Rept.Bk.No. 64/69
G.S. No. 3680

Seismic Central & Southern Murray Basin

MURRAY 67 (April 19)

DEPARTMENT OF MINES
SOUTH AUSTRALIA

GEOLOGICAL SURVEY
PETROLEUM EXPLORATION DIVISION

REPORT ON RECONNAISSANCE SEISMIC REFRACTION SURVEYS IN THE CENTRAL AND SOUTHERN PORTIONS OF THE MURRAY BASIN IN SOUTH AUSTRALIA 1965

by

R. COPPIN
GEOPHYSICIST
SEISMIC GEOPHYSICS SECTION

D.M. 242/65

19th April, 1967

RTB 64/69

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SOUTH AUSTRALIA

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REPORT ON RECONNAISSANCE SEISMIC REFRACTION SURVEYS IN THE CENTRAL AND SOUTHERN PORTIONS OF THE MURRAY BASIN IN SOUTH AUSTRALIA 1965

ABSTRACT

In 1965 twenty reconnaissance refraction depth probes were surveyed in the central and southern portions of the Murray Basin, in a search for local sedimentary troughs. No such troughs were discovered in the main basin, although a single probe near Meningie, in conjunction with previous survey information, has revealed the possible existence of shallow Permian depressions roughly parallel to the Coorong. A high velocity refraction (18,000-20,000ft/sec.), considered to originate in igneous or metamorphic bedrock, was encountered at depths less than 2,000 feet. In general, the sedimentary section thickens to the north, from 600 feet near Keith to 1,600feet. near Halidon.

INTRODUCTION

In 1965 the South Australian Department of Mines No.2 Seismic Party surveyed twenty broadly spaced refraction depth probes in the central and southern portions of the Murray Basin (see Plan 67-149). These profiles were surveyed along existing roads as the reconnaissance nature of the survey did not warrant any regular pattern of probes. The primary function of the programme was to determine depths to economic basement and hence locate any thicker, more prospective sedimentary sections.

The refraction survey covers an area extending from Keith in the south to Halidon in the north. The southern group of probes, generally along roads branching from the Tailem Bend to Bordertown highway have been given the prefix C, signifying they are to be found in the general Culburra area. Those probes in the north of the survey area have been given the prefix K, as

part of the general Karoonda area. All the refraction probes lie within the Murray plains which are of low topographic relief and are covered with Mallee scrub in the areas not cleared for farming.

GEOLOGICAL SUMMARY

The Murray Basin is an area of Mesozoic and Tertiary sedimentation separated in the south from the Gambier Embayment of the Otway Basin, by a basement structural high known as the Padthaway Ridge. To the south of the Murray River, most bores reaching basement entered phyllitic slates, micaceous schists, greywacke or granitised rocks of the Kanmantoo Group. In the central portion of the basin no bore has so far reached basement, although the Beach Petroleum Monash No. 1 well was drilled five miles NW of Monash to a total depth of 3,445 feet. The well penetrated a sequence of Tertiary, Cretaceous and Permian rocks, and below 3,320 feet, entered a pink sandstone which may be of (?)Devonian age (Ludbrook (1)).

In the main portion of the basin, Upper Palaeozoic and Mesozoic rocks are only known from occurrences at depth in a limited number of oil wells in the Loxton-Renmark-Monash area. Apart from the above mentioned possible (?)Devonian, the Palaeozoic is represented by Permian sediments. One thousand eight hundred feet of Permian sands and shales were penetrated in the Geoil Ltd. Donna No. 1 well, (Freeman (2)), which was drilled 5½ miles south-east of Milang. The Mesozoic is represented by Cretaceous shales, mudstones and sandstones of Aptian and (?)Albian age.

The Mesozoic is everywhere unconformably overlain by Tertiary sediments, which generally do not exceed 1,000 feet in thickness. The oldest Tertiary strata belong to the Knight Group of Eocene age. At this time, in the south, the Padthaway Ridge formed a series of islands around which the sediments of the Knight Group were deposited. On the north side of the ridge, these sediments were laid down on a basement floor which dipped to the north-

east. In the upper Eocene, sediments of the Buccleuch Group were deposited over a limited area in the southwest of the basin. Above the top of the Buccleuch Group is generally a green or green-grey, glauconitic clay with pisolitic ironstone. This clay is probably the equivalent of the Compton Conglomerate and marks the beginning of the Oligocene Glenelg Group. This group and the overlying Miocene Murray Group consist of a sequence of limestones, sandy limestones and marls. Both groups are thickest in the main basin, thinning and becoming more marly and sandy towards the margins. The Murray Group is overlain by the Bookpurnong beds (sands and marls), the wide-spread Loxton Sands and the Pliocence Norwest Bend formation.

A positive movement of the Padthaway Ridge appears to have begun at the end of the Oligocene, causing seas to shallow and drain away to the northeast. Progressively younger beds of the Miocene Murray Group are thus restricted to smaller and smaller areas in this direction. The (?)Mio-Pliocene Loxton Sands are more widely distributed than the Middle and upper Miocene beds and appear to have been derived from different source rocks; possibly the exposed granites of the Padthaway Ridge.

PREVIOUS GEOPHYSICAL SURVEYS

An aeromagnetic survey of the southern portion of the area was flown by Adastra Hunting Geophysics Ltd. for Murray Basin Oil Syndicate in 1955. The same company flew the northern portion of the area for the S.A. Department of Mines in 1956. Total intensity magnetic contour maps of these areas are available from Departmental Records. A network of gravity stations was established by Seedsman for the S.A. Department of Mines between 1952 and 1956. These surveys were generally made along the same roads as the present refraction probes. Seedsman also established gravity stations along the Coorong and around the Murray Mouth. A local gravity survey was made in the Milang area by Geosurveys of

Australia Ltd. for W.S. Goyder (Geoil) in 1963. This survey revealed the presence of relatively thick sediments thought to be of Permian age, along a NW trending basement depression, parallel to the Finiss Arm.

Reconnaissance refraction depth probes were shot in 1961 and 1963 by the S.A. Department of Mines, between Naracoorte and Paruna, and Kingston and Meningie. These probes showed a generally thin sedimentary section resting on high speed basement.

METHODS OF OPERATION AND INTERPRETATION

Camp

A mobile camp containing accommodation for 24 men in four berth and two berth caravans, was used. Separate caravans provided cooking, dining, washing and office facilities. Food, spare parts, refrigeration and 240 volt power supply were stored or mounted on four wheel trailors.

Surveying

Each refraction probe was surveyed using theodolite and chain for horizontal control. Shot points were surveyed every 1,200 feet, and geophone markers placed at 300 foot intervals. All geophone and shot points were levelled with a Wild microptic level and staff, and were related to sea level datum through South Australian Railways' bench marks.

Drilling

Two Mayhew 1,000 drilling rigs mounted on International R190 6 x 6 prime movers were used for shot hole drilling. Each rig was served by an 800 gallon water tanker. The shooter's truck also carried an 800 gallon tank. Drilling water was generally obtained from tanks and bores.

Shooting and Recording

A Texas Instruments 7000 B system and a Techno 401 magnetic recorder-reproducer were used for recording. These instruments were mounted on an International AB 120 4 x 4 truck. HSI ($4\frac{1}{2}$ c/s) geophones, in sets of two, were used throughout the survey. These geophones were connected to takeouts every 300 feet along a total spread length of 7,200 feet. Explosive charges varied between 10 and 85 lbs. Record quality was fair to good.

Computing Procedures

All results were computed to a common sea level datum. Several methods for calculating depth and dip of refracting horizons were used. The majority of depth probes were computed using the methods of Dooley (3). A few probes were computed using the method devised by Vale and Smith (4), and a few refractor profiles were determined using the methods devised by Barthelmes (5) and Hale (6).

The weathering profile was obtained by shooting upholes and generally, two short weathering spreads for each refraction probe were shot.

RESULTS AND INTERPRETATION

Refraction depth probes in the southern portion of the survey area, in the vicinity of the Tailem Bend to Bordertown Highway and the Padthaway Ridge, show a high speed refractor (18,100-19,900 ft/sec.) at depths between 300 and 600 feet below surface. Borehole logs in the same areas show weathered basement of schists and granites at slightly shallower depths. The seismic refraction probably originates in fresh basement material below the zone of weathering. Refraction probe C9, about six miles west of Keith, recorded a refractor 610 feet below surface, with a

velocity of 19,900 ft/sec; 20 miles further west probe C_{11} recorded a refractor of velocity 18,130ft/sec., 430feet below surface. Eight miles south of Keith, igneous rock of the Padthaway Ridge outcrops at Mt. Monster. These and other probes from Coonalpyn to Keith, follow the trend of the Padthaway Ridge and record basement at depths less than 610 feet, with the exception of C4 which is centered 15 miles west of Coonalpyn on the Coonalpyn to Meningie road.

This probe recorded a velocity of 7350 ft/sec. at 45 feet and 17400ft./sec. at 1590 feet below surface. A water bore in the same general area entered possible Permian at 250feet (O'Driscoll (7)) and was in the same material at total depth 280ft. A few miles to the east a water bore entered schist at 252 feet after penetrating Tertiary and younger strata. A rapid deepening of the basement and local Permian sedimentation, which is generally not detected as a separate refraction, is thus suggested on the south-western side of the Padthaway Ridge.

Earlier refraction depth probes (Seedsman (8)) showed a basement refractor of 16,500ft/sec., 700feet below surface, approximately 24 miles southeast of Meningie, and two miles to the west, on the edge of the Coorong, a Refractor of 17,800ft/sec., 1270 feet below the surface. A third probe, a further 12 miles south recorded basement 1,500 feet below surface with a velocity of 20,100 ft/sec. Seedsman states that "The overlying low velocity refractors are considered to be Tertiary sediments. Nowhere were there recorded definite refractors of intermediate velocity which might indicate the presence of pre-Tertiary sediments."

Probe C4 shows an intermediate velocity of 7350 ft/sec. which could possibly originate in relatively unconsolidated Permian or Mesozoic sediments. The probe appears to be sited over the margin of a basement depression and shows a rapid deepening of the high speed refractor from 600 to 1590 feet.

This depression is probably similar to the Finiss Arm gravity depression as defined by Stackler (9). The Geoil, Donna

No.1 well, drilled slightly off the centre of the Finiss depression penetrated 1800 feet of Permian sands before drilling was halted at 2300 feet.

It is probable that the Permian need not be associated with an intermediate velocity; and probe C4, with the previous probes of Seedsman, lie along a depression, or series of depressions of varying depth, trending roughly parallel to the Coorong and containing a quantity of Permian sediments. Earlier unpublished Mines Department regional gravity surveys along the Coorong and near the Murray mouth suggest the existance of basement depressions inland from Meningie and along the Coorong. The gravity coverage is not good enough to show whether these depressions are in any way connected. Such depressions would probably parallel the Finiss Arm gravity depression as defined by Stockler (9).

Away from the Padthaway Ridge the refraction probes show a slightly undulating basement gradually deepening to the northeast (see Plan L67-164). Probe C10, approximately 19 miles NNW of Bordertown recorded basement 1,150 feet below surface. Earlier probes 23 and 24 of Seedsman (8) to the east of C10, near the South Australian-Victorian border, found basement at 530 and 460 feet below surface, suggesting a slight thinning of section near the border. Probes in the central portion of the basin along the Tailem Bend to Lameroo road and Karoonda to Peebinga railway line, show a gently undulating shallow basement that gradually deepens northwards. The thickest sedimentary section of the survey was recorded by probes along the Karoonda to Renmark railway line. These probes (K2, K3) are the most northerly and probably only reflect the general N to NE deepening of the basement. Refraction probe K1 west of Karoonda, reflects a general shallowing of basement toward actual outcrop at the edge of the Mount Lofty Ranges.

CONCLUSIONS

In the central portion of the Murray Basin, the survey revealed no local sedimentary depressions. Depths to basement obtained from the refraction depth probes show a sedimentary section gradually thickening to the northeast, away from the Padthaway Ridge. Nowhere in this portion of the survey area is there present a sufficient thickness of sedimentary section to encourage further petroleum exploration. In the southwest of the basin near Meningie, probe C4 recorded a depth to basement of ~~2,500~~ 1590 feet. This depth along with the information contained in earlier reports of Seedsman (8) and O'Driscoll (7), suggests possible basement depressions striking roughly NE parallel to the Coorong. Until further geophysical work has been done in the area of the Murray Mouth and Lakes to test this theory, it should be approached with caution. However, should such depressions exist with a considerable Permian section, further petroleum exploration may be warranted in the area.

ACKNOWLEDGEMENTS

This report has been written to present results obtained by the S.A. Department of Mines No. 2 Seismic party in 1965, with E. Moorcroft as party chief. He and J. McG. Hall were responsible for most velocity and depth determinations.

R.C:SMA:CM
19.4.1967

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APPENDIX

A REFRACTION DEPTH PROBE NEAR GEOIL LTD. DONNA NO. 1 WELL IN THE MILANG AREA

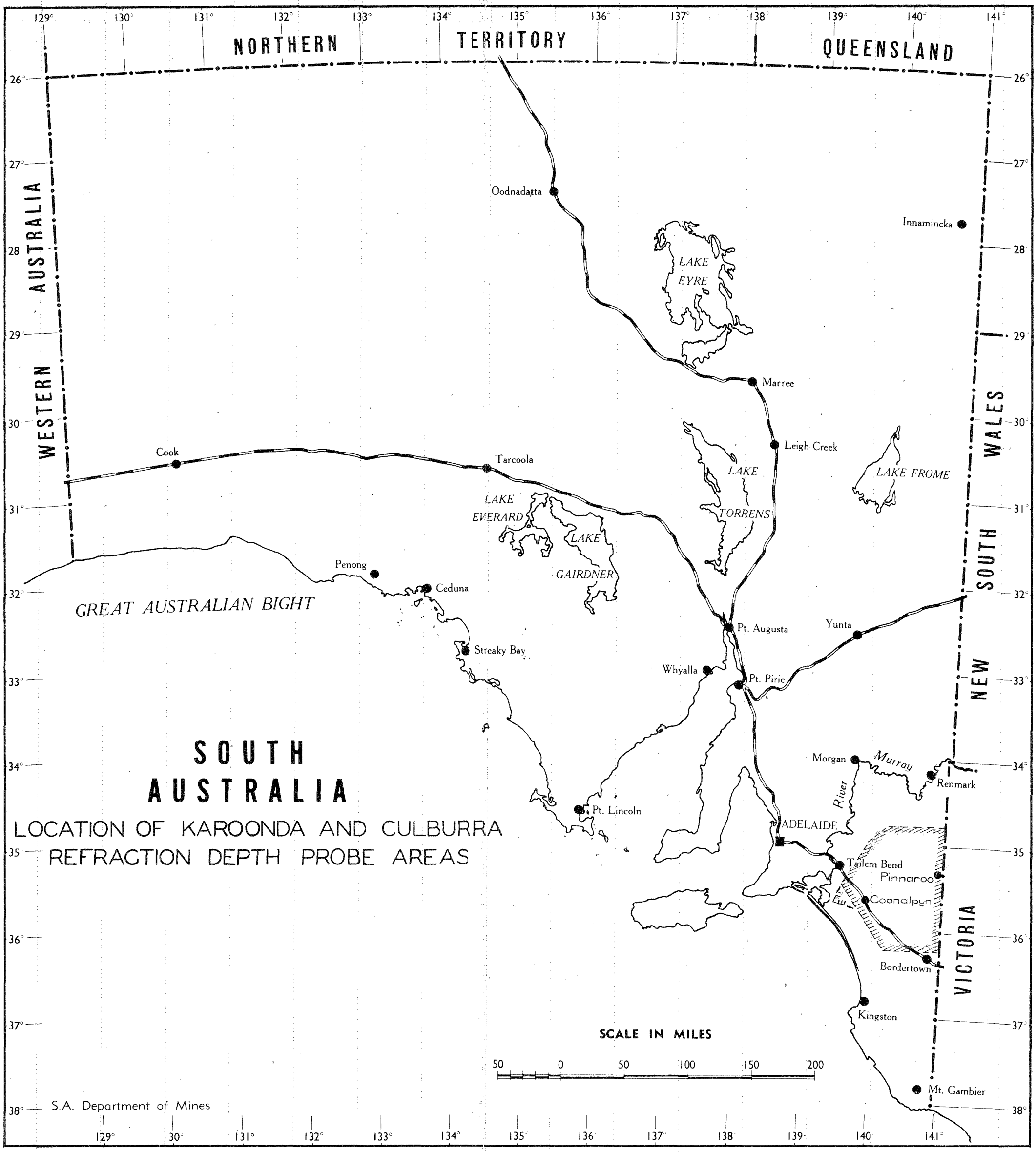
This opportunity has been taken to present results obtained in April, 1965, by the Department's No.2 seismic party under E. Moorcroft as party chief.

The survey was undertaken to determine whether there existed in this area, refracting horizons which could be correlated with any geological layering revealed by the Donna No.1 Well Depth to the high speed refractor was computed using Dooley's method (3), and the refractor profile determined using the method devised by Barthelmes (5). The depth probe revealed three refractors; a high speed layer with a velocity of 17,900 ft/sec., 1660 feet below surface, and two overlying low speed layers with velocities of 9000ft/sec. 580 feet below surface and 7000 ft/sec. from 580 feet to surface. Both the refractor profile and the time distance curves are shown on plan 67-328.

It seems unlikely that the 17,900 ft/sec. refractor correlates with any bed revealed in the Donna No.1 Well, although it has been suggested that it might correlate with the sequence of more massive Permian sands detected below 1,175 feet. It is more probable that the high sp ed refractor is igneous or metamorphic basement. Basement dips between 1° and 2° towards the well.

It is probable that the 9000ft/sec refractor detected 580 feet below surface correlates with a higher speed Permian sandstone layer revealed in the Donna No.1 Well logs near 600 feet. Thislayer is near, but does not coincide with, the top of the Permian which was encountered at 500 feet.

Should any further geophysical work be undertaken in the area, it would be profitable to extend the survey south across the well location.



