COMMONWEALTH OF AUSTRALIA
DEPARTMENT OF NATIONAL DEVELOPMENT
BUREAU OF MINERAL RESOURCES.
GEOLOGY AND GEOPHYSICS

RECORD No. 1962/17

OODNADATTA EXPERIMENTAL SEISMIC SURVEY,

SOUTH AUSTRALIA 1957

by

K. B. LODWICK and E. R. SMITH

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SUMMARY

In July and August 1957 an experimental seismic survey was done in the Oodnadatta area of the Great Artesian Basin. The purposes of the survey were to find whether reflections could be recorded from beneath duricrust, a siliceous surface deposit, and whether structures mapped by surface geological methods persist with depth.

Reflections were recorded from beneath the duricrust using shallow pattern holes and six geophones per trace; the sub-surface structure was mapped with reasonable accuracy. In areas where the duricrust is eroded, reflections of fair quality were obtained using a single shot-hole and six geophones per trace.

A seismic reflection traverse across the Oodnadatta anticline indicated that the structure was present in a horizon which corresponds to the top of the artesian aquifer at a depth of about 1000 ft below datum (400 ft above MSL). The seismic results indicated that the anticline was of smaller relief than had been estimated from surface mapping. There was a change from fair-quality persistent reflections at shallow depths to poor-quality less numerous reflections with sporadic dips at greater depths; this probably represents the base of the Cretaceous. The greatest depth from which Cretaceous sediments were recorded was about 2350 ft below datum. Reflection depths computed by seismic methods correspond closely with lithological boundaries, and in particular the base of the Cretaceous sediments, encountered in the Santos No. 1 bore.

The results of a refraction traverse on the crest of the Oodnadatta anticline show the presence of a 'basement' refractor with a velocity of 13,900 ft/sec at a depth of about 1245 ft below datum. There is slight evidence of a refractor with a substantially higher velocity at about twice this depth. The 'basement' velocity of 13,900 ft/sec is consistent with the assumption that there is a pre-Cretaceous layer between the Cretaceous sediments and the Precambrian basement complex.

1. INTRODUCTION

In July and August 1957 a seismic party from the Bureau of Mineral Resources, Geology and Geophysics made an experimental seismic survey near Oodnadatta, South Australia.

Oodnadatta is a small town about 600 miles north of Adelaide on the railway between Port Augusta and Alice Springs. It is on the western margin of the Great Artesian Basin (Plate 1), just within the western limit of the flowing bores. The Oodnadatta artesian bore is 1571 ft deep and, when first drilled, provided a supply of good water which rose 34 ft above the ground surface (Jack, 1915).

The seismic work done by the Bureau was requested by Santos Ltd through the Department of Mines, South Australia. Santos Ltd was represented during the survey by the geological and geophysical consulting company, Geosurveys (Aust) Ltd. Mr. J.E. Webb, senior geophysicist of the Department of Mines, visited the seismic party in the field.

The main purposes of the seismic survey were:-

(1) To find whether reflections could be recorded in the Oodnadatta area, particularly from beneath a surface formation of silicified shale (duricrust). This involved experimental work using various arrays of geophones and shot-holes.

(2) To investigate geological structure of the Cretaceous sediments, which are believed to lie directly over metamorphic basement rocks, and to find whether geologically mapped surface structures such as the Oodnadatta and Gidgea anticlines (see Plate 2) persist at depth.

While the seismic survey was in progress, Santos Ltd completed a stratigraphic bore on the geologically mapped crest of the Oodnadatta anticline (Plate 3). A velocity survey of the bore was made, and the results assisted in the interpretation of the seismic survey.

2. FIELD WORK

The seismic party travelled by road from Melbourne to Oodnadatta and established camp about 8 miles north-west of Oodnadatta township on 9th July 1957. A list of the personnel and equipment is given in Appendix A.

The country around Oodnadatta is rough in places, particularly over the duricrust, which breaks up into round stones (gibbers) ranging in size from an inch to eighteen inches. Duricrust has been eroded extensively in some areas which are dissected by small steep-sided watercourses. Vehicles could move only very slowly over most parts of the traverses and the party's progress was hindered by this to some extent. Surveying was not difficult, however, as the vegetation was very sparse and the traverses needed no clearing. Grass and stunted trees are the only growth over the greater part of the area, although larger trees including gums grow along the rivers and creeks.

Traverse A was surveyed on a true bearing of approximately 47° extending both sides of Santos No. 1 bore. The position of the traverse is shown on Plate 3. It was found desirable to bend the traverse at Shot-points 90 and 97 to avoid high ridges of duricrust upon which it was difficult to record reflections. Between Shot-points 9 and 57, shot-holes were spaced at one-eighth-mile intervals (half the standard distance) so that information might be obtained from shallow horizons. As shot-point numbers had been allocated to the quarter mile intervals, the intermediate shot-points were designated by the appropriate halves (e.g. Shot-point 9½ is between Shot-points 9 and 10).

Traverse A was surveyed to cross the axial trend of the Oodnadatta anticline at right angles, as nearly as possible. Traverse B was surveyed at right angles to Traverse A on the crest of the Oodnadatta anticline; it had been intended originally for refraction work, but was also subsequently shot for reflections using shot-points at intervals of one-eighthmile (Plate 3).

A list of the distance surveyed and shot and the footage drilled is given in Appendix B.

Drilling was easy in places where there was no duricrust and it was possible to use drag bits exclusively. In areas of duricrust, drilling was very slow and rock bits had to be used. In some places circulation was lost, and sometimes gibbers from near-surface layers fell into the shot-hole.

Water supplied for drilling were obtained from the Neales River and the Oodnadatta bore. Samples of the formations penetrated were taken from each shot-hole and sent to the Bureau's Geological Branch for investigation. The samples were also made available to Geosurveys (Aust) Ltd.

3. GEOLOGY AND GEOPHYSICS

The earliest account of the geology of the Oodnadatta area was written in 1896 by H.Y.L. Brown and further exploration was done by Jack (1915). A description of the succession of strata forming the Great Artesian Basin is presented by Whitehouse (1954). He pays particular attention to the Queensland portion, but on a generalized cross-section of the basin postulates the continuance of the sandstone of the Blythesdale Group across the basin to form the artesian aquifer in the Oodnadatta area. Whitehouse (1954) believes that the equivalents of the Roma and Tambo Formations (marine Cretaceous) form the cap rock to this sandstone in the Oodnadatta area. Mott (1952a & b) has independently arrived at a similar conclusion.

The most recent and detailed survey of the Oodnadatta area was made by Geosurveys (Aust.) Ltd. Dr. H. Wopfner was in charge of field work, and his confidential report was made available to the Bureau (Wopfner, 1956).

The following succession of strata is recognised by Wöpfner in the Oodnadatta area:-

RECENT QUATERNARY TERTIARY	Duricrust and alluvial deposits	
CRETACEOUS	Mount Willoughby Shale Mount Beviss Sandstone Upper Oodnadatta Shale Wooldridge Limestone Lower Oodnadatta Shale	Marine
	Artesian aquifer,	Blythesdale equivalent
PALAEOZOIC	Probably formed in topographic 'lows' of the basement of metamorphic rocks.	

