COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

PETROLEUM SEARCH SUBSIDY ACTS

Publication No. 19

QUILPIE-THARGOMINDAH-CHARLEVILLE SEISMIC SURVEY, QUEENSLAND, 1959-1960

BY

PHILLIPS PETROLEUM COMPANY

AND

SUNRAY MID-CONTINENT OIL COMPANY

Issued under the Authority of Senator the Hon. W. H. Spooner,
Minister for National Development

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COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

Minister: SENATOR THE HON. W. H. SPOONER, M.M.

Secretary: H. G. RAGGATT, C.B.E.

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

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FOREWORD.

In 1959, the Commonwealth Government enacted the Petroleum Search Subsidy Act 1959, under which companies proposing to drill for new stratigraphic information or to carry out either geophysical or bore-hole surveys in search of petroleum could be subsidised for the cost of drilling or of survey operations approved by the Minister for National Development.

The Bureau of Mineral Resources, Geology and Geophysics is required, on behalf of the Department of National Development, to examine the applications, maintain surveillance of the operations and in due course publish the results.

A seismic survey was carried out under the Petroleum Search Subsidy Act 1959 in the Quilpie-Thargomindah-Charleville area of Queensland by Petty Geophysical Engineering Company for Phillips Petroleum Company and Sunray Mid-Continent Oil Company. This Publication deals with that survey and contains the information furnished by Phillips Petroleum Company and Sunray Mid-Continent Oil Company and edited in the Geophysical Branch of the Bureau of Mineral Resources. The final report was written jointly by Mr. C. D. Hier, Chief Geophysicist, Australian Operations, Phillips Petroleum Company and Mr. C. J. Spivey, Supervisor, Australian Operations, Petty Geophysical Engineering Company. The methods of carrying out the seismic survey and the results obtained are presented in detail.

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ILLUSTRATIONS. (Continued)

LOCATION MAP & GEOLOGIC SKETCH MAP

after F. W. Whitehouse

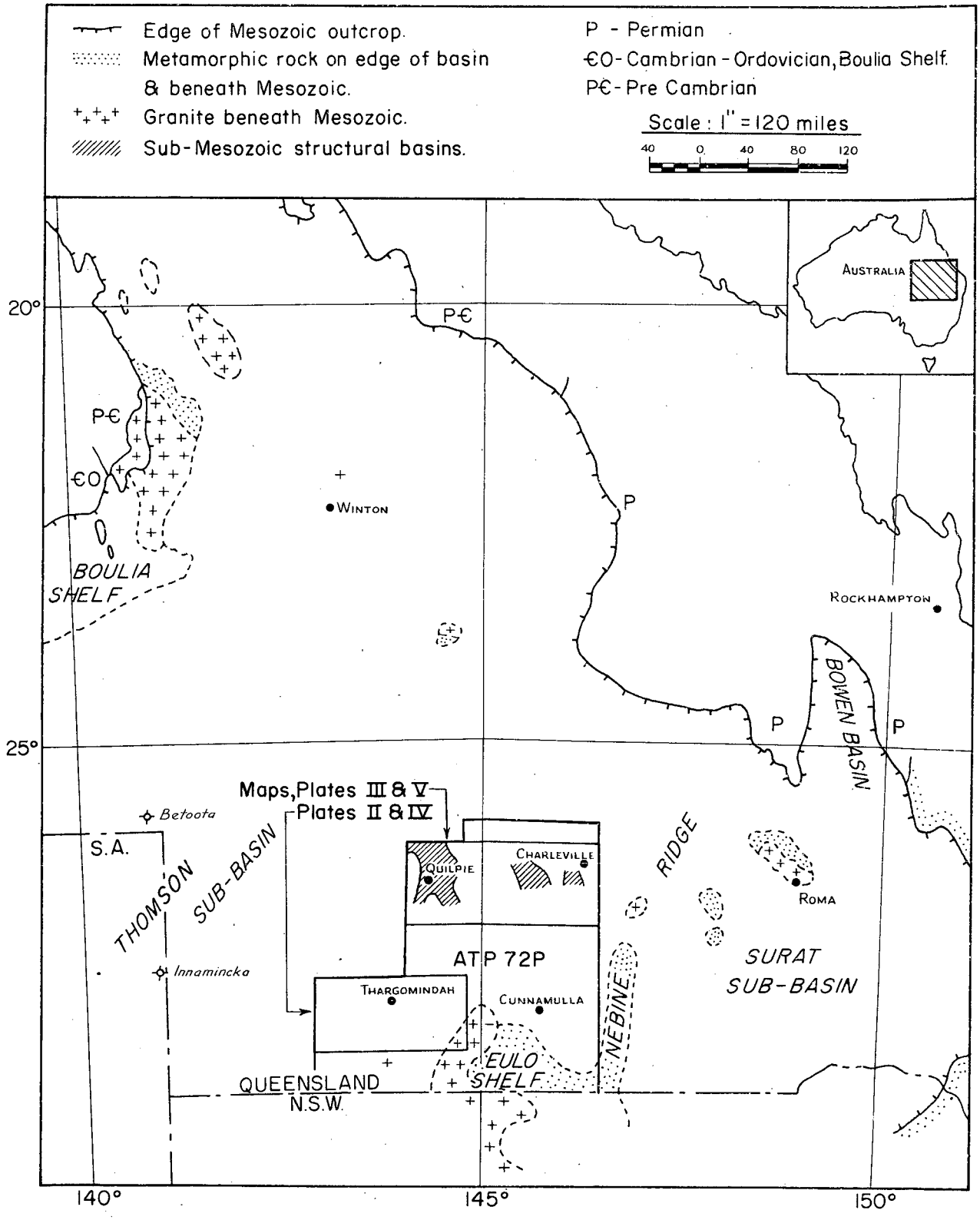


Plate I.

ABSTRACT.

A reconnaissance seismic survey, subsidised by the Commonwealth of Australia, was made for Phillips Petroleum Company of Bartlesville, Oklahoma, U.S.A. and Sunray Mid-Continent Oil Company of Tulsa, Oklahoma, U.S.A. by Petty Geophysical Engineering Company of San Antonio, Texas. This survey was located within Authority to Prospect 72P in the Quilpie-Thargomindah-Charleville area of South-western Queensland.

The purpose of the survey was to obtain information on the regional geology beneath the Mesozoic formations of the Great Artesian Basin north and west of the Eulo Shelf. Three deep structural basins beneath the sub-Mesozoic unconformity are indicated.

INTRODUCTION.

The seismic survey is located in Authority to Prospect (ATP) 72P in the Quilpie-Thargomindah-Charleville area of South-western Queensland, Australia.

The seismic work was done by Petty Geophysical Engineering Company of San Antonio, Texas with Mr. Oliver McClellan as Party Chief. Other key personnel included W. P. Le Croix, Party Manager; Ken Kallestad, Observer; Ross Smitherman, Surveyor; and Clarence Moore, Driller. Sixteen additional men completed the crew.

Topography varied from flat plains to rolling hills with brush and trees covering most of the area, but not sufficiently thick to require bulldozed trails for the reconnaissance survey.

Average elevation above sea-level was about 800 feet. Local relief rarely exceeded 100 feet.

There were three field crew headquarters in towns (Quilpie, Thargomindah, and Charleville) and two in camp sites (Cooladdi and 20 miles north of Quilpie). The average distance from field headquarters to the working area was about 20 miles and the average round trip driving time was about $1\frac{1}{2}$ hours.

The weather was generally clear and dry; however, the crew was unable to work on five days owing to rain.

The results of a previous seismic survey are also incorporated in this report. This earlier survey took about two weeks and was carried out near the town of Quilpie in June 1958 by Foreign Oil Exploration, Inc. for Oklahoma-Australian Oil Company.

GEOLOGY AND PURPOSE OF THE SURVEY.

The Quilpie-Thargomindah-Charleville area lies on the eastern flank of the Thomson Sub-Basin of the Great Artesian Basin. The known geologic framework of the Queensland portion of the Great Artesian Basin is indicated in Plate I, after Dr. F. W. Whitehouse (1954).

The surface geology is poorly exposed, the outcrop consisting almost entirely of a surficial lateritic zone developed on the Cretaceous Rolling Downs Group. The siliceous "duricrust" zone of the lateritic profile is well developed in this area and caps most of the interstream divides. The wide channels of the Bulloo, Paroo, and Warrego Rivers are floored with alluvial silt.

Deep water bores in the area indicate the presence of about 2500 feet maximum thickness of the Rolling Downs Group overlying a variable thickness of Blythesdale Group and subjacent Jurassic and Triassic sediments. Seismic data indicate a maximum thickness of about 5000 feet for the total Mesozoic in the area. The "Mesozoic" section may include Permian strata as well.

The nature of the rocks underlying the Mesozoic sedimentary basin is unknown over most of the area. Granite of Devonian(?) age is present in outcrop on the Eulo Shelf, and has been penetrated at shallow depth in water bores in the same area. Slate and other metamorphic rocks of unknown age are present in deep bores along the Nebine Ridge, which separates the Thomson and Surat Sub-basins.

Appreciable dips have been observed on the "duricrust" surface. For the most part the apparent gentle surface "structure" has no relation to structure mapped at shallow depth seismically, and appears to represent an undulating ancient surface of erosion. Locally, however, dip in excess of 15 degrees is present where the "duricrust" surface appears to dip beneath adjacent alluvial plains. One such structure at Mt. Constance was investigated with a short seismic traverse (see Cross-section, Plate XII). No major surface anticlines such as those mapped to the west by Santos geologists (Sprigg, 1958) are present in the Quilpie-Thargomindah-Charleville area.

The purpose of the survey described in this report was to investigate a thick section of stratified rock unconformably underlying the Mesozoic. This thick section had been demonstrated earlier in a short traverse shot through Quilpie in 1958 by Foreign Oil Exploration, Inc. It was also intended to investigate other possible areas of thick section north and west of the Eulo Shelf, with a view to delineating potential "basins" of thick strata for localising detailed seismic work, and, eventually, determining a favourable location for a well to evaluate the petroleum possibilities of the area.

FIELD PROCEDURES.

Equipment.

Vehicles (all International) used for the survey included two 6 x 6 RF-190 trucks mounted with Mayhew-1000 air-water drills, two 6 x 6 RF-190 trucks mounted with 1500-gallon water-tanks, a 4 x 4 R-194 shooting truck mounted with 1000-gallon water-tank, a 4 x 4 B-120 recording truck, a ten-passenger personnel carrier, and two pick-up trucks.

Recording equipment included a 24-channel SIE MS-15A magnetic recorder, an SIE DL-8 dual demodulator for making field play-backs, and Hall-Sears HS-1 geophones.

Shooting Techniques.

Most of the shooting was done with split-spread continuous profiling. Shot-points were spaced at intervals of 1740 feet along the line and geophone stations were 145 feet apart. From 4 to 32 geophones per station were used spaced 30 feet apart. Multiple geophone patterns used were as follows:

No. of geophones	Pattern
4 to 8	In line
16	"X"
32	Parallelogram

A 20-90 filter setting was used as standard procedure on the magnetic tapes and also on the play-backs. However, various other filter settings were tried for experimental and comparison purposes.

