1958/101
Copy 3

COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS.

RECORDS

1958 NO. 101.

PRELIMINARY REPORT

on

AN EXPERIMENTAL SEISMIC SURVEY, LATROBE VALLEY, VICTORIA.

by

K. B. Lodwick.

RECORDS 1958 NO. 101

PRELIMINARY REPORT

on

AN EXPERIMENTAL SEISMIC SURVEY, LATROBE VALLEY, VICTORIA.

by

K. B. Lodwick.

CONTENTS.

Page.

ABSTRACT.

1. INTRODUCTION.

2. RESULTS

Traverse A
Interpretation of Traverse A
Traverse B.

3. REFERENCES.

ILLUSTRATIONS.

Plate 1. Detailed Gravity Survey, 1958, Maryvale/Traralgon Parishes.

Plate 2. Seismic Reflection Cross-Section Traverse 'A' (Bennett's Creek).

Plate 3. Profile from Refraction Work Traverse 'A' (Bennett's Creek).

Plate 4. Seismic Reflection Cross-Section Traverse 'B' (Maryvale).

ABSTRACT.

An experimental seismic survey was made in Morwell-Traralgon area of the Latrobe Valley, Gippsland, Victoria.

Reflections were obtained from within the brown coal measures and their general structure, within the area surveyed was indicated.

Refraction tests indicated velocities at depths which can probably be attributed to basalt. Only the more important aspects of the results are given but a detailed report will be issued later.

1. INTRODUCTION.

During April and May 1958 the Bureau of Mineral Resources carried out an experimental seismic survey in the Morwell-Traralgon Area of the Latrobe Valley. The objects of the survey were to delineate structure within the coal measures, and to determine the depth to basement which was thought to be either the basaltic Narracan Group or Jurassic Sediments.

2. RESULTS.

Plate 1 is a Bouguer anomaly map of the area which also shows the position of the seismic traverses. The latest gravity observations along the seismic traverses (and also at several new stations along roads) are incorporated in the map. Only slight modifications to the earlier Bouguer anomaly maps (Neumann 1951) were necessary.

Traverse A.

A reflection cross-section between shot points 5½ and 14 on traverse A is shown on Plate 2. At the top of the plate the surface elevation, drill logs of shot holes and the thickness of the low velocity surface layer (the weathered layer) are shown on an exaggerated scale. The reflections recorded have been plotted on a natural scale (500 feet equals 1 inch) with reference to a datum of 250 feet above M.S.L. When reflected energy is recorded from a geological horizon, its wave form on the oscillograph record extends over two or three cycles. Each cycle has been plotted as a separate line on the cross-section and hence a single reflection representing a single geological horizon may be represented by two or three lines on the cross-section. Reflections have been plotted vertically below the shot point at which they were recorded so that dipping reflections are not plotted in their true positions. The reflection time is measured on the seismic record and to enable this to be presented in terms of depth, a velocity distribution for the Section has to be determined. In this case, in the absence of velocity data from bore holes, a statistical analysis of reflections was carried out to determine the velocity distribution. These results may be as much as 10% in error, which will in turn mean that the depths indicated on the cross-sections may also be as much as 10% in error.

The reflection cross-section indicates conformable reflection horizons from 500 feet to 2,000 feet below shot point 14 and it is possible to correlate reflections from one shot point to the other as far as shot point 8, where a sharp discontinuity in the correlation of reflections from one shot point to the next is noticeable. Another less pronounced discontinuity can be observed under shot point 6½. Reflection quality is not as good between shot point 5½ and 8 as on the remainder of the traverse. There appear to be changes in the character of the cross-section at two different depths. At SP14, the reflections above 2100 feet are of far better quality than those below, and this change in character can be followed along the cross-section to SP8, where it is at a depth of about 1600 feet. The change is more noticeable on the records than on the cross-section, and although there is no apparent angular unconformity between the reflections above and below the change, it seems to be a major break in the section. A second change, below which the reflections are more sparsely distributed, is noticeable 2600 feet below shot point 14 and may be followed along the cross-section to shot point 8.