Little is known of the strata below the main artesian aquifer at the base of the Cretaceous, as bores drilled for water do not penetrate farther than the best water supply. Wopfner (op.cit.) points out that the sediments of the Oodnadatta area were deposited over a basement relief of metamorphic rocks. Outcrops of metamorphic basement provide some present-day topographical features, for example Mount Dutton and Mount Alice (See Plate 2). The geology of these metamorphic outcrops has been described by Reyner (1955). Palaeozoic sediments may have been deposited in the topographic 'lows' before the deposition of the Cretaceous sediments (op.cit.).

There have been no great tectonic movements in the Oodnadatta area during or since the Cretaceous Period. Structural features in the Cretaceous sediments are considered by Wopfner to have originated from their deposition over an ancient basement relief combined with vertical earth movements associated with the drying up of the whole of the Great Artesian Basin. The Oodnadatta anticline is believed to have been formed by differential compaction over a basement ridge along a line joining Mount Dutton and Mount Alice (Wopfner,1956). Other anticlines in the area are believed to have formed over similar basement ridges. Faults and flexures mapped in the Alberga-Mount Sarah area (See Plate 2) are believed to be evidence of vertical earth movement.

A geological sketch map on Plate 2 shows the distribution of stratigraphic units and structural features. A more detailed geological map of the traverse area is shown on Plate 3.

Gravity measurements have been made on a regional scale by the Department of Mines, South Australia, and by Geosurveys (Aust.)Ltd. Although in some places there appears to be some correlation between the structural features in the Cretaceous sediments and the Bouguer anomalies, the relation is not necessarily a simple one. As well as representing structure and changes in thickness of the Mesozoic rocks, the Bouguer anomalies may be caused by changes in the densities of the basement complex and overlying sediments of Palaeozoic age.

4. RECORDING AND SHOOTING TECHNIQUES

Spread lengths of one-eighth mile each side of the shot-point were used between Shot-points 9 and 56½ on Traverse A and throughout Traverse B. Quarter-mile spread lengths each side of the shot-point were used on the northern end of Traverse A (Shot-points 9 and 117) to provide information on the deeper strata more speedily.

Using four geophones at 5-ft intervals per trace and a single shot-hole, reflections of from poor to fair quality were recorded in areas where duricrust has been partly eroded. Fair-quality reflections were recorded where there is no duricrust, and 'very poor' to 'no recognisable' reflections were recorded in areas of thick duricrust.

To devise a technique for recording reflections from beneath a duricrust cover, experiments were made using:

(a) single shot-holes with the depth of shot ranging from 20ft to 180ft.

(b) various filter settings for the amplifier pass band.

(c) six geophones per trace at various spacings.

(d) nine-hole diamond pattern shots with shot-holes spaced 25 ft apart and with shot depths of 50 and 20 ft.

During the experiments only one of the four parameters was varied at a time.

The results of the experiments showed that:

(a) for all spacings used, six geophones produced better quality reflections than four geophones spaced 5 ft apart; the spacing of the six geophones was not critical in the limits tried (11 to 22 ft).

(b) pattern shot-holes produced better results than single shot-holes; the depth of shot in the pattern holes was not critical.

(c) the best quality record was obtained using a filter setting of L33 H33 (pass band 33-65 c/s, see Plate 9).

The experiments described above showed that it was possible to record fair-quality reflections from beneath a cover of duricrust. Nevertheless, the results were little, if any, better than those obtained from single shot-holes in areas where the duricrust cover was absent. Air shots were fired over duricrust areas but, although reflections were recorded, the technique was not as successful as shooting pattern holes at a depth of 20 ft. Drilling even shallow holes in duricrust, however, was very slow. In general, 9-hole patterns were used over areas covered by duricrust, and single deep shot-holes were used elsewhere.

5. RESULTS

Velocity measurements

A velocity survey was made in the Santos No. 1 bore which was situated near Shot-point 23 on Traverse A. Although the bore was drilled to a depth of 1295 ft, it could be surveyed only to a depth of 960 ft below the surface. A datum of 400 ft above sea level was used for reduction of the results (i.e. the same datum as was used for the reflection seismic work). Three shot-holes were drilled; A 100 ft north-east, B 200 ft north-east, and C 100 ft south-east of the bore. Shots were fired in A while the well-geophone was progressively lowered in approximately 100-ft steps between 180 and 832 ft below datum. These measurements were duplicated from either Shot-point B or Shot-point C. At 940 ft a result was obtained from Shot-point C only.

Comparison of well-geophone times from Shot-points B and C with those from A, indicated that true seismic breaks were recorded and no confusion was caused by cable breaks; the shallowest shot, however, gave a doubtful result. The times obtained from A were used for the computation of results except for the maximum depth of 940 ft.

Corrected vertical times corresponding to measured geophone depths, together with the computed average and interval velocities, are shown on Plate 7. The average velocity is fairly constant, around 6000 ft/sec, but it reaches a value of 6200 ft/sec at 940 ft below datum.

A $t:\Delta t$ analysis of the reflections has been made, and this agrees fairly well with the results of the velocity survey (see Plate 8). It shows that the average velocity has increased to 6700 ft/sec at 2400 ft. The reflection cross-sections were plotted before these results were available, and a constant average velocity of 7000 ft/sec was used to a depth of 2500 ft. Thus the actual depths plotted on the cross-section to 2500 ft will range from about 5 to 10 percent too deep. Below 2500 ft, a constant average velocity of 14,000 ft/sec was used, as metamorphic basement rocks were expected to exist below this depth.

Reflection traverses

The reflection cross-sections along Traverses A and B are shown on Plates 4 and 5 respectively.

Individual weathering corrections were computed for each trace using the graphical method (Vale, 1960). On duricrust the first breaks were difficult to record, and it was not possible to obtain reliable weathering data. In some places two velocities were recorded in the weathered layer (viz. 1500 and 4500 ft/sec, Plate 4) but for most of the traverses the weathered-layer velocity was 2000 ft/sec. The velocity for the sub-weathered layer is shown on Plates 4 and 5.

On the cross-sections the centre trace time of a reflection is plotted vertically beneath the shot-point, and end trace times are plotted vertically below the midpoint of the spread; i.e., a dipping reflection is not migrated.

The cross-sections were plotted on a scale of 500 ft to one inch. Only reflections with times less than 1.6 seconds were plotted, because only at two or three shot-points were reflections recorded at times greater than this (up to 2.1 seconds) and these were not considered significant. Most of the good-quality persistent reflections were recorded at times less than 0.8 seconds.

Refraction traverse

Results of the refraction work done on Traverse B are shown on Plate 6. A refractor profile has been calculated for a 13,900-ft/sec refractor and is shown on Plate 6 on the same scale as the reflection cross-section (Plate 5).

6. INTERPRETATION

The distribution of the reflections illustrated on the cross-sections (Plate 4 and 5) makes it possible to divide the cross-sections into two zones. Above a depth which varies between 1300 and 2500 ft a conformable set of reflections of fair quality were recorded persistently along Traverses A and B. Below this, poor-quality reflections with sporadic dips were recorded with reflection times as great as 2.1 seconds. The reflection distribution is what might be expected when a thin layer of sediments (Cretaceous), represented by the conformable reflections, overlies a basement of older sedimentary or metamorphic rocks represented by the poor-quality reflections. As a number of reflections were recorded below the conformable reflections, some of the basement rocks may be stratified.

Four main reflection bands were recorded in the upper zone of conformable reflections, and each band was fairly persistent along the length of Traverse A. At Shot-point 22½ the four main reflection bands were recorded at times of 175, 276, 331, and 441 millisec (Plate 4).