Owing to variation of surface conditions in the area, optimum shot-hole depths ranged from 60 to 150 feet and charge of explosive from 2 to 30 pounds.

In some localities where it appeared that no pre-Mesozoic sediments are present, shot-holes were spaced 2 miles apart and reflections were correlated.

Experiments in recording were made using various shot-depths to 295 feet, shot-hole patterns of 2, 3, and 5 holes, multiple geophone patterns of 4, 8, 16, and 32 per trace in various layouts, and a noise analysis study.

Drilling.

Two Mayhew-1000 drills, equipped for air or water drilling and mounted on 6-wheel-drive International trucks, were used for shot-hole drilling. Two 1500-gallon water-tanks, mounted on 6-wheel-drive International trucks, were used for supplying water for drilling. Water was usually available from water wells, rivers, or creeks. Approximately 90% of the shot-holes were drilled with water and 10% with air.

Most of the drilling was in sand, clay, and shale; gravel and lignite were occasionally encountered. In some localities, drilling was difficult and rock bit consumption high owing to a very hard layer of "duricrust", sometimes as thick as 30 feet, on or near the ground surface. One particular shot-hole required 10 hours drilling time and 4 rock bits to penetrate this layer. During the survey one of the Mayhew drills was modified for air percussion drilling and was then able to penetrate 30 feet of duricrust in about one hour, thus saving a great deal of drilling time and many rock bits.

Surveying.

Horizontal and vertical control were obtained by alidade and plane table and, in a few cases, by transit. Bench marks, astronomical points, and landmarks such as fences, roads, creeks, trees, bores, etc. were tied in while making the survey. Vertical closures along traverse were accurate within 5 feet and horizontal closures were made with a minor amount of error. Magnetic declination in the area averaged about $7\frac{1}{2}$ degrees east of true north.

RESULTS OF THE SURVEY.

Presentation of Results.

The results of the seismic survey are presented with this Publication in the form of contour maps, plotted cross-sections, and record sections.

The following additional data have been filed with the Bureau of Mineral Resources, Geology and Geophysics, and are available for future reference:-

(i) Complete set of plotted cross sections;
(ii) Complete set of record sections.

Record Quality.

Record quality varied from good in the river flood plains to practically unusable in some of the "duricrust" areas. To ensure optimum record quality it was necessary to confine the traverse lines to flood plains and valleys as much as possible. This resulted in some crooked lines, but the sacrifice of straight lines appeared justified in these cases by the improved record quality.

Record quality was usually improved when multiple shot-holes and multiple geophones were used. However, this resulted in a loss of ground coverage, and, in many localities, the improvement in record quality did not appear to justify the use of multiple shot-holes, or multiple geophones in excess of eight per trace.

The data used in the sub-surface structure maps are considered generally reliable.

METHODS OF COMPUTATION.

Up-hole times were used for weathering corrections, and data were corrected for elevation differences to a datum of +600 feet using an elevation velocity of 7000 feet per second. A "t,Δt" analysis served to establish a velocity curve for the Mesozoic reflections conforming to the formula $V = 5700 + 5T$ where V equals average velocity in feet per second and T equals one-way time in milliseconds. The limited Δt information from pre-Mesozoic sediments was not considered sufficient to establish reliable velocities; however, it appears that these velocities are approximately 16,000 to 18,000 feet per second.

At reflection time of 1.200 seconds (one-way time of 0.600 second) the average velocity was calculated to be 8700 feet per second. This reflection time, in terms of depth, was near the pre-Mesozoic unconformity in the structurally lowest localities, and was chosen as the velocity for spacing of shot-points, i.e. 1740 feet between shot-points divided by 8700 feet per second equals 0.200 second. The cross-sections were thus constructed with one centimetre horizontally representing 0.050 second, and one centimetre vertically representing 0.050 second one-way time or 0.100 second two-way time.

Data were plotted in time on cross-sections and migrated by time resolution. By this method, shot-points are spaced on the sections with the horizontal scale nearly the same as the vertical scale. Time data plotted below the shot-points are then swung in arcs from the datum plane. Tangents to the arcs from connecting data are drawn to position the reflecting horizons. Reflection times, however, are written directly under their respective shot-points.

The "t,Δt" analysis indicates that interval velocities in pre-Mesozoic sediments (16,000 to 18,000 feet per second) are much greater than interval velocities in the Mesozoic. Pre-Mesozoic reflections, therefore, are deeper vertically relative to the horizontal distance than they appear on the plotted cross-sections.

INTERPRETATION OF RESULTS.

The correlated reflection event contoured on Plates II and III as the "Blythesdale" horizon is believed to be near the base of the Juro-Cretaceous Blythesdale Group. The "Base of Mesozoic" horizon contoured on Plate IV is immediately above the assumed base of the Mesozoic rocks. The "pre-Mesozoic Phantom" horizon (Plate V) is a phantom horizon beneath the sub-Mesozoic unconformity.

It is assumed that the major angular unconformity at roughly 3000 to 5000 feet below datum where deep reflections were obtained represents the base of the Mesozoic. In areas where consistent reflections below this depth were not obtained, it is assumed that the Mesozoic rests on granite or metamorphic basement.

Thargomindah Area. (Plates II and IV.)

Correlation shot-points in the Thargomindah area were spaced at two-mile intervals except for three miles of continuous profiling near Thargomindah on Line 201, and six miles near Mt. Constance on Line 204, where a surface structure is indicated on the "duricrust". Little or no reflection energy was obtained from below the Mesozoic in preliminary shooting; therefore, two-mile skips were made to speed an effort to locate pre-Mesozoic sediments. Reflection indications from depths below the Mesozoic were questionable throughout the Thargomindah area, however, which suggests that pre-Mesozoic sediments are not present along the line worked in this survey.

The two contour maps, "Blythesdale" and "Base of Mesozoic", are based on limited but fairly reliable correlations and show similar structure.

General north-west dip is shown in the eastern and central part of the area, with a structural nose or possible closure indicated at Shot-point 376, Line 202, and a broad structural nose indicated along Line 203 about twenty-two miles south-west of Thargomindah.

To the west, a synclinal axis is suggested near Shot-point 322 by the higher elevation of the mapping horizons at Shot-point 327, Line 201. On similar grounds, another synclinal axis is suggested near Shot-point 402 by the data at Shot-point 405, Line 203. An alternative interpretation, however, could show the high points up-thrown by faulting.

A fault is indicated (see Plate XII) in the south-western part of the area on Line 204 between Shot-points 410 and 411 near Mt. Constance. The throw of this fault appears to be about 500 feet with the down-thrown side to the east. It corresponds to a narrow zone of steep easterly dip in "duricrust" which forms the eastern flank of Mt. Constance Dome, noted on an unpublished photo-geological map of the Bulloo Quadrangle prepared by Geosurveys, Ltd.

Quilpie Area. (Plates III and V.)

Continuous profiling was used in the Quilpie area except from Shot-point 99 to 106 on Line 1 where correlation shot-points were spaced at two-mile intervals. Reflections from pre-Mesozoic horizons were observed over an area extending north-south approximately 45 miles and east-west approximately 20 miles, centred about 10 miles east of the town of Quilpie. Eastward from Shot-point 58 on Line 1 and eastward from Shot-point 128 on Line 4, only questionable reflection events were observed from pre-Mesozoic sediments.

The structure contour maps on the "Blythesdale" and the "pre-Mesozoic Phantom" in the Quilpie area (Plates III and V) are believed to give reliable representations of the general regional structure. The pre-Mesozoic phantom horizon is about 2000 feet above presumed basement.

A synclinal axis trending north-south about three miles east of Quilpie is shown on both the Mesozoic and pre-Mesozoic phantom horizons (see cross-section on Plate VI). A major angular unconformity is established at the presumed base of the Mesozoic. Structural dip ratio between the Mesozoic and pre-Mesozoic sediments is about 1:20.

Pre-Mesozoic sediments truncated at the unconformity have steep east dip of about 35^{o} from a point about one mile west of Quilpie to the axis of the syncline, where they reach a thickness of about 13,000 feet. It is inferred that granite basement is present immediately beneath the unconformity in areas where reflections were not obtained below the Mesozoic sediments.

Three anticlinal axes were crossed within the Quilpie structural basin. One occurs 13 miles south-east of Quilpie centred on Shot-point 862, Line 11, and has about 4,000 feet of structural relief on this line (see cross-section on Plate VII,Sheet 1). A second anticlinal axis about 7 miles north-east of Quilpie, with its crest at Shot-point 447, Line 9, has about 700 feet of structural relief on the "pre-Mesozoic Phantom" horizon (see cross-section on Plate IX and record section on Plate XIII). A third anticlinal axis is indicated 15 miles north of Quilpie on Line 4 (see cross-section on Plate VIII, Sheet 1). Further work would be necessary to determine whether these features are structurally closed and also whether they have sufficient pre-Mosozoic section at their culmination to provide a satisfactory drilling prospect.

Four lines in the Quilpie area (F1, F2, F3, and F4) were shot by Foreign Oil Exploration, Inc. Shot-point numbers for these lines are preceded by the letter "F" on all maps in this report.

Charleville Area. (Plates III and V.)

The seismic survey in the Charleville area consisted of shooting along a generalised east-west line about fifteen miles south of Charleville and extending from the eastern boundary of ATP 72P westward for approximately ninety miles. Also included is about 16 miles of line north of the village of Cooladdi. Continuous profiling was used where pre-Mesozoic reflections were obtained. In areas where only questionable pre-Mesozoic reflections were indicated, two to ten-mile traverse skips were made.

The "Blythesdale" and "pre-Mesozoic Phantom" maps are believed to give reliable representations of the general regional structure.

In the vicinity of Cooladdi a structural trough, which trends from north-west to south-east, is shown on both maps with structural relief in the ratio of about 1:20 (see cross-section on Plate X, Sheet 2). The pre-Mesozoic trough is shown to be about eighteen miles wide, bounded on the south-west by a fault down-thrown to the east, with apparent displacement of 10,000 feet or more (see cross-section on Plate X, Sheet 1). Steep dip, or a fault with about 500 feet displacement, is shown here in the Blythesdale Group. It is inferred that pre-Mesozoic sediments have been removed by erosion west of the fault where true reflections do not

appear to exist below the Mesozoic. Steep south-west dip of about 30^{o} is shown on the north-eastern flank of the Cooladdi trough; the pre-Mesozoic sediments thicken to about 16,000 feet at the synclinal axis.

About fifteen miles south of Charleville, in the vicinity of Westgate, another structural trough trending in a north-south direction is shown on both maps (see cross-section on Plate XI). The pre-Mesozoic trough is about sixteen miles wide, with steep flanks on either side. Pre-Mesozoic sediments are estimated to be about 10,000 feet thick at the axis of the Westgate trough.

In addition to the unconformity at the base of the Mesozoic, another major unconformity, within the pre-Mesozoic sediments, is indicated at several places in the Charleville area. An anticlinal axis is indicated in sediments below this deeper unconformity (at about 12,000 feet in depth) at Shot-point 798 on Line 109, about eighteen miles south-west of Charleville (see cross-section on Plate XI, Sheet 1, and record section on Plate XV).

