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COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

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SOUTHERN SURAT BASIN, SEISMIC SURVEY 1961

by

K. B. LODWICK and A. L BIGG-WITHER

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CONTENTS

ILLUSTRATIONS

SUMMARY

During 1961 in the southern part of the Surat Basin a seismic party from the Bureau of Mineral Resources surveyed two main traverses by means of seismic reflection and refraction methods; the first was in an east-west direction between Yelarbon and St George and the second was in a north-south direction between Meandarra and Moree. The main purposes of the survey were to find whether the Bowen Basin Permian sediments extend as far south as the latitude of Goondiwindi and whether the Bowen Basin in Queensland and the Sydney Basin in New South Wales formed a continuous region of sedimentation during the Permian period.

The east-west seismic traverse indicated a trough of sediments of greatest thickness, about 14,800 ft beneath Toobeah; the trough is bounded on the eastern side at Goondiwindi by a fault down-thrown more than 7000 ft to the west and is bounded on the western side by a series of step-faults beneath Bungunya and Talwood. The results along the north-south traverse indicated that the trough beneath Meandarra, which represents the southern extension of the Bowen Basin, continues south to Toobeah. The nature of the link, if any, between the Bowen Basin and the Sydney Basin was not established.

On the eastern side of the Surat Basin, seismic results indicated that the rocks beneath the Mesozoic sediments are stratified and probably metamorphic. A shelf area between Talwood and St George has about 6000 ft of sediments above a probable metamorphic 'basement'. An anticlinal structure with a dip-reversal of about 1000 ft throw was located between Goondiwindi and Toobeah.

1. INTRODUCTION

During 1958, 1959, and 1960, a seismic party from the Bureau of Mineral Resources worked in the Surat Basin and by 1960 had completed a reconnaissance seismic reflection traverse from Roma through Surat to Tara and Jondaryan 25 miles south-east of Dalby (Plate 2). The result of this regional traverse indicated that between the shelf areas of the Roma/Surat area and the Dalby area there was a trough with up to 20,000 ft of sediments (Lodwick & Watson, 1960 and Smith & Lodwick, 1962). The trough was interpreted as an extension of the Bowen Basin plunging beneath the Mesozoic sediments of the Surat Basin. A major uplift was discovered near Cabawin with strong faulting and buried erosional surfaces and was called the Cabawin Anticline (Lodwick and Watson, 1960).

The discovery of the major uplift near Cabawin has led to a great deal of seismic and aeromagnetic surveying since 1960 by Union Oil Corporation, in conjunction with Kern County Land Company and the Australian Oil and Gas Corporation; much of this geophysical exploration was subsidised by the Commonwealth Government. The geophysical exploration has subsequently led to the drilling of Cabawin No. 1 well in which oil was discovered, Cabawin East No. 1 which was dry, and the Moonie No. 1, 2, and 3 wells in which oil was also discovered.

In 1961, the Bureau planned another seismic reconnaissance survey in the southern part of the Surat Basin with the following objectives:

(a) to survey a roughly east-west reconnaissance traverse in the southern part of the Basin, in order to determine the structure and sedimentation of the Basin,

(b) to extend a reconnaissance traverse south to determine the southern margin of the Basin, assuming the east-west reconnaissance line showed that a large thickness of sediments exists,

(c) to survey a reconnaissance traverse north, towards Meandarra, to tie the work in the southern part of the Basin to that done in the north during 1959 and 1960.

It was expected that the east-west traverse would indicate whether the trough of sediments discovered between Glenmorgan and Goranba extended southward. It is not clear whether the sedimentary trough beneath Meandarra extends far enough south to join the Sydney Basin in NSW or whether a basement 'high' separates the two basins.

2. GEOLOGY AND PREVIOUS GEOPHYSICAL WORK

Geology

The Surat Basin, which is a sub-basin of the Great Artesian Basin, is separated from the Eromanga sub-basin on the west by the Nebine Ridge (Plate 1) and is bounded on the east by metamorphic and granitic rocks. The geology of the Mesozoic sediments that crop out on the eastern margin has been described by Mott (1952) and Whitehouse (1954). With the exception of the Roma and Tambo Formations, which lie on the surface in the Surat Basin, the Mesozoic sediments are mainly freshwater deposits. Therefore the potential of the Surat Basin as a petroleum province depends largely on the extension of the marine sediments of the Bowen Basin southwards beneath the Mesozoic formations.

The contour of the outcrops of the Permian sediments of the Bowen Basin and the overlying Triassic sediments in the Emerald/Duaringa area suggests that the Bowen Basin extends south under the Mesozoic formations of the Surat Basin. The discovery of Permian sediments in the Pickanjinnie No. 1 well and the Cabawin No. 1 well, combined with the delineation of the deep trough of sediments between Meandarra and Goranba by seismic surveying, indicated that the Bowen Basin extends as far south as Cabawin and probably as far as the Queensland/NSW border. Whitehouse (1954) suggested a western limit of Permian sedimentation in the Surat Basin beneath the Mesozoic sediments and, after studying fauna from both basins, he also suggested that the Bowen and Sydney basins were separated by a basement 'high'.

Aeromagnetic

Aeromagnetic surveys over nearly all of the Surat Basin have been completed by Union Oil Development Corporation but at present only the interpretation of the survey in the northern part of the Basin is available. In broad terms the interpretation of the aeromagnetic anomalies agrees with the seismic results along the Surat/Jondaryan traverse (Union Oil Development Corp., in preparation). The basement contours from the aeromagnetic survey are shown on Plate 2 and indicate a trough about 20,000 ft deep in the Meandarra area with a north trending basement-fault west of Glenmorgan forming the western margin of the trough. In the eastern part of the trough, the aeromagnetic basement contours indicate much basement faulting east of Tara, but the Cabawin Anticline is not clearly indicated. Local magnetic anomalies have been checked by seismic work but there seems to be little correlation between the results.

Gravity

Gravity surveys in the Surat and Bowen Basins have been confined mainly to the north where work was done by Associated Australian Oilfields and by the Bureau of Mineral Resources (Dooley, 1950) in the Roma area, by Australian Oil and Gas Corporation (company map) in the Surat area, by the Bureau of Mineral Resources (Oldham, 1958) in the Comet/Rolleston area, and by Mines Administration Pty Ltd in the Emerald/Duaringa area. Shell (Queensland) Development Pty Ltd made regional surveys of parts of the Surat and Bowen Basins. Normal correlation between actual structure (indicated by drilling, seismic work, and regional geology) and the Bouguer anomalies seems to apply in the Emerald/Duaringa area of the Bowen Basin. Farther south, in the Roma and Glenmorgan areas, no simple relation between known structure and Bouguer anomalies is apparent; but as more information on the actual structure is available it seems that a reverse correlation may apply in the deeper parts of the Basin between Glenmorgan and Goranba.

Seismic

Seismic surveying using both reflection and refraction methods has proved very useful in the Surat Basin. Extensive surveys have been made by Associated Australian Oilfields in the Roma area, by Union Oil Development Corporation in the Miles/Tara/Cabawin area, and by the Bureau in the Roma/Surat/Tara/Jondaryan areas. Structure may be mapped on two main reflecting horizons, viz. 'G' horizon which corresponds to the lower part of the Bundamba Group (second horizon of Lodwick and Watson, 1960) and the 'L' horizon which corresponds to the equivalent of the Kianga Coal Measures at the top of the Permian (fourth horizon of Lodwick and Watson, 1960). This correlation has become apparent after the drilling of the Union/Kern/AOG Cabawin No. 1 bore (Kahanoff, 1961 and Smith and Lodwick, 1962). In the parts of the Basin surveyed so far the structure in the 'G' horizon shows, in general, little relief in areas where large structures are apparent in the 'L' horizon, e.g. over the Cabawin Anticline and the Meandarra Trough (Lodwick and Watson, 1960). For this reason, structural features in the Surat Basin are barely recognisable on the surface where the 'L' horizon shows large structural features. Seismic reflection surveys reveal structural information below the 'L' horizon in a few places, e.g. east of Tara where a strong reflection was recorded (Smith and Lodwick, 1962), but elsewhere sporadic and incoherent dips have been recorded from reflections beneath the 'L' horizon. Refraction depth probes made by the Bureau in the Meandarra area indicated that there is a thickness of at least 5000 ft of sediments between the 'L' horizon and a high-velocity (19,000-ft/sec) refractor (Smith and Lodwick, 1962).

Most of the structure of the Surat Basin has been mapped by correlating the 'L' horizon, and the following is a summary of the structure indicated by the correlations, combined with the results of the Cabawin No. 1 well.

(a) Meandarra Syncline (Jenkins, 1958; Lodwick & Watson, 1960) Between Glenmorgan and Goranba (Plate 2) there is a deep trough with about 15,000 ft of sediments above the 'L' horizon in its deepest part.

(b) Cabawin Anticline. In the middle of the trough there is an anticlinal structure, with a relief of about 8000 ft, over which the 'L' horizon has been faulted and eroded.

(c) Western margin of the Meandarra Trough. Seismic traverses near Glenmorgan on the western margin have not proved faulting on the western margin of the trough. Continuous traversing has not been done and it is probable that the fault suggested by aeromagnetic surveys (Union Oil Development Corp., in preparation) lies between two portions covered by continuous profiling.

(d) Eastern margin of the Meandarra Trough. Continuous reflection profiling (Smith and Lodwick, 1962) indicated that the eastern margin is formed by a series of step faults near Goranba.

(e) Basin-filling formation. Most of the thickening of sediments takes place between the horizons represented by 'G' and 'L' where the Cabawin Formation, a partly tuffaceous sequence of probable Triassic age, was deposited. This formation was encountered in the Cabawin No. 1 well.

(f) On the western shelf areas in the Surat/Roma area. A reflection similar in character to that from the 'L' horizon is recorded which may be reflected from the base of the Mesozoic and not from within the Kianga Coal Measures (Upper Permian) as in the deeper parts of the Basin.

(g) Union Oil Development Corporation reports (Kahanoff, 1961) show that the Cabawin Anticline does not extend much farther south than the Cabawin No. 1 well and that the two troughs (the Meandarra Syncline in the west and the Tara Syncline in the east) combine to form a single trough in the southern Surat Basin.

(h) Considering the depth of the trough of sediments beneath Meandarra, and extending the margins of the trough in a southerly direction, it seemed likely that the trough may persist at least to the latitude of Goondiwindi and lie between Goondiwindi and Talwood (Plate 3).

3. FIELD WORK

The following summarises the objectives in view, and the traverses surveyed (Plate 3) which were planned to attain the objectives :

(a) to locate the extension of the Bowen Basin southward through the Meandarra Trough. Three five-mile portions of Traverse A of continuous reflection profiling spaced fifteen miles apart were surveyed on the Goondiwindi/St George Road. The middle traverse (Traverse A, shot-points 1 to 20) was located near Toobeah and showed the deepest sediments, with a depth of over 9000 ft to the 'L' horizon.

(b) to locate the eastern margin of the trough, its structure, and the extension of sub-Mesozoic formations to the east. The eastern traverse in (a) was extended from Shot-point 100 to Shot-point 132. It was intended to survey the extension of this traverse between Goondiwindi and Yetman but difficulties were encountered in drilling in river gravel at shallow depth and it was decided instead to continue the traverse east from Goondiwindi on the northern side of the Macintyre River.

(c) to investigate an anticlinal structure west of the eastern margin of the Basin (an objective added during the course of the survey). The eastern traverse in (a) was extended westward (Shot-points 80 to 43).

(d) to investigate the western margin of the trough and the depth of sediments between Bungunya and St George. The western traverse in (a) was extended westward using the reconnaissance method of continuous reflection profiling for two or five-mile lengths with spaces of from five to ten miles between each part of the traverse (Traverses A, D, M, and N; Shot-points 346 to 699).

(e) to record the depth and velocity of a probable basement refractor east of the margin of the trough. Traverses B and E were shot using the refraction depth-probing technique (Vale and Smith, 1961).

(f) to record the velocities in surface outcrops of metamorphic rock and granite for comparison with velocities in refractors recorded within, and on the margins of, the Basin. Between Yetman and Texas two traverses, each ¾ mile long, were shot using the refraction technique. (Shot-points to 2001-2004 on metamorphic rock and Shot-points 2007 to 2010 on granite).

(g) to measure the throw of the faulted eastern margin of the trough. Two refraction traverses were shot using the depth-probing technique, <u>viz</u>. Traverses H and K which are east and west of the fault respectively. Each traverse was shot to record the 'basement' refractor.

(h) to measure the depths to, and velocities in, the 'basement' refractor and other refractors within the sediments. Traverse C was shot using the refraction depth-probing technique over the deepest part of the trough.

(i) to record the depth to, and velocity in, the 'basement' west of the western margin of the trough. Traverse L was shot using the refraction depth-probing technique near Weengallon.

(j) to derive a subsurface velocity distribution and also to determine whether multiple reflections were recorded on reflection records. A reflection velocity spread was shot along Traverse C with the layout of shot-points and geophones as shown on Plate 22.

