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COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RECORD No. 1964/109

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MOREE AREA SEISMIC SURVEY, NEW SOUTH WALES 1962

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by

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

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SUMMARY

Between April and July 1962, a seismic party from the Bureau of Mineral Resources, Geology and Geophysics made a seismic reflection and refraction survey in the Moree area of New South Wales. The main purpose of the survey was to investigate whether the southern extension of the Bowen Basin beneath the Great Artesian Basin from Meandarra to Toobeah continued as far south as Moree and joined the Sydney Basin.

Three east-west traverses were shot using a method of reconnaissance reflection shooting, the first near Dolgelly Bore, the second through Moree, and the third through Bellata. The third traverse was extended eastward as far as the Horton River to investigate the Hunter-Bowen Thrust zone. In addition, three north-south refraction traverses were shot in the middle, and on both ends, of the east-west traverse through Moree. A north-south reflection traverse was shot north of Dolgelly Bore.

Results in the Moree and Bellata areas were of poor quality and in the Bellata area in particular, owing to surface basalt flows, little information was obtained. The Hunter-Bowen Thrust area was not distinguished by the seismic work.

The seismic results indicated that the trough of sediments extending southwards through Dolgelly Bore was at least 7500 ft deep south of Dolgelly Bore. The eastern margin of the trough is probably an overthrust fault.

In the Moree area, two troughs were indicated, viz. the Biniguy Trough in the east where about 7000 ft of sediments was estimated separated by the Pallamallawa Ridge from the Moree Trough in the west where about 11,000 ft of sediments was estimated.

Poor results in the Bellata area failed to indicate whether the Moree Trough joined the Sydney Basin.

1. INTRODUCTION

Seismic surveys in the Surat Basin from 1959 to 1961 have revealed a north-south trough which is probably the extension of the Bowen Basin southwards (Smith and Lodwick, 1962). The trough, which extends through Meandarra and Toobeah, was thought to persist at least as far south as Dolgelly Bore (Lodwick and Bigg-Wither, 1962). It was planned to extend the seismic work south to the Moree area during 1962 with the main object of defining the extension of the Bowen Basin southward and to find its relation to the Sydney Basin in New South Wales.

An east-west traverse between Goondiwindi and St George, which was shot in 1961, defined a trough of sediments between Goondiwindi and Talwood. The deepest part of the trough was beneath Toobeah where the thickness of Mesozoic sediments indicated by the depth of the 'L' horizon (a strong correlatable reflection) was about 9600 ft. It was shown from the formations penetrated by the Union-Kern-A.O.G. Cabawin No. 1 well that the 'L' horizon probably corresponds to the Kianga Formation, a fresh-water Permian formation containing coal seams. Refraction work near Toobeah indicated that there is about 5200 ft of sediments below the 'L' horizon; a refractor in which the velocity is about 19,000 ft/sec, which probably corresponds to unprospective metamorphic or granitic basement, was measured at a depth of 14,800 ft.

The trough defined by the 1961 survey (Lodwick and Bigg-Wither, 1962) is bounded on the eastern side near Goondiwindi by a fault with a throw possibly greater than 7000 ft, downthrown to the west. The western margin of the trough is probably formed by a series of step faults between Bungunya and Talwood.

South of Toobeah near Dolgelly Bore the probable 'L' horizon is about 7000 ft deep and continues to rise to the south until it is apparently truncated at a depth of about 6000 ft some eight miles south of Dolgelly Bore. Farther south near Ashley, reflection shooting indicated an horizon, which may be the 'L' horizon, at a depth of 6000 ft. It was suggested (Lodwick and Bigg-Wither, 1962) that the truncation of the 'L' horizon was against the western margin of the trough rather than against the southern limit.

From the results of the 1961 survey it seemed possible that the Bowen Basin might extend south through Moree and perhaps join the Sydney Basin. From the available bore information the most-likely place that the two basins may join was through a trough about 30 miles wide near Moree.

2. PLAN OF SURVEY

The proposed programme, together with the work actually done during the survey, is set out below:

Proposed programme

(a) An east-west reflection traverse through Moree. This was expected to indicate whether a deep trough with possible pre-Mesozoic sediments existed in the area, and if so, to define its margins,

(b) A refraction traverse in the vicinity of Moree to confirm the depth of section suggested by the reflection traverse in (a), and to measure the seismic velocity in basement,

(c) Assuming that (a) and (b) indicated a deep trough at the latitude of Moree, to extend reflection shooting south towards Narrabri. An east-west traverse, probably through Bellata, to locate the margins could also be surveyed if the trough extended towards Narrabri,

(d) Shoot a short reflection traverse between Dolgelly Bore and Toobeah (see Plate 2) to fill in a large gap in the north-south traverse of 1961 (Lodwick and Bigg-Wither, 1962), and an east-west reflection and refraction traverse about latitude 29° 05'S,

(e) On the recommendation of the Bureau's Chief Geologist the proposed east-west traverse near Bellata, (c) above, was to be extended east as far as the Horton River to ensure that the Hunter-Bowen Thrust zone was crossed.

Alterations to proposed programme

Work omitted. The proposed north-south reflection traverse between Moree and Narrabri was omitted owing to the extra time spent on the east-west traverse through Moree. The latter traverse was estimated to take five weeks but took over three months. Reasons for the time exceeding the original estimate included poor drilling and recording conditions, and an extension of the seismic coverage because of the poor quality of reflections and the consequent uncertainty of interpretation.

Additional work. Towards the end of the survey it was decided to shoot two refraction traverses (Traverses W and V, Plate 2), one west of Moree and the other at the eastern end of Traverse P, in order to assist in the interpretation of the east-west reflection traverse.

Completed programme

The work actually done during the survey was as follows (Traverses shown on Plate 2):

(a) An east-west traverse through Moree: Traverses P and R,

(b) A refraction depth-probe near Moree: Traverse S,

(c) An east-west reflection traverse between Bellata and Berrygil which was later extended to the Horton River to cross the zone of the Hunter Thrust : Traverse U,

(d) A reflection traverse (Traverse J) shot north of Dolgelly Bore and an east-west reflection traverse (Traverse T) shot about latitude 29° 05'S,

(e) Refraction traverse west of Moree: Traverse W,

(f) Refraction traverse near the eastern edge of the Artesian Basin sediments: Traverse V.

3. RESULTS

Subsurface velocity distribution

Reflections recorded in the Moree area, particularly along Traverses P, R, and U, were not of sufficiently high quality for an estimate of subsurface velocities to be made from a $t:\Delta t$ analysis. Depth estimates of the recorded reflections shown on the seismic reflection cross-sections were made using the velocity distribution derived from a $t:\Delta t$ analysis of reflections recorded in the Goondiwindi area during the 1961 survey. The curves relating average velocity, depth, and interval velocity in the Goondiwindi area are shown in Plate 10.

In the Moree area, average velocities calculated from the matched profiles in the refraction depth-probes indicate that the velocity distribution in the Moree area is similar to that in the Goondiwindi area.

The eastern end of Traverse U (Shot-points 3021 to 3028 and 3052 to 3058) was located on Carboniferous or Permo-Carboniferous outcrops. The reflections were poor and it was not possible to derive a velocity/depth relation. Owing to high first-break velocities (between 13,000 and 16,000 ft/sec), depth estimates of the reflections recorded were made assuming a constant average velocity of 16,000 ft/sec.

Reflection traverses

Spreads of 1320-ft length were used for most of the survey. Towards the end of the survey, however, longer cables became available and it was decided to change to 1800-ft spreads to obtain greater subsurface coverage.

Traverse J (North of Dolgelly Bore). A seismic reflection cross-section, plotted in depth and drawn from corrected-record cross-sections, is shown in Plate 3, and a variable-intensity cross-section in Plate 11.

Good-to-fair-quality reflections were recorded using single shot-holes and six geophones per trace, the geophones spaced 22 ft apart in the line of the traverse. Intervals of 1800 ft were used between shot-points (i.e. 3600-ft split spreads). Shot depths were about 120 ft, but it seemed likely from the uphole times and the energy level that reflection quality would be improved with deeper shot-holes. Easy drilling conditions were encountered.

Traverse T (east-west traverse at 29°S). The seismic reflection cross-section along Traverse T is shown in Plate 5 and the variable-intensity cross-section in Plate 13. The shot-point interval used was 1320 ft.

Good-to-fair-quality reflections were recorded at all shot-points along Traverse T except on the western end where a slight deterioration was noticeable. Single shot-holes and six geophones per trace in the line of traverse were used. A shot depth of about 120 ft was satisfactory. Drilling conditions through sand and clay were good.

Traverses P and R (east-west traverse through Moree). A seismic reflection cross-section along Traverses P and R is shown in Plate 4 and a variable-intensity cross-section in Plate 12. A 1320-ft interval between shot-points was used.

Reflection quality along Traverses P and R was poor to fair. Poor reflections were recorded from single shot-holes using six geophones per trace. This was due to the failure of the drilling rigs to penetrate coarse gravel beds that were encountered at depths of about 20 ft. Using the Mayhew rig with a large-capacity mud pump and a viscous mud, some success was achieved in penetrating the gravel beds. The Mayhew rig was not available until towards the end of the survey.

To improve record quality when shooting above the gravel beds, the number of geophones per group was increased from six to twelve and three holes were drilled at the shot-points. The spacings of the shot-holes and geophones were selected after noise tests were made using shot-holes drilled to the top of the gravel beds. The noise tests showed that with 12 geophones per trace the best spacing for noise cancellation was probably 20 ft in the line of traverse. The best spacing for three shot-holes was 80 ft in the line of traverse. In areas towards the edges of the Basin where steeply dipping reflections were expected the geophone spacing was altered to 10 ft and the shot-hole spacing to 40 ft.

The quality of reflections recorded was generally improved by the use of these multiple geophones and multiple shot-holes. All shot-points on this traverse other than Shot-points 2496 to 2513, 2522 to 2548, and 1965 to 1972 were shot using the multiple geophones and shot-holes.

Traverse U (east-west traverse through Bellata). The seismic reflection cross-section along Traverse U is shown in Plate 6 and a variable-intensity cross-section in Plate 14. The shot-point interval used was 1320 ft.