CONCLUSIONS.

Analysis of seismic results indicates the following geological features:-

(1) A major angular unconformity separates the known Mesozoic sequence (Great Artesian Basin) from a pre-Mesozoic group of stratified rocks, of unknown age or lithology, at least 16,000 feet thick.
In the Westgate area south of Charleville, a second, deeper angular unconformity is present at a depth of about 12,000 feet. This unconformity is tentatively correlated with the angular unconformity at the base of the Lower Carboniferous/Upper Devonian Drummond Series in the Springsure area, 200 miles to the north-east.

(2) The pre-Mesozoic sequence occurs as a series of large, truncated, asymmetrical structural basins or troughs, trending approximately north-south. It is inferred that basement rocks (granites and/or metamorphics) lie between the basins.

(3) The apparent absence of stratified rocks between the structural basins is indicative of deep erosion prior to deposition of the Mesozoic sediments of the Great Artesian Basin.

(4) Structural configuration of the Mesozoic strata above the deep structural basins is similar to that of the pre-Mesozoic but much less pronounced. This may be explained by compaction of the pre-Mesozoic or by slight structural rejuvenation. Low-relief surface structure mapped on the surficial lateritic zone appears to bear no relation to subsurface structure and probably represents topography at the time of lateritisation. However, steep dip of the "duricrust" on the eastern flank of Mt. Constance appears to overlie a fault of Late Tertiary or Recent age.

(5) Secondary folding is present within the presumably Palaeozoic structural basins. Further seismic work would be necessary to determine favourable prospects for a well location in order to test the petroleum possibilities of the area.

REFERENCES.

SPRIGG, R. C., 1958 - Petroleum prospects of western parts of Great Australian Artesian Basin. Bull. Amer. Ass. Petrol. Geol. 42, 2465-2491.

WHITEHOUSE, F.W., 1954 - The geology of the Queensland portion of the Great Australian Artesian Basin, ARTESIAN WATER SUPPLIES IN QUEENSLAND, Appendix G. Dept. of the Co-ordinator-General of Public Works, Queensland.

APPENDIX.

Statistics.

Date survey begun	December 5, 1959
Date survey completed	July 9, 1960
Total number of working days	151 (Average 10.8 hours per day)
Total number of shooting days	145 (1632 hours)
Total number of moving days	6 (65.6 hours)
Number of shot-points	851
Average number of shot-points per day	5.9
Number of records	1740
Number of magnetic records	1753
Number of holes drilled	1110
Total footage drilled	135,645
Average hole depth	122 feet
Average spread length	3480 feet (1740 - 1740)
Average size of charge	12.3 lb.
Amount of explosives	21,517 lb.
Average amount of explosives per hole	25 lb.
Electric blasting caps	2187

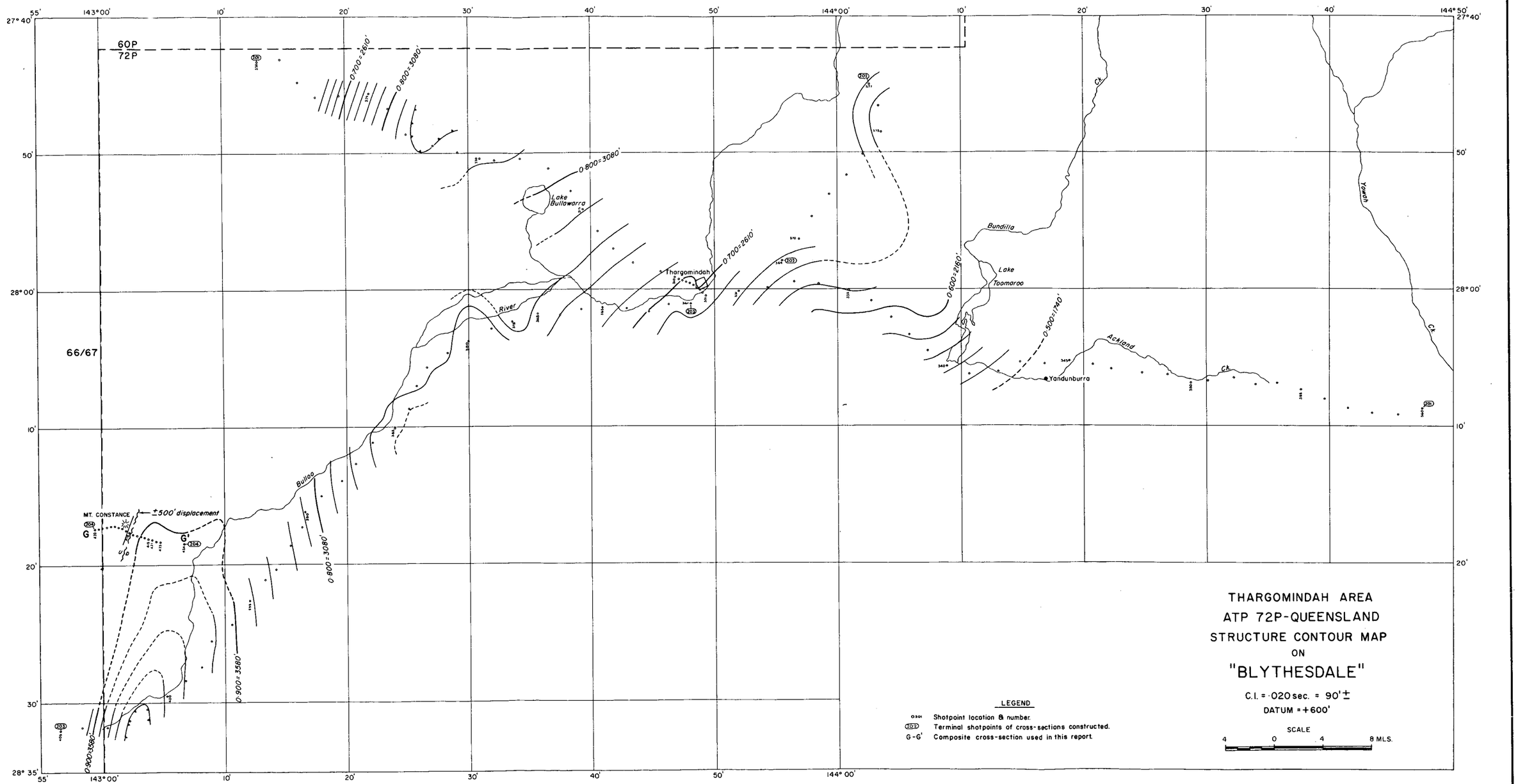
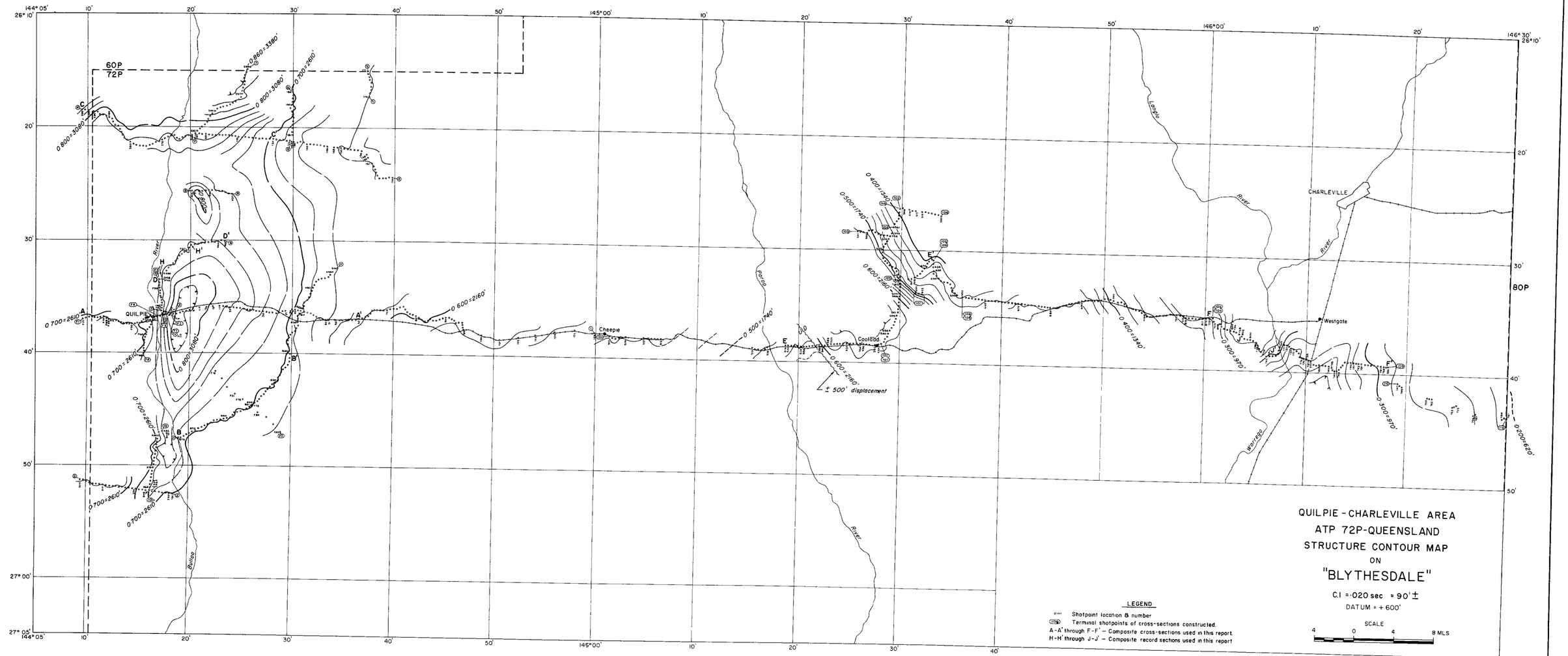

27° 40'
55'
143° 00'
10'
20'
30'
40'
50'
144° 00'
144° 50'
60P
72P
50'
28° 00'
66/67
10'
20'
30'
28° 35'
0.700=2610'
0.800=3080'
0.900=3580'
Lake Bullawarra
Thargomindah
River
Bullo
Bundilla
Lake Toomaroo
0.600=2160'
0.500=1740'
Ackland Ck
Yandunburra
Yowah Ck
MT. CONSTANCE
±500' displacement
G
G'
LEGEND
Shotpoint location & number.
Terminal shotpoints of cross-sections constructed.
G-G' Composite cross-section used in this report.
THARGOMINDAH AREA
ATP 72P-QUEENSLAND
STRUCTURE CONTOUR MAP
ON
"BLYTHESDALE"
C.I. = ·020 sec. = 90'±
DATUM = +600'
SCALE
4 0 4 8 MLS.

