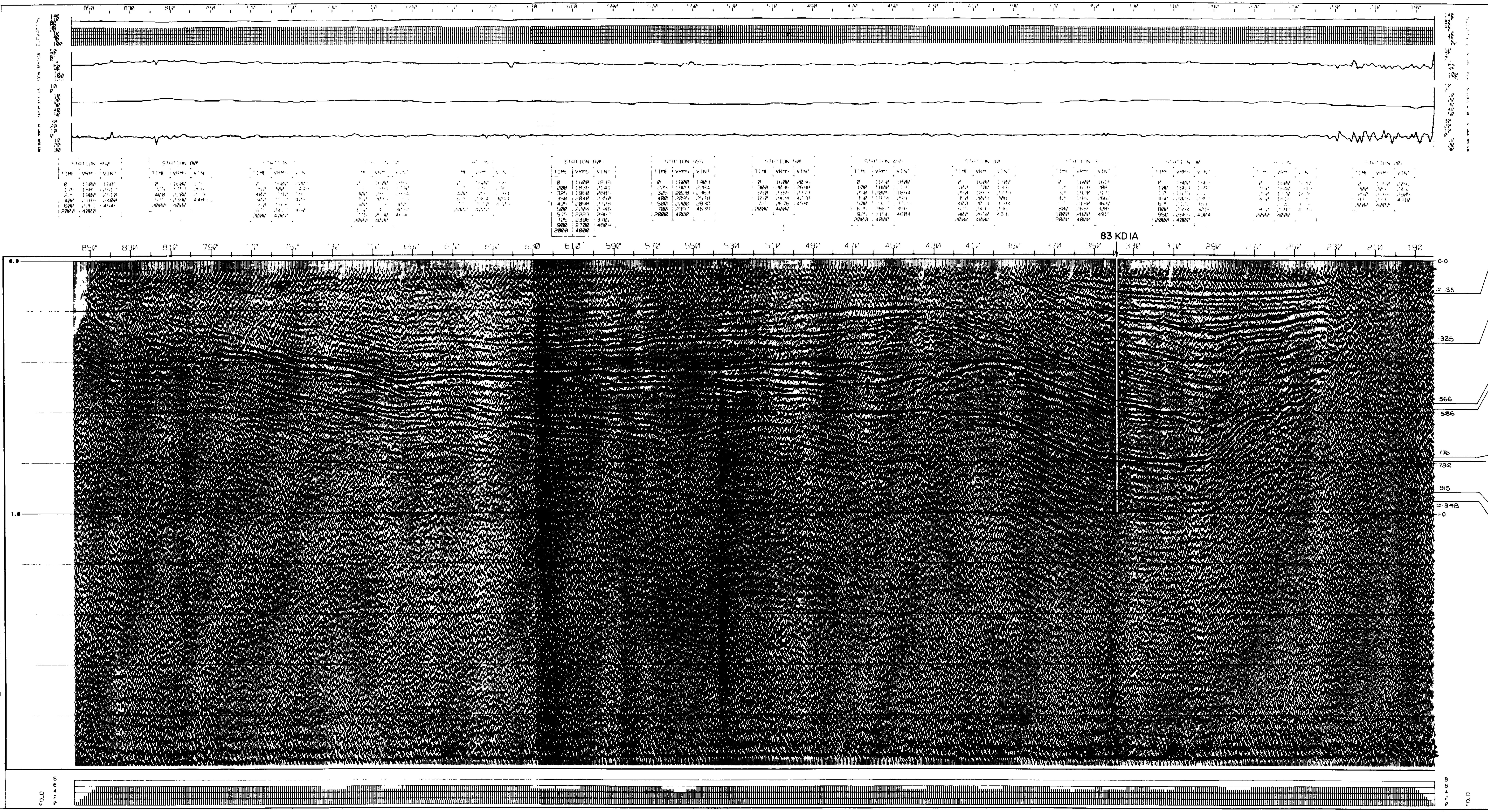
QUALITY CONTROL CHECK

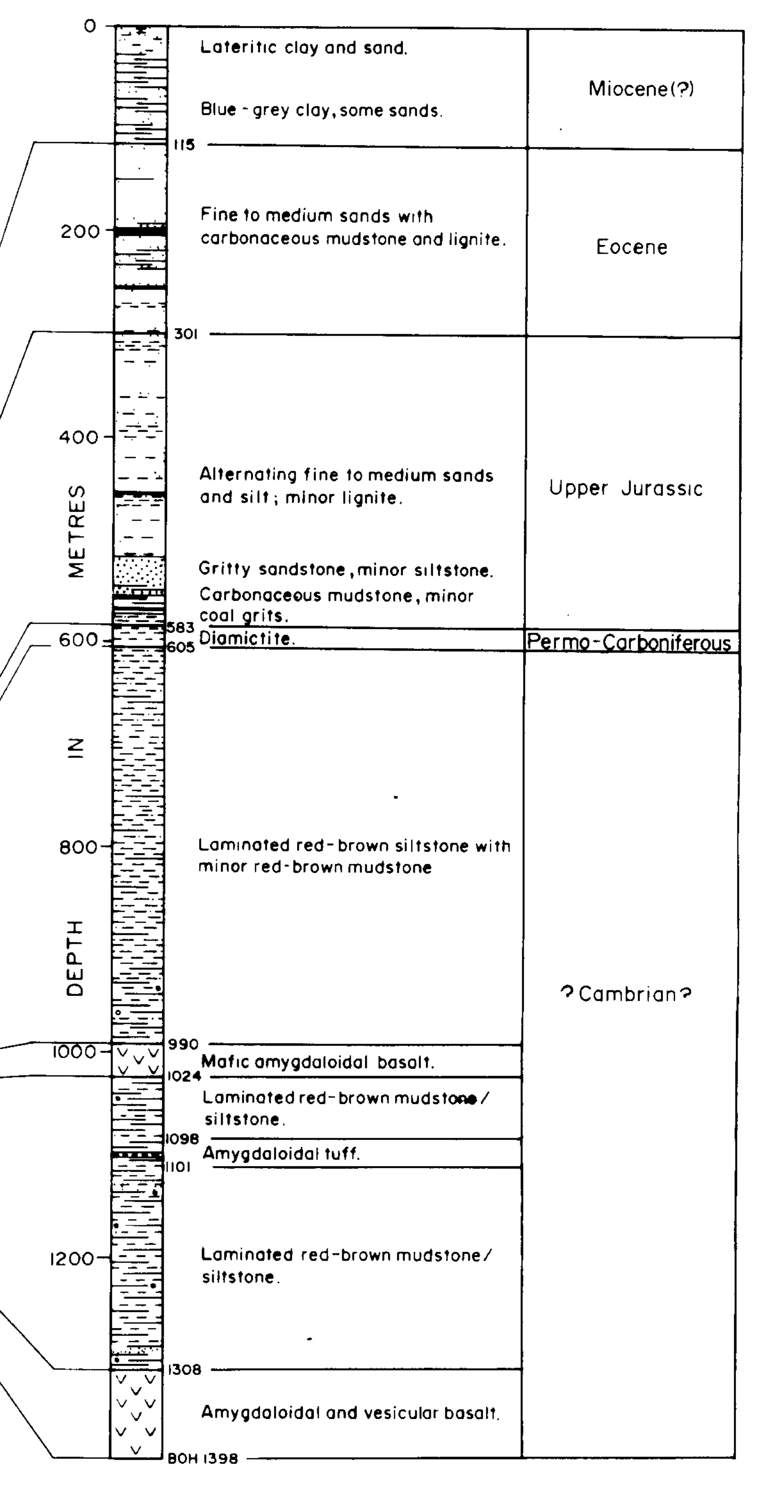
GEOPHYSICIST : RICK SLACK
SUPERVISOR : KEN ALLEN

DATE : OCTOBER 1983

HORIZONTAL SCALE : 50 TRACES/INCH
VERTICAL SCALE : 5 INCHES/SEC
POLARITY : NORMAL RELATIVE TO FIELD RECORDING

4271





8288-7

FIG. 6

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

WELL VELCCITY SURVEY FOR
DRILLHOLE C.R.A.E. KD1A E.L. 1054, POLDA BASIN

SEISMIC REFLECTION LINE
PB 83-001

P Hough
JW
Jan '87
11.3.87

86-819

Department of Mines and Energy – South Australia

WELL VELOCITY CALCULATION FORM

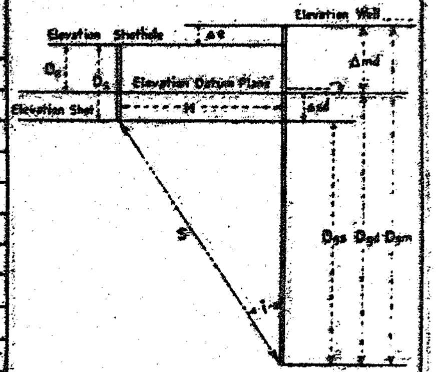
SHOTHOLE INFORMATION
Elevation: Elevation of mud sump 109·77 m
Distance & Direction from Well: Distance 18 m west of well