(k) to determine whether the trough of sediments beneath Toobeah has a southern margin or continues south to join the Sydney Basin. Reflection reconnaissance traverses were surveyed between Toobeah and Moree (Traverses C and J). Another traverse (Traverse P) was planned east of Moree but gravel formations near the surface prevented shot-holes being drilled deep enough to record interpretable results. Traverses C, J, and P did not attain the objective and as a result, further seismic work is planned in the Moree area in 1962.

(l) to establish a tie between the Goondiwindi/St George and the Surat/Jondaryan regional traverses. Traverse G was surveyed northward from Bungunya, near the western margin of the trough, towards Meandarra. The traverse was not surveyed as originally planned from the axis of the trough towards Meandarra, as conveniently-placed roads were not available. It is considered, however, that Traverse G fulfilled the main aim in establishing a tie between the reconnaissance traverses in the northern and southern parts of the Surat Basin.

Good-quality reflections were obtained, and those from the 'G' and 'L' horizons could be recognised on the seismic records in most areas. The technique of traversing across the Basin by continuous reflection profiling along parts of the traverse, with five to seven-mile spaces between each portion of continuous profiling, proved to be successful in outlining the regional structure of the Basin. This method of traversing proved successful along the Surat/Jondaryan traverse where characteristic reflections from the 'G' and 'L' horizons were also recorded (Lodwick & Watson, 1960 and Smith & Lodwick, 1962).

Shooting conditions were good between Goondiwindi and Talwood where high-quality reflections were recorded with a shot depth of 90 ft and a charge of about 15 lb.

East of Goondiwindi (Traverse B) and near Moree (Traverse P) gravel formations were encountered at shallow depths and the drills could not penetrate them. Reflection quality from the shallow holes was so poor that the results could not be interpreted, as mentioned in (b) and (k) above.

Along Traverse G, shot-holes were drilled to nearly 200 ft and charges of about 25 lb were used to obtain good to fair-quality reflections. West of Talwood, surface formations were lateritic, and poorer-quality reflections than those obtained east of Talwood were recorded using the normal recording method of a single shot-hole and six geophones per trace, spaced 22 ft apart. After shooting some 'noise' spreads, experiments were made using up to 36 geophones (spaced 22 ft apart) per trace and with nine shallow pattern shot-holes, spaced 20 and 50 ft apart. This improved reflection quality. However, the noise experiments were not comprehensive enough to disclose the optimum geophone spacing, and a greater improvement in record quality may be expected after a further analysis of noise. West of Talwood, using single shot-holes up to 200 ft deep and six geophones per trace, the quality of reflections was good enough for correlation of reflection horizons and mapping of regional structure.

The details of party organisation are shown in Appendix A. Field procedures and a statistical summary of the survey are shown in Appendix B.

4. SUBSURFACE VELOCITY INFORMATION

The subsurface velocity control used throughout the survey for depth determinations was derived from a $t:\Delta t$ analysis of reflections in the deeper parts of the Basin near Toobeah. The average velocities, interval velocities, and depth curves plotted against reflection time are shown on Plate 21.

A reflection velocity spread was shot along Traverse C in the manner illustrated on Plate 22. The velocity spread indicated that multiple reflections were not a problem. The average and interval velocities and the depth in relation to reflection time are shown on Plate 22.

On Plate 24, the average velocity curves derived from the $t:\Delta t$ analysis and from the reflection velocity spread in the Goondiwindi area are shown for comparison. The velocity information from the velocity survey of the Cabawin No. 1 well (Wylie and Gray, 1961) and a $t:\Delta t$ analysis of reflection along Traverse G (Lodwick and Watson, 1960) in the northern Surat Basin are also shown. It will be noticed that the two curves from the Goondiwindi area agree fairly closely and so do the two curves from the northern Surat Basin. Relative to the velocities in the northern Surat Basin, the velocities measured in the Goondiwindi area are lower near the surface, and increase more quickly after a reflection time of about 1200 msec. The increase in velocity at this time (corresponding to a depth of about 5600 ft) indicates that there is a higher velocity in the formation below the 'G' horizon than in the corresponding Cabawin Formation in the Cabawin No. 1 well.

The reflection time/depth curves corresponding to the four separate velocity curves shown on Plate 24 are shown on Plate 23.

5. PRESENTATION OF RESULTS

The seismic reflection cross-sections along the east-west traverses (Traverses A, D, M, and N between Yelarbon and St George) are shown on Plates 4 to 6. The reflection cross-sections along the north-south traverses (Traverses G, C, and J) are shown on Plate 8 to 10. These cross-sections have been drawn from corrected seismic record cross-sections and converted to depth using the results of a $t:\Delta t$ analysis.

A generalised cross-section in the east-west direction between Yelarbon and St. George is shown on Plate 7. A similar cross-section in the north-south direction between Meandarra and Moree is shown on Plate 11. These cross-sections were drawn by projecting the positions of the traverses onto the lines shown on Plate 3 and exaggerating the vertical scale. A Bouguer anomaly profile computed from observations made by the Bureau is shown beneath each generalised cross-section for comparison.

Seismic reflection cross-sections for the few reflection shots recorded along refraction Traverses H and K are shown on Plate 12.

The depth probing technique was used for shooting refraction traverses (Vale and Smith, 1961). The results are shown for Traverse C on Plate 14, Traverse E on Plate 15, Traverse H on Plate 16, Traverse K on Plate 17, and Traverse L on Plate 18. On all traverses except Traverse H the depths to the refractors under investigation were calculated using times, corrected to first-break time, of the first events on the records. On Traverse H, however, three events with velocity greater than 17,000 ft/sec were recorded in one direction of shooting. The reciprocal times of each of the three events agreed fairly closely with the reciprocal time in the opposite direction. After drawing profiles for each velocity, the pairing of the second event (18,550 ft/sec) with the single event (20,000 ft/sec) in the opposite direction produced matching profiles. An accurate depth estimate of the refractor(s) on Traverse H is not possible, and the results shown on Plate 16 should be regarded as doubtful.

On Traverse L, a second event was recorded in both directions of shooting. An accurate depth estimate of the refractor (velocity about 10,800 ft/sec) could not be made.

Refraction profiles were not calculated for Traverse B, as the energy recorded from each direction of shooting was not refracted from the same part of the refractor. Time/distance curves and an estimate of the depth are shown on Plate 13.

A refraction shot was fired in one direction only on Traverse P near Moree; owing to lack of seismic energy the results could not be interpreted and they are not included in the Record. Gravel beds prevented shot-holes being drilled deeper than about 10 ft (see Field Work). More refraction work is planned in the Moree area in 1962.

Velocities in metamorphic rock (Carboniferous?) and granite were measured on outcrops along the Yetman/Texas Road. The results were calculated assuming that any deviation from a constant velocity was due to changes in thickness of the thin weathered layer. There is, however, some evidence at one end of each traverse of an intermediate layer between the weathered layer and the granite (or metamorphic rock). The results for metamorphic rock are shown on Plate 20 and for granite on Plate 19.

6. INTERPRETATION OF RESULTS

As in previous seismic work between Surat and Jondaryan (Lodwick & Watson, 1960 and Smith & Lodwick, 1962) it has been possible to correlate two strong-reflecting horizons along most traverses, viz. the 'G' horizon, which corresponds closely to the base of the Bundamba Group, and the 'L' horizon, which corresponds closely to the Kianga Coal Measures at the top of the Permian strata. (Kahanoff, 1961).

The 'L' horizon is in general characterised by a strong reflection which may be correlated at least within the same band of energy over distances of some miles. In the Goondiwindi area the sediments represented by the 'L' horizon have been subjected to earth movements, as there is evidence of faulting, small-scale folding, and probable erosion. As a result the character of the 'L'-horizon reflection alters over short distances. In the vicinity of Toobeah (Plate 5, Shot-points 792 to 5) several strong-reflecting horizons at reflection times between 1500 and 1700 msec make it impossible to nominate the 'L' horizon. The position of the 'L' horizon is plotted on all reflection cross-sections where recognisable (Plates 4 to 12).

The 'G' horizon is characterised by a strong band of seismic energy which may persist for up to 300 msec. It is not possible to correlate the horizon accurately except by continuous correlation reflection shooting. In correlating between the short lengths of continuous profiling, it is possible that the correlated times of the reflection are in error by several cycles. In the interpretation of the seismic traverses at Goondiwindi, the term "zone of the 'G' horizon" has been thought more appropriate that the term 'G' horizon and has been marked on the seismic cross-sections (Plates 7 to 12).

Throughout the southern Surat Basin the 'G' horizon shows little relief and only slightly reflects the relief indicated by the 'L' horizon beneath it. The configuration of the strata represented by the 'G' horizon, is geologically consistent with a gradual general subsidence throughout the whole Basin at the time the strata were deposited. These strata show only slight variations in the rate of subsidence over areas that were previously subsiding rapidly. As most of the bores throughout the Great Artesian Basin penetrate only to the Bundamba Group (represented by the 'G' horizon), structural information about the deeper sediments may be indicated by stratigraphic correlation at this level between bores only if the points of correlation are established accurately.

It is evident in the Goondiwindi area, as in the northern part of the Surat Basin (Keller, 1961) that the sediments between the strata represented by the 'G' and 'L' horizons are an 'infill' formation (equivalent of the Cabawin Formation) which was deposited during and after differential earth movements took place after the deposition of the sediments represented by the 'L' horizon and before the deposition of the sediments represented by the 'G' horizon.

It is convenient to discuss the interpretation of the seismic survey under the following headings :

East-west traverse, Yelarbon/St George

North-south traverse, Meandarra/Moree

East-west traverse, Yelarbon/St George

The main structural features that may be interpreted from the east-west seismic reflection cross-section (Traverses A, D, M, and N) are shown on the generalised cross-section (Plate 7). The main structure indicated by the configuration of the 'L' horizon is the presence of a deep trough beneath Toobeah with a depth of over 9600 ft to the 'L' horizon. The trough is bounded on the east by a fault beneath Shot-point 98 near Goondiwindi, where the 'L' horizon is apparently truncated. The presence of this fault is indicated by the steep westerly dip in the sediments above the 'G' horizon, probably representing the Bundamba and Blythesdale Groups and the Walloon Coal Measures.

A refraction traverse was shot on each side of the fault (which will be called the Goondiwindi Fault); Traverse H east of the fault indicated a depth of 6350 ft to a 19,300-ft/sec refractor and Traverse K west of the fault indicated a depth of 14,100 ft to a 21,240-ft/sec refractor. The throw of the fault which is downthrown to the west, is about 7750 ft if the refracting layers are similar on each side of the fault. The results of Traverse K indicate that the sediments may be about 6000 ft thick beneath the 'L' horizon and the 21,240-ft/sec refractor on the western side of the Goondiwindi Fault.

About 16 miles east of Goondiwindi, near Kurumbul on Traverse E, refraction work indicated the presence of a 17,820-ft/sec refractor at a depth of 1900 ft. Correlating this refractor with the 19,300-ft/sec refractor on Traverse H, the results indicate that the high-velocity refractor rises by about 4000 ft between Goondiwindi and Kurumbul.

Steeply-dipping reflections east of Goondiwindi suggest that the high-velocity refractors recorded on Traverses E and H may represent a stratified rock similar to the metamorphic Devonian and Carboniferous rocks near Inglewood (Plate 2). Farther east between Yetman and Texas, velocities measured in outcropping granite and metamorphic rocks (Carboniferous?) were 17,540 and 17,650 ft/sec respectively. The measurements suggest that velocities higher than those measured at depth in the Surat Basin should, in the first instance, be interpreted as indicating unprospective basement. The correlation between high-velocity refractors and magnetic basement in the Surat/Jondaryan area supports this criterion.

Between the deepest part of the trough at Toobeah and the Goondiwindi Fault, an anticlinal structure was indicated by the 'L' horizon and the reflections suggest (Plate 7) that there may have been some erosion of the sediments represented by the 'L' horizon at the crest. The anticline is named here the 'Callandoon Anticline'. The amount of dip reversal measured is greater than 1000 ft. On the western flank of the anticline both the 'L' horizon and the 'G' horizon are faulted.

Three refractors were recorded on Traverse C (Plate 14) : the shallowest has a measured seismic velocity of 9900 ft/sec and is about 900 ft deep; the second has a measured velocity of 14,000 ft/sec and is about 5400 ft deep; the deepest has a velocity of 19,000 ft/sec and is about 14,800 ft deep. The second refractor corresponds closely in depth with the 'G' horizon and compares closely with the velocity measured at the base of the Bundamba Group in the Pickanjinnie No. 1 well (Lodwick & Smith, 1962). The velocity in the deepest refractor (19,000 ft/sec) suggests that this refractor represents metamorphic basement rock and its depth (14,800 ft) indicates that in the deepest part of the trough there is more than 5000 ft of sediments below the top of the Permian (represented by the 'L' horizon).

The western margin of the trough is formed by a series of step faults. Two of the faults were indicated by reflection shooting; the first near Bungunya (Plate 5) has an apparent throw of about 500 ft and the second near Talwood has a throw of similar magnitude. Correlation of the 'L' horizon between the parts of the traverses (Plates 4 to 7) where continuous profiling was done, suggests that there may be similar faults between Bungunya and Shot-point 632 (about six miles west of Talwood).

