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No. 158

GREAT ARTESIAN BASIN

1960 GREAT ARTESIAN BASIN SEISMIC SURVEY SOUTH AUSTRALIA & QUEENSLAND PRELIMINARY REPORT

Submitted by

Department of Mines South Australia
1961

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CONTENTS ENVELOPE 158TENEMENT: Not RelatedTENEMENT HOLDER: Dept. of MinesREPORT:

Seismic Survey Great Artesian Basin, S.A. & QLD. (pgs. 3-32)

PLANS:

Betoota-Cordillo Downs Traverse	(158-1)
Refraction Survey Rainbow Plan	(158-2)
Continuous Reflection Profile Time Cross Sec.	
Innamincka Dome	(158-3)
Birdsville-South Reflection Correlation Survey	(158-4)
Seismic Survey, Breadalbane-Birdsville-Betoota Traverses	(158-5)
Reflection Correlation Survey Birdsville-Breadalbane	(158-6)
Seismic Survey Roseberth Area	(158-7)
" " Boulia Area	(158-8)
" " Betoota-Cadelga Cordillo Downs	(158-9)
Seismic Survey Cannuaukaninna Bore	(158-10)
Seismic Refraction Survey Well Creek	(158-11)
Betoota Dome Time Distance Curves	(158-12)
Birdsville-Betoota Reflection Correlation Survey	(158-13)
Cluny Area Time Distance Curves and Interpretation	(158-14)
Cluny Airstrip Area Refraction Survey	(158-15)
Clayton Bore Area Time Distance Curves and Interpretation	(158-16)
Roseberth Area Reflection Cross Section	(158-17)
Plot of Average Velocity v Time from Surface Western Sec. of Great Artesian Basin	(158-18)
Plot of depth v Time from surface of Western Sec. of Great Artesian Basin	(158-19)
Time Distance curves and interpretation Great Artesian Basin	(158-20)
" " " " Kamaran Downs Area	(158-21)
Reflection Survey Cluny No. 4 Bore Area	(158-22)
Refraction Survey Innamincka Dome	(158-23)
Time Distance Curves and Alternative Interpretation	(158-24)
Betoota Dome - <u>Refraction Line</u>	(158-25)

DEPARTMENT OF MINES
SOUTH AUSTRALIA

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SEISMIC SURVEY 1960
GREAT ARTESIAN BASIN
SOUTH AUSTRALIA and QUEENSLAND
PRELIMINARY REPORT

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GEOLOGICAL SURVEY
GEOPHYSICAL SECTION

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TABLE OF CONTENTS

0004

	Page
Locality Maps	
Part I - Results of Survey	1
A Introduction	1
B Results Submitted	2
C Discussion	2
D Conclusions	13
Part II - Survey Methods and Procedures	14
A General	14
B Drilling	14
C Surveying	15
D Recording	15
E Computing	16
Statistics	
Computation Diagram	Figure I
Preliminary Shot Point Location Map -	
Breadalbane-Birdsville-Betoota	
Traverses	L60-125
Betoota - Cordillo Downs Traverse	60-513
Traverse BM	61-23
Well Creek Area	S2526
Clayton Bore Area	S2532
Cannuaukaninna Bore Area	S2533
Kamaran No. 3 Area	S2529
Boulia Area	S2527
Reflection Correlation Survey - Time	
Cross Section	
Birdsville - Breadalbane	L60-122/1
Birdsville - Betoota	L60-126
Betoota - Cordillo Downs	L60-127
Birdsville - South (BM)	61-54
Boulia Area - Time Distance Curves	
and Interpretation	60-394
Breadalbane Area - Time Distance	
Curves and Interpretation	60-490
Kamaran Downs Area - Time Distance	
Curves and Interpretation	
and Reflection Time Cross Section	L61-2
Cluny Airstrip Area - Time Distance	
Curves and Interpretation	60-488

Cluny No. 4 Bore Area - Time Distance Curves and Interpretation	L60-78
- Reflection Survey	L60-79
Old Roseberth Area - Time Distance Curves and Interpretation	L60-121/1
- Reflection Cross Section	60-489
New Roseberth Area (SP BBl6) - Time Distance Curves and Interpretation	L61-3
Betoota Dome - Time Distance Curves and Interpretation	L60-124
- Reflection Cross Section	L60-123
Innaminka Dome - Time Distance Curves and Interpretation	L60-139
- Reflection Cross Section	60-589
Rainbow Plain - Time Distance Curves and Interpretation	L60-129
Cannuwanakaninna Bore - Time Distance Curves and Interpretation and Preliminary Reflection Depth Plot	60-382
Clayton Bore Area - Time Distance Curves and Interpretation	61-59
Well Creek Area - Time Distance Curves and Interpretation	L60-97
Velocity versus Time Curves	61-60
Depth versus Time Curves	61-29.

TEXT OF REPORT - PART I

0006

RESULTS OF SURVEY

A. INTRODUCTION

1. Purpose of Survey

The overall purpose of the survey was to obtain regional data on the total depth of sediments in the Great Artesian Basin, and the thickness and structure of the major formations. It was decided to seek this information along the Marree-Birdsville-Boulia road with tie traverses to Betoota and Cordillo Downs. This overall purpose was broken down into four main objectives:-

- (a) to trace as far southward as possible the Cambrian and/or Ordovician rocks which outcrop near Boulia at the north western margin of the Basin.
- (b) to trace the Mesozoic-Proterozoic contact as far northward as possible from near Marree;
- (c) to determine the thickness and structure of Mesozoic sediments along the traverses;
- (d) to determine the extent of the (?) Devonian rocks encountered in the Innamincka Well along the route covered.

2. Programme

A series of short single line reversed refraction surveys aimed at recording all refractors down to basement and accompanied by continuous reflection profiling along the same line was carried out at the following locations:-

Well Creek (near Marree), Clayton Bore, Cannuwaikaninna Bore, Philippi No. 3 Bore(Kamaram Downs), Boulia, Breadalbane, Cluny No. 4 Bore, Old Roseberth H.S., Cluny Airstrip, New Roseberth, Delhi-Frome-Santos Betoota No. 1 Well, Rainbow Plain and D.F.S. Innamincka No. 1.

These surveys were linked by reflection stations shot for character and interval correlation at distances of approximately two miles.

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The survey commenced near Marree on 23rd March, 1960 and concluded about 50 miles south of Birdsville on 16th November. The original intention of completing the traverse to the southern margin of the basin was not realized as the programme was interrupted from 24th August to 1st November to carry out other work in the Innamincka-Durham Downs area for the operating company.

B. RESULTS SUBMITTED

(1) Refraction Surveys

For each location a set of time-distance curves and computed velocities and depths is presented with a reflection time cross section where reflections were obtained. There appear to be three main refractors in the Mesozoic - of velocities approximately 7,500 ft/sec., 9,000ft/sec and 14,000 ft/sec. although not all are necessarily recorded at any one location. No more than two refractors have been recorded below the Mesozoic.

(2) Reflection Surveys

The results of the character/interval correlation surveys connecting the locations of the refraction work are presented as time cross sections for each of four traverses:-

Birdsville-Breadalbane, Birdsville-Betoota,

Betoota-Cordillo Down and Birdsville-South

Two main reflectors, thought to be the top of the Blythesdale Formation, and the base of the Mesozoic respectively, can be traced almost throughout. These are labelled "C" and "Z" Two other horizons can be traced over considerable distances.

C. DISCUSSION

1. Velocity Analyses

Velocity distributions were obtained by TAT analysis, using all records in which reflection quality was sufficiently good to determine move-out from the outer traces corrected to a horizontal datum. The reflection times were re-corrected to the surface, at the shot point. As it was possible to correlate

events from two reflectors over practically the whole area shot, average velocities from the surface were calculated to each of these reflectors, and also to any other reflector which could be correlated over a reasonable distance. The number of observations so obtained from profiles shot between 50 miles south of Birdsville and Breadalbane, Birdsville and Betoota, and Betoota and Cordillo Downs was:

Reflector "A"	No. of reflections	158
"B"		65
"C"		407
"D"		124
"Z"		246

Because of the large number of reflections for which move-out could be obtained, the data for each reflector was split into groups of .050 second, e.g. for the Blythesdale sandstone ("C") a range of .50 - .55; .55 - .60; 1.25 - 1.30; 1.30 - 1.35 seconds was covered; and both $T_{\text{(surface)}}$ and ΔT averaged within each group. The average velocity $\bar{V}$ was then calculated from:-

$$\bar{V} = 1200/(2T\Delta T)^{\frac{1}{2}}$$

for each group, and $\bar{V}$ plotted as ordinate against $T_{\text{(surface)}}$ as abscissa.

The plotted points for each of four reflectors suggest a velocity distribution with $d\bar{V}/dT$ decreasing, and a possible approach to some asymptotic value (different for each reflector). Curves were fitted to each group of observations by the method of Gaussian least squares using the first three terms of a polynomial, viz.

$$\bar{V} = a + bT + cT^2$$

Such curves fit the observed points quite closely. These velocity/time curves give the average velocity to a given reflector but not the velocity distribution at any shot point, as the velocity functions obtained refer to increasing depth of a given reflector.

For the purpose of plotting a depth cross-section, the relations $\bar{z} = \frac{1}{2}T(\text{surface})\bar{V}$ and $\bar{V} = a + bT + cT^2$ were used to obtain $\bar{z} = (aT)/2 + (bT^2)/2 + (cT^3)/2$ and these latter functions plotted. Graphs of $\bar{V}$ v T and $\bar{z}$ v T (drawings 61-60 and 61-29) are included in the report, the former showing the plotted data from which the regression formulae were calculated. The results are in good agreement with off-structure refraction information, with depths to the "C" reflector from artesian bore logs along the Birdsville Track, and on-structure with data from the Innamincka Well Shoot to the "C" (see table of the following section).

Both the velocity and depth functions have turning points, but such turning points for reflectors "B", "C" and "Z" in the former case and for all reflectors in the latter lie outside the range of T values for which the regression formulae have been computed, i.e. if the functions describe the physical change of velocity with depth, they do so only within the range of data from which they are obtained, and values of $\bar{V}$ and $\bar{z}$ cannot be obtained by extrapolating T . The shape of the $\bar{V} = f(T)$ curves suggests an approach to an exponential form at depths beyond those plotted. Accordingly an attempt has been made to find the type of function which will describe the velocity/time relationship by expanding various functions in series form and equating the co-efficients of the first three terms with those of the fitted curves (a , b and c). One such function which in series form converges quickly is:-

$$\bar{V} = A(1 - Be^{-CT})^n \quad \text{where}$$

C is chosen

$$B = (4ac + 2b^2 - Cab)/(4ac + 2b^2)$$

$$n = 2b^2/(4ac + 2b^2 - Cab)$$

$$A = a/(1 - B)^n$$

For the "C" curve, this function becomes

$$\bar{V} = 9290(1 - .447e^{-1.1T})^{1.543}$$

with the values at $T = .55$ $\bar{V} = 6030'/\text{sec.}$

$$= 1.35 \quad = 7880$$

and an asymptotic value of $= 9290$

These values compare with those of the fitted curve:-

$$T = 1.55 \quad \bar{V} = 6120'/\text{sec.}$$

$$= 1.35 \quad = 7830'/\text{sec.}$$

The curves "A" and "D" for which the turning points lie within the range of T plotted are based on the following data:-

(a) Curve "A". $T\Delta T$ obtained from all reflections above "B", and therefore the function is not constructed from observations from a single, consistent reflector.

(b) Curve "D". The reflections which are between "C" and "Z" are certainly not from a single reflector, and correlations have not the same weight as those of reflectors "B", "C" and "Z".

The extension of the "Z" curve beyond about 1.55 seconds does not appear to apply on the Betoota - Cordillo Downs traverse. The reflection quality from basement along this line is poor, and few reflections could be used to calculate values of ΔT for velocity determination. Most of the values in the region 1.50 to 1.65 seconds were obtained south of Birdsville. This is also indicated by the lack of agreement between refraction and reflection depths at the Rainbow Plain depth probe.

Further profiles will be shot south of Birdsville at a later date to complete the project, and it is hoped that further $T\Delta T$ data will be available to extend the curves to greater depths.

2. Depth Determinations

Table I shows depths computed from the above analyses compared with refraction depths and intersections in water and oil exploration bores.

More extensive determinations for the compilation of depth cross sections have not yet been performed.

TABLE I

Location	Reflection time (surface)	Ave. velo. to Reflector	Source of Velocity	Reflection Depth (sub. surface)	Refractor Velocity	Refractor Depth (subsurface)	Bore	Bore Intersection	Depth in Bore
Boulia					18000'/s	280'			
Breadalbane (SP100)	.250 .510?	6000'/s 8000	Assumed "	750' 2040'?	15400'/s 17900'/s	780' 1820'	Breadalbane No. 9	"Red Marl" "Limestone"	735' 758'
Bedourie SFS CB34 CB35	.358/.310	6050/5890'/s	Tot	990'			Ludlow No. 2	Blythesdale	906'
Bedourie SFS CB27-CB28	.412	6200'/s	Tot	1260'			Bedourie No. 2	Blythesdale	1189'
Kamaran (SP100)	.359est. .506est.	5900'/s 5990'/s	Assumed Tot	1060' 1500'	18500'/s	1540'	Phillipi No. 3	Granite	1500'
Cluny Airstrip (CB16)	.611 .721	6320'/s 7270'/s	Tot Tot	1920' 2620'	18300'/s	2400'			
Cluny No. 4 (SP104)	.613 .734 .874 .984	5760'/s 6690'/s 7310'/s 7700'/s	Tot Tot Tot Tot	1720' 2460' 3180' 3886'	19400'/s	3580'	Cluny No. 4	Blythesdale	2257'

Location	Reflection times (surface)	Ave. velo. to Reflector	Source of Velocity	Reflection Depth (sub surface)	Refractor Velocity	Refractor Depth (subsurface)	Bore	Bore Intersection	Depth in Bore
Cacoory (SPS RCL6-RCL7)	.807/.810	6900'/s	T T	2780'			Cacoory	Blythesdale	2556'
Old Roseberth (SP98)	.463 .641 .939 1.070 1.180 1.230	6310'/s 6540'/s 7200'/s 7880'/s? 8080'/s? 7970'/s	TaT TaT TaT TaT TaT TaT	1460' 2090' 3380' 4220' 4770' 4900'	9700'/s 19400'/s	2310' 4680'			
New Roseberth (SP BBL6/99)	.396 .565 .906 1.038 1.196 1.268 1.396	6160'/s 6480'/s 6900'/s 7400'/s 8100'/s 8190'/s 9090'/s	TaT TaT TaT TaT TaT TaT TaT	1220' 1840' 3120' 3850' 4840'? 5180'? 5640'	7800'/s 18,100	1460' 5250'			
Betoota (SP117)	.615 .761 .915 1.060 1.193 1.366	6520'/s 7470'/s 6380'/s 7660'/s 7150'/s 7860'/s 8250'/s 8830'/s 8070'/s 9280'/s	TaT Innamincka No. 1 TaT Inn. No. 1 TaT Inn. No. 1 Inn. No. 1 Inn. No. 1 TaT Inn. No. 1	2000' 2420' 2440' 3040' 3270' 3720' 4500' 5400' 5510' 6460'	 14600'/s 16400'/s	 3730' 5770'	Betoota No. 1 Albian/ Aptian. Blythesdale Pre-Mesozoic	 2560' 3450' 5760'	

Location	Reflection times (surface)	Ave. velo to Reflector	Source of Velocity	Reflection Depth (sub surface)	Refractor Velocity	Refractor Depth (subsurface)	Bore	Bore Intersection	Depth in Bore
Rainbow Plain (SP EC38)	.674	6540'/s	TaT	2200'	9100'/s	2100'			
	1.578	8150'/s?	TaT	6440'	13600'/s 18700'/s	4810' 7390'			
Innamineka (SP 233/0)	.491	6360'/s	TaT	1560'	9100'/s	1750'	Innamineka No. 1	Albian	1750'
		?	Inn. No. 1	1630'					
	1.081	7470'	TaT	4040'	14400'/s	4550'		Neocomian	3920'
		?	Inn. No. 1	4180'				Blythesdale	4600'
	1.295	?	Inn. No. 1	5540'				Lower Jurassic?	5500'
	1.506	8130'/s?	TaT	6230'	16400'/s	7480'		Pre-Mesozoic	7050'
		?	Inn. No. 1	6940'					
(SP102)	.609	6320'/s	TaT	1920'			Cannuwanikanima		
	.786	6840'/s	TaT	2680'					
	1.015	7760'/s	TaT	3920'	18800'/s	3260'		Blythesdale	2618'
Clayton					13800'/s 18700'/s	1650' 2650'	Clayton	Blythesdale	1611'
Wall Creek					19300'/s	1000'	Wall Creek	Slate	944'

3. Reflection Continuity

Two reflecting horizons can be traced over the majority of the area surveyed. The upper of these is labelled "C" and is believed to be at the top of the sandstones of the Blythesdale Group. It can be traced with considerable certainty as far north as SP CBL7, where it occurs at .458 seconds. The Mesozoic section northward of this point becomes shallower and reflections become difficult to separate. Probably the reflection at .250 secs. at SP CB34 is "C". Further north the horizon is too shallow to record a usable reflection. From CBL7 the reflection dips gently southward with some apparent minor reversal to 1.019 secs. at shot point RB9 near Birdsville and to 1.286 secs. at SP BM24 approximately 50 miles south of Birdsville which was the southern limit of the traverse.

Eastward from Birdsville the reflector remains nearly horizontal as far as BB33 beyond which a slight easterly component of dip develops until the reflection is at 1.133 seconds at BB45. Further east the reflector is folded up to .796 secs. at SP117 near the culmination of the Betoota Dome.

From shot point BB48 the reflector deepens slightly on the traverse to Cordillo Downs and is identified with a reflection at 1.329 secs. (different datum) at SP 45 of the Patchawarra - Cordillo Downs traverse run for Delhi Australian Petroleum Ltd. in 1959. This can be traced back to tie in to the Blythesdale Group in Innamincka No. 1 Well.

The lower extensive reflecting horizon has been labelled "Z" and is considered to be the base of the Mesozoic Section. North of the Breadalbane refraction line this is too shallow to record but it deepens from approximately .170 seconds here to 1.581 secs. at shot point BM8 south of Birdsville, remaining almost parallel to "C". Over this distance (170 miles) there may be rocks of several ages immediately underlying the Mesozoic. This will be discussed later. Between BM8 and BM 24 the "Z" reflection cannot be identified with certainty.

East of Birdsville the "Z" reflection remains more or less parallel to "C" and can be traced as far east as shot point BB40. East of this again, it cannot be identified with certainty but is probably at 1.408 seconds at shot point BB48. From here, although quality is generally very poor, it can be followed southward to Cordillo Downs, being at 1.634 secs. (current datum) at SP45 of the earlier survey mentioned above.

Above "C" there are often numerous reflections but only one can be correlated over more than a few miles. This occurs about 150 milliseconds earlier than "C" and may represent the Albian/Aptian boundary. It cannot be followed with certainty south of Birdsville or south of shot point BCL5 on the Betoota-Cordillo Downs traverse but this may be due to general decrease in record quality in these areas rather than any change in the reflector.