SOUTH AUSTRALIA

LOCATION OF KAROONDA AND CULBURRA REFRACTION DEPTH PROBE AREAS

67-149 Ja/c

Sherlock

Peake

Jabuk

Geranium

Parrakie

Lameroo

Coomandook

Yumali

Kiki

Coonalpyn

Culburra

Tintinara

KEITH

K8
62 57 54 51 46
θ - 0° 29'
18,800 l/s at 635 ft below MSL
at 850 ft below Surface

K9
62 57 54 51 46
θ - 0° 49'
17,500 l/s at 760 ft below MSL
at 1020 ft below Surface

K10
62 57 54 51 46
θ - 3° 9'
18,300 l/s at 670 ft below MSL
at 1010 ft below Surface

C1
62 57 54 51 46
θ - 0° 3'
18,200 l/s at 650 ft below MSL
at 710 ft below MSL

C2
62 57 54 51 46
θ - 0° 21'
18,400 l/s at 250 ft below MSL
at 310 ft below Surface

C3
46 51 54 57 62
θ - 0° 4'
18,100 l/s at 340 ft below MSL
at 620 ft below Surface

C4
62 57 54 51 46
V1 = 7350 l/s
V2 = 17,400 l/s at 1560 ft below MSL
V3 = 17,400 l/s at 1590 ft below Surface

C5
46 51 54 57 62
θ - 0° 5'
19300 l/s at 430 ft below MSL
at 490 ft below Surface

C6
46 51 54 57 62
θ - 0° 2'
18,200 l/s at 420 ft below MSL
at 520 ft below Surface

C7
46 51 54 57 62
θ - 1° 3'
18,600 l/s at 450 ft below MSL
at 490 ft below Surface

C8
46 51 54 57 62
θ - 0° 21'
18,400 l/s at 250 ft below MSL
at 310 ft below Surface

C9
62 57 54 51 46
θ - 0° 13'
19900 l/s at 450 ft below MSL
at 610 ft below Surface

C10
62 57 54 51 46
θ - 2° 13'
18,150 l/s at 650 ft ? below MSL
at 1150 ft ? below Surface

C11
46 51 54 57 62
θ - 0° 38'
18,130 l/s at 270 ft below MSL
at 430 ft below Surface

N

FEET 10,000 5000 0 10,000 20,000 30,000 40,000 FEET

S.A. DEPT. OF MINES
SEISMIC SURVEY 1965
DEPTH PROBES
COONALPYN AREA
C1 to C11
LOCALITY PLAN

L65-83
JK
DATE: 11 6 65

K3
62 57 54 51 46
θ = 1° 39'
18040 ft/s at 1360 ft below MSL
at 1590 ft below Surface.

HALIDON

θ = 0° 36'
19700 ft/s at 723 ft below MSL
at 960 ft below Surface.
K1
63 58 53 50 51 46 37

62 57 54 51 46
θ = 2° 24'
16,900 ft/s at 1330 ft below MSL
at 1620 ft below Surface.
K2

Borrika

KAROONDA

θ = 0° 47'?
15,860 ft/s at 1770 ft? below MSL
at 1980 ft? below Surface.
Nunkeri
46 51 54 57 62
K4

Yurgo

Marama

Kulkami
46 51 54 57 61
K5
θ = 0° 18'
18,300 ft/s at 1100 ft below MSL
at 1300 ft below Surface.

Mulpata

Wirha

θ = 1° 21'
18,300 ft/s at 900 ft below MSL
at 1180 ft below Surface.
62 57 54 51 46
K6

Gurrai

Karte

θ = 0° 42'
18,800 ft/s at 1120 ft below MSL
at 1440 ft below Surface.
K7
62 57 54 51 46

N

VICTORIA

PINNAROO

Chandos

θ = 0° 29'
18,800 ft/s at 635 ft below MSL
at 850 ft below Surface.
K8
62 57 54 51 46

Lameroo

θ = 5° 3'?
18,300 ft/s at 670 ft below MSL
at 1010 ft below Surface.
K10
62 57 54 51 46

Peake

θ = 0° 49'
17,500 ft/s at 760 ft below MSL
at 1020 ft below Surface.
K9
62 57 54 51 46

Jabuk

Geranium

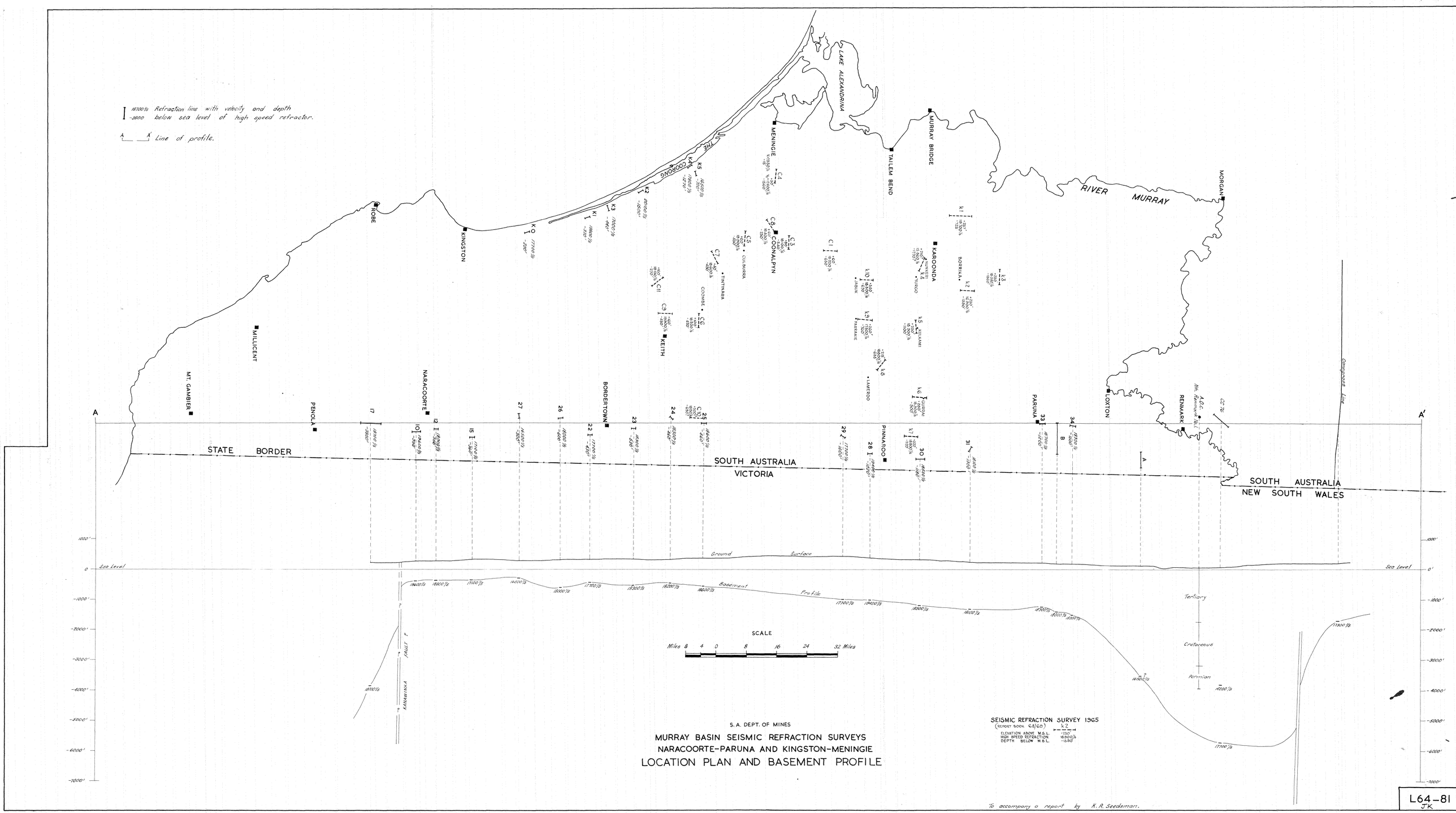
Parrakie

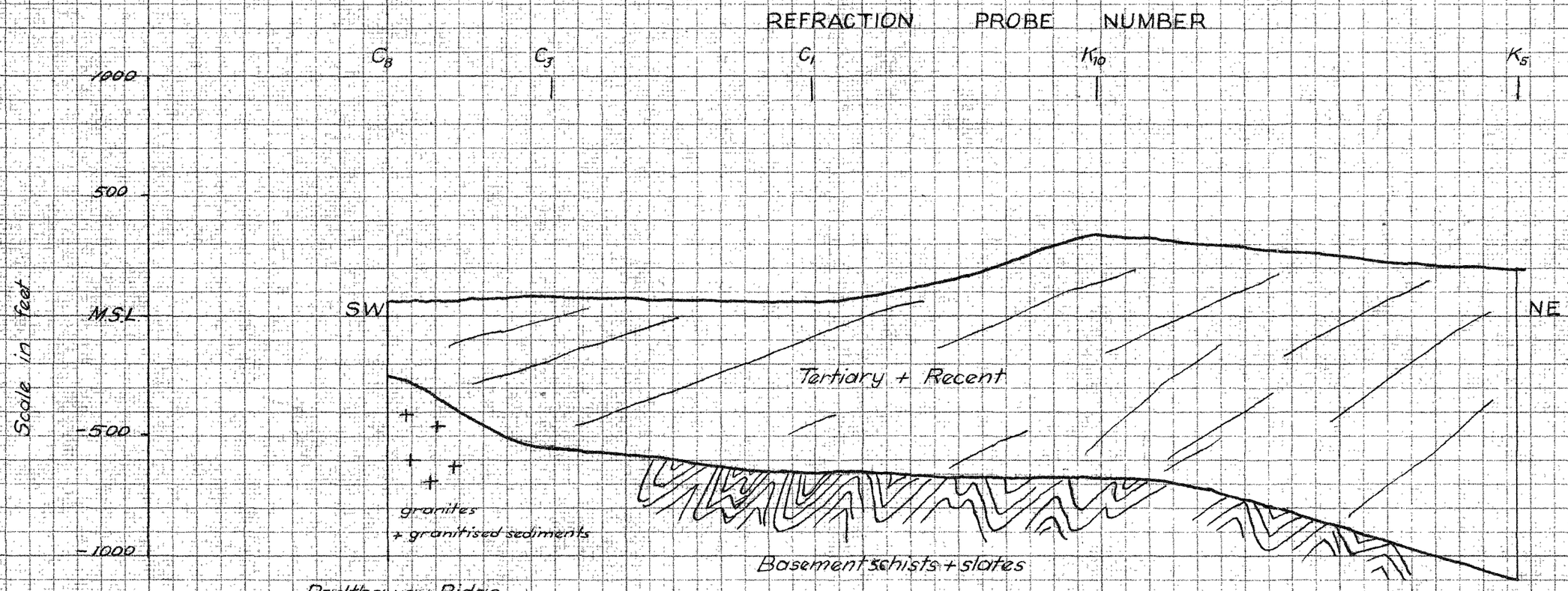
C1
62 57 54 51 46
θ = 0° 9'
18,200 ft/s at 650 ft below MSL
at 710 ft below Surface.

FEET 10000 5000 0 10000 20000 30000 40000 FEET

S.A. DEPT. OF MINES
SEISMIC SURVEY 1965
DEPTH PROBES
KAROONDA AREA
K1-K10 & C1
LOCALITY PLAN

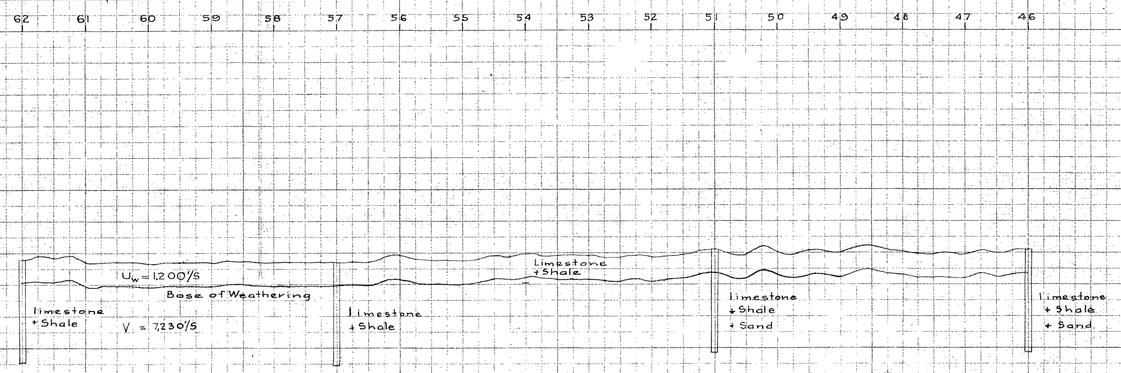
L65-81
Jcd
Date: 20-5-65.

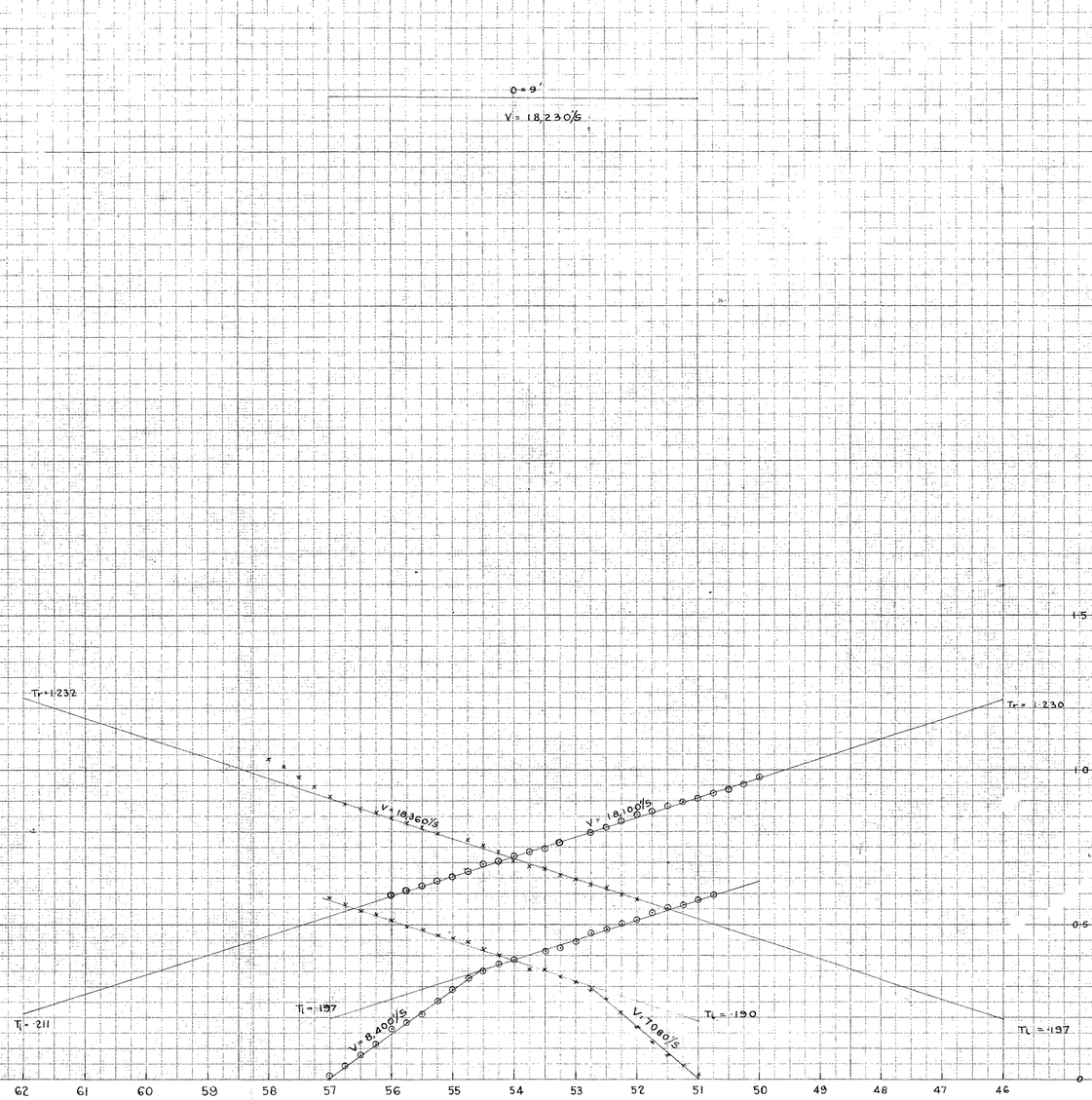

I 18700 ft/s Refraction line with velocity and depth -3800 below sea level of high speed refractor.
A A' Line of profile.
LAKE ALEXANDRINA
THE COORONG
MENINGIE
TAILEM BEND
MURRAY BRIDGE
RIVER MURRAY
MORGAN
ROBE
KINGSTON
COONALPYN
KAROONDA
BORDERTOWN
KEITH
NARACOORTE
PENOLA
MILLICENT
MT. GAMBIER
PINNAROO
PARUNA
LOXTON
RENMARK
Commonwealth Line
STATE BORDER
SOUTH AUSTRALIA
VICTORIA
SOUTH AUSTRALIA
NEW SOUTH WALES
A
A'
Ground Surface
Sea Level
Basement Profile
Tertiary
Cretaceous
Permian
SCALE
Miles 8 4 0 8 16 24 32 Miles
S. A. DEPT. OF MINES
MURRAY BASIN SEISMIC REFRACTION SURVEYS
NARACOORTE-PARUNA AND KINGSTON-MENINGIE
LOCATION PLAN AND BASEMENT PROFILE
SEISMIC REFRACTION SURVEY 1965
(REPORT BOOK G4/65)
ELEVATION ABOVE M.S.L.
HIGH SPEED REFRACTION
DEPTH BELOW M.S.L.
To accompany a report by K.R. Seedsman.
L64-81
JK