Between Talwood and Nindigully the reflection horizon that has been correlated with the 'L' horizon indicates a flat shelf area with the deepest persistent reflections recorded at about 5000 ft. On Traverse L a 19,240-ft/sec refractor was recorded at a depth of 5700 ft (Plate 18). The depth of the probable 'L' horizon at Shot-point 537 about one mile from Traverse L was 4500 ft. These measurements indicate that only about 1000 ft of sediments may be expected below the sediments represented by the probable 'L' horizon on the shelf area between Talwood and Nindigully.

North-west of Nindigully on Traverse M (Plates 4 and 7) reflection shooting indicated that the depth to the probable 'L' horizon has increased by about 500 ft.

On Traverse N west of St George, the depth of the probable 'L' horizon is about 4500 ft. Beneath Shot-point 354 there was interpreted a small fault that affects both the 'L' horizon and the 'G' horizon. The probable 'L' horizon dips slightly west on the western side of the fault. On Traverse N, deep reflections were recorded from a depth of 25,000 ft, which are persistent enough to suggest that there is a stratified sequence of rocks to this depth.

The Bouguer anomaly along the east-west traverse (Goondiwindi to St George) does not correlate in the normal way with the structure indicated by seismic work; e.g. there is a gravity 'high' corresponding to the deepest part of the Basin and a 'low' over the western shelf area. Over the deeper parts of the Basin (the Meandarra Trough), it seems that there is a reverse correlation which may correspond with the thickening of the Cabawin Formation between the 'L' and the 'G' horizons. It is apparent that more information on stratigraphy and density will be needed to interpret the Bouguer anomalies in terms of post-Permian structure. The Cabawin Formation is the only formation with large variations in thickness throughout the Surat Basin which could cause the Bouguer anomalies.

<u>North-south traverse, Meandarra/Moree</u>

The generalised cross-section (Plate 11) illustrates the main structural features that may be interpreted from the results of Traverses G, C, and J.

Between Bungunya and Meandarra the structure indicated by the 'L' horizon is a general deepening from 7700 ft at Bungunya to about 16,700 ft about seven miles south of Meandarra. Near Meandarra, refraction work in conjunction with reflection work indicated that over 5000 ft of sediments may be expected below the strata represented by the 'L' horizon (Smith & Lodwick, 1962).

On the northern end of the Meandarra/Moree traverse, the depths to the 'G' and 'L' horizons are shown from seismic work done by Union Oil Development Corporation.

The north-south traverse was surveyed to cross the Coomrith Inlier in the vicinity of Shot-points 1214 to 1235. No structural evidence of the inlier was indicated by either the 'L' or 'G' horizons.

The 'L' and 'G' horizons have been correlated over a distance of about 30 miles where no seismic work was done between Traverse C and Dolgelly bore.

The 'L' horizon shows evidence of faulting near the Dolgelly bore and dips north along the traverse between Shot-points 1381 and 1400. Beneath Shot-point 1381 the characteristic 'L' horizon has disappeared and may have been eroded (Plates 10 and 11). The 'L' horizon is not recognisable between Shot-points 1350 and 1359. However, a faulted reflecting horizon between Shot-points 1298 and 1317 may be the 'L' horizon. The reason for the apparent absence of the 'L' horizon between Shot-points 1350 and 1359 may be that Traverse J is in a direction such that the western margin of the trough is being approached in the vicinity of Shot-point 1380 (Plate 3). The traverse from Shot-point 1381 to Shot-point 1400 may be in a direction towards the axis of the trough. If the western margin of the trough is defined by producing the fault indicated by aeromagnetic surveying near Glenmorgan through Bungunya, it is seen (Plate 3) that Shot-point 1381 lies very close to this extrapolated western margin.

The Bouguer anomaly profile in the north-south direction (Plate 11), as in the east-west direction, indicates that the normal correlation does not hold between thickness of sediments above the 'L' horizon and the Bouguer anomaly curve.

7. CONCLUSIONS

The following summarises the conclusions that may be reached from the results of the seismic survey:

(a) A trough of sediments was defined with a depth of about 14,800 ft near Toobeah. About 5000 ft of these sediments may be expected to be below the base of the Mesozoic. The trough is bounded in the east by the Goondiwindi Fault with a probable throw of over 7000 ft, and in the west by a series of faults between Bungunya and a point about six miles west of Talwood.

(b) The trough of sediments is the southern extension of the trough between Glenmorgan and Goranba, i.e. the Meandarra Trough, and the thickness of sediments decreases from about 19,000 ft near Meandarra to about 14,800 ft near Toobeah.

(c) The 'L' horizon decreases in depth from 9600 ft beneath Toobeah to about 6000 ft south of Dolgelly bore. This is largely caused by thinning of the sediments between the 'G' and 'L' horizons. This thinning may in part be due to the traverses south of Toobeah approaching the western margin of the trough.

(d) On the eastern side of the Goondiwindi Fault, there is evidence from deep persistent reflections that the Mesozoic sediments may lie over a stratified geological sequence. However, refraction velocities are high enough to indicate that these rocks are probably metamorphic and are unprospective for petroleum.

(e) West of the sedimentary trough, the sediments are about 6000 ft thick, about 1000 ft of which probably lie below the base of the Mesozoic.

(f) The survey has not shown conclusively that the Meandarra Trough, representing the southern extension of the Bowen Basin, is separated from the Sydney Basin. This problem will be investigated further in 1962.

(g) The Callandoon Anticline lies between the Goondiwindi Fault and the axis of the sedimentary trough beneath Toobeah. The dip reversal amounts to about 1000 ft and there is evidence that the sediments represented by the 'L' horizon have been eroded on the crest of the anticline.

(h) The correlation between Bouguer anomalies and pre-Mesozoic structure indicated by the 'L' horizon is not clear. However, considering the results of seismic surveys in the northern and southern parts of the Surat Basin, it seems that there may be a reverse correlation between the thickness of the Cabawin Formation and the Bouguer anomalies.

(i) Stratigraphic correlation between bores above the Cabawin Formation must be precise if it is expected to indicate likely structure below the 'L' horizon.

8. REFERENCES

DOOLEY, J.C. 1950 Gravity and magnetic reconnaissance, Roma district, Queensland. Bur. Min. Resour. Aust. Bull. 18.

JENKINS, T.B.H. 1958 The geology of the Surat Inlier and its structural significance. Australian Oil and Gas Corporation, Confidential Report. (Unpubl.)

*KAHANOFF, S. 1961 Final report on the Cabawin seismic survey, Queensland 1960-61. Union Oil Development Corporation.

*KELLER, A.S. and McGARRY, D.J. 1961 Well completion report No. 1 Union-Kern-AOG Cabawin No. 1. Union Oil Development Corporation.

LODWICK, K.B. and SMITH, E.R. 1962 Pickanjinnie No. 1 bore seismic velocity survey near Roma, Queensland 1960. Bur. Min. Resour. Aust. Rec. 1962/52 (unpubl.)

LODWICK, K.B. and WATSON, S.J. 1960 Surat Basin seismic reconnaissance survey, Queensland 1959. Bur. Min. Resour. Aust. Rec. 1960/107 (unpubl.)

MOTT, W.D. 1952 Oil in Queensland. Qld. Govt Min. J. 53, No. 612.

OLDHAM, W.H. 1958 Semi-detailed gravity survey in the Comet-Rolleston area, Queensland. Bur. Min. Resour. Aust. Rec. 1958/10 (unpubl.)

SMITH, E.R. and LODWICK, K.B.	1962	Surat Basin seismic reconnaissance survey, Queensland 1960. Bur. Min. Resour. Aust. Rec. 1962/133 (unpubl.)
VALE, K.R.	1960	A discussion on corrections for weathering and elevation in exploration seismic work, 1959. Bur. Min. Resour. Aust. Rec. 1960/13.
VALE, K.R. and SMITH, E.R.	1961	The depth probing technique using seismic refraction methods. Bur. Min. Resour. Aust. Rec. 1961/79.
WHITEHOUSE, F.W.	1954	Artesian water supplies in Queensland; Appendix G - The geology of the Queensland portion of the Great Artesian Basin. pp. 1-26. Govt Printer, Brisbane.
UNION OIL DEVELOPMENT CORPORATION		Surat Basin aeromagnetic survey, Queensland 1959-1960. Bur. Min. Resour. Aust. PSSA Publ.
*WYLIE, I.C. and GRAY, H.D.	1961	The velocity survey of Union-Kern-AOG Cabawin No. 1 well. United Geophysical Company.

* These reports will be included in Bureau of Mineral Resources PSSA Publications.

APPENDIX A

STAFF AND EQUIPMENT

STAFF:

Party leader	K.B. Lodwick
Geophysicist	A.L. Bigg-Wither
Surveyors	J. Ransom, H. Thompson (Dept of the Interior)
Clerk	W.E. Rossendell
Observers	L. Vliegenthart, R. Krege
Shooter	E.H. Cherry
Toolpusher	B.G. Findlay
Driller	R. Reith K. Suehle
Mechanics	A. Tregear, T.H. Clark

EQUIPMENT:

Seismic amplifiers	TIC model 621
Seismic oscillograph	TIC 50-trace
Magnetic recorder	DS7-700
Geophones	TIC 20 c/s
Drills	Failing 750, Carey H1
Water tankers	3 x 600-gallon
Shooting truck	1 x 600-gallon

APPENDIX B

TABLE OF OPERATIONS

Sedimentary basin	Surat Basin
Area	Goondiwindi/St George
Camp site	Toobeah
Established camp	28th March 1961
Surveying commenced	29th March 1961
Drilling commenced	30th March 1961
Shooting commenced	4th April 1961
Miles surveyed	201
Topographic survey control	Land Dept maps and Main Roads Dept bench marks
Total footage drilled	65,692
Explosives used	23,000 lb
Datum level for corrections	600 ft above M.S.L.
Weathering velocities	1800 to 2500 ft/sec
Sub-weathering velocities	6000 to 8000 ft/sec
Source of velocity distribution	$t:\Delta t$ analysis of reflections and velocity profile

REFLECTION SHOOTING DATA:

Shot-point interval	1320 ft
Geophone group	6 per trace
Geophone group interval	22 ft
No. of holes shot	400
Miles traversed	99 continuously
Common shooting depths	90 to 150 ft
Usual recording filter	L2H3 (23 to 75 c/s)
Usual playback filter	L2H3
Common charge sizes	15 to 20 lb
Weathering corrections	After Vale (1960)

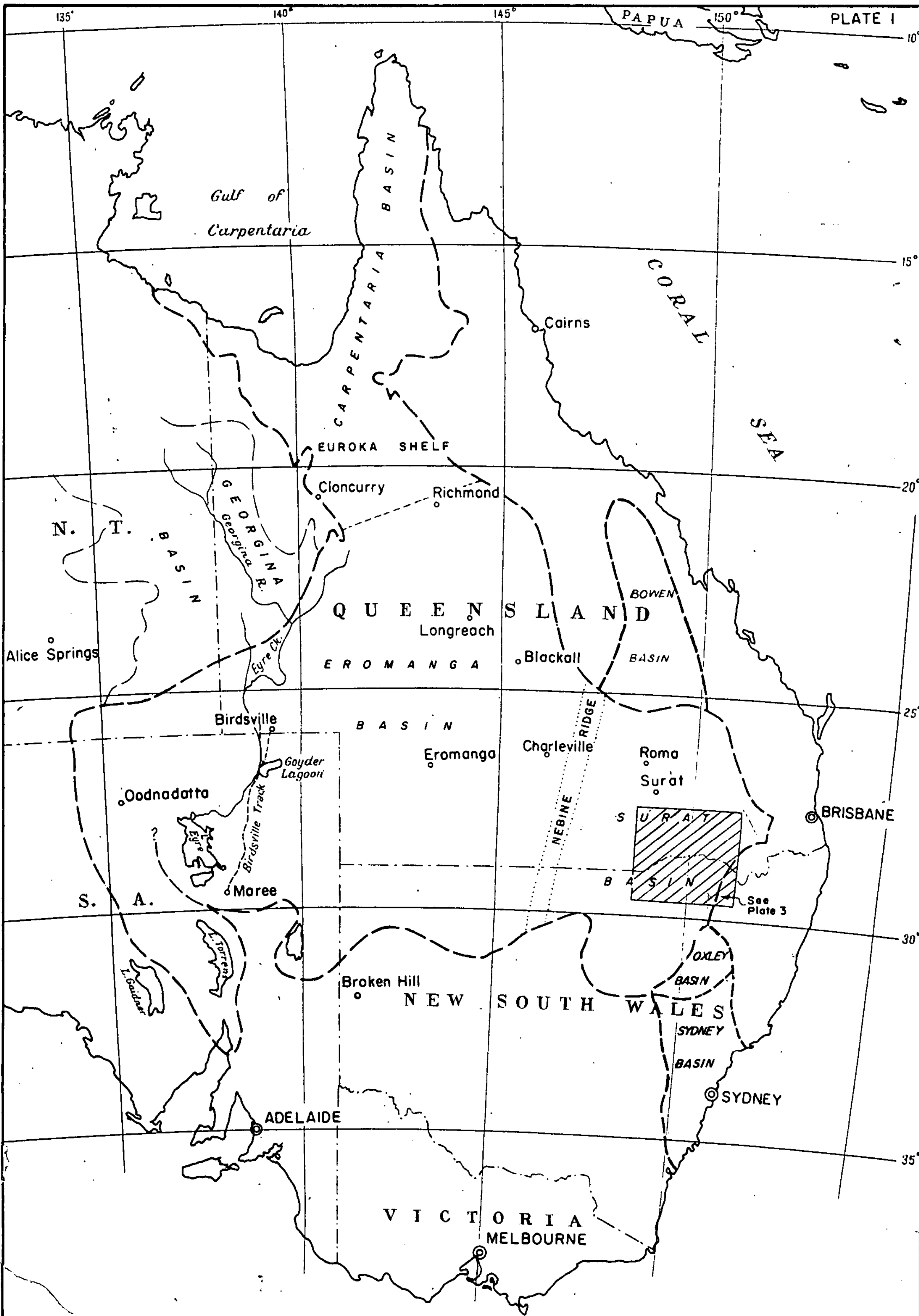
REFRACTION SHOOTING DATA:

Geophone group	Two close together
Geophone group interval	220 ft.