WELL
Name: C.R.A.E. KD # 1A
Unit Number: 6130004SW00138

Elevation (Derrick Floor): 110·25 m A.H.D.
Total Depth: 1398 metres

LOCATION
Coordinates: 33° 35' 00" 136° 2' 38" approx.
Section: SEC. 70
Hundred, 1:250000 Sheet: Hundred of Smeaton
Area or Field: Polda Basin

Record Number	Shothole Number	D_{gm}	D_s	t_{us}	t_r	T Reading	T Polarity	T Grade	D_{gs}	H	cotan i	cos i	T_{gs}	Δsd	Δsd/V	T_{gd}	T_{gd} Average	D_{gd}	$ΔD_{gd}$	$ΔT_{gd}$	V_i Interval Velocity	V_a Average Velocity
1	2ozs	200	0·5		32	128·6			199·03	18		0·996	128·09	9·27	12·8	115·29	115·29	189·75				1646
2	1ozs	100	0·5		32	?			99·03	18		0·984	–	9·27	12·8							
3	DET	200	0	–	0	?			200	0		1·000	–	CASING								
4	2ozs	200	0·5		26	?			199·03	18		0·996	–	9·27	12·8							
5	5ozs	301	0·5		32	175·8			300·03	18		0·998	175·45	9·27	12·8	162·65	162·65	290·75				1788
6	10ozs	516	0·5		34	277·0			515·03	18		0·999	276·72	9·27	12·8	263·92	263·92	505·75				1916
7	10ozs	605	0·5		32	306			604·03	18		1·000	306·0	9·27	12·8	293·20	293·20	594·75				2028
8	15ozs	990	0·5		32	401			989·03	18		1·000	401·0	9·27	12·8	388·20	388·20	979·75				2524
9	3/2kg	1380	0·74		–	–			1381·22	100_3		0·997	–	11·47	15·8							
10	2/2kg	1380	0·74		100	486			1381·48	100_2		0·997	484·54	11·73	16·2	468·34	468·34	1369·75				2925
11	1/2kg	1380	0·74		–	–			1381·19	50_1		0·999	–	11·44	15·8							
12	20ozs	1380	0·5		34	–			1379·03	18		1·000	–	9·27	12·8							
13	20ozs	1308	0·5		–	–			1307·03	18		1·000	–	9·27	12·8							
14	20ozs	1250	0·5		–	–			1249·03	18		1·000	–	9·27	12·8							
15	2/2kg	1250	0·74		60	459			1251·35	50_2		0·999	458·54	11·60	16·0	442·54	442·54	1239·75				2801
16	3/2kg	1308	0·74		–	–			1309·37	50_3		0·999		11·62	16·0							
17	2/2kg	1308	0·90		–	474			1309·19	50_2		0·999	473·53	11·44	15·8	457·73	457·73	1297·75				2835
18	4/2kg	1200	0·74		–	–			1201·37	50_4		0·999	–	11·62	16·0							
19	5/2kg	1100	0·74		58	426·5			1101·35	50_5		0·999	426·07	11·60	16·0	410·07	410·07	1089·75				2657
20	6/2kg	1024	0·74		–	–			1025·58	50_6		0·999	–	11·88	16·3							
21	20ozs	1024	0·5		–	–			1023·03	18		1·000	–	9·27	12·8							
22	20ozs	1024	0·5		–	409			1023·03	18		1·000	409·0	9·27	12·8	396·20	396·2	1013·75				2559
23	15ozs	800	0·5		33	358			799·03	18		1·000	358·0	9·27	12·8	345·20	345·2	789·75				2288
24	15ozs	700	0·5		34	334·5			699·03	18		1·000	334·5	9·27	12·8	321·70	321·7	689·75				2144
25	15ozs	583	0·5		33	296			582·03	18		1·000	296·0	9·27	12·8	283·20	283·2	572·75				2022
26	15ozs	455	0·5		35·5	247·5			454·03	18		0·999	247·25	9·27	12·8	234·45	234·45	444·75				1897
27	10ozs	360	0·5		36·0	206·5			359·03	18		0·999	206·29	9·27	12·8	193·49	193·49	349·75				1808
28	10ozs	240	0·5		35·4	148·2			239·03	18		0·997	147·76	9·27	12·8	134·96	134·96	229·75				1702
29	10ozs	199	0·5		36·0	127·6			198·03	18		0·996	127·09	9·27	12·8	114·29	114·29	188·75				1652
30	10ozs	150	0·5		36·6	98·8			149·03	18		0·993	98·11	9·27	12·8	85·31	85·51	139·75				1638
31	5ozs	100	0·5		38·0	70·6			99·03	18		0·984	69·47	9·27	12·8	56·67	56·67	89·75				1584
32	5ozs	50	0·5		37·6	40·8			49·03	18		0·939	38·31	9·27	12·8	25·51	25·51	39·75				1558



D_{gm} = Geophone depth measured from well elevation
D_{gs} = " " " " shot "
D_{gd} = " " " " datum "
D_s = Depth of shot
D_e = Shothole elevation to datum plane
H = Horizontal distance from well to shotpoint
S = Straight line travel path from shot to well geophone
t_{us} = Uphole time at shotpoint
T = Observed time from shotpoint to well geophone.
t_r = " " " to reference geophone.
Δe = Difference in elevation between well & shotpoint.
Δsd = " " " " shot & datum plane.
$Δsd = D_s - D_e$
$D_{gs} = D_{gm} - D_s \pm Δe$; $\tan i = \frac{H}{D_{gs}}$
$T_{gs} = \cos i\ T$ = Vert. travel time from shot elev. to geophone
$T_{gd} = T_{gs} \pm \frac{Δsd}{V}$ " " " " datum plane " "
$D_{gd} = D_{gm} - Δmd$
V_i = Interval velocity = $\frac{ΔD_{gd}}{ΔT_{gd}}$
V_a = Average " = $\frac{D_{gd}}{T_{gd}}$

Surveyed by: ....
Date: ....
Weathering Data:
Av. velocity from surface to 100m A.H.D. 725 m/sec.

Casing Record

PLAN S19016A

4271

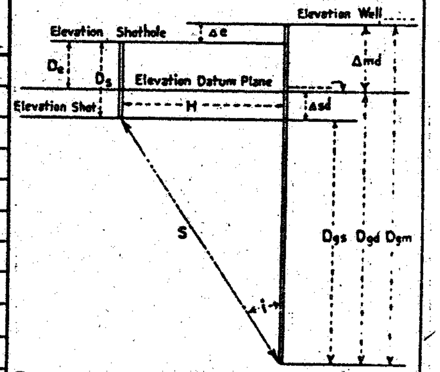
Department of Mines and Energy – South Australia

WELL VELOCITY CALCULATION FORM

00145
MF172

SHOTHOLE INFORMATION	WELL	Elevation (Derrick Floor)	Total Depth	LOCATION
Elevation: Elevation of mud sump 109·77m Distance & Direction from Well: Distance 18m west of well	Name: C.R.A.E. KD # 1A Unit Number: Point 338 P.B. 83-001	110·25 metres	1398	Coordinates: 33° 35' 00" 136° 2' 38" approx. Section: SEC. 70 Hundred, 1:250000 Sheet: Hundred of Smeaton Area or Field: Polda Basin