Plate II



QUILPIE - CHARLEVILLE AREA
ATP 72P-QUEENSLAND
STRUCTURE CONTOUR MAP
ON
"BLYTHESDALE"

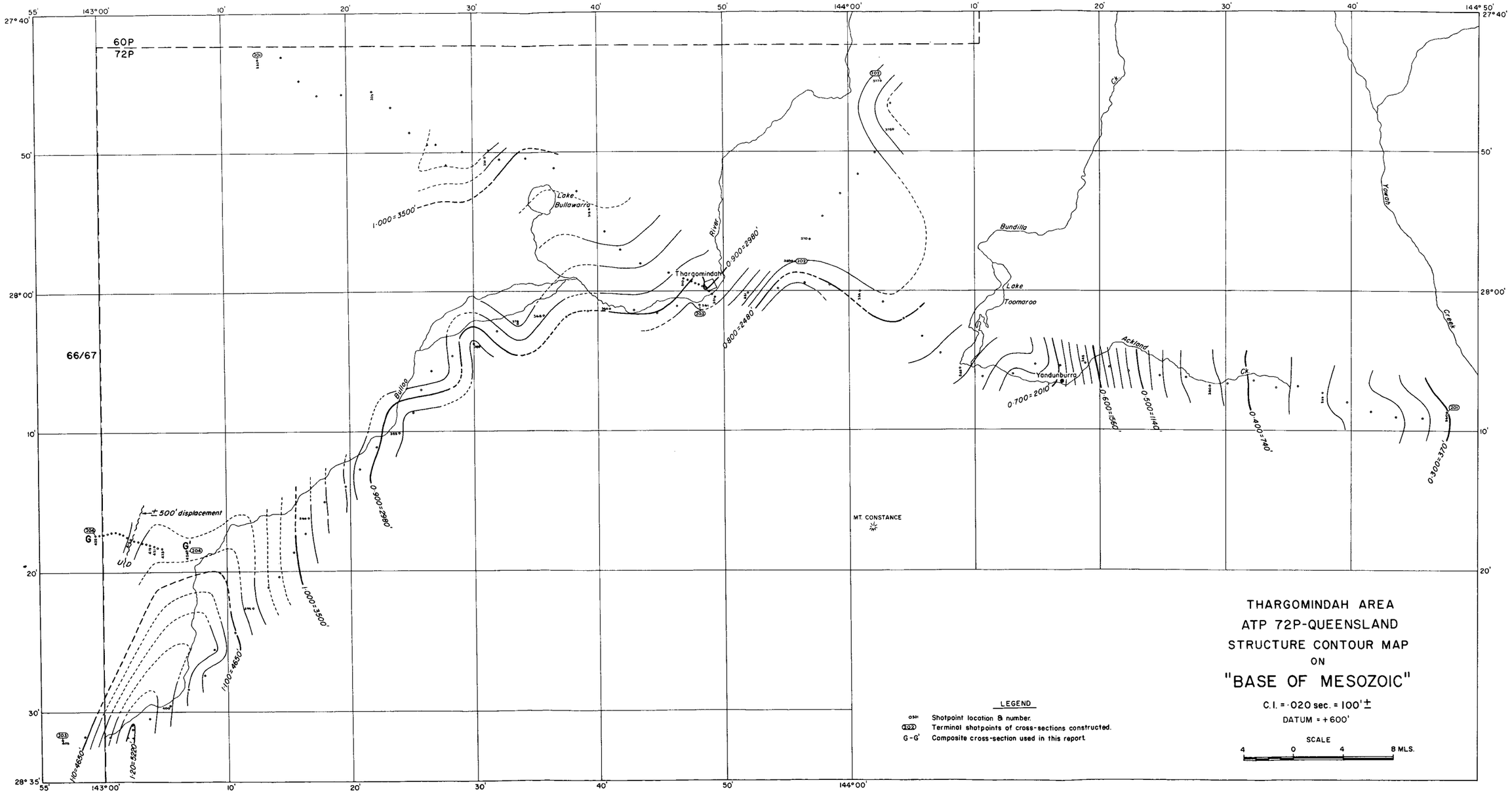
C.I = ·020 sec = 90'±
DATUM = + 600'

SCALE
4 0 4 8 MLS

LEGEND

- Shotpoint location & number
- Terminal shotpoints of cross-sections constructed.
- A-A' through F-F' — Composite cross-sections used in this report.
- H-H' through J-J' — Composite record sections used in this report

Plate III



LEGEND

0501 Shotpoint location & number.

102 Terminal shotpoints of cross-sections constructed.

G-G' Composite cross-section used in this report.

THARGOMINDAH AREA
ATP 72P-QUEENSLAND
STRUCTURE CONTOUR MAP
ON
"BASE OF MESOZOIC"

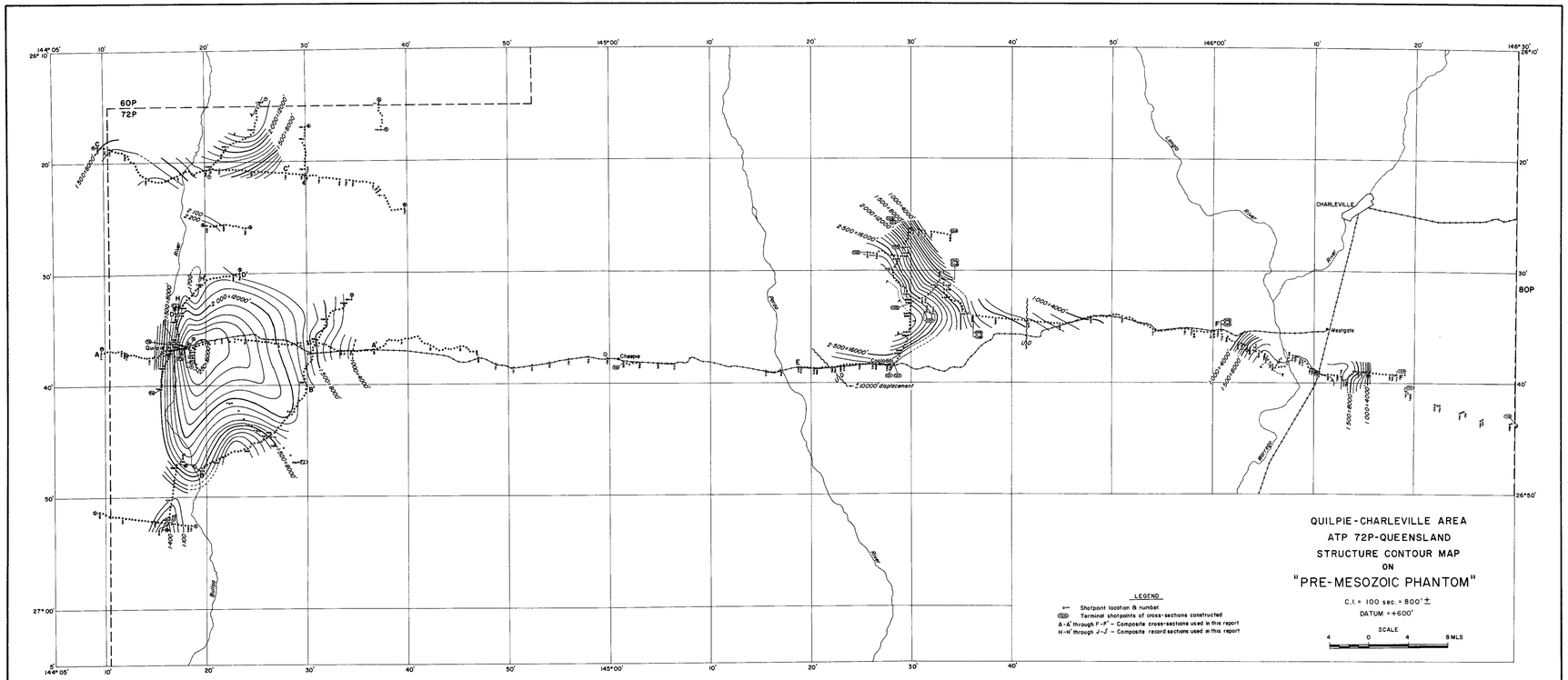
C.I. = ·020 sec. = 100' ±

DATUM = +600'

SCALE

4 0 4 8 MLS.

Plate IV



QUILPIE-CHARLEVILLE AREA
ATP 72P-QUEENSLAND
STRUCTURE CONTOUR MAP
ON
"PRE-MESOZOIC PHANTOM"

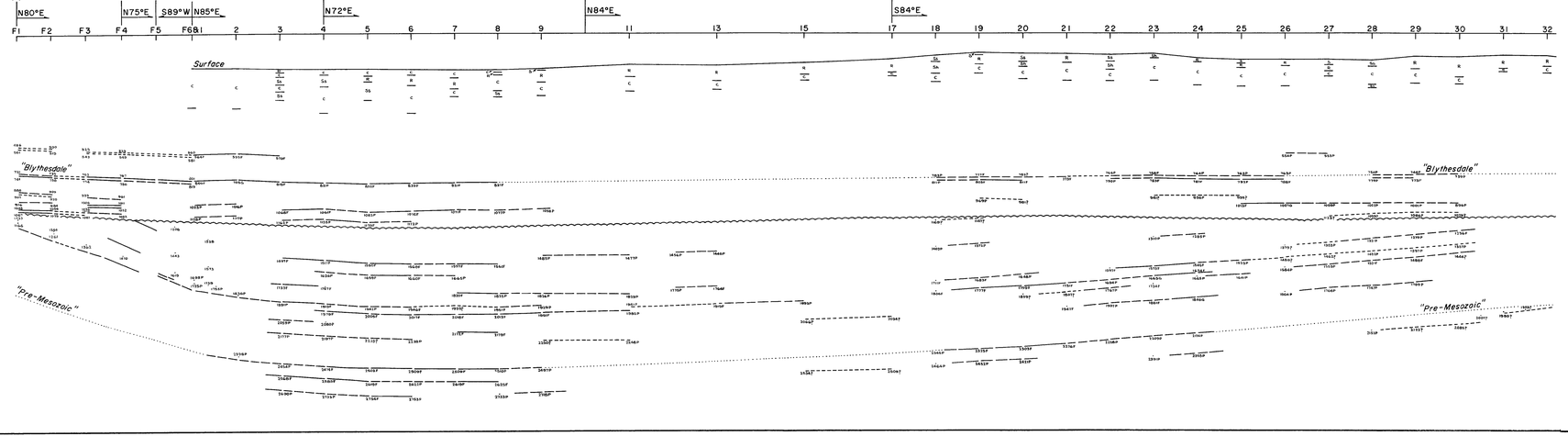
C.I. = 100 sec. = 800'±
DATUM = +600'

SCALE
4 0 4 8 MLS

LEGEND

- Shotpoint location & number.
- Terminal shotpoints of cross-sections constructed
- A-A' through F-F' – Composite cross-sections used in this report
- H-H' through J-J' – Composite record sections used in this report

Plate V



Continued on Sheet 2

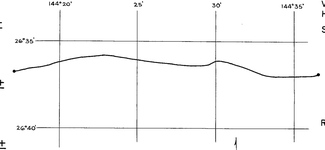
Elevation
+700'
+600'
+500'

Time Depth
·500sec. = 1700'±
1·000sec. = 4000'±
1·500sec. = 8000'±
2·000sec. = 12000'±
2·500sec. = 16000'±
3·000sec. = 20000'±

