COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RECORD No. 1963/5

PALM VALLEY-HERMANNSBURG SEISMIC SURVEY, NORTHERN TERRITORY 1961

by

A. TURPIE and F.J. MOSS

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SUMMARY

The Bureau of Mineral Resources'No. 2 seismic party conducted a survey over the Palm Valley Anticline 80 miles west of Alice Springs, from 2nd November to 22nd November 1961.

The seismic reflection method showed (a) the anticlinal structure existed at depth and (b) at the northern end of the main north-south traverse in the Missionary Plains north-dipping reflections were recorded from about 2500-ft depth.

A shallow refractor was recorded in which the velocity was 17,800 ft/sec. This refractor, which could not be positively identified, prevented any useful deeper refraction information being recorded.

1. INTRODUCTION

Following a request in March 1961 by Magellan Petroleum Corporation, it was decided that the Bureau of Mineral Resources' No. 2 seismic party would, on completion of the Amadeus Basin survey, conduct a short survey over the Palm Valley Anticline. The objectives of this survey were as follows:

(a) to test the applicability of the seismic method in the area,

(b) to confirm the anticlinal structure at depth,

(c) to determine the thickness of the Pertnjarra-Mareenie interval,

(d) to determine the total depth of sediments.

It was found that along the proposed reflection traverse in the Finke River bed, which cut through the surface expression of the anticline:

(a) shot holes were difficult to drill in the gravel and would not stay open,

(b) movement of vehicles was difficult in the deep, loose sand,

(c) seismic records from a small pattern of shallow holes were noisy and showed no reflected energy.

It was decided to move the traverse out of the river bed to the plains north of the outcrops and to record:

(a) a reflection traverse perpendicular to the strike,

(b) a refraction depth probe along the strike.

Good reflections were obtained, and therefore a velocity survey was recorded on the traverse along strike.

A high-velocity refractor (17,800 ft/sec) in the Pertnjarra series prevented any useful deeper information being obtained by refraction with offsets up to 6 miles.

In the remainder of the time available, one mile of reflection traverse was shot in the bed of the River Finke south of the crest of the anticline. Single shots at a depth of 40 feet were used in shot holes in bedrock exposed as sandstone ledges at the edge of the canyon. The records obtained were of sufficient quality to prove the anticlinal structure at depth.

A minimum of two week's extra work would have been needed for further testing of the applicability of the seismic method in the Finke River bed.

The survey was made between 2nd and 22nd November 1961.

2. GEOLOGY

Harris (1961) considered that surface and photo-geology in the Palm Valley-Hermannsburg area indicated a closed structure in the Pertnjarra outcrops and was hopeful that the full Cambro-Ordovician geological cross-section was preserved in favourable facies beneath a moderately thick blanket of Pertnjarra formation. The expected geologicalcross-section on the crest of the anticline was:

Age	Group	Formation	Thickness (ft)	Lithology
		Pertnjarra / Mareenie	5000	Sandstone and siltstone
Ordovician	Larapinta	Stokes	1300	Shale and thin limestone
		- - - DISCONFORMITY - - -		
		Stairway	600	Sandstone
		Horn Valley	350	Shale and thin limestone
Cambrian	Pertacorrta	Pacoota	1000	Sandstone
		Goyder	800	Sandstone and shale
		Jay Creek	800	Limestone and clastics
		Hugh River	600	Shale
Upper Proterozoic		Arumbera	400	Sandstone
		Pertatataka	2100	Shale with some sand
		Areyonga	400	Sandstone with some conglomerate
		- - - DISCONFORMITY - - -		
		Bitter Springs	500 + +	Limestone

Magellan Petroleum Corporation in a more recent appraisal of the Palm Valley Anticline has shown no surface closure to the west.

3. RESULTS

Individual traverses

Traverse H (Shot-points 53 to 65) (Plate 5). Reflection quality ranges from poor to good, and reflections are evident at more than 2.9 sec, representing a depth of about 26000 ft. Good reflection records were obtained over this portion of the traverse by using 30-lb charges at depths of 50 to 60 ft, with six geophones per trace at 22-feet intervals.

A poor reflection is recorded at about 0.95 sec (7500 ft) under Shot-point 63, and it can be followed intermittently to Shot-point 53, where it is at about 4500-ft depth. The reflection is possibly from the boundary between the Mareenie and Stokes Formations. No reflections are evident within the Pertnjarra-Mareenie intervals. There is no evidence of unconformity in the reflection cross-section down to 2.0 sec (18,000 ft) at Shot-point 53. At this depth there is a possible unconformity shown in the cross-section. It is most pronounced under Shot-point 57 but reflection quality at 2.0 sec is poor north of Shot-point 57.

Traverse H (Shot-points 9A to 12A) (Plate 6). Reflections along this part of the traverse were difficult to obtain. Fair-quality reflections recorded at about 1.1 sec and 2.0 sec confirm the south dip at depth. These reflections may correlate with the good-quality reflections recorded at 1.2 sec and 2.1 sec under Shot-point 53 (Plate 5).

Traverse I (Plate 7). This traverse was surveyed along the strike and good-quality reflections were recorded at more than 2.9 sec. Below 2.4 sec there is the suggestion of unconformity in the cross-section but reflections are very confused.

Shot-points 22 and 25 were shot at 25 to 40-ft depth whereas the other shot points were shot at 65 to 80-ft depth. This is probably the cause of the misalignment from record to record of good reflections in this cross-section.