Record Number	Shothole Number	D_{gm}	D_s	t_{us}	t_r	T Reading	T Polarity	T Grade	D_{gs}	H	cotan i	cos i	T_{gs}	Δsd	$\frac{\Delta sd}{V}$	T_{gd}	T_{gd} Average	D_{gd}	ΔD_{gd}	ΔT_{gd}	V_i Interval Velocity	V_a Average Velocity
																	0	0				
		50															25·51	39·75	39·75	25·51	1558	
		100															56·67	89·75	50·0	31·16	1605	
		150															85·31	139·75	50·0	28·64	1746	
		199															114·29	188·75	49·0	28·98	1691	
		200															115·29	189·75	1·00	1·00	1000	
		240															134·96	229·75	40·00	19·67	2034	
		301															162·65	290·75	61·00	27·66	2205	
		360															193·49	349·75	59·00	30·84	1913	
		455															234·45	444·75	95·00	40·96	2319	
		516															263·92	505·75	61·00	29·47	2070	
		583															283·20	572·75	67·00	19·28	3475	
		605															293·20	594·75	22·00	10·00	2200	
		700															321·70	689·75	95·00	28·50	3330	
		800															345·20	789·75	100·0	23·50	4255	
		990															388·20	979·75	190·0	43·00	4419	
		1024															396·20	1013·75	34·0	8·00	4250	
		1100															410·07	1089·75	76·0	13·87	5479	
		1250															442·54	1239·75	150·0	32·47	4620	
		1308															457·73	1297·75	58·0	15·19	3818	
		1380															468·34	1369·75	72·0	10·61	6786	



D_{gm} = Geophone depth measured from well elevation
D_{gs} = " " " " shot "
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D_s = Depth of shot
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t_r = " " to reference geophone.
Δe = Difference in elevation between well & shotpoint.
Δsd = " " " shot & datum plane.
$\Delta sd = D_s - D_e$
$D_{gs} = D_{gm} - D_s \pm \Delta e$; $\tan i = \frac{H}{D_{gs}}$
$T_{gs} = \cos i \cdot T$ = Vert. travel time from shot elev. to geophone
$T_{gd} = T_{gs} \pm \frac{\Delta sd}{V}$ = " " " " datum plane " "
$D_{gd} = D_{gm} - \Delta_{md}$
V_i = Interval velocity = $\frac{\Delta D_{gd}}{\Delta T_{gd}}$
V_a = Average = $\frac{D_{gd}}{T_{gd}}$

Surveyed by: ....
Date: ....
Weathering Data

Casing Record

PLAN
S19016B

4271

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DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

REPT.BK.NO. 88/6

THE LATE PROTEROZOIC KILROO FORMATION OF THE POLDA BASIN

GEOLOGICAL SURVEY

by

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JANUARY, 1988 DME.151/87

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SOUTH AUSTRALIA

REPT BK. NO. 88/6
DME NO. 151/87
DISK NO. 24

THE LATE PROTEROZOIC KILROO FORMATION OF THE POLDA BASIN

ABSTRACT

Drillhole 83KD1A by CRA Exploration Pty. Ltd. in the eastern Polda Basin intersected 793 m of interlayered amygdaloidal basalts and evaporite-bearing reddish-brown mudstones below Carboniferous-Permian sediments. K-Ar geochronology and geochemistry indicate a Late Proterozoic age, probably equivalent to initial sequences in the Adelaide Geosyncline.

INTRODUCTION

An intracratonic graben on the southern Gawler Craton is narrow (less than 25 km wide) but extends for more than 350 km from near Cleve in the east, past Elliston westwards to the continental margin in the Great Australian Bight (Fig. 1). The graben is fault-bounded, contains up to 5 000 m of sediments and is totally covered by Cainozoic sediments. Sediments associated with the graben include the ?Middle Proterozoic Blue Range Beds (Flint & Parker, 1981), volcanics, halite and evaporite-bearing clastics of previously assumed early Palaeozoic age (McClure, 1982a & 1982b; CRAE, 1984), Carboniferous - Permian Coolardie Formation (Cooper et al., 1982), Jurassic Polda Formation (Gatehouse & Cooper, 1982), Eocene Poelpena Formation (Harris, 1964) and unnamed Pliocene and Pleistocene sediments. Of these, only the volcanic-evaporite sequence, and Palaeozoic and Mesozoic sediments are totally restricted to the graben. Sediment thicknesses of the Blue Range Beds and Tertiary sequences are much greater within the graben, but the units also laterally extend onto Archaean - Early Proterozoic granitoids and metamorphics of the neighbouring craton.

Basin terminology has varied considerably. The term Polda Basin (Jack, 1914) initially applied to a groundwater basin in Quaternary sediments, but subsequent discovery of Tertiary and Mesozoic sediments led Wopfner (1970) to include all Mesozoic -

Recent sediments. A graben offshore was named Elliston Trough (Hammons, 1966; Smith & Kammerling, 1969) while Polda Trough was used for both offshore and onshore grabens (Parkin, 1969). Both Polda Basin and Polda Trough were used by Nelson et al. (1986). In this paper, preference is given to Polda Basin and it is used for all sediments deposited within the fault-bordered graben. Sedimentation from the ?Middle Proterozoic to Tertiary was episodic and controlled by rejuvenation of tectonism along the same fundamental fault planes.

Reviews of general stratigraphy for the Polda Basin are presented in Cooper & Gatehouse (1983) and Parker et al. (1986) whereas a summary of geophysical exploration and interpretation is documented by Nelson et al. (1986). Drilling throughout the basin is extensive but shallow (<200 m) and is targetted on groundwater, coal and uranium in Cainozoic and Mesozoic sediments. Stratigraphic information is poorly known for older sequences, especially prior to the late Palaeozoic Coolardie Formation, despite the fact that gravity and aeromagnetic data suggest a total basin thickness approaching 5 000 m. For the entire Polda Basin, only four drillholes have intersected pre-Carboniferous-Permian sediments; they are Australian Occidental Pty. Ltd. Columbia 1 and Mercury 1, SADME Colton 1 and CRA 83KD1A. The sequence in the latter drillhole was fully cored and, based on petrological, geochemical and geochronological investigations, is here defined as the Kilroo Formation (new name).

KILROO FORMATION

Derivation: Adapted from Kilroo Corner, a prominent road junction 14 km SW of Darke Peak township on the KIMBA 1:250 000 topographic map.

Type section: Interval 605.3 - 1398.2 m in drillhole CRA 83KD1A (Fig. 2) which is stored in the SADME Core Library at Glenside.

Distribution: Probable correlatives of the formation occur to the west in Colton 1 (110.0 - 124.65 m), and further west (offshore) in Mercury 1 (886 - 3100 m) and Columbia 1 (771 - 1701 m) (Flint, in prep.). The unit is probably widespread throughout deeper portions of the Polda Basin.

Thickness: Ranges from at least 793 m in CRA 83KD1A to possibly 2214 m in Mercury 1.

Lithologies: The formation has not been subdivided into members and thus contains a variety of rock types including both volcanics and sediments. Thin section descriptions are contained in Appendix 1.

In CRA 83KD1A, basalts are medium- to coarse-grained and consist of subophitic albitic plagioclase laths, clinopyroxene, pseudomorphed olivine, and opaques. Interstitial material is either chlorite or intensely-altered, very fine-grained basalt comprising skeletal plagioclase laths, chloritised pyroxene, opaques and epidote. Amygdales up to 10 mm are abundant, consisting of either chlorite or chlorite rims with centres of calcite and/or large clusters of radiating prehnite. An ?andesite crystal tuff contains very angular fragments of quartz, feldspar and ?pumice in a chlorite + calcite + opaque matrix. Within the tuff, ellipsoids (?amygdales or pumice) are common; constituent minerals are chlorite, calcite and anhydrite. Associated sediments are dominantly reddish-brown, laminated siltstones and mudstones. Characteristics include thin bedding, graded bedding, detrital quartz + feldspar + mica, and anhydrite aggregates, layers and veins.

In Columbia 1 and Mercury 1, volcanics are absent but similar laminated reddish-brown mudstones are associated with medium-grained sandstones, carbonate-cemented sandstones and siliceous siltstones. Evaporites are also present, particularly in Mercury 1 which contains a 1707 m -thick interval of predominantly massive rock salt.

Environment of deposition: The abundance of reddish-brown clastics and evaporite minerals infer deposition in an arid, terrestrial, fluvial system. Massive rock salt suggests a continental, playa-lake environment. Multiple basaltic lava flows and an ?andesitic crystal tuff indicate active tectonism and volcanism synchronous with sedimentation. Collectively, the environmental setting was probably an intracratonic graben or rift valley with predominantly basic volcanism associated with sedimentation in arid, terrestrial fluvial systems and playa lakes.

<u>Boundary relationship:</u> The Kilroo Formation is unconformably overlain by diamictites of the late Palaeozoic Coolardie Formation. Basalt clasts occur within the diamictites. The lower contact is ambiguous, and absent in CRA 83KD1A and Colton 1. Within Mercury 1 and Columbia 1, brecciation, secondary silicification and discontinuity in bedding orientation suggest a stratigraphic break. Importance of the break is unknown; lower white quartzose sandstones may represent either a continuation of the succession or an older clastic sequence like the ?Middle Proterozoic Blue Range Beds (Flint, in prep.).