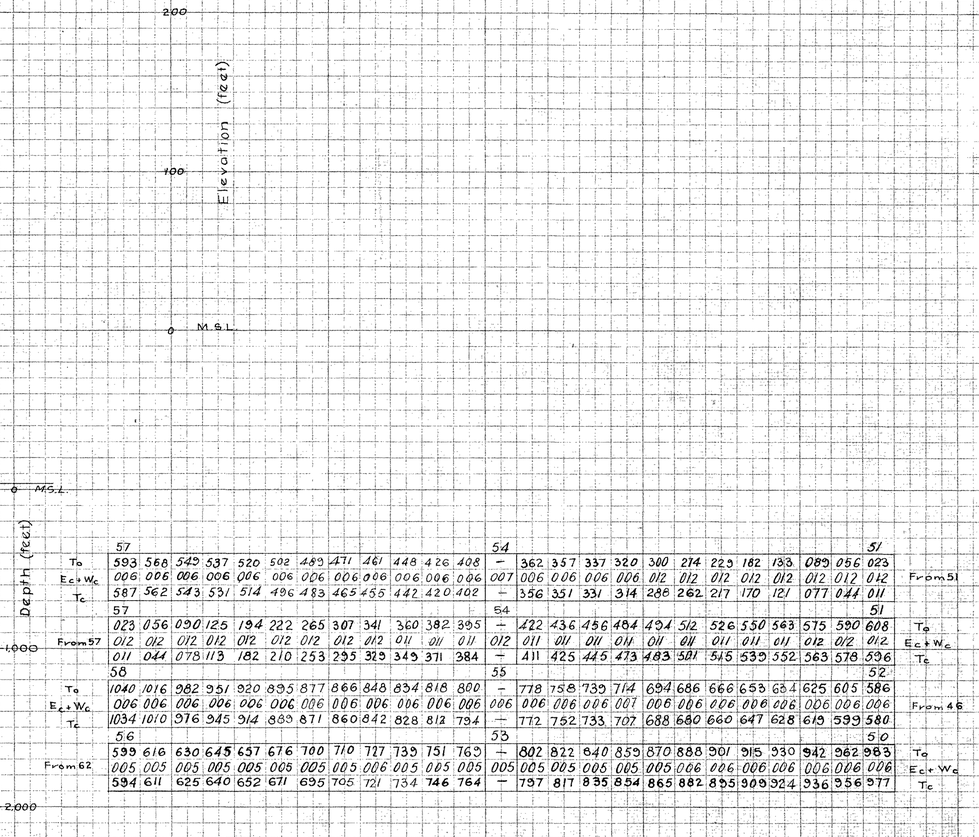


RECONNAISSANCE REFRACTION SURVEY
CENTRAL AND SOUTHERN MURRAY BASIN
GENERAL BASEMENT PROFILE COONALPYN TO KULKAMI

67-164
JK







		57												54														51		
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	T_c	587	562	543	531	514	496	483	465	455	442	420	402	–	356	351	331	314	288	262	217	170	121	077	044	011				
		57												54														51		
		023	056	090	125	194	222	265	307	341	360	382	395	–	422	436	456	484	494	512	526	550	563	575	590	608		T_o		
	From 57	012	012	012	012	012	012	012	012	012	011	011	011	012	011	011	011	011	011	011	011	011	011	012	012	012		E_c+W_c		
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		58												55														52		
	T_o	1040	1016	982	951	920	895	877	866	848	834	818	800	–	778	758	739	714	694	686	666	653	634	625	605	586				
	E_c+W_c	006	006	006	006	006	006	006	006	006	006	006	006	006	006	006	006	007	006	006	006	006	006	006	006	006		From 46		
	T_c	1034	1010	976	945	914	889	871	860	842	828	812	794	–	772	752	733	707	688	680	660	647	628	619	599	580				
		56												53														50		
		599	616	630	645	657	676	700	710	727	739	751	769	–	802	822	840	859	870	888	901	915	930	942	962	983		T_o		
	From 62	005	005	005	005	005	005	005	005	006	005	005	005	005	005	005	005	005	005	006	006	006	006	006	006	006		E_c+W_c		
		594	611	625	640	652	671	695	705	721	734	746	764	–	797	817	835	854	865	882	895	909	924	936	956	977		T_c		

Horizontal scale	1cm = 600 ft	Interpretation	E Moorcroft
Vertical scales	as shown		
Datum	mean sea level	Date	22 · 5 · 65

DEPARTMENT OF MINES — SOUTH AUSTRALIA

SEISMIC SURVEY

MURRAY BASIN 1965

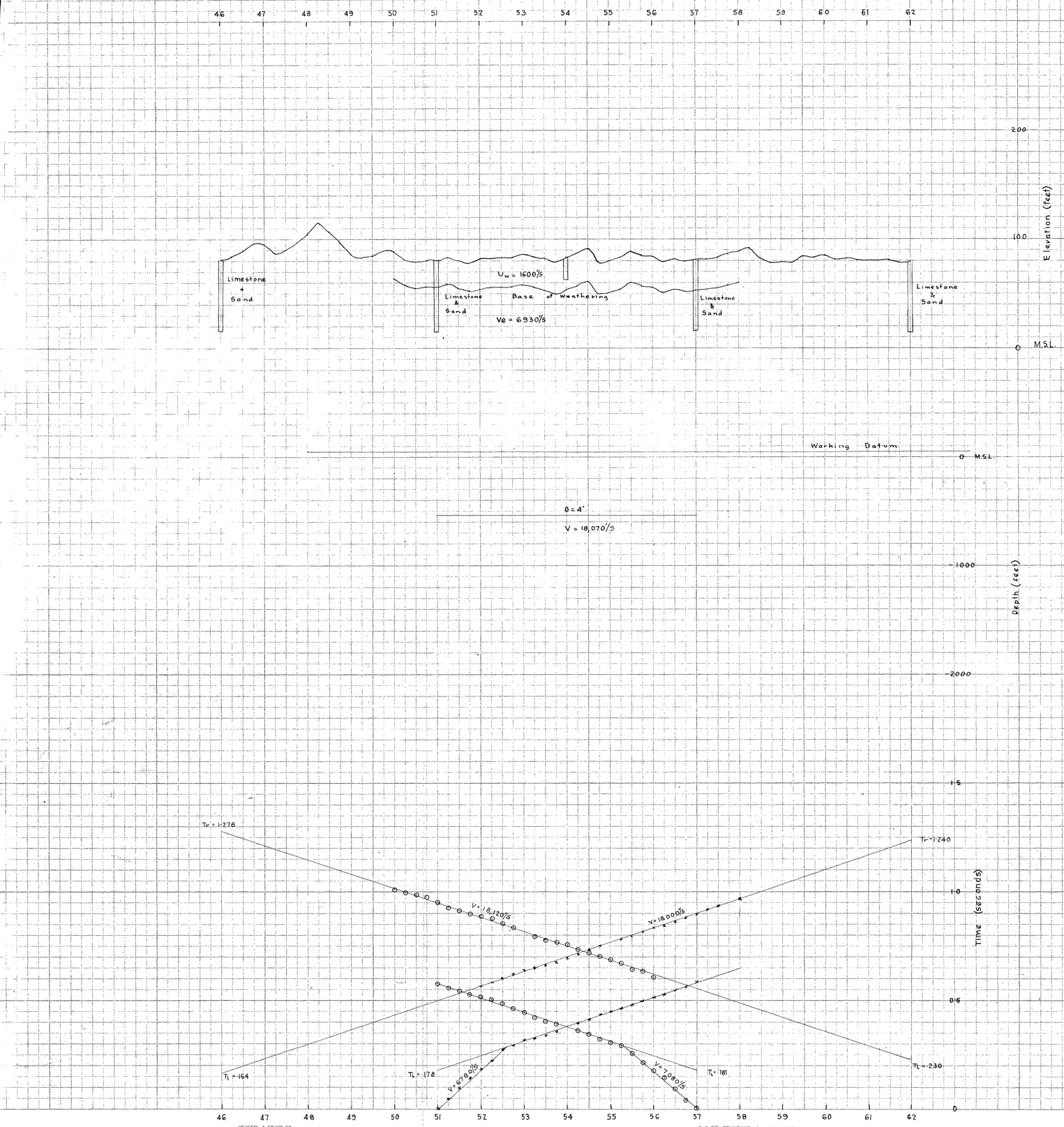
CULBURRA AREA

TIME DISTANCE CURVES & INTERPRETATION

DEPTH PROBE C1

65-846
JK.

KEUFFEL & ESSER CO.
MADE IN U.S.A.
K&E STANDARD ◎ CROSS SECTION
MILLIMETER



	51												54																57	
To	589	568	554	536	527	514	497	476	456	434	415	403	—	377	360	335	321	306	271	230	192	161	110	059	019					
E_c+W_c	011	011	012	011	012	012	013	013	013	013	013	013	014	015	016	013	013	014	018	017	017	017	017	017	017	From 57				
T_c	578	557	542	525	515	502	484	463	443	421	402	390	—	362	344	322	308	292	253	213	175	144	093	042	002					
	51												54																57	
	016	064	112	156	196	238	286	304	329	340	350	369	—	410	428	447	461	478	494	512	527	541	561	577	598	To				
From 51	015	015	015	015	016	016	013	013	013	013	013	013	014	015	016	013	013	014	014	013	013	012	013	012	012	E_c+W_c				
	001	048	097	141	182	222	273	291	316	327	337	356	—	395	412	434	448	464	480	499	514	529	548	565	586	T_c				
	50												53																56	
To	1023	1011	999	986	962	930	926	909	893	880	869	849	—	809	791	779	771	752	736	714	697	685	658	647	622					
E_c+W_c	013	013	012	012	012	012	013	012	013	013	014	014	014	014	014	014	015	016	017	014	014	015	015	014	014	From 62				
T_c	1010	998	987	974	950	927	915	897	886	875	855	835	—	795	777	765	756	736	719	700	683	670	643	633	608					
	52												55																58	
	580	597	614	632	652	662	674	689	709	728	748	764	—	794	811	830	844	858	875	892	910	929	947	—	982	To				
From 46	012	012	013	013	013	013	013	013	014	015	016	013	013	014	014	013	013	012	013	012	012	013	013	013	014	E_c+W_c				
	568	585	601	619	639	649	661	676	695	713	732	751	—	780	797	817	831	846	862	880	898	916	934	—	968					

Horizontal scale 1 cm = 600ft Interpretation E.Moorcroft
Vertical scales as shown
Datum mean sea level Date 23rd May 1965

DEPARTMENT OF MINES — SOUTH AUSTRALIA

SEISMIC SURVEY

MURRAY BASIN 1965

CULBURRA AREA

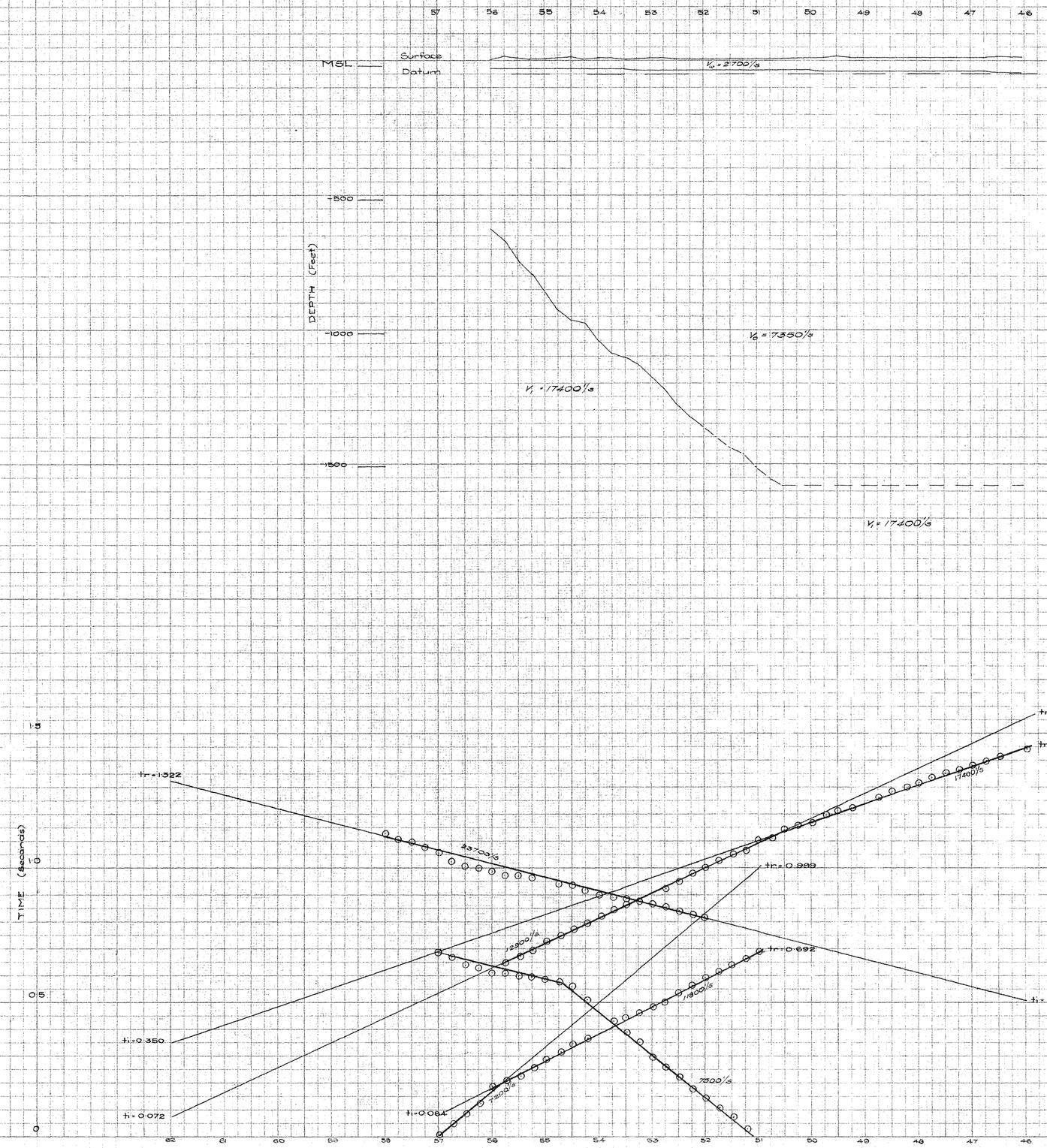
TIME DISTANCE CURVES & INTERPRETATION

DEPTH PROBE C3

65-847
J.K.

KEUFFEL & ESSER CO.
MADE IN U.S.A.
K&E STANDARD ⊕ CROSS SECTION
MILLIMETER
KEUFFEL & ESSER CO.
MADE IN U.S.A.
K&E STANDARD ⊕ CROSS SECTION
MILLIMETER

	57											54												51				
Tb	018	081	103	140	188	230	252	279	308	341	371	381	–	452	468	485	536	552	553	563	618	643	663	688	713				
Ec - Wc	016	015	016	015	017	020	026	023	023	025	036	023	026	024	024	024	025	026	024	024	024	024	024	024	024	Fr. 57			
Tc	002	046	087	125	171	210	226	256	286	316	345	368	–	428	445	461	481	506	535	565	594	619	645	664	689				
	57											54												51				
Tb	713	630	663	654	641	634	623	620	609	605	580	532	–	453	410	374	320	280	242	201	167	129	094	055	016				
Ec - Wc	022	022	022	021	023	026	025	023	022	025	020	016	020	019	018	019	019	020	019	019	019	018	018	019	019	Fr. 51			
Tc	691	668	644	633	618	608	603	597	587	580	560	516	–	434	392	356	301	260	233	182	148	110	076	036	-003				
	58												55												52				
Tb	1152	1136	1126	1105	1086	[redacted]						004	934	–	977	970	948	938	926	920	910	899	888	877	859	846				
Ec - Wc	028	031	032	029	029	[redacted]						032	030	029	032	033	030	033	031	031	031	031	033	031	031	031	Ec. 46		
Tc	1123	1105	1083	1057	1025	[redacted]						972	864	–	945	937	913	905	895	889	870	868	855	846	828	815			
	62												49												46				
Tb	1023	1044	1068	1085	1117	1132	1160	1178	1190	1210	1235	1249	–	1295	1307	1324	1340	1360	1371	1390	1404	1402	1438	–	1470				
Ec - Wc	018	016	016	016	016	017	017	018	016	019	021	020	020	018	020	018	020	021	019	021	021	021	032	021	021	Fr. 62			
Tc	1007	1028	1052	1068	1101	1116	1143	1160	1172	1181	1214	1229	–	1226	1287	1305	1320	1380	1352	1369	1383	1393	1416	–	1449				
	56												53												50				
Tb	650	671	694	717	744	744	799	816	846	870	882	899	–	945	970	1001	1028	1049	1073	1091	1122	1137	1164	1181	1195				
Ec - Wc	019	022	022	019	019	021	022	019	022	020	020	020	021	022	020	020	020	020	020	020	020	021	021	023	035	Fr. 62			
Tc	631	649	672	696	725	763	776	797	823	850	862	870	–	923	950	981	1008	1029	1053	1071	1102	1116	1143	1158	1172				

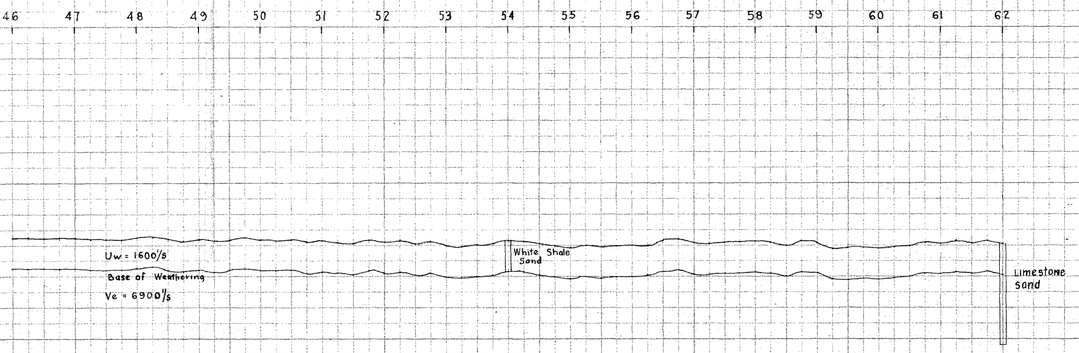


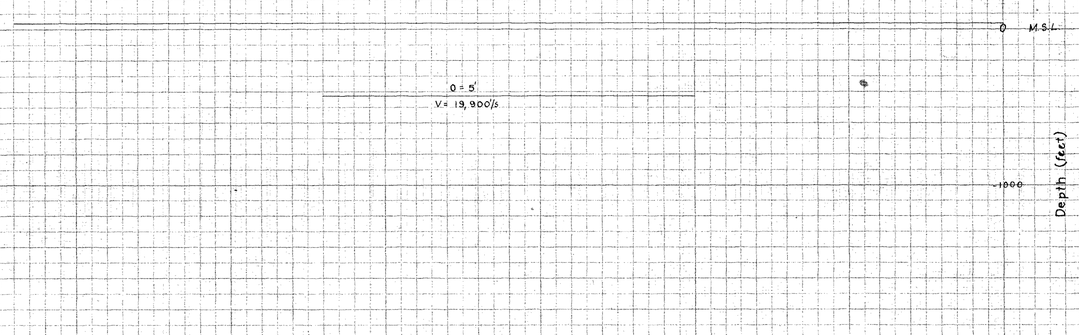
HORIZONTAL SCALE 1 CM = 600 FT. DATE FEB. 1966