It is of interest to compare the depths associated with the times of the four bands of reflections recorded at Shot-point 22½ with the depths of strata encountered in Santos No. 1 bore, drilled at Shot-point 23. In the following table, reflection depths have been estimated from the $t:\Delta t$ analysis of the whole survey as summarized on Plate 8.

Reflection	Reflection time (millisec)	Depth of reflector	Depth of stratigraphic horizon in bore, ft below datum (400 ft above MSL).
1	175	570	No correlatable horizon.
2	276	860	Change from mudstone to shale 899 ft.
3	331	1030	Artesian aquifer 996 ft.
4	411	1295	Fine-grained lightly cemented sandstone possibly Palaeozoic - 'basement'. 1271 ft. (J. Geol. Soc. Aust. 5(2), 90.)

The correspondence between the third reflector and the aquifer and the correspondence between the fourth reflector and the "basement", is almost certain evidence that the reflections originate at these stratigraphic horizons.

To aid in the interpretation of the results, a phantom horizon has been drawn on Traverse A (Plate 4) based, as far as possible, on the third reflection (i.e. the Artesian aquifer). In some places identification of the third reflection was difficult and doubtful, and the phantom horizon was drawn using the second and fourth reflections as a guide. This is reasonable, as the four reflections appear to be conformable throughout other parts of the traverse.

The structure of the shallow sediments (Cretaceous) along Traverse A is indicated by this phantom horizon, and in particular it should represent the structure of the top of the artesian sand horizon. The Oodnadatta anticline is shown as a gentle structure with a dip of about 1° on the north-eastern flank and about $3\frac{1}{2}^{\circ}$ on the south-western flank. Dips are smaller than those indicated by surface geology. The crest of the Oodnadatta anticline indicated by the phantom horizon corresponds closely to the geologically mapped crest. The flank dips to the north-east, continues to the north-eastern end of the traverse, and may be the start of the regional plunge into the Great Artesian Basin.

(extend down (5))

In the trough of the syncline, beneath Shot-point $34\frac{1}{2}$, the probable Cretaceous sediments are estimated to about 2350 ft. Two minor anticlines with axes beneath Shot-points 37 and 40, respectively, are indicated by the phantom horizon. These two folds may be a result of 'gravity creep', of which there is evidence at Oodnadatta (Wopfner, 1956).

Between Shot-points 41 and 44 there is a sudden thinning of the sediments from about 2350 ft to about 1200 ft accompanied by a change in the velocity of the sub-weathered layer (Plate 4); this suggests faulting. South-west of this possible fault, there appears to be a very broad anticline, which was not recognized in the surface geology.

The interpretation of the refraction results on Traverse B, shown on Plate 6, agrees only partly with the interpretation of the reflection results. It agrees in that a layer with a velocity of about 6300 ft/sec (Cretaceous) overlies a basement layer. The velocity of the basement layer measured by the refraction work was 13,900 ft/sec. A velocity of 11,440 ft/sec, probably from an intermediate layer, was measured in one direction only. A dip of $2\frac{1}{2}^{\circ}$ to the south-east has been calculated from the velocities measured in the basement layer. This does not agree with the results of the reflection work on Traverse B (Plate 5) where there is no dip. The interpretation presented may be an over-simplification, as it does not take into consideration the presence of an intermediate layer.

The depth below datum (400 ft above MSL) of the 13,900-ft/sec reffactor is 1245 ft computed using an overburden velocity of 6300 ft/sec obtained from a $t:\Delta t$ analysis of reflections (Plate 8). This agrees, within the limits of accuracy of the refraction method, with the depth of 1271 ft below datum, at which a fine-grained sandstone 'basement' rock was encountered in the Santos No. 1 bore. It is suggested that the 13,900-ft/sec refractor represents the fine-grained sandstone 'basement'.

There is an indication on the time-distance curve for Shot-point 107 (Plate 6) that a refractor of higher velocity may lie below the 13,900-ft/sec refractor. Because there are only three points representing the higher velocity, an accurate measurement of the velocity and depth of the refractor is not possible. An estimate of the depth, however, assuming that its velocity is 20,000 ft/sec, is about 2800 ft below datum.

This refractor, if it exists, may represent the Precambrian basement complex similar to that which crops out in the Mount Dutton area. The 13,900-ft/sec refractor would presumably represent a pre-Cretaceous sandstone lying above it.

7. CONCLUSIONS

The seismic survey at Oodnadatta has shown that the structure of the upper sediments (i.e. to 2500 ft) may be mapped reliably using the seismic method. In areas where there is no duricrust cover, fair-quality results are obtained using pattern geophones (six in line) and single shot-holes. Over a duricrust cover, however, it is necessary to use pattern shot-holes as well as pattern geophones or some comparable technique to obtain results of even poor to fair quality. Better, but probably more complicated, patterns could probably be devised to improve the results.

Seismic results have shown that the Oodnadatta anticline, which had been mapped by surface geology, persists with depth; the dips, however, appear to be smaller than those indicated by surface geological methods. The traverse was not extended to investigate the Gidgea anticline. There are, however, indications of a dip to the south-west on the south-western end of Traverse A, suggesting the axis of a broad anticline at Shot-point 47. The north-eastern flank of this anticline is probably faulted near Shot-point 43. The thickness of Cretaceous sediments is readily deduced from the time of the change in character of the reflections on the seismic records. The deepest Cretaceous sediments measured are at about 2350 ft in the syncline south-west of the Oodnadatta anticline. On top of the Oodnadatta anticline the Cretaceous sedimentary thickness has been estimated from reflection results as 1295 ft, from refraction results as 1245 ft, and is known from the results of the Santos No. 1 bore to be 1271 ft. The agreement between the results of the seismic work and the bore information indicates that the velocity information obtained from the Santos No. 1 bore and the $t:\Delta t$ analysis of reflections is fairly accurate.

The results of the refraction traverse show the presence of a 'basement' refractor with a velocity of 13,900 ft/sec at a depth of about 1245 ft below datum. There is, however, slight evidence of a refractor with a substantially higher velocity at about twice this depth. The 'basement' velocity of 13,900 ft/sec is consistent with the assumption that there is a layer of pre-Cretaceous sediments between the base of the Cretaceous and the Precambrian basement complex.

8. REFERENCES

GABY, P.P. 1947 Grading System for Seismic Reflections and Correlation. Geophysics 12 (4)

JACK, R.L. 1915 The geology and prospects of the region to the south of the Musgrave Ranges, and the geology of the western portion of the Great Artesian Basin. Bull.geol. Survey, S. Aust. 5

MOTT, W.D. 1952 a The Search for Petroleum in Queensland. Qd Govt. Min.J. 53, No. 611.

MOTT, W.D.	1952b	Oil in Queensland. Qd. Govt. Min. J. 53, No. 612.
REYNER, M.L.	1955	The geology of the Peake and Denison region. Rep. Invest. geol. Surv. S. Aust. 6
VALE, K.R.	1960	A discussion on corrections for weathering and elevation in exploration seismic work, 1959. Bur. Min. Resour. Aust. Rec. 1960/13.
WHITEHOUSE, F.W.	1954	Artesian water supplies in Queensland; Appendix G - The geology of the Queensland portion of the Great Australian Artesian Basin. Govt. Printer, Brisbane.
WOPFNER, H.	1956	The Geology of the area west and north-west of Oodnadatta. Geosurveys (Aust) Ltd Report (Unpubl.)