<u>APPENDIX B</u> Continued

No. of holes shot	26
Usual recording filter	LOH3
No. of refraction traverses	9
Maximum charge size	750 lb
Maximum shot/geophone distance	14½ miles
Weathering control	from reflection shooting
Weathering and elevation corrections	After Vale and Smith (1961)

PLATE I



SOUTHERN SURAT BASIN
SEISMIC SURVEY 1961

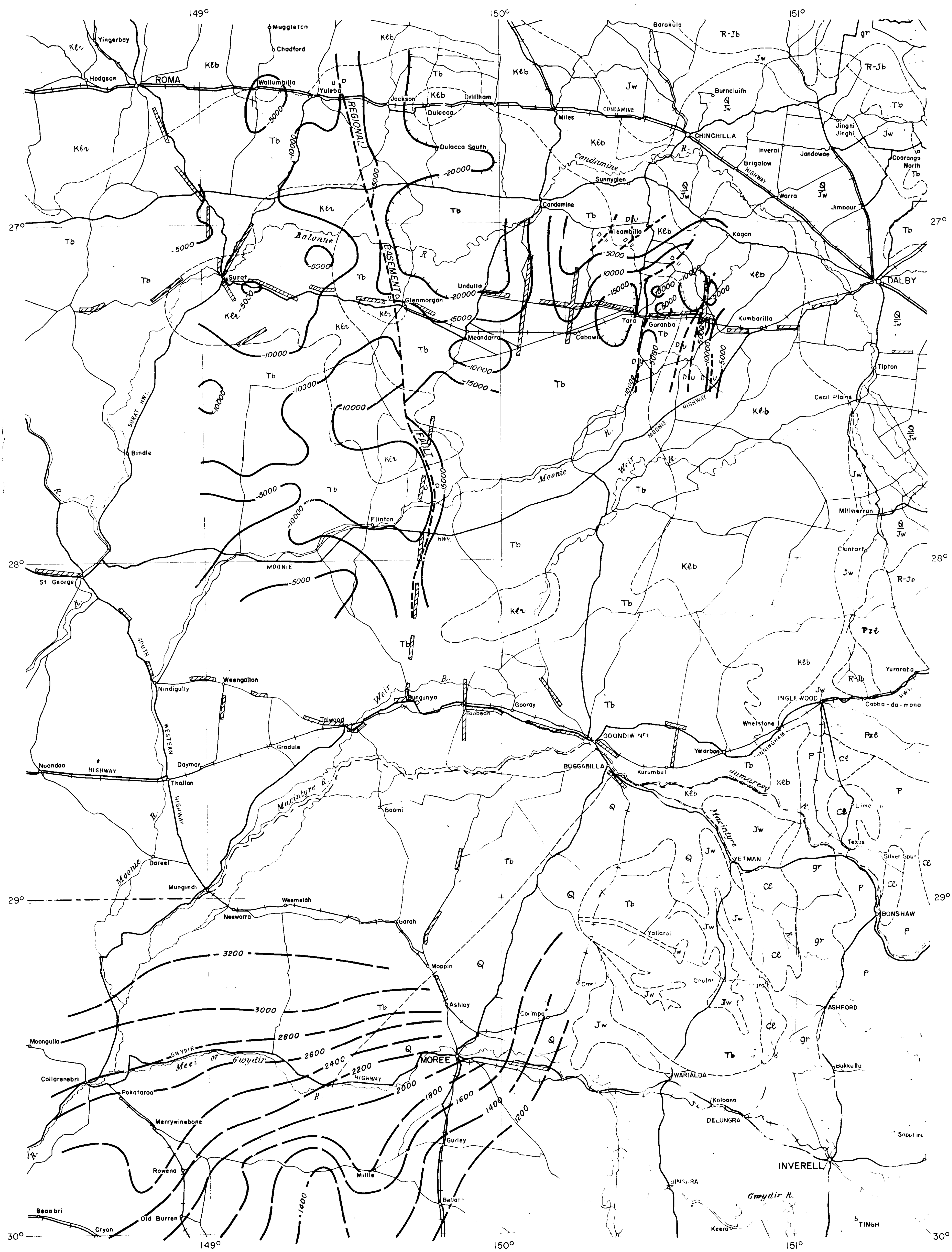
LOCALITY MAP

LEGEND
Boundary of Great Artesian Basin

SCALE IN MILES
100 0 100 200 300

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics. G 55/B3-1

To Accompany Record No 196?/18?



LEGEND

Tb	Volcanics (mainly basalt)	Klr	Roma Formation
Pzl	Anakie Metamorphics	Klb	Blythesdale Group
gr	Mainly Granite	Cl	Carboniferous
Q/Jw	Alluvium overlying Walloon Coal Measures		Traverses
Q	Alluvium		Faults interpreted from aeromagnetic survey
Jw	Walloon Coal Measures		Geological Boundaries
R-Jm	Marburg Sandstone (f-w)		Basement contours from Borehole data after A.O.G. Corp.
R-Jb	Bundamba Group (f-w)		Aeromagnetic Basement contours after Union Oil Development Corp.

SURAT BASIN

REGIONAL GEOLOGY AND BASEMENT CONTOURS FROM AEROMAGNETIC AND BOREHOLE DATA

SCALE IN MILES

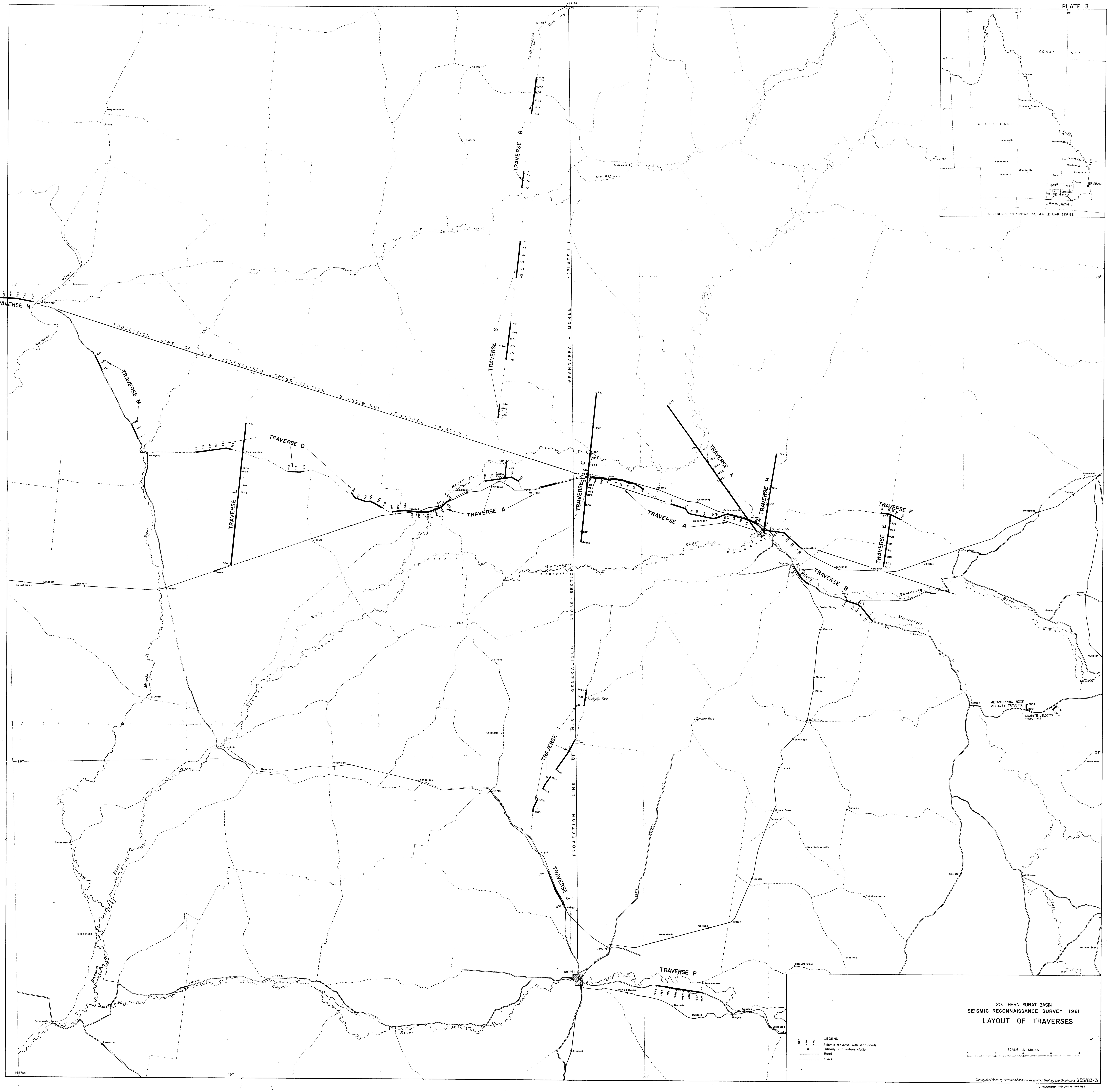
10 5 0 10 20 30 40 50

(AFTER 1:1,000,000 I.C.A.O. CHARTS)

To Accompany Record No 1962/183

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics G55/B3-2

PLATE 3



SOUTHERN SURAT BASIN
SEISMIC RECONNAISSANCE SURVEY 1961

LAYOUT OF TRAVERSES

LEGEND
- 920 916 912 Seismic traverse with shot-points
- Railway with railway station
- Road
- Track

SCALE IN MILES
4 0 4 8 12

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics G55/B3-3

TO ACCOMPANY RECORD No 1962/183


TRAVERSE N
TRAVERSE M
TRAVERSE D
DEPTH IN FEET BELOW DATUM
ELEVATION IN FEET ABOVE M.S.L.
DATUM 600 FT ABOVE M.S.L.
NOT SHOT
PROBABLE 'G' HORIZON
PROBABLE 'L' HORIZON
LEGEND
CLAY Cl
SHALE Sh
SAND S
SANDSTONE SS
GRAVEL Gvl
Br BROWN
W WHITE
Gr GREEN
B BLUE
R RED
G GREY
DEPTH IN FEET 4550 4450
SEISMIC REFLECTION CORRELATION CROSS-SECTION
ST GEORGE — TALWOOD
1961
PLOTTED FROM CORRECTED SEISMIC RECORD SECTIONS
SCALE IN FEET
2000 0 2000 4000 6000

PLATE 5

ENE
E
SE
ENE
ESE
NOT SHOT
DATUM 600 FT. ABOVE M.S.L.
DEPTH IN FEET BELOW DATUM
ELEVATION IN FEET ABOVE M.S.L.
'G' HORIZON
'L' HORIZON
TRAVERSE A
LEGEND
CLAY Cl
SHALE Sh
SAND S
SANDSTONE S S
GRAVEL Gvl
DEPTH IN FEET
Br. BROWN
W. WHITE
Gr. GREEN
B. BLUE
Yl. YELLOW
R. RED
G. GREY
SEISMIC REFLECTION CORRELATION CROSS-SECTION
TALWOOD-GOORAY
1961
PLOTTED FROM CORRECTED SEISMIC RECORD SECTIONS
SCALE IN FEET
2000 0 2000 4000 6000

SEISMIC REFLECTION CORRELATION CROSS—SECTION

GOORAY — YELARBON

1961

PLOTTED FROM CORRECTED SEISMIC RECORD SECTIONS

TO ACCOMPANY RECORD No 1962/183 GEOPHYSICAL BRANCH, BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS G55/B3-