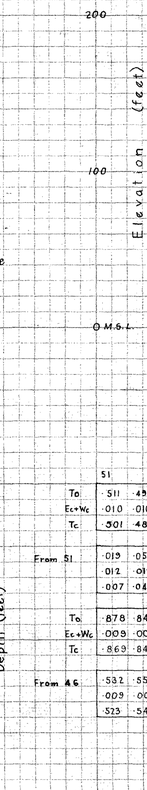
INTERPRETATION J.M. & G.HALL

DEPARTMENT OF MINES - SOUTH AUSTRALIA
SEISMIC SURVEY
MURRAY BASIN 1965
CULBURRA AREA
REFRACTION DEPTH PROBE C4

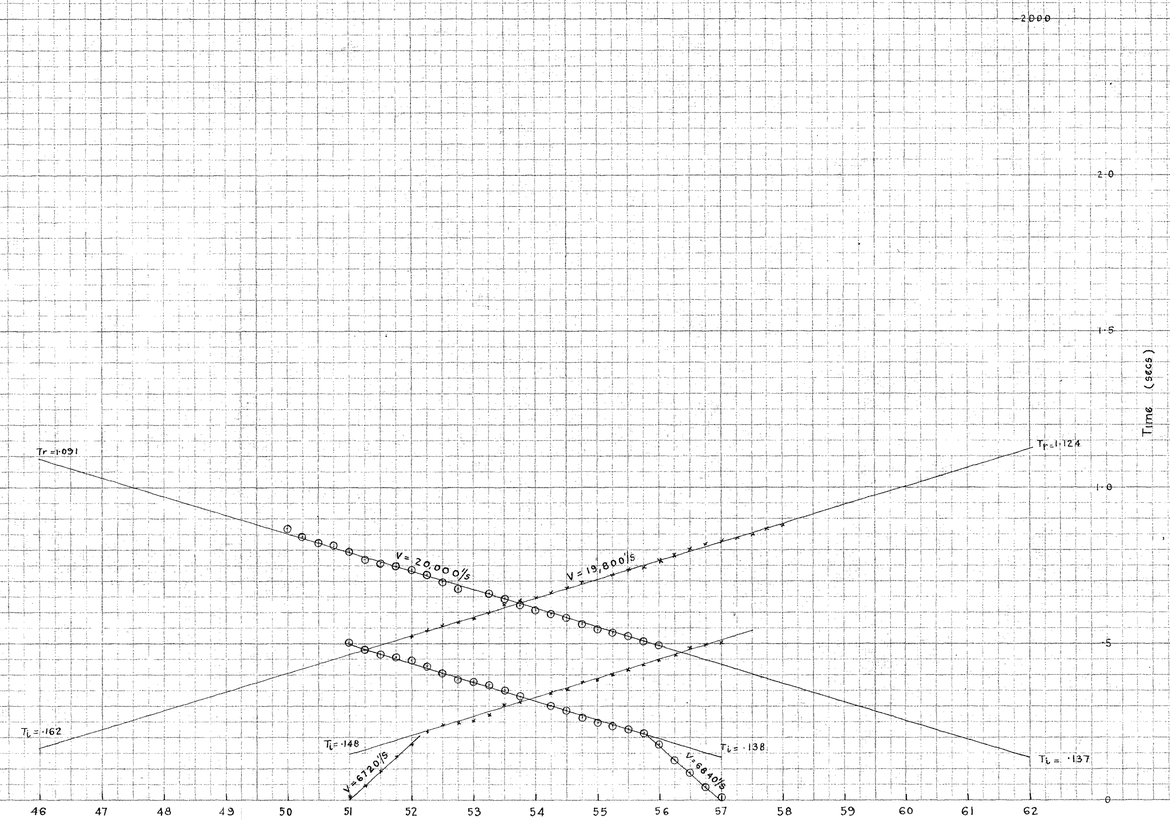
67-166
JK







		51																												57
	To	·511	·490	·476	·465	·456	·439	·416	·393	·385	·377	·360	·340		·311	·296	·274	·259	·248	·233	·221	·189	·141	·100	·053	·017	From 57
	Ec+We	·010	·010	·010	·010	·012	·010	·010	·010	·010	·010	·010	·010	·010	·010	·010	·010	·010	·010	·010	·010	·012	·012	·012	·012	·012	
	Tc	·501	·480	·466	·459	·446	·429	·406	·383	·375	·367	·350	·330		·301	·286	·264	·249	·238	·223	·211	·177	·129	·088	·041	·005	
From 51		·019	·037	·104	·150	·189	·228	·246	·254	·262	·280	·311	·322		·343	·361	·384	·393	·409	·424	·440	·454	·471	·491	·506	·510	To
		·012	·012	·012	·012	·012	·009	·009	·009	·009	·009	·009	·009	·009	·009	·009	·009	·009	·009	·009	·009	·009	·009	·010	·009	Ec+We	
		·007	·045	·092	·138	·177	·219	·237	·245	·253	·271	·302	·313		·340	·353	·375	·384	·400	·415	·431	·445	·462	·482	·496	·501	Tc
	To	·878	·843	·830	·819	·801	·778	·764	·757	·746	·729	·706	·682		·668	·650	·631	·617	·602	·589	·568	·555	·541	·528	·514	·500	From 62
	Ec+We	·009	·008	·009	·008	·008	·008	·008	·008	·008	·008	·008	·008	·008	·008	·008	·008	·008	·008	·008	·008	·008	·008	·008	·008	·008	
	Tc	·869	·841	·821	·811	·793	·770	·756	·749	·738	·721	·698	·674		·660	·642	·623	·609	·594	·581	·560	·547	·533	·520	·506	·492	
From 46		·532	·552	·568	·577	·588	·606	·632	·644	·656	·672	·686	·705		·728	·746	·762	·776	·791	·809	·827	·836	·844	·857	·877	·887	To
		·009	·009	·009	·009	·009	·009	·009	·009	·009	·009	·009	·009	·009	·009	·009	·009	·009	·009	·009	·009	·009	·009	·009	·009	·009	Ec+We
		·523	·543	·559	·568	·579	·597	·623	·635	·647	·663	·677	·696		·719	·737	·753	·767	·782	·800	·818	·827	·835	·848	·866	·878	



Horizontal scale 1cm=100ft Interpretation E.Moorcroft
Vertical scales as shown
Datum mean sea level Date 27th May 1965

DEPARTMENT OF MINES — SOUTH AUSTRALIA

SEISMIC SURVEY

MURRAY BASIN 1965

CULBURRA AREA

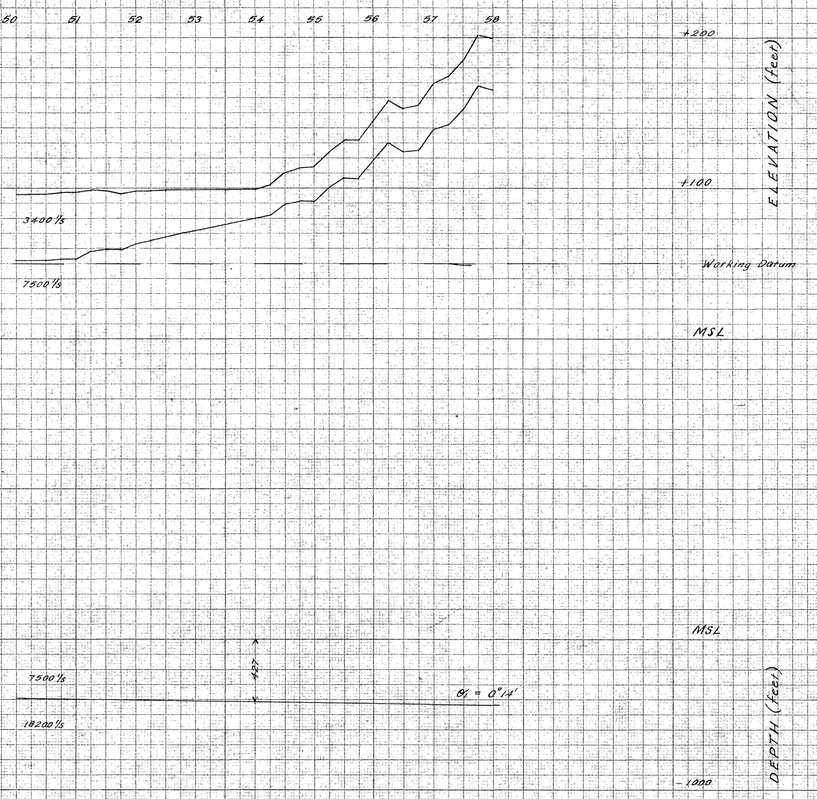
TIME DISTANCE CURVES & INTERPRETATION

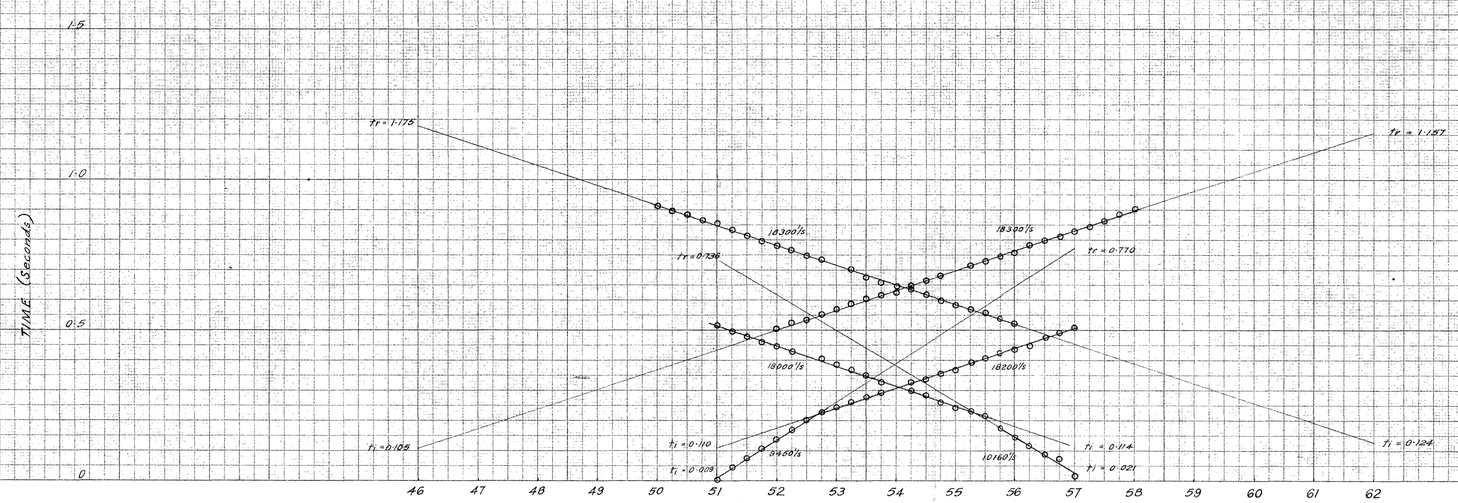
DEPTH PROBE C5

65-848.
JK.

KEUFFEL & ESSER CO.
MADE IN U.S.A.
K&E STANDARD © CROSS SECTION
MILLIMETER

	51											54											57	
T_o	017	056	088	119	146	179	211	238	258	274	291	303	–	338	349	370	384	403	422	439	462	481	499	572	529	
$E_c + W_c$	012	013	013	012	012	011	011	010	014	014	014	013	013	013	014	015	016	017	017	018	020	022	021	022	024	Fr 51
T_c	003	043	075	107	134	168	200	228	244	260	277	290	–	325	335	355	368	392	405	421	432	459	478	490	505	
	51											54											57	
T_o	540	521	500	481	471	451	–	425	408	391	368	345	–	320	304	284	265	256	241	180	149	125	095	079	023	
$E_c + W_c$	024	024	024	023	023	023	023	022	022	022	022	021	021	021	022	023	024	025	025	007	007	007	007	008	008	Fr 57
T_c	516	499	476	458	448	428	–	403	386	369	346	324	–	289	282	261	241	231	216	173	142	118	088	071	015	
	52											55											58	
T_o	514	534	544	563	581	596	613	624	633	687	671	692	–	728	742	758	772	800	817	831	847	865	887	910	929	
$E_c + W_c$	012	012	012	011	011	011	011	010	010	010	011	012	013	014	014	015	017	019	018	019	021	023	025	026	025	Fr 46
T_c	502	522	532	552	570	585	602	614	623	647	660	680	–	714	728	743	755	781	799	812	826	842	862	884	904	
	56											59											60	
T_o	541	558	578	590	599	616	634	651	662	673	693	720	–	751	766	781	797	811	830	850	872	889	902	912	931	
$E_c + W_c$	023	021	020	020	019	018	017	016	016	016	017	017	017	017	018	018	018	018	019	019	019	019	019	019	019	Fr 62
T_c	518	537	558	570	580	598	617	635	646	657	676	703	–	734	748	763	779	793	811	831	853	866	883	893	912	





HORIZONTAL SCALE 1 CM = 600 FT DATE FEB. 1966

INTERPRETATION J. McG. HALL

DEPARTMENT OF MINES SOUTH AUSTRALIA
SEISMIC SURVEY
MURRAY BASIN 1965
CULBURRA AREA
REFRACTION DEPTH PROBE C6

67-167
JK

	57												54												51	
T_o	563	539	523	518	505	495	417	456	435	417	397	385	—	347	331	317	300	283	257	229	189	151	109	056	011	
$E_c + W_c$	619	018	018	018	017	016	016	014	014	014	014	013	014	014	014	013	012	012	012	005	009	008	008	008	008	F_r 51
T_c	544	521	505	500	488	479	461	442	421	403	383	372	—	333	317	304	288	271	245	220	180	143	101	048	003	
	87												54												51	
	017	061	116	161	195	—	251	262	281	293	307	330	—	376	384	404	422	445	462	474	490	505	526	540	551	T_o
F_r 57	017	017	016	015	014	016	016	014	014	014	014	013	014	014	014	013	012	012	012	012	012	011	011	011	011	$E_c + W_c$
	0	044	100	146	181	—	235	248	267	279	293	317	—	362	370	391	410	433	450	462	478	434	515	529	540	T_c
	58												55												52	
T_o	985	969	960	948	928	907	892	886	876	865	851	831	—	793	778	765	748	729	712	696	680	663	643	620	604	
$E_c + W_c$	022	022	023	023	021	020	020	020	019	018	018	016	016	016	016	015	016	016	016	015	014	014	014	014	014	F_r 46
T_c	963	947	937	925	907	887	872	866	857	847	833	815	—	777	762	750	732	713	696	681	666	649	629	606	590	
	56												53												50	
	553	577	595	608	627	636	651	673	697	720	730	746	—	787	809	819	828	840	864	880	895	910	—	948	961	T_o
F_r 62	019	018	018	016	016	016	016	015	016	016	016	015	014	014	014	014	014	013	013	013	013	013	014	013	014	$E_c + W_c$
	534	559	577	592	611	620	635	658	681	704	714	731	—	773	795	805	814	827	851	867	882	897	—	935	947	T_c

Horizontal Scale 1 cm = 600 ft. Intereretation E. Moorcroft

Vertical Scale as shown

Datum Sea Level Date 11-11-65

DEPARTMENT OF MINES SOUTH AUSTRALIA

SEISMIC SURVEY

MURRAY BASIN 1965

CULBURRA AREA

TIME DISTANCE CURVES AND INTERPRETATION

DEPTH PROBE C7

66-142

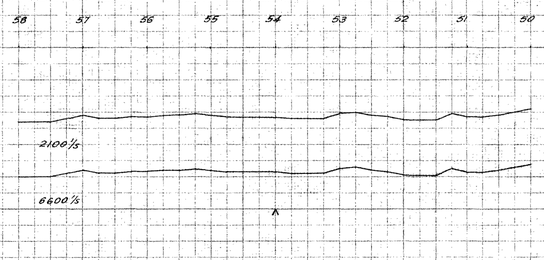
JK

KEUFFEL & ESSER CO.
MADE IN U.S.A.

K+E STANDARD ⊕ CROSS SECTION
MILLIMETER

KEUFFEL & ESSER CO.
MADE IN U.S.A.

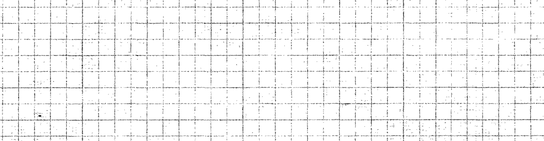
	51											54													57	
T_o	018	067	110	152	190	207	218	237	242	254	274	299	–	329	339	359	370	392	407	424	440	459	476	500	515	
$E_c + W_c$	015	015	015	015	022	022	022	022	022	022	022	028	022	022	022	022	022	022	022	022	022	022	022	022	022	Fr 51
T_c	083	052	096	137	168	188	196	215	220	232	252	277	–	307	317	337	348	370	385	402	418	437	454	478	493	
	51											54													57	
T_o	508	495	475	458	441	420	401	378	354	341	335	319	–	276	258	244	228	212	196	181	172	130	099	059	017	
$E_c + W_c$	017	017	017	017	017	017	017	017	017	017	017	017	017	017	017	017	017	017	017	017	017	015	015	015	015	Fr 57
T_c	491	478	458	441	424	403	384	361	337	324	318	302	–	259	241	227	211	195	179	164	155	115	084	044	002	
	52											55													58	
T_o	497	514	527	540	560	562	580	603	621	635	643	664	–	698	710	726	742	760	782	806	815	826	842	862	872	
$E_c + W_c$	021	021	021	021	021	021	021	021	021	021	021	021	021	021	021	021	021	021	021	021	021	021	021	021	021	Fr 46
T_c	476	493	506	519	529	541	559	582	600	614	622	643	–	677	689	705	721	739	761	785	794	805	821	841	851	
	50											53													56	
T_o	862	846	832	822	821	801	783	765	748	726	703	685	–	648	644	629	609	576	570	564	541	522	509	492	488	
$E_c + W_c$	023	022	022	022	022	022	022	022	022	022	022	028	022	022	022	022	022	022	022	022	022	022	022	022	022	Fr 62
T_c	839	824	810	800	799	779	761	743	726	704	687	603	–	626	622	607	587	554	546	532	513	500	487	470	498	



100'

MSL

ELEVATION (Feet)

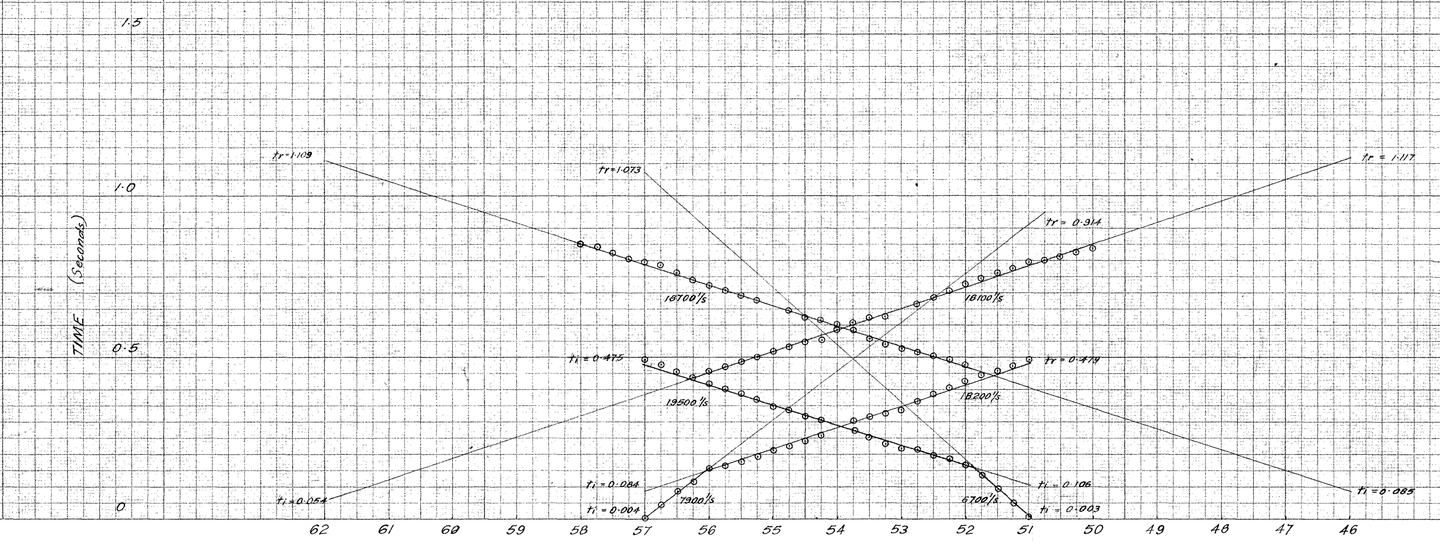


-100'

-200'

-300'

DEPTH (Feet)



HORIZONTAL SCALE 1 CM = 600 FT DATE FEB 1966

INTERPRETATION J. McG. HALL

DEPARTMENT OF MINES SOUTH AUSTRALIA
SEISMIC SURVEY
MURRAY BASIN 1965
CULBURRA AREA
REFRACTION DEPTH PROBE C8

67-168
JK

KE STANDARD ⊗ CROSS SECTION MILLIMETER
KEUFFEL & ESSER CO MADE IN U.S.A.