APPENDIX A

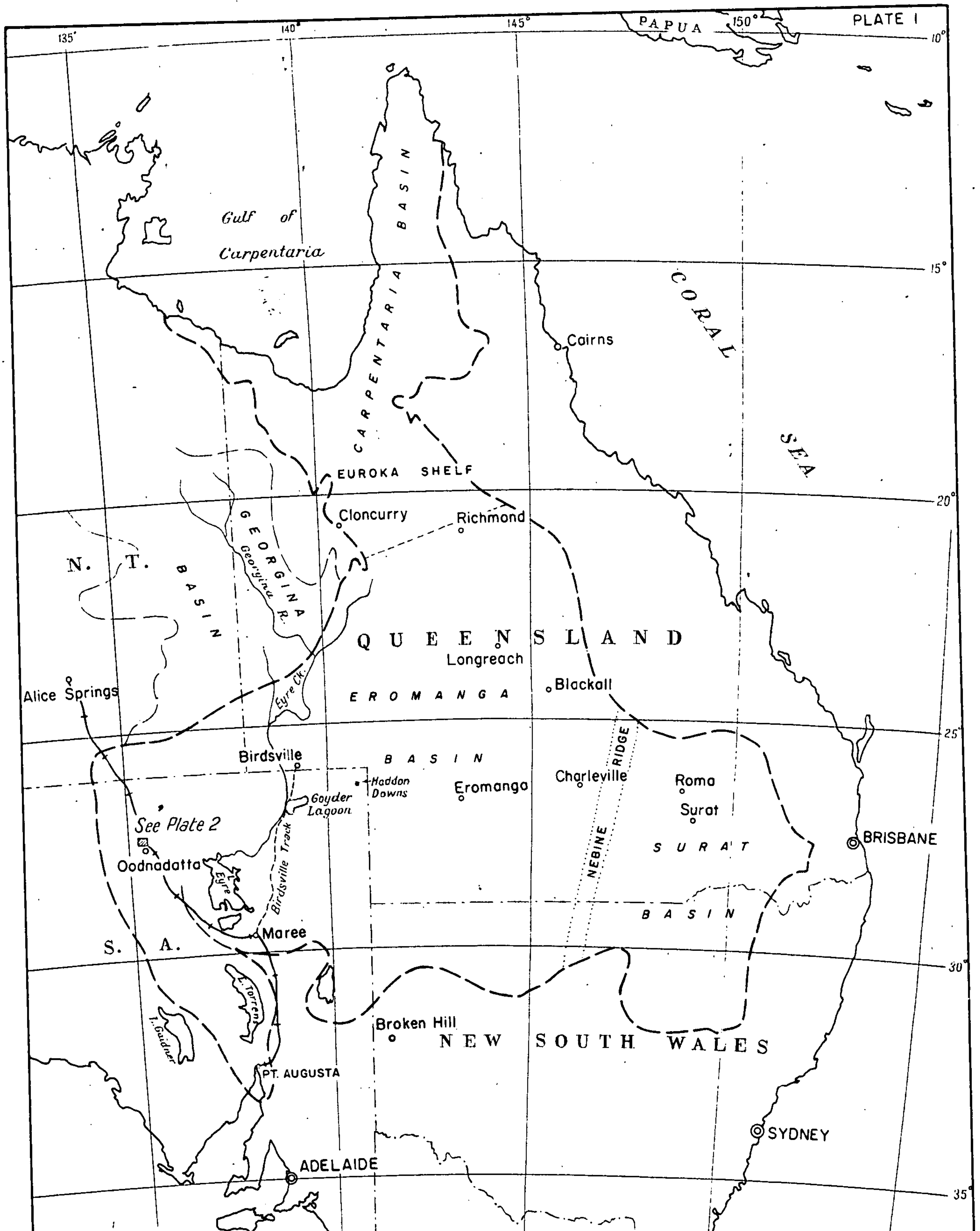
STAFF AND EQUIPMENT

STAFF:	Party Leader	E.R. Smith
	Geophysicists	K.B. Lodwick
		E.E. Jesson
	Surveyor	L. Kirston (Geosurveys)
	Clerk	W.E. Rossendell
	Observer	G.L. Abbs
	Shooter	C.A. Fogarty
	Drillers	L. Sprynskyj
		B. Findlay
	Mechanic	G.C. Bennett
EQUIPMENT:	Seismic amplifiers	TIC Model 621
	Seismic oscillograph	TIC 50-trace, mixing
	Geophones	TIC 20-cycle multiple 4, 5 ft apart.
		TIC 6-cycle (used for 6-geophone patterns).
	Drills	Two Failing 750

APPENDIX B

TABLE OF OPERATIONS

Sedimentary Basin	Great Artesian Basin, western margin.
Area	Oodnadatta.
Camp sites	9 miles NW of Oodnadatta.
Established camp	9/7/57.
Survey commenced	10/7/57.
Miles surveyed	29
Topographic survey	Sketch maps from air photos.
Total footage	22,567 ft.
Number of holes drilled	217
Datum level for corrections	400 ft above MSL.
Weathering velocities	1500 to 2000 ft/sec.
Sub-weathering velocities	6000 to 9000 ft/sec.
Source of velocity distribution	Velocity survey, Santos No. 1 bore, t: Δt analysis.
Shot-point interval	660 and 1320 ft.
Geophone group	Six 6-c/s geophones 11 ft apart, in line of traverse.
Geophone group interval	55 and 110 ft.
Common shooting depths	20 ft (pattern holes) 50 ft, 100 ft, 180 ft.
Usual recording filter	L33 H33 (See Plate 9)
Common charge sizes	10 lb.
Weathering corrections	After Vale (1960).
Grading system	After Gaby (1947)