SEISMIC REFLECTION SURVEY OF THE QUILPIE-THARGOMINDAH-CHARLEVILLE AREA QUEENSLAND

CROSS SECTION OF TRAVERSE A-A'

Datum = 600' A.S.L.
Ve = 7000'/sec.
Vert scale: as shown
Hor. scale: 0 1750' 3480'



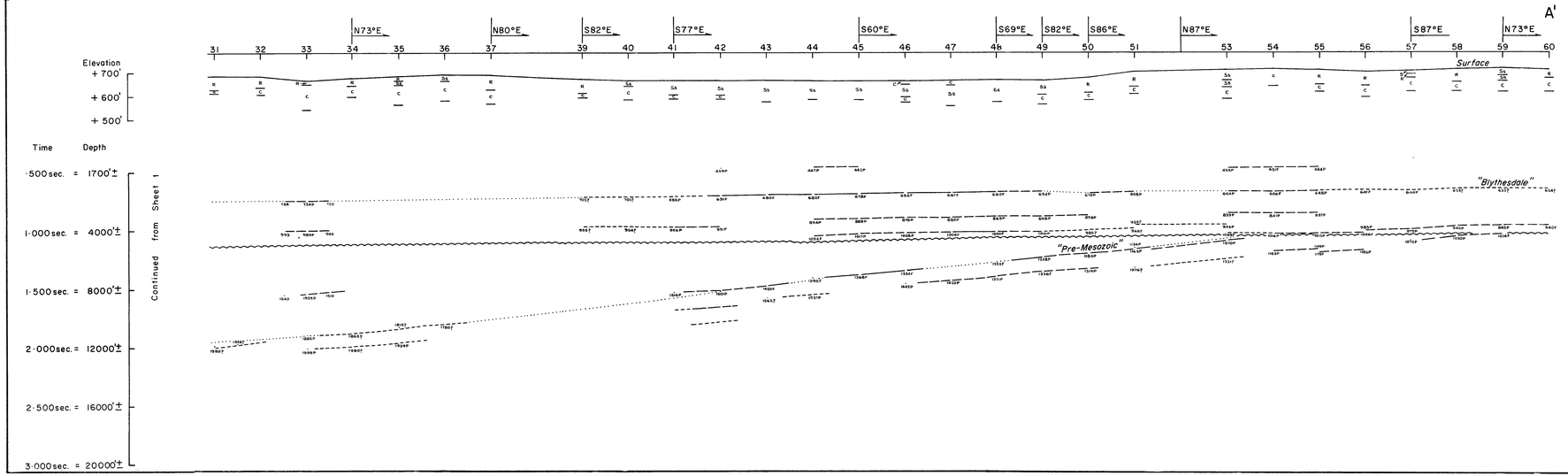
Location Map
Scale
0 1 2 3 4 miles

Shothole Legend
L = Loam
C = Clay
Si = Silt
R = Rock
G = Gravel
S = Sand
Ss = Sandstone
Sh = Shale

Reflection Grading:
Good
Poor
Questionable

Survey by
Petty Geophysical Engineering Co.
for
Phillips Petroleum Co. & Sunray Mid-Continent Oil Co.
1959-60

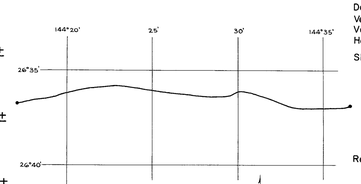
Plate VI



Elevation
+700'
+600'
+500'
Time
Depth
·500sec. = 1700'±
1·000sec. = 4000'±
1·500sec. = 8000'±
2·000sec. = 12000'±
2·500sec. = 16000'±
3·000sec. = 20000'±

SEISMIC REFLECTION SURVEY OF THE QUILPIE-THARGOMINDAH-CHARLEVILLE AREA QUEENSLAND

CROSS SECTION OF TRAVERSE A-A'



Datum = 600' A.S.L.
Ve = 7000'/sec.
Vert. scale: as shown
Hor. scale: 0 1750' 3480'

Shothole Legend
L = Loam
C = Clay
Si = Silt
R = Rock
G = Gravel
S = Sand
Ss = Sandstone
Sh = Shale

Reflection Grading:
Good
Poor
Questionable

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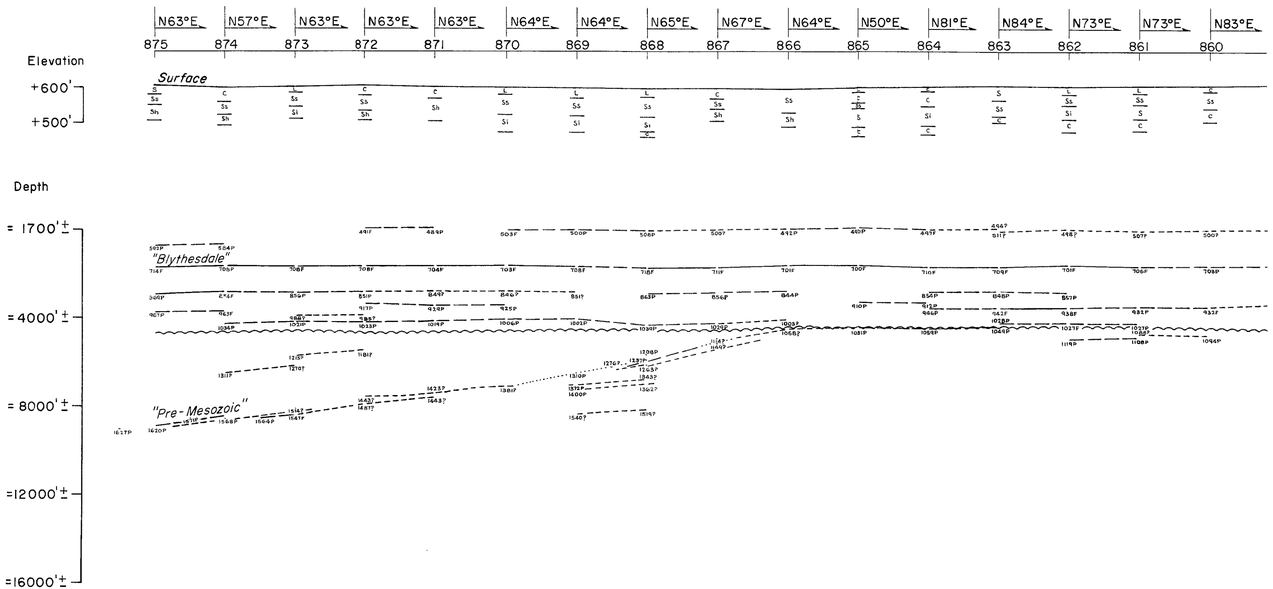
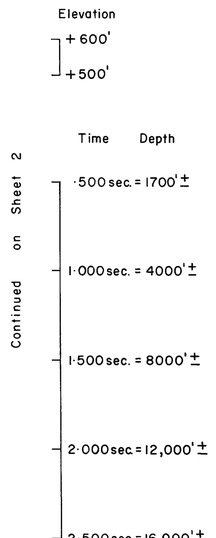
1959-60

Plate VI

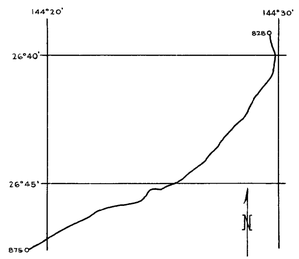
B



Continued on Sheet 2



SEISMIC REFLECTION SURVEY
OF THE
QUILPIE - THARGOMINDAH - CHARLEVILLE AREA
QUEENSLAND
CROSS SECTION OF TRAVERSE B-B'



Location Map
Scale
0 1 2 3 4 mls.

Datum = 600' A.S.L.
Ve = 7000/sec.
Vert. scale: as shown
Hor. scale: 0 1740' 3480'

Shothole Legend.
L = Loam
C = Clay
Si = Silt
G = Gravel
S = Sand
Sh = Shale
Ss = Sandstone

Reflection Grading:
Good ———
Poor — — —
Questionable --------

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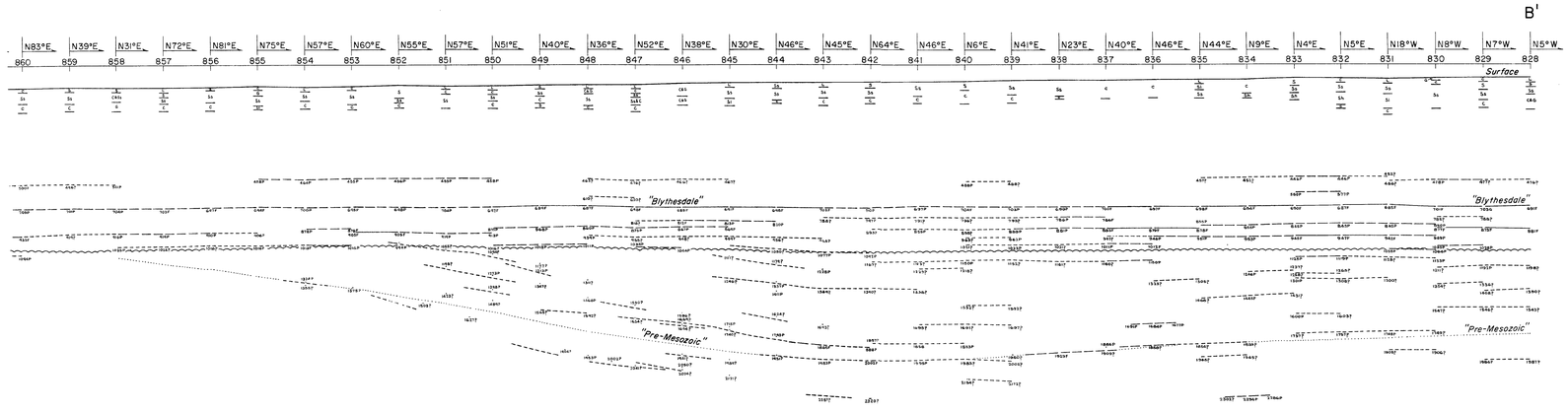
1959-60

Plate VII

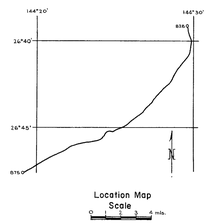
B'



Elevation
+600'
+500'
Time Depth
·500 sec. = 1700'±
1·000 sec. = 4000'±
1·500 sec. = 8000'±
2·000 sec. = 12,000'±
2·500 sec. = 16,000'±

SEISMIC REFLECTION SURVEY OF THE QUILPIE - THARGOMINDAH - CHARLEVILLE AREA QUEENSLAND

CROSS SECTION OF TRAVERSE B-B'



Datum = 600' A.S.L.
Ve = 7000/sec.
Vert. scale: as shown
Hor. scale: 1740' 3480'

Shothole Legend.
L = Loam
C = Clay
Si = Silt
G = Gravel
S = Sand
Sh = Shale
Ss = Sandstone

Reflection Grading:
Good ———
Poor — — —
Questionable ·····

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1959-60

Plate VII

C

S75°E S85°E S79°E S58°E S75°E S81°E S74°E S58°E S70°E S13°E S36°E S69°E S22 1/2°E S22 1/2°E S21°E S36°E S56°E S56°E S58°E S65°E S78°E S85°E N88°E N76°E N67°E N59°E N80°E N63°E N62°E N66°E N66°E N79°E S43°E S69°E

299 298 297 295 294 293 292 291 290 289 288 287 286 285 284 283 282 281 280 279 278 277 276 275 274 273 272 271 270 269 268 267 266 265

Elevation
+800'
+700'
+600'

Surface

Time Depth

·500sec. = 1700'±
1·000sec. = 4000'±
1·500sec. = 8000'±
2·000sec. = 12000'±
2·500sec. = 16000'±

"Blythesdale"
"Pre-Mesozoic"

Continued on Sheet 2

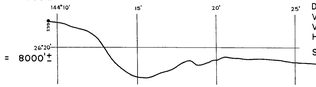
Elevation
+900'
+800'
+700'
+600'

Time Depth

·500sec. = 1700'±
1·000sec. = 4000'±
1·500sec. = 8000'±
2·000sec. = 12000'±
2·500sec. = 16000'±

SEISMIC REFLECTION SURVEY OF THE QUILPIE-THARGOMINDAH-CHARLEVILLE AREA QUEENSLAND

CROSS SECTION OF TRAVERSE C-C'



Location Map
Scale
0 1 2 3 4 mls.