GEOCHRONOLOGY

K-Ar geochronology was attempted on five basalt samples from CRA 83KD1A, two from the upper volcanic unit and three from the lowermost basalts. All the specimens are amygdaloidal, thus isotopic analyses were performed on plagioclase and clinopyroxene mineral separates. Procedural methods are outlined in Webb et al. (1986). Plagioclase concentrates contained significant quantities of carbonate in addition to iron-stained feldspar, and were acid leached in dilute HCl (10%) and very dilute HF (<1%) to obtain carbonate-free, clouded plagioclase concentrates. The K-Ar data are presented in Table 1.

Plagioclase analyses yield ages of 768 ± 9 and 764 ± 42 Ma which are within analytical uncertainty of each other. A higher uncertainty (±5.5%) for sample 6130 RS 122 results from imprecision in the duplicate K determinations, whereas the age for 6130 RS 121 is artificially more precise since there was only sufficient feldspar for a single K determination. Both plagioclase concentrates have significant radiogenic Ar (87.6 and 70.3%) and K contents are within the normal range for feldspar.

K contents in clinopyroxene concentrates are abnormally low, especially 6130 RS 122 for which no age is calculated. The pyroxene ages range from 235 ± 15 to 884 ± 97 Ma. Although the precision of the duplicate K analyses appears good, internal replication of each analysis is poor and overall precision is >10% (standard deviation). The older ages of 884 ± 97 and 817 ± 12 Ma suggest a Late Proterozoic age for extrusion of the basalts. Younger clinopyroxene ages may result from clinopyroxene crystals not remaining as closed systems with respect to K and Ar since crystallisation.

The plagioclase K-Ar ages of 768 ± 9 and 764 ± 42 Ma are considered to provide a better estimate than the pyroxene ages for the minimum time elapsed since crystallisation of these amygdaloidal basalts. Both the plagioclase and older pyroxene ages are similar to the age of the Rook Tuff in the Willouran Ranges of the northern Adelaide Geosyncline. The Rook Tuff formed contemporaneously with early Adelaidean sedimentation and has a U-Pb zircon age of 802 ± 10 Ma (Fanning et al., 1986). Collectively, K-Ar mineral ages from drillhole CRA 83KD1A imply that evaporitic red beds and interlayered amygdaloidal basalts in the eastern Polda Basin are also Late Proterozoic (Adelaidean).

GEOCHEMISTRY

Silicate and trace-element analyses of 9 basalts from CRA 83KD1A (Table 2) were compared with assumed Cambrian amygdaloidal basalts of the Kulyong Volcanics from the northern Officer Basin (4742 RS 1-5), altered basalt of unknown age from drillhole Mallabie #1 on the eastern Nullarbor Plain (5034 RS 1), amygdaloidal basalts from the Stuart Shelf and basal successions in the Adelaide Geosyncline (6333 RS 45, 6334 RS 94-99, 6434 RS 1-10, 6041 RS 161-164, 6737 RS 1167-1169) and altered basalts of the Middle Proterozoic Roopena Volcanics (6332 RS 476-487).

On the Pearce and Cann (1973) Ti/100 - Zr - 3Y triangular diagram often used to determine the tectonic setting of basalts, analyses of basalts from both the Polda Basin and Adelaide Geosyncline plot within the field for "within-plate basalts". Analyses for the Kulyong Volcanics from the Officer Basin plot within the "volcanic-arc basalt" field.

On the chondrite-normalised diagram (Fig. 3), basalts from the Polda Basin and Adelaide Geosyncline show a similar pattern but with the former having consistently lower chondrite-normalised values. Sr, a relatively mobile element, is the only exception. The Kulyong Volcanics and Roopena Volcanics exhibit very different patterns which are also illustrated in the Ti-Zr discrimination diagram (Fig. 4). Geochemical similarities between basalts from the Polda Basin and Adelaide Geosyncline are further supported. A comparison of basalt from Mallabie #1 to the other volcanics is inconclusive, probably due to the high degree of alteration in the only sample, which may also not be representative.

DISCUSSION

The possible presence of Adelaidean sediments within the Polda Basin has not been previously suspected. The K-Ar isotopic and geochemical data for basalts from CRA 83KD1A in the eastern Polda Basin imply that some (?majority) of the sediments in deeper portions of the basin are of Adelaidean age, rather than the previously assumed early Palaeozoic age which was based on regional lithological correlations with the Officer Basin.

Some, but not all, features of the Polda Basin are consistent with it being an aulacogen of the Adelaide Geosyncline. Aulacogens are "elongated basins (of the order of ten times as long as wide) closely associated with geosynclines, from which they branch and penetrate far into the craton" and "are bounded by deep-seated faults" (Preiss, 1987). Typically the mouths of aulacogens merge with the geosyncline, however the Polda Basin and Adelaide Geosyncline are disjoint and the corresponding portion of the geosyncline lacks any early Adelaidean, rift-related sediments. Tectonic activity, aulacogen width and thickness, and diversity of sediments typically increase towards the geosyncline (Preiss, 1987). Insufficient data are known about the Polda Basin to make definitive statements on easterly or westerly trends, however volcanics are only known from the eastern end of the basin.

Hydrocarbon and mineral potential of the Polda Basin require re-assessment because of the revised stratigraphic interpretation. During exploration for hydrocarbons in the western Officer Basin, a thick Late Proterozoic, evaporite-bearing sequence (Browne Beds) was discovered below both Cambrian sediments and basalts and Late Proterozoic glacial sediments (Townson, 1985). The possibility exists that early Adelaidean sediments, evaporites and volcanics exist, not only in deeper portions of the Polda Basin, but also within the western and eastern Officer Basins.

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TABLE 1 K-Ar data for basalts within drillhole CRA 83KD1A

DEPTH (m)	SAMPLE	MINERAL	%K	^{40}Ar ($\times 10^{-10}$ moles/g)	$^{40}Ar^*/^{40}Ar$ total	AGE#
Upper volcanic unit:						
991.85-993.80	6130 RS 121	Plagioclase	0.448	7.4508	0.876	768±9
"	"	Clinopyroxene	0.016 0.015	0.0678	0.157	235±15
1007.6	6130 RS 73	Clinopyroxene	0.004 0.004	0.03342 0.03322	0.235 0.196	427±51 425±60
Lower volcanic unit:						
1354.9	6130 RS 69	Clinopyroxene	0.007 0.007	0.1385	0.374	884±97
1379.6	6130 RS 71	Clinopyroxene	0.044 0.043	0.7793	0.761	817±12
1385.9-1387.0	6130 RS 122	Plagioclase	0.105 0.112	1.7828	0.703	764±42
"	"	Clinopyroxene	0.001 0.001	0.0501	0.239	-

*Radiogenic ^{40}Ar

Error limits for analytical uncertainty at one standard deviation

Constants: ^{40}K = 0.01167 atom %

$\lambda\beta = 4.962 \times 10^{-10} y^{-1}$ atom %

$\lambda E = 0.581 \times 10^{-10} y^{-1}$

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	6130 RS 71	6130 RS 75	6130 RS 76	6130 RS 77	6130 RS 78	6130 RS 79	6130 RS 80	6130 RS 81	6130 RS 82
DEPTH (m)	1379.6	997-998	1007-1008	1017-1018	1324-1325	1329-1330	1334-1335	1339-1340	1344-1345
SiO_2	49.10	49.20	48.30	48.20	47.10	49.30	49.20	49.40	49.00
TiO_2	1.67	1.31	1.08	1.19	1.52	1.61	1.64	1.61	1.60
Al_2O_3	13.30	13.90	13.90	13.50	13.80	13.40	13.70	13.60	13.50
Fe_2O_3	13.00	12.00	11.10	11.50	11.90	12.70	12.70	12.60	12.60
MnO	0.23	0.20	0.16	0.17	0.18	0.17	0.16	0.16	0.16
MgO	6.75	7.20	8.45	10.40	7.55	7.20	7.00	7.05	7.00
CaO	8.80	8.80	9.65	6.10	7.95	7.45	8.75	9.05	9.05
Na_2O	3.12	4.54	3.94	3.58	4.92	4.88	3.18	3.20	3.12
K_2O	1.90	0.18	0.14	1.53	0.24	0.74	2.06	1.87	1.78
P_2O_5	0.13	0.07	0.06	0.08	0.10	0.12	0.10	0.08	0.11
LOI	1.95	3.26	3.60	4.48	4.56	2.84	2.12	2.14	2.02
TOTAL	99.95	100.66	100.38	100.73	99.82	100.41	100.61	100.76	99.94
Ba	270	<10	<10	230	60	95	300	170	140
Ce	25	20	20	<20	20	<20	30	<20	20
Co	80	26	32	30	38	28	22	22	20
Cr	180	6	6	6	14	8	6	6	6
Cu	<10	20	18	20	26	42	16	12	12
Nb	8	7	5	6	10	10	10	9	8
Ni	110	38	60	50	60	48	36	36	34
Pb	<50	8	8	6	4	4	6	6	4
Rb	52	6	8	55	9	32	85	75	60
Sr	170	44	38	150	90	120	230	220	220
V	410	220	160	180	230	210	200	220	230
Y	40	14	8	12	20	18	20	16	18
Zn	150	80	65	36	90	95	32	48	65
Zr	150	75	60	65	95	95	95	95	100