The quality of reflections varied considerably along Traverse U. Basalt flows were encountered at shallow depth at many places between Shot-points 2900 and 2970. Where basalt was encountered, reflection quality was very poor as the drilling rigs could not penetrate the basalt at an economical rate and consequently only shallow holes were drilled. Fair-quality reflections were recorded where basalt flows were not encountered.

Noise tests were made to try to determine a method to improve record quality when shooting in shallow holes. After an analysis of the noise and using five shot-holes in the line of traverse, a spacing of 30 ft was calculated as the most effective for noise cancellation. Twelve geophones per trace, spaced 10 ft apart in the line of traverse, were used in conjunction with the five-hole patterns. Reflection quality was improved but was not considered satisfactory. More-comprehensive noise studies and larger numbers of geophones will have to be tried in an effort to obtain satisfactory results over the areas where basaltic flows occur.

On the eastern end of Traverse U two short additions (Shot-points 3021 to 3028 and 3053 to 3058) were shot to try to obtain information on the Hunter-Bowen Thrust zone. The rocks over which the two traverses were shot were very hard and only shallow holes could be drilled in the time available. High velocities (13,000 to 16,000 ft/sec) were recorded as first-break velocities. Poor-to-fair-quality reflections were recorded.

Traverses S and V. Two short reflection traverses were shot in the middle of each of these refraction traverse. The seismic reflection cross-sections are shown in Plate 3 and the variable-intensity cross-section in Plate 11. The shot-point interval used was 1320 ft on Traverse S and 1800 ft on Traverse V.

Fair-quality reflections were recorded along Traverse V using single shot-holes with a shot depth of about 120 ft and using six geophones per trace in the line of traverse. Gravel beds were encountered on Traverse S and multiple geophones and pattern-holes were used in a similar manner to that described for Traverses P and R.

Refraction traverses

Three refraction traverses were shot, viz. Traverses S, V, and W, to determine depths to, and velocities in, probable basement rocks. The positions of the traverses are shown in Plate 2.

Traverse S. The results of Traverse S, including refraction profiles, are shown in Plate 7.

The presence of gravel beds at shallow depths along Traverse S made it difficult to record sufficient energy over distances greater than about four miles when the shot-holes failed to penetrate the gravel beds. The energy level was greatly increased when it became possible to penetrate the gravel beds with the Mayhew rig which became available towards the end of the survey. The amplitude of the energy arriving from the distant shots on the southern end of Traverse S is very small, and although the arrival of the onset of the energy has been estimated from a later phase the velocities measured are considered reliable.

Traverse V. The results of Traverse V are shown in Plate 8.

Drilling and shooting conditions were good along Traverse V and fair-quality results were obtained.

Traverse W. The results of Traverse W are shown in Plate 9.

Although gravel beds were encountered on Traverse W it was possible to penetrate the beds with the Mayhew rig and sufficient energy was recorded. The arrivals recorded from the shallow refractor, shooting from the eastern end, are difficult to time accurately; hence reliable matching of the recorded profiles from two directions of shooting was not possible. Interference possibly as a result of faulting has complicated the wave-form of the energy arrivals. The estimated reciprocal times at the end shot-points for the deeper refractor do not agree closely. The matched segments of the refractor, however, compare closely and it is considered that the same refractor was recorded in each direction of shooting.

4. INTERPRETATION

North of Moree (Plates 3 and 5) a strong reflecting horizon was recorded at depths of 9000 ft below datum (600 ft above M.S.L.) on Traverse J and at 7500 ft below datum at the deepest point on Traverse T. This reflecting horizon probably correlates with the 'L' horizon recorded in the Toobeah area (Lodwick and Bigg-Wither, 1962).* On Traverse J the reflecting horizon shows a gentle dip to the north throughout the length of the traverse.

In the east-west direction (on Traverse T) the probable 'L' horizon rises both to the east and to the west, forming a trough with its deepest part beneath Shot-point 2754. The horizon is not recognisable on Shot-points 2841 to 2847 and is probably truncated between the two parts of the traverse (i.e. between Shot-points 2792 and 2841). The eastern margin of the trough is almost certainly faulted beneath Shot-point 2843. Referring to the variable-intensity cross-section (Plate 13) reflections below 3000 ft, which are clearly visible below Shot-points 2841 and 2842, disappear or are interfered with below Shot-point 2843. A curved event, which commences at about 3200 ft below Shot-point 2843 and continues across Shot-point 2844 to 2847, is probably a diffraction from a fault below Shot-point 2843. Steeply dipping events on the record from Shot-point 2842, shown at about 4000-ft depth, may also be diffractions, or perhaps reflections associated with steep dips near the fault. It is inferred therefore that a fault exists at a depth of 3200 ft below Shot-point 2843. However, a reflection at 1.2 secs (5700 ft) at Shot-point 2842 appears to continue through to Shot-point 2844, i.e. it continues underneath the fault. This may mean that the fault is overthrust from the east. It may correlate with the Goondiwindi Fault indicated by seismic work in 1961 (Lodwick and Bigg-Wither, 1962). Aeromagnetic surveys by Union Oil (1963a) suggest that the Goondiwindi Fault extends southward from Goondiwindi. A good correlatable reflection between 2000 ft and 3000 ft is continuous across the fault and is draped over it in an anticlinal fold. The fault is taken to be the eastern margin of the pre-Artesian Basin sedimentary trough (i.e. the Bowen Basin extension), with the Artesian Basin sediments overlapping it to the east. An outcrop of quartzite about five miles east of this traverse (near Croppa Creek) indicates the margin of the Artesian Basin.

The western margin was not crossed by the seismic traverse, but it is apparent from the easterly dips of the reflections between Shot-points 2725 and 2732 that the margin of the trough was being approached. The probable 'L' horizon rises to a depth of about 6000 ft beneath Shot-point 2725. The western margin of the trough may be reflected in the surface geology where there is an outcrop of a sandy formation passing about 15 miles east of Boomi southward through Sandholes (Plate 2).

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* Recent exploration by Union Oil Development Corporation (subsidised by the Commonwealth Government) in the Goondiwindi area has shown that there is some doubt whether the horizon that was interpreted as the 'L' horizon by Lodwick and Bigg-Wither (1962) is in fact the 'L' hroizon. Recent interpretations by Union Oil after extensive seismic work suggest that the 'L' horizon recognised by Lodwick and Bigg-Wither is associated with a basement reflection. On this basis another interpretation may be warranted.

Between Shot-points 2755 and 2763 on Traverse T, a structure with a relief of about 500 ft is shown in the probable 'L' horizon. The reflecting horizon is interfered by diffractions under Shot-points 2753 to 2756 and possibly also on the east flank of the structure (see Plate 13). It is difficult to interpret the events, but it appears that the structure may be a fault-block, rather than a simple anticlinal fold. An anticline appears to exist in the shallower formations however.

The reflecting horizons above the probable 'L' horizon in general show a similar structure to the 'L' horizon except where the 'L' horizon is faulted, but the relief becomes less pronounced with decreasing depth. One of the reflecting horizons, which probably corresponds to the 'G' horizon recognisable in the Goondiwindi area, was recorded at a depth of about 4000 ft in the deeper parts of the trough. The 'G' horizon corresponds closely with the Bundamba Formation in the northern part of the Surat Basin. The horizon, which probably correlates with the 'G' horizon on Traverse T, appears to correspond closely with the deepest and most prolific aquifer in Dolgelly Bore between Traverses J and T.

The reflection cross-section along the east-west traverse through Moree (Traverse P and R) is shown in Plate 4. The poor quality of reflections along both traverses makes it impossible to suggest correlations with horizons farther north.

The eastern end of the reflection cross-section indicates a trough reaching a depth of nearly 7000 ft beneath Shot-point 1978 on Traverse P. Between Shot-point 2496 on Traverse R and Shot-point 1955 on Traverse P the reflections, although poor-quality, suggest the sediments are about 8000 ft thick. The dips of reflections between Shot-points 1955 and 1974 suggest an anticlinal feature with its axis approximately beneath Shot-point 1961. In general the reflection cross-section suggests that in the Moree area there are two troughs, viz. the Biniguy Trough in the east and the Moree Trough in the west, separated by the Pallamallawa Ridge. Reflection quality was very poor over the ridge but it is possible that the ridge is an expression of a fault zone.

The eastern margin of the Biniguy Trough was not crossed by the traverse but the westerly dips of the shallow reflections suggest that the margin was being approached. Volcanic rocks and tuffaceous sediments, probably of Carboniferous age, crop out about two miles east of Shot-point 2000.

The western margin of the Moree Trough was not crossed by a seismic traverse. Results along a reflection traverse west of Moree (Traverse R, Shot-points 2400 to 2419) suggest that the sediments are about 5000 ft thick. It seems therefore that the western margin of the Moree Trough lies between Shot-points 2419 and 2496 where a change of about 3000 ft in the depth of sediments may be inferred from the reflection results. The part of Traverse R between Shot-points 2400 and 2419 is apparently on a shelf area.

The reflection cross-section along the middle part of refraction Traverse V is shown in Plate 3. There is an unconformity indicated in the geological cross-section between the strata above 4000 ft which are sub-horizontal, and the strata represented by a reflecting horizon dipping north from about 5500 ft beneath Shot-point 3440 to about 8000 ft beneath Shot-point 3449. Other apparent reflections below this horizon have variable dips. Refraction work along Traverse V recorded an 18,000-ft/sec refractor, which probably represents metamorphic basement, 6000 ft beneath Shot-point 3446 (Plate 8). This refractor corresponds closely with the north-dipping

reflection mentioned above. Many of the apparently deeper reflections on Traverse V probably, therefore, represent horizons in metamorphic rocks or are multiple reflections.

Refraction depth-probing on Traverse S in the Moree Trough recorded a 20,400-ft/sec refractor, at a depth of 11,250 ft. It seems, therefore, that the reflections recorded to a depth of about 8000 ft in the Moree Trough were reflected from sediments above metamorphic rock, and that the sediments may be as much as 11,000 ft thick in this trough. On the other hand, the results on Traverse V suggest that metamorphic basement in the Biniguy Trough will be at 7000-ft depth or less, i.e. in approximate agreement with the estimate of 7000-ft thickness of sediments made from the reflection Traverse P. The Pallamallawa Ridge may represent the faulted western extension of this metamorphic basement and may also represent the eastern margin of the Palaeozoic sediments of the Moree Trough.