KEUFFEL & ESSER CO
MADE IN U.S.A.

K&E STANDARD @ CROSS SECTION
MILLIMETER

KEUFFEL & ESSER CO
MADE IN U.S.A.

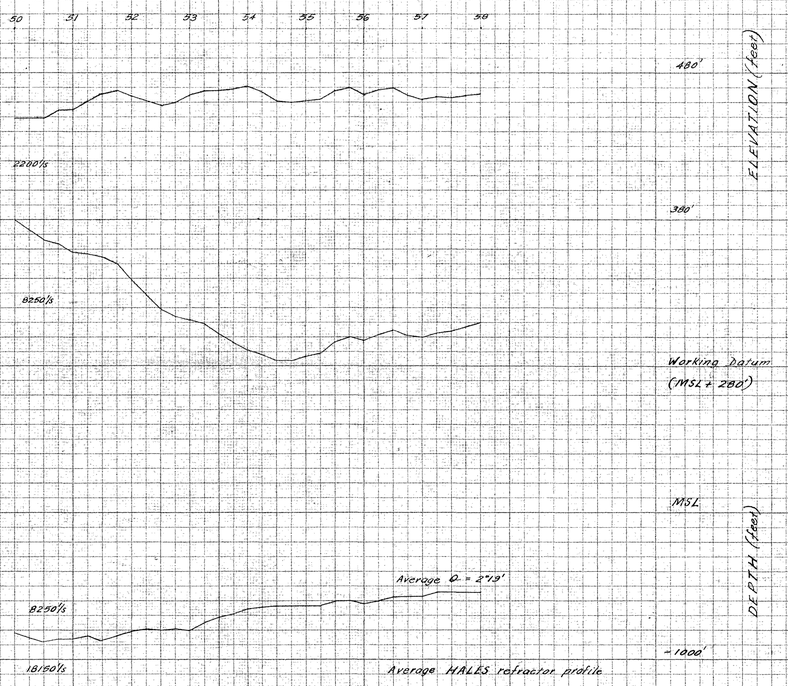
	52												55													58	
T_o	521	535	554	568	587	607	620	635	654	658	674	694	←	725	738	761	763	780	795	810	828	837	854	868	885		
$E_c + W_c$	013	013	013	013	013	013	013	013	013	013	013	013	013	013	013	013	013	013	013	013	013	013	013	013	013		Fr. 46
T_c	508	522	541	555	574	594	607	622	641	646	661	681	–	712	725	238	760	767	782	797	815	824	841	855	872		
	51												54													57	
T_o	011	043	072	106	124	212	232	248	265	285	298	314	←	341	354	374	397	406	419	433	444	462	477	492	508		
$E_c + W_c$	009	009	009	009	009	009	009	007	014	014	014	014	014	014	014	014	014	014	014	014	014	014	014	014	014		Fr. 51
T_c	002	034	063	097	118	203	223	239	251	271	284	300	–	327	340	360	383	392	405	419	430	448	403	478	494		
	51												54													57	
T_o	508	495	477	463	447	430	420	406	389	380	361	344	←	308	294	281	268	245	227	164	147	098	070	039	011		
$E_c + W_c$	013	013	013	013	013	013	013	013	013	013	013	013	013	013	013	013	013	009	009	009	009	009	009	009	009		Fr. 57
T_c	495	480	464	450	434	417	407	393	376	367	348	331	–	295	281	268	255	236	218	195	138	089	061	030	002		
	50												53													56	
T_o	879	864	847	837	820	808	788	775	761	744	732	718	←	695	676	657	643	621	607	595	582	560	541	527	510		
$E_c + W_c$	014	014	014	014	014	014	014	014	014	014	014	014	014	014	014	014	014	014	014	014	014	014	014	014	014		Fr. 62
T_c	865	850	833	823	806	794	774	761	747	730	718	704	–	681	662	643	629	607	593	581	568	546	527	513	496		

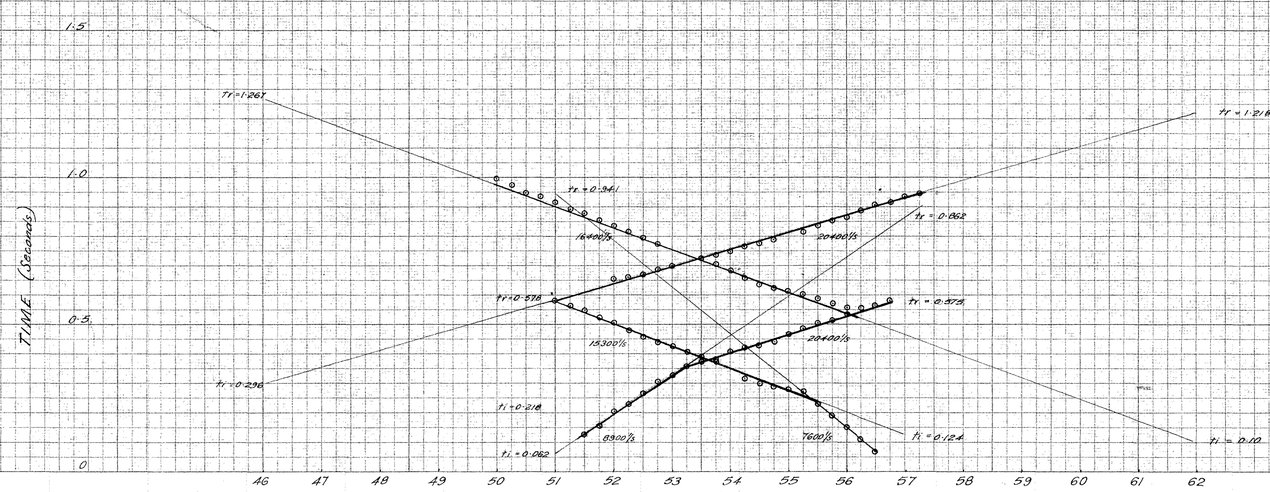
HORIZONTAL SCALE 1 CM = 600 FT DATE FEB 1966
INTERPRETATION J. Mc G. HALL

DEPARTMENT OF MINES SOUTH AUSTRALIA
SEISMIC SURVEY
MURRAY BASIN 1965
CULBURRA AREA
REFRACTION DEPTH PROBE C9

67-169
JK

	50											53														56	
T_D	1090	1076	1051	1041	1026	1010	997	980	959	939	919	902	–	–	863	844	828	799	776	762	752	741	726	711	694	
$E_c + W_c$	131	124	106	108	112	116	119	122	124	126	128	131	134	136	139	141	144	143	142	141	140	140	140	140	139	Fr 62
T_C	991	972	945	933	914	894	878	858	835	813	791	771	–	–	724	703	684	656	634	621	612	601	586	570	555	
	51											54														57	
T_D	713	700	689	668	650	626	606	591	583	564	550	533	–	493	463	450	440	407	365	334	284	243	200	130	024	
$E_c + W_c$	133	137	140	143	145	147	149	152	154	157	160	162	165	164	163	162	161	136	136	135	134	133	132	–	–	Fr 57
T_C	580	563	549	525	505	479	457	439	429	407	390	371	–	319	300	288	279	271	230	189	150	110	068	–	–	
	51											54														57	
T_D	018	140	209	248	297	323	367	411	482	494	514	524	–	556	567	573	594	628	628	645	654	677	696	705	721	
$E_c + W_c$	–	–	087	091	094	097	101	104	138	140	143	145	148	147	146	145	144	144	144	144	143	143	143	142	141	Fr 51
T_C	–	–	122	157	203	226	266	307	324	354	371	379	–	409	421	428	440	464	484	501	511	534	553	563	580	
	52											55														58	
T_D	143	761	764	781	799	–	829	841	867	872	882	895	–	922	940	958	970	992	1007	1018	1035	1048	–	1083	–	
$E_c + W_c$	091	093	095	098	101	103	106	108	111	110	109	108	107	107	107	107	107	106	106	106	105	104	103	102	103	102	Fr 46
T_C	682	668	663	683	698	–	723	733	748	762	773	787	–	815	833	851	864	886	901	913	931	945	–	980	–	





HORIZONTAL SCALE 1 CM = 600 FT DATE FEB 1967

INTERPRETATION R.J. COPPIN

DEPARTMENT OF MINES SOUTH AUSTRALIA
SEISMIC SURVEY
MURRAY BASIN 1965
CULBURRA AREA
REFRACTION DEPTH PROBE C 10

67-170
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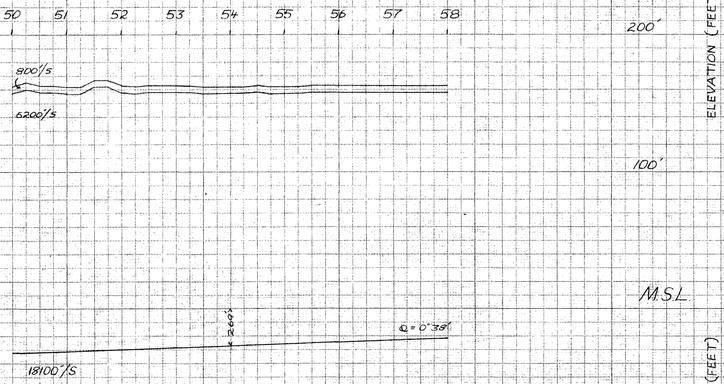
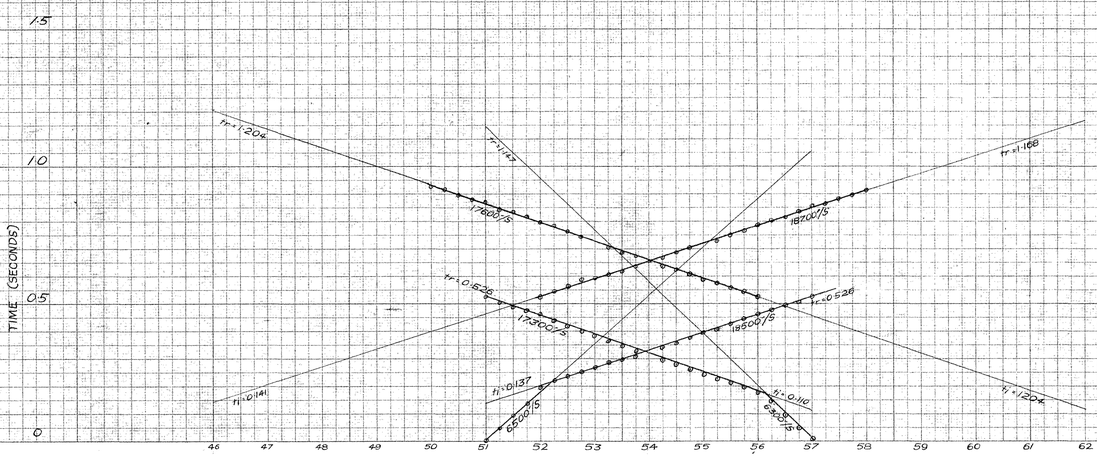
K&E STANDARD ® CROSS SECTION
MILLIMETER

	50												53												56	
To	934	923	901	887	877	851	840	825	805	788	768	748	+	713	693	681	664	645	631	616	594	579	565	549	533	
Ec+Wc	007	007	007	007	007	007	008	008	007	007	007	007	007	007	007	007	007	007	007	007	007	007	007	007	007	Fr 62
Tc	927	916	894	880	870	844	832	817	798	781	761	742	+	706	686	674	657	638	624	609	587	572	558	542	526	
	51												54												57	
To	532	509	496	482	467	445	425	406	388	370	350	335	+	301	286	268	246	233	218	203	184	155	105	055	013	
Ec+Wc	006	006	007	007	006	006	006	006	006	006	006	006	006	006	006	006	006	006	006	006	006	006	006	006	006	Fr 57
Tc	526	503	489	475	461	439	419	400	382	364	344	329	+	295	280	262	240	227	212	197	178	149	099	049	007	
	51												54												57	
To	007	052	100	144	206	224	243	259	271	285	300	315	+	347	364	385	401	412	432	450	468	486	499	512	531	
Ec+Wc	006	006	006	006	007	007	007	007	007	007	007	007	007	007	007	007	007	007	007	007	007	007	007	007	007	Fr 51
To	001	046	094	138	199	217	236	252	264	278	293	308	+	340	357	378	394	405	425	443	461	479	492	505	524	
	52												55												58	
To	532	551	569	584	597	613	623	640	660	674	691	710	+	735	756	723	740	809	820	839	858	869	888	898	917	
Ec+Wc	006	006	006	006	006	006	006	006	006	006	006	006	006	006	006	006	006	006	006	006	006	006	006	006	006	Fr 46
To	526	545	563	578	591	607	617	634	654	668	685	704	+	729	750	767	784	803	814	833	852	863	882	892	911	



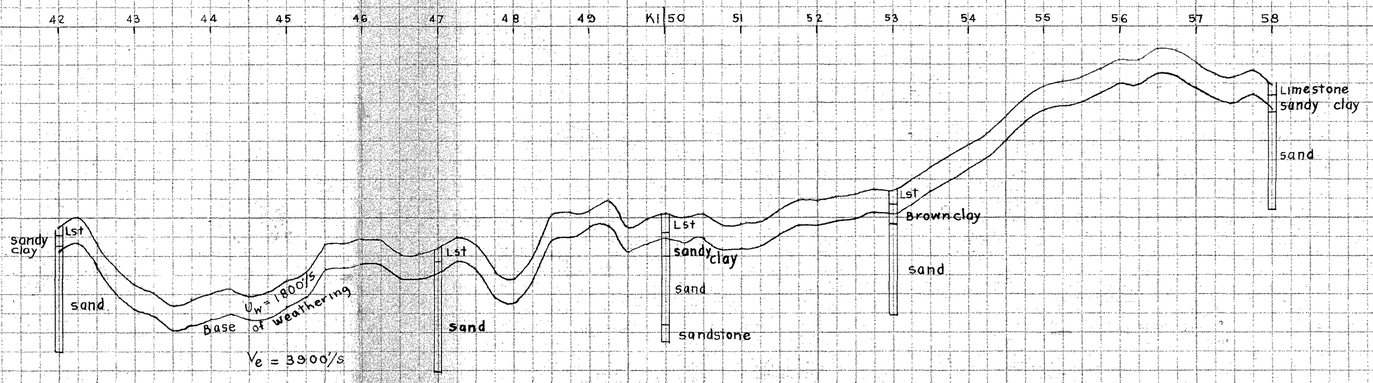


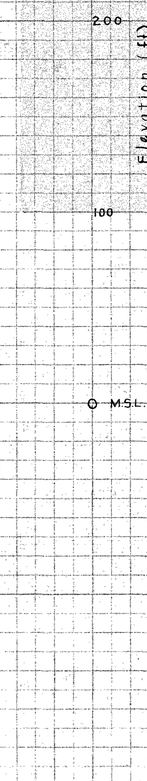
HORIZONTAL SCALE 1CM = 600 FT DATE FEB 1966

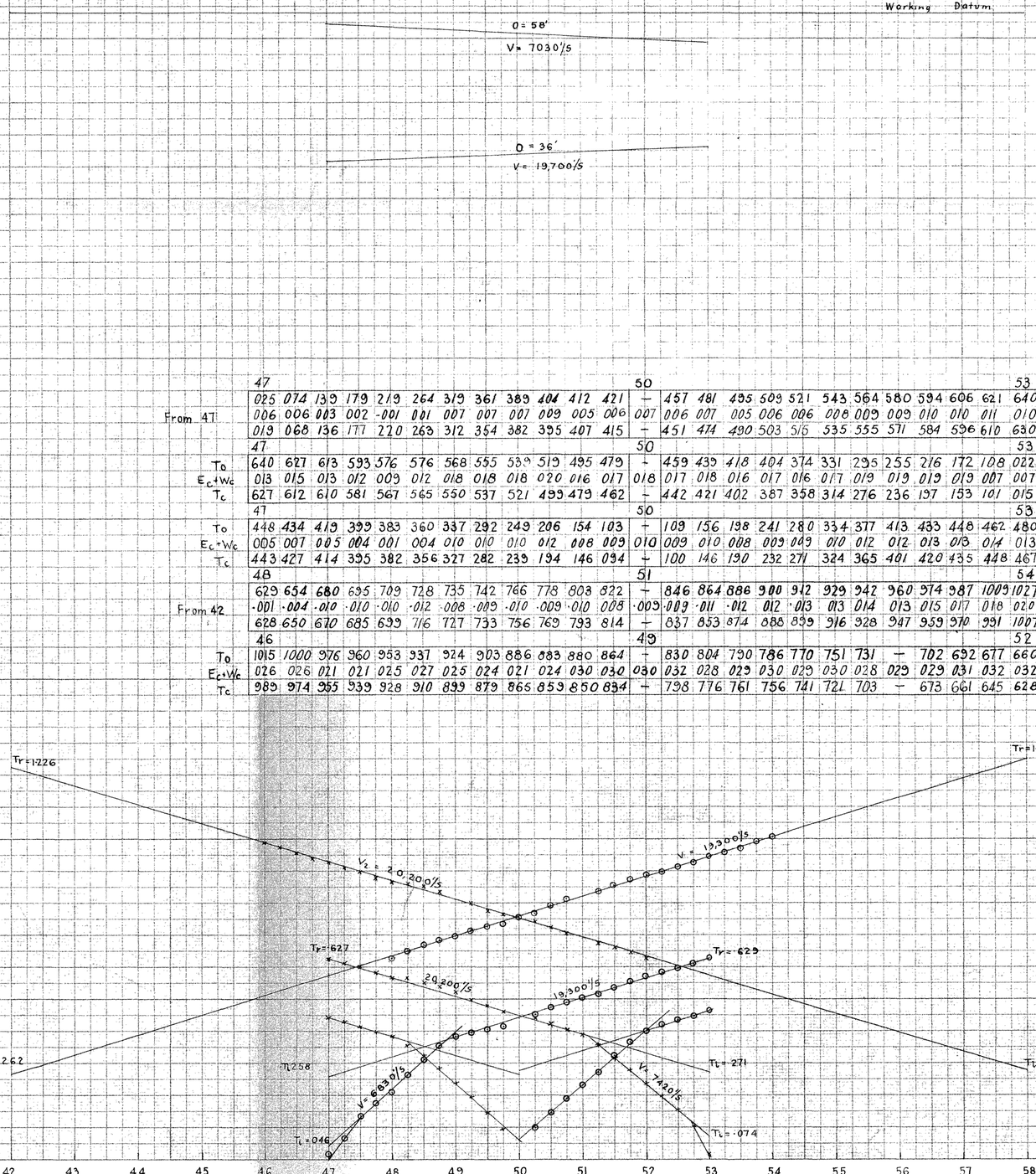
INTERPRETATION R.J. COPPIN

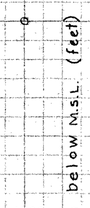
DEPARTMENT OF MINES SOUTH AUSTRALIA
SEISMIC SURVEY
MURRAY BASIN 1965
CULBURRA AREA
REFRACTION DEPTH PROBE C11