PLATE 7


West
East
DATUM 600' A.S.L.
DATUM 600 A.S.L.
ZONE OF "G" HORIZON
PROBABLE "L" HORIZON
PROBABLE "L" HORIZON
PROBABLE "L" HORIZON
"L" HORIZON
"L" HORIZON
"L" HORIZON APPARENTLY TRUNCATED
FAULT ZONE
DEPTH IN FEET
5000
10,000
15,000
20,000
25,000
BOUGUER ANOMALY IN MILLIGALS
0
-10
-20
-30
-40
GENERALISED CROSS-SECTION
ST GEORGE - YELARBON
1961
FEET
Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics. G55/B3-7

PLATE 8
9 MILES
8 MILES
WESTMAR
N
BRITISH MADE "ALLIANCE"
ELEVATION IN FEET ABOVE M.S.L.
DATUM 600 FT. ABOVE M.S.L.
DEPTH IN FEET BELOW DATUM
ZONE OF 'G' HORIZON
'L' HORIZON
Vo in FT./SEC.
LEGEND
CLAY Cl
SHALE Sh
SAND S
SANDSTONE SS
GRAVEL Gvl
DEPTH IN FEET 4550 4450
Br BROWN
W WHITE
Gr. GREEN
B BLUE
Yl YELLOW
R RED
G GREY
SEISMIC REFLECTION CORRELATION CROSS-SECTION
MEANDARRA-MOREE, NORTHERN PORTION
1961
PLOTTED FROM CORRECTED SEISMIC RECORD SECTIONS
SCALE IN FEET
2000 0 2000 4000 6000

SEISMIC REFLECTION CORRELATION CROSS-SECTION
MEANDARRA-MOREE, CENTRAL PORTION
1961

PLOTTED FROM CORRECTED SEISMIC RECORD SECTIONS

TO ACCOMPANY RECORD No 1962/183 GEOPHYSICAL BRANCH, BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS G 55/B3-9

PLATE 10
ASHLEY
5 MILES
NE
N
1 1/4 MILES
1 1/2 MILES
8 MILES
NNW
ELEVATION IN FEET ABOVE M.S.L.
DATUM 600 FT. ABOVE M.S.L.
NO REFLECTIONS
ZONE OF "L" HORIZON
"L" HORIZON
"L" HORIZON NOT RECOGNISABLE
PROBABLE "L" HORIZON
DEPTH IN FEET BELOW DATUM
TRAVERSE J
LEGEND
CLAY Cl
SHALE Sh
SAND S
SANDSTONE SS
GRAVEL Gvl
DEPTH IN FEET
Br BROWN
W WHITE
Gr GREEN
B BLUE
Yl YELLOW
R RED
G GREY
SEISMIC REFLECTION CORRELATION CROSS-SECTION
MEANDARRA-MOREE, SOUTHERN PORTION
1961
PLOTTED FROM CORRECTED SEISMIC RECORD SECTIONS
SCALE IN FEET
2000 0 2000 4000 6000
V_a IN FT./SEC.

GENERALISED CROSS SECTION

MEANDARRA - MOREE

1961

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics. G 55/B3-II

TO ACCOMPANY RECORD No 1962/183

TRAVERSES H and K

SEISMIC REFLECTION CORRELATION CROSS—SECTION

PLOTTED FROM CORRECTED SEISMIC RECORD SECTION

TO ACCOMPANY RECORD No 1962/83 GEOPHYSICAL BRANCH, BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

PLATE 13

S.P. 219

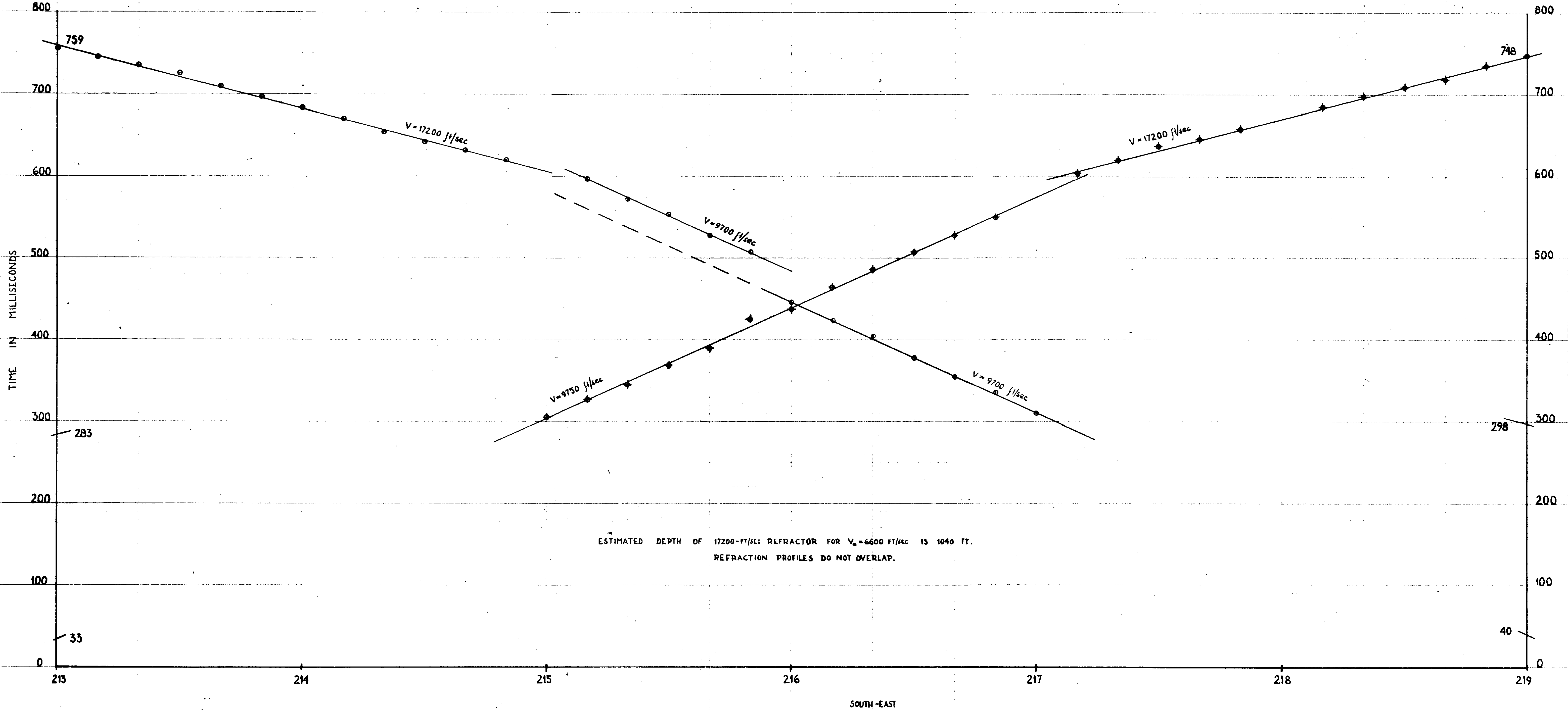
S.P. Geo.	213 24						214 18						215 -
1st BK. TIME	797	786	775	765	751	738	724	711	695	682	672	661	-
Wx CORR	41	41	41	41	41	41	41	41	41	41	41	41	-
CORR TIME	756	745	734	724	710	697	683	670	654	641	631	620	-

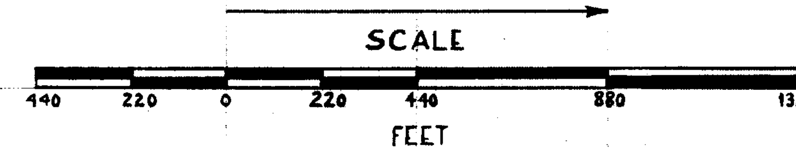
S.P. Geo.						216 7						217 1
1st BK. TIME	632	606	587	563	543	480	459	439	414	391	369	345
Wx CORR	35	35	35	35	35	35	35	35	35	35	35	35
CORR TIME	597	571	552	528	508	445	424	404	379	356	334	310

S.P. 213

S.P. Geo.	215 24						216 18						217 -
1st BK TIME	340	363	380	404	425	459	473	498	522	543	563	585	-
Wx CORR	35	35	35	35	35	35	35	35	35	35	35	35	-
CORR TIME	305	328	345	369	390	424	438	463	487	508	528	550	-

S.P. Geo.						218 7						219 1
1st BK TIME	643	660	678	684	699	-	724	738	749	759	774	789
Wx CORR	40	40	40	40	40	-	40	40	40	40	40	40
CORR TIME	603	620	638	644	659	-	684	698	709	719	734	749





SEISMIC REFRACTION RESULTS

TRAVERSE B

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics. G55/B3-13

TO ACCOMPANY RECORD 1962/183

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics G 55/B3-14
To Accompany Record No 1962/183

PLATE 15

S.P. 930 V_u = 17950 FT/SEC

S.P / GEO	916 24						917 18						918 –						919 7						920 1
1st BK TIME	1676	1663	1650	1635	1621	1610	1601	1587	1575	1565	1548	1538	–	1514	1505	1492	1477	1467	1455	1441	1432	1418	1404	1391	1375
W_x CORR	55	55	55	55	55	55	55	55	55	55	55	55	–	55	55	55	55	55	55	55	55	55	55	55	55
CORR TIME	1621	1608	1595	1580	1566	1555	1546	1532	1520	1510	1493	1483	–	1459	1450	1437	1422	1412	1400	1386	1377	1363	1349	1336	1320

S.P. 905 V_d = 17650 FT/SEC

S.P / GEO	917 24						918 18						919 –						920 7						921 1
1st BK TIME	1422	1433	1445	1456	1464	1478	1492	1502	1515	1529	1541	1556	–	1575	1592	1607	1616	1631	1639	1652	1665	1680	1696	1708	1721
W_x CORR	57	57	57	57	57	57	57	57	57	57	57	57	–	57	57	57	57	57	57	57	57	57	57	57	57
CORR TIME	1365	1376	1388	1399	1407	1421	1435	1445	1458	1472	1484	1499	–	1518	1535	1550	1559	1574	1582	1595	1608	1623	1639	1651	1664

S.P. 908 V = 17700 FT/SEC

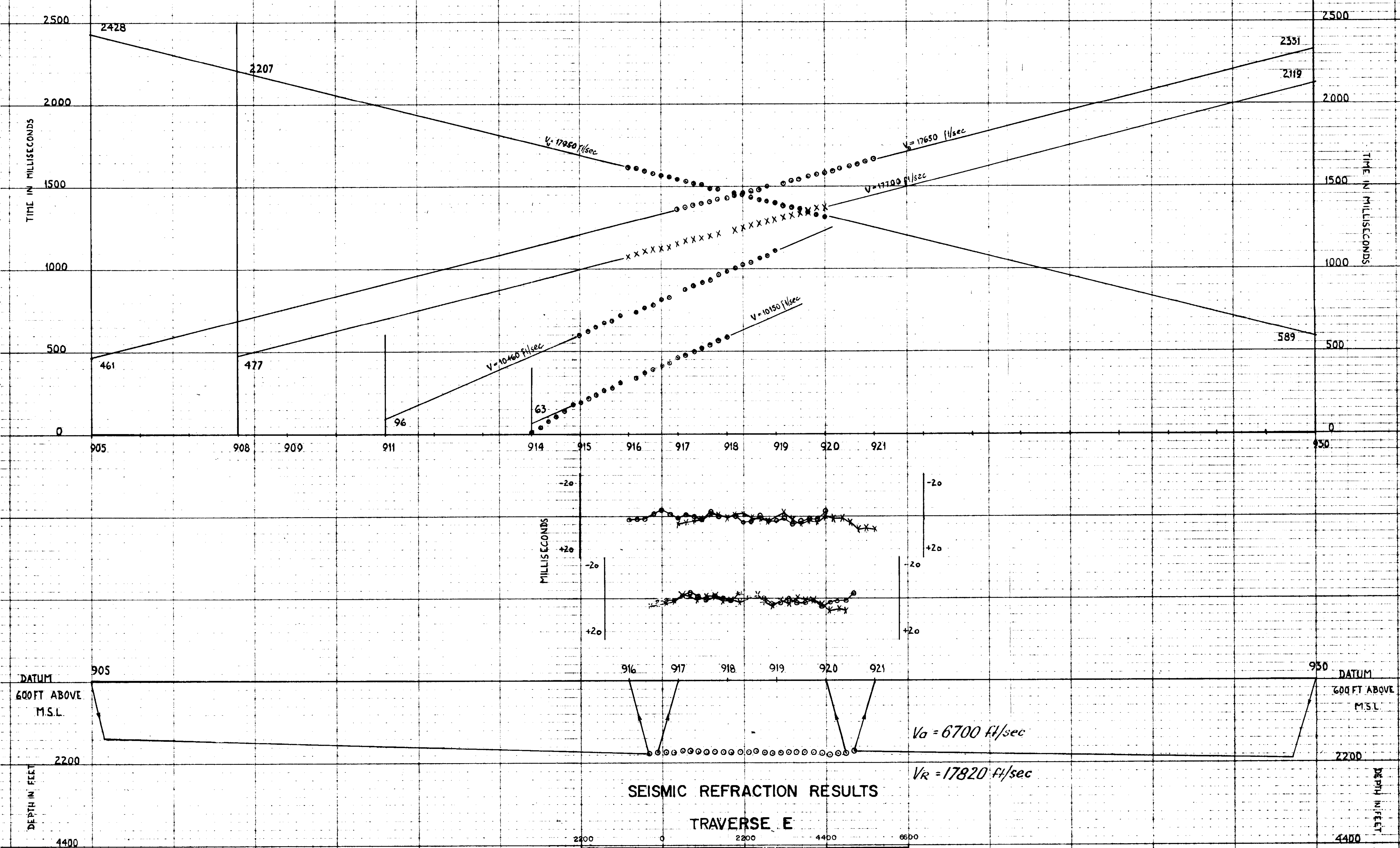
S.P / GEO	916 24						917 18						918 –						919 7		–				920 1
1st BK TIME	1130	1147	1160	1170	1182	1191	1208	1222	1232	1244	1254	1267	–	1290	1303	1317	1330	1344	1357	1367	1381	1398	1407	1422	1427
W_x CORR	56	56	56	56	56	56	56	56	56	56	56	56	–	56	56	56	56	56	56	56	56	56	56	56	56
CORR TIME	1074	1091	1104	1114	1126	1135	1152	1166	1176	1188	1198	1211	–	1234	1247	1261	1274	1288	1301	1311	1325	1342	1351	1366	1371