On Traverse W, west of Moree, a 17,470-ft/sec refractor was recorded at about 5400 ft. It is considered that this velocity is high enough to represent metamorphic or igneous rock; thus the interpretation of the reflection results, viz. that Shot-points 2400 to 2419 overlie a relatively shallow shelf area, is supported by the refraction results.

The reflection cross-section along Traverse U is shown in Plate 6. The reflection quality is very poor and it is not possible to estimate the depth of sediments in the area. Beneath some shot-points where fair-quality reflections were recorded, the deepest reflections were about 5500 ft deep (e.g. Shot-points 2906 to 2908, 2968, and 2969). It is not known whether the Moree Trough extends as far south as Bellata.

The two small eastern additions of the traverse, viz. Shot-points 3021 to 3028 and 3053 to 3058, indicate that reflections may be recorded on the older metamorphic rocks (probably Carboniferous). The results do not show the Hunter-Bowen Thrust zone and give little information on the general structure.

The seismic survey of the Moree area was not conclusive in showing whether the Bowen Basin joins the Sydney Basin beneath the Mesozoic formations of the Surat Basin. It seems possible, however, that the Bowen Basin, which extends southward through a trough beneath Meandarra and Toobeah, persists as far south as Moree where it is probably about 16 miles wide.

5. CONCLUSIONS

The following summarises the results of the survey in terms of the aims set out in Section 2 :

(a) Results of the north-south traverse north of Dolgelly Bore indicate that the trough of sediments recorded beneath Toobeah continues southward,

(b) The east-west traverse about latitude 29°05'S showed that there is a trough of sediments with a depth of at least 7500 ft beneath the traverse. A faulted structure with a relief of about 500 ft was indicated in the middle of the trough. The western margin of the trough was not crossed by the reflection traverse. The eastern margin of the trough is probably an overthrust fault,

(c) A trough exists between Moree and Pallamallawa, which probably contains 11,000 ft of Mesozoic and Palaeozoic sediments. The western margin of the Moree Trough is probably just west of Moree, with a shelf area farther west on which 5500 ft of sediments have been deposited. It is bounded in the east by the Pallamallawa Ridge, which separates it from the Biniguy Trough. The latter probably contains less than 7000 ft of unmetamorphosed sediments, and probably no unmetamorphosed Palaeozoic sediments. The Moree Trough may represent the extension of Bowen Basin sedimentation of this area,

(d) Reflection quality was very poor in the Bellata area and it is not possible to estimate the depth of sediments. Little information was obtained on the structure of the sediments underlying the east-west traverse through Bellata. The two short additions on the eastern end of Traverse U showed that reflections could be recorded from the high-velocity metamorphosed sediments, but little information was obtained on the subsurface structure of the sediments or the Hunter-Bowen Thrust zone,

(e) The results of the survey were not conclusive in finding whether the Bowen Basin joins the Sydney Basin. It seems likely, however, that the Bowen Basin extends as far south as Moree. Before any future exploration programme is planned in the area, a more comprehensive assessment of the geophysical results, including the results of subsidised geophysical surveys in the Goondiwindi (Union Oil, 1936b) and Narrabri-Coonamble (Amoseas, 1962) areas, should be made.

6. REFERENCES

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* Report on Commonwealth-subsidised operation.

APPENDIX A

STAFF AND EQUIPMENT

STAFF

Party leader	:	E.R. Smith (to April 1962) K.B. Lodwick
Geophysicist	:	A.L. Bigg-Wither
Surveyors	:	W. Lamond)Dept of the P. Pullinen (asst surveyor)Interior
Clerk	:	W.E. Rossendell
Observer	:	R. Krege
Shooter	:	J. Ryman
Toolpusher	:	B.G. Findlay
Drillers	:	R. Larter A. Zoska
Drill Assistants	:	C.R. Greenway N.S. Armstrong
Mechanics	:	T.V. Buckley B.C. Gunn

EQUIPMENT

Seismic amplifiers	:	TIC 8000 Explorer
Seismic oscillograph	:	SIE TR06
Magnetic recorder	:	Electro-Tech DS7/7
Geophones	:	Electro-Tech EVS-2 (Reflection) TIC 6 c/s (Refraction)
Drills	:	Failing 750 (rotary) Carey H1 (Auger, air and fluid) Mayhew 1000 (with air compressor) (for last four weeks of survey only)
Water tankers	:	2 International 4 x 4, 600 gal. 1 Bedford 4 x 4, 600 gal. 1 Bedford 4 x 4, 1000 gal (last four weeks of survey)
Shooting truck	:	Bedford 4 x 4, 3 ton

APPENDIX B

TABLE OF OPERATIONS

Sedimentary basin	Southern Surat Basin, part of the Great Artesian Basin.
Area	Moree, NSW
Camp site	9 miles south-east of Moree.
Established camp	2nd April 1962.
Survey commenced	2nd April 1962.
Drilling commenced	4th April 1962.
Shooting commenced	6th April 1962.
Miles surveyed	102½
Topographic level control	Moree Railway Station
Total footage drilled	29,962
Explosives used	14,000 lb
Datum level for corrections	600 feet above M.S.L., Traverses P, R, T, & W. 800 feet above M.S.L., Traverse T, Shot-points 2842 to 2848. 900 feet above M.S.L., Traverse V
Weathering velocities	1800-2500 ft/sec
Sub-weathering velocities	6000-14,000 ft/sec
Weathering corrections	Uphole method and also after Vale (1960)
Source of velocity distribution	From t: Δt analysis, Goondiwindi area (Lodwick and Bigg-Wither, 1962)

Reflection shooting data

Shot-point intervals	1320 ft, Traverses P, R, S, T, & U. 1800 ft, Traverse J & V.
Geophone group	6 per trace in the line of the traverse, 22 ft apart; 12 per trace in line of traverse, 20 ft apart; 12 per trace in line of traverse, 10 ft apart.
Geophone group interval	110 ft for 1320-ft spread 150 ft for 1800-ft spread
Holes shot	223
Miles traversed	57¾
Common shooting depth	20 ft for pattern holes (3 in line, 40 ft apart; 3 in line, 80 ft apart; 5 in line, 30 ft apart) and 120 ft for single holes.
Usual recording filters	K22-125
Usual playback filters	M22-55
Common charge size	20 lb for single hole, 30 lb for pattern holes.
Instrumental difficulties	On some tapes timing errors are evident owing to the tape stopping momentarily on record and also when the tape had not reached full speed before the time break was recorded

Refraction shooting data

Geophone group	2 close together
Geophone group interval	220 ft, Traverse S 300 ft, Traverses S, V, & W
Holes shot	30
Usual recording filter	No low cut - 55 high cut
Number of refraction traverses	3

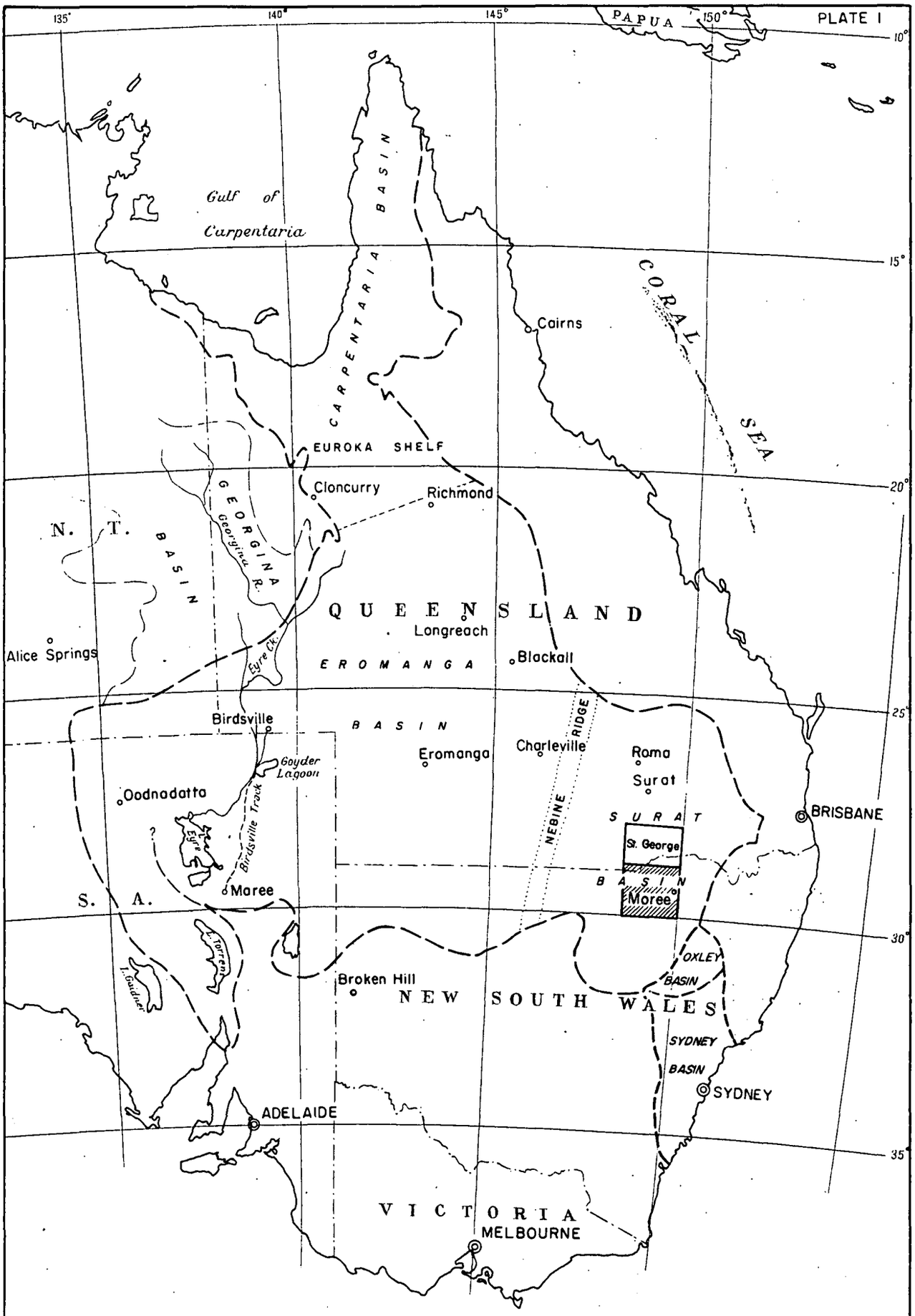
Charge size	50 to 600 lb
Maximum shot-geophone distance	$10\frac{3}{4}$ miles
Weathering and elevation corrections	After Vale and Smith (1961)
Weathering control	From reflection work
Presentation of results	After Vale and Smith (1961)