Refraction shooting revealed the presence of a layer having a velocity of 14,000 feet per record beneath shot point 11. The calculation of the depth of the layer depends on the average velocity assumed for the sediments above it. From considerations of the near surface velocities and the statistical anlysis of reflections, average velocity of 6500 ft/sec. appears the best value to use. Reasonable limits of the velocity would be 6000 ft/sec. minimum and 7000 ft/sec. maximum. The depth calculated using these three velocities are shown on the profile.

Refraction work was also carried out between shot points 5 and 17 on the south-eastern end of traverse A and a velocity of 12,000 ft/sec. was recorded. The depth to this velocity was calculated at several shot points and a profile of the top of the refractor is shown on Plate 3. The same natural scale (500 feet equals 1 inch) as the reflection cross-section (Plate 2) was used so that a continuous cross-section from shot point 14 to shot point 16½ may be made by joining the two plates.

Interpretation of Traverse A.

Basalt is known to crop out about half a mile south-east of shot point 17, and it was expected to dip beneath the coal measures for at least a short distance to the north-west and it may be present throughout a great part of the Latrobe Valley. The velocity of 12,000 feet per second measured by refraction work between shot points 5 and 17 is a reasonable value for basalt and, taking into account the dip of the profile on Plate 3, it is reasonable to assume that the top of the basalt is represented by the profile of the 12,000 feet per second layer. Since the completion of the seismic work information on two bores has come to hand. The depth to basalt in the bores is plotted on Plate 3 and the agreement with the profile confirms that the 12,000 feet per second layer is basalt.

The depth of basalt from refraction work is shown beneath shot point 5 on Plate 2 and it may be correlated confidently with a reflection at a depth of about 940 feet below shot point 6. It is possible to correlate the reflection to a depth of 1,400 feet below shot point 8. The discontinuity in correlation beneath shot point 6½ may be interpreted as a small fault with a throw of 100 feet or less and downthrown to the north-west.

In the sedimentary sequence of the Latrobe Valley presented by Thomas (1953) two major changes in character are evident. It seems a logical interpretation of the reflection cross-section between shot points 8 and 14 to correlate the first geological change at the top of the basaltic Narracan Group with the first change in character of the reflection cross-section (i.e. at 2100 feet below shot point 14) and the second geological change at the top of the Jurassic with the second change in the character of the reflection cross-section (i.e. at 2600 feet below shot point 14).

A serious argument against this interpretation arises from the results of refraction work. The velocity of 14,000 feet per second, which was recorded beneath shot point 11 seems too high for the Jurassic sediments even at a depth of 3000 feet and it is more likely that of basalt. The most probable value for the depth of this high velocity layer (representing the basaltic Narracan Group) is 2440 feet corresponding with the second change in the reflection cross-section (see Plate 2), not the first as suggested above.

Two changes in the interpretation which would bring agreement between the reflection work and the refraction work are suggested below:

(a) A significant change in the sedimentary character of the Upper Latrobe Valley Coal Measures may exist which could account for the first change in character of the reflection cross-section, thus allowing part of the upper coal measures to be represented by the reflections between the two changes in character of the cross-section at 2,100 and 2,500 feet respectively below shot point 14.

(b) Basalt may not exist in the sedimentary sequence on this part of the traverse and the velocity of 14,000 feet per second may represent the Jurassic sediments. It is most unlikely that, if the basalt does exist above the Jurassic sediments, the velocity recorded is that of these sediments.

The sharp break in correlation beneath shot point 8 is almost certainly a fault. The magnitude of the throw is uncertain because of the uncertainty of interpretation between shot points 8 and 14. If the top of the basalt were taken as approximately corresponding to the first change in character of the cross-section (this is not in agreement with the refraction work), the throw would be about 200 feet. It would be about 800 feet if the basalt were to correspond to the second change in character of the cross-section.

Traverse B.