S.P. 911 V = 10460 FT/SEC

S.P / GEO	915 24						916 18						917 –						918 7						919 1
1st BK TIME	640	662	687	706	727	749	–	789	809	825	845	870	–	915	939	958	976	999	1020	1040	1060	1079	1099	1124	1146
W_x CORR	39	39	39	39	39	39	–	39	39	39	39	39	–	39	39	39	39	39	39	39	39	39	39	39	39
CORR TIME	601	623	648	667	688	710	–	740	760	786	806	831	–	876	900	919	937	960	981	1001	1021	1040	1060	1085	1107

S.P. 914 V = 10150 FT/SEC

S.P / GEO	914 24						915 18						916 –						917 7						918 1
1st BK TIME	39	68	105	142	174	206	232	255	280	302	323	345	–	388	410	426	446	473	496	516	538	559	582	603	625
W_x CORR	28	28	28	28	28	28	38	38	38	38	38	38	–	38	38	38	38	38	38	38	38	38	38	38	38
CORR TIME	11	40	77	104	146	178	194	217	242	264	285	307	–	350	372	388	408	435	458	478	500	521	544	565	587



SEISMIC REFRACTION RESULTS

TRAVERSE E

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics. G 55/B 3-15

TO ACCOMPANY RECORD No. 1962 / 183

SEISMIC REFRACTION RESULTS

TRAVERSE H

S.P. 1609 V_{co}

S.P. GEO.	1560 24						1561 18						1562 –						1563 7						1564 1
1st Bk TIME	4793	–	4771	4761	4751	4741	4729	4719	4713	4703	4691	4684		4662	4653	4643	4629	4612	4601	4591	4579	4563	4555	4539	4534
WX CORR	21		21	21	21	21	21	22	22	23	22	23		23	23	25	25	25	25	25	26	25	25	23	23
CORR. TIME	4772	–	4750	4740	4730	4726	4708	4697	4691	4680	4669	4661		4639	4630	4618	4604	4587	4576	4566	4553	4538	4530	4516	4511

S.P. 1526 V_{co}

S.P. GEO.	1576 24						1577 18						1578 –						1579 7						1580 1
1st Bk TIME	4924	4939	4944	4950	4954	4969	4976	4988	4990	–	5011	5017		5046	5056	5059	5074	5080	5091	5099	5108	5125	5131	5149	5164
Wx CORR	17	17	17	19	19	17	16	17	17		17	16		17	17	17	17	17	17	17	17	17	17	17	17
CORR TIME	4907	4922	4927	4931	4935	4952	4960	4971	4973	–	4996	5001		5029	5039	5042	5057	5063	5074	5082	5091	5108	5144	5132	5147

SEISMIC REFRACTION RESULTS

TRAVERSE K

FEET (Horizontal and Vertical)

PLATE 18

S.P 1879 V = 10610 FT/SEC

S.P GEO	1842 24						1843 18						1844 —						1845 7						1846 1
1st BK TIME	5395	5379	5358	5339	5325	5298	5274	5256	5237	5224	–	5185	–	5119	5106	5083	5066	5040	5024	5009	4988	4966	4945	4925	4905
Wx CORR	15	15	15	15	15	15	15	15	15	17	–	15	–	15	15	15	15	14	14	14	14	14	14	14	14
CORR TIME	5380	5364	5343	5324	5310	5283	5259	5241	5222	5207	–	5170	–	5104	5091	5068	5051	5026	5010	4995	4974	4952	4931	4911	4891

S.P 1812 V = 10960 FT/SEC

S.P GEO	1847 24						1848 18						1849 —						1850 7						1851 1
1st BK TIME	4798	4811	4851	4866	4872	4899	4919	4935	4962	4975	5009	5020	–	5062	5091	5100	5114	5142	5172	5182	5199	5220	5241	5259	5269
Wx CORR	7	7	8	8	8	8	8	8	8	8	8	8	–	8	8	8	8	8	8	8	8	8	9	9	9
CORR TIME	4791	4804	4833	4858	4864	4891	4911	4927	4954	4967	5001	5012	–	5054	5083	5092	5106	5134	5164	5174	5191	5212	5232	5250	5260

$V_u = 19490$ FT/SEC

1st BK TIME	3578	3568	3555	3544	3530	–	3504	3496	3486	3472	3460	3451	–	3431	3424	3411	3399	3388	3375	3361	3350	3337	3327	3315	3304
Wx CORR	20	20	20	20	20	–	20	20	20	21	21	20	–	20	20	20	20	20	20	20	20	20	20	20	20
CORR TIME	3558	3548	3535	3524	3510	–	3484	3476	3466	3451	3439	3431	–	3411	3404	3391	3379	3368	3355	3341	3330	3317	3307	3295	3284

$V_D = 19020$ FT/SEC

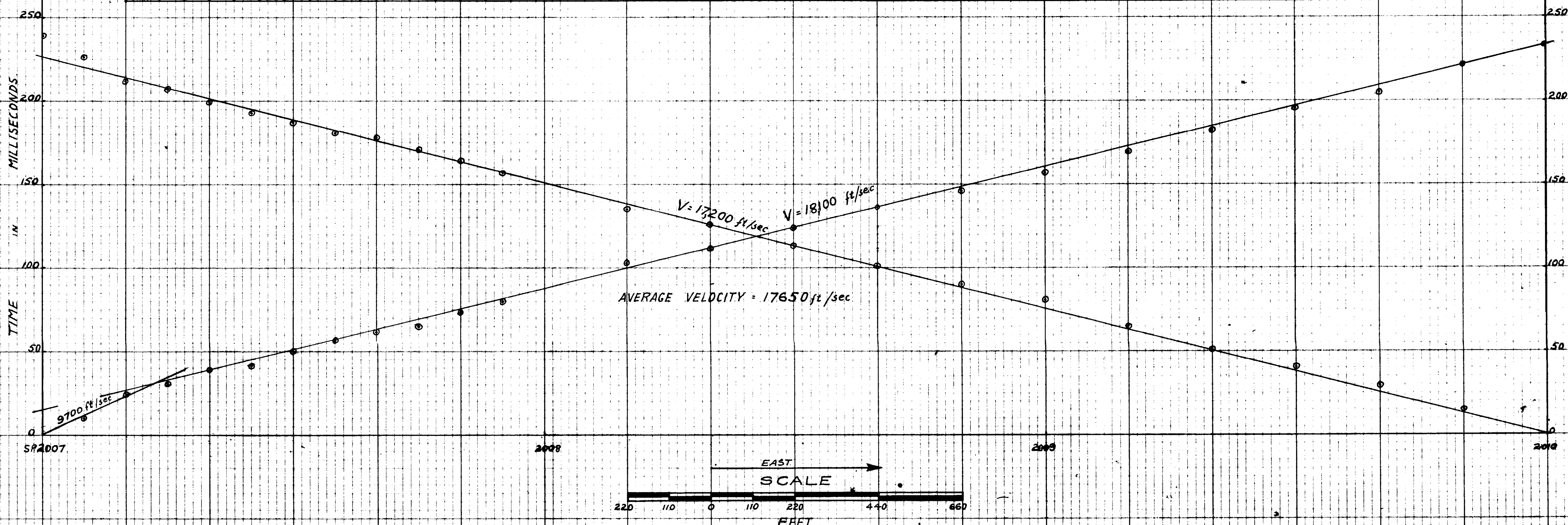
1st BK TIME	3444	3452	3456	3466	3481	3489	3501	3516	3525	3534	3556	3562	–	3585	3604	3610	3622	3634	3644	3660	3667	3678	3686	3702	3713
Wx CORR	19	19	19	19	19	19	19	19	19	19	19	19	–	19	19	19	19	19	19	19	19	19	19	19	19
CORR TIME	3425	3433	3437	3447	3462	3470	3482	3497	3506	3515	3536	3543	–	3566	3585	3591	3603	3615	3625	3641	3648	3659	3667	3683	3694

SEISMIC REFRACTION RESULTS.

TRAVERSE L

Geo. (SP 2007)	1	2	3	4	5	6	7	8	9	10	11	12	SP 2008	13	14	15	16	17	18	19	20	21	22	23	24
UnCor. Time	10	20	40	42	50	55	62	67	72	80	94	103		137	145	155	160	161	175	193	229	241	233	263	257
Wthg Corr.	10	10	16	11	12	13	12	10	10	15	21	23		34	33	31	24	15	18	24	47	45	28	41	24
Corr. Time	0	10	24	31	38	42	50	57	62	65	73	80		103	112	124	136	146	157	169	182	196	206	222	233

Geo. (SP 2010)	1	2	3	4	5	6	7	8	9	10	11	12	SP 2008	13	14	15	16	17	18	19	20	21	22	23	24
UnCor. Time	249	237	228	218	211	206	199	191	188	186	185	180		169	159	144	125	105	94	89	99	86	57	56	24
Wthg Corr.	10	10	16	11	12	13	12	10	10	15	21	23		34	33	31	24	15	18	24	47	45	28	41	24
Corr. Time	239	227	212	207	199	193	187	181	178	171	164	157		135	126	113	101	90	76	65	52	41	29	15	0



GRANITE VELOCITY MEASUREMENT

YETMAN – TEXAS ROAD

N S W 1961

SEISMIC SURVEY "GOONDIWINDI" 1961.