EXPERIMENTAL SEISMIC SURVEY, OODNADATTA, SOUTH AUSTRALIA

LOCALITY MAP

SCALE IN MILES

100 0 100 200 300

LEGEND

— — — Boundary of Great Artesian Basin

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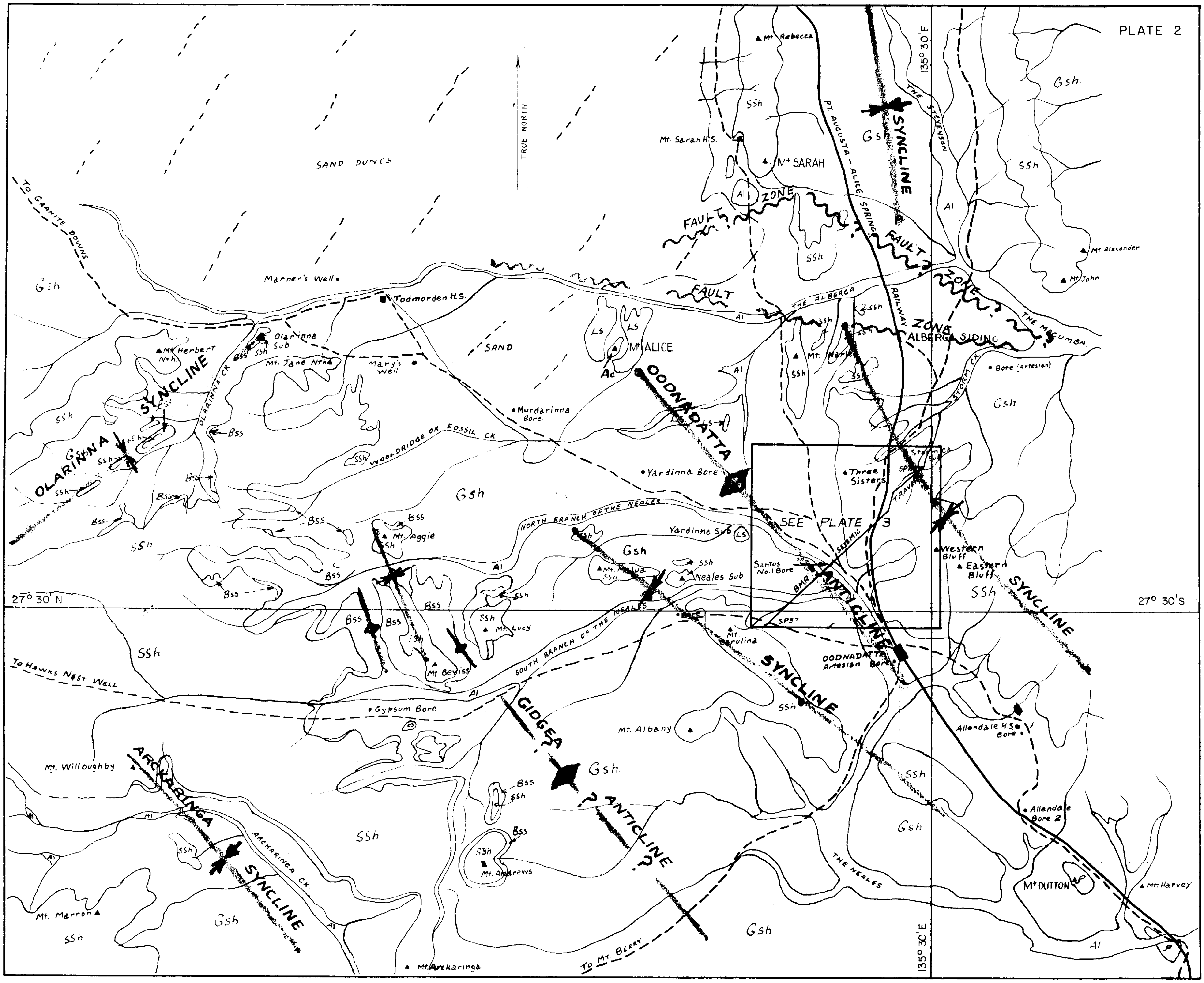
To Accompany Record No. 1962/17



LEGEND

Al	*Recent Alluvium*	
SSh	*Mt. Willoughby Shale*	CRETACEOUS
Bss	*Mt Beviss Sandstone*	CRETACEOUS
Gsh	*Oodnadatta Shale*	CRETACEOUS
LS	*Wooldridge Limestone*	CRETACEOUS
Ac	*Mt Alice Conglomerate*	CRETACEOUS
P	*Precambrian Complex*	

EXPERIMENTAL SEISMIC SURVEY, OODNADATTA, S.A.

GEOLOGICAL SKETCH MAP

(GEOLOGY BY GEOSURVEYS LTD - WOPFNER, 1956)

APPROX. SCALE IN MILES

8 0 8 16 24

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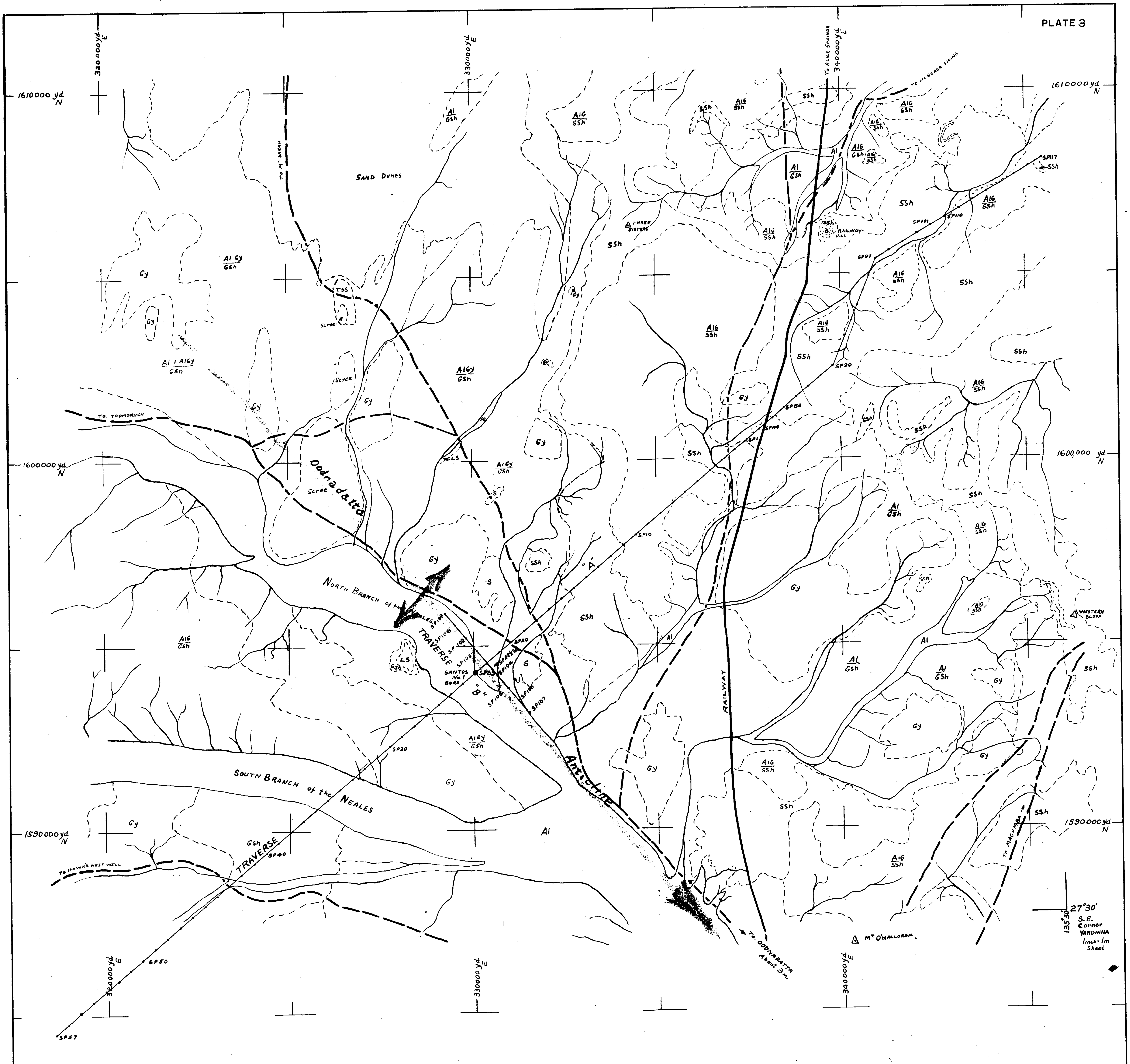

LEGEND

QUATERNARY	Al	Alluvium	
	Cl	Clay pan	
	S	Sand dunes	
	AlG	Gibber and duricrust	
	AlGy	Gypsiferous soil	
CRETACEOUS	SSh	Shale	Mt. Willoughby shale
	AlG / SSh	Duricrust covered	
	GSh	Shale	Oodnadatta shale
	AlG or AlGy / GSh	Duricrust or gypsiferous soil covered	
	Gy	Gypsum	
	LS	Wooldridge limestone	
	TSS	Mt. Alice limestone	

EXPERIMENTAL SEISMIC SURVEY, OODNADATTA, S. A.