Between "C" and "Z" one or two reflectors can be correlated over considerable distances in various parts of the traverses but quality and continuity are not as good as in "C" and "Z".

Only in the area north of shot point OBL3 and perhaps east of shot point BB40 is there any certain development of reflections from below the base of the Mesozoic. These reflections will be discussed later.

4. Refraction Results

One of the main purposes of the refraction surveys was to differentiate between rocks of various ages immediately below Mesozoic formations by their refraction velocities.

The velocity in Proterozoic slates known to exist at a depth of 944 feet at Well Creek near Marree was found to be 19300 feet/second. At Clayton and Cannuaukaninna Bores, 25 miles and 55 miles respectively further into the Basin, where similar rocks are expected to form basement below Mesozoic formations, the velocities recorded were 18,700 and 18,800ft/sec.

A few miles west of Boulia, where about 300 feet of Mesozoic rocks are underlain by dense limestones of early

Palaeozoic age, a velocity of 18,000 ft/sec. was measured. At Breadalbane, about 70 miles southward into the Basin, a refractor of velocity 17,900 ft/sec. at a depth of 1,820 feet was recorded. This is only a few miles north of a point where a reflecting section extending considerably deeper was encountered. This refractor is probably the same formation as at Boulbia although an increase in velocity with depth of burial might have been expected. Facies change may account for the absence of this.

At Phillipi No. 3 Bore on Kamaran Downs the velocity in the granite encountered at 1500 feet was found to be 18,500 ft/sec.

At Cluny No. 4 Bore, Old Roseberth, New Roseberth and Rainbow Plain refractors of velocities 19,400 ft/sec., 19,400 ft/sec., 18,100 ft/sec and 18,700 ft/sec. appear to coincide with the reflection "Z". The absence of reliable reflections below "Z" between these localities suggests that the Mesozoic is not underlain by Palaeozoic sediments there.

At Betoota and Innamincka a velocity of 16,400 ft/sec. was recorded for formations underlying the Mesozoic which are almost certainly Palaeozoic. At Breadalbane a velocity of 15,400 ft/sec. was recorded for a formation below the Mesozoic, bores penetrating the top few feet of which log "red marl" and "limestone". These may be upper Palaeozoic. At no other localities were velocities of 15,000 ft/sec. or 16,000 ft/sec. recorded.

At Betoota, Rainbow Plain, Innamincka and Clayton (doubtful) a velocity close to 14,000 ft/sec. coincides with the reflection "C" at the top of the Blythesdale Group. This reflection is continuous through most of the other refraction locations but the 14,000 ft/sec. velocity is not recorded there. Some difference in the nature of the Blythesdale Group must develop towards the deeper, central part of the Basin to account for this.

At Old Roseberth, New Roseberth, Betoota, Rainbow Plain and Innamincka a refractor of velocity approximately 9000 ft/sec.

appears to be at the top of the Albian. This formation is probably too thin nearer the margins of the Basin to be recorded.

5. Major Structural Features

Folding of Mesozoic sediments on the scale of the Betoota and Innamincka anticlines was not disclosed elsewhere on the course of this survey. Slight closure on the "C" and "Z" reflections between BB14 and BB15 near New Roseberth may express the end of a structure similar to the surface folding prominent on the road between Miranda and Cadellga.

Total depth to the base of the Mesozoic increases from 735 feet near Breadalbane to about 6,500 feet near BM8, south of Birdsville, at an average rate of nearly 40 feet per mile. The depth also increases eastward from Birdsville and along the traverse towards Cordillo Downs, being about 7,500 feet at the latter place. There is a sudden increase in depth between shot points RC9 and RC11, about 40 miles north of Birdsville, which may be due to large scale faulting. Displacement of "Z" between these two shot points is about 700 feet.

North of shot point CB19 near Cluny the Mesozoic is underlain by a reflecting section the upper part of which is the 15,400 ft/sec. refractor at Breadalbane, the red marl/limestone sequence of probable upper Palaeozoic age. The lower part is the 17,900 ft/sec. refractor at Breadalbane and is probably a Cambrian and/or Ordovician sequence. Reflections at CB29 indicate a thickness greater than 5,000 feet for this sequence. The boundary between upper and lower Palaeozoic is possibly represented by the reflector labelled "Y" between CB21 and CB29. The upper Palaeozoic thins southward and is not present at CB19. South of this point the Mesozoic may be underlain by lower Palaeozoic but the absence of reliable reflections from below the Mesozoic south of CB 8 suggests that the lower Palaeozoic may not continue further south. West of Bedourie the Palaeozoic has disappeared at Lake Phillipi on Kamaran Downs where a water bore found granite beneath a thin Mesozoic section.

East of shot point BB40 towards Betoota the reflecting section thickens and in the Betoota No. 1 Well steeply-dipping rocks of probable Palaeozoic age underlie the Mesozoic.

There may be a curving line extending from a point between Bedourie and Lake Phillipi through the northern part of Lake Machattie to a point about 20 miles west of Betoota marking the western boundary of Palaeozoic sedimentation. From Betoota it may continue southward and swing westerly through a point about 12 miles north of Patchawarra Bore where the discontinuity was discovered on a previous survey.

D. CONCLUSIONS

The objectives of the survey have been partly attained. Cambro-Ordovician rocks probably exist at a depth of less than 2000 feet near Breadalbane and are overlain by later Palaeozoic and Mesozoic formations. They continue southward to Bedourie but are probably not present south of Lake Machattie where the Mesozoic is underlain by a non-reflecting, high velocity formation which is more likely to be Pre-Cambrian. Palaeozoic rocks are present at Betoota and Innamincka and could include Cambrian or Ordovician formations but very high velocities to be expected from deeply-buried, dense limestones were not recorded.

The thickness of Mesozoic rocks increases uniformly from the margins toward the centre of the basin in the areas surveyed and reaches 7,500 feet near Cordillo Downs. There is no major folding of the Mesozoic along the Breadalbane-Birdsville-Betoota road but anticlinal folding similar to that at Betoota Dome may occur south-east of Roseberth H.S., which is about 18 miles east of Birdsville.

Palaeozoic (Devonian? and Permian) rocks occur beneath Mesozoic at Innamincka and may be present in the Betoota structures. They are not present from 20 miles west of Betoota to Birdsville but may occur in the Palaeozoic sequence in the Bedourie-Breadalbane area.

TEXT OF REPORT - PART II

0019

SURVEY METHODS AND PROCEDURES

A. GENERAL

1. Disposition of Original Data

All original records, cross sections and level books are retained by the Geophysical Section (Seismic) of the S.A. Department of Mines. Field data books containing original data of the horizontal survey control are held by the S.A. Department of Lands.

2. Size of Area

The total traverse length was approximately 500 miles.

3. Transportation

Heavy supplies were brought to the field camp from the rail head at Marree, S.A. along country tracks. Perishable items and personnel where necessary were carried by Trans-Australia Airlines Channel Services calling fortnightly at a number of the cattle stations in the area of the operation.

Traverses were shot mainly along bush tracks. Travelling off such tracks is generally very slow and difficult due to sand dunes, creek channels and gibbers.

4. Outside services

The South Australian Government Department of Lands provided survey control by tellurometer traverses for the compilation of survey maps from aerial photographs. At the time of writing such maps had not been completed and preliminary shot point location maps only accompany this report. Similarly most cross sections show station intervals approximately only.

B. DRILLING

The majority of drilling was in yellow, pink or grey shales, sandy shales or clayey sands in which progress was good and compressed air mainly used. However a major source of difficulty occurs widely over the area. This is an earlier land surface with which may be associated laterites, silicified

shales, silts and sandstones and loose caving sands. These formations may be not more than a few feet thick but in places are extremely hard and at times reduced drilling rate to less than a foot per hour, often at the cost of a hard formation roller bit per shothole. Most difficulty from these formations was encountered on the Betoota - Cordillo Downs traverse. Water was generally required for drilling the loose sands often associated with the very hard silicified formations.

C. SURVEYING

1. Methods

Spreads were laid and levelled relative to shot points with theodolite, chain and a target staff. Elevations were carried from shot point to shot point by level and staff. Shot points were identified on aerial photographs which were controlled by telirometer traverses to produce an accurate map.

2. Surface Conditions and Topography

The roads which were utilized for the traverses mainly follow open country - gibber plains, clay pans and inter-dunal flats. Under the prevailing drought conditions there was very little herbage. The only timber of any size encountered was in the vicinity of the main channels of the seasonal watercourses such as Eyre Creek and the Diamantina River.

3. Level Origins

The levelling system was tied to the Commonwealth Railways system at Marree, S.A., and to a Department of the Interior system between Boulia, Birdsville and Betoota in Queensland.

D. RECORDING

1. Instruments

Seismic equipment used was Houston Technical Laboratories 7000B with conventional photographic recording. Dual recordings were made. For reflection shots the top 24

traces were recorded straight and the lower 24 with a 50% unilateral mixing. Filter settings used were generally low cut 24 c.p.s., high cut 57 c.p.s. For refraction shots the upper 24 traces were recorded at four times the amplitude of the lower 24.

2. Spreads (reflection)

A split spread covering 2400 feet was laid with geophone point interval 100 feet. Ten geophones per trace, at intervals of ten feet along the direction of the spread, were used for most of the survey. Twenty geophones per trace were used at times but the improvement in record quality was generally not sufficient to warrant their use.

3. Spreads (refraction)

A standard spread of 24 geophones at intervals of 200 feet was used. Shot points were offset at intervals of 4800 feet in either direction until reversed coverage of all refractors was obtained. The spread was moved accordingly to ensure coverage of the same vertical section.

4. Record quality

Reflection records were graded for certainty according to Gaby. Overall, quality was poor to fair. Poor records were generally obtained in areas where hard silicified layers and loose sands discussed above were present near the surface. Variations in shot depth, pattern shots and extra geophones gave little improvement in quality in these areas.

E. COMPUTING

A datum plane at 100 feet above sea level was used for the majority of the survey. At some of the isolated refraction surveys a different plane was chosen. In the reflection results the method of computing corrections to datum is shown in Figure I. The correction velocities used were obtained from analyses of first breaks or uphole surveys.

The refraction survey technique employed is fully described in a Record of the Bureau of Mineral Resources

(Australian Department of National Development) entitled
"The Depth Probing Technique using Seismic Refraction Methods"
by K. R. Vale and E. R. Smith.

E. E. MILTON
GEOPHYSICIST

K. R. SEEDSMAN,
SENIOR GEOPHYSICIST

BEM:KRS:CERF
10/2/61

STATISTICS

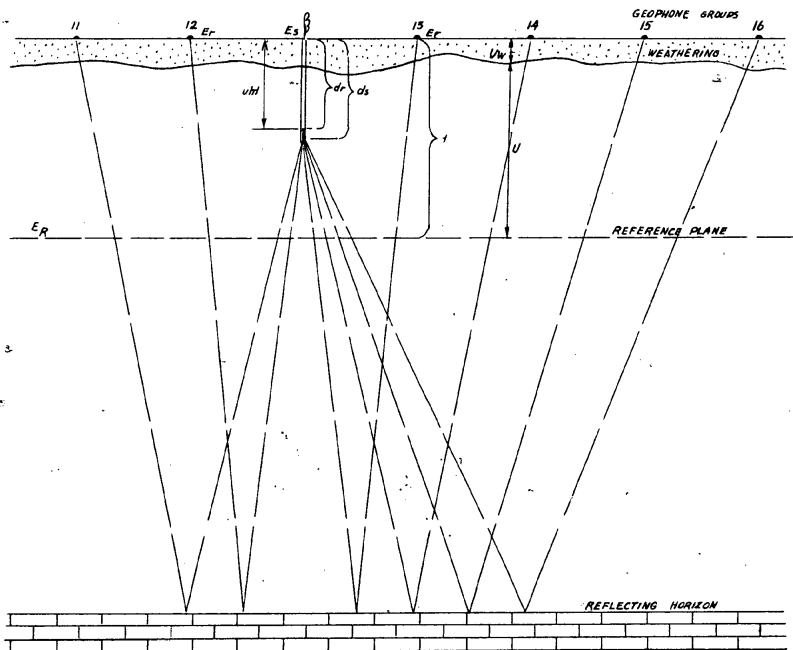
0023

Inclusive Dates of Shooting; 24th March - 19th August, 1960
and 10th November - 16th November, 1960

FIELD DATA

Method of Survey	Wide Interval Reflection Correlation		Single Line Refraction with Accompanying Continuous Reflection Profiling		Overall
	<u>In Queensland</u>	<u>In S.A.</u>	<u>In Queensland</u>	<u>In S.A.</u>	
Average shot depth	59 feet	66 feet	59 feet	85 feet	64 feet
Average weight of charge	12 lbs.	17 lbs.	30 lbs	38 lbs.	23 lbs.
No. of recording days worked	36	16	35	17	104
Good profiles shot	164	54	163	54	435
Repeat test and weathering profiles	59	36	181	91	367
Average profiles per day	6.2	5.6	9.8	8.5	7.7
Dynamite used	2241 lbs	1246 lbs	5720 lbs.	3087 lbs.	12294 lbs.
Detonators used	236	167	383	165	951
Total drill days worked	60	31	65	36	192
Total holes drilled	171	113	159	73	516
Total feet drilled	11600	5912	13457	7192	38161
Footage per drill per day	193	191	207	200	199
Average hole depth	68 feet	52 feet	85 feet	99 feet	74 feet

0024



E_s Elevation of Shot Point, or Uphole geophone.

E_r Mean elevation of the two center traces.

d_s Depth of base of charge.

d_r Depth of top of charge.

E_R Reference plane.

$2vht$ Two times the Uphole time.

td Time of detonation of charge.

U Assumed velocity to reference plane.

t Total time correction.

COMPUTATION DIAGRAM

E_s 260	E_r 257	$-2vht = -.064$
$-d_s$ 150	$-d_r$ 140	$-td = -$
110	117	$\frac{-227}{v7000^{1/4}} = -.032$
$-E_R$ S.L.	$-E_R$ S.L.	
$- (+110)$	$+ (+117)$	$t = -.096$

Fig. 1

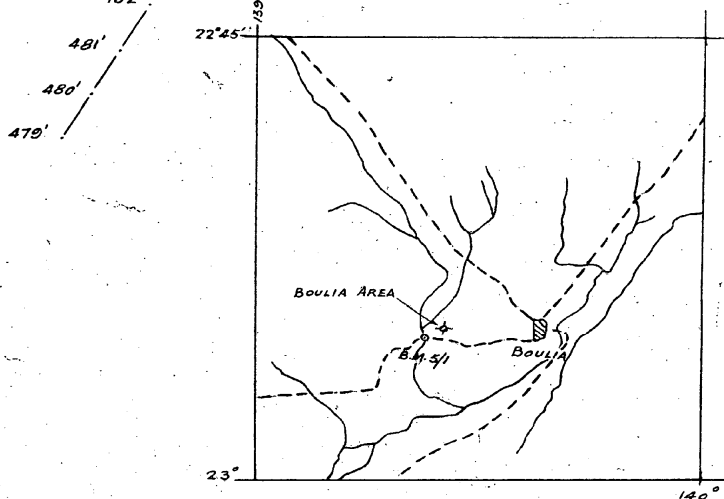
S2522
994.3

S.P.103 LAT. $22^{\circ}56'22''$
LONG. $139^{\circ}53'15''$

0025

T. || N.

FOR OFFICE USE ONLY
15 Envelope 158



GREAT ARTESIAN BASIN SEISMIC SURVEY
BOULIA AREA

S2527
994.3

FOR OFFICE USE ONLY
traverse to 15-8

0026

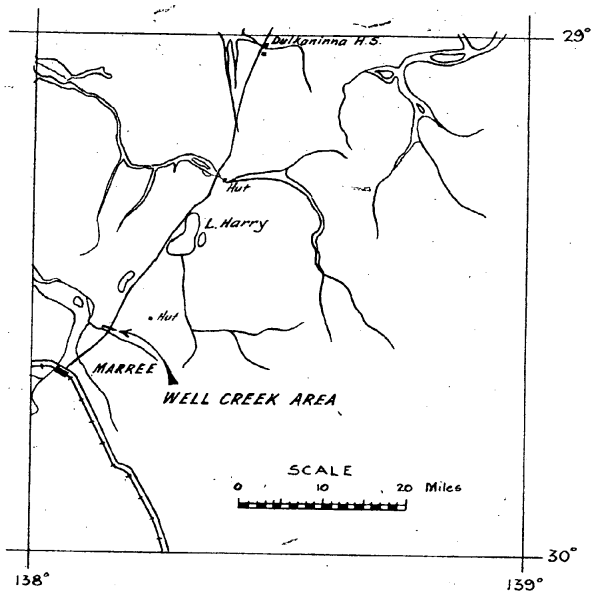
SCALE
 1200 Ft. to 1 in.



SP 100 Lat. $29^{\circ}32'36''$

Long. $138^{\circ}10'30''$

From solarfix on peg 47 of stadia
 traverse from Well Cr. towards Marree.



GREAT ARTESIAN BASIN SEISMIC SURVEY
 WELL CREEK AREA
 S2526
 CC

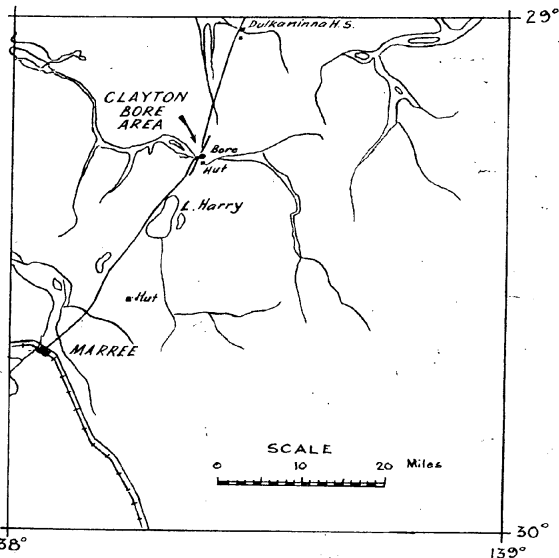
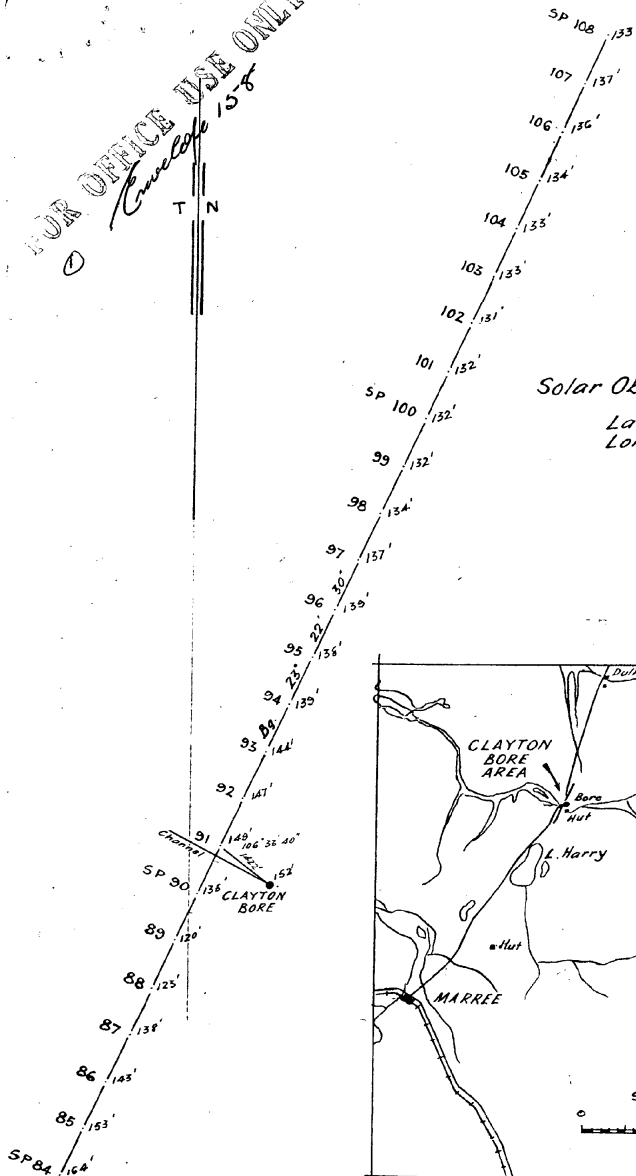
FOR OFFICE USE ONLY
 1
 T N

0027

SCALE
 2400 ft. to 1 in.