TABLE 2 Silicate and trace element geochemistry for basalts within CRA 83KD1A

APPENDIX 1

THIN SECTION DESCRIPTIONS

[redacted]
00159

SPECIMEN: 6130 RS 120

LOCATION: 1386.4-1386.45 m in CRA 83KD1A

ROCK NAME: Basalt

THIN SECTION: C48312 (Amdel)

The basalt is similar to 6130 RS 70 and has both coarse- and fine-grained phases.

Coarser-grained minerals include relic olivine, clinopyroxene and plagioclase. Anhedral olivine crystals, up to 1.5 mm, are not common (1%) and have been entirely pseudomorphed by very fine-grained ?antigorite and reddish-brown opaques. Clinopyroxene (30%) forms large crystals up to 1 mm in size. Many are zoned having clear, pale-green centres and greenish-brown rims. Clinopyroxene has an ophitic texture with large (<1.5 mm) feldspars. The feldspars are dominantly polysynthetically-twinned plagioclase, but blockier (up to 1.0 x 0.4 mm) untwinned crystals are also present.

A finer-grained, basaltic matrix (20-25%) dominantly consists of skeletal, plagioclase laths, abundant opaques and very fine-grained ?epidote. Opaques are fine-grained and form either a rectangular network or radiating clusters.

Amygdales are not common (3-5%) though large (up to 10 mm) and entirely consist of very coarse-grained radiating clusters of prehnite.

SPECIMEN: 6130 RS 70

LOCATION: 1374.9 m in CRA 83KD1A

ROCK NAME: Basalt

THIN SECTION: C42169 (Amdel)

The basalt is amygdaloidal and consists of both coarse- and fine-grained basaltic phases.

Coarser-grained minerals consist of relic olivine, clinopyroxene and plagioclase. Euhedral olivine crystals (<1%) up to 1.7 mm have been psuedomorphed by ?antigorite, opaques and leucoxene. Clinopyroxene (15%) forms large subhedral crystals (<1.5 mm) which display sector zoning and zoning from clear, pale green centres to thin, greenish-brown rims. Plagioclase is the dominant mineral constituent (35%) and has intense cloudiness due to either minute inclusions or alteration to clay. Grainsize of the plagioclase is similar to the clinopyroxene and the two minerals have a subophitic texture.

Between the coarse-grained crystals of clinopyroxene, plagioclase and relic olivine is a finer-grained basaltic matrix with a grainsize less than 0.15 mm (25%). The composition is chiefly intensely-altered chloritised pyroxene, skeletal plagioclase, abundant opaques and minor epidote.

Amygdales are common (25%) and consist of chlorite, chlorite rims with calcite centres and chlorite rims with centres of prehnite.

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00161

SPECIMEN: 6130 RS 69

LOCATION: 1354.9 m in CRA 83KDIA

ROCK NAME: Basalt

THIN SECTION: C42168

The specimen is a medium- to coarse-grained basalt containing amygdales, altered plagioclase, clinopyroxene and opaques.

Possible olivine phenocrysts (< 1%), and up to 1mm, have been completely altered to very fine-grained ?antigorite, reddish-brown opaques and ?leucoxene. Clinopyroxene (25%) forms large crystals up to 1.5mm which are zoned with clear centres and greenish brown rims. clinopyroxene is ophitically intergrown with coarse-grained laths of plagioclase, 1-2mm in length and extensively altered to sericite and prehnite. Plagioclase is abundant (50%). Opaques (5-10%) form both anhedral aggregates (< 0.5mm) but is also enriched in zones of finer-grained basalt between coarser basaltic material.

Amygdales (20%) are less than 3mm across consist of either totally chlorite or chlorite rims and prehnite-rich centres.

SPECIMEN: 6130 RS 119

LOCATION: 1351.2 - 1351.3m in CRA 83KD1A

ROCK NAME: Amygdaloidal basalt

THIN SECTION: C48311 (Amdel)

This medium- to coarse-grained basalt contains relatively-fresh plagioclase, clinopyroxene and opaques, and amygdales containing chlorite and prelinite.

Clinopyroxene occurs in two forms. Large crystals (up to 2mm) are clear to pale green and zoned with thin darker rims. A much greater population of smaller grains (< 0.1 mm and 25%) are generally darker green, but also present are zoned crystals. Both forms of clinopyroxene are subophitically with plagioclase. Plagioclase laths (45%) up to 2mm in length are clouded due to numerous fine inclusions. Opaques (10%) form both interstitial infill in anhedral aggregates up to 0.2 0.3 mm and is concentrated (within the basalt) near the margins of amygdales.

Amygdales are abundant (20%), irregular in shape and up to 7mm across. Chlorite rims the amygdales, however prehnite in radiating coarse-grained clusters is the dominant constituent.

SPECIMEN: <u>6130 RS 68</u>

LOCATION: 1344.9 m in CRA 83KD1A

ROCK NAME: Basalt

THIN SECTION: C42167 (Amdel)

This fine-grained basalt is very similar in composition and texture to 6130 RS 67, consisting of serictised plagioclase (40%), uralitised clinopyroxene (40%) and opaques (10%). Chlorite occurs as an interstitial phase (5%).

SPECIMEN: 6130 RS 67

LOCATION: 1344.2 m in CRA 83KD1A

ROCK NAME: Basalt

THIN SECTION: C42166 (Amdel)

The basalt is very similar in compostion to 6130 RS 66. Fine-grained, sericitised plagioclase (40%), uralitised clinopyroxene (35-40%) and opaques are intergrown with a random intergranular texture. Chlorite forms an interstitial infill (10-15%) but does not form melanocratic banding as in 6130 RS 66 and 118.

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00165

SPECIMEN: 6130 RS 66

LOCATION: 1335 m in CRA 83KD1A

ROCK NAME: Basalt

THIN SECTION: C42165 (Amdel)

This specimen is a fine-grained basalt displaying melanocratic banding, similar to 6130 RS 118. Plagioclase laths (35%), less than 0.3mm, are heavily sericitised. Pyroxene crystals (30%) are anhedral, fine grained and moderately uralitised. Interstitial opaques are anhedral, up to 0.4mm, and form 7-10%. Chlorite occurs as a fine-grained interstitial infill and is the cause for the melanocratic banding observable in the drillcore.

SPECIMEN: 6130 RS 118

LOCATION: 1334m in CRA 83KD1A

ROCK NAME: Basalt

THIN SECTION: C48310 (Amdel)

This fine-grained basalt displays prominent, melanocratic banding which is defined by a greater abundance of opaques and interstitial chlorite.

Plagioclase laths (35%) are albitic, extensively sericitised, randomly oriented and range in size up to 0.4mm. Clinopyroxene (?augite) occur as numerous small, anhedral crystals (0.1mm - 35%). Interstitial opaque aggregates to 0.3mm are common (5-7%).

Melanocratic banding and aggregates (consipcuous in drillcore and forming 20%) is defined by enrichment in opaques and chloritised groundmass. The bands are up to 3mm wide and irregular in outline. They consist of marginally finer-grained plagioclase, iron-rich pyroxene rimmed by abundant opaques and very fine-grained epidote (collectively 65% of the bands), whereas the remainder is a very fine-grained chloritised groundmass.

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00167

SPECIMEN: 6130 RS 117B

LOCATION: 1308.4 - 1308.5m in CRA 83KD1A

ROCK NAME: Amygdaloidal basalt

THIN SECTION: C48309 (Amdel)

An amygdaloidal basalt, similar to 6130 RS 117A, but differs in containing xenoliths of mudstone.