A velocity profile was shot over this portion of the traverse with maximum shot-to-geophone distance of $1\frac{1}{4}$ miles. Reflection quality was good. A velocity distribution was obtained using the t^2/x^2 method and the results are presented on Plates 3 and 4.

Traverse I Refraction (Plate 8). Refraction breaks were good using the offsets, depths, and charges shown. However, a high-velocity (17,800 ft/sec) refractor was recorded at a depth of 2300 to 2500 ft. Insufficient time and explosives were available to attempt to probe deeper. This refractor does not correspond to any reflection appearing on the variable-area reflection cross-section from this traverse.

General

It can be concluded in general that:

(a) the reflection seismic method is suited to the investigation of the structure and of the depth of sediments in this region,

(b) the anticlinal structure has been shown to exist at depth in the north south direction and, although the precise location of the axis of folding in the deep sediments has not been recorded, it may be inferred with reasonable accuracy,

(c) the thickness of the Pertnjarra - Mareenie complex is about 4000 ft at the top of the Anticline,

(d) the total thickness of sediments exceeds 18,000 ft.

4. REFERENCES

GABY, P.P. 1947 Grading system for seismic reflection correlation. Geophysics 12, 590-617.

HARRIS, H.I. 1961 Magellan Petroleum Corporation. Personal communication.

VALE, K.R. 1960 A discussion on corrections for weathering and elevation in exploration seismic work 1959. Bur. Min. Resour. Aust. Rec. 1960/13.

APPENDIX A

STAFF AND EQUIPMENT

STAFF:

Party leader	A. Turpie
Geophysicist	F.J. Moss
Surveyors	R. Leetham M. Francki
Clerk	E.J. Quinn
Observer	G.L. Abbs
Shooter	R. Cherry
Toolpusher	J.G. Halls
Drillers	R. Larter J. Chandler
Mechanics	I. Pirie H. McPherson

EQUIPMENT:

Seismic amplifiers	TIC 7000B portable
Seismic oscillograph	Electro Tech ER 66
Magnetic Recorder	Electro Tech DS7/700
Geophones	Electro Tech EVS-2B (20 c/s) TIC(6 c/s)
Drills	One Failing 750 (not used) Two Carey type H1
Water tankers	Four Bedford 4 x 4, 700 gallon
Shooting truck	Bedford 4 x 4, 700 gallon

APPENDIX B

TABLE OF OPERATIONS

Sedimentary Basin	Amadeus Basin
Area	Palm Valley - Hermannsburg, NT
Camp Site	Three miles east of Hermannsburg Mission
Established camp	1st November 1961
Surveying commenced	1st November 1961
Drilling commenced	2nd November 1961
Shooting commenced	3rd November 1961
Miles surveyed	19
Topographic survey control	Magellan Petroleum Corporation gravity survey
Explosives used	2602 lb Geophex
Datum level for corrections	1900 ft above MSL
Weathering velocities	2000 and 2200 ft/sec
Sub-weathering velocities	11,500 and 14,000 ft/sec
Source of velocity distribution	t^2/x^2 velocity shoot

REFLECTION SHOOTING DATA:

Shot-point interval	1320 ft
Geophone group	Six geophones, 20 c/s, 22 ft apart
Geophone group interval	110 ft
Holes shot	33
Miles traversed	Five
Common shooting depth	70 ft
Usual recording filter	K24 K75
Usual playback filter	K30 K57
Common charge size	30 lb
Weathering corrections	Graphical method (Vale, 1960)
Grading system	After Gaby (1947)

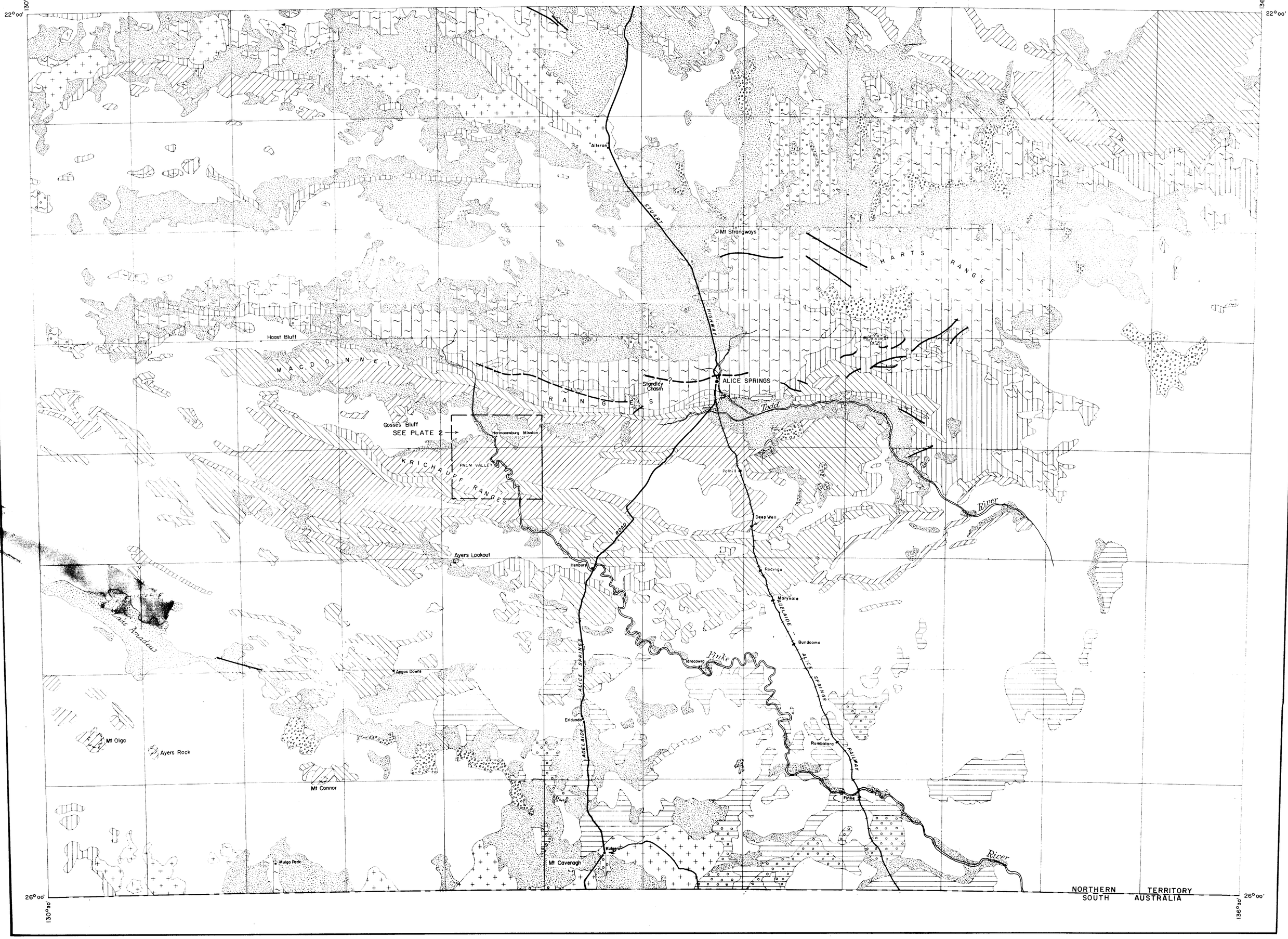
REFRACTION SHOOTING DATA:

Geophone group	Two geophones, 6 c/s, together
Geophone group interval	220 ft
Holes shot	Five
Usual recording filter	K0 K40
Number of refraction traverses	One
Charge size	500 lb
Maximum shot-to-geophone distance	Seven miles
Weathering control	Reflection shooting
Weathering and elevation corrections	Graphical method (Vale, 1960)

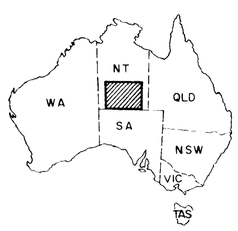
APPENDIX C

Seismic shot-hole drilling statistics

Total footage drilled	3678 ft
Total number of holes drilled	85
Average depth of holes	43.2 ft
Deepest hole drilled	100 ft
No. of shifts worked	30
Maintenance to drill	24½ hr
Travelling time and rigging up	65½ hr
Time lost waiting for water	4 hr
Time lost in repairs to drill	19½ hr
Time lost in repairs to rig engine	3½ hr
Time lost waiting on surveyors	6¼ hr
Time lost standing by for recorder	6 hr
Bentonite used	12 bags
Drilling time	141½ hr
Average rate of penetration	26 ft/hr



LOCATION



FIRST EDITION, MARCH 1960

MAP DATA

PROJECTION: LAMBERT CONFORMAL CONIC. STANDARD PARALLELS 24°40' AND 27°20'.

CONTROL: ASTRONOMICAL FIXATIONS BY THE DIVISION OF NATIONAL MAPPING.

DETAIL: BASE MAP FROM 1:1,000,000 I.C.A.O. AERONAUTICAL CHARTS, (3231) LAKE MACKAY, (3232) ALICE SPRINGS, (3345) ODNADATTA (2nd EDITION) AND (3344) PETERMANN RANGES. GEOLOGY FROM DRAFT COPY BY BMR GEOLOGICAL BRANCH AT 12 MILES TO 1 INCH APPROXIMATE SCALE. PLANIMETRY FROM 1:1,000,000 I.C.A.O. CHARTS.

RELIABILITY: PLANIMETRIC - SKETCH.
GEOLOGICAL - REGIONAL GEOLOGY.

PALM VALLEY–HERMANNSBURG, N.T.
SEISMIC SURVEY 1961
REGIONAL GEOLOGY

SCALE IN MILES

10 0 10 20 30 40 50 60

LEGEND

- Deep weathering profile (laterite) Superimposed on formations concerned
- RECENT AND PLEISTOCENE: Aeolian sands
- RECENT AND PLEISTOCENE: Alluvium, wash, red earth soil, calcrete evaporites, clays, terrace gravels.
- TERTIARY: Chalcedony, calcareous silt, gypseous clays.
- MESOZOIC AND PERMIAN: Undifferentiated sandstones, siltstones, claystones, also silty sandstones, boulder bed, arkose and conglomerate of "Finke Series."
- UPPER PALAEOZOIC AND DEVONIAN: Sandstones, conglomerates, shales, "Pertnjara form'n" Mareeba and Dulcie Sandstones
- ORDOVICIAN AND CAMBRIAN: Sandstone, limestone, dolomite, shale, quartz, greywacke, (includes members of "Pertaoorrta and Larapinta Groups" and the "Sandover Beds")
- PROTEROZOIC: Sandstone, quartzite, shale, limestone, conglomerate, boulder beds
- UNDIFFERENTIATED PRECAMBRIAN: Gneiss, schist, amphibolite, granite, granodiorite, basic intrusive pegmatites, dolerite, "Arunta Complex."
- Granite.