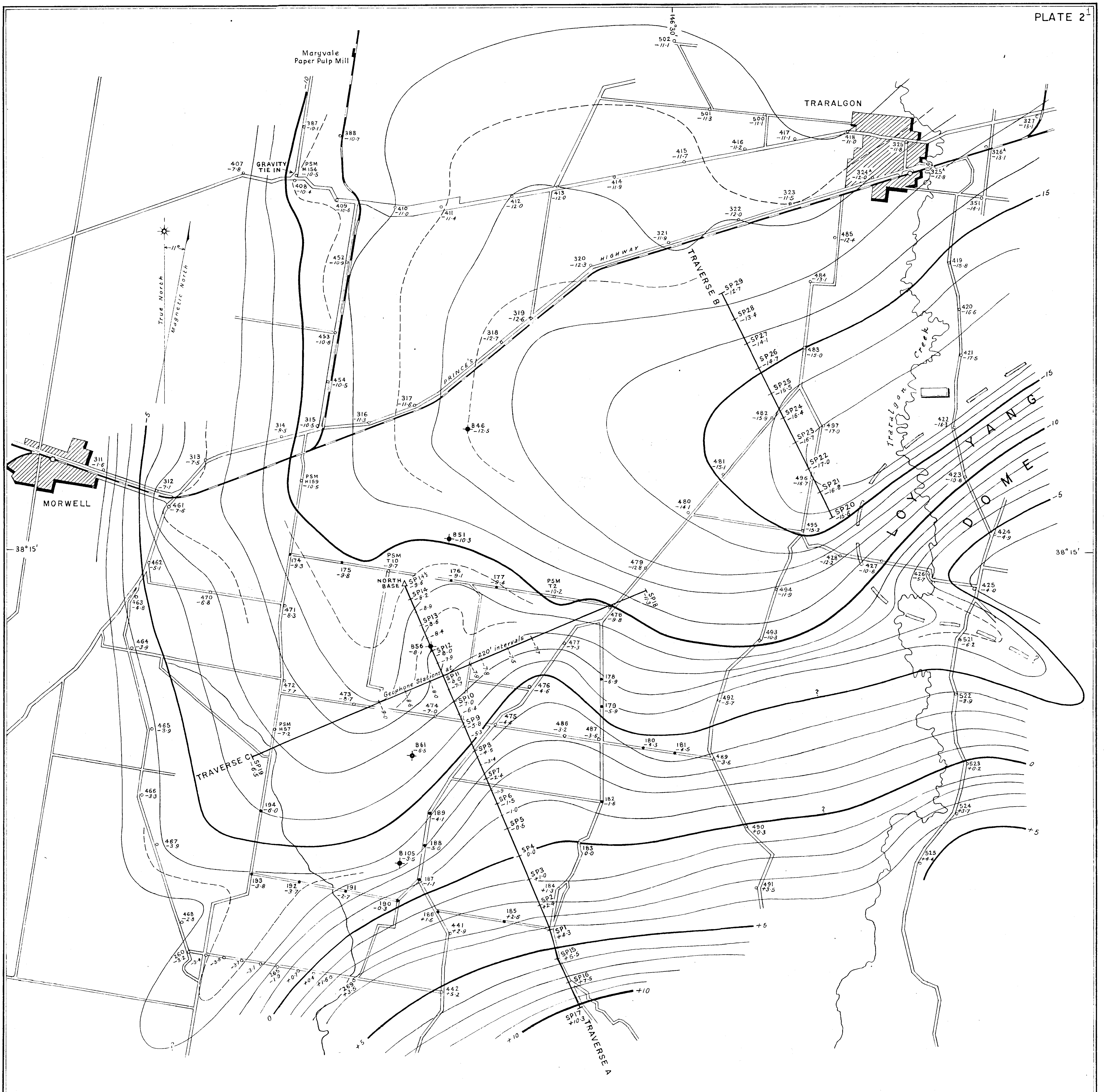
The reflection cross-section along traverse B is shown on Plate 4. The lack of shallow information is noticeable when it is compared with Plate 2. This is due to the fact that shot holes were spaced a quarter mile apart on traverse B (Plate 4) and an eighth mile apart on traverse A (Plate 2).