APPENDIX C

SEISMIC SHOT-HOLE DRILLING STATISTICS

	Carey	Failing 750	Mayhew
Total footage drilled	18,574	8370	3457
Number of holes drilled	342	169	33
Average depth of holes (ft)	57.5	105	54.2
Deepest hole drilled (ft)	157	200	180
Travelling time and rigging up (hr)	183	154¾	57
Time lost waiting on water (hr)	0	8½	0
Time lost, repairs to drill - ? (hr)	23	62½	0?
Time lost because of rain	-	-	-
Time lost, repairs to rig engine	-	-	-
Time lost waiting on surveyors	-	-	-
Time lost, public holidays - ?	-	-	-
Drilling time (hr)	396	194	40
Number of shifts worked	71	49	20
Maintenance to drill (hr)	65	43	13½
Bentonite used (bags)	48	31	-
Fishing job (hr)	4¼	3	-
Drilling rate (ft/hr)	47.3	39	86
Barytes used (bags)	-	14	-

PLATE I



MOREE SEISMIC SURVEY 1962

LOCALITY MAP

LEGEND

Boundary of sedimentary basin

Reference to Australia 1:250,000 map series: St.George and Moree

SCALE IN MILES

100 0 100 200 300

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics. H55/B 3 - 16

TO ACCOMPANY RECORD No. 1964/109

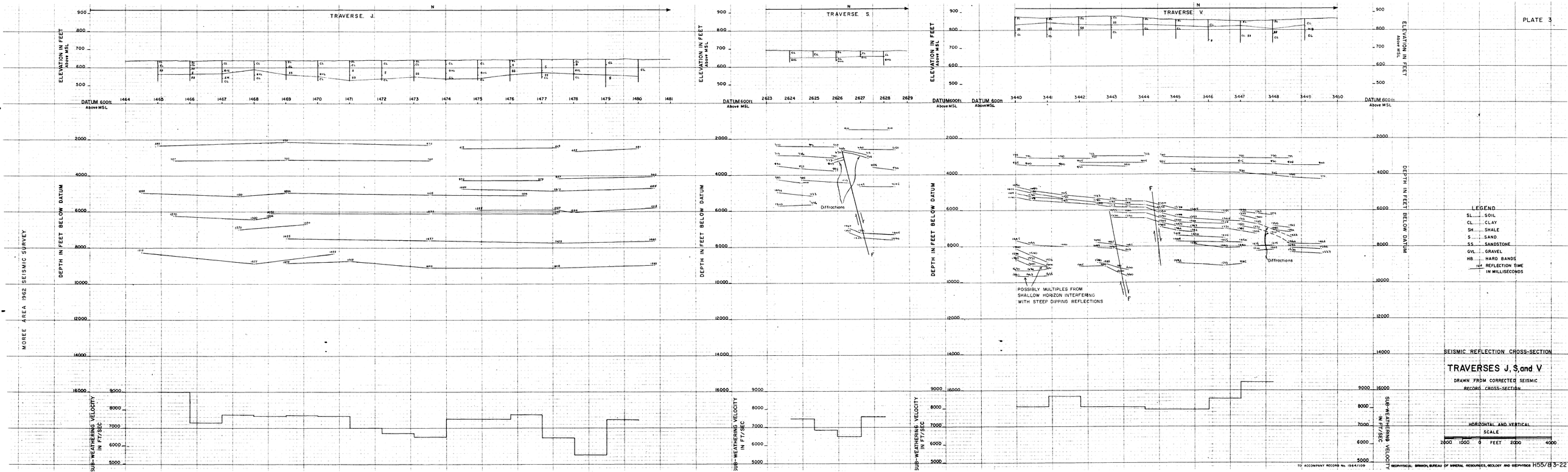
PLATE 2

MOREE AREA N. S. W.
SEISMIC SURVEY
1962.
LAYOUT OF TRAVERSES

SCALE IN MILES 4 0 4 8 12 16

TO ACCOMPANY RECORD No 1964 - 109

Geophysical Branch, Bureau of Mineral Resources Geology and Geophysics H55/B 3 - 19


MOREE AREA 1962 SEISMIC SURVEY
TRAVERSE J
TRAVERSE S
TRAVERSE V
N
ELEVATION IN FEET Above MSL
DATUM 600ft Above MSL
DEPTH IN FEET BELOW DATUM
SUB-WEATHERING VELOCITY IN FT/SEC
Diffractions
POSSIBLY MULTIPLES FROM SHALLOW HORIZON INTERFERING WITH STEEP DIPPING REFLECTIONS
LEGEND
SL.... SOIL
CL.... CLAY
SH.... SHALE
S.... SAND
SS.... SANDSTONE
GVL.... GRAVEL
HB.... HARD BANDS
REFLECTION TIME IN MILLISECONDS
PLATE 3
SEISMIC REFLECTION CROSS-SECTION
TRAVERSES J, S, and V
DRAWN FROM CORRECTED SEISMIC RECORD CROSS-SECTION
HORIZONTAL AND VERTICAL SCALE
2000 1000 0 FEET 2000 4000
TO ACCOMPANY RECORD No. 1964/109
GEOPHYSICAL BRANCH, BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS H55/B3-22

MOREE AREA 1962 SEISMIC SURVEY

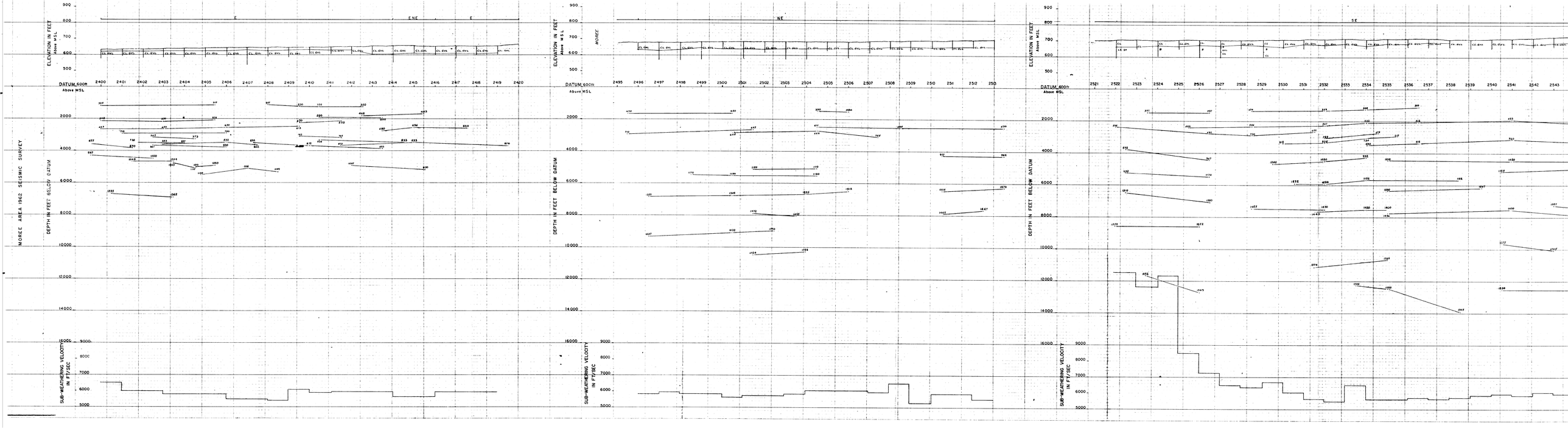
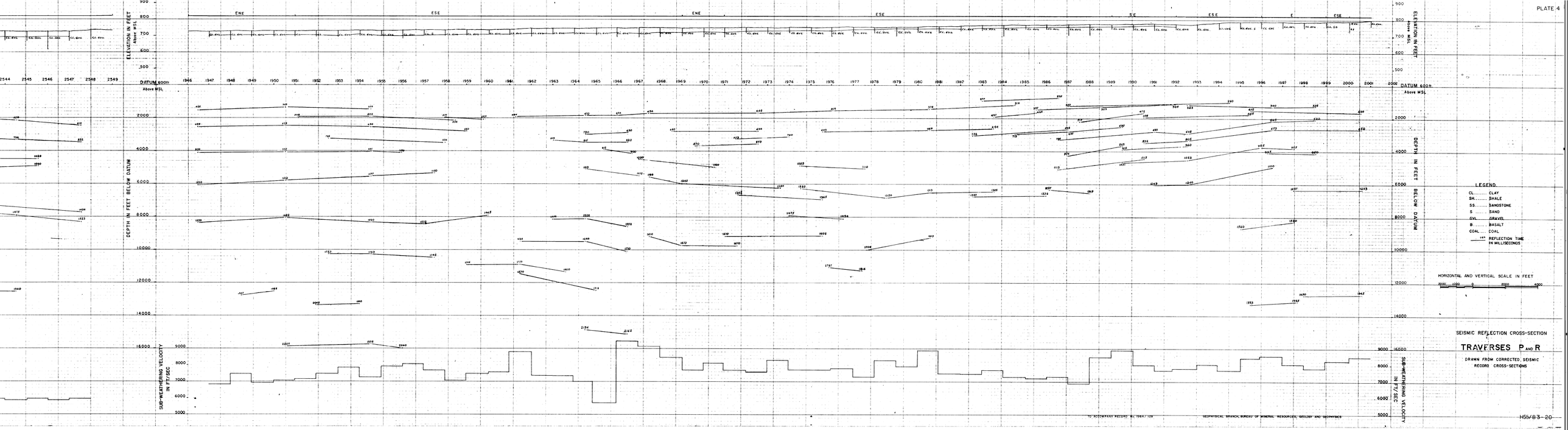