Datum = 600' A.S.L.
Ve = 7000'/sec.
Vert. scale: as shown
Hor. scale: 0 1760' 3480'

Shothole Legend:
L = Loam
C = Clay
Si = Silt
G = Gravel
S = Sand
Sh = Shale
Ss = Sandstone
R = Rock

Reflection Grading:
Good
Poor
Questionable

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1959-60

Plate VIII

C'

S43°E | S69°E | N65°E | N65°E | N71°E | N85°E | N61°E | N86°E | S87°E | N88°E | S88°E | S85°E | S83°E | N89°E | S82°E | S85°E | S81°E | N87°E | S84°E | S80°E

6 265 264 263 262 261 260 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128 129 130

Surface

Elevation +800' +700' +600'

Time Depth

·500 sec. = 1700'±

1·000 sec. = 4000'±

1·500 sec. = 8000'±

2·000 sec. = 12000'±

2·500 sec. = 16000'±

Continued from Sheet 1

"Blythesdale"

"Pre-Mesozoic"

"Blythesdale"

"Pre-Mesozoic"

Elevation +900' +800' +700' +600'

Time Depth

·500 sec. = 1700'±

1·000 sec. = 4000'±

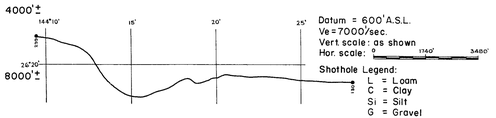
1·500 sec. = 8000'±

2·000 sec. = 12000'±

2·500 sec. = 16000'±

SEISMIC REFLECTION SURVEY OF THE QUILPIE-THARGOMINDAH-CHARLEVILLE AREA QUEENSLAND

CROSS SECTION OF TRAVERSE C-C'



Location Map Scale 0 1 2 3 4 mls.

Datum = 600' A.S.L.
Ve = 7000'/sec.
Vert scale: as shown
Hor. scale: 0 1740' 3480'

Shothole Legend:
L = Loam
C = Clay
Si = Silt
G = Gravel
S = Sand
Sh = Shale
Ss = Sandstone
R = Rock

Reflection Grading:
Good
Poor
Questionable

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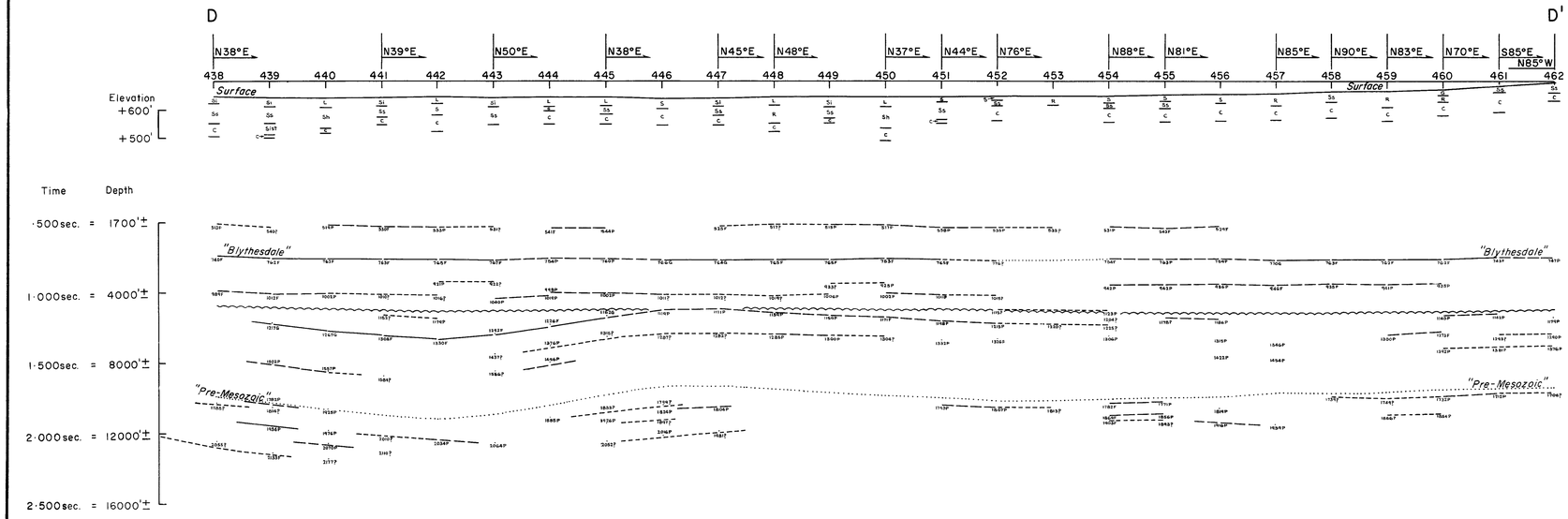
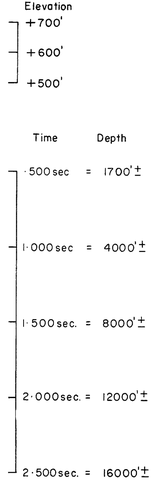
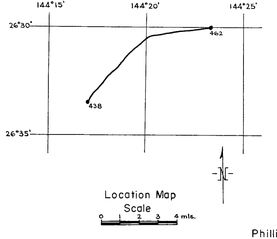
Plate VIII





SEISMIC REFLECTION SURVEY
OF THE
QUILPIE-THARGOMINDAH-CHARLEVILLE AREA
QUEENSLAND
CROSS SECTION OF TRAVERSE D-D'



Datum = 600' A.S.L.
Ve = 7000'/sec.
Vert. scale: as shown
Hor. scale: 0 1760' 3480'

Shothole Legend
L = Loam
C = Clay
Si = Silt
Sist = Siltstone
G = Gravel
S = Sand
Sh = Shale
R = Rock
Ss = Sandstone

Reflection Grading:
Good
Poor
Questionable

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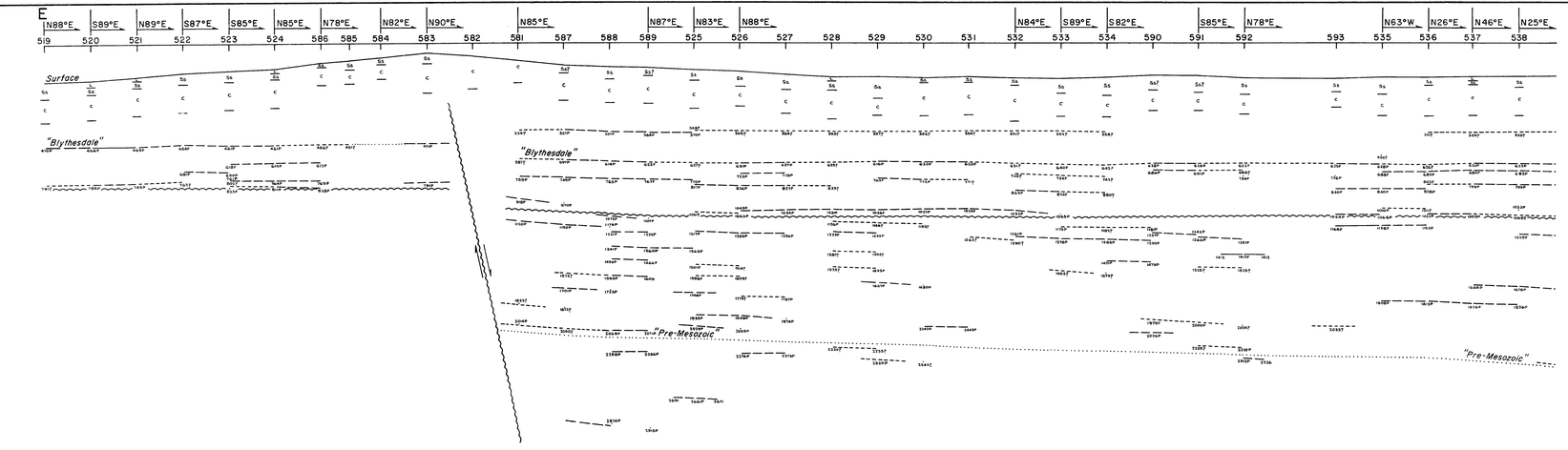
1959-60

Plate IX



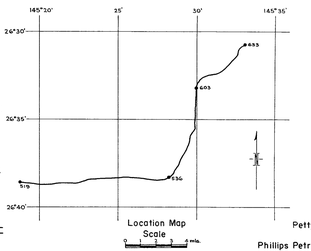
Continued on Sheet 2

Elevation
+ 1000'
+ 900'
+ 800'
+ 700'

Time Depth
·500sec. = 1700'±
1·000sec. = 4000'±
1·500sec. = 8000'±
2·000sec = 12000'±
2·500sec. = 16000'±
3·000sec = 20000'±

SEISMIC REFLECTION SURVEY OF THE QUILPIE - THARGOMINDAH - CHARLEVILLE AREA QUEENSLAND

CROSS SECTION OF TRAVERSE E-E'



Location Map
Scale
0 1 2 3 4 mile.