Solar Observation on SP 91

Lat. $29^{\circ}14'42''$
 Long $138^{\circ}23'15''$

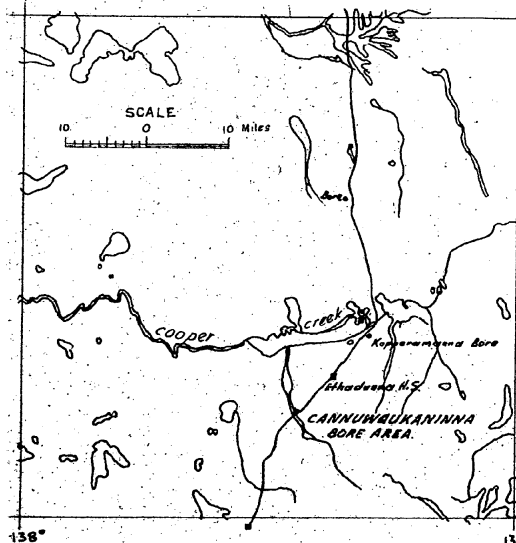
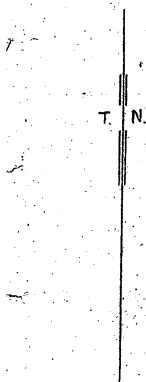


GREAT ARTESIAN BASIN SEISMIC SURVEY
 CLAYTON BORE AREA
 S2532

SCALE
2400 ft. to 1 in.

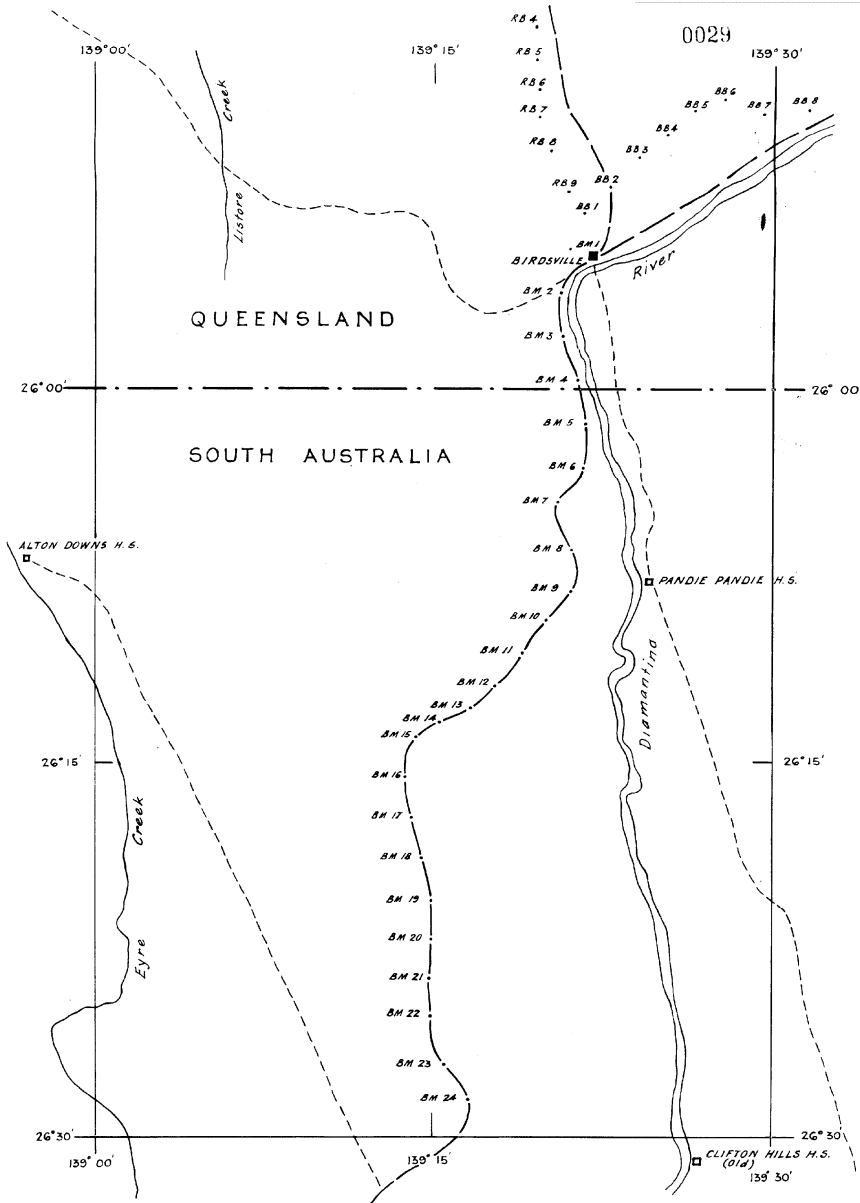
0028

Solar Fix on SP100.
Lat. $28^{\circ} 47' 49''$
Long $138^{\circ} 31' 46''$



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28. *Trumble 1-5-8*

GREAT ARTESIAN BASIN SEISMIC SURVEY
CANNUWAUKANINNA BORE AREA S 2533
Ca



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20 Envelope 158

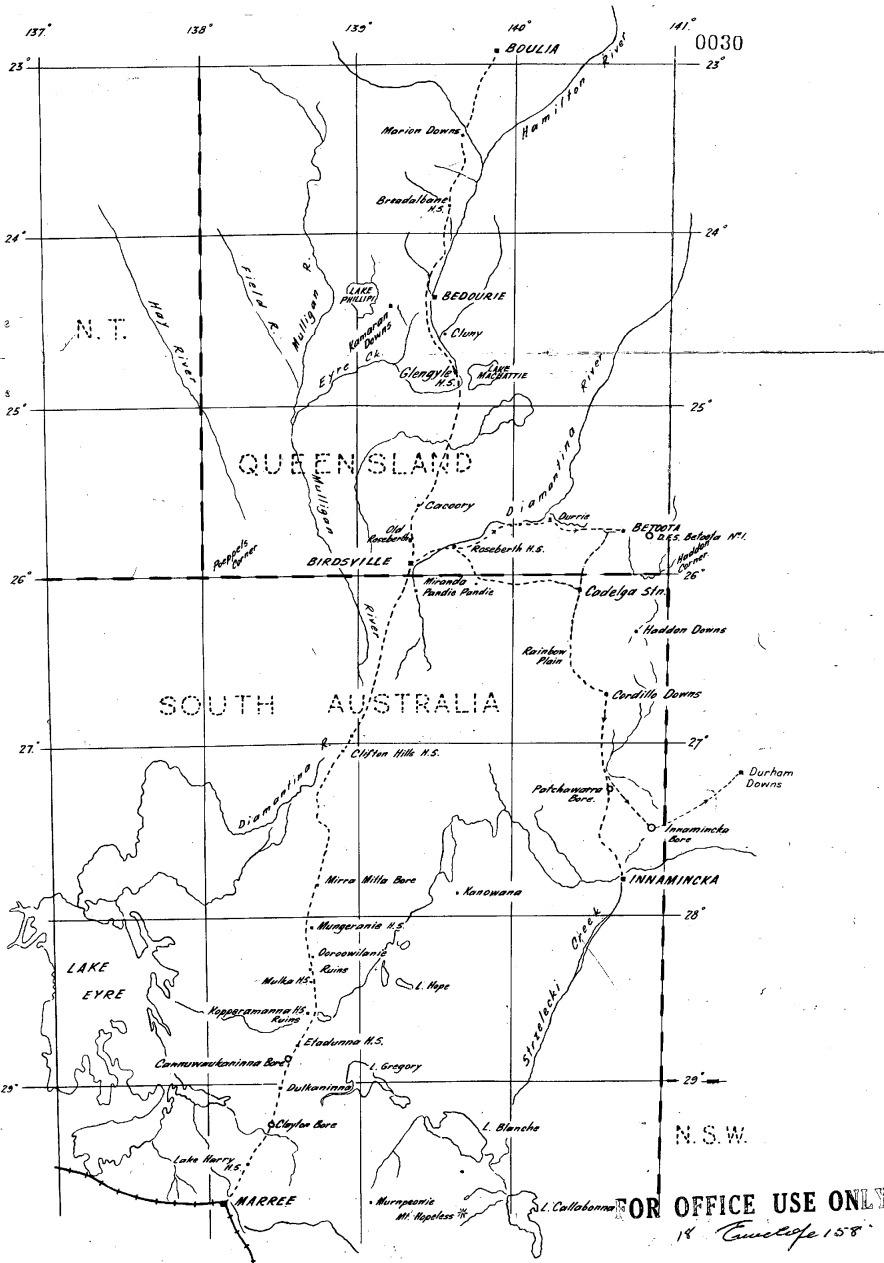
Shot point positions are approximate only.
An accurate survey plan will be produced later.

S.A. DEPARTMENT OF MINES

SEISMIC SURVEY
GREAT ARTESIAN BASIN
SHOT POINT LOCATION PLAN
TRAVERSE BM

Approved	Passed	Scale: 20 000 1" = 20 M.
		Dm. Tct. R.R. Ckt. Ext.
Director		61-23 994-2/3 Date 12-11-61

No. Amendment Exd. Date



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14 Cautley 158

S.A. DEPARTMENT OF MINES

GREAT AUSTRALIAN ARTESIAN BASIN
(SOUTH AUSTRALIA - QUEENSLAND)
SEISMIC SURVEY
LOCALITY PLAN

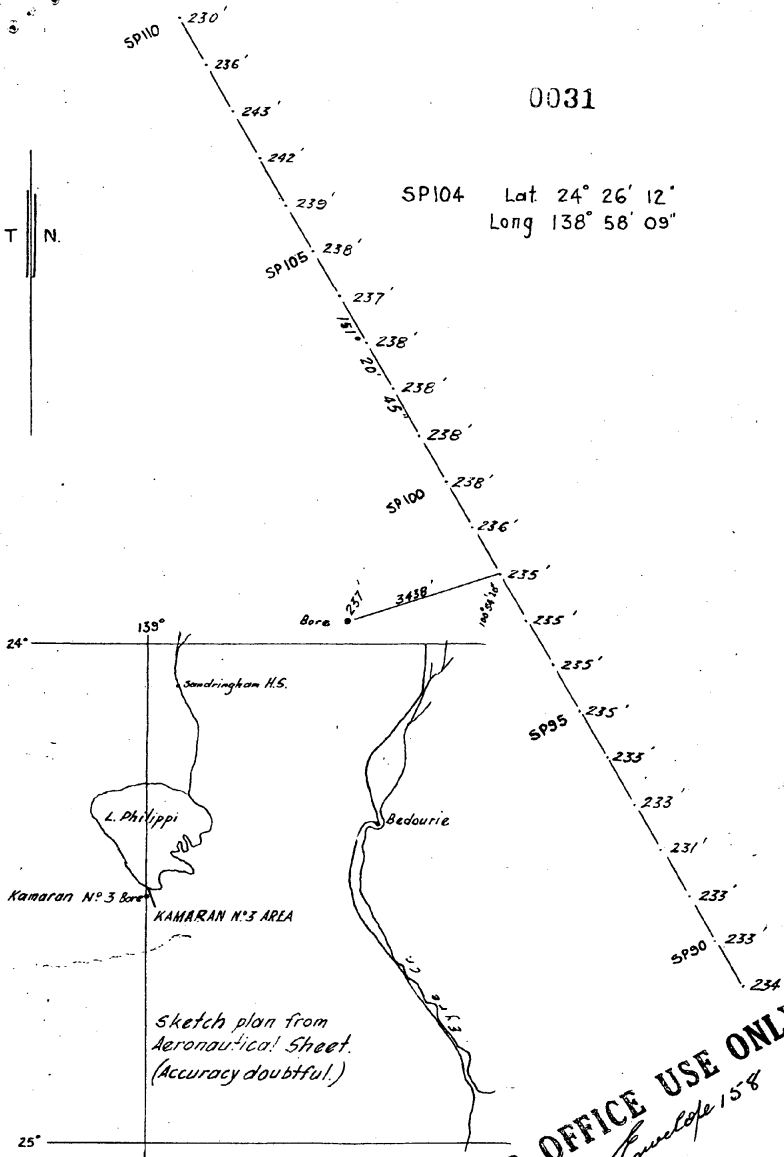
Approved	Passed	Scale: 1" = 32 M
	<i>[Signature]</i>	59-410
	Dm.	
	Tcd.	
	Ckd.	20-2/8
Director	Enl.	Date 27-11-59

No. Amendment Ext. Date

0031

T N.

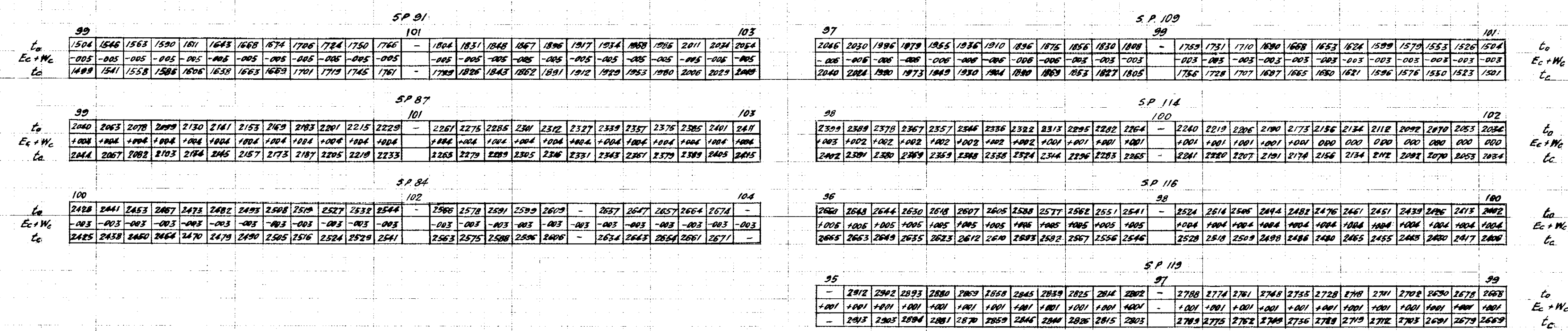
SPI04 Lat. $24^{\circ} 26' 12''$
Long $138^{\circ} 58' 09''$



FOR OFFICE USE ONLY
12. Envelope 158

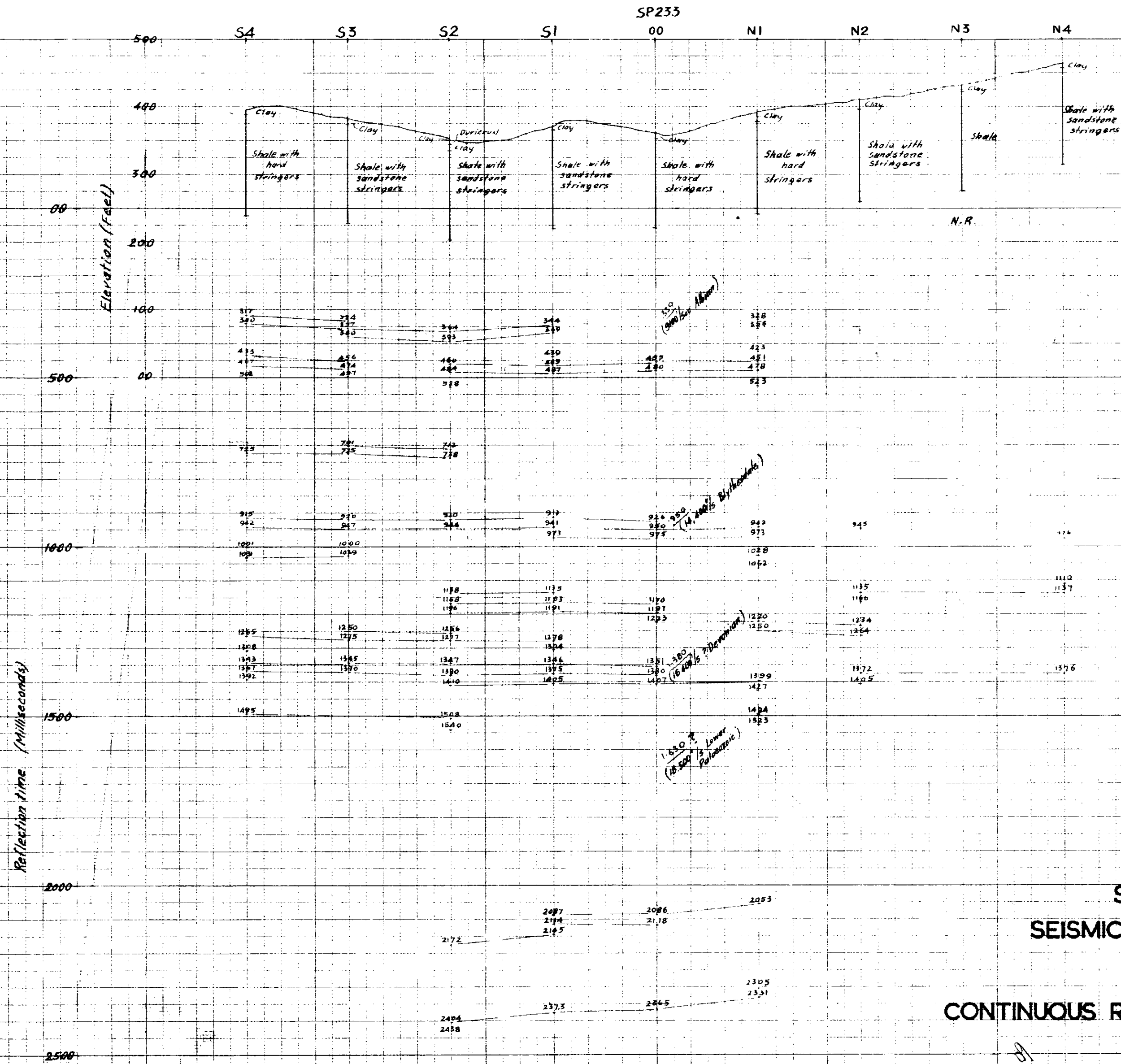
GREAT ARTESIAN BASIN SEISMIC SURVEY
KAMARAN N°3 AREA

S2529
994.3



$V_1 = 6400 \frac{1}{\text{sec}}$
 $V_2 = 9100 \frac{1}{\text{sec}}$
 $V_3 = 13600 \frac{1}{\text{sec}}$
 $V_4 = 18700 \frac{1}{\text{sec}}$
 $L_1 = 482 \text{ sec}$
 $L_2 = 1017 \text{ sec}$
 $L_3 = 1398 \text{ sec}$
 $t_2 = \frac{24 \cdot \cos 42^\circ}{V_1}$
 $t_3 = \frac{24 \cdot \cos 43^\circ}{V_1} + \frac{24 \cdot \cos 43^\circ}{V_2}$
 $t_4 = \frac{24 \cdot \cos 44^\circ}{V_1} + \frac{24 \cdot \cos 44^\circ}{V_2} + \frac{24 \cdot \cos 44^\circ}{V_3}$
 $h_1 = 2080'$
 $h_2 = 2712'$
 $h_3 = 2877'$
 $\text{of } V_2 = 1900' \quad (\text{bearing star})$
 $V_2 = 4610'$
 $V_4 = 7190'$

L60-129
9942



ENV. 158-3
 Envelope 158
 6

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S.A. DEPARTMENT OF MINES

SEISMIC SURVEY - GREAT ARTESIAN BASIN

INNAMINCKA DOME

CONTINUOUS REFLECTION PROFILE - TIME CROSS SECTION

Horizontal Scale = 400 ft to 1 cm.