PLATE 4



SEISMIC REFLECTION CROSS-SECTION

TRAVERSES P AND R

DRAWN FROM CORRECTED SEISMIC RECORD CROSS-SECTIONS

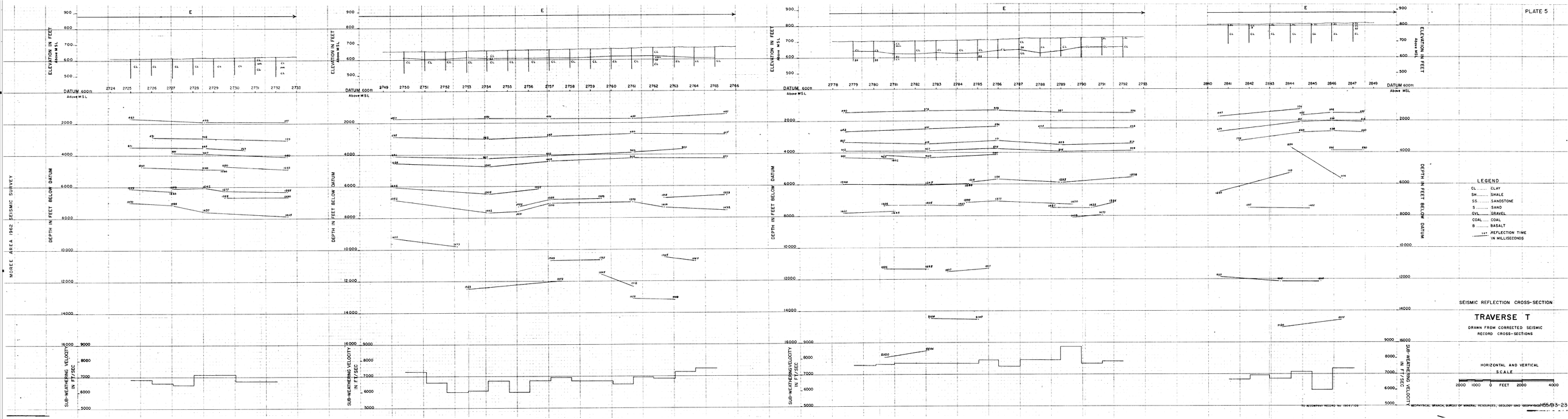
TO ACCOMPANY RECORD NO. 1964/109

GEOPHYSICAL BRANCH, BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

H56783-20

PLATE 5

MOREE AREA 1962 SEISMIC SURVEY



LEGEND

CL ..... CLAY
SH ..... SHALE
SS ..... SANDSTONE
S ..... SAND
GVL ..... GRAVEL
COAL ..... COAL
B ..... BASALT
1617 ..... REFLECTION TIME IN MILLISECONDS

SEISMIC REFLECTION CROSS-SECTION

TRAVERSE T

DRAWN FROM CORRECTED SEISMIC RECORD CROSS-SECTIONS

HORIZONTAL AND VERTICAL SCALE

2000 1000 0 FEET 2000 4000

TO ACCOMPANY RECORD No. 1964/129

GEOPHYSICAL BRANCH, BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

1964-23

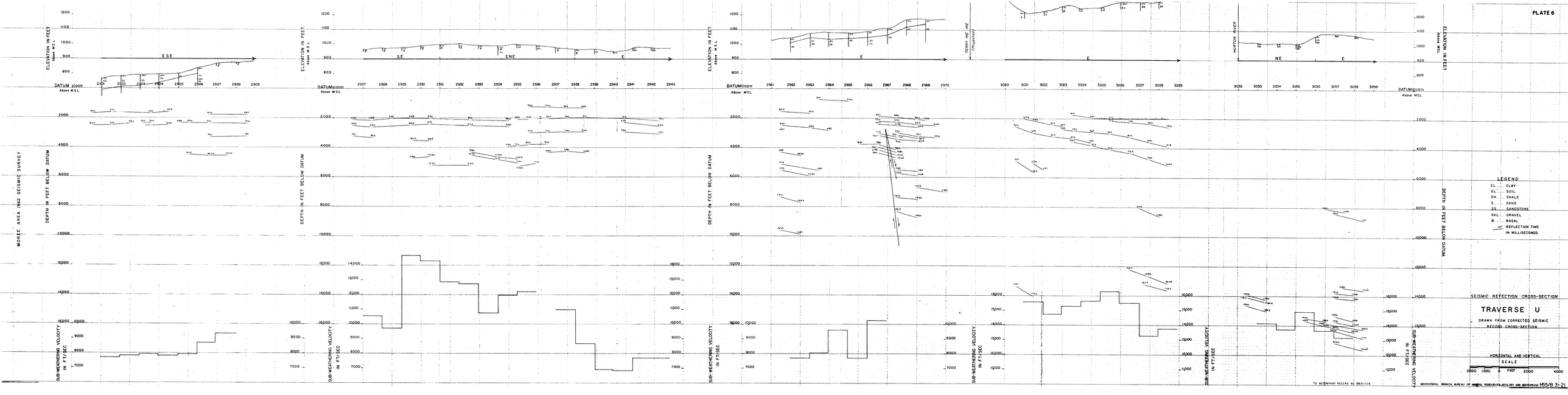


PLATE 6
MOREE AREA 1962 SEISMIC SURVEY
ELEVATION IN FEET Above M.S.L.
DEPTH IN FEET BELOW DATUM
SUB-WEATHERING VELOCITY IN FT/SEC
DATUM 1000ft Above M.S.L.
ESE
SE
ENE
E
NE
TERRY HIE (Projected)
MORTON RIVER
LEGEND
CL ... CLAY
SL ... SOIL
SH ... SHALE
S ... SAND
SS ... SANDSTONE
GVL ... GRAVEL
B ... BASAL
.147 REFLECTION TIME IN MILLISECONDS
SEISMIC REFLECTION CROSS-SECTION
TRAVERSE U
DRAWN FROM CORRECTED SEISMIC RECORD CROSS-SECTION
HORIZONTAL AND VERTICAL SCALE
2000 1000 0 FEET 2000 4000
TO ACCOMPANY RECORD No. 1964/109
GEOPHYSICAL BRANCH, BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS H55/B 3-21

PLATE 7

BRITISH MADE "ALLIANCE"

SP 2666 R

	24	23	22	21	20	19	18	17	16	15	14	13	2619B	12	11	10	9	8	7	6	5	4	3	2	1
t_o	4958	4943	4932	4910	4900	4880	4870	4860	4845	4831	4818	4808		4789	4778	4769	4752	4724	4724	4710	4694	4676	4662	4638	4630
W_t+E_t	-23	-23	-23	-23	-23	-23	-23	-23	-23	-23	-23	-23		-23	-23	-23	-23	-23	-23	-23	-23	-23	-23	-23	-23
t_c	4935	4920	4909	4887	4877	4857	4847	4837	4822	4808	4795	4785		4766	4755	4746	4729	4701	4701	4687	4671	4653	4639	4615	4607

Geophone spacing 300 feet

SP 2586

	24	23	22	21	20	19	18	17	16	15	14	13	2628	12	11	10	9	8	7	6	5	4	3	2	1
t_o	4136	4145	—	4191	—	4215	4233	4244	4259	4288	4299	4319		4350	4367	4386	4395	4412	4418	4435	4453	4476	4491	4506	4526
W_t+E_t	-32	-32	-32	-31	-30	-30	-30	-29	-29	-28	-28	-27	-27	-27	-27	-28	-28	-28	-28	-28	-28	-28	-28	-28	-28
t_c	4108	4117	—	4163	—	4186	4205	4216	4231	4254	4272	4291		4322	4339	4358	4367	4384	4390	4407	4425	4448	4463	4478	4498

Geophone spacing 300 feet

SP 2643

	24	23	22	21	20	19	18	17	16	15	14	13	2624	12	11	10	9	8	7	6	5	4	3	2	1
t_o	2576	2559	2549	2536	2521	2510	2495	2485	2457	2457	2441	—		2406	2392	2377	—	2333	2306	2294	2272	2258	2242	2229	2216
W_t+E_t	-24	-24	-24	-24	-24	-24	-24	-24	-24	-24	-24	-24		-24	-24	-24	-24	-24	-24	-24	-24	-24	-24	-24	-24
t_c	2552	2535	2525	2512	2497	2486	2471	2460	2433	2433	2417	—		2382	2368	2353	—	2309	2282	2270	2248	2234	2218	2205	2192

SP 2610

	24	23	22	21	20	19	18	17	16	15	14	13	2628	12	11	10	9	8	7	6	5	4	3	2	1
t_o	2108	2120	2135	2153	2162	2190	2210	2220	2236	2251	2266	2279		2300	2346	2356	2379	2385	2395	—	2417	2431	2441	2457	2472
W_t+E_t	-36	-35	-35	-35	-34	-34	-34	-33	-33	-33	-33	-32	-32	-32	-32	-32	-32	-32	-32	-32	-32	-32	-32	-32	-32
t_c	2072	2085	2100	2118	2127	2156	2176	2186	2203	2218	2233	2247		2268	2314	2324	2338	2353	2363	—	2385	2399	2409	2425	2440

SP 2638

	24	23	22	21	20	19	18	17	16	15	14	13	2624	12	11	10	9	8	7	6	5	4	3	2	1
t_o	2257	2228				2138	2122	2108	2088	2068	2056	2026		1988	1972	1948	1921	1897	1878	1857	1831	1815	1796	1780	1766
W_t+E_t	-32	-32	-32	-32	-32	-32	-32	-32	-32	-32	-32	-32		-32	-32	-32	-32	-32	-32	-32	-32	-32	-32	-32	-32
t_c	2225	2196	2173	2151	2128	2106	2090	2076	2056	2036	2024	1994		1956	1941	1916	1889	1865	1846	1825	1799	1783	1764	1748	1734