Xenoliths vary in size up to 10mm. They consist of mudstone which contain angular quartz, plagioclase, muscovite in a clay-rich matrix, and also have iron-rich rims up to 0.3mm wide. Epidote occurs as recrystallised grains and aggregates, and some recrystallisation of quartz also occurring.

Adjacent to the larger xenoliths is a zone, 0.3 - 0.4mm wide, which consists of radiating ?zeolite clusters, very fine - grained opaques and some plagioclase laths. Within amygdales immediately in contact with the xenoliths, recrystallised quartz, calcite and anhydrite occur.

SPECIMEN: <u>6130 RS 117A</u>

LOCATION: 1308.4 - 1308.5m in CRA 83KD1A

ROCK NAME: Amygdaloidal basalt

THIN SECTION: C48309 (Amdel)

This altered, amygdaloidal basalt was sampled near the top of the lowermost basaltic sequence.

Plagioclase (35%) varies from small blocky crystals to long laths up to 1.5mm. Plagioclase is albitic and moderately sercitised. Opaques occur both as subhedral crystals (< 0.75mm - 1%), but mostly (15%) in association with ?leucoxene and represent altered ?pyroxene. Aggregates of reddish-brown iron oxides (< 0.4mm) may represent former olivine phenocrysts. A fine-grained interstitial groundmass (25-30%) is mostly chlorite.

Amygdales are common (20%), irregular in shape and are characterised by an enrichment of opaques and leucoxene within the adjacent basalt. Amygdales chiefly consist of chlorite-rich rims and calcite, but minor intergrowths of calcite and anhydrite are also present.

SPECIMEN: 6130 RS 116

LOCATION: 1103m in CRA 83KD1A

ROCK NAME: Amygdaloidal crystal tuff

THIN SECTION: C48308 (Amdel)

The specimen is an ?andesitic crystal tuff containing angular fragments of quartz and feldspar in a very extensively altered matrix. Ellipsoidal, probable amygdales range in size up to 4mm.

Crystal fragments, forming 5%, consist of feldspar, quartz and feldspar composites. Most fragments are angular to very angular and small < 0.05mm. Composite feldspar aggregates are up to 0.2mm in size, cloudy and moderately altered to ?prehnite. Minor muscovite flakes are also present.

The matrix (65%) consists of abundant small mafic grains which have been extensively altered to chlorite and very-fine, disseminated opaques. Chlorite also occurs as an interstitial infill (15-20%), within which very tiny ellipsoids occur (similar to RS 115).

Large elliposids, up to 4mm in size, contain a variety of infilling minerals. They include;

- chlorite
- chlorite rims with anhydrite in the centre,
- chlorite rims with calcite and opaques,
- calcite,
- calcite rims with anhydrite in the centre,
- very coarsely - crystalline anhydrite.

The ellipsoids probably represent amygdales.

[redacted]
00170

SPECIMEN: 6130 RS 115

LOCATION: 1100.8 - 1100.9m in CRA 83KD1A

ROCK NAME: Andesitic crystal tuff

THIN SECTION: C48307 (Amdel)

A very - chloritised, ?andesitic tuff containing angular fragments of quartz, plagioclase, potassium feldspar, mica and ?pumice.

Plagioclase (2%) occurs as small (< 0.1mm), angular fragments exhibiting polysynthetic twinning. Potassium feldspar (? anorthoclase) (2%) similarly occurs as very angular grains up to 0.2mm. Angular quartz grains (2%) range in size up to 0.15mm. One zircon crystal (0.1mm in size), minor chloritised biotite and muscovite flakes are also present.

The matrix consists of three components. The dominant phase (70%) is mafic material extensively altered to chlorite and calcite, and with opaques (10%) occurring as both aggregates and finely disseminated material. The remaining matrix (25%) is also chlorite which occurs as interstitial infill. Within this material, are rims of opaques. These represent either altered pumice (fiamme) or former gas bubbles.

Near the contact of the crystal tuff with mudstone, calcite is common occurring as large aggregates to 2mm and interstitial infill. Calcite veins (containing minor anhydrite) also occur within the mudstone.

[redacted]
00171

SPECIMEN: 6130 RS 74

LOCATION: 1022.8m in CRA 83KD1A

ROCK NAME: Amygdaloidal basalt

THIN SECTION: 1158225 (Pontifex)

A fine-grained, altered basalt containing plagioclase, clinopyroxene, opaques and amygdales.

Plagioclase laths (40%) are randomly oriented, commonly 0.2 - 0.3mm in length but with some laths up to 1.5mm. Plagioclase is heavily sericitised and clouded by clay alteration. Clinopyroxene (30%0 occurs both as large crystals (< 0.4mm) with subophitic plagioclase and as much smaller interstitial grains; both types are extensively chlorised. Limonite and ?antigorite aggregates (< 0.3mm) may reprsent former olivine phenocrysts (2-3%). Opaques minerals occur both as discrete cystals and as finely disseminated material (10%).

Amygdales (20%) range in size up to 3mm. Most consist of radiating chlorite aggegrates but some also contain a very thin rim of ?quartz.

[redacted]
00172

SPECIMEN: 6130 RS 72)

LOCATION: 992.4m in CRA 83KD1A

ROCK NAME: Amygdaloidal basalt

THIN SECTION: 1158223 (Pontifex)

A medium-grained, relatively-fresh basalt containing clinopyroxene, plagioclase, opaques and abundant amygdales (20%).

Albitic plagioclase laths up to 1.0mm in length, are only weakly sericitised and are randomly oriented. Plagioclase (50%) is subophitically intergrown with clinopyroxene. Clinopyroxene cystals (< 0.4mm) are occasionally zoned and often have altered margins (10-15%). Interstitial opaques (< 0.2mm) are common (5-10%). ?Antigorite and limonite aggregates probably represent relic olivine phenocrysts.

Irregularly distributed are finer-grained zones of basalt; these areas up to 10mm across and commonly near amygdales contain finer-grained diopside, finer-grained plagioclase laths which are intensely sericitised, and opaques.

Amygdales are common and range in size up to 10mm. They are rimmed by fine-grained chlorite, and in the larger amygdales coarse-grained (2.5mm) radiating aggregates of prelinite have been partly altered to an isotropic brownish clay. Chlorite also occurs as an interstitial infill between plagioclase laths.

[redacted]

00173

SPECIMEN: 6130 RS 114

LOCATION: 1024.9 - 1025.0 m in CRA 83KD1A

ROCK NAME: Laminated mudstone

THIN SECTION: C48306 (Amdel)

A laminated, reddish-brown mudstone which exhibits graded bedding and veins of crystalline anhydrite.

Coarser layers within the mudstone consist of very fine-grained (< 0.1mm) quartz, plagioclase, ?potassium feldspar, opaques, muscovite and clay. Muscovite flakes (< 0.5mm) are common, and detrital quartz and feldspar grains are dominantly angular. Opaques are also common, often forming 10-15% of these coarser layers.

The clay-rich layers consist dominantly of clay and opaques (85-90%), with minor muscovite and very fine-grained angular quartz and feldspar.

Several veins of anhydrite, up to 2mm wide, cosist of coarsely-crystalline crystals up to 0.75mm. The anhydrite exhibits typical rectangular cleavage and variable relief when the stage is rotated. Anhydrite also occurs in some of the coarser silty units, as does minor gypsum. One prominent anhydrite vein disrupts bedding and indicates very local thrusting.

SPECIMEN: 6130 RS 113

LOCATION: 1007.0 m in CRA 83KD1A

ROCK NAME: Amygdaloidal basalt

THIN SECTION: C48305 (Amdel)

A medium-grained, relatively-fresh basalt containing clinopyroxene, plagioclase, opaques and abundant amygdales.

Plagioclase laths (40%) < 0.75mm in length show variable sericitisation from weak to intense, and are subophitically intergrown with clinopyroxene. Clinopyroxene phenocrysts (20-25%) are occasionally zoned, exhibit lamellar twinning and are only weakly chloritised. Opaque minerals (5%) occur as both large aggregates (< 1.5mm) and as intergranular infill.

Amygdales are common (35%), irregularly shaped up to 7mm and consist mostly of fine-grained chlorite.

[redacted]

00175

SPECIMEN: 6130 RS 73

LOCATION: 1007.6m in CRA 83KD1A

ROCK NAME: Amygdaloidal basalt

THIN SECTION: 1158224 (Pontifex)

A medium - to coarse-grained basalt containing plagioclase, clinopyroxene, opaques and abundant amygdales.