Estimated Reflection times at SP 2534 from Refraction depths and Well Shot Velocities shown thus:

20-70-1960

BM 24 BM 23 BM 22 BM 21 BM 20 BM 19 BM 18 BM 17 BM 16 BM 15 BM 14 BM 13 BM 12 BM 11 BM 10 BM 9 BM 8 BM 7 BM 6 BM 5 BM 4 BM 3 BM 2 BM 1 Birdsville RB 9A

Elevation above sea level (feet)

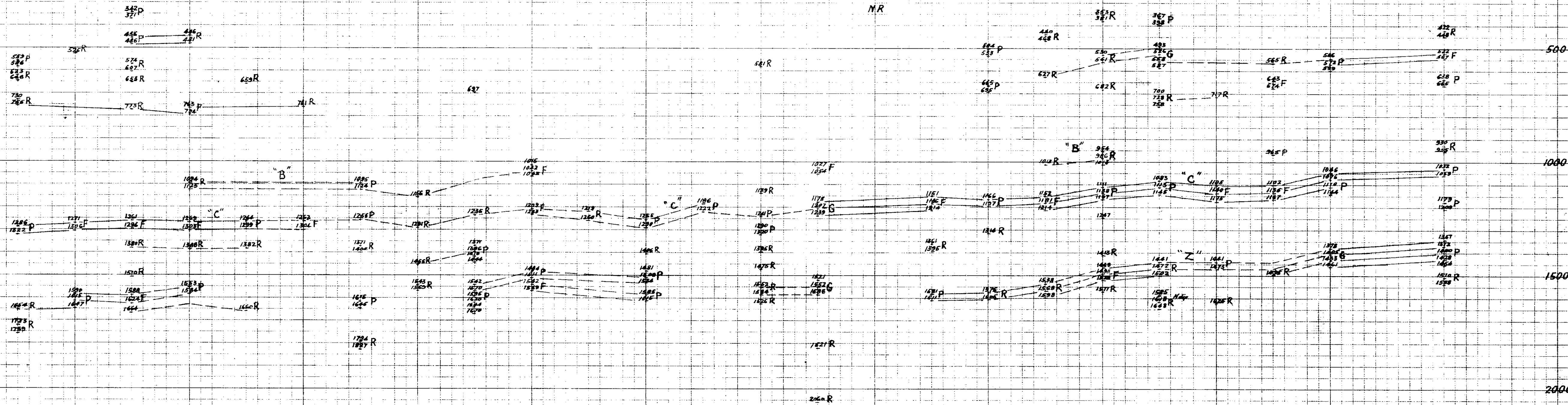
Elevation above sea level (feet)

Sandy clay Sand Sandy shale	Clay Sand & silt	Sandy clay Silt Shale	Clay Sand & silt	Clay Sand Shale	Clay & sand Brown shale	Sandy clay Sand & silt Shale	Clay Sandy clay Shale and Sandy shale	Clay & sand Brown & white shale	Clay & sand Brown shale White shale	Clay & sandy clay Shale and sandy shale	Sandy clay Sand with same clay Sandy shale Shale & mudstone alongside	Clay & sand Brown & white shale	Clay Sandy clay Sandy clay with bands of sand Shale Silt & mudstone alongside	Clay Sand, clay & silt Sandy pink shale	Sandy clay Sand Sandy clay, silt and gravel Shale	Clay Clay, sand & silt Pink shale White shale with limestone	Sandy clay Sand Pink & gray shale Mudstone	Clay & sand Sand & silt Pink & gray shale Mudstone	Clay Sand and silt Mudstone No circulation	Clay Sand Clay & gravel Shale with hard bands	Clay Sand & silt Mudstone Yellow shale	Clay Sand & silt Mudstone Yellow shale	Sandy clay Mudstone Shale	Clay Gravel yellow shale Darker 100
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Seismic Datum

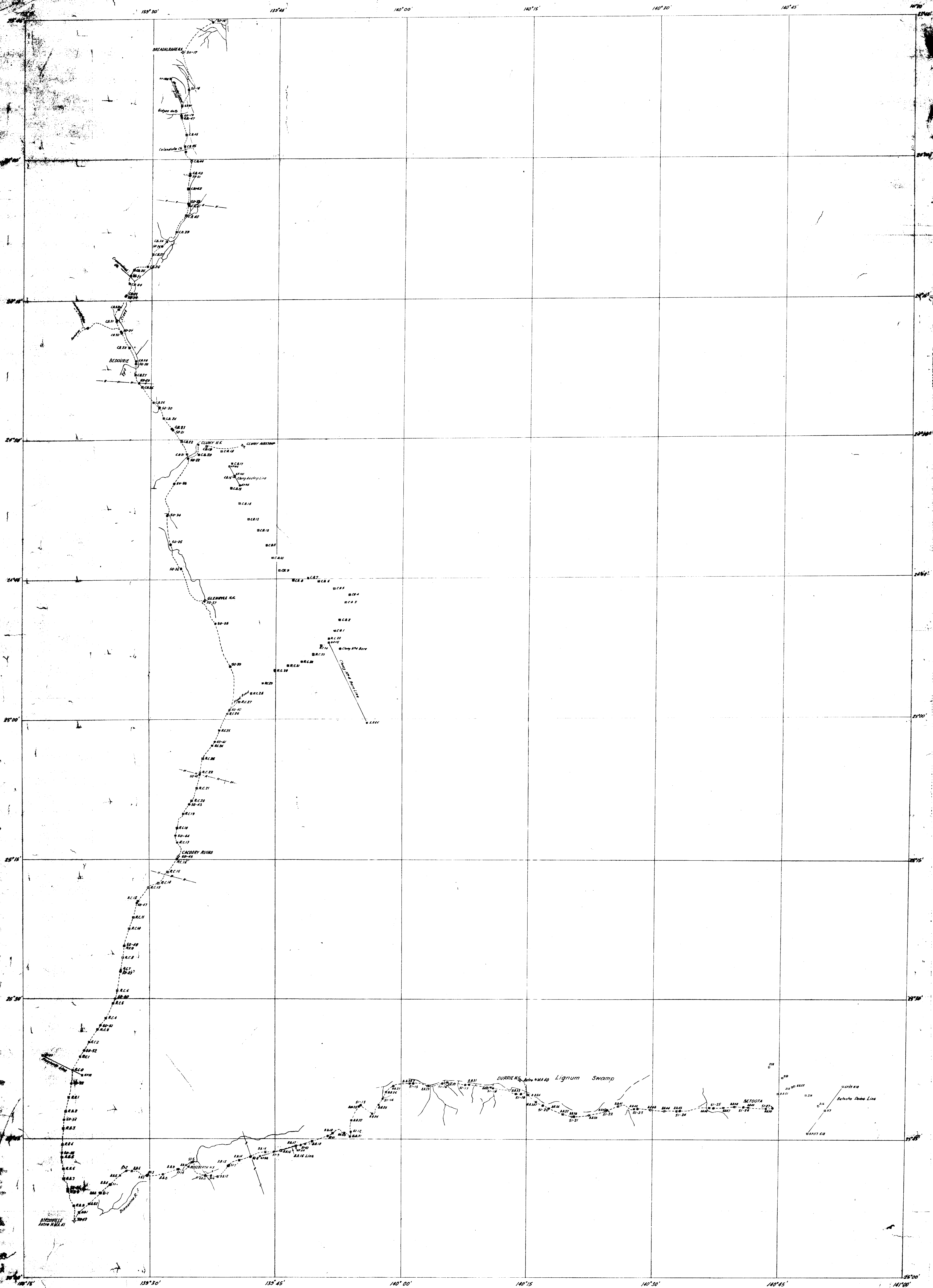
Reflection Time (milliseconds)

Reflection Time (milliseconds)



S.A. DEPT. OF MINES
SEISMIC SURVEY - GREAT ARTESIAN BASIN
BIRDSVILLE - SOUTH
REFLECTION CORRELATION SURVEY —
TIME CROSS SECTION
HORIZONTAL SCALE 1CM = 0.8 MILE (APPROX.)

FOR OFFICE USE ON
ENV. 158-4



NOTE: This is not an accurate survey map.
Shot points have been identified on 1"=1 mile
uncontrolled photo-mosaics and scaled down.
An accurate survey map will be presented
with the final report.

□ SCS Seismic Shot Point
○ S-1 B.M.R. Gravity Station

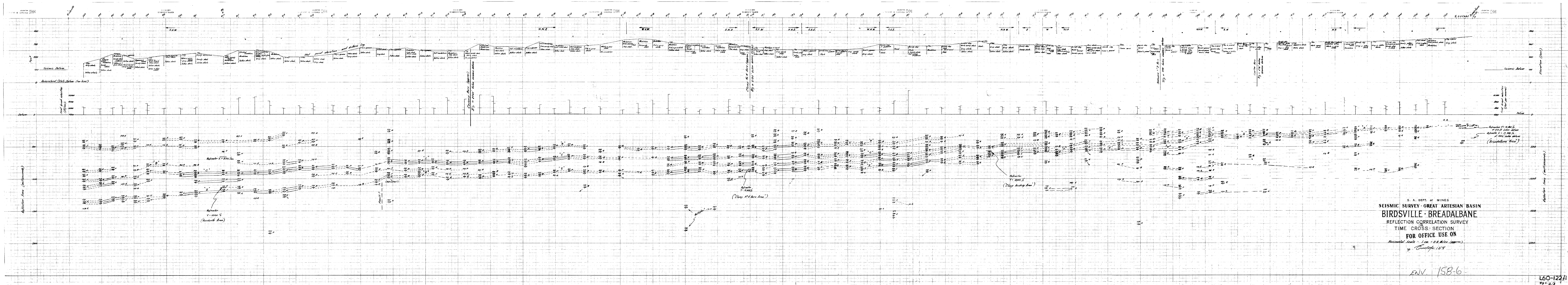
S. A. Dept. of Mines
Seismic Survey - Great Artesian Basin
Preliminary Shot Point Location Map
Breadalbane - Birdsville - Betoota Traverses
Scale 1 in = 4 miles

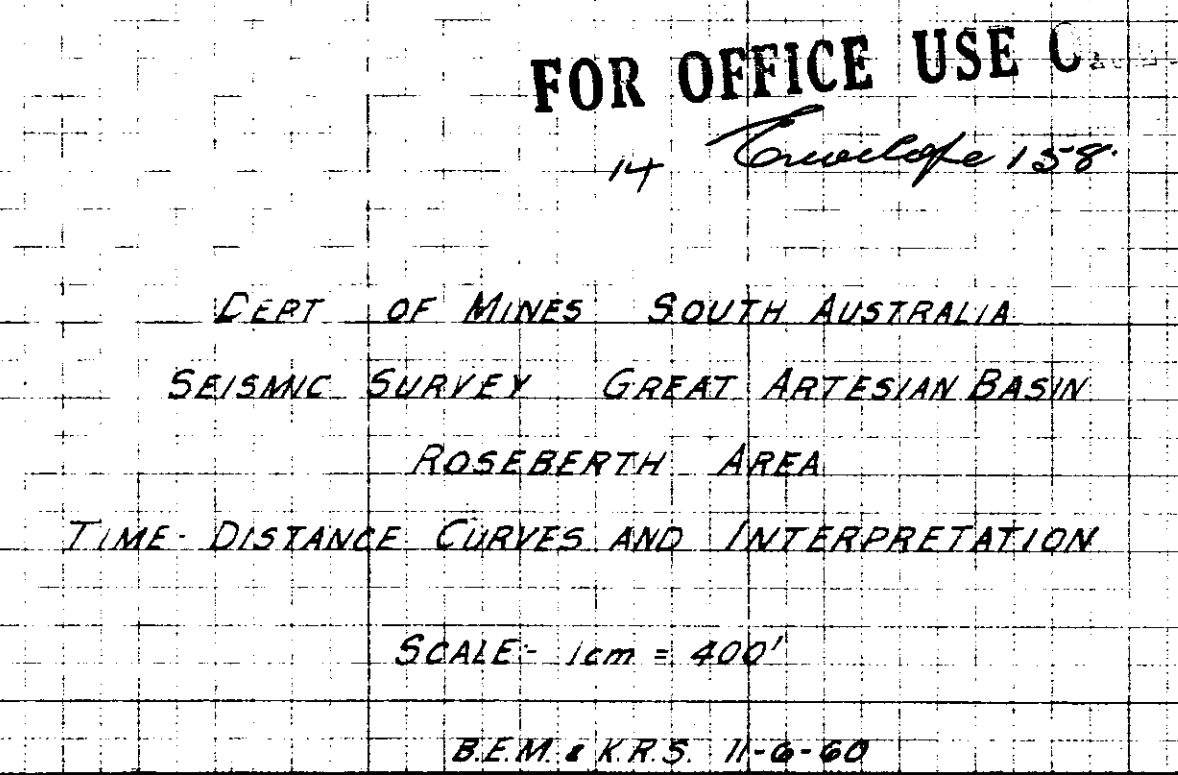
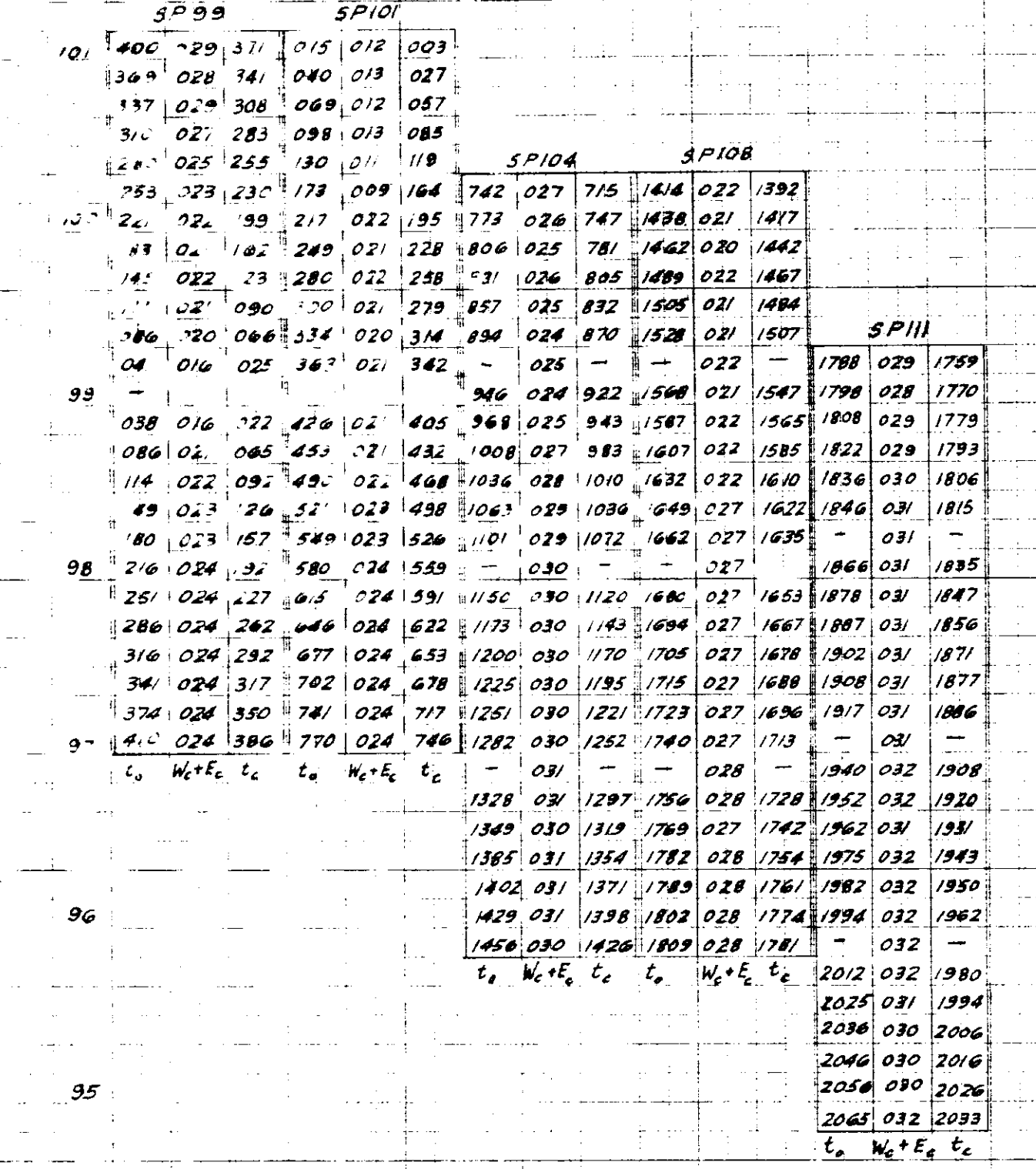
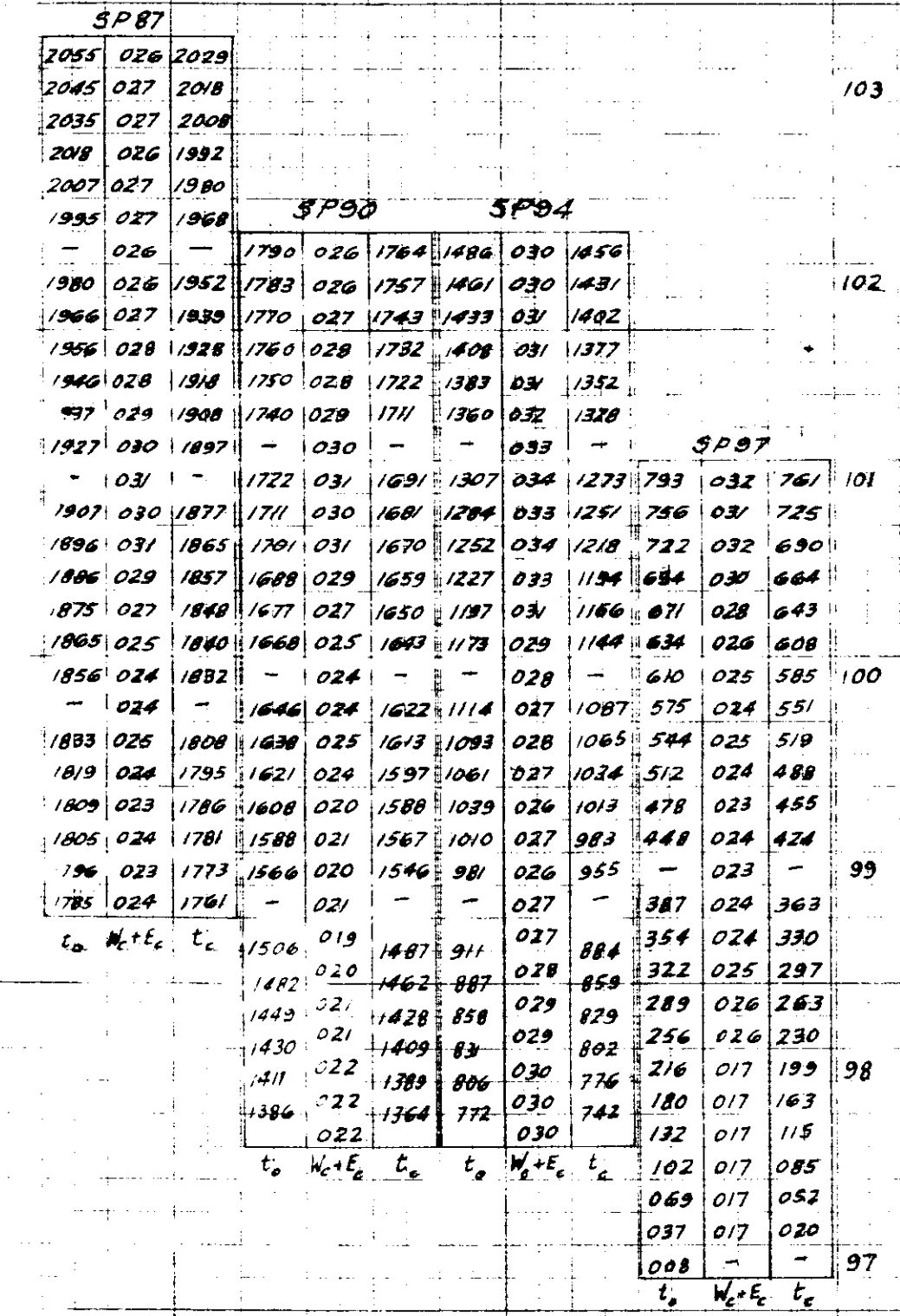
FOR OFFICE USE ONLY
21 *Ametop 158*