67-171
JK









	47												50												53	
	025	074	139	179	219	264	319	361	389	404	412	421	–	457	481	495	509	521	543	564	580	594	606	621	640	To
From 47	006	006	003	002	-001	001	007	007	007	009	005	006	007	006	007	005	006	006	008	009	009	010	010	011	010	Ec+Wc
	019	068	136	177	220	263	312	354	382	395	407	415	–	451	474	490	503	515	535	555	571	584	596	610	630	Tc
	47												50												53	
To	640	627	613	593	576	576	568	555	539	519	495	479	–	459	439	418	404	374	331	295	255	216	172	108	022	
Ec+Wc	013	015	013	012	009	012	018	018	018	020	016	017	018	017	018	016	017	016	017	019	019	019	019	007	007	From 53
Tc	627	612	610	581	567	565	550	537	521	499	479	462	–	442	421	402	387	358	314	276	236	197	153	101	015	
	47												50												53	
To	448	434	419	399	383	360	337	292	249	206	154	103	–	109	156	198	241	280	334	377	413	433	448	462	480	
Ec+Wc	005	007	005	004	001	004	010	010	010	012	008	009	010	009	010	008	009	009	010	012	012	013	013	014	013	From 50
Tc	443	427	414	395	382	356	327	282	239	194	146	094	–	100	146	190	232	271	324	365	401	420	435	448	467	
	48												51												54	
	629	654	680	695	709	728	735	742	766	778	808	822	–	846	864	886	900	912	929	942	960	974	987	1009	1027	To
From 42	-001	-004	-010	-010	-010	-012	-008	-009	-010	-009	-010	-008	-009	-009	-011	-012	-012	-013	-013	-014	-013	-015	-017	-018	-020	Ec + Wc
	628	650	670	685	699	716	727	733	756	769	793	814	–	837	853	874	888	899	916	928	947	959	970	991	1007	Tc
	46												49												52	
To	1015	1000	976	960	953	937	924	903	886	883	880	864	–	830	804	790	786	770	751	731	–	702	692	677	660	
Ec+Wc	026	026	021	021	025	027	025	024	021	024	030	030	030	032	028	029	030	029	030	028	029	029	031	032	032	From 58
Tc	989	974	955	939	928	910	899	879	865	859	850	834	–	798	776	761	756	741	721	703	–	673	661	645	628	

Horizontal scale 1cm = 600ft. Interpretation E. Moorcroft.
Vertical scales as shown
Datum mean sea level Date 5th May 1965

DEPARTMENT OF MINES – SOUTH AUSTRALIA

SEISMIC SURVEY

MURRAY BASIN 1965

KAROONDA AREA

TIME DISTANCE CURVES & INTERPRETATION

DEPTH PROBE KI

65-849
Jcd

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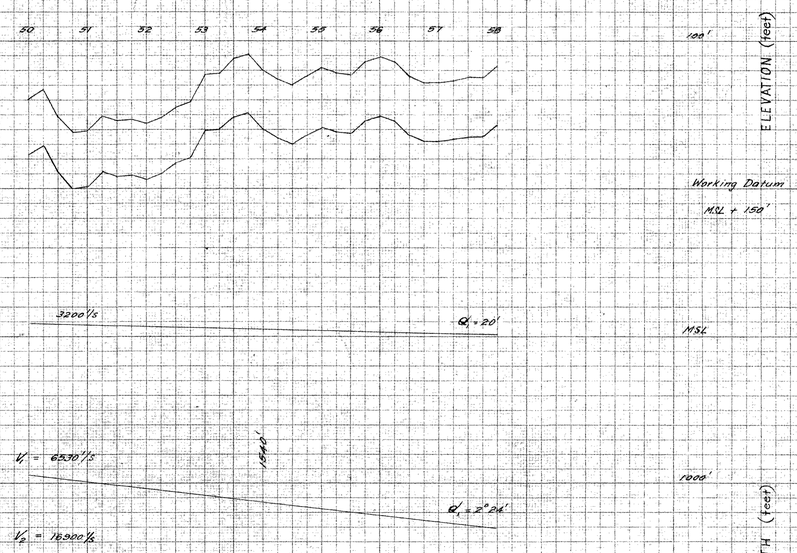
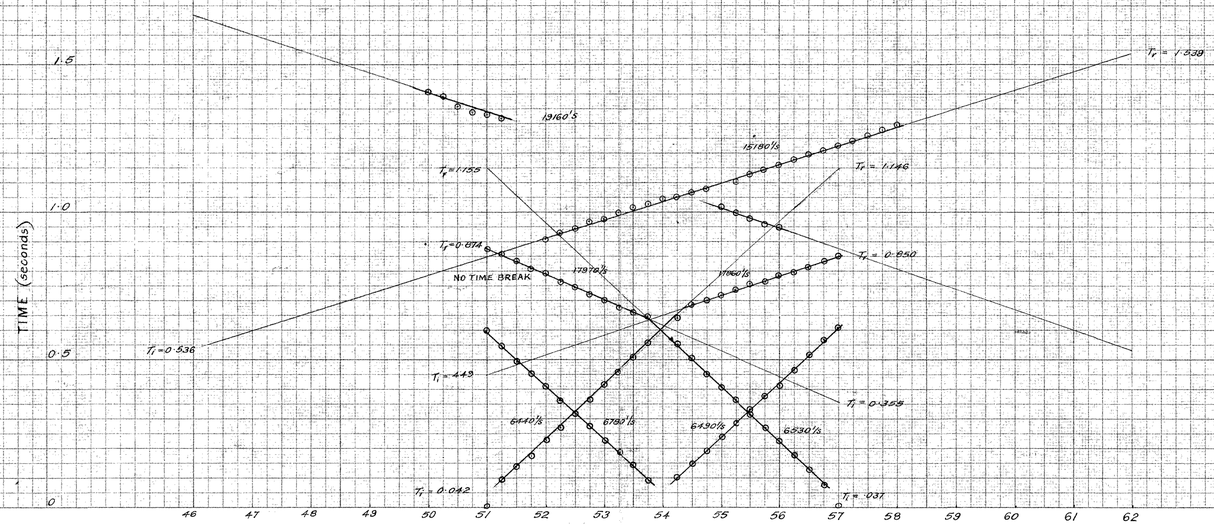
	51											54											57	
T_D	019	118	160	184	252	292	341	391	444	488	540	592	–	671	711	734	751	769	785	805	823	834	843	867	885	
E_C+W_C	017	023	022	023	022	023	025	026	032	032	035	036		031	030	034	036	035	034	037	038	037	034	032	032	Fr 51
T_C	002	095	138	161	230	269	316	365	412	456	503	556		640	681	700	715	734	751	768	785	797	811	835	853	
	51											54											57	
T_D	026	092	164	220	285	310	335	401	445	493	540	590		687	705	717	742	755	780	793	820	835	864	890	902	
E_C+W_C	017	017	037	041	041	041	038	038	039	041	036	037		046	045	042	041	035	034	031	030	031	031	032	028	Fr 57
T_C	009	075	127	179	227	269	317	363	406	452	504	553		641	660	675	701	720	746	762	790	804	833	858	874	
	51											54											57	
T_D	638	598	549	497	452	405	362	319	280	229	193	146		133	182	228	269	316	356	404	451	495	532	583	632	
E_C+W_C	029	032	031	032	031	032	034	035	041	041	044	045		040	039	040	042	041	041	044	044	044	040	037	037	Fr 54
T_C	609	566	518	465	421	373	328	284	239	188	149	101		093	143	188	227	275	315	360	407	451	492	546	595	
	52											55											58	
T_D	319	340	360	383	1005	1020	1040	1057	1066	1072	1084	1103	–	1134	1151	1166	1185	1201	1217	1228	1248	1262	1283	1299	1319	
E_C+W_C	012	013	016	017	023	024	027	028	024	022	021	026		024	023	025	027	026	023	021	021	022	022	022	025	Fr 46
T_C	907	927	944	966	972	996	1013	1029	1042	1060	1063	1077		1110	1128	1140	1158	1175	1194	1207	1227	1240	1261	1297	1294	



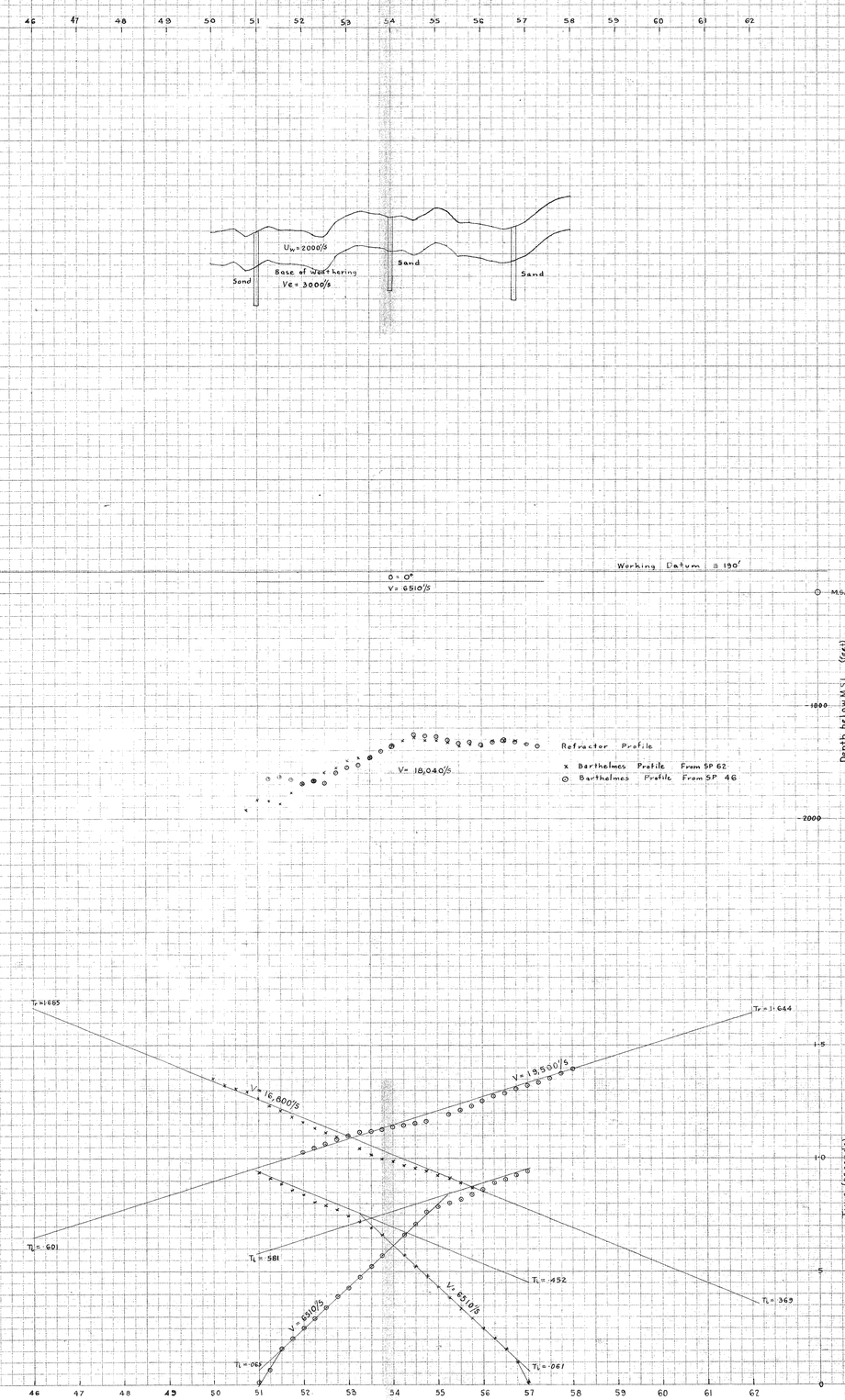


HORIZONTAL SCALE 1CM 600 FT DATE FEB 1966
INTERPRETATION R.J. COPPIN

DEPARTMENT OF MINES SOUTH AUSTRALIA
SEISMIC SURVEY
MURRAY BASIN 1965
KAROONDA AREA
REFRACTION DEPTH PROBE K2

67-165
JK

	51											54												57	
	124	080	166	201	255	295	341	395	436	484	531	578	–	671	716	772	797	811	826	846	869	896	910	928	940	To
From 51	011	011	003	003	003	002	001	005	007	009	008	008	007	007	006	008	010	009	006	006	005	004	004	004	006	E_c+W_c
	013	069	163	204	252	293	340	390	429	475	523	570	–	664	710	764	787	802	820	840	864	892	906	924	940	Tc
	51												54											57	
To	942	916	893	864	843	813	733	780	754	730	704	670	–	580	531	489	442	393	344	299	256	211	165	106	024	
E_c+W_c	004	006	005	005	005	004	003	008	010	011	011	010	009	009	008	011	012	011	008	008	007	006	006	006	013	From 57
Tc	938	910	888	859	838	809	730	772	744	719	693	660	–	571	523	478	430	382	336	291	249	205	159	100	011	
	52												55											58	
	1023	1037	1056	1084	1098	1118	1121	1128	1140	1148	1153	1166	–	1198	1214	1231	1252	1273	1287	1307	1323	1340	1362	1383	1404	To
From 46	-003	-004	-005	0	002	003	003	002	001	002	0	002	004	003	0	0	-001	-002	-002	-002	0	003	006	007	007	E_c+W_c
	1026	1041	1061	1084	1096	1115	1116	1126	1139	1146	1153	1164	–	1195	1214	1231	1253	1275	1289	1309	1323	1337	1356	1376	1397	Tc
	50												53											56	
To	1379	1349	1335	1319	1289	1260	1239	1210	1186	1159	1138	1125	–	1079	1054	1033	1019	1003	988	978	962	946	919	902	885	
E_c+W_c	029	029	030	027	028	030	029	029	029	028	027	032	034	035	035	034	033	034	032	034	036	035	032	032	031	From 62
Tc	1350	1320	1305	1292	1261	1230	1210	1181	1159	1131	1111	1093	–	1044	1019	999	986	969	956	944	926	911	887	870	854	



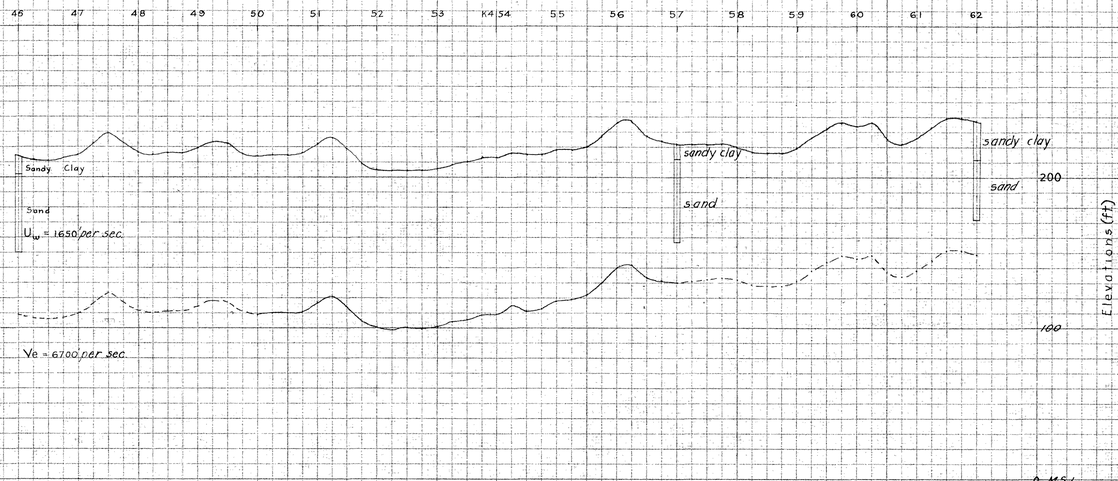
Horizontal scale 1cm=600' Interpretation E.Moorcroft
Vertical scales as shown
Datum mean sea level Date 19th May 1965

DEPARTMENT OF MINES — SOUTH AUSTRALIA

SEISMIC SURVEY
MURRAY BASIN 1965
KAROONDA AREA
TIME DISTANCE CURVES & INTERPRETATION
DEPTH PROBE K3

65-850
Jcd.