Clinopyroxene cystals (< 1.5mm) and comprising 15% are occassionally zoned, exhibit lamellar twinning and are relatively fresh. Clinopyroxene and plagioclase show a subophitic texture. Plagioclase laths, up to 1.5mm, are clouded by clay alteration and, in part, extensively altered to prehnite. Interstitial opaques are common. Anhedral crystals to 1mm which are completely altered to ?antigorite and/or chlorite and opaques may represent relic olivine phenocrysts.

Amygdales are common (15%), range in size up to 2mm and consist dominantly of fine-grained chlorite.

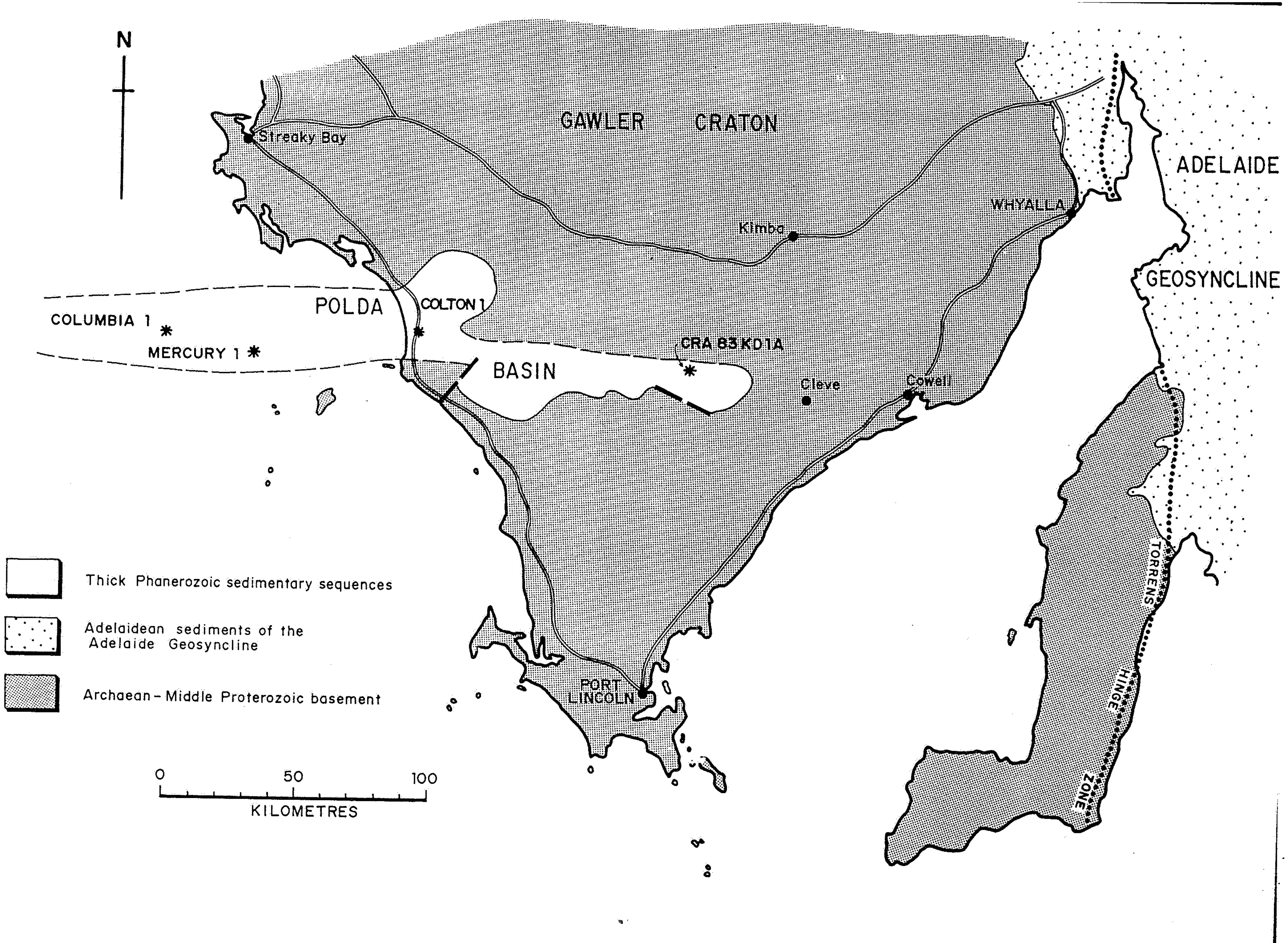


FIG. 1

DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

KILROO FORMATION - POLDA BASIN

REGIONAL LOCALITY

COMPILED R. F.	C D O	DATE
DRAWN M. B.	SCALE As shown	
DATE Nov '87	PLAN NUMBER	
CHECKED	S19700	

[redacted]