SP 2617

	24	23	22	21	20	19	18	17	16	15	14	13	2627	12	11	10	9	8	7	6	5	4	3	2	1
t_o	1220	1240	1256	1277	1296	1320	1341	1362	1390	1404	1428	1452		1487	1511	1526	1547	1562	1586	1604	1627	1651	1674	1694	1714
W_t+E_t	-35	-35	-35	-34	-34	-34	-34	-33	-33	-32	-32	-31	-31	-31	-31	-30	-30	-30	-30	-30	-30	-30	-30	-30	-30
t_c	1185	1205	1221	1243	1262	1286	1307	1329	1347	1372	1395	1421		1456	1480	1496	1517	1532	1556	1574	1597	1621	1644	1664	1684

TIME IN MILLISECONDS

DEPTH IN FEET

Datum 600 ft above MSL

V= 20720 · SP 2666 R · V= 18630 · SP 2586 · V= 14570 · V= 10790 · SP 2643 · V= 14090 · SP 2610 · V= 10960 · SP 2638 · SP 2617

2586 2590 2595 2600 2605 2610 2619D 2619B 2620 2626A 2630 2628B 2635 2638 2640 2643 2645 2650 2655 2660 2665 2666

Δt dip element in refractor = 10,660 ft/sec

Δt dip element in refractor = 14,300 ft/sec

Δt dip element in refractor = 20,400 ft/sec

Vo= 8200
V= 10,660

Vo= 8620
V = 14,300

Vo= 11570
V= 20400

SCALES

HORIZONTAL 2200 0 2200 4400 6600 FEET

(Vertical scales as shown)

MOREE AREA, N S W 1962

SEISMIC REFRACTION RESULTS

TRAVERSE S

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

TO ACCOMPANY RECORD No. 1964/109

BRITISH MARK "ALLIANCE"

BRITISH MARK "ALLIANCE"

SP 3474

	24	23	22	21	20	19	18	17	16	15	14	13		12	11	10	9	8	7	6	5	4	3	2	1
t_o	4328	4310	4293	4276	4259	4245	4229	4216	4198	4179	4166	4153	SP 3443	4119	4100		4069	4050	4033	4017	3995	3978	3961	3946	3929
v_o-t_o	+ 16	+ 15	+ 14	+ 13	+ 12	+ 11	+ 10	+ 9	+ 8	+ 7	+ 7	+ 6	-	-	+ 7	+ 8	+ 9	+ 10	+ 11	+ 11	+ 12	+ 12	+ 13	+ 14	+ 15	+ 15
t_c	4344	4325	4307	4289	4271	4256	4239	4225	4207	4187	4173	4159	-	-	4126	4108		4079	4061	4044	4029	4007	3991	3975	3961	3944

SP 3419

	24	23	22	21	20	19	18	17	16	15	14	13		12	11	10	9	8	7	6	5	4	3	2	1
t_o	3723	3734	3748		3779	3793	3811	3827	3843	3862	3878	3895	SP 3448	3919	3944	3962	3981	3995	4123	4128	4142	4058	4077	4091	4112
v_o-t_o	+ 25	+ 26	+ 26	+ 27	+ 28	+ 29	+ 29	+ 29	+ 29	+ 30	+ 30	+ 30			+ 29	+ 28	+ 27	+ 26	+ 25	+ 24	+ 24	+ 24	+ 24	+ 24	+ 24	+ 24
t_c	3748	3760	3774		3807	3822	3840	3856	3872	3892	3908	3925		3948	3972	3989	4007	4020	4047	4052	4066	4082	4101	4115	4136

SP 3453

	24	23	22	21	20	19	18	17	16	15	14	13		12	11	10	9	8	7	6	5	4	3	2	1
t_o			1882	1857	1835	1815	1794	1765	1745	1721	1696	1671	SP 3444	1624	1597	1574	1551	1524	1502	1478	1454	1432	1404	1378	1354
v_o-t_o+1		0	0	+ 1	+ 1	+ 2	+ 2	+ 2	+ 1	0	+ 1	+ 1		+ 2	+ 3	+ 3	+ 4	+ 5	+ 6	+ 6	+ 6	+ 5	+ 5	+ 4	+ 4
t_c			1882	1858	1836	1817	1796	1767	1746	1721	1696	1672		1626	1600	1580	1555	1529	1508	1484	1460	1437	1409	1382	1358

SP 3437

	24	23	22	21	20	19	18	17	16	15	14	13		12	11	10	9	8	7	6	5	4	3	2	1
t_o	1354	1379	1400	1419	1445	1470	1494	1520	1544	1570	1593	1614	SP 3446	1660	1681	1710	1730	1753	1778	1801	1821	1844	1869	1889	1908
v_o-t_o	+ 8	+ 9	+ 10	+ 11	+ 11	+ 12	+ 12	+ 12	+ 11	+ 11	+ 11	+ 10			+ 11	+ 12	+ 13	+ 14	+ 15	+ 15	+ 15	+ 15	+ 16	+ 16	+ 16
t_c	1362	1388	1410	1430	1456	1482	1506	1532	1555	1581	1604	1624		1671	1693	1723	1744	1763	1793	1816	1836	1859	1885	1905	1924

SP 3414 V=11800 SP 3419 V=11400 SP 3450 V=11050 SP 3444 V=10950 SP 3448 V=11400 SP 3437 V=12470 SP 3453 V=10610 V=11040 SP 3440 V=11200

TIME IN MILLISECONDS

MOREE AREA 1962 SEISMIC SURVEY

3419 3430 3434 3437 3440 3442 3444 3446 3448 3450 3453 3456 3459 3475

MILLISECONDS

Δt dip element in refractor = 12,650 ft/sec

Δt dip element in refractor = 18,280 ft/sec

SEISMIC REFRACTION RESULTS

TRAVERSE V

SCALES

HORIZONTAL 3000 0 3000 6000 FEET

(Vertical scales as shown)

DATUM 900 ft Above MSL

DEPTH IN FEET

Vo = 8350 V = 12,650

Vo = 9750 V = 18,280

TO ACCOMPANY RECORD No. 1964/109

Geophysical Branch, Bureau of Mineral Resources Geology and Geophysics H55/B3-2

PLATE 9

BRITISH MADE "ALLIANCE"

BRITISH MADE "ALLIANCE"

SP 3569

	24	23	22	21	20	19	18	17	16	15	14	13	3544	12	11	10	9	8	7	6	5	4	3	2	1
to	3850	3829	3820	3800	3781	3763	3742	3709	3687	3669	3648	3632		3596	3581	3563	3547	3529	3509	3491	3472	3452	2439	3421	3406
Wc+Ec	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5	-5
tc	3845	3824	3815	3795	3776	3758	3737	3704	3682	3664	3643	3627		3591	3576	3558	3542	3524	3504	3486	3467	3447	3434	3416	3401

SP 3528

	24	23	22	21	20	19	18	17	16	15	14	13	3548	12	11	10	9	8	7	6	5	4	3	2	1
to	2856	2868	2887	2901	2916	2931	2947	2960	2968	2986	3002	3022		3057	3074	3084	3102	3115	3130	3141	3164	3180	3199	3212	3222
Wc+Ec	-2	-2	-2	-2	-2	-2	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	+1	-1	-1	-1
tc	2854	2866	2885	2899	2914	2929	2946	2959	2967	2985	3001	3021		3056	3073	3083	3101	3114	3129	3140	3163	3179	3198	3211	3221

SP 3537

	24	23	22	21	20	19	18	17	16	15	14	13	3548	12	11	10	9	8	7	6	5	4	3	2	1
to	1693	1720	1745	1769	1795	1821	1836	1857	1872	1901	1924	1948		1989	2013	2024	2052	2069	2089	2101	2128	2147	—	—	—
Wc+Ec	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
tc	1693	1720	1745	1769	1795	1821	1836	1857	1872	1901	1924	1948		1989	2013	2024	2052	2069	2089	2101	2128	2147	—	—	—

SP 3557

	24	23	22	21	20	19	18	17	16	15	14	13	3546	12	11	10	9	8	7	6	5	4	3	2	1
to	2249	2213	2196	2174	2149	—	2104	2076	2052	2024	1998	1970		1949	1926	1897	1866	1843	1815	1793	1765	1741	1714	1688	1660
Wc+Ec	-7	-7	-7	-7	-7	-7	-7	-7	-7	-7	-7	-7	-7	-7	-7	-7	-7	-7	-7	-7	-7	-7	-7	-7	-7
tc	2242	2206	2189	2167	2142	2120	2097	2069	2045	2017	1991	1963		1942	1919	1892	1859	1836	1808	1786	1758	1734	1707	1681	1653