F53/B3-2

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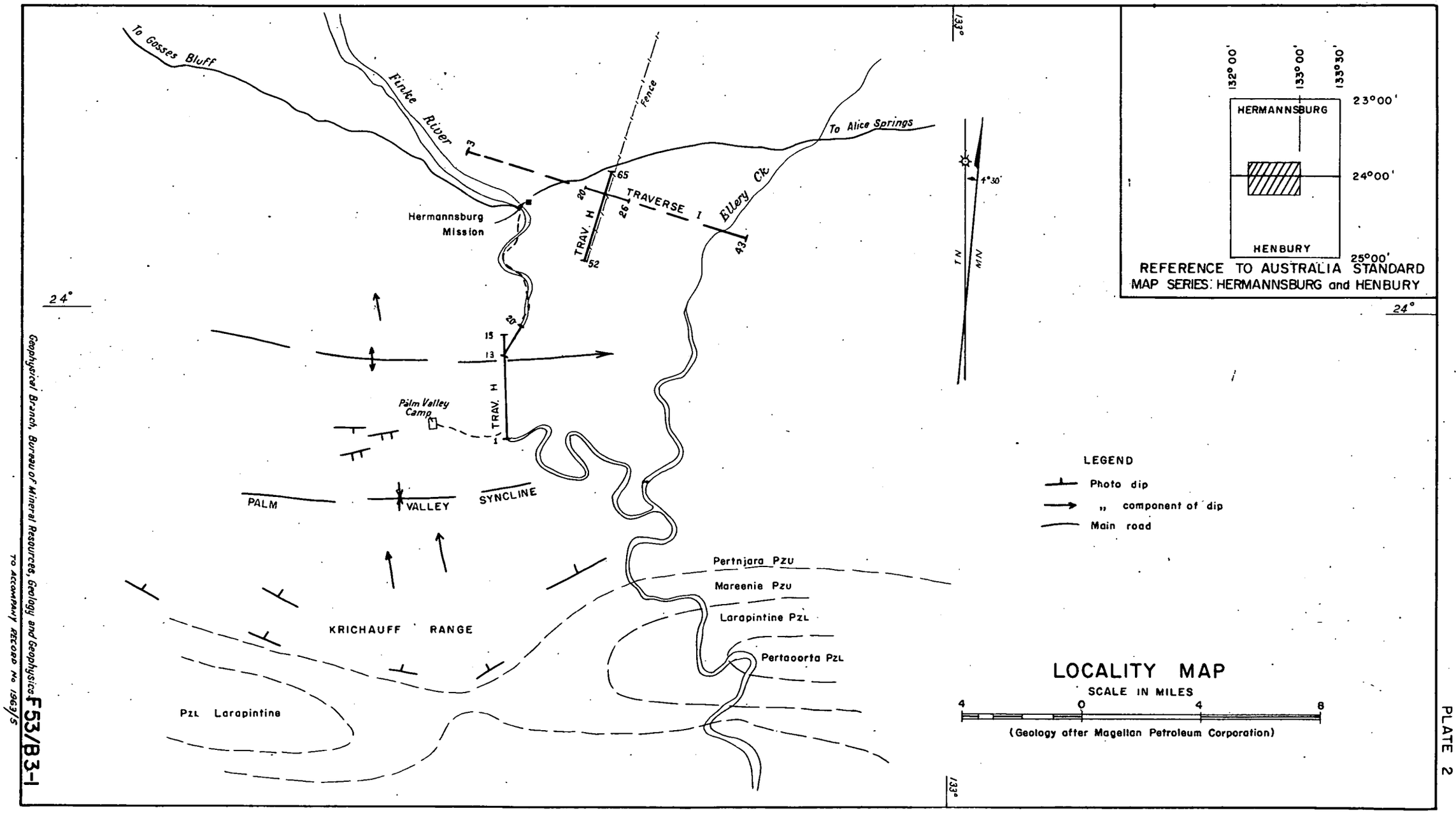
TO ACCOMPANY RECORD 1963/5

PALM VALLEY - HERMANNSBURG SEISMIC 1961

55



Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics

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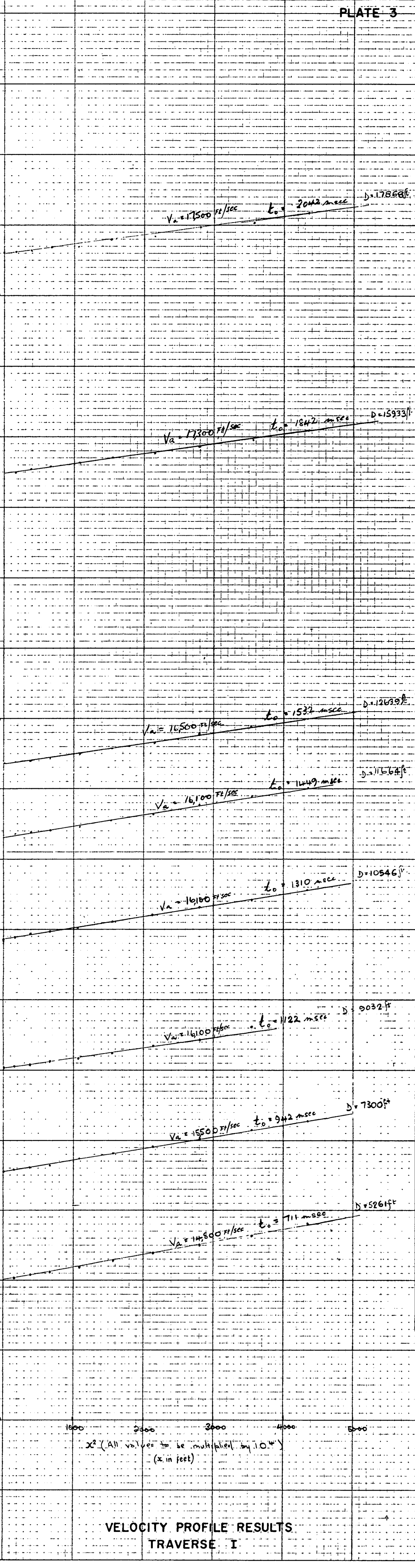
F53/B3-1