Datum = 600' A.S.L.
Ve = 7000'/sec.
Vert. scale: as shown
Hor. scale: 0 1760' 3480'

Shothole Legend
L = Loam
C = Clay
Si = Silt
G = Gravel
S = Sand
Sh = Shale
Ss = Sandstone
Dur = Sandstone

Reflection Grading:
Good
Poor
Questionable

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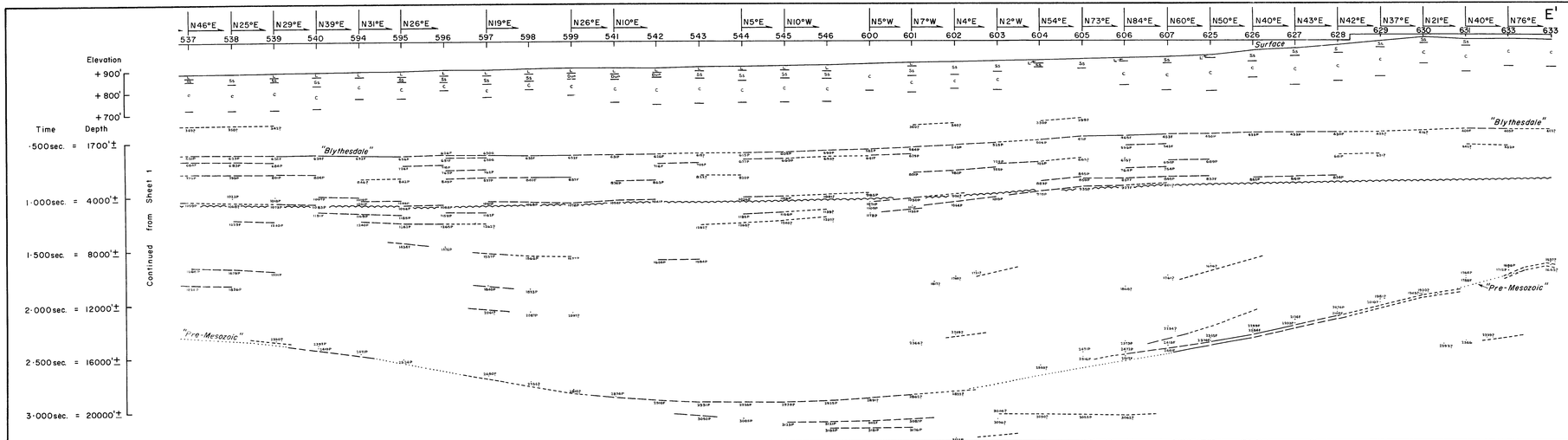
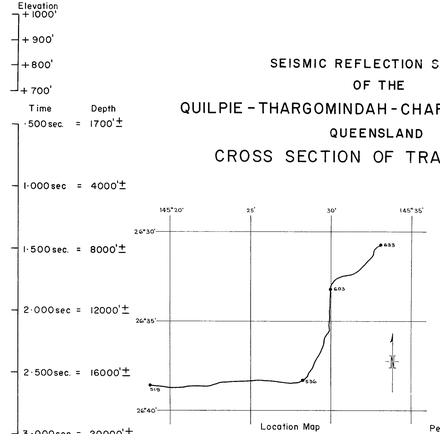
1959-60

Plate X





SEISMIC REFLECTION SURVEY OF THE QUILPIE-THARGOMINDAH-CHARLEVILLE AREA QUEENSLAND

CROSS SECTION OF TRAVERSE E-E'

Datum = 600' A.S.L.
Ve=7000/sec.
Vert scale: as shown
Hor. scale: 0 1740' 3480'

Shothole Legend
L = Loam
C = Clay
Si = Silt
G = Gravel
S = Sand
Sh = Shale
Ss = Sandstone
Dur= Sandstone

Reflection Grading:
Good
Poor
Questionable
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1959-60

Plate X

Sheet 1

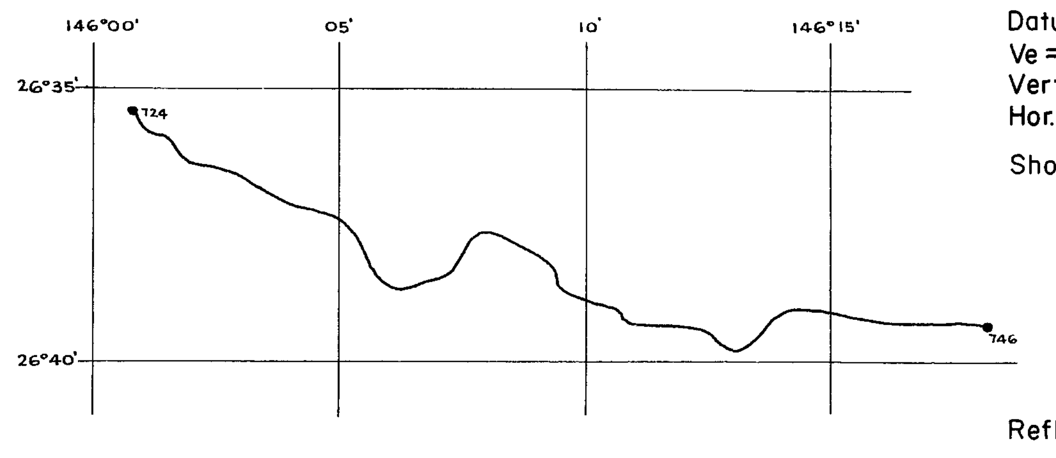
Elevation
+1000'
+900'
+800'

Time Depth
·500sec. = 1700'±
1·000sec. = 4000'±
1·500sec. = 8000'±
2·000sec. = 12000'±
2·500sec. = 16000'±
3·000sec. = 20000'±

Continued on Sheet 2

SEISMIC REFLECTION SURVEY OF THE QUILPIE-THARGOMINDAH-CHARLEVILLE AREA QUEENSLAND

CROSS SECTION OF TRAVERSE F-F'



Location Map
Scale
0 1 2 3 4 mls.

Datum = 600' A.S.L.
Ve = 7000'/sec.
Vert. scale: as shown
Hor. scale: 0' 1740' 3480'

Shothole Legend:
- L = Loam
- C = Clay
- R = Rock
- G = Gravel
- S = Sand
- Sh = Shale
- Ss = Sandstone

Reflection Grading:
- Good ————
- Poor — — —
- Questionable --------

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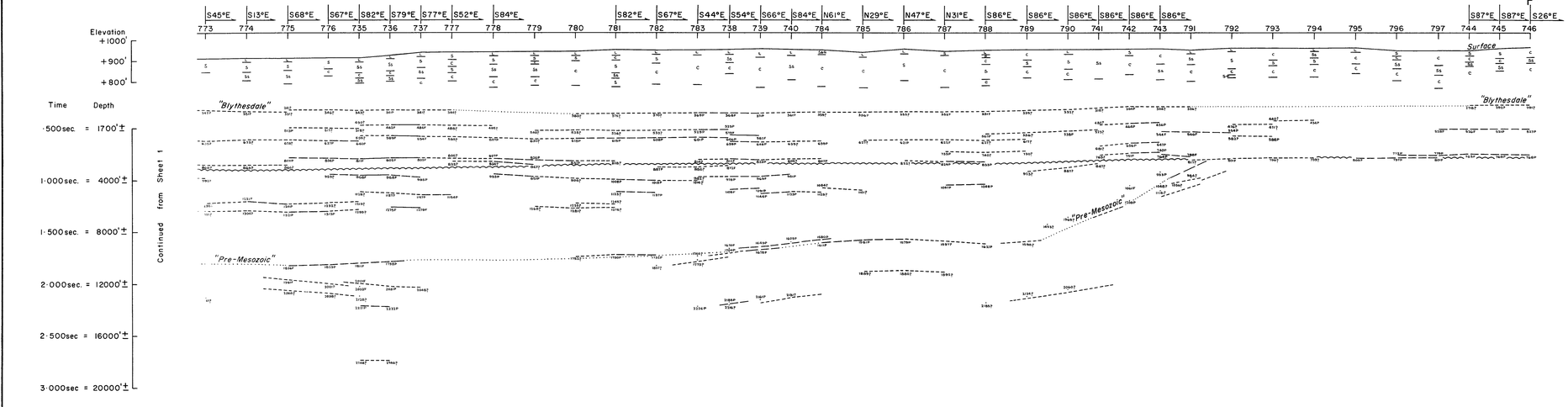
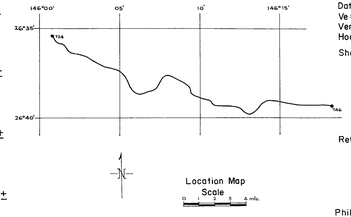
1959-60

Plate XI

SEISMIC REFLECTION SURVEY
OF THE
QUILPIE - THARGOMINDAH - CHARLEVILLE AREA
QUEENSLAND
CROSS SECTION OF TRAVERSE F-F'



Elevation
+1000'
+900'
+800'
Time Depth
·500sec. = 1700'±
1·000sec. = 4000'±
1·500sec. = 8000'±
2·000sec. = 12000'±
2·500sec. = 16000'±
3·000sec. = 20000'±



Datum = 600' A.S.L.
Ve = 7000/sec.
Vert. scale: as shown
Hor. scale: 0 1740' 3480'

Shothole Legend:
- L = Loam
- C = Clay
- R = Rock
- G = Gravel
- S = Sand
- Sh = Shale
- Ss = Sandstone

Reflection Grading:
- Good ———
- Poor — — —
- Questionable -------

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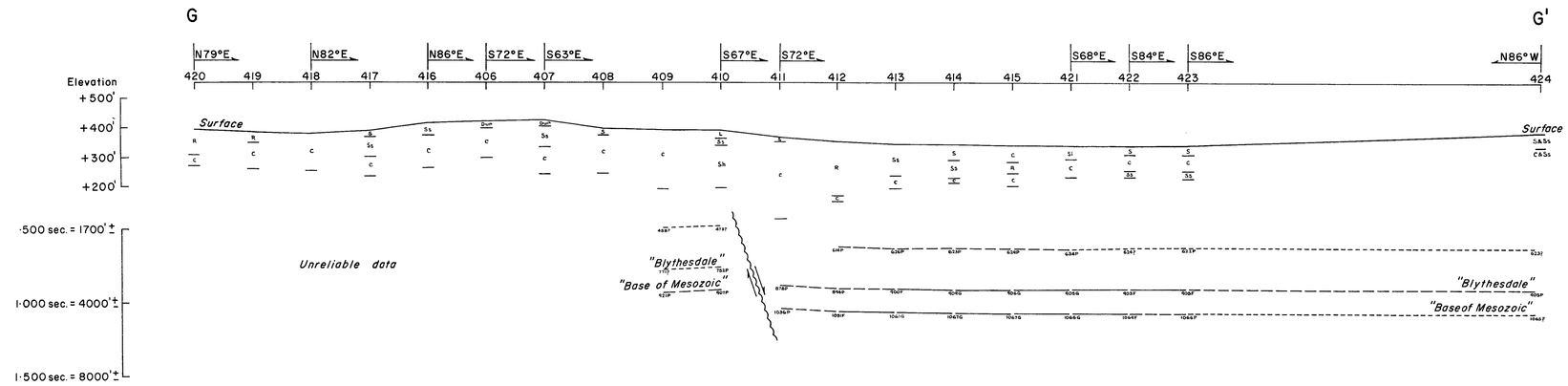
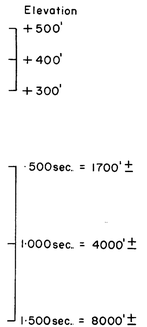
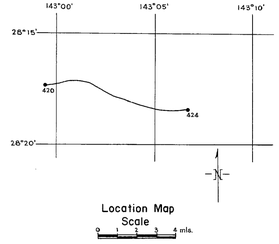
1959-60