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics. G55/B3-19

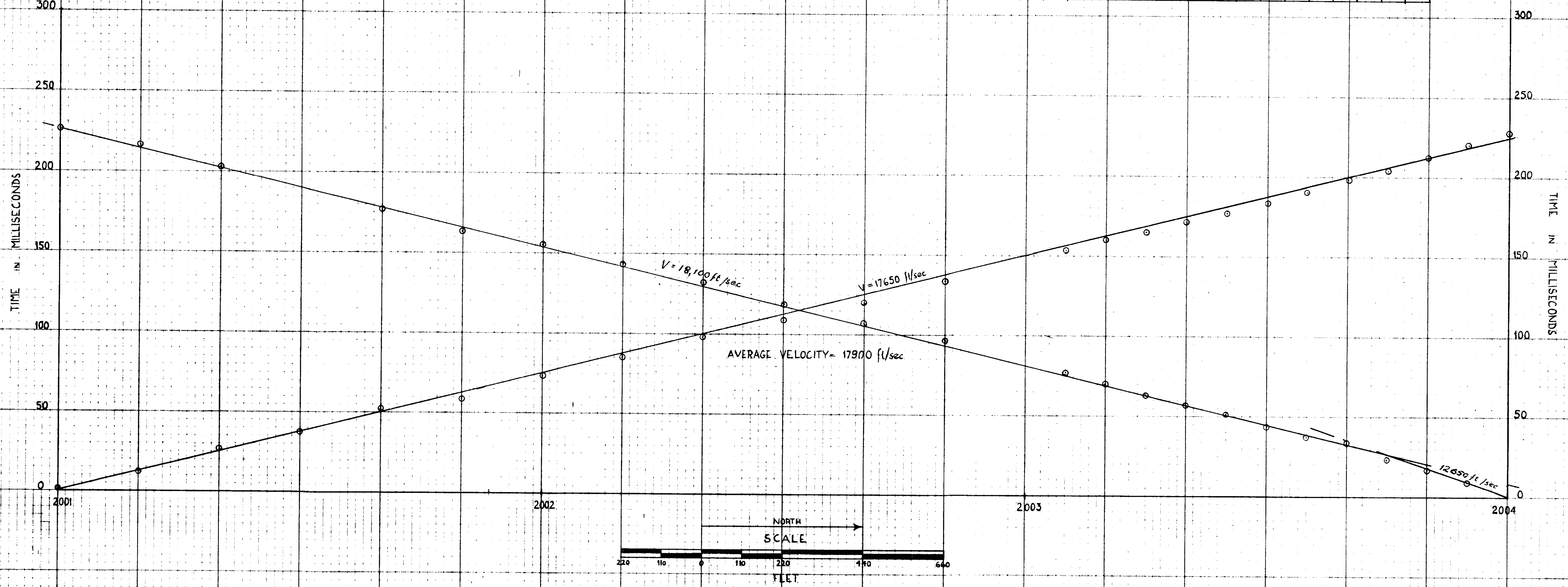
TO ACCOMPANY RECORD No 1962/183

S.P 2001

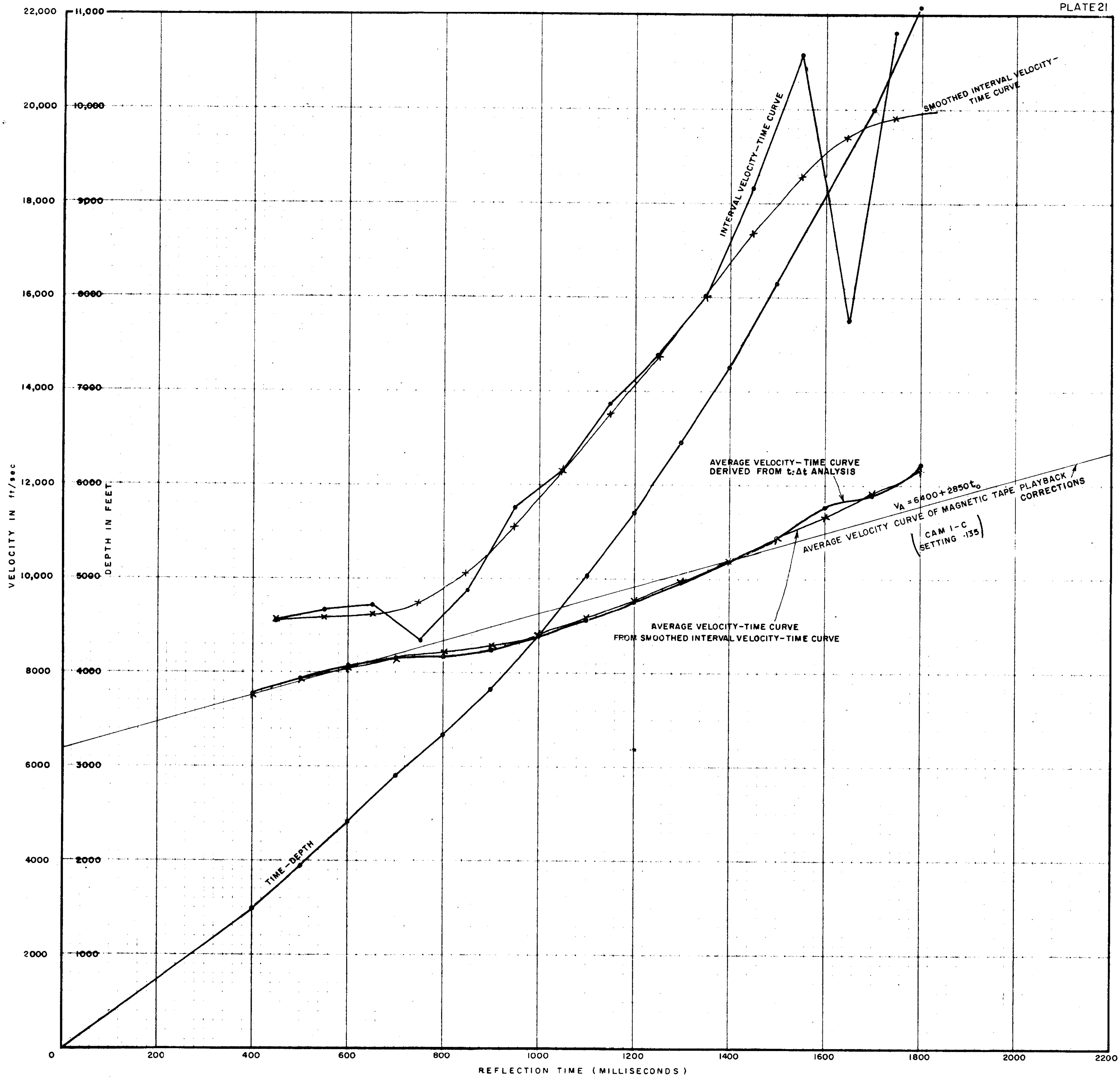
GEO	1	2	3	4	5	6	7	8	9	10	11	12	S.P 2003	13	14	15	16	17	18	19	20	21	22	23	24
1st BK TIME	242	234	226	222	212	210	202	193	184	176	172	166		152	140	123	122	112	92	74	70	53	42	26	18
Wx CORR	14	14	14	18	14	20	18	16	13	11	12	13		18	20	14	24	27	19	15	18	16	16	14	17
CORR TIME	228	220	212	204	198	190	184	177	171	165	160	153		134	120	109	98	85	73	59	52	37	26	12	1

S.P 2004

GEO	1	2	3	4	5	6	7	8	9	10	11	12	S.P. 2003	13	14	15	16	17	18	19	20	21	22	23	24
1st BK TIME	13	23	30	41	47	57	62	67	70	74	82	90		114	127	133	156	170	174	178	194	-	219	230	243
Wx CORR	14	14	14	18	14	20	18	16	13	11	12	13		18	20	14	24	27	19	15	18	-	16	14	17
CORR TIME	-1	9	16	23	33	37	44	51	57	63	70	77		96	107	119	132	143	155	163	176	-	203	216	226



METAMORPHIC ROCK VELOCITY MEASUREMENT, YETMAN-TEXAS ROAD, N.S.W. 1961.



TRAVERSE A { SP 1–20 (120 POINTS)
SP 80–100 (160 POINTS)
SP 700–720 (120 POINTS) }

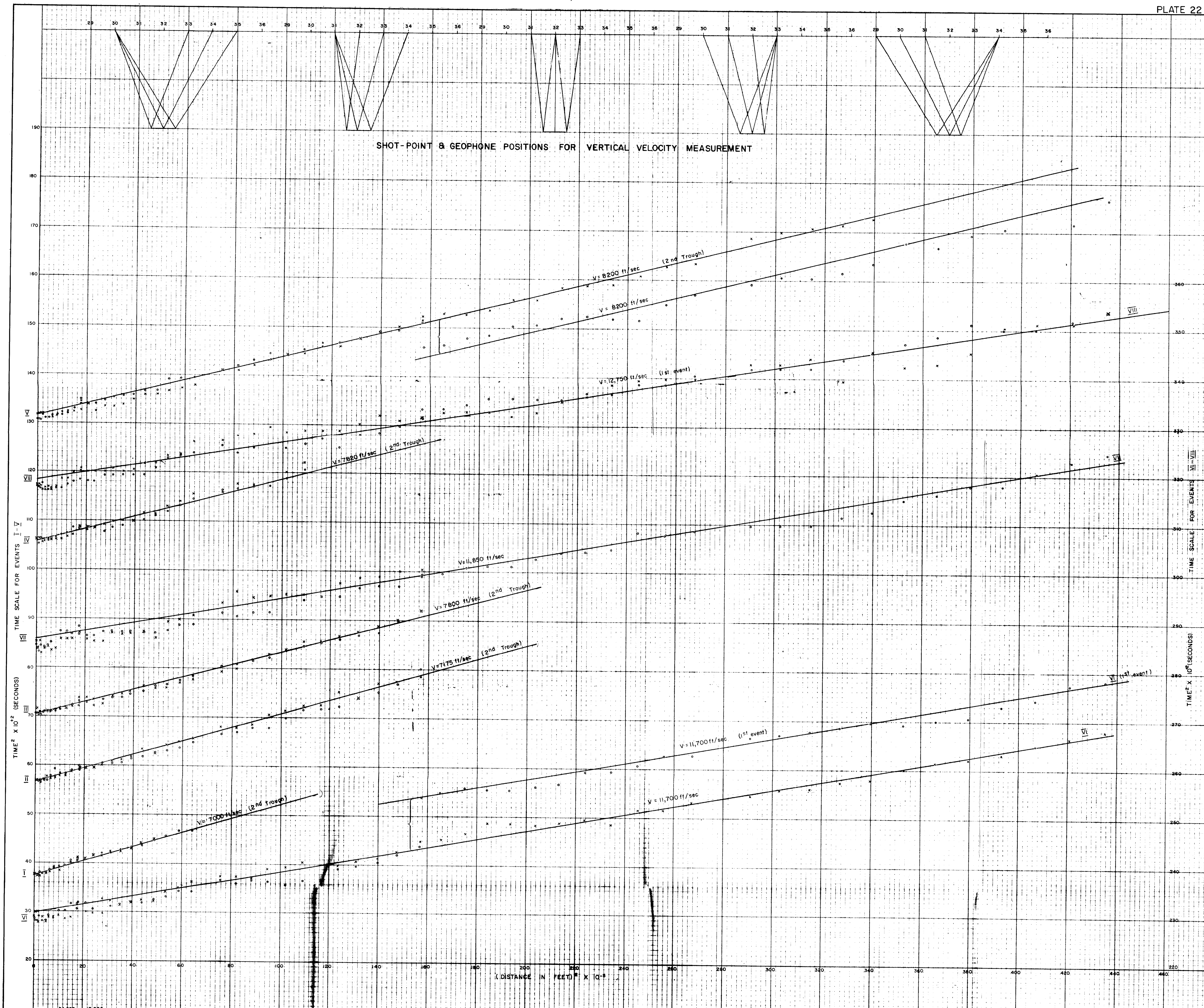
CURVES FROM t : Δt ANALYSIS (400 POINTS)

AVERAGE VELOCITY, DEPTH, INTERVAL VELOCITY IN RELATION TO REFLECTION TIME

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics G55/B3-21

TO ACCOMPANY RECORD No 1962/183

SURAT BASIN 1961.