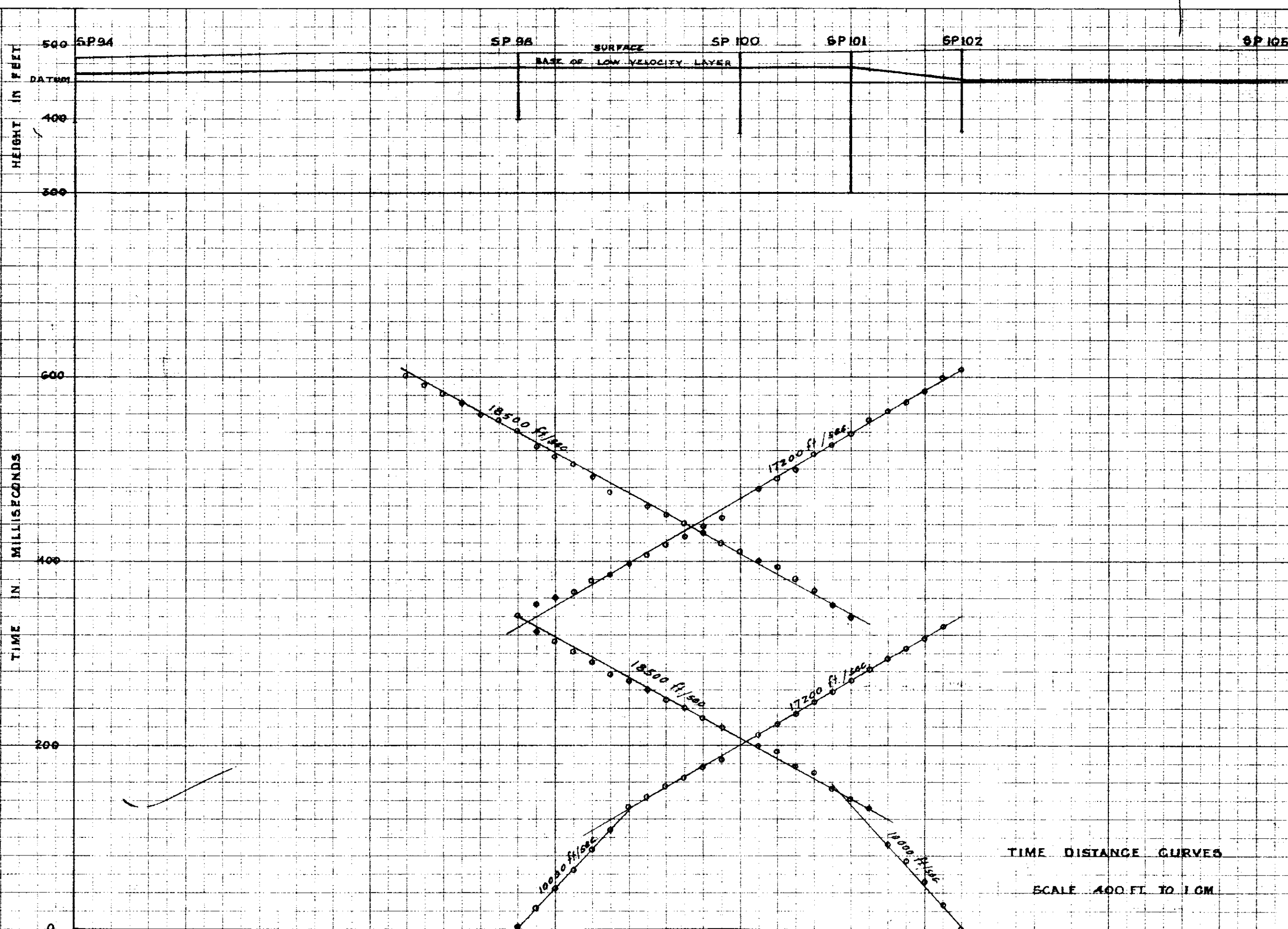
1/7/60

L60-125
994-B

ENV. 158-5





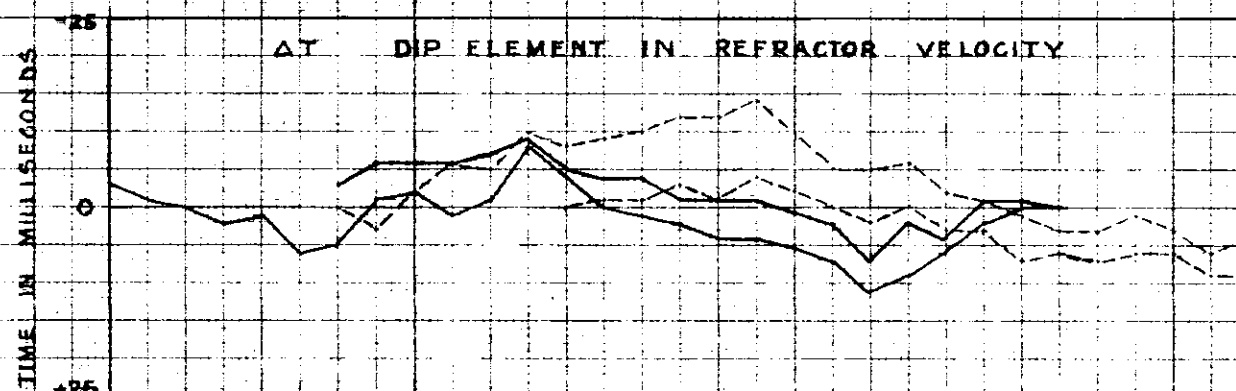


TIME DISTANCE CURVES

SCALE 400 FT. TO 1 CM.

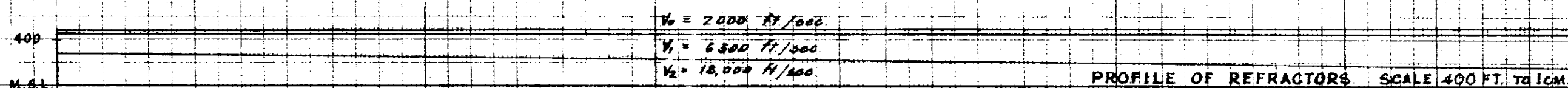
SP 98														98	100
T ₀	020	033	055	075	097	119	140	150	161	170	183	192	-	-	-
E _c +W _c	017	010	010	010	010	006	006	006	006	006	006	007	-	-	-
T _c	003	023	045	066	087	109	134	144	155	164	177	185	+	+	+
SP 102														100	102
T ₀	-	218	231	240	254	266	280	291	305	316	328	342	354	-	-
E _c +W _c	-	007	007	007	007	007	007	008	008	010	011	012	013	-	-
T _c	-	211	224	233	247	259	273	283	296	306	316	330	341	+	+

SP 102														100	102
T ₀	-	206	200	184	175	159	148	139	106	090	068	046	028	T ₀	T ₀
E _c +W _c	-	006	006	006	006	006	006	007	013	015	016	018	027	E _c +W _c	E _c +W _c
T _c	-	200	194	178	169	153	142	132	093	075	052	028	001	T _c	T _c
SP 105														98	100
T ₀	349	329	318	307	295	282	275	265	254	246	235	225	-	T ₀	T ₀
E _c +W _c	005	005	005	005	005	005	005	005	005	005	005	006	+	E _c +W _c	E _c +W _c
T _c	344	324	313	302	290	277	270	260	249	241	230	219	+	T _c	T _c



SP 94														98	100
T ₀	345	359	365	372	384	390	403	413	423	432	443	453	-	-	-
E _c +W _c	005	006	006	005	005	005	005	005	005	006	006	006	+	+	+
T _c	340	354	360	367	379	385	398	408	418	427	438	447	+	+	+
SP 105														100	102
T ₀	-	484	495	505	520	532	546	559	570	581	595	610	620	-	-
E _c +W _c	-	006	006	006	006	006	006	007	007	008	010	011	012	-	-
T _c	-	478	489	499	514	526	539	542	563	572	585	599	608	+	+

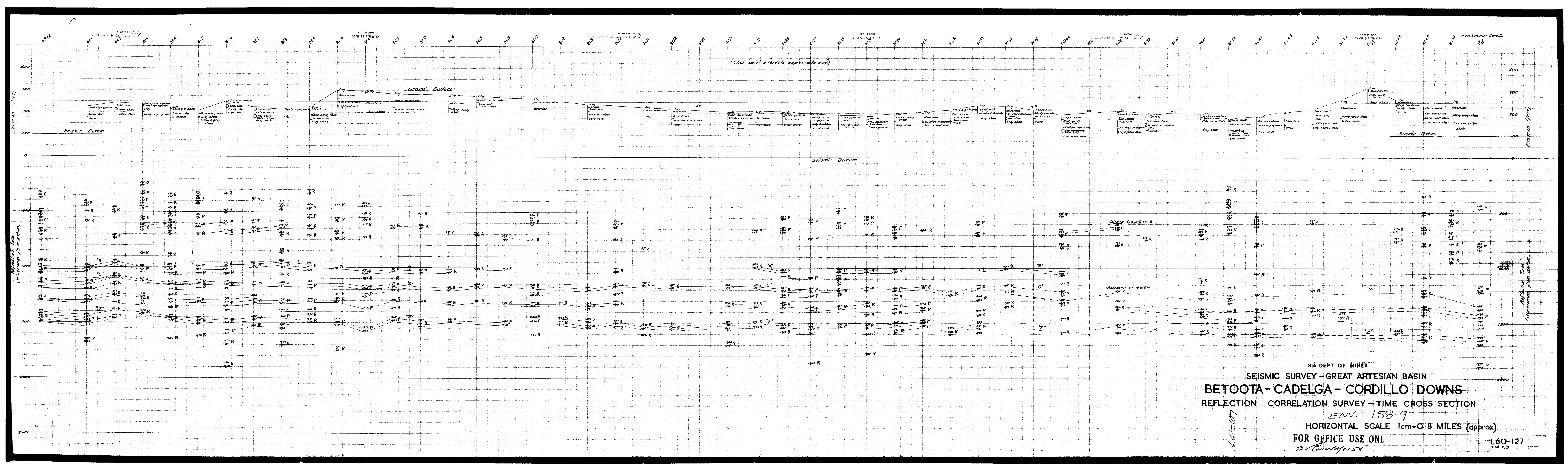
SP 105														98	100
T ₀	-	466	456	446	437	427	417	408	401	388	378	359	346	T ₀	T ₀
E _c +W _c	-	006	006	006	006	007	007	007	007	007	007	007	007	E _c +W _c	E _c +W _c
T _c	-	460	450	440	431	420	410	401	394	381	367	352	339	T _c	T _c
SP 101														98	100
T ₀	606	597	587	578	568	560	548	531	519	511	498	480	-	T ₀	T ₀
E _c +W _c	006	006	006	006	006	006	006	006	006	006	006	006	-	E _c +W _c	E _c +W _c
T _c	600	591	581	572	560	554	542	525	513	505	492	474	-	T _c	T _c

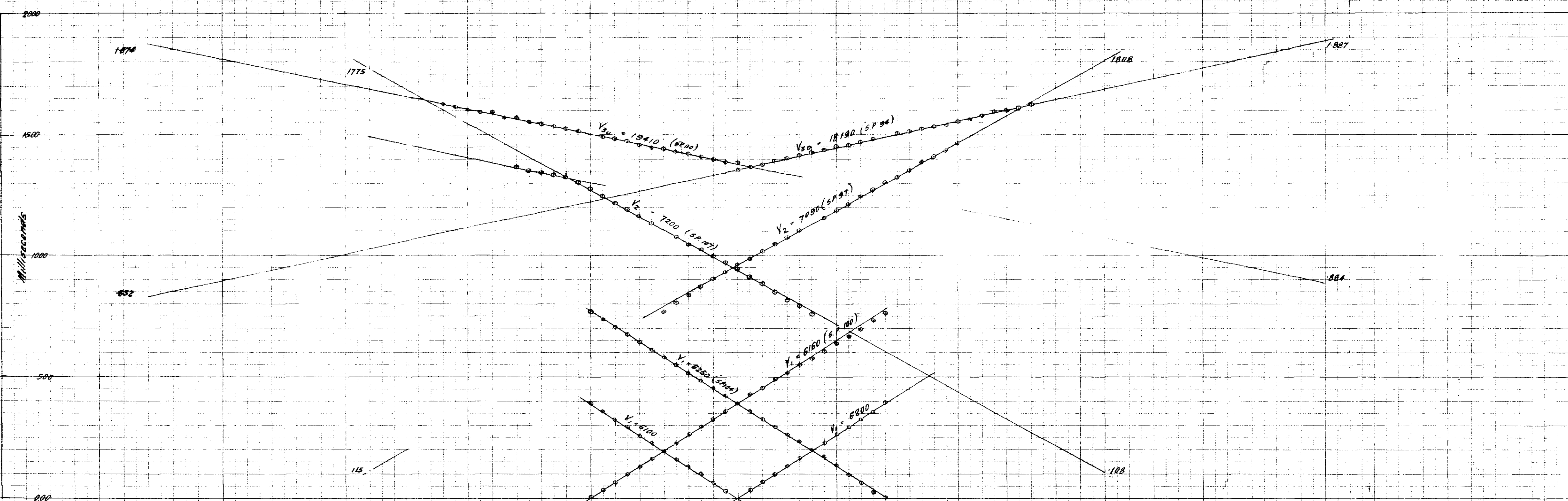


DEPARTMENT OF MINES - SOUTH AUSTRALIA
 GREAT ARTESIAN BASIN SEISMIC SURVEY
BOULIA AREA
 TIME DISTANCE CURVES AND INTERPRETATION
 D.M.P. 6-5-60

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25
 ENCL. 158-8
 ENV. 158-8



[illegible]

S. A. DEPT OF MINES

SEISMIC SURVEY - GREAT ARTESIAN BASIN

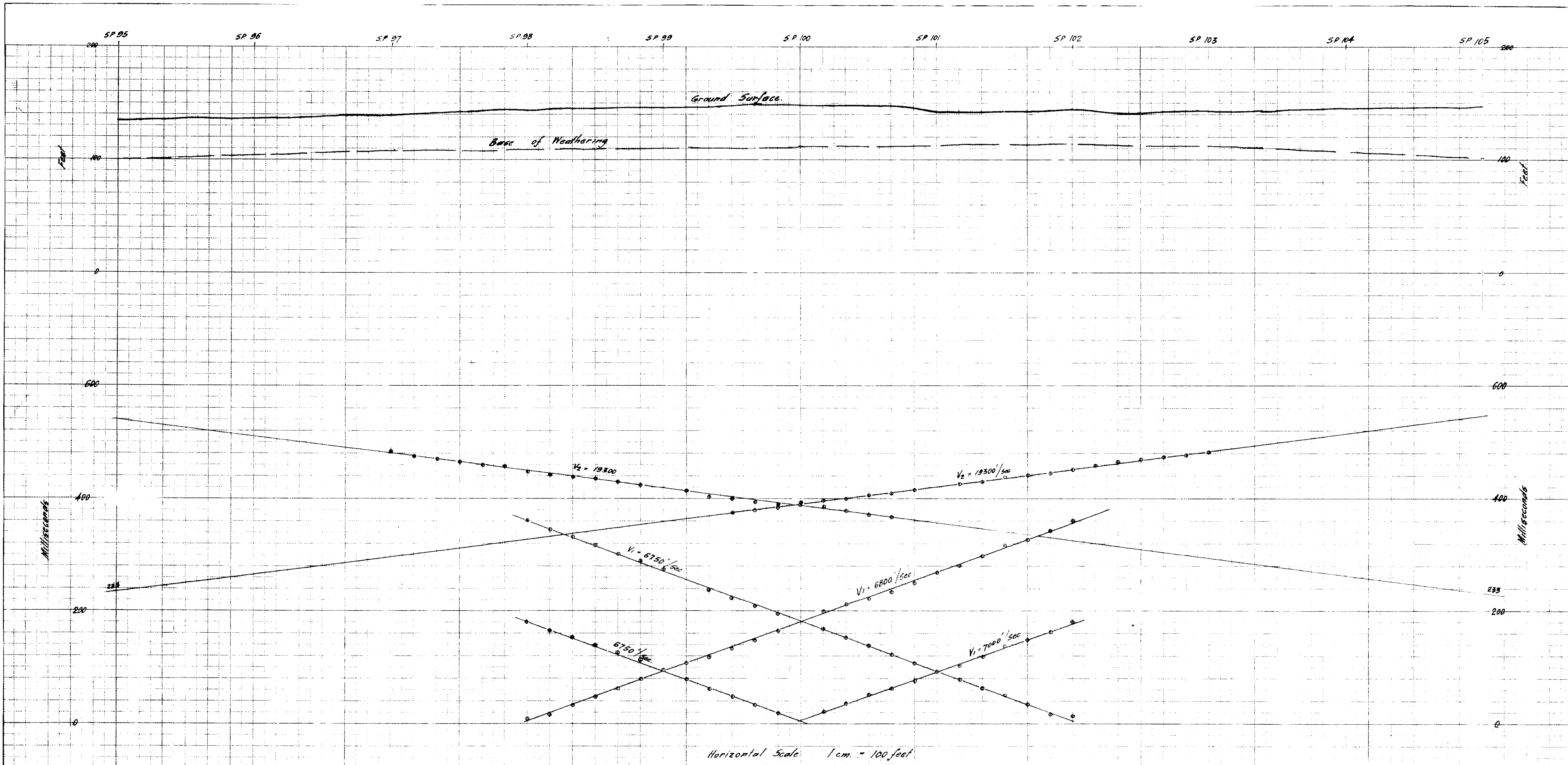
CANNUWAUKANINNA BORE 60382

TIME - DISTANCE CURVES AND PRELIMINARY REFRACTION & REFLECTION DEPTH PLOT

26-1-8 ENV 158-10

Horizontal Scale: 1 cm. = 400 ft.