GEOLOGY AND TRAVERSES

(GEOLOGY BY GEOSURVEYS LTD – WOPFNER 1956)

SCALE IN MILES

1 0 1 2 3

Reliability: Sketch only.

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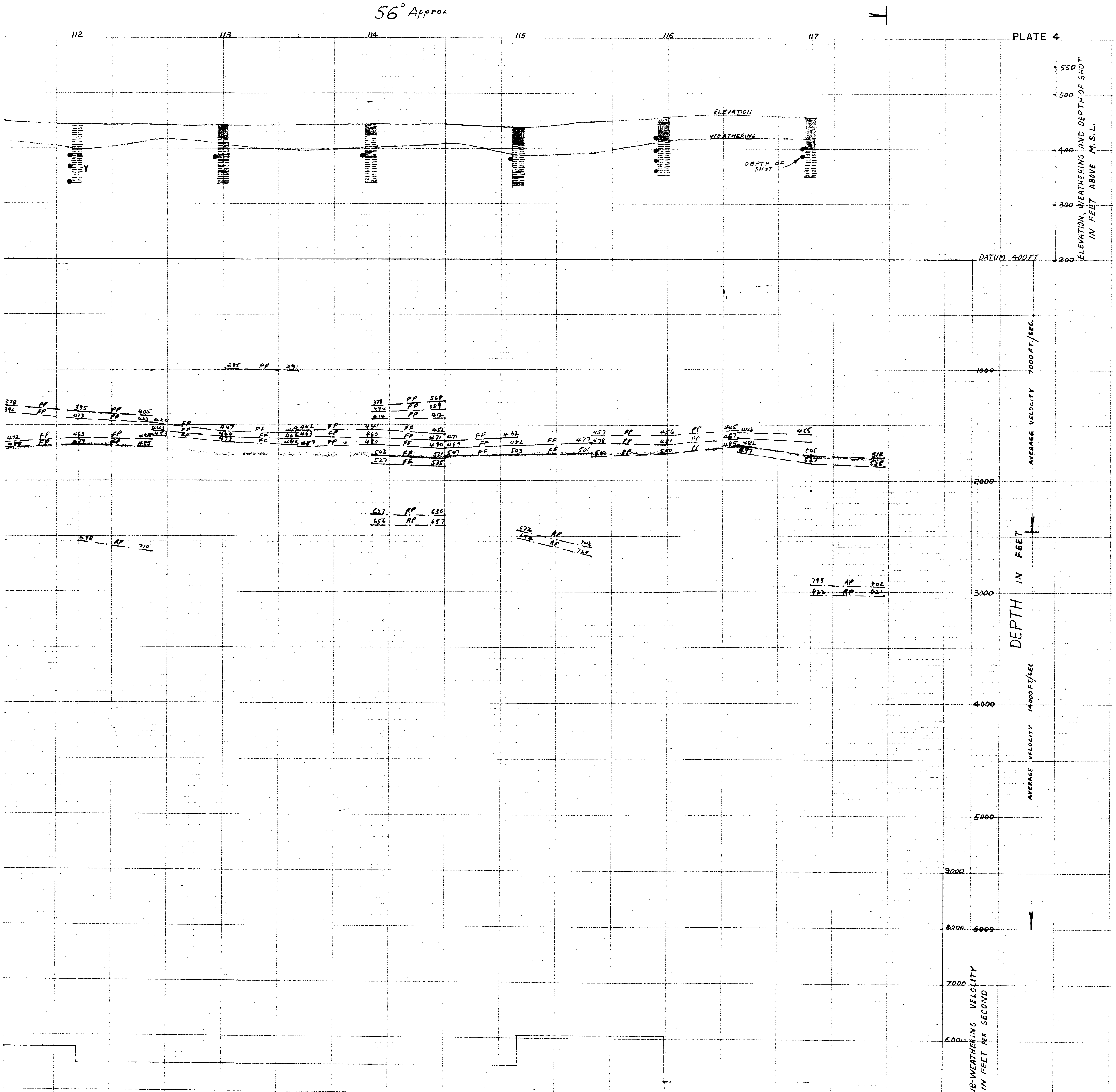
Sheet 2 of 4

Geophysical Section, Bureau of Mineral Resources, Geology and Geophysics. G 315-7
Sheet 3 of 4



LEGEND

Sand	Blue Yellow Black Brown Green Grey White Gypsum	Shale			
Clay		Gypsum			
		Hard bands			
		Silicified shale and duricrust			
		Conglomerate and pebbles			

CROSS-SECTION

- Good Quality Reflection
- Fair " "
- Poor " "
- Doubtful " "
- Phantom Horizon

NOTE: THE PHANTOM HORIZON HAS BEEN PLOTTED BY CORRELATING REFLECTIONS FROM ONE SHOT POINT TO THE NEXT.

EXPERIMENTAL SEISMIC SURVEY,
OODNADATTA, S.A.

SEISMIC REFLECTION CROSS-SECTION
TRAVERSE A

HORIZONTAL AND VERTICAL SCALES IN FEET

500 0 500 1000 1500

GEOPHYSICIST

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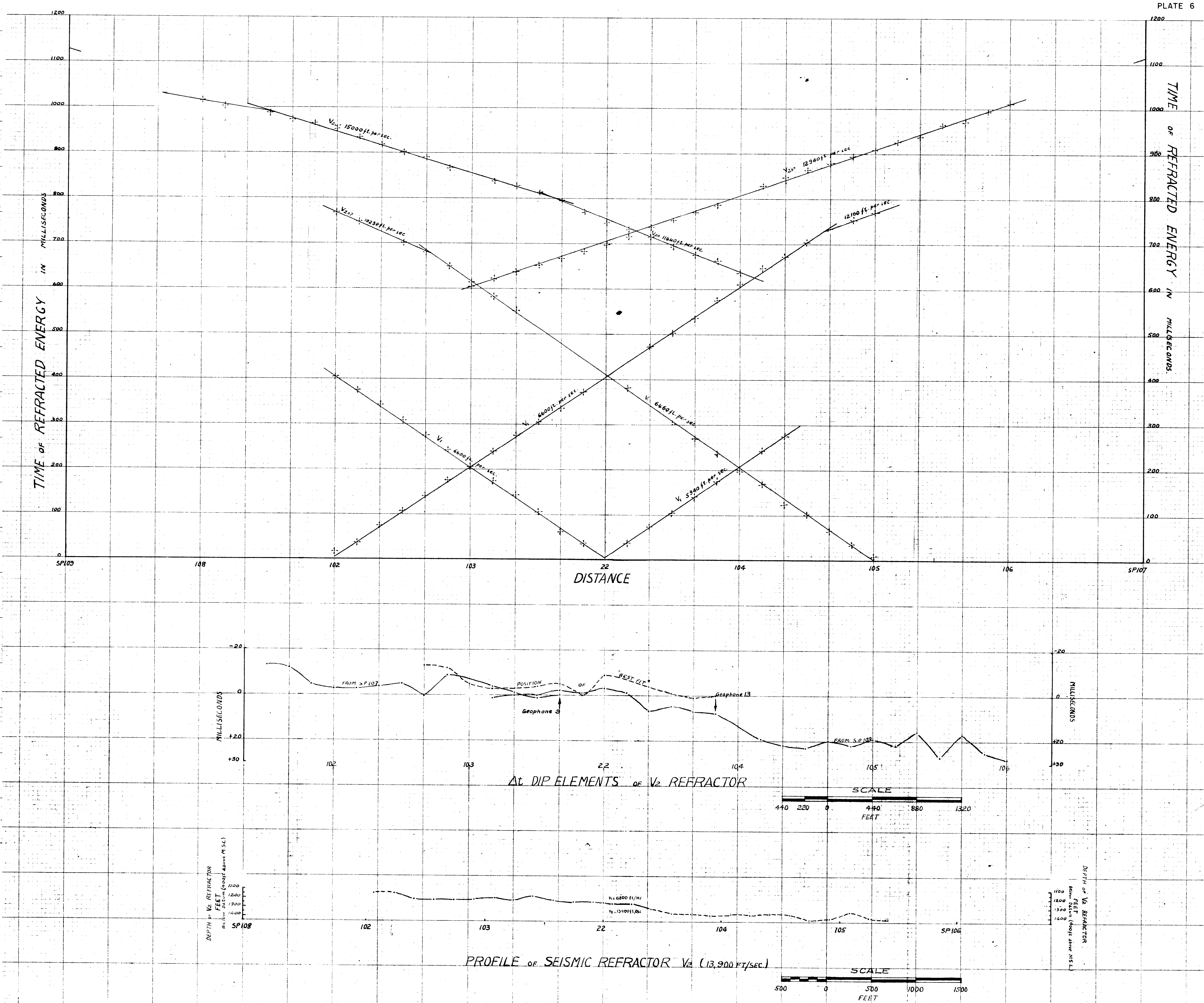