PLATE 2

PLATE 3



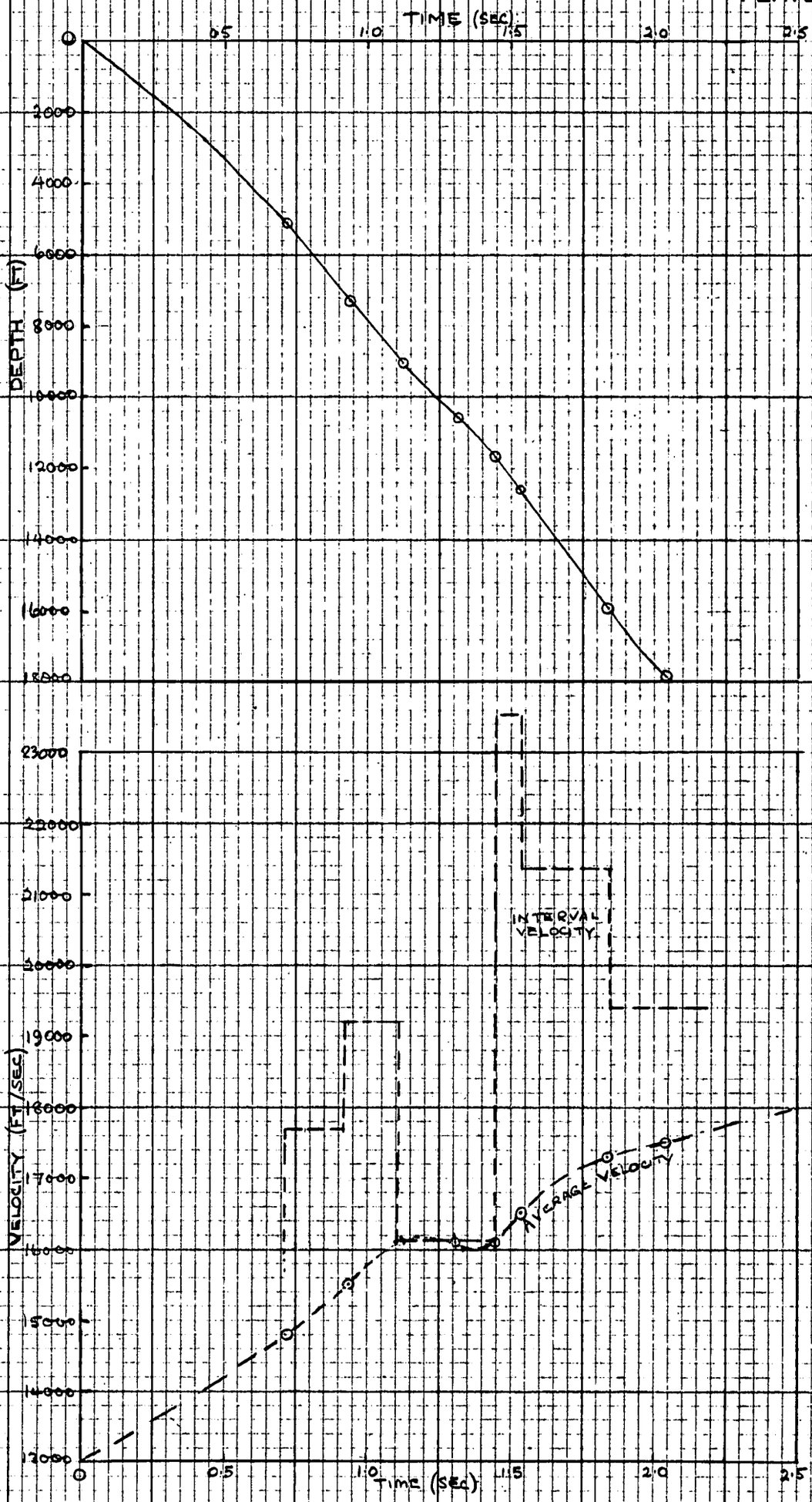
PALM VALLEY - HEAMANNSBURG SEISMIC TRAV. I