00177

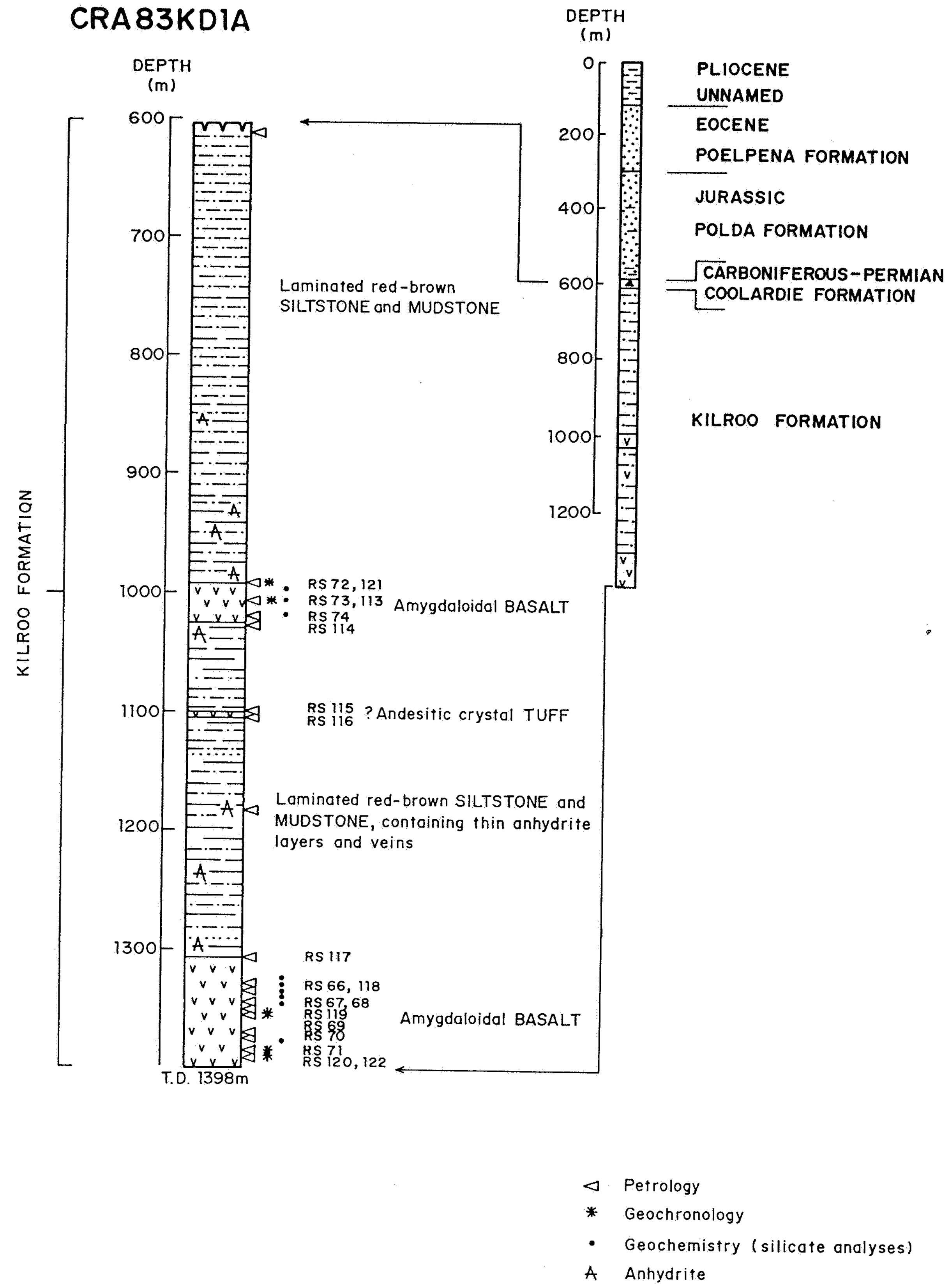


FIG. 2

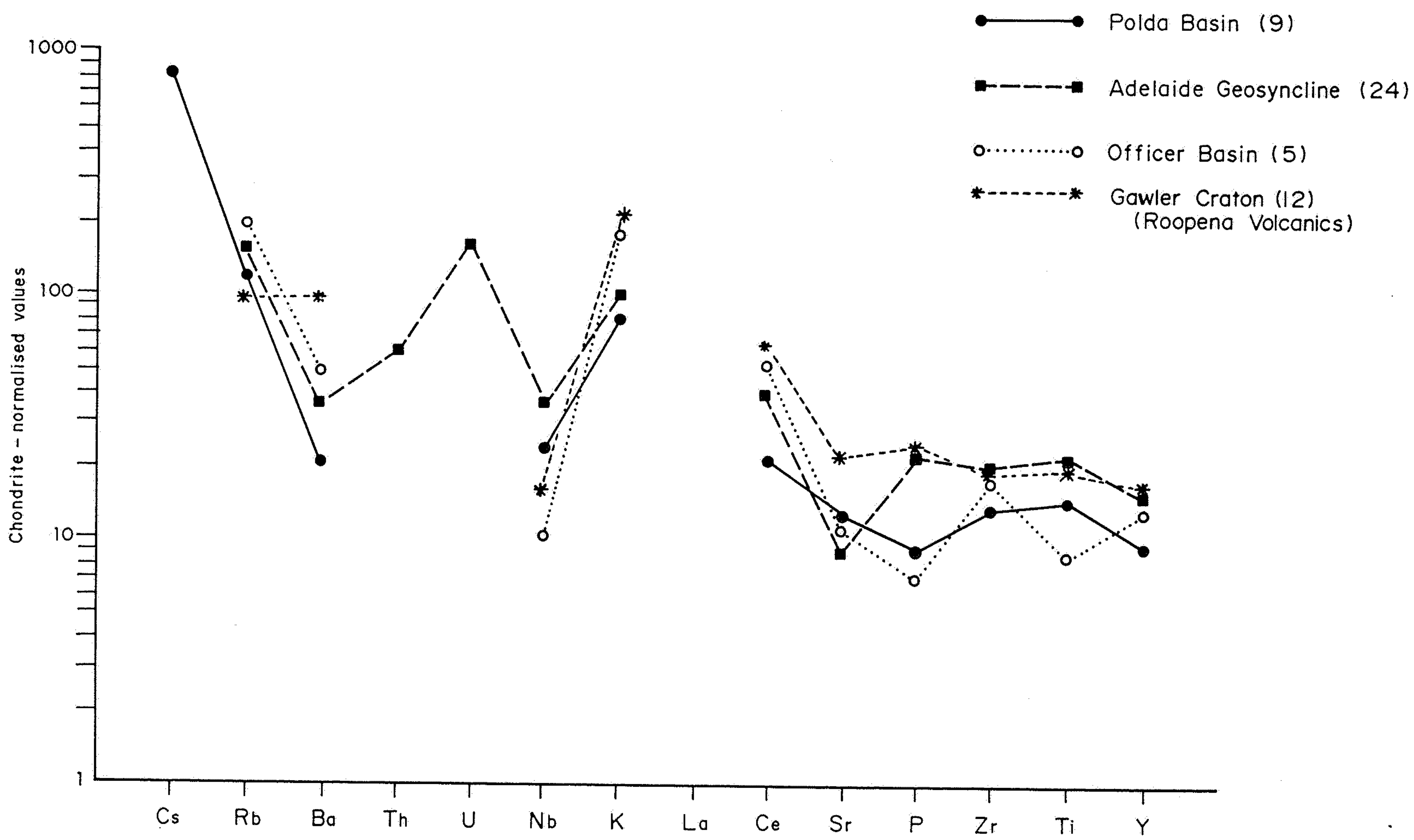
DEPARTMENT OF MINES AND ENERGY
SOUTH AUSTRALIA

KILROO FORMATION – POLDA BASIN

LOG CRA 83 KD1A

COMPILED R. F.	CDO	DATE
DRAWN M. B.	SCALE	
DATE Nov '87	PLAN NUMBER S19701	
CHECKED		

MEAN BASALTIC ANALYSES



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SOUTH AUSTRALIA

KILROO FORMATION - POLDA BASIN

MEAN BASALTIC ANALYSES

COMPILED R. F.	C D O	DATE
DRAWN M. B.	SCALE	
DATE Nov '87	PLAN NUMBER	
CHECKED	S19702	

FIG. 3

[redacted]

00179

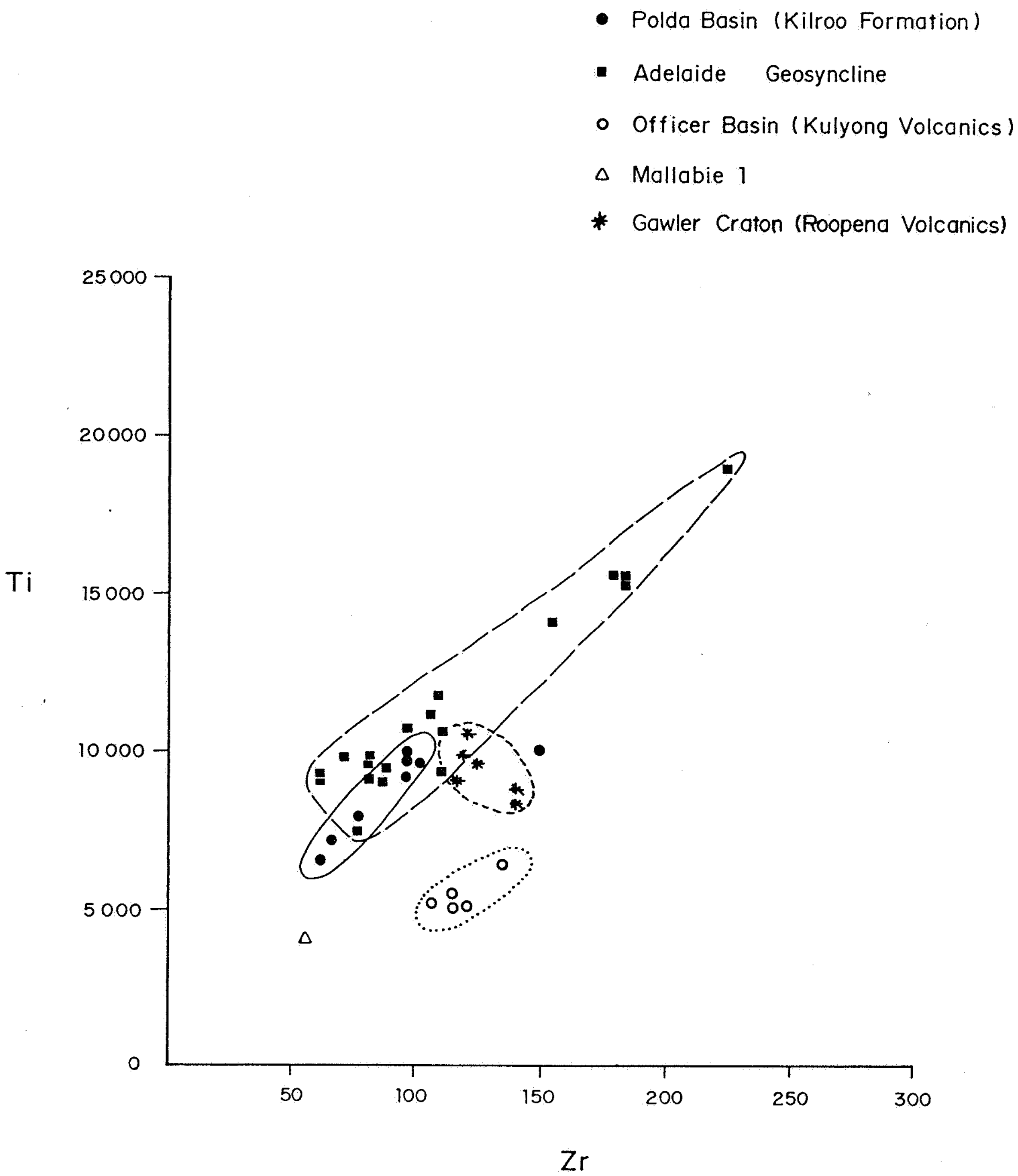

FIG. 4

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KILROO FORMATION – POLDA BASIN

Ti vs Zr

COMPILED R.F.	C D O	DATE
DRAWN M. B.	SCALE	
DATE Nov '87	PLAN NUMBER	
CHECKED	S19703	