EXPERIMENTAL SEISMIC SURVEY
OODNADATTA, S.A.

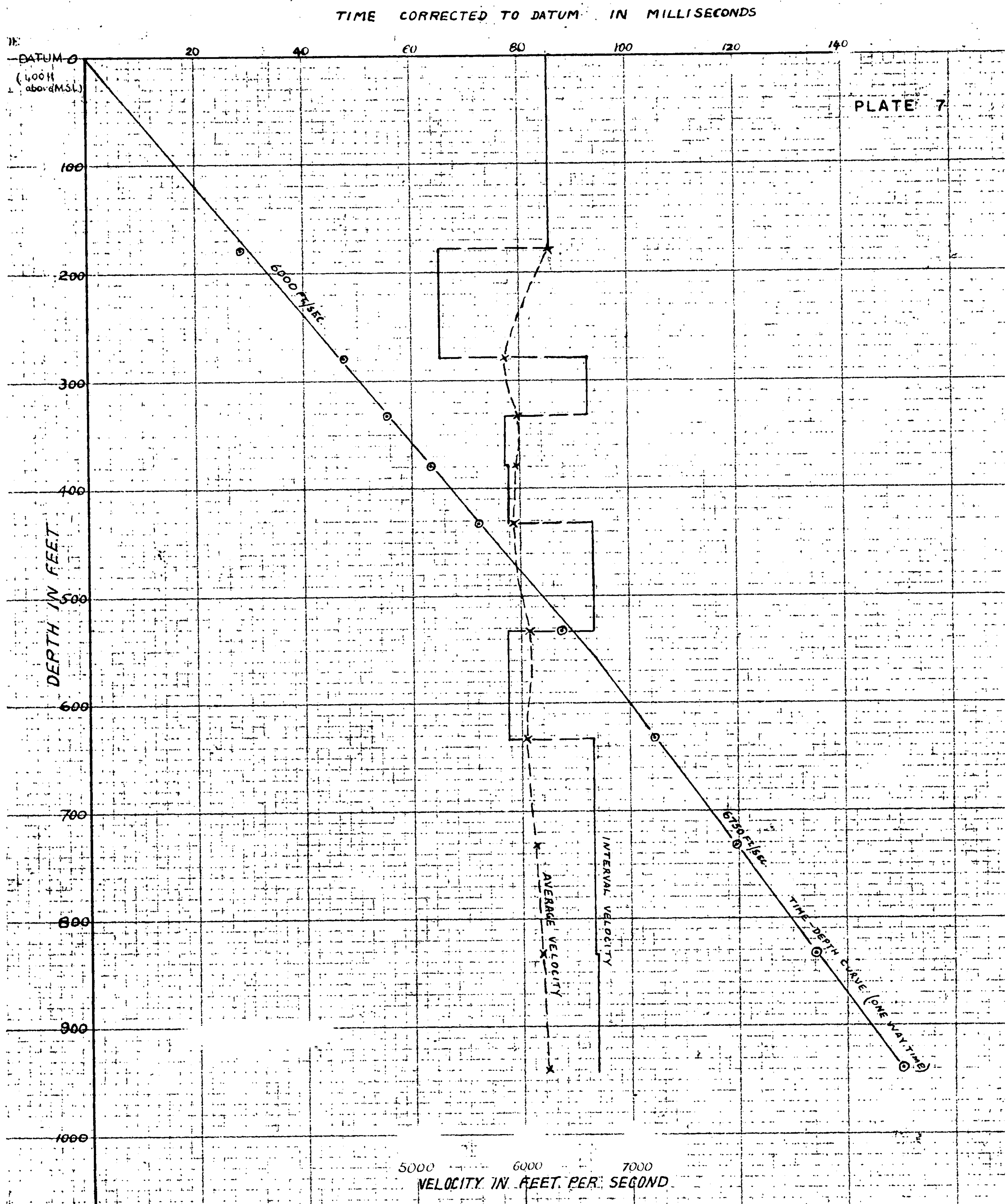
TRAVERSE B

SEISMIC REFRACTION RESULTS

(May 1958)

Geophysical Branch, Bureau of Mineral Resources, Geology & Geophysics. G 315-1

To Accompany Record No 1962/47



EXPERIMENTAL SEISMIC SURVEY, OODNADATTA, S.A.

VELOCITY SURVEY, SANTOS No. I BORE

AT S.P. 23, OODNADATTA

Elevation of Bore = 420ft
Depth of Bore = 1252 ft

Time depth curve and variation of average and interval velocities with depth.