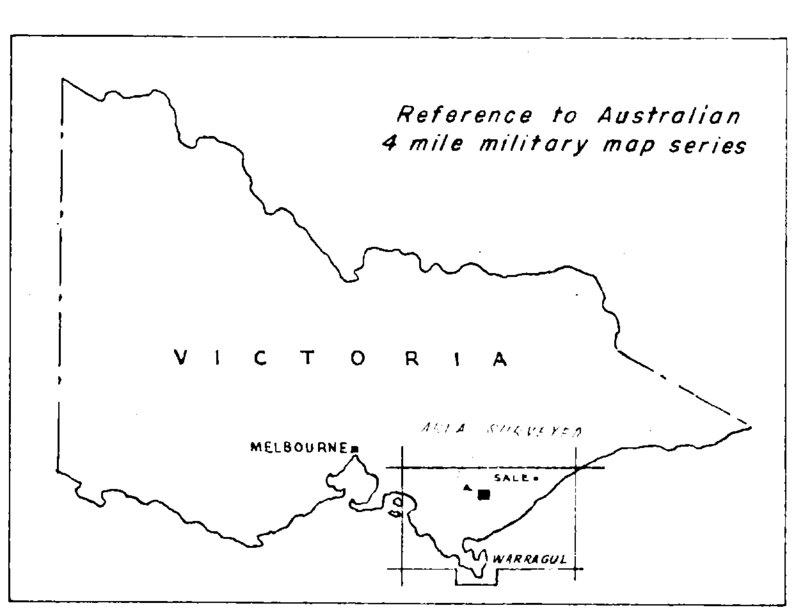
The cross-section indicates that the coal measures are unlikely to be deeper than 2500 feet below which the reflections are fewer and not as easily correlated as above. A shallow synclinal feature with its axis below shot point 25 is indicated by reflection dips on the cross-section. It appears from the results obtained on this traverse that it would be necessary in any future work to space shot holes at eighth mile intervals in order to obtain reliable information on the structure of the coal measures.

3. REFERENCES.

Thomas, D.E., 1953 - Geology of the Brown Coal of Victoria. Fifth Min. and Metall. Cong. Aust. and N.Z., 1953. Publications Vol. VI Coal in Australia.

Neumann, G., 1951 - Analysis of Gravity Survey of the Yallourn-Morwell-Traralgon Area, Victoria. Bur.Min.Res. Geology and Geophysics Records 1951/10.





SCALE IN MILES

½ ¼ 0 ½ 1 1½ 2 2½

Contour Interval 1 Milligal

LEGEND

SP8	Seismic Traverse
10 / 5	Gravity Contours
• 176	Gravity Station 1958
○ 215	Earlier Gravity Station
—4·7	Relative Bouguer Anomaly
	Road
	Railway
B61	Bore Hole

EXPLANATION

Contours show Bouguer values relative to an arbitary datum. An average density of 1·887 has been assumed for rocks between station site and sea level in reduction of gravity values.

To convert to Bouguer Anomalies relative to theoretical values on International Ellipsoid (density $\sigma = 2{\cdot}67$), subtract from values shown:

$$(9{\cdot}13 + 0{\cdot}01 \times h) \text{ milligal,}$$

where 'h' is the station altitude in feet above Sea Level.

1958 EXPERIMENTAL SEISMIC SURVEY, LATROBE VALLEY, VICTORIA.

MORWELL-TRARALGON AREA

BOUGUER ANOMALY MAP AND SEISMIC TRAVERSES

E. Neumann

GEOPHYSICIST

To Accompany Records 1959, No. 151

PLATE 24

LEGEND

DRILL LOGS

Clay

Sand

Coal

CROSS-SECTION

Good quality reflection

Fair quality reflection

Poor quality reflection

Doubtful quality reflection

(1) Depth to top of layer with a velocity of 14000 ft per second, assuming an average velocity of 5500 ft. per second for the sediments above it (1990 ft.)