V = 15940

V = 19380

V = 12510

V = 14040

5506

4838

3246

3099

1103

535

966

368

TIME IN MILLISECONDS

3528 3537 3542 3544 3550 3557 3569

MILLISECONDS -40 -20 0 +20 +40

Δt dip element in refractor ≃ 13,225 ft/sec
Profiles do not match

Δt dip element in refractor = 17,470 ft/sec

DEPTH IN FEET

Datum 600 feet above MSL

Va = 9050
V = 17,470

MOREE AREA, NSW 1962

SEISMIC REFRACTION RESULTS

TRAVERSE W

SCALES

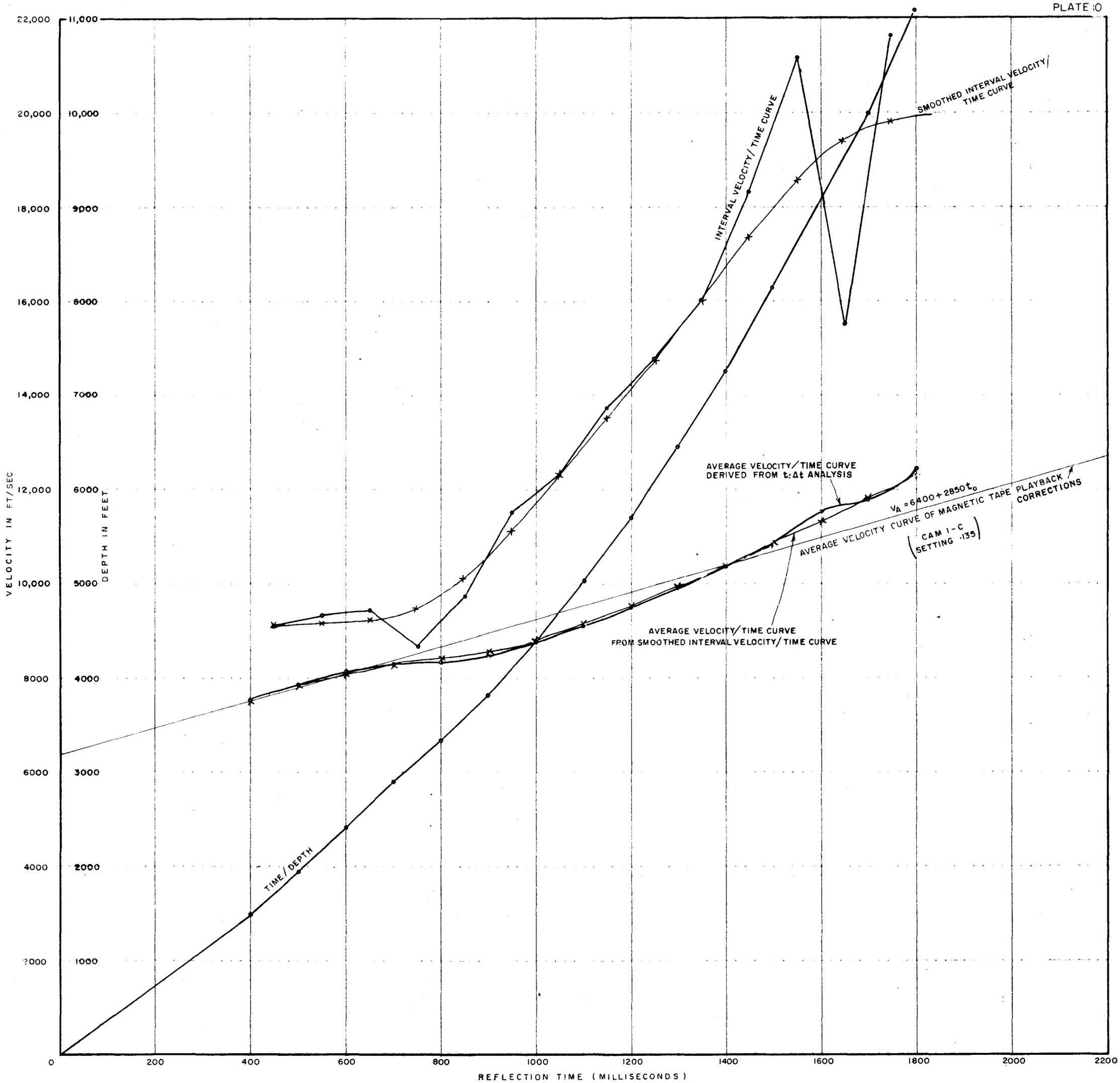
HORIZONTAL 3000 0 3000 6000 9000 FEET

(Vertical scales as shown)

To ACCOMPANY RECORD No. 1964/109

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics H55/B3-3

PLATE 10



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

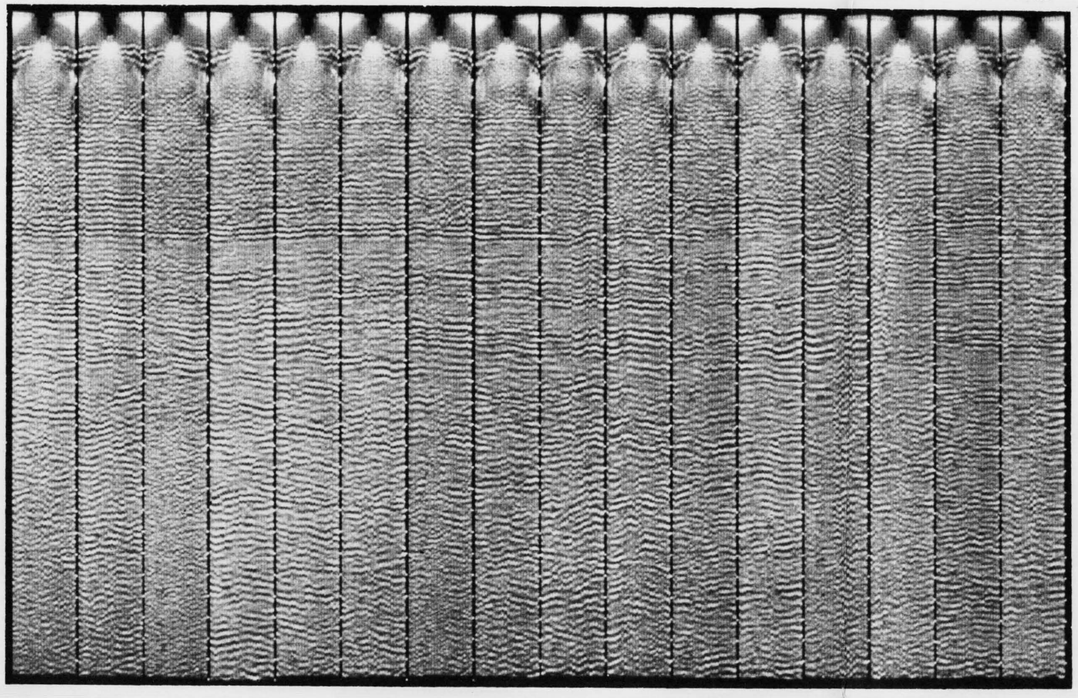
Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics G55/B3-21 - 1