VELOCITY PROFILE RESULTS
TRAVERSE I

F53/B3-3

TO ACCOMPANY RECORD No 1963/5

PLATE 4



TIME/DEPTH CURVE, AVERAGE AND INTERVAL VELOCITIES

F53/B3-4

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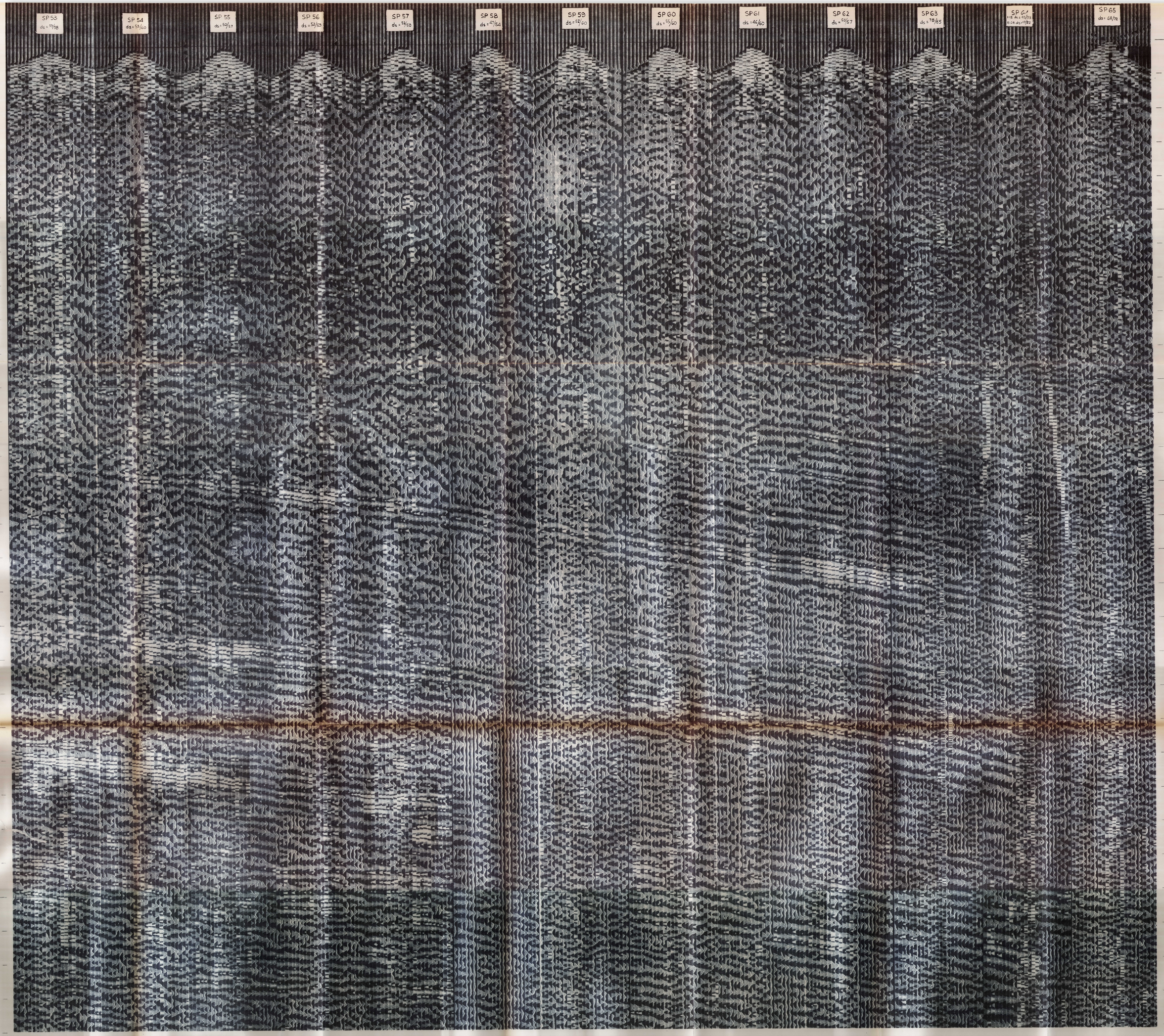
PALM VALLEY-HERRMANNSBURG SEISMIC 1961

55

PLATE 5

SP 53 ds = 53/58 | SP 54 ds = 53/60 | SP 55 ds = 50/57 | SP 56 ds = 52/53 | SP 57 ds = 52/53 | SP 58 ds = 47/54 | SP 59 ds = 52/60 | SP 60 ds = 55/60 | SP 61 ds = 46/60 | SP 62 ds = 50/57 | SP 63 ds = 78/85 | SP 64 1-12 ds = 15/23 13-24 ds = 17/22 | SP 65 ds = 68/72



DATUM 1900 ft

DEPTH (FEET) — TIME (SECONDS) — REFLECTION

0 — 1000 — 2000 — 3000 — 0·5 — 4000 — 5000 — 6000 — 7000 — 1·0 — 8000 — 9000 — 10000 — 11000 — 12000 — 1·5 — 13000 — 14000 — 15000 — 16000 — 17000 — 2·0 — 18000 — 19000 — 20000 — 21000 — 22000 — 2·5 — 23000 — 24000 — 25000 — 26000

LEGEND

SHOT POINT INTERVAL: 1320 ft
GEOPHONES: 6 per station
GEOPHONE INTERVAL: 22 ft in line