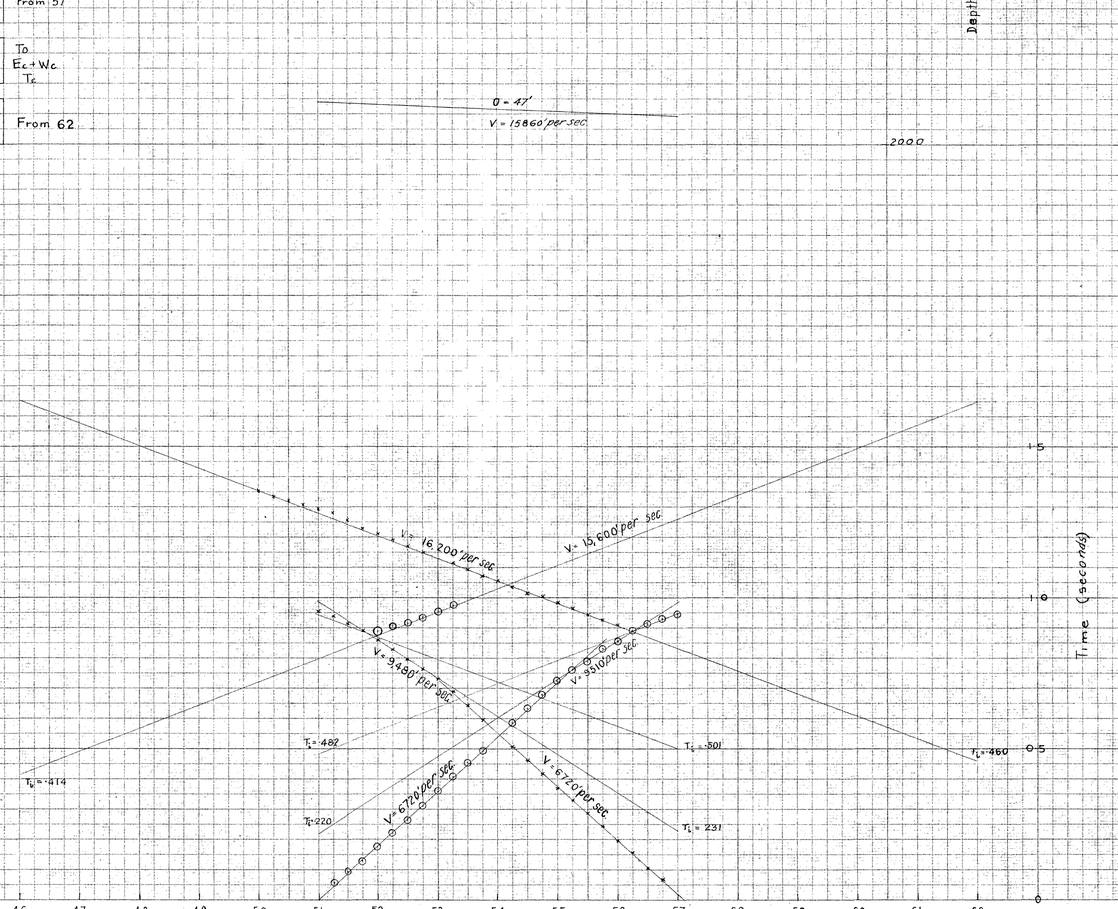
KEUFFEL & ESSER CO. MADE IN U.S.A.



Elevation Working Datum = 103ft.

0 M.S.L.

	51												54																57
	030	140	176	213	260	305	349	395	444	493	536	579	—	670	716	763	809	845	879	923	948	985	1005	1022	1040	To
From 51		085	085	085	085	085	085	085	085	085	085	085	085	085	085	085	085	085	091	092	094	094	094	093	093	Ec + Wc
		051	091	128	175	220	264	310	359	408	451	494	—	585	631	678	724	760	788	831	854	891	911	929	947	Tc
	51												54																57
To	1039	1025	998	973	941	910	877	847	809	766	719	673	—	584	538	495	447	407	362	320	275	234	185	134	017	
Ec+Wc	085	086	083	082	082	081	082	082	078	078	078	078	078	078	078	078	078	078	078	078	078	078	078	078		From 57
Tc	954	933	915	891	859	829	795	765	731	688	641	595	—	506	460	417	369	329	284	242	195	156	105	066		
	52												55																58
	878	934	1006	1023	1042	1065																				To
From 46	089	088	083	089	089	085																				Ec+Wc
	889	906	917	934	953	876																				Tc
	50												53																56
To	1458	1420	1406	1393	1380	1368	1342	1314	1256	1277	1254	1234	—	1139	1178	1156	1141	1123	1103	1088	1068	1052	1032	1013	998	
Ec+Wc	086	086	086	086	087	088	087	085	085	084	085	085	085	085	085	086	086	087	087	087	087	087	088	089	091	From 62
Tc	1352	1334	1320	1307	1293	1280	1255	1229	1211	1193	1169	1149	—	1114	1093	1070	1055	1036	1014	1001	981	965	944	926	907	



Horizontal scale 1cm = 600ft Interpretation E.Moorcroft
Vertical scales as shown
Datum mean sea level Date 5th May 1965

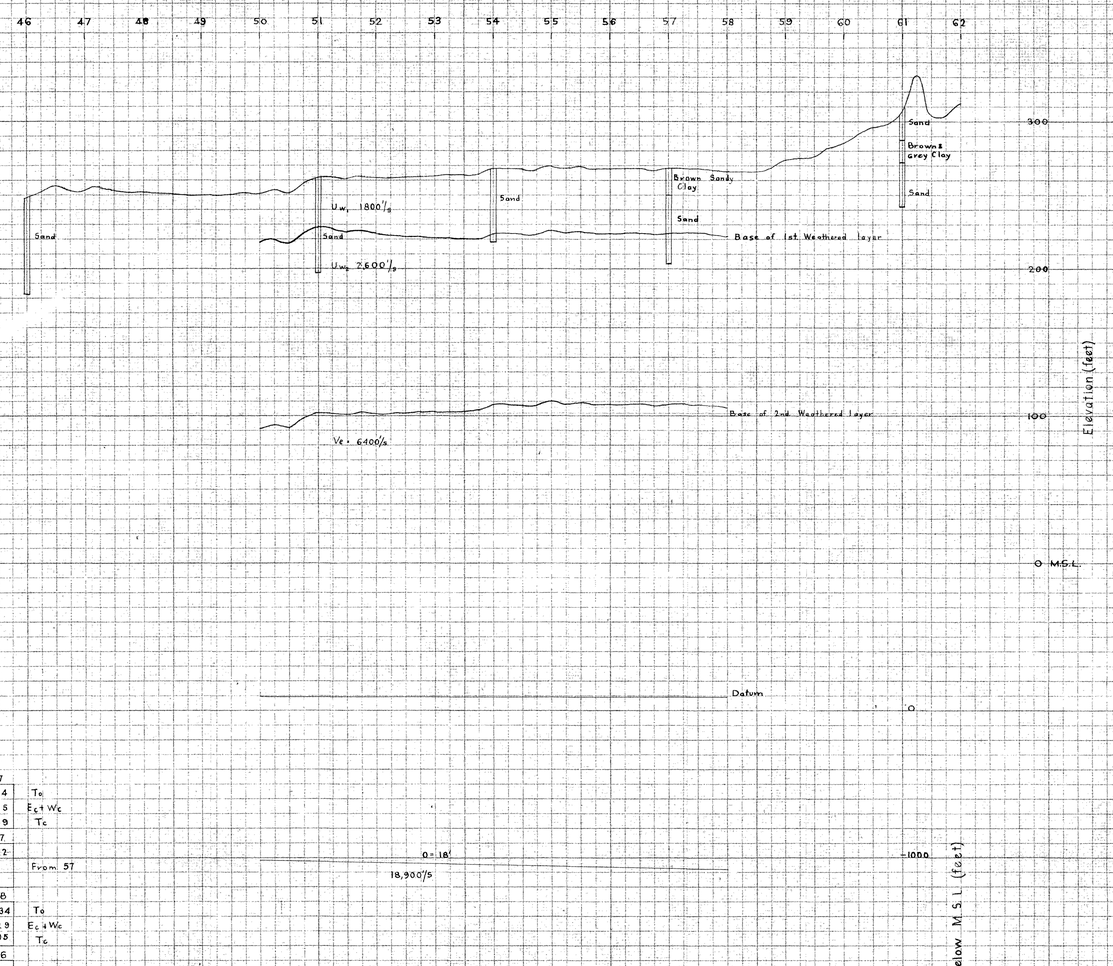
DEPARTMENT OF MINES – SOUTH AUSTRALIA

SEISMIC SURVEY
MURRAY BASIN 1965
KAROONDA AREA

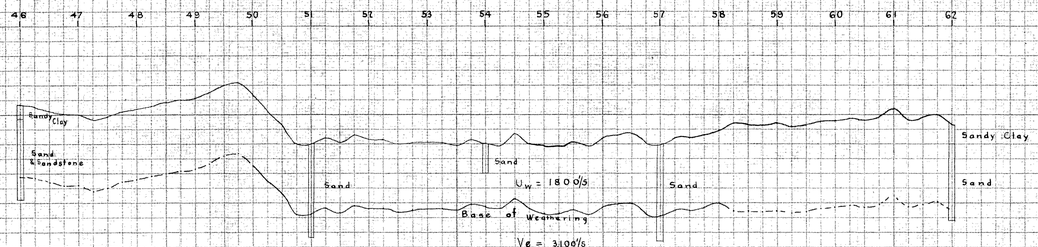
TIME DISTANCE CURVES & INTERPRETATION
DEPTH PROBE K4

65-851
Jcd.

KEUFFEL & ESSER CO. MADE IN U.S.A.
K+E STANDARD @ CROSS SECTION MILLIMETER
KEUFFEL & ESSER CO. MADE IN U.S.A.
K+E STANDARD @ CROSS SECTION MILLIMETER


46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62
Sand
Brown grey Clay
Sand
Brown Sandy Clay
Sand
Sand
Sand
Uw1 1800'/s
Uw2 2600'/s
Base of 1st Weathered layer
Base of 2nd Weathered layer
Ve = 6400'/s
Datum
300
200
100
0 M.S.L.
-1000
-2000
Elevation (feet)
Depth below M.S.L. (feet)

| | | |



	51											54																57	
	·020	·119	·205	·252	·294	·342	·387	·432	·475	·514	·556	·563	—	·606	·624	·647	·670	·691	·700	·715	·729	·749	·755	·763	—	To
From 51	·022	·002	·026	·027	·025	·025	·024	·025	·021	·024	·023	·025	·024	·024	·027	·024	·024	·024	·025	·024	·026	·027	·028	·026	·026	E_c+ W_c
	·002	·097	·179	·225	·269	·317	·363	·407	·451	·490	·533	·544	—	·582	·597	·623	·646	·667	·675	·691	·703	·722	·727	·737	—	T_c
	51											54																57	
To	·782	·770	·752	·732	·711	·697	·675	·654	·642	·621	·607	·594	—	·576	·555	·516	·477	·432	·385	·335	·286	·239	·191	·135	·037	
E_c+W_c	·023	·024	·024	·025	·023	·023	·021	·022	·022	·022	·021	·022	·021	·021	·024	·020	·020	·020	·022	·021	·022	·023	·024	·022	·022	From 57
T_c	·759	·746	·728	·707	·688	·674	·654	·632	·620	·599	·586	·572	—	·555	·531	·496	·457	·412	·363	·314	·264	·216	·167	·113	·015	
	52											55																58	
To	·795	·812	·825	·838	·850	·868	·880	·892	·916	·928	·947	·967	—	·1010	·1022	·1032	·1045	·1065	·1076	·1091	·1114	·1125	·1134	·1139	·1154	
E_c+W_c	·032	·032	·030	·031	·031	·031	·030	·031	·030	·030	·033	·030	·030	·030	·031	·030	·032	·033	·034	·032	·031	·033	·033	·033	·035	From 46
T_c	·763	·780	·795	·807	·819	·837	·850	·861	·886	·898	·914	·937	—	·980	·991	·1002	·1013	·1032	·1042	·1059	·1083	·1092	·1101	·1106	·1119	
	50											53																56	
To	·1179	·1171	·1146	·1138	·1113	·1093	·1083	·1059	·1041	·1025	·1013	·985	—	·950	·935	·913	·911	·906	·884	·867	·855	·837	·820	·800	·782	
E_c+W_c	·038	·035	·032	·027	·027	·028	·028	·029	·027	·027	·025	·026	·026	·026	·025	·026	·025	·025	·028	·025	·025	·025	·026	·025	·027	From 62
T_c	·1141	·1136	·1114	·1111	·1086	·1065	·1055	·1030	·1014	·998	·978	·959	—	·924	·910	·887	·886	·881	·856	·842	·830	·812	·794	·775	·755	

Horizontal scale 1cm=600ft Interpretation E.Moorcroft.
Vertical scales as shown
Datum mean sea level Date 12th May 1965

DEPARTMENT OF MINES — SOUTH AUSTRALIA

SEISMIC SURVEY

MURRAY BASIN 1965

KAROONDA AREA

TIME DISTANCE CURVES & INTERPRETATION

DEPTH PROBE K 6

65-857
Jcd

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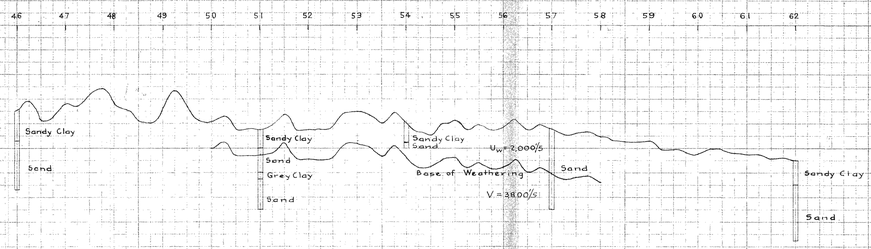
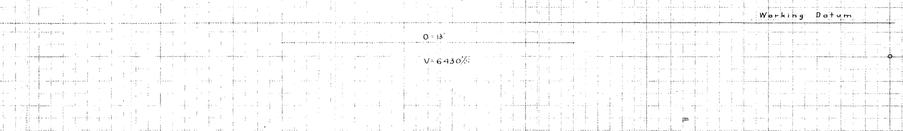
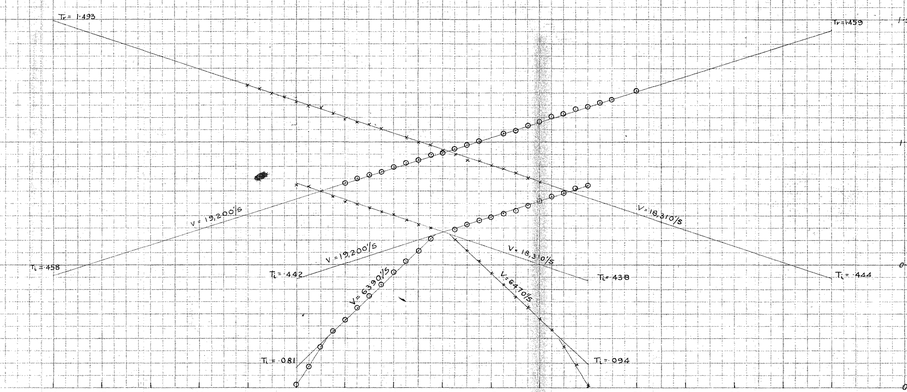


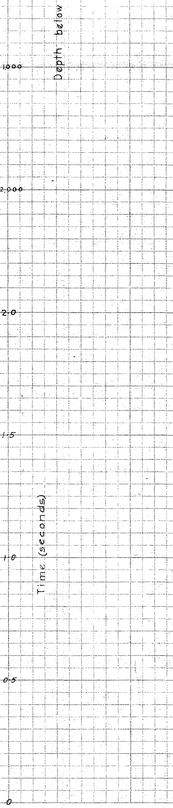


	51												54											57	
To	023	094	175	241	286	334	386	436	486	532	571	618	–	656	675	695	708	733	734	761	775	796	810	826	839
From 51 Ec+Wc	009	009	010	011	011	011	013	016	016	015	014	016	013	012	011	014	016	013	014	017	014	016	014	015	015
Tc	014	085	163	230	275	323	373	420	470	517	557	602	–	614	664	681	692	710	720	744	761	780	796	811	824
	51												54											57	
To	838	826	814	798	769	756	744	731	718	697	677	664	–	613	570	530	482	433	383	344	292	251	183	165	025
Ec+Wc	010	011	014	010	010	010	012	015	013	014	013	013	012	012	012	014	015	014	015	016	015	016	014	015	015
Tc	828	217	800	778	759	746	732	716	703	683	664	649	–	601	558	516	467	419	368	328	277	235	169	094	008
	52												55											58	
To	851	866	884	900	913	935	946	969	973	985	1005	1026	–	1053	1067	1081	1104	1125	1137	1155	1168	1180	1192	–	1228
From 46 Ec+Wc	017	017	017	021	022	021	019	021	019	017	018	018	021	016	015	022	019	021	019	020	020	018	015	015	018
Tc	834	851	867	879	891	914	929	948	954	972	988	1007	–	1035	1048	1069	1085	1104	1118	1135	1148	1162	1173	–	1210
	50												53											56	
To	1238	1225	1202	1187	1168	1154	1147	1120	1101	1085	1075	1063	–	1023	1008	994	974	957	931	929	914	898	880	864	845
Ec+Wc	006	007	004	005	005	006	006	004	005	005	005	003	010	005	009	007	009	007	005	007	009	006	007	010	007
Tc	1232	1218	1198	1182	1163	1148	1139	1116	1096	1080	1070	1054	–	1020	999	987	965	950	926	922	905	892	873	854	838

From 67

From 62





Horizontal scale 1cm=200ft Interpretation E.Moorcroft
Vertical scales as shown
Datum mean sea level Date 12th May 1965

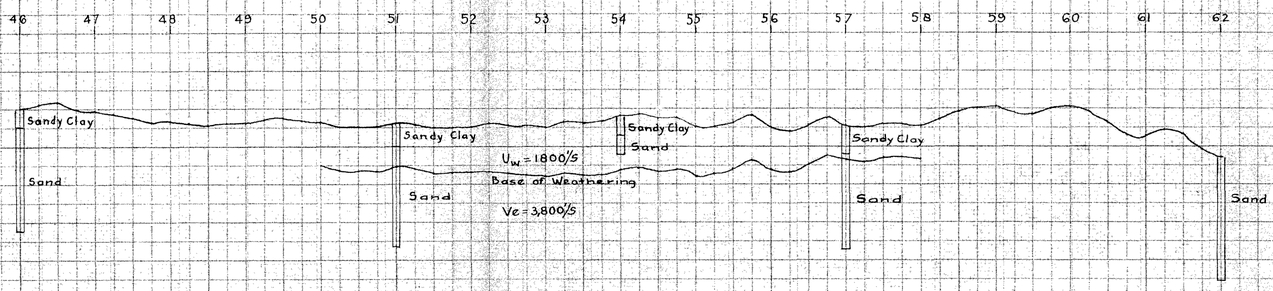
DEPARTMENT OF MINES — SOUTH AUSTRALIA

SEISMIC SURVEY
MURRAY BASIN 1965
KAROONDA AREA

TIME DISTANCE CURVES & INTERPRETATION
DEPTH PROBE K7

65-853
Jcd

K&E STANDARD @ CROSS SECTION MILLIMETER
KEUFFEL & ESSER CO MADE IN U.S.A.



Working Datum.