TO ACCOMPANY RECORD No. 1964 / 109

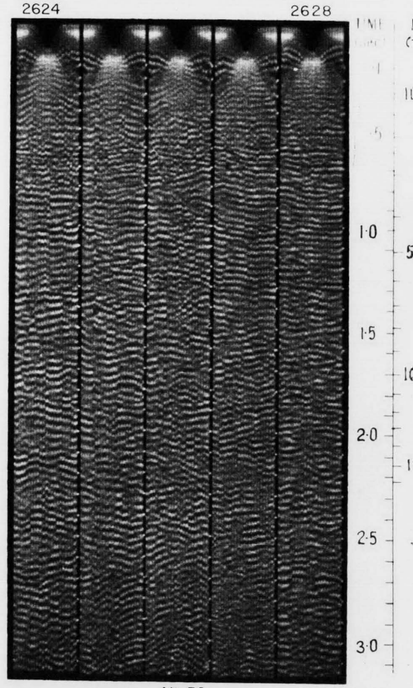
SURAT BASIN 1961

MORERE AREA, NSW, 1962

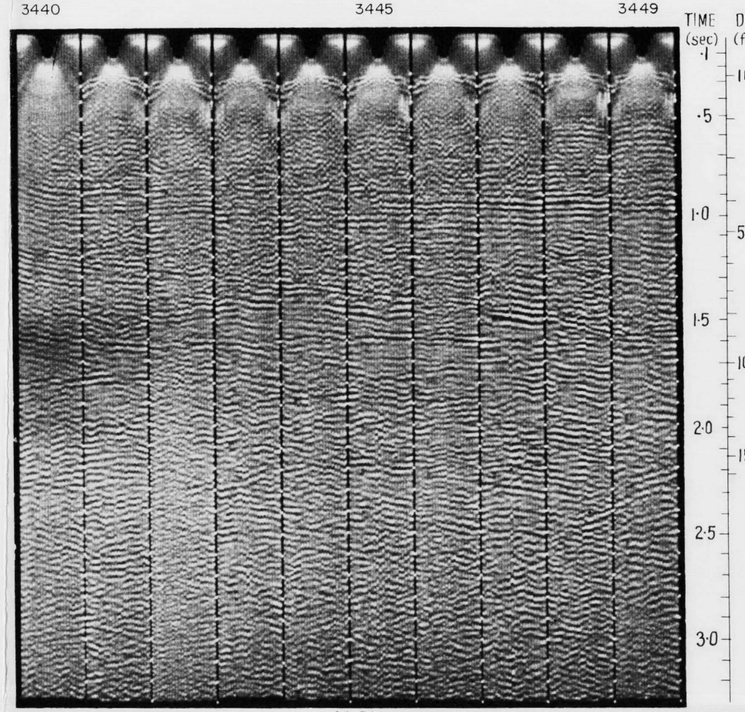
TRAVERSE J



TRAVERSE S



TRAVERSE V



VARIABLE-INTENSITY CROSS-SECTION

TRAVERSES J, S, AND V

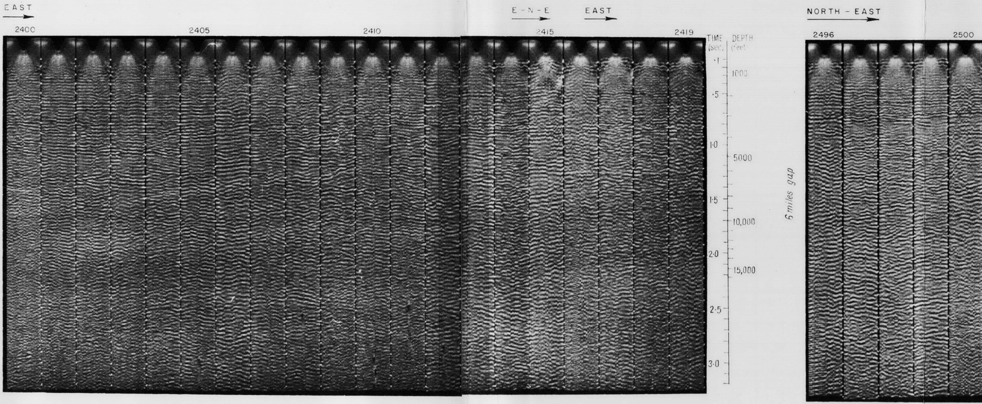
HORIZONTAL SCALE IN MILES

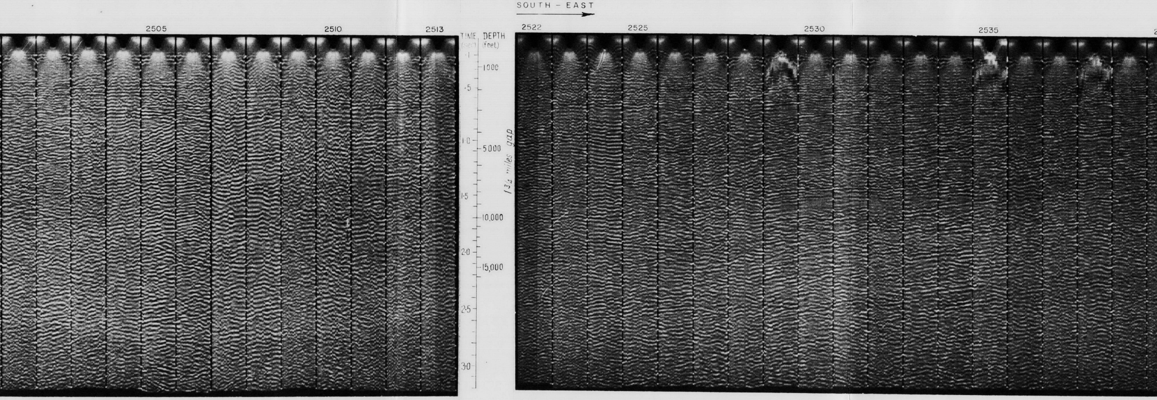
0 1/4 1/2 1 1 1/2 2

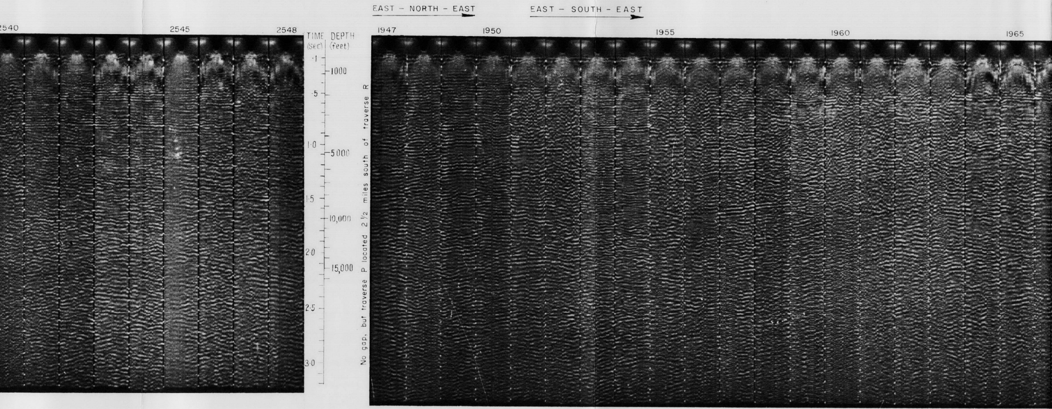
Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics H55/B 3-28

TO ACCOMPANY RECORD No. 1964/109

MOREE AREA, NSW, 1962

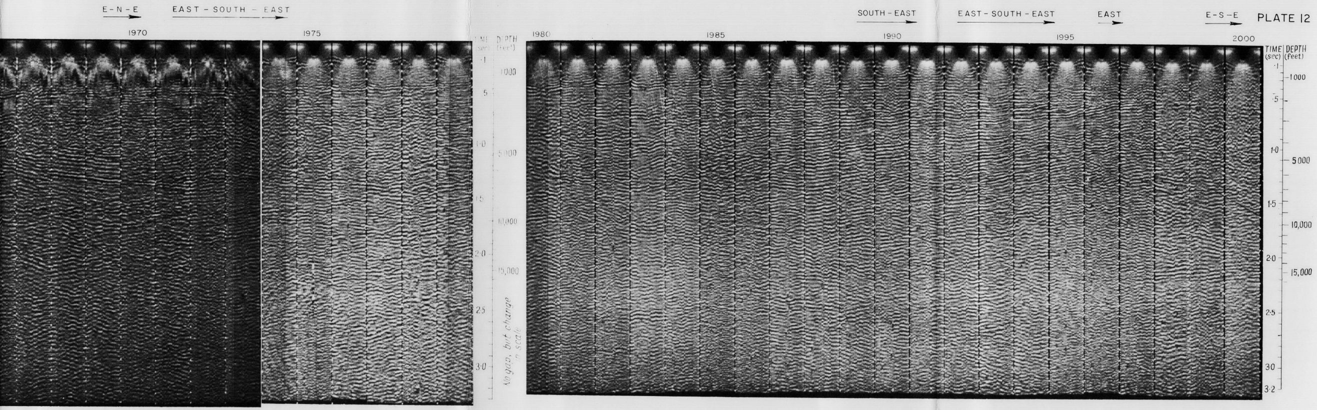






No gap, but traverse P located 2½ miles south of traverse R

PLATE 12



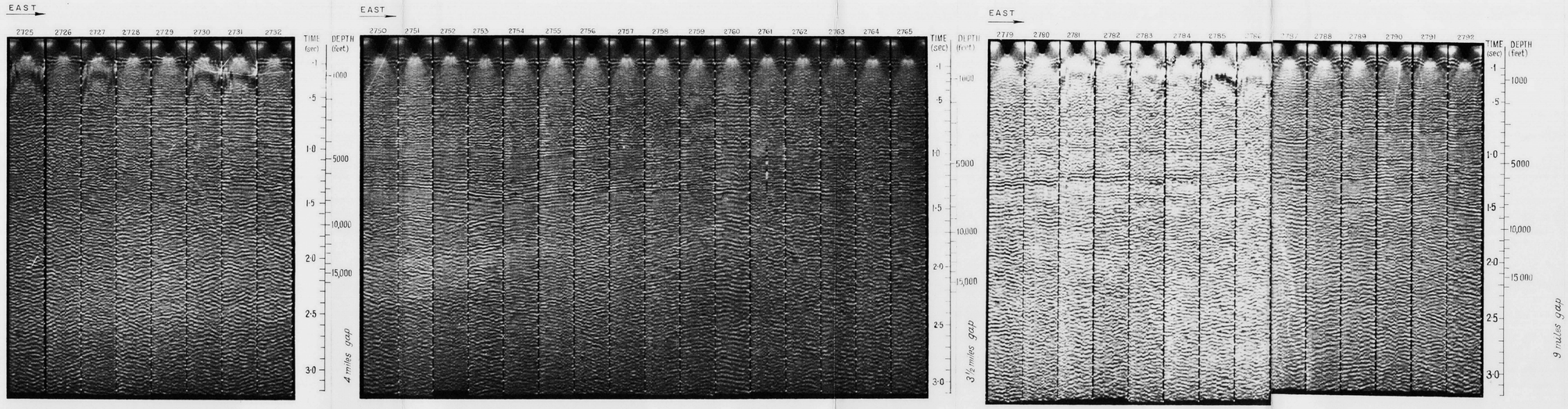
VARIABLE-INTENSITY CROSS-SECTION

TRAVERSES P AND R

HORIZONTAL SCALE IN MILES
0 1/4 1/2 1 1 1/2 2

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics. H55/B 3-27

TO ACCOMPANY RECORD No. 1964/109



VARIABLE-INTENSITY CROSS-SECTION

TRAVERSE T

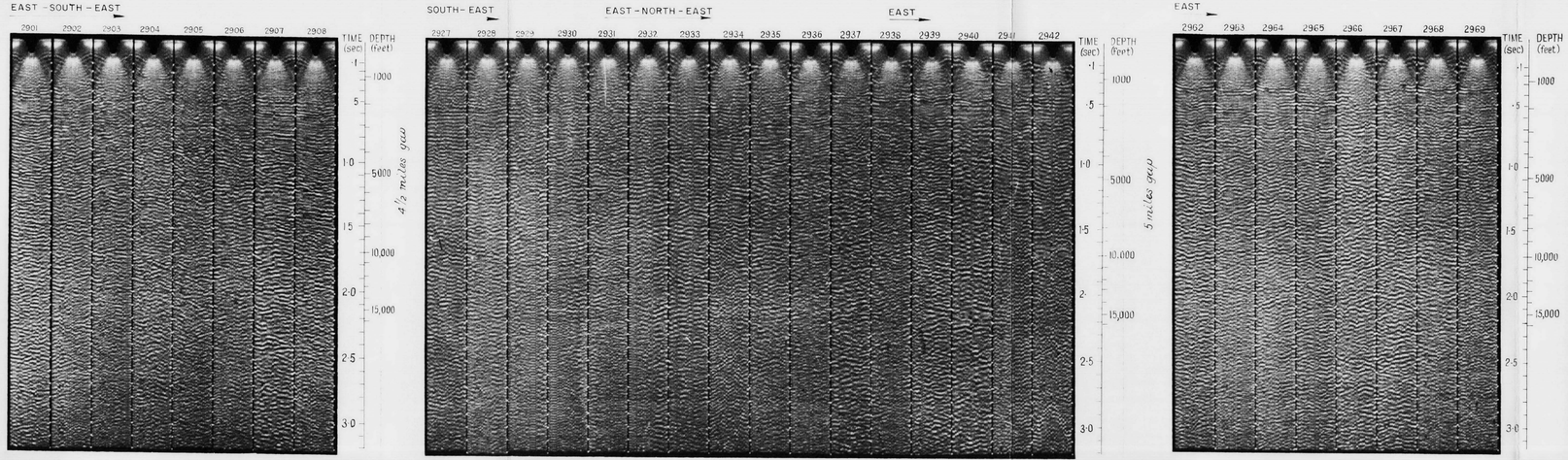
HORIZONTAL SCALE IN MILES

0 ¼ ½ 1 1½ 2

Geophysical Branch, Bureau o Mineral Resources, Geology and Geophysics. H55/B 3-26

TO ACCOMPANY RECORD No. 1964/109

MOREE AREA, N.S.W., 1962



VARIABLE - INTENSITY CROSS - SECTION

TRAVERSE U

HORIZONTAL SCALE IN MILES

0 ¼ ½ 1 1½ 2

Geophysical Branch, Bureau of Mineral Resources, Geology and Geophysics. H 55/B 3-25
TO ACCOMPANY RECORD No. 1964/109