(2) As above. Assuming velocity of 6000 ft. per second (2200 ft.)

(3) As above. Assuming velocity of 6500 ft per second (2440 ft.)

Note: Above depths converted to equivalent times and shown relative to plotted reflections.

(4) Depth to top of layer with a velocity of 12000 ft per second at shot point 5. Measured velocity of Overlying Strata 5800 ft per second.

PHANTOM HORIZONS

FIRST PHANTOM HORIZON: Derived by correlating an arbitrarily chosen reflection (1000 feet below datum at S.P. 13) from one shot point to the next.

SECOND PHANTOM HORIZON: Drawn along the first change in character of the cross-section by progressively following the mean of the dips of the reflections between the two changes in character of the cross-section.

THIRD PHANTOM HORIZON: Drawn along the second change in character of the cross-section by progressively following the mean of the dips of reflections below it.

EXPERIMENTAL SEISMIC SURVEY, LATROBE VALLEY, VIC.

SEISMIC REFLECTION CROSS-SECTION
TRAVERSE A
(BENNETT'S CREEK)

UNMIGRATED CORRELATION SECTION

HORIZONTAL SCALE IN FEET

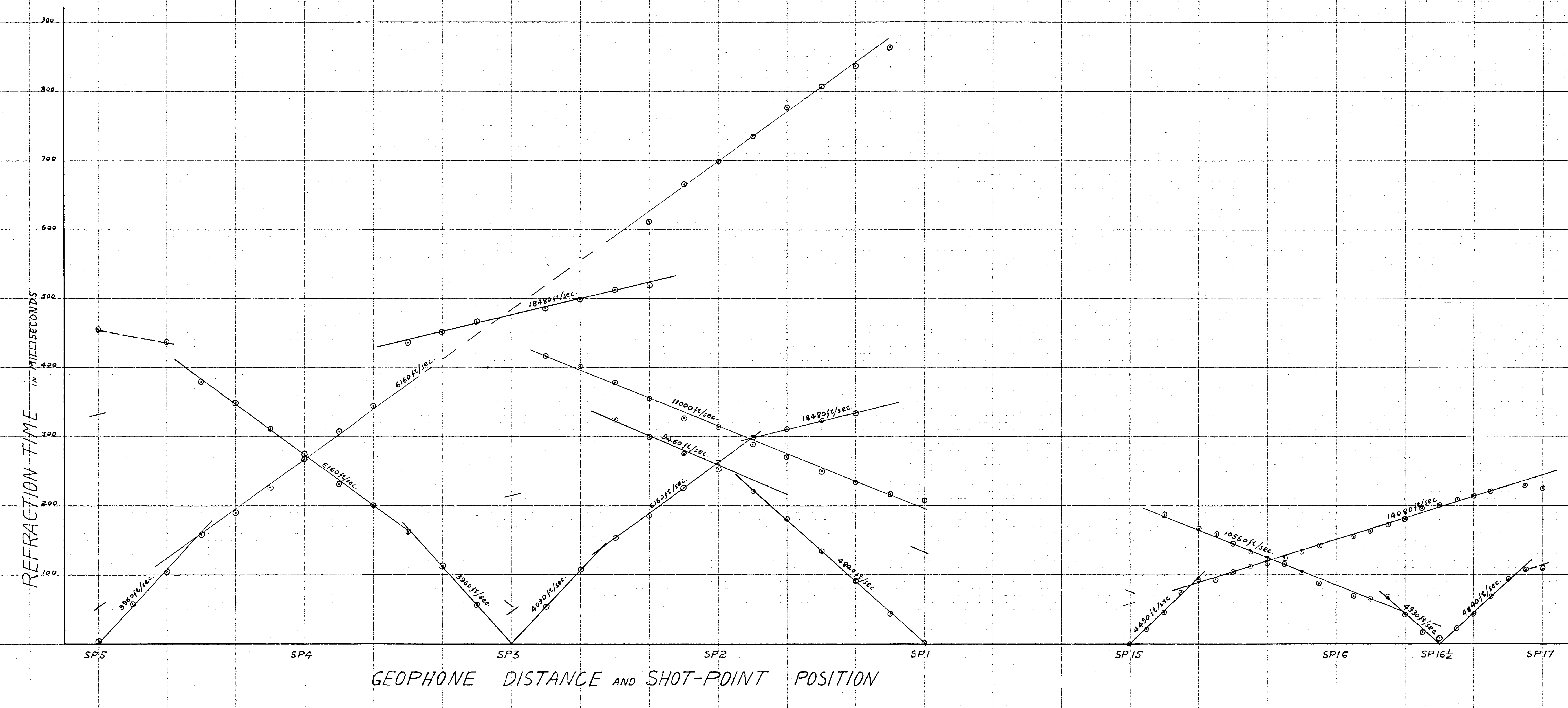