RECORD FILTERS: K24 K75
PLAYBACK FILTERS: K30 K57
AMPLIFIERS: HTL 7000B
CAMERA: ELECTRO TECH ERGG

VELOCITY INFORMATION

Velocity spread shot on cross traverse at SP62

TRAVERSE H

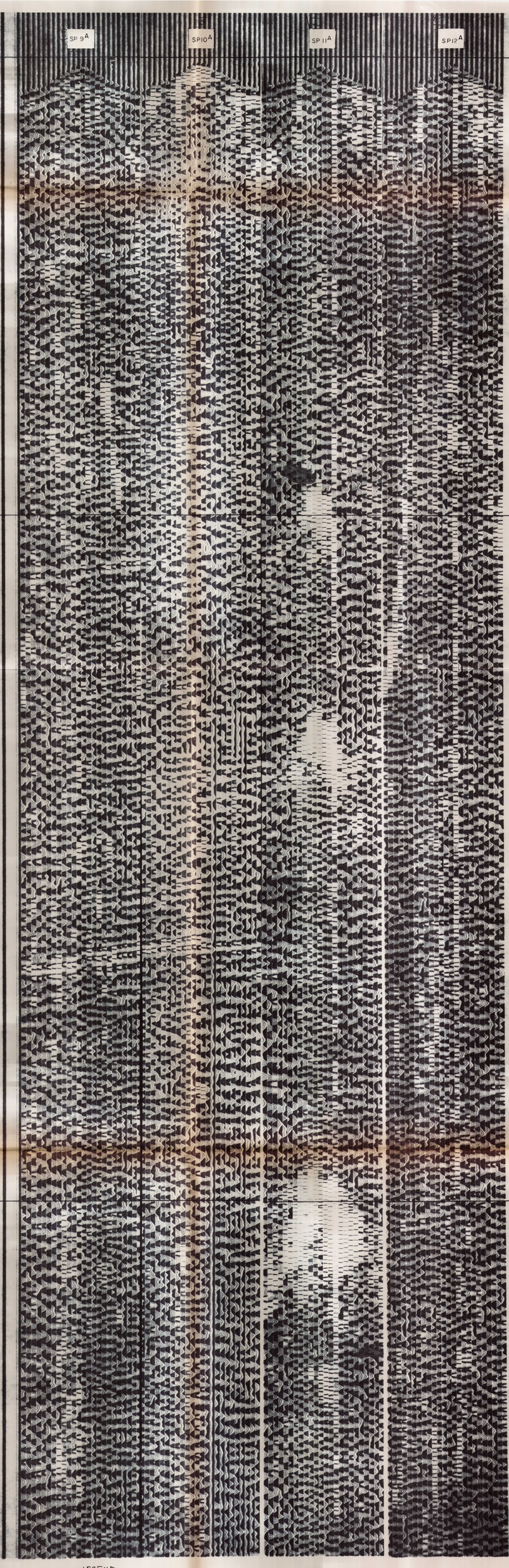
SHOT-POINTS 53 TO 65

REFLECTION CROSS-SECTION

F53/B3-5

TO ACCOMPANY RECORD No. 1963/5

PLATE 6



REFLECTION TIME (SECONDS)

0
0.5
1.0
1.5
2.0
2.5
3.0
3.2

DATUM
0 1300Ft
1000
2000
3000
4000
5000
6000
7000
8000
9000
10,000
11,000
12,000
13,000
14,000
15,000
16,000
17,000
18,000
19,000
20,000
21,000
22,000
23,000
24,000
25,000
26,000

DEPTH (FEET)

LEGEND

SHOT POINT INTERVAL 1320 Ft
GEOPHONES 6 per station
GEOPHONE INTERVAL 22 Ft in line

RECORD FILTERS: K24 K75
PLAYBACK FILTERS K30 K57
AMPLIFIERS: HTL 7000 B
CAMERA: ELECTRO TECH ER 66

VELOCITY INFORMATION
Velocity spread shot on traverse I

TRAVERSE H
SHOT-POINTS 9A TO 12A
REFLECTION CROSS-SECTION

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TO ACCOMPANY RECORD No. 1863/5

PLATE 7

SP 21 ds = 66/80

SP 22 ds = 28/38

SP 23 ds = 63/70

SP 24 ds = 73/80

SP 25 ds = 25/32

DATUM 1900 ft

DEPTH (FEET) — TIME (SECONDS) — REFLECTION

0 — 1000 — 2000 — 3000 — 0.5 — 4000 — 5000 — 6000 — 7000 — 1.0 — 8000 — 9000 — 10000 — 11000 — 12000 — 1.5 — 13000 — 14000 — 15000 — 16000 — 17000 — 2.0 — 18000 — 19000 — 20000 — 21000 — 22000 — 2.5 — 23000 — 24000 — 25000

LEGEND

SHOT POINT INTERVAL: 1320 Ft
GEOPHONES: 6 per station
GEOPHONE INTERVAL 22 Ft/in line
RECORD FILTERS: K24 K75
PLAYBACK FILTERS: K30 K57
AMPLIFIERS: HTL 7000B
CAMERA: ELECTRO TECH ER66