60-382
Ca



Depth to V_2 refractor = 850 feet below datum (L.W.O.S.T. Pt. Adelaide) (from average intercept time & standard formula)
 = 1020 feet below surface at S.P. 100

S.P. 100

SP 98	SP 99	SP 100	SP 101	SP 102
t_0 193 179 167 153 140 126 112 093 077 063 048 034	037 051 066 077 091 106 116 132 150 162 176 194	t_0		
W_c -013 -014 -014 -014 -014 -014 -014 -015 -015 -015 -015 -015	-015 -015 -015 -015 -015 -015 -013 -013 -013 -013 -013 -013	W_c		
t_c 180 165 155 139 126 112 099 079 062 049 033 019	022 036 051 062 076 093 103 119 137 149 165 181	t_c		

S.P. 102

SP 98	SP 99	SP 100	SP 101	SP 102
t_0 374 359 346 331 316 304 289	253 239 224 210	184 168 154 138 123 108 091 076 063 047 030 026	t_0	
W_c -018 -014 -014 -014 -014 -014 -014	-015 -015 -015 -015 -015 -015 -015	-015 -015 -015 -015 -015 -013 -013 -013 -013 -013 -013	W_c	
t_c 361 345 332 317 302 290 275	238 224 209 195	189 133 139 123 108 095 078 063 050 034 017 013	t_c	

S.P. 98

SP 98	SP 99	SP 100	SP 101	SP 102
022 030 047 062 077 093 110 122 133 149 164 180	214 227 237 249 265 282 294 311 330 340 356 374	t_0		
-013 -014 -014 -014 -014 -014 -014 -015 -015 -015 -015 -015	-015 -015 -015 -015 -015 -013 -013 -013 -013 -013 -013 -013	W_c		
009 016 033 048 063 079 096 108 118 134 149 165	199 212 222 234 250 263 281 298 317 327 343 361	t_c		

S.P. 105

SP 97	SP 98	SP 99	SP 100	SP 101
t_0 518 510 505 490 485 473 464 459 454 448 441	450 441 437 431 427 423 416 411 405 396 386	t_0		
W_c -035 -035 -035 -035 -035 -036 -036 -036 -036 -036 -036	-036 -037 -037 -037 -037 -037 -037 -037 -037 -037 -037	W_c		
t_c 484 475 470 465 459 457 449 442 433 436 430 425	414 404 400 394 390 380 366 359 372 360	t_c		

S.P. 95

SP 99	SP 100	SP 101	SP 102	SP 103
374 387 400 411 415 420 429 433 436 442 445 451	460 464 472 475 480 487 493 498 502 506 511 516	t_0		
-036 -036 -036 -036 -036 -036 -036 -036 -036 -036 -036 -036	-034 -034 -034 -034 -035 -035 -034 -033 -033 -034 -034 -034	W_c		
375 379 384 393 397 400 406 409 415	426 430 438 441 445 452 459 465 469 473 477 482	t_c		

Weathering data from:

Uphole Survey S.P. 100

Weathering spreads S.P. 97, 103

Uphole times S.P. 95, 98, 102, 105

$V = 2250' / \text{sec}$

$V_1 = 6800' / \text{sec}$

$V_2 = 19300' / \text{sec}$

S.A. DEPT. OF MINES

SEISMIC REFRACTION SURVEY

WELL CREEK

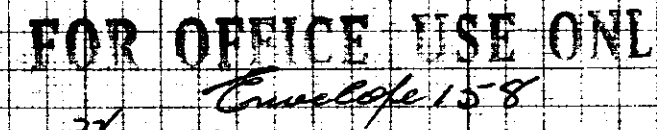
(NEAR MURREE - S.W. AUSTRALIA)

TIME-DISTANCE CURVES

FOR OFFICE USE ONLY

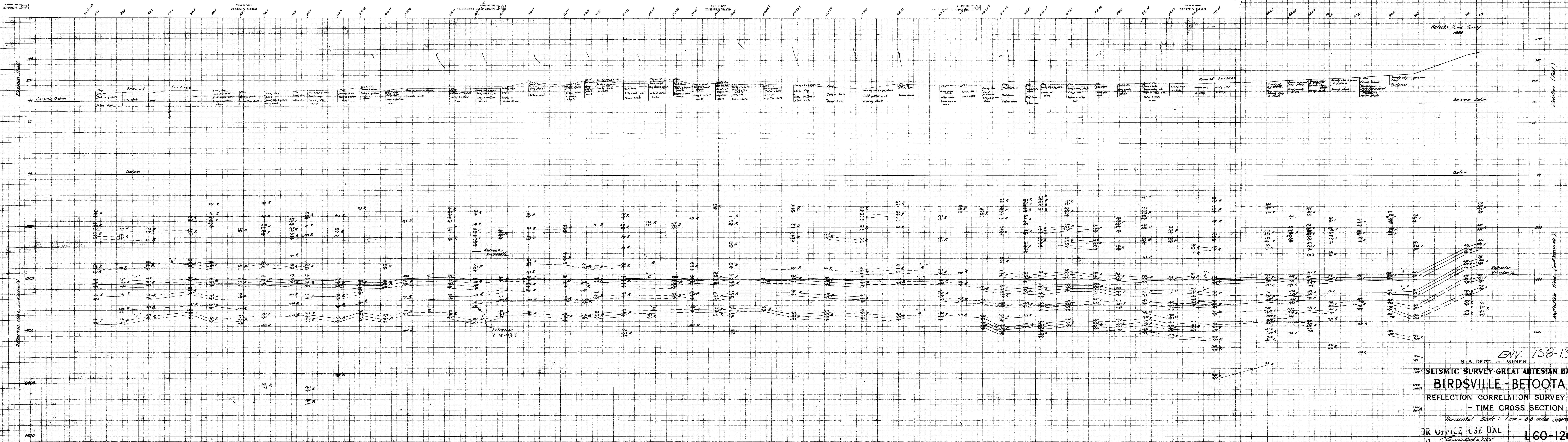
31 Contour 15' 8"

L60-97

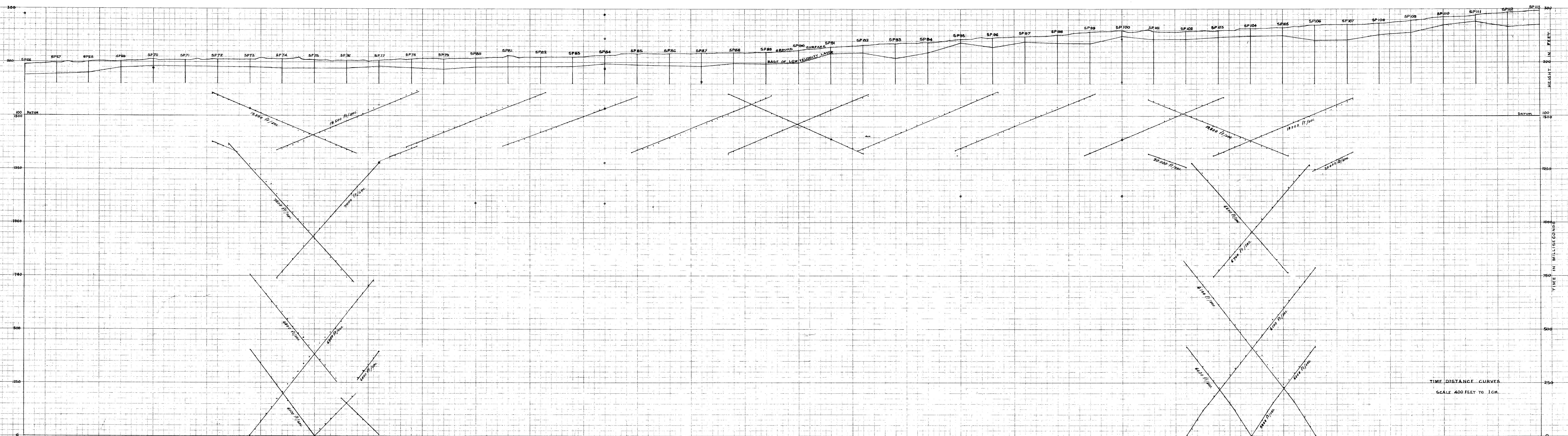


Scale: 1 cm = 400 ft

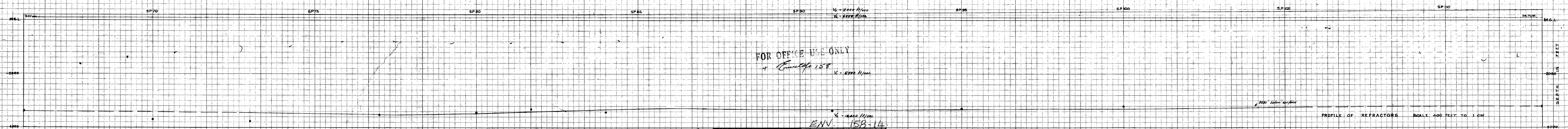
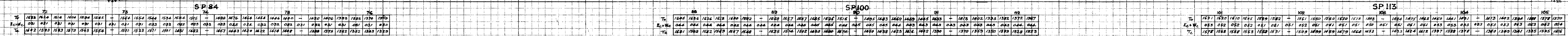
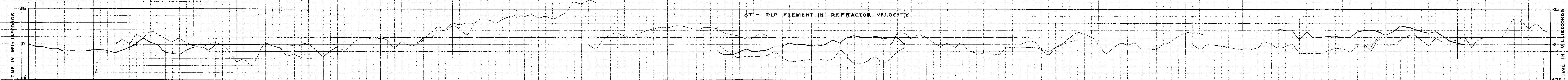
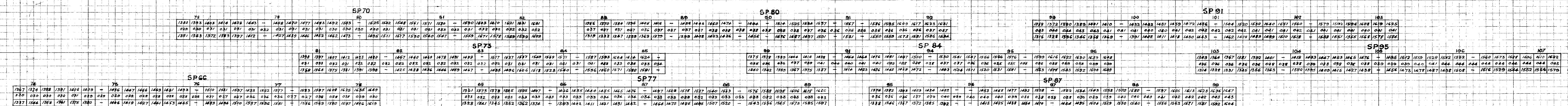
ENV. 15812



ENV. 158-13
S.A. DEPT. OF MINES
SEISMIC SURVEY: GREAT ARTESIAN BASIN
BIRDSVILLE - BETOOTA
REFLECTION CORRELATION SURVEY -
- TIME CROSS SECTION
Horizontal Scale: 1 cm = 0.9 miles (approx)
OR OFFICE USE ONLY
1. *Time Scale 1950*
L60-126
994.5



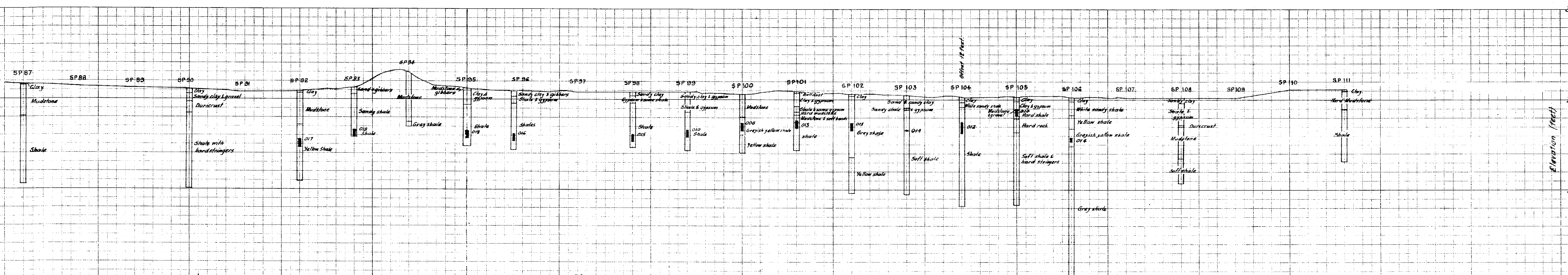
TIME DISTANCE CURVES
SCALE 400 FEET TO 1 CM



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+ Envelope 158
V. = 5700 ft/sea

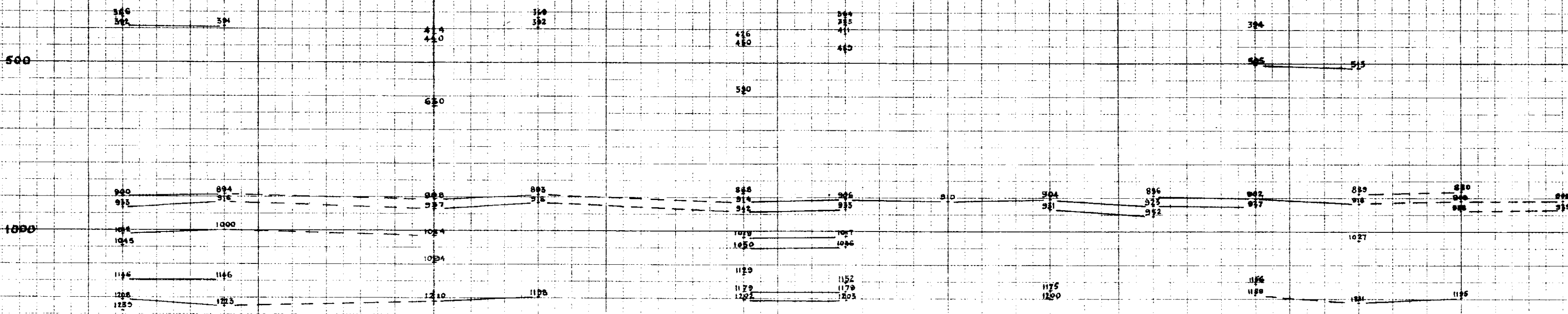
DEPARTMENT OF MINES - SOUTH AUSTRALIA
GREAT ARTERIAN BASIN SEISMIC SURVEY
CLUNY AREA
TIME DISTANCE CURVES AND INTERPRETATION
D.M.P. 26-5-60

L60-70



Approximate depth scale (feet)
3420
3640
3860
4080
4300
4520
4740

Reflection time (milliseconds)



S.A. Dept. of Mines
Seismic Survey - Great Artesian Basin
Roseberth Area
Reflection Cross Section
Horizontal scale 1 cm. = 400 ft.
Working Datum - 100 feet above Queensland State Datum

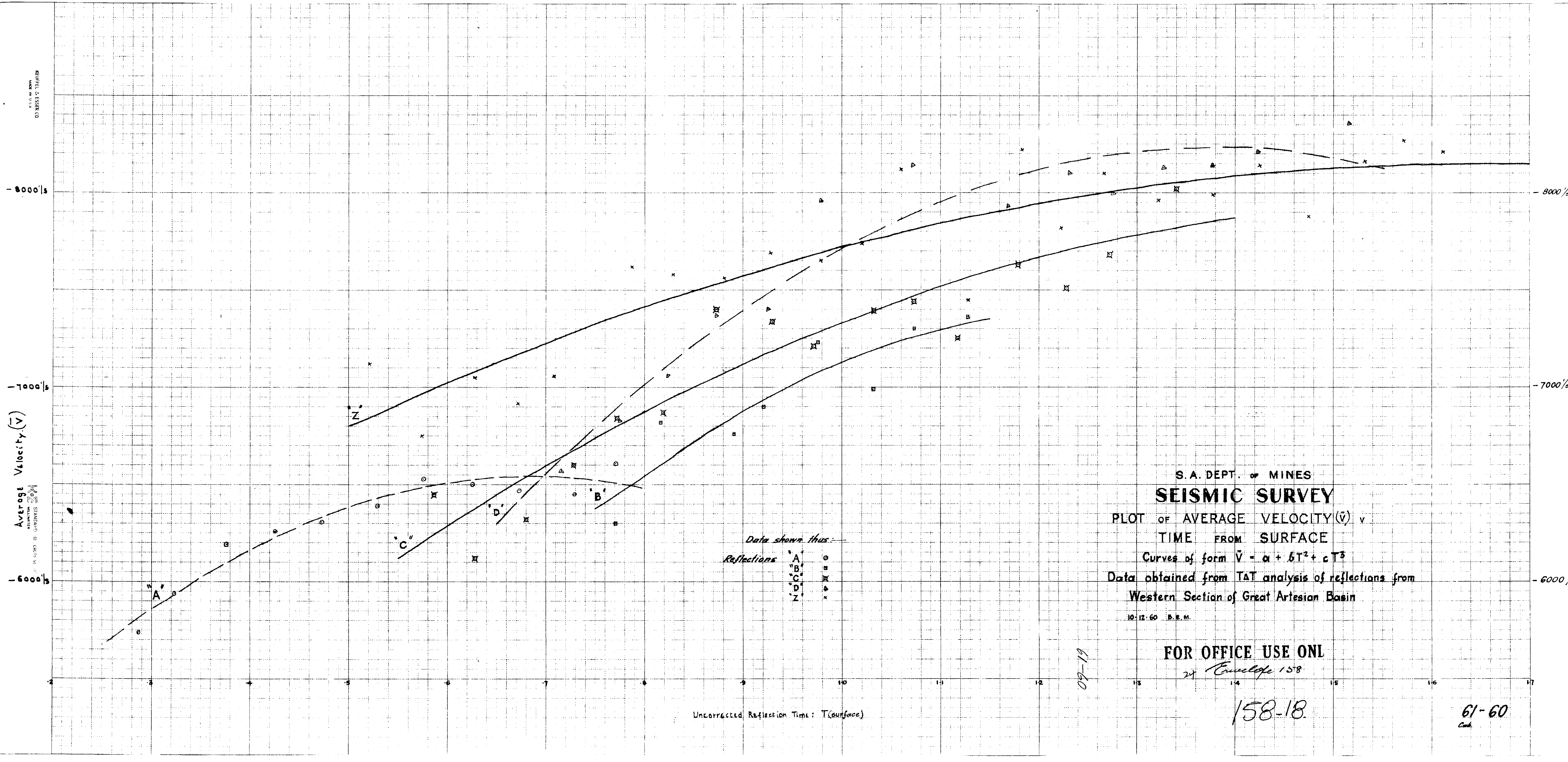
22 Envelope 158

ENV. 158-17

60-489

994.3

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



6000'
STANDARD CROSS SECTION
SURFACE

4000'