500 400 300 200 100 0 500 1000

Geophysical Section, Bureau of Mineral Resources, Geology & Geophysics

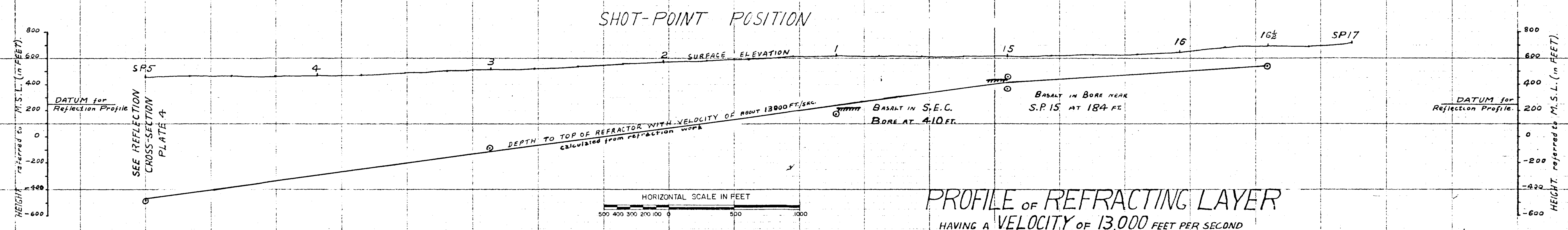
G 93-61

To Accompany Records 1959, No. 151

PLATE 3



TIME-DISTANCE CURVE



PROFILE OF REFRACTING LAYER
HAVING A VELOCITY OF 13,000 FEET PER SECOND

EXPERIMENTAL SEISMIC SURVEY, LATROBE VALLEY, VIC.

SEISMIC REFRACTION RESULTS TRAVERSE A

(BENNETT'S CREEK)

Geophysical Branch, Bureau of Mineral Resources, Geology & Geophysics

G 93-60

To Accompany Records 1959, No. 151

PLATE 6
153·5° App.
29
28
27
26
25
24
23
22
21
HEIGHT referred to M.S.L (in FEET)
DATUM 250' above M.S.L
ELEVATION
WEATHERING
DEPTH OF SHOT
DEPTH below DATUM in FEET.
SUB-WEATHERING VELOCITY IN FT./SEC.
LEGEND
DRILL LOGS
Clay
Sand
CROSS - SECTION
Good Quality Reflection
Fair Quality Reflection
Poor Quality Reflection
Doubtful Quality Reflection
EXPERIMENTAL SEISMIC SURVEY, LATROBE VALLEY, VIC.
SEISMIC REFLECTION CROSS-SECTION
TRAVERSE B
(MARYVALE)
UNMIGRATED CORRELATION SECTION
HORIZONTAL SCALE IN FEET
Geophysical Branch, Bureau of Mineral Resources, Geology & Geophysics
G 93-63
To Accompany Records 1959, No. 151