VELOCITY INFORMATION

Velocity spread shot on this traverse

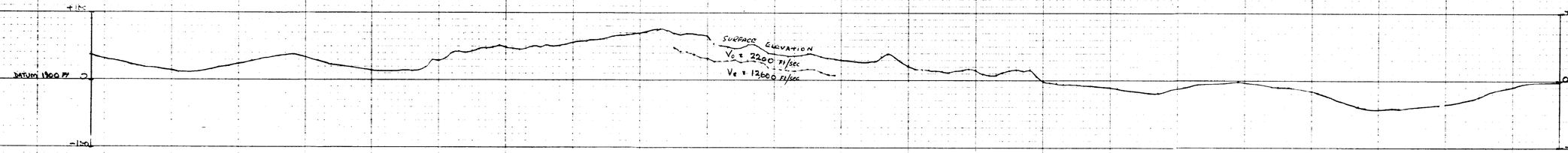
TRAVERSE I
REFLECTION CROSS-SECTION

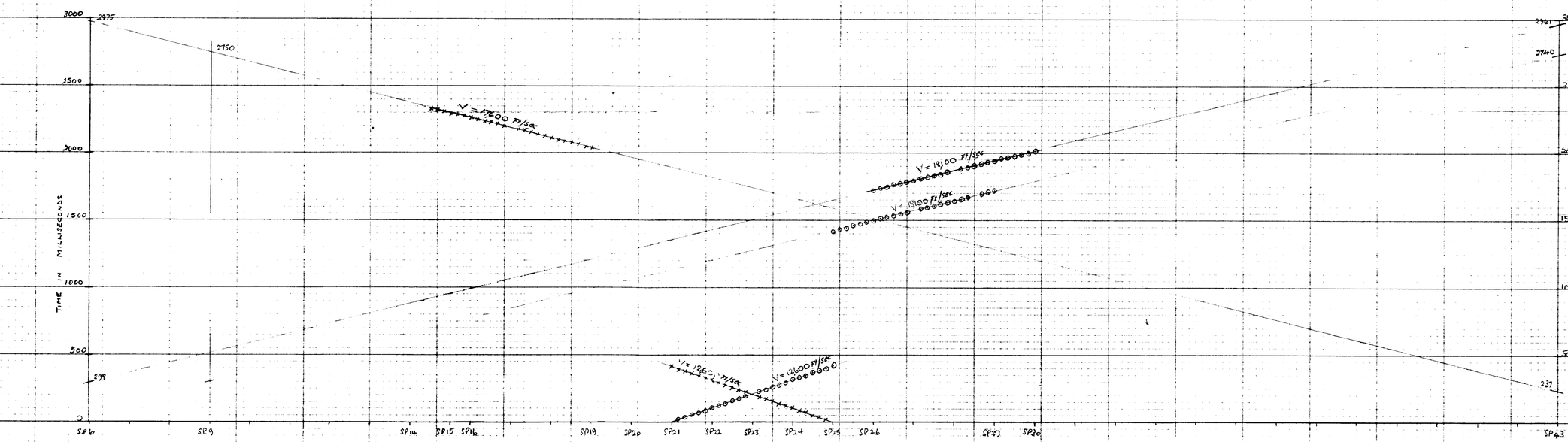
F53/B3-7

To ACCOMPANY RECORD No 1963/5

PALM VALLEY - HERMANNSBURG SEISMIC 1961

PLATE 8





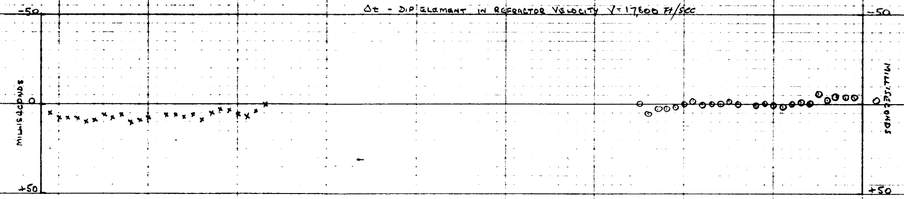
SP26						SP28															SP30	
t_o	1728	1746	1752	1760	1778	1789	1799	1814	1826	1838	1852	1863	-	1889	1900	1913	1924	1938	1948	1962	1966	1984	1995	2005	2020
W_c+E_c	-10	-10	-10	-10	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-9	-8	-8	-8	-9	-9	-9	-9	-9	-8
t_c	1718	1736	1746	1750	1769	1780	1790	1795	1817	1829	1844	1854	-	1880	1891	1904	1916	1926	1940	1953	1959	1975	1986	1999	2012

SP6 $\frac{dS}{dt}$ = 35/61 CHANGE 400 lbs

SP25							SP27															SP29	
t_o	1626	1639	1652	1666	1677	1691	1502	1517	1525	1542	1553	1563	-	1586	1599	1611	1626	1637	1650	1658	1676	-	1701	1715	1726
W_c+E_c	-8	-8	-7	-7	-7	-8	-8	-8	-8	-7	-7	-7	-7	-7	-7	-7	-7	-7	-7	-7	-7	-7	-6	-6	-6
t_c	1618	1631	1645	1659	1670	1683	1494	1509	1517	1534	1546	1556	-	1579	1592	1604	1619	1630	1643	1651	1669	-	1695	1709	1720

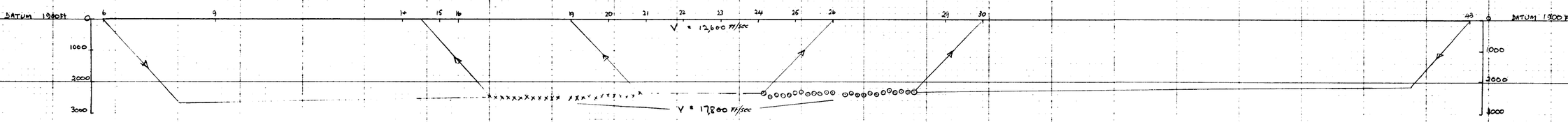
SP9 $\frac{dS}{dt}$ = 43/80 CHANGE 240 lbs

Δt - DIP ELEMENT IN REFRACTOR VELOCITY V = 17,600 FT/SEC



SP42		SP15		SP14		SP17			SP18			SP19	
2344	781	2830	2807	2797	2784	2769	2758	2745	2735	2732	2710	-	2683
-8	-7	-8	-8	-8	-8	-8	-8	-8	-7	-7	-8	-8	-8
2336	2324	2312	2299	2289	2276	2261	2250	2237	2227	2224	2202	-	2675

SP43 $\frac{dS}{dt}$ = 35/80 CHANGE 500 lbs



PROFILE OF REFRACTOR SHOWING RAY PATHS

SCALE

HORIZONTAL 0 2200 4400 Feet

VERTICAL 0 2000 4000 Feet

REFRACTION TRAVERSE I

TIME/DISTANCE CURVES, AND INTERPRETATION

PALM VALLEY — HERMANN SEISMIC SURVEY 1961

F53/B3-8

TO ACCOMPANY RECORD No 1963/5