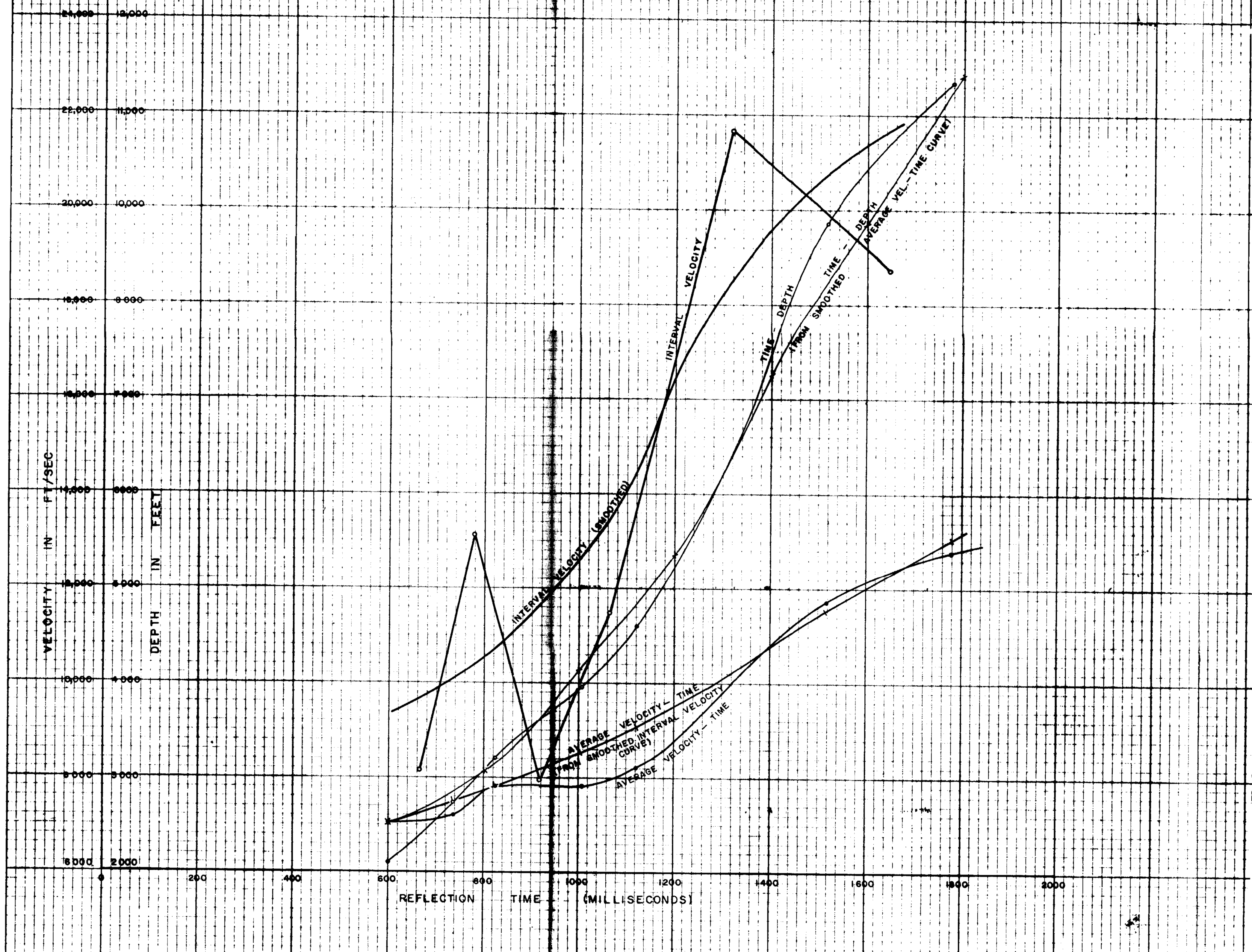
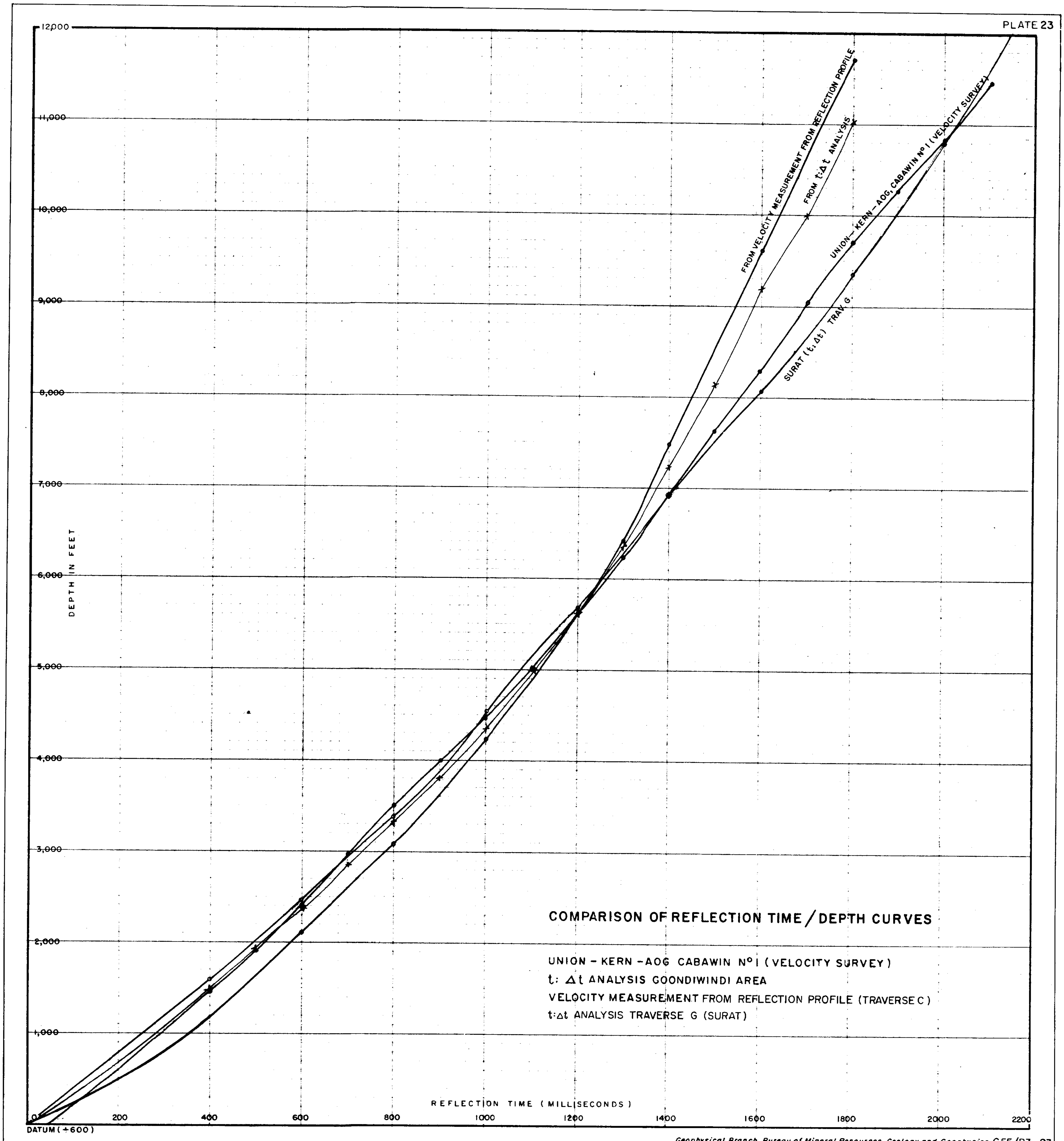


TABLE OF CALCULATIONS

REFLECTION No.	v_a AVERAGE VEL	tc	CORRECTION TO ONSET	tc (CORR. TO ONSET)	d = v_a tc /2	Δd	Δtc	v_i
I	7000	0·616	0·018	0·598	2085	555	0·137	8100
II	7175	0·755	0·020	0·735	2640	570	0·087	13,100
III	7800	0·840	0·018	0·822	3210	730	0·185	7890
IV	7820	1·030	0·023	1·007	3940	660	0·115	11,480
V	8200	1·147	0·025	1·122	4600	4275	0·395	21,650
VI	11,700	1·517	0	1·517	8875			
VII	11,850	1·691	?			2491	0·266	18,720
VIII	12,750	1·783	0	1·783	11,366			

VELOCITY-PROFILE RESULTS

TRAVERSE C



Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics G55/B3-23

SURAT BASIN 1961

TO ACCOMPANY RECORD No 1962/183

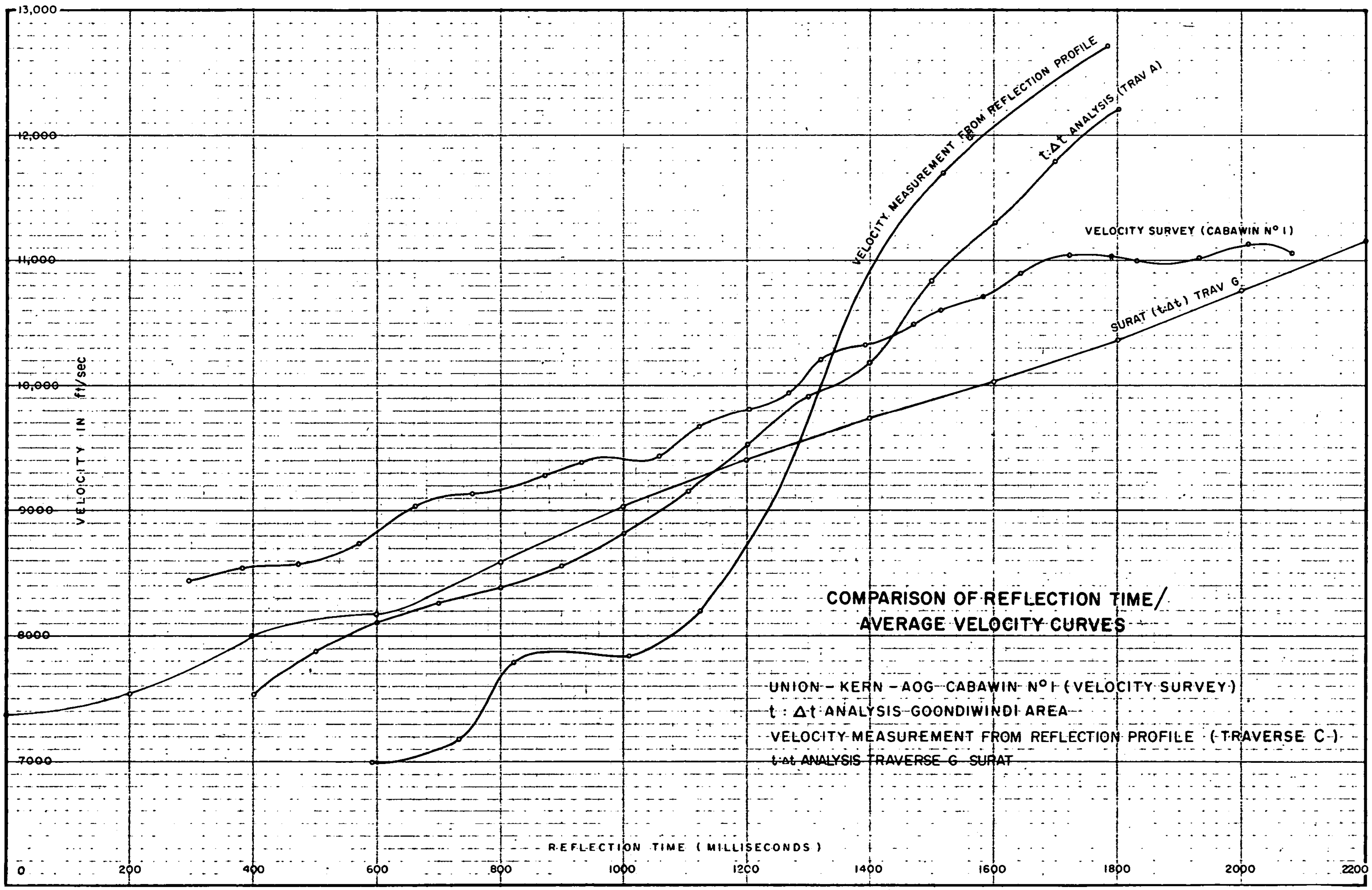
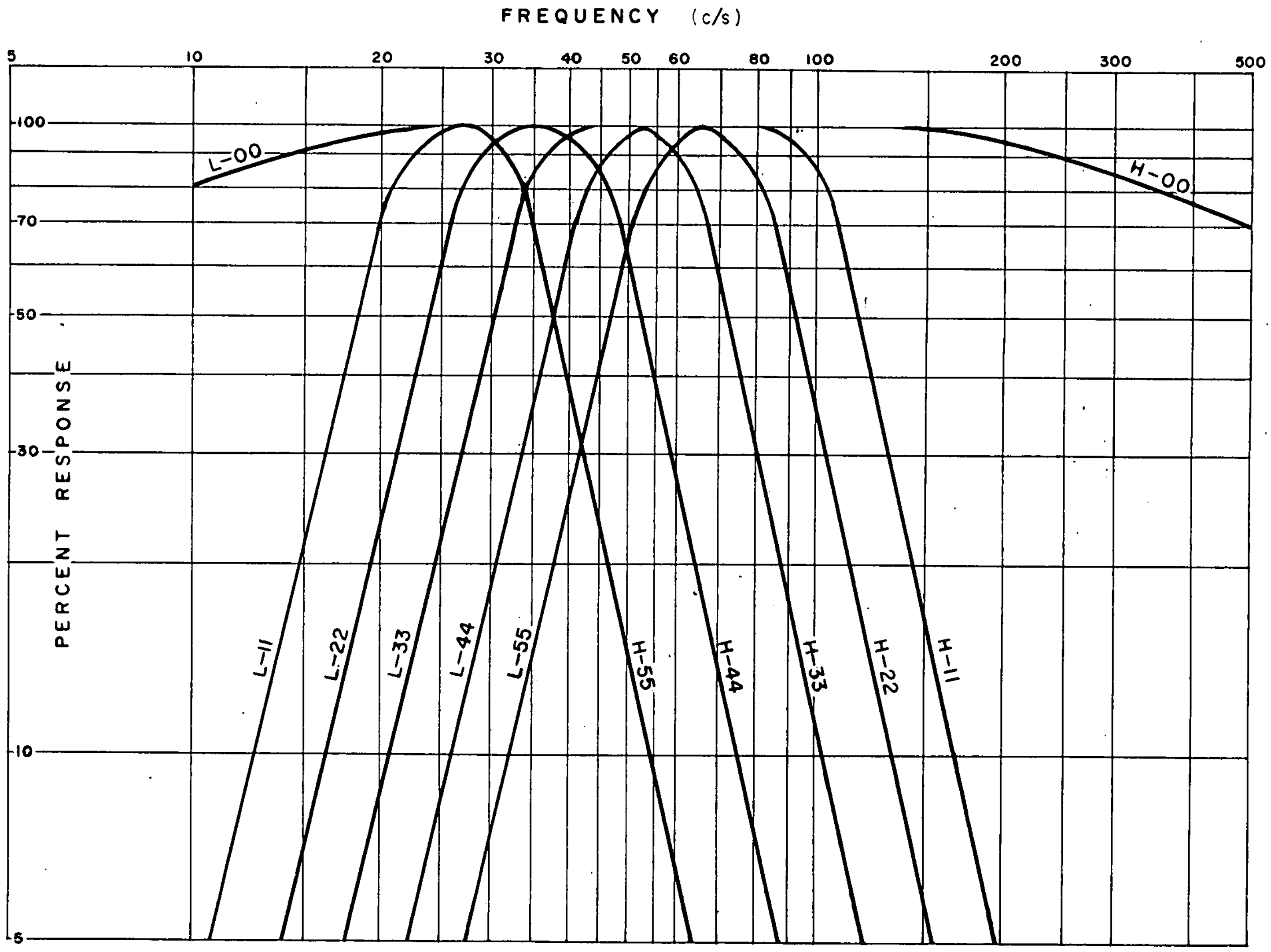


PLATE 24

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics G55/B3-24

To Accompany Record No 1962/183



2 Sections low cut
2 Sections high cut

MODEL 621-1 AMPLIFIER RESPONSE

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics G 55/B3-25

To Accompany Record No 1962/183

(Based on G 85-84)