Plate XI





SEISMIC REFLECTION SURVEY
OF THE
QUILPIE - THARGOMINDAH - CHARLEVILLE AREA
QUEENSLAND
CROSS SECTION OF TRAVERSE G-G'



Datum = 600' A.S.L.
Ve = 7000'/sec.
Vert. scale: as shown
Hor. scale: 0 1740' 3480'

Shothole Legend:
L = Loam
C = Clay
Si = Silt
R = Rock
S = Sand
Sh = Shale
Ss = Sandstone
Dur = Duricrust

Reflection Grading:
Good ———
Poor — — —
Questionable --------

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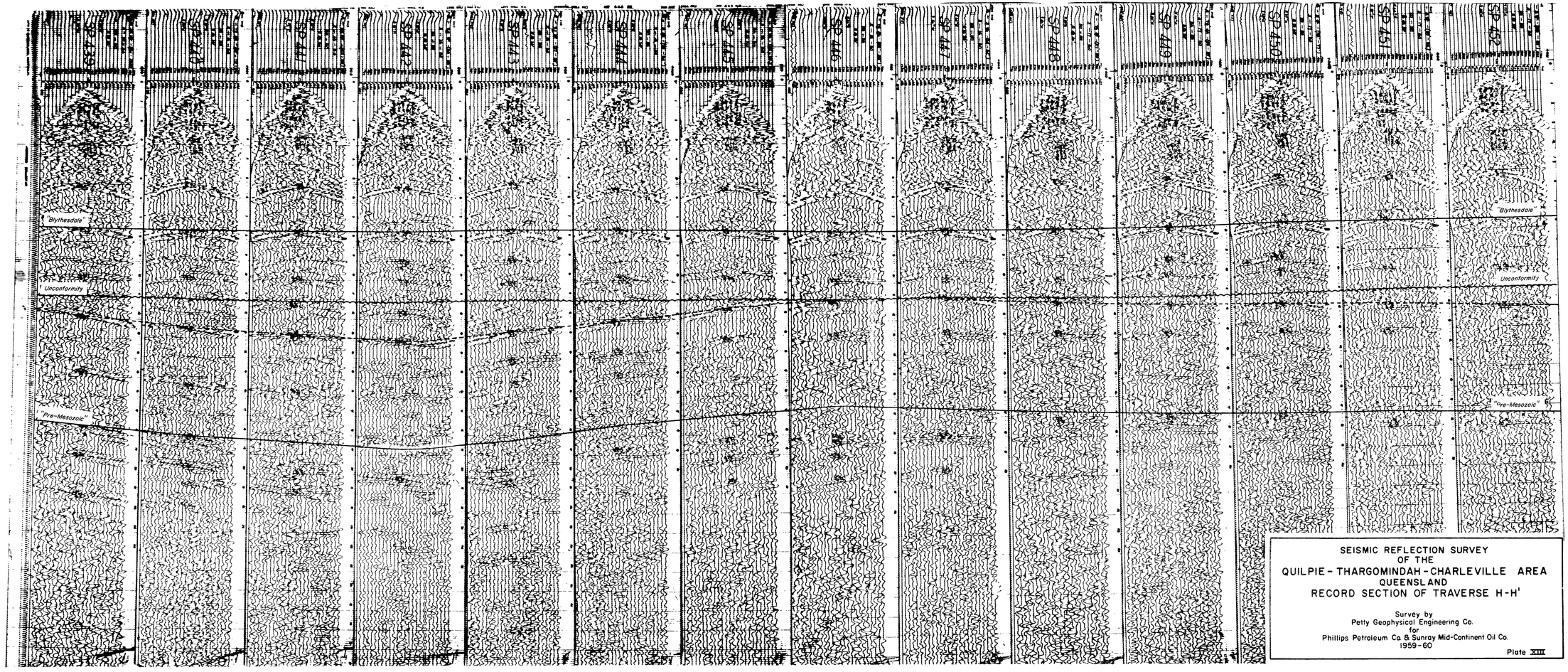
1959-60

Plate XII



SEISMIC REFLECTION SURVEY
OF THE
QUILPIE - THARGOMINDAH - CHARLEVILLE AREA
QUEENSLAND
RECORD SECTION OF TRAVERSE H-H'

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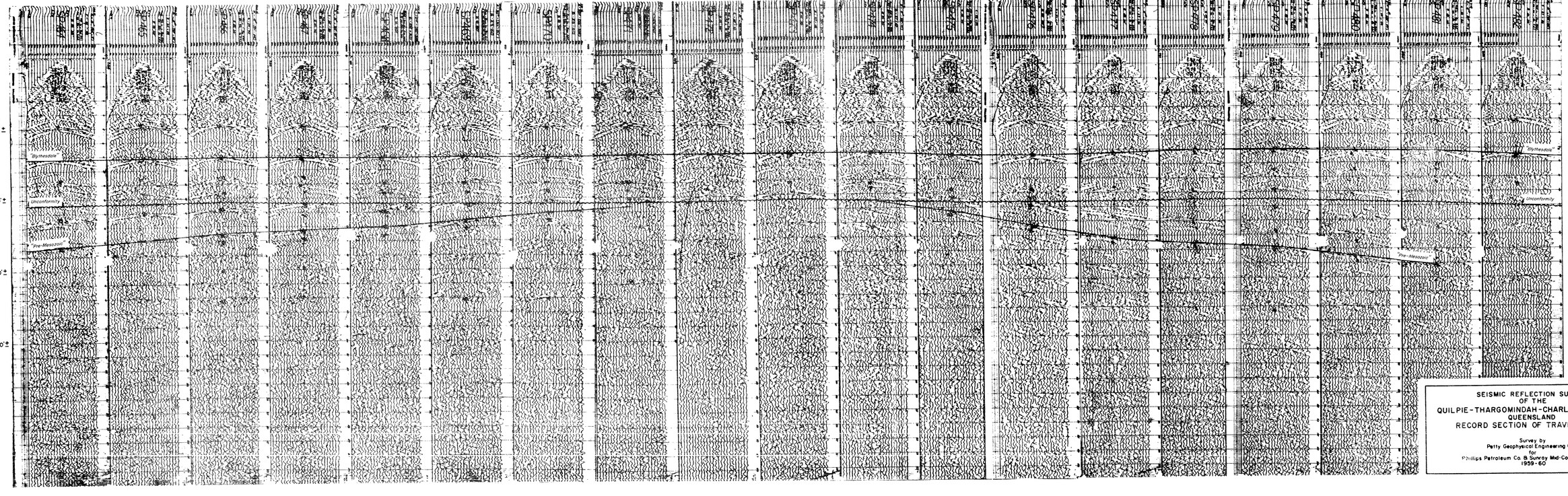
1959-60

Plate XIII



SEISMIC REFLECTION SURVEY
OF THE
QUILPIE-THARGOMINDAH-CHARLEVILLE AREA
QUEENSLAND
RECORD SECTION OF TRAVERSE I-I'

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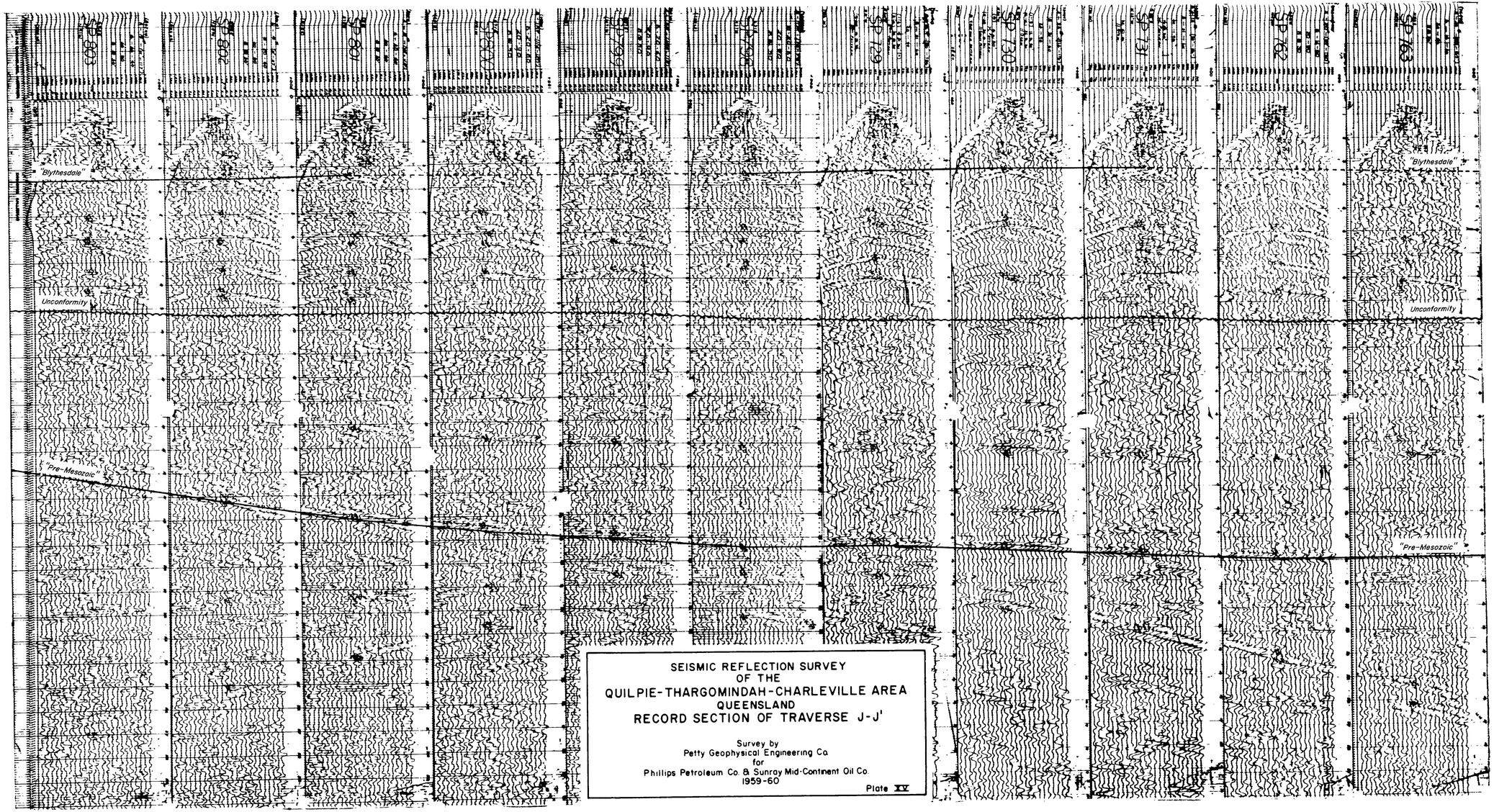
1959-60

Plate XIX



SEISMIC REFLECTION SURVEY
OF THE
QUILPIE-THARGOMINDAH-CHARLEVILLE AREA
QUEENSLAND
RECORD SECTION OF TRAVERSE J-J'

Survey by
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1959-60

Plate XV