MAY 1958

G 315-3

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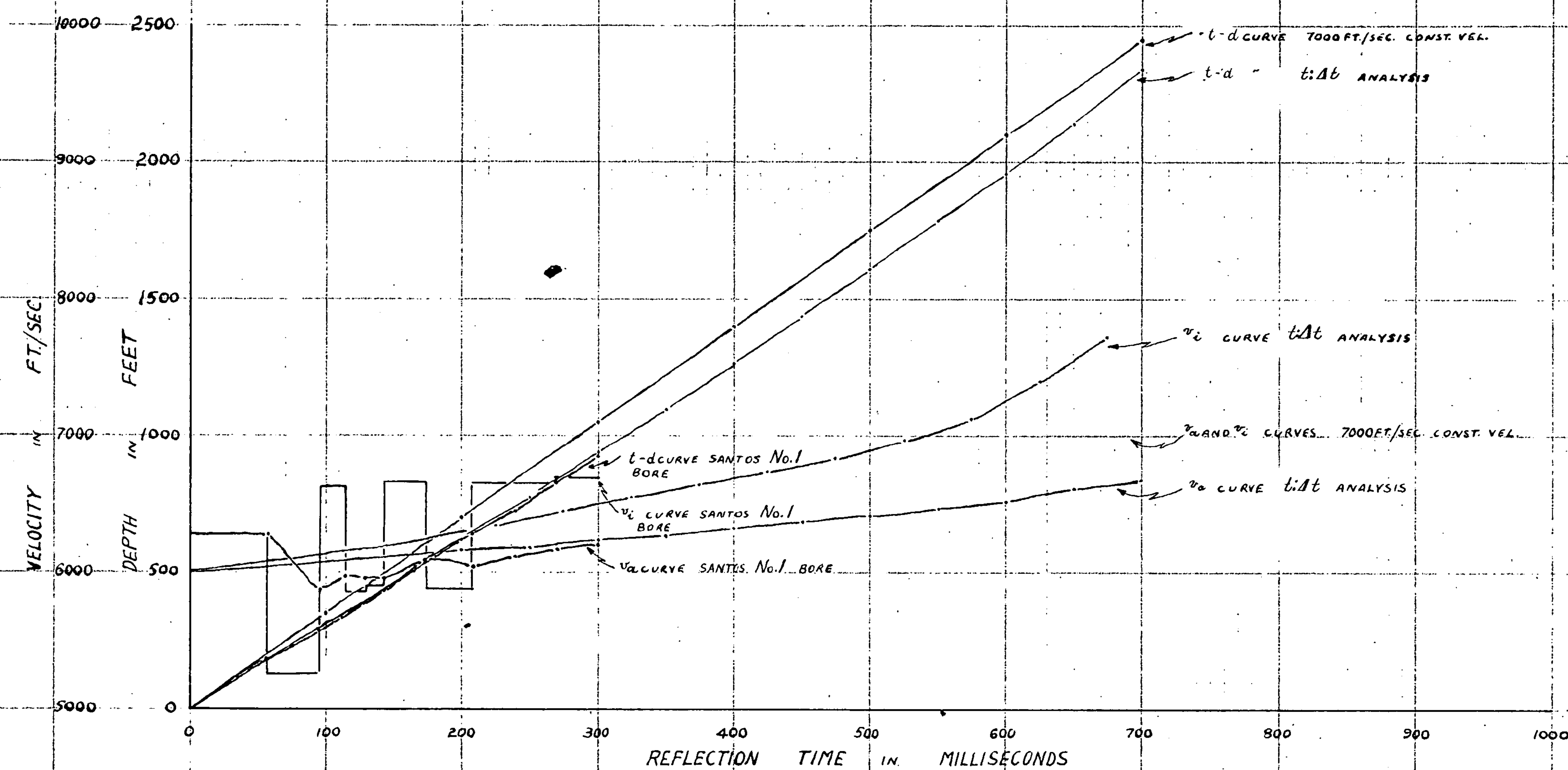

t - d = TIME-DEPTH

EXPERIMENTAL SEISMIC SURVEY, OODNADATTA, S.A.

CURVES RELATING AVERAGE AND INTERVAL VELOCITIES AND DEPTH WITH REFLECTION TIME

Comparison of constant velocity 7000 ft/sec. used for plotting Cross-Sections, with velocities derived from t:Δt analysis of reflections and seismic velocity survey of SANTOS No. 1 bore

MAY 1958

PLATE 8

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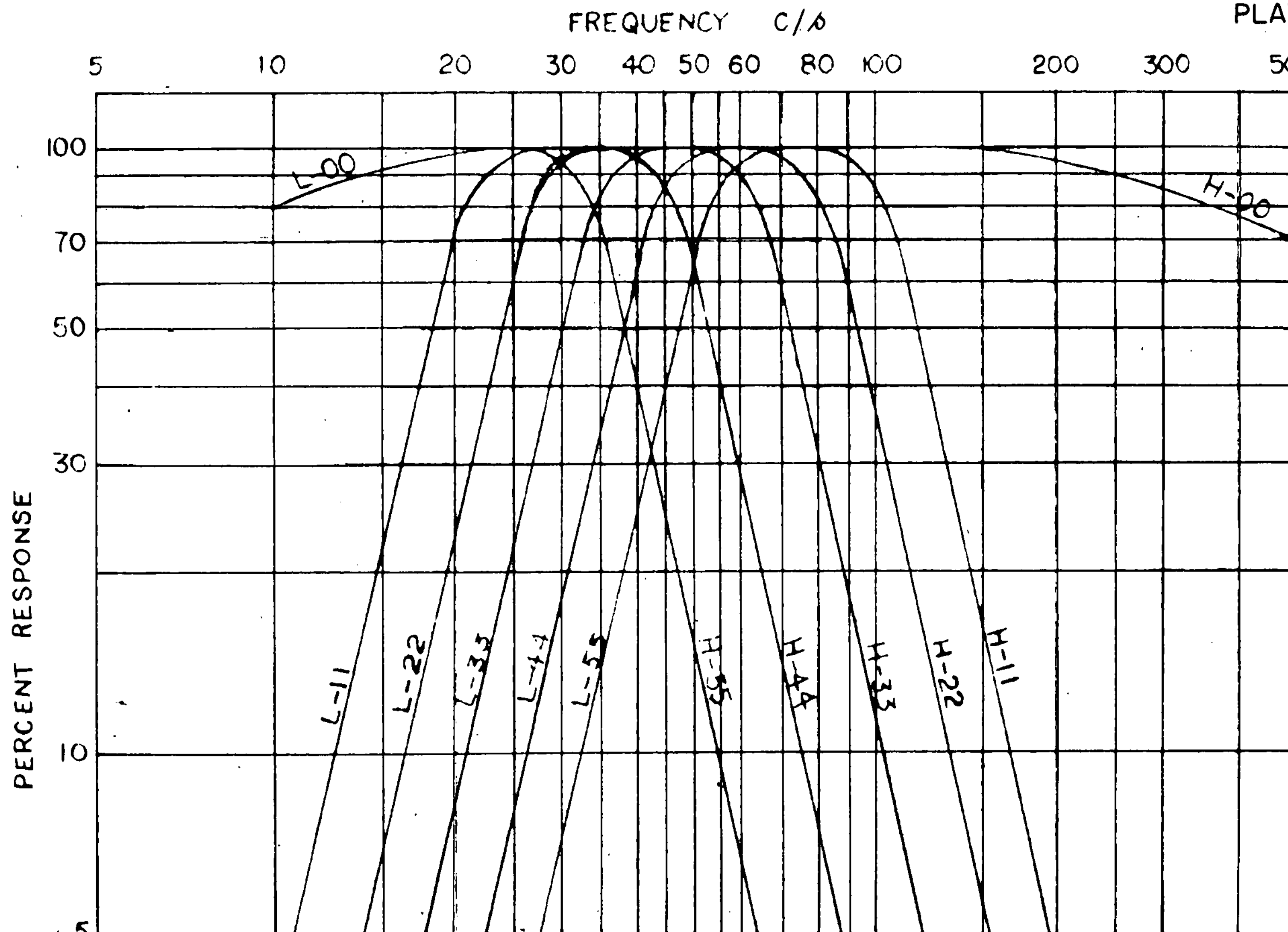
To Accompany Record No. 1962/17

PLATE 9



FREQUENOY RESPONSE CURVE TIC MODEL 621 AMPLIFIER

2 Sections low cut
2 Sections high cut

G 85-84

To Accompany Record No. 1962/17