0 = 0

V = 6,600'/s

0 = 29'

V = 18,800'/s

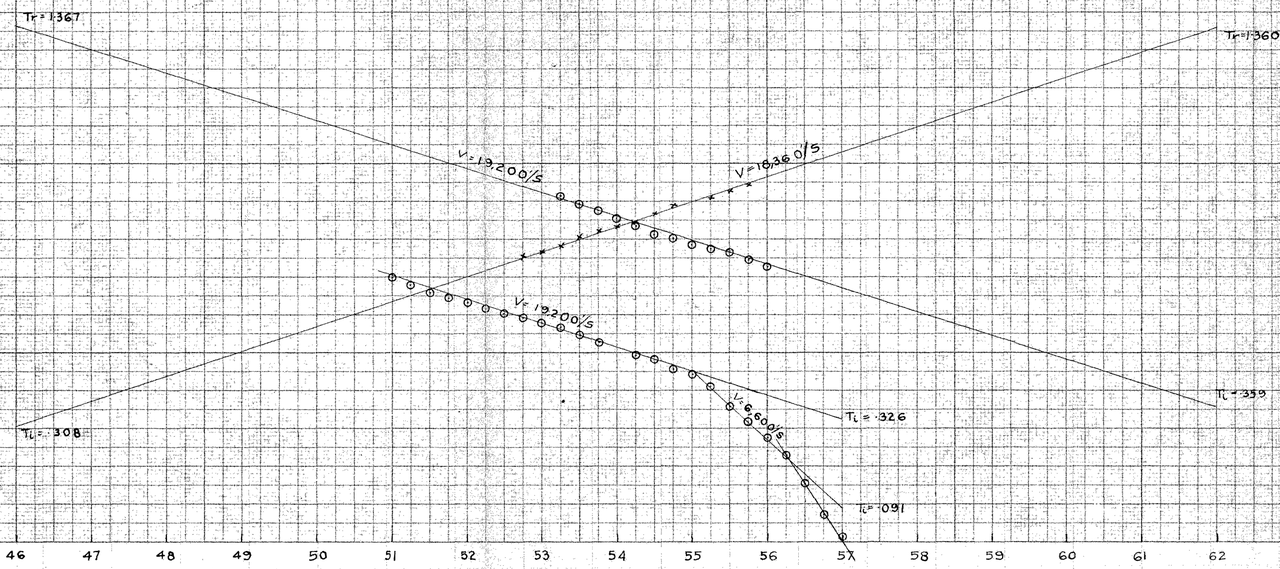
	51											54											57
To	705	685	665	650	637	620	610	597	584	574	553	534	–	498	488	464	446	417	366	323	282	234	166	080	022
E_c+W_c	006	005	005	005	005	006	006	005	005	007	006	006	007	008	007	007	005	006	007	007	006	005	010	009	009
T_c	699	680	660	645	632	614	604	592	579	567	547	528	–	490	481	457	441	411	359	316	276	229	156	071	013

From 57

To													–	916	893	877	859	838	814	803	785	774	765	746	726
E_c+W_c														002	011	011	002	003	002	002	0	0	0	002	-001
T_c														914	882	866	857	835	812	801	785	774	765	746	727

From 62

From 46	–	–	–	764	777	794	817	831	845	853	879	899	–	917	936	955									
				008	008	010	009	009	010	010	010	010	008	008	008	010									
				756	769	784	808	822	835	842	869	889	–	909	928	945									



Elevation (Feet)

Depth, below M.S.L. (Feet)

Time (Seconds)

Horizontal scale 1cm=600ft. Interpretation E. Moorcraft.
Vertical scales as shown
Datum mean sea level Date 20th May 1965

DEPARTMENT OF MINES — SOUTH AUSTRALIA

SEISMIC SURVEY

MURRAY BASIN 1965

KAROONDA AREA

TIME DISTANCE CURVES & INTERPRETATION

DEPTH PROBE K8

65-854
Jcd.

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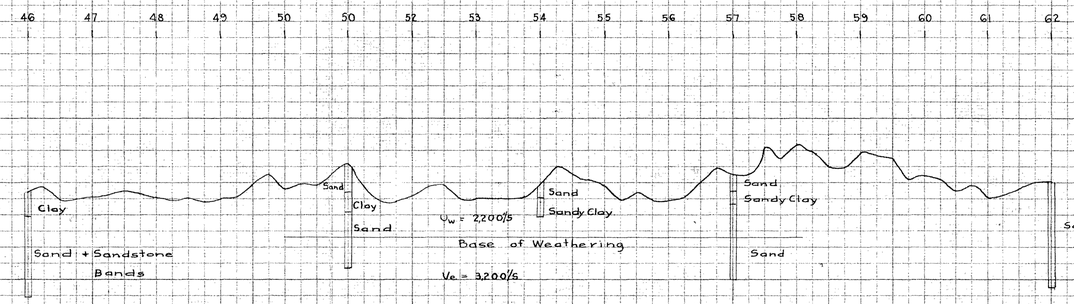

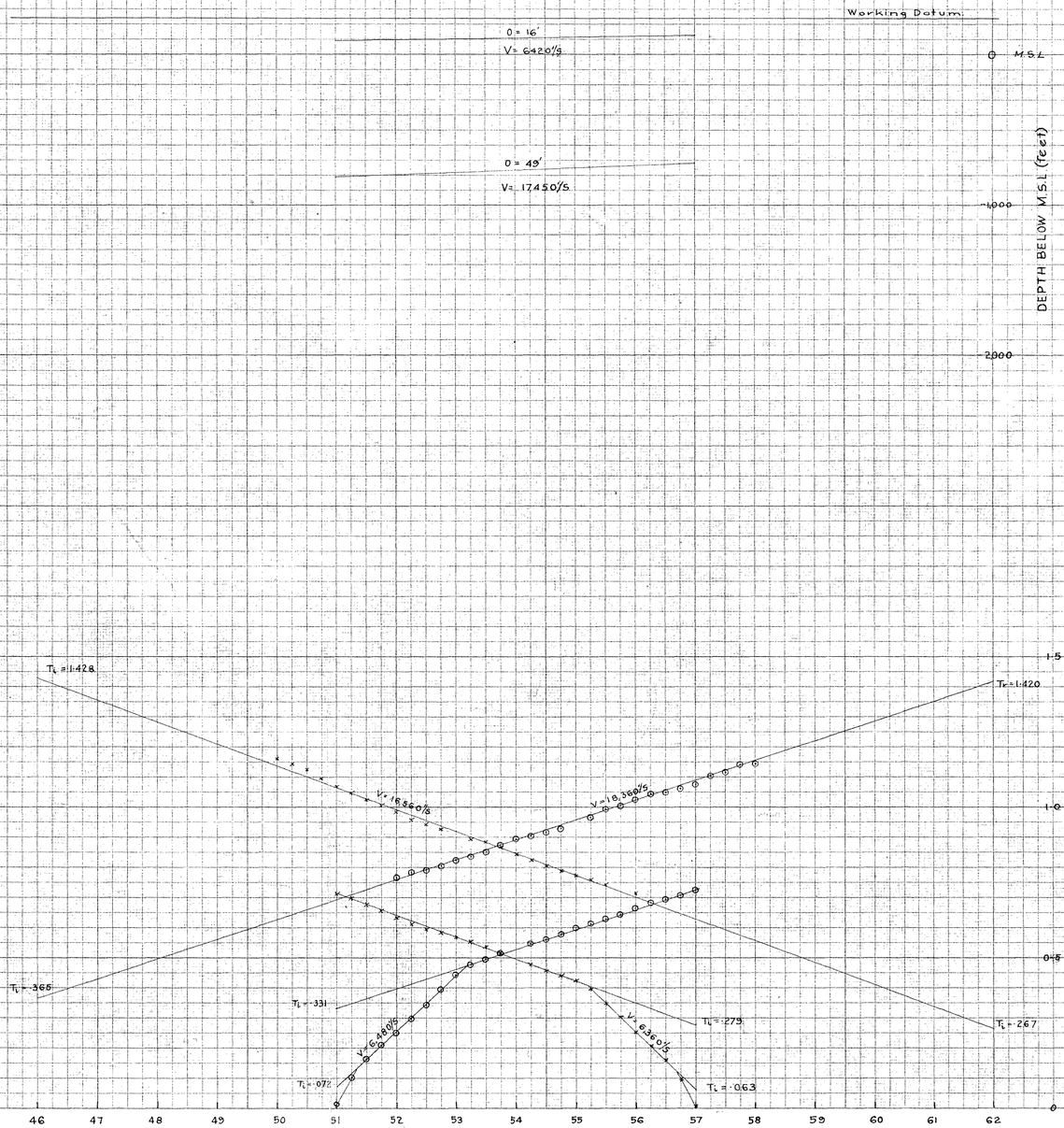

	51												54															57	
	026	113	172	217	259	309	354	402	451	485	501	524	—	564	575	589	611	619	638	651	674	689	709	722	737		To
From 51	015	011	007	007	009	011	012	008	008	007	007	008	011	016	014	012	011	007	009	007	007	008	012	015	014		E_c+W_c
	011	102	165	210	250	298	342	394	443	478	494	516	—	548	561	577	600	612	630	644	667	681	697	707	723		T_c
	51												54															57	
To	735	717	692	672	650	632	613	588	584	568	553	533	—	502	480	461	445	412	367	318	267	215	182	109	021			
E_c+W_c	025	019	015	015	017	019	019	016	016	016	016	016	020	025	023	021	019	015	017	015	015	016	020	014	013		From 57
T_c	710	698	677	657	633	613	594	582	568	552	537	517	—	477	457	440	426	397	350	303	252	209	162	095	008		
	52												55															58	
	770	787	796	807	824	836	853	874	902	912	926	937	—	966	993	1005	1026	1044	1056	1071	1086	1115	1133	1154	1162		To
From 46	003	005	005	002	002	002	002	002	006	010	009	008	005	001	003	001	001	002	006	010	009	009	016	013	017		E_c+W_c
	767	782	791	805	822	834	851	872	896	901	917	929	—	965	990	1004	1025	1042	1050	1061	1077	1106	1117	1141	1145		T_c
	50												53															56	
To	1167	1150	1133	1106	1081	1053	1025	1005	984	965	948	932	—	900	889	873	852	838	815	796	780	763	749	—	718			
E_c+W_c	007	006	006	011	013	007	003	003	005	007	007	004	004	004	004	004	004	008	013	011	009	007	003	006	003	003		From 62
T_c	1160	1144	1127	1095	1068	1046	1022	1002	979	958	941	928	—	896	885	869	844	825	804	787	773	760	743	—	715			

Horizontal scale 1cm = 600'
Vertical scales as shown
Datum Mean Sea level

Interpretation E. Moorcroft
Date 19.5.65.

DEPARTMENT OF MINES — SOUTH AUSTRALIA

SEISMIC SURVEY

MURRAY BASIN 1965

KAROONDA AREA

TIME DISTANCE CURVES & INTERPRETATION

DEPTH PROBE K9

65-855
Jcd.

K&E STANDARD @ CROSS SECTION MILLIMETER
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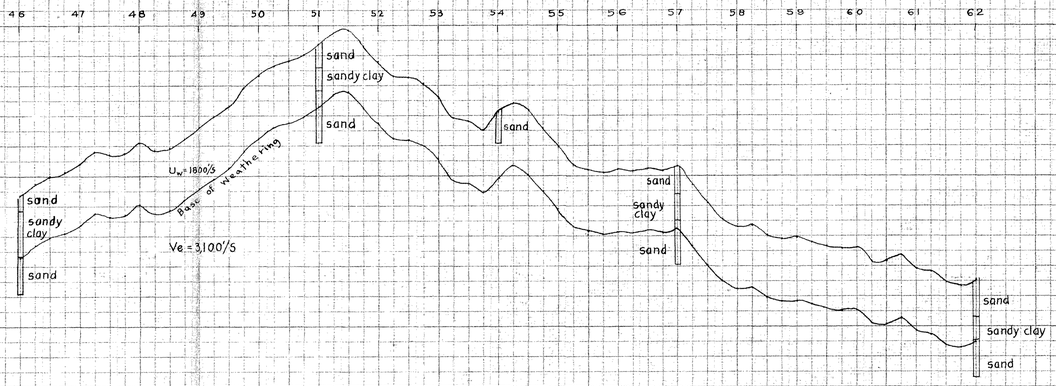
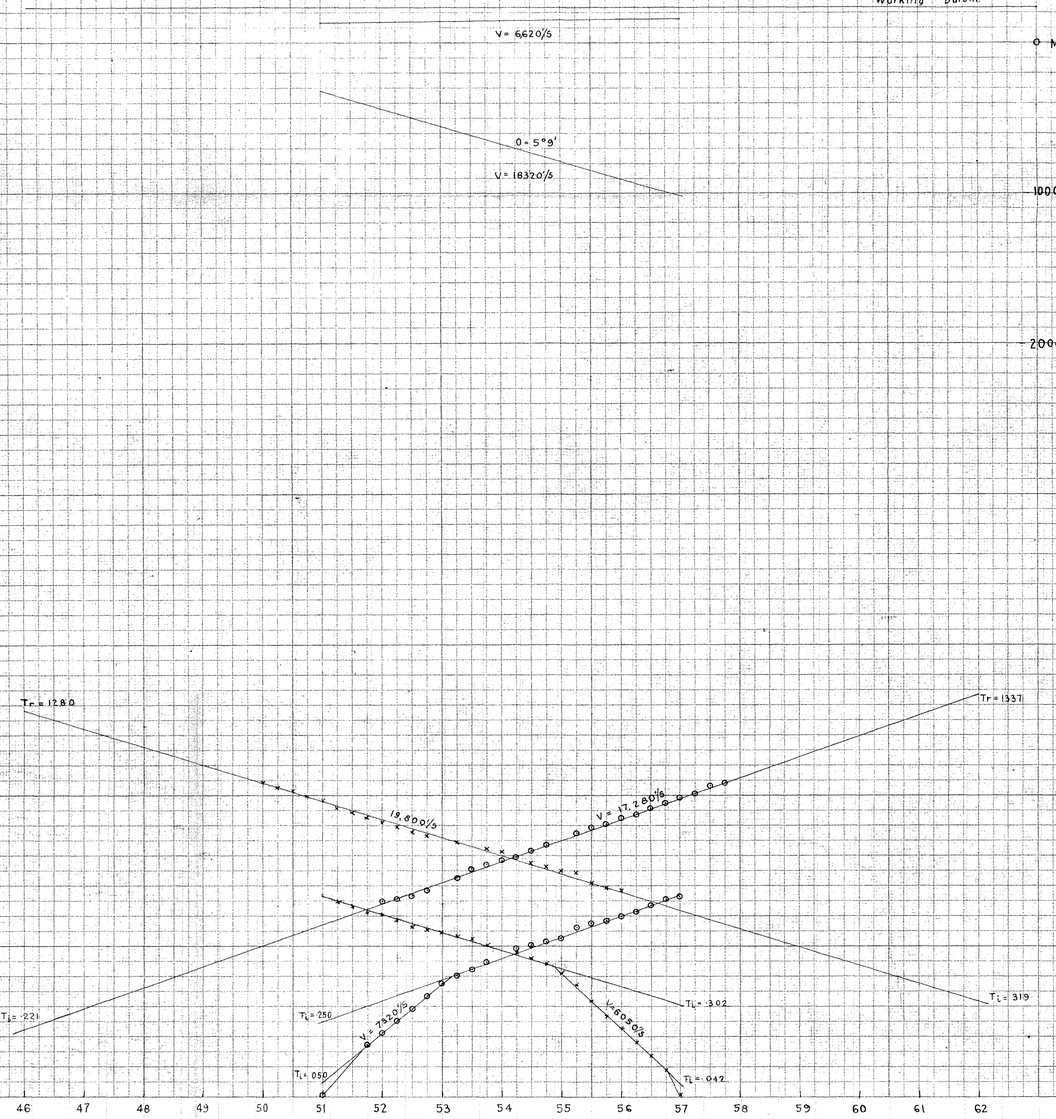
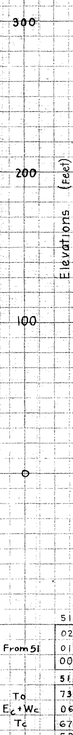
K&E STANDARD @ CROSS SECTION MILLIMETER
KEUFFEL & ESSER CO. MADE IN U.S.A.







	51											54											57				
	026	123	199	253	293	328	365	403	458	471	494	515	—	565	574	582	591	623	636	645	659	673	697	713	726		To
From 51	019	013	013	080	077	074	074	073	070	070	070	068	071	073	072	068	064	061	061	060	061	060	061	060	061		Ec+Wc
	007	104	180	173	216	254	291	356	388	401	424	447	—	492	502	514	527	562	575	585	598	613	636	653	665		Tc
	51											54											57				
To	734	715	699	679	664	643	623	608	599	583	574	553	—	532	512	488	448	408	353	303	264	214	170	107	023		
Ec+Wc	064	067	067	064	061	057	057	056	053	049	048	046	050	052	050	046	038	035	035	034	035	034	035	019	013		From 57
Tc	670	648	632	615	603	586	566	552	546	534	526	507	—	480	462	442	410	373	318	269	229	180	135	088	004		
	52											55											56				
To	702	706	718	732	—	770	795	809	825	842	861	875	—	907	924	935	953	966	989	1005	1022	1032	1055	1060	—		
From 46	054	050	050	043	046	042	041	039	043	045	043	039	035	032	031	030	031	030	031	030	031	027	021	020	—		
	648	656	668	683	—	728	754	770	782	797	818	836	—	875	893	905	922	936	958	975	991	1005	1031	1040	—		
	50											53											56				
To	1075	1063	1053	1036	1024	1000	985	964	945	928	911	896	—	867	—	845	837	822	800	785	764	755	722	706	696		
Ec+Wc	032	035	036	037	039	042	042	039	036	032	032	031	028	024	023	021	025	027	025	021	017	014	013	012	013		From 62
Tc	1043	1028	1017	999	985	958	943	925	909	896	879	865	—	843	—	824	812	795	775	764	747	741	709	694	683		

Horizontal scale 1cm=600ft Interpretation E.Moorcroft
Vertical scales as shown
Datum mean sea level Date 21st May 1965

DEPARTMENT OF MINES — SOUTH AUSTRALIA

SEISMIC SURVEY

MURRAY BASIN 1965

KAROONDA AREA

TIME DISTANCE CURVES & INTERPRETATION

DEPTH PROBE K10

65-856.
Jcd.

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FINNISS

MILANG

TN

HUNDRED OF ALEXANDRINA

LAKE ALEXANDRINA

FINNISS RIVER

GEOIL DONNA Nº1

CLAYTON

GOOLWA

HUNDRED OF HINDMARSH

NANGKITA ISLAND

GOOSE ISLD

GOAT ISLD

RAT ISLD

Point Sturt

POINT STURT

46 2399 2368 149 145 2358 2370

51 52 54 57 2380 62 81

118 117

LEGEND

S.A Dept of Mines refraction line and shot points.

Geosurveys (Aust) Ltd seismic line (Not shot.)

DEPARTMENT OF MINES — SOUTH AUSTRALIA

REFRACTION SEISMIC SURVEY MURRAY BASIN MILANG AREA 1:31,673

		Drn. PGH.	SCALE: ½ ML. TO 1 IN.
		Tcd. PGH.	65-782 A Hc 9/10
		Ckd.	
Director of Mines		Exd.	DATE: 29-7-65