2000'

0'

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

6000'

4000'

2000'

0'

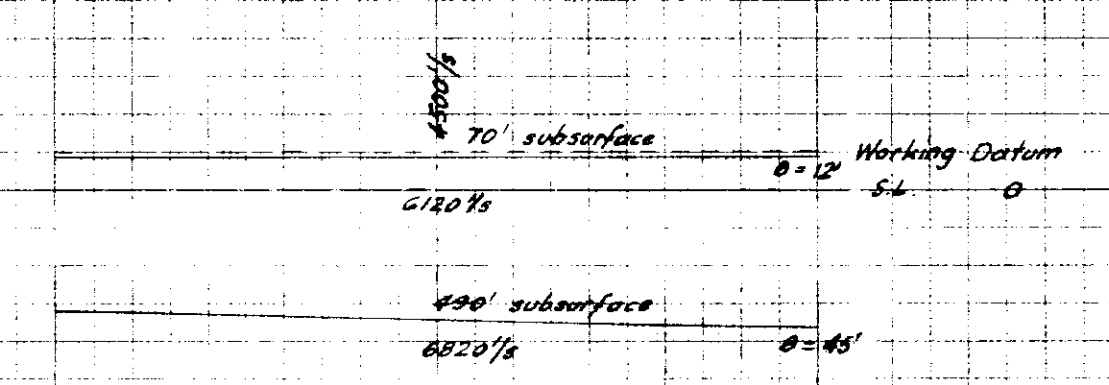
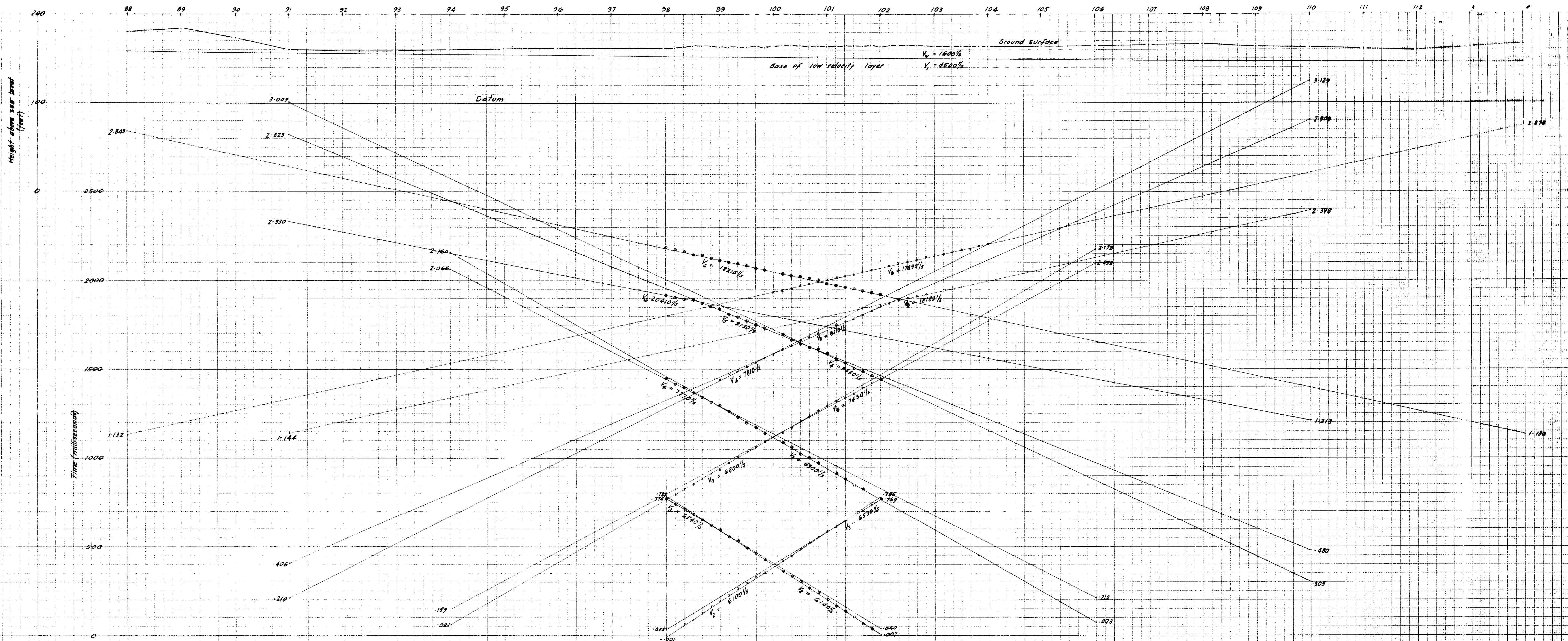
Unweighted Reflection Time

S.A. DEPT. OF MINES
SEISMIC SURVEY
PLOT OF DEPTH (') V TIME FROM SURFACE
Curves of form $\tau = aT + bT^2 + cT^3$
Data obtained from TAT —
— ANALYSIS OF REFLECTIONS FROM
WESTERN SECTION OF GREAT ARTESIAN BASIN
15-12-58 R.H.M.

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ENV 158-19

61-29
OK



SP 98	010 039 069 089 129 146 198 229 268 299 330 359 005 005 014 016 016 016 016 016 016 016 016 016 015 044 077 105 145 181 212 243 282 314 346 374	421 449 489 526 556 590 614 655 675 704 740 772 017 017 017 018 018 018 018 019 019 018 019 019 438 466 508 542 572 608 632 666 696 722 759 781	L_c $E_c + W_c$ L_c
SP 96	762 792 824 852 885 917 945 975 1008 1035 1064 1091 014 014 014 015 015 015 014 014 014 015 015 015 776 806 836 867 900 932 959 989 1022 1050 1079 1106	1142 1169 1210 1235 1267 1294 1320 1339 1365 1395 1426 1456 016 016 016 016 015 015 015 015 017 017 015 017 016 1158 1185 1226 1250 1282 1309 1335 1355 1382 1410 1449 1472	L_c $E_c + W_c$ L_c
SP 91 From SP 98 to SP 103	1461 1463 1489 1515 1543 1563 1585 1611 1636 1663 1687 1710 011 011 011 012 013 012 013 014 014 014 014 014 1482 1474 1500 1527 1556 1578 1598 1625 1647 1677 1701 1724	1750 1769 1789 1806 1828 1858 1871 1892 1904 1912 1922 1930 014 014 014 014 014 014 015 016 016 016 016 015 1764 1783 1803 1820 1842 1872 1886 1908 1920 1928 1938 1953	L_c $E_c + W_c$ L_c
SP 88 From SP 100 to SP 104	1954 1945 1954 1978 1983 1994 2006 2018 2023 2035 2050 2059 013 013 013 013 013 013 013 013 013 013 013 013 1947 1958 1967 1991 1996 2007 2019 2031 2036 2049 2063 2072	2082 2098 2104 2114 2132 2141 2148 2158 2171 2174 2197 2207 014 014 014 014 014 013 013 013 013 013 014 014 2090 2112 2118 2128 2146 2154 2161 2171 2184 2187 2211 2221	L_c $E_c + W_c$ L_c

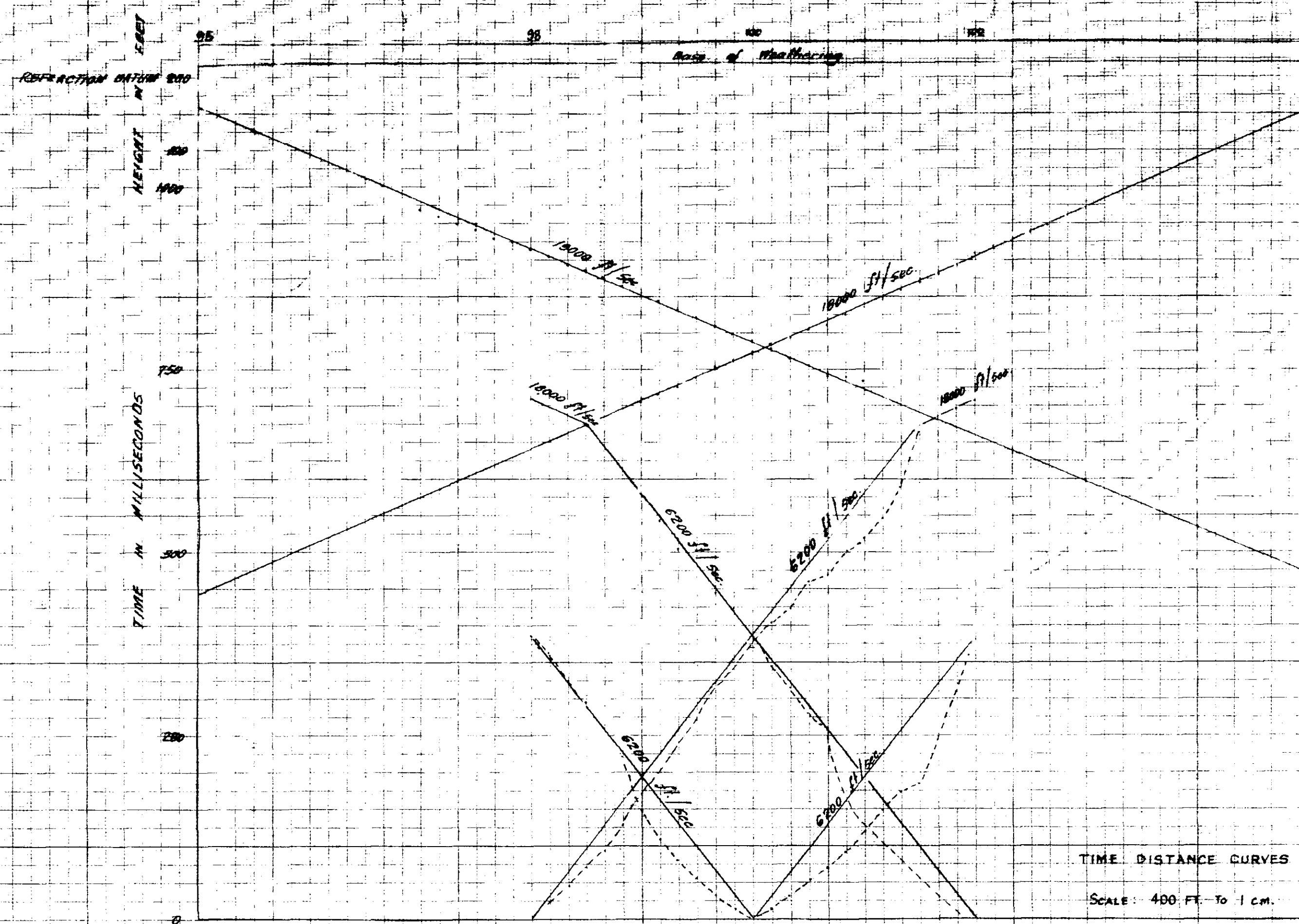
U.S. DEPT. OF MINES
SEISMIC SURVEY - GREAT ARTESIAN BASIN
REFRACTION SURVEY NEAR S.P. BEIG (New Roseberry)

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27 *Encl. 158*

HORIZONTAL SCALE 1 cm = 200 feet

ENV. 158-20
41-3

61-3
114.3



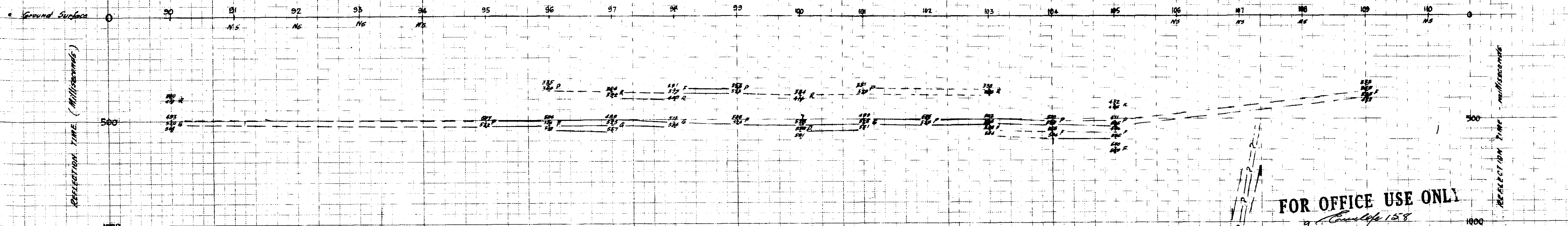
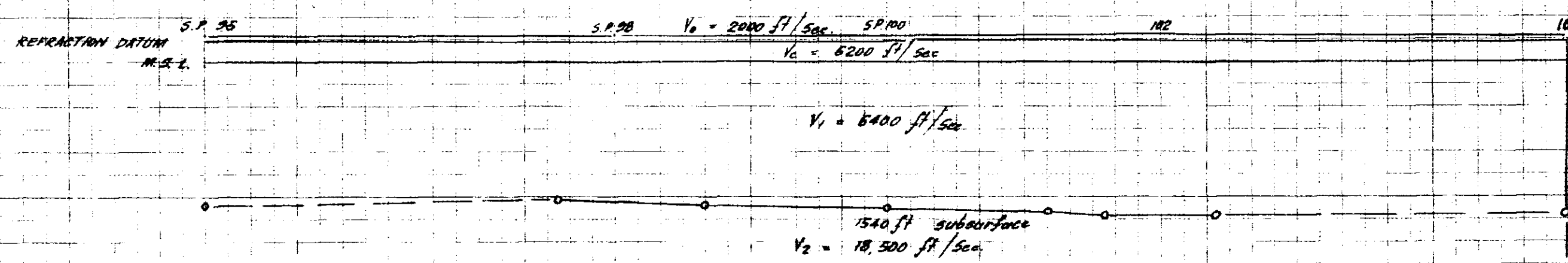
SP 95

99	749	749	751	743	757	767	760	791	799	809	817	828	
T_0	004	004	004	004	004	004	005	005	005	004	004	003	
W_0+L_0	788	715	727	759	783	763	775	786	794	805	813	825	
T_0													
W_0+L_0	851	864	874	886	898	913	924		944	952	966	977	
T_0	003	003	003	003	003	003	003	003	003	003	003	003	
W_0+L_0	840	861	871	882	895	910	921		941	949	963	974	
T_0													

ΔT DIP ELEMENT IN REFRACTOR VELOCITY

SP 105

99	850	840	827	817	807	797	788	774	764	752	747	740	T_0
	007	007	007	007	007	008	008	008	007	007	006	006	W_0+L_0
	843	853	820	810	800	789	780	766	757	745	741	734	T_0
97	973	966	958	950	940	932	922	914	902	894	885	871	T_0
	008	008	008	008	007	007	007	007	007	007	007	007	W_0+L_0
	870	858	850	842	832	825	815	807	806	807	808	804	T_0



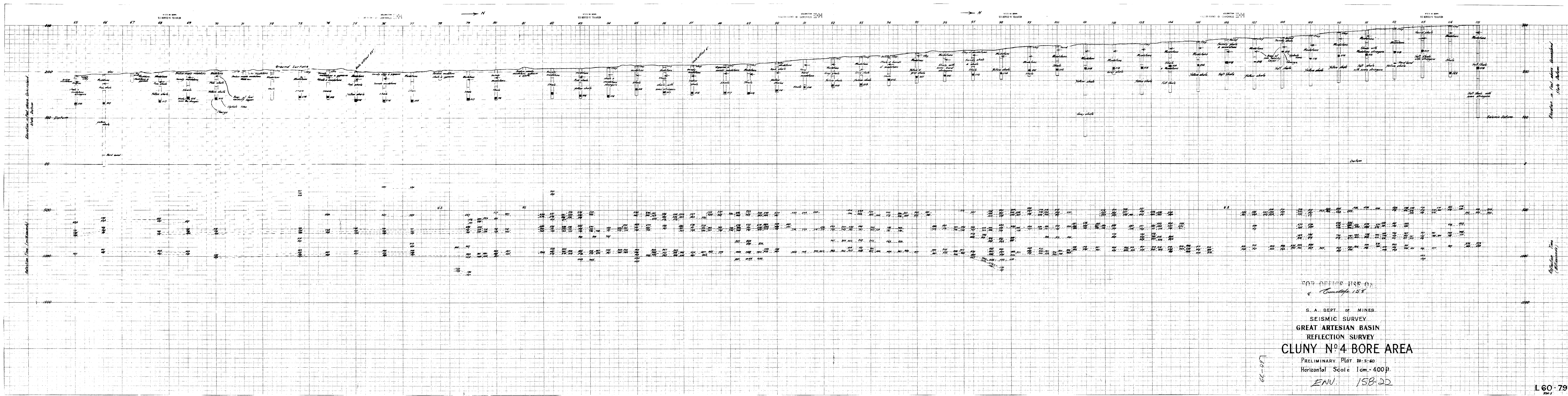
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y. 158-21

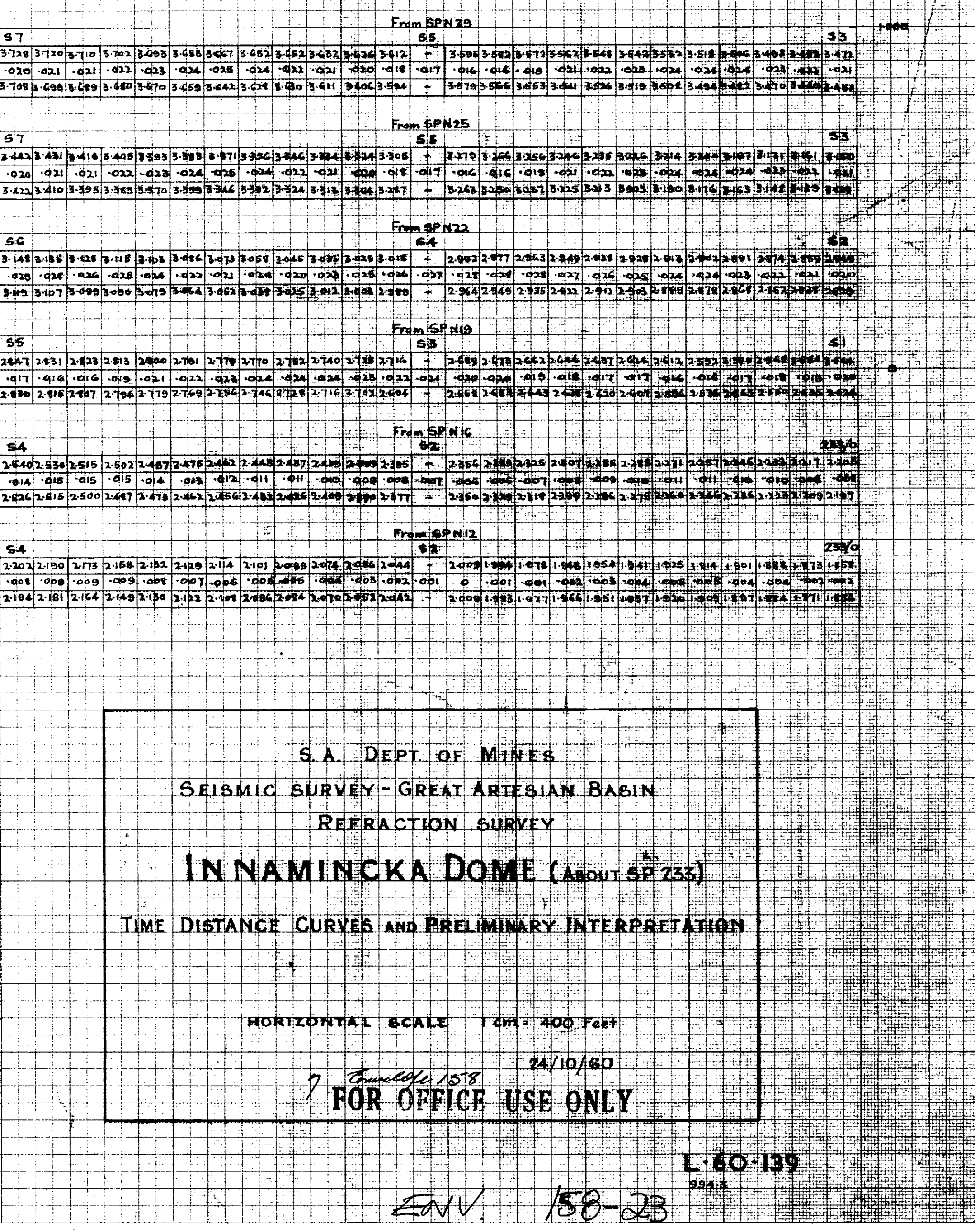
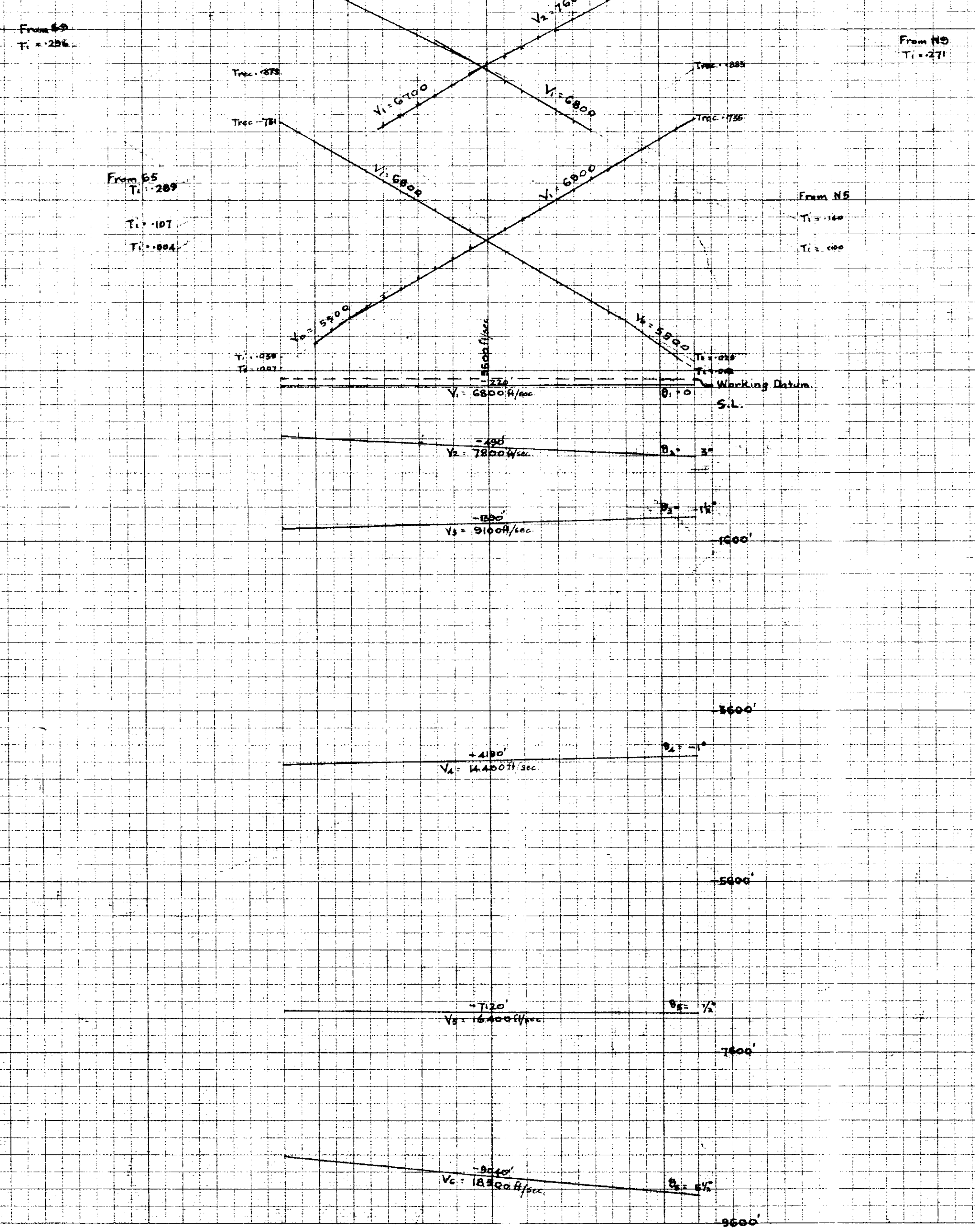
S. A. DEPT. OF MINES
GREAT ARTESIAN BASIN SEISMIC SURVEY
KAMARAN DOWNS AREA
TIME DISTANCE CURVES AND INTERPRETATION
AND REFLECTION TIME CROSS-SECTION

ENV. 158-21

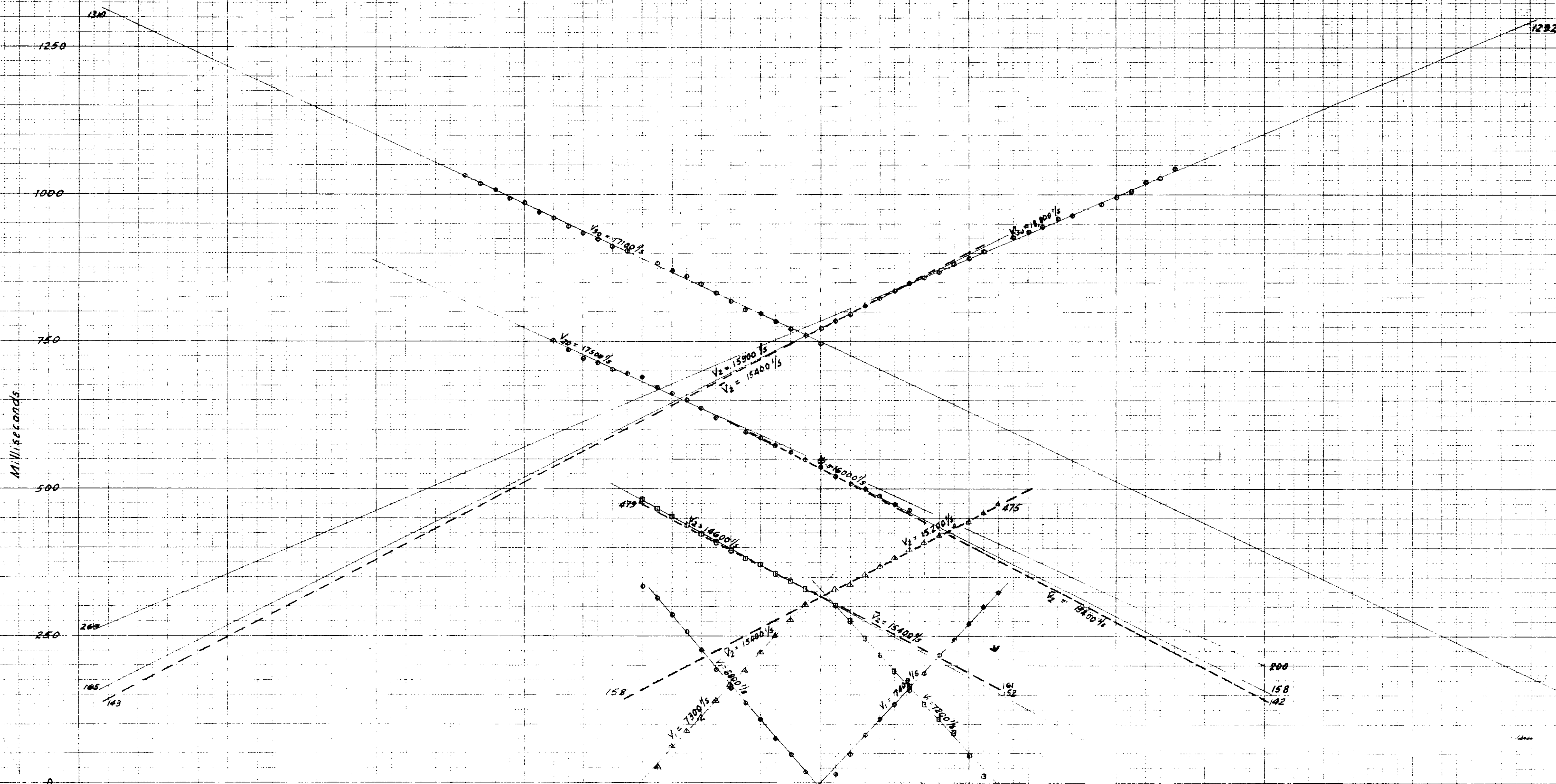
D.M.P. 2-5-60

L 61-2



[illegible]

SP92 SP93 SP94 SP95 SP96 SP97 SP98 SP99 SP100 SP101 SP102 SP103 SP104 SP105 SP106 SP107 SP108



SP 98											
98	100	102	104	106	108	110	112	114	116	118	120
0.21	0.67	1.03	1.30	1.53	1.82	2.09	2.34	2.63	2.90	3.18	3.44
0.42	0.81	0.81	0.81	0.81	0.82	0.82	0.82	0.82	0.82	0.82	0.81
0.02	0.26	0.62	0.89	1.12	1.40	1.67	1.92	2.23	2.50	2.78	3.03
100											102
to	-	383	391	406	420	434	447	460	472	487	497
Ec + Wc	-	0.53	0.54	0.52	0.51	0.50	0.51	0.51	0.51	0.53	0.53
tc	-	330	337	354	369	384	397	409	421	436	444

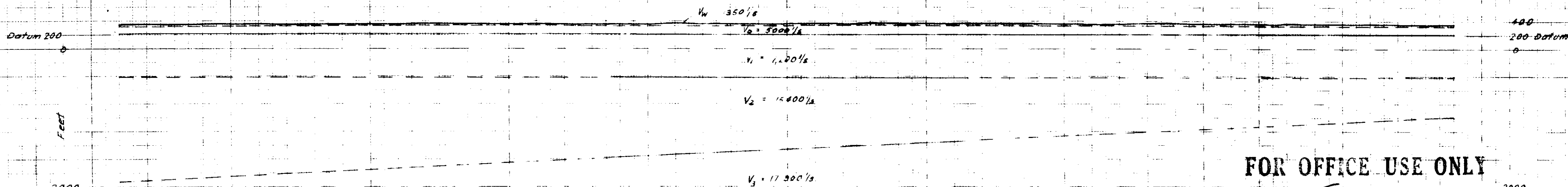
SP 92											
100	102	104	106	108	110	112	114	116	118	120	122
8.24	8.35	8.46	8.52	8.70	8.81	8.95	9.05	9.15	9.28	9.39	9.52
0.52	0.51	0.51	0.50	0.48	0.46	0.46	0.48	0.47	0.47	0.49	0.49
7.72	7.84	7.95	8.09	8.22	8.35	8.49	8.61	8.68	8.81	8.90	9.03
102											104
to	-	977	986	996	1010	1015	-	1036	1050	1061	1074
Ec + Wc	-	0.50	0.50	0.52	0.52	0.52	0.53	0.54	0.56	0.57	0.58
tc	-	927	936	944	958	963	-	982	994	1004	1027

SP 100											
98	100	102	104	106	108	110	112	114	116	118	120
9.73	9.82	9.94	10.03	10.13	10.23	10.33	10.43	10.53	10.63	10.73	10.83
0.39	0.38	0.37	0.37	0.37	0.38	0.38	0.37	0.37	0.37	0.37	0.38
9.34	9.44	9.54	9.64	9.74	9.84	9.94	10.04	10.14	10.24	10.34	10.44
100											102
to	-	0.53	0.55	1.17	1.42	1.67	1.91	2.19	2.50	2.78	3.05
Ec + Wc	-	0.38	0.36	0.35	0.34	0.33	0.33	0.33	0.34	0.35	0.36
tc	-	0.45	0.49	0.82	1.08	1.34	1.58	1.86	2.17	2.44	2.70

SP 105											
98	100	102	104	106	108	110	112	114	116	118	120
6.43	6.33	6.19	6.08	5.97	5.83	5.69	5.55	5.44	5.31	5.17	5.08
0.48	0.47	0.46	0.46	0.47	0.47	0.48	0.47	0.45	0.44	0.44	0.44
5.95	5.86	5.73	5.62	5.50	5.36	5.21	5.08	4.99	4.87	4.73	4.64
100											102
to	-	800	786	774	766	753	745	738	722	710	698
Ec + Wc	-	0.48	0.51	0.54	0.52	0.51	0.50	0.49	0.49	0.48	0.48
tc	-	742	735	720	714	702	695	688	672	661	650

SP 102											
100	102	104	106	108	110	112	114	116	118	120	122
-	3.41	3.13	2.82	2.59	2.25	1.99	1.70	1.45	1.21	0.84	0.69
0.40	0.38	0.37	0.36	0.35	0.35	0.36	0.36	0.36	0.38	0.38	0.39
3.01	2.75	2.45	2.17	1.90	1.64	1.36	1.09	0.85	0.66	0.41	-0.03
100											102
to	-	534	517	504	491	476	460	447	433	421	406
Ec + Wc	-	0.52	0.52	0.52	0.52	0.51	0.51	0.51	0.50	0.50	0.50
tc	-	482	465	452	439	424	409	396	382	371	356

SP 108											
98	100	102	104	106	108	110	112	114	116	118	120
-	9.35	9.22	9.11	8.98	8.83	8.69	8.55	8.45	8.32	8.20	8.10
0.52	0.51	0.51	0.51	0.51	0.51	0.51	0.48	0.48	0.49	0.50	0.50
8.83	8.71	8.60	8.47	8.32	8.18	8.04	7.97	7.83	7.71	7.60	7.46
100											102
to	-	1082	1070	1058	1043	1036	1020	1009	998	979	965
Ec + Wc	-	0.50	0.52	0.50	0.50	0.50	0.49	0.49	0.54	0.53	0.51
tc	-	1032	1018	1008	993	986	970	960	945	934	925



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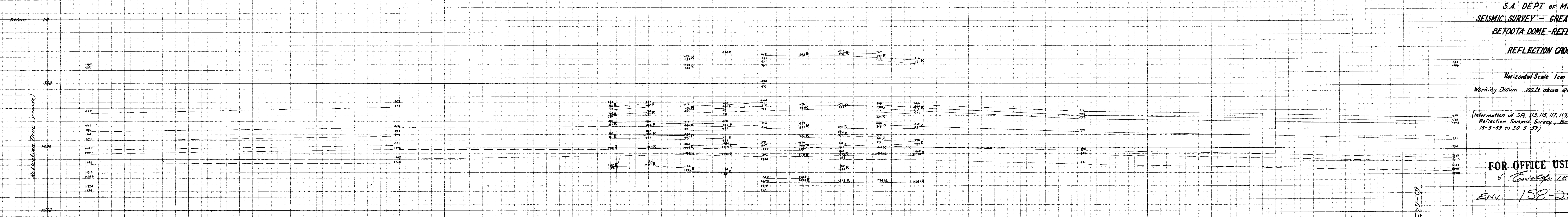
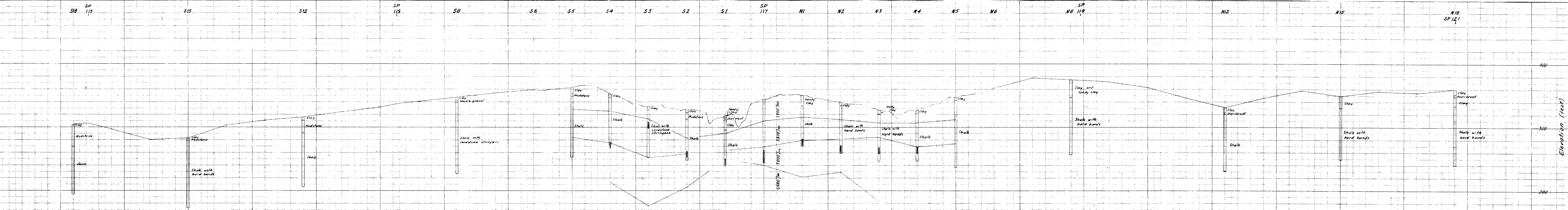
10 Envelope 158

DEPT OF MINES - SOUTH AUSTRALIA
SEISMIC SURVEY - GREAT ARTESIAN BASIN
BREADALBANE AREA
TIME DISTANCE CURVES AND ALTERNATIVE INTERPRETATION
SCALE - 1cm = 400'

Working Datum = 200 feet above Queensland State Datum

K.R.S. 11-G-60

ENV. 158-24. 60-490
994.3



S.A. DEPT. OF MINES
SEISMIC SURVEY - GREAT ARTESIAN BASIN
BETOOTA DOME - REFRACTION LINE
REFLECTION CROSS SECTION

Horizontal Scale 1cm = 400 ft.
Working Datum - 100 ft above Queensland State Datum.

(Information at SP. 113, 115, 117, 119, 121 from Reconnaissance
Reflection Seismic Survey, Betoota Dome Area
15-5-59 to 30-5-59)

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5. *Conclude 158*
